Title: Explorations in Particle Theory - Lecture 6

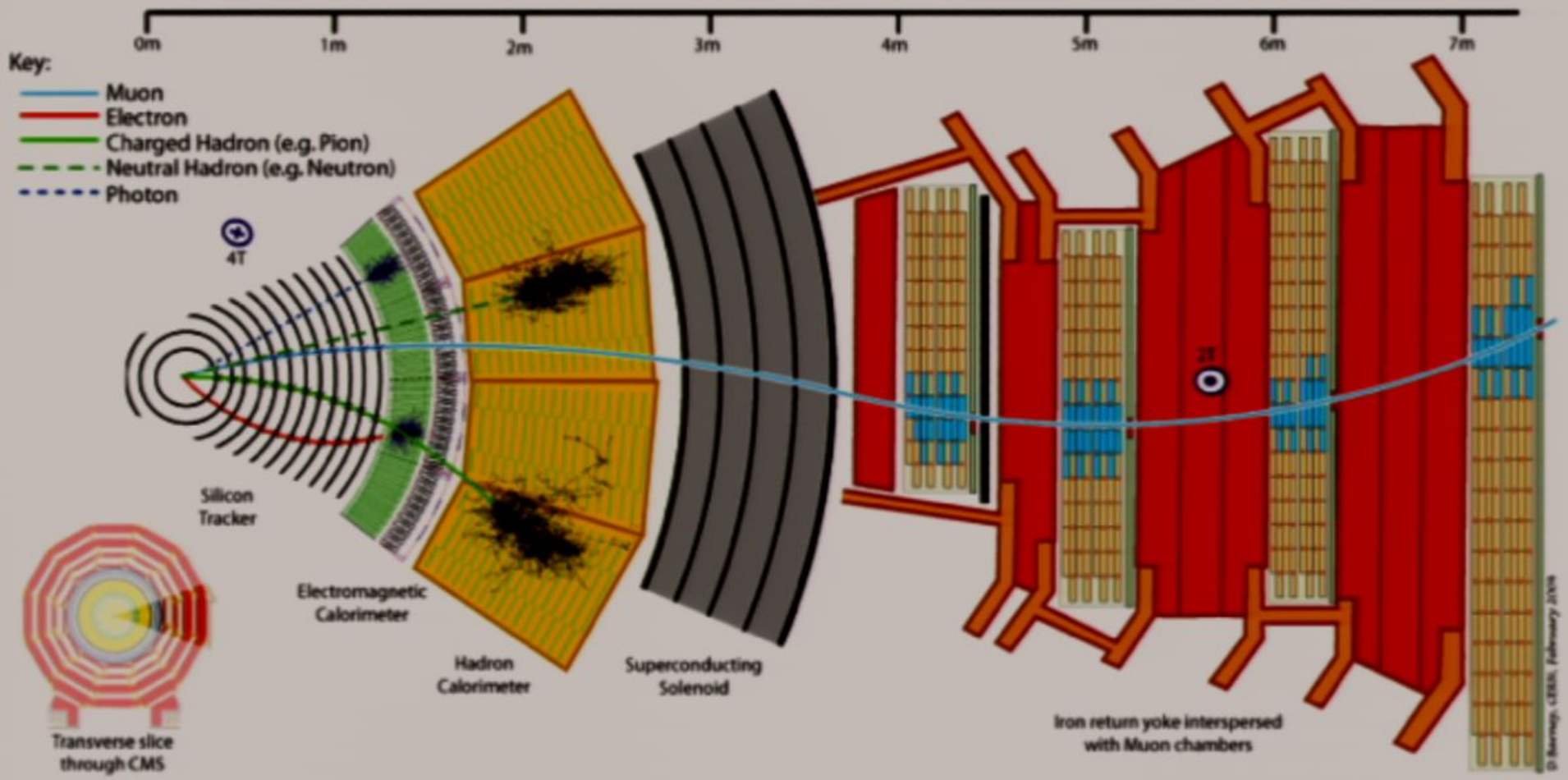
Date: Apr 15, 2011 10:15 AM

URL: http://pirsa.org/11040028

Abstract:


perimeter scholars
international

Cartoon ‘slice’ of CMS detector



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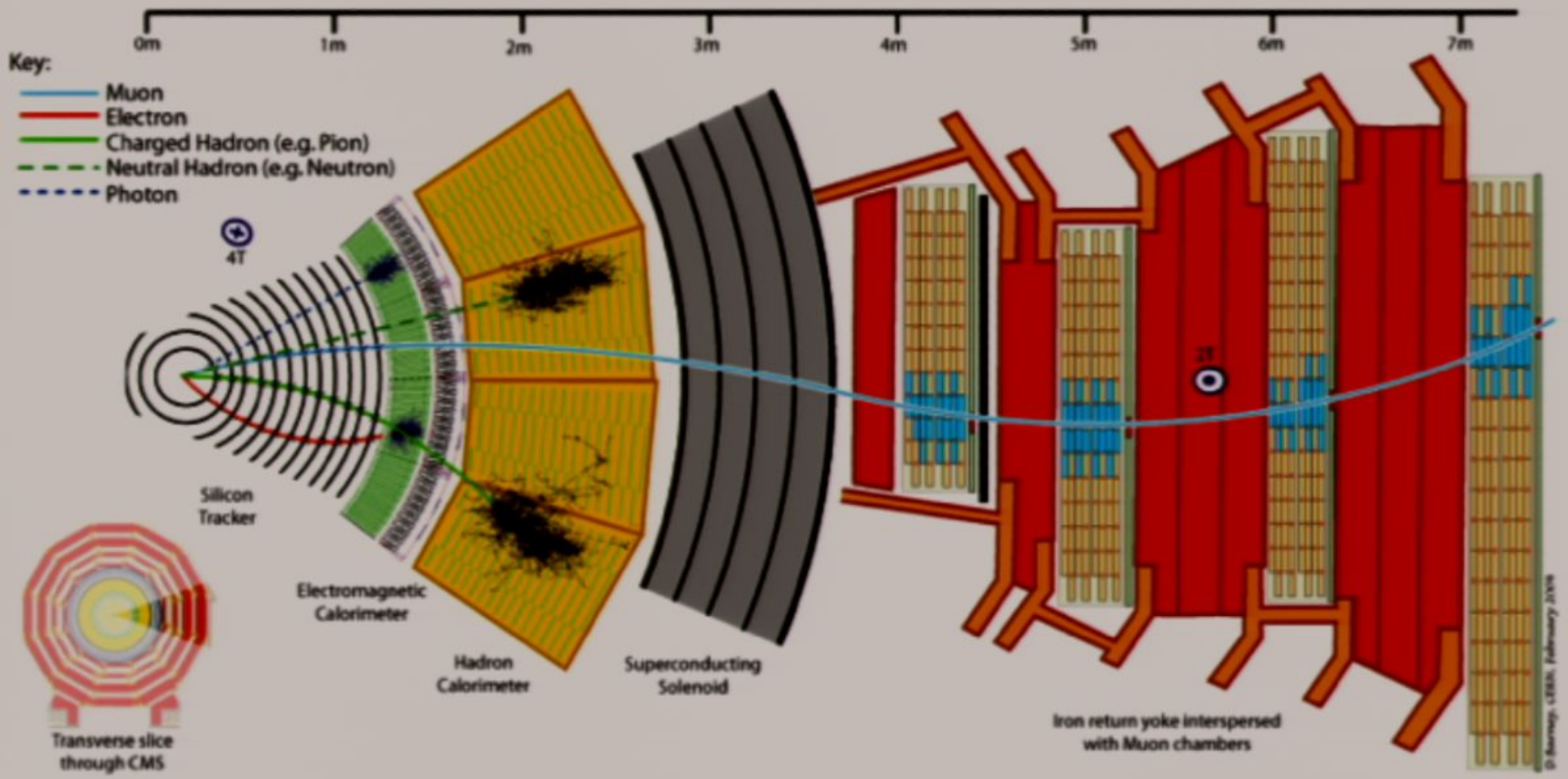
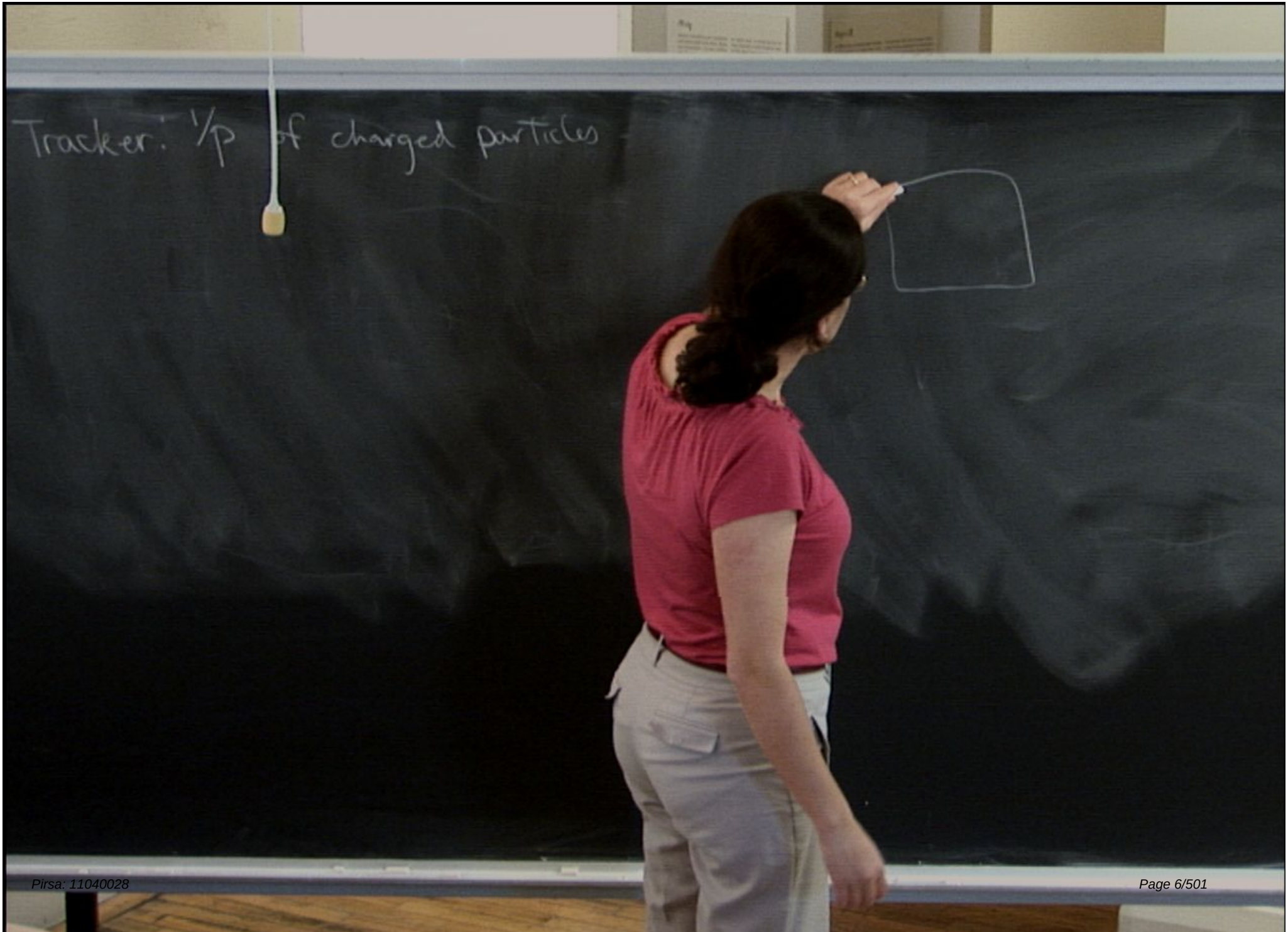



Tracker: 1/p of charged particles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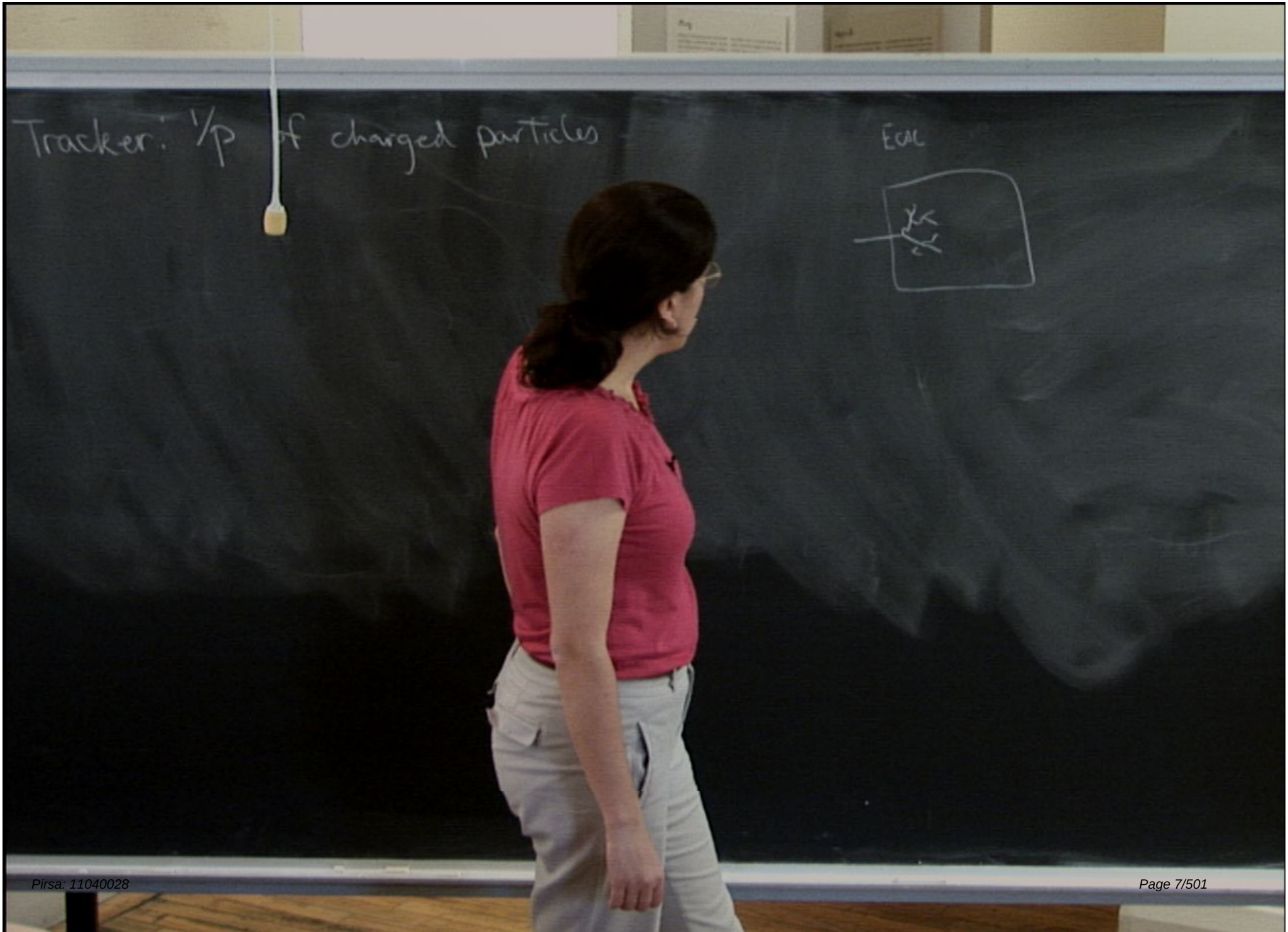
Tracker: 1/p of charged particles
ECAL

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ECAL

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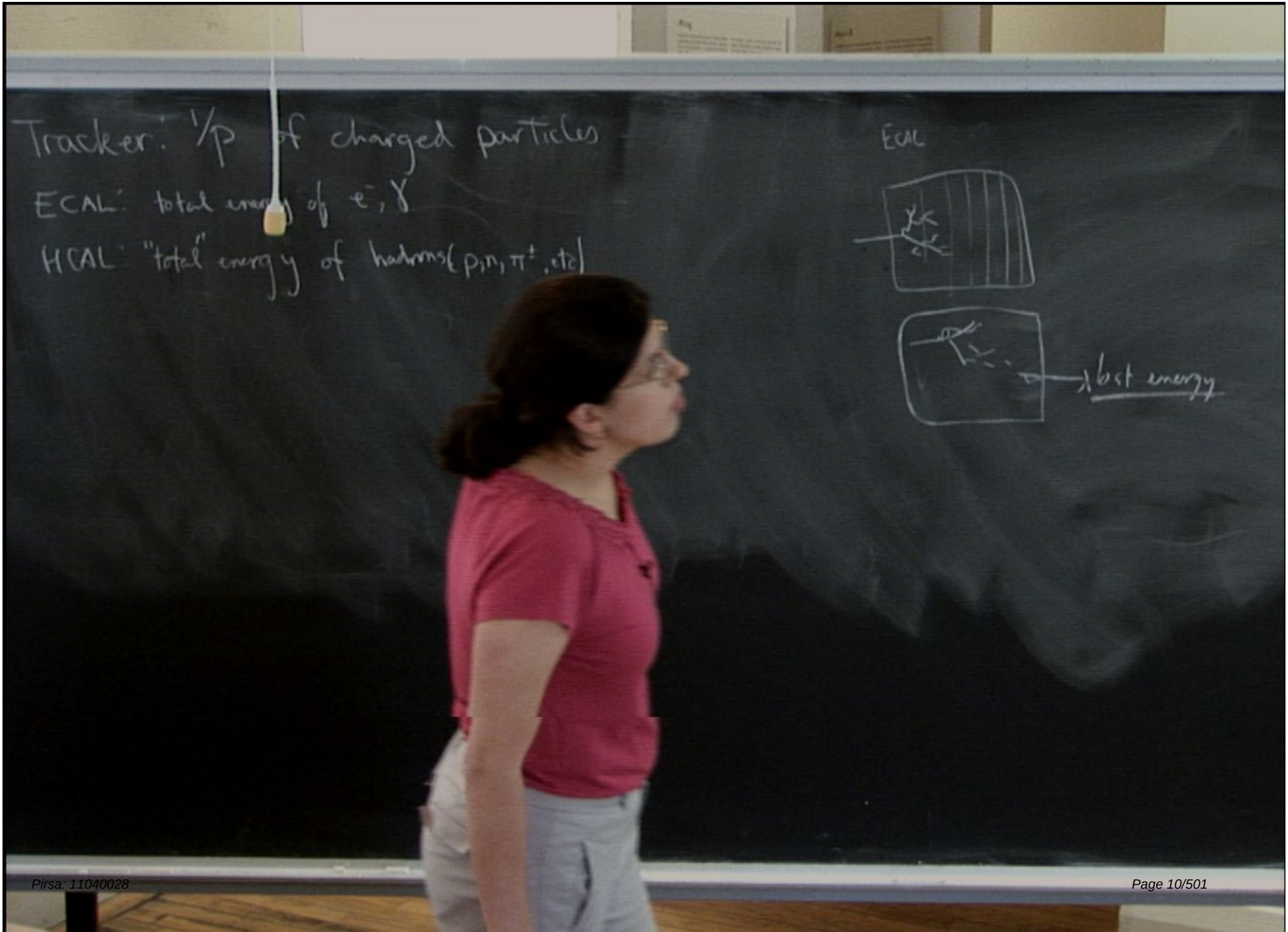
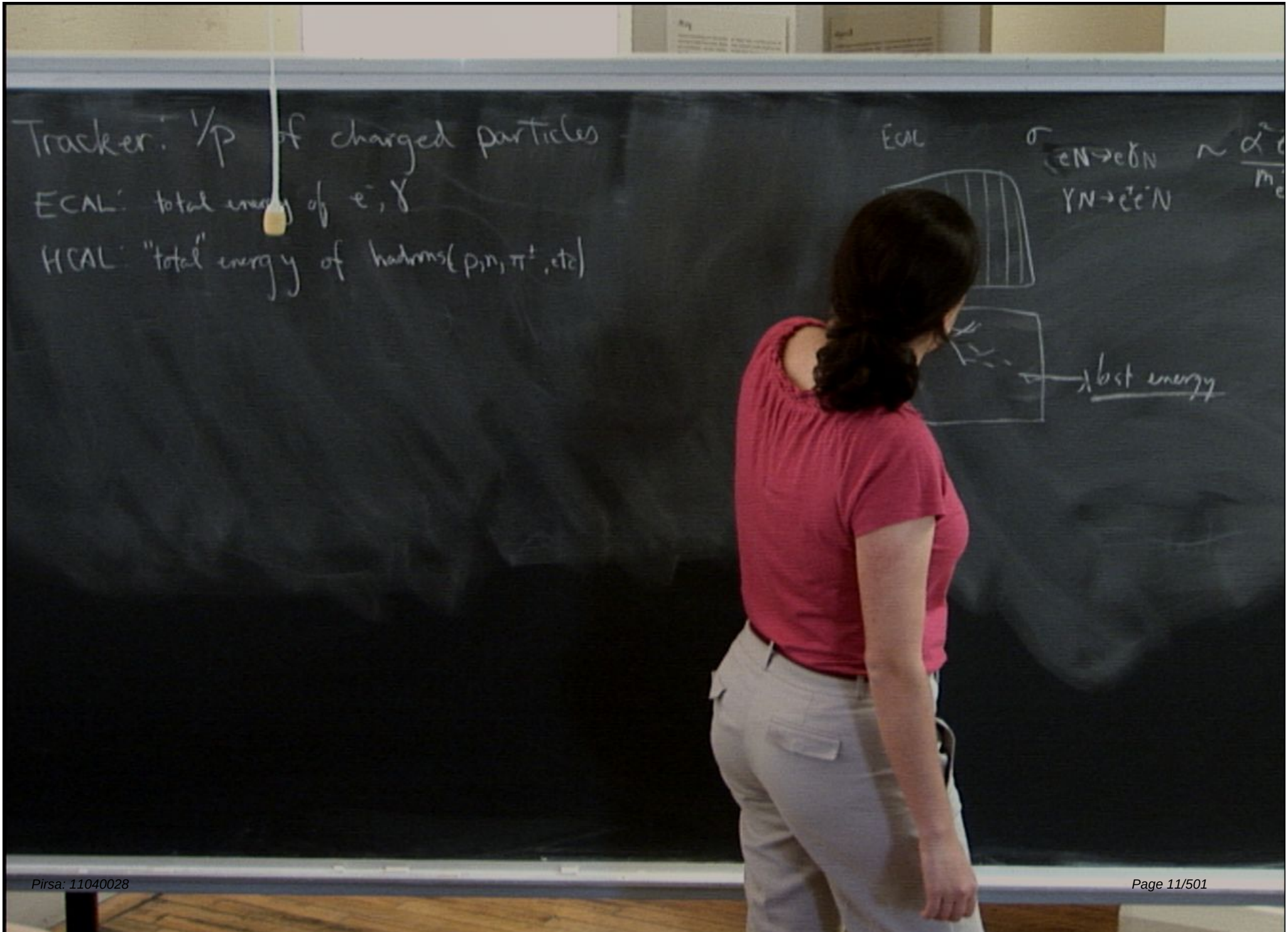
ECAL: total energy of e^-, γ

HCAL: "total" energy of hadrons ($p, n, \pi^\pm$, etc)

ECAL


Tracker: 1/p of charged particles
ECAL: total energy of e⁻, γ
HCAL: "total" energy of hadrons (p, n, π±, etc)
ECAL
lost energy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ECAL
σ
eN → eγN
γN → e⁺e⁻N
lost energy

Tracker: 1/p of charged particles

ECAL: total energy of e^-, γ

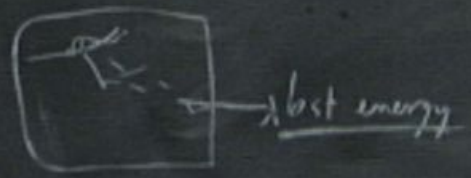
HCAL: "total" energy of hadrons ($p, n, \pi^\pm$, etc)

ECAL

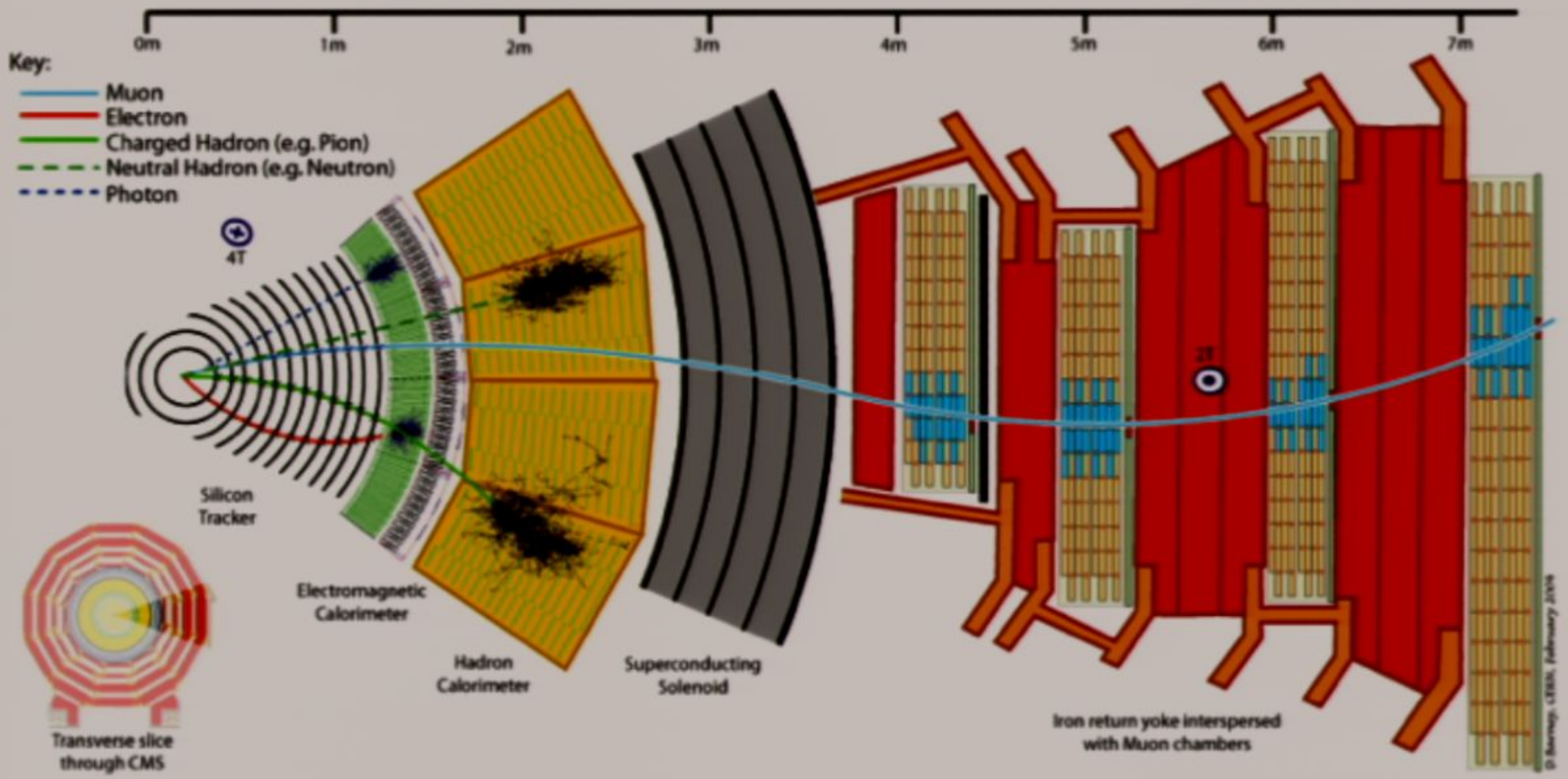
$\sigma_{eN \to e\gamma N} \sim \frac{\alpha^2 Z^2}{m_e^2}$

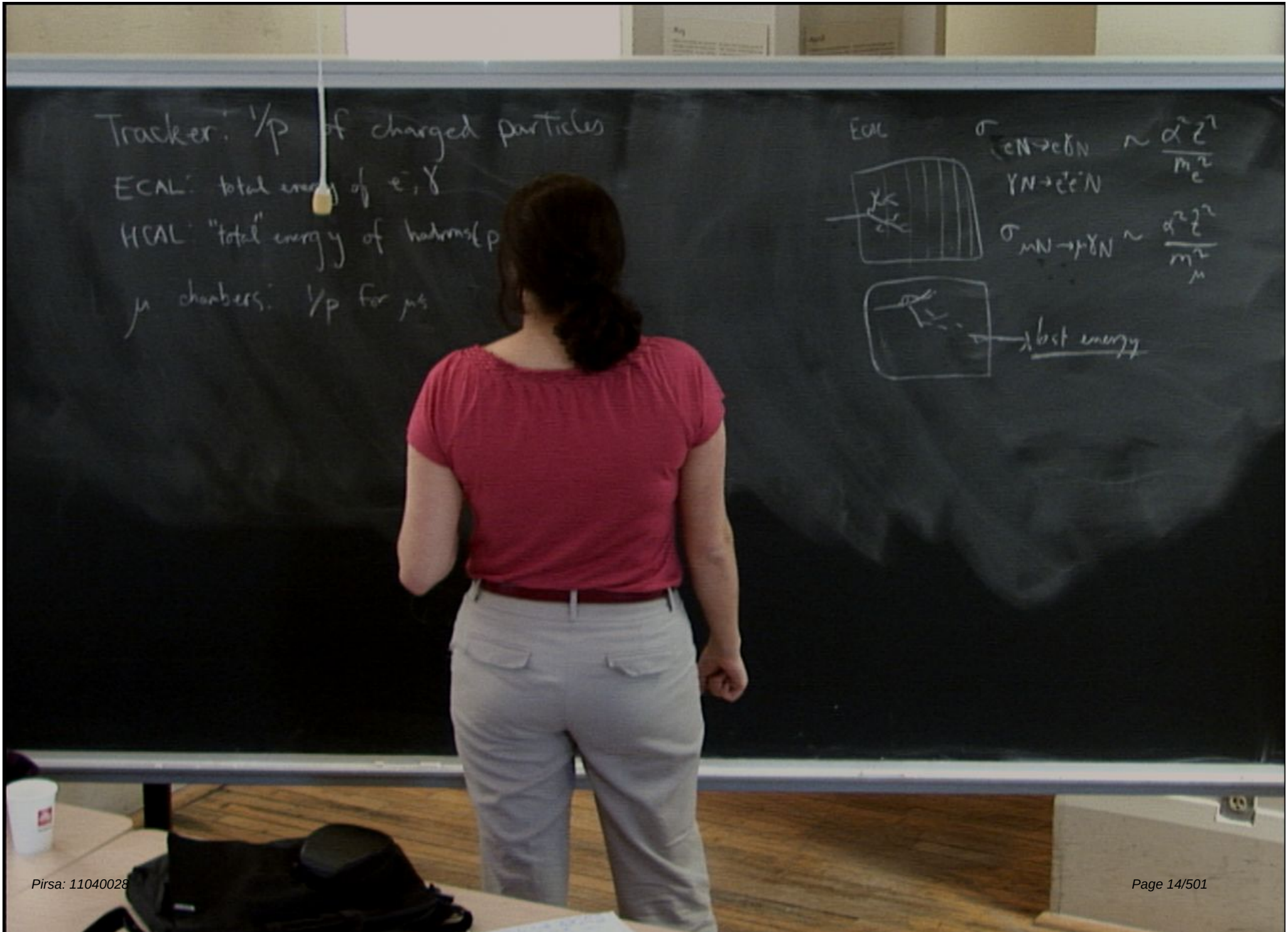
$\gamma N \to e^+ e^- N$

$\sigma_{\mu N \to \mu\gamma N} \sim \frac{\alpha^2 Z^2}{m_\mu^2}$



Cartoon ‘slice’ of CMS detector

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ECAL: total energy of e, γ
HCAL: "total" energy of hadrons(p
μ chambers: 1/p for μs
ECAL
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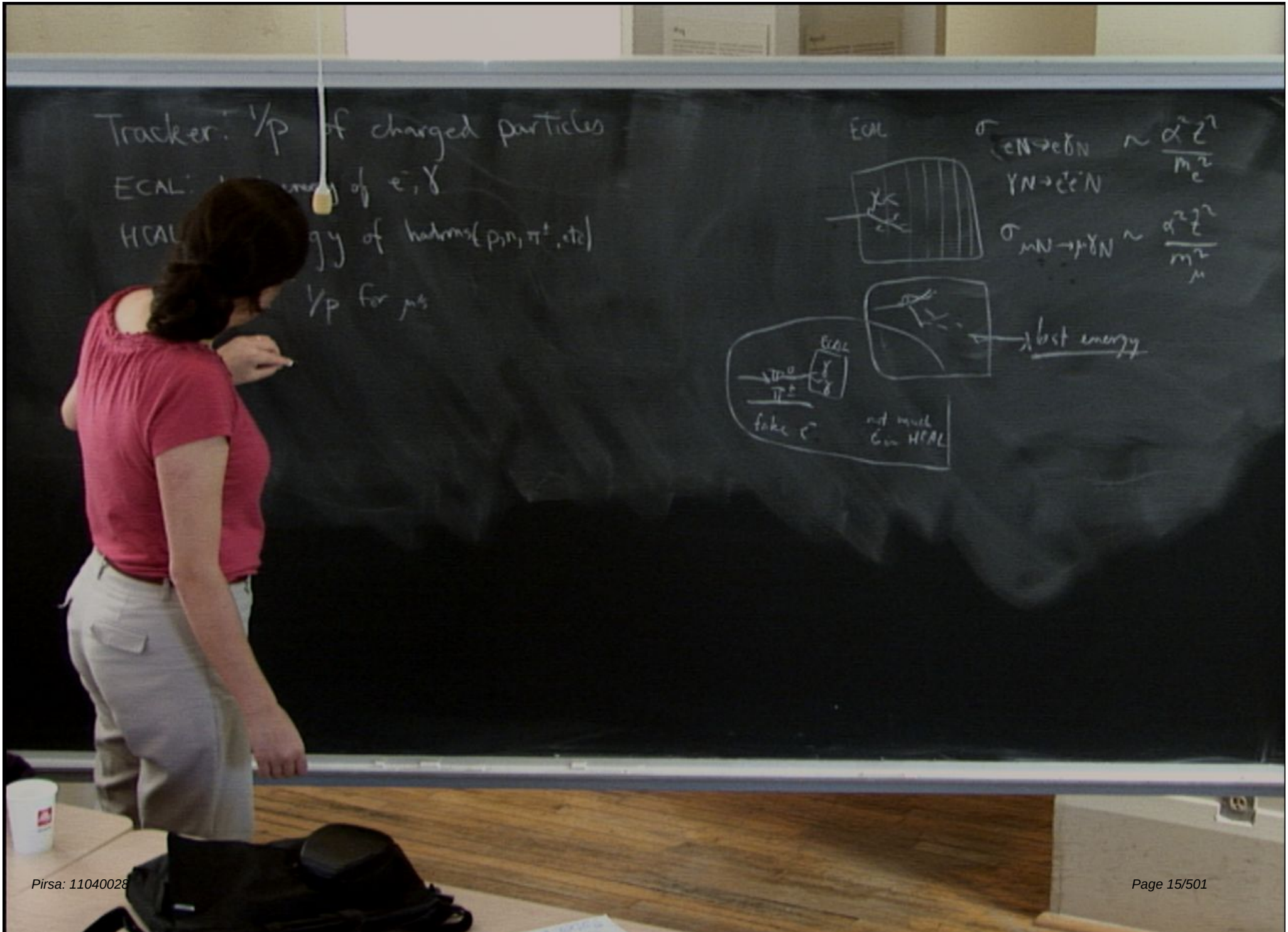
lost energy


Tracker: 1/p of charged particles
ECAL
HCAL
1/p for μs
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$\sigma_{eN \to e\gamma N} \sim \frac{\alpha^2 Z^2}{m_e^2}$
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lost energy
ECAL
HCAL
fake e⁻
not much E in HCAL

Tracker: 1/p of charged particles

ECAL: total energy of e^-, γ

HCAL: "total" energy of hadrons ($p, n, \pi^\pm$, etc)

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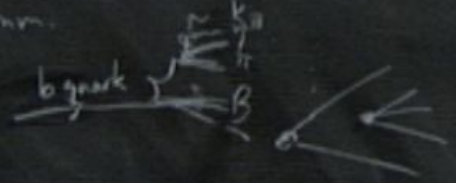
B mesons $c\tau \sim \frac{1}{2}$ mm.



ECAL

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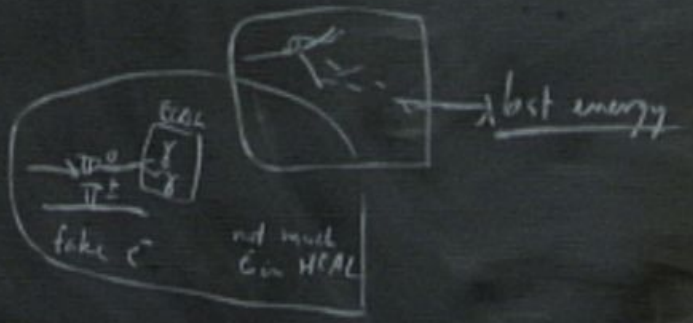
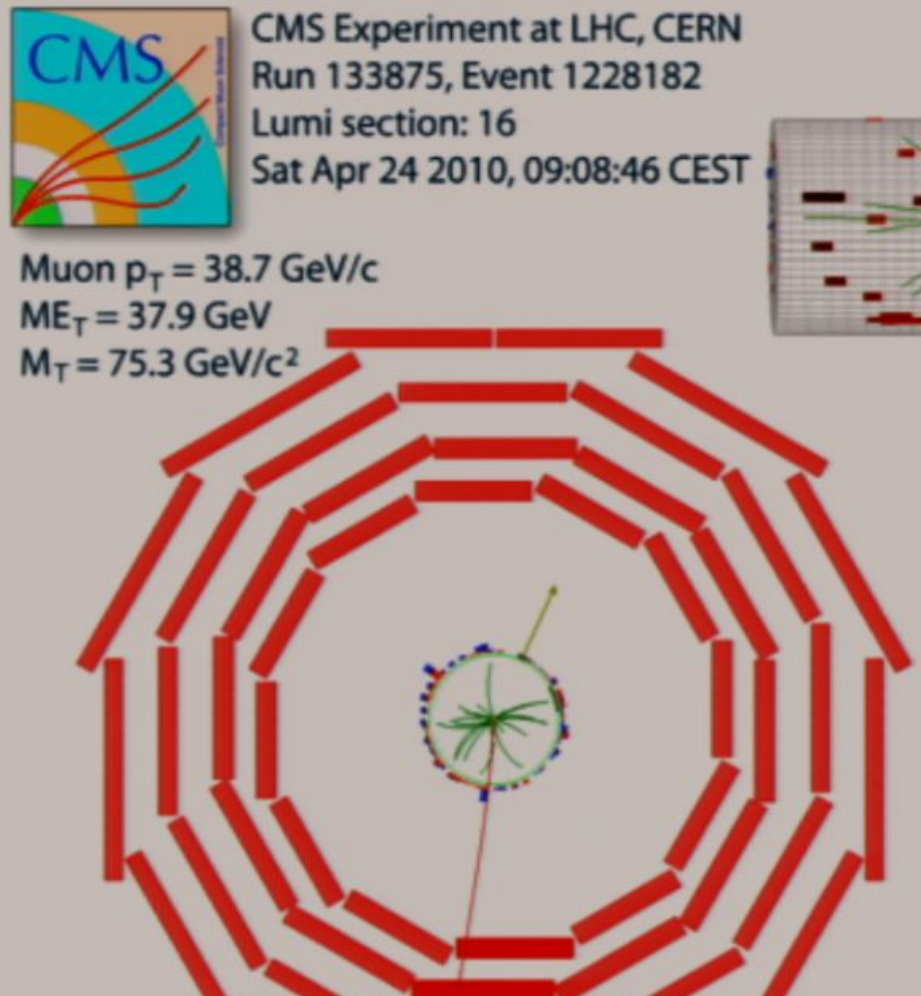


W and Z event displays from CMS

https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEWK#EventDisplays



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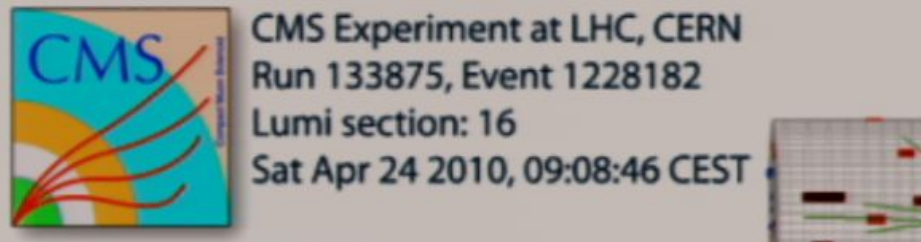
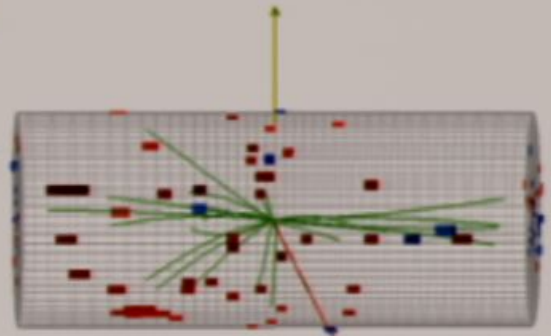
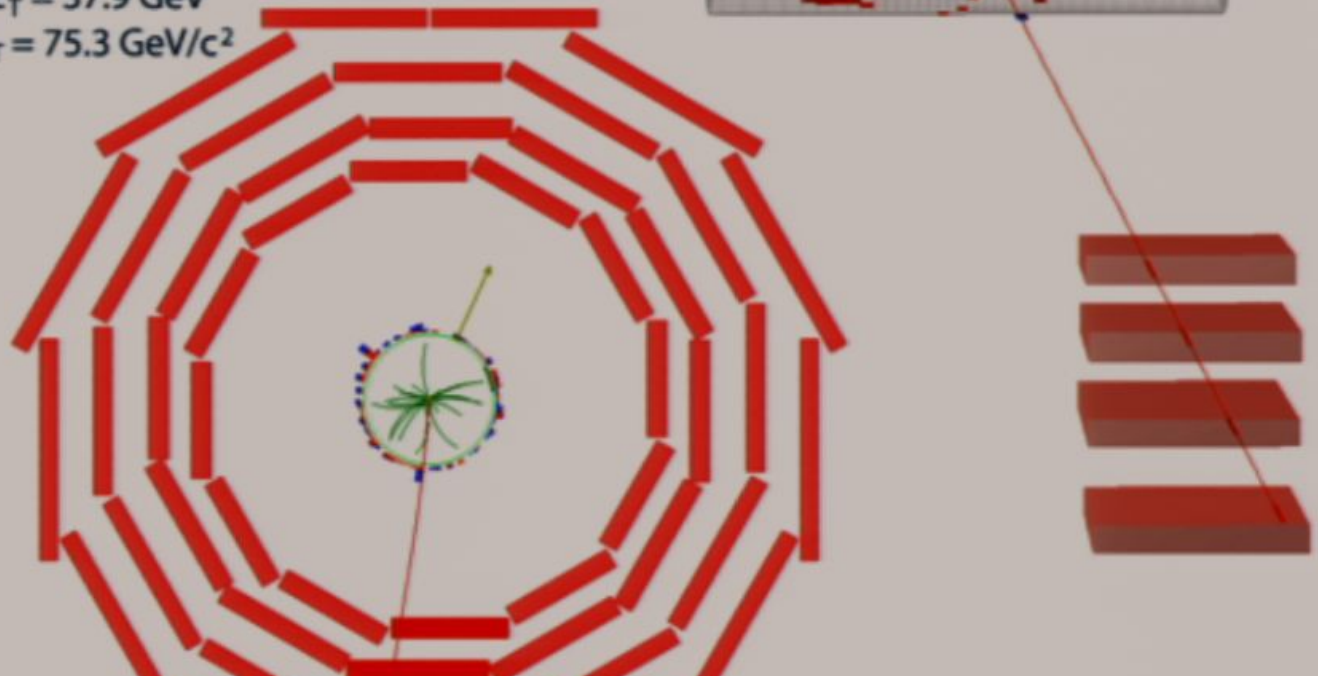


CMS Experiment at LHC, CERN
Run 133875, Event 1228182
Lumi section: 16
Sat Apr 24 2010, 09:08:46 CEST

Muon $p_T = 38.7$ GeV/c
$ME_T = 37.9$ GeV
$M_T = 75.3$ GeV/c^2





W and Z event displays from CMS

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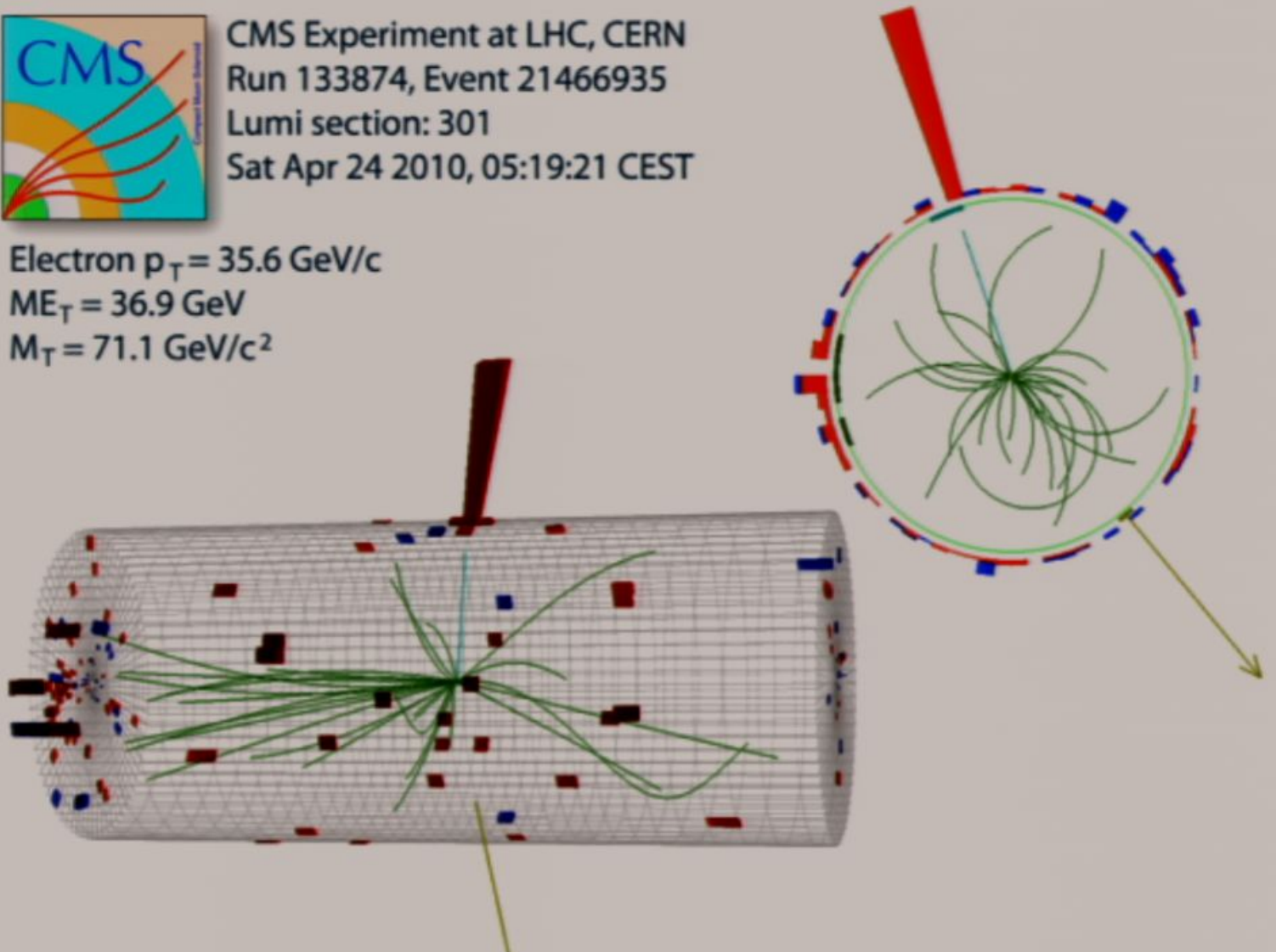
CMS Experiment at LHC, CERN
Run 133874, Event 21466935
Lumi section: 301
Sat Apr 24 2010, 05:19:21 CEST

Electron $p_T = 35.6$ GeV/c
$ME_T = 36.9$ GeV
$M_T = 71.1$ GeV/c^2



W and Z event displays from CMS

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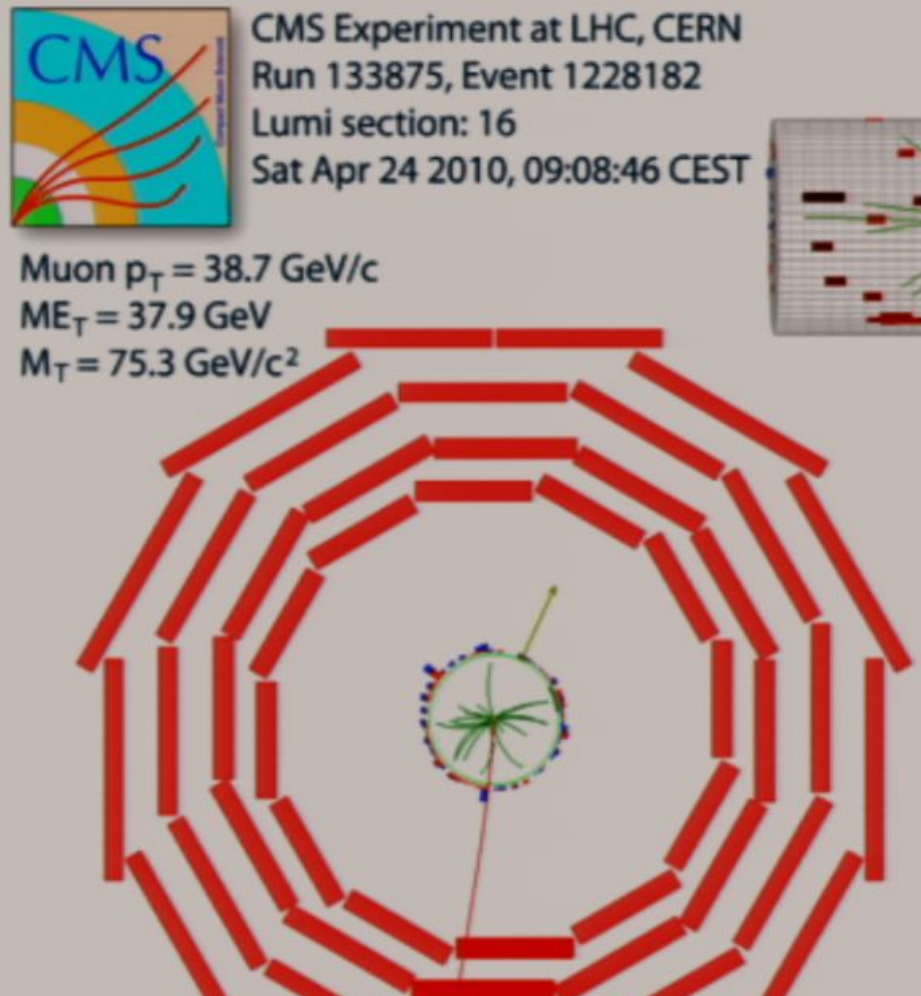
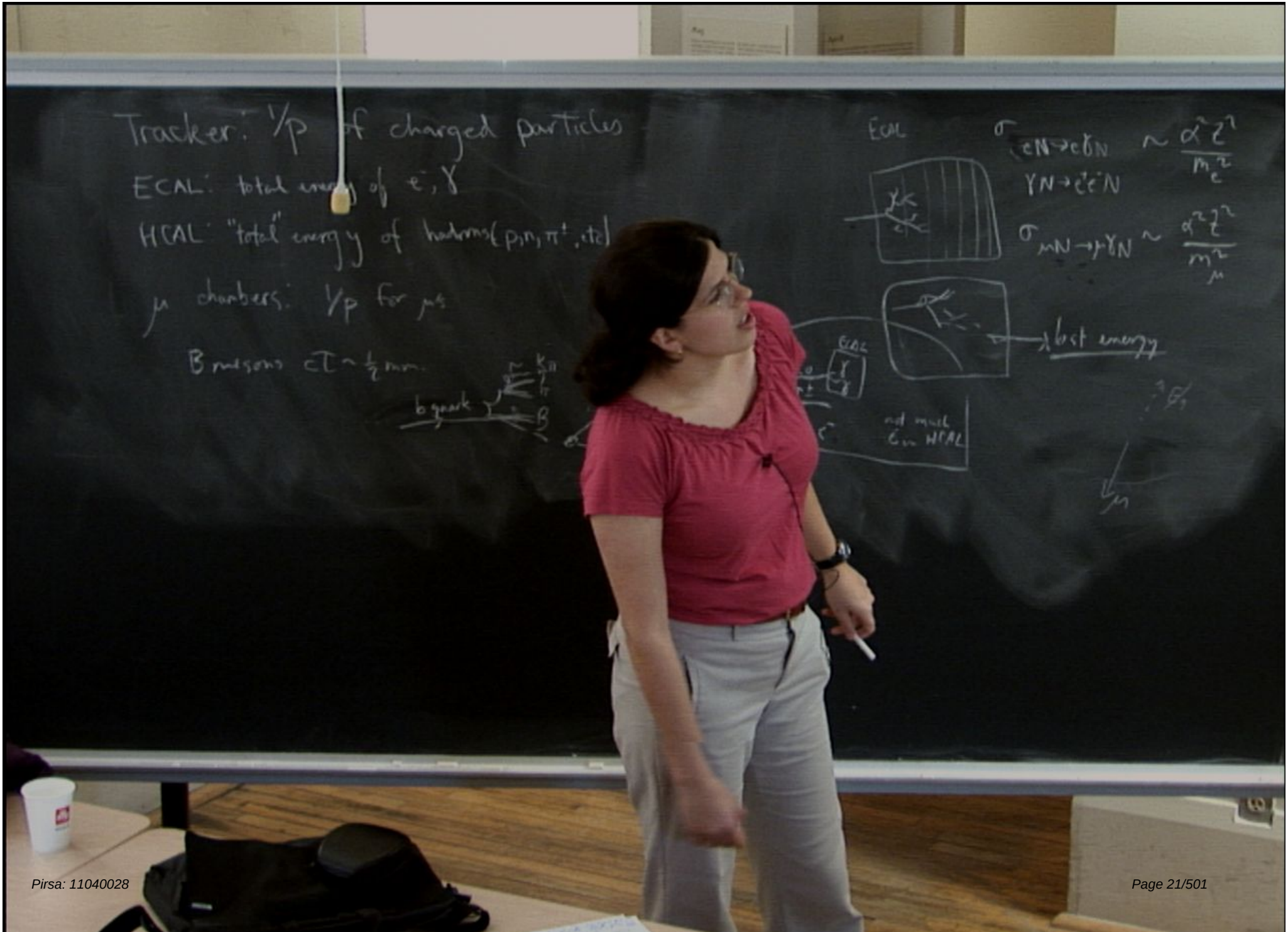
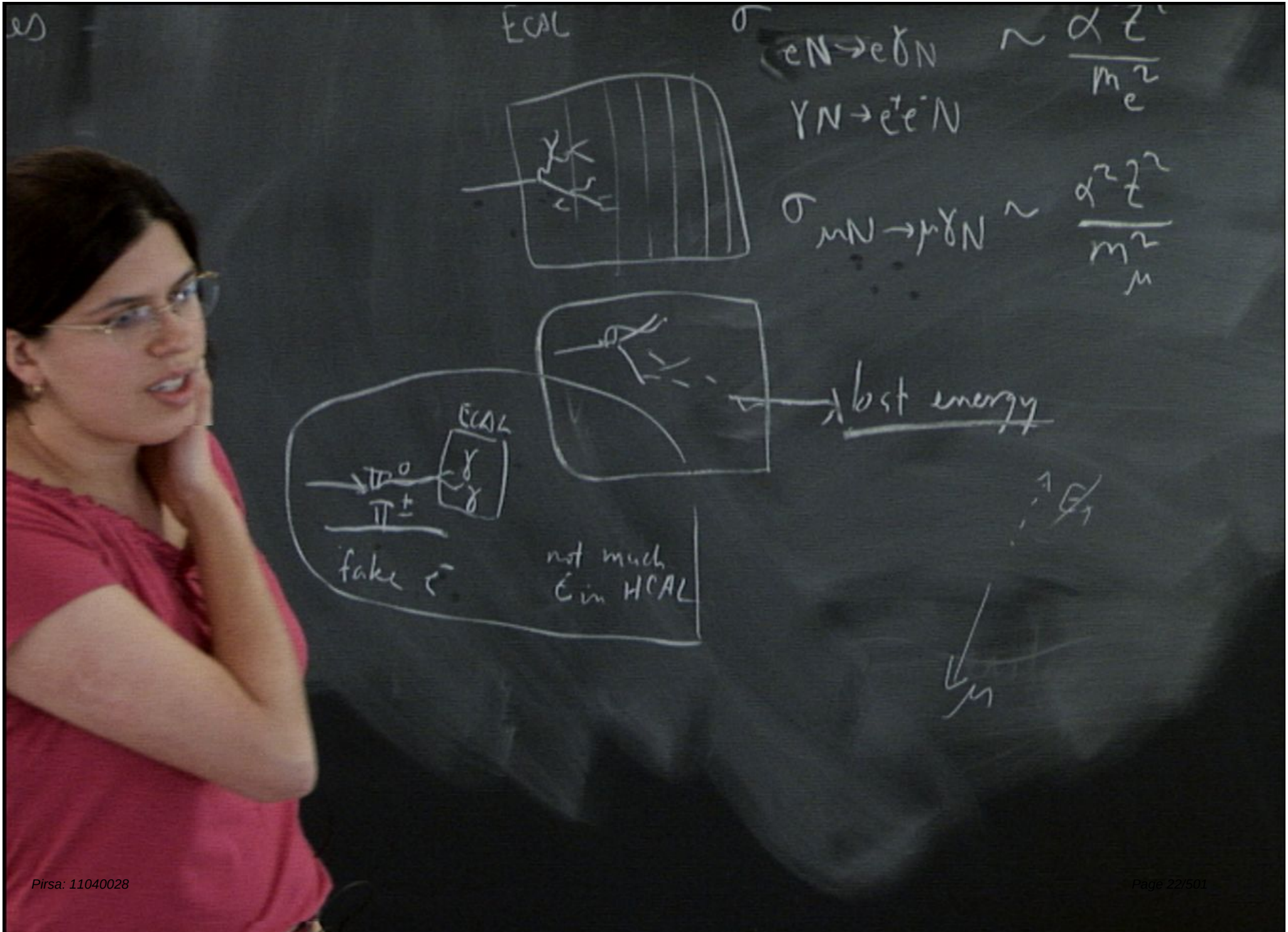



Tracker: 1/p of charged particles
ECAL: total energy of e, γ
HCAL: "total" energy of hadrons (p, n, π±, etc)
μ chambers: 1/p for μs
B mesons cτ ~ ½ mm.
b quark
ECAL
not much E in HCAL
ECAL
lost energy


ECAL
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$\gamma N \to e^+ e^- N$
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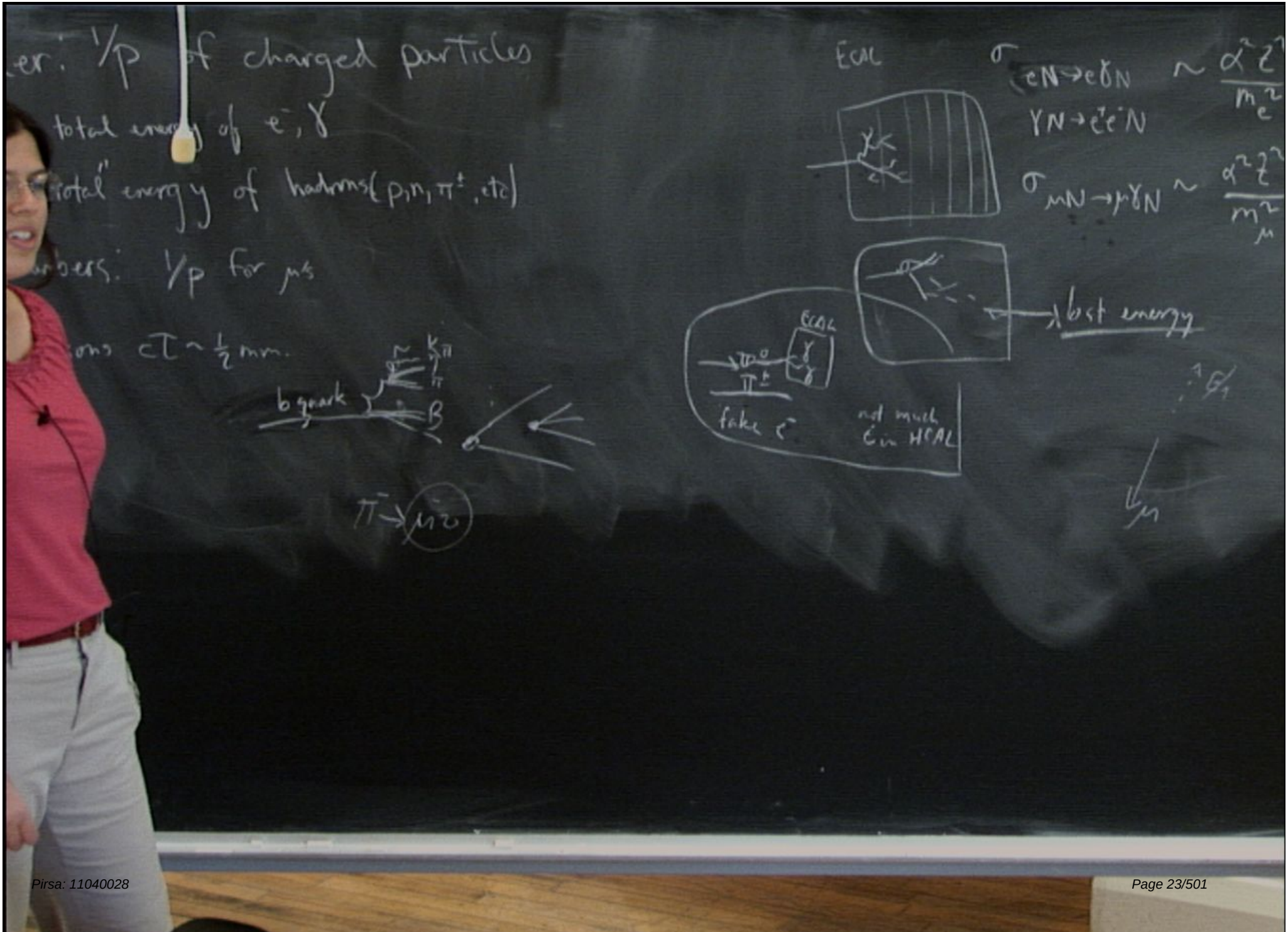
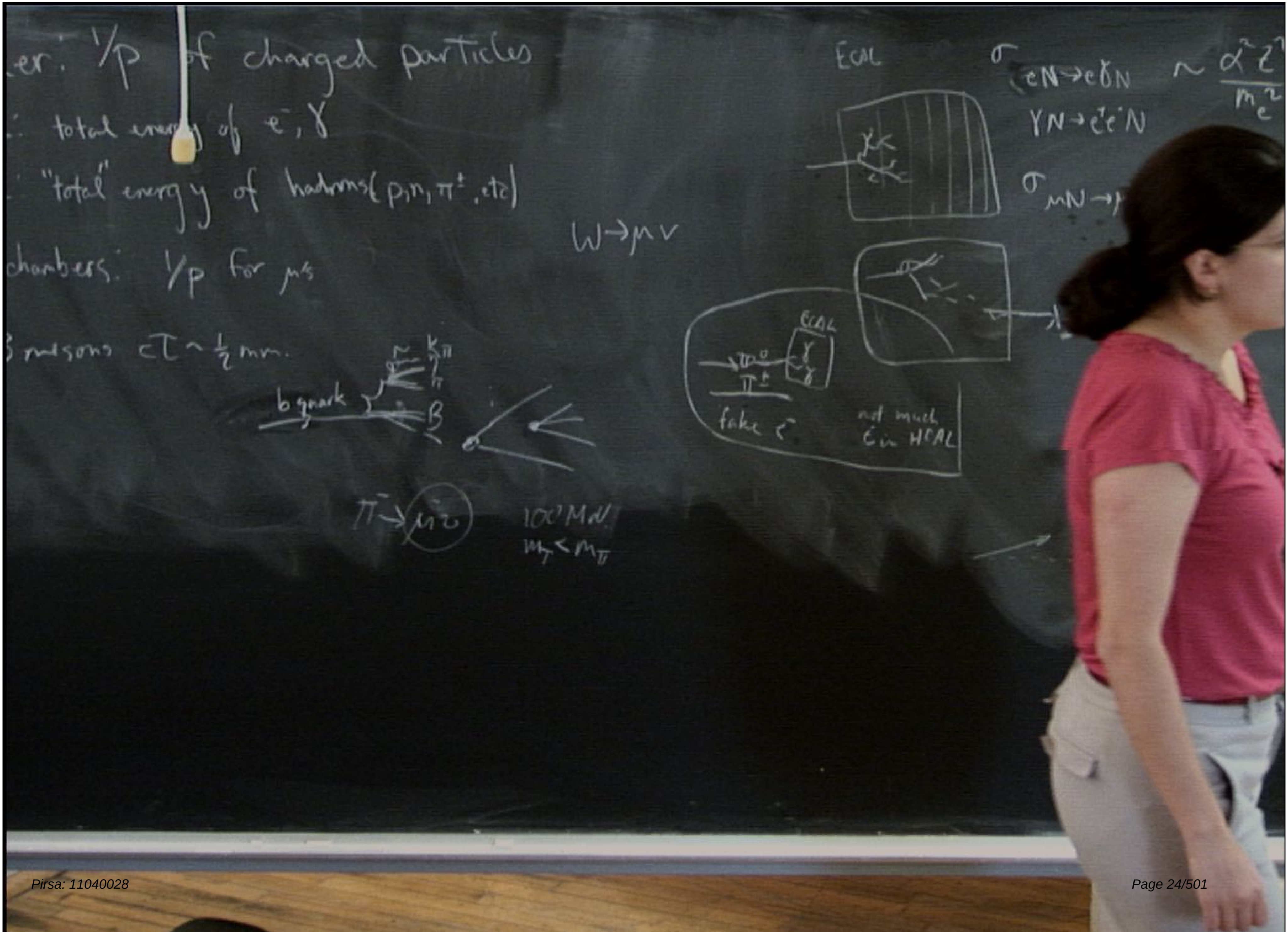
lost energy
ECAL
π^0
$\pi^\pm$
fake e^-
not much $\vec{E}$ in HCAL
$\vec{E}_T$
μ


er. 1/p of charged particles
total energy of e⁻, γ
"total" energy of hadrons (p, n, π±, etc)
ers. 1/p for μs
ons cτ ~ ½ mm.
b quark
B
π⁻ → μ ν
ECAL
σ eN → eγN ~ α²Z² / m_e²
γN → e⁺e⁻N
σ μN → μγN ~ α²Z² / m_μ²
best energy
ECAL
π⁰
γ
γ
π±
fake e⁻
not much E in HCAL
μ



1/p of charged particles
total energy of e⁻, γ
"total" energy of hadrons (p, n, π±, etc)
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B mesons cτ ~ ½ mm.
b quark
W→μν
ECAL
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π⁻→μν
100 MeV
mμ < mπ
σ eN→eγN ~ α²Z²/me²
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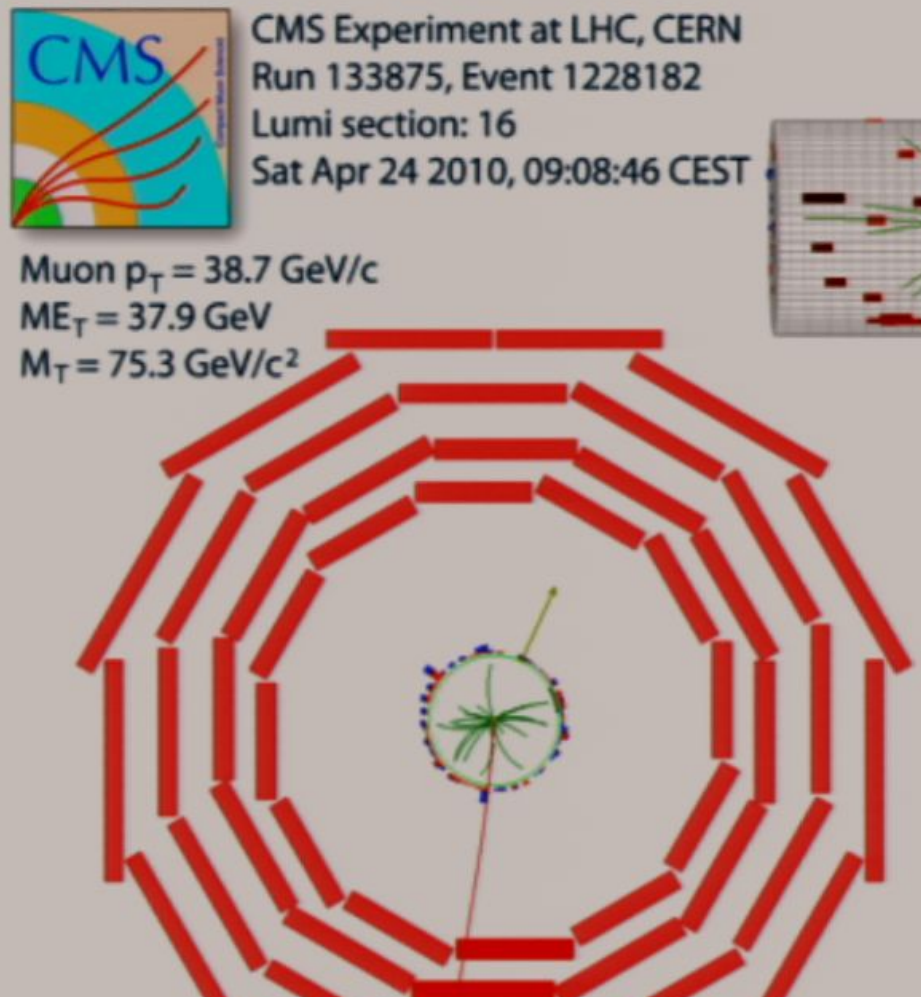

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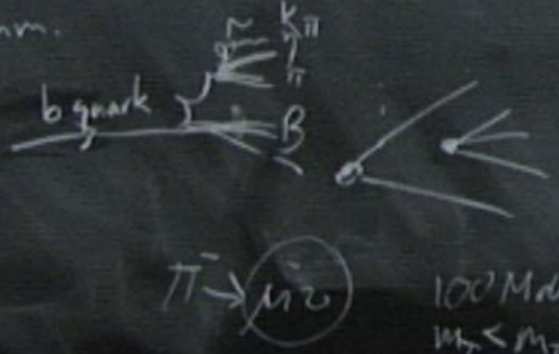
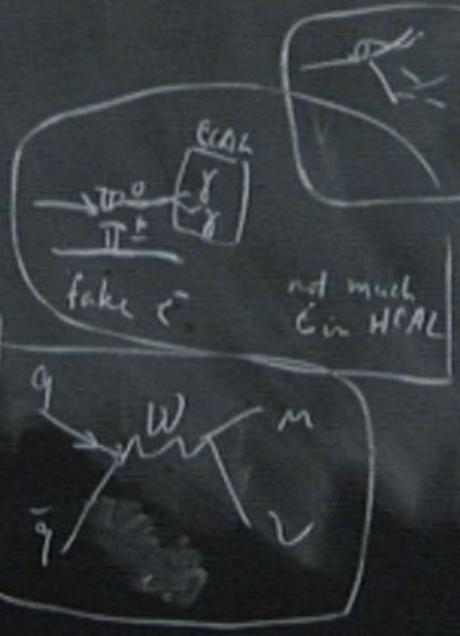
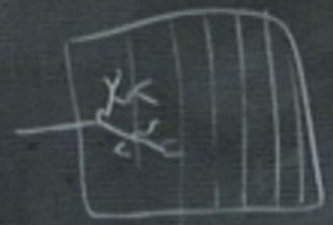


$W \to \mu\nu$





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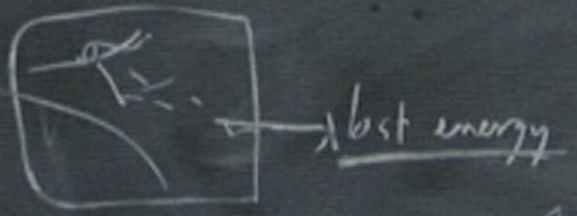

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Run 133875, Event 1228182
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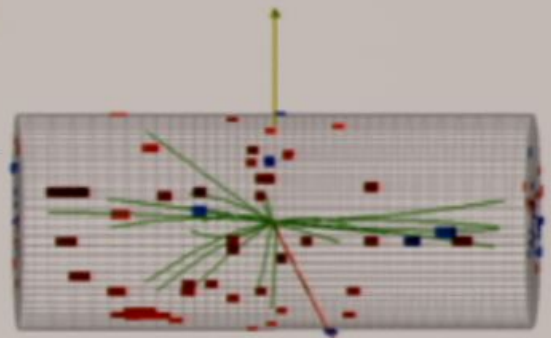

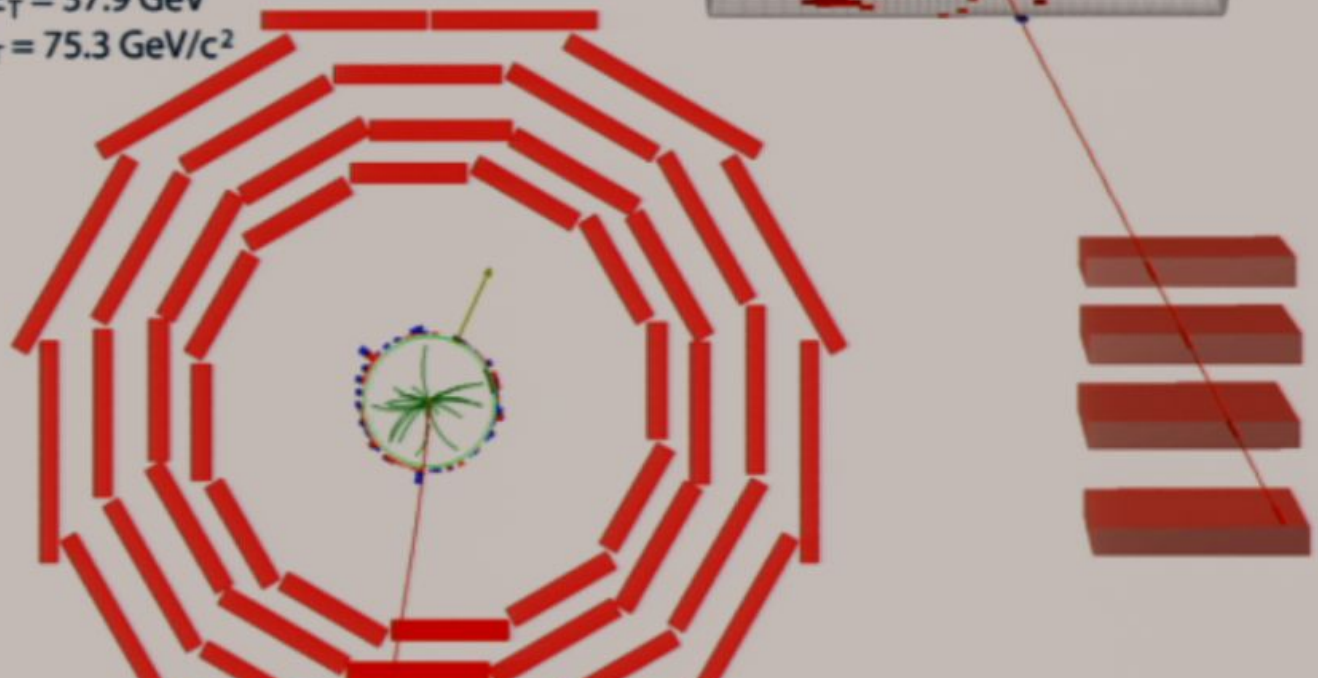

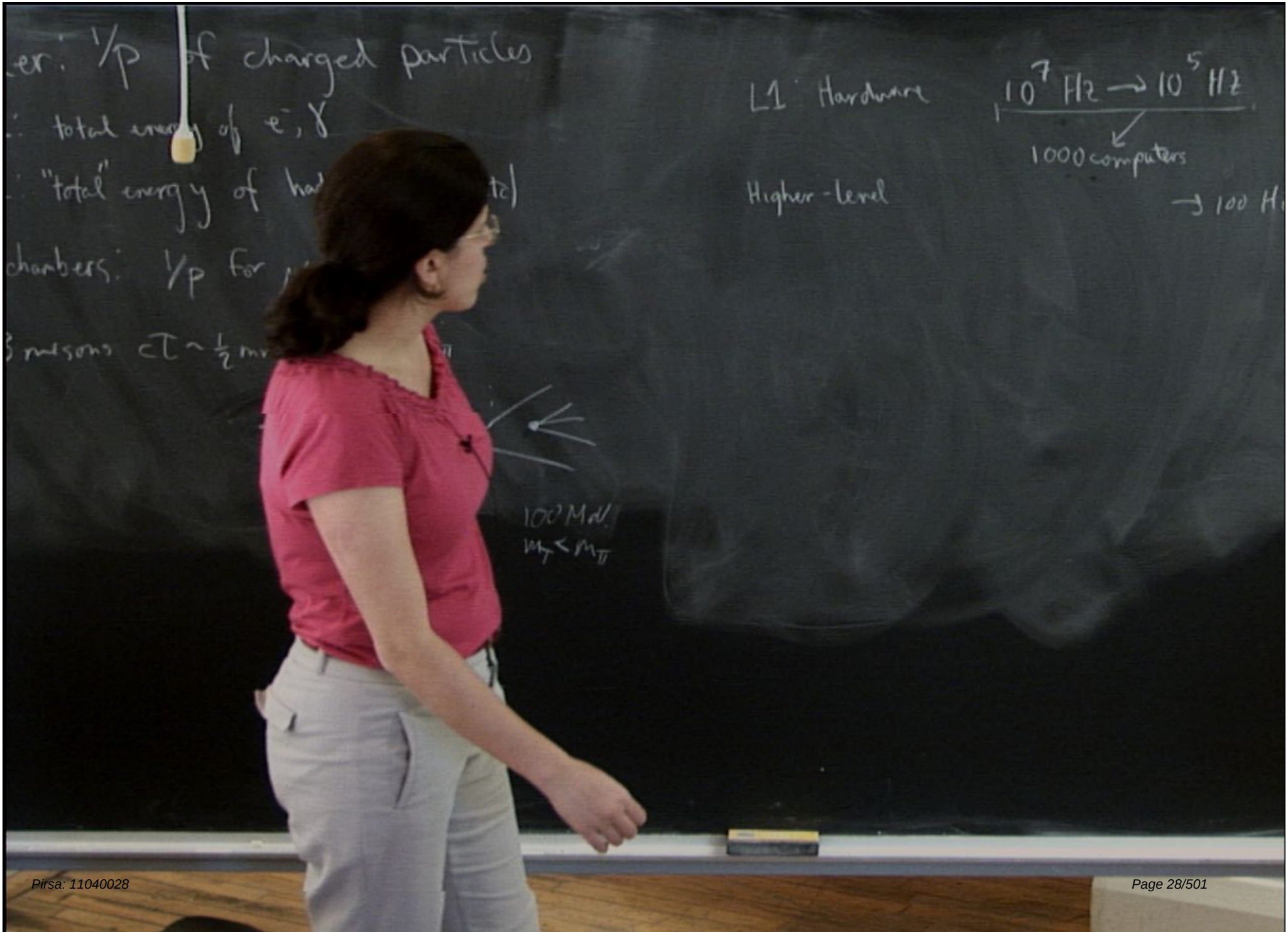
L1 Hardware
10^7 Hz → 10^5 Hz
1000 computers
Higher-level
100 MeV

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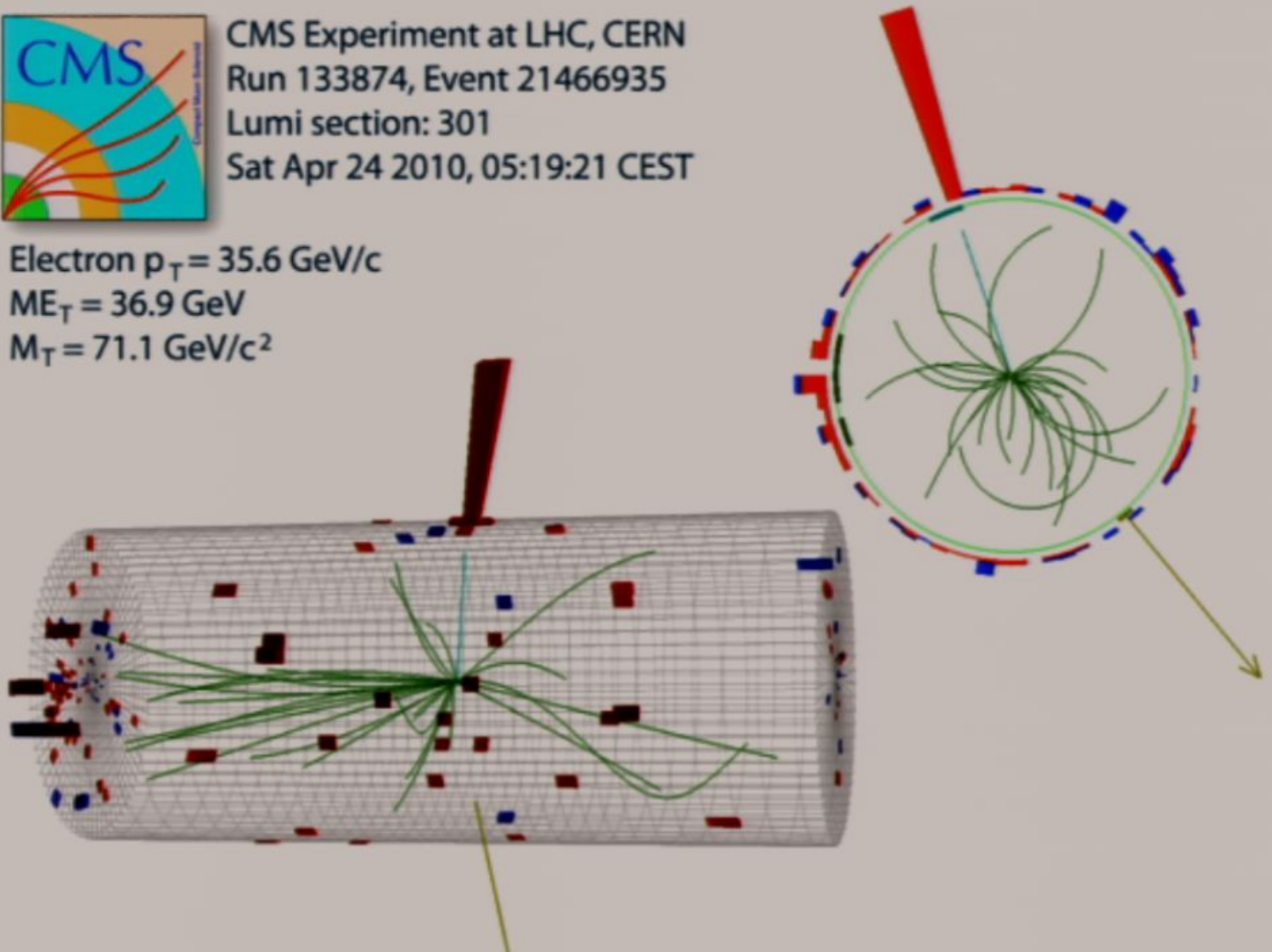

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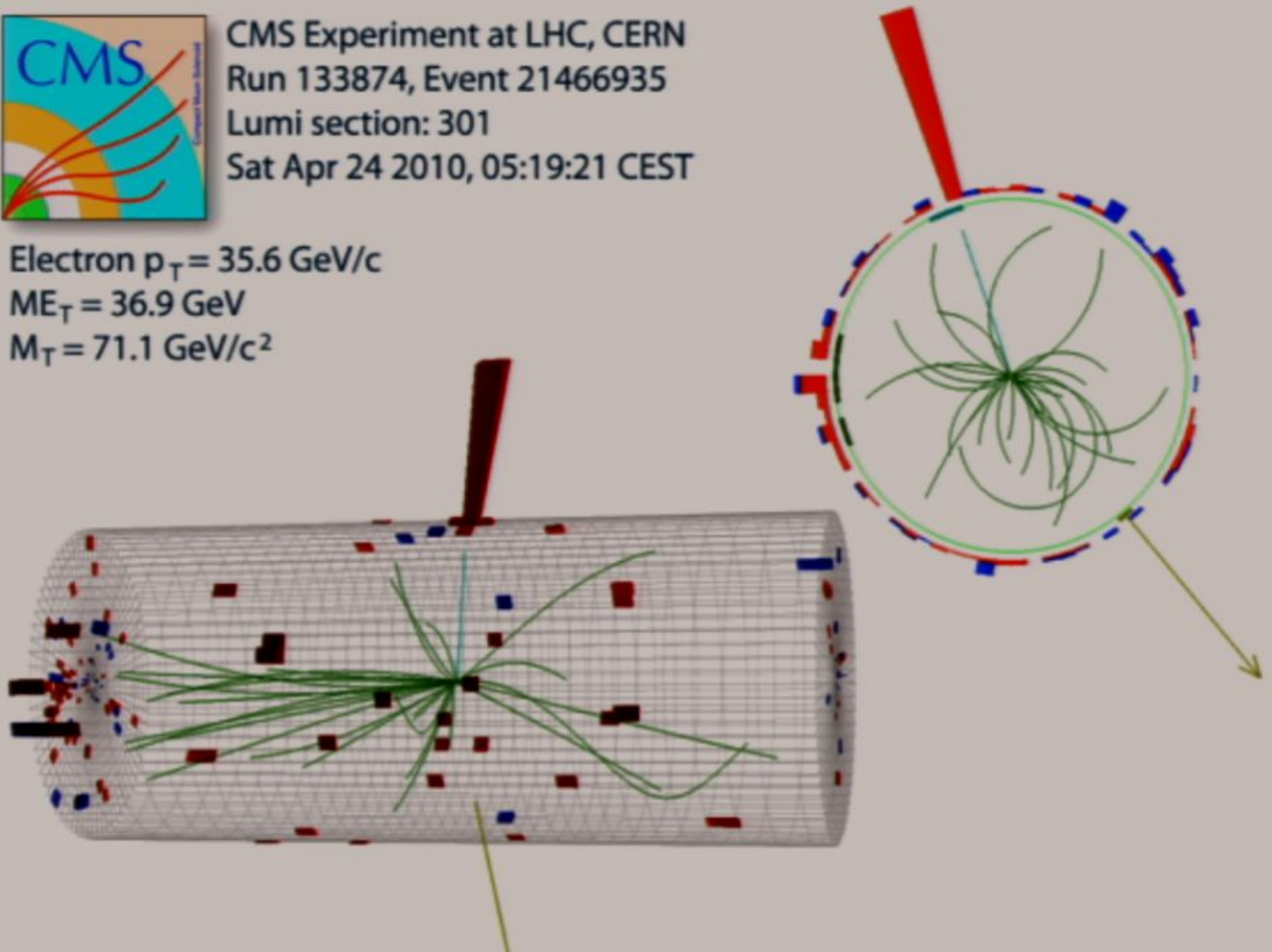

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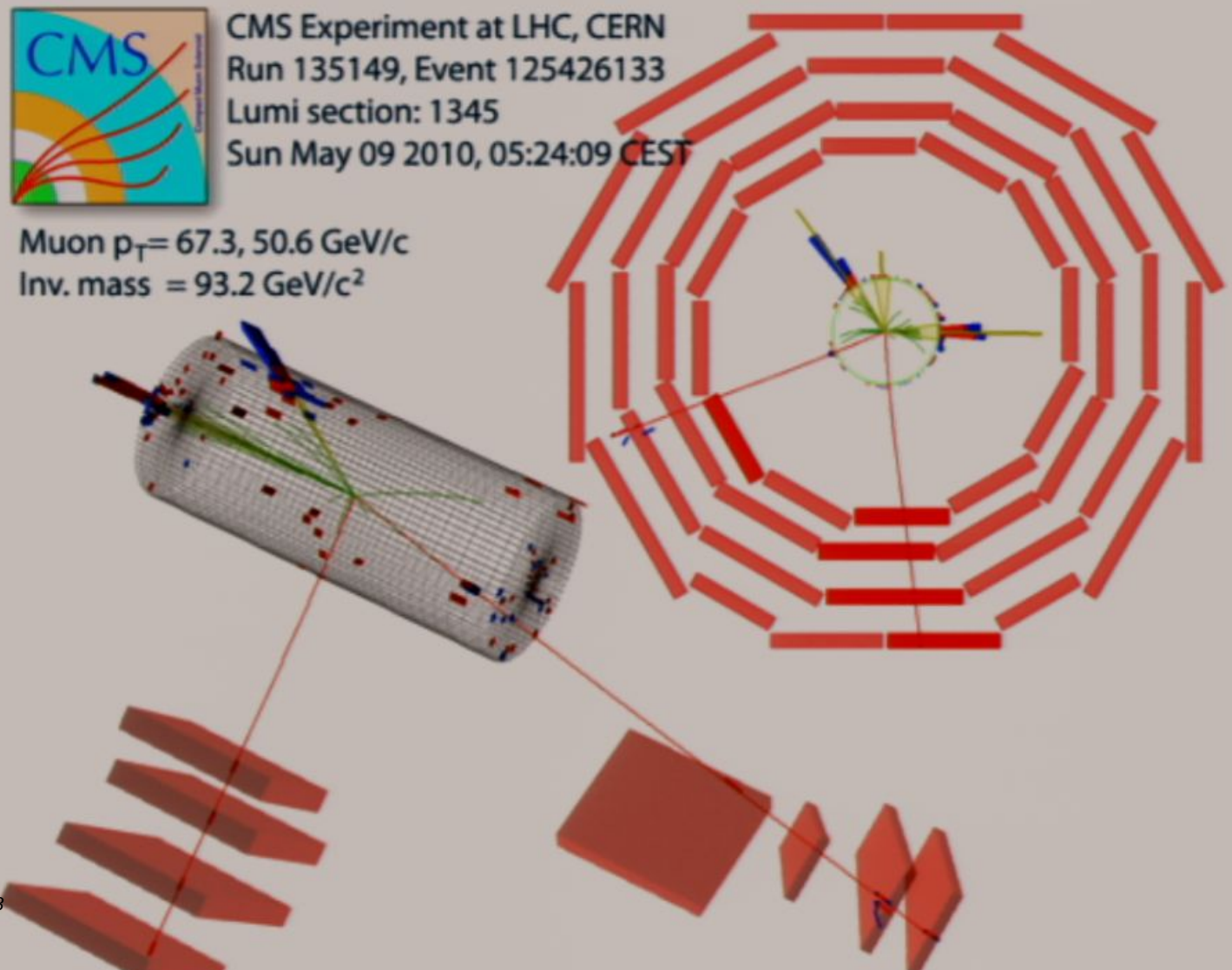

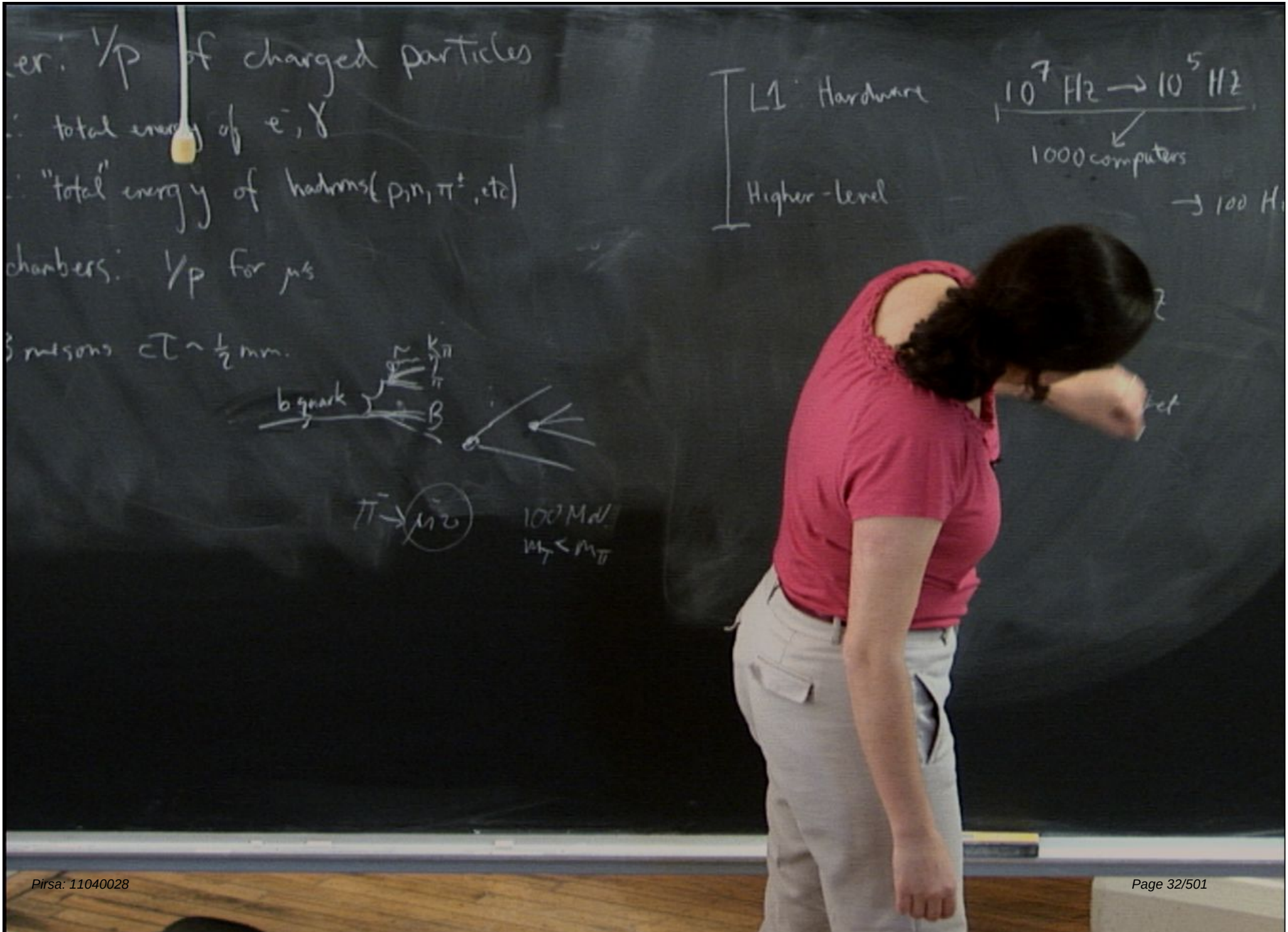
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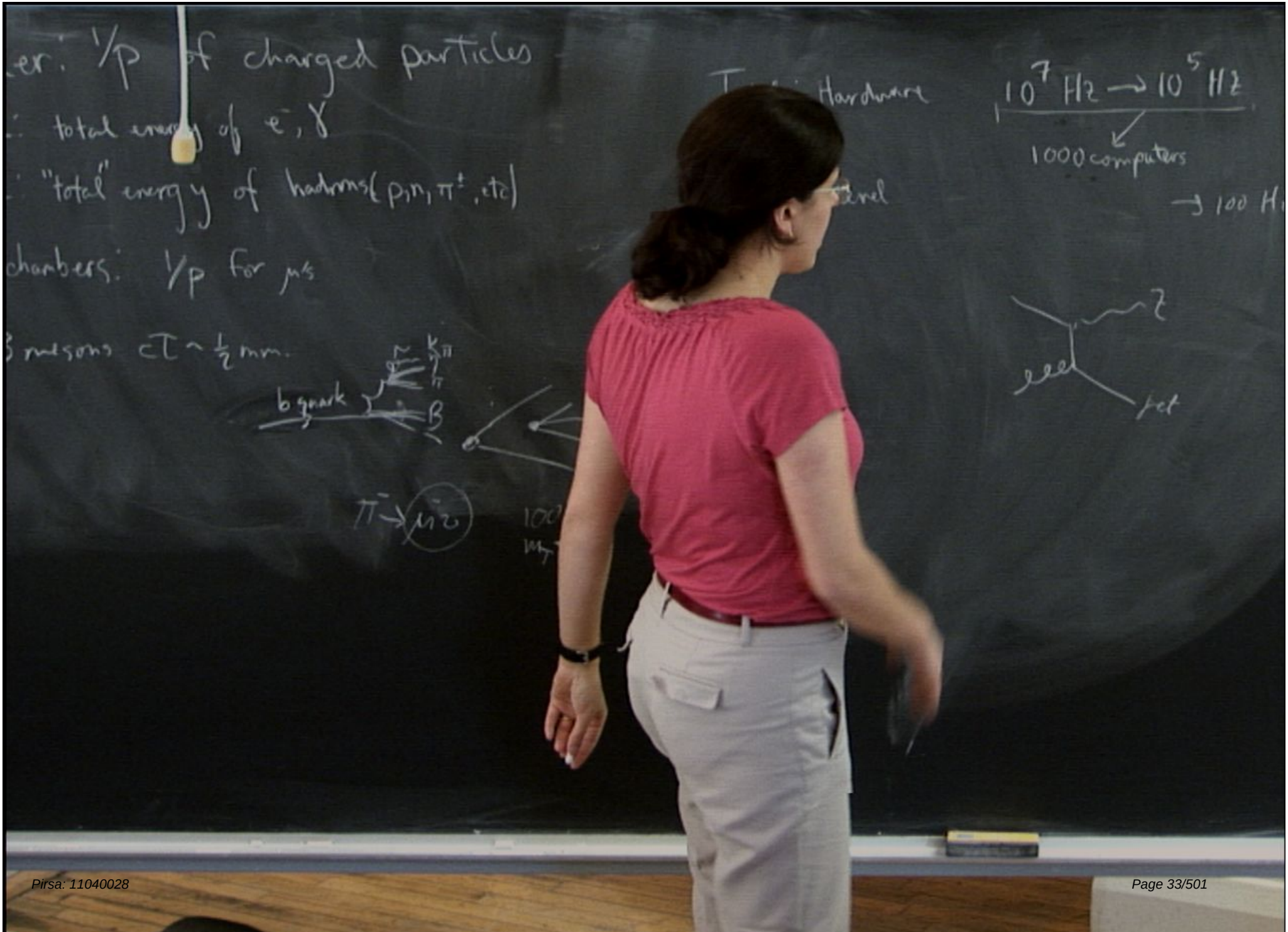
mesons cτ ~ ½ mm.
b quark
B
π⁻ → μ⁻ ν̄
100 MeV
m_μ < m_π
L1: Hardware
Higher-level
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 H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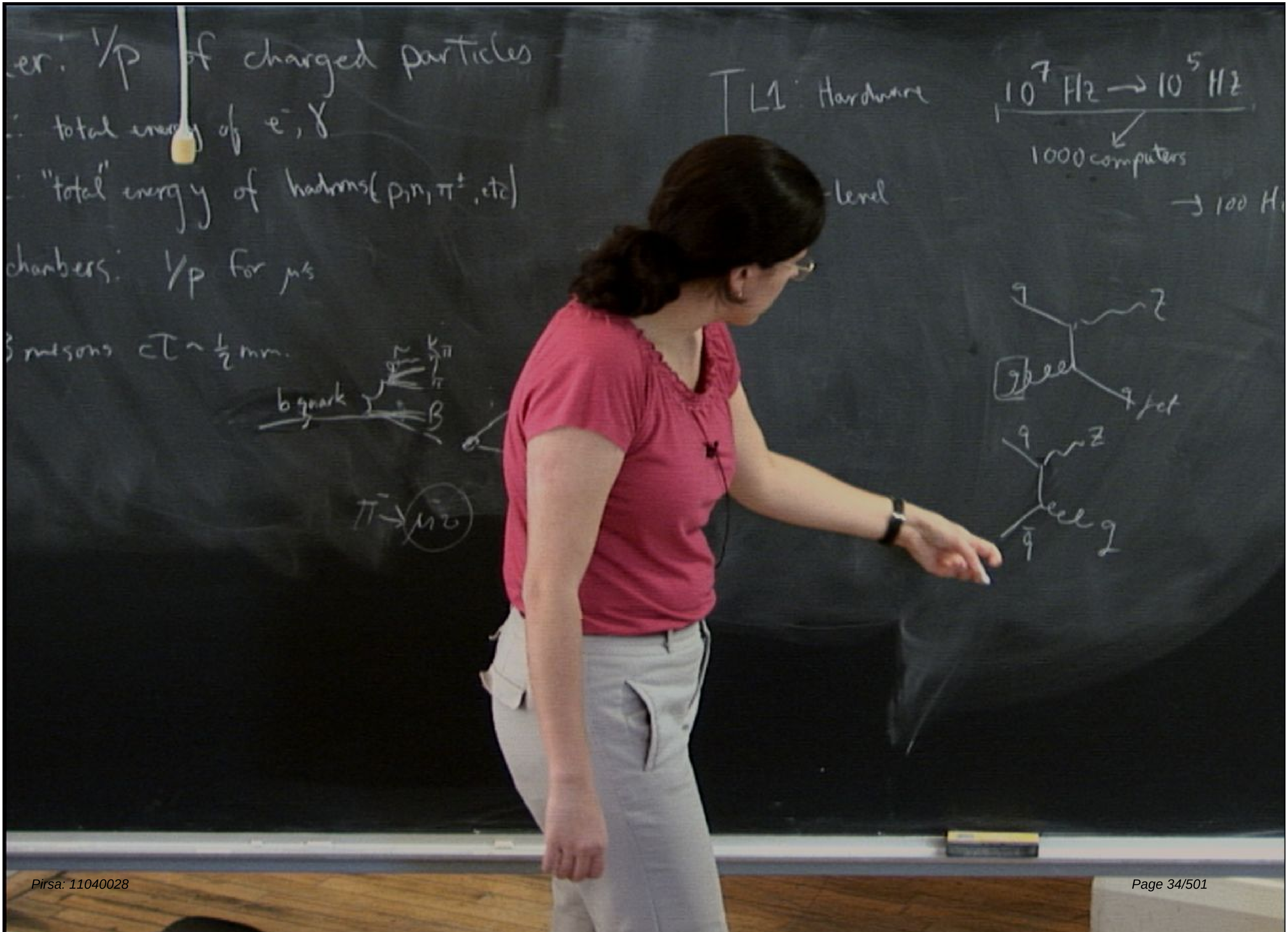
b quark
B
Hardware
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 H
Z
jet


1/p of charged particles
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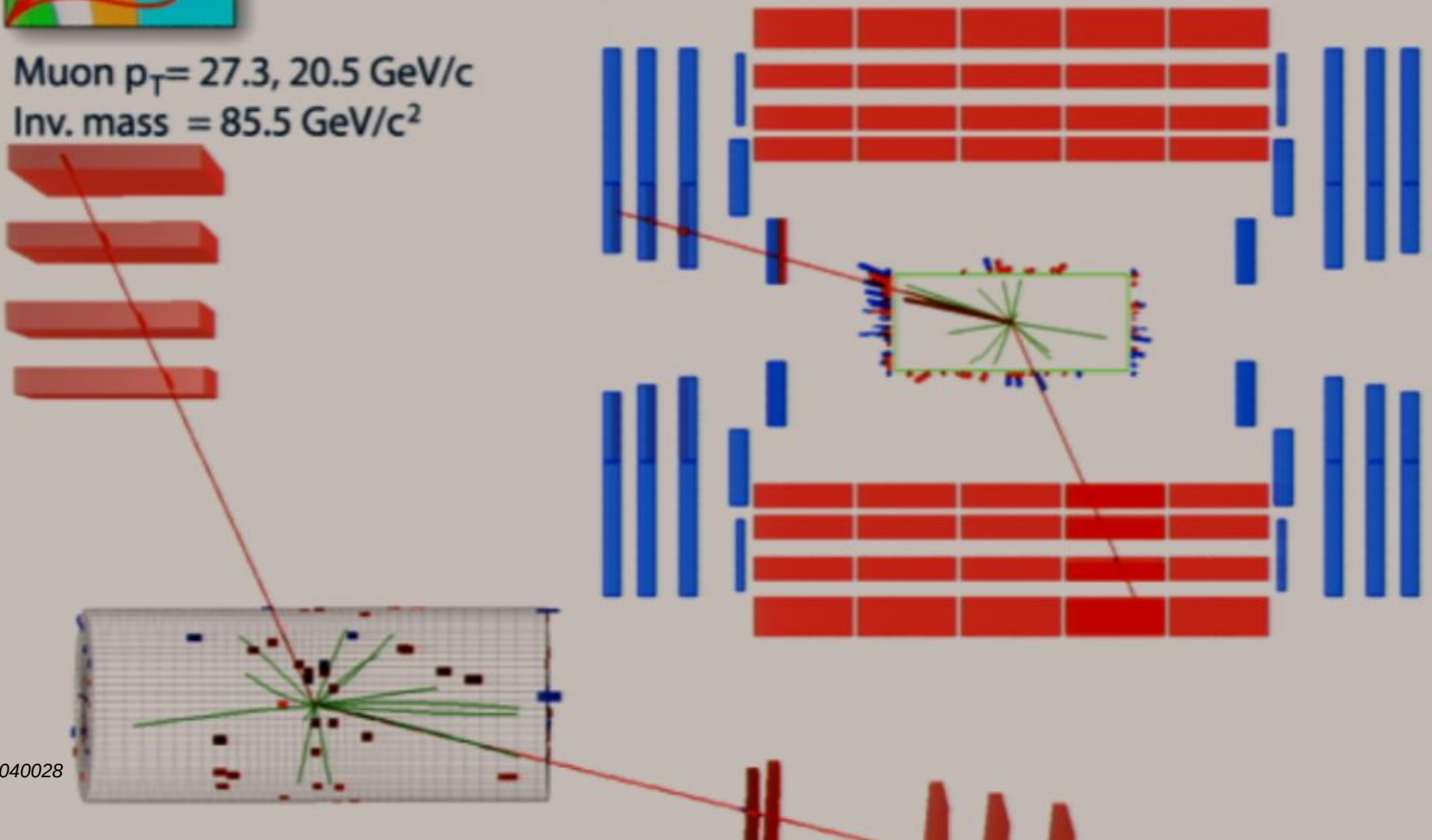
chambers: 1/p for μ's
B mesons cτ ~ ½ mm.
b quark
B
L1: Hardware
level
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 H
jet

W and Z event displays from CMS

https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEWK#EventDisplays

CMS Experiment at LHC, CERN
Run 136087 Event 39967482
Lumi section: 314
Mon May 24 2010, 15:31:58 CEST

Muon p_T= 27.3, 20.5 GeV/c
Inv. mass = 85.5 GeV/c^2



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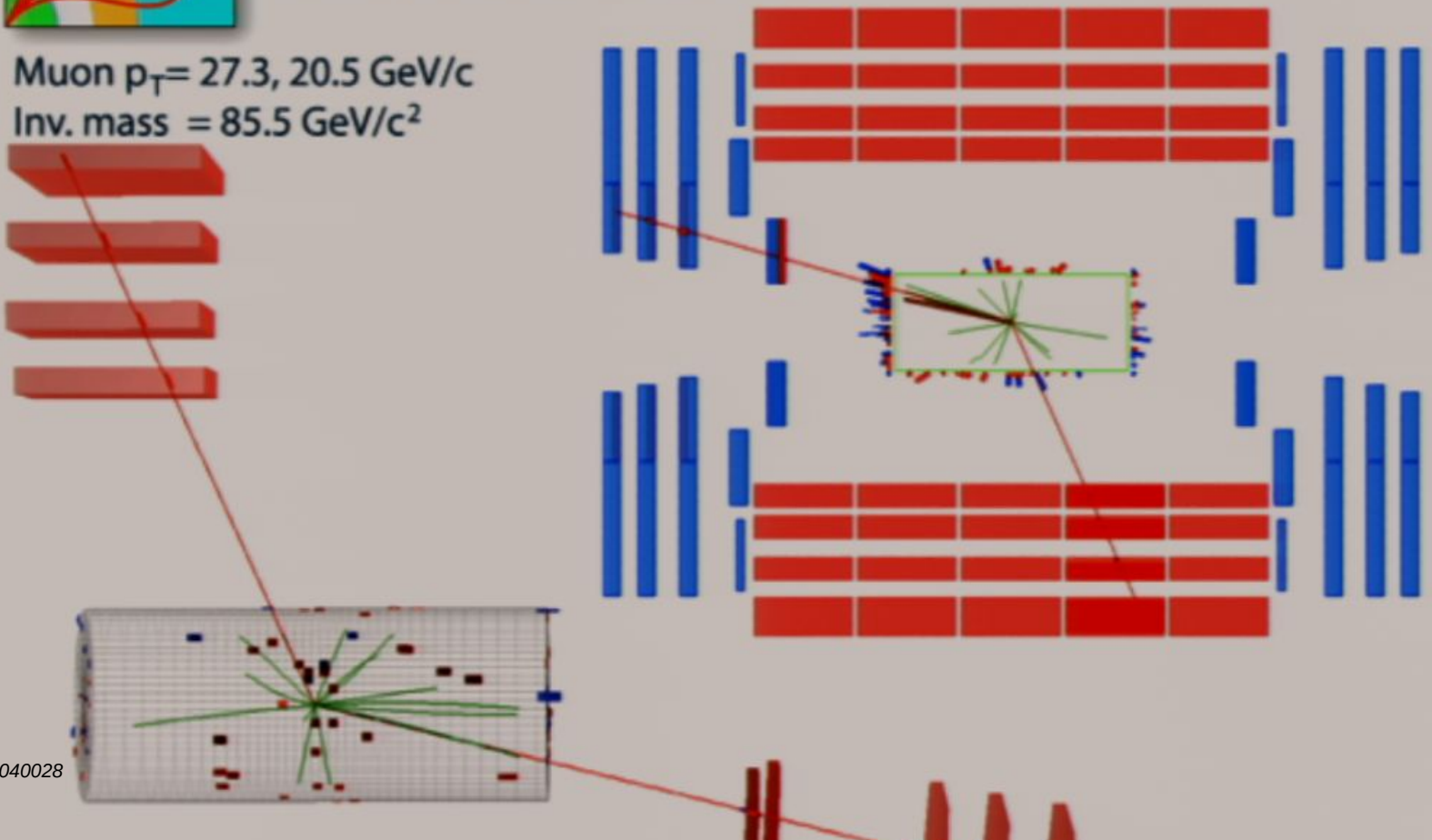
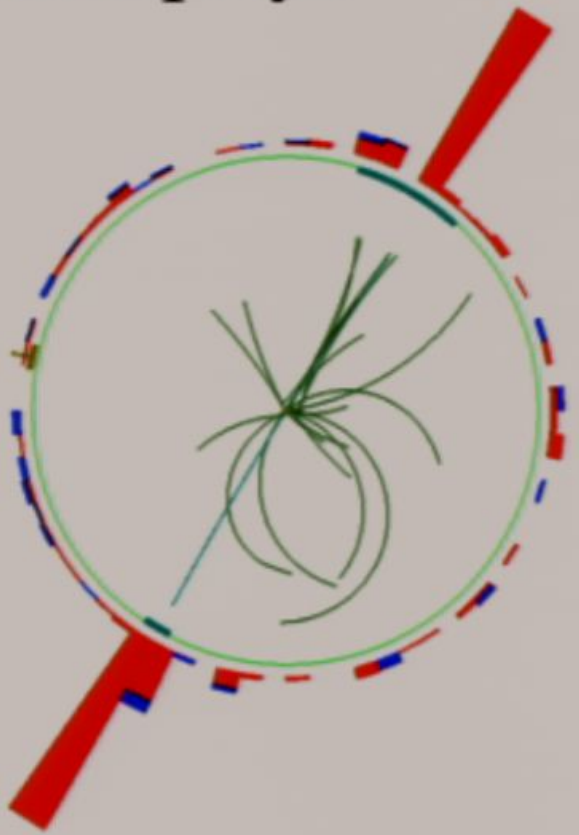


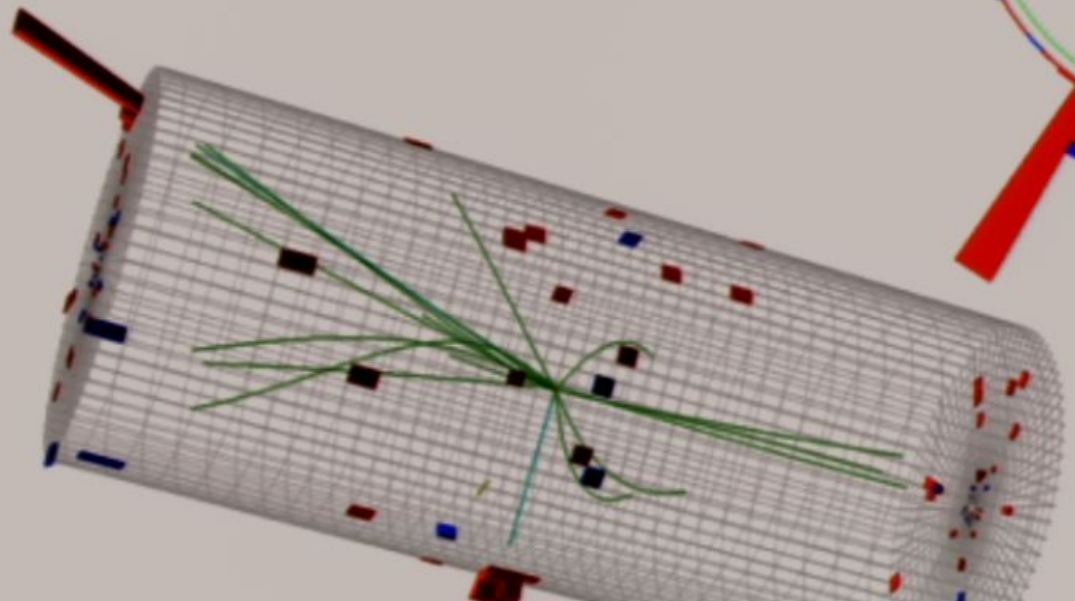
W and Z event displays from CMS

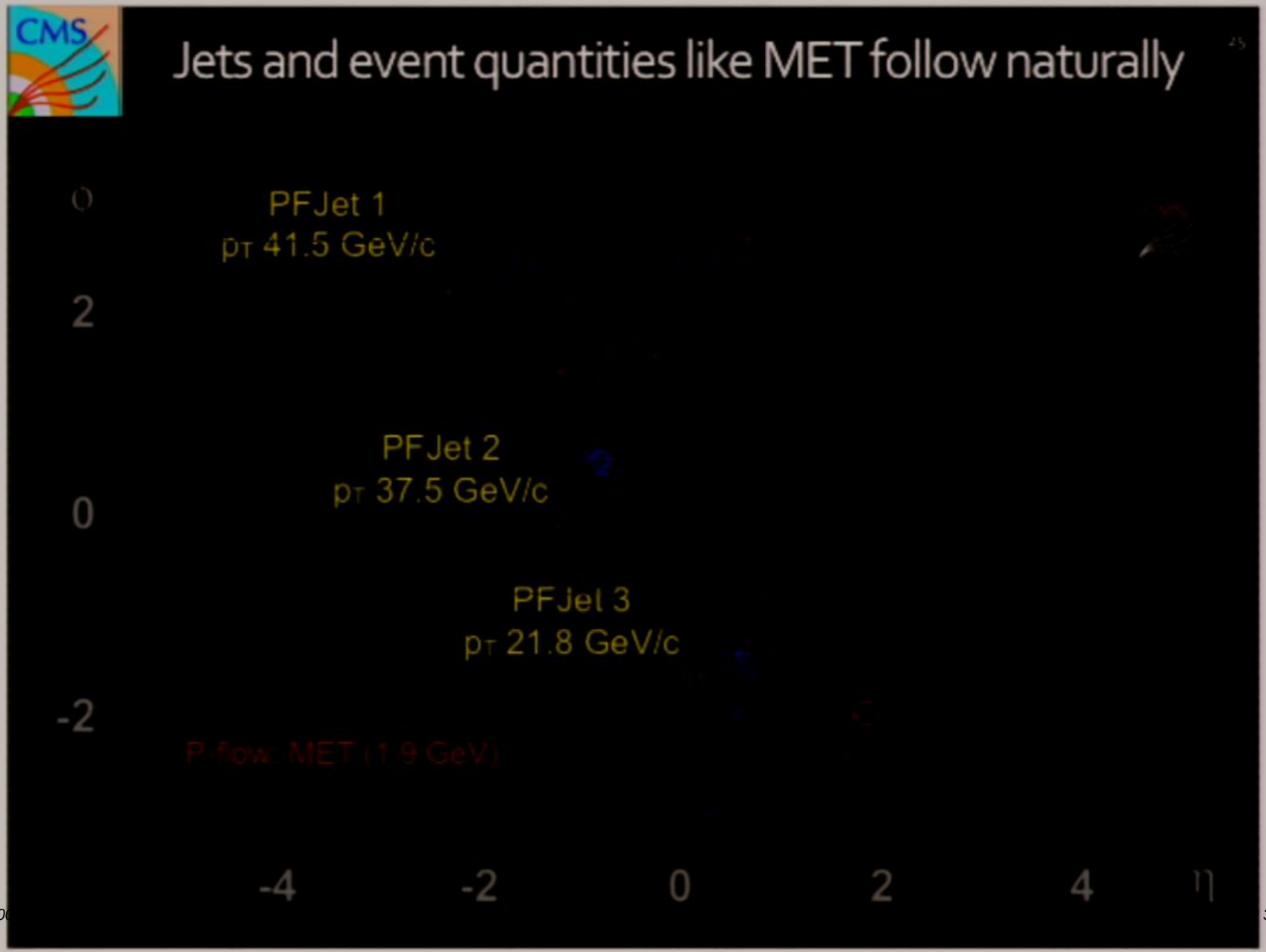
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEWK#EventDisplays

CMS Experiment at LHC, CERN
Run 133877, Event 28405693
Lumi section: 387
Sat Apr 24 2010, 14:00:54 CEST

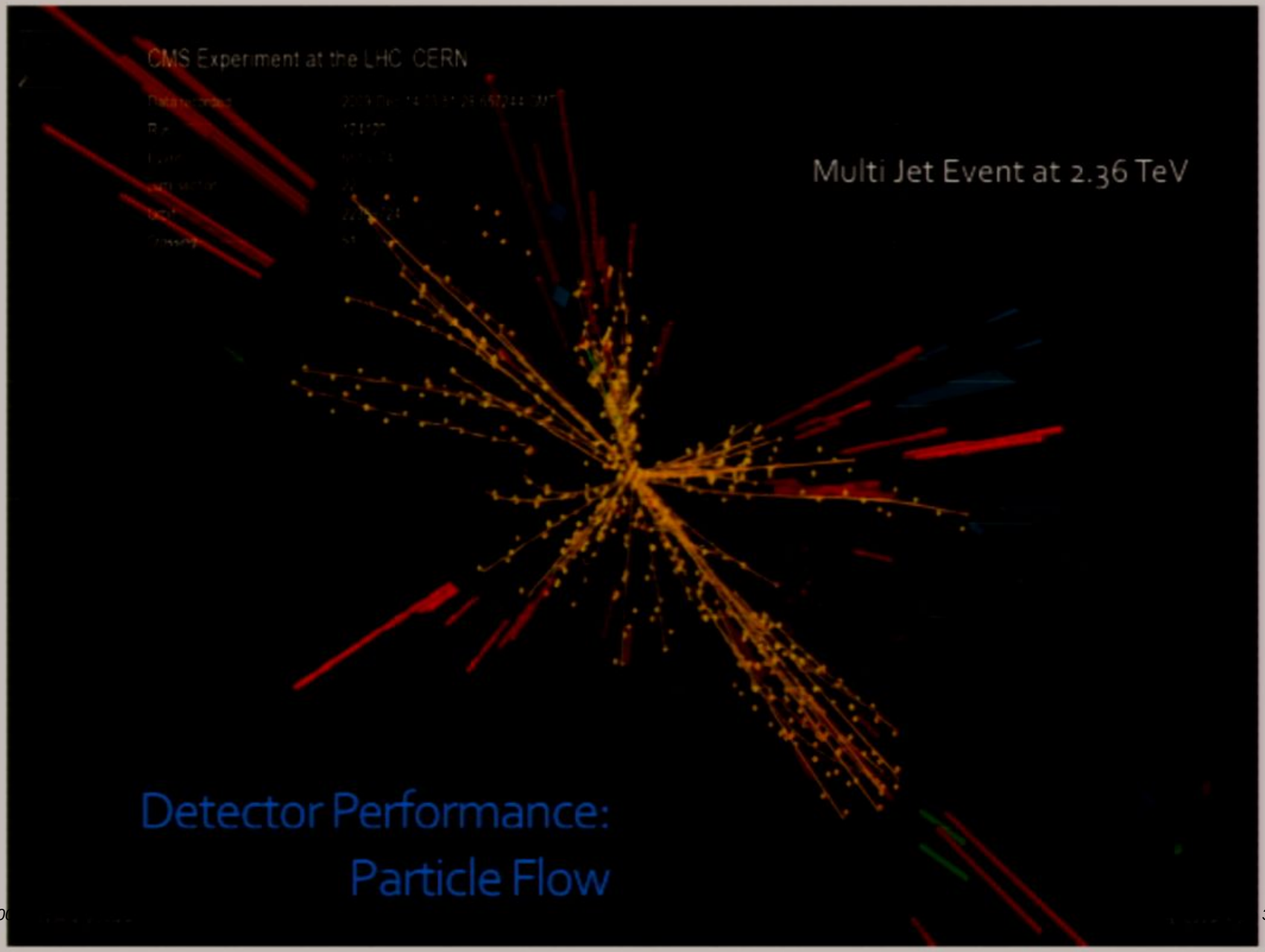
Electrons p_T = 34.0, 31.9 GeV/c
Inv. mass = 91.2 GeV/c^2

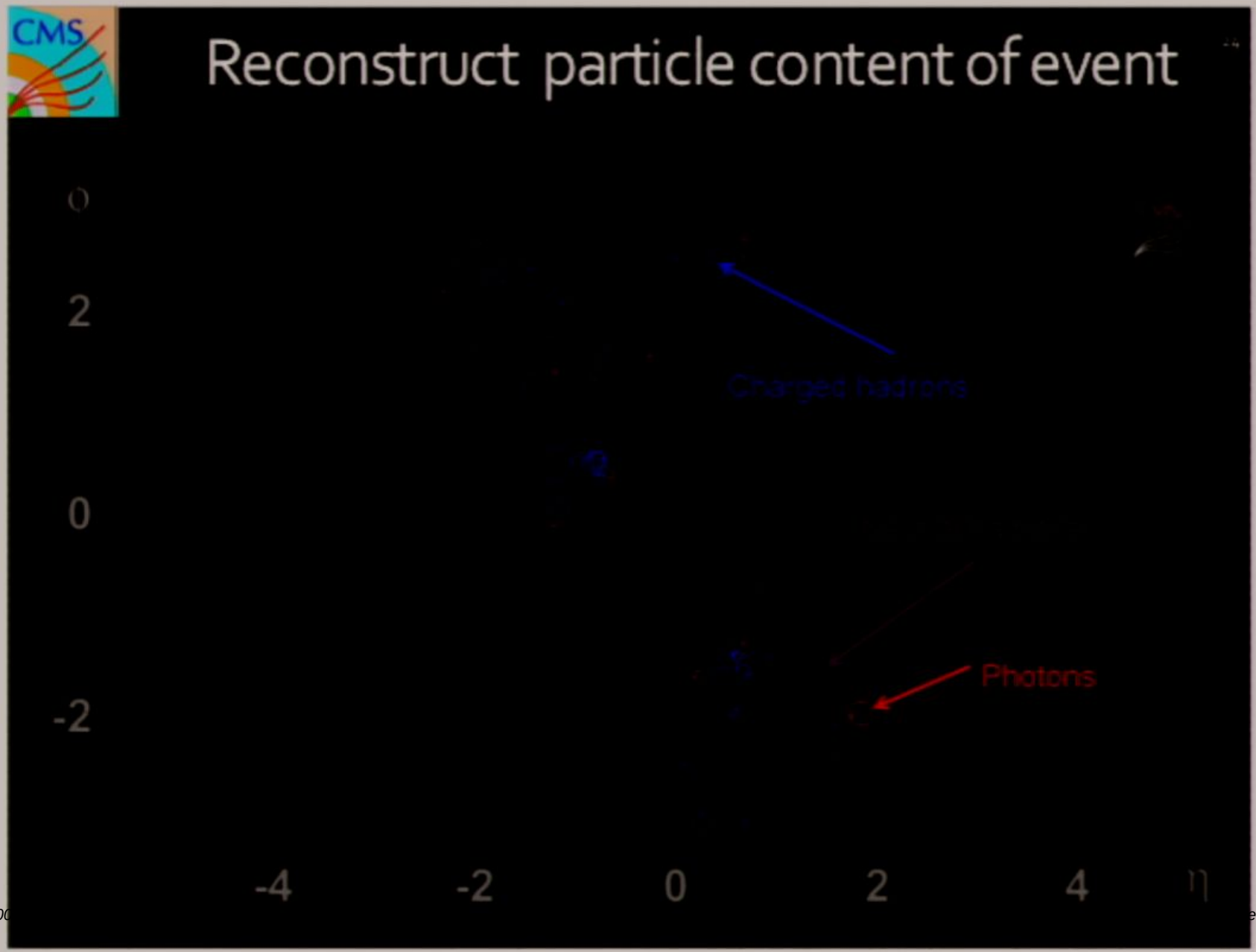


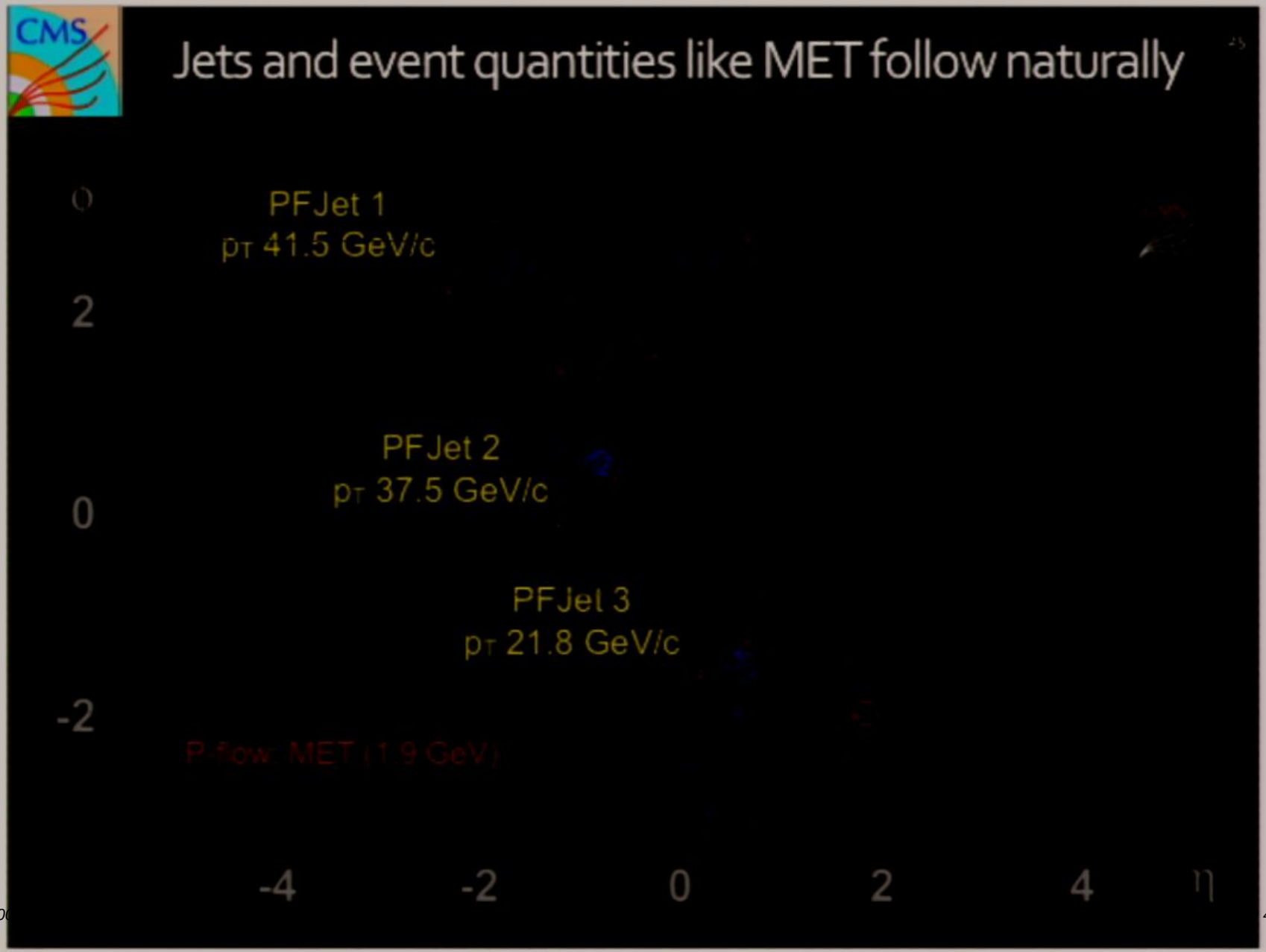



CMS
Jets and event quantities like MET follow naturally
PFJet 1
pT 41.5 GeV/c
PFJet 2
pT 37.5 GeV/c
PFJet 3
pT 21.8 GeV/c
P flow MET 11.9 GeV
2
0
-2
-4
-2
0
2
4
η

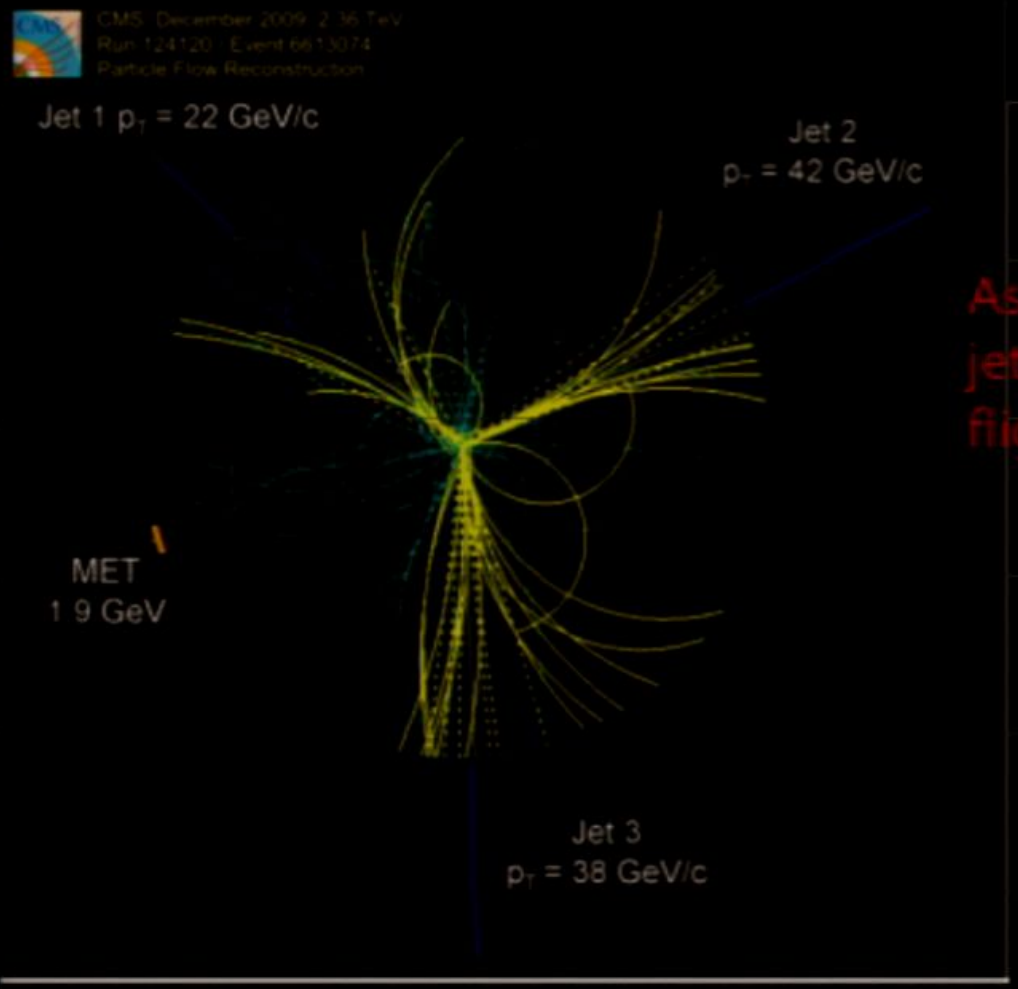
Particle Flow




CMS
Reconstruct particle content of event
Charged hadrons
Photons
2
0
-2
-4
-2
0
2
4
η

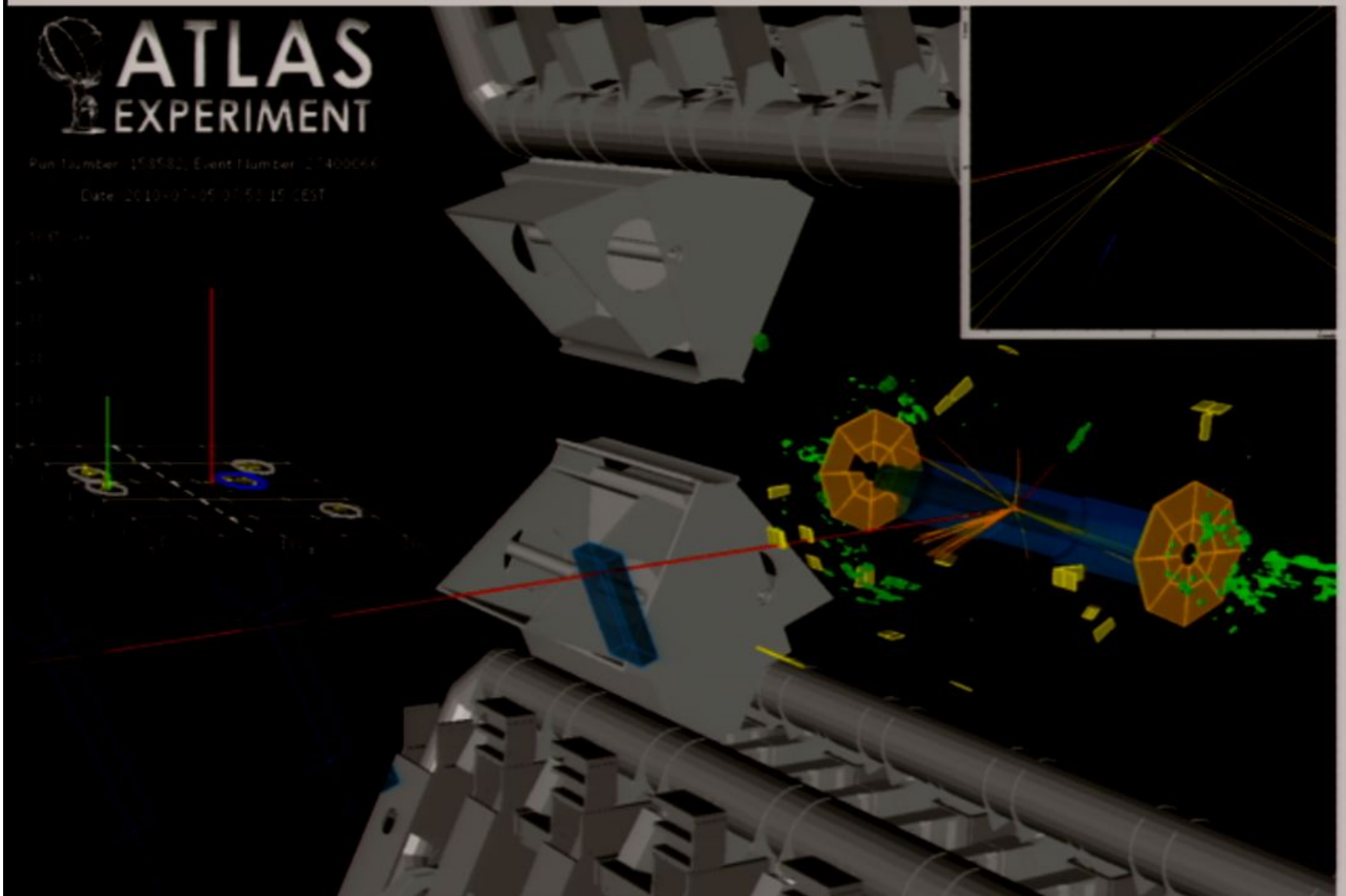

CMS
Jets and event quantities like MET follow naturally
PFJet 1
pT 41.5 GeV/c
PFJet 2
pT 37.5 GeV/c
PFJet 3
pT 21.8 GeV/c
P-flow MET (1.9 GeV)
2
0
-2
-4
-2
0
2
4
η

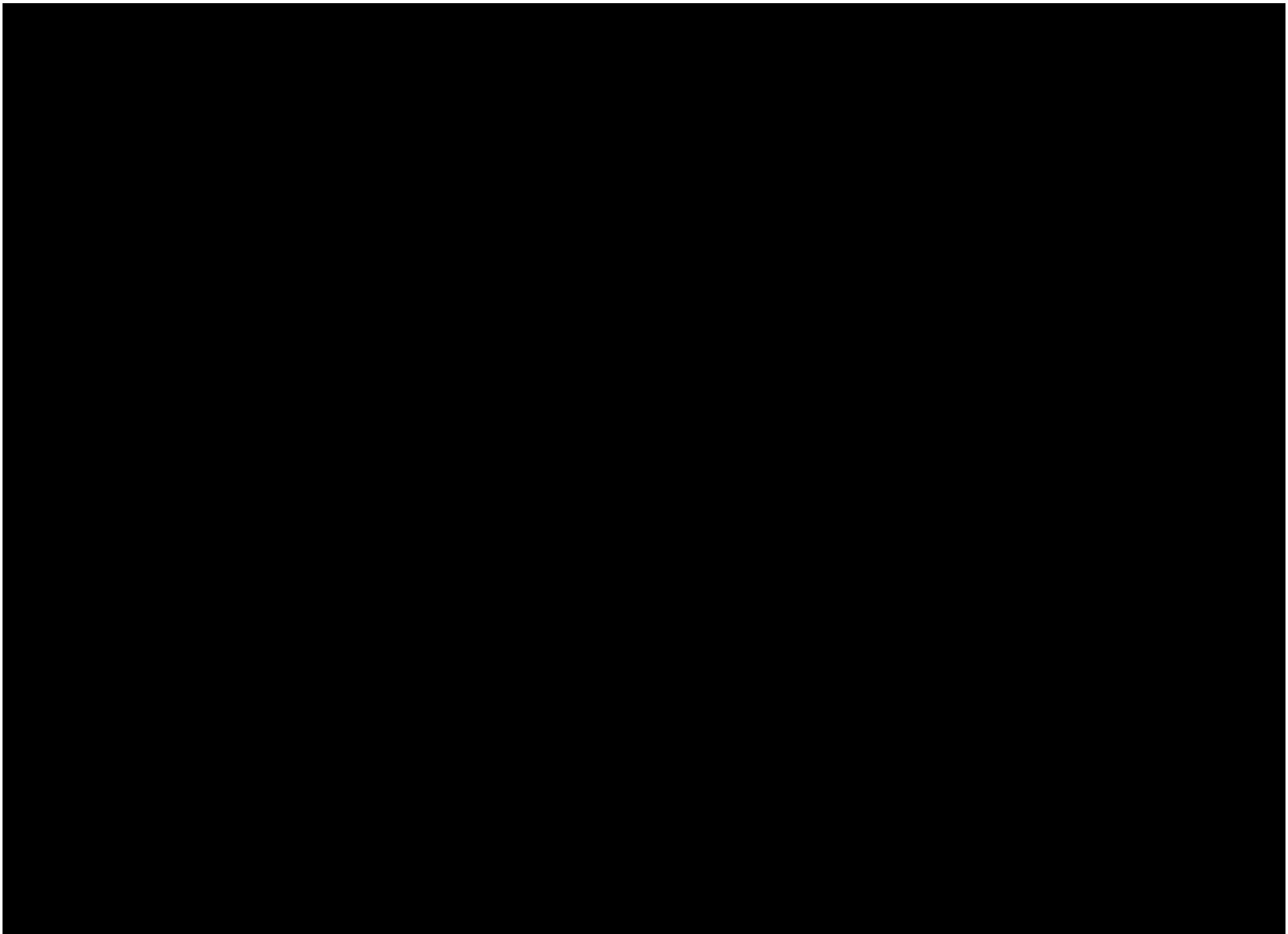
PF jets

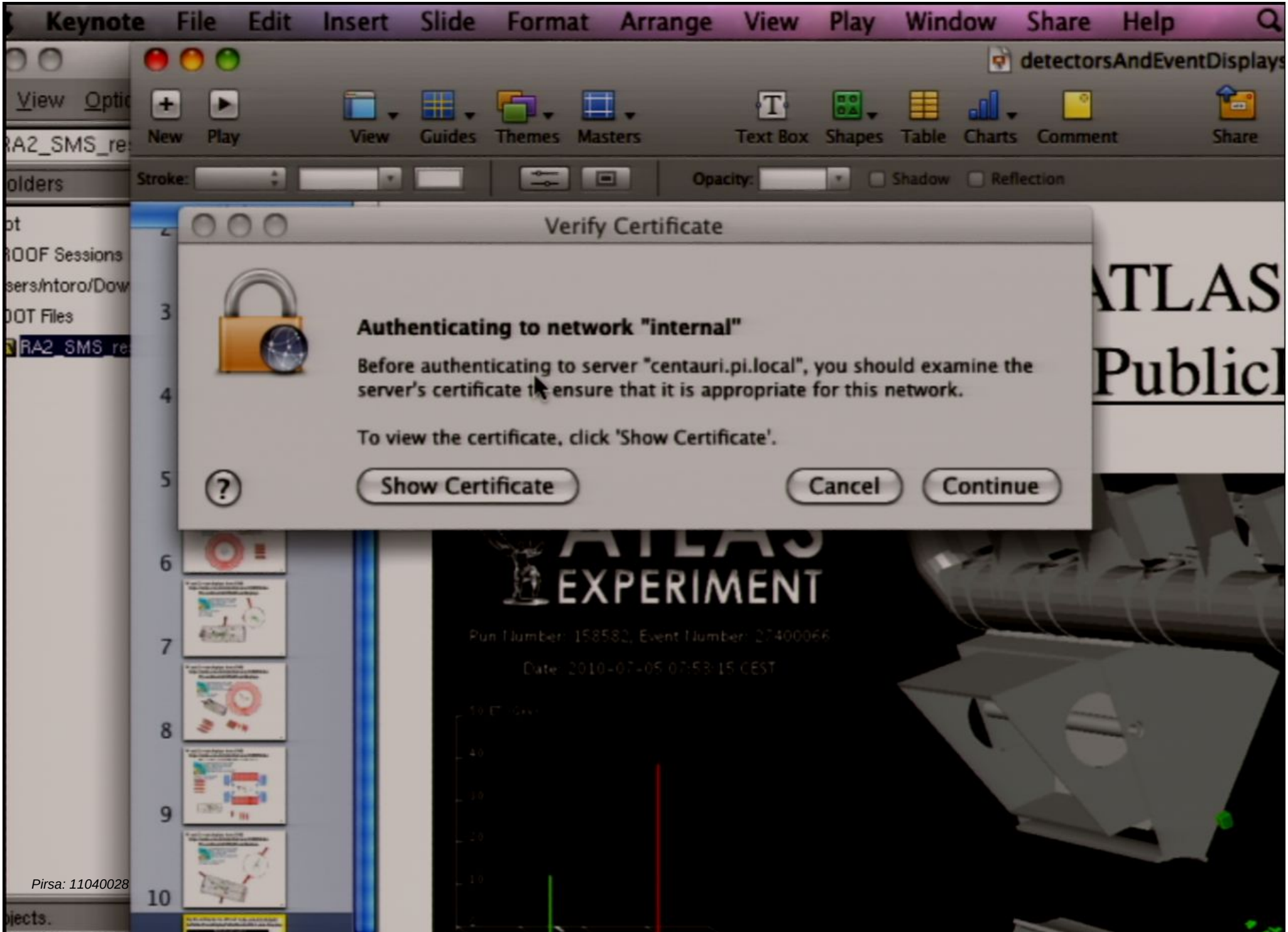


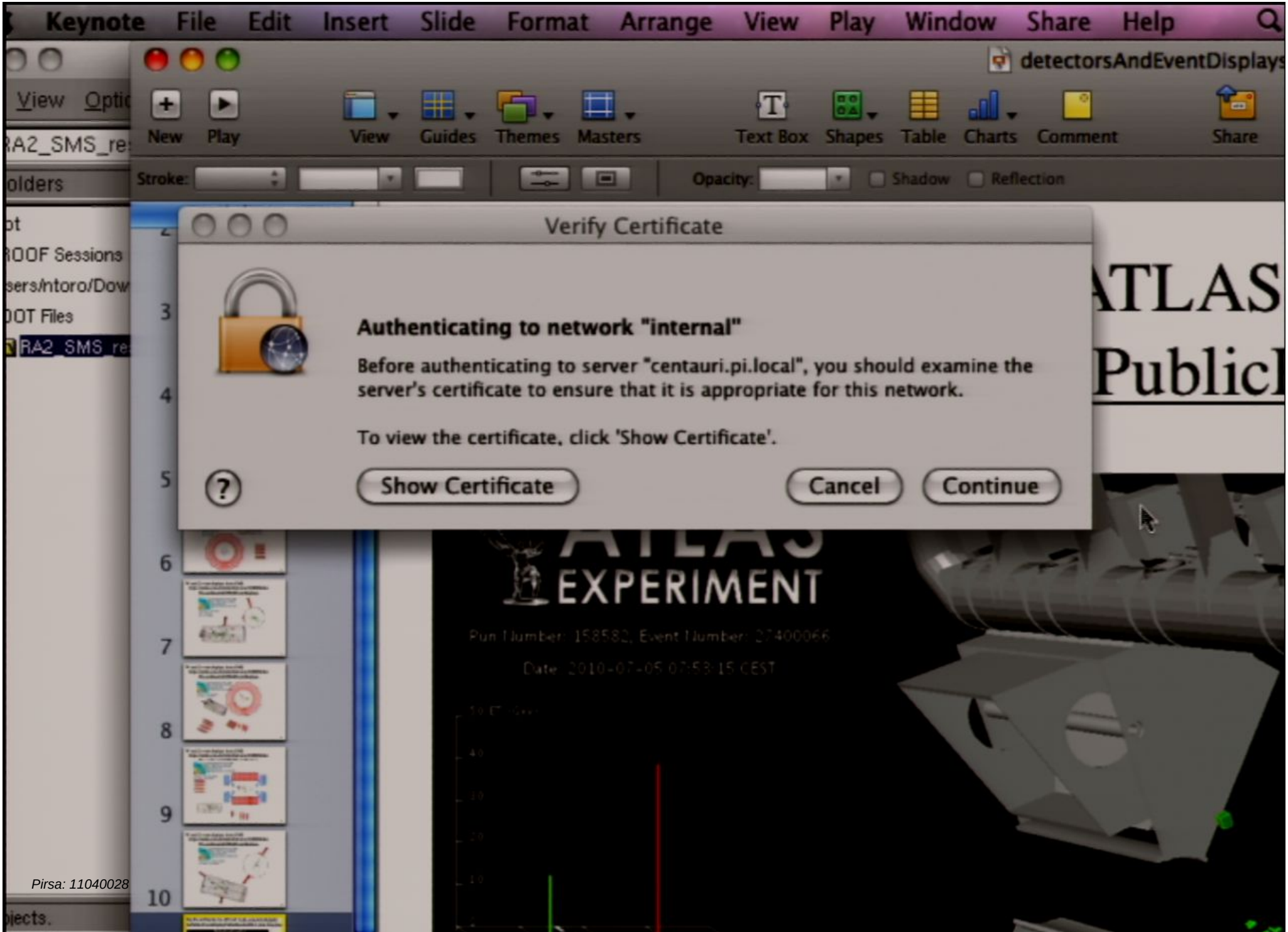
Associate particles to jets using their initial flight directions

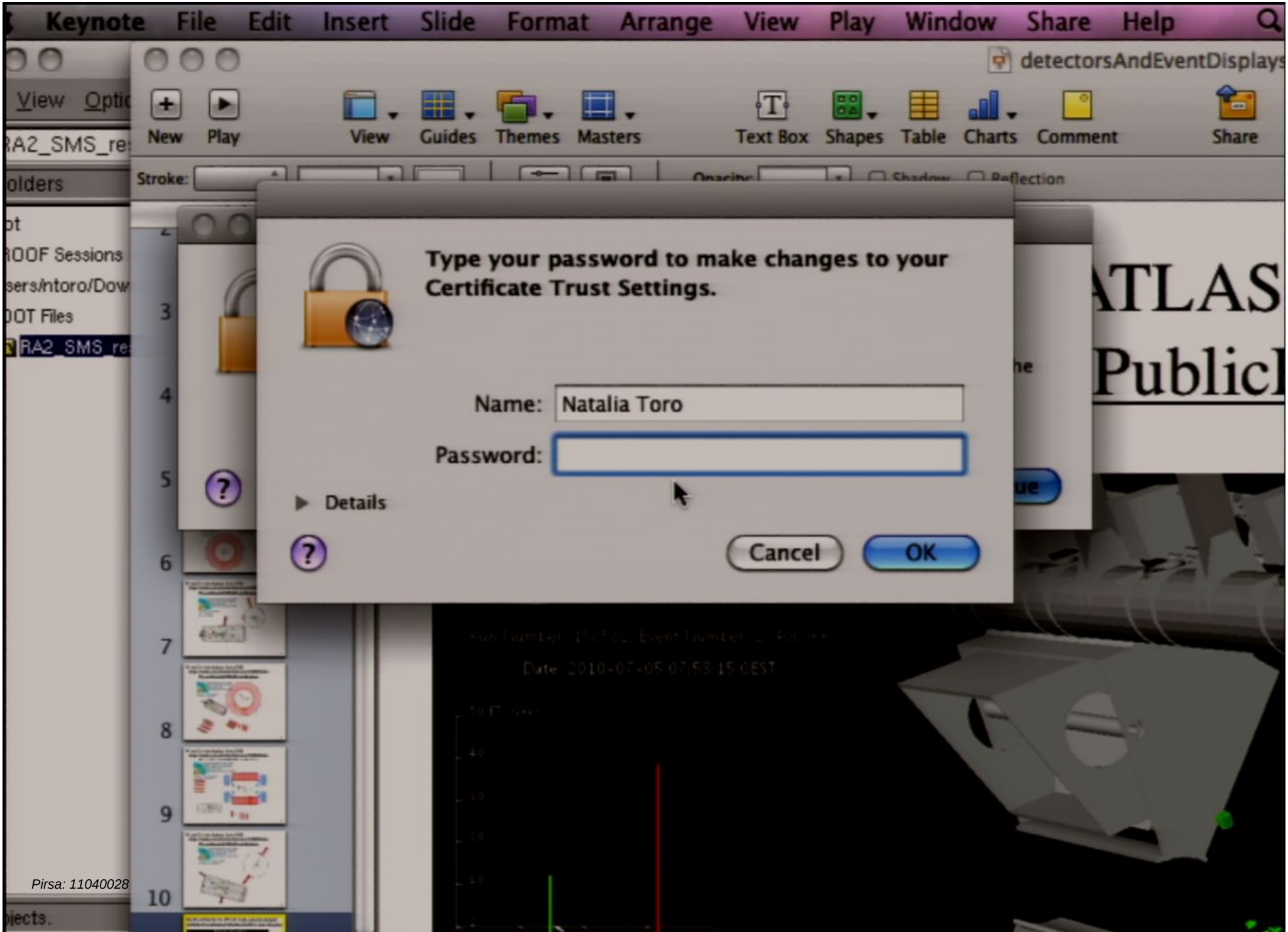
Top Event Display fro ATLAS: twiki.cern.ch/twiki/pub/lasPublic/EventDisplayPublicResults/DL2_emu_btag.png

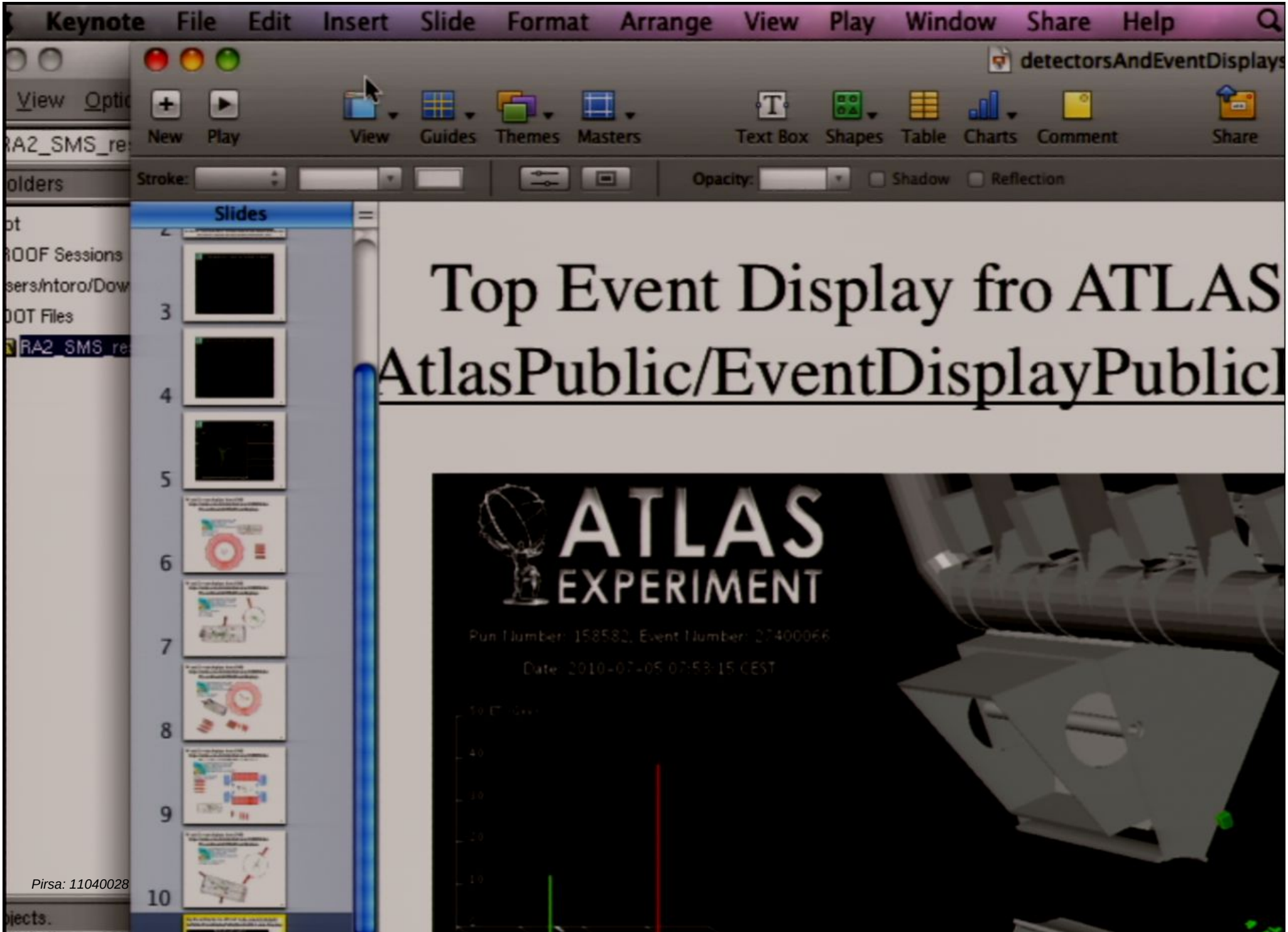


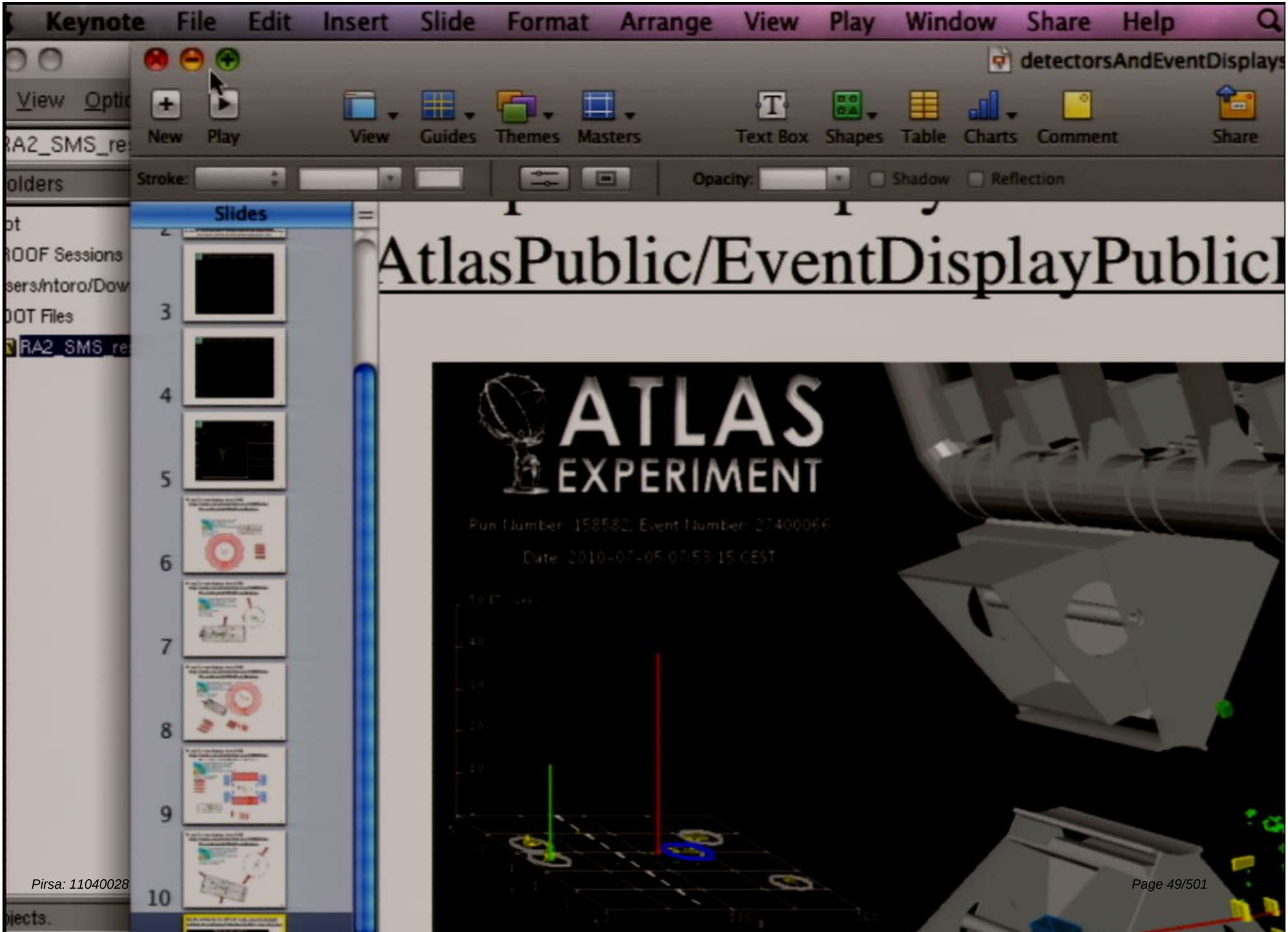







Keynote File Edit Insert Slide Format Arrange View Play Window Share Help
detectorsAndEventDisplays
New Play View Guides Themes Masters Text Box Shapes Table Charts Comment Share
Stroke:
Type your password to make changes to your Certificate Trust Settings.
Name: Natalia Toro
Password:
Details
Cancel
OK
ATLAS
Public
Pirsa: 11040028

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detectorsAndEventDisplays
New Play View Guides Themes Masters Text Box Shapes Table Charts Comment Share
Stroke: Opacity: Shadow Reflection
Slides
AtlasPublic/EventDisplayPublicI
ATLAS
EXPERIMENT
Run Number: 158582, Event Number: 27400066
Date: 2010-07-05 07:53:15 CEST

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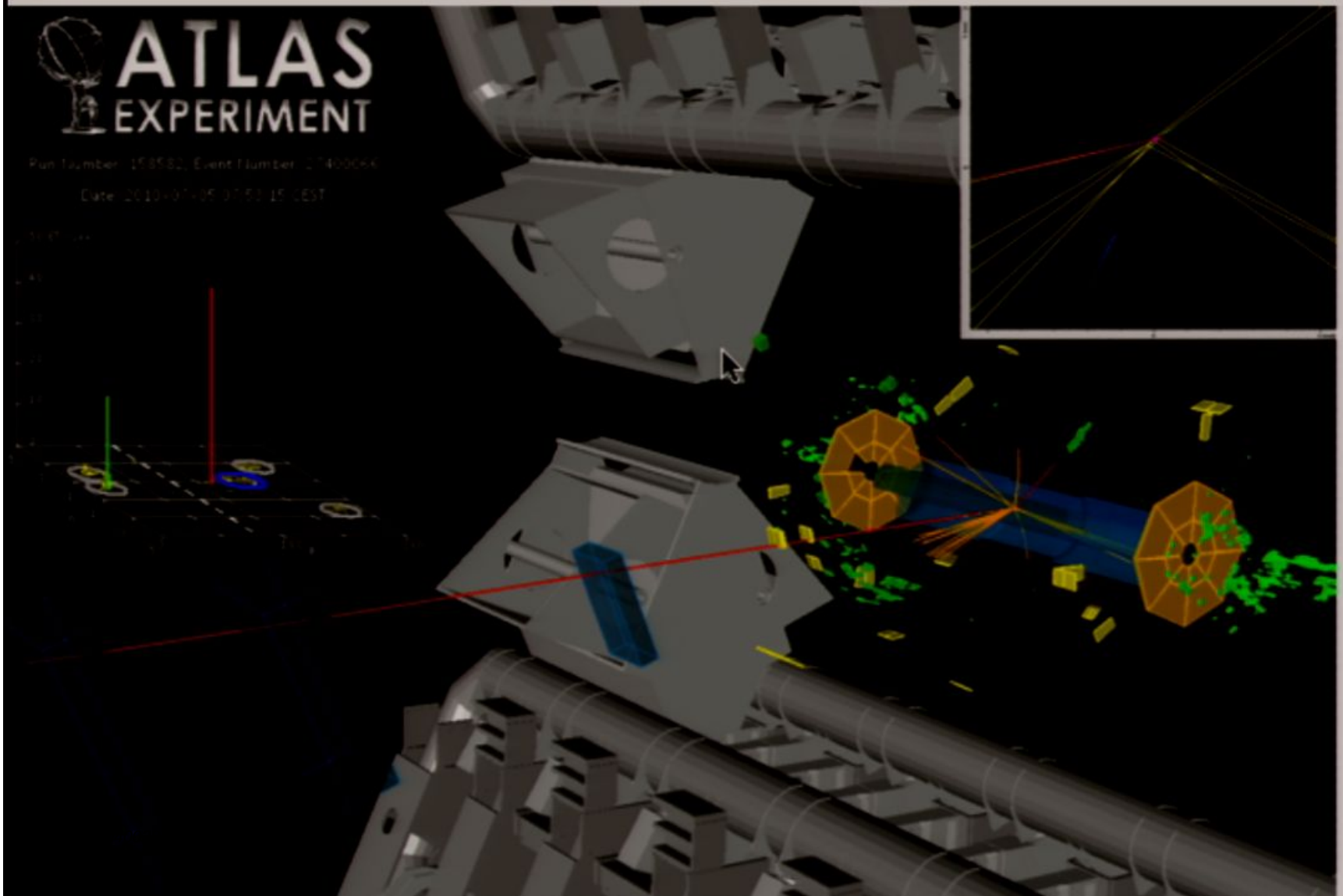
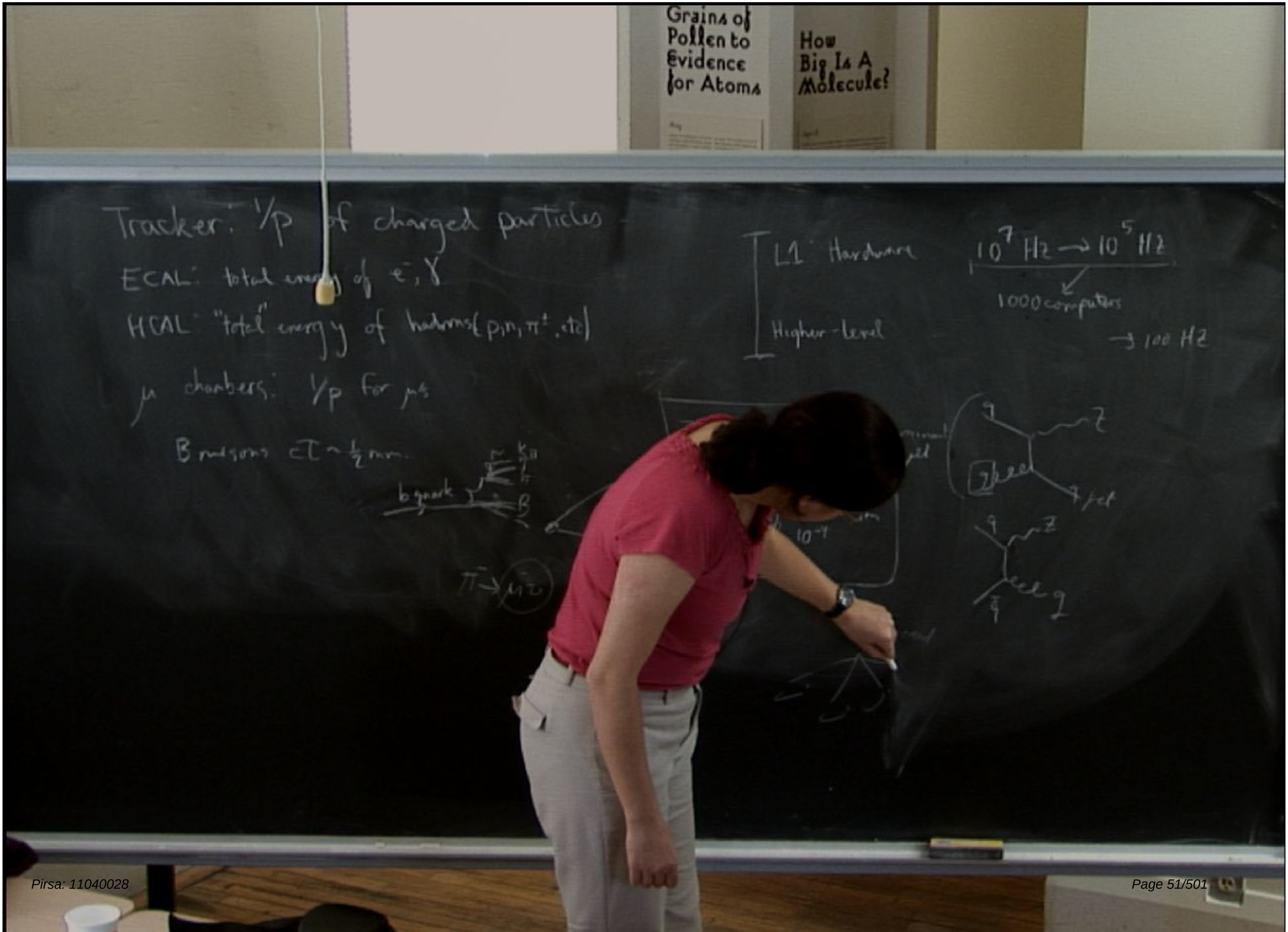
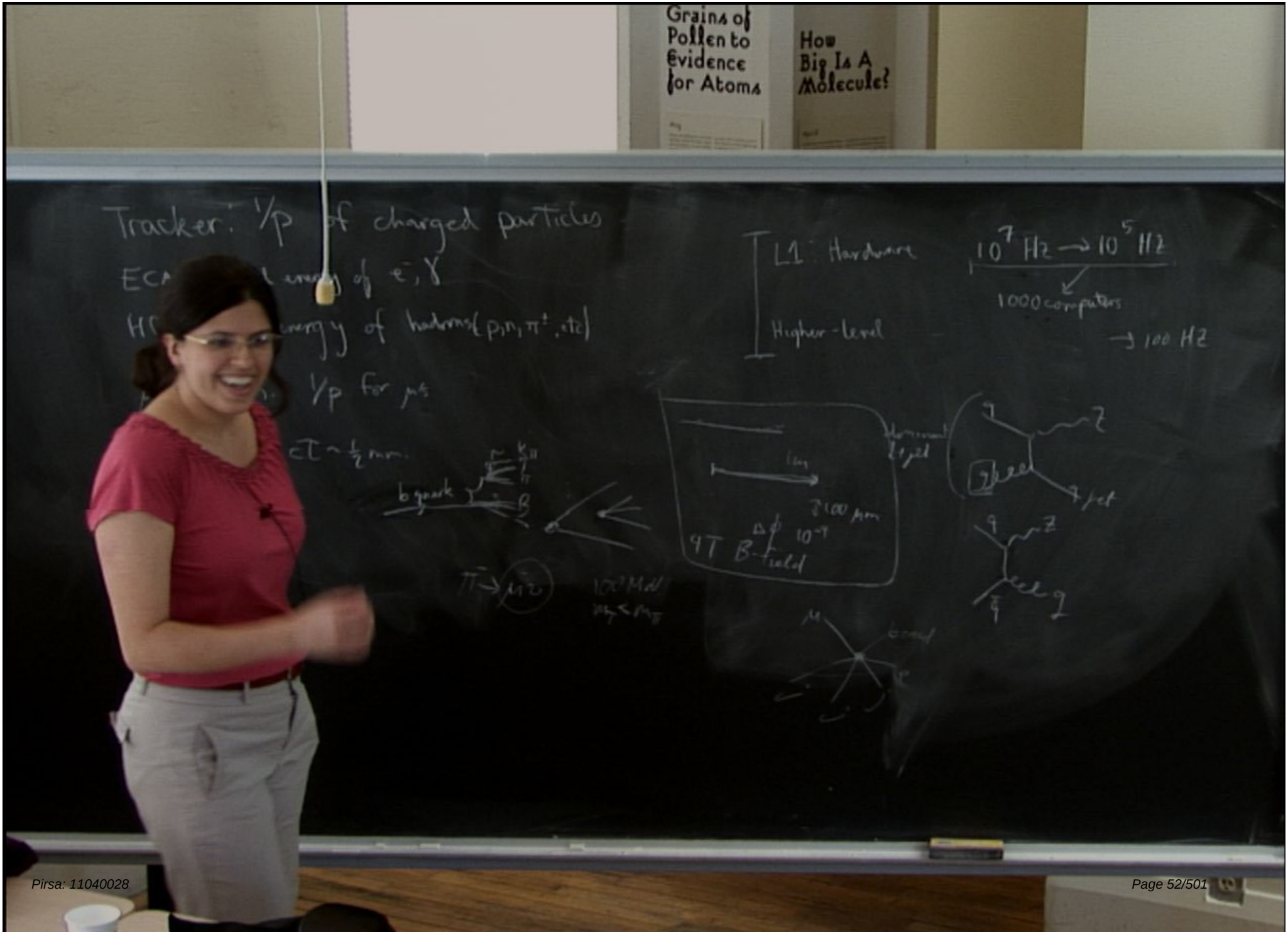
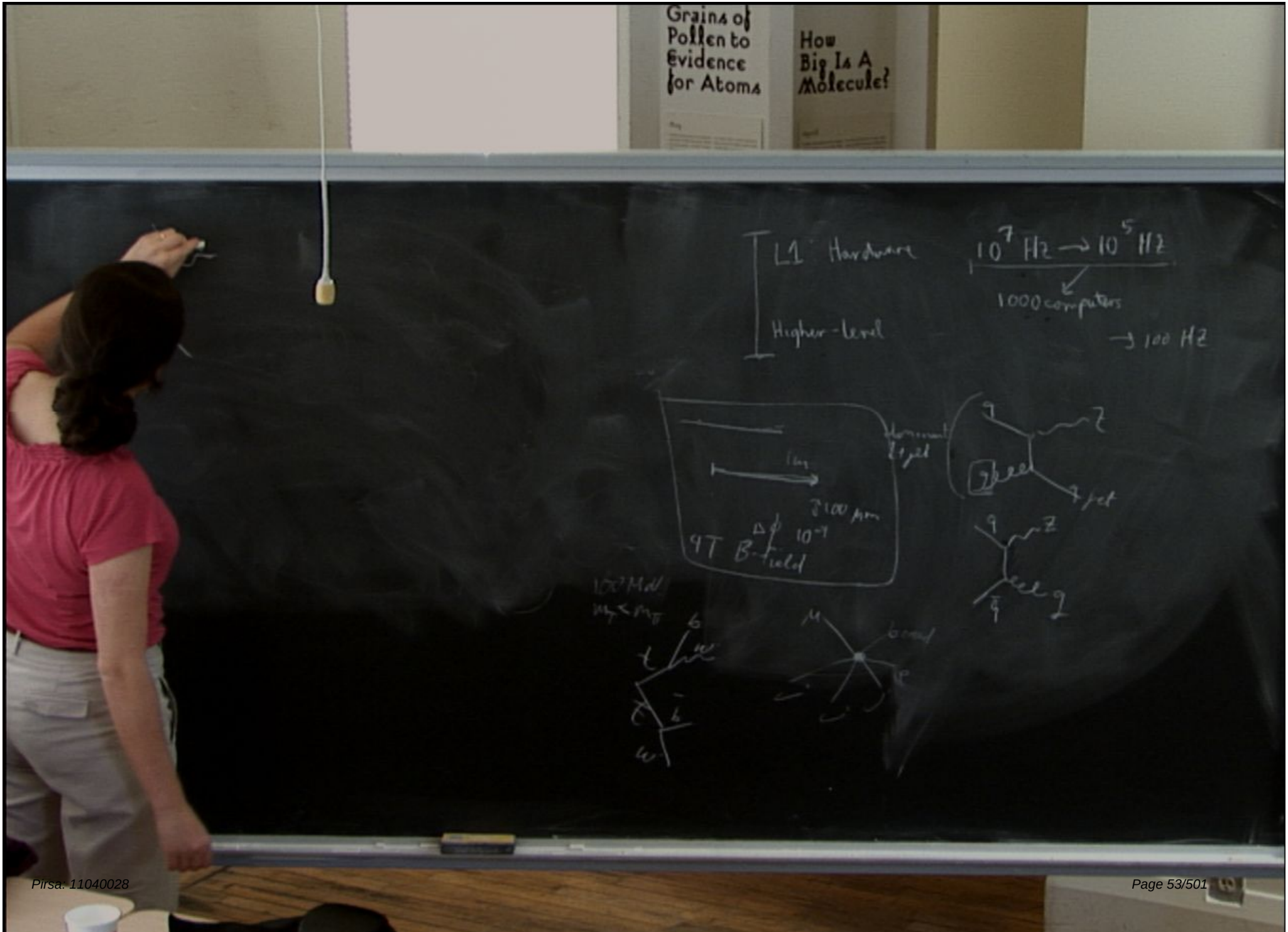
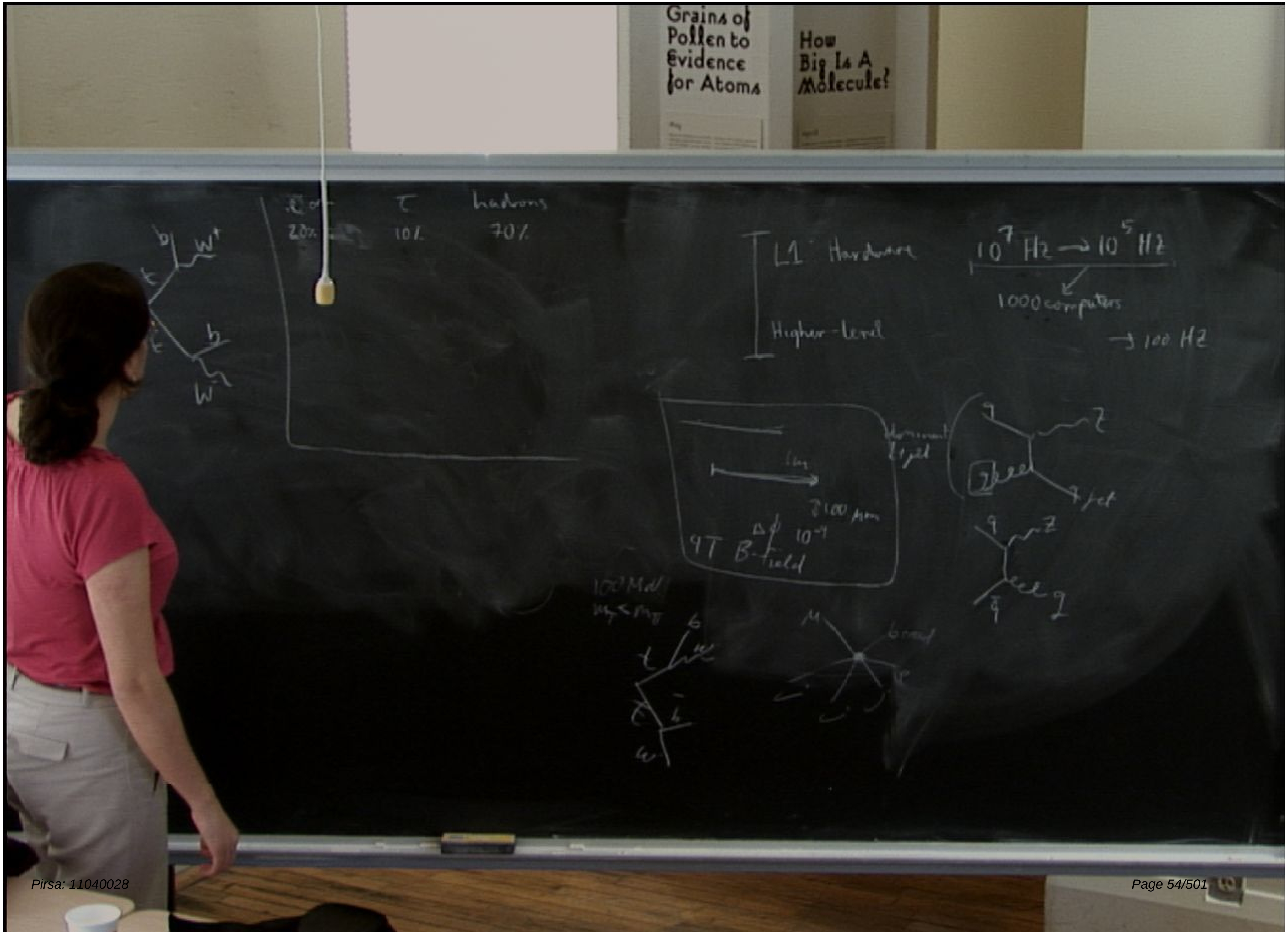
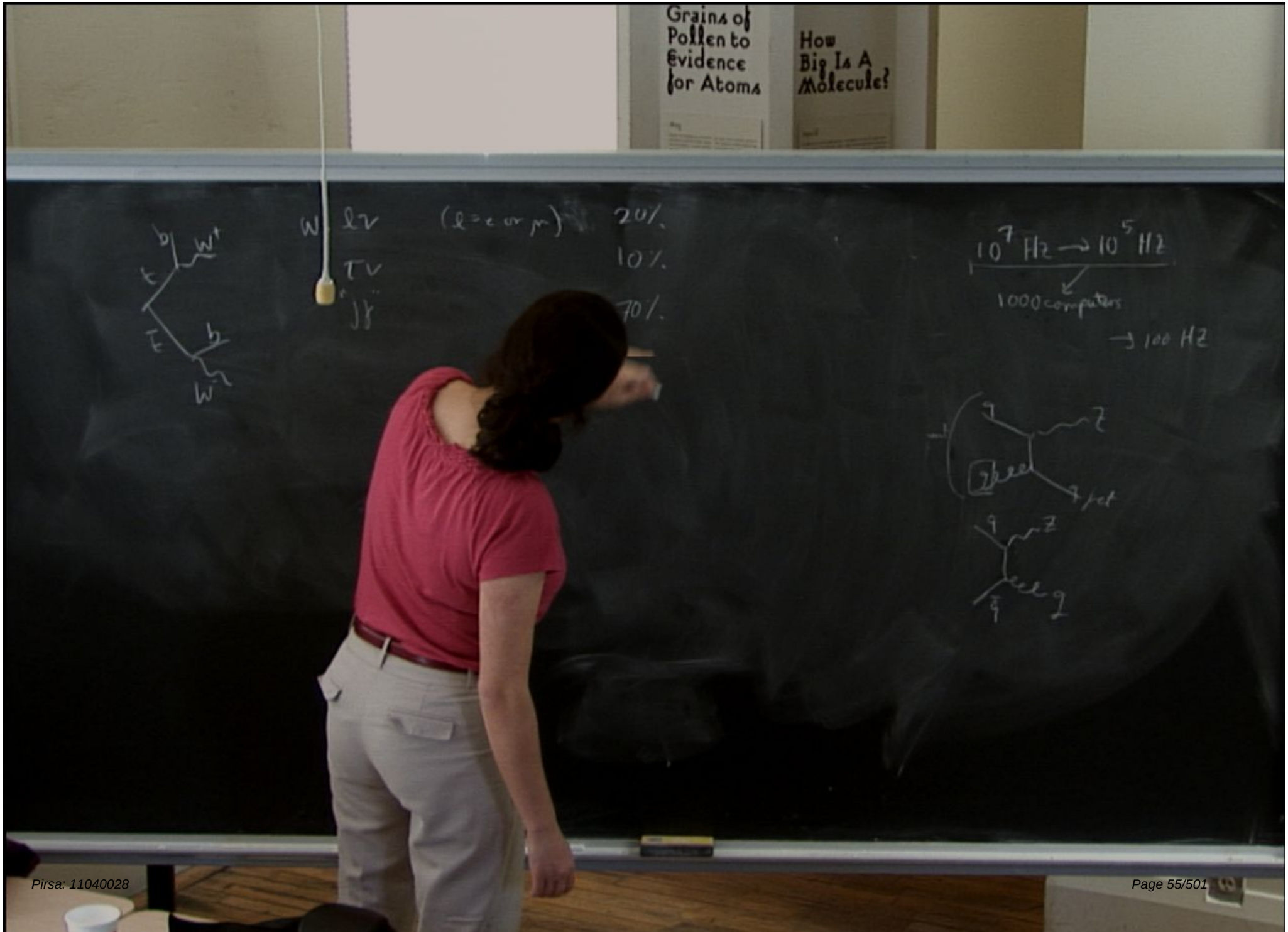


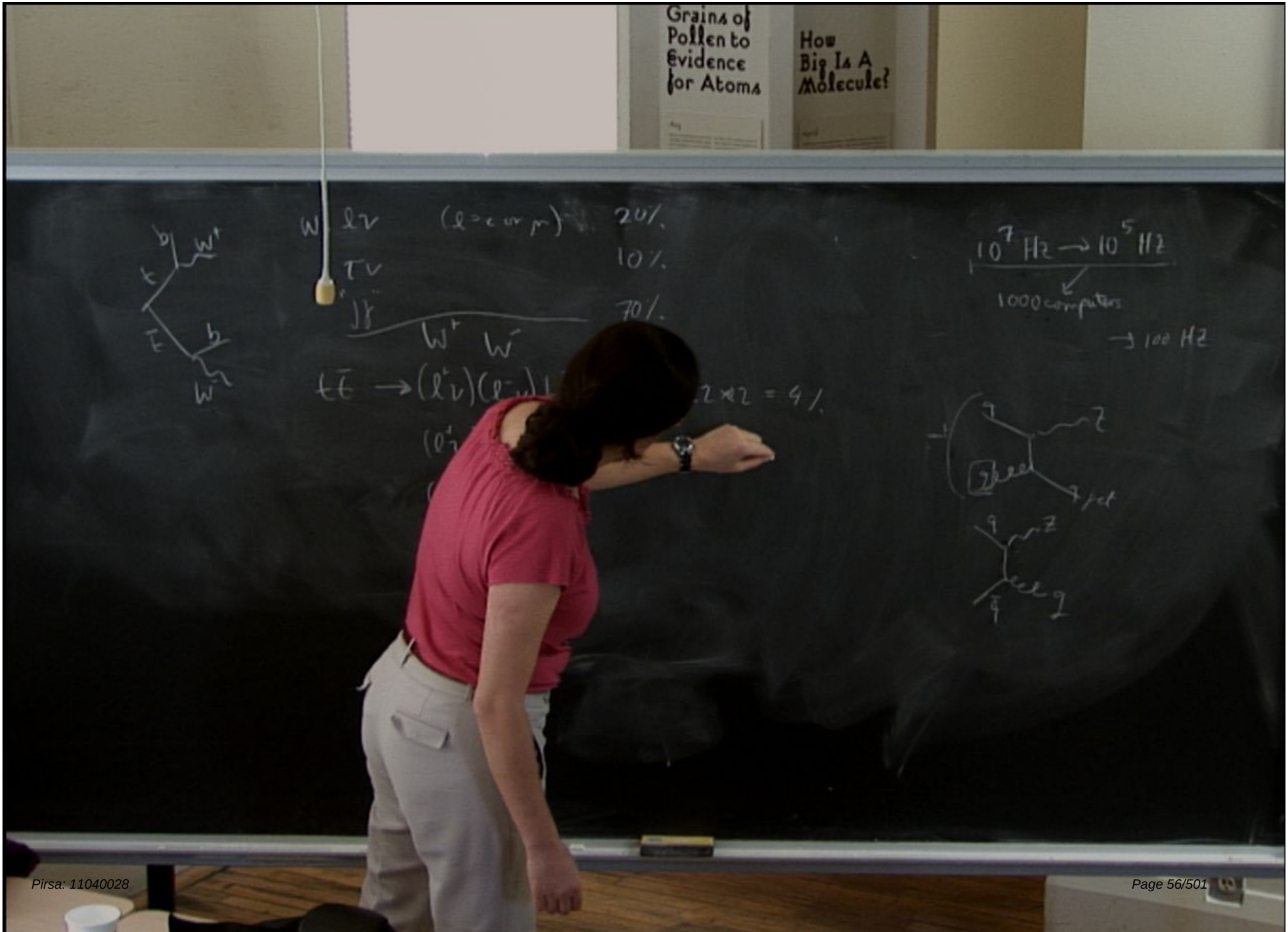

Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
Tracker: 1/p of charged particles
ECAL: total energy of e⁻, γ
HCAL: "total" energy of hadrons (p, n, π±, etc)
μ chambers: 1/p for μs
B mesons cτ ~ ½ mm
b quark
L1 Hardware
Higher-level
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz

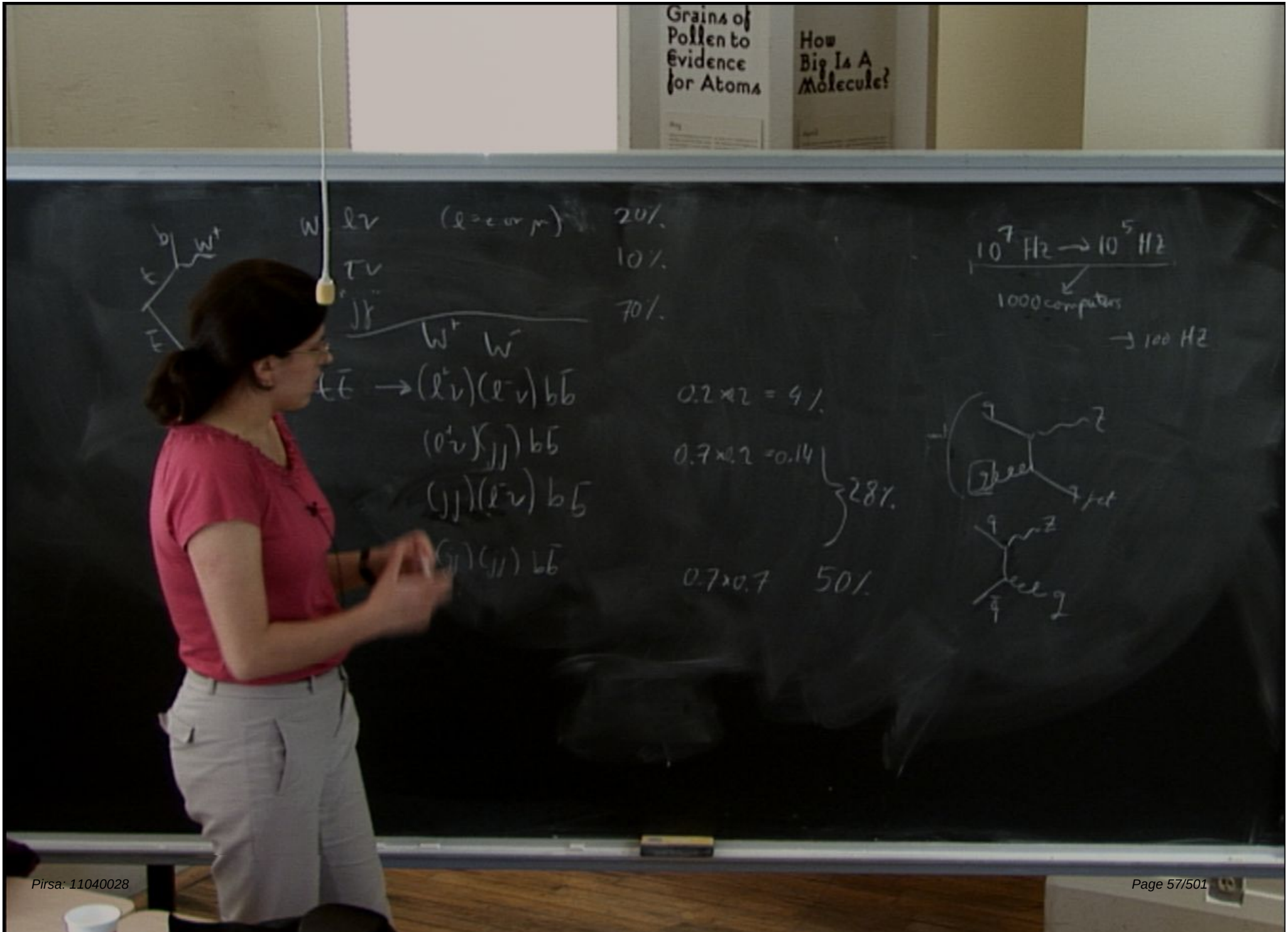

Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
Tracker: 1/p of charged particles
L1: Hardware
Higher-level
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
1/p for μs
b quark
4T B-field

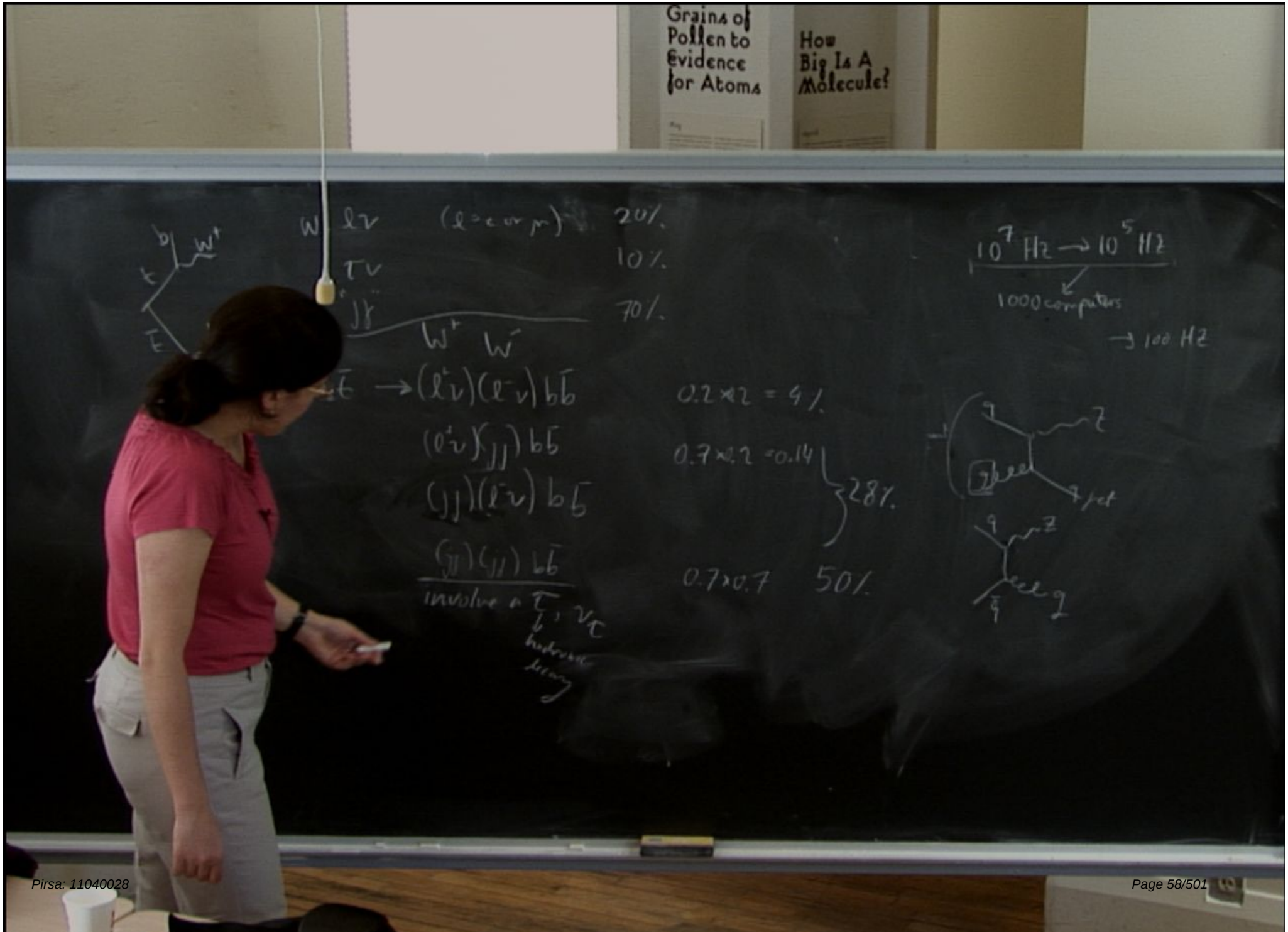

Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
L1 Hardware
Higher-level
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
4T B-field
jet
jet


Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
τ
hadrons
20%
10%
70%
L1 Hardware
Higher-level
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
4T B-field


Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
W lν (l = e or μ) 20%
τν 10%
jj 70%
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz


Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
$W \to l\nu$ $(l = e \text{ or } \mu)$ 20%
$\tau\nu$ 10%
jj 70%
$W^+ W^-$
$t\bar{t} \to (l^+\nu)(l^-\nu)$
$2 \times 2 = 4\%$
10^7 Hz $\to 10^5$ Hz
1000 computers
$\to$ 100 Hz
jet


Grains of Pollen to Evidence for Atoms
How Big Is A Molecule?
W lν (l=e or μ) 20%
τν 10%
jj 70%
W⁺ W⁻
tt̄ → (l⁺ν)(l⁻ν) bb̄ 0.2×2 = 4%
(l⁺ν)(jj) bb̄ 0.7×0.2 = 0.14
(jj)(l⁻ν) bb̄ } 28%
(jj)(jj) bb̄ 0.7×0.7 50%
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz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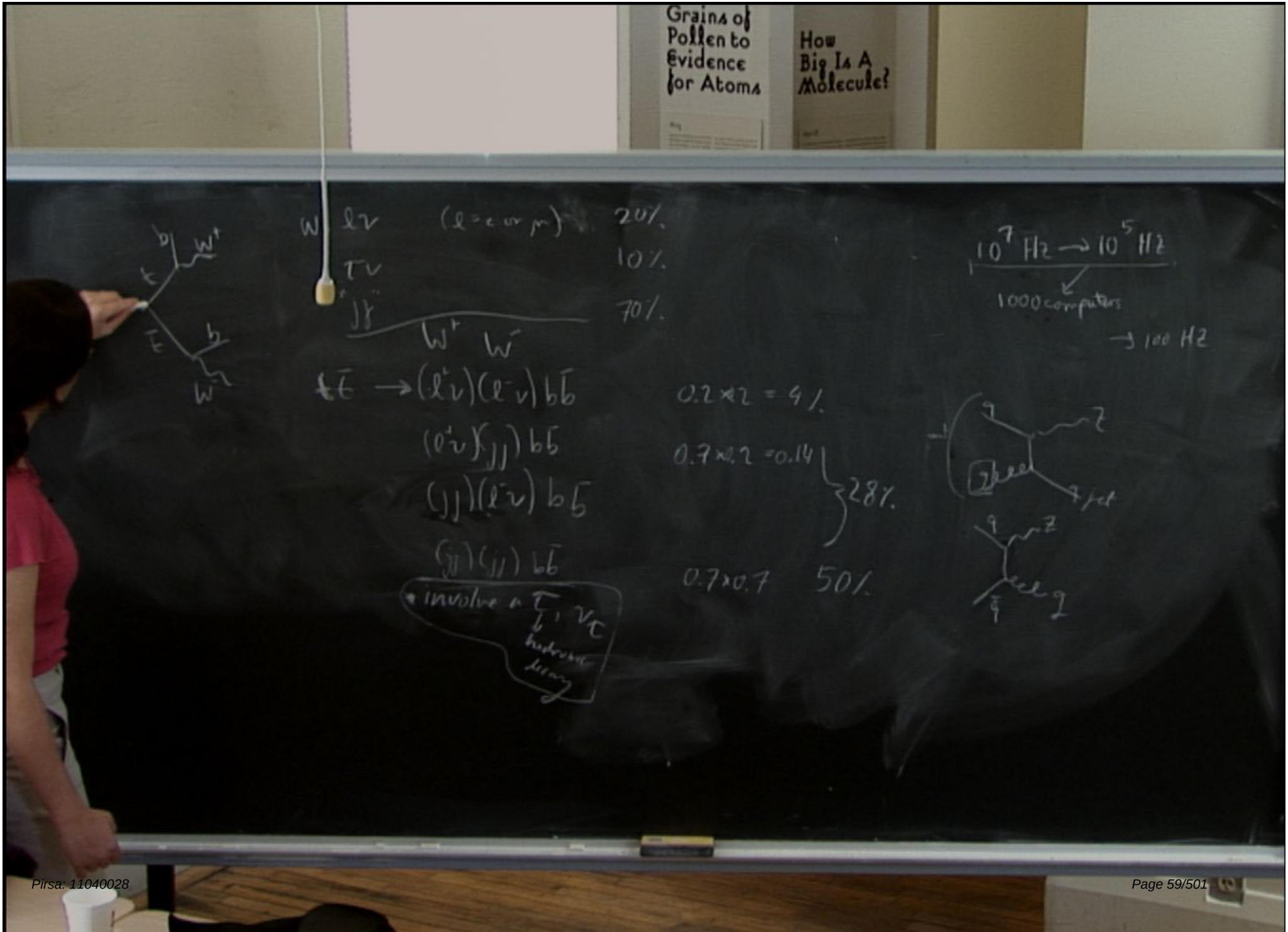
(jj)(l⁻ν) bb̄ } 28%
(jj)(jj) bb̄ 0.7×0.7 50%
involve a τ, ν_τ
hadronic decay
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
jet
jet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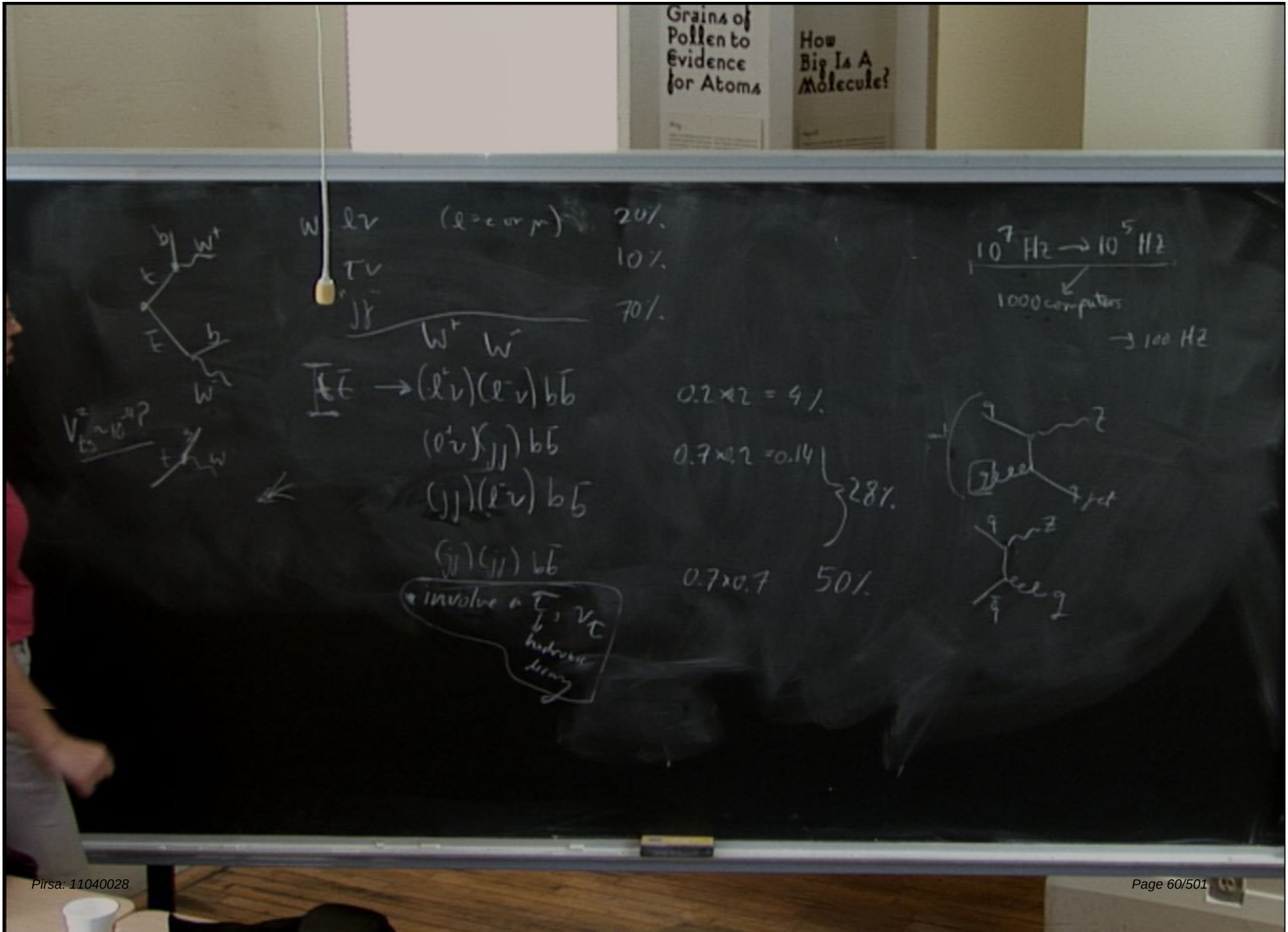
• involve a τ, ν_τ
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
jet
jet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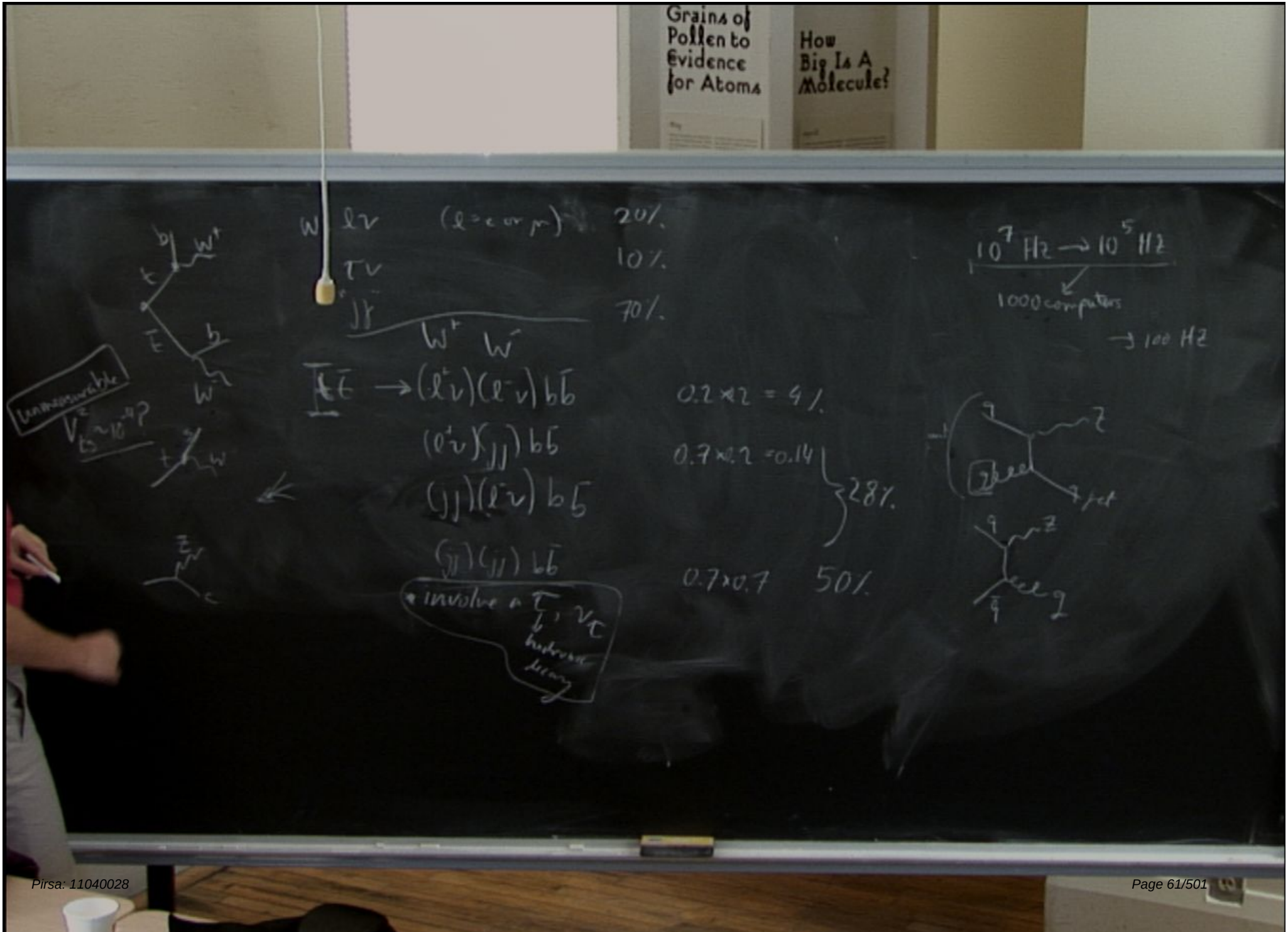
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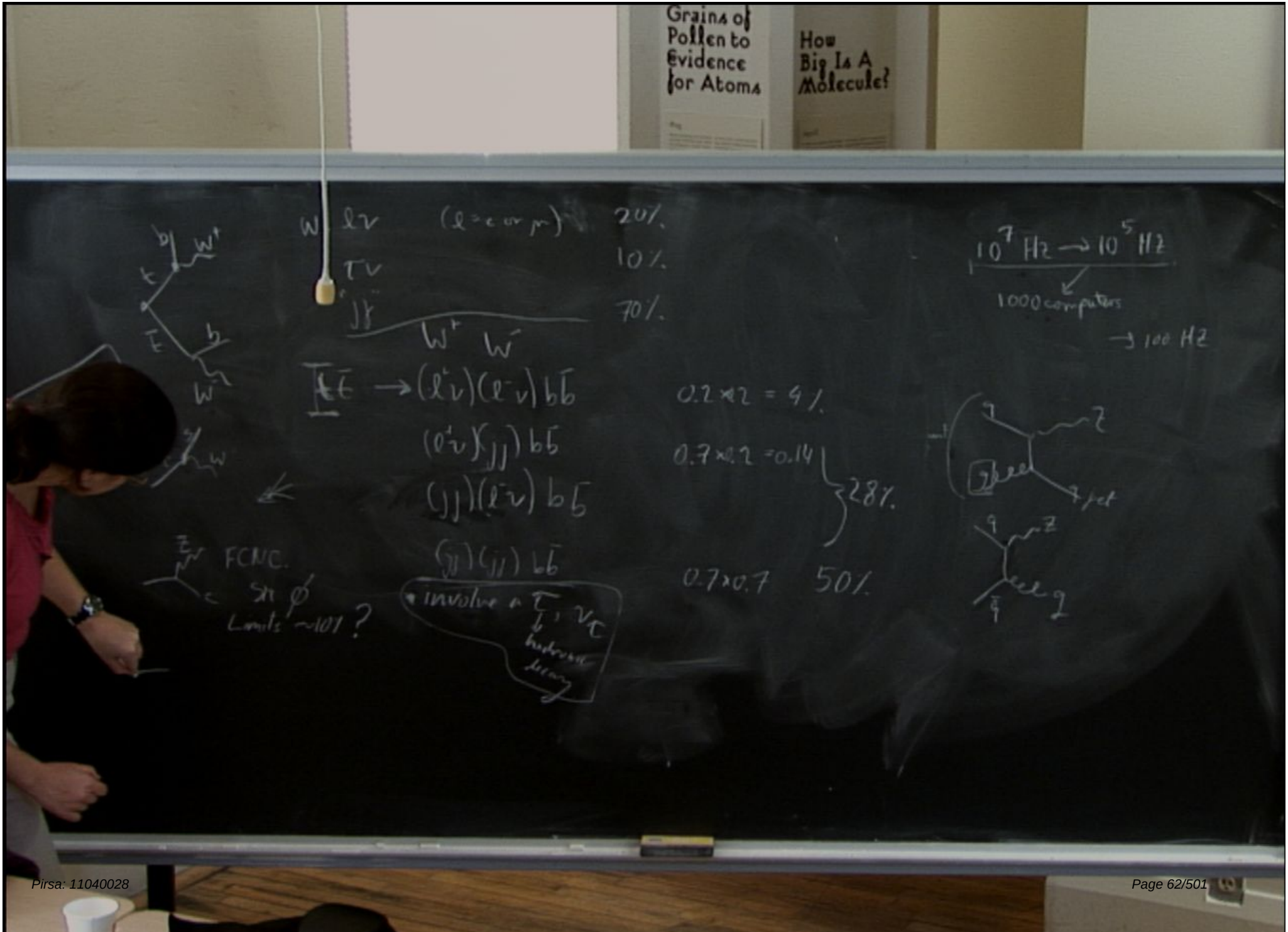
(jj)(l⁻ν) bb̄ } 28%
(jj)(jj) bb̄ 0.7×0.7 50%
• involve a τ, ν_τ
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
Unmeasurable
V_ts ~ 10⁻⁴?
jet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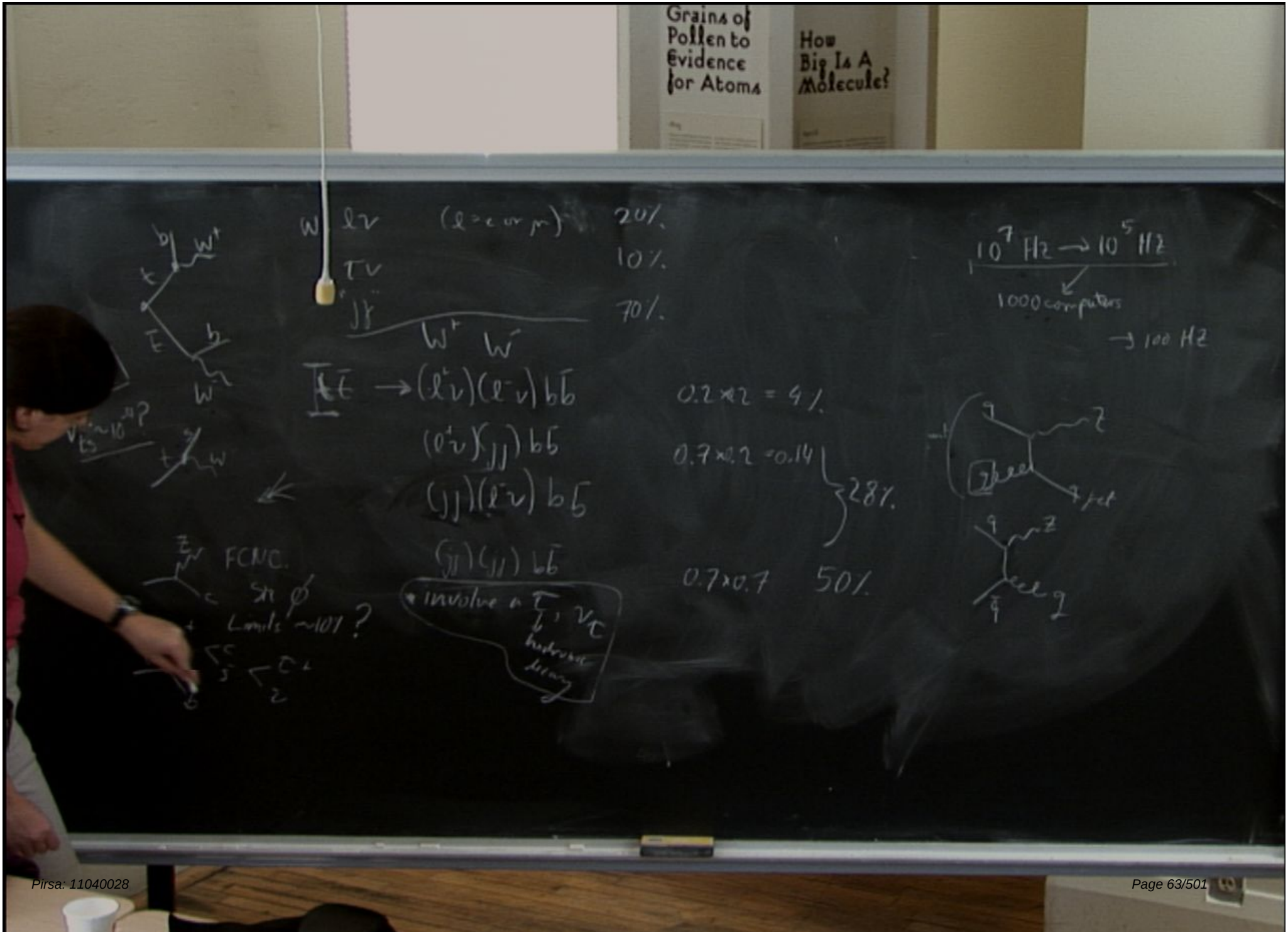
(l⁺ν)(jj) bb̄ 0.7×0.2 = 0.14
(jj)(l⁻ν) bb̄ } 28%
(jj)(jj) bb̄ 0.7×0.7 50%
FCNC.
Limits ~10?
involve a τ, ν_τ
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
jet
jet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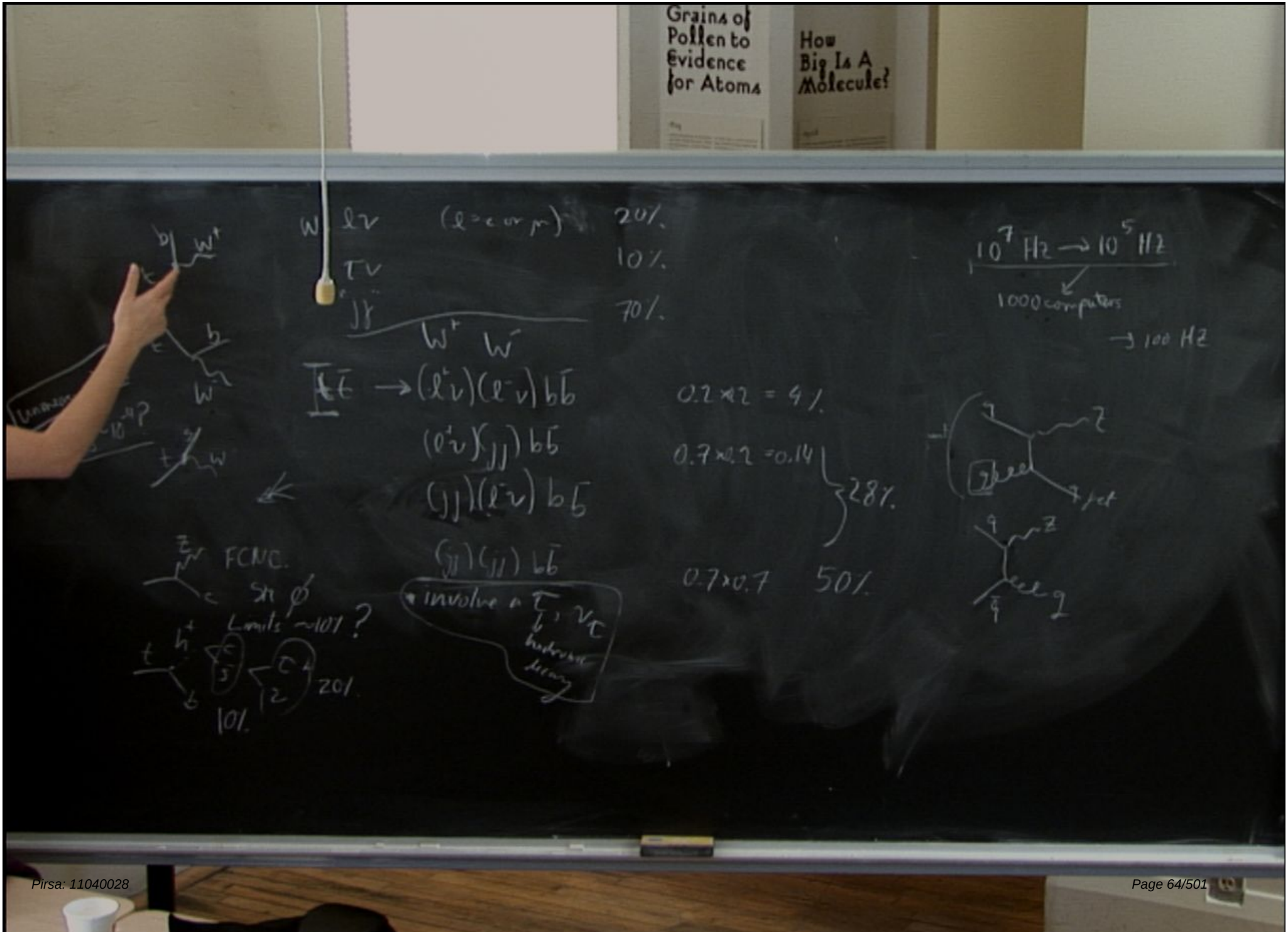
(jj)(jj) bb̄ 0.7×0.7 50%
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
FCNC.
Limits ~10?
involve a τ, ν_τ
hadronic decay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20%
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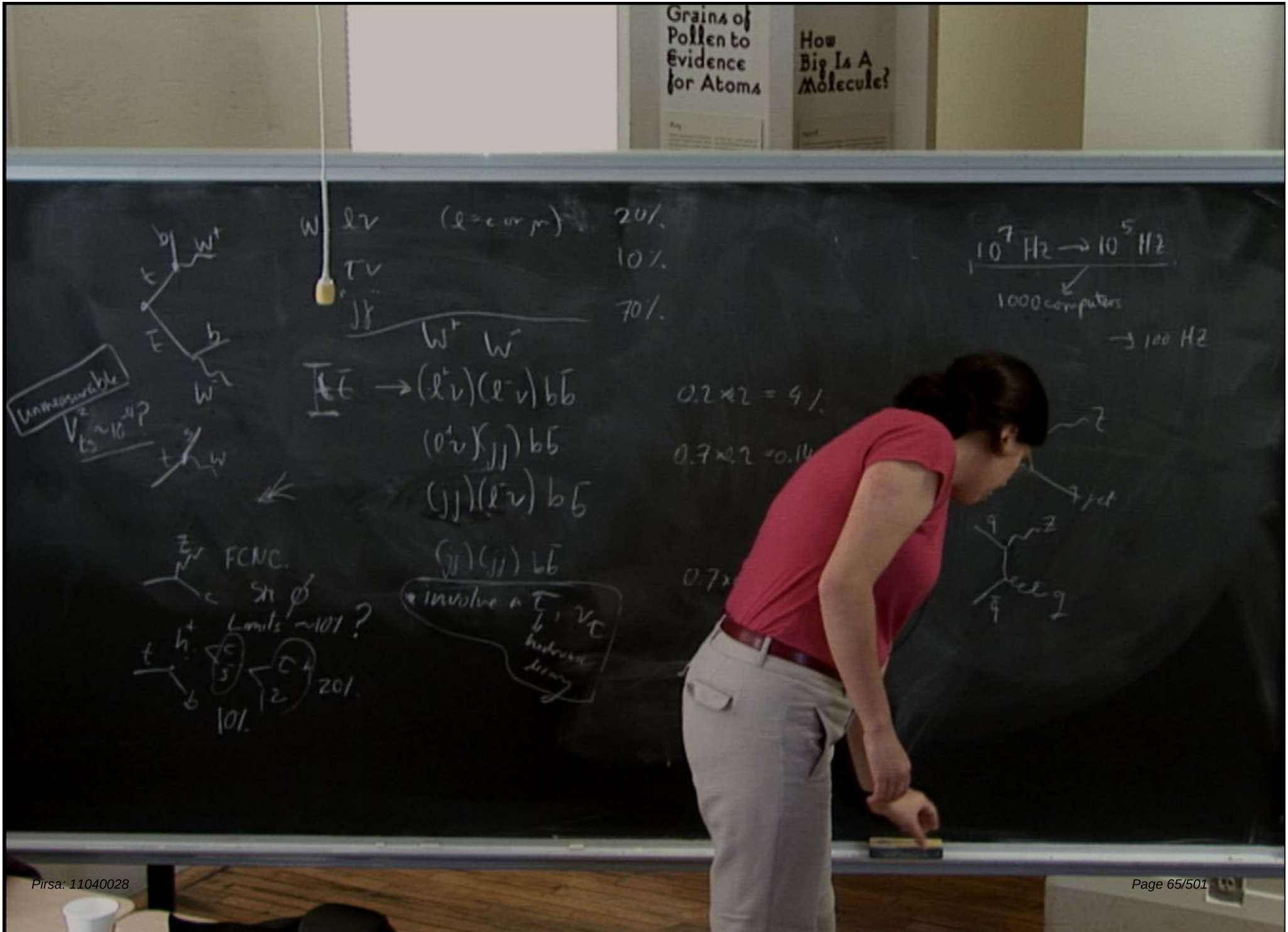
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1000 computers
→ 100 Hz
Unmeasurable
FCNC.
Limits ~10%?
20%
10%
involve a τ, ν_τ
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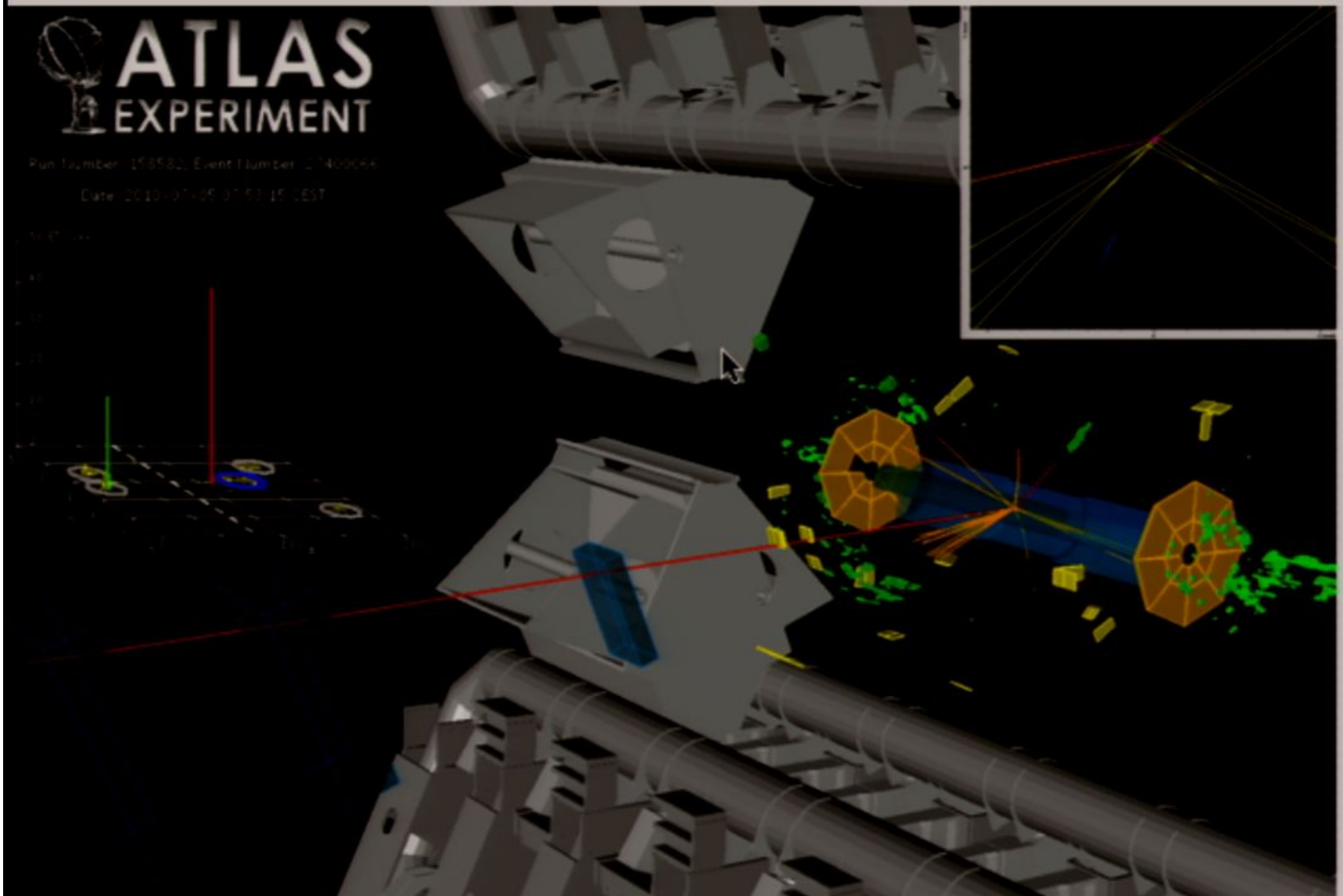
Top Event Display fro ATLAS: twiki.cern.ch/twiki/pub/lasPublic/EventDisplayPublicResults/DL2_emu_btag.png



Lectures

Week 1

- April 4th
  - Video: Lecture 1
- April 5th
  - Video: Lecture 2
  - Tutorial: Tutorial 1
- April 6th
  - Video: Lecture 3
- April 7th
  - Video: Lecture 4
  - Tutorial: Tutorial 2 (same as tutorial 1)
  - Solution: Partial Solution to the Weak Decay Problem - I've tried to get the signs rig
- April 8th
  - Video: Lecture 5

M. E. Peskin and D. V. Schroeder

- Errata for the book by Peskin and Schroeder

- Phenomenology of Particle Physics

S. P. Martin

- This is a nice, comprehensive introduction to the Standard Model.

Rough Plan

Particle physicists use a wide variety of experiments to piece together the underlying theor
(LHC) is taking data that is expected to cast considerable light on the origin of weak-interac
space and time.

The aim of this course is to understand how we go from data to theory, with particular empl
look at the results of the latest particle physics experiments, from the LHC and beyond, and
experiments have allowed us to deduce the symmetries of the Standard Model, and then u
beyond the Standard Model. We'll be using the event generator Pythia to simulate LHC eve
between models of new physics.

In week 3 we'll develop these ideas to understand and incorporate the data from dark matt

You will need to have a basic familiarity with the Standard Model; the PSI Review of BSM P

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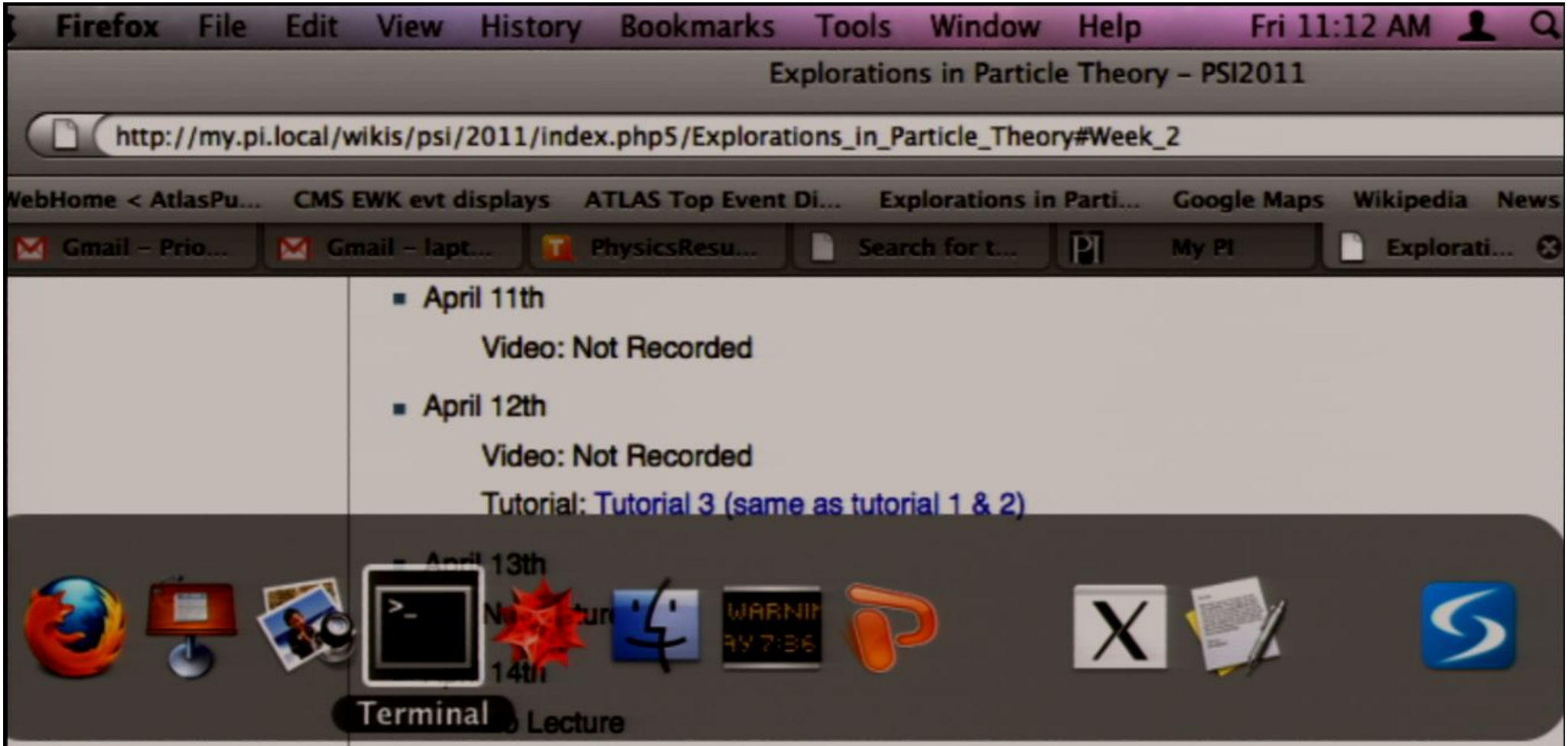
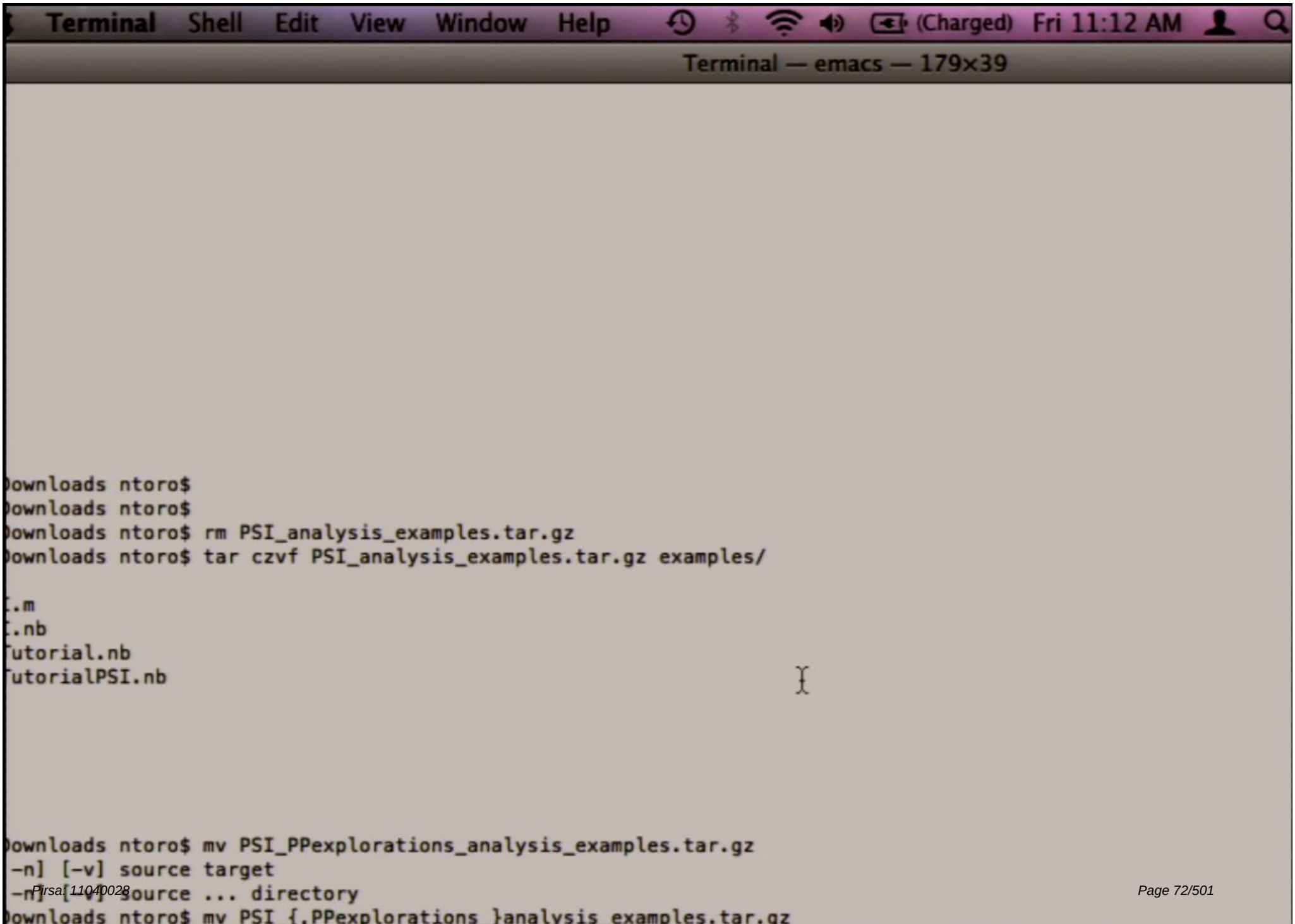
- April 11th
  - Video: Not Recorded
- April 12th
  - Video: Not Recorded
  - Tutorial: Tutorial 3 (same as tutorial 1 & 2)
- April 13th
  - No Lecture
- April 14th
  - No Lecture
- April 15th
  - Files for kinematics/analysis tutorial: [3]
  - Video: Lecture 8
  - Video: Lecture 9


Firefox File Edit View History Bookmarks Tools Window Help Fri 11:12 AM
Explorations in Particle Theory – PSI2011
http://my.pi.local/wikis/psi/2011/index.php5/Explorations_in_Particle_Theory#Week_2
WebHome < AtlasPu... CMS EWK evt displays ATLAS Top Event Di... Explorations in Parti... Google Maps Wikipedia News
Gmail – Prio... Gmail – lapt... PhysicsResu... Search for t... My PI Explorati...
April 11th
Video: Not Recorded
April 12th
Video: Not Recorded
Tutorial: Tutorial 3 (same as tutorial 1 & 2)
Terminal
Lecture
April 15th
Files for kinematics/analysis tutorial:
Video: Lecture 8
Video: Lecture 9
This page was last modified on 15 April 2011, at 14:12.
This page has been accessed 70 times.


Terminal Shell Edit View Window Help (Charged) Fri 11:12 AM
Terminal — emacs — 179×39
ownloads ntoro$
ownloads ntoro$
ownloads ntoro$ rm PSI_analysis_examples.tar.gz
ownloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
.m
.nb
utorial.nb
utorialPSI.nb
ownloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
-n] [-v] source target
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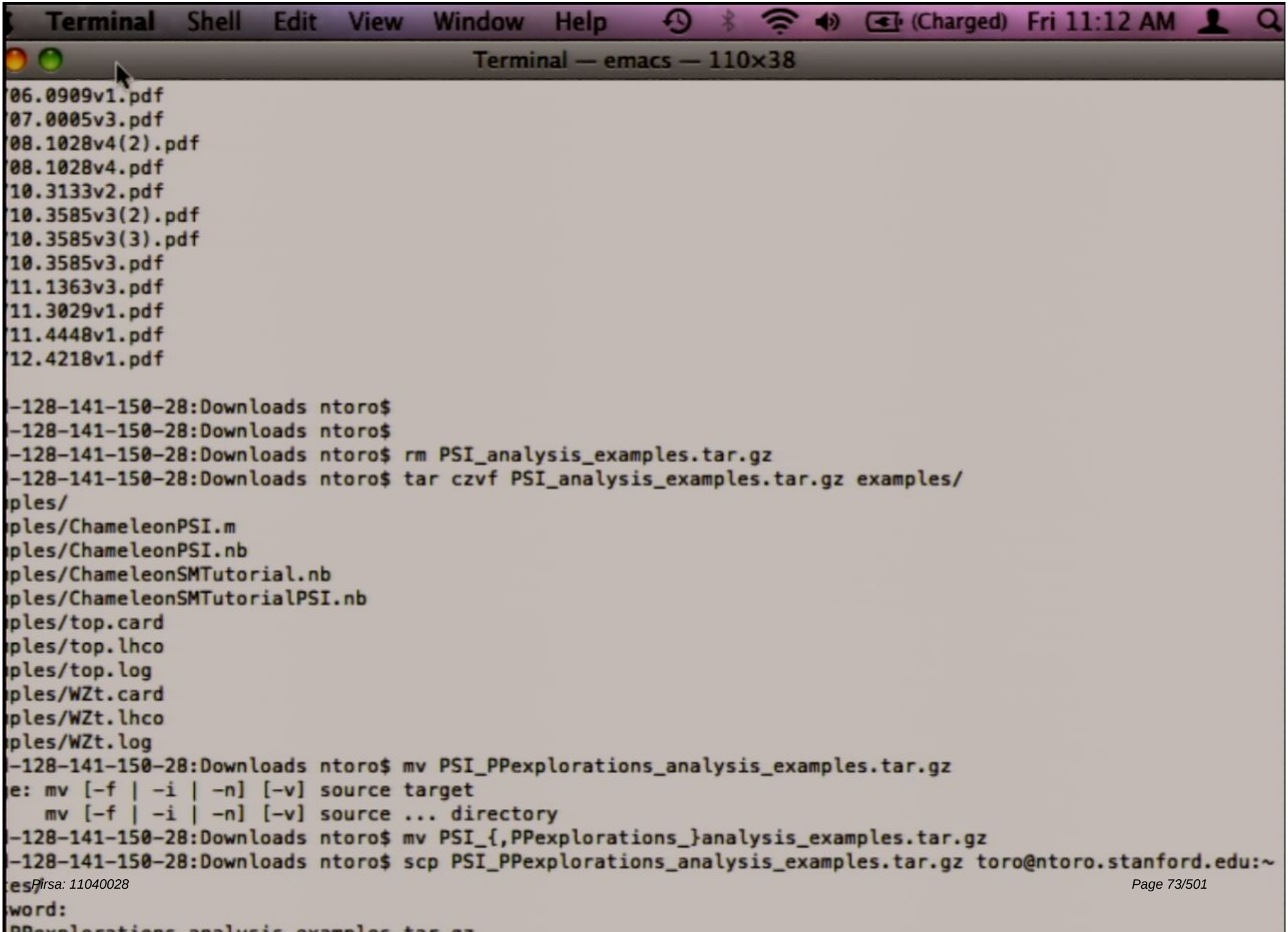
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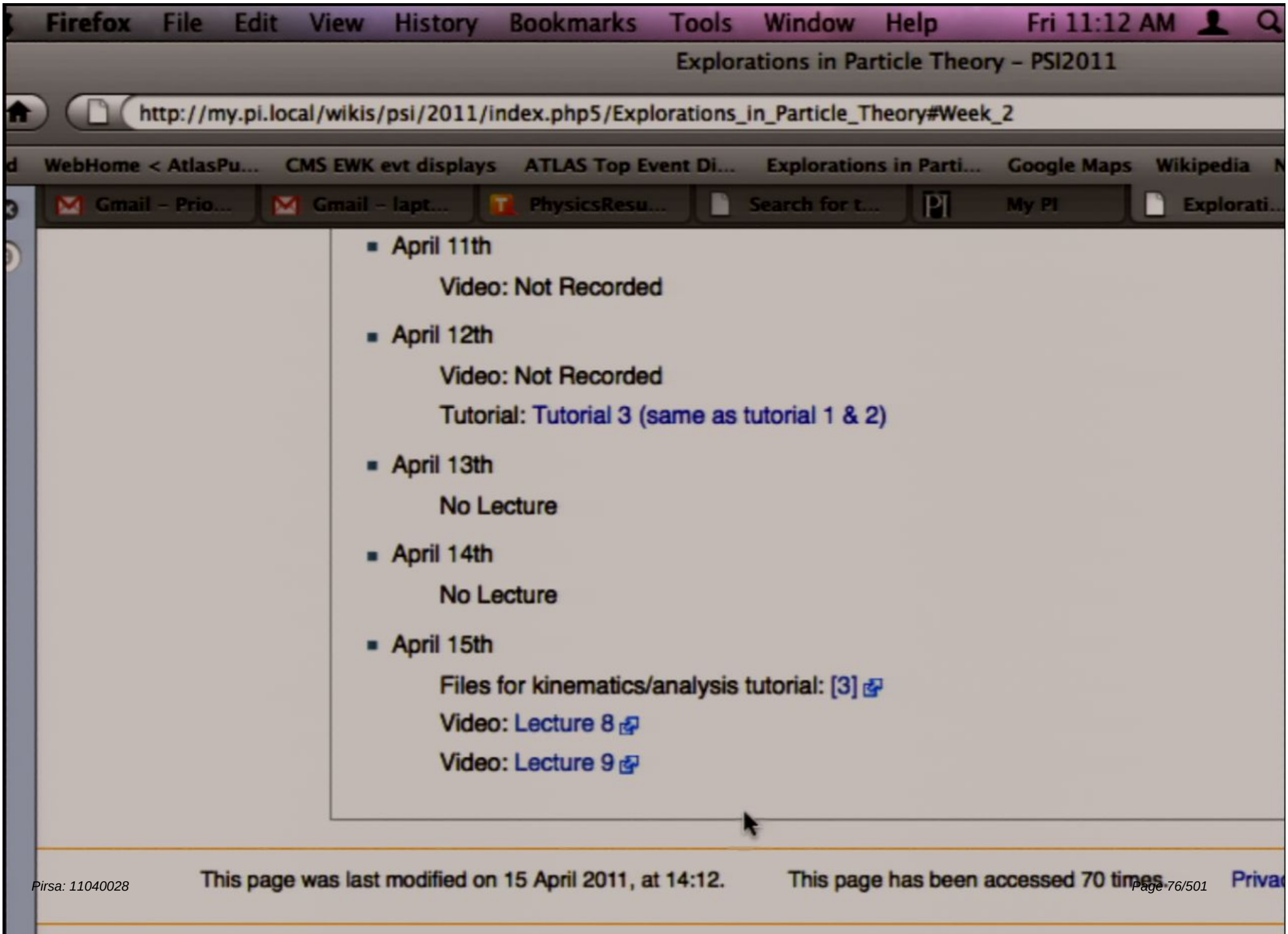
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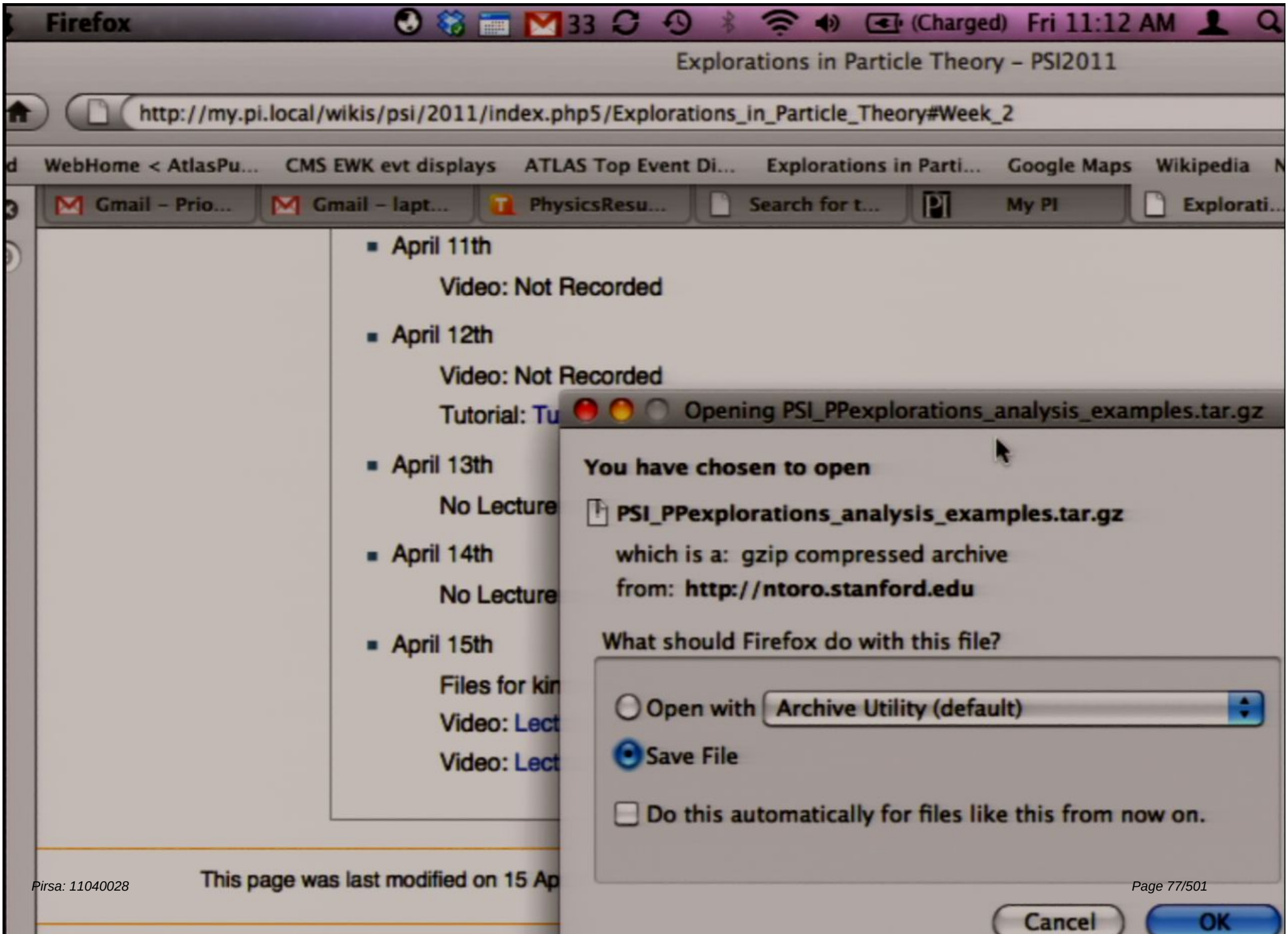
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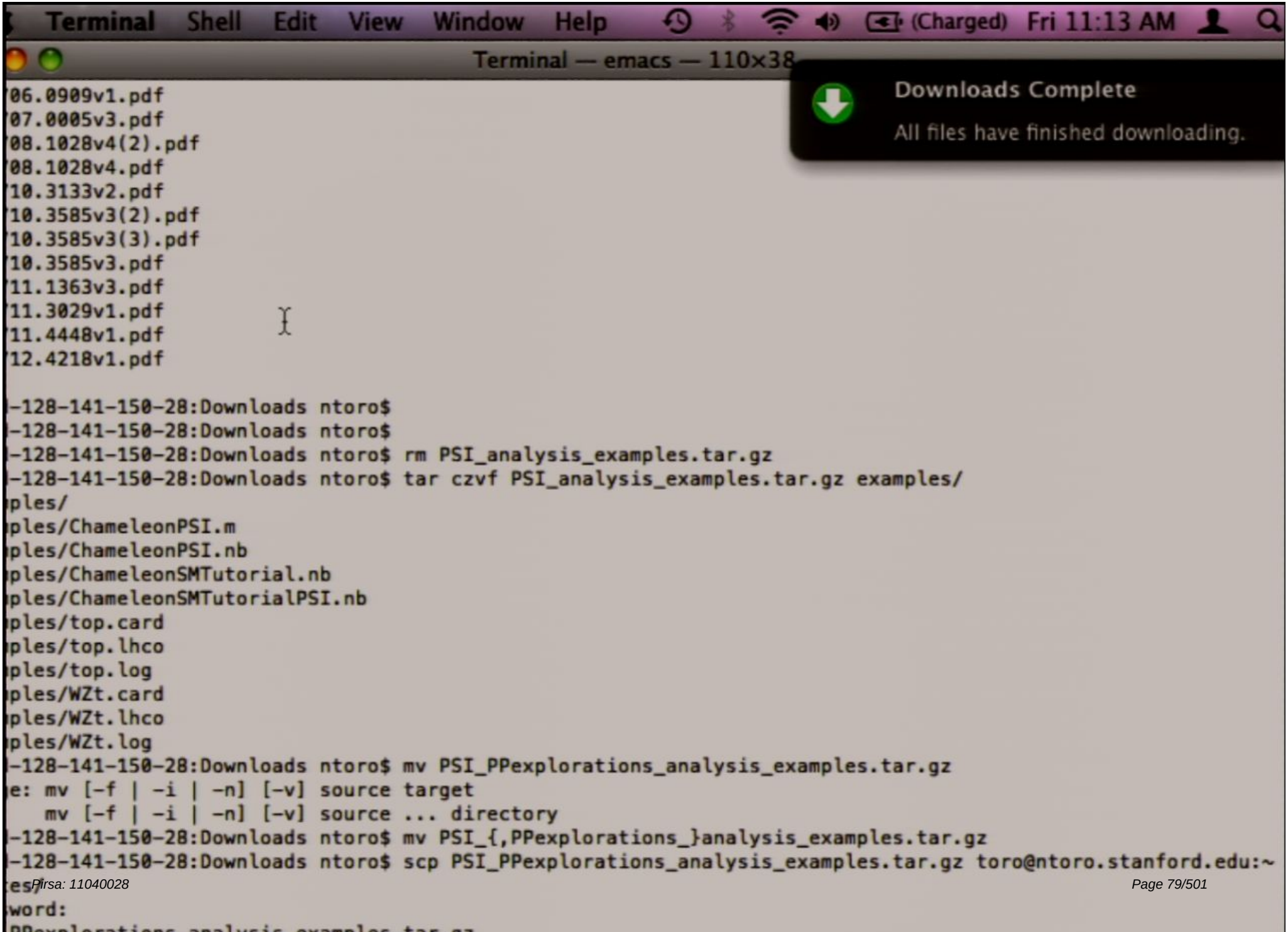
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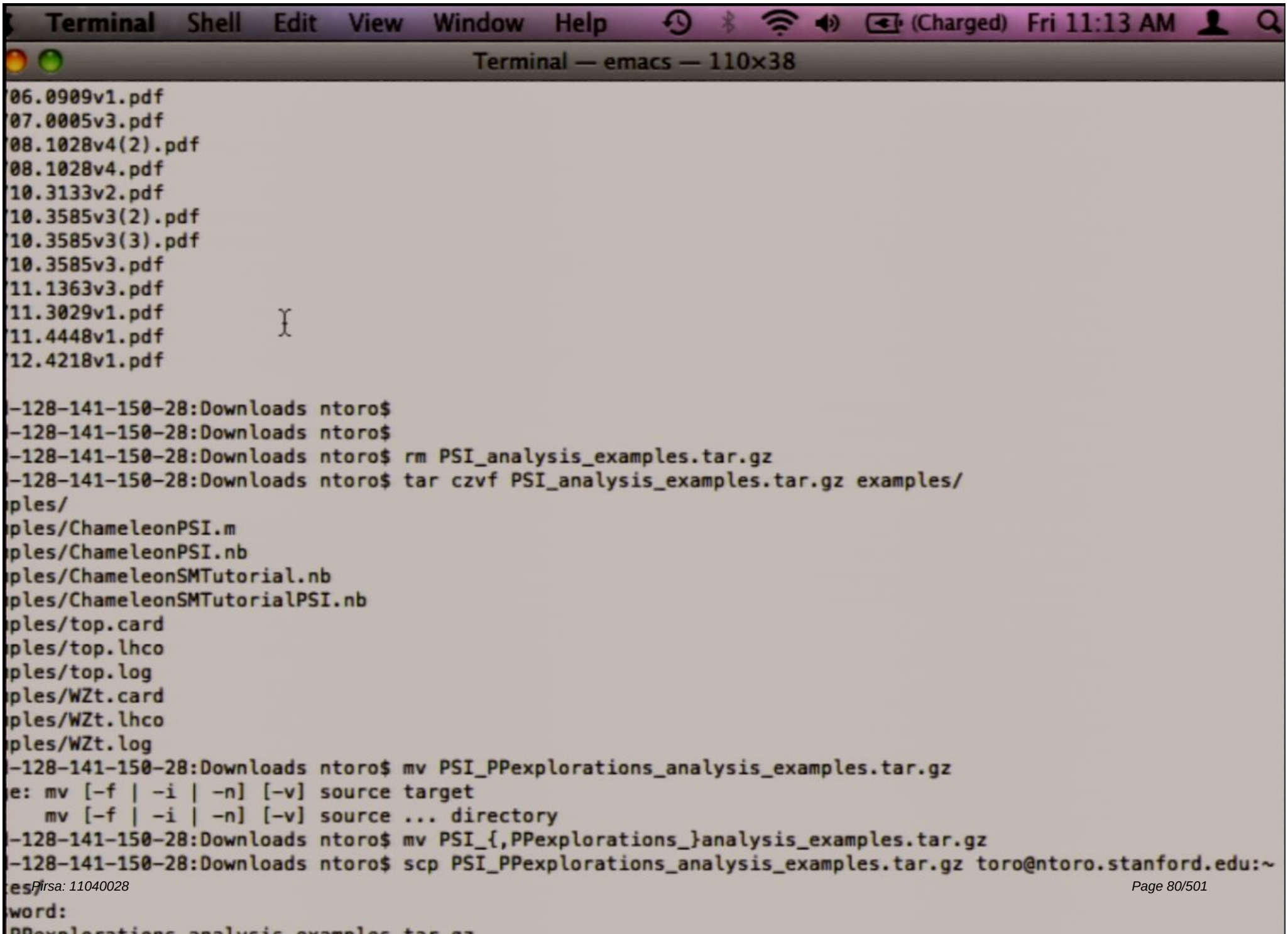
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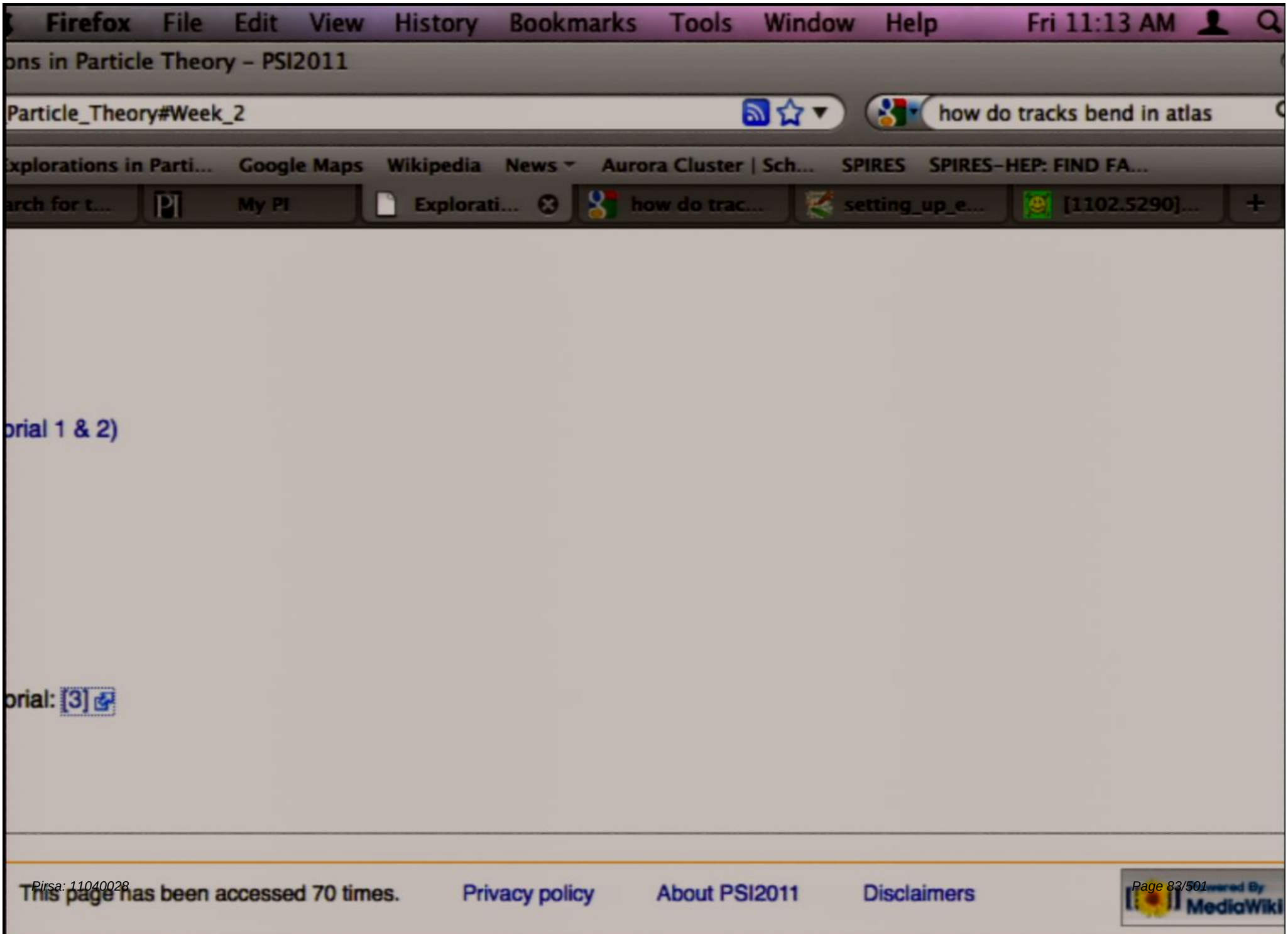
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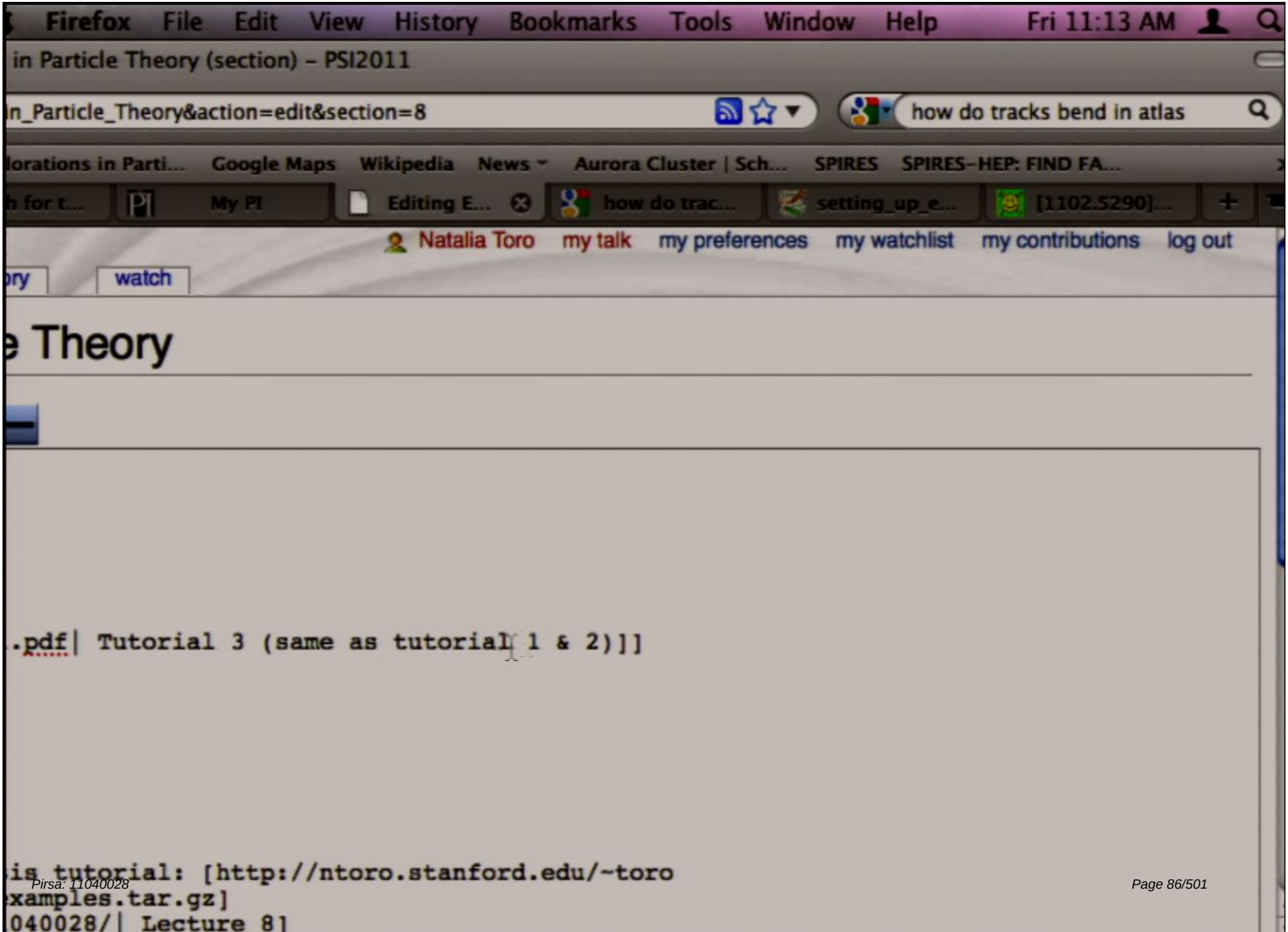
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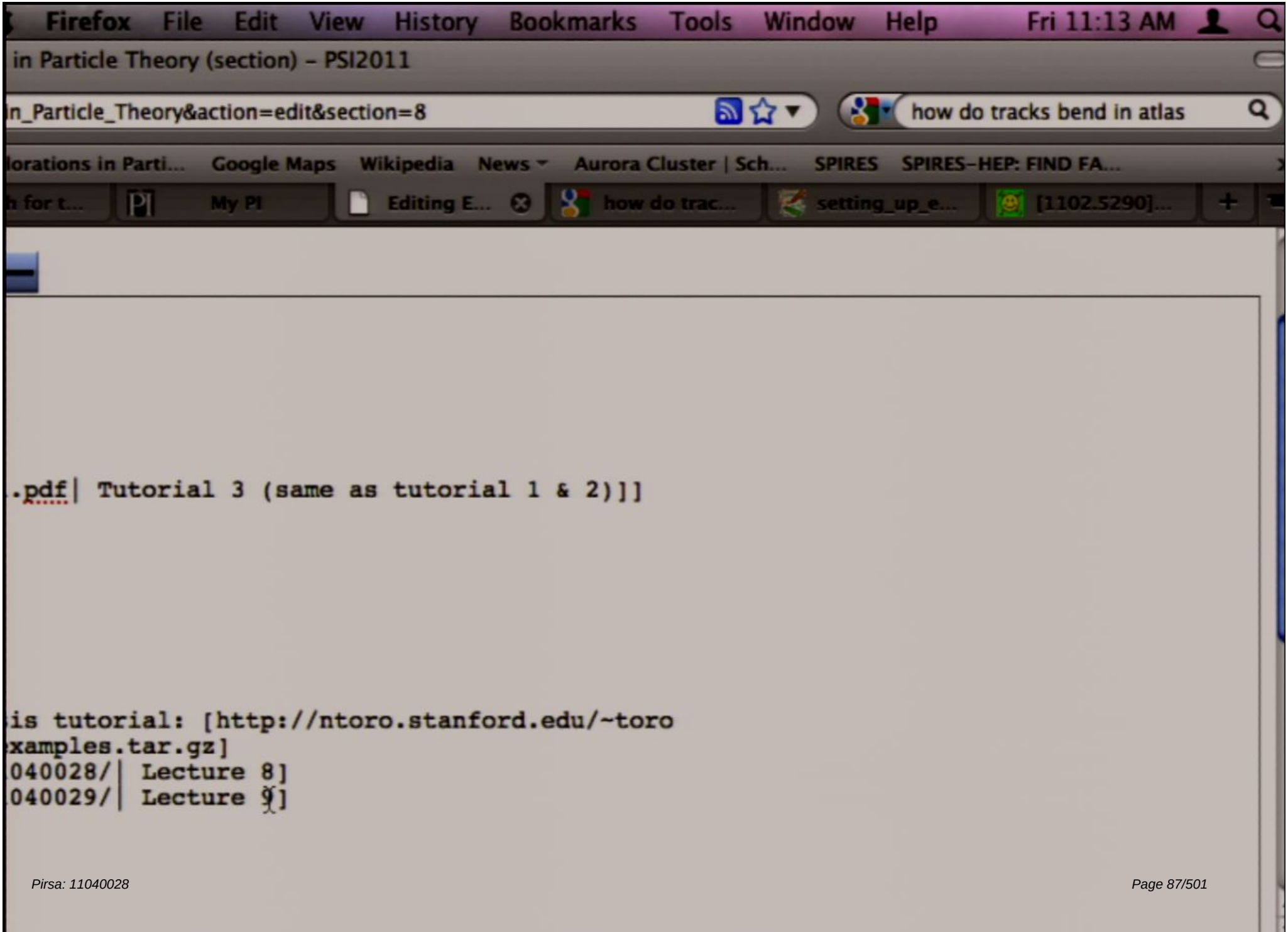
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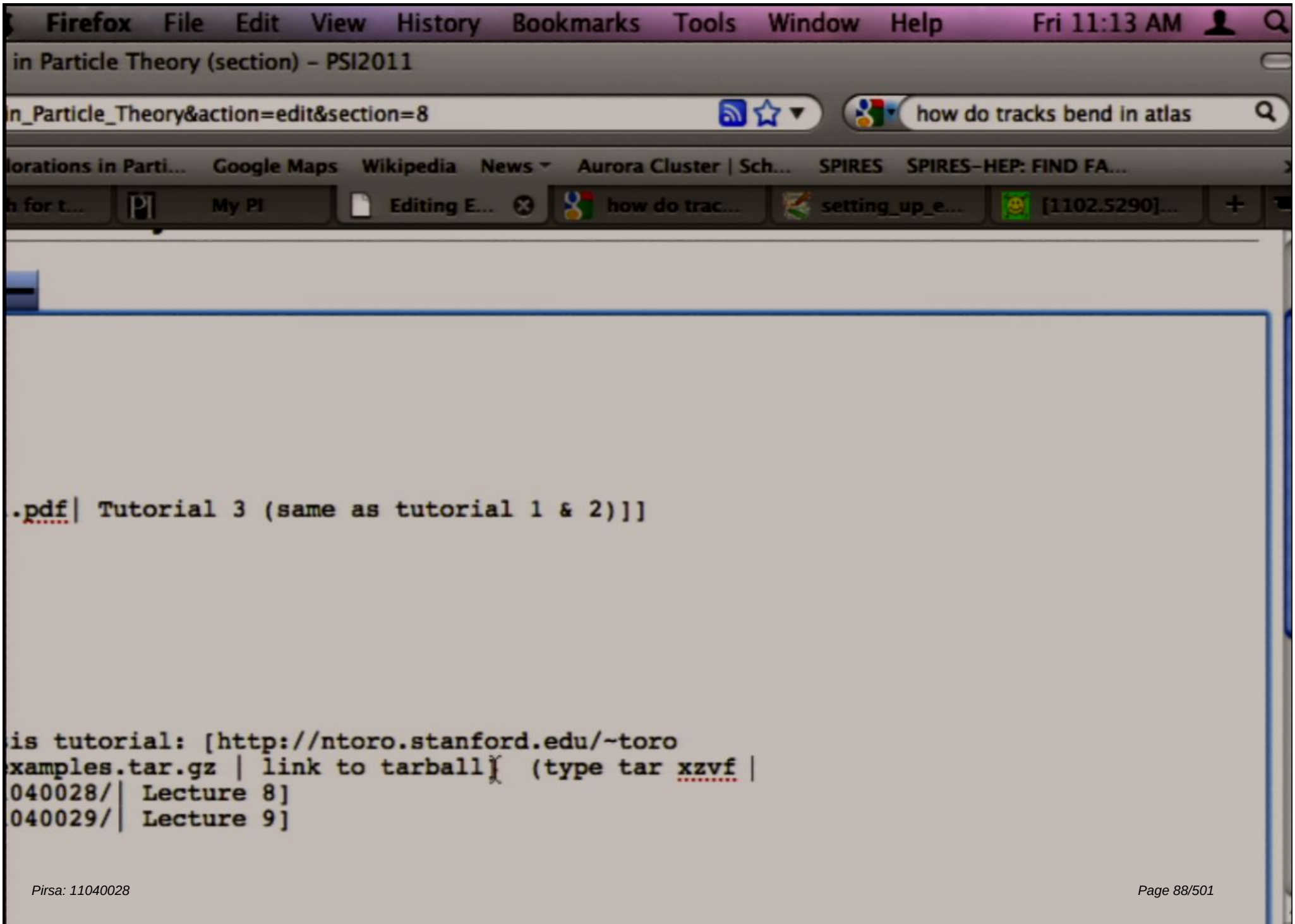
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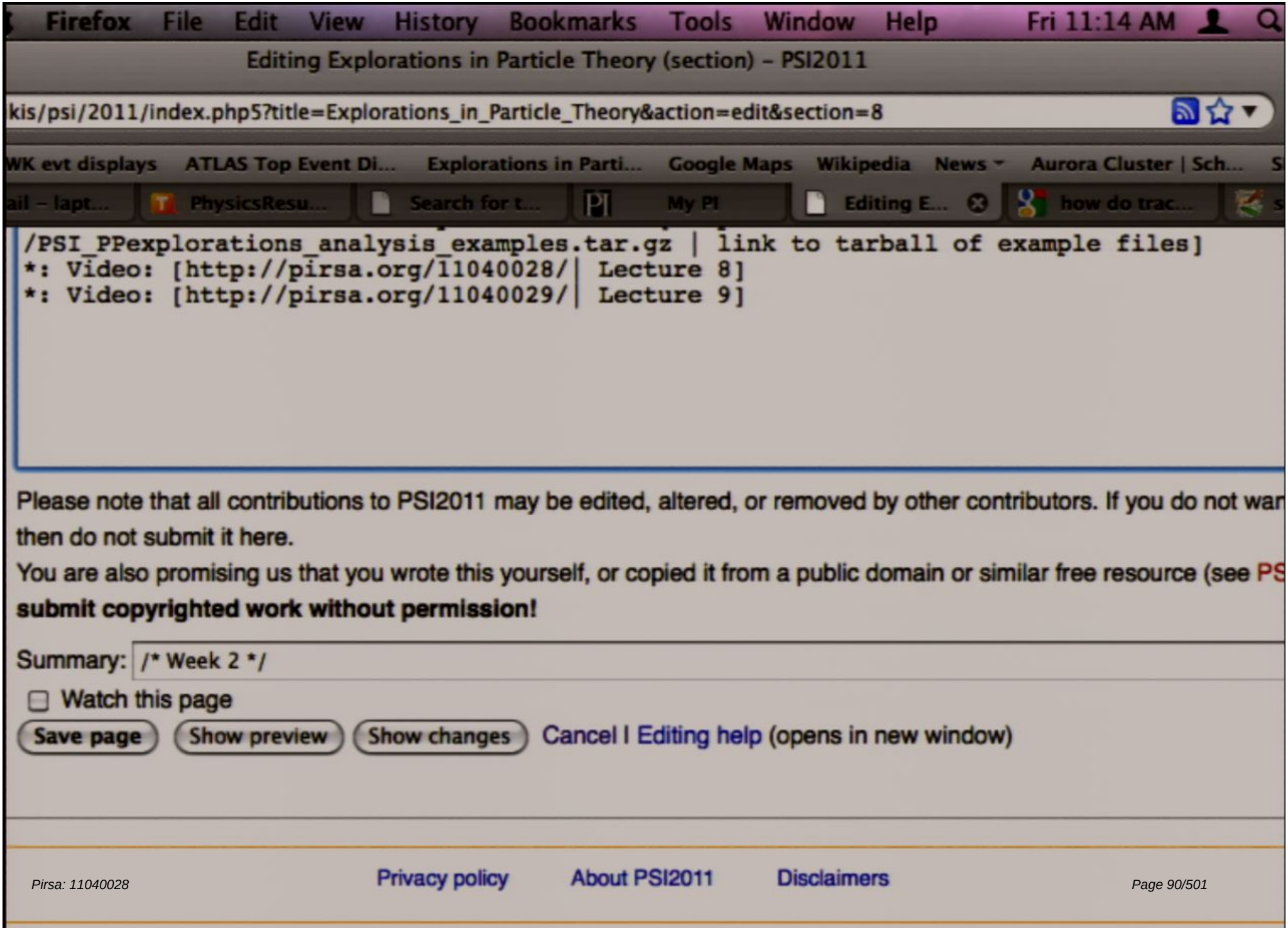
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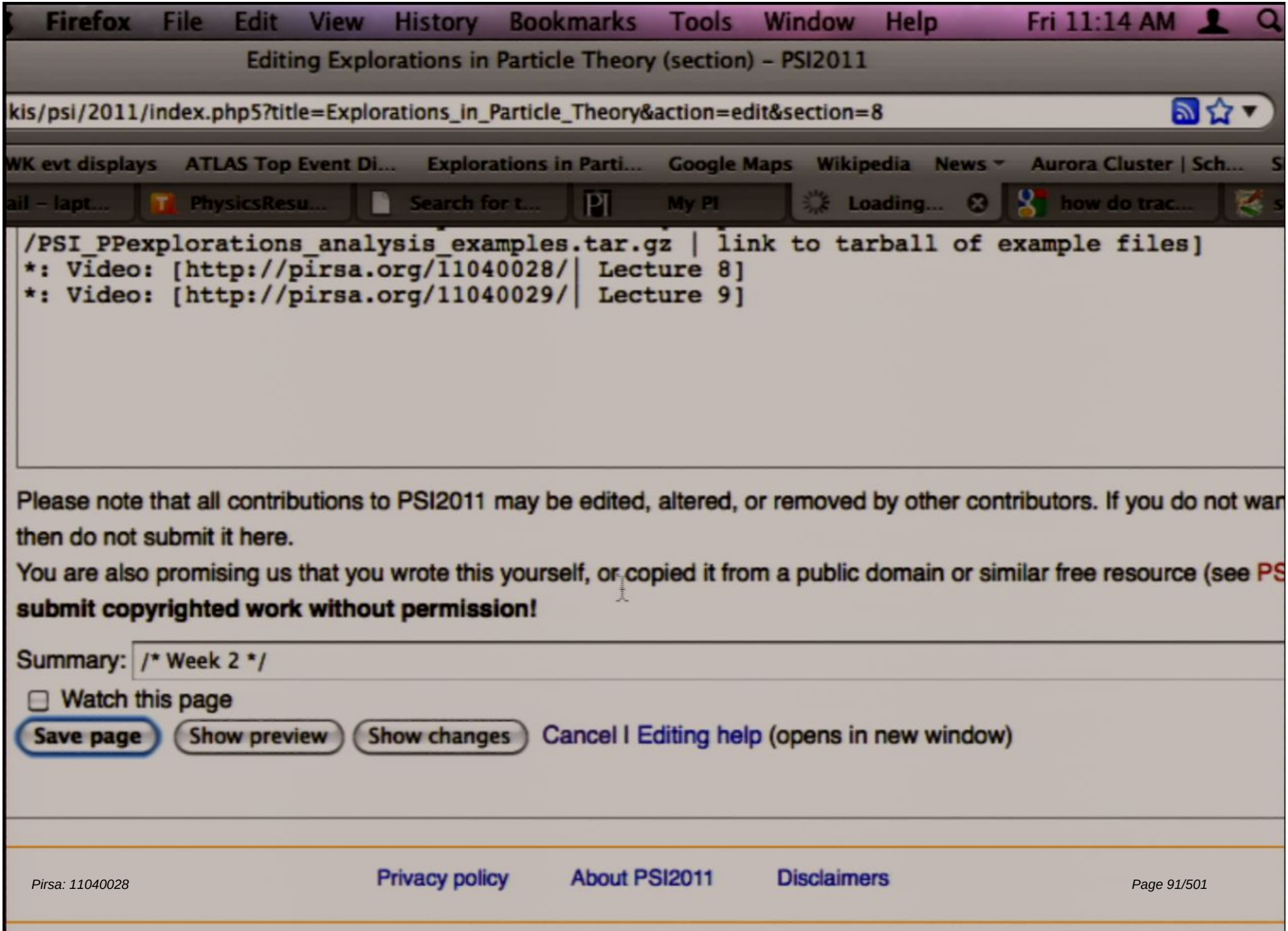
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- April 14th

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ChameleonSMTutorialPSI

hameleon/SM Reconstruction Tutorial

talia Toro, April 2011

ased on
AC Chameleon/Standard Model tutorial, NT and Philip Schuster, July 2008
ameleon 0.51 tutorial, developed by Harvard Blackbox Team:
na Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam Fitzpatrick, Tom Hartman, Can Kilic, Philip Schuster, Jesse Thaler, Natalia Toro, Lian-Tao Wang
v 2, 2005)

BASIC SETUP: Set directory, configure "master cuts", load data sets, basic checks

es You Need to Download.

re using Chameleon, you need to download a few files from the LHC olympics website:

`hameleonPSI.m` contains the definitions of all functions we will use here.

`hameleonPSI.nb` is used to generate `ChameleonPSI.m`. You don't need it to run this package, but if you want to improve on our functions or ow they're defined, you'll want to start here. If you modify `ChameleonPSI.nb`, it should automatically update `ChameleonPSI.m`.

ata sets from the website or that you've generated yourself. This package uses `WZt.lhco`. You can change the commands later in this section to from other files.

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

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SetDirectory["/Users/ntoro/Desktop/"];
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uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

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ou can't get this to work, uncomment the line below to bring up a file browser. Ignore the warning about overwriting files--it won't.

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

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WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
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```

```
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```

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ply muon isolation

muon in an event (e.g. from a b quark decay...) will propagate to the muon chambers and be identified as a muon, but it is often useful to study

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
SetDirectory["/Users/atoro/Desktop/"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
or compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

```
Reading data as PGS Version 4...set $PGSVersion=3
  for compatibility with older (6-column, no-trigger) data format
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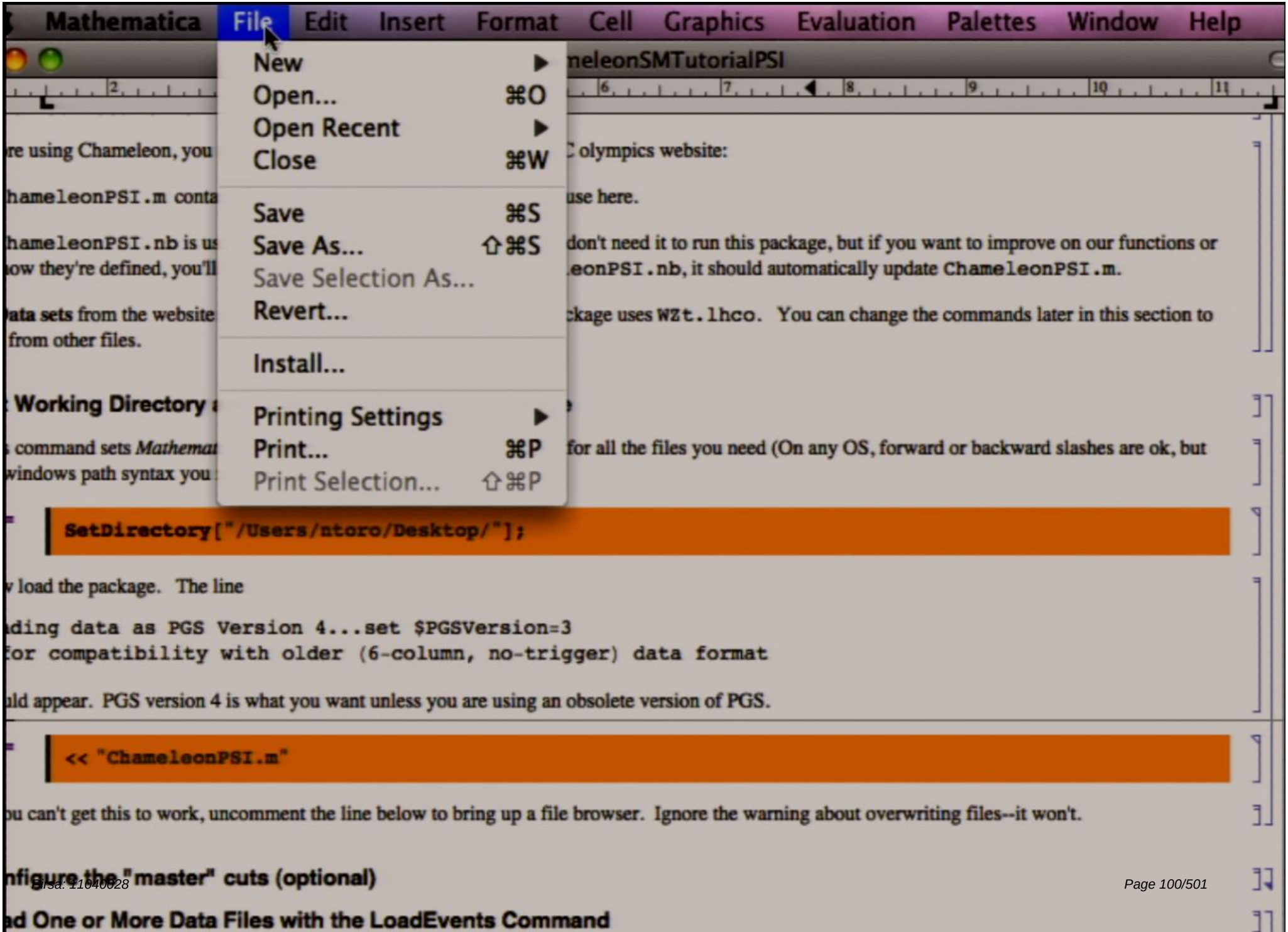
Mathematica
File
Edit
Insert
Format
Cell
Graphics
Evaluation
Palettes
Window
Help
New
Open... ⌘O
Open Recent
Close ⌘W
Save ⌘S
Save As... ⇧⌘S
Save Selection As...
Revert...
Install...
Printing Settings
Print... ⌘P
Print Selection... ⇧⌘P
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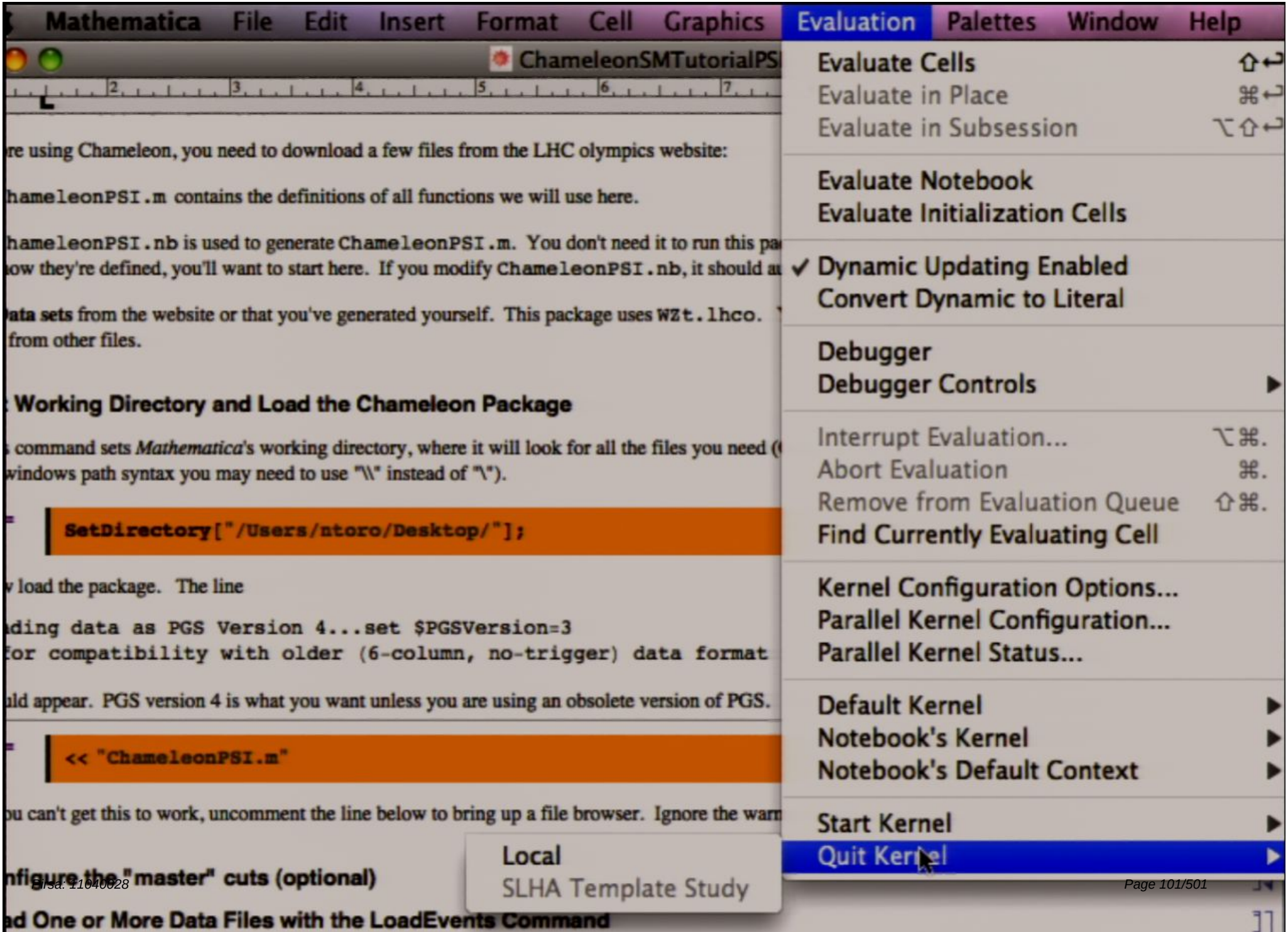
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
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nfigure the "master" cuts (optional)
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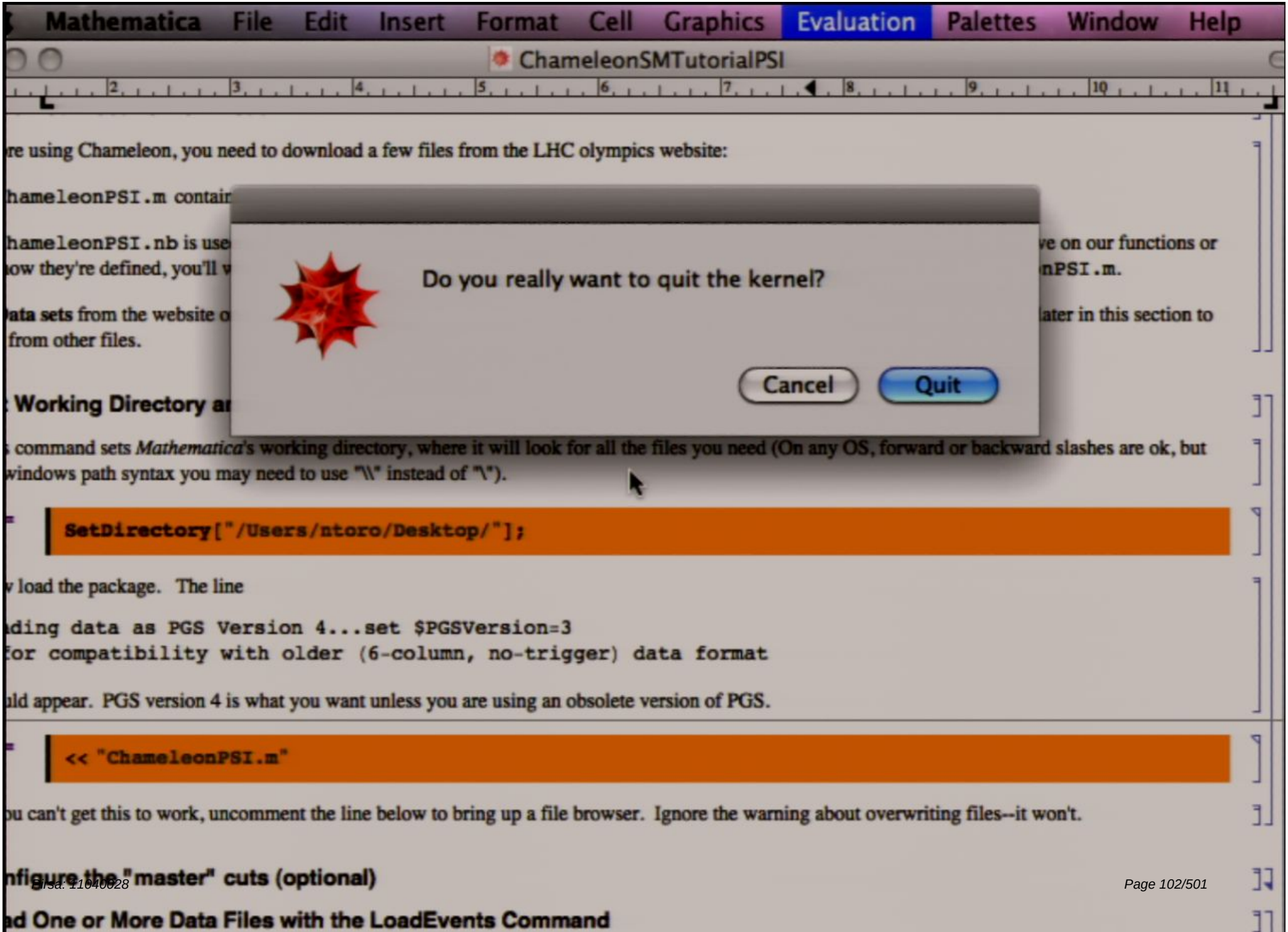
Evaluate Cells
Evaluate in Place
Evaluate in Subsession
Evaluate Notebook
Evaluate Initialization Cells
Dynamic Updating Enabled
Convert Dynamic to Literal
Debugger
Debugger Controls
Interrupt Evaluation...
Abort Evaluation
Remove from Evaluation Queue
Find Currently Evaluating Cell
Kernel Configuration Options...
Parallel Kernel Configuration...
Parallel Kernel Status...
Default Kernel
Notebook's Kernel
Notebook's Default Context
Start Kernel
Quit Kernel
Local
SLHA Template Study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Do you really want to quit the kernel?
Cancel
Quit

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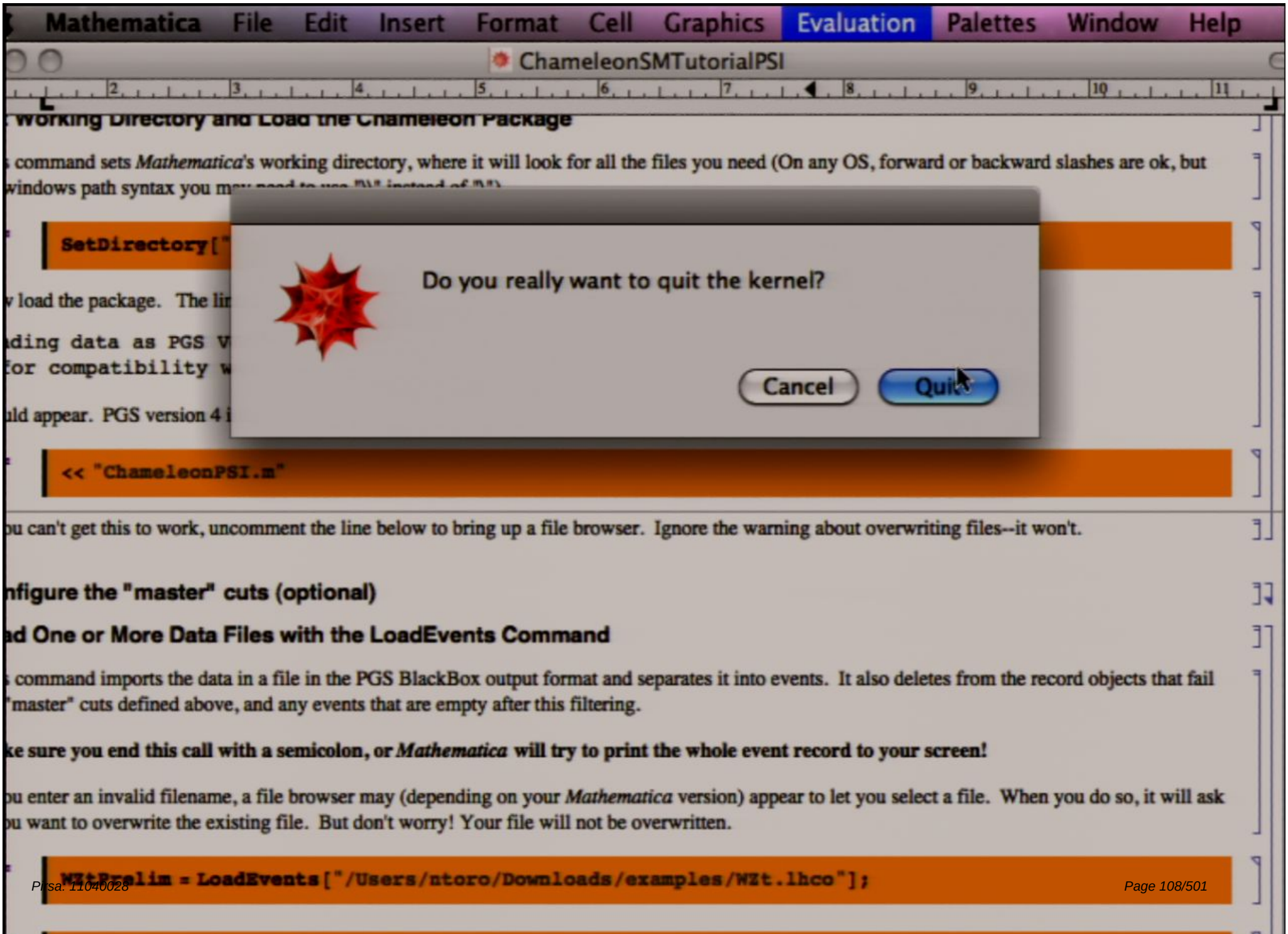
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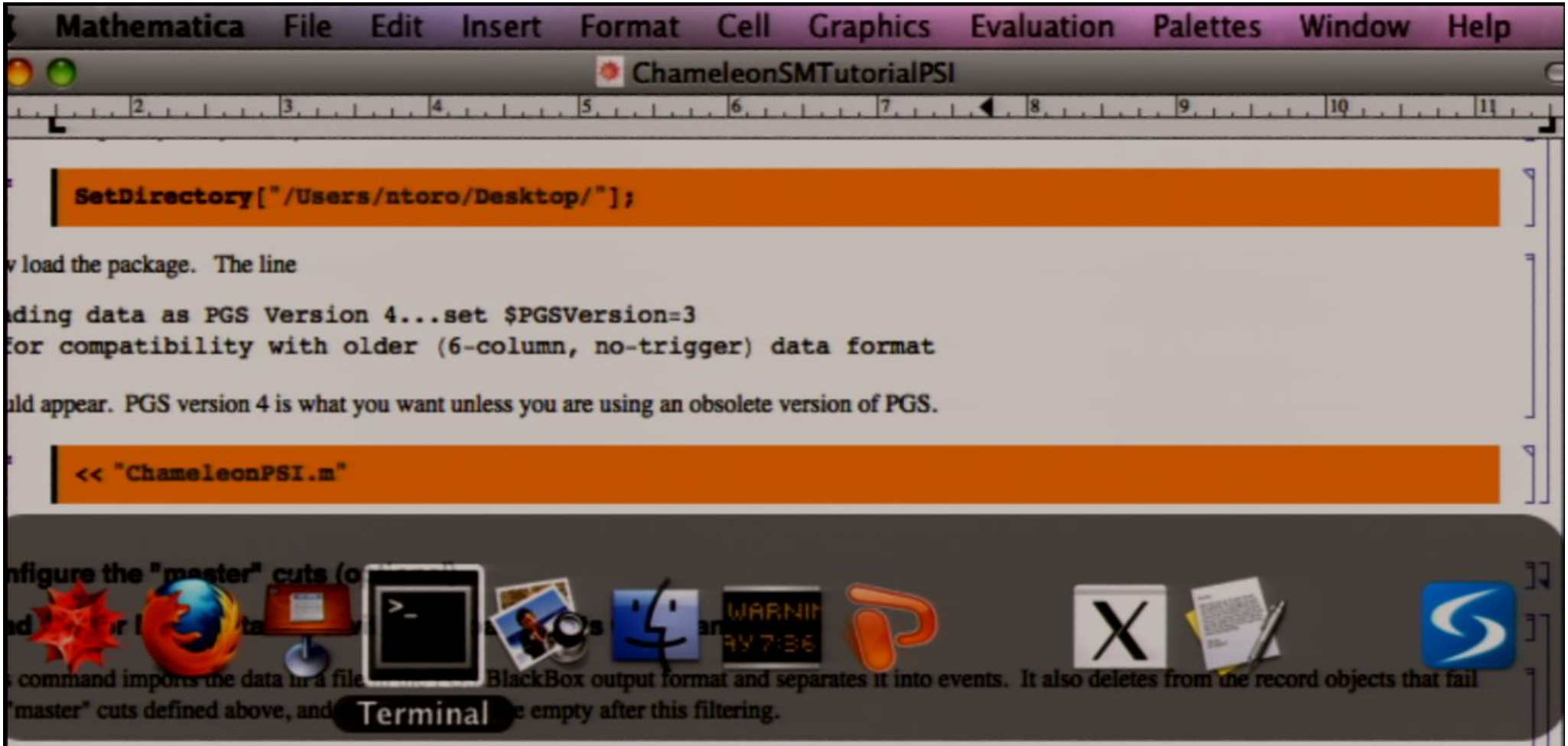
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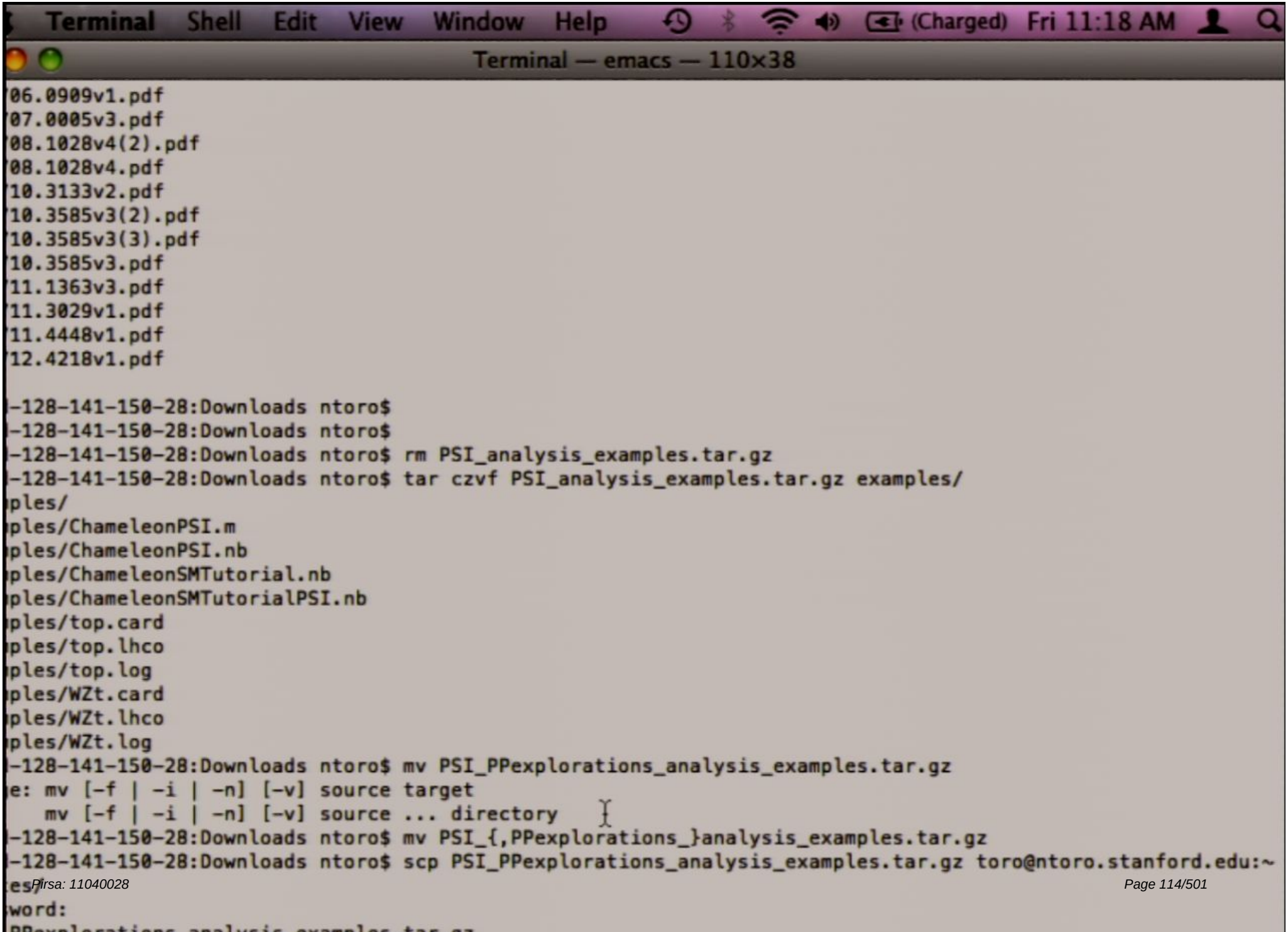
Terminal Shell Edit View Window Help (Charged) Fri 11:18 AM
Terminal — emacs — 110×38
06.0909v1.pdf
07.0005v3.pdf
08.1028v4(2).pdf
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10.3133v2.pdf
10.3585v3(2).pdf
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11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
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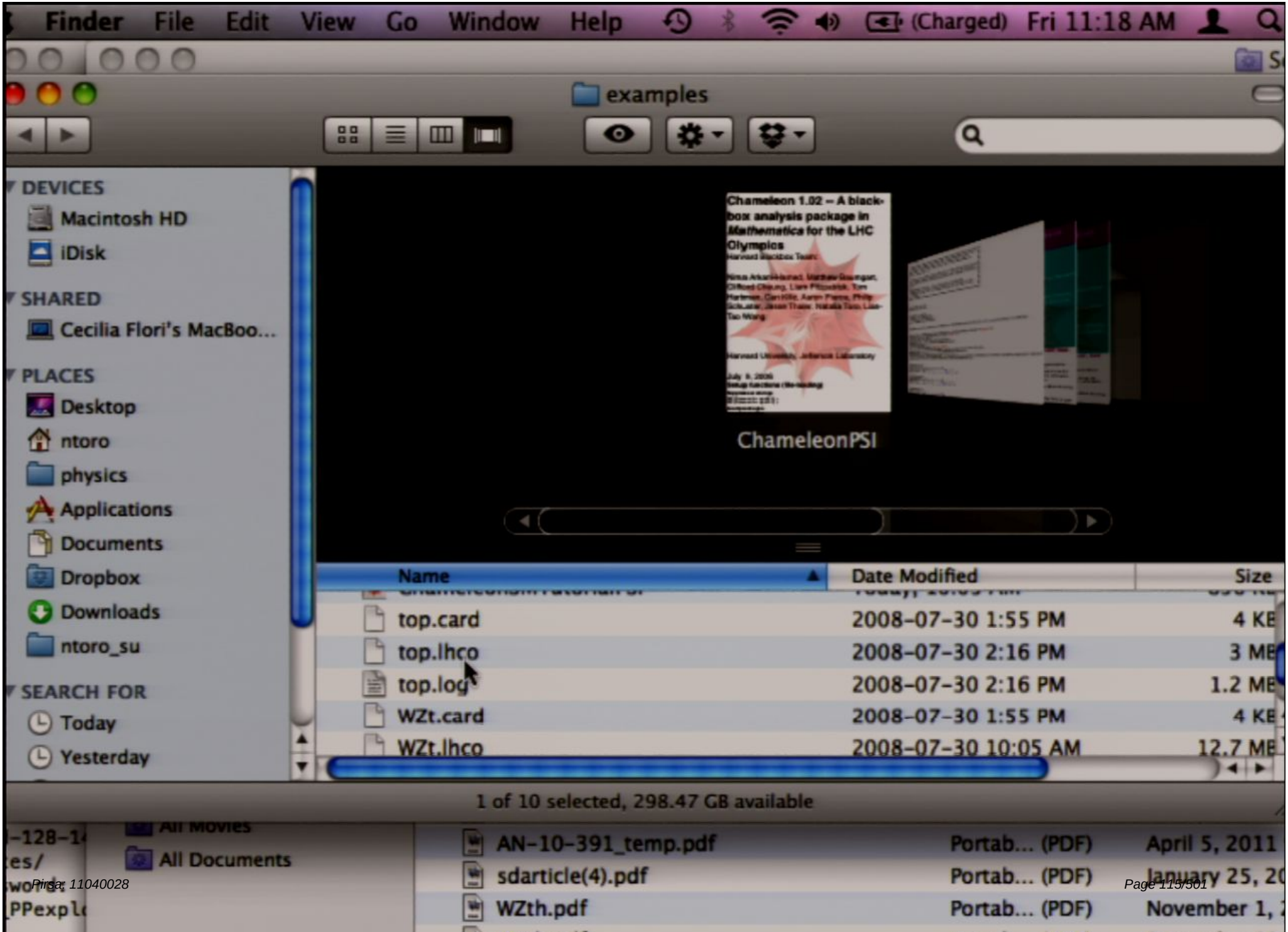
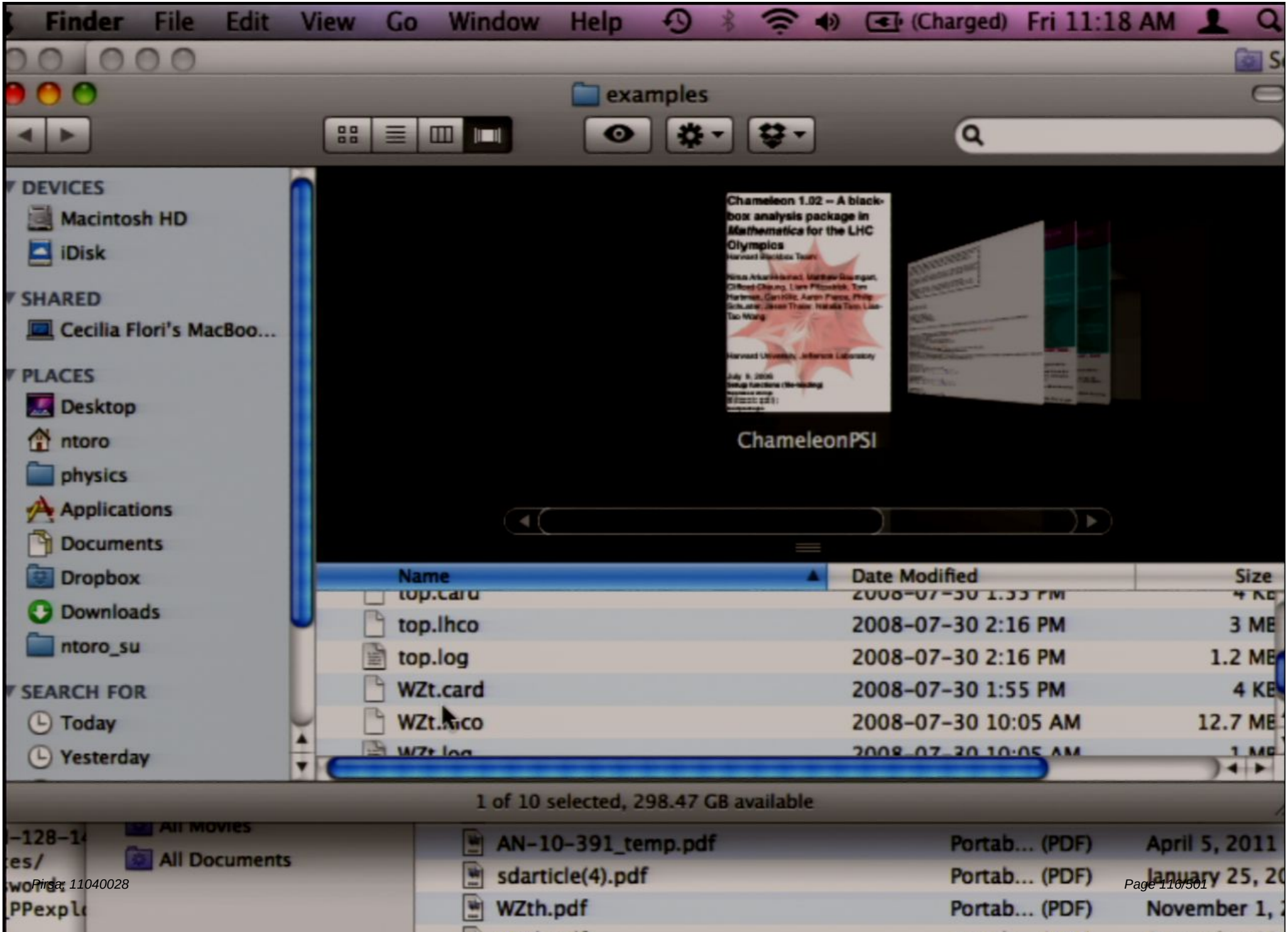
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:


Finder File Edit View Go Window Help (Charged) Fri 11:18 AM
examples
DEVICES
Macintosh HD
iDisk
SHARED
Cecilia Flori's MacBoo...
PLACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
SEARCH FOR
Today
Yesterday
Chameleon 1.02 -- A black-box analysis package in Mathematica for the LHC Olympics
ChameleonPSI
Name
Date Modified
Size
top.card 2008-07-30 1:55 PM 4 KB
top.lhco 2008-07-30 2:16 PM 3 MB
top.log 2008-07-30 2:16 PM 1.2 MB
WZt.card 2008-07-30 1:55 PM 4 KB
WZt.lhco 2008-07-30 10:05 AM 12.7 MB
1 of 10 selected, 298.47 GB available
All Movies
All Documents
AN-10-391_temp.pdf Portab... (PDF) April 5, 2011
sdarticle(4).pdf Portab... (PDF)
WZth.pdf Portab... (PDF) November 1,


Finder File Edit View Go Window Help (Charged) Fri 11:18 AM
examples
DEVICES
Macintosh HD
iDisk
SHARED
Cecilia Flori's MacBoo...
PLACES
Desktop
ntoro
physics
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Documents
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SEARCH FOR
Today
Yesterday
Chameleon 1.02 -- A black-box analysis package in Mathematica for the LHC Olympics
ChameleonPSI
Name
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top.lhco
2008-07-30 2:16 PM
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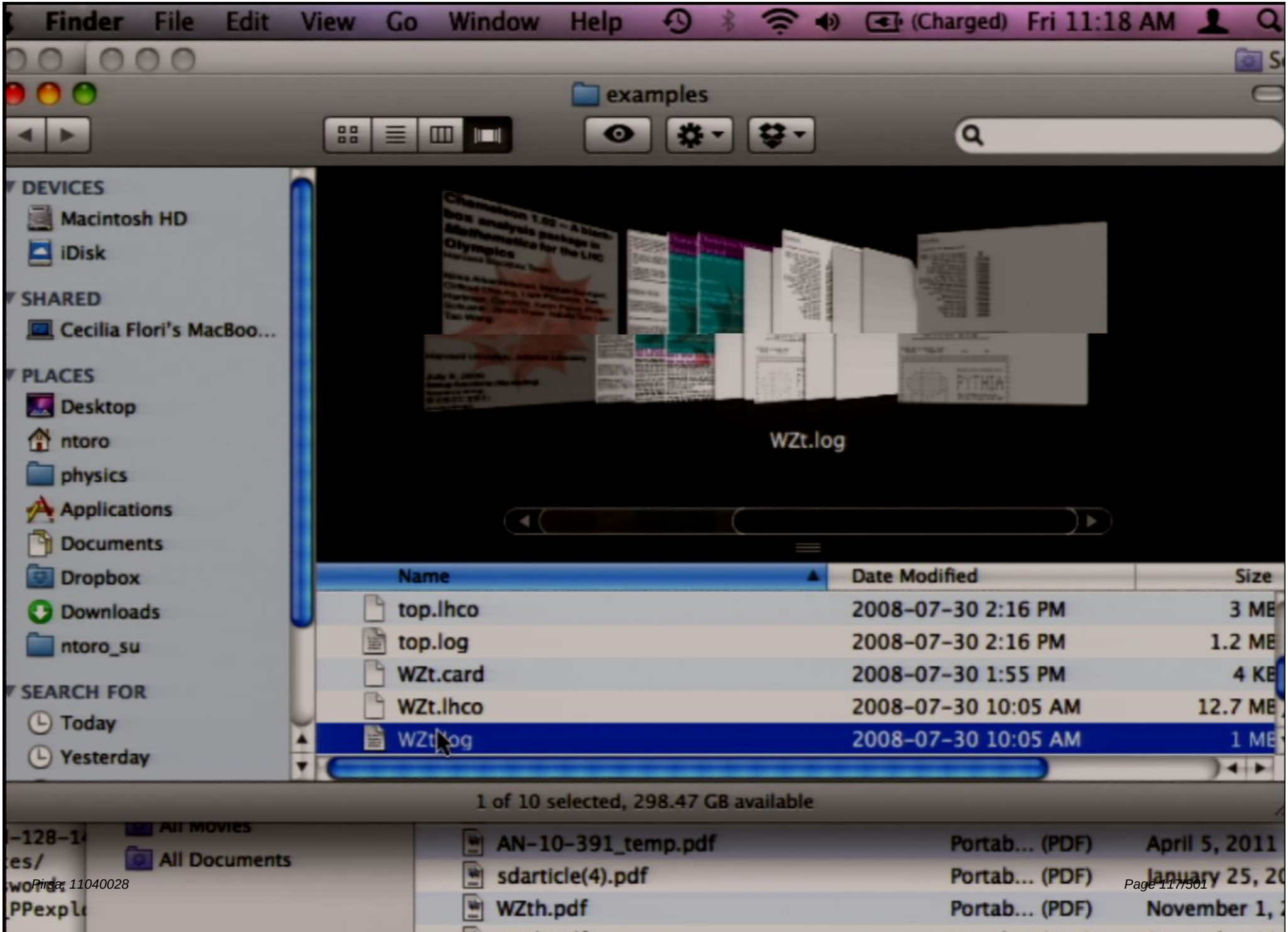
2008-07-30 2:16 PM
1.2 MB
WZt.card
2008-07-30 1:55 PM
4 KB
WZt.lhco
2008-07-30 10:05 AM
12.7 MB
1 of 10 selected, 298.47 GB available
All Movies
All Documents
AN-10-391_temp.pdf
Portab... (PDF)
April 5, 2011
sdarticle(4).pdf
Portab... (PDF)
WZth.pdf
Portab... (PDF)
November 1,


Finder File Edit View Go Window Help (Charged) Fri 11:18 AM
examples
DEVICES
Macintosh HD
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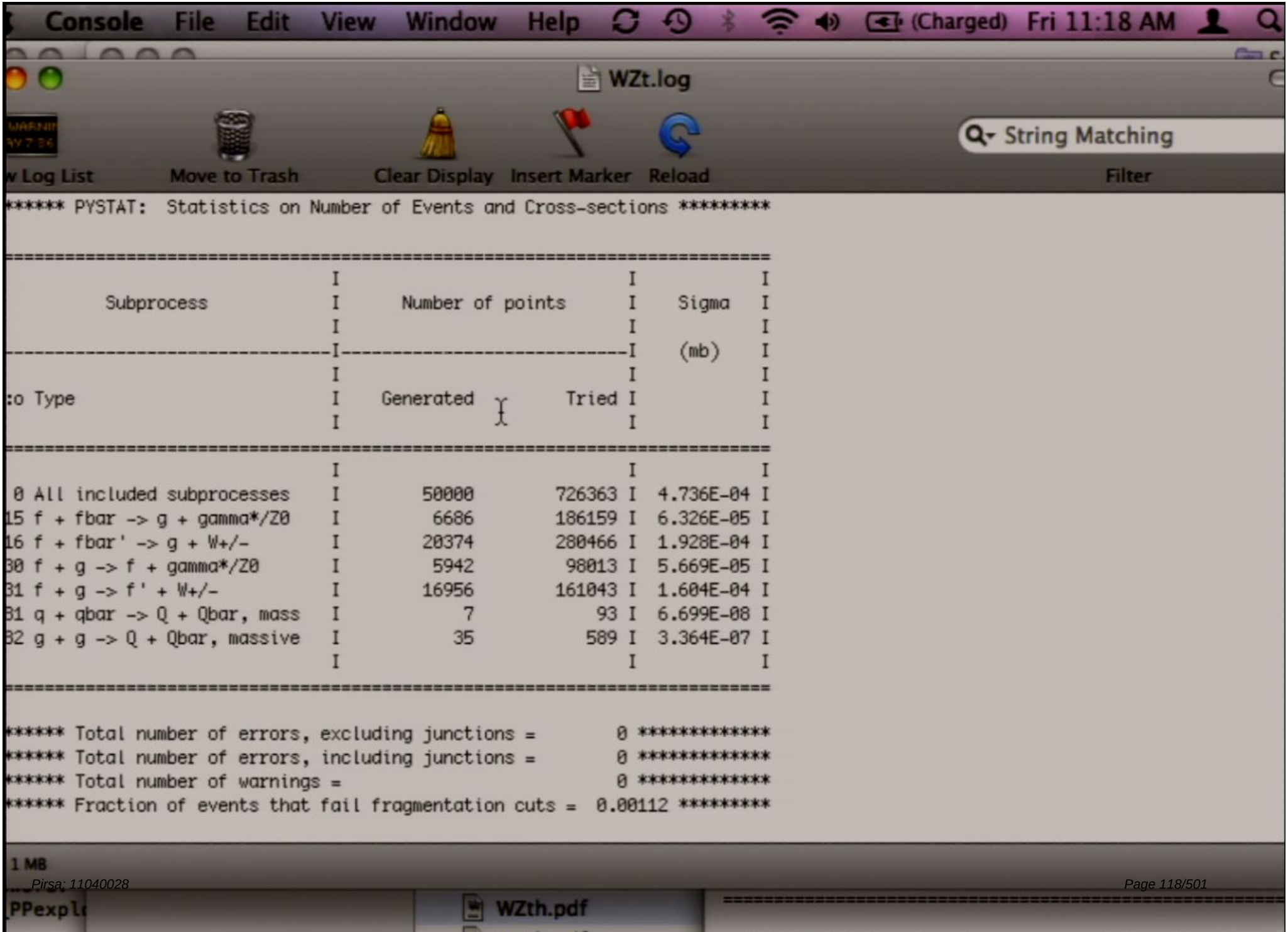
SHARED
Cecilia Flori's MacBoo...
PLACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
SEARCH FOR
Today
Yesterday
WZt.log
Name
Date Modified
Size
top.lhco
2008-07-30 2:16 PM
3 ME
top.log
2008-07-30 2:16 PM
1.2 ME
WZt.card
2008-07-30 1:55 PM
4 KE
WZt.lhco
2008-07-30 10:05 AM
12.7 ME
WZt.log
2008-07-30 10:05 AM
1 ME
1 of 10 selected, 298.47 GB available
All Movies
All Documents
AN-10-391_temp.pdf
Portab... (PDF)
April 5, 2011
sdarticle(4).pdf
Portab... (PDF)
WZth.pdf
Portab... (PDF)
November 1,


Console File Edit View Window Help (Charged) Fri 11:18 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
****** Fraction of events that fail fragmentation cuts = 0.00112 *********
1 MB
PPexpl
WZth.pdf

Console File Edit View Window Help (Charged) Fri 11:18 AM

WZt.log

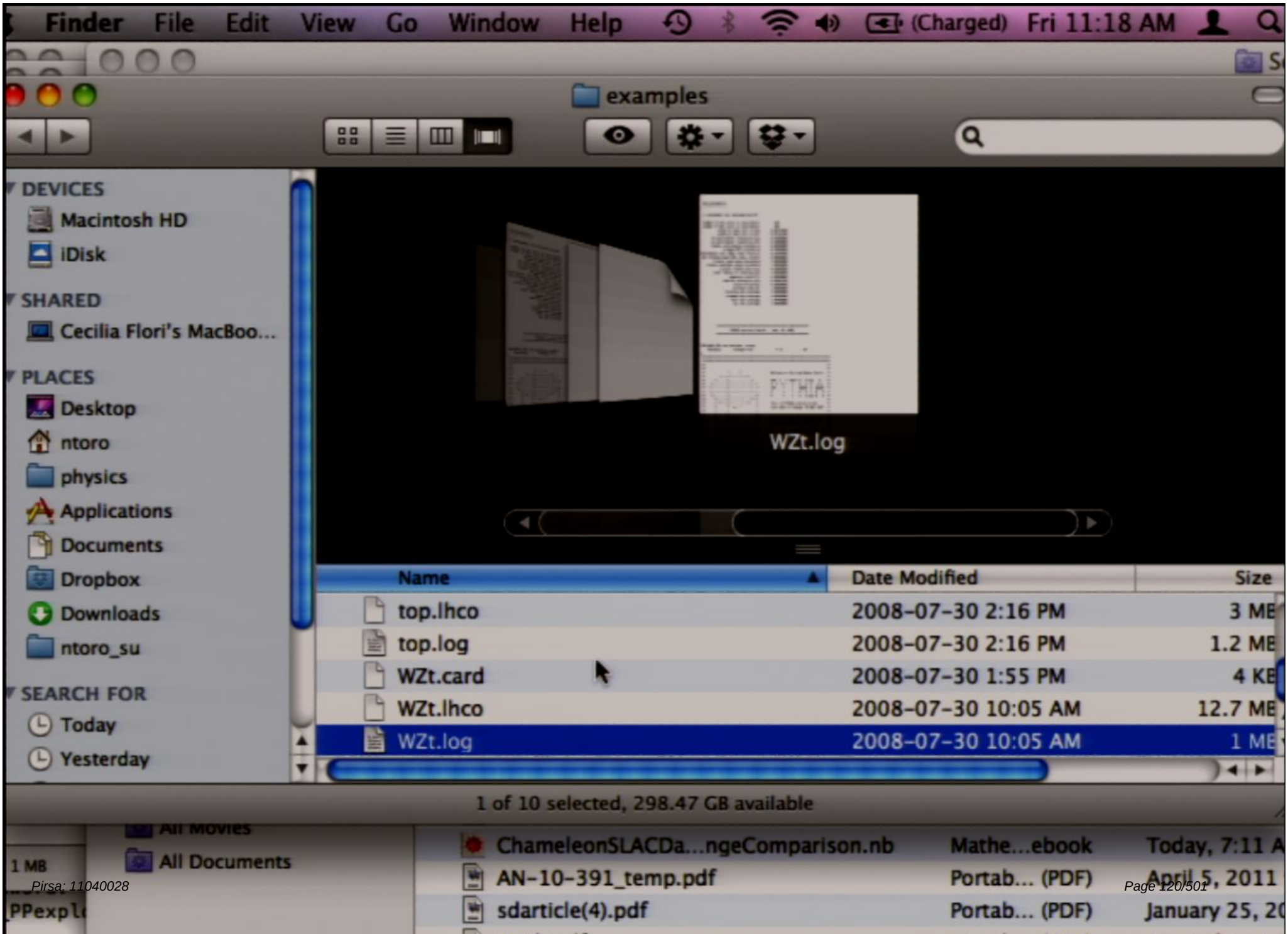
w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==========================================================================
                                I                           I           I
         Subprocess             I     Number of points      I   Sigma   I
                                I                           I           I
--------------------------------I---------------------------I   (mb)    I
                                I                           I           I
:o Type                         I   Generated        Tried  I           I
                                I                           I           I
==========================================================================
                                I                           I           I
 0 All included subprocesses    I      50000        726363  I 4.730E-04 I
15 f + fbar -> g + gamma*/Z0    I       6686        186159  I 6.326E-05 I
16 f + fbar' -> g + W+/-        I      20374        280466  I 1.928E-04 I
30 f + g -> f + gamma*/Z0       I       5942         98013  I 5.669E-05 I
31 f + g -> f' + W+/-           I      16956        161043  I 1.604E-04 I
81 q + qbar -> Q + Qbar, mass   I          7            93  I 6.699E-08 I
82 g + g -> Q + Qbar, massive   I         35           589  I 3.364E-07 I
                                I                           I           I
==========================================================================

****** Total number of errors, excluding junctions =       0 *************
****** Total number of errors, including junctions =       0 *************
****** Total number of warnings =                          0 *************
****** Fraction of events that fail fragmentation cuts =  0.00112 *********
```

1 MB

PPexpl | sdarticle(4).pdf


Finder File Edit View Go Window Help (Charged) Fri 11:18 AM
examples
DEVICES
Macintosh HD
iDisk
SHARED
Cecilia Flori's MacBoo...
PLACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
SEARCH FOR
Today
Yesterday
WZt.log
Name
Date Modified
Size
top.lhco
2008-07-30 2:16 PM
3 ME
top.log
2008-07-30 2:16 PM
1.2 ME
WZt.card
2008-07-30 1:55 PM
4 KE
WZt.lhco
2008-07-30 10:05 AM
12.7 ME
WZt.log
2008-07-30 10:05 AM
1 ME
1 of 10 selected, 298.47 GB available
All Movies
All Documents
1 MB
ChameleonSLACDa...ngeComparison.nb
Mathe...ebook
Today, 7:11 A
AN-10-391_temp.pdf
Portab... (PDF)
April 5, 2011
sdarticle(4).pdf
Portab... (PDF)
January 25, 20

Console File Edit View Window Help (Charged) Fri 11:18 AM

WZt.log

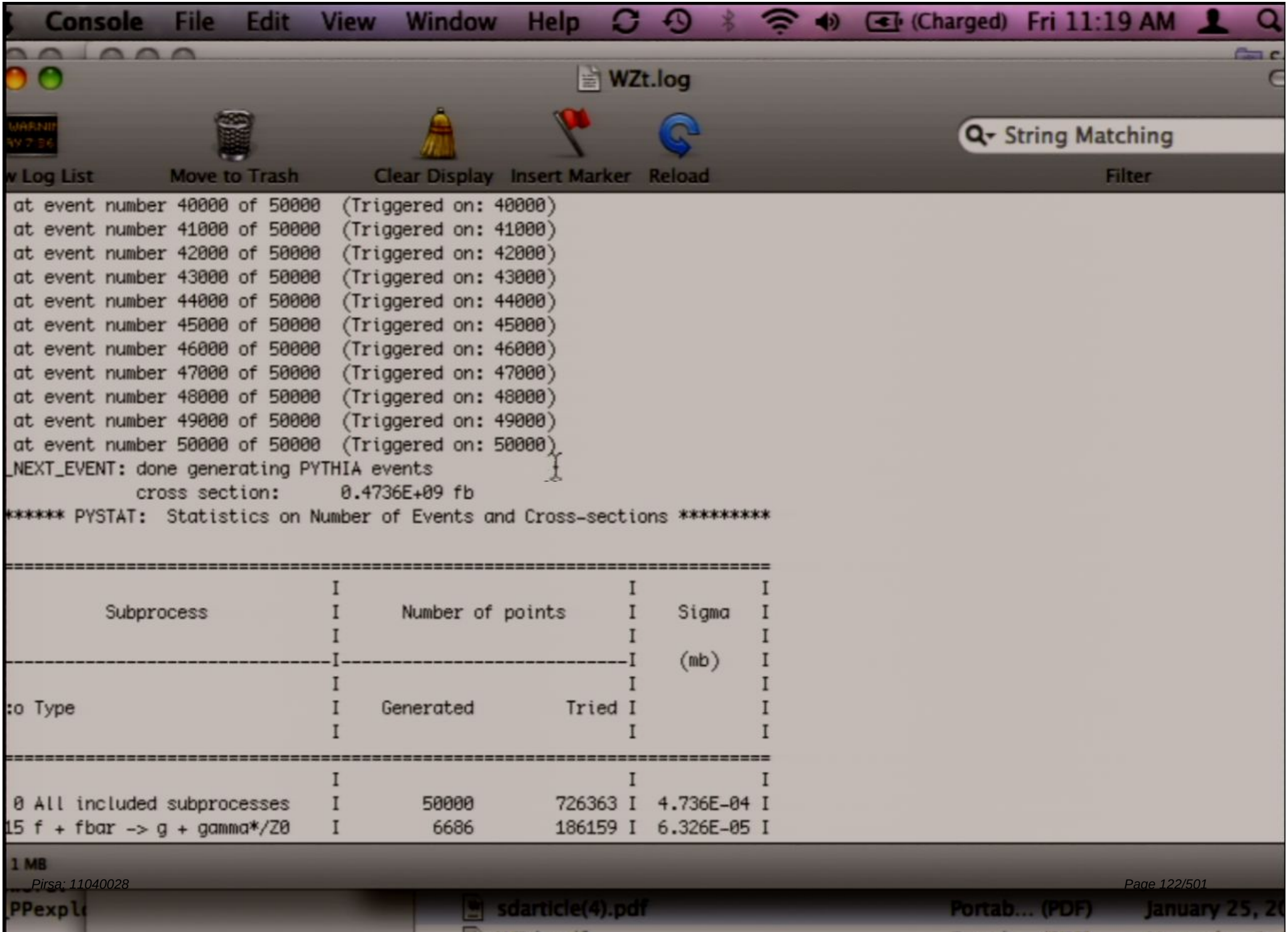
w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==============================================================================
                                 I                              I            I
           Subprocess            I      Number of points        I   Sigma    I
                                 I                              I            I
---------------------------------I------------------------------I   (mb)     I
                                 I                              I            I
:o Type                          I    Generated          Tried  I            I
                                 I                              I            I
==============================================================================
                                 I                              I            I
 0 All included subprocesses     I        50000         726363  I 4.736E-04  I
15 f + fbar -> g + gamma*/Z0     I         6686         186159  I 6.326E-05  I
16 f + fbar' -> g + W+/-         I        20374         280466  I 1.928E-04  I
30 f + g -> f + gamma*/Z0        I         5942          98013  I 5.669E-05  I
31 f + g -> f' + W+/-            I        16956         161043  I 1.604E-04  I
81 q + qbar -> Q + Qbar, mass    I            7             93  I 6.699E-08  I
82 g + g -> Q + Qbar, massive    I           35            589  I 3.364E-07  I
                                 I                              I            I
==============================================================================

****** Total number of errors, excluding junctions =        0 *************
****** Total number of errors, including junctions =        0 *************
****** Total number of warnings =                           0 *************
****** Fraction of events that fail fragmentation cuts =  0.00112 *********
```

1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 40000 of 50000 (Triggered on: 40000)
at event number 41000 of 50000 (Triggered on: 41000)
at event number 42000 of 50000 (Triggered on: 42000)
at event number 43000 of 50000 (Triggered on: 43000)
at event number 44000 of 50000 (Triggered on: 44000)
at event number 45000 of 50000 (Triggered on: 45000)
at event number 46000 of 50000 (Triggered on: 46000)
at event number 47000 of 50000 (Triggered on: 47000)
at event number 48000 of 50000 (Triggered on: 48000)
at event number 49000 of 50000 (Triggered on: 49000)
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
1 MB
PPexpl
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Console File Edit View Window Help (Charged) Fri 11:19 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 48000 of 50000  (Triggered on: 48000)
 at event number 49000 of 50000  (Triggered on: 49000)
 at event number 50000 of 50000  (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
            cross section:     0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********

==========================================================================
                            I                            I          I
          Subprocess        I      Number of points      I   Sigma  I
                            I                            I          I
----------------------------I----------------------------I   (mb)   I
                            I                            I          I
:o Type                     I   Generated          Tried I          I
                            I                            I          I
==========================================================================
                            I                            I          I
 0 All included subprocesses I      50000        726363 I 4.736E-04 I
15 f + fbar -> g + gamma*/Z0 I       6686        186159 I 6.326E-05 I
16 f + fbar' -> g + W+/-     I      20374        280466 I 1.928E-04 I
30 f + g -> f + gamma*/Z0    I       5942         98013 I 5.669E-05 I
31 f + g -> f' + W+/-        I      16956        161043 I 1.604E-04 I
81 q + qbar -> Q + Qbar, mass I          7            93 I 6.699E-08 I
82 g + g -> Q + Qbar, massive I         35           589 I 3.364E-07 I
                            I                            I          I
==========================================================================
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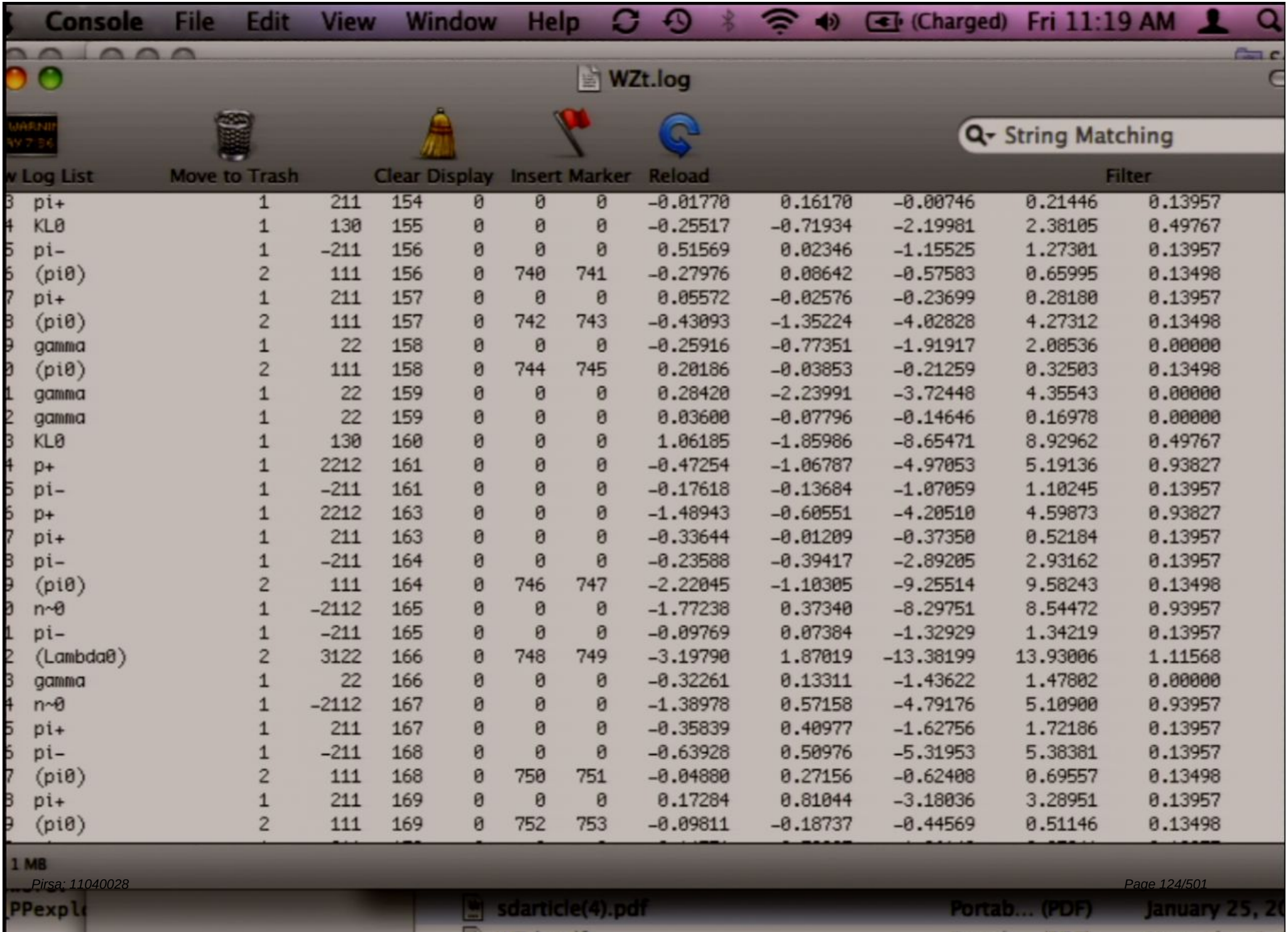
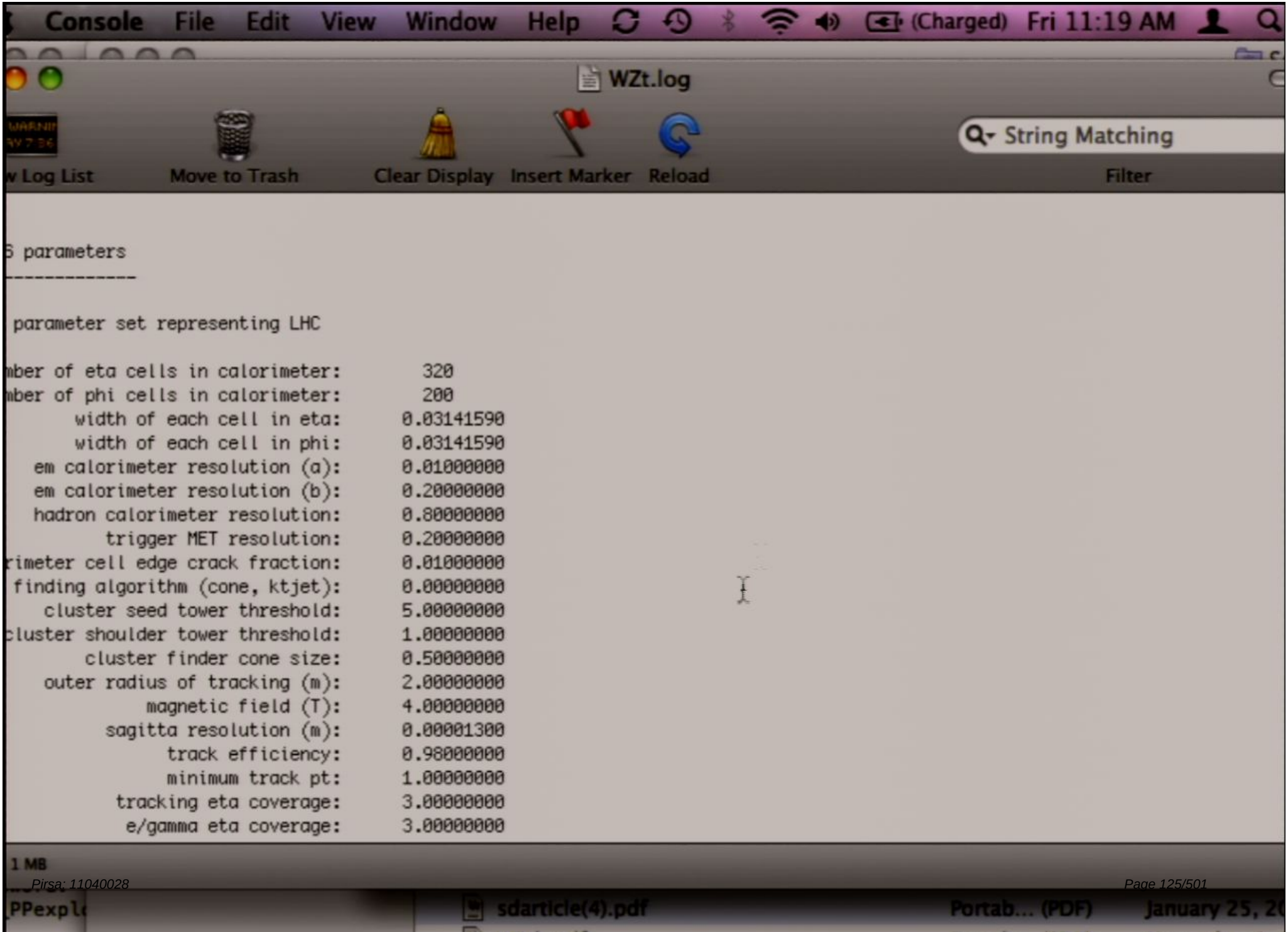
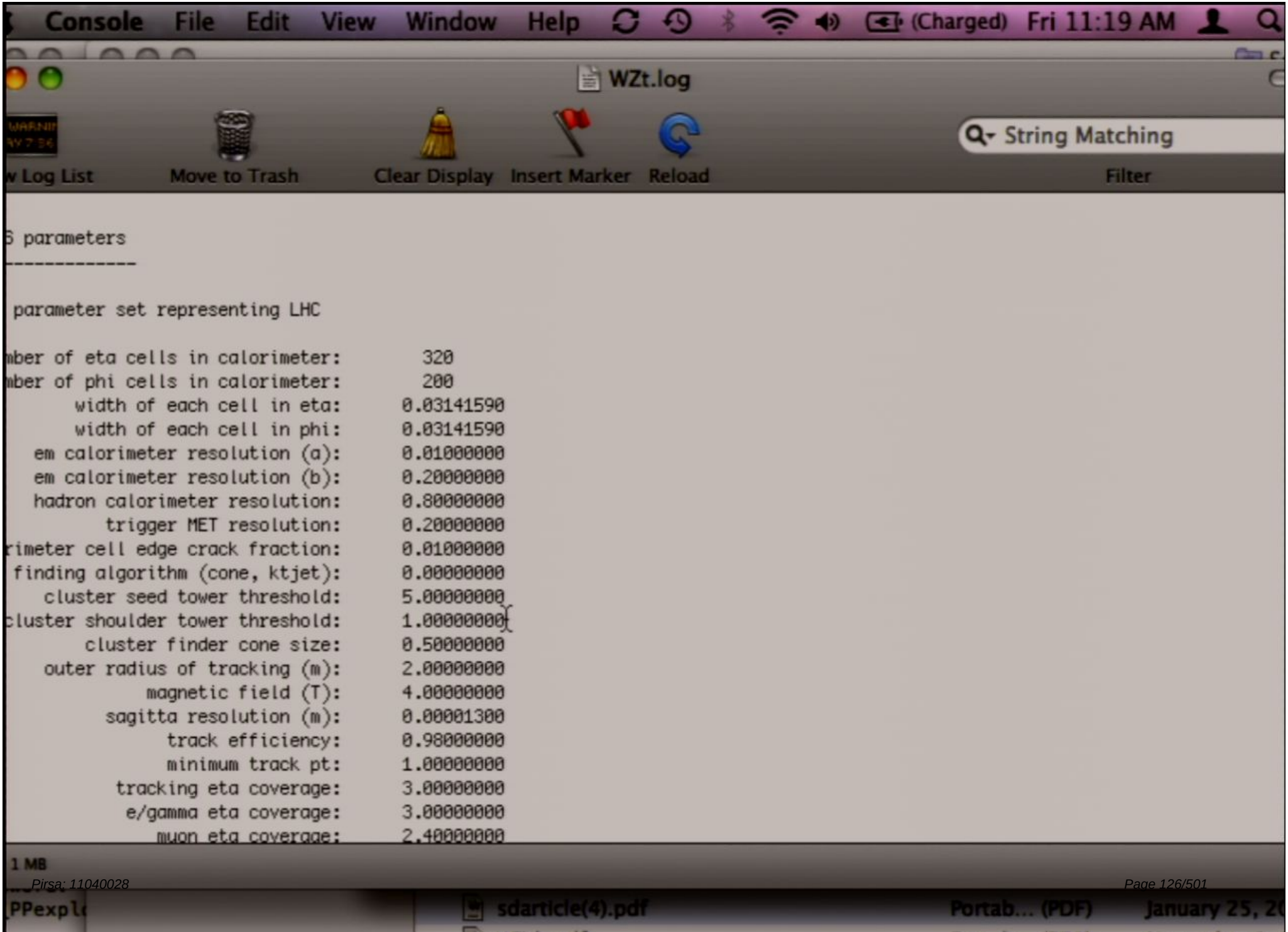
1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
3 pi+ 1 211 154 0 0 0 -0.01770 0.16170 -0.00746 0.21446 0.13957
4 KL0 1 130 155 0 0 0 -0.25517 -0.71934 -2.19981 2.38105 0.49767
5 pi- 1 -211 156 0 0 0 0.51569 0.02346 -1.15525 1.27301 0.13957
6 (pi0) 2 111 156 0 740 741 -0.27976 0.08642 -0.57583 0.65995 0.13498
7 pi+ 1 211 157 0 0 0 0.05572 -0.02576 -0.23699 0.28180 0.13957
8 (pi0) 2 111 157 0 742 743 -0.43093 -1.35224 -4.02828 4.27312 0.13498
9 gamma 1 22 158 0 0 0 -0.25916 -0.77351 -1.91917 2.08536 0.00000
0 (pi0) 2 111 158 0 744 745 0.20186 -0.03853 -0.21259 0.32503 0.13498
1 gamma 1 22 159 0 0 0 0.28420 -2.23991 -3.72448 4.35543 0.00000
2 gamma 1 22 159 0 0 0 0.03600 -0.07796 -0.14646 0.16978 0.00000
3 KL0 1 130 160 0 0 0 1.06185 -1.85986 -8.65471 8.92962 0.49767
4 p+ 1 2212 161 0 0 0 -0.47254 -1.06787 -4.97053 5.19136 0.93827
5 pi- 1 -211 161 0 0 0 -0.17618 -0.13684 -1.07059 1.10245 0.13957
6 p+ 1 2212 163 0 0 0 -1.48943 -0.60551 -4.20510 4.59873 0.93827
7 pi+ 1 211 163 0 0 0 -0.33644 -0.01209 -0.37350 0.52184 0.13957
8 pi- 1 -211 164 0 0 0 -0.23588 -0.39417 -2.89205 2.93162 0.13957
9 (pi0) 2 111 164 0 746 747 -2.22045 -1.10305 -9.25514 9.58243 0.13498
0 n~0 1 -2112 165 0 0 0 -1.77238 0.37340 -8.29751 8.54472 0.93957
1 pi- 1 -211 165 0 0 0 -0.09769 0.07384 -1.32929 1.34219 0.13957
2 (Lambda0) 2 3122 166 0 748 749 -3.19790 1.87019 -13.38199 13.93006 1.11568
3 gamma 1 22 166 0 0 0 -0.32261 0.13311 -1.43622 1.47802 0.00000
4 n~0 1 -2112 167 0 0 0 -1.38978 0.57158 -4.79176 5.10900 0.93957
5 pi+ 1 211 167 0 0 0 -0.35839 0.40977 -1.62756 1.72186 0.13957
6 pi- 1 -211 168 0 0 0 -0.63928 0.50976 -5.31953 5.38381 0.13957
7 (pi0) 2 111 168 0 750 751 -0.04880 0.27156 -0.62408 0.69557 0.13498
8 pi+ 1 211 169 0 0 0 0.17284 0.81044 -3.18036 3.28951 0.13957
9 (pi0) 2 111 169 0 752 753 -0.09811 -0.18737 -0.44569 0.51146 0.13498
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
6 parameters
parameter set representing LHC
mber of eta cells in calorimeter: 320
mber of phi cells in calorimeter: 200
width of each cell in eta: 0.03141590
width of each cell in phi: 0.03141590
em calorimeter resolution (a): 0.01000000
em calorimeter resolution (b): 0.20000000
hadron calorimeter resolution: 0.80000000
trigger MET resolution: 0.20000000
rimeter cell edge crack fraction: 0.01000000
finding algorithm (cone, ktjet): 0.00000000
cluster seed tower threshold: 5.00000000
cluster shoulder tower threshold: 1.00000000
cluster finder cone size: 0.50000000
outer radius of tracking (m): 2.00000000
magnetic field (T): 4.00000000
sagitta resolution (m): 0.00001300
track efficiency: 0.98000000
minimum track pt: 1.00000000
tracking eta coverage: 3.00000000
e/gamma eta coverage: 3.00000000
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
6 parameters
parameter set representing LHC
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width of each cell in phi: 0.03141590
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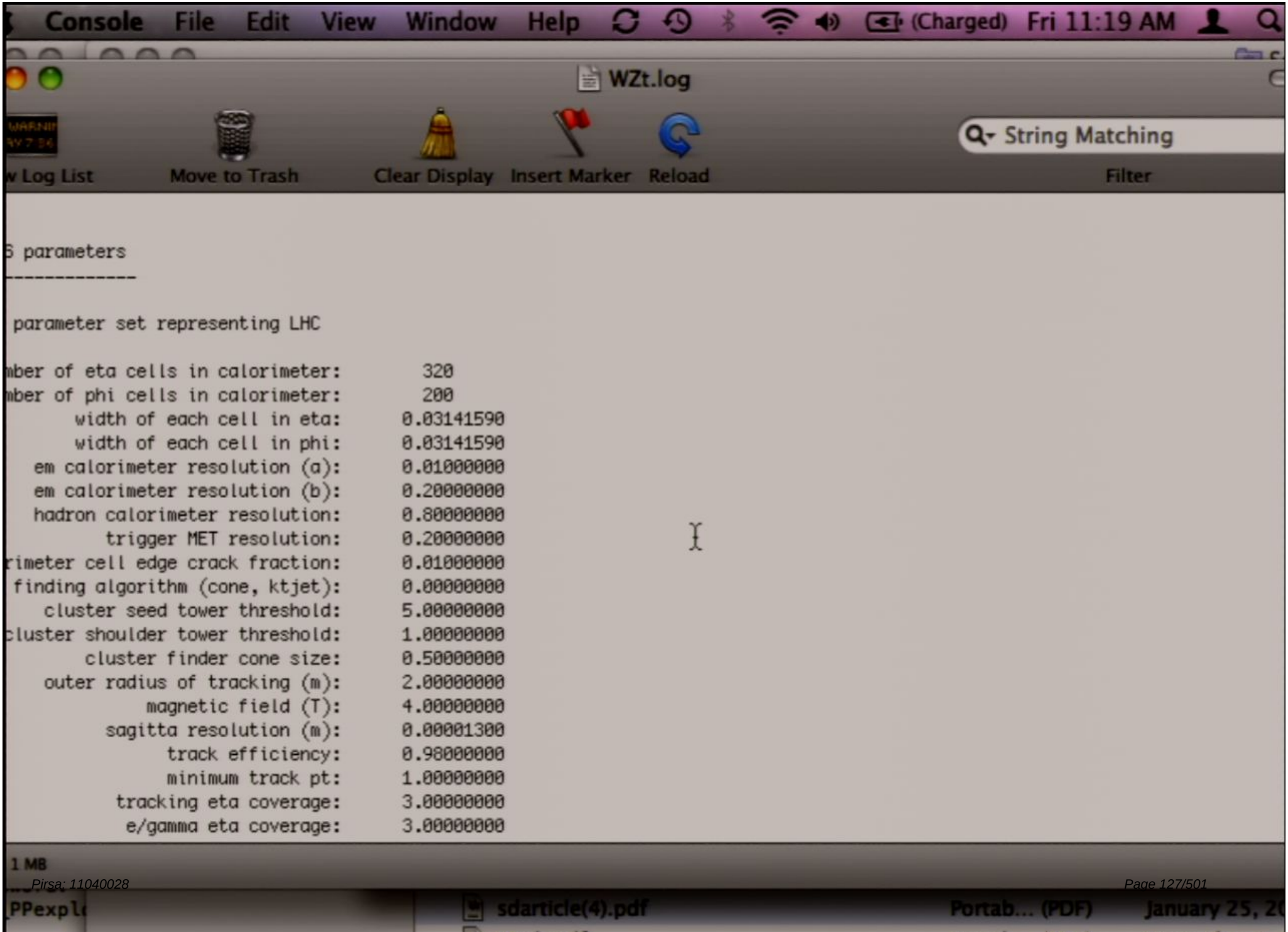
em calorimeter resolution (b): 0.20000000
hadron calorimeter resolution: 0.80000000
trigger MET resolution: 0.20000000
rimeter cell edge crack fraction: 0.01000000
finding algorithm (cone, ktjet): 0.00000000
cluster seed tower threshold: 5.00000000
cluster shoulder tower threshold: 1.00000000
cluster finder cone size: 0.50000000
outer radius of tracking (m): 2.00000000
magnetic field (T): 4.00000000
sagitta resolution (m): 0.00001300
track efficiency: 0.98000000
minimum track pt: 1.00000000
tracking eta coverage: 3.00000000
e/gamma eta coverage: 3.00000000
muon eta coverage: 2.40000000
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
6 parameters
parameter set representing LHC
mber of eta cells in calorimeter: 320
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width of each cell in eta: 0.03141590
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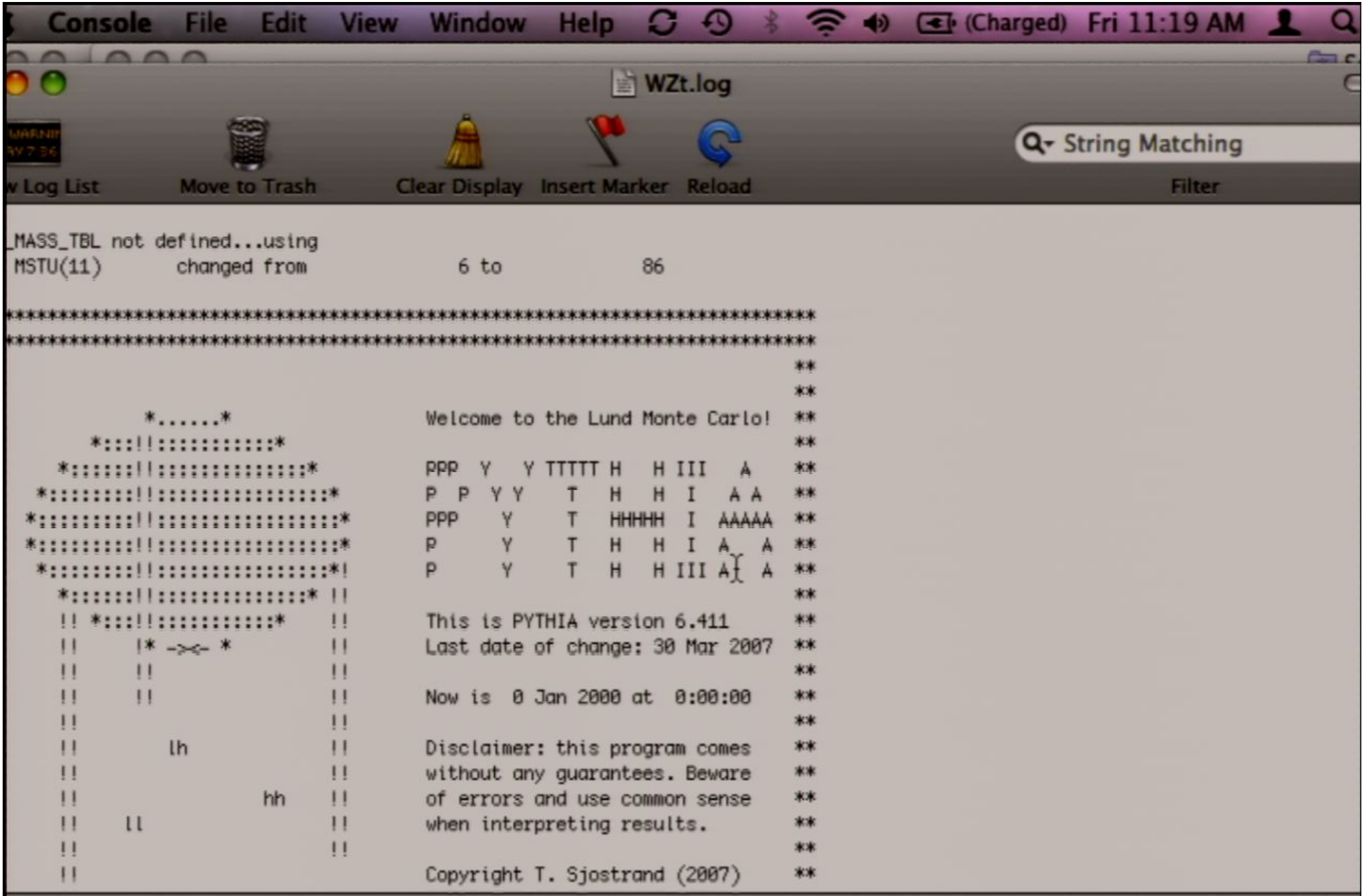
em calorimeter resolution (a): 0.01000000
em calorimeter resolution (b): 0.20000000
hadron calorimeter resolution: 0.80000000
trigger MET resolution: 0.20000000
rimeter cell edge crack fraction: 0.01000000
finding algorithm (cone, ktjet): 0.00000000
cluster seed tower threshold: 5.00000000
cluster shoulder tower threshold: 1.00000000
cluster finder cone size: 0.50000000
outer radius of tracking (m): 2.00000000
magnetic field (T): 4.00000000
sagitta resolution (m): 0.00001300
track efficiency: 0.98000000
minimum track pt: 1.00000000
tracking eta coverage: 3.00000000
e/gamma eta coverage: 3.00000000
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
_MASS_TBL not defined...using
MSTU(11) changed from 6 to 86
Welcome to the Lund Monte Carlo!
PPP Y Y TTTTT H H III A
P P Y Y T H H I A A
PPP Y T HHHHH I AAAAA
P Y T H H I A A
P Y T H H III A A
This is PYTHIA version 6.411
Last date of change: 30 Mar 2007
Now is 0 Jan 2000 at 0:00:00
Disclaimer: this program comes
without any guarantees. Beware
of errors and use common sense
when interpreting results.
Copyright T. Sjostrand (2007)
1 MB

Console File Edit View Window Help (Charged) Fri 11:19 AM

WZt.log

Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

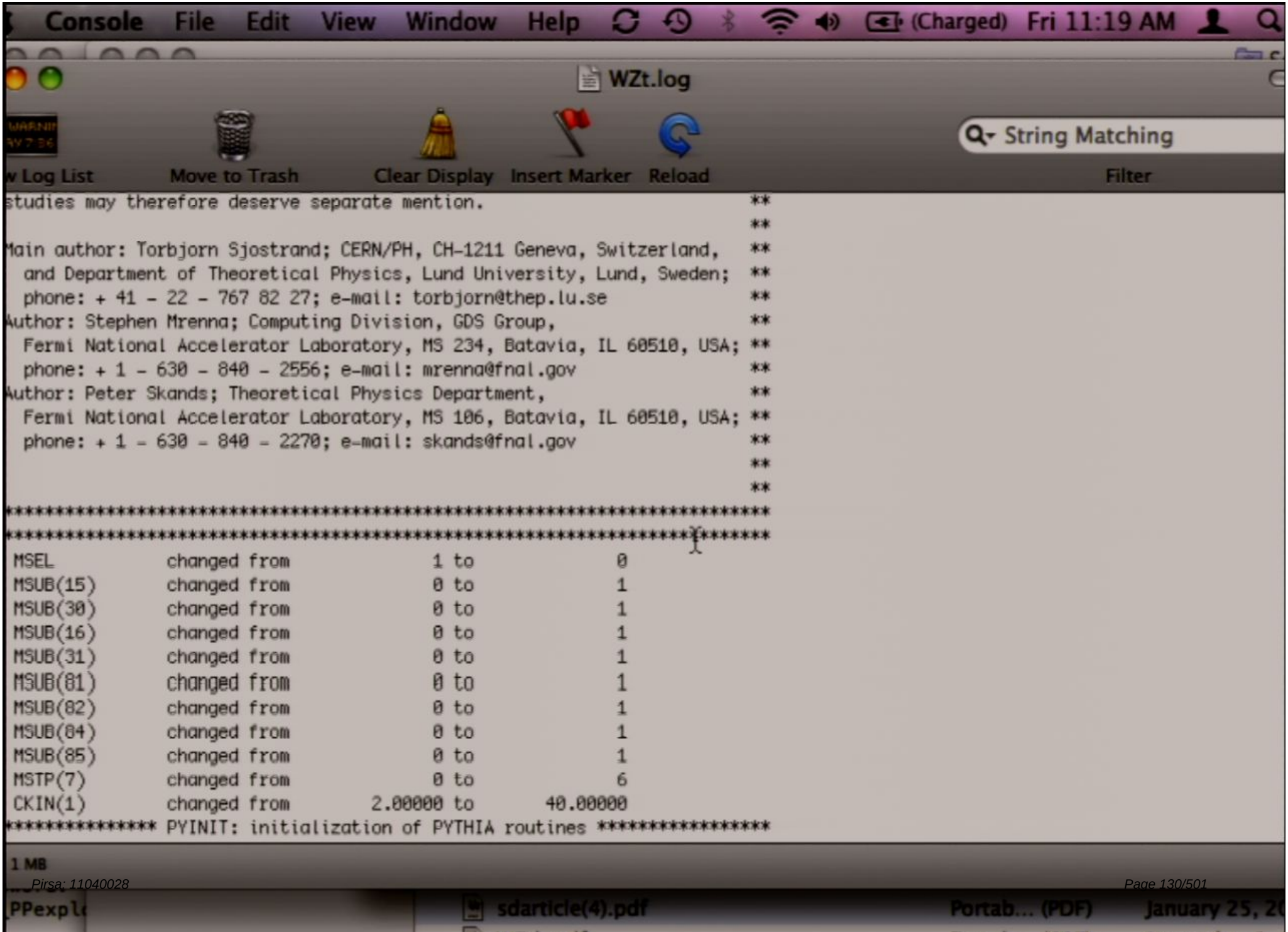
```
    ***********************************************************

_MASS_TBL not defined...using
 MSTU(11)       changed from              6 to              86

******************************************************************************
******************************************************************************
                                                                            **
                                                                            **
              *......*                  Welcome to the Lund Monte Carlo!    **
         *:::!!:::::::::::*                                                 **
      *::::::!!::::::::::::::*          PPP  Y   Y TTTTT H   H III   A      **
    *::::::::!!::::::::::::::::*        P  P  Y Y    T   H   H  I   A A     **
   *:::::::::!!:::::::::::::::::*       PPP    Y     T   HHHHH  I  AAAAA    **
   *:::::::::!!:::::::::::::::::*       P      Y     T   H   H  I  A   A    **
    *::::::::!!::::::::::::::::*!       P      Y     T   H   H III A   A    **
      *::::::!!::::::::::::::* !!                                           **
      !! *:::!!:::::::::::*    !!       This is PYTHIA version 6.411        **
      !!     !* -><- *         !!       Last date of change: 30 Mar 2007    **
      !!     !!                !!                                           **
      !!     !!                !!       Now is  0 Jan 2000 at  0:00:00      **
      !!                       !!                                           **
      !!        lh             !!       Disclaimer: this program comes      **
      !!                       !!       without any guarantees. Beware      **
      !!                 hh    !!       of errors and use common sense      **
      !!    ll                 !!       when interpreting results.          **
```

1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
studies may therefore deserve separate mention. **
**
Main author: Torbjorn Sjostrand; CERN/PH, CH-1211 Geneva, Switzerland, **
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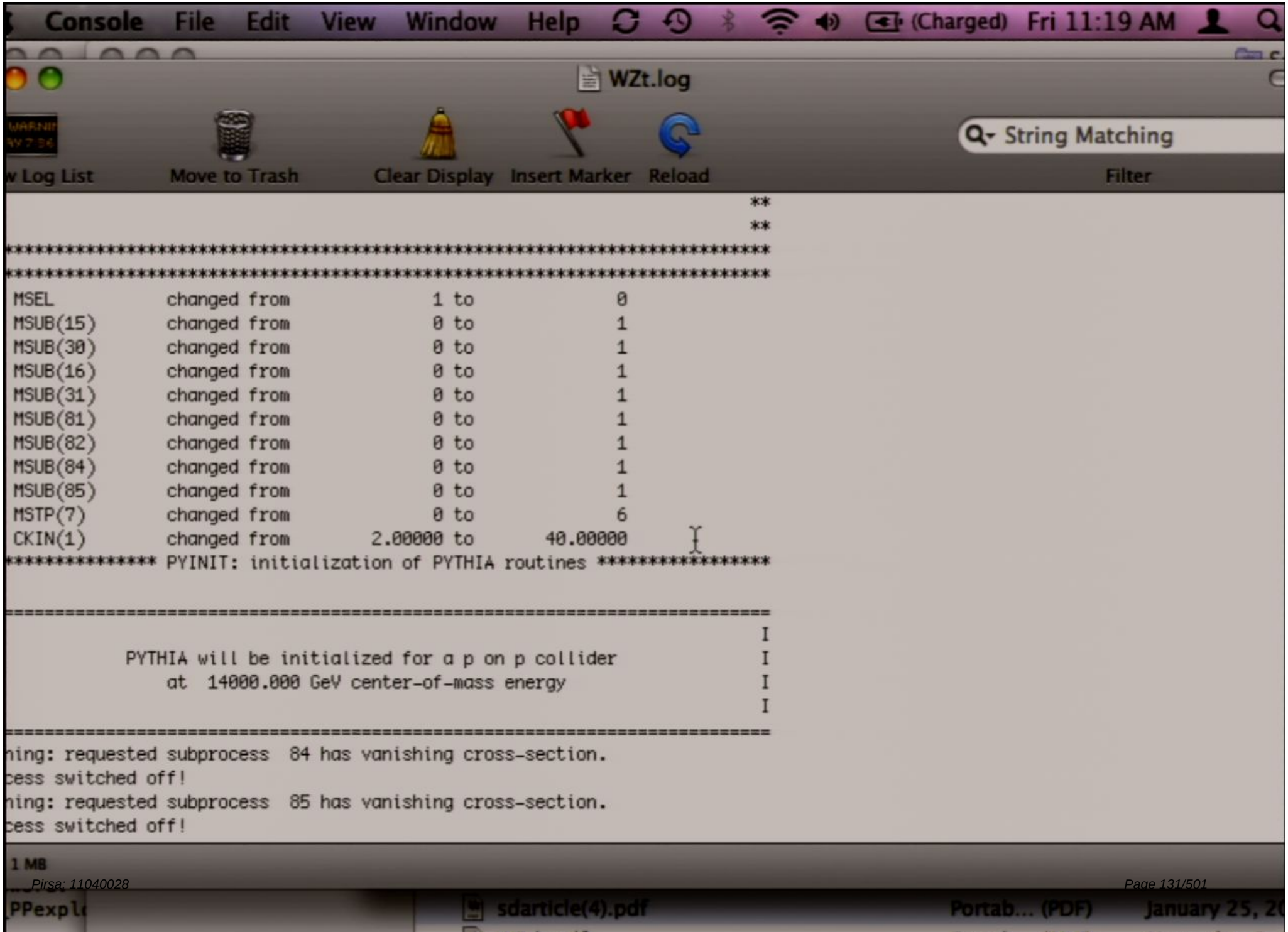
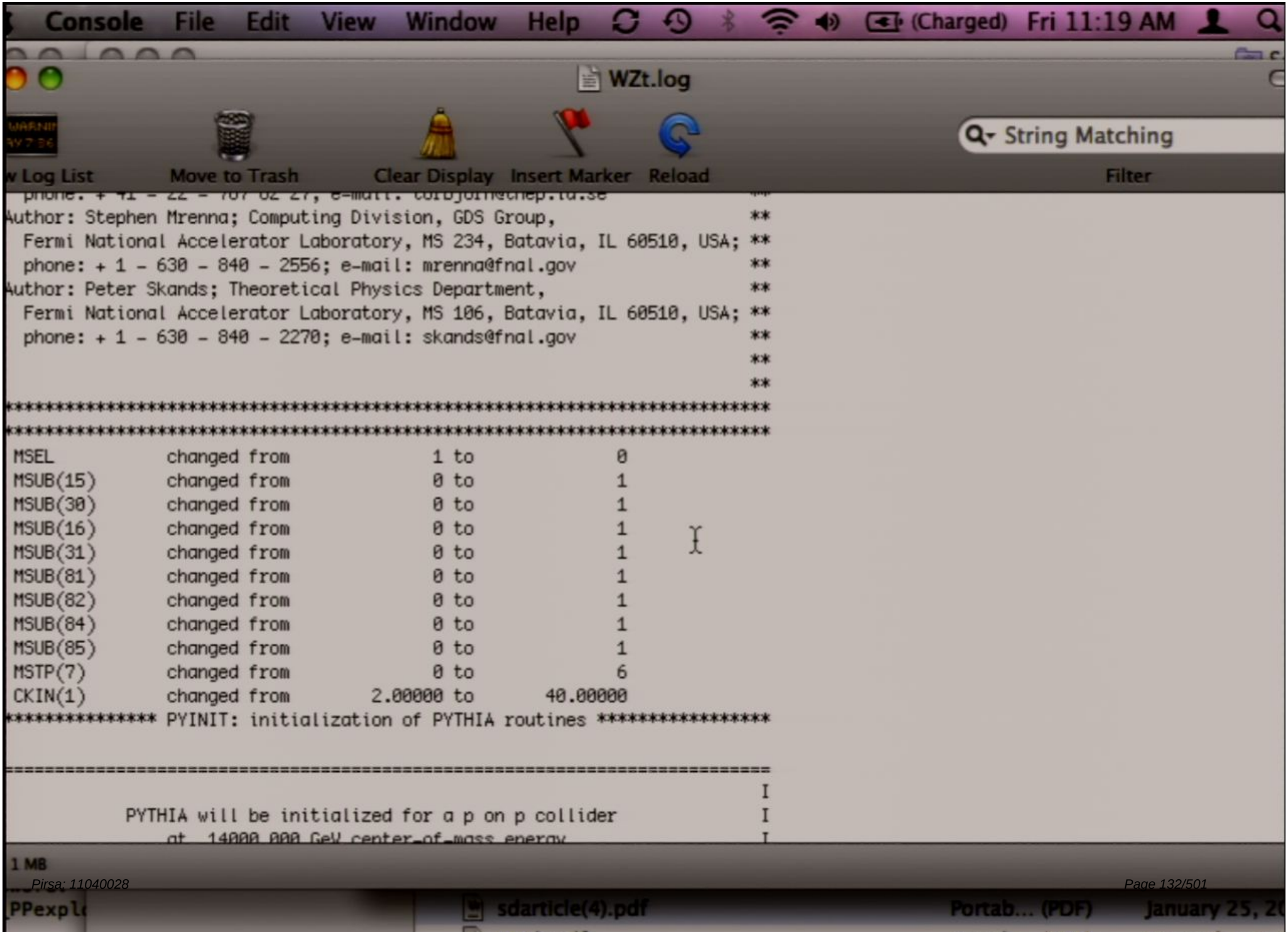
phone: + 41 - 22 - 767 82 27; e-mail: torbjorn@thep.lu.se **
Author: Stephen Mrenna; Computing Division, GDS Group, **
Fermi National Accelerator Laboratory, MS 234, Batavia, IL 60510, USA; **
phone: + 1 - 630 - 840 - 2556; e-mail: mrenna@fnal.gov **
Author: Peter Skands; Theoretical Physics Department, **
Fermi National Accelerator Laboratory, MS 106, Batavia, IL 60510, USA; **
phone: + 1 - 630 - 840 - 2270; e-mail: skands@fnal.gov **
**
**
MSEL changed from 1 to 0
MSUB(15) changed from 0 to 1
MSUB(30) changed from 0 to 1
MSUB(16) changed from 0 to 1
MSUB(31) changed from 0 to 1
MSUB(81) changed from 0 to 1
MSUB(82) changed from 0 to 1
MSUB(84) changed from 0 to 1
MSUB(85) changed from 0 to 1
MSTP(7) changed from 0 to 6
CKIN(1) changed from 2.00000 to 40.00000
PYINIT: initialization of PYTHIA routines
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:19 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
**
**
MSEL changed from 1 to 0
MSUB(15) changed from 0 to 1
MSUB(30) changed from 0 to 1
MSUB(16) changed from 0 to 1
MSUB(31) changed from 0 to 1
MSUB(81) changed from 0 to 1
MSUB(82) changed from 0 to 1
MSUB(84) changed from 0 to 1
MSUB(85) changed from 0 to 1
MSTP(7) changed from 0 to 6
CKIN(1) changed from 2.00000 to 40.00000
********** PYINIT: initialization of PYTHIA routines **********
PYTHIA will be initialized for a p on p collider
at 14000.000 GeV center-of-mass energy
ning: requested subprocess 84 has vanishing cross-section.
cess switched off!
ning: requested subprocess 85 has vanishing cross-section.
cess switched off!
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2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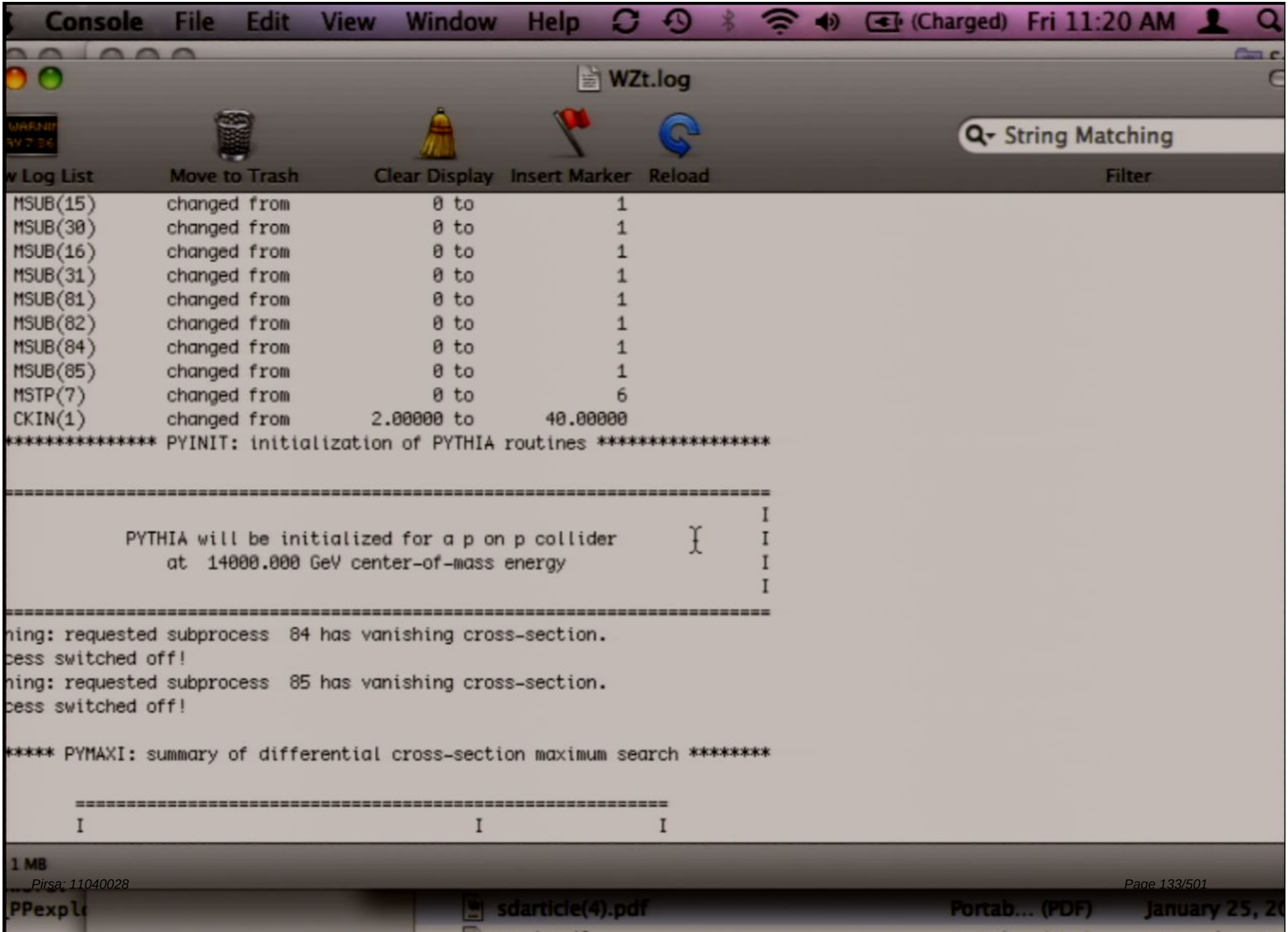
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
Author: Stephen Mrenna; Computing Division, GDS Group,
Fermi National Accelerator Laboratory, MS 234, Batavia, IL 60510, USA;
phone: + 1 - 630 - 840 - 2556; e-mail: mrenna@fnal.gov
Author: Peter Skands; Theoretical Physics Department,
Fermi National Accelerator Laboratory, MS 106, Batavia, IL 60510, USA;
phone: + 1 - 630 - 840 - 2270; e-mail: skands@fnal.gov
MSEL changed from 1 to 0
MSUB(15) changed from 0 to 1
MSUB(30) changed from 0 to 1
MSUB(16) changed from 0 to 1
MSUB(31) changed from 0 to 1
MSUB(81) changed from 0 to 1
MSUB(82) changed from 0 to 1
MSUB(84) changed from 0 to 1
MSUB(85) changed from 0 to 1
MSTP(7) changed from 0 to 6
CKIN(1) changed from 2.00000 to 40.00000
PYINIT: initialization of PYTHIA routines
PYTHIA will be initialized for a p on p collider
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2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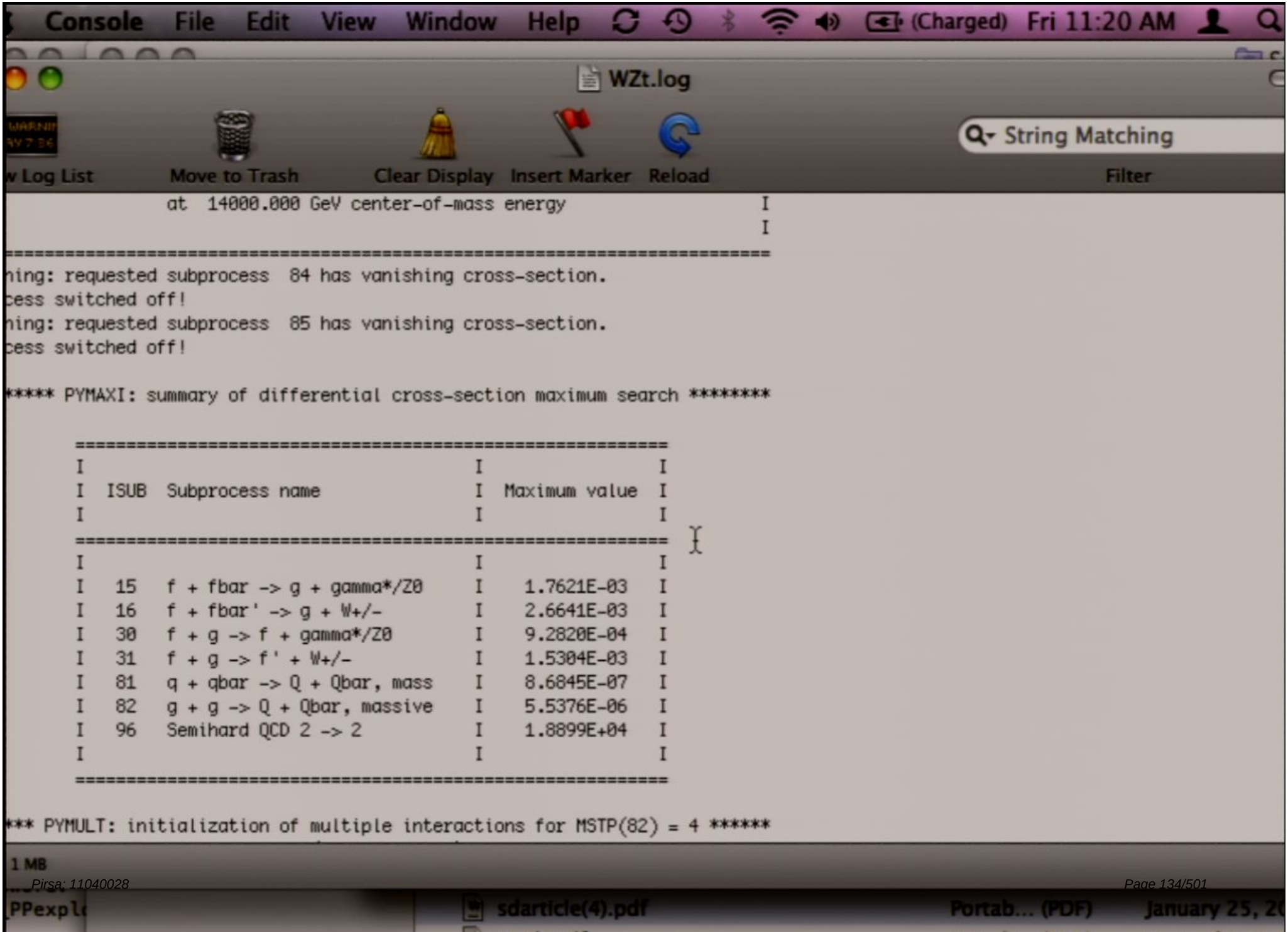
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
MSUB(15) changed from 0 to 1
MSUB(30) changed from 0 to 1
MSUB(16) changed from 0 to 1
MSUB(31) changed from 0 to 1
MSUB(81) changed from 0 to 1
MSUB(82) changed from 0 to 1
MSUB(84) changed from 0 to 1
MSUB(85) changed from 0 to 1
MSTP(7) changed from 0 to 6
CKIN(1) changed from 2.00000 to 40.00000
********** PYINIT: initialization of PYTHIA routines **********
PYTHIA will be initialized for a p on p collider
at 14000.000 GeV center-of-mass energy
ning: requested subprocess 84 has vanishing cross-section.
cess switched off!
ning: requested subprocess 85 has vanishing cross-section.
cess switched off!
***** PYMAXI: summary of differential cross-section maximum search *******
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 20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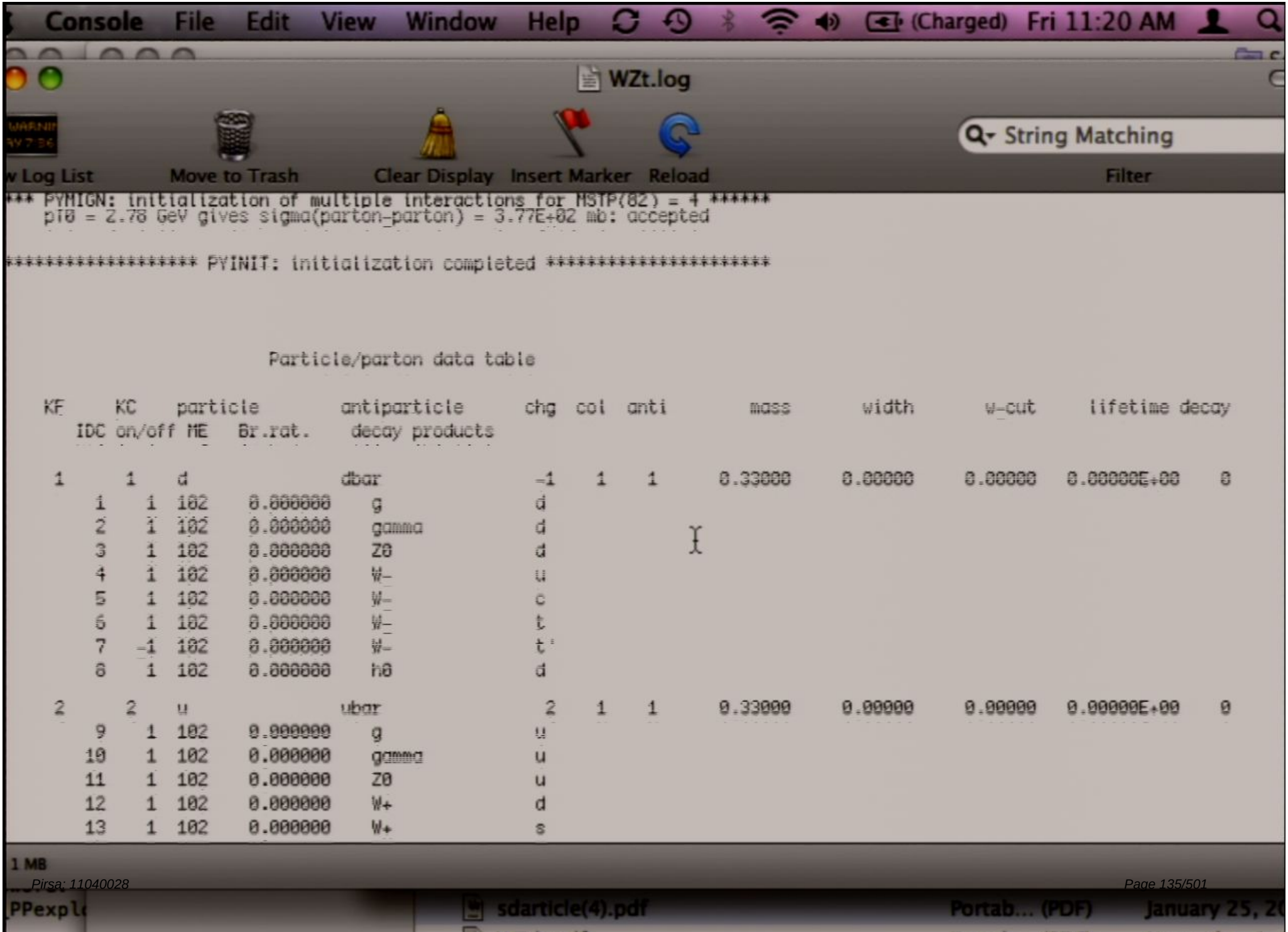
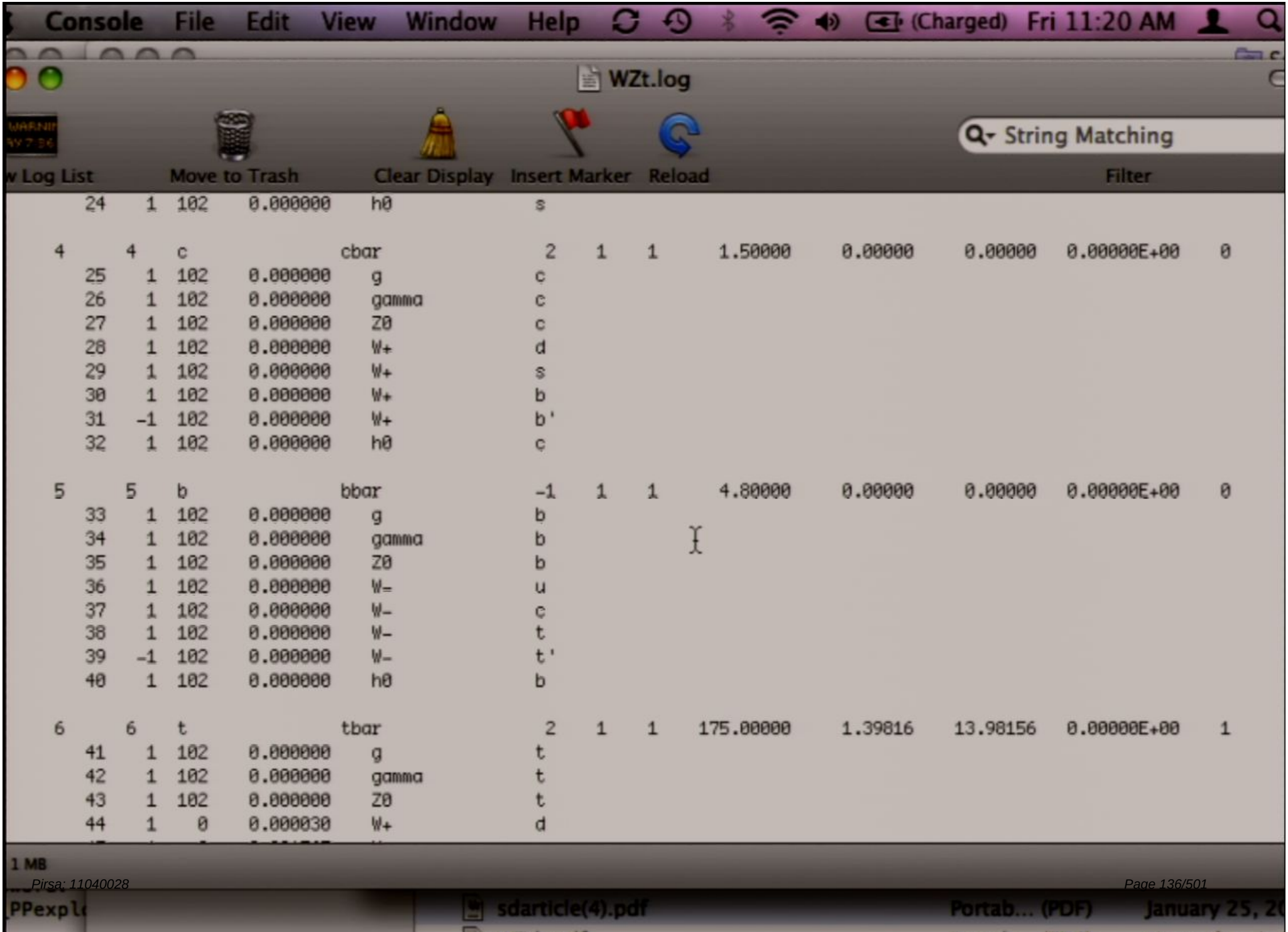
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at 14000.000 GeV center-of-mass energy
ning: requested subprocess 84 has vanishing cross-section.
cess switched off!
ning: requested subprocess 85 has vanishing cross-section.
cess switched off!
***** PYMAXI: summary of differential cross-section maximum search *******
ISUB Subprocess name Maximum value
15 f + fbar -> g + gamma*/Z0 1.7621E-03
16 f + fbar' -> g + W+/- 2.6641E-03
30 f + g -> f + gamma*/Z0 9.2820E-04
31 f + g -> f' + W+/- 1.5304E-03
81 q + qbar -> Q + Qbar, mass 8.6845E-07
82 g + g -> Q + Qbar, massive 5.5376E-06
96 Semihard QCD 2 -> 2 1.8899E+04
*** PYMULT: initialization of multiple interactions for MSTP(82) = 4 ******
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:20 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
*** PYMIGN: initialization of multiple interactions for MSTP(82) = 4 ******
pT0 = 2.78 GeV gives sigma(parton-parton) = 3.77E+02 mb: accepted
****** PYINIT: initialization completed ******
Particle/parton data table
KF KC particle antiparticle chg col anti mass width w-out lifetime decay
IDC on/off ME Br.rat. decay products
1 1 d dbar -1 1 1 0.33000 0.00000 0.00000 0.00000E+00 0
1 1 102 0.000000 g d
2 1 102 0.000000 gamma d
3 1 102 0.000000 Z0 d
4 1 102 0.000000 W- u
5 1 102 0.000000 W- c
6 1 102 0.000000 W- t
7 -1 102 0.000000 W- t'
8 1 102 0.000000 h0 d
2 2 u ubar 2 1 1 0.33000 0.00000 0.00000 0.00000E+00 0
9 1 102 0.000000 g u
10 1 102 0.000000 gamma u
11 1 102 0.000000 Z0 u
12 1 102 0.000000 W+ d
13 1 102 0.000000 W+ s
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2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Clear Display
Insert Marker
Reload
String Matching
Filter
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4 4 c cbar 2 1 1 1.50000 0.00000 0.00000 0.00000E+00 0
25 1 102 0.000000 g c
26 1 102 0.000000 gamma c
27 1 102 0.000000 Z0 c
28 1 102 0.000000 W+ d
29 1 102 0.000000 W+ s
30 1 102 0.000000 W+ b
31 -1 102 0.000000 W+ b'
32 1 102 0.000000 h0 c
5 5 b bbar -1 1 1 4.80000 0.00000 0.00000 0.00000E+00 0
33 1 102 0.000000 g b
34 1 102 0.000000 gamma b
35 1 102 0.000000 Z0 b
36 1 102 0.000000 W- u
37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
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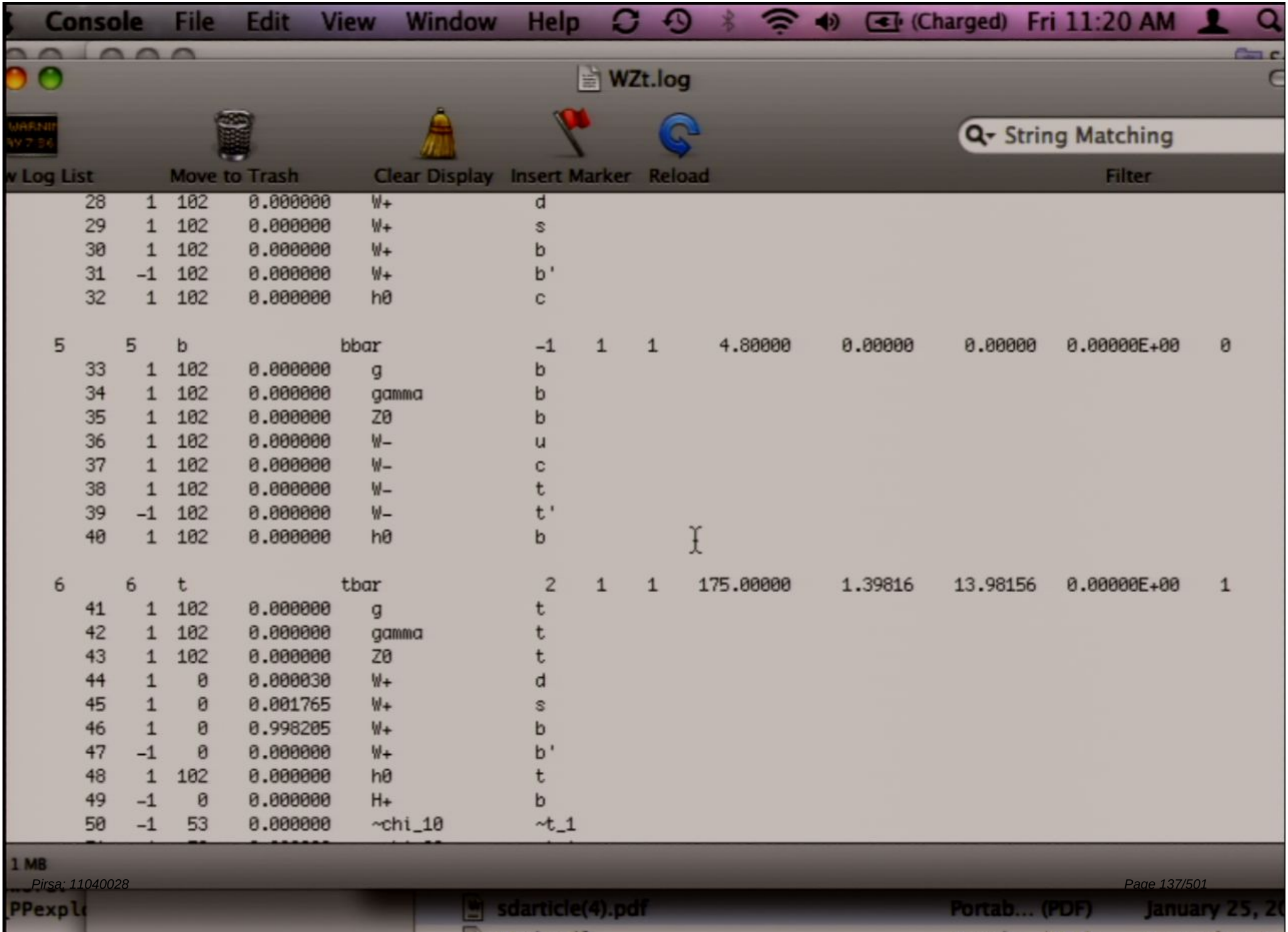
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:20 AM
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String Matching
w Log List
Move to Trash
Clear Display
Insert Marker
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Filter
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29 1 102 0.000000 W+ s
30 1 102 0.000000 W+ b
31 -1 102 0.000000 W+ b'
32 1 102 0.000000 h0 c
5 5 b bbar -1 1 1 4.80000 0.00000 0.00000 0.00000E+00 0
33 1 102 0.000000 g b
34 1 102 0.000000 gamma b
35 1 102 0.000000 Z0 b
36 1 102 0.000000 W- u
37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
44 1 0 0.000030 W+ d
45 1 0 0.001765 W+ s
46 1 0 0.998205 W+ b
47 -1 0 0.000000 W+ b'
48 1 102 0.000000 h0 t
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50 -1 53 0.000000 ~chi_10 ~t_1
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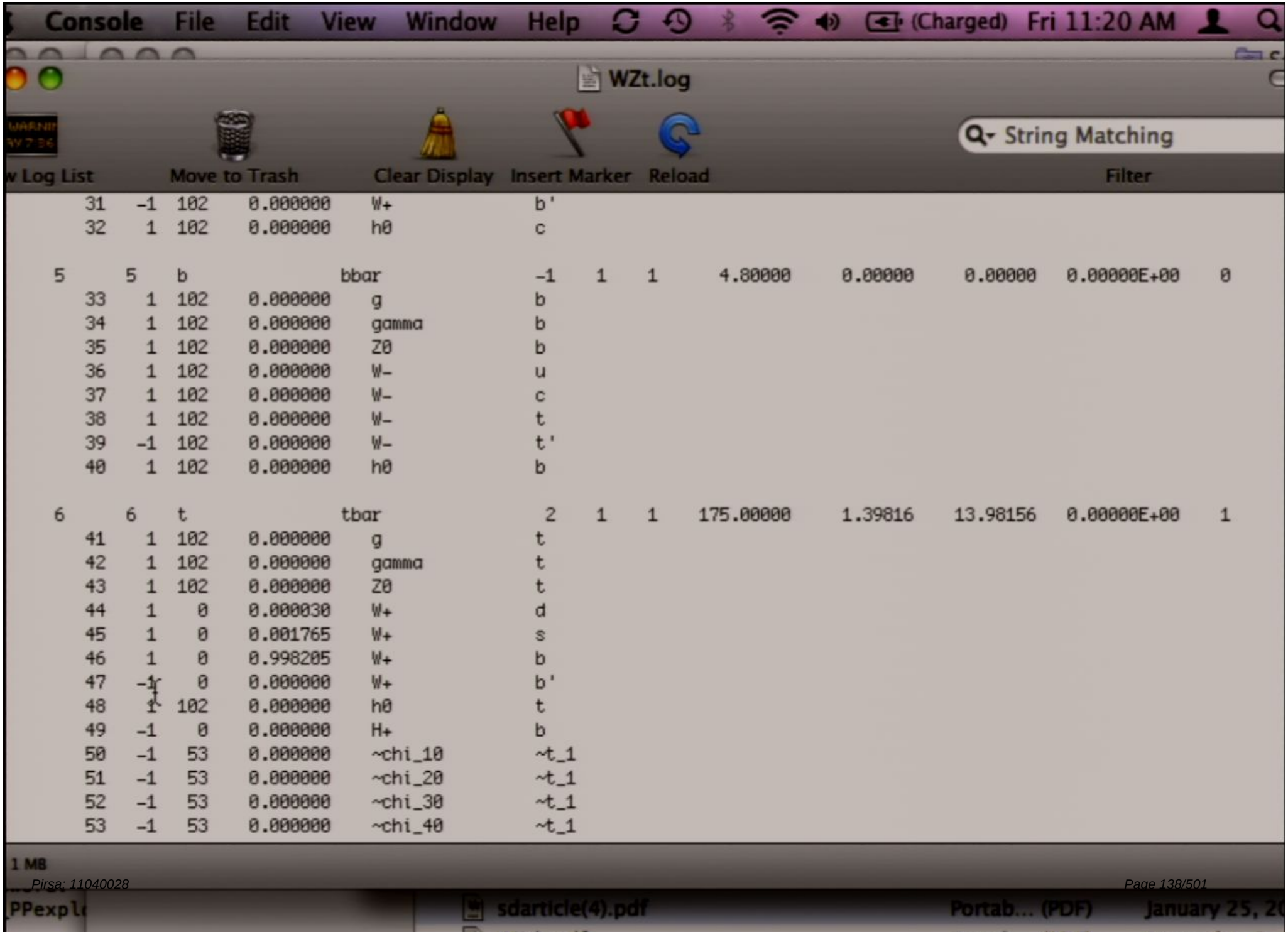
sdarticle(4).pdf
Portab... (PDF)
January 25, 2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Filter
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5 5 b bbar -1 1 1 4.80000 0.00000 0.00000 0.00000E+00 0
33 1 102 0.000000 g b
34 1 102 0.000000 gamma b
35 1 102 0.000000 Z0 b
36 1 102 0.000000 W- u
37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
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45 1 0 0.001765 W+ s
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47 -1 0 0.000000 W+ b'
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50 -1 53 0.000000 ~chi_10 ~t_1
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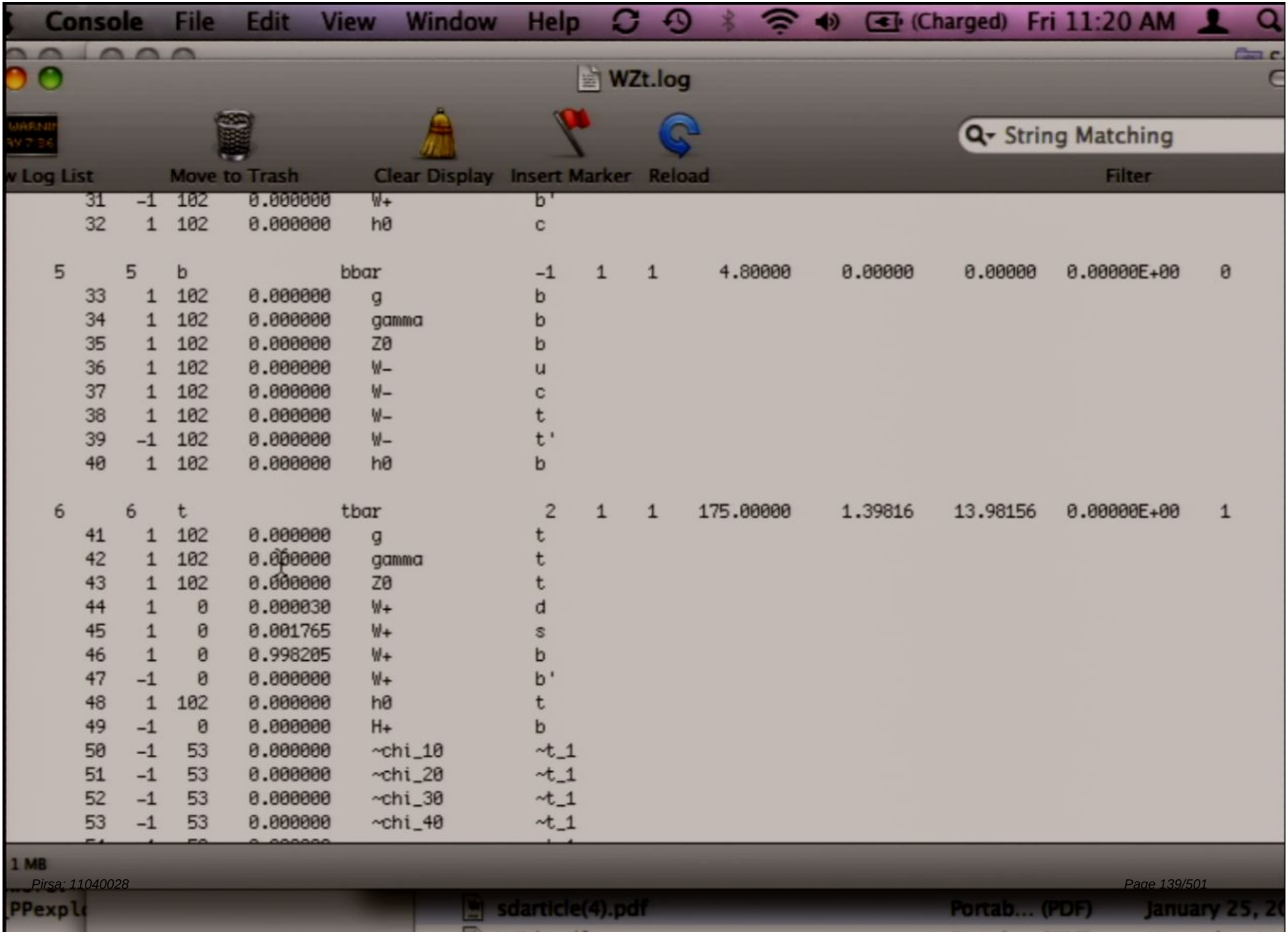
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:20 AM
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32 1 102 0.000000 h0 c
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33 1 102 0.000000 g b
34 1 102 0.000000 gamma b
35 1 102 0.000000 Z0 b
36 1 102 0.000000 W- u
37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
44 1 0 0.000030 W+ d
45 1 0 0.001765 W+ s
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48 1 102 0.000000 h0 t
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50 -1 53 0.000000 ~chi_10 ~t_1
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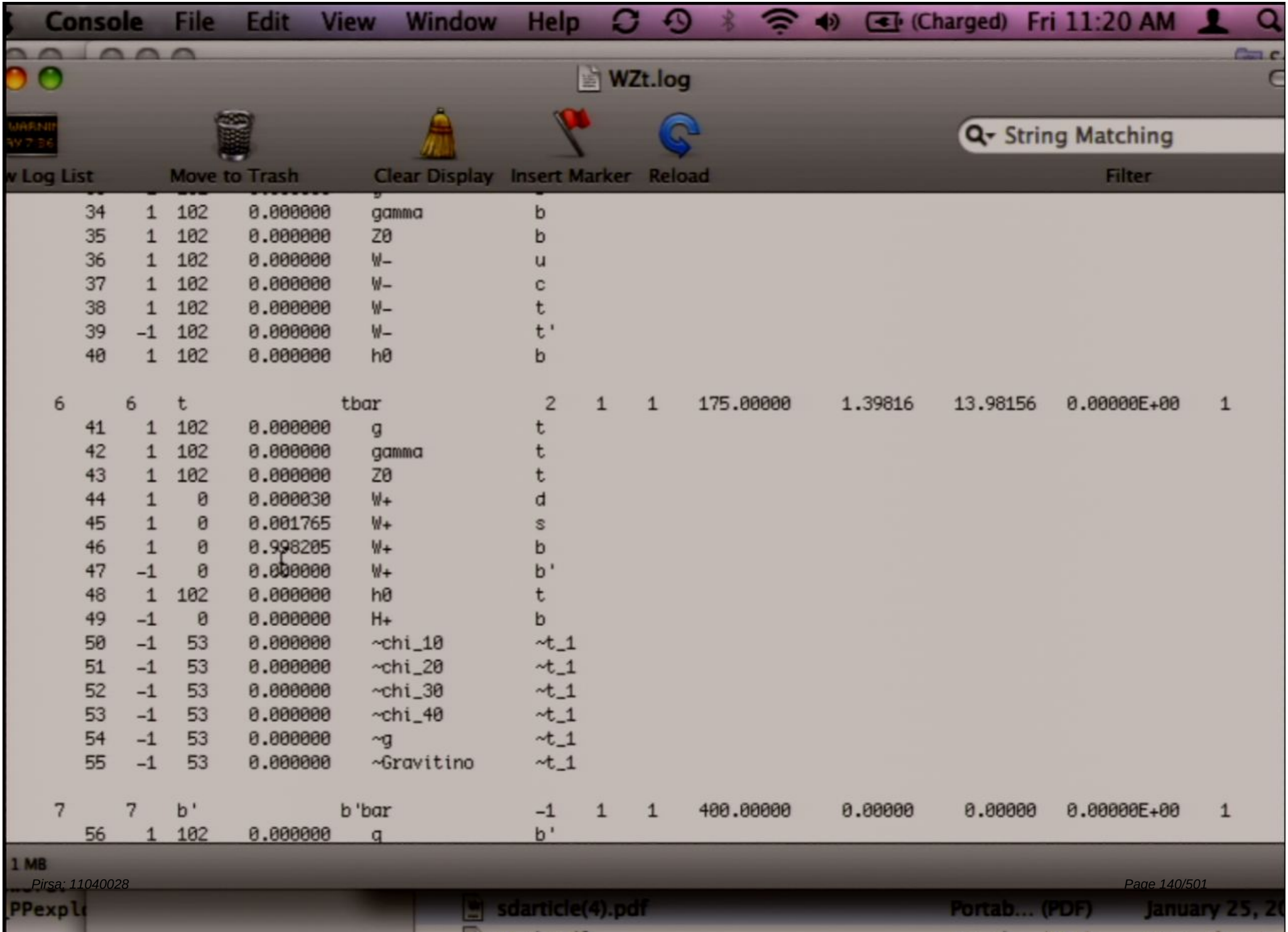
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:20 AM
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String Matching
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37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
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41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
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45 1 0 0.001765 W+ s
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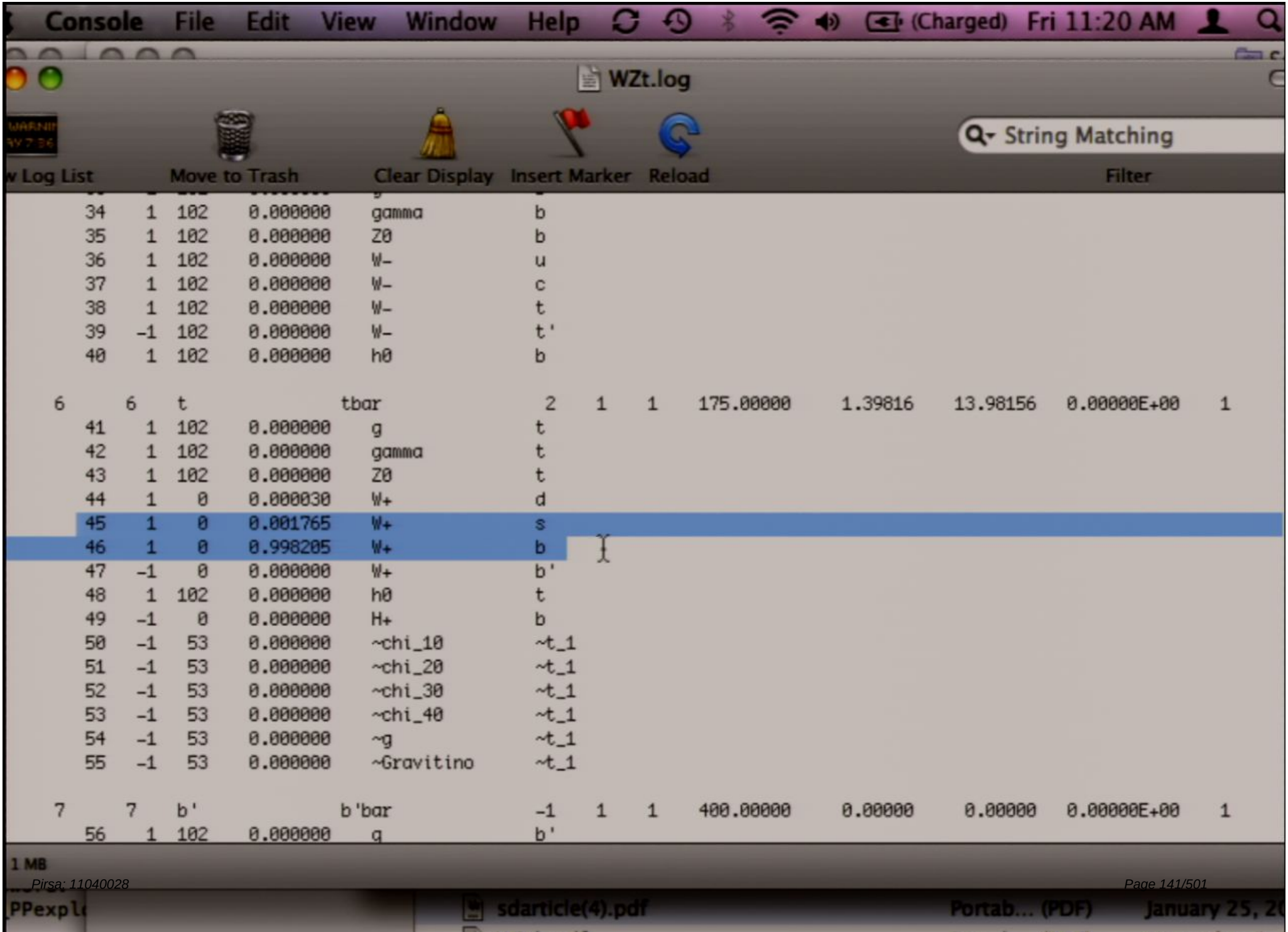
January 25, 20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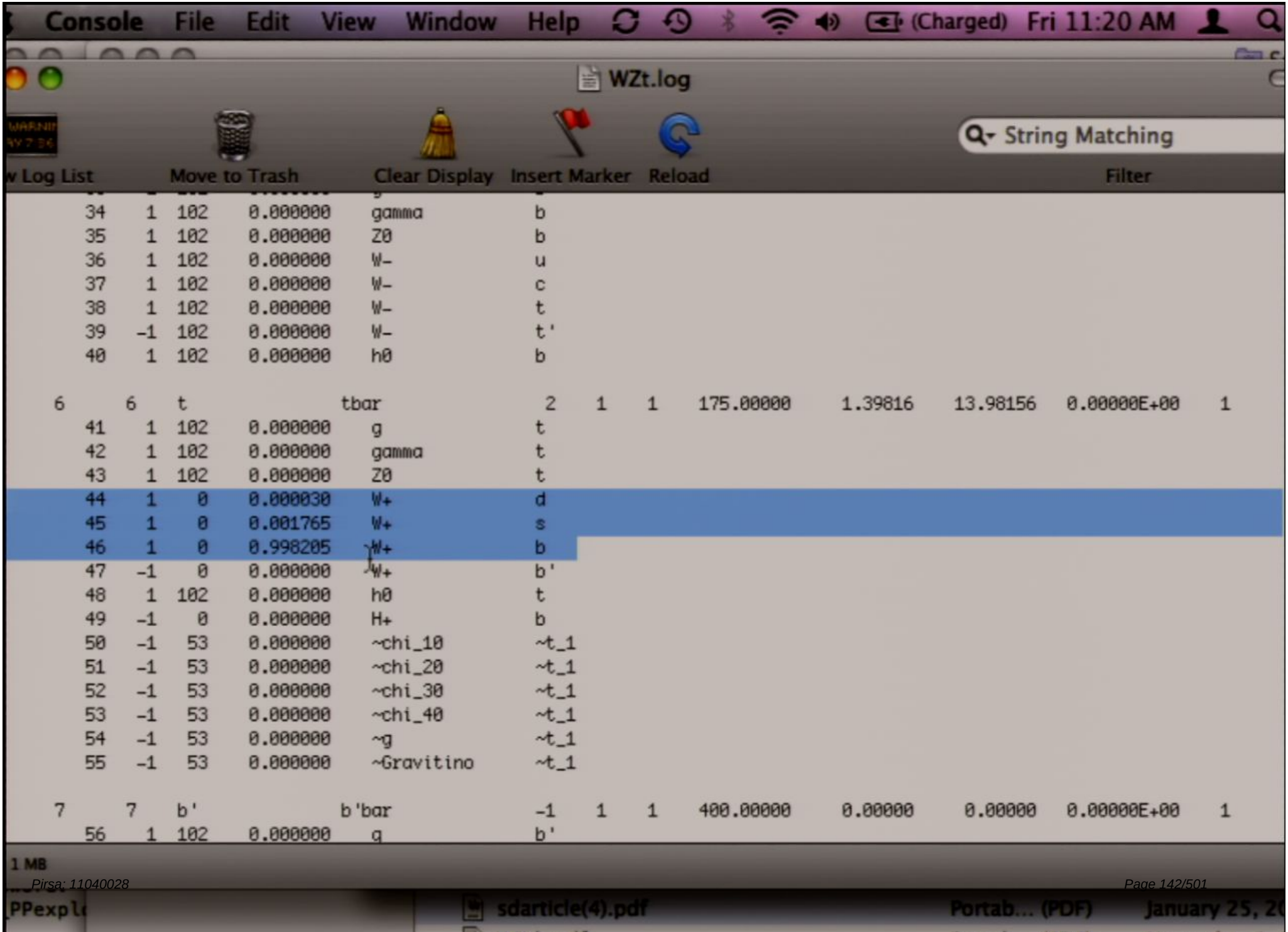
January 25, 2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40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
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42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
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50 -1 53 0.000000 ~chi_10 ~t_1
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7 7 b' b'bar -1 1 1 400.00000 0.00000 0.00000 0.00000E+00 1
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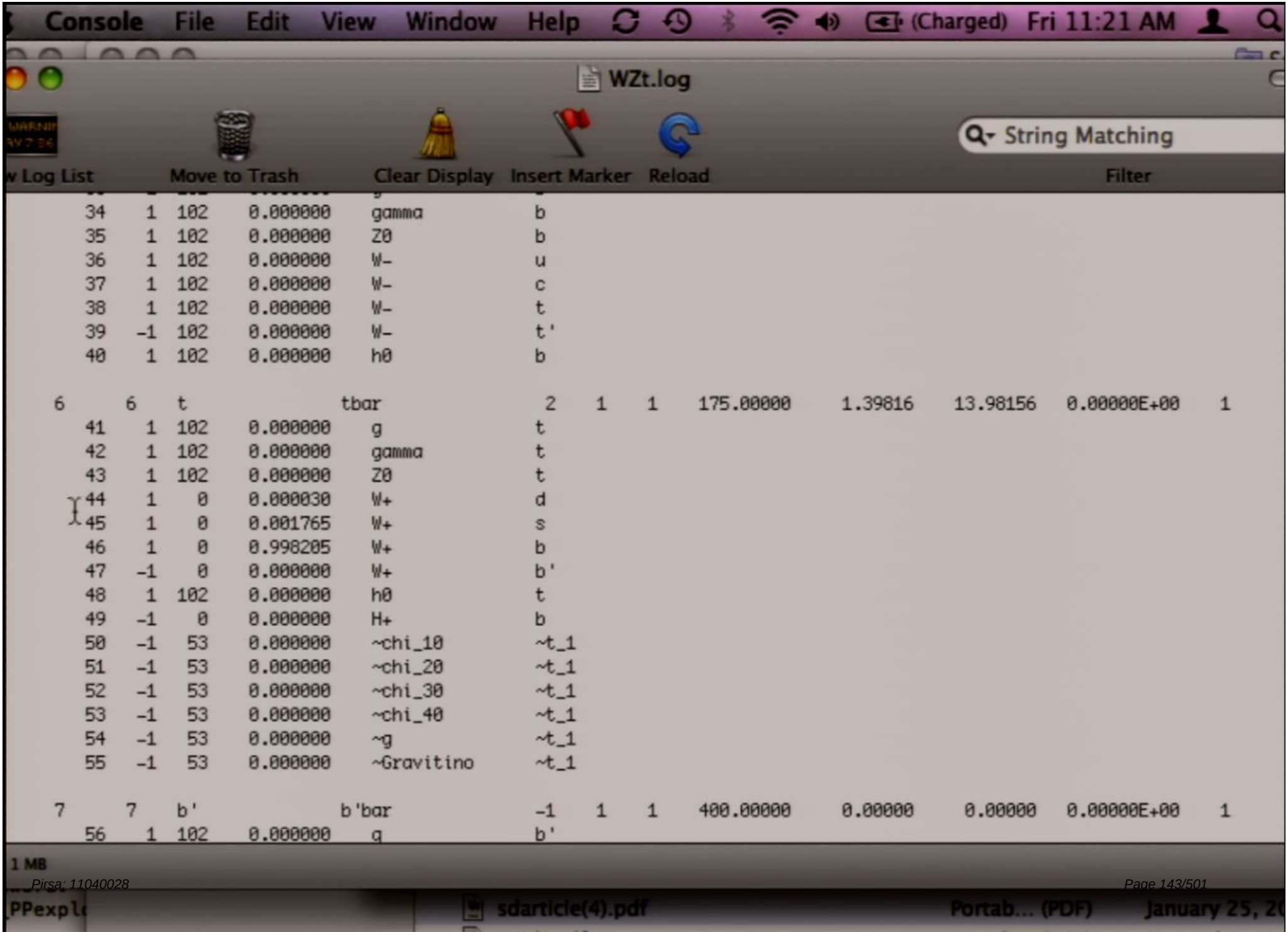
Portab... (PDF)
January 25, 2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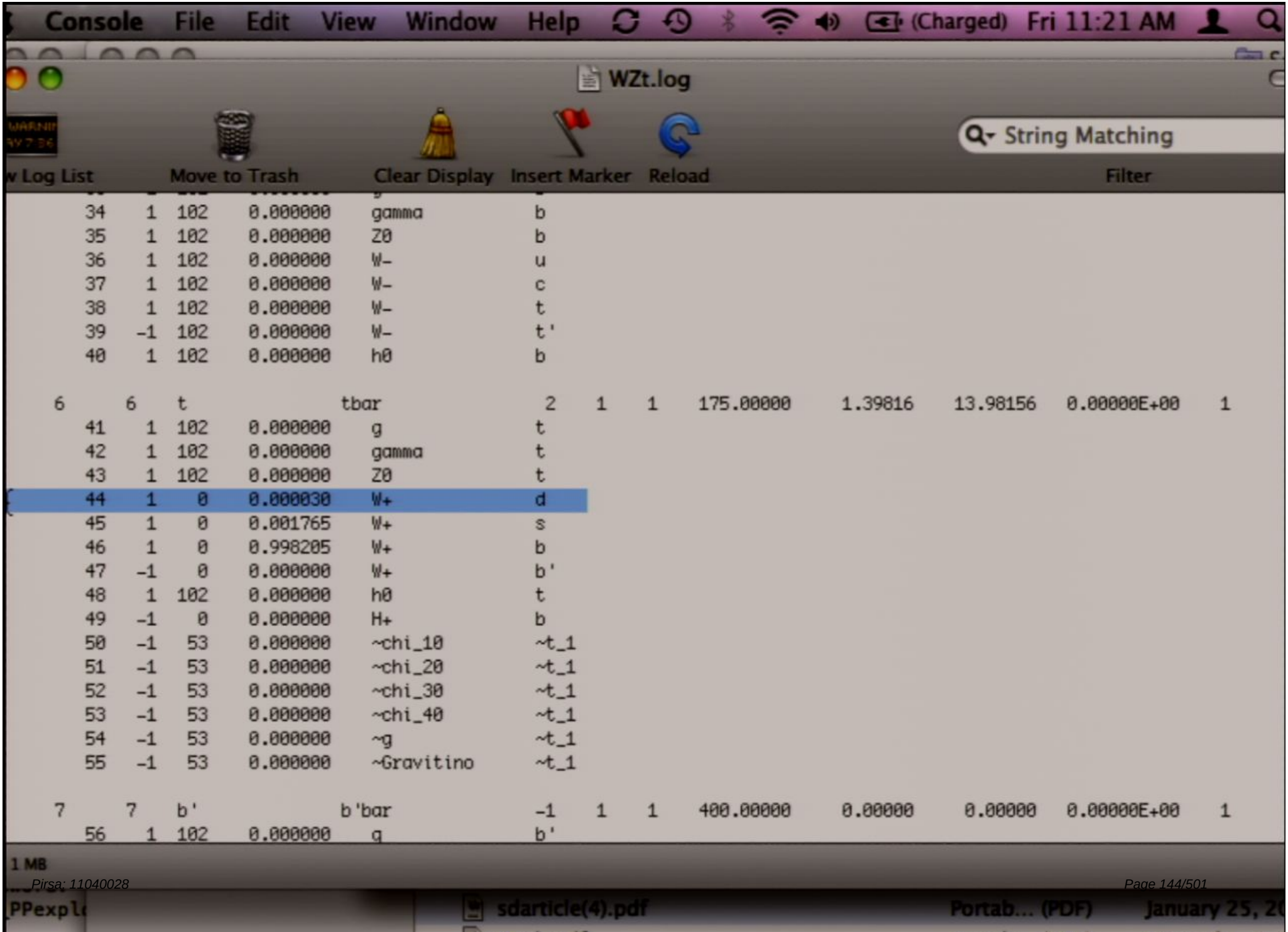
January 25, 2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40 1 102 0.000000 h0 b
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41 1 102 0.000000 g t
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45 1 0 0.001765 W+ s
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53 -1 53 0.000000 ~chi_40 ~t_1
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55 -1 53 0.000000 ~Gravitino ~t_1
7 7 b' b'bar -1 1 1 400.00000 0.00000 0.00000 0.00000E+00 1
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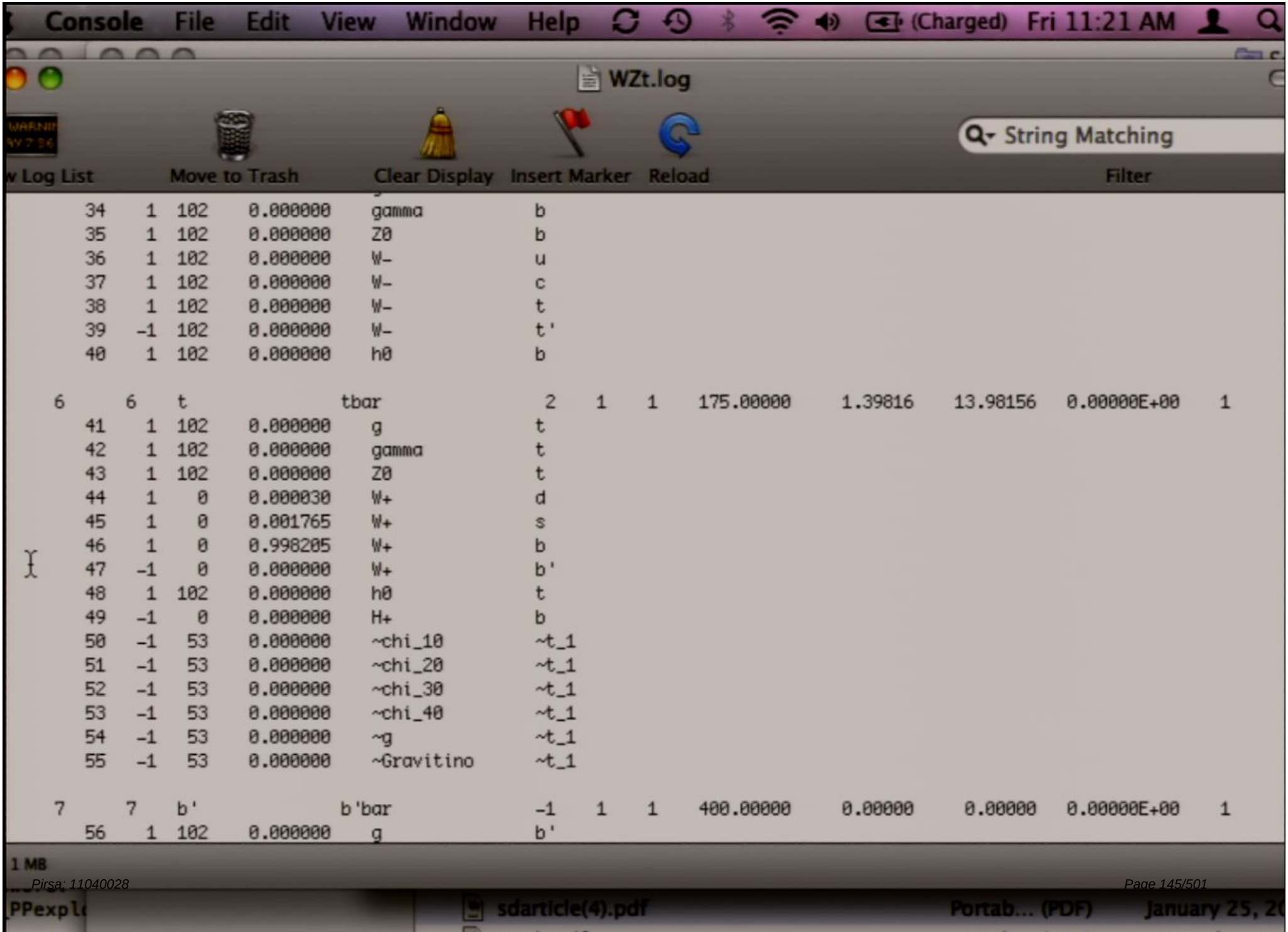
Portab... (PDF)
January 25, 20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46 1 0 0.998205 W+ b
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53 -1 53 0.000000 ~chi_40 ~t_1
54 -1 53 0.000000 ~g ~t_1
55 -1 53 0.000000 ~Gravitino ~t_1
7 7 b' b'bar -1 1 1 400.00000 0.00000 0.00000 0.00000E+00 1
56 1 102 0.000000 g b'
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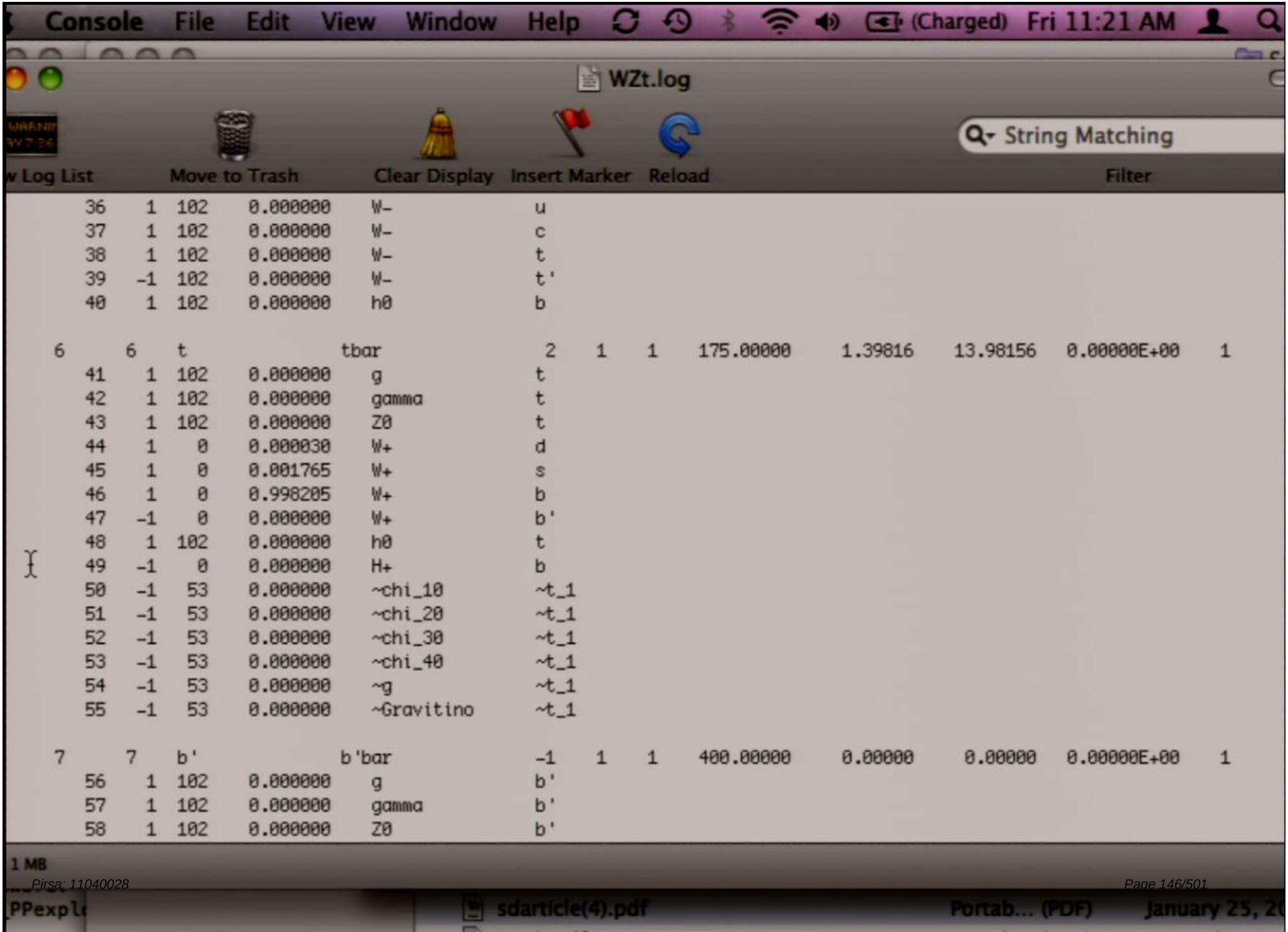
January 25, 2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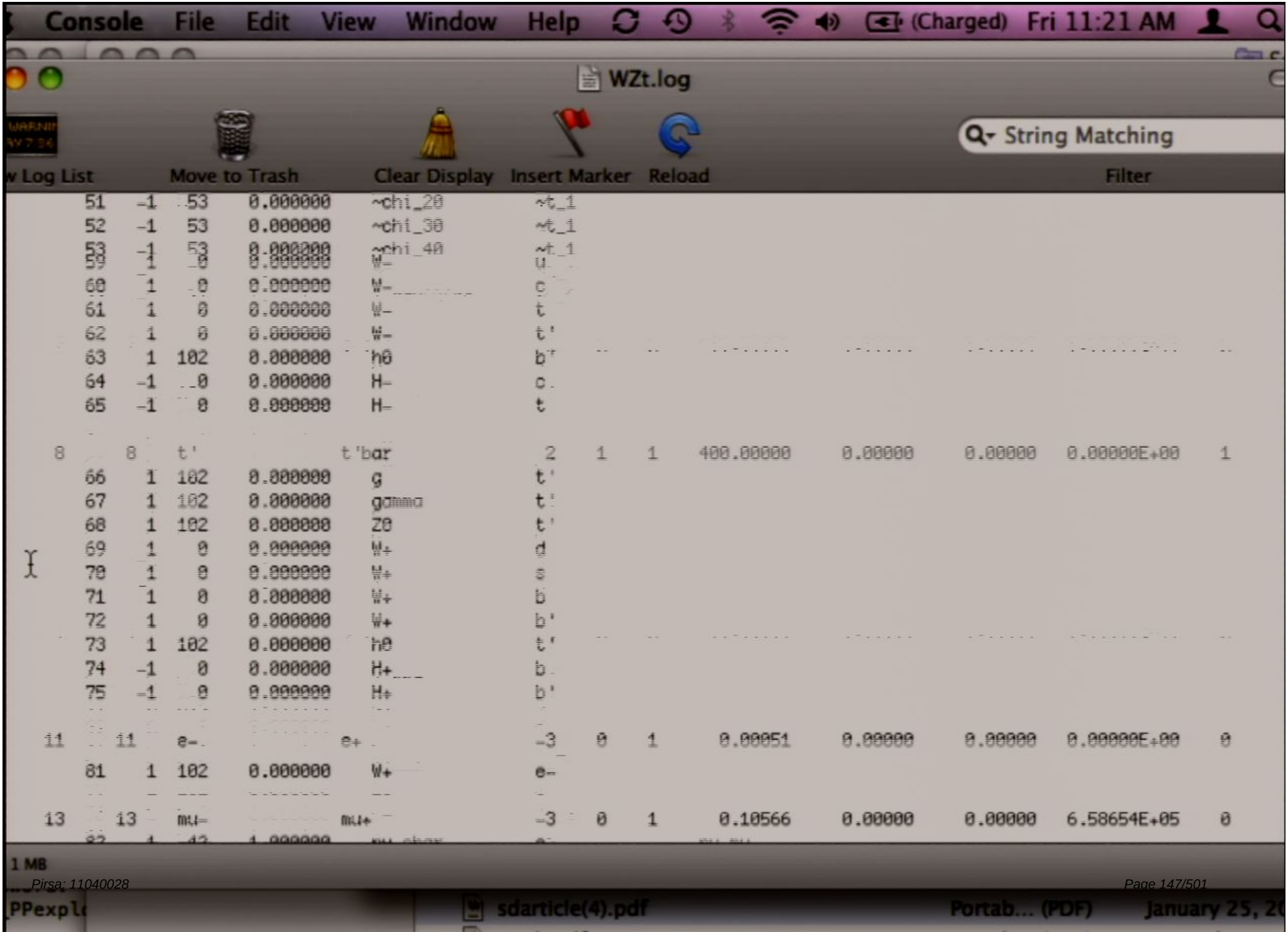
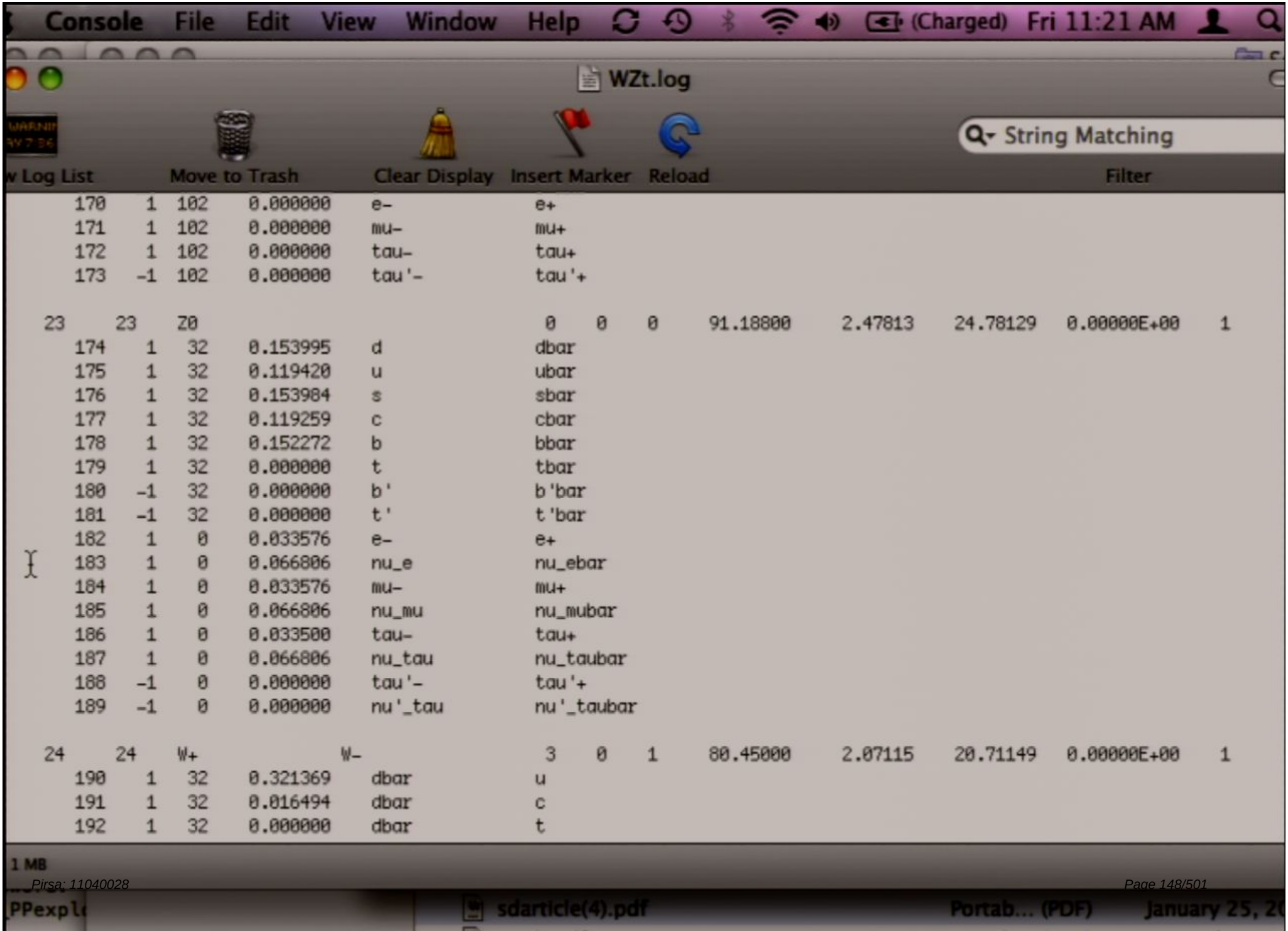
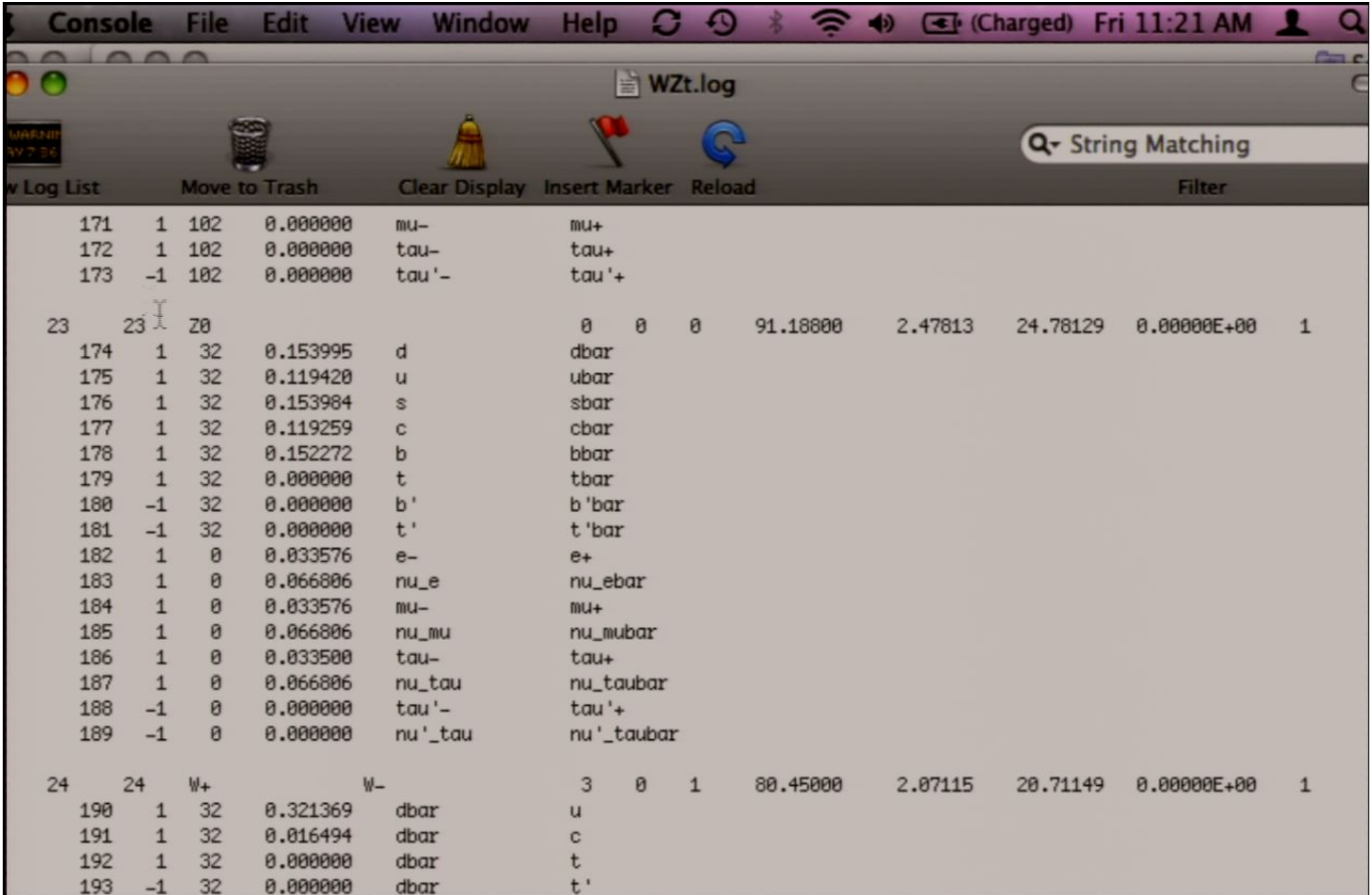
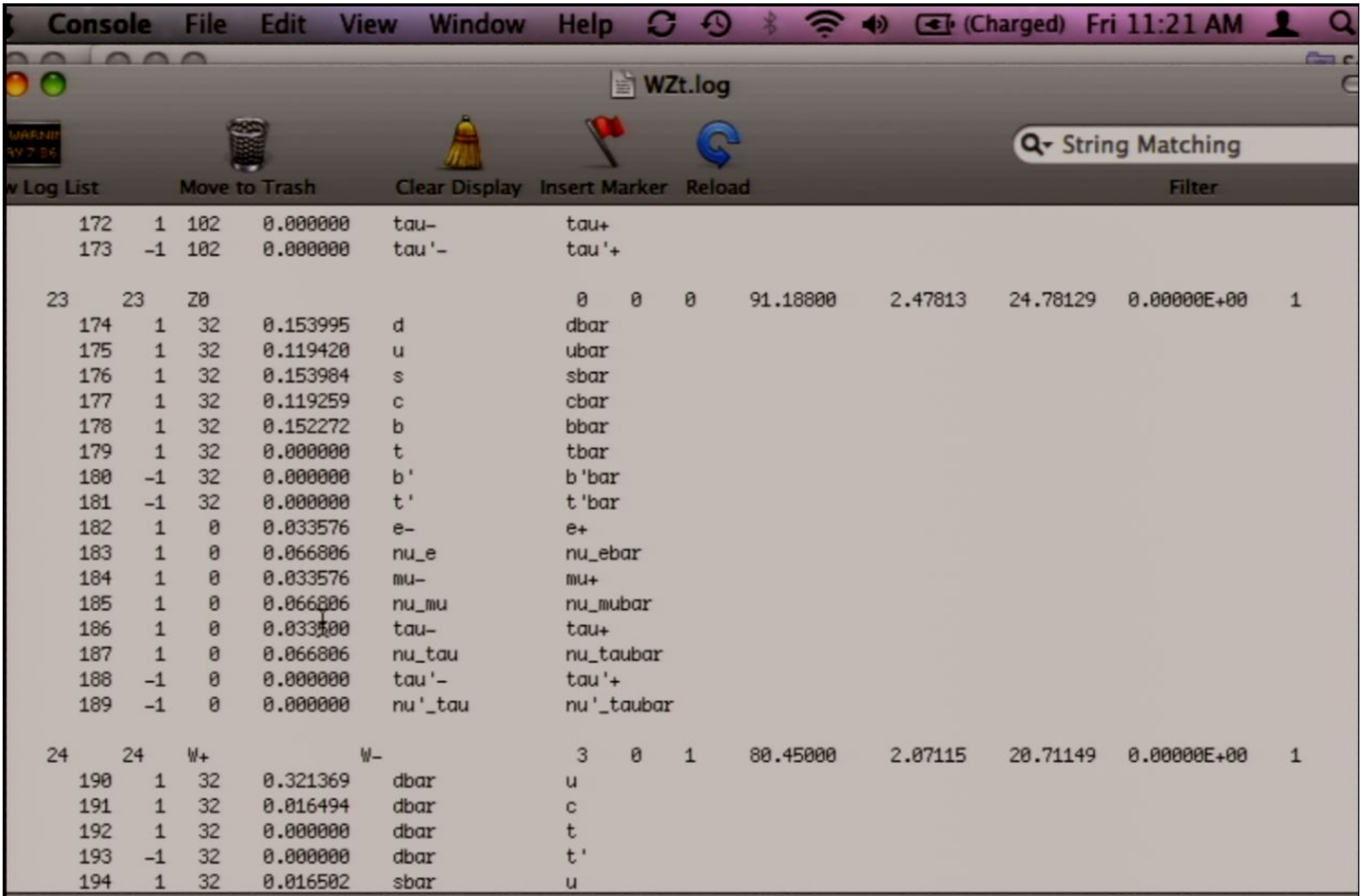
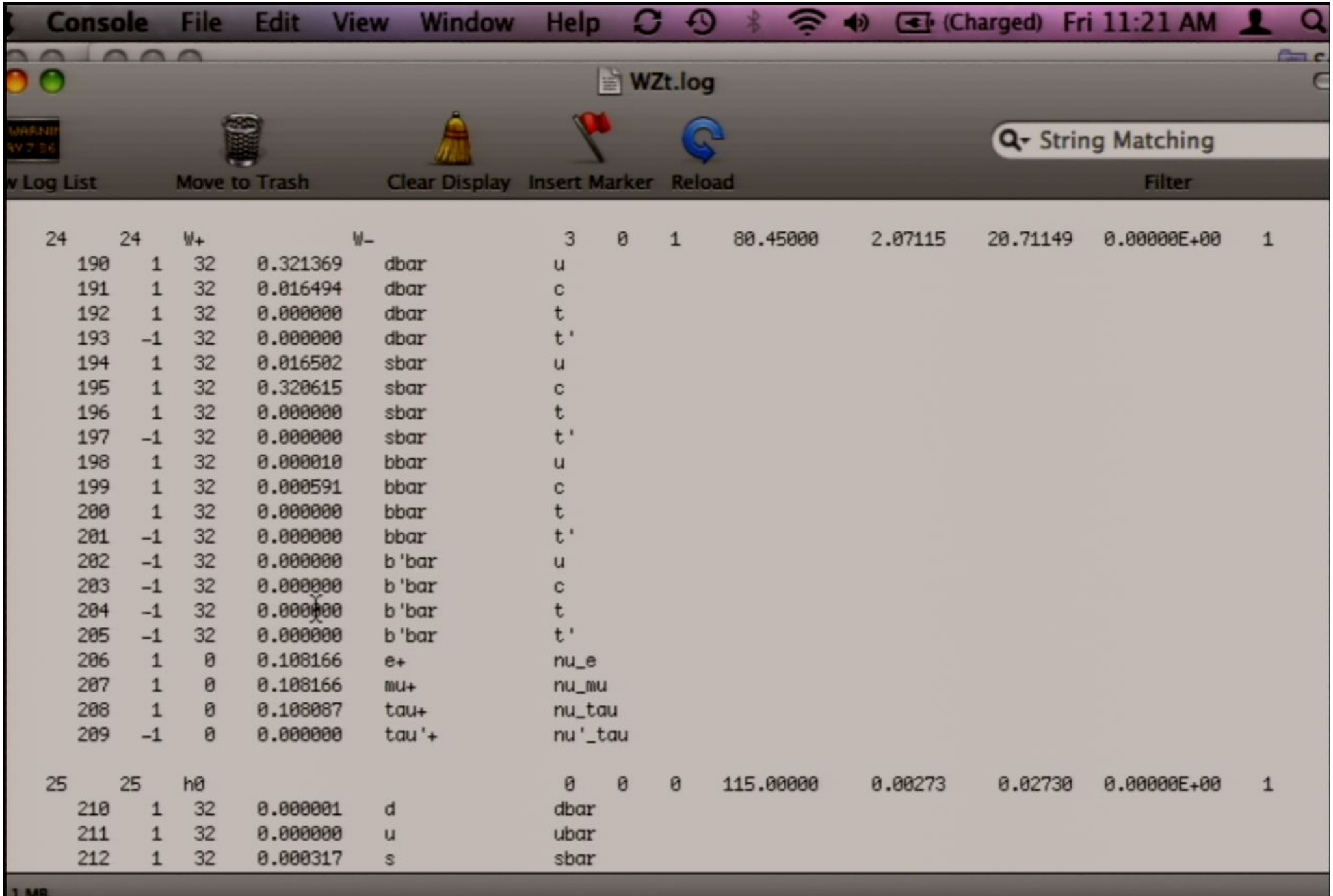
String Matching
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
Filter
36 1 102 0.000000 W- u
37 1 102 0.000000 W- c
38 1 102 0.000000 W- t
39 -1 102 0.000000 W- t'
40 1 102 0.000000 h0 b
6 6 t tbar 2 1 1 175.00000 1.39816 13.98156 0.00000E+00 1
41 1 102 0.000000 g t
42 1 102 0.000000 gamma t
43 1 102 0.000000 Z0 t
44 1 0 0.000030 W+ d
45 1 0 0.001765 W+ s
46 1 0 0.998205 W+ b
47 -1 0 0.000000 W+ b'
48 1 102 0.000000 h0 t
49 -1 0 0.000000 H+ b
50 -1 53 0.000000 ~chi_10 ~t_1
51 -1 53 0.000000 ~chi_20 ~t_1
52 -1 53 0.000000 ~chi_30 ~t_1
53 -1 53 0.000000 ~chi_40 ~t_1
54 -1 53 0.000000 ~g ~t_1
55 -1 53 0.000000 ~Gravitino ~t_1
7 7 b' b'bar -1 1 1 400.00000 0.00000 0.00000 0.00000E+00 1
56 1 102 0.000000 g b'
57 1 102 0.000000 gamma b'
58 1 102 0.000000 Z0 b'
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

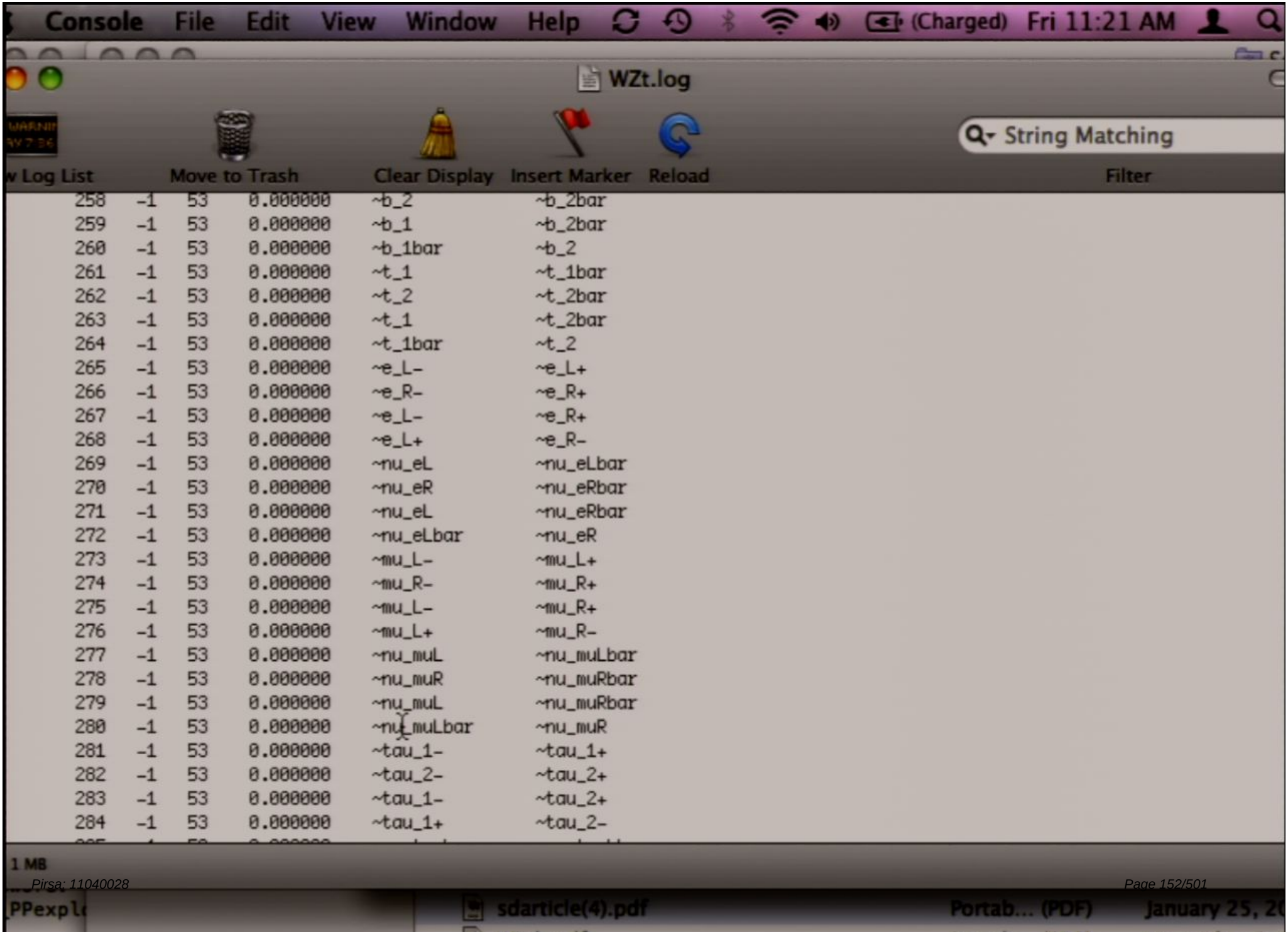

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
String Matching
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
Filter
51 -1 53 0.000000 ~chi_20 ~t_1
52 -1 53 0.000000 ~chi_30 ~t_1
53 -1 53 0.000000 ~chi_40 ~t_1
60 1 0 0.000000 W- c
61 1 0 0.000000 W- t
62 1 0 0.000000 W- t'
63 1 102 0.000000 h0 b'
64 -1 0 0.000000 H- c
65 -1 0 0.000000 H- t
8 8 t' t'bar 2 1 1 400.00000 0.00000 0.00000 0.00000E+00 1
66 1 102 0.000000 g t'
67 1 102 0.000000 gamma t'
68 1 102 0.000000 Z0 t'
69 1 0 0.000000 W+ d
70 1 0 0.000000 W+ s
71 1 0 0.000000 W+ b
72 1 0 0.000000 W+ b'
73 1 102 0.000000 h0 t'
74 -1 0 0.000000 H+ b
75 -1 0 0.000000 H+ b'
11 11 e- e+ -3 0 1 0.00051 0.00000 0.00000 0.00000E+00 0
81 1 102 0.000000 W+ e-
13 13 mu- mu+ -3 0 1 0.10566 0.00000 0.00000 6.58654E+05 0
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 20

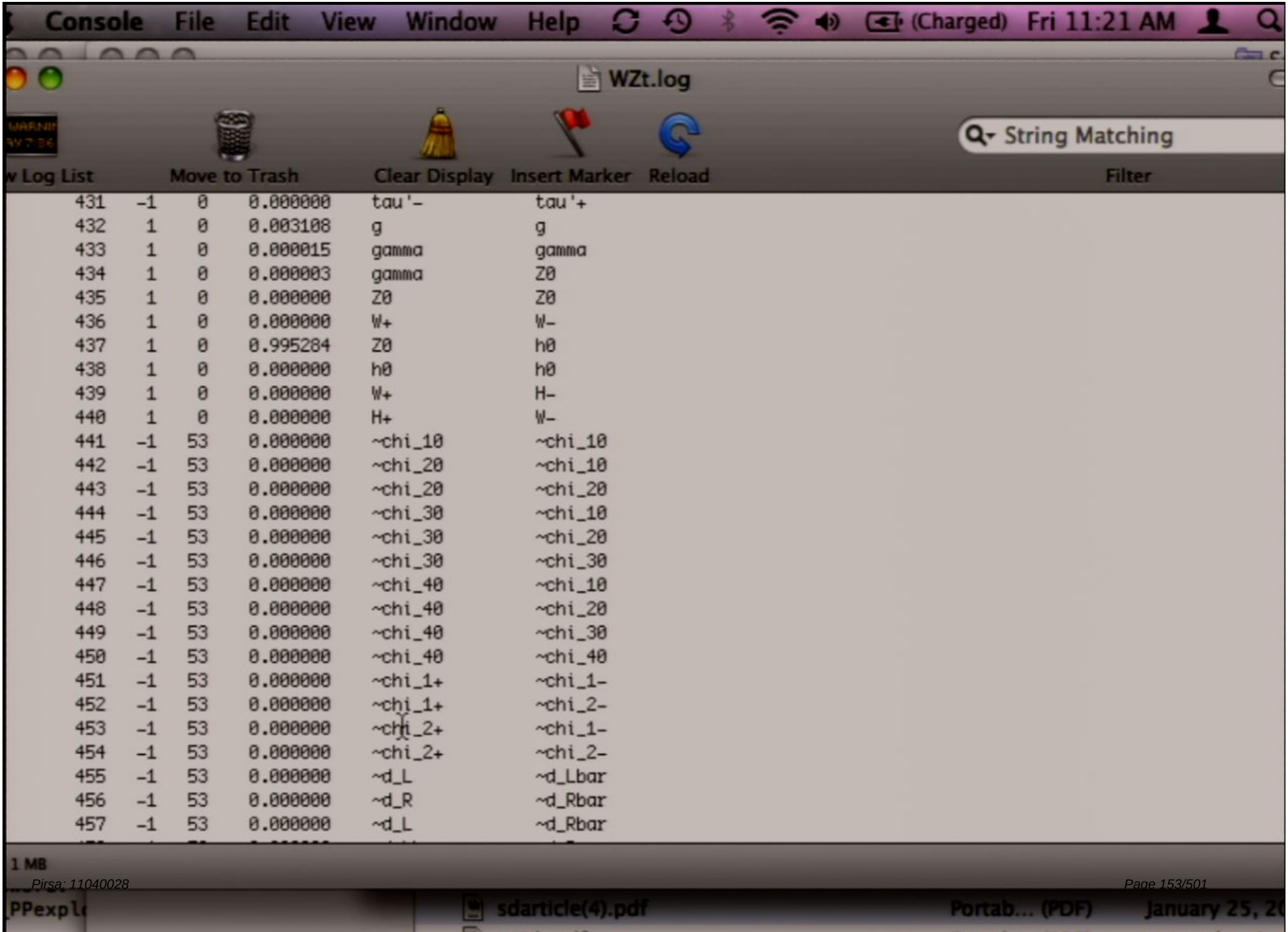

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
170 1 102 0.000000 e- e+
171 1 102 0.000000 mu- mu+
172 1 102 0.000000 tau- tau+
173 -1 102 0.000000 tau'- tau'+
23 23 Z0 0 0 0 91.18800 2.47813 24.78129 0.00000E+00 1
174 1 32 0.153995 d dbar
175 1 32 0.119420 u ubar
176 1 32 0.153984 s sbar
177 1 32 0.119259 c cbar
178 1 32 0.152272 b bbar
179 1 32 0.000000 t tbar
180 -1 32 0.000000 b' b'bar
181 -1 32 0.000000 t' t'bar
182 1 0 0.033576 e- e+
183 1 0 0.066806 nu_e nu_ebar
184 1 0 0.033576 mu- mu+
185 1 0 0.066806 nu_mu nu_mubar
186 1 0 0.033500 tau- tau+
187 1 0 0.066806 nu_tau nu_taubar
188 -1 0 0.000000 tau'- tau'+
189 -1 0 0.000000 nu'_tau nu'_taubar
24 24 W+ W- 3 0 1 80.45000 2.07115 20.71149 0.00000E+00 1
190 1 32 0.321369 dbar u
191 1 32 0.016494 dbar c
192 1 32 0.000000 dbar t
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

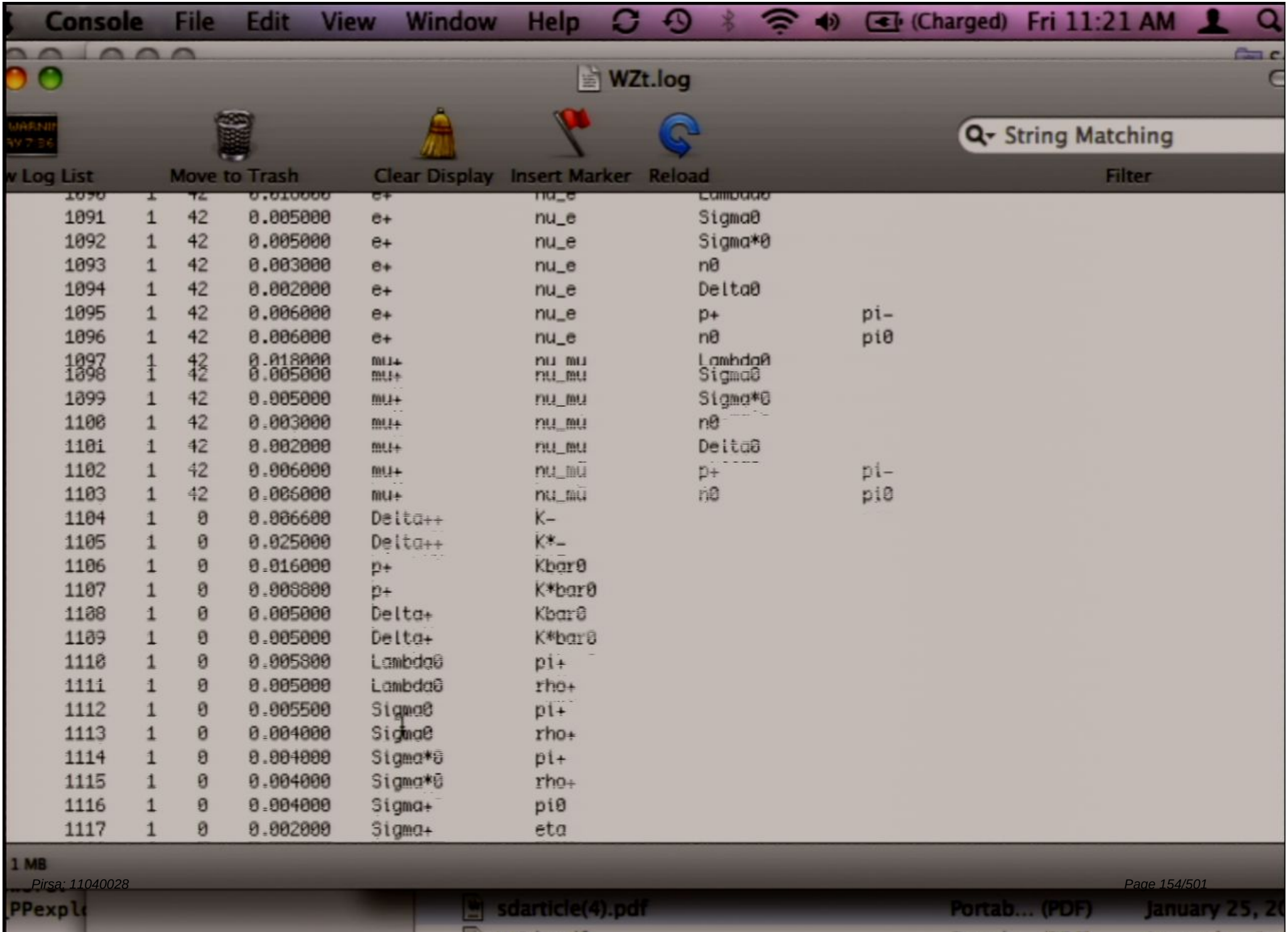

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
171 1 102 0.000000 mu- mu+
172 1 102 0.000000 tau- tau+
173 -1 102 0.000000 tau'- tau'+
23 23 Z0 0 0 0 91.18800 2.47813 24.78129 0.00000E+00 1
174 1 32 0.153995 d dbar
175 1 32 0.119420 u ubar
176 1 32 0.153984 s sbar
177 1 32 0.119259 c cbar
178 1 32 0.152272 b bbar
179 1 32 0.000000 t tbar
180 -1 32 0.000000 b' b'bar
181 -1 32 0.000000 t' t'bar
182 1 0 0.033576 e- e+
183 1 0 0.066806 nu_e nu_ebar
184 1 0 0.033576 mu- mu+
185 1 0 0.066806 nu_mu nu_mubar
186 1 0 0.033500 tau- tau+
187 1 0 0.066806 nu_tau nu_taubar
188 -1 0 0.000000 tau'- tau'+
189 -1 0 0.000000 nu'_tau nu'_taubar
24 24 W+ W- 3 0 1 80.45000 2.07115 20.71149 0.00000E+00 1
190 1 32 0.321369 dbar u
191 1 32 0.016494 dbar c
192 1 32 0.000000 dbar t
193 -1 32 0.000000 dbar t'
1 MB

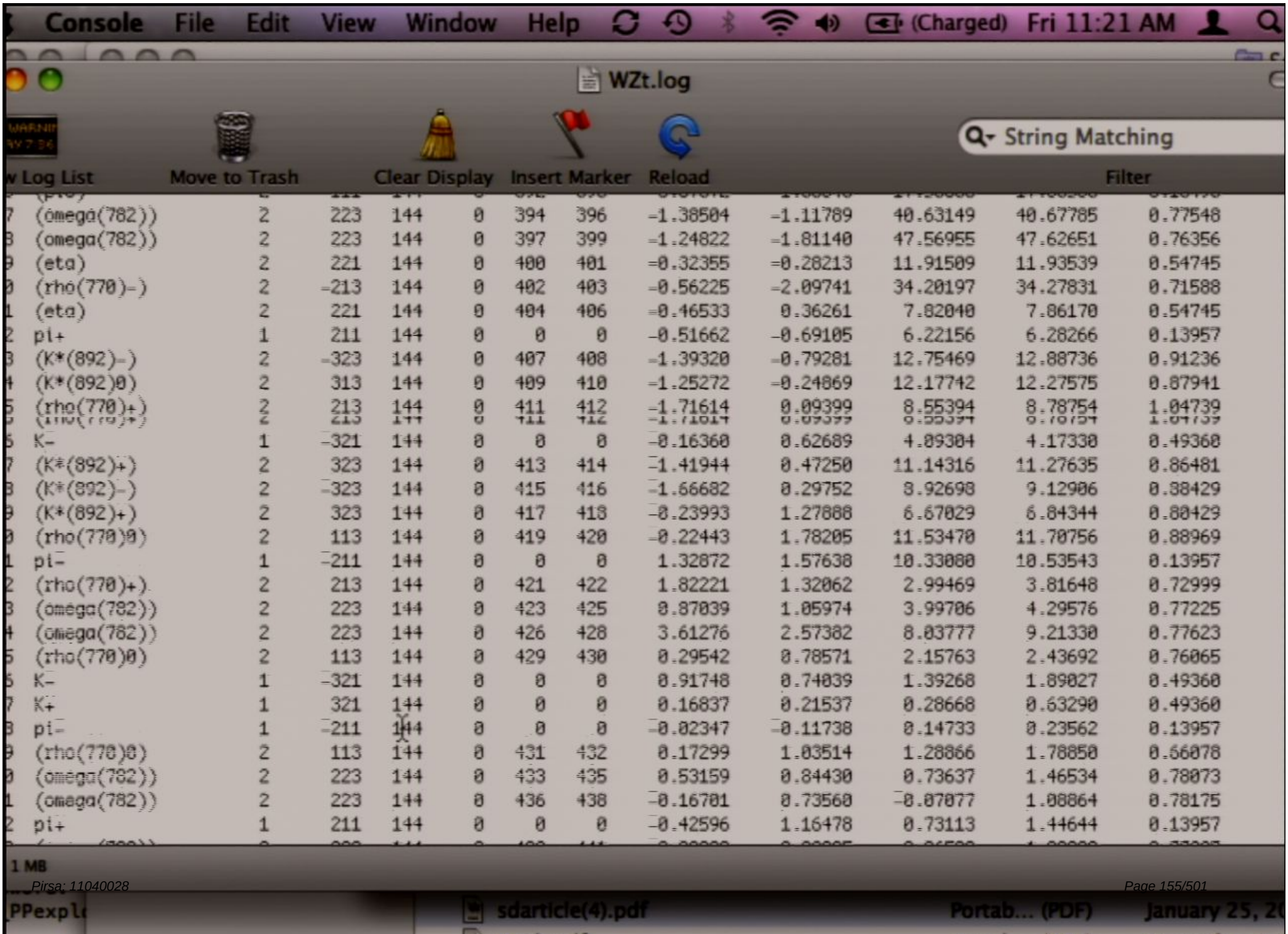

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
172 1 102 0.000000 tau- tau+
173 -1 102 0.000000 tau'- tau'+
23 23 Z0 0 0 0 91.18800 2.47813 24.78129 0.00000E+00 1
174 1 32 0.153995 d dbar
175 1 32 0.119420 u ubar
176 1 32 0.153984 s sbar
177 1 32 0.119259 c cbar
178 1 32 0.152272 b bbar
179 1 32 0.000000 t tbar
180 -1 32 0.000000 b' b'bar
181 -1 32 0.000000 t' t'bar
182 1 0 0.033576 e- e+
183 1 0 0.066806 nu_e nu_ebar
184 1 0 0.033576 mu- mu+
185 1 0 0.066806 nu_mu nu_mubar
186 1 0 0.033500 tau- tau+
187 1 0 0.066806 nu_tau nu_taubar
188 -1 0 0.000000 tau'- tau'+
189 -1 0 0.000000 nu'_tau nu'_taubar
24 24 W+ W- 3 0 1 80.45000 2.07115 20.71149 0.00000E+00 1
190 1 32 0.321369 dbar u
191 1 32 0.016494 dbar c
192 1 32 0.000000 dbar t
193 -1 32 0.000000 dbar t'
194 1 32 0.016502 sbar u
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

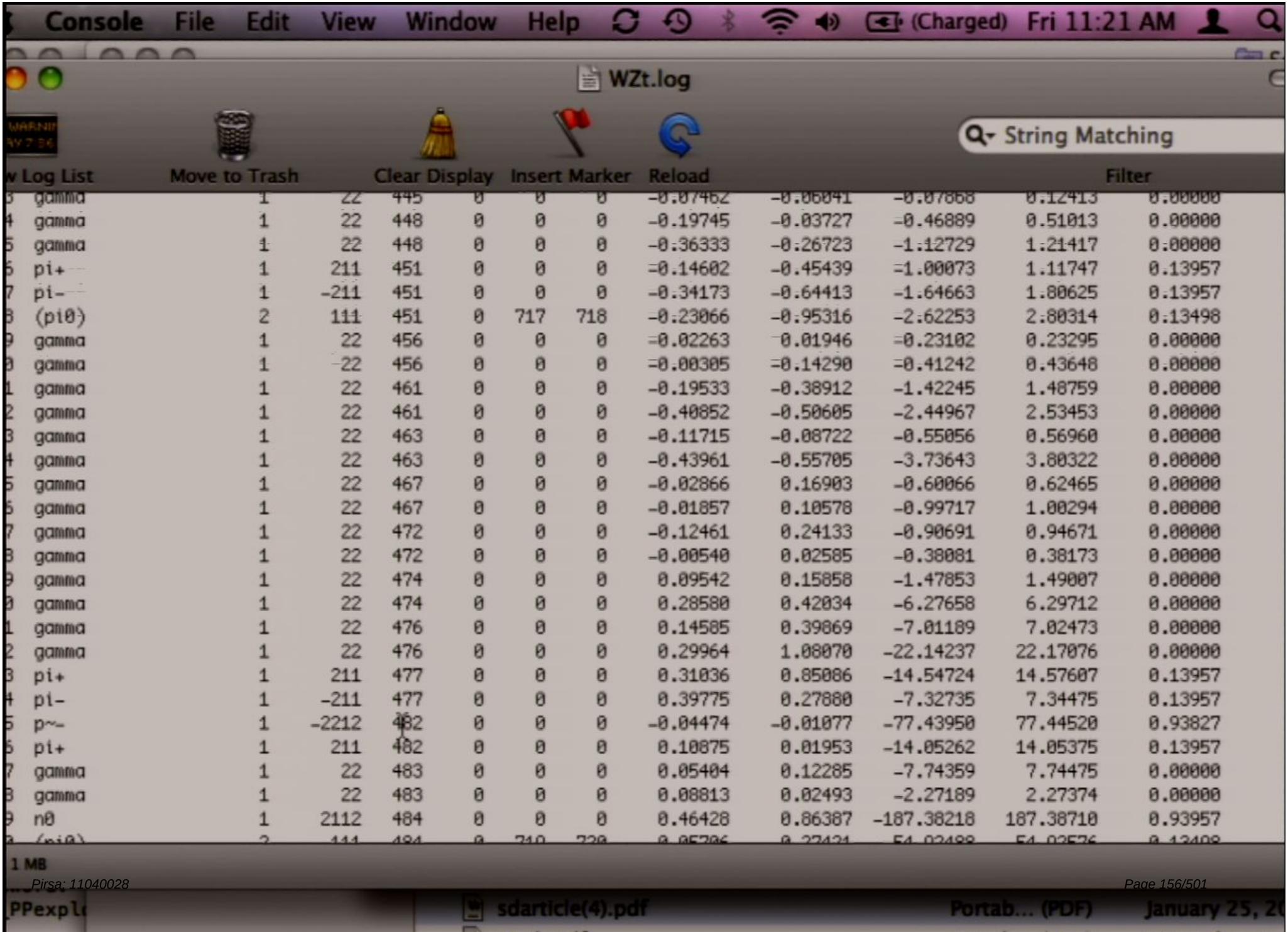

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
24 24 W+ W- 3 0 1 80.45000 2.07115 20.71149 0.00000E+00 1
190 1 32 0.321369 dbar u
191 1 32 0.016494 dbar c
192 1 32 0.000000 dbar t
193 -1 32 0.000000 dbar t'
194 1 32 0.016502 sbar u
195 1 32 0.320615 sbar c
196 1 32 0.000000 sbar t
197 -1 32 0.000000 sbar t'
198 1 32 0.000010 bbar u
199 1 32 0.000591 bbar c
200 1 32 0.000000 bbar t
201 -1 32 0.000000 bbar t'
202 -1 32 0.000000 b'bar u
203 -1 32 0.000000 b'bar c
204 -1 32 0.000000 b'bar t
205 -1 32 0.000000 b'bar t'
206 1 0 0.108166 e+ nu_e
207 1 0 0.108166 mu+ nu_mu
208 1 0 0.108087 tau+ nu_tau
209 -1 0 0.000000 tau'+ nu'_tau
25 25 h0 0 0 0 115.00000 0.00273 0.02730 0.00000E+00 1
210 1 32 0.000001 d dbar
211 1 32 0.000000 u ubar
212 1 32 0.000317 s sbar
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
258 -1 53 0.000000 ~b_2 ~b_2bar
259 -1 53 0.000000 ~b_1 ~b_2bar
260 -1 53 0.000000 ~b_1bar ~b_2
261 -1 53 0.000000 ~t_1 ~t_1bar
262 -1 53 0.000000 ~t_2 ~t_2bar
263 -1 53 0.000000 ~t_1 ~t_2bar
264 -1 53 0.000000 ~t_1bar ~t_2
265 -1 53 0.000000 ~e_L- ~e_L+
266 -1 53 0.000000 ~e_R- ~e_R+
267 -1 53 0.000000 ~e_L- ~e_R+
268 -1 53 0.000000 ~e_L+ ~e_R-
269 -1 53 0.000000 ~nu_eL ~nu_eLbar
270 -1 53 0.000000 ~nu_eR ~nu_eRbar
271 -1 53 0.000000 ~nu_eL ~nu_eRbar
272 -1 53 0.000000 ~nu_eLbar ~nu_eR
273 -1 53 0.000000 ~mu_L- ~mu_L+
274 -1 53 0.000000 ~mu_R- ~mu_R+
275 -1 53 0.000000 ~mu_L- ~mu_R+
276 -1 53 0.000000 ~mu_L+ ~mu_R-
277 -1 53 0.000000 ~nu_muL ~nu_muLbar
278 -1 53 0.000000 ~nu_muR ~nu_muRbar
279 -1 53 0.000000 ~nu_muL ~nu_muRbar
280 -1 53 0.000000 ~nu_muLbar ~nu_muR
281 -1 53 0.000000 ~tau_1- ~tau_1+
282 -1 53 0.000000 ~tau_2- ~tau_2+
283 -1 53 0.000000 ~tau_1- ~tau_2+
284 -1 53 0.000000 ~tau_1+ ~tau_2-
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

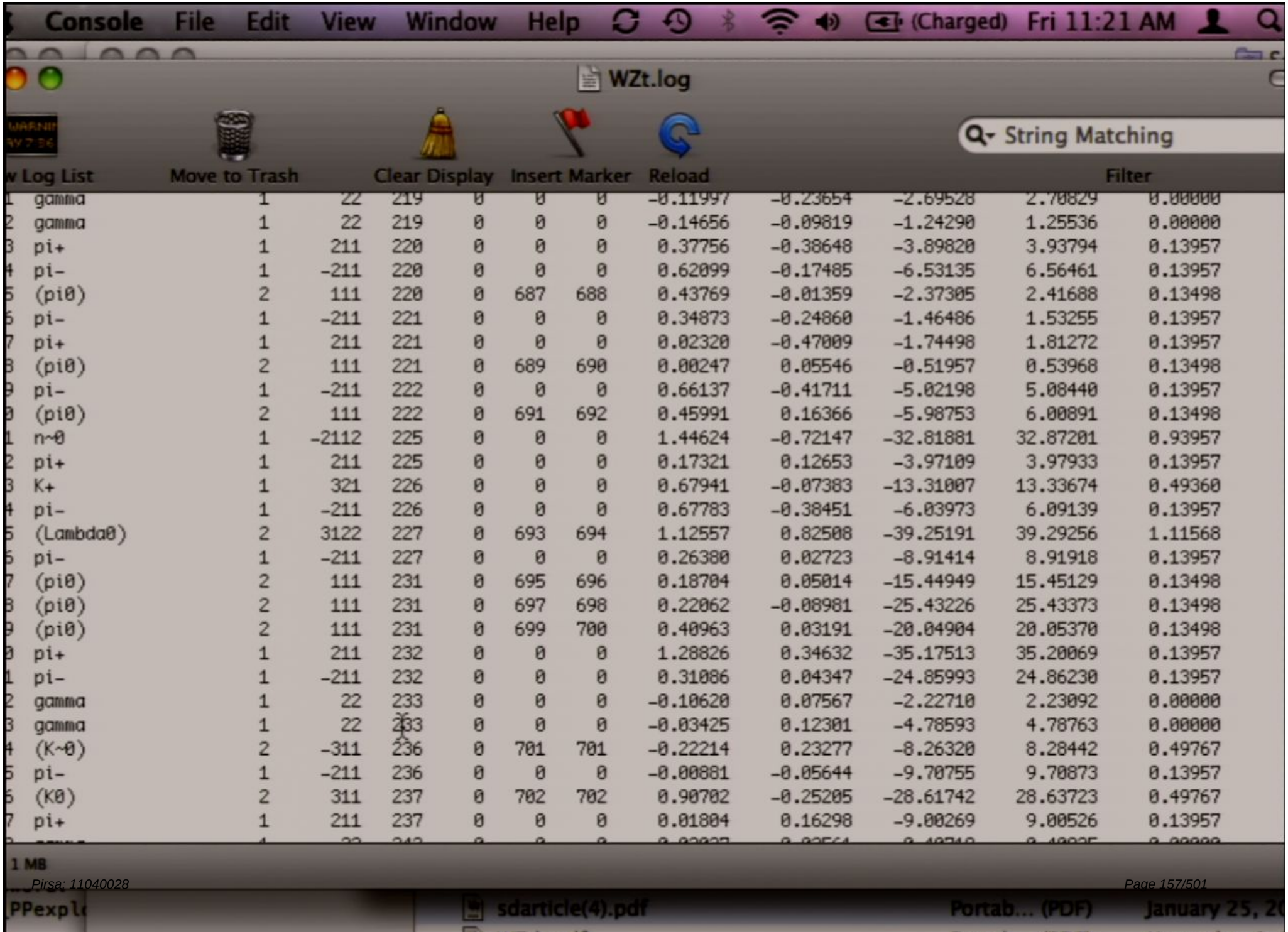

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
431 -1 0 0.000000 tau'- tau'+
432 1 0 0.003108 g g
433 1 0 0.000015 gamma gamma
434 1 0 0.000003 gamma Z0
435 1 0 0.000000 Z0 Z0
436 1 0 0.000000 W+ W-
437 1 0 0.995284 Z0 h0
438 1 0 0.000000 h0 h0
439 1 0 0.000000 W+ H-
440 1 0 0.000000 H+ W-
441 -1 53 0.000000 ~chi_10 ~chi_10
442 -1 53 0.000000 ~chi_20 ~chi_10
443 -1 53 0.000000 ~chi_20 ~chi_20
444 -1 53 0.000000 ~chi_30 ~chi_10
445 -1 53 0.000000 ~chi_30 ~chi_20
446 -1 53 0.000000 ~chi_30 ~chi_30
447 -1 53 0.000000 ~chi_40 ~chi_10
448 -1 53 0.000000 ~chi_40 ~chi_20
449 -1 53 0.000000 ~chi_40 ~chi_30
450 -1 53 0.000000 ~chi_40 ~chi_40
451 -1 53 0.000000 ~chi_1+ ~chi_1-
452 -1 53 0.000000 ~chi_1+ ~chi_2-
453 -1 53 0.000000 ~chi_2+ ~chi_1-
454 -1 53 0.000000 ~chi_2+ ~chi_2-
455 -1 53 0.000000 ~d_L ~d_Lbar
456 -1 53 0.000000 ~d_R ~d_Rbar
457 -1 53 0.000000 ~d_L ~d_Rbar
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
String Matching
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
Filter
1091 1 42 0.005000 e+ nu_e Sigma0
1092 1 42 0.005000 e+ nu_e Sigma*0
1093 1 42 0.003000 e+ nu_e n0
1094 1 42 0.002000 e+ nu_e Delta0
1095 1 42 0.006000 e+ nu_e p+ pi-
1096 1 42 0.006000 e+ nu_e n0 pi0
1097 1 42 0.018000 mu+ nu_mu Lambda0
1098 1 42 0.005000 mu+ nu_mu Sigma0
1099 1 42 0.005000 mu+ nu_mu Sigma*0
1100 1 42 0.003000 mu+ nu_mu n0
1101 1 42 0.002000 mu+ nu_mu Delta0
1102 1 42 0.006000 mu+ nu_mu p+ pi-
1103 1 42 0.006000 mu+ nu_mu n0 pi0
1104 1 0 0.006600 Delta++ K-
1105 1 0 0.025000 Delta++ K*-
1106 1 0 0.016000 p+ Kbar0
1107 1 0 0.008800 p+ K*bar0
1108 1 0 0.005000 Delta+ Kbar0
1109 1 0 0.005000 Delta+ K*bar0
1110 1 0 0.005800 Lambda0 pi+
1111 1 0 0.005000 Lambda0 rho+
1112 1 0 0.005500 Sigma0 pi+
1113 1 0 0.004000 Sigma0 rho+
1114 1 0 0.004000 Sigma*0 pi+
1115 1 0 0.004000 Sigma*0 rho+
1116 1 0 0.004000 Sigma+ pi0
1117 1 0 0.002000 Sigma+ eta
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

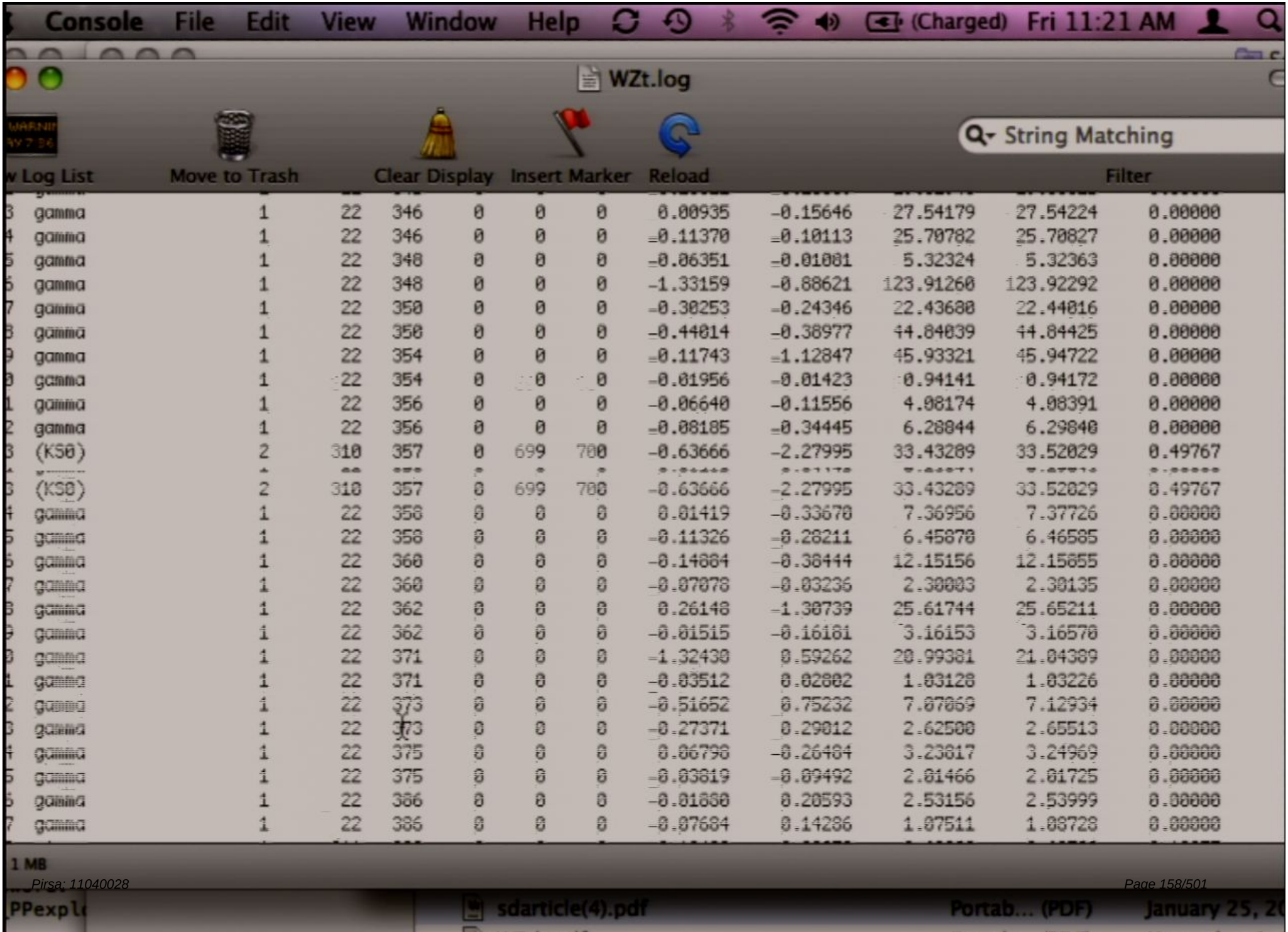

Console File Edit View Window Help (Charged) Fri 11:21 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
7 (omega(782)) 2 223 144 0 394 396 -1.38504 -1.11789 40.63149 40.67785 0.77548
8 (omega(782)) 2 223 144 0 397 399 -1.24822 -1.81140 47.56955 47.62651 0.76356
9 (eta) 2 221 144 0 400 401 -0.32355 -0.28213 11.91509 11.93539 0.54745
0 (rho(770)-) 2 -213 144 0 402 403 -0.56225 -2.09741 34.20197 34.27831 0.71588
1 (eta) 2 221 144 0 404 406 -0.46533 0.36261 7.82040 7.86170 0.54745
2 pi+ 1 211 144 0 0 0 -0.51662 -0.69105 6.22156 6.28266 0.13957
3 (K*(892)-) 2 -323 144 0 407 408 -1.39320 -0.79281 12.75469 12.88736 0.91236
4 (K*(892)0) 2 313 144 0 409 410 -1.25272 -0.24869 12.17742 12.27575 0.87941
5 (rho(770)+) 2 213 144 0 411 412 -1.71614 0.09399 8.55394 8.78754 1.04739
6 K- 1 -321 144 0 0 0 -0.16360 0.62689 4.09304 4.17330 0.49360
7 (K*(892)+) 2 323 144 0 413 414 -1.41944 0.47250 11.14316 11.27635 0.86481
8 (K*(892)-) 2 -323 144 0 415 416 -1.66682 0.29752 8.92698 9.12906 0.88429
9 (K*(892)+) 2 323 144 0 417 418 -0.23993 1.27888 6.67029 6.84344 0.80423
0 (rho(770)0) 2 113 144 0 419 420 -0.22443 1.78205 11.53470 11.70756 0.88969
1 pi- 1 -211 144 0 0 0 1.32872 1.57638 10.33080 10.53543 0.13957
2 (rho(770)+) 2 213 144 0 421 422 1.82221 1.32062 2.99469 3.81648 0.72999
3 (omega(782)) 2 223 144 0 423 425 0.87039 1.05974 3.99706 4.29576 0.77225
4 (omega(782)) 2 223 144 0 426 428 3.61276 2.57382 8.03777 9.21330 0.77623
5 (rho(770)0) 2 113 144 0 429 430 0.29542 0.78571 2.15763 2.43692 0.76065
6 K- 1 -321 144 0 0 0 0.91748 0.74039 1.39268 1.89027 0.49360
7 K+ 1 321 144 0 0 0 0.16837 0.21537 0.28668 0.63290 0.49360
8 pi- 1 -211 144 0 0 0 -0.02347 -0.11738 0.14733 0.23562 0.13957
9 (rho(770)0) 2 113 144 0 431 432 0.17299 1.03514 1.28866 1.78850 0.66078
0 (omega(782)) 2 223 144 0 433 435 0.53159 0.84430 0.73637 1.46534 0.78073
1 (omega(782)) 2 223 144 0 436 438 -0.16701 0.73560 -0.07077 1.08864 0.78175
2 pi+ 1 211 144 0 0 0 -0.42596 1.16478 0.73113 1.44644 0.13957
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2



3	gamma	1	22	445	0	0	0	-0.07462	-0.06041	-0.07868	0.12413	0.00000
4	gamma	1	22	448	0	0	0	-0.19745	-0.03727	-0.46889	0.51013	0.00000
5	gamma	1	22	448	0	0	0	-0.36333	-0.26723	-1.12729	1.21417	0.00000
6	pi+	1	211	451	0	0	0	-0.14602	-0.45439	-1.00073	1.11747	0.13957
7	pi-	1	-211	451	0	0	0	-0.34173	-0.64413	-1.64663	1.80625	0.13957
8	(pi0)	2	111	451	0	717	718	-0.23066	-0.95316	-2.62253	2.80314	0.13498
9	gamma	1	22	456	0	0	0	-0.02263	-0.01946	-0.23102	0.23295	0.00000
0	gamma	1	22	456	0	0	0	-0.00305	-0.14290	-0.41242	0.43648	0.00000
1	gamma	1	22	461	0	0	0	-0.19533	-0.38912	-1.42245	1.48759	0.00000
2	gamma	1	22	461	0	0	0	-0.40852	-0.50605	-2.44967	2.53453	0.00000
3	gamma	1	22	463	0	0	0	-0.11715	-0.08722	-0.55056	0.56960	0.00000
4	gamma	1	22	463	0	0	0	-0.43961	-0.55705	-3.73643	3.80322	0.00000
5	gamma	1	22	467	0	0	0	-0.02866	0.16903	-0.60066	0.62465	0.00000
6	gamma	1	22	467	0	0	0	-0.01857	0.10578	-0.99717	1.00294	0.00000
7	gamma	1	22	472	0	0	0	-0.12461	0.24133	-0.90691	0.94671	0.00000
8	gamma	1	22	472	0	0	0	-0.00540	0.02585	-0.38081	0.38173	0.00000
9	gamma	1	22	474	0	0	0	0.09542	0.15858	-1.47853	1.49007	0.00000
0	gamma	1	22	474	0	0	0	0.28580	0.42034	-6.27658	6.29712	0.00000
1	gamma	1	22	476	0	0	0	0.14585	0.39869	-7.01189	7.02473	0.00000
2	gamma	1	22	476	0	0	0	0.29964	1.08070	-22.14237	22.17076	0.00000
3	pi+	1	211	477	0	0	0	0.31036	0.85086	-14.54724	14.57607	0.13957
4	pi-	1	-211	477	0	0	0	0.39775	0.27880	-7.32735	7.34475	0.13957
5	p~-	1	-2212	482	0	0	0	-0.04474	-0.01077	-77.43950	77.44520	0.93827
6	pi+	1	211	482	0	0	0	0.10875	0.01953	-14.05262	14.05375	0.13957
7	gamma	1	22	483	0	0	0	0.05404	0.12285	-7.74359	7.74475	0.00000
8	gamma	1	22	483	0	0	0	0.08813	0.02493	-2.27189	2.27374	0.00000
9	n0	1	2112	484	0	0	0	0.46428	0.86387	-187.38218	187.38710	0.93957
0	(pi0)	2	111	484	0	710	720	0.05706	0.27421	-54.02488	54.02576	0.13498



1	gamma	1	22	219	0	0	0	-0.11997	-0.23654	-2.69528	2.70829	0.00000
2	gamma	1	22	219	0	0	0	-0.14656	-0.09819	-1.24290	1.25536	0.00000
3	pi+	1	211	220	0	0	0	0.37756	-0.38648	-3.89820	3.93794	0.13957
4	pi-	1	-211	220	0	0	0	0.62099	-0.17485	-6.53135	6.56461	0.13957
5	(pi0)	2	111	220	0	687	688	0.43769	-0.01359	-2.37305	2.41688	0.13498
6	pi-	1	-211	221	0	0	0	0.34873	-0.24860	-1.46486	1.53255	0.13957
7	pi+	1	211	221	0	0	0	0.02320	-0.47009	-1.74498	1.81272	0.13957
8	(pi0)	2	111	221	0	689	690	0.00247	0.05546	-0.51957	0.53968	0.13498
9	pi-	1	-211	222	0	0	0	0.66137	-0.41711	-5.02198	5.08440	0.13957
10	(pi0)	2	111	222	0	691	692	0.45991	0.16366	-5.98753	6.00891	0.13498
11	n~0	1	-2112	225	0	0	0	1.44624	-0.72147	-32.81881	32.87201	0.93957
12	pi+	1	211	225	0	0	0	0.17321	0.12653	-3.97109	3.97933	0.13957
13	K+	1	321	226	0	0	0	0.67941	-0.07383	-13.31007	13.33674	0.49360
14	pi-	1	-211	226	0	0	0	0.67783	-0.38451	-6.03973	6.09139	0.13957
15	(Lambda0)	2	3122	227	0	693	694	1.12557	0.82508	-39.25191	39.29256	1.11568
16	pi-	1	-211	227	0	0	0	0.26380	0.02723	-8.91414	8.91918	0.13957
17	(pi0)	2	111	231	0	695	696	0.18704	0.05014	-15.44949	15.45129	0.13498
18	(pi0)	2	111	231	0	697	698	0.22062	-0.08981	-25.43226	25.43373	0.13498
19	(pi0)	2	111	231	0	699	700	0.40963	0.03191	-20.04904	20.05370	0.13498
20	pi+	1	211	232	0	0	0	1.28826	0.34632	-35.17513	35.20069	0.13957
21	pi-	1	-211	232	0	0	0	0.31086	0.04347	-24.85993	24.86230	0.13957
22	gamma	1	22	233	0	0	0	-0.10620	0.07567	-2.22710	2.23092	0.00000
23	gamma	1	22	233	0	0	0	-0.03425	0.12301	-4.78593	4.78763	0.00000
24	(K~0)	2	-311	236	0	701	701	-0.22214	0.23277	-8.26320	8.28442	0.49767
25	pi-	1	-211	236	0	0	0	-0.00881	-0.05644	-9.70755	9.70873	0.13957
26	(K0)	2	311	237	0	702	702	0.90702	-0.25205	-28.61742	28.63723	0.49767
27	pi+	1	211	237	0	0	0	0.01804	0.16298	-9.00269	9.00526	0.13957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9 gamma 1 22 354 0 0 0 -0.11743 -1.12847 45.93321 45.94722 0.00000
0 gamma 1 22 354 0 0 0 -0.01956 -0.01423 0.94141 0.94172 0.00000
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2 gamma 1 22 356 0 0 0 -0.08185 -0.34445 6.28044 6.29840 0.00000
3 (KS0) 2 310 357 0 699 700 -0.63666 -2.27995 33.43289 33.52029 0.49767
3 (KS0) 2 310 357 0 699 700 -0.63666 -2.27995 33.43289 33.52029 0.49767
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5 gamma 1 22 358 0 0 0 -0.11326 -0.28211 6.45870 6.46585 0.00000
6 gamma 1 22 360 0 0 0 -0.14884 -0.38444 12.15156 12.15655 0.00000
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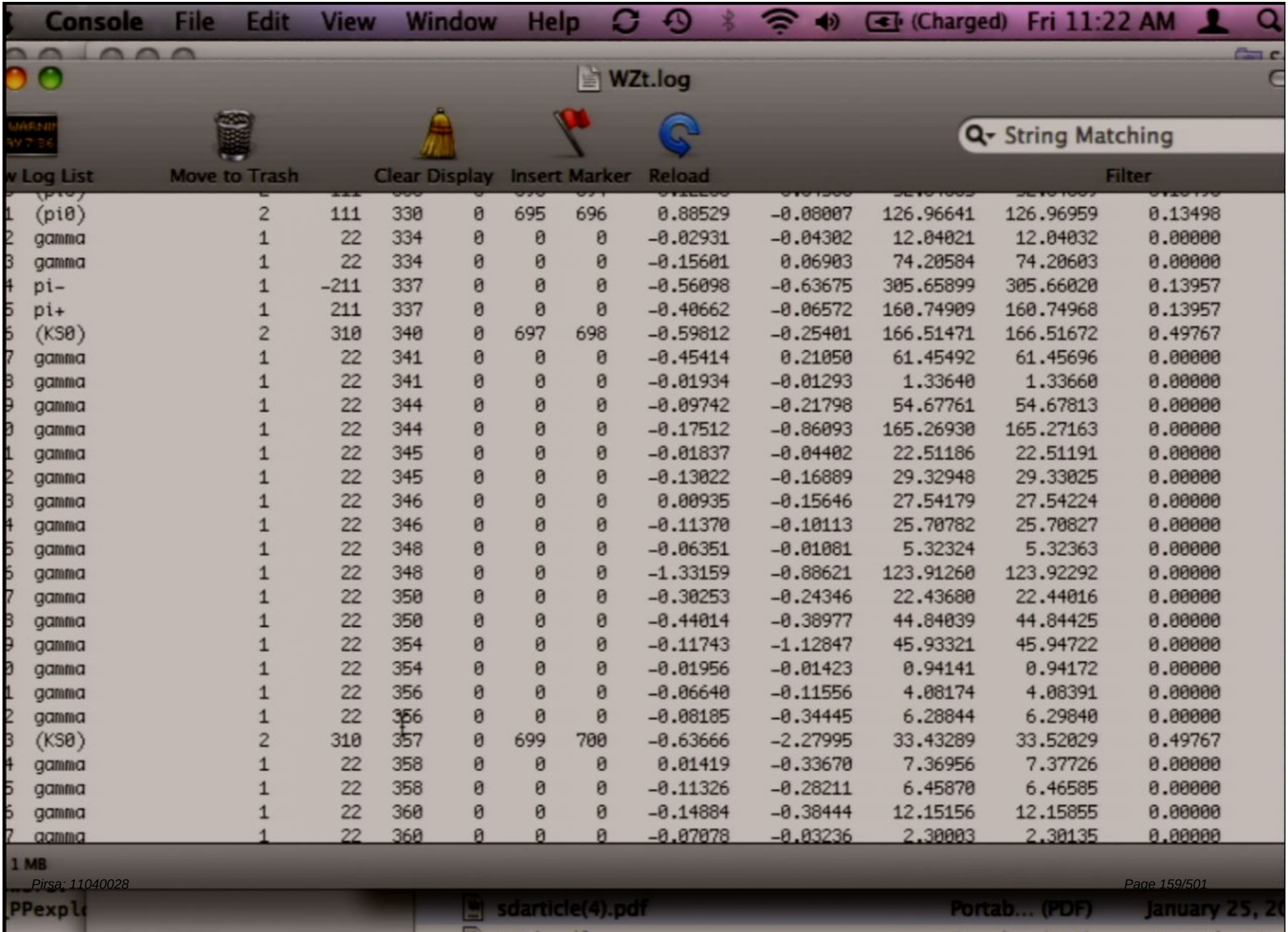
Portab... (PDF)
January 25, 2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3 gamma 1 22 334 0 0 0 -0.15601 0.06903 74.20584 74.20603 0.00000
4 pi- 1 -211 337 0 0 0 -0.56098 -0.63675 305.65899 305.66020 0.13957
5 pi+ 1 211 337 0 0 0 -0.40662 -0.06572 160.74909 160.74968 0.13957
6 (KS0) 2 310 340 0 697 698 -0.59812 -0.25401 166.51471 166.51672 0.49767
7 gamma 1 22 341 0 0 0 -0.45414 0.21050 61.45492 61.45696 0.00000
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9 gamma 1 22 344 0 0 0 -0.09742 -0.21798 54.67761 54.67813 0.00000
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4 gamma 1 22 346 0 0 0 -0.11370 -0.10113 25.70782 25.70827 0.00000
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8 gamma 1 22 350 0 0 0 -0.44014 -0.38977 44.84039 44.84425 0.00000
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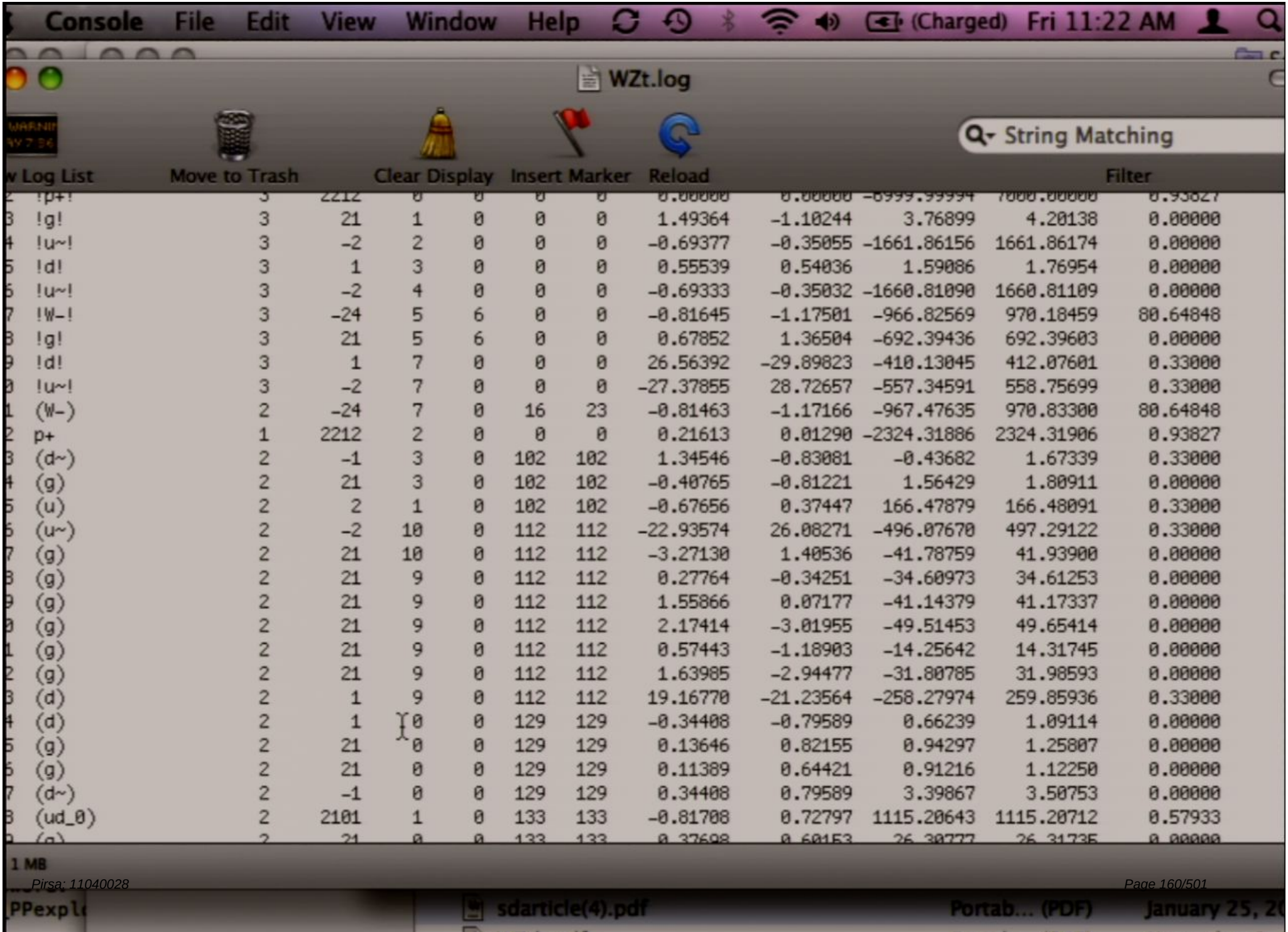
January 25, 2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!u~! 3 -2 2 0 0 0 -0.69377 -0.35055 -1661.86156 1661.86174 0.00000
!d! 3 1 3 0 0 0 0.55539 0.54036 1.59086 1.76954 0.00000
!u~! 3 -2 4 0 0 0 -0.69333 -0.35032 -1660.81090 1660.81109 0.00000
!W-! 3 -24 5 6 0 0 -0.81645 -1.17501 -966.82569 970.18459 80.64848
!g! 3 21 5 6 0 0 0.67852 1.36504 -692.39436 692.39603 0.00000
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p+ 1 2212 2 0 0 0 0.21613 0.01290 -2324.31886 2324.31906 0.93827
(d~) 2 -1 3 0 102 102 1.34546 -0.83081 -0.43682 1.67339 0.33000
(g) 2 21 3 0 102 102 -0.40765 -0.81221 1.56429 1.80911 0.00000
(u) 2 2 1 0 102 102 -0.67656 0.37447 166.47879 166.48091 0.33000
(u~) 2 -2 10 0 112 112 -22.93574 26.08271 -496.07670 497.29122 0.33000
(g) 2 21 10 0 112 112 -3.27130 1.40536 -41.78759 41.93900 0.00000
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(d) 2 1 9 0 112 112 19.16770 -21.23564 -258.27974 259.85936 0.33000
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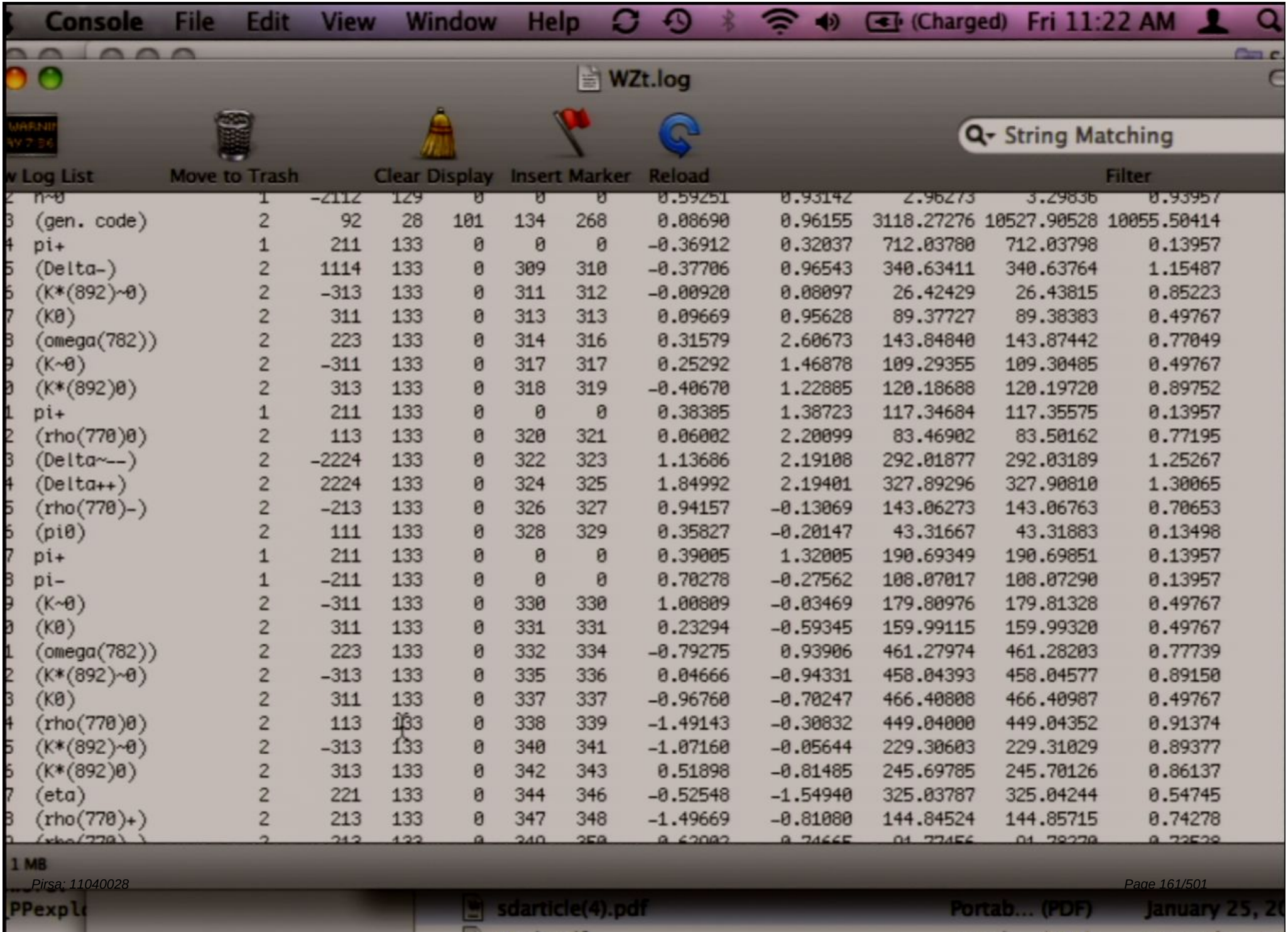
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(gen. code) 2 92 28 101 134 268 0.08690 0.96155 3118.27276 10527.90528 10055.50414
pi+ 1 211 133 0 0 0 -0.36912 0.32037 712.03780 712.03798 0.13957
(Delta-) 2 1114 133 0 309 310 -0.37706 0.96543 340.63411 340.63764 1.15487
(K*(892)~0) 2 -313 133 0 311 312 -0.00920 0.08097 26.42429 26.43815 0.85223
(K0) 2 311 133 0 313 313 0.09669 0.95628 89.37727 89.38383 0.49767
(omega(782)) 2 223 133 0 314 316 0.31579 2.60673 143.84840 143.87442 0.77049
(K~0) 2 -311 133 0 317 317 0.25292 1.46878 109.29355 109.30485 0.49767
(K*(892)0) 2 313 133 0 318 319 -0.40670 1.22885 120.18688 120.19720 0.89752
pi+ 1 211 133 0 0 0 0.38385 1.38723 117.34684 117.35575 0.13957
(rho(770)0) 2 113 133 0 320 321 0.06002 2.20099 83.46902 83.50162 0.77195
(Delta~--) 2 -2224 133 0 322 323 1.13686 2.19108 292.01877 292.03189 1.25267
(Delta++) 2 2224 133 0 324 325 1.84992 2.19401 327.89296 327.90810 1.30065
(rho(770)-) 2 -213 133 0 326 327 0.94157 -0.13069 143.06273 143.06763 0.70653
(pi0) 2 111 133 0 328 329 0.35827 -0.20147 43.31667 43.31883 0.13498
pi+ 1 211 133 0 0 0 0.39005 1.32005 190.69349 190.69851 0.13957
pi- 1 -211 133 0 0 0 0.70278 -0.27562 108.07017 108.07290 0.13957
(K~0) 2 -311 133 0 330 330 1.00809 -0.03469 179.80976 179.81328 0.49767
(K0) 2 311 133 0 331 331 0.23294 -0.59345 159.99115 159.99320 0.49767
(omega(782)) 2 223 133 0 332 334 -0.79275 0.93906 461.27974 461.28203 0.77739
(K*(892)~0) 2 -313 133 0 335 336 0.04666 -0.94331 458.04393 458.04577 0.89150
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(K*(892)0) 2 313 133 0 342 343 0.51898 -0.81485 245.69785 245.70126 0.86137
(eta) 2 221 133 0 344 346 -0.52548 -1.54940 325.03787 325.04244 0.54745
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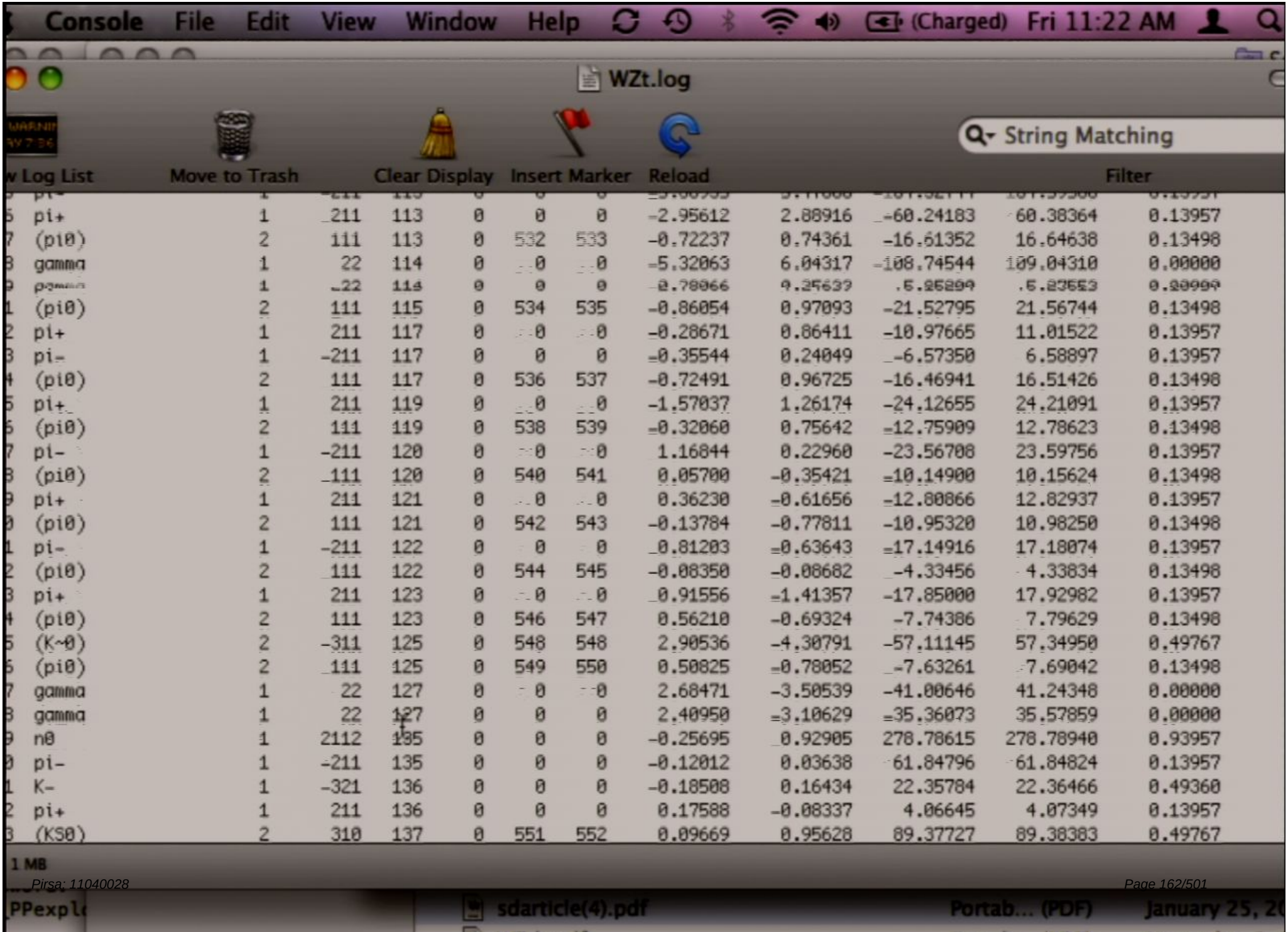

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7	(pi0)	2	111	113	0	532	533	-0.72237	0.74361	-16.61352	16.64638	0.13498
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1	(pi0)	2	111	115	0	534	535	-0.86054	0.97093	-21.52795	21.56744	0.13498
2	pi+	1	211	117	0	0	0	-0.28671	0.86411	-10.97665	11.01522	0.13957
3	pi-	1	-211	117	0	0	0	-0.35544	0.24049	-6.57350	6.58897	0.13957
4	(pi0)	2	111	117	0	536	537	-0.72491	0.96725	-16.46941	16.51426	0.13498
5	pi+	1	211	119	0	0	0	-1.57037	1.26174	-24.12655	24.21091	0.13957
6	(pi0)	2	111	119	0	538	539	-0.32060	0.75642	-12.75909	12.78623	0.13498
7	pi-	1	-211	120	0	0	0	1.16844	0.22960	-23.56708	23.59756	0.13957
8	(pi0)	2	111	120	0	540	541	0.05700	-0.35421	-10.14900	10.15624	0.13498
9	pi+	1	211	121	0	0	0	0.36230	-0.61656	-12.80866	12.82937	0.13957
0	(pi0)	2	111	121	0	542	543	-0.13784	-0.77811	-10.95320	10.98250	0.13498
1	pi-	1	-211	122	0	0	0	-0.81203	-0.63643	-17.14916	17.18074	0.13957
2	(pi0)	2	111	122	0	544	545	-0.08350	-0.08682	-4.33456	4.33834	0.13498
3	pi+	1	211	123	0	0	0	-0.91556	-1.41357	-17.85000	17.92982	0.13957
4	(pi0)	2	111	123	0	546	547	0.56210	-0.69324	-7.74386	7.79629	0.13498
5	(K~0)	2	-311	125	0	548	548	2.90536	-4.30791	-57.11145	57.34950	0.49767
6	(pi0)	2	111	125	0	549	550	0.50825	-0.78052	-7.63261	7.69042	0.13498
7	gamma	1	22	127	0	0	0	2.68471	-3.50539	-41.00646	41.24348	0.00000
8	gamma	1	22	127	0	0	0	2.40950	-3.10629	-35.36073	35.57859	0.00000
9	n0	1	2112	135	0	0	0	-0.25695	0.92905	278.78615	278.78940	0.93957
0	pi-	1	-211	135	0	0	0	-0.12012	0.03638	61.84796	61.84824	0.13957
1	K-	1	-321	136	0	0	0	-0.18508	0.16434	22.35784	22.36466	0.49360
2	pi+	1	211	136	0	0	0	0.17588	-0.08337	4.06645	4.07349	0.13957
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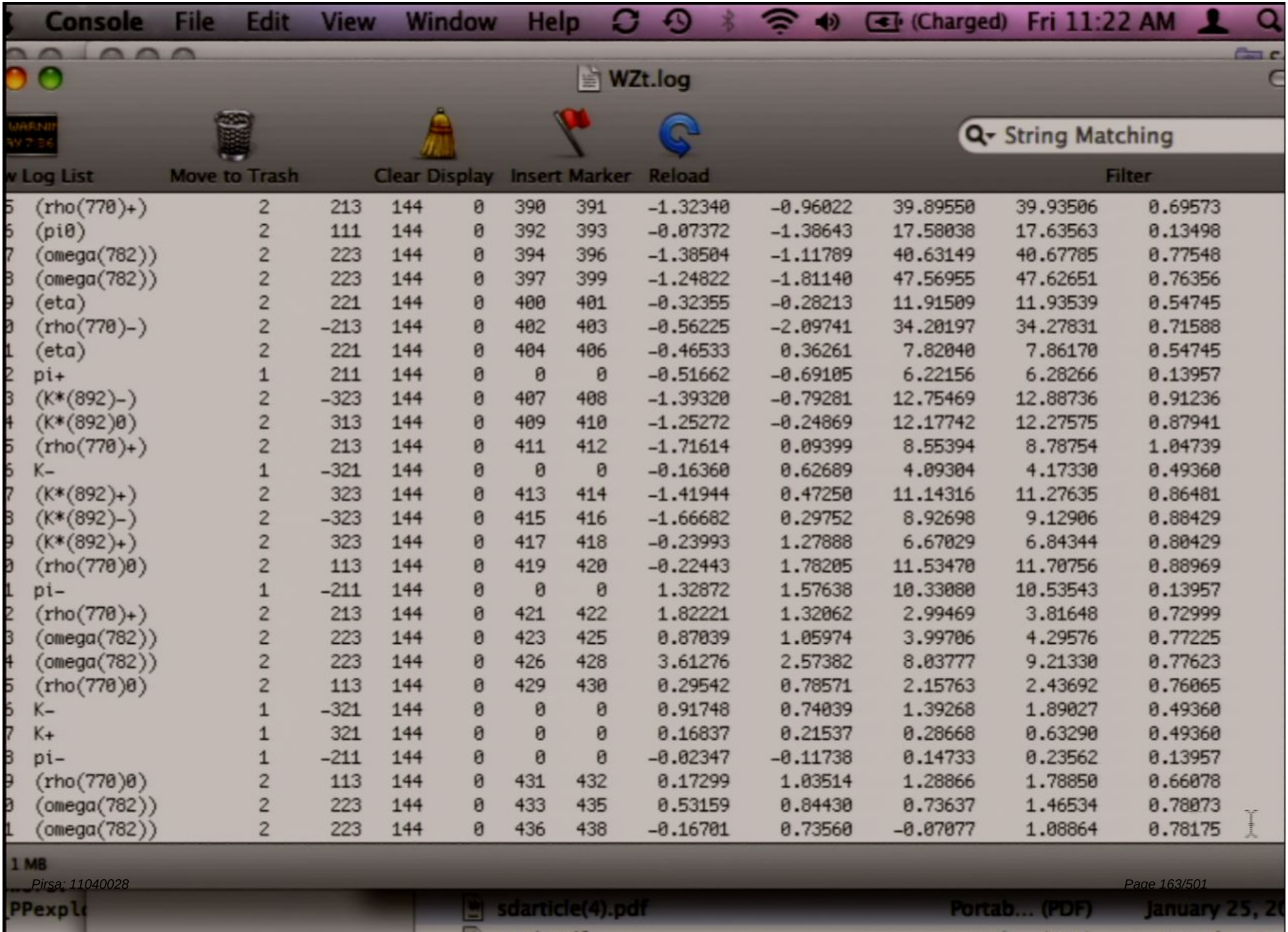
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6 (pi0) 2 111 144 0 392 393 -0.07372 -1.38643 17.58038 17.63563 0.13498
7 (omega(782)) 2 223 144 0 394 396 -1.38504 -1.11789 40.63149 40.67785 0.77548
8 (omega(782)) 2 223 144 0 397 399 -1.24822 -1.81140 47.56955 47.62651 0.76356
9 (eta) 2 221 144 0 400 401 -0.32355 -0.28213 11.91509 11.93539 0.54745
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1 (eta) 2 221 144 0 404 406 -0.46533 0.36261 7.82040 7.86170 0.54745
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3 (K*(892)-) 2 -323 144 0 407 408 -1.39320 -0.79281 12.75469 12.88736 0.91236
4 (K*(892)0) 2 313 144 0 409 410 -1.25272 -0.24869 12.17742 12.27575 0.87941
5 (rho(770)+) 2 213 144 0 411 412 -1.71614 0.09399 8.55394 8.78754 1.04739
6 K- 1 -321 144 0 0 0 -0.16360 0.62689 4.09304 4.17330 0.49360
7 (K*(892)+) 2 323 144 0 413 414 -1.41944 0.47250 11.14316 11.27635 0.86481
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1 pi- 1 -211 144 0 0 0 1.32872 1.57638 10.33080 10.53543 0.13957
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3 (omega(782)) 2 223 144 0 423 425 0.87039 1.05974 3.99706 4.29576 0.77225
4 (omega(782)) 2 223 144 0 426 428 3.61276 2.57382 8.03777 9.21330 0.77623
5 (rho(770)0) 2 113 144 0 429 430 0.29542 0.78571 2.15763 2.43692 0.76065
6 K- 1 -321 144 0 0 0 0.91748 0.74039 1.39268 1.89027 0.49360
7 K+ 1 321 144 0 0 0 0.16837 0.21537 0.28668 0.63290 0.49360
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9 (rho(770)0) 2 113 144 0 431 432 0.17299 1.03514 1.28866 1.78850 0.66078
0 (omega(782)) 2 223 144 0 433 435 0.53159 0.84430 0.73637 1.46534 0.78073
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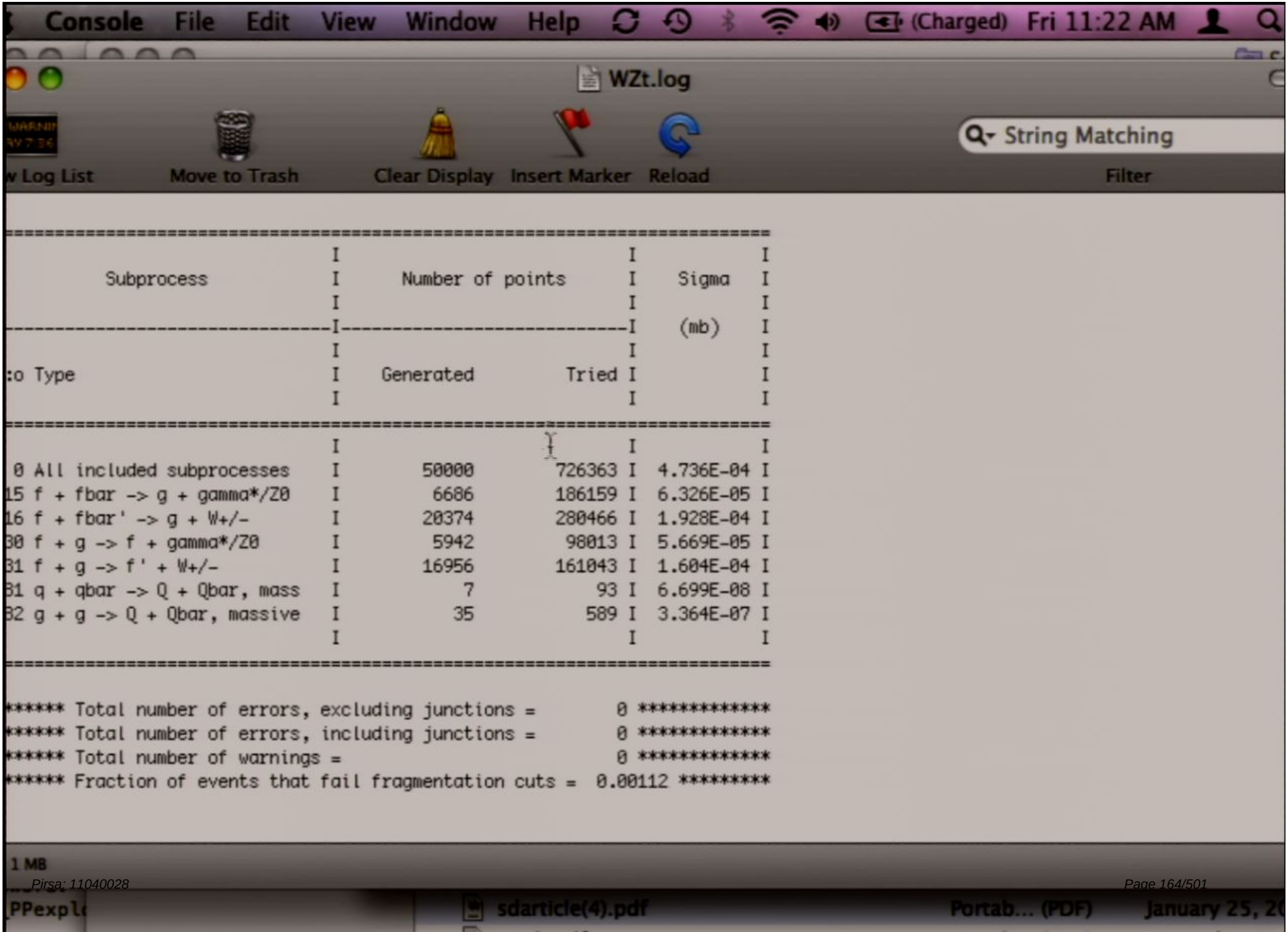

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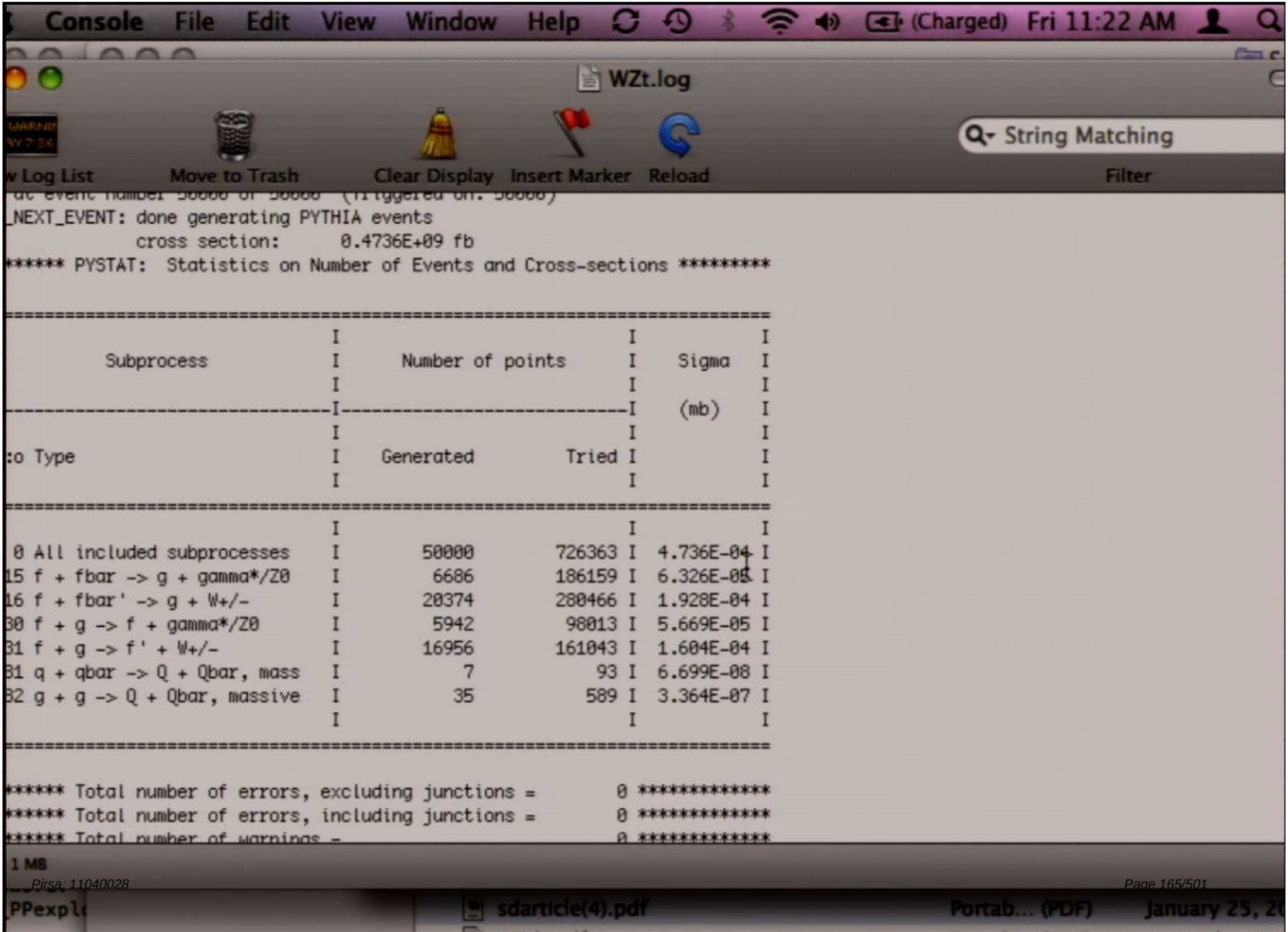
16 f + fbar' -> g + W+/-	20374	280466	1.928E-04
30 f + g -> f + gamma*/Z0	5942	98013	5.669E-05
31 f + g -> f' + W+/-	16956	161043	1.604E-04
81 q + qbar -> Q + Qbar, mass	7	93	6.699E-08
82 g + g -> Q + Qbar, massive	35	589	3.364E-07

****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
****** Fraction of events that fail fragmentation cuts = 0.00112 *********


Console File Edit View Window Help (Charged) Fri 11:22 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Console File Edit View Window Help (Charged) Fri 11:22 AM

WZt.log

Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
            cross section:      0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********

=============================================================================
                              I                             I            I
        Subprocess            I      Number of points       I    Sigma   I
                              I                             I            I
------------------------------I-----------------------------I    (mb)    I
                              I                             I            I
:o Type                       I    Generated         Tried  I            I
                              I                             I            I
=============================================================================
                              I                             I            I
 0 All included subprocesses  I       50000         726363  I  4.736E-04 I
15 f + fbar -> g + gamma*/Z0  I        6686         186159  I  6.326E-05 I
16 f + fbar' -> g + W+/-      I       20374         280466  I  1.928E-04 I
30 f + g -> f + gamma*/Z0     I        5942          98013  I  5.669E-05 I
31 f + g -> f' + W+/-         I       16956         161043  I  1.604E-04 I
81 q + qbar -> Q + Qbar, mass I           7             93  I  6.699E-08 I
82 g + g -> Q + Qbar, massive I          35            589  I  3.364E-07 I
                              I                             I            I
=============================================================================

****** Total number of errors, excluding junctions =        0 *************
****** Total number of errors, including junctions =        0 *************
****** Total number of warnings =                           0 *************
```

1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2

Console File Edit View Window Help (Charged) Fri 11:22 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
            cross section:      0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********


============================================================================
                                 I                            I            I
           Subprocess            I      Number of points      I    Sigma   I
                                 I                            I            I
---------------------------------I----------------------------I    (mb)    I
                                 I                            I            I
:o Type                          I    Generated         Tried I            I
                                 I                            I            I
============================================================================
                                 I                            I            I
 0 All included subprocesses     I       50000         726363 I  4.736E-04 I
15 f + fbar -> g + gamma*/Z0     I        6686         186159 I  6.326E-05 I
16 f + fbar' -> g + W+/-         I       20374         280466 I  1.928E-04 I
30 f + g -> f + gamma*/Z0        I        5942          98013 I  5.669E-05 I
31 f + g -> f' + W+/-            I       16956         161043 I  1.604E-04 I
81 q + qbar -> Q + Qbar, mass    I           7             93 I  6.699E-08 I
82 g + g -> Q + Qbar, massive    I          35            589 I  3.364E-07 I
                                 I                            I            I
============================================================================

****** Total number of errors, excluding junctions =        0 *************
****** Total number of errors, including junctions =        0 *************
****** Total number of warnings =                           0 *************
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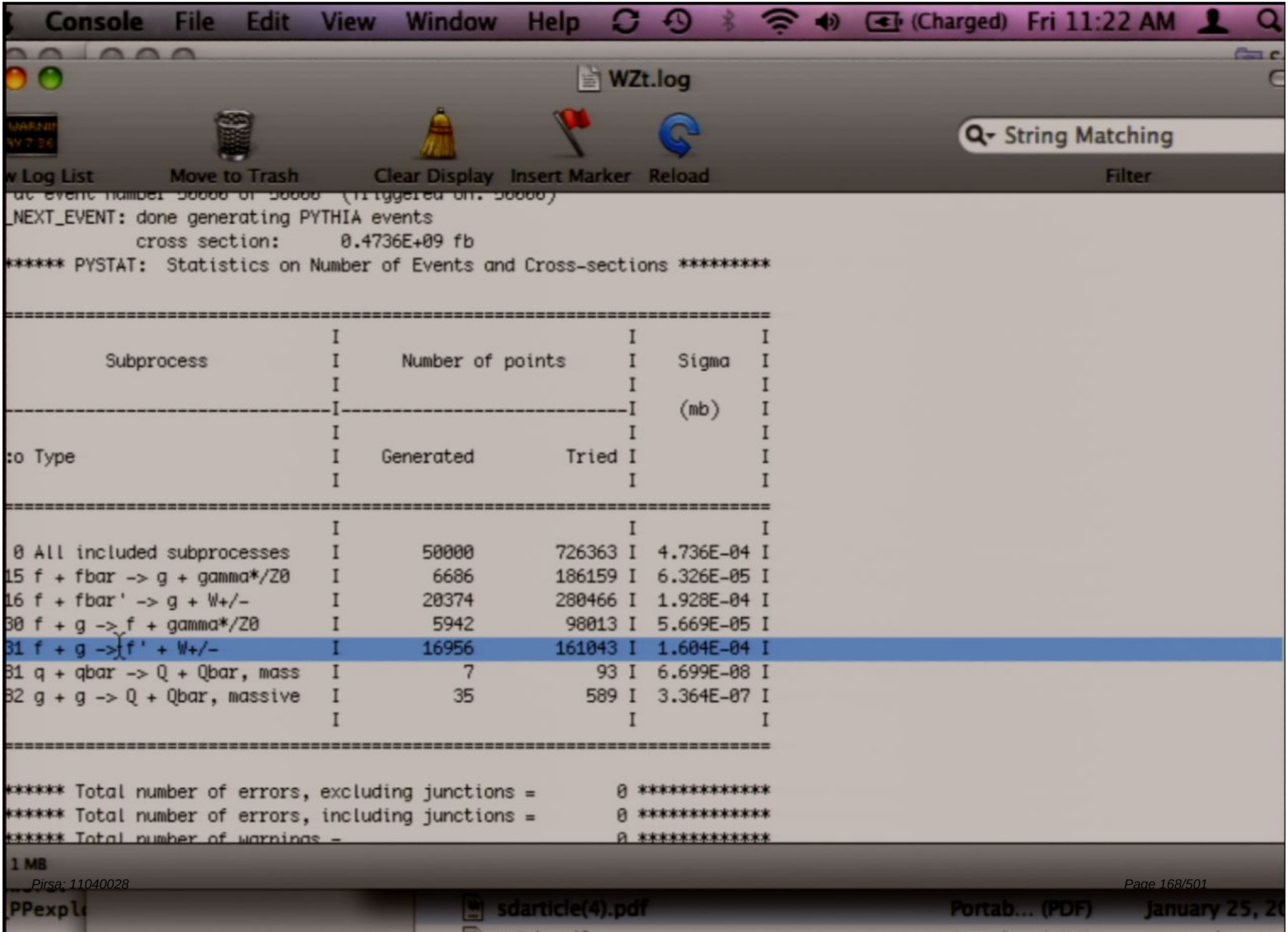
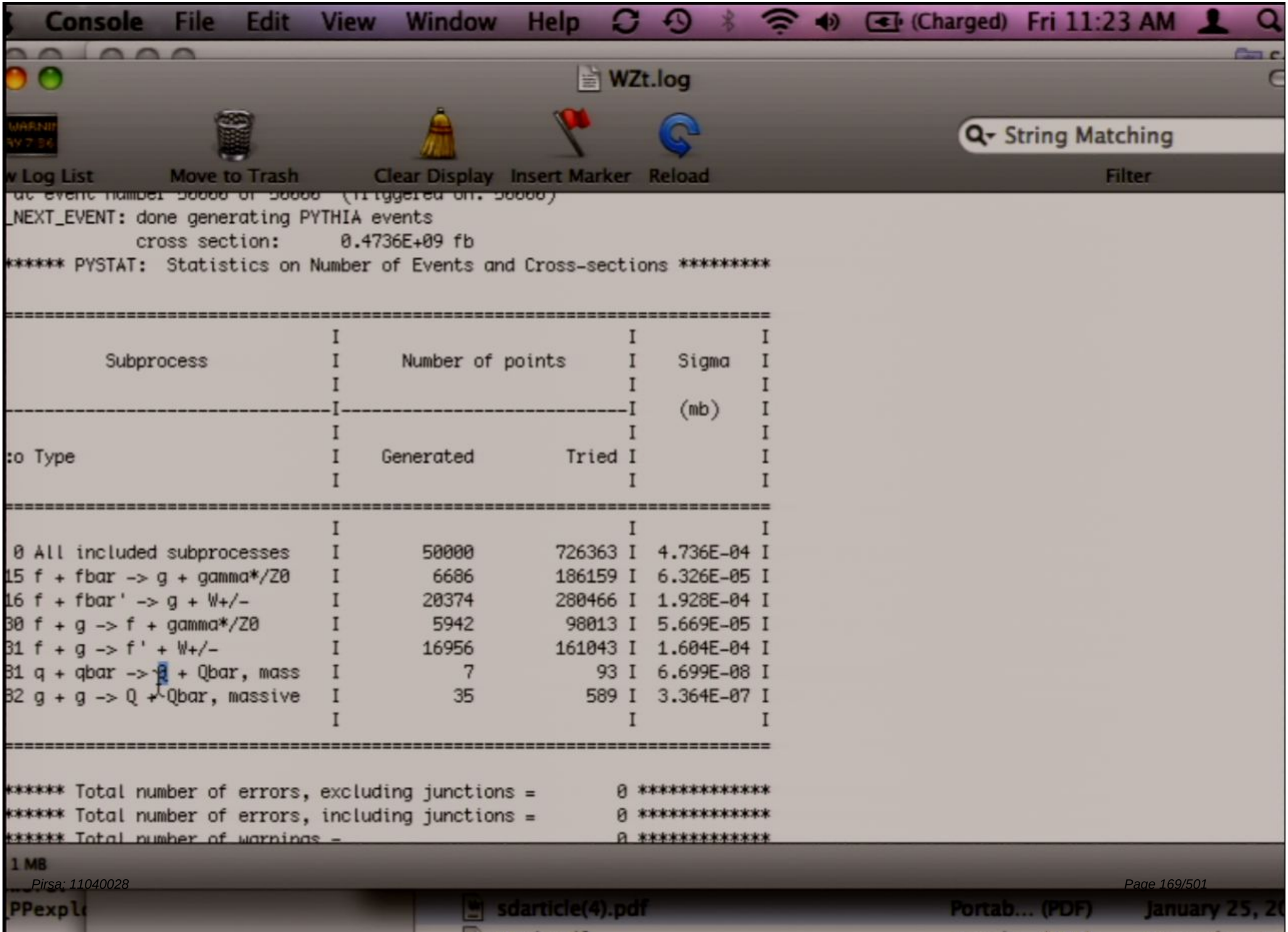
1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:22 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 20


Console File Edit View Window Help (Charged) Fri 11:23 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 20

Console File Edit View Window Help (Charged) Fri 11:23 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==========================================================================
                             I                            I            I
        Subprocess           I      Number of points      I   Sigma    I
                             I                            I            I
-----------------------------I----------------------------I    (mb)    I
                             I                            I            I
:o Type                      I    Generated        Tried I            I
                             I                            I            I
==========================================================================
                             I                            I            I
 0 All included subprocesses I       50000       726363 I  4.736E-04 I
15 f + fbar -> g + gamma*/Z0 I        6686       186159 I  6.326E-05 I
16 f + fbar' -> g + W+/-     I       20374       280466 I  1.928E-04 I
30 f + g -> f + gamma*/Z0    I        5942        98013 I  5.669E-05 I
31 f + g -> f' + W+/-        I       16956       161043 I  1.604E-04 I
81 q + qbar -> Q + Qbar, mass I          7           93 I  6.699E-08 I
82 g + g -> Q + Qbar, massive I         35          589 I  3.364E-07 I
                             I                            I            I
==========================================================================

****** Total number of errors, excluding junctions =        0 *************
****** Total number of errors, including junctions =        0 *************
****** Total number of warnings =                           0 *************
****** Fraction of events that fail fragmentation cuts =  0.00112 *********
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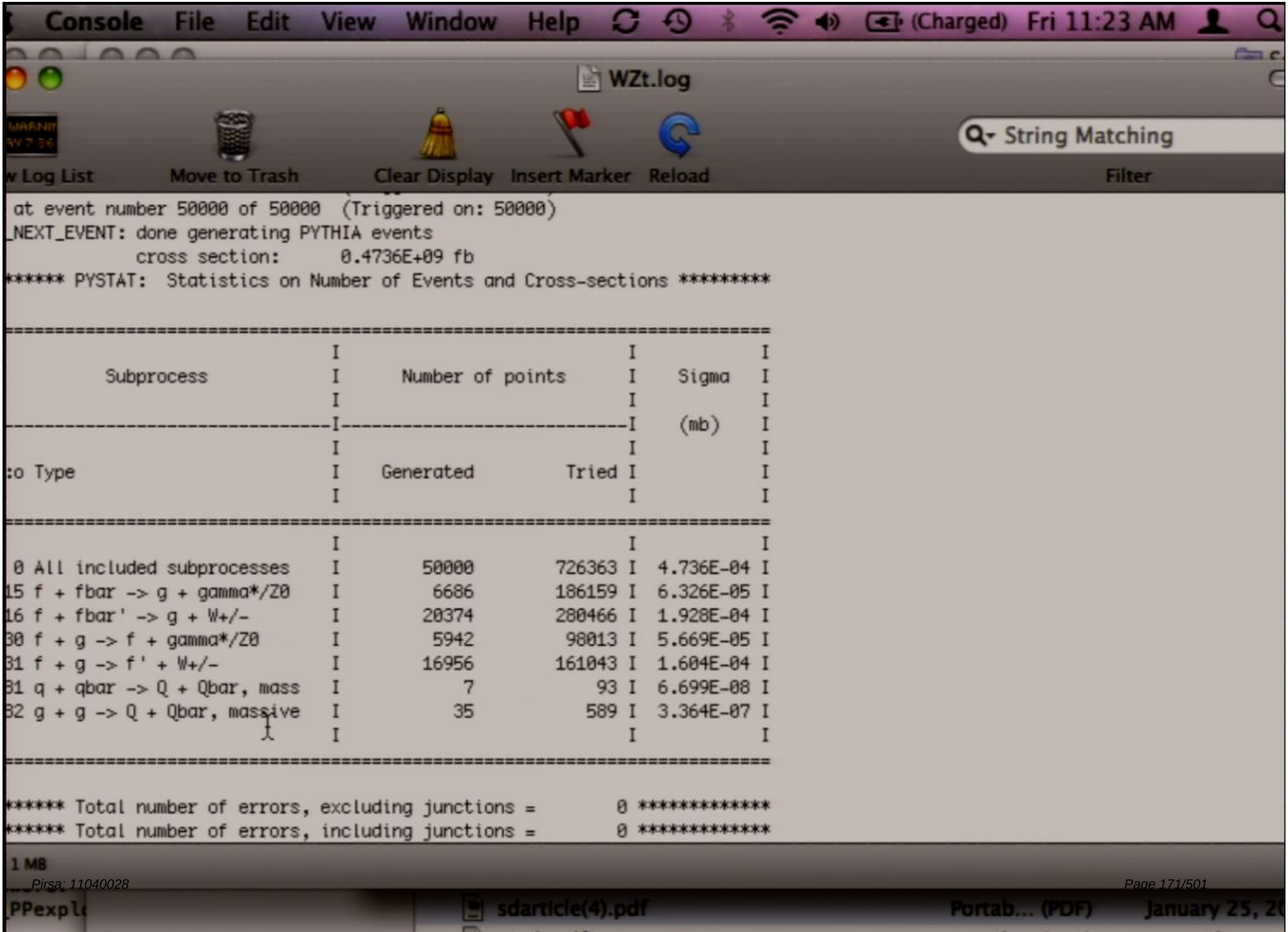
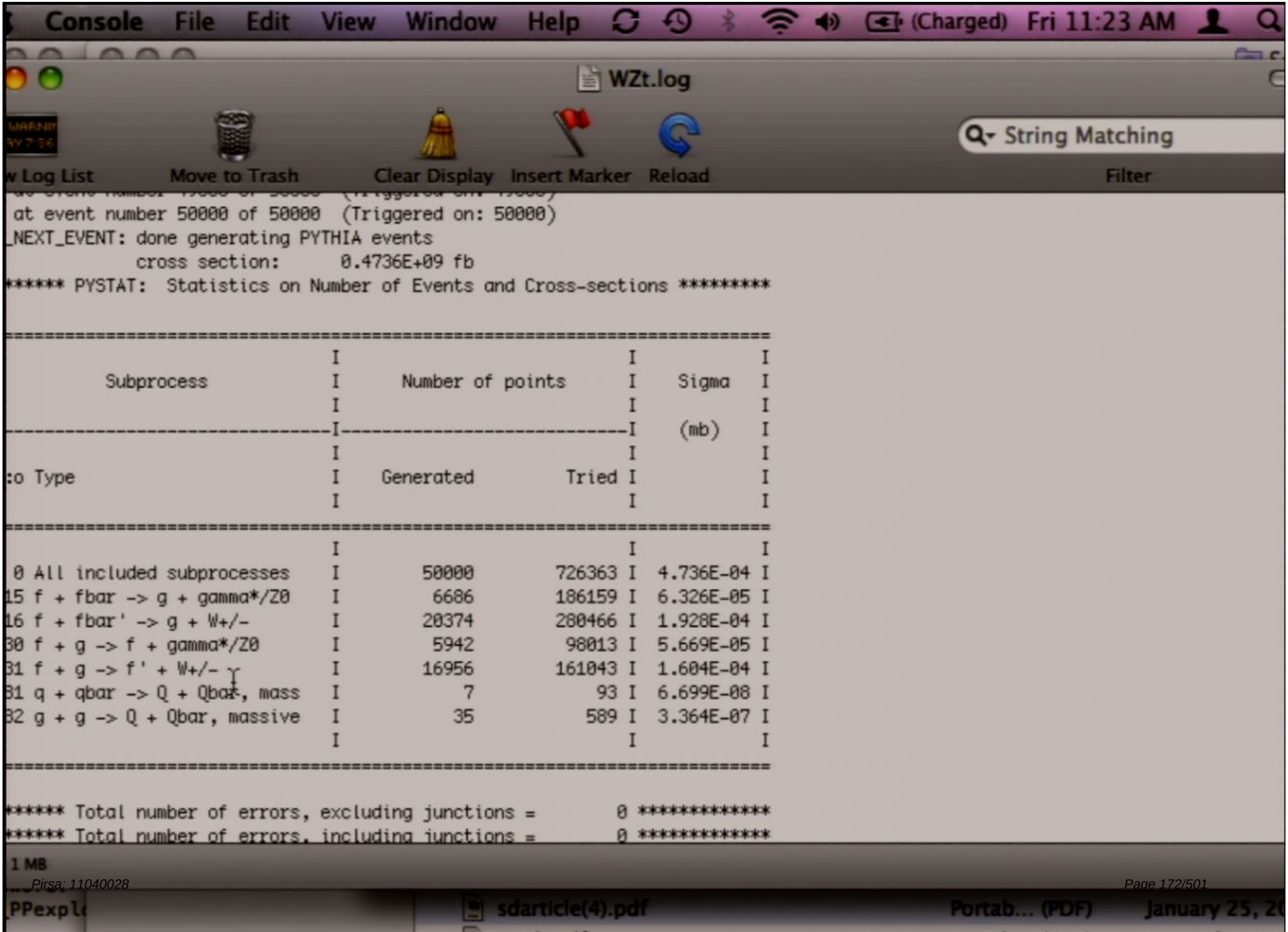
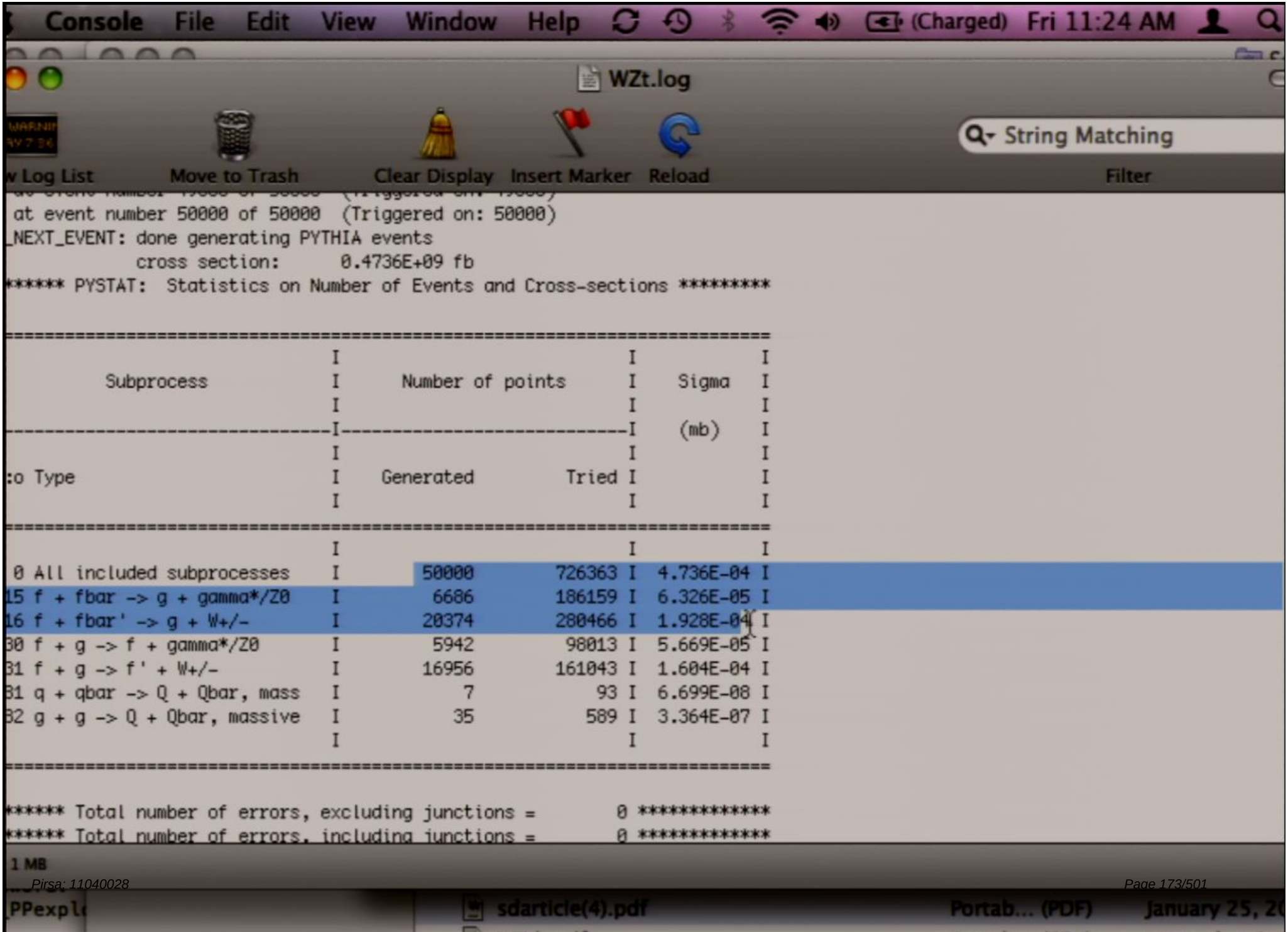
1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:23 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:23 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:24 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Console File Edit View Window Help (Charged) Fri 11:24 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 50000 of 50000  (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
          cross section:      0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********

==========================================================================
                            I                            I           I
        Subprocess          I     Number of points       I   Sigma   I
                            I                            I           I
----------------------------I----------------------------I   (mb)    I
                            I                            I           I
:o Type                     I    Generated         Tried I           I
                            I                            I           I
==========================================================================
                            I                            I           I
 0 All included subprocesses I        50000       726363 I 4.736E-04 I
15 f + fbar -> g + gamma*/Z0 I         6686       186159 I 6.326E-05 I
16 f + fbar' -> g + W+/-     I        20374       280466 I 1.928E-04 I
30 f + g -> f + gamma*/Z0    I         5942        98013 I 5.669E-05 I
31 f + g -> f' + W+/-        I        16956       161043 I 1.604E-04 I
81 q + qbar -> Q + Qbar, mass I            7           93 I 6.699E-08 I
82 g + g -> Q + Qbar, massive I           35          589 I 3.364E-07 I
                            I                            I           I
==========================================================================

****** Total number of errors, excluding junctions =       0 *************
****** Total number of errors, including junctions =       0 *************
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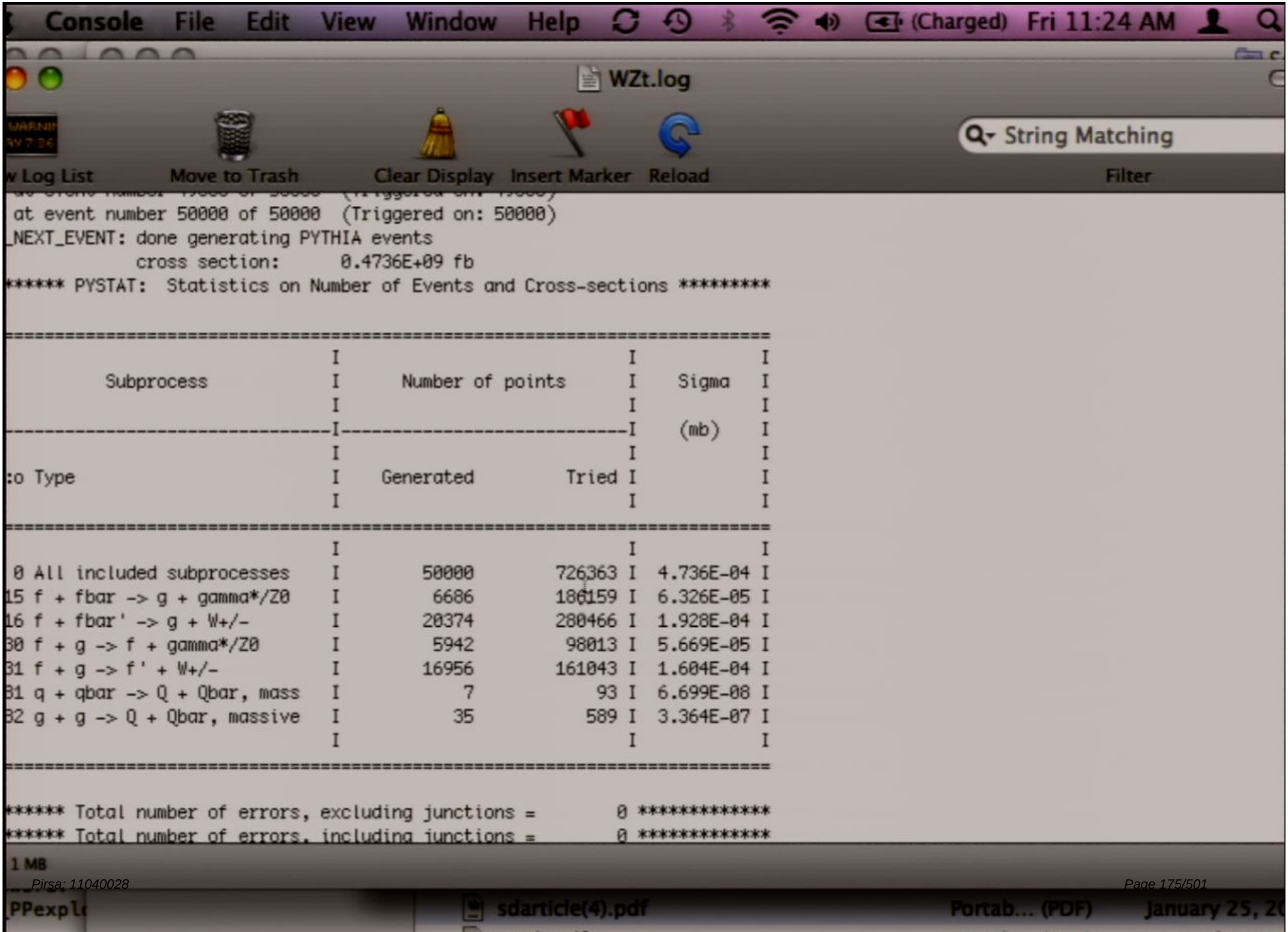
1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:24 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Console File Edit View Window Help (Charged) Fri 11:24 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 50000 of 50000  (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
          cross section:      0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********

==============================================================================
                              I                              I           I
         Subprocess           I       Number of points       I   Sigma   I
                              I                              I           I
------------------------------I------------------------------I   (mb)    I
                              I                              I           I
:o Type                       I    Generated           Tried I           I
                              I                              I           I
==============================================================================
                              I                              I           I
 0 All included subprocesses  I       50000           726363 I  4.736E-04 I
15 f + fbar -> g + gamma*/Z0  I        6686           186159 I  6.326E-05 I
16 f + fbar' -> g + W+/-      I       20374           280466 I  1.928E-04 I
30 f + g -> f + gamma*/Z0     I        5942            98013 I  5.669E-05 I
31 f + g -> f' + W+/-         I       16956           161043 I  1.604E-04 I
81 q + qbar -> Q + Qbar, mass I           7               93 I  6.699E-08 I
82 g + g -> Q + Qbar, massive I          35              589 I  3.364E-07 I
                              I                              I           I
==============================================================================

****** Total number of errors, excluding junctions =        0 *************
****** Total number of errors, including junctions =        0 *************
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1 MB

PPexpl | sdarticle(4).pdf | Portab... (PDF) | January 25, 2

Console File Edit View Window Help (Charged) Fri 11:24 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
 at event number 50000 of 50000  (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
           cross section:      0.4736E+09 fb
****** PYSTAT:  Statistics on Number of Events and Cross-sections *********

===========================================================================
                              I                        I           I
         Subprocess           I     Number of points   I   Sigma   I
                              I                        I           I
------------------------------I------------------------I   (mb)    I
                              I                        I           I
:o Type                       I   Generated      Tried I           I
                              I                        I           I
===========================================================================
                              I                        I           I
 0 All included subprocesses  I      50000      726363 I 4.736E-04 I
15 f + fbar -> g + gamma*/Z0  I       6686      186159 I 6.326E-05 I
16 f + fbar' -> g + W+/-      I      20374      280466 I 1.928E-04 I
30 f + g -> f + gamma*/Z0     I       5942       98013 I 5.669E-05 I
31 f + g -> f' + W+/-         I      16956      161043 I 1.604E-04 I
81 q + qbar -> Q + Qbar, mass I          7          93 I 6.699E-08 I
82 g + g -> Q + Qbar, massive I         35         589 I 3.364E-07 I
                              I                        I           I
===========================================================================

****** Total number of errors, excluding junctions =       0 *************
****** Total number of errors, including junctions =       0 *************
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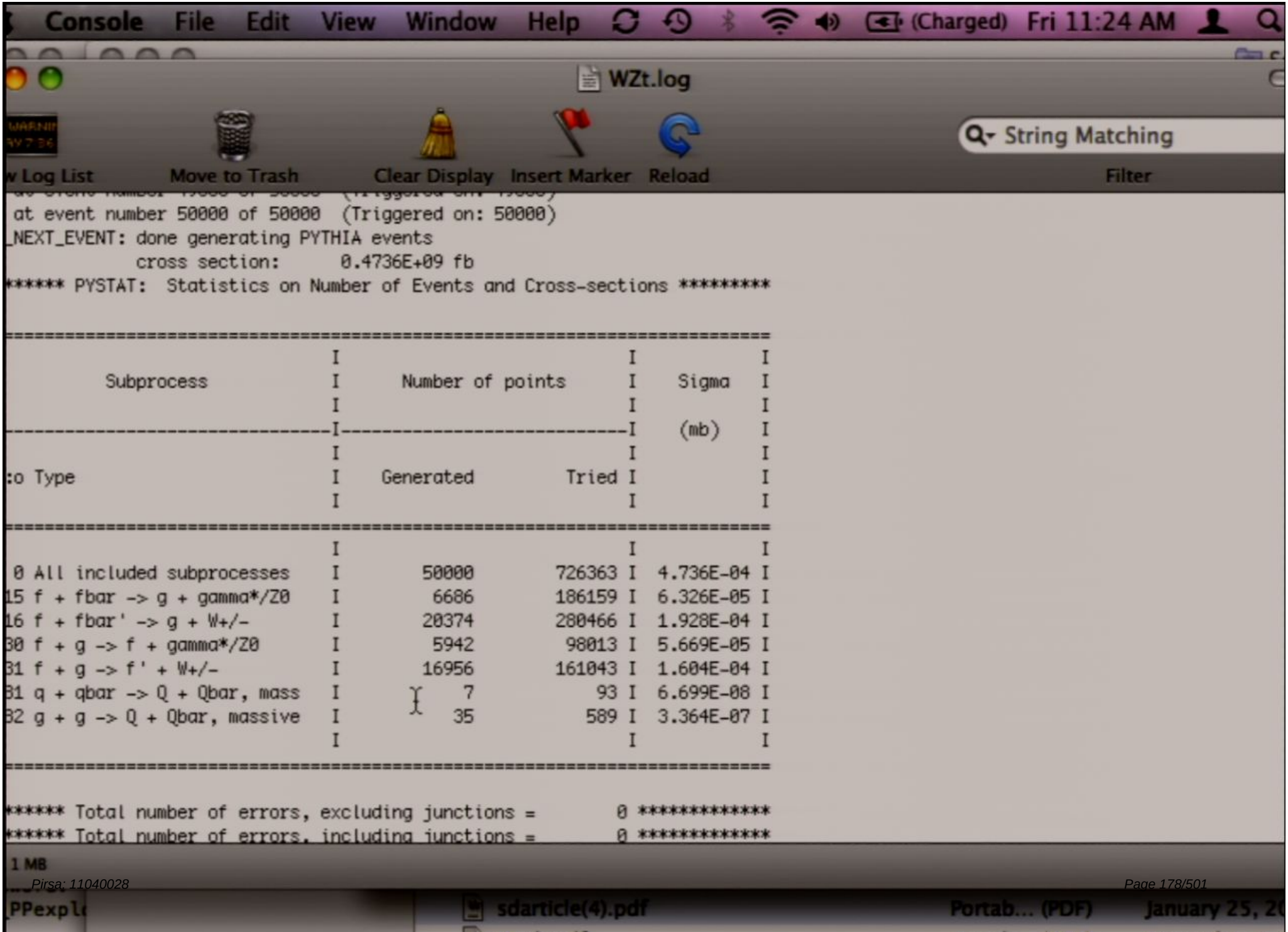
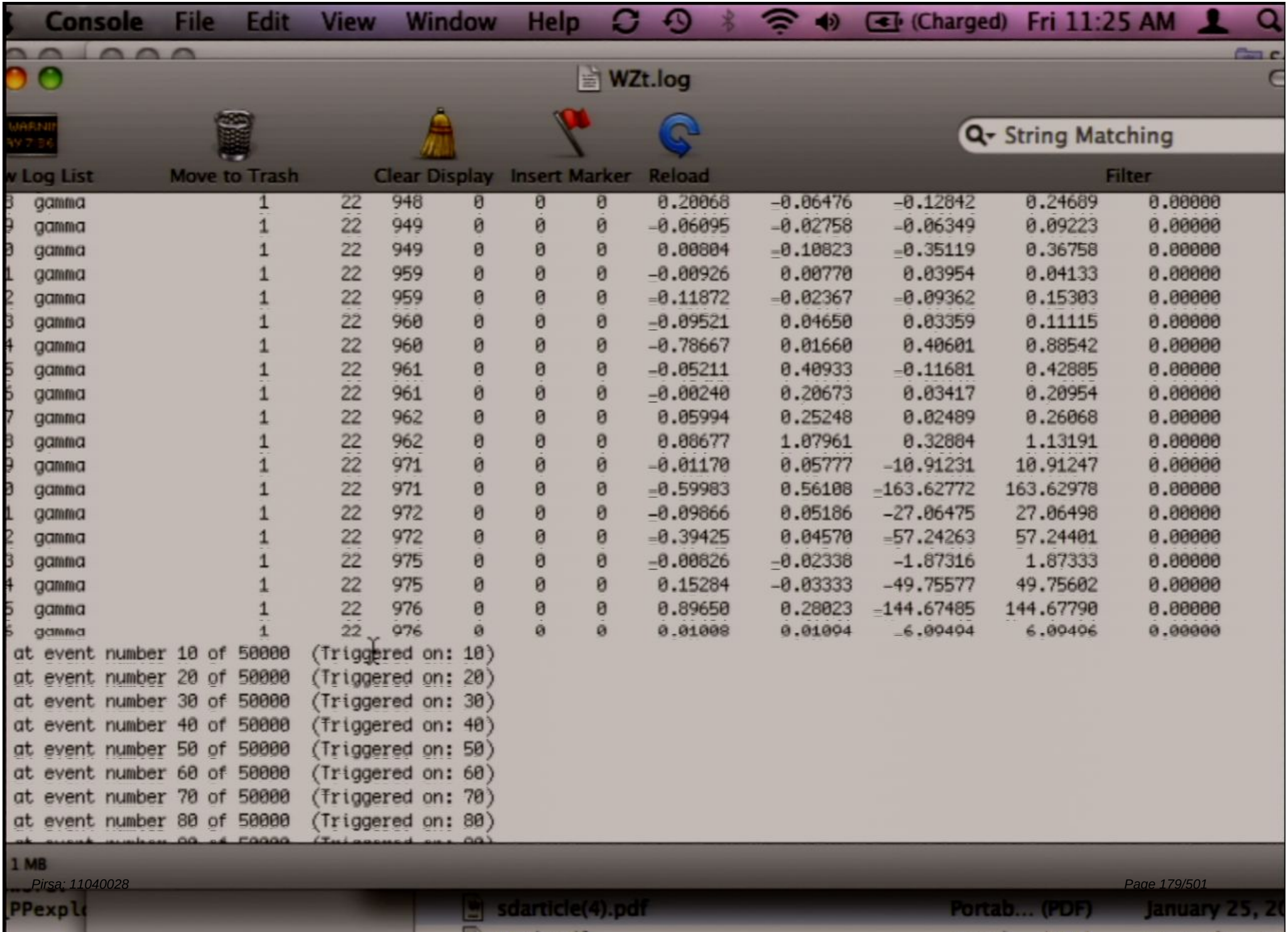
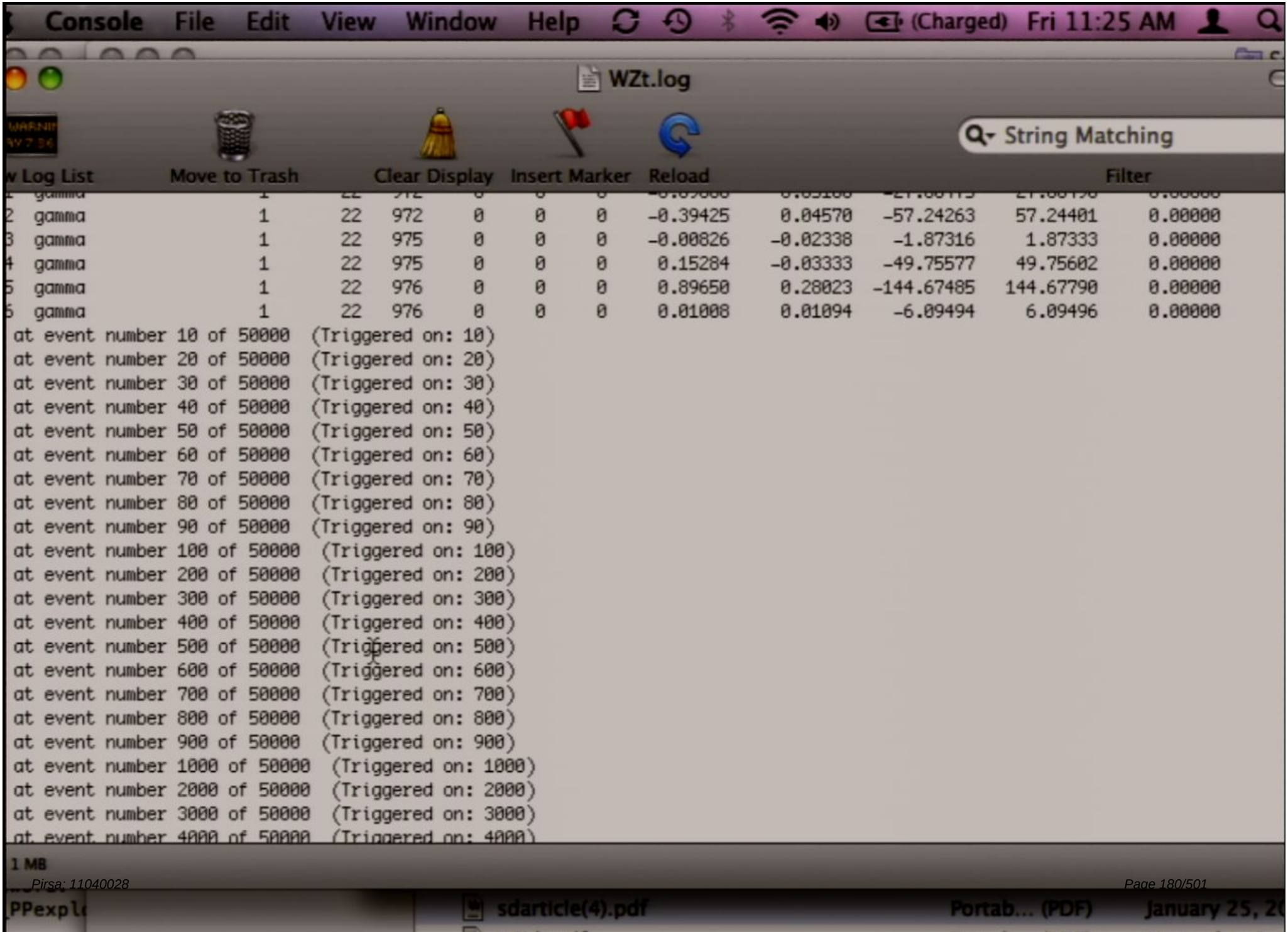
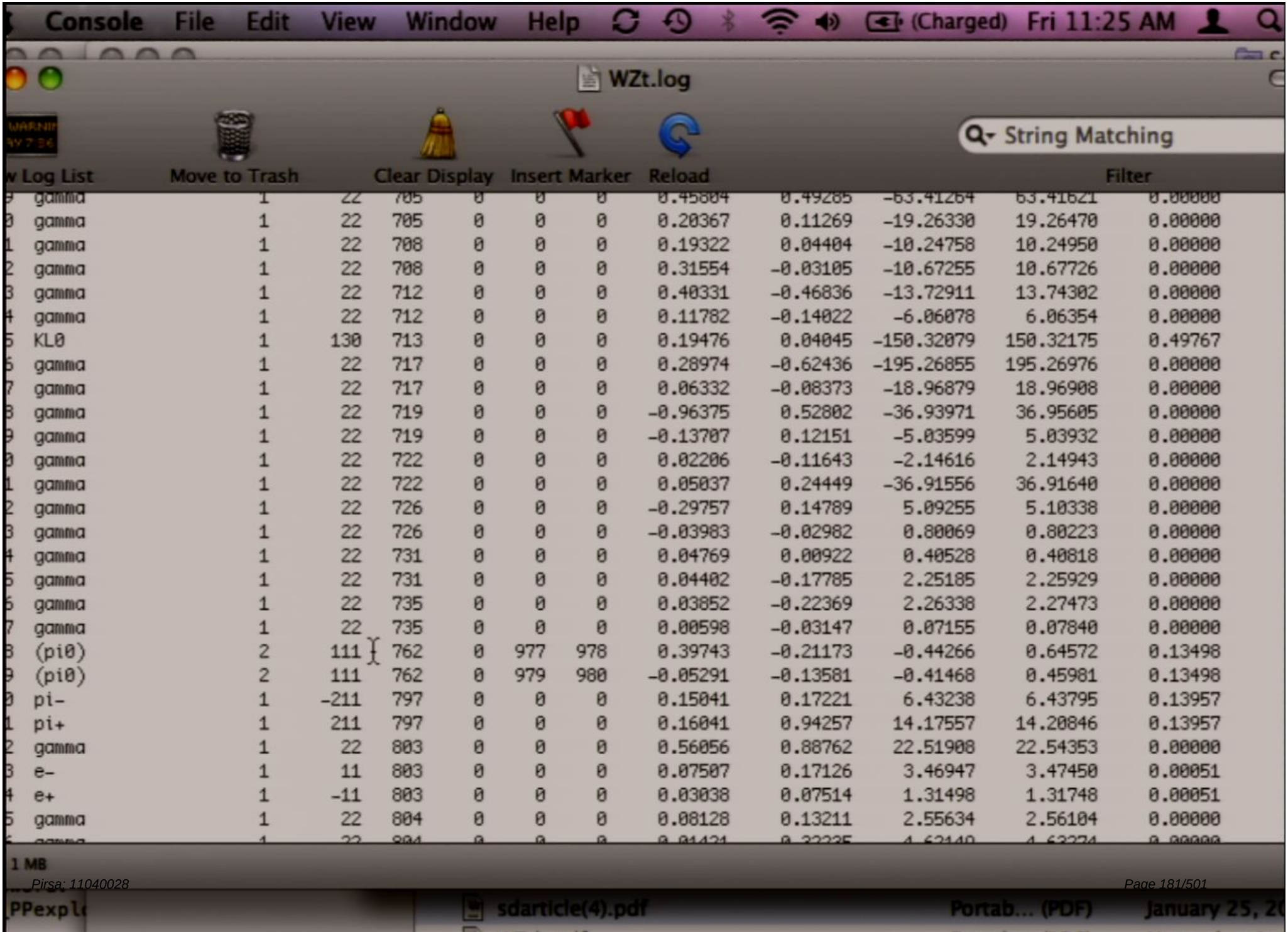
1 MB

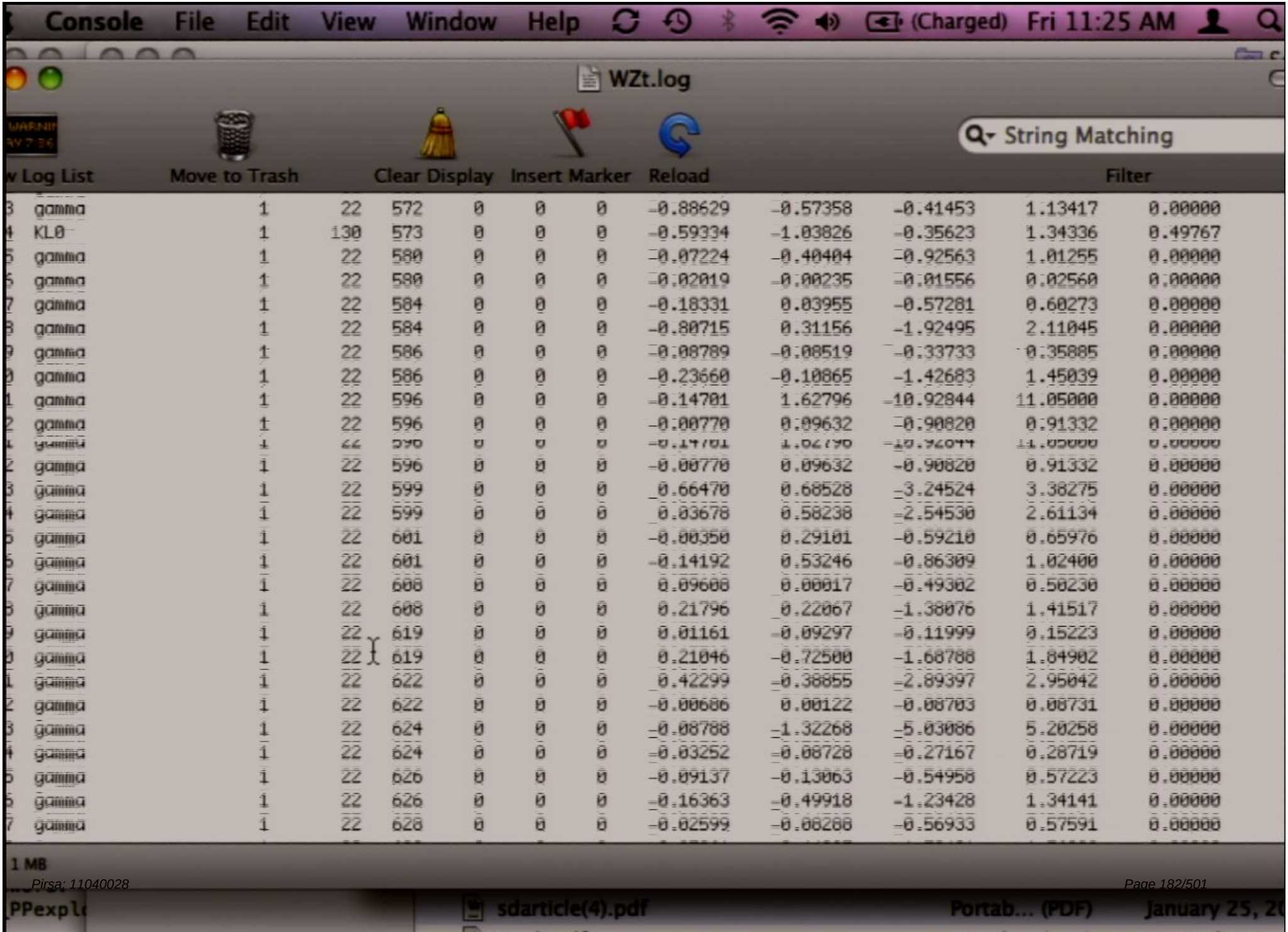
PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2


Console File Edit View Window Help (Charged) Fri 11:24 AM
WZt.log
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
at event number 50000 of 50000 (Triggered on: 50000)
_NEXT_EVENT: done generating PYTHIA events
cross section: 0.4736E+09 fb
****** PYSTAT: Statistics on Number of Events and Cross-sections *********
Subprocess
Number of points
Sigma
(mb)
:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma*/Z0 6686 186159 6.326E-05
16 f + fbar' -> g + W+/- 20374 280466 1.928E-04
30 f + g -> f + gamma*/Z0 5942 98013 5.669E-05
31 f + g -> f' + W+/- 16956 161043 1.604E-04
81 q + qbar -> Q + Qbar, mass 7 93 6.699E-08
82 g + g -> Q + Qbar, massive 35 589 3.364E-07
****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:25 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
3 gamma 1 22 948 0 0 0 0.20068 -0.06476 -0.12842 0.24689 0.00000
9 gamma 1 22 949 0 0 0 -0.06095 -0.02758 -0.06349 0.09223 0.00000
0 gamma 1 22 949 0 0 0 0.00804 -0.10823 -0.35119 0.36758 0.00000
1 gamma 1 22 959 0 0 0 -0.00926 0.00770 0.03954 0.04133 0.00000
2 gamma 1 22 959 0 0 0 -0.11872 -0.02367 -0.09362 0.15303 0.00000
3 gamma 1 22 960 0 0 0 -0.09521 0.04650 0.03359 0.11115 0.00000
4 gamma 1 22 960 0 0 0 -0.78667 0.01660 0.40601 0.88542 0.00000
5 gamma 1 22 961 0 0 0 -0.05211 0.40933 -0.11681 0.42885 0.00000
6 gamma 1 22 961 0 0 0 -0.00240 0.20673 0.03417 0.20954 0.00000
7 gamma 1 22 962 0 0 0 0.05994 0.25248 0.02489 0.26068 0.00000
8 gamma 1 22 962 0 0 0 0.00677 1.07961 0.32884 1.13191 0.00000
9 gamma 1 22 971 0 0 0 -0.01170 0.05777 -10.91231 10.91247 0.00000
0 gamma 1 22 971 0 0 0 -0.59983 0.56108 -163.62772 163.62978 0.00000
1 gamma 1 22 972 0 0 0 -0.09866 0.05186 -27.06475 27.06498 0.00000
2 gamma 1 22 972 0 0 0 -0.39425 0.04570 -57.24263 57.24401 0.00000
3 gamma 1 22 975 0 0 0 -0.00826 -0.02338 -1.87316 1.87333 0.00000
4 gamma 1 22 975 0 0 0 0.15284 -0.03333 -49.75577 49.75602 0.00000
5 gamma 1 22 976 0 0 0 0.89650 0.28023 -144.67485 144.67790 0.00000
6 gamma 1 22 976 0 0 0 0.01008 0.01004 -6.00404 6.00406 0.00000
at event number 10 of 50000 (Triggered on: 10)
at event number 20 of 50000 (Triggered on: 20)
at event number 30 of 50000 (Triggered on: 30)
at event number 40 of 50000 (Triggered on: 40)
at event number 50 of 50000 (Triggered on: 50)
at event number 60 of 50000 (Triggered on: 60)
at event number 70 of 50000 (Triggered on: 70)
at event number 80 of 50000 (Triggered on: 80)
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:25 AM
WZt.log
Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
2 gamma 1 22 972 0 0 0 -0.39425 0.04570 -57.24263 57.24401 0.00000
3 gamma 1 22 975 0 0 0 -0.00826 -0.02338 -1.87316 1.87333 0.00000
4 gamma 1 22 975 0 0 0 0.15284 -0.03333 -49.75577 49.75602 0.00000
5 gamma 1 22 976 0 0 0 0.89650 0.28023 -144.67485 144.67790 0.00000
6 gamma 1 22 976 0 0 0 0.01008 0.01094 -6.09494 6.09496 0.00000
at event number 10 of 50000 (Triggered on: 10)
at event number 20 of 50000 (Triggered on: 20)
at event number 30 of 50000 (Triggered on: 30)
at event number 40 of 50000 (Triggered on: 40)
at event number 50 of 50000 (Triggered on: 50)
at event number 60 of 50000 (Triggered on: 60)
at event number 70 of 50000 (Triggered on: 70)
at event number 80 of 50000 (Triggered on: 80)
at event number 90 of 50000 (Triggered on: 90)
at event number 100 of 50000 (Triggered on: 100)
at event number 200 of 50000 (Triggered on: 200)
at event number 300 of 50000 (Triggered on: 300)
at event number 400 of 50000 (Triggered on: 400)
at event number 500 of 50000 (Triggered on: 500)
at event number 600 of 50000 (Triggered on: 600)
at event number 700 of 50000 (Triggered on: 700)
at event number 800 of 50000 (Triggered on: 800)
at event number 900 of 50000 (Triggered on: 900)
at event number 1000 of 50000 (Triggered on: 1000)
at event number 2000 of 50000 (Triggered on: 2000)
at event number 3000 of 50000 (Triggered on: 3000)
at event number 4000 of 50000 (Triggered on: 4000)
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:25 AM
WZt.log
String Matching
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
Filter
gamma 1 22 705 0 0 0 0.45804 0.49285 -63.41264 63.41621 0.00000
gamma 1 22 705 0 0 0 0.20367 0.11269 -19.26330 19.26470 0.00000
gamma 1 22 708 0 0 0 0.19322 0.04404 -10.24758 10.24950 0.00000
gamma 1 22 708 0 0 0 0.31554 -0.03105 -10.67255 10.67726 0.00000
gamma 1 22 712 0 0 0 0.40331 -0.46836 -13.72911 13.74302 0.00000
gamma 1 22 712 0 0 0 0.11782 -0.14022 -6.06078 6.06354 0.00000
KL0 1 130 713 0 0 0 0.19476 0.04045 -150.32079 150.32175 0.49767
gamma 1 22 717 0 0 0 0.28974 -0.62436 -195.26855 195.26976 0.00000
gamma 1 22 717 0 0 0 0.06332 -0.08373 -18.96879 18.96908 0.00000
gamma 1 22 719 0 0 0 -0.96375 0.52802 -36.93971 36.95605 0.00000
gamma 1 22 719 0 0 0 -0.13707 0.12151 -5.03599 5.03932 0.00000
gamma 1 22 722 0 0 0 0.02206 -0.11643 -2.14616 2.14943 0.00000
gamma 1 22 722 0 0 0 0.05037 0.24449 -36.91556 36.91640 0.00000
gamma 1 22 726 0 0 0 -0.29757 0.14789 5.09255 5.10338 0.00000
gamma 1 22 726 0 0 0 -0.03983 -0.02982 0.80069 0.80223 0.00000
gamma 1 22 731 0 0 0 0.04769 0.00922 0.40528 0.40818 0.00000
gamma 1 22 731 0 0 0 0.04402 -0.17785 2.25185 2.25929 0.00000
gamma 1 22 735 0 0 0 0.03852 -0.22369 2.26338 2.27473 0.00000
gamma 1 22 735 0 0 0 0.00598 -0.03147 0.07155 0.07840 0.00000
(pi0) 2 111 762 0 977 978 0.39743 -0.21173 -0.44266 0.64572 0.13498
(pi0) 2 111 762 0 979 980 -0.05291 -0.13581 -0.41468 0.45981 0.13498
pi- 1 -211 797 0 0 0 0.15041 0.17221 6.43238 6.43795 0.13957
pi+ 1 211 797 0 0 0 0.16041 0.94257 14.17557 14.20846 0.13957
gamma 1 22 803 0 0 0 0.56056 0.88762 22.51908 22.54353 0.00000
e- 1 11 803 0 0 0 0.07507 0.17126 3.46947 3.47450 0.00051
e+ 1 -11 803 0 0 0 0.03038 0.07514 1.31498 1.31748 0.00051
gamma 1 22 804 0 0 0 0.08128 0.13211 2.55634 2.56104 0.00000
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2


Console File Edit View Window Help (Charged) Fri 11:25 AM
WZt.log
w Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
3 gamma 1 22 572 0 0 0 -0.88629 -0.57358 -0.41453 1.13417 0.00000
4 KL0 1 130 573 0 0 0 -0.59334 -1.03826 -0.35623 1.34336 0.49767
5 gamma 1 22 580 0 0 0 -0.07224 -0.40404 -0.92563 1.01255 0.00000
6 gamma 1 22 580 0 0 0 -0.02019 -0.00235 -0.01556 0.02560 0.00000
7 gamma 1 22 584 0 0 0 -0.18331 0.03955 -0.57281 0.60273 0.00000
8 gamma 1 22 584 0 0 0 -0.80715 0.31156 -1.92495 2.11045 0.00000
9 gamma 1 22 586 0 0 0 -0.08789 -0.08519 -0.33733 0.35885 0.00000
0 gamma 1 22 586 0 0 0 -0.23660 -0.10865 -1.42683 1.45039 0.00000
1 gamma 1 22 596 0 0 0 -0.14701 1.62796 -10.92844 11.05000 0.00000
2 gamma 1 22 596 0 0 0 -0.00770 0.09632 -0.90820 0.91332 0.00000
2 gamma 1 22 596 0 0 0 -0.00770 0.09632 -0.90820 0.91332 0.00000
3 gamma 1 22 599 0 0 0 -0.66470 0.68528 -3.24524 3.38275 0.00000
4 gamma 1 22 599 0 0 0 -0.03678 0.58238 -2.54530 2.61134 0.00000
5 gamma 1 22 601 0 0 0 -0.00350 0.29101 -0.59210 0.65976 0.00000
6 gamma 1 22 601 0 0 0 -0.14192 0.53246 -0.86309 1.02400 0.00000
7 gamma 1 22 608 0 0 0 0.09608 0.00017 -0.49302 0.50230 0.00000
8 gamma 1 22 608 0 0 0 0.21796 -0.22067 -1.38076 1.41517 0.00000
9 gamma 1 22 619 0 0 0 0.01161 -0.09297 -0.11999 0.15223 0.00000
0 gamma 1 22 619 0 0 0 0.21046 -0.72500 -1.68788 1.84902 0.00000
1 gamma 1 22 622 0 0 0 -0.42299 -0.38855 -2.89397 2.95042 0.00000
2 gamma 1 22 622 0 0 0 -0.00686 0.00122 -0.00703 0.00731 0.00000
3 gamma 1 22 624 0 0 0 -0.08788 -1.32268 -5.03086 5.20258 0.00000
4 gamma 1 22 624 0 0 0 -0.03252 -0.08728 -0.27167 0.28719 0.00000
5 gamma 1 22 626 0 0 0 -0.09137 -0.13063 -0.54958 0.57223 0.00000
6 gamma 1 22 626 0 0 0 -0.16363 -0.49918 -1.23428 1.34141 0.00000
7 gamma 1 22 628 0 0 0 -0.02599 -0.08288 -0.56933 0.57591 0.00000
1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Console File Edit View Window Help (Charged) Fri 11:25 AM

WZt.log

w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

Subprocess	Number of points		Sigma
:o Type	Generated	Tried	(mb)
0 All included subprocesses	50000	726363	4.736E-04
15 f + fbar -> g + gamma*/Z0	6686	186159	6.326E-05
16 f + fbar' -> g + W+/-	20374	280466	1.928E-04
30 f + g -> f + gamma*/Z0	5942	98013	5.669E-05
31 f + g -> f' + W+/-	16956	161043	1.604E-04
81 q + qbar -> Q + Qbar, mass	7	93	6.699E-08
82 g + g -> Q + Qbar, massive	35	589	3.364E-07

****** Total number of errors, excluding junctions = 0 **********
****** Total number of errors, including junctions = 0 **********
****** Total number of warnings = 0 **********
****** Fraction of events that fail fragmentation cuts = 0.00112 *********

1 MB

PPexpl sdarticle(4).pdf Portab... (PDF) January 25, 2(

Console File Edit View Window Help (Charged) Fri 11:25 AM

WZt.log

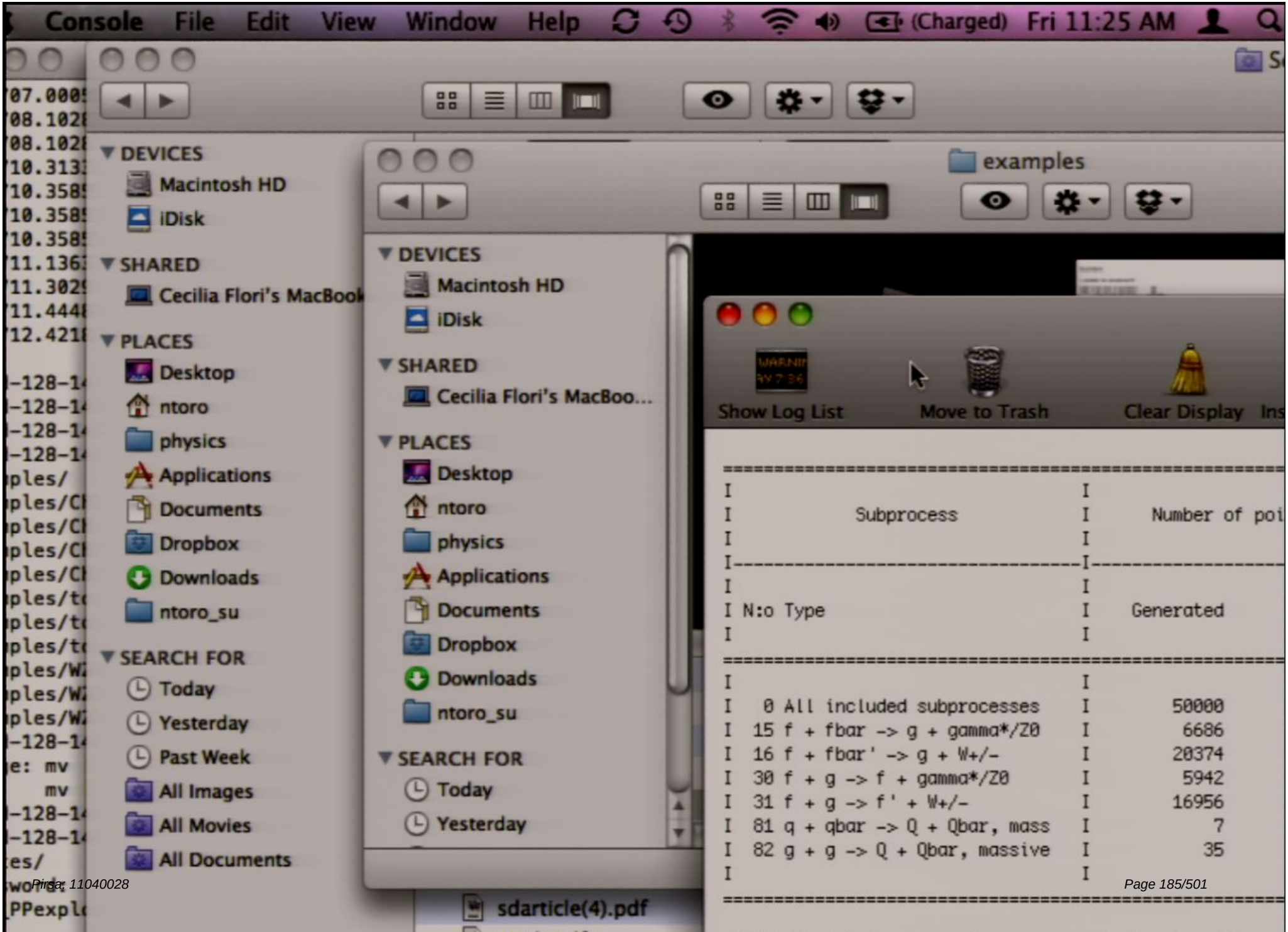
w Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

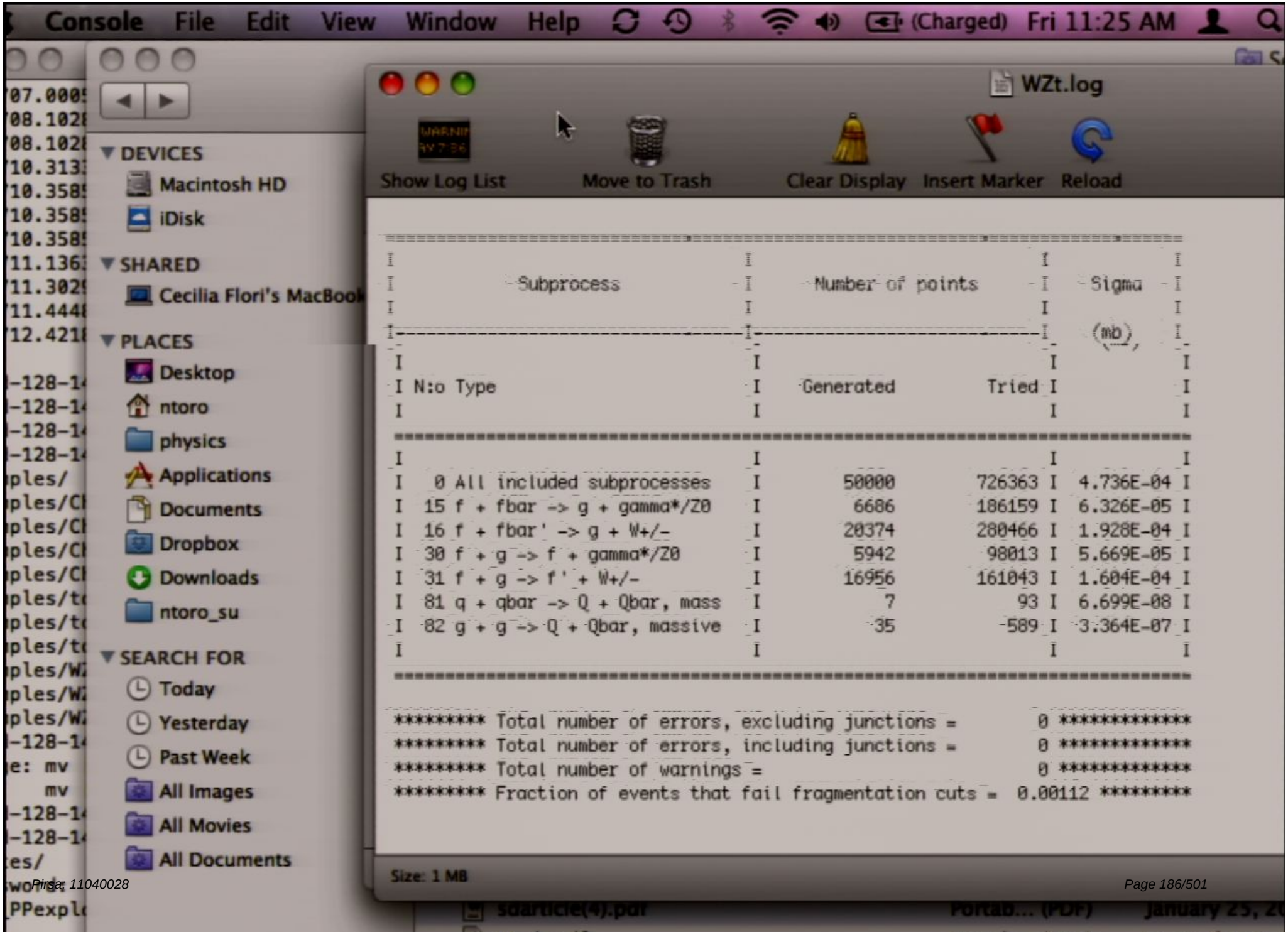
```
==========================================================================
                              I                           I           I
          Subprocess          I     Number of points      I   Sigma   I
                              I                           I           I
------------------------------I---------------------------I   (mb)    I
                              I                           I           I
:o Type                       I   Generated         Tried I           I
                              I                           I           I
==========================================================================
                              I                           I           I
 0 All included subprocesses  I       50000        726363 I 4.736E-04 I
15 f + fbar -> g + gamma*/Z0  I        6686        186159 I 6.326E-05 I
16 f + fbar' -> g + W+/-      I       20374        280466 I 1.928E-04 I
30 f + g -> f + gamma*/Z0     I        5942         98013 I 5.669E-05 I
31 f + g -> f' + W+/-         I       16956        161043 I 1.604E-04 I
81 q + qbar -> Q + Qbar, mass I           7            93 I 6.699E-08 I
82 g + g -> Q + Qbar, massive I          35           589 I 3.364E-07 I
                              I                           I           I
==========================================================================

****** Total number of errors, excluding junctions =       0 *************
****** Total number of errors, including junctions =       0 *************
****** Total number of warnings =                          0 *************
****** Fraction of events that fail fragmentation cuts =  0.00112 *********
```

1 MB

PPexpl | sdarticle(4).pdf | Portab... (PDF) | January 25, 2


Console File Edit View Window Help (Charged) Fri 11:25 AM
DEVICES
Macintosh HD
iDisk
SHARED
Cecilia Flori's MacBook
PLACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
SEARCH FOR
Today
Yesterday
Past Week
All Images
All Movies
All Documents
examples
DEVICES
Macintosh HD
iDisk
SHARED
Cecilia Flori's MacBoo...
PLACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
SEARCH FOR
Today
Yesterday
Show Log List
Move to Trash
Clear Display
Subprocess
Number of poi
N:o Type
Generated
0 All included subprocesses 50000
15 f + fbar -> g + gamma*/Z0 6686
16 f + fbar' -> g + W+/- 20374
30 f + g -> f + gamma*/Z0 5942
31 f + g -> f' + W+/- 16956
81 q + qbar -> Q + Qbar, mass 7
82 g + g -> Q + Qbar, massive 35
sdarticle(4).pdf



Subprocess		Number of points		Sigma
N:o	Type	Generated	Tried	(mb)
0	All included subprocesses	50000	726363	4.736E-04
15	f + fbar -> g + gamma*/Z0	6686	186159	6.326E-05
16	f + fbar' -> g + W+/-	20374	280466	1.928E-04
30	f + g -> f + gamma*/Z0	5942	98013	5.669E-05
31	f + g -> f' + W+/-	16956	161043	1.604E-04
81	q + qbar -> Q + Qbar, mass	7	93	6.699E-08
82	g + g -> Q + Qbar, massive	35	589	3.364E-07

********* Total number of errors, excluding junctions = 0 **********
********* Total number of errors, including junctions = 0 **********
********* Total number of warnings = 0 **********
********* Fraction of events that fail fragmentation cuts = 0.00112 *********

Console File Edit View Window Help (Charged) Fri 11:25 AM

WZt.log

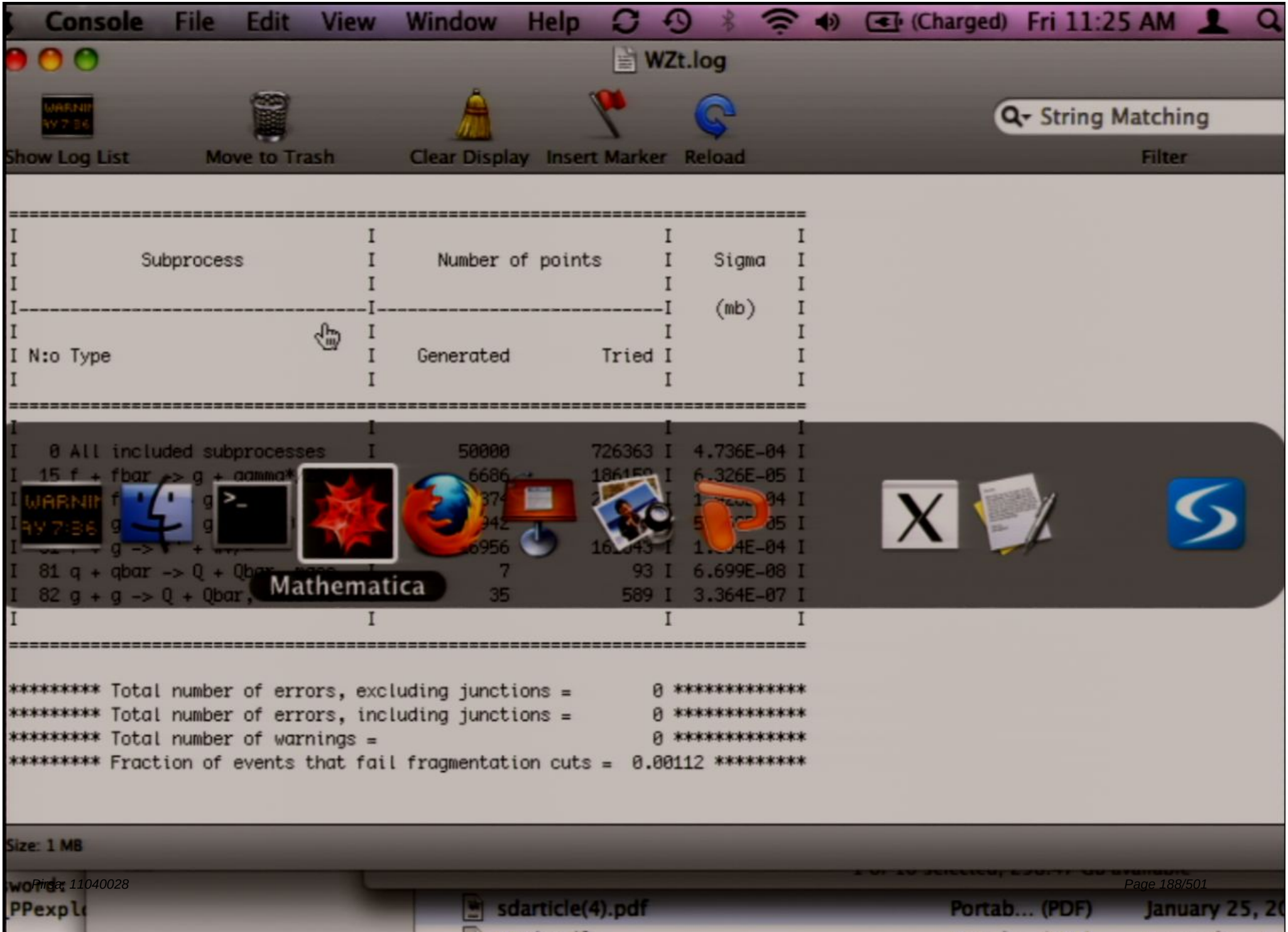
Show Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==============================================================================
I                                  I                            I            I
I            Subprocess            I      Number of points      I    Sigma   I
I                                  I                            I            I
I----------------------------------I----------------------------I    (mb)    I
I                                  I                            I            I
I N:o Type                         I    Generated         Tried I            I
I                                  I                            I            I
==============================================================================
I                                  I                            I            I
I   0 All included subprocesses    I        50000        726363 I  4.736E-04 I
I  15 f + fbar -> g + gamma*/Z0    I         6686        186159 I  6.326E-05 I
I  16 f + fbar' -> g + W+/-        I        20374        280466 I  1.928E-04 I
I  30 f + g -> f + gamma*/Z0       I         5942         98013 I  5.669E-05 I
I  31 f + g -> f' + W+/-           I        16956        161043 I  1.604E-04 I
I  81 q + qbar -> Q + Qbar, mass   I            7            93 I  6.699E-08 I
I  82 g + g -> Q + Qbar, massive   I           35           589 I  3.364E-07 I
I                                  I                            I            I
==============================================================================

********* Total number of errors, excluding junctions =        0 *************
********* Total number of errors, including junctions =        0 *************
********* Total number of warnings =                           0 *************
********* Fraction of events that fail fragmentation cuts =  0.00112 *********
```

Size: 1 MB

sdarticle(4).pdf Portab... (PDF) January 25, 20


Console File Edit View Window Help (Charged) Fri 11:25 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
Subprocess
Number of points
Sigma
(mb)
N:o Type
Generated
Tried
0 All included subprocesses 50000 726363 4.736E-04
15 f + fbar -> g + gamma* 6686 186150 6.326E-05
81 q + qbar -> Q + Qbar 7 93 6.699E-08
82 g + g -> Q + Qbar, 35 589 3.364E-07
Mathematica
********* Total number of errors, excluding junctions = 0 **********
********* Total number of errors, including junctions = 0 **********
********* Total number of warnings = 0 **********
********* Fraction of events that fail fragmentation cuts = 0.00112 *********
Size: 1 MB
sdarticle(4).pdf
Portab... (PDF)
January 25, 2

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
SetDirectory["/Users/ntoro/Desktop/"];
```

v load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
50 000
```

```
Triggers Passed:{1, 10, 11, 12}
```

4]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Triggers Passed:{1}
```

5]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

ead these lists, you need to know the basic types in the lhco event format:

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
50 000
```

```
Triggers Passed:{1, 10, 11, 12}
```

4}//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Triggers Passed:{1}
```

5}//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

ead these lists, you need to know the basic types in the lhco event format:

hoton

lectron: charge in ntrk column

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
50 000
```

```
Triggers Passed:{1, 10, 11, 12}
```

4]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
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4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Triggers Passed:{1}
```

5]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

ead these lists, you need to know the basic types in the lhco event format:

hoton

lectron: charge in ntrk column

uon: charge in ntrk column

u (hadronic): ntrk sign = charge of tau, 1 or 3 indicates 1- or 3-prong decay

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
50 000
```

```
Triggers Passed:{1, 10, 11, 12}
```

4]//MatrixForm=

	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
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2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Triggers Passed:{1}
```

5]//MatrixForm=

	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

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uon: charge in ntrk column

for compatibility with older (6-column, no-trigger) data format

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```
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```
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```

```
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```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
or compatibility with older (6-column, no-trigger) data format
```

ıld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this cell with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou ... pear to let you ... file ... you do so, it w
ou w... our file will not ... writ...

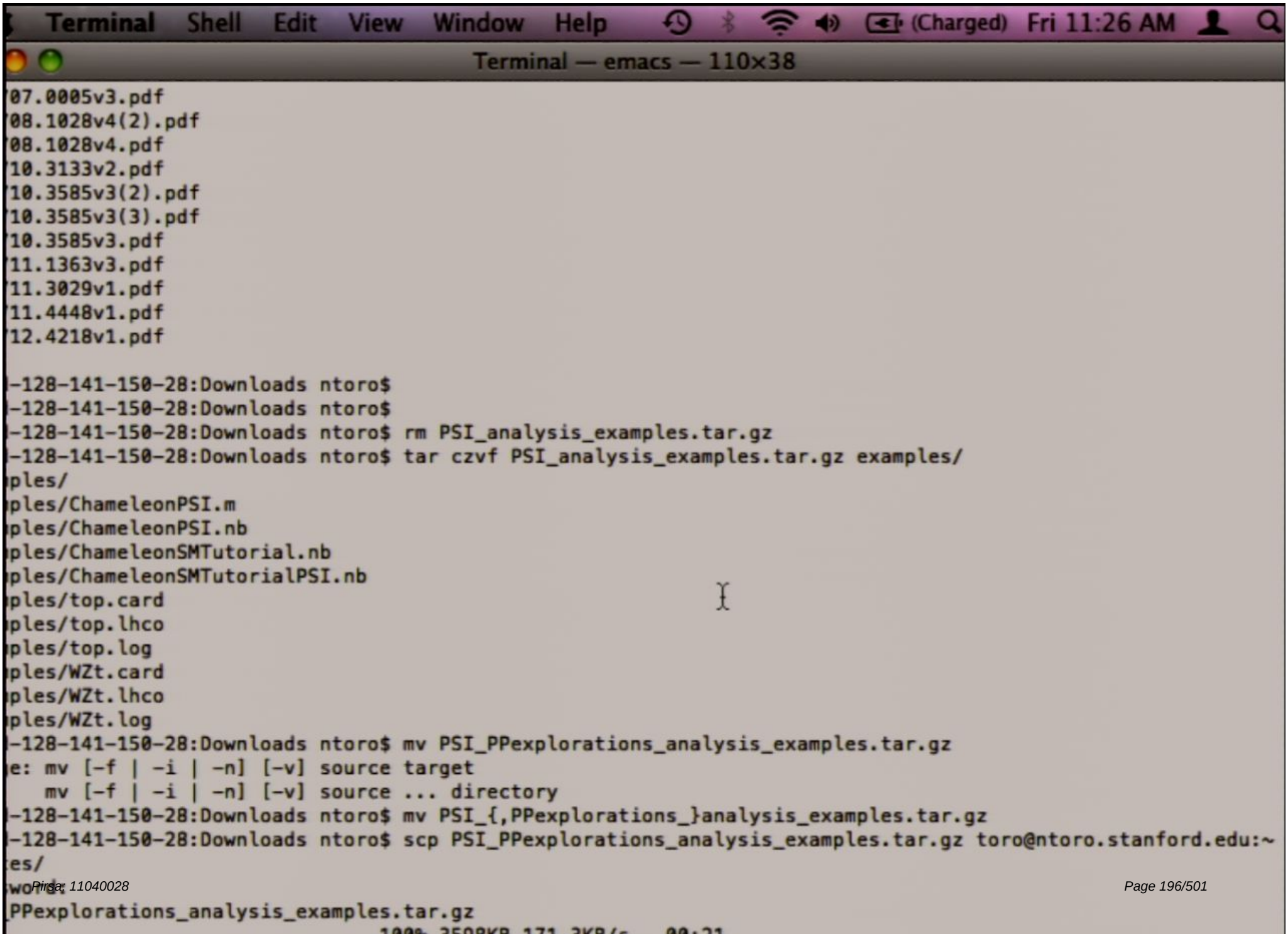
```
...vents["/Users/ntoro/Downloads/examples/W3t.lhco"];
```

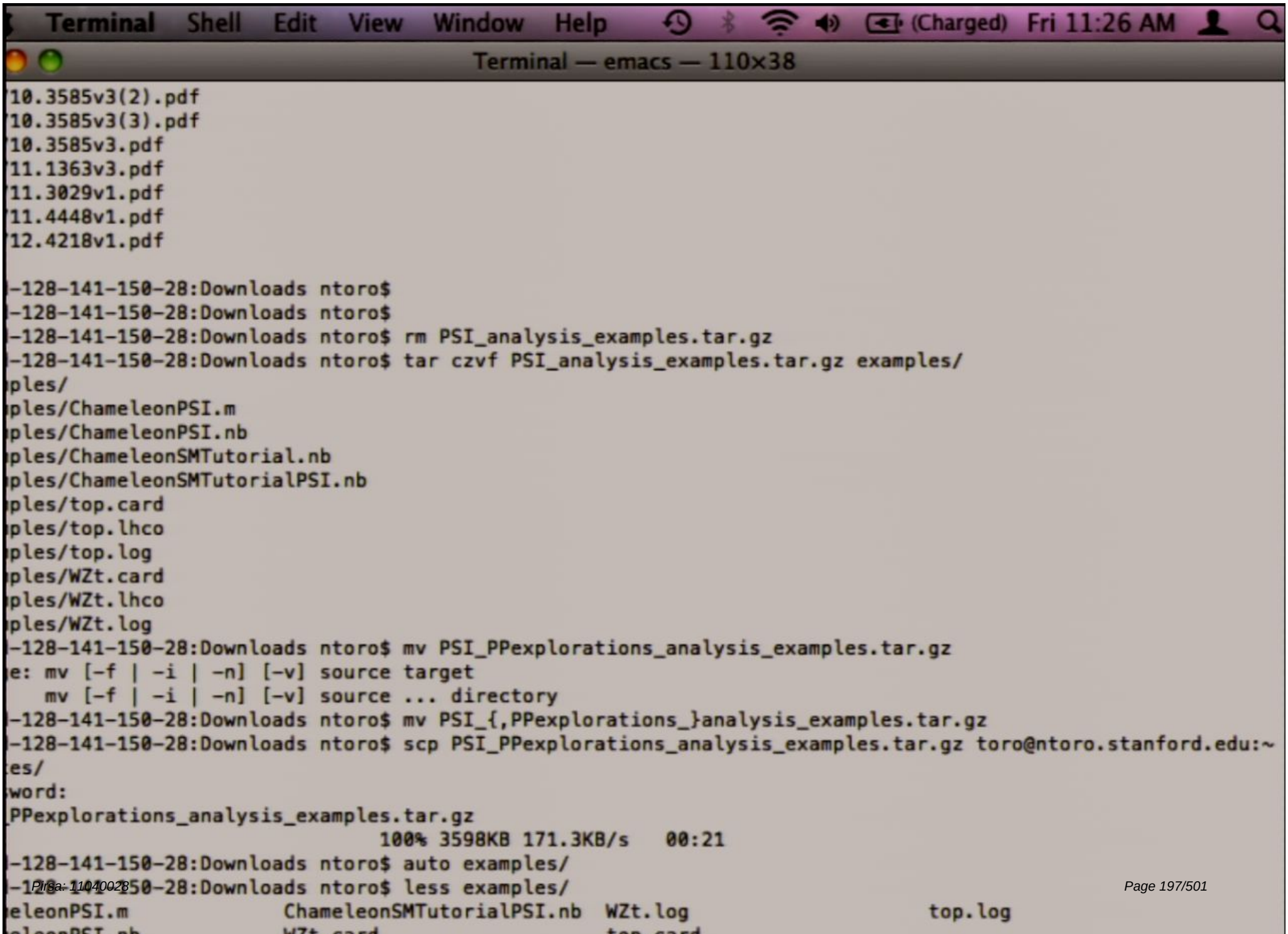
```
example = LoadEvents[""]; (* select file from file browser *)
```

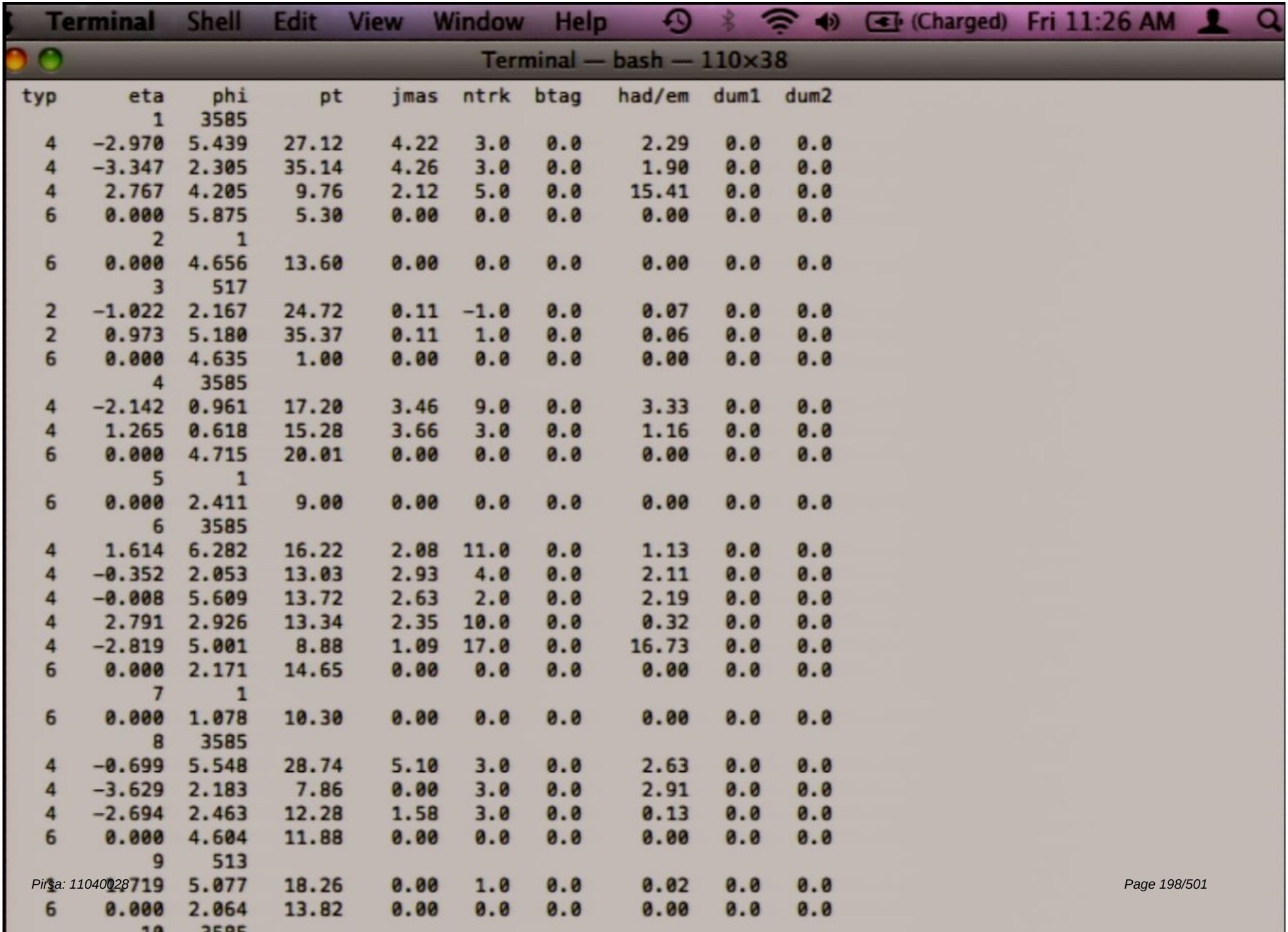
ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.


Terminal Shell Edit View Window Help (Charged) Fri 11:26 AM
Terminal — emacs — 110×38
07.0005v3.pdf
08.1028v4(2).pdf
08.1028v4.pdf
10.3133v2.pdf
10.3585v3(2).pdf
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
PPexplorations_analysis_examples.tar.gz


Terminal Shell Edit View Window Help (Charged) Fri 11:26 AM
Terminal — emacs — 110×38
10.3585v3(2).pdf
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:
PPexplorations_analysis_examples.tar.gz
100% 3598KB 171.3KB/s 00:21
-128-141-150-28:Downloads ntoro$ auto examples/
-128-141-150-28:Downloads ntoro$ less examples/
eleonPSI.m ChameleonSMTutorialPSI.nb WZt.log top.log



typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2
	1	3585							
4	-2.970	5.439	27.12	4.22	3.0	0.0	2.29	0.0	0.0
4	-3.347	2.305	35.14	4.26	3.0	0.0	1.90	0.0	0.0
4	2.767	4.205	9.76	2.12	5.0	0.0	15.41	0.0	0.0
6	0.000	5.875	5.30	0.00	0.0	0.0	0.00	0.0	0.0
	2	1							
6	0.000	4.656	13.60	0.00	0.0	0.0	0.00	0.0	0.0
	3	517							
2	-1.022	2.167	24.72	0.11	-1.0	0.0	0.07	0.0	0.0
2	0.973	5.180	35.37	0.11	1.0	0.0	0.06	0.0	0.0
6	0.000	4.635	1.00	0.00	0.0	0.0	0.00	0.0	0.0
	4	3585							
4	-2.142	0.961	17.20	3.46	9.0	0.0	3.33	0.0	0.0
4	1.265	0.618	15.28	3.66	3.0	0.0	1.16	0.0	0.0
6	0.000	4.715	20.01	0.00	0.0	0.0	0.00	0.0	0.0
	5	1							
6	0.000	2.411	9.00	0.00	0.0	0.0	0.00	0.0	0.0
	6	3585							
4	1.614	6.282	16.22	2.08	11.0	0.0	1.13	0.0	0.0
4	-0.352	2.053	13.03	2.93	4.0	0.0	2.11	0.0	0.0
4	-0.008	5.609	13.72	2.63	2.0	0.0	2.19	0.0	0.0
4	2.791	2.926	13.34	2.35	10.0	0.0	0.32	0.0	0.0
4	-2.819	5.001	8.88	1.09	17.0	0.0	16.73	0.0	0.0
6	0.000	2.171	14.65	0.00	0.0	0.0	0.00	0.0	0.0
	7	1							
6	0.000	1.078	10.30	0.00	0.0	0.0	0.00	0.0	0.0
	8	3585							
4	-0.699	5.548	28.74	5.10	3.0	0.0	2.63	0.0	0.0
4	-3.629	2.183	7.86	0.00	3.0	0.0	2.91	0.0	0.0
4	-2.694	2.463	12.28	1.58	3.0	0.0	0.13	0.0	0.0
6	0.000	4.604	11.88	0.00	0.0	0.0	0.00	0.0	0.0
	9	513							
1	-1.719	5.077	18.26	0.00	1.0	0.0	0.02	0.0	0.0
6	0.000	2.064	13.82	0.00	0.0	0.0	0.00	0.0	0.0
	10	3585							

or compatibility with older (6-column, no-trigger) data format

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

hameleonPSI.m contains the definitions of all functions we will use here.

hameleonPSI.nb is used to generate ChameleonPSI.m. You don't need it to run this package, but if you want to improve on our functions or ow they're defined, you'll want to start here. If you modify ChameleonPSI.nb, it should automatically update ChameleonPSI.m.

ata sets from the website or that you've generated yourself. This package uses WZt.lhco. You can change the commands later in this section to from other files.

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Desktop/"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
or compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

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Terminal — bash — 110×38

typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2
	1	3585							
4	-2.970	5.439	27.12	4.22	3.0	0.0	2.29	0.0	0.0
4	-3.347	2.305	35.14	4.26	3.0	0.0	1.90	0.0	0.0
4	2.767	4.205	9.76	2.12	5.0	0.0	15.41	0.0	0.0
6	0.000	5.875	5.30	0.00	0.0	0.0	0.00	0.0	0.0
	2	1							
6	0.000	4.656	13.60	0.00	0.0	0.0	0.00	0.0	0.0
	3	517							
2	-1.022	2.167	24.72	0.11	-1.0	0.0	0.07	0.0	0.0
2	0.973	5.180	35.37	0.11	1.0	0.0	0.06	0.0	0.0
6	0.000	4.635	1.00	0.00	0.0	0.0	0.00	0.0	0.0
	4	3585							
4	-2.142	0.961	17.20	3.46	9.0	0.0	3.33	0.0	0.0
4	1.265	0.618	15.28	3.66	3.0	0.0	1.16	0.0	0.0
6	0.000	4.715	20.01	0.00	0.0	0.0	0.00	0.0	0.0
	5	1							
6	0.000	2.411	9.00	0.00	0.0	0.0	0.00	0.0	0.0
	6	3585							
4	1.614	6.282	16.22	2.08	11.0	0.0	1.13	0.0	0.0
4	-0.352	2.053	13.03	2.93	4.0	0.0	2.11	0.0	0.0
4	-0.008	5.609	13.72	2.63	2.0	0.0	2.19	0.0	0.0
4	2.791	2.926	13.34	2.35	10.0	0.0	0.32	0.0	0.0
4	-2.819	5.001	8.88	1.09	17.0	0.0	16.73	0.0	0.0
6	0.000	2.171	14.65	0.00	0.0	0.0	0.00	0.0	0.0
	7	1							
6	0.000	1.078	10.30	0.00	0.0	0.0	0.00	0.0	0.0
	8	3585							
4	-0.699	5.548	28.74	5.10	3.0	0.0	2.63	0.0	0.0
4	-3.629	2.183	7.86	0.00	3.0	0.0	2.91	0.0	0.0
4	-2.694	2.463	12.28	1.58	3.0	0.0	0.13	0.0	0.0
6	0.000	4.604	11.88	0.00	0.0	0.0	0.00	0.0	0.0
	9	513							
1	1.719	5.077	18.26	0.00	1.0	0.0	0.02	0.0	0.0
6	0.000	2.064	13.82	0.00	0.0	0.0	0.00	0.0	0.0
	10	3585							

```
4   -3.863  1.241   50.27   6.91   3.0   0.0   1.90   0.0   0.0
6    0.000  5.629    2.52   0.00   0.0   0.0   0.00   0.0   0.0
        30   3585
3    0.288  2.233   15.01   0.00   1.0   0.0   1.17   0.0   0.0
4   -0.679  5.189   21.57   3.98   3.0   0.0   0.88   0.0   0.0
6    0.000  1.691    3.13   0.00   0.0   0.0   0.00   0.0   0.0
        31   3585
3   -0.901  4.062   20.93   0.00   1.0   0.0   4.40   0.0   0.0
4    0.422  1.311   28.21   2.52   3.0   0.0   8.46   0.0   0.0
4    1.478  0.110    7.68   0.88   2.0   0.0   0.89   0.0   0.0
6    0.000  1.878    6.36   0.00   0.0   0.0   0.00   0.0   0.0
        32   3585
4   -3.751  5.299   26.18   2.50   9.0   0.0   2.48   0.0   0.0
4   -1.861  2.564   29.65   4.02   8.0   0.0   1.24   0.0   0.0
4   -1.567  1.228   22.18   3.82   6.0   0.0   4.21   0.0   0.0
6    0.000  3.913    3.38   0.00   0.0   0.0   0.00   0.0   0.0
        33   3585
4   -1.033  2.728   29.52   3.00   5.0   0.0   1.99   0.0   0.0
4   -3.712  4.546   12.68   1.38   6.0   0.0   1.19   0.0   0.0
4   -3.152  1.473   25.16   4.59   5.0   0.0  18.71   0.0   0.0
4    1.709  2.750   10.00   1.12   5.0   0.0   4.54   0.0   0.0
6    0.000  6.275   23.75   0.00   0.0   0.0   0.00   0.0   0.0
        34   3585
3    0.112  0.222   36.30   0.00  -1.0   0.0   1.54   0.0   0.0
4    1.889  2.794   15.58   2.17   7.0   0.0   0.81   0.0   0.0
6    0.000  3.468    4.63   0.00   0.0   0.0   0.00   0.0   0.0
        35   3585
3    0.252  3.661   18.03   0.00  -1.0   0.0   4.19   0.0   0.0
4    3.270  0.624   19.02   1.64   2.0   0.0   5.56   0.0   0.0
4   -1.266  3.204   30.16   2.59   4.0   0.0   2.06   0.0   0.0
4   -0.271  6.277   34.80   3.10   3.0   0.0   3.48   0.0   0.0
6    0.000  1.600    7.06   0.00   0.0   0.0   0.00   0.0   0.0
        36    513
3    1.072  5.037   27.07   0.00   1.0   0.0   2.53   0.0   0.0
6    0.000  2.021   28.08   0.00   0.0   0.0   0.00   0.0   0.0
```

```
4   -0.342  5.575   35.72    8.38    8.0   0.0     5.40   0.0   0.0
4   -1.853  0.632    8.73    1.59    7.0   0.0    13.86   0.0   0.0
6    0.000  2.669    6.93    0.00    0.0   0.0     0.00   0.0   0.0
        38   3585
4    0.950  4.278   33.98    4.56    3.0   0.0     1.31   0.0   0.0
4    1.873  1.250   28.45    4.41    4.0   0.0     1.67   0.0   0.0
4   -1.218  3.467   14.75    3.40    1.0   0.0     2.51   0.0   0.0
6    0.000  1.243    9.64    0.00    0.0   0.0     0.00   0.0   0.0
        39   3585
3    0.452  0.384   16.17    0.00    1.0   0.0     4.32   0.0   0.0
4    3.171  3.478   17.78    1.90   11.0   0.0     0.71   0.0   0.0
4    1.278  1.463   17.14    2.62    7.0   0.0     2.09   0.0   0.0
6    0.000  4.124   10.30    0.00    0.0   0.0     0.00   0.0   0.0
        40   3585
4    1.094  3.971   15.14    3.18    2.0   0.0     0.89   0.0   0.0
4   -2.451  4.743   15.47    4.46   15.0   0.0     1.75   0.0   0.0
4   -1.306  0.512   13.68    3.09   10.0   0.0     4.53   0.0   0.0
6    0.000  3.125    4.94    0.00    0.0   0.0     0.00   0.0   0.0
        41   3585
4    2.553  1.661    9.28    1.79   13.0   0.0     5.44   0.0   0.0
4    2.703  0.809   10.46    0.85   13.0   0.0     2.66   0.0   0.0
6    0.000  5.040   20.12    0.00    0.0   0.0     0.00   0.0   0.0
        42      1
6    0.000  0.318   23.54    0.00    0.0   0.0     0.00   0.0   0.0
        43   3585
4    0.806  3.312   34.48    7.38    9.0   0.0     2.22   0.0   0.0
4   -0.522  0.334   47.74   13.02   10.0   0.0     1.33   0.0   0.0
4   -0.707  5.702    5.30    0.00    2.0   0.0     2.05   0.0   0.0
6    0.000  4.537   14.62    0.00    0.0   0.0     0.00   0.0   0.0
        44   3585
4   -2.885  5.902   20.18    3.11   24.0   0.0     9.48   0.0   0.0
4    0.151  4.285   10.78    1.36    3.0   0.0     2.02   0.0   0.0
4   -2.234  3.541   15.76    4.19   20.0   0.0     4.67   0.0   0.0
4    0.510  2.355   12.46    2.36    6.0   0.0     2.57   0.0   0.0
6    0.000  2.460   30.50    0.00    0.0   0.0     0.00   0.0   0.0
```

```
4   -3.151  4.495   58.04   8.03   4.0   0.0    3.90   0.0   0.0
4   -3.863  1.241   50.27   6.91   3.0   0.0    1.90   0.0   0.0
6    0.000  5.629    2.52   0.00   0.0   0.0    0.00   0.0   0.0
        30   3585
3    0.288  2.233   15.01   0.00   1.0   0.0    1.17   0.0   0.0
4   -0.679  5.189   21.57   3.98   3.0   0.0    0.88   0.0   0.0
6    0.000  1.691    3.13   0.00   0.0   0.0    0.00   0.0   0.0
        31   3585
3   -0.901  4.062   20.93   0.00   1.0   0.0    4.40   0.0   0.0
4    0.422  1.311   28.21   2.52   3.0   0.0    8.46   0.0   0.0
4    1.478  0.110    7.68   0.88   2.0   0.0    0.89   0.0   0.0
6    0.000  1.878    6.36   0.00   0.0   0.0    0.00   0.0   0.0
        32   3585
4   -3.751  5.299   26.18   2.50   9.0   0.0    2.48   0.0   0.0
4   -1.861  2.564   29.65   4.02   8.0   0.0    1.24   0.0   0.0
4   -1.567  1.228   22.18   3.82   6.0   0.0    4.21   0.0   0.0
6    0.000  3.913    3.38   0.00   0.0   0.0    0.00   0.0   0.0
        33   3585
4   -1.033  2.728   29.52   3.00   5.0   0.0    1.99   0.0   0.0
4   -3.712  4.546   12.68   1.38   6.0   0.0    1.19   0.0   0.0
4   -3.152  1.473   25.16   4.59   5.0   0.0   18.71   0.0   0.0
4    1.709  2.750   10.00   1.12   5.0   0.0    4.54   0.0   0.0
6    0.000  6.275   23.75   0.00   0.0   0.0    0.00   0.0   0.0
        34   3585
3    0.112  0.222   36.30   0.00  -1.0   0.0    1.54   0.0   0.0
4    1.889  2.794   15.58   2.17   7.0   0.0    0.81   0.0   0.0
6    0.000  3.468    4.63   0.00   0.0   0.0    0.00   0.0   0.0
        35   3585
3    0.252  3.661   18.03   0.00  -1.0   0.0    4.19   0.0   0.0
4    3.270  0.624   19.02   1.64   2.0   0.0    5.56   0.0   0.0
4   -1.266  3.204   30.16   2.59   4.0   0.0    2.06   0.0   0.0
4   -0.271  6.277   34.80   3.10   3.0   0.0    3.48   0.0   0.0
6    0.000  1.600    7.06   0.00   0.0   0.0    0.00   0.0   0.0
        36    513
3   -1.072  5.037   27.07   0.00   1.0   0.0    2.53   0.0   0.0
```

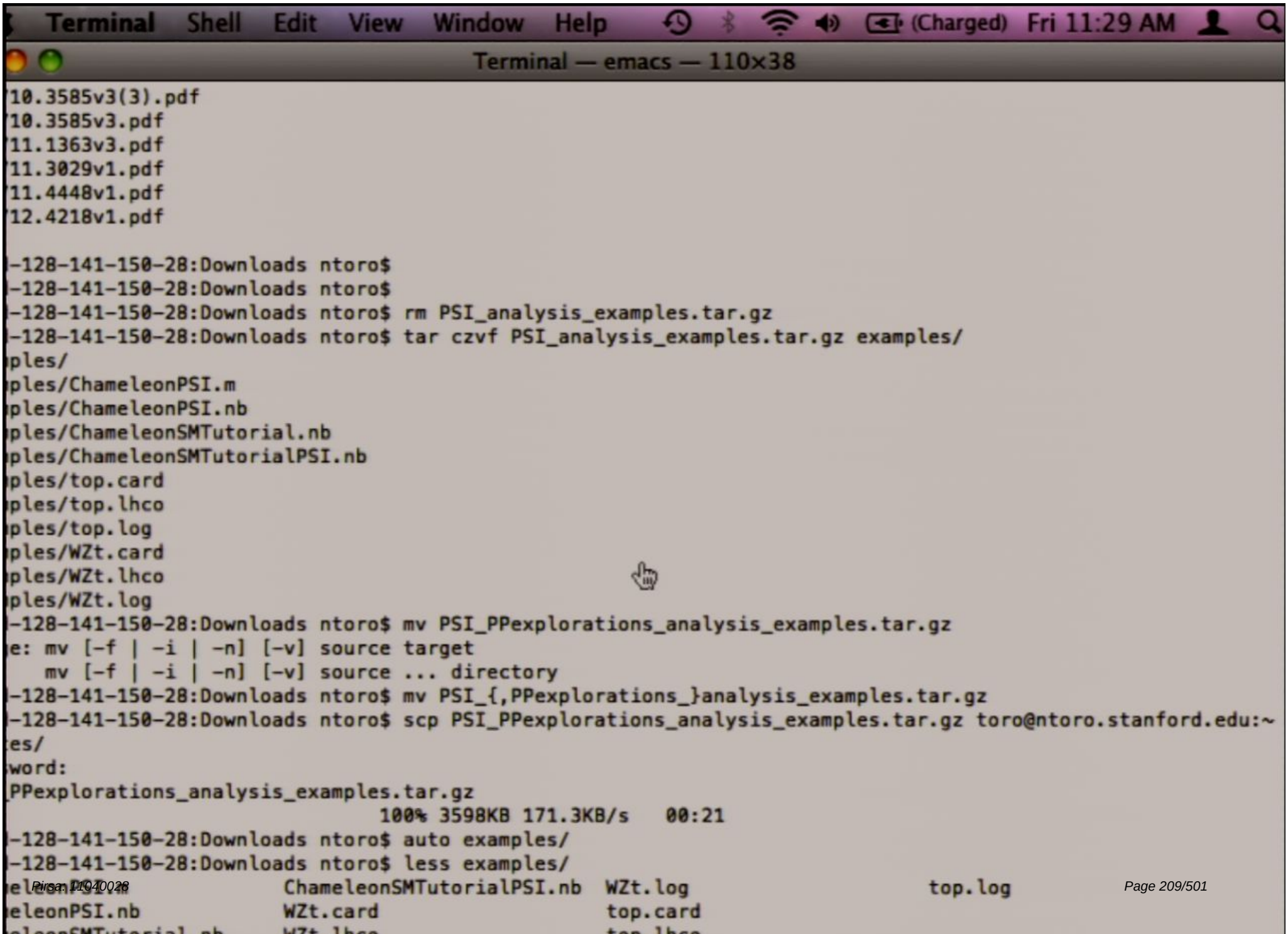
```
4    1.530  0.358  21.56  2.79  2.0  0.0  0.30  0.0  0.0
4    2.739  3.360  28.02  1.53  6.0  0.0  2.90  0.0  0.0
6    0.000  4.625   4.96  0.00  0.0  0.0  0.00  0.0  0.0
       25     1
6    0.000  1.709   3.91  0.00  0.0  0.0  0.00  0.0  0.0
       26   3585
4    2.728  5.157  32.92  0.69  3.0  0.0 14.71  0.0  0.0
4    3.561  1.896  33.00  3.45  3.0  0.0  3.29  0.0  0.0
4    2.511  2.717   7.62  1.45  3.0  0.0  0.63  0.0  0.0
6    0.000  1.019   1.23  0.00  0.0  0.0  0.00  0.0  0.0
       27   3585
4    2.208  4.227  22.19  3.85 10.0  0.0  1.76  0.0  0.0
4    1.305  4.673  19.15  3.28 11.0  0.0  1.75  0.0  0.0
4    1.813  1.521  14.54  2.01  7.0  0.0  0.97  0.0  0.0
6    0.000  1.088  30.52  0.00  0.0  0.0  0.00  0.0  0.0
       28   3585
4    0.947  2.699  17.84  1.40  3.0  0.0  0.94  0.0  0.0
6    0.000  3.358   1.58  0.00  0.0  0.0  0.00  0.0  0.0
       29   3585
4   -3.151  4.495  58.04  8.03  4.0  0.0  3.90  0.0  0.0
4   -3.863  1.241  50.27  6.91  3.0  0.0  1.90  0.0  0.0
6    0.000  5.629   2.52  0.00  0.0  0.0  0.00  0.0  0.0
       30   3585
3    0.288  2.233  15.01  0.00  1.0  0.0  1.17  0.0  0.0
4   -0.679  5.189  21.57  3.98  3.0  0.0  0.88  0.0  0.0
6    0.000  1.691   3.13  0.00  0.0  0.0  0.00  0.0  0.0
       31   3585
3   -0.901  4.062  20.93  0.00  1.0  0.0  4.40  0.0  0.0
4    0.422  1.311  28.21  2.52  3.0  0.0  8.46  0.0  0.0
4    1.478  0.110   7.68  0.88  2.0  0.0  0.89  0.0  0.0
6    0.000  1.878   6.36  0.00  0.0  0.0  0.00  0.0  0.0
       32   3585
4   -3.751  5.299  26.18  2.50  9.0  0.0  2.48  0.0  0.0
4   -1.861  2.564  29.65  4.02  8.0  0.0  1.24  0.0  0.0
4   -1.567  1.228  22.18  3.82  6.0  0.0  4.21  0.0  0.0
```

Terminal — bash — 110×38

typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2
	1	3585							
4	-2.970	5.439	27.12	4.22	3.0	0.0	2.29	0.0	0.0
4	-3.347	2.305	35.14	4.26	3.0	0.0	1.90	0.0	0.0
4	2.767	4.205	9.76	2.12	5.0	0.0	15.41	0.0	0.0
6	0.000	5.875	5.30	0.00	0.0	0.0	0.00	0.0	0.0
	2	1							
6	0.000	4.656	13.60	0.00	0.0	0.0	0.00	0.0	0.0
	3	517							
2	-1.022	2.167	24.72	0.11	-1.0	0.0	0.07	0.0	0.0
2	0.973	5.180	35.37	0.11	1.0	0.0	0.06	0.0	0.0
6	0.000	4.635	1.00	0.00	0.0	0.0	0.00	0.0	0.0
	4	3585							
4	-2.142	0.961	17.20	3.46	9.0	0.0	3.33	0.0	0.0
4	1.265	0.618	15.28	3.66	3.0	0.0	1.16	0.0	0.0
6	0.000	4.715	20.01	0.00	0.0	0.0	0.00	0.0	0.0
	5	1							
6	0.000	2.411	9.00	0.00	0.0	0.0	0.00	0.0	0.0
	6	3585							
4	1.614	6.282	16.22	2.08	11.0	0.0	1.13	0.0	0.0
4	-0.352	2.053	13.03	2.93	4.0	0.0	2.11	0.0	0.0
4	-0.008	5.609	13.72	2.63	2.0	0.0	2.19	0.0	0.0
4	2.791	2.926	13.34	2.35	10.0	0.0	0.32	0.0	0.0
4	-2.819	5.001	8.88	1.09	17.0	0.0	16.73	0.0	0.0
6	0.000	2.171	14.65	0.00	0.0	0.0	0.00	0.0	0.0
	7	1							
6	0.000	1.078	10.30	0.00	0.0	0.0	0.00	0.0	0.0
	8	3585							
4	-0.699	5.548	28.74	5.10	3.0	0.0	2.63	0.0	0.0
4	-3.629	2.183	7.86	0.00	3.0	0.0	2.91	0.0	0.0
4	-2.694	2.463	12.28	1.58	3.0	0.0	0.13	0.0	0.0
6	0.000	4.604	11.88	0.00	0.0	0.0	0.00	0.0	0.0
	9	513							
1	1.719	5.077	18.26	0.00	1.0	0.0	0.02	0.0	0.0
6	0.000	2.064	13.82	0.00	0.0	0.0	0.00	0.0	0.0
	10	3585							

```
4   -0.107  0.195    9.24    2.21   1.0   0.0    1.81   0.0   0.0
6    0.000  2.776    7.29    0.00   0.0   0.0    0.00   0.0   0.0
        11     1
6    0.000  4.120    8.04    0.00   0.0   0.0    0.00   0.0   0.0
        12  3969
0   -0.958  5.702   13.05    0.00   0.0   0.0    0.02   0.0   0.0
0   -0.958  5.765   13.90    0.00   0.0   0.0    0.00   0.0   0.0
4   -1.953  2.514   28.49    3.48   3.0   0.0    1.48   0.0   0.0
6    0.000  2.943    6.30    0.00   0.0   0.0    0.00   0.0   0.0
        13  3585
4    1.613  2.364   27.33    2.59   5.0   0.0    2.30   0.0   0.0
6    0.000  5.055   17.22    0.00   0.0   0.0    0.00   0.0   0.0
        14  3585
3   -0.304  4.677   16.05    0.00  -3.0   0.0    2.50   0.0   0.0
4    1.577  0.945   15.83    0.55   5.0   0.0    5.31   0.0   0.0
4    2.014  4.075   32.14    3.42   9.0   0.0    0.46   0.0   0.0
6    0.000  3.200    3.16    0.00   0.0   0.0    0.00   0.0   0.0
        15  3585
4    1.816  3.070   20.70    4.75  10.0   0.0    4.99   0.0   0.0
4    1.191  0.202   22.01    4.56   8.0   0.0    2.69   0.0   0.0
4    0.735  6.133   12.04    2.45   8.0   0.0    1.84   0.0   0.0
6    0.000  3.427    4.79    0.00   0.0   0.0    0.00   0.0   0.0
        16  3585
3    0.569  3.805   21.54    0.00  -3.0   0.0    1.66   0.0   0.0
4   -3.017  0.642   31.37    2.25  12.0   0.0    6.54   0.0   0.0
4    1.332  0.303   10.61    1.12   3.0   0.0   16.57   0.0   0.0
4   -1.802  3.876   28.61    8.50  16.0   0.0    2.01   0.0   0.0
6    0.000  1.235   16.35    0.00   0.0   0.0    0.00   0.0   0.0
        17  3585
4   -3.250  2.638   27.23    2.61   8.0   0.0    6.11   0.0   0.0
6    0.000  0.401    4.56    0.00   0.0   0.0    0.00   0.0   0.0
        18   513
1   -2.858  2.634   34.24    0.00  -1.0   0.0    0.00   0.0   0.0
6    0.000  5.776   36.15    0.00   0.0   0.0    0.00   0.0   0.0
        19  3585
```

```
6    0.000  3.498   3.52   0.00   0.0   0.0   0.00   0.0   0.0
        20     1
6    0.000  5.429   4.41   0.00   0.0   0.0   0.00   0.0   0.0
        21  3585
3   -0.149  2.644  37.74   0.00  -3.0   0.0   2.10   0.0   0.0
4    0.825  5.985  15.61   1.15   4.0   0.0   0.60   0.0   0.0
6    0.000  6.185   8.09   0.00   0.0   0.0   0.00   0.0   0.0
        22  3585
3    1.015  0.981  23.18   0.00  -1.0   0.0   0.51   0.0   0.0
4    2.630  4.013  26.40   4.05   6.0   0.0   6.93   0.0   0.0
6    0.000  5.927   3.78   0.00   0.0   0.0   0.00   0.0   0.0
        23  3587
2    1.870  2.386   6.70   0.11   1.0   2.0   0.12   0.0   0.0
4    2.604  1.616  28.18   6.59  14.0   0.0   2.89   0.0   0.0
4    2.289  4.962  18.39   3.46  14.0   0.0   1.52   0.0   0.0
6    0.000  4.591  10.95   0.00   0.0   0.0   0.00   0.0   0.0
        24  3585
4    1.530  0.358  21.56   2.79   2.0   0.0   0.30   0.0   0.0
4    2.739  3.360  28.02   1.53   6.0   0.0   2.90   0.0   0.0
6    0.000  4.625   4.96   0.00   0.0   0.0   0.00   0.0   0.0
        25     1
6    0.000  1.709   3.91   0.00   0.0   0.0   0.00   0.0   0.0
        26  3585
4    2.728  5.157  32.92   0.69   3.0   0.0  14.71   0.0   0.0
4    3.561  1.896  33.00   3.45   3.0   0.0   3.29   0.0   0.0
4    2.511  2.717   7.62   1.45   3.0   0.0   0.63   0.0   0.0
6    0.000  1.019   1.23   0.00   0.0   0.0   0.00   0.0   0.0
        27  3585
4    2.208  4.227  22.19   3.85  10.0   0.0   1.76   0.0   0.0
4    1.305  4.673  19.15   3.28  11.0   0.0   1.75   0.0   0.0
4    1.813  1.521  14.54   2.01   7.0   0.0   0.97   0.0   0.0
6    0.000  1.088  30.52   0.00   0.0   0.0   0.00   0.0   0.0
        28  3585
4    0.947  2.699  17.84   1.40   3.0   0.0   0.94   0.0   0.0
6    0.000  3.358   1.58   0.00   0.0   0.0   0.00   0.0   0.0
```


Terminal Shell Edit View Window Help (Charged) Fri 11:29 AM
Terminal — emacs — 110×38
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
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12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:
PPexplorations_analysis_examples.tar.gz
100% 3598KB 171.3KB/s 00:21
-128-141-150-28:Downloads ntoro$ auto examples/
-128-141-150-28:Downloads ntoro$ less examples/
ChameleonSMTutorialPSI.nb WZt.log top.log
eleonPSI.nb WZt.card top.card

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

hameleonPSI.m contains the definitions of all functions we will use here.

hameleonPSI.nb is used to generate ChameleonPSI.m. You don't need it to run this package, but if you want to improve on our functions or ow they're defined, you'll want to start here. If you modify ChameleonPSI.nb, it should automatically update ChameleonPSI.m.

ata sets from the website or that you've generated yourself. This package uses WZt.lhco. You can change the commands later in this section to from other files.

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Desktop/"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
or compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects all "master" cuts defined above, and any events that are empty after this filtering.

tor compatibility with older (6-column, no-trigger) data format

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
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```

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```
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```

```
example = LoadEvents[""];  (* select file from file browser *)
```

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```
WZt = ApplyMuonIsolation[WZtPrelim];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

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```
WZt = ApplyMuonIsolation[WZtPrelim];
```


eck the Data Set

"master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

"master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
Len
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
```

"master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtPrelim = LoadEvents["/Users/ntoro/Downloads/examples/WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
0
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

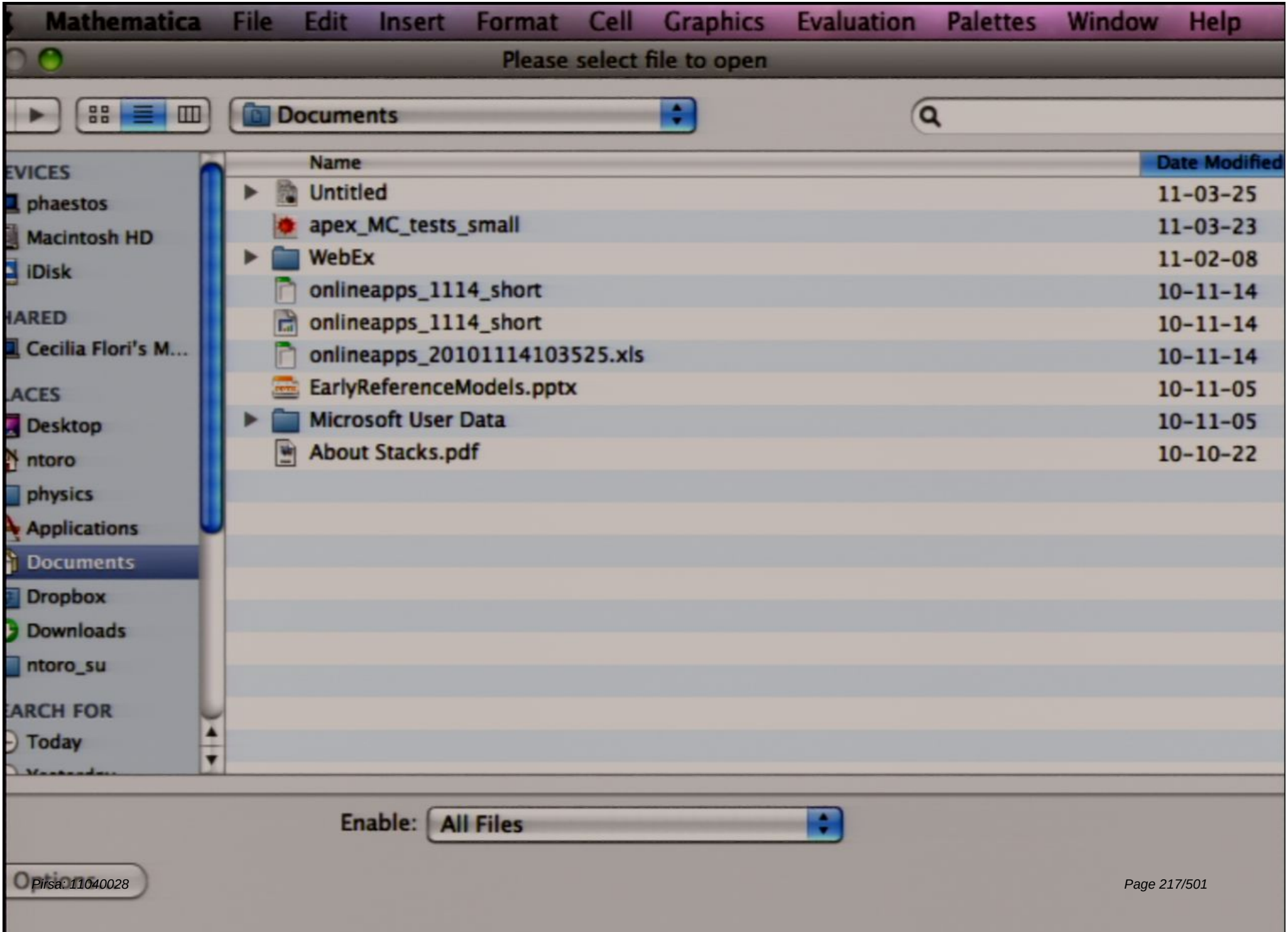
ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Please select file to open
Documents
EVICES
phaestos
Macintosh HD
iDisk
HARED
Cecilia Flori's M...
LACES
Desktop
ntoro
physics
Applications
Documents
Dropbox
Downloads
ntoro_su
EARCH FOR
Today
Name
Date Modified
Untitled 11-03-25
apex_MC_tests_small 11-03-23
WebEx 11-02-08
onlineapps_1114_short 10-11-14
onlineapps_1114_short 10-11-14
onlineapps_20101114103525.xls 10-11-14
EarlyReferenceModels.pptx 10-11-05
Microsoft User Data 10-11-05
About Stacks.pdf 10-10-22
Enable: All Files
Options

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Desktop/"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

ou enter an invalid filename, a file browser may (depending on your *Mathematica* version) appear to let you select a file. When you do so, it will ask ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.

```
WZtProblem = LoadEvents["WZt.lhco"];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/example"];
```

SetDirectory::cdir : Cannot set current directory to /Users/ntoro/Downloads/example. »

load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

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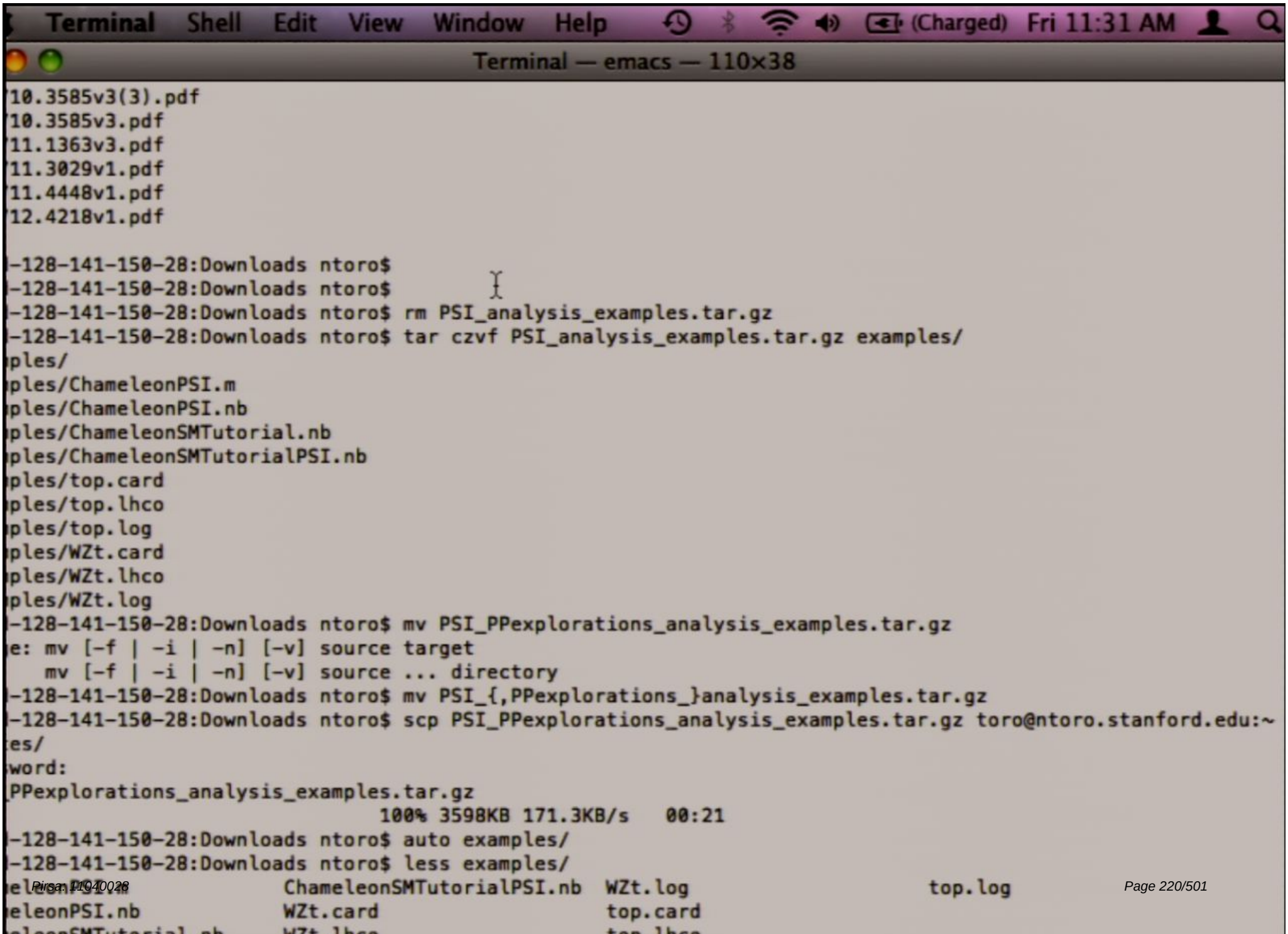
```
WZtPrelim = LoadEvents["WZt.lhco"];
```


Terminal Shell Edit View Window Help (Charged) Fri 11:31 AM
Terminal — emacs — 110×38
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:
_PPexplorations_analysis_examples.tar.gz
100% 3598KB 171.3KB/s 00:21
-128-141-150-28:Downloads ntoro$ auto examples/
-128-141-150-28:Downloads ntoro$ less examples/
ChameleonSMTutorialPSI.nb WZt.log top.log
eleonPSI.nb WZt.card top.card

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/example"];
```

SetDirectory::cdir : Cannot set current directory to /Users/ntoro/Downloads/example. »

load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

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nfigure the "master" cuts (optional)

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```
NZtPrelim = LoadEvents["NZt.lhco"];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

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```
WZtProblem = LoadEvents["WZt.lhco"];
```

```
ding data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Import::chtype : First argument $Canceled is not a valid file, directory, or URL specification. >>
Part::partd : Part specification $Failed[1, 1] is longer than depth of object. >>
Drop::normal : Nonatomic expression expected at position 1 in Drop[$Failed, 1]. >>
First::normal : Nonatomic expression expected at position 1 in First[$Failed]. >>
First::normal : Nonatomic expression expected at position 1 in First[1]. >>
Drop::normal : Nonatomic expression expected at position 1 in Drop[$Failed, 1]. >>
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Running...ChameleonSMTutorialPSI

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WZtPrelim = LoadEvents["WZt.lhco"];
```

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Import::chtype : First argument $Canceled is not a valid file, directory, or URL specification. >>
Part::partd : Part specification $Failed[1, 1] is longer than depth of object. >>
Drop::normal : Nonatomic expression expected at position 1 in Drop[$Failed, 1]. >>
First::normal : Nonatomic expression expected at position 1 in First[$Failed]. >>
First::normal : Nonatomic expression expected at position 1 in First[1]. >>
Drop::normal : Nonatomic expression expected at position 1 in Drop[$Failed, 1]. >>
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details

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```
Length[WZtPrelim]
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```
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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

BASIC SETUP: Set directory, configure "master cuts", load data sets, basic checks

es You Need to Download.

re using Chameleon, you need to download a few files from the LHC olympics website:

hameleonPSI.m contains the definitions of all functions we will use here.

hameleonPSI.nb is used to generate ChameleonPSI.m. You don't need it to run this package, but if you want to improve on our functions or ow they're defined, you'll want to start here. If you modify ChameleonPSI.nb, it should automatically update ChameleonPSI.m.

ata sets from the website or that you've generated yourself. This package uses WZt.lhco. You can change the commands later in this section to from other files.

Working Directory and Load the Chameleon Package

s command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

v load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

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```


nfigure the "master" cuts (optional)

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

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ChameleonSMTutorialPSI

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WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

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```
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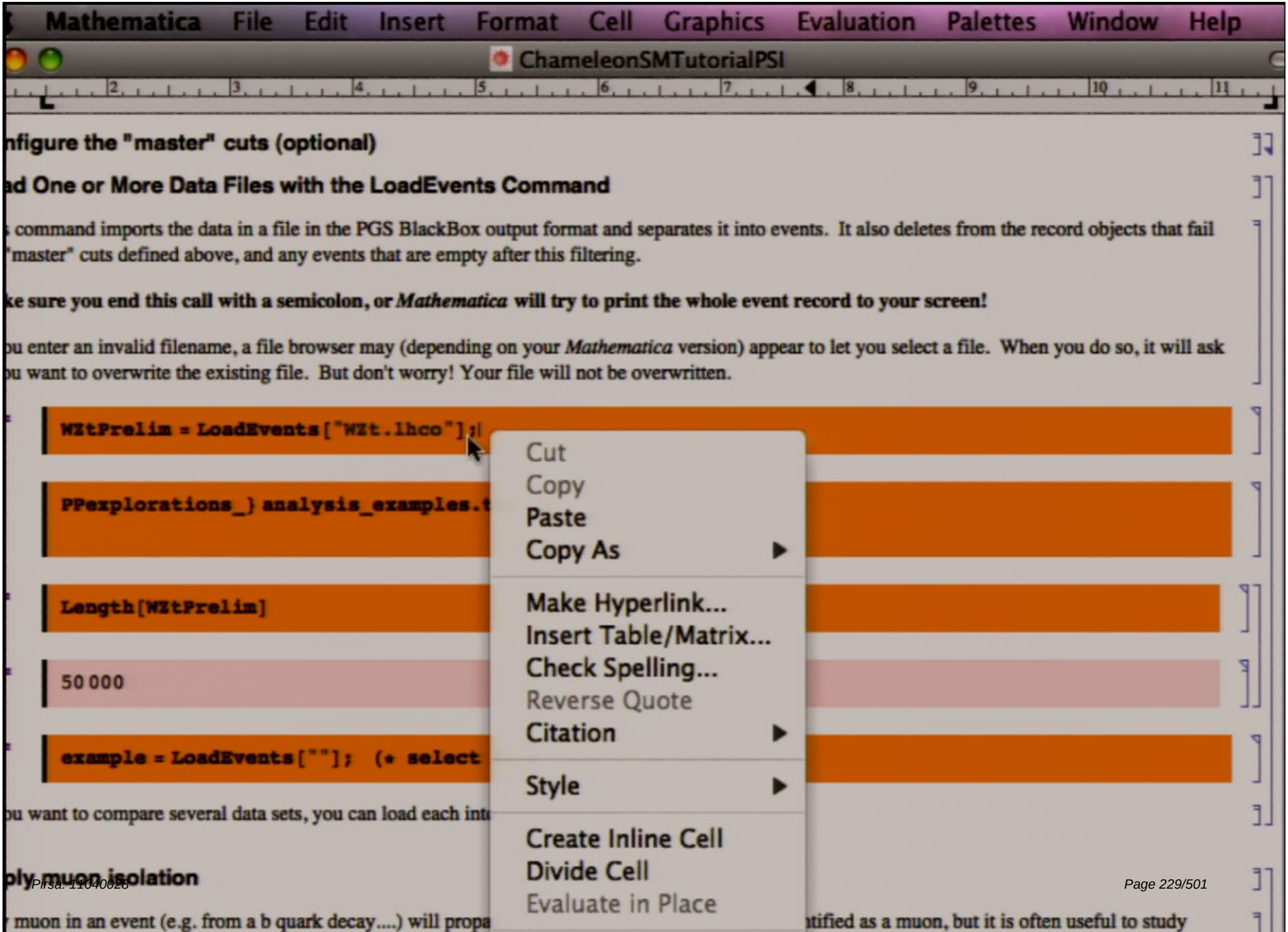
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
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ou want to overwrite the existing file. But don't worry! Your file will not be overwritten.
WZtPrelim = LoadEvents["WZt.lhco"];
PPexplorations_} analysis_examples.t
Length[WZtPrelim]
50 000
example = LoadEvents[""]; (* select
Cut
Copy
Paste
Copy As
Make Hyperlink...
Insert Table/Matrix...
Check Spelling...
Reverse Quote
Citation
Style
Create Inline Cell
Divide Cell
Evaluate in Place
ou want to compare several data sets, you can load each int
ply muon isolation
muon in an event (e.g. from a b quark decay....) will propa
tified as a muon, but it is often useful to study

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s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
PPexplorations_} analysis_examples.tar.gz
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

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ply muon isolation

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ChameleonSMTutorialPSI

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```
50 000
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WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZT
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
50 000
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

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```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
50 000
```

```
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```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Running...ChameleonSMTutorialPSI

```
Length[WZtPrelim]
```

```
50 000
```

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```

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```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

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muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

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WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```

ead these lists, you need to know the basic types in the lhco event format:

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

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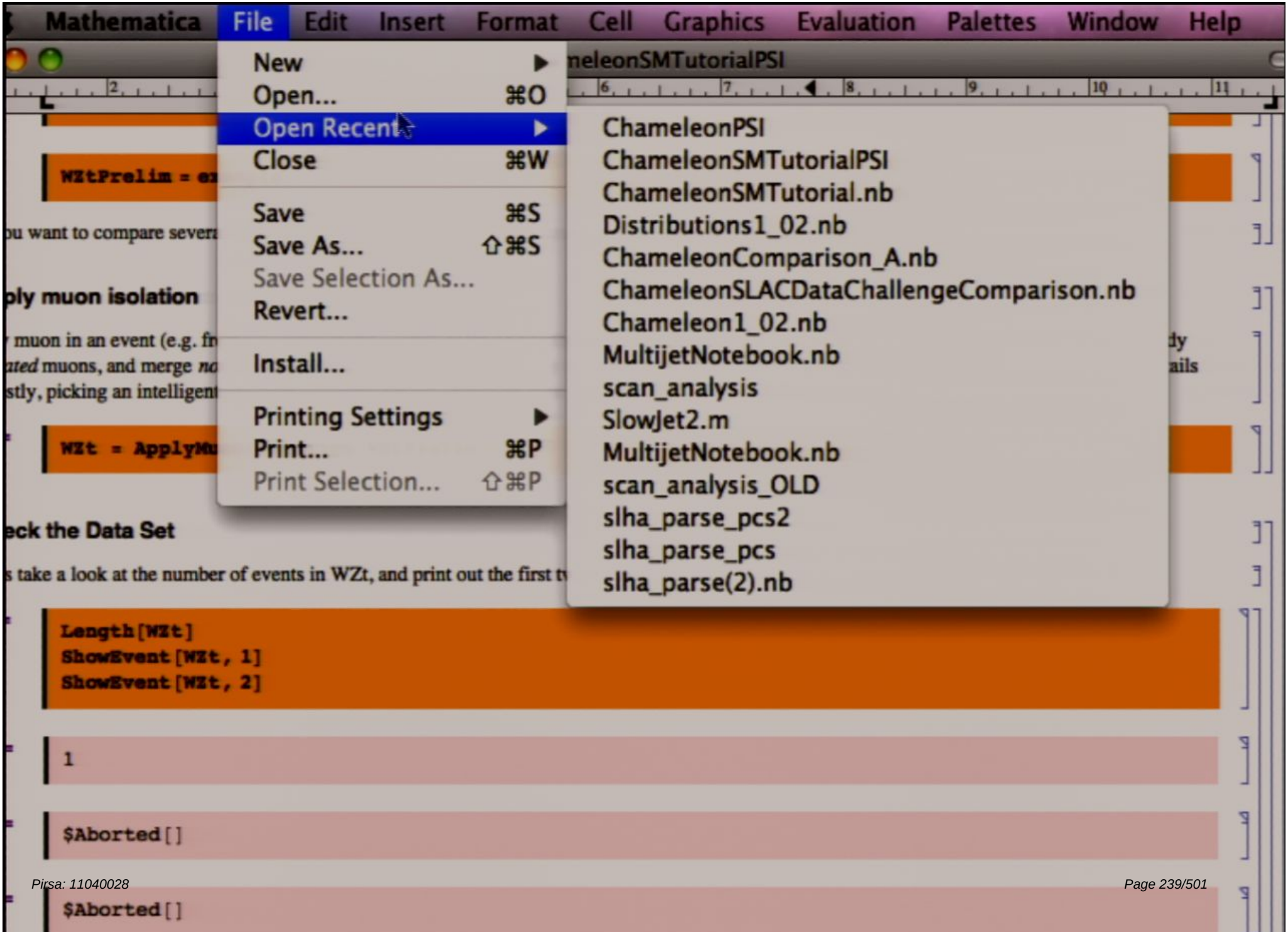
```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

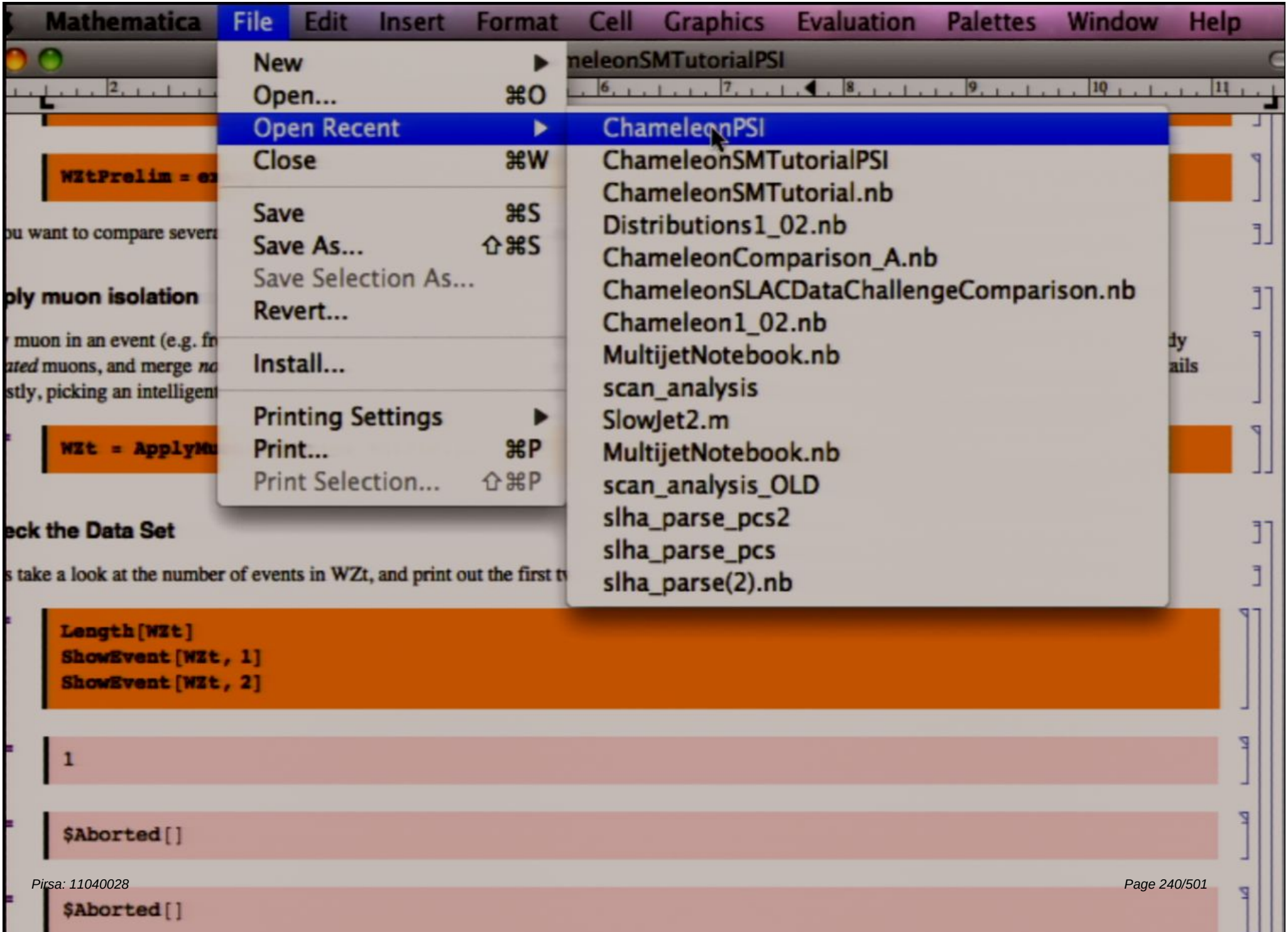
```
1
```

```
$Aborted[]
```



```
$Aborted[]
```


Mathematica
File
Edit
Insert
Format
Cell
Graphics
Evaluation
Palettes
Window
Help
New
Open... ⌘O
Open Recent
Close ⌘W
Save ⌘S
Save As... ⇧⌘S
Save Selection As...
Revert...
Install...
Printing Settings
Print... ⌘P
Print Selection... ⇧⌘P
ChameleonPSI
ChameleonSMTutorialPSI
ChameleonSMTutorial.nb
Distributions1_02.nb
ChameleonComparison_A.nb
ChameleonSLACDataChallengeComparison.nb
Chameleon1_02.nb
MultijetNotebook.nb
scan_analysis
SlowJet2.m
MultijetNotebook.nb
scan_analysis_OLD
slha_parse_pcs2
slha_parse_pcs
slha_parse(2).nb
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
1
$Aborted[]
$Aborted[]


Mathematica
File
Edit
Insert
Format
Cell
Graphics
Evaluation
Palettes
Window
Help
New
Open... ⌘O
Open Recent
Close ⌘W
Save ⌘S
Save As... ⇧⌘S
Save Selection As...
Revert...
Install...
Printing Settings
Print... ⌘P
Print Selection... ⇧⌘P
ChameleonPSI
ChameleonSMTutorialPSI
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slha_parse(2).nb
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ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
1
$Aborted[]
$Aborted[]

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

Chameleon 1.02 -- A black-box analysis package in *Mathematica* for the LHC Olympics

Harvard Blackbox Team:
Nima Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam Fitzpatrick, Tom Hartman, Can Kilic, Aaron Pierce, Philip Schuster, Jesse Thaler, Natalia Toro, Lian-Tao Wang

Harvard University, Jefferson Laboratory
July 9, 2006

Setup functions (file-loading)

- **Suppress warnings**


```
Off[General::spell1];
Off[General::spell1];
```

```
oLightLeptonMinus = oLLM = (oElectronMinus | oMuonMinus);

oLeptonType[-3] = oTauMinus;
oLeptonType[-2] = oMuonMinus;
oLeptonType[-1] = oElectronMinus;
oLeptonType[0] = object_ /; False;
oLeptonType[1] = oElectronPlus;
oLeptonType[2] = oMuonPlus;
oLeptonType[3] = oTauPlus;

oPhoton = oγ = {_, 0, _, _, _, _, _, __};
oJet = {_, 4, _, _, _, _, _, __};
oBJetTight = oBT = oBJet2 = oB2 = {_, 4, _, _, _, _, _, 2.0, ___};
oBJetLoose = oBL = oBJet1 = oB1 = {_, 4, _, _, _, _, _, 1.0, ___} | oB2;
oB = oBJet = If[$PGSVersion == 4, oB1, oB1];
oNonBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonLooseBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonTightBJet = oNonB | oB1;
oMissingPT = oMPT = {_, 6, _, _, _, _, _, __};

oReconstructed = oRec = oR = {_, 7, _, _, _, _, _, __};

oAny = {_, _, _, _, _, _, _, __};

oNot[oType_] := Except[oType, oAny];
```

- **Hardness-selecting patterns**

```
oHard[oType_, pthard_] = oType?((ptOf[#] ≥ pthard) &);
oLessHard[oType_, pthard_] = oType?((ptOf[#] < pthard) &);

oTrigger = {0, _, __};
```

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ChameleonPSI

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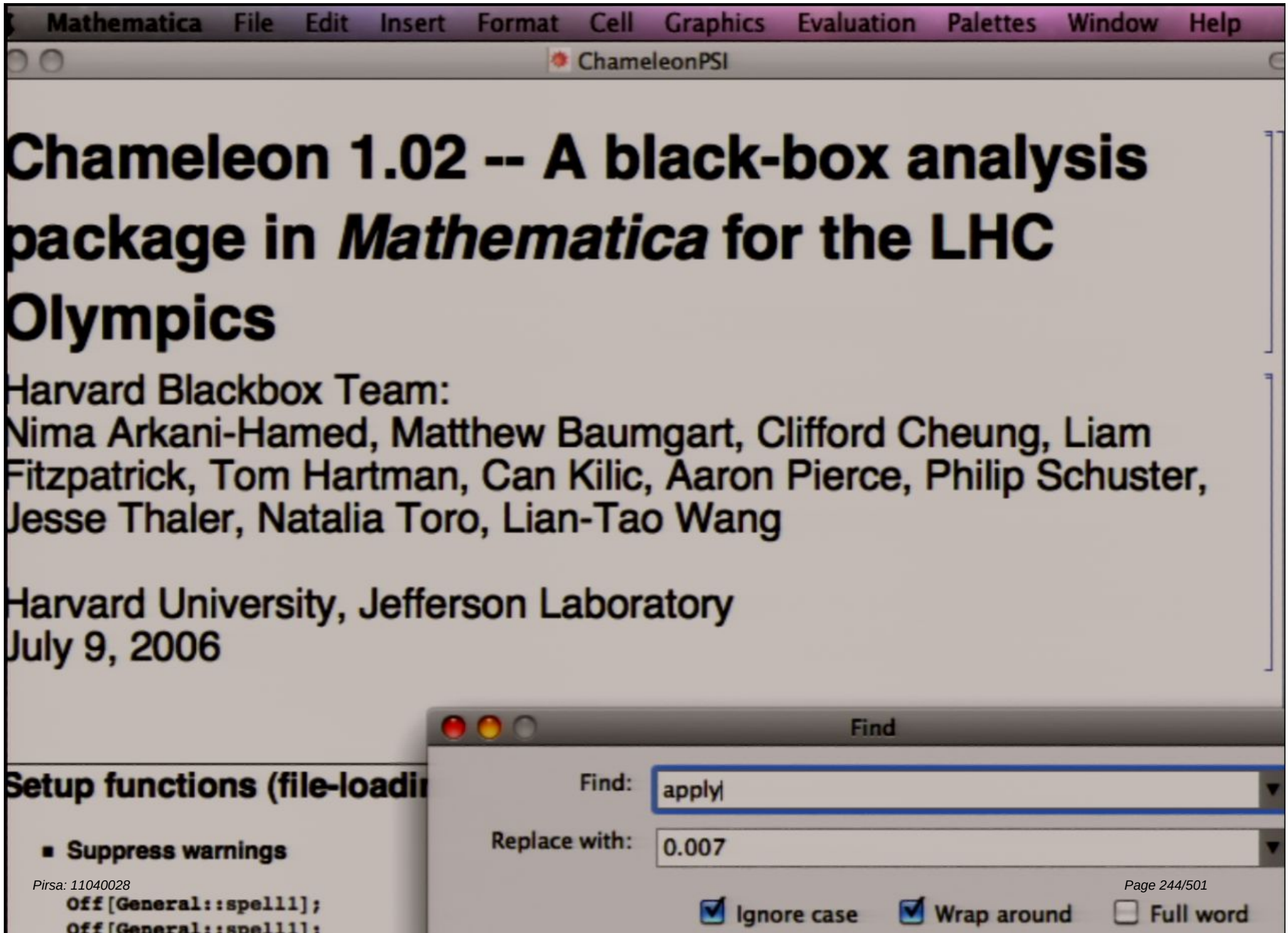
Harvard University, Jefferson Laboratory
July 9, 2006

Setup functions (file-loading)

- **Suppress warnings**


```
Off[General::spell1];
Off[General::spell11];
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
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Harvard University, Jefferson Laboratory
July 9, 2006
Find
Find:
apply
Replace with:
0.007
Ignore case
Wrap around
Full word
Setup functions (file-loadi
Suppress warnings
Off[General::spell];
Off[General::spell1];

```
    tempfunctionvalue = function[list[[i]]];
    If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalue = tempfunctionvalue,
     Null]
    , {i, 2, Length[list]}];
   {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
  ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
   Do[
    themuon = muonlist[[i]];
    thejetinfo = FindListMax[tempevent, -DeltaRToMuon[themuon, #, Options] &];
    thejetindex = thejetinfo[[1]];
    thejet = thejetinfo[[3]];
    If[MatchQ[thejet, oJet] ,
     tempevent[[thejetindex]] = ReconstructParent[{themuon, thejet}, Type → 4,
       ObjectCounter → thejet[[1]] , NTrack → thejet[[7]] + 0.1, Btag → thejet[[8]],
       HadEmFraction → thejet[[9]]];
     tempevent = DeleteCases[tempevent, themuon],
     tempevent = DeleteCases[tempevent, themuon]
    ],
    {i, Length[muonlist], 1, -1}];
   tempevent
  ];

ApplyMuonIsolation[evtList_, Options___] := CheckMuonsInEvent[#, Options] & /@ evtList

RemoveTriggerObject[event_] :=
```

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ChameleonPSI

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Harvard University, Jefferson Laboratory
July 9, 2006

Setup functions (file-loading)

- **Suppress warnings**


```
Off[General::spell1];
Off[General::spell1];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
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eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```

```
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```

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```

eck the Data Set

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```
?App
```

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```

```
WZtPrelim = example;
```

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eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
?ApplyMuonIsolation
```

```
Global`ApplyMuonIsolation
```

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

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WZtPrelim = example;
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```

```
1
```

```
$Aborted[]
```



```
$Aborted[]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```



```
$Aborted[]
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

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```
1
```

```
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```

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
or compatibility with older (6-column, no-trigger) data format
```

ld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

d One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

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```

```
? Ap
```

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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

v load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

```
?ApplyMuonIsolation
```

```
Global`ApplyMuonIsolation
```

nfigure the "master" cuts (optional)

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

v load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

```
?ApplyMuonIso
```

Information::notfound : Symbol ApplyMuonIso not found. »

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

s command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

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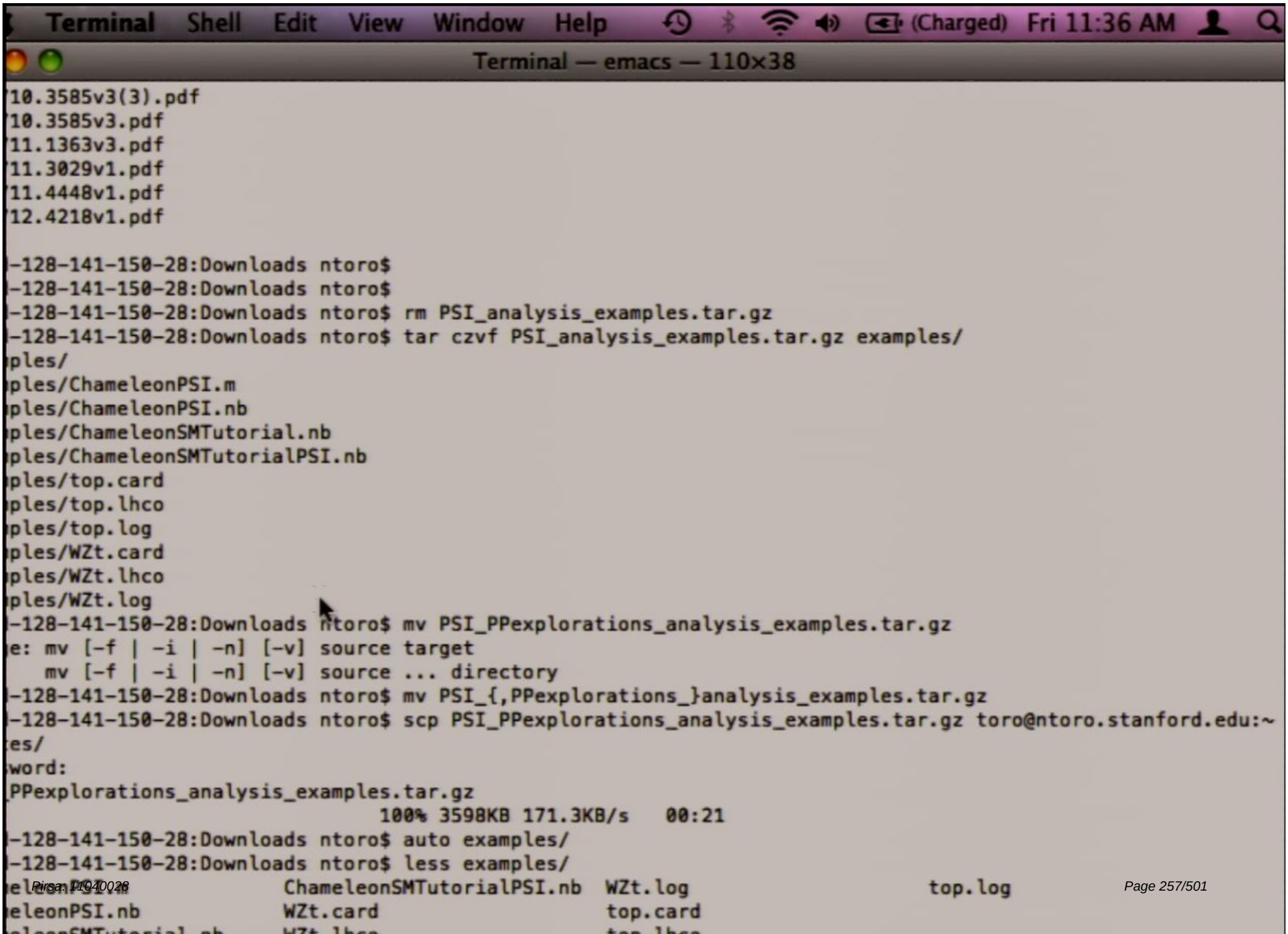
Terminal Shell Edit View Window Help (Charged) Fri 11:36 AM
Terminal — emacs — 110×38
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:
PPexplorations_analysis_examples.tar.gz
100% 3598KB 171.3KB/s 00:21
-128-141-150-28:Downloads ntoro$ auto examples/
-128-141-150-28:Downloads ntoro$ less examples/
ChameleonSMTutorialPSI.nb WZt.log top.log
eleonPSI.nb WZt.card top.card

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
ding data as PGS Version 4...set $PGSVersion=3
or compatibility with older (6-column, no-trigger) data format
```

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```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

d One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

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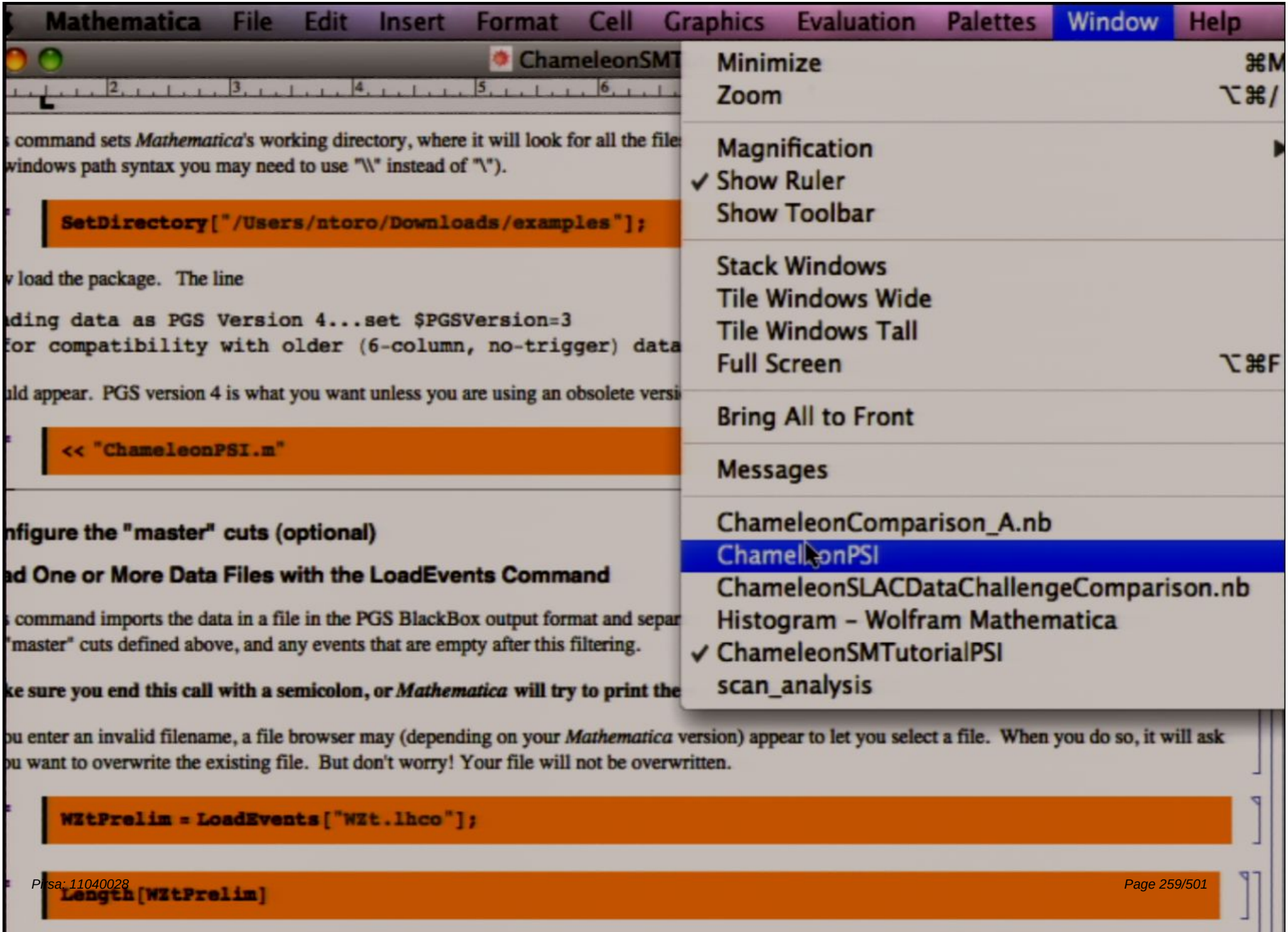
```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMT
command sets Mathematica's working directory, where it will look for all the file
windows path syntax you may need to use "\\" instead of "\").
SetDirectory["/Users/ntoro/Downloads/examples"];
load the package. The line
ding data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data
uld appear. PGS version 4 is what you want unless you are using an obsolete versi
<< "ChameleonPSI.m"
nfigure the "master" cuts (optional)
d One or More Data Files with the LoadEvents Command
command imports the data in a file in the PGS BlackBox output format and separ
"master" cuts defined above, and any events that are empty after this filtering.
ke sure you end this call with a semicolon, or Mathematica will try to print the
u enter an invalid filename, a file browser may (depending on your Mathematica version) appear to let you select a file. When you do so, it will ask
u want to overwrite the existing file. But don't worry! Your file will not be overwritten.
WZtPrelim = LoadEvents["WZt.lhco"];
Length[WZtPrelim]
Minimize ⌘M
Zoom ⌥⌘/
Magnification
Show Ruler
Show Toolbar
Stack Windows
Tile Windows Wide
Tile Windows Tall
Full Screen ⌥⌘F
Bring All to Front
Messages
ChameleonComparison_A.nb
ChameleonPSI
ChameleonSLACDataChallengeComparison.nb
Histogram - Wolfram Mathematica
ChameleonSMTutorialPSI
scan_analysis

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
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```

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```
<< "ChameleonPSI.m"
```

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ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

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ChameleonPSI

Chameleon 1.02 -- A black-box analysis

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ChameleonPSI

hameleon 1.02 -- A black-box analysis ackage in *Mathematica* for the LHC lympics

arvard Blackbox Team:
ma Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam tzpatrick, Tom Hartman, Can Kilic, Aaron Pierce, Philip Schuster, sse Thaler, Natalia Toro, Lian-Tao Wang

arvard University, Jefferson Laboratory
ly 9, 2006

tup functions (file-loading)

- **Suppress warnings**


```
Off[General::spell1];
Off[General::spell1];
```

```
    Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]], {i, 0, nfiles - 1}]], 1]];
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec_, LoadEventsOptions___] :=
  TakeUpTo[Select[LoadEvents[namespec],
    Criteria /. {LoadEventsOptions} /. Options[LoadEvents]],
   MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
```

rticle-matching Patterns

```
If[$PGSVersion = 4,
 oElectron = oE = {_, 1, _, _, _, _, _, __};
 oElectronPlus = oEP = {_, 1, _, _, _, _, 1.0, __};
 oElectronMinus = oEM = {_, 1, _, _, _, _, -1.0, __};]

If[$PGSVersion = 3,
 oElectron = oE = {_, 1, _, _, _, _, _, __};
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If[$PGSVersion = 4,
 oMuon = oμ = {_, 2, _, _, _, _, _, __};
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If[$PGSVersion = 3,
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 oMuonMinus = oμM = {_, 2, _, _, _, -1.0, _, __};]

If[$PGSVersion = 4,
```

```
 oTauPlus = otP = {_, 3, _, _, _, 1.0, _, __};
 oTauMinus = otM = {_, 3, _, _, _, -1.0, _, __};
]

oLepton = oL = (oElectron | oMuon | oTau);
oLeptonPlus = oLP = (oElectronPlus | oMuonPlus | oTauPlus);
oLeptonMinus = oLM = (oElectronMinus | oMuonMinus | oTauMinus);
oLightLepton = oLL = (oElectron | oMuon);
oLightLeptonPlus = oLLP = (oElectronPlus | oMuonPlus);
oLightLeptonMinus = oLLM = (oElectronMinus | oMuonMinus);

oLeptonType[-3] = oTauMinus;
oLeptonType[-2] = oMuonMinus;
oLeptonType[-1] = oElectronMinus;
oLeptonType[0] = object_ /; False;
oLeptonType[1] = oElectronPlus;
oLeptonType[2] = oMuonPlus;
oLeptonType[3] = oTauPlus;

oPhoton = oγ = {_, 0, _, _, _, _, _, __};
oJet = {_, 4, _, _, _, _, _, __};
oBJetTight = oBT = oBJet2 = oB2 = {_, 4, _, _, _, _, _, 2.0, ___};
oBJetLoose = oBL = oBJet1 = oB1 = {_, 4, _, _, _, _, _, 1.0, ___} | oB2;
oB = oBJet = If[$PGSVersion == 4, oB1, oB1];
oNonBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonLooseBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonTightBJet = oNonB | oB1;
oMissingPT = oMPT = {_, 6, _, _, _, _, _, __};

oReconstructed = oRec = oR = {_, 7, _, _, _, _, _, __};

oAny = {_, _, _, _, _, _, _, __};

oNot[oType_] := Except[oType, oAny];
```

```
oTrigger = {0, _, __};
```

eaning functions

▪ Enforcing muon isolation

```
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[etratio]];
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
  tempmaxindex = 1;
  tempmaxvalue = function[list[[1]]];
  Do[
   tempfunctionvalue = function[list[[i]]];
   If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalue = tempfunctionvalue,
    Null]
   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
```

```
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
   Do[
    themuon = muonlist[[i]];
    thejetinfo = FindListMax[tempevent, -DeltaRToMuon[themuon, #, Options] &];
    thejetindex = thejetinfo[[1]];
    thejet = thejetinfo[[3]];
    If[MatchQ[thejet, oJet] ,
     tempevent[[thejetindex]] = ReconstructParent[{themuon, thejet}, Type → 4,
       ObjectCounter → thejet[[1]] , NTrack → thejet[[7]] + 0.1, Btag → thejet[[8]],
       HadEmFraction → thejet[[9]]];
     tempevent = DeleteCases[tempevent, themuon],
     tempevent = DeleteCases[tempevent, themuon]
    ],
    {i, Length[muonlist], 1, -1}];
   tempevent
  ];

ApplyMuonIsolation[evtList_, Options___] := CheckMuonsInEvent[#, Options] & /@ evtList

RemoveTriggerObject[event_] :=
 DeleteCases[event, oTrigger]

ShowEvent[x_] := ShowEvent[{x}, 1]
```

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ChameleonPSI

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tup functions (file-loading)

- **Suppress warnings**


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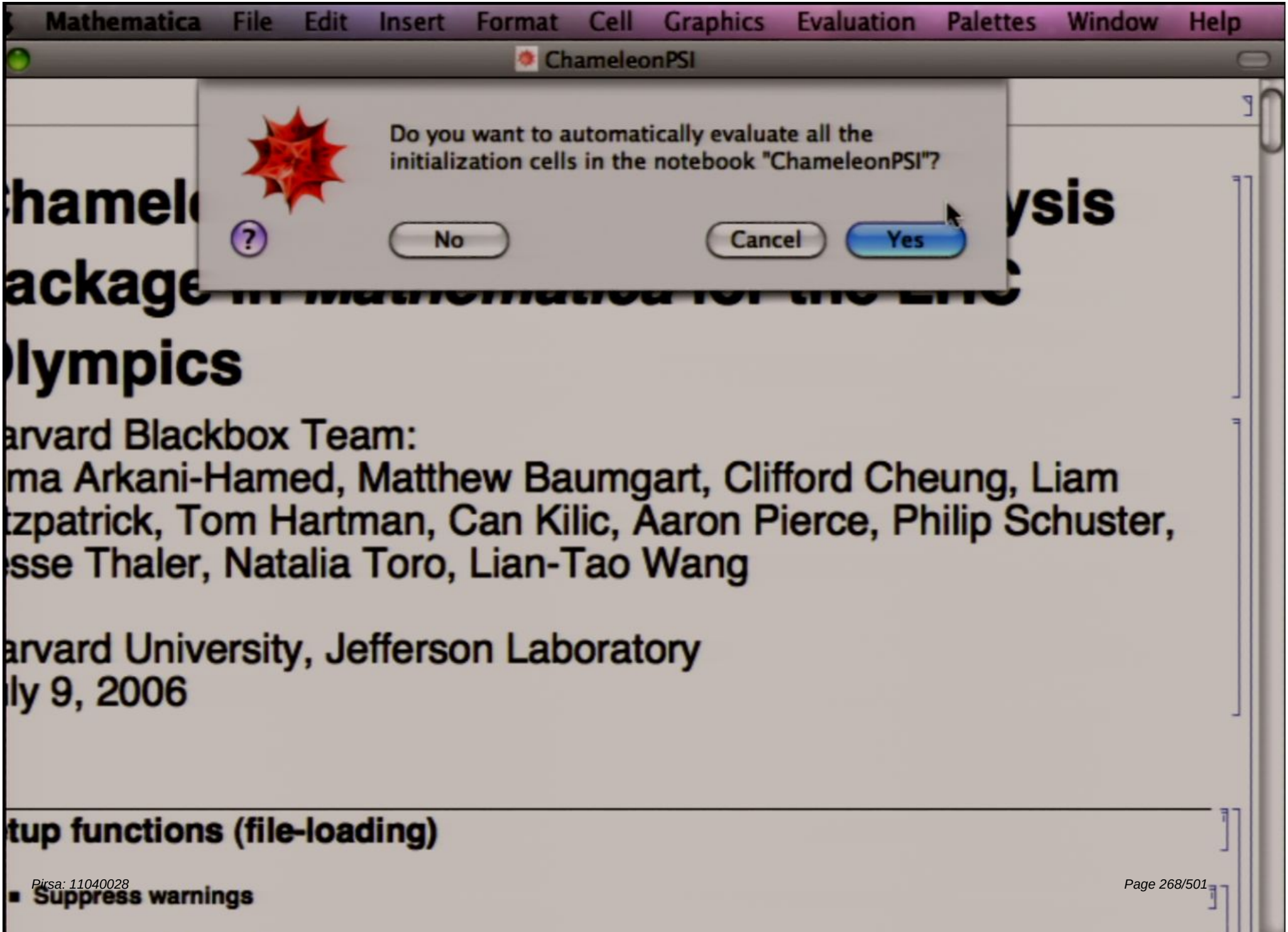
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
Do you want to automatically evaluate all the initialization cells in the notebook "ChameleonPSI"?
No
Cancel
Yes
ackage
lympics
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ChameleonPSI

```
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec_, LoadEventsOptions___] :=
  TakeUpTo[Select[LoadEvents[namespec],
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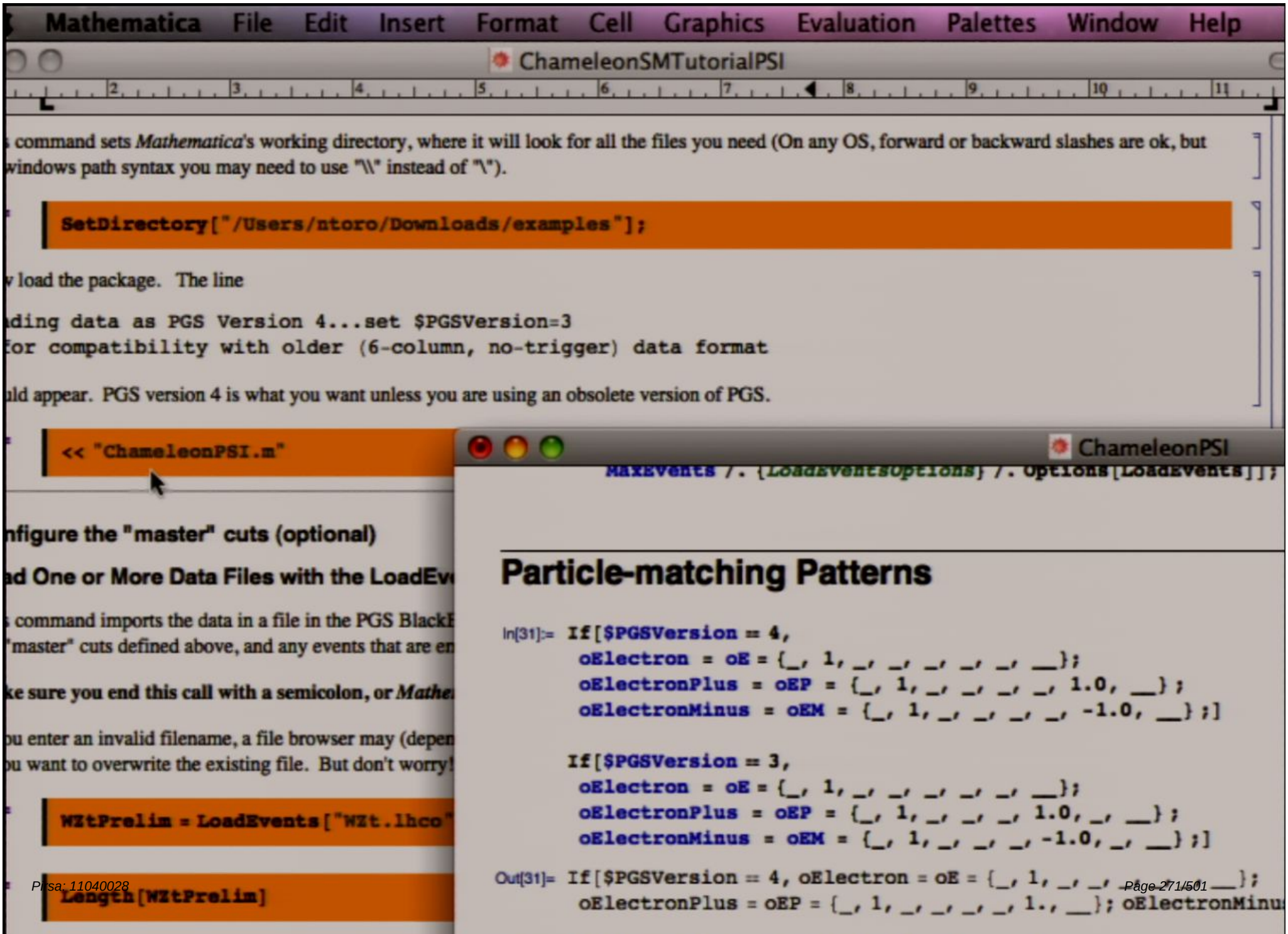
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
command sets Mathematica's working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").
SetDirectory["/Users/ntoro/Downloads/examples"];
load the package. The line
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WZtPrelim = LoadEvents["WZt.lhco"
Length[WZtPrelim]
ChameleonPSI
MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
Particle-matching Patterns
In[31]:= If[$PGSVersion == 4,
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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""];  (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

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```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
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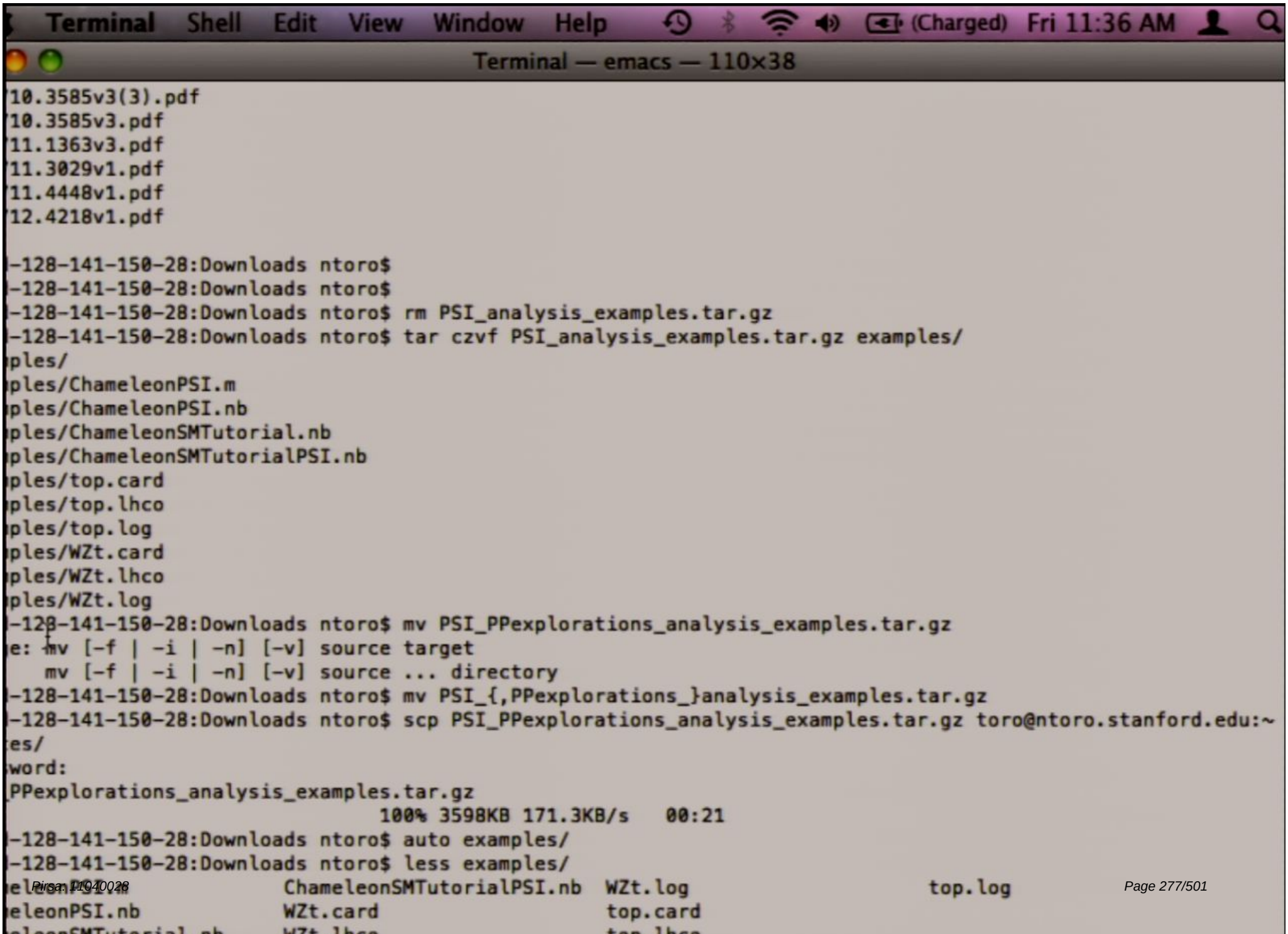
```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted
```


Terminal Shell Edit View Window Help (Charged) Fri 11:36 AM
Terminal — emacs — 110×38
10.3585v3(3).pdf
10.3585v3.pdf
11.1363v3.pdf
11.3029v1.pdf
11.4448v1.pdf
12.4218v1.pdf
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$
-128-141-150-28:Downloads ntoro$ rm PSI_analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ tar czvf PSI_analysis_examples.tar.gz examples/
ples/
ples/ChameleonPSI.m
ples/ChameleonPSI.nb
ples/ChameleonSMTutorial.nb
ples/ChameleonSMTutorialPSI.nb
ples/top.card
ples/top.lhco
ples/top.log
ples/WZt.card
ples/WZt.lhco
ples/WZt.log
-128-141-150-28:Downloads ntoro$ mv PSI_PPexplorations_analysis_examples.tar.gz
e: mv [-f | -i | -n] [-v] source target
mv [-f | -i | -n] [-v] source ... directory
-128-141-150-28:Downloads ntoro$ mv PSI_{,PPexplorations_}analysis_examples.tar.gz
-128-141-150-28:Downloads ntoro$ scp PSI_PPexplorations_analysis_examples.tar.gz toro@ntoro.stanford.edu:~
es/
word:
PPexplorations_analysis_examples.tar.gz
100% 3598KB 171.3KB/s 00:21
-128-141-150-28:Downloads ntoro$ auto examples/
-128-141-150-28:Downloads ntoro$ less examples/
ChameleonSMTutorialPSI.nb WZt.log top.log
eleonPSI.nb WZt.card top.card

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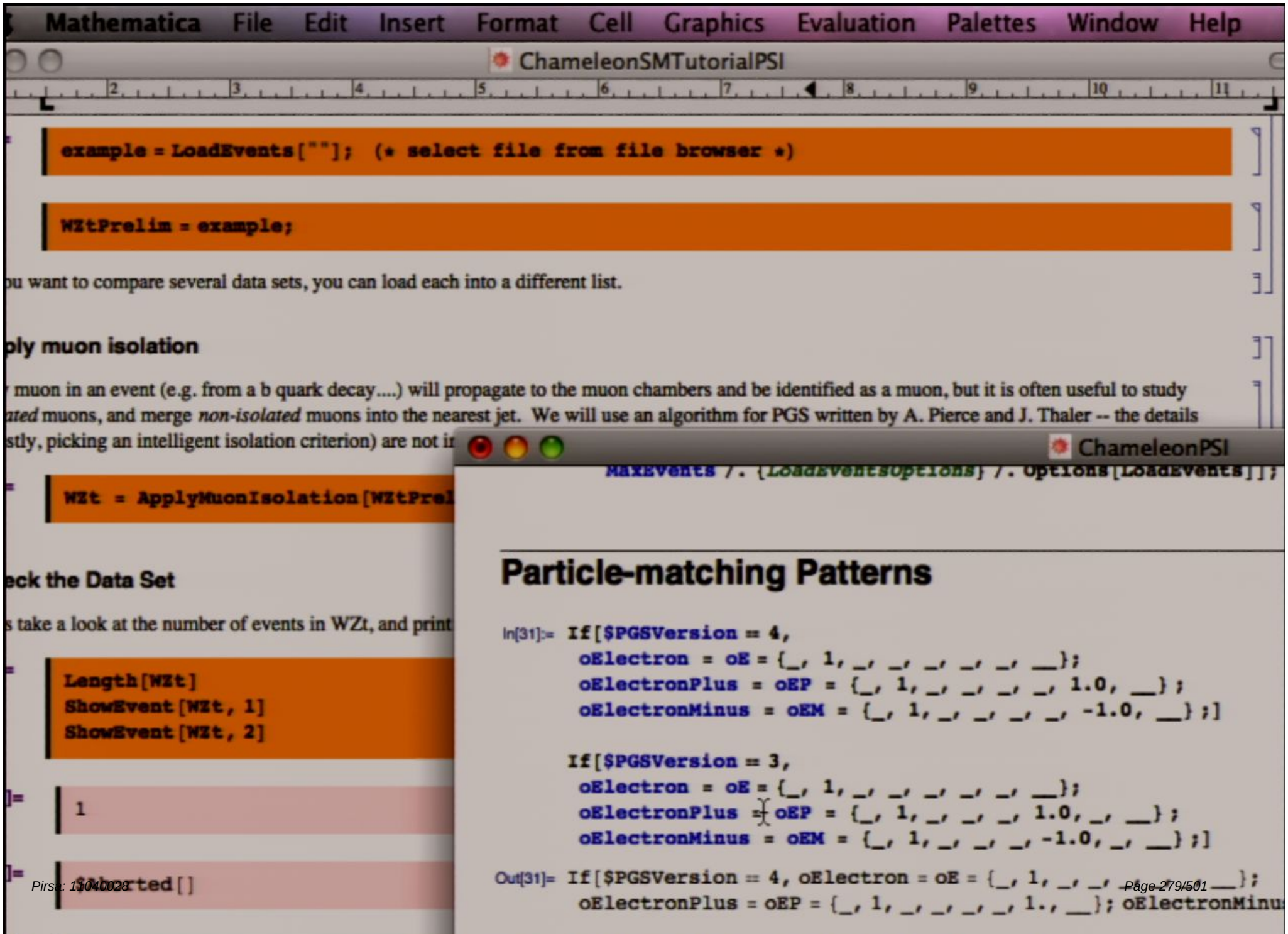
```
$Aborted[]
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
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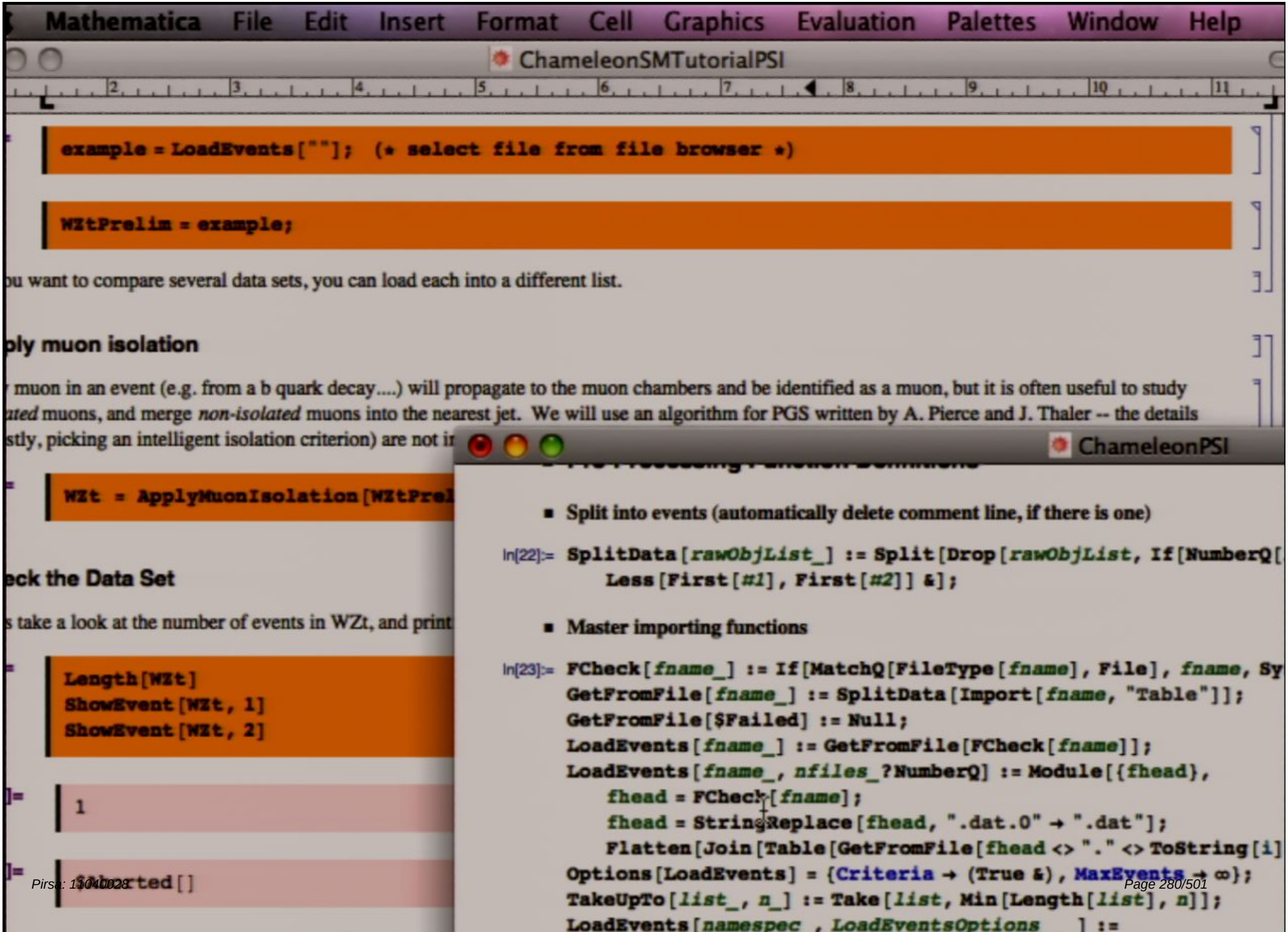
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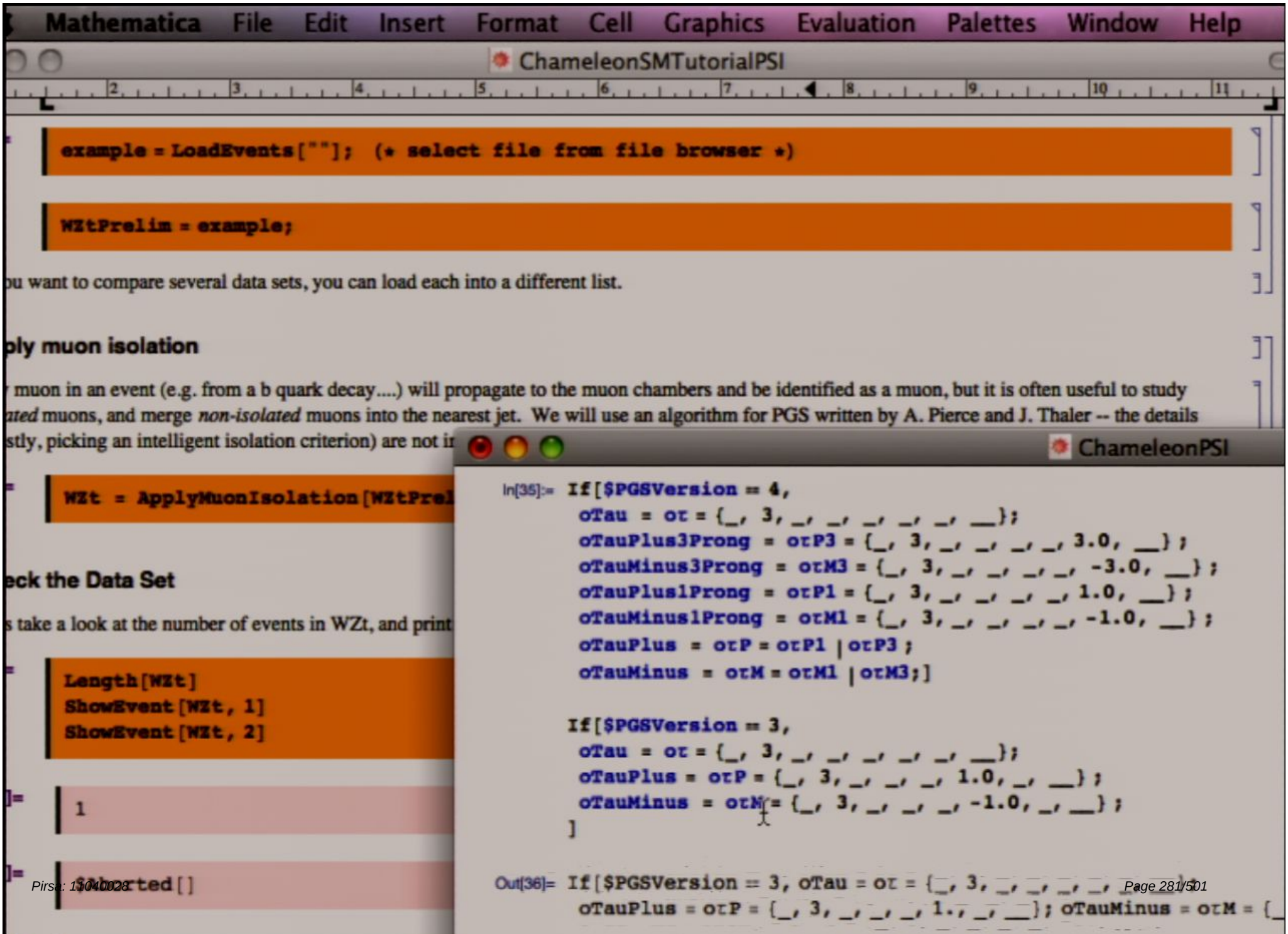
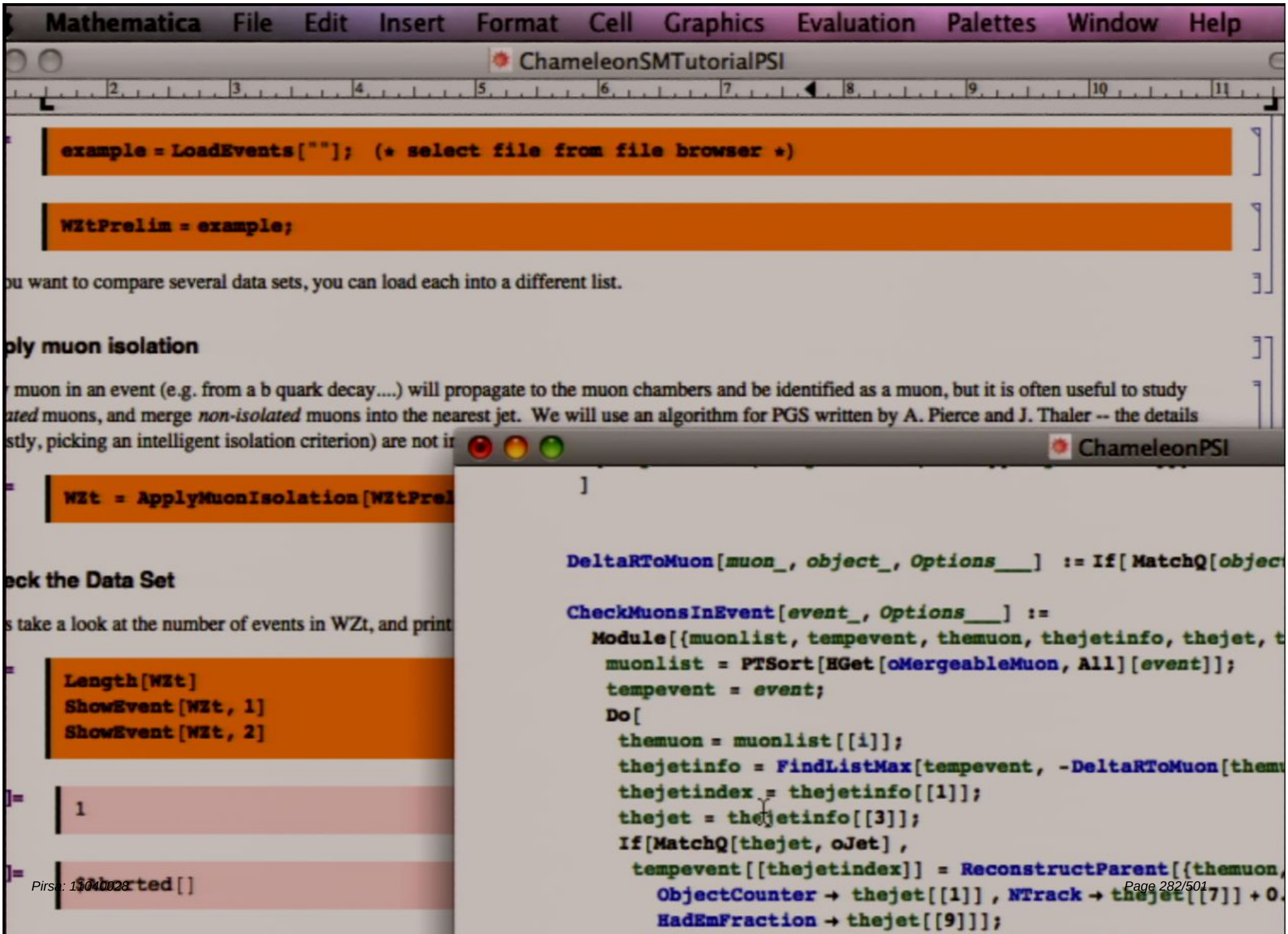
s take a look at the number of events in WZt, and print
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
1
ChameleonPSI
Split into events (automatically delete comment line, if there is one)
In[22]:= SplitData[rawObjList_] := Split[Drop[rawObjList, If[NumberQ[
Less[First[#1], First[#2]] &];
Master importing functions
In[23]:= FCheck[fname_] := If[MatchQ[FileType[fname], File], fname, Sy
GetFromFile[fname_] := SplitData[Import[fname, "Table"]];
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
fhead = FCheck[fname];
fhead = StringReplace[fhead, ".dat.0" → ".dat"];
Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec , LoadEventsOptions] :=
Pirsa: 11040028
Page 280/501


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
example = LoadEvents[""]; (* select file from file browser *)
WZtPrelim = example;
u want to compare several data sets, you can load each into a different list.
ply muon isolation
muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study
ated muons, and merge non-isolated muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details
stly, picking an intelligent isolation criterion) are not ir
WZt = ApplyMuonIsolation[WZtPrel
eck the Data Set
s take a look at the number of events in WZt, and print
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
1
Aborted[]
ChameleonPSI
In[35]:= If[$PGSVersion == 4,
oTau = oT = {_, 3, _, _, _, _, _, __};
oTauPlus3Prong = oTP3 = {_, 3, _, _, _, _, 3.0, __};
oTauMinus3Prong = oTM3 = {_, 3, _, _, _, _, -3.0, __};
oTauPlus1Prong = oTP1 = {_, 3, _, _, _, _, 1.0, __};
oTauMinus1Prong = oTM1 = {_, 3, _, _, _, _, -1.0, __};
oTauPlus = oTP = oTP1 | oTP3;
oTauMinus = oTM = oTM1 | oTM3;]
If[$PGSVersion == 3,
oTau = oT = {_, 3, _, _, _, _, _, __};
oTauPlus = oTP = {_, 3, _, _, _, 1.0, _, __};
oTauMinus = oTM = {_, 3, _, _, _, -1.0, _, __};
]
Out[36]= If[$PGSVersion == 3, oTau = oT = {_, 3, _, _, _, _, _, __};
oTauPlus = oTP = {_, 3, _, _, _, 1., _, __}; oTauMinus = oTM = {_


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
example = LoadEvents[""]; (* select file from file browser *)
WZtPrelim = example;
ply muon isolation
eck the Data Set
WZt = ApplyMuonIsolation[WZtPrel
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
1
ChameleonPSI
DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[objec
CheckMuonsInEvent[event_, Options___] :=
Module[{muonlist, tempevent, themuon, thejetinfo, thejet, t
muonlist = PTSort[HGet[oMergeableMuon, All][event]];
tempevent = event;
Do[
themuon = muonlist[[i]];
thejetinfo = FindListMax[tempevent, -DeltaRToMuon[themu
thejetindex = thejetinfo[[1]];
thejet = thejetinfo[[3]];
If[MatchQ[thejet, oJet] ,
tempevent[[thejetindex]] = ReconstructParent[{themuon,
ObjectCounter → thejet[[1]] , NTrack → thejet[[7]] + 0.
HadEmFraction → thejet[[9]]];

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
]= 1
```

```
]= $Aborted[]
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

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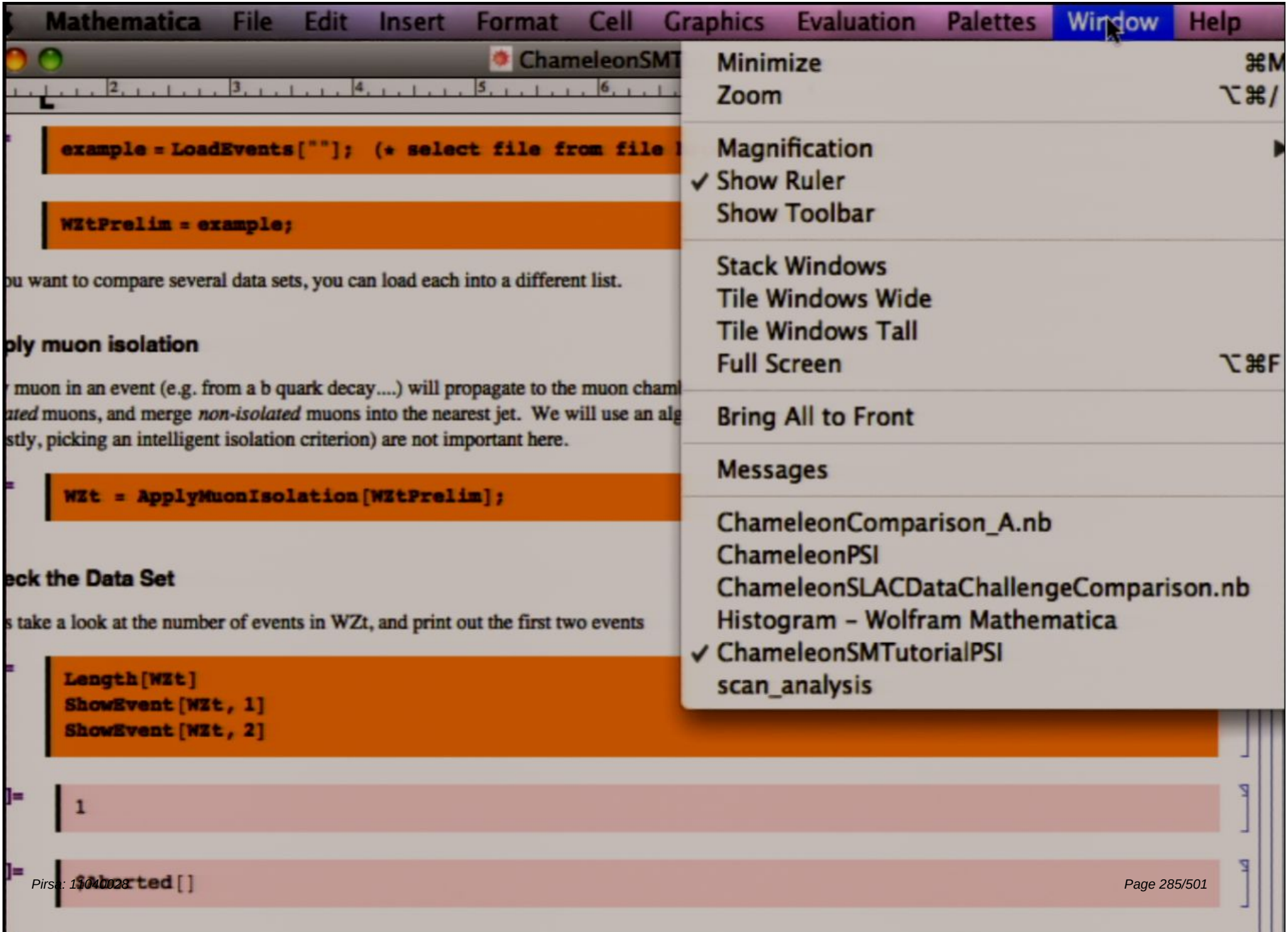
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```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Magnification
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Show Toolbar
Stack Windows
Tile Windows Wide
Tile Windows Tall
Full Screen ⌥⌘F
Bring All to Front
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ChameleonComparison_A.nb
ChameleonPSI
ChameleonSLACDataChallengeComparison.nb
Histogram - Wolfram Mathematica
✓ ChameleonSMTutorialPSI
scan_analysis
example = LoadEvents[""]; (* select file from file
WZtPrelim = example;
u want to compare several data sets, you can load each into a different list.
ply muon isolation
muon in an event (e.g. from a b quark decay....) will propagate to the muon cham
ated muons, and merge non-isolated muons into the nearest jet. We will use an alg
stly, picking an intelligent isolation criterion) are not important here.
WZt = ApplyMuonIsolation[WZtPrelim];
eck the Data Set
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Length[WZt]
ShowEvent[WZt, 1]
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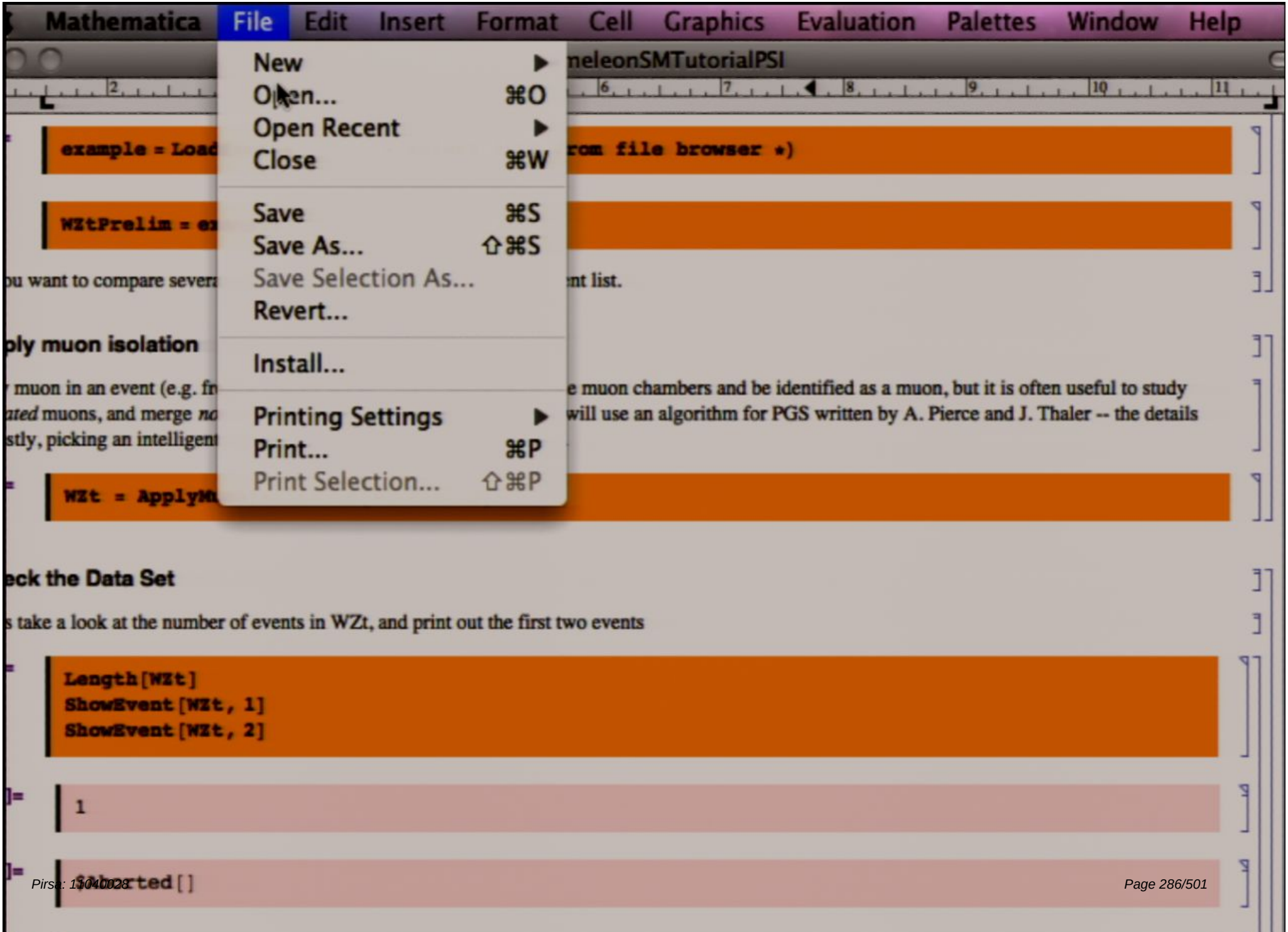
1
Aborted[]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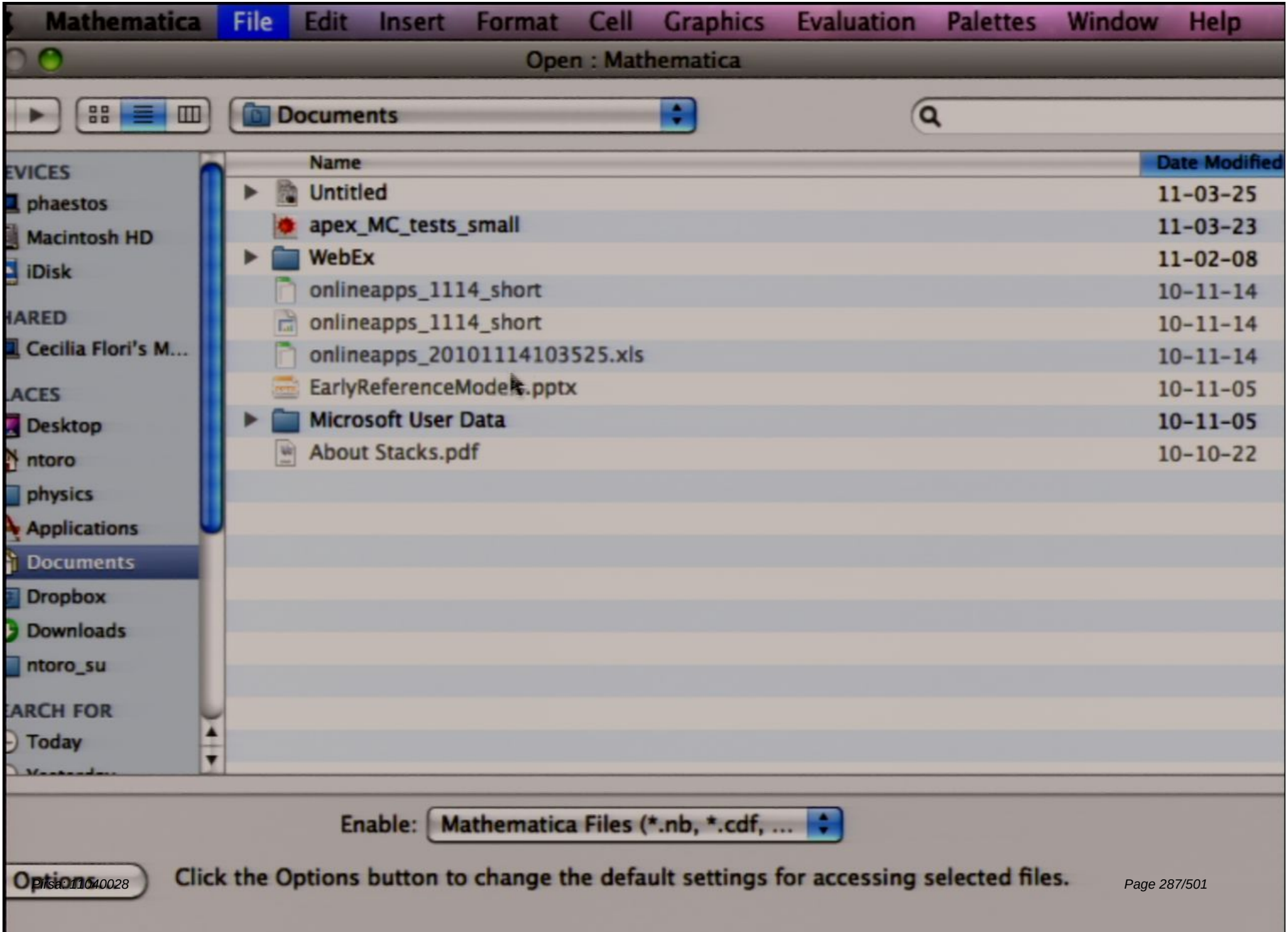
Aborted[]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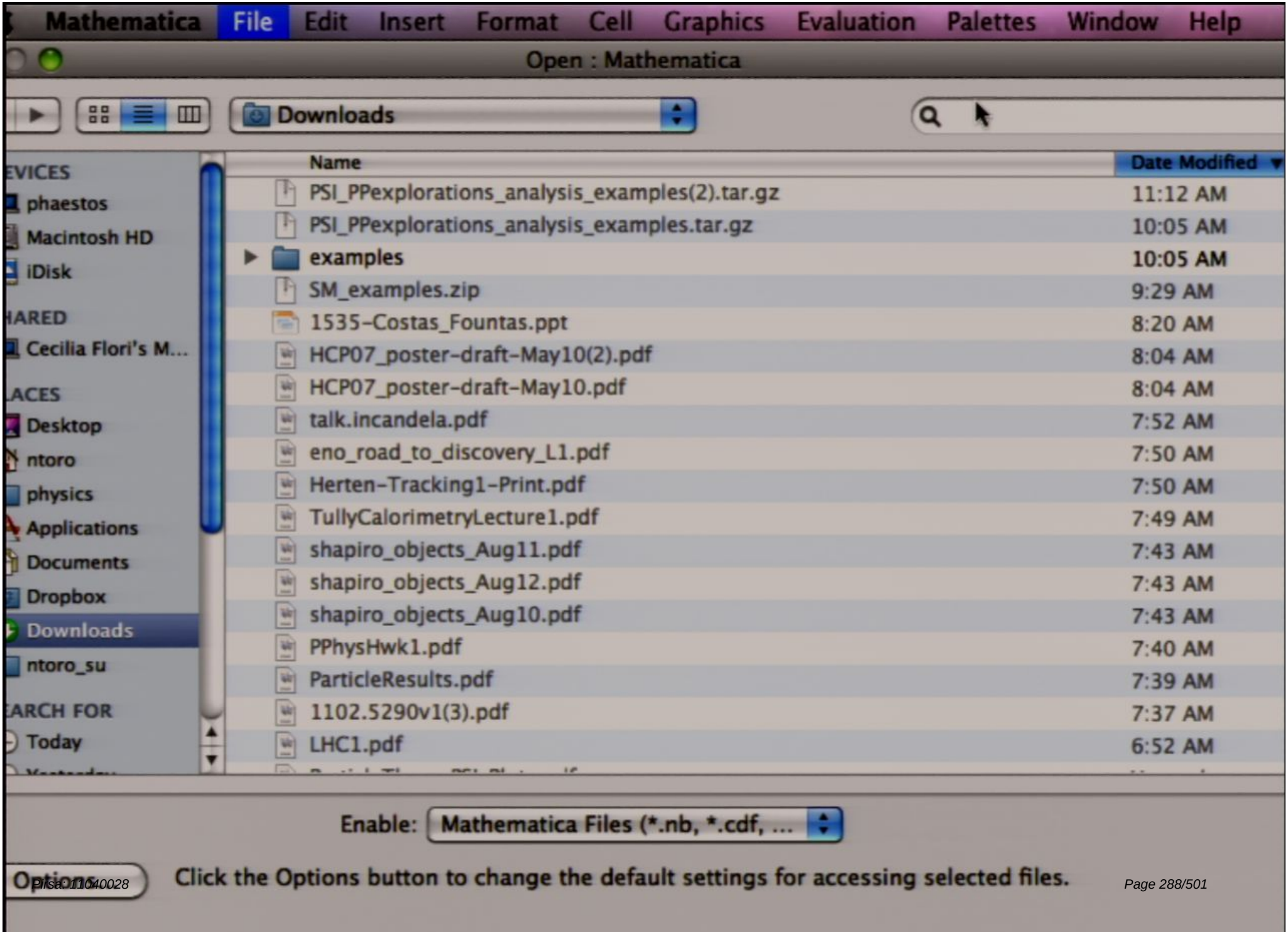
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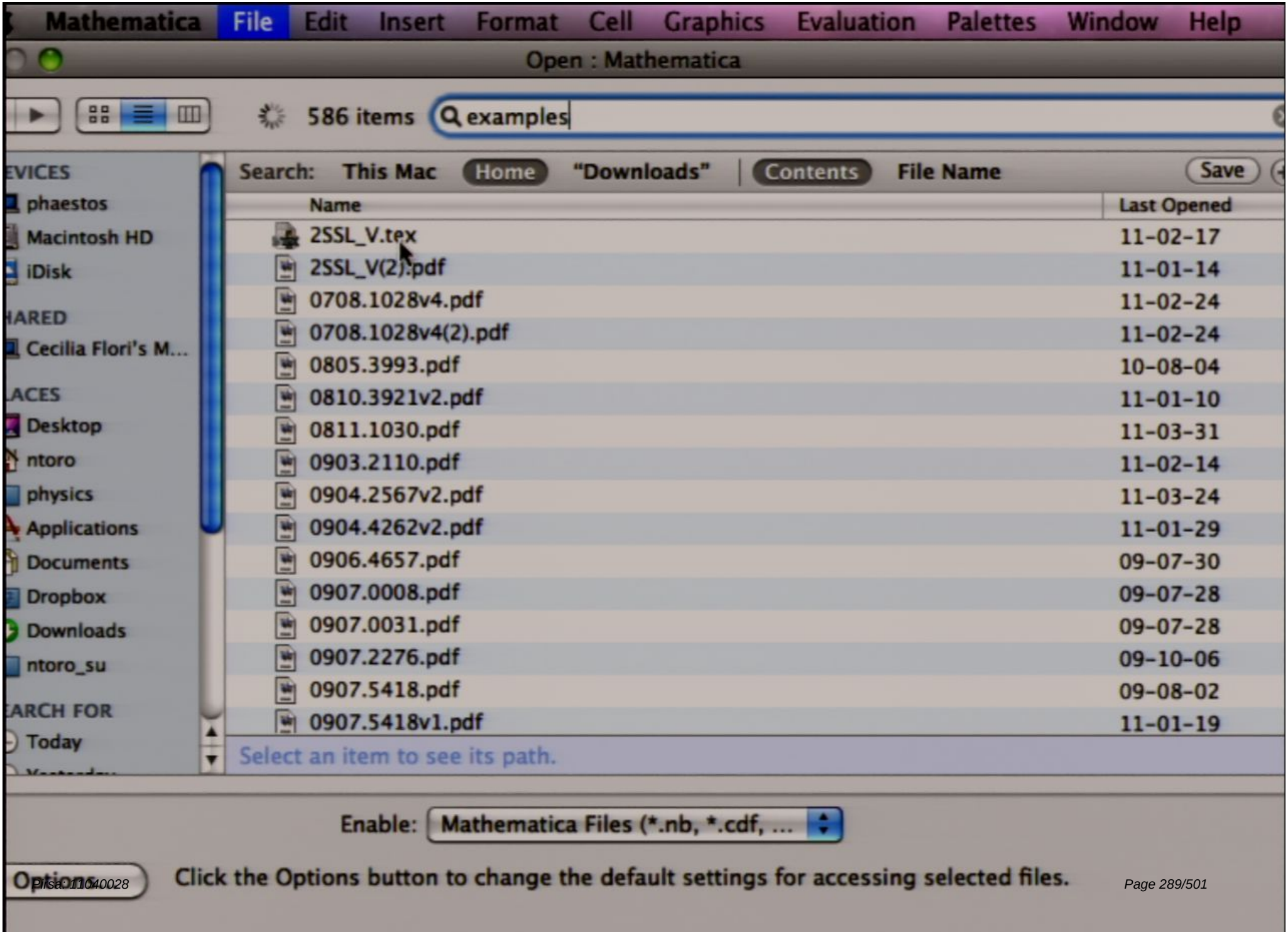
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0903.2110.pdf 11-02-14
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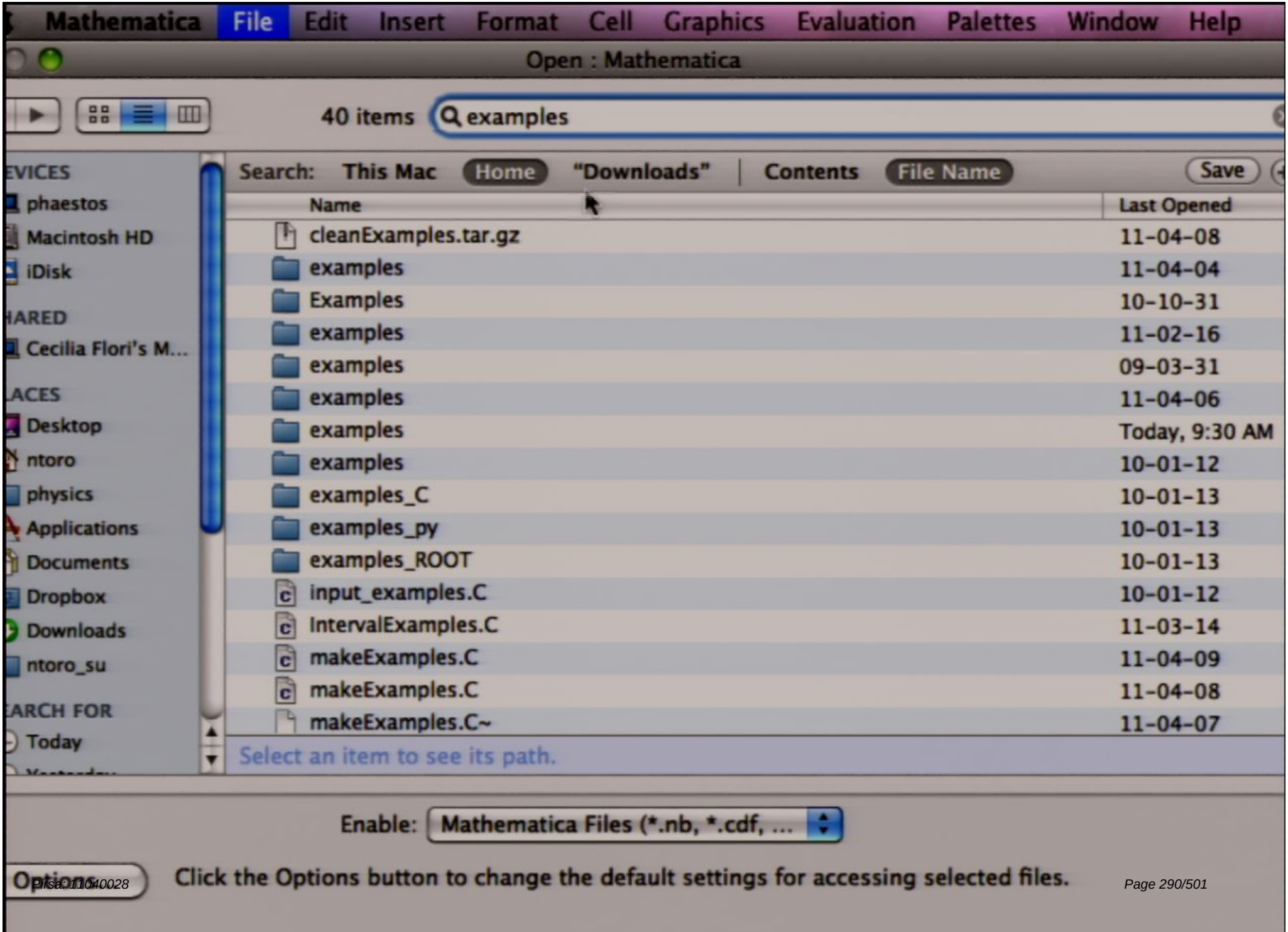
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examples 11-02-16
examples 09-03-31
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examples_C 10-01-13
examples_py 10-01-13
examples_ROOT 10-01-13
input_examples.C 10-01-12
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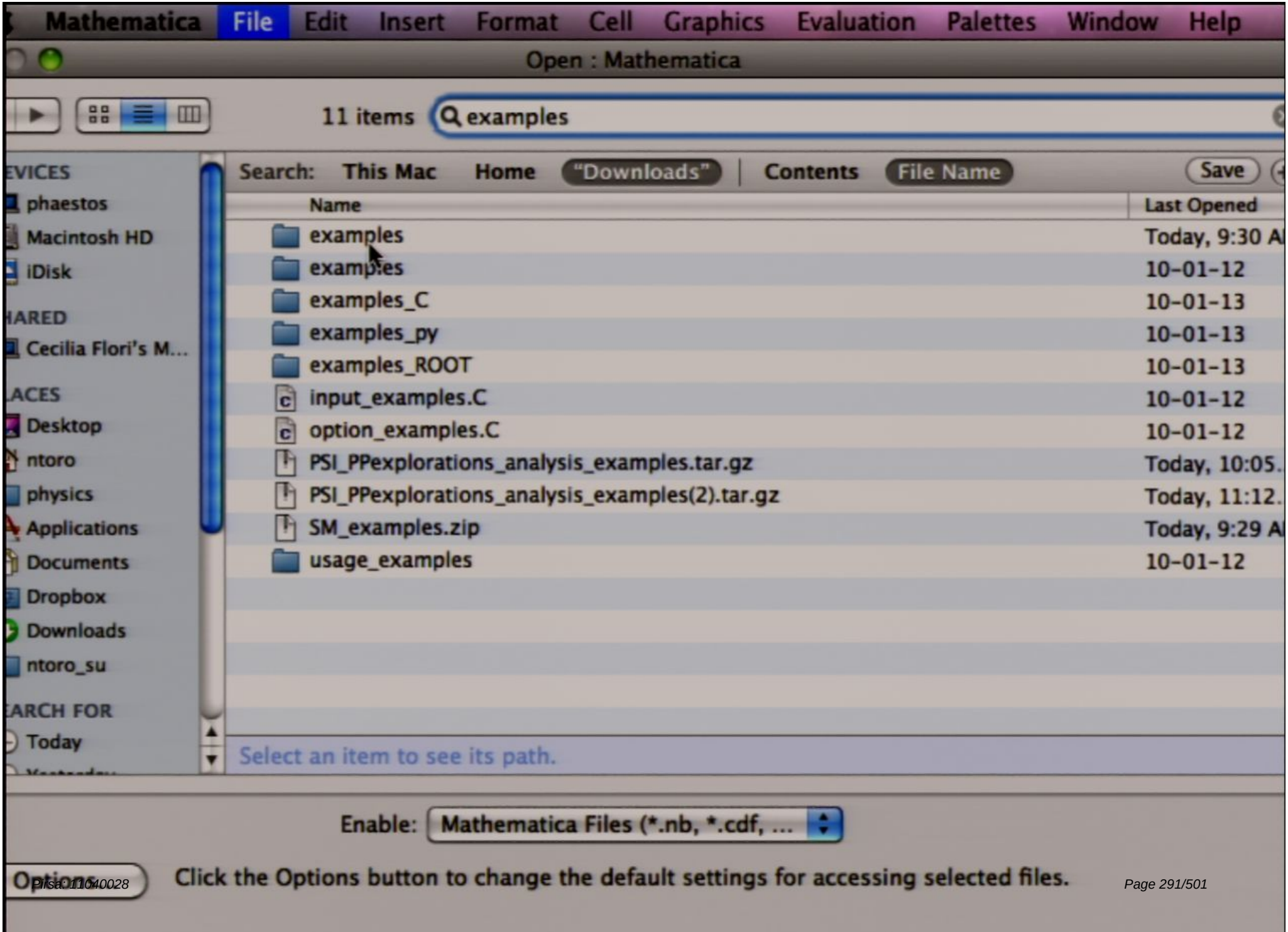
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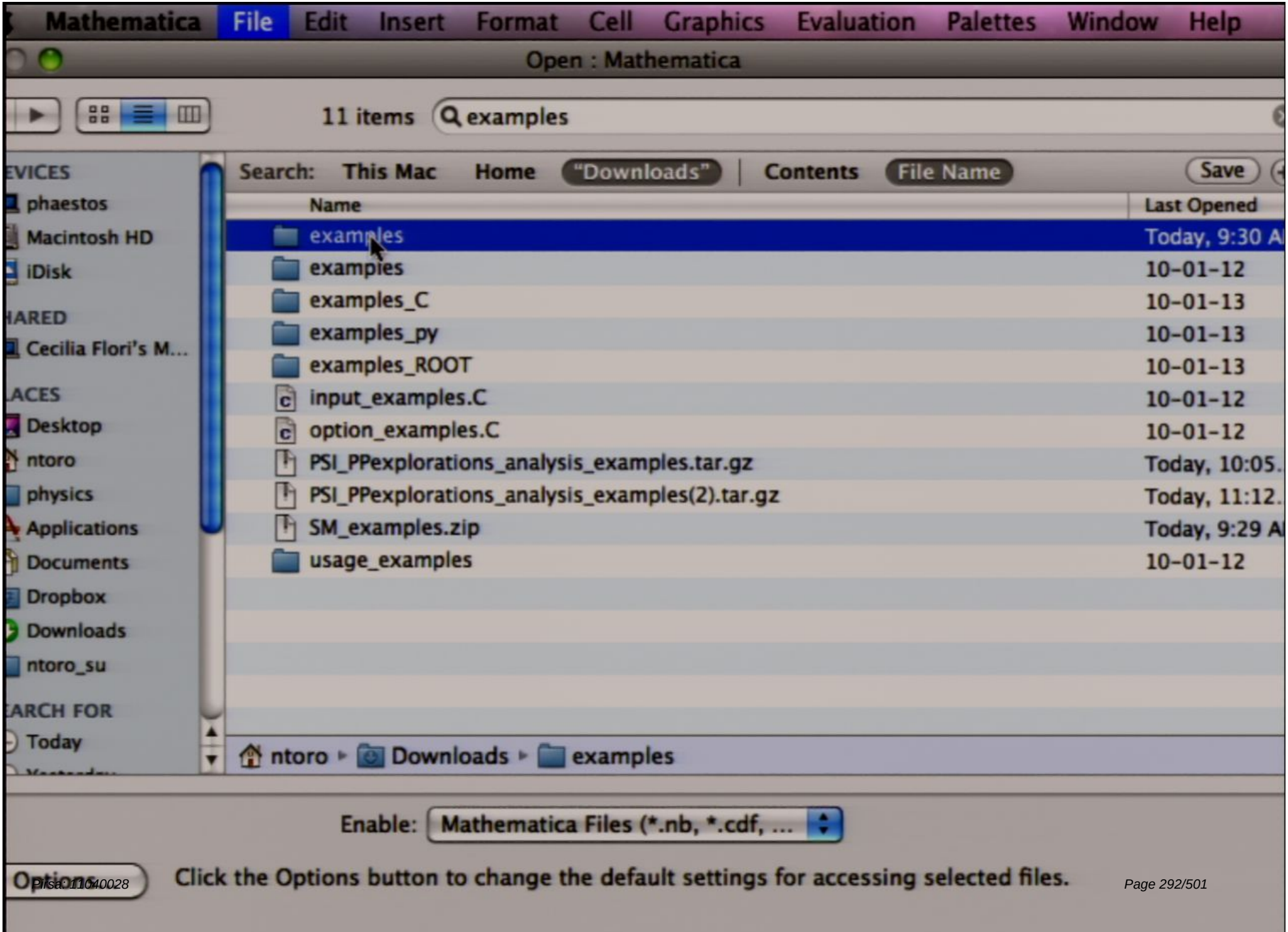
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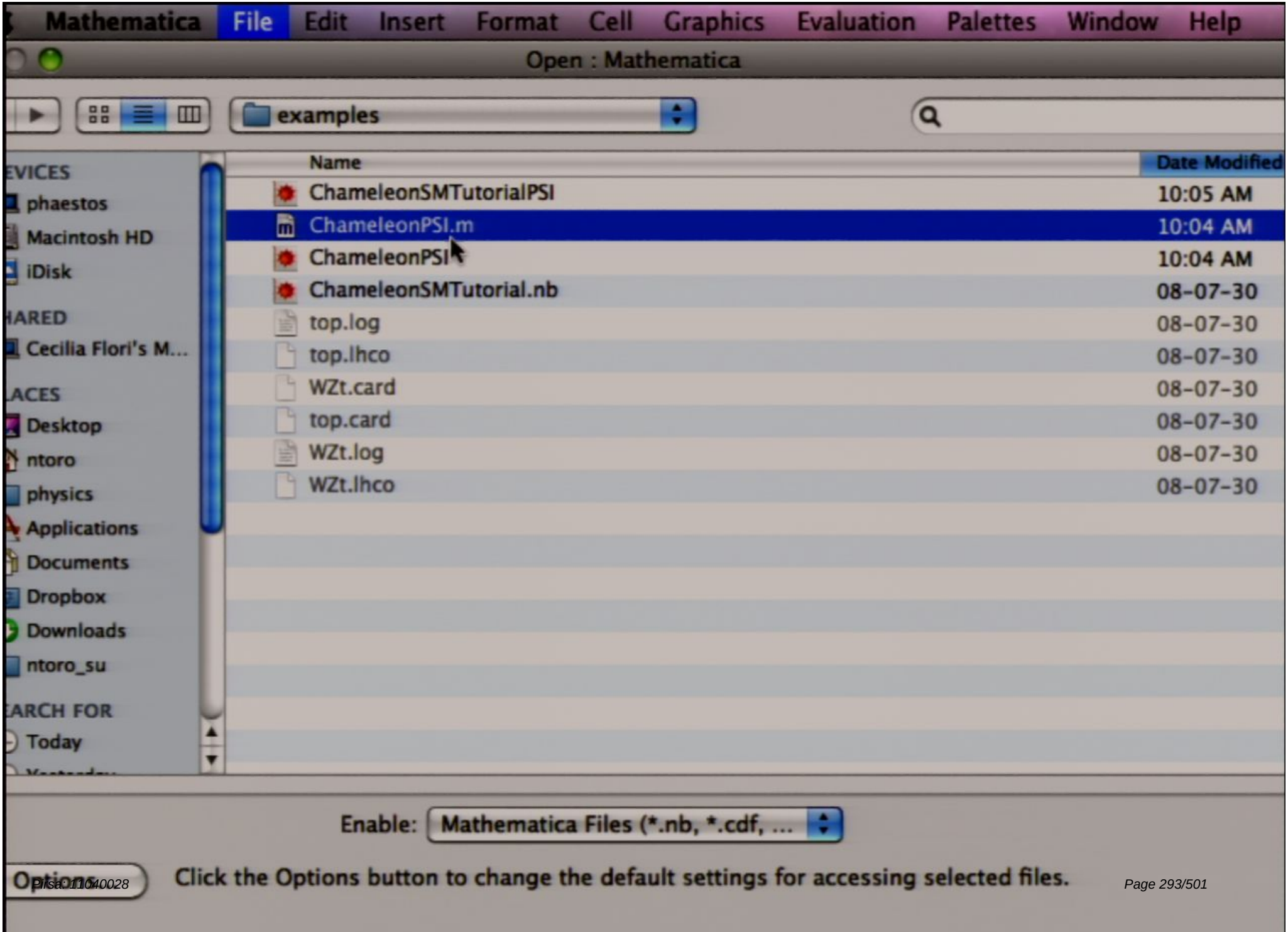
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Enable: Mathematica Files (*.nb, *.cdf, ...
Options
Click the Options button to change the default settings for accessing selected files.

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

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```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

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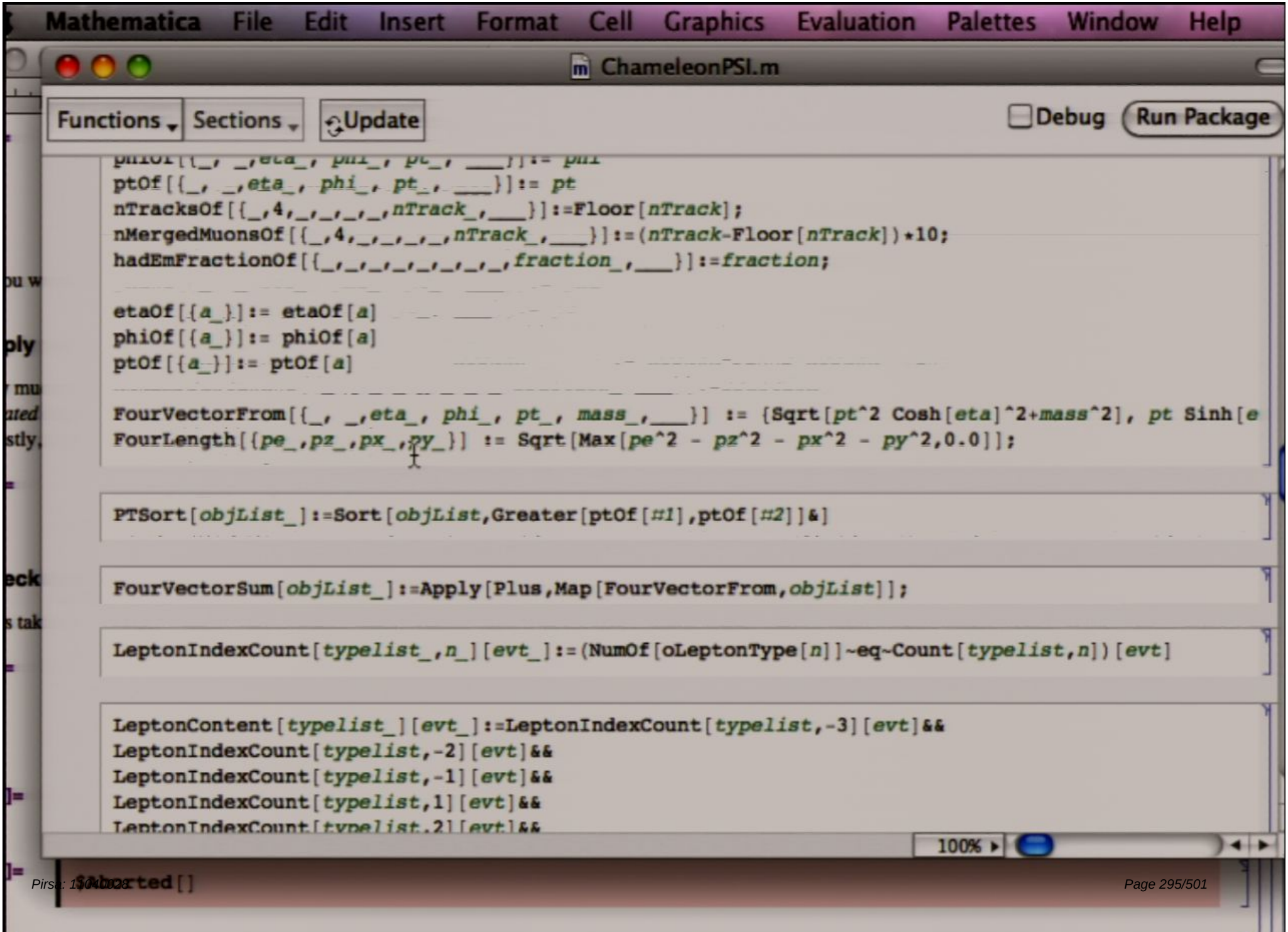
```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI.m
Functions
Sections
Update
Debug
Run Package
ptOf[{_, _,eta_, phi_, pt_, ___}]:= pt
nTracksOf[{_,4,_,_,_,_,nTrack_,___}]:=Floor[nTrack];
nMergedMuonsOf[{_,4,_,_,_,_,nTrack_,___}]:=(nTrack-Floor[nTrack])*10;
hadEmFractionOf[{_,_,_,_,_,_,_,_,fraction_,___}]:=fraction;
etaOf[{a_}]:= etaOf[a]
phiOf[{a_}]:= phiOf[a]
ptOf[{a_}]:= ptOf[a]
FourVectorFrom[{_, _,eta_, phi_, pt_, mass_,___}] := {Sqrt[pt^2 Cosh[eta]^2+mass^2], pt Sinh[e
FourLength[{pe_,pz_,px_,py_}] := Sqrt[Max[pe^2 - pz^2 - px^2 - py^2,0.0]];
PTSort[objList_]:=Sort[objList,Greater[ptOf[#1],ptOf[#2]]&]
FourVectorSum[objList_]:=Apply[Plus,Map[FourVectorFrom,objList]];
LeptonIndexCount[typelist_,n_][evt_]:=(NumOf[oLeptonType[n]]~eq~Count[typelist,n])[evt]
LeptonContent[typelist_][evt_]:=LeptonIndexCount[typelist,-3][evt]&&
LeptonIndexCount[typelist,-2][evt]&&
LeptonIndexCount[typelist,-1][evt]&&
LeptonIndexCount[typelist,1][evt]&&
100%
$Aborted[]

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ChameleonPSI.m

Functions Sections Update Debug Run Package

```
LEPLIST={-1,-2,-3,1,2,3};

SingleLeptonCount[evtList_]:=Module[{TMPLIST},
TMPLIST=Select[evtList,(NumOf[oLepton]~eq~1)];
MatrixForm[{{"e-","μ-","τ-","e+","μ+","τ+"},
Map[CriterionCount[TMPLIST,LeptonContent[{#}]]&,LEPLIST]}]];

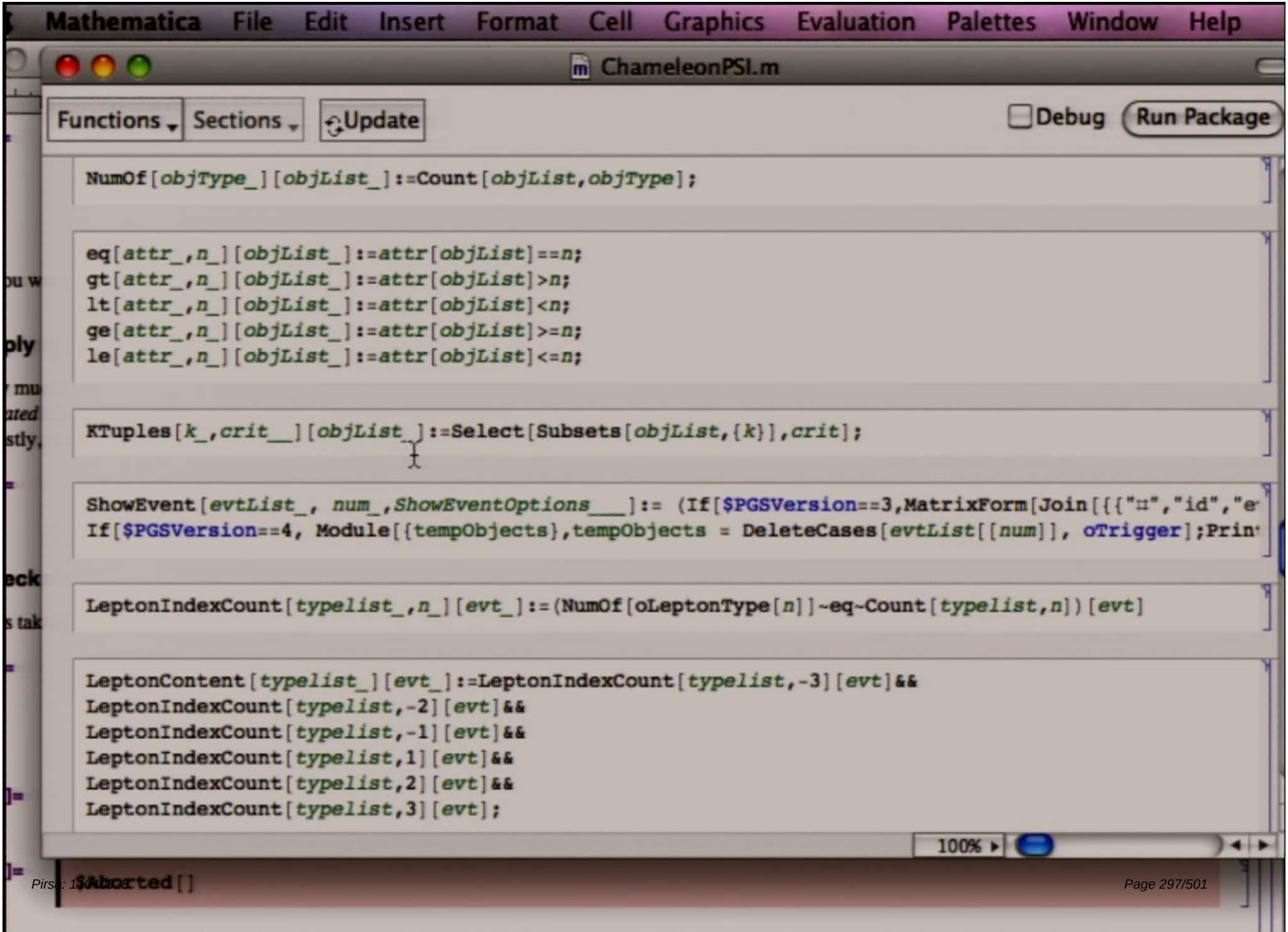
DiLeptonCount[evtList_]:=Module[{TMPLIST,F1,UTfnc},
TMPLIST=Select[evtList,(NumOf[oLepton]~eq~2)];
F1[a_]:=Abs[a]+2 Sign[a];
UTfnc[l_]:=F1[l[[1]]]<=F1[l[[2]]];
MatrixForm[Transpose[Join[{{"-","e-","μ-","τ-","e+","μ+","τ+"}},Transpose[Join[{{"e-","μ-","τ-","
Map[If[UTfnc[#],CriterionCount[TMPLIST,LeptonContent[#]],0]&,Outer[List,LEPLIST,LEPLIST],{2}]]]]

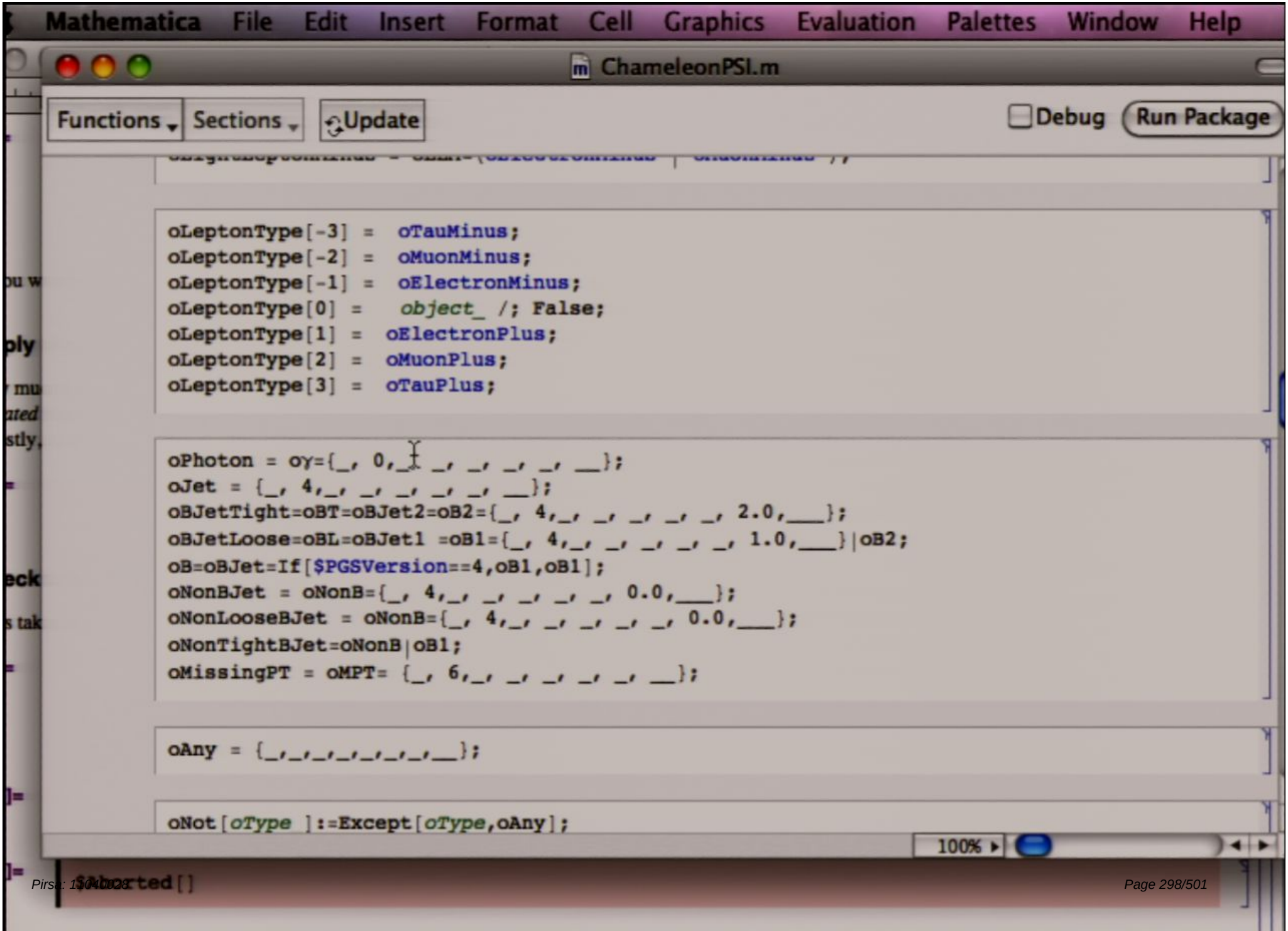
AdvancedCount[evtList_,crit_,objsel_,boolFunc_]:=Count[objsel/@Select[evtList,crit],ev_/;boolFun

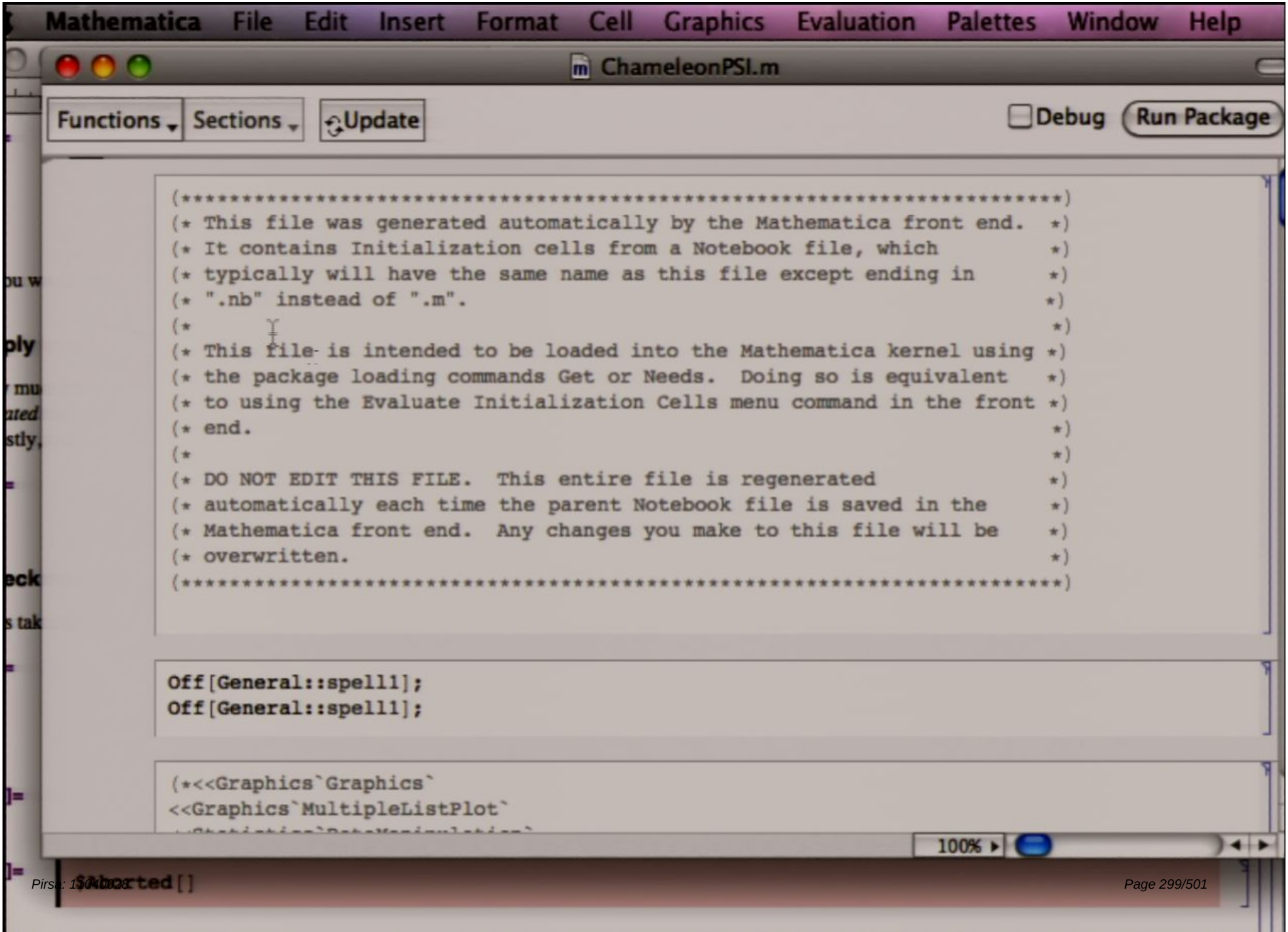
RunInclusiveCounts[evtList_]:=Print["\nPhotons: ",SpeciesCount[evtList,oγ,4],"    Jets: ",Species

$Aborted[]
```

100%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI.m
Functions
Sections
Update
Debug
Run Package
NumOf[objType_][objList_]:=Count[objList,objType];
eq[attr_,n_][objList_]:=attr[objList]==n;
gt[attr_,n_][objList_]:=attr[objList]>n;
lt[attr_,n_][objList_]:=attr[objList]<n;
ge[attr_,n_][objList_]:=attr[objList]>=n;
le[attr_,n_][objList_]:=attr[objList]<=n;
KTuples[k_,crit__][objList_]:=Select[Subsets[objList,{k}],crit];
ShowEvent[evtList_, num_,ShowEventOptions___]:= (If[$PGSVersion==3,MatrixForm[Join[{{"#","id","e
If[$PGSVersion==4, Module[{tempObjects},tempObjects = DeleteCases[evtList[[num]], oTrigger];Prin
LeptonIndexCount[typelist_,n_][evt_]:=(NumOf[oLeptonType[n]]~eq~Count[typelist,n])[evt]
LeptonContent[typelist_][evt_]:=LeptonIndexCount[typelist,-3][evt]&&
LeptonIndexCount[typelist,-2][evt]&&
LeptonIndexCount[typelist,-1][evt]&&
LeptonIndexCount[typelist,1][evt]&&
LeptonIndexCount[typelist,2][evt]&&
LeptonIndexCount[typelist,3][evt];
100%
$Aborted[]


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI.m
Functions
Sections
Update
Debug
Run Package
oLeptonType[-3] = oTauMinus;
oLeptonType[-2] = oMuonMinus;
oLeptonType[-1] = oElectronMinus;
oLeptonType[0] = object_ /; False;
oLeptonType[1] = oElectronPlus;
oLeptonType[2] = oMuonPlus;
oLeptonType[3] = oTauPlus;
oPhoton = oγ={_, 0,_, _, _, _, _, __};
oJet = {_, 4,_, _, _, _, _, __};
oBJetTight=oBT=oBJet2=oB2={_, 4,_, _, _, _, _, 2.0,___};
oBJetLoose=oBL=oBJet1 =oB1={_, 4,_, _, _, _, _, 1.0,___}|oB2;
oB=oBJet=If[$PGSVersion==4,oB1,oB1];
oNonBJet = oNonB={_, 4,_, _, _, _, _, 0.0,___};
oNonLooseBJet = oNonB={_, 4,_, _, _, _, _, 0.0,___};
oNonTightBJet=oNonB|oB1;
oMissingPT = oMPT= {_, 6,_, _, _, _, _, __};
oAny = {_,_,_,_,_,_,_,__};
oNot[oType]:=Except[oType,oAny];
100%
$Aborted[]


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI.m
Functions
Sections
Update
Debug
Run Package
(***)
(* This file was generated automatically by the Mathematica front end. *)
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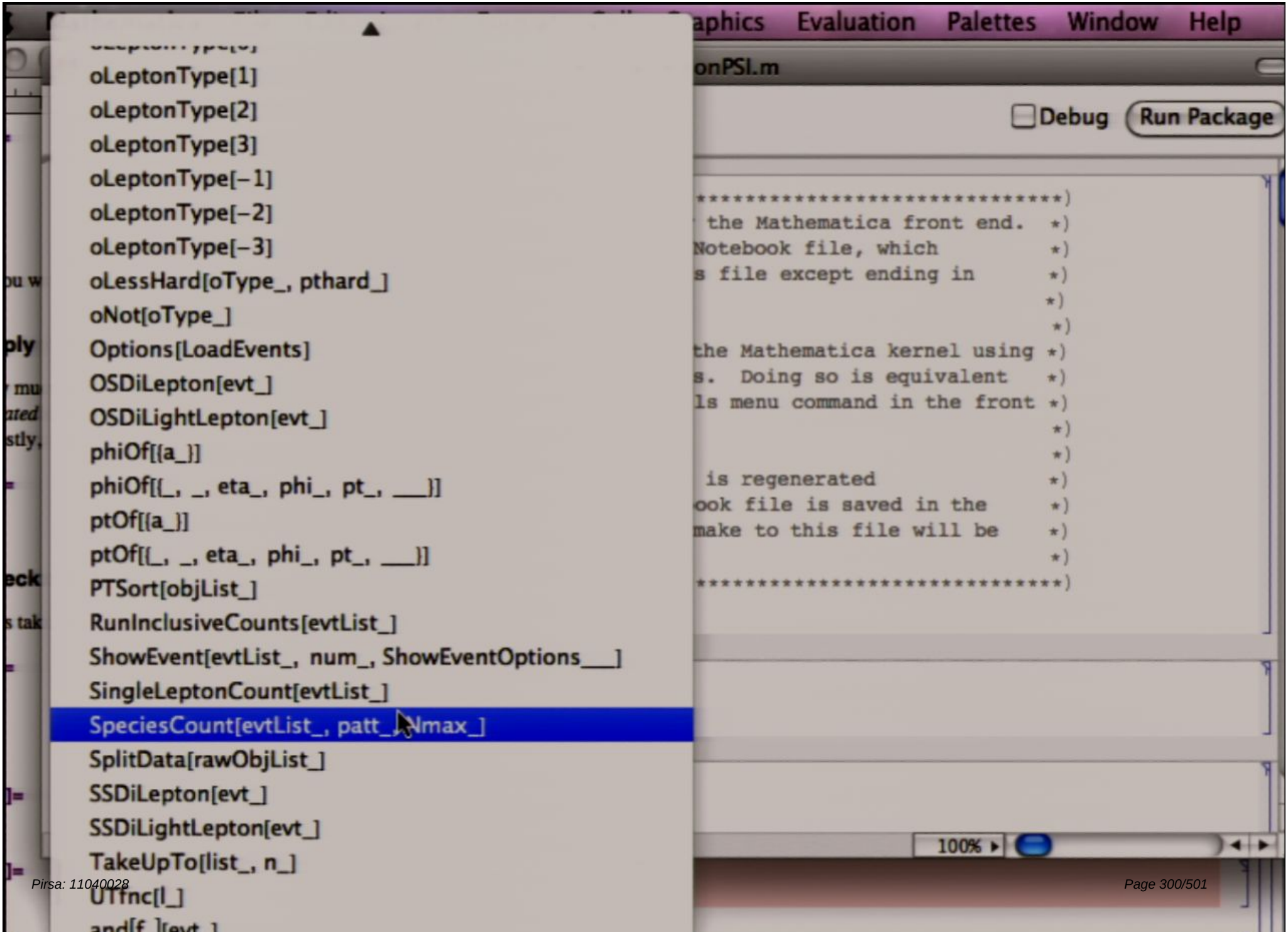
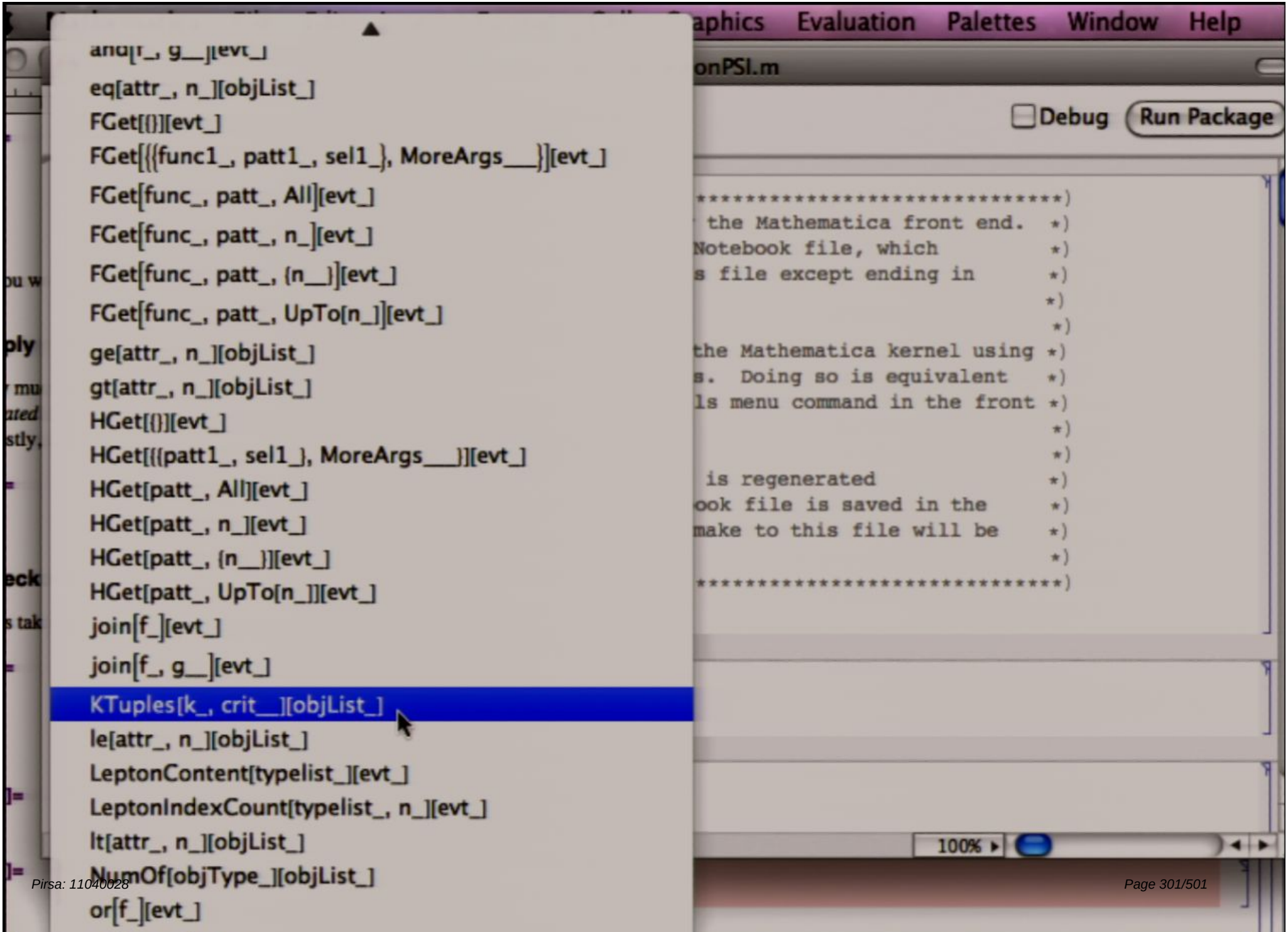
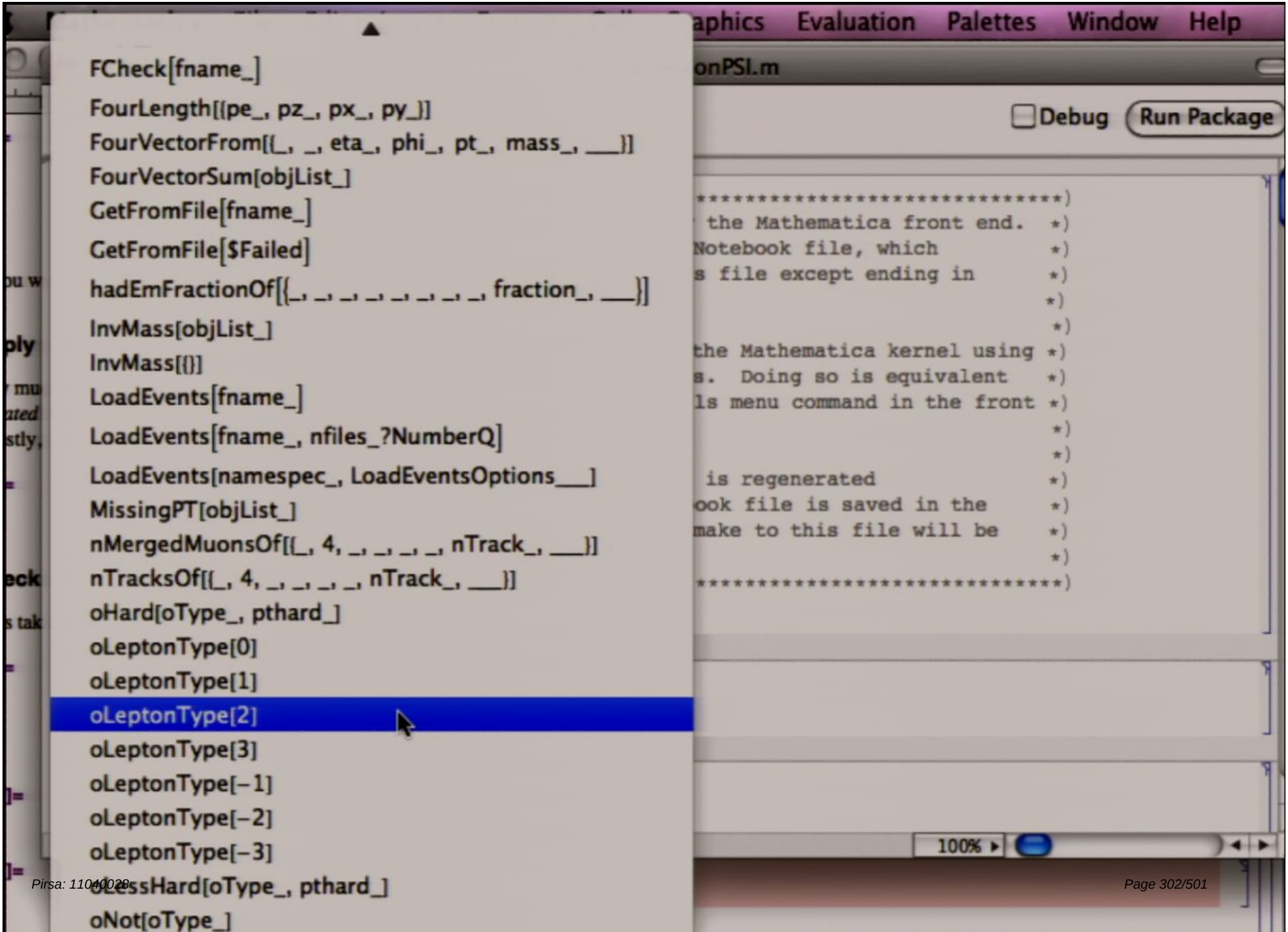
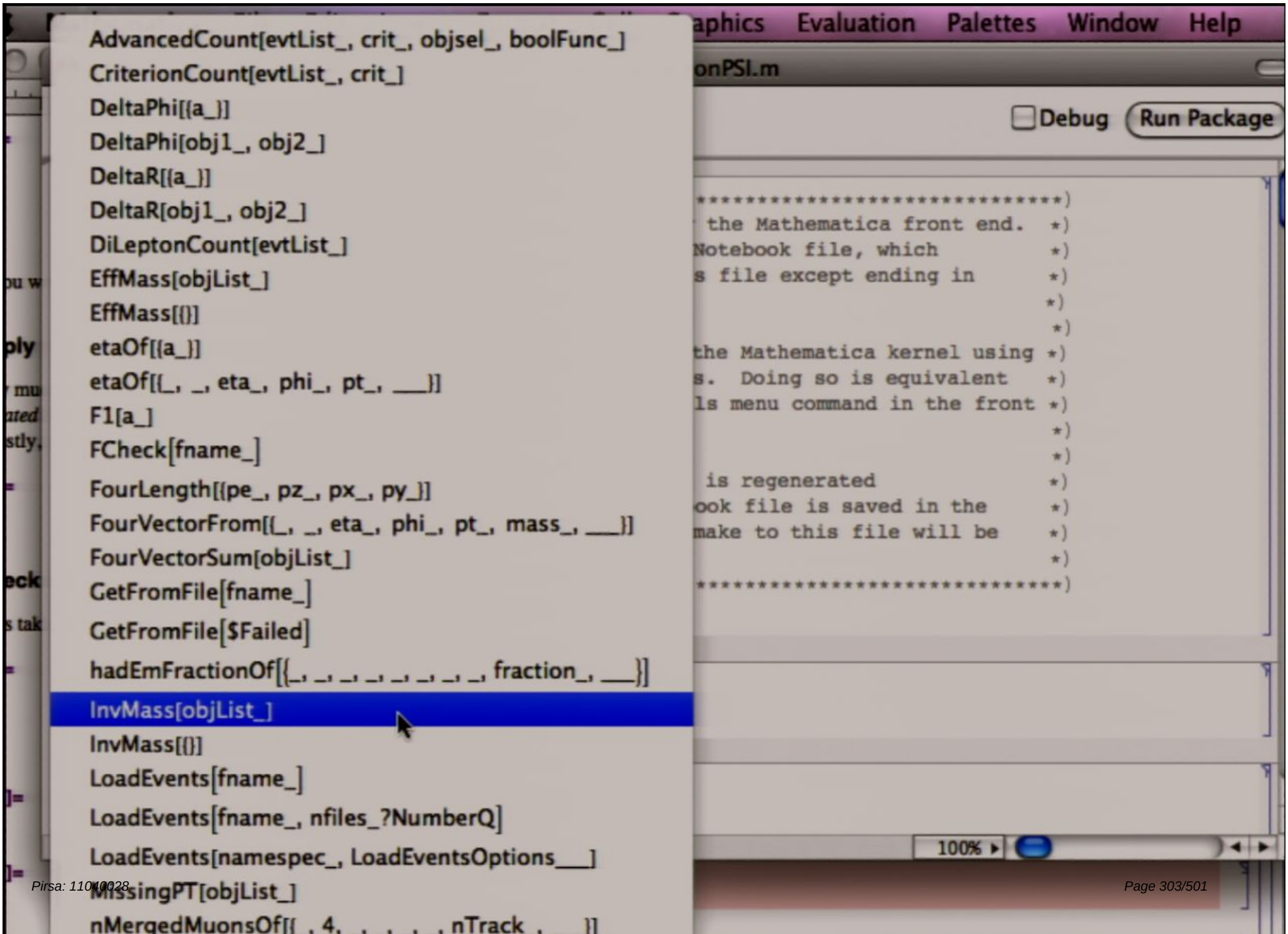
(* to using the Evaluate Initialization Cells menu command in the front *)
(* end. *)
(* *)
(* DO NOT EDIT THIS FILE. This entire file is regenerated *)
(* automatically each time the parent Notebook file is saved in the *)
(* Mathematica front end. Any changes you make to this file will be *)
(* overwritten. *)
(***)
Off[General::spell1];
Off[General::spell1];
(*<<Graphics`Graphics`
<<Graphics`MultipleListPlot`
100%
$Aborted[]


Graphics Evaluation Palettes Window Help
onPSI.m
Debug
Run Package
oLeptonType[1]
oLeptonType[2]
oLeptonType[3]
oLeptonType[−1]
oLeptonType[−2]
oLeptonType[−3]
oLessHard[oType_, pthard_]
oNot[oType_]
Options[LoadEvents]
OSDiLepton[evt_]
OSDiLightLepton[evt_]
phiOf[{a_}]
phiOf[{_, _, eta_, phi_, pt_, ___}]
ptOf[{a_}]
ptOf[{_, _, eta_, phi_, pt_, ___}]
PTSort[objList_]
RunInclusiveCounts[evtList_]
ShowEvent[evtList_, num_, ShowEventOptions___]
SingleLeptonCount[evtList_]
SpeciesCount[evtList_, patt_, Nmax_]
SplitData[rawObjList_]
SSDiLepton[evt_]
SSDiLightLepton[evt_]
TakeUpTo[list_, n_]
UTfnc[l_]
the Mathematica front end. *)
Notebook file, which *)
s file except ending in *)
the Mathematica kernel using *)
s. Doing so is equivalent *)
ls menu command in the front *)
is regenerated *)
ook file is saved in the *)
make to this file will be *)
100%


aphics Evaluation Palettes Window Help
onPSI.m
Debug
Run Package
the Mathematica front end.
Notebook file, which
s file except ending in
the Mathematica kernel using
s. Doing so is equivalent
ls menu command in the front
is regenerated
ook file is saved in the
make to this file will be
eq[attr_, n_][objList_]
FGet[{}][evt_]
FGet[{{func1_, patt1_, sel1_}, MoreArgs___}][evt_]
FGet[func_, patt_, All][evt_]
FGet[func_, patt_, n_][evt_]
FGet[func_, patt_, (n__)][evt_]
FGet[func_, patt_, UpTo[n_]][evt_]
ge[attr_, n_][objList_]
gt[attr_, n_][objList_]
HGet[{}][evt_]
HGet[{{patt1_, sel1_}, MoreArgs___}][evt_]
HGet[patt_, All][evt_]
HGet[patt_, n_][evt_]
HGet[patt_, (n__)][evt_]
HGet[patt_, UpTo[n_]][evt_]
join[f_][evt_]
join[f_, g__][evt_]
KTuples[k_, crit__][objList_]
le[attr_, n_][objList_]
LeptonContent[typelist_][evt_]
LeptonIndexCount[typelist_, n_][evt_]
lt[attr_, n_][objList_]
NumOf[objType_][objList_]
or[f_][evt_]
100%


aphics Evaluation Palettes Window Help
onPSI.m
Debug
Run Package
FCheck[fname_]
FourLength[{pe_, pz_, px_, py_}]
FourVectorFrom[{_, _, eta_, phi_, pt_, mass_, ___}]
FourVectorSum[objList_]
GetFromFile[fname_]
GetFromFile[$Failed]
hadEmFractionOf[{_, _, _, _, _, _, _, _, fraction_, ___}]
InvMass[objList_]
InvMass[{}]
LoadEvents[fname_]
LoadEvents[fname_, nfiles_?NumberQ]
LoadEvents[namespec_, LoadEventsOptions___]
MissingPT[objList_]
nMergedMuonsOf[{_, 4, _, _, _, _, nTrack_, ___}]
nTracksOf[{_, 4, _, _, _, _, nTrack_, ___}]
oHard[oType_, pthard_]
oLeptonType[0]
oLeptonType[1]
oLeptonType[2]
oLeptonType[3]
oLeptonType[-1]
oLeptonType[-2]
oLeptonType[-3]
oLessHard[oType_, pthard_]
oNot[oType_]
the Mathematica front end. *)
Notebook file, which *)
s file except ending in *)
the Mathematica kernel using *)
s. Doing so is equivalent *)
ls menu command in the front *)
is regenerated *)
ook file is saved in the *)
make to this file will be *)
100%


aphics Evaluation Palettes Window Help
onPSI.m
Debug
Run Package
AdvancedCount[evtList_, crit_, objsel_, boolFunc_]
CriterionCount[evtList_, crit_]
DeltaPhi[{a_}]
DeltaPhi[obj1_, obj2_]
DeltaR[{a_}]
DeltaR[obj1_, obj2_]
DiLeptonCount[evtList_]
EffMass[objList_]
EffMass[{}]
etaOf[{a_}]
etaOf[{_, _, eta_, phi_, pt_, ___}]
F1[a_]
FCheck[fname_]
FourLength[{pe_, pz_, px_, py_}]
FourVectorFrom[{_, _, eta_, phi_, pt_, mass_, ___}]
FourVectorSum[objList_]
GetFromFile[fname_]
GetFromFile[$Failed]
hadEmFractionOf[{_, _, _, _, _, _, _, _, fraction_, ___}]
InvMass[objList_]
InvMass[{}]
LoadEvents[fname_]
LoadEvents[fname_, nfiles_?NumberQ]
LoadEvents[namespec_, LoadEventsOptions___]
MissingPT[objList_]
nMergedMuonsOf[{ , 4, , , , , , nTrack , , }]
the Mathematica front end. *)
Notebook file, which *)
s file except ending in *)
the Mathematica kernel using *)
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ls menu command in the front *)
is regenerated *)
ook file is saved in the *)
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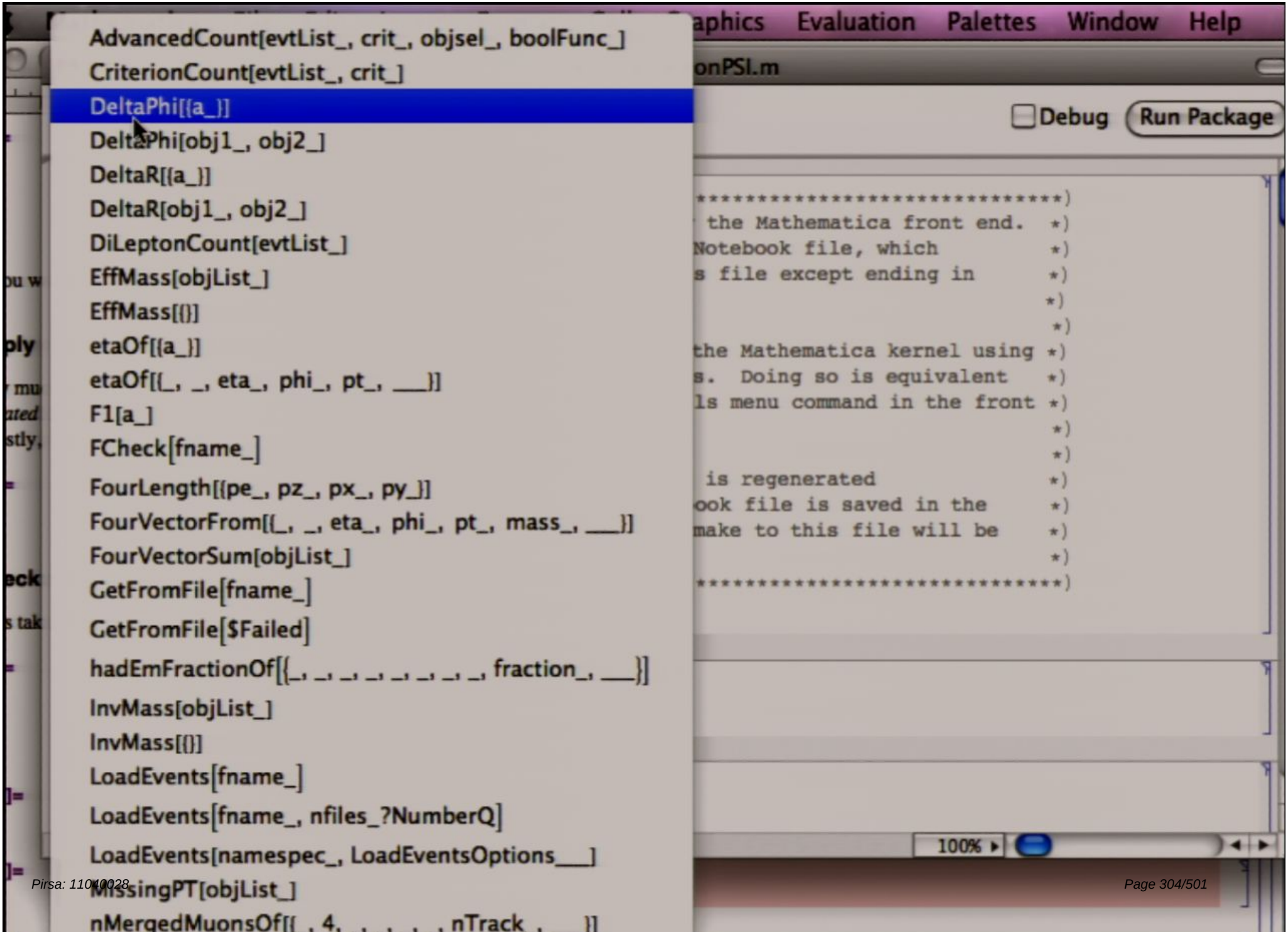
100%


aphics Evaluation Palettes Window Help
onPSI.m
Debug
Run Package
AdvancedCount[evtList_, crit_, objsel_, boolFunc_]
CriterionCount[evtList_, crit_]
DeltaPhi[{a_}]
DeltaPhi[obj1_, obj2_]
DeltaR[{a_}]
DeltaR[obj1_, obj2_]
DiLeptonCount[evtList_]
EffMass[objList_]
EffMass[{}]
etaOf[{a_}]
etaOf[{_, _, eta_, phi_, pt_, ___}]
F1[a_]
FCheck[fname_]
FourLength[{pe_, pz_, px_, py_}]
FourVectorFrom[{_, _, eta_, phi_, pt_, mass_, ___}]
FourVectorSum[objList_]
GetFromFile[fname_]
GetFromFile[$Failed]
hadEmFractionOf[{_, _, _, _, _, _, _, _, fraction_, ___}]
InvMass[objList_]
InvMass[{}]
LoadEvents[fname_]
LoadEvents[fname_, nfiles_?NumberQ]
LoadEvents[namespec_, LoadEventsOptions___]
MissingPT[objList_]
nMergedMuonsOf[{ , 4, , , , , , nTrack , , }]
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Notebook file, which *)
s file except ending in *)
the Mathematica kernel using *)
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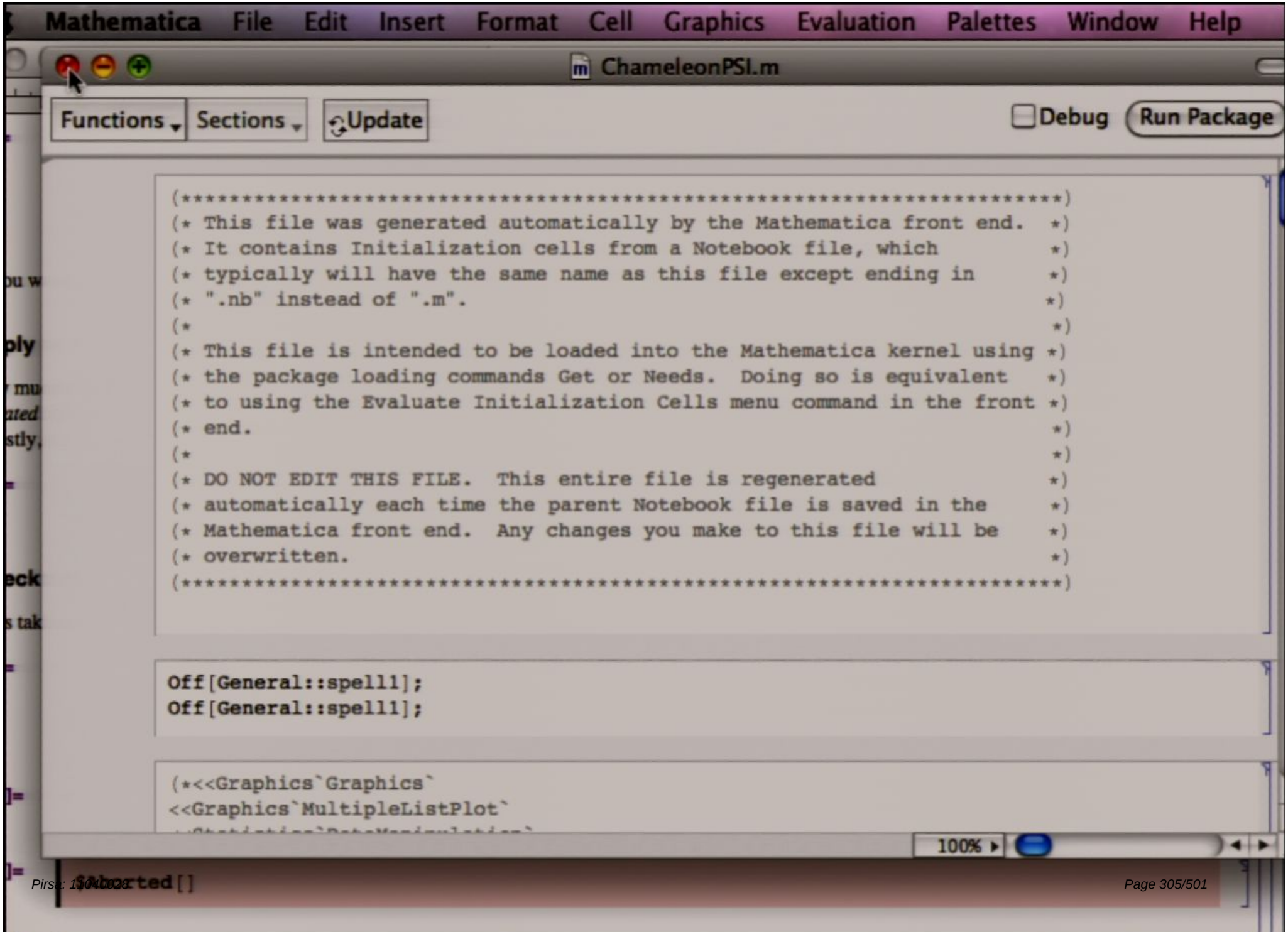
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI.m
Functions
Sections
Update
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(***)
Off[General::spell1];
Off[General::spell1];
(*<<Graphics`Graphics`
<<Graphics`MultipleListPlot`
100%
$Aborted[]

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

```
1
```

```
$Aborted[]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

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```
1
```

```
$Aborted[]
```

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Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Running...ChameleonSMTutorialPSI

```
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```

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```

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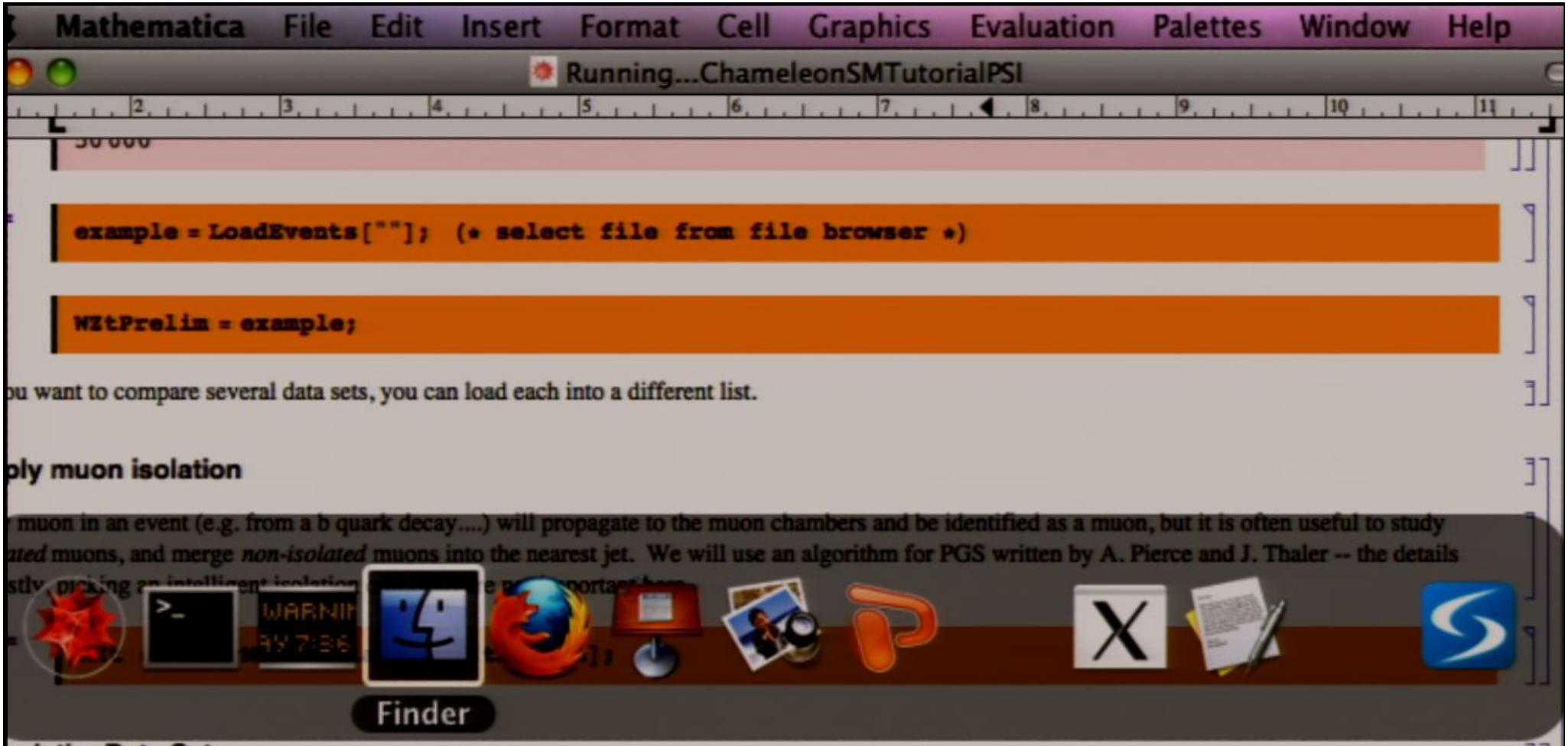
```
ShowEvent[WZtPrelim, 1]
```

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Running...ChameleonSMTutorialPSI
example = LoadEvents[""]; (* select file from file browser *)
WZtPrelim = example;
ply muon isolation
muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study
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Finder
eck the Data Set
s take a look at the number of events in WZt, and print out the first two events
ShowEvent[WZtPrelim, 1]
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

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ply muon isolation

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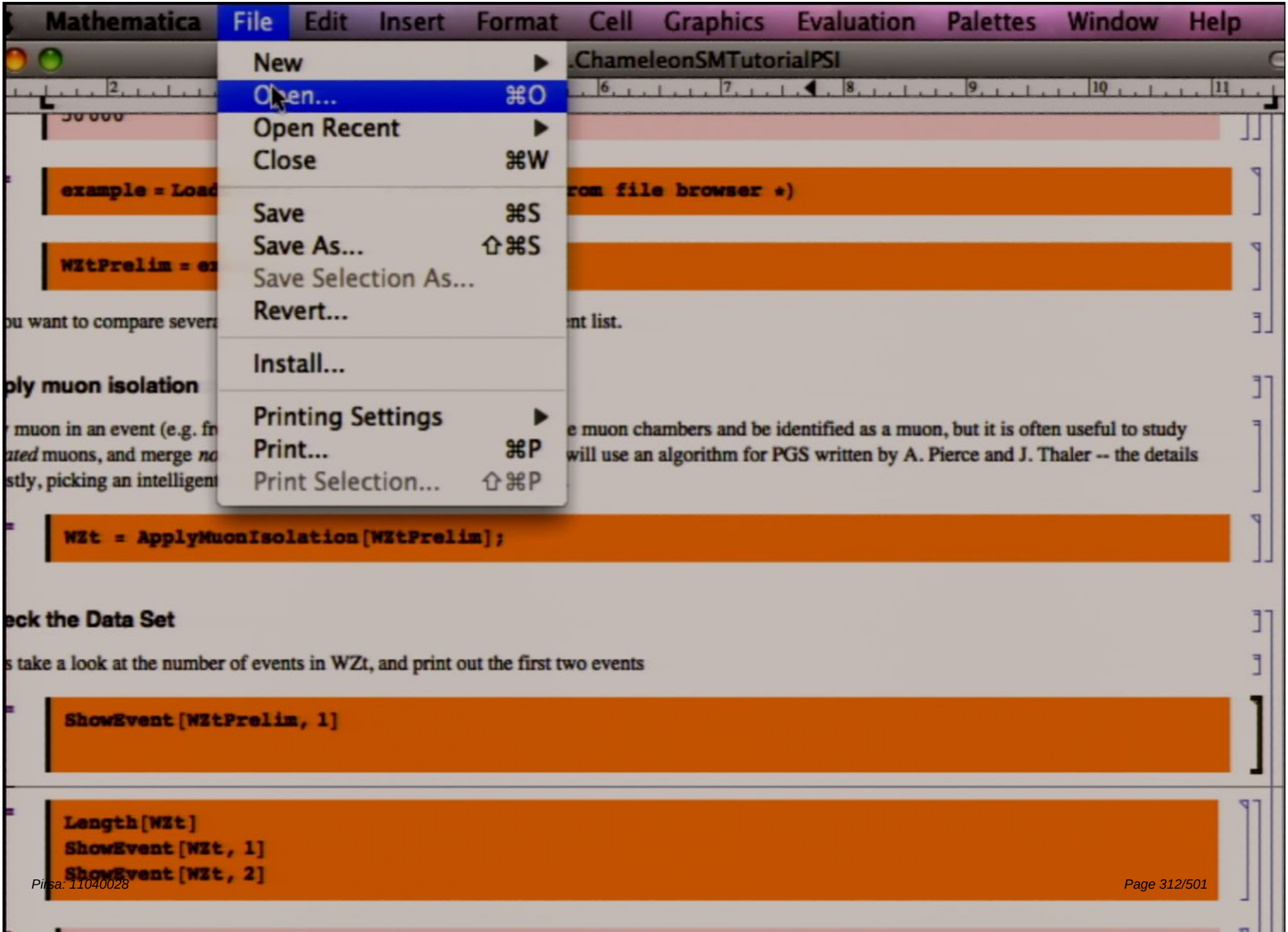
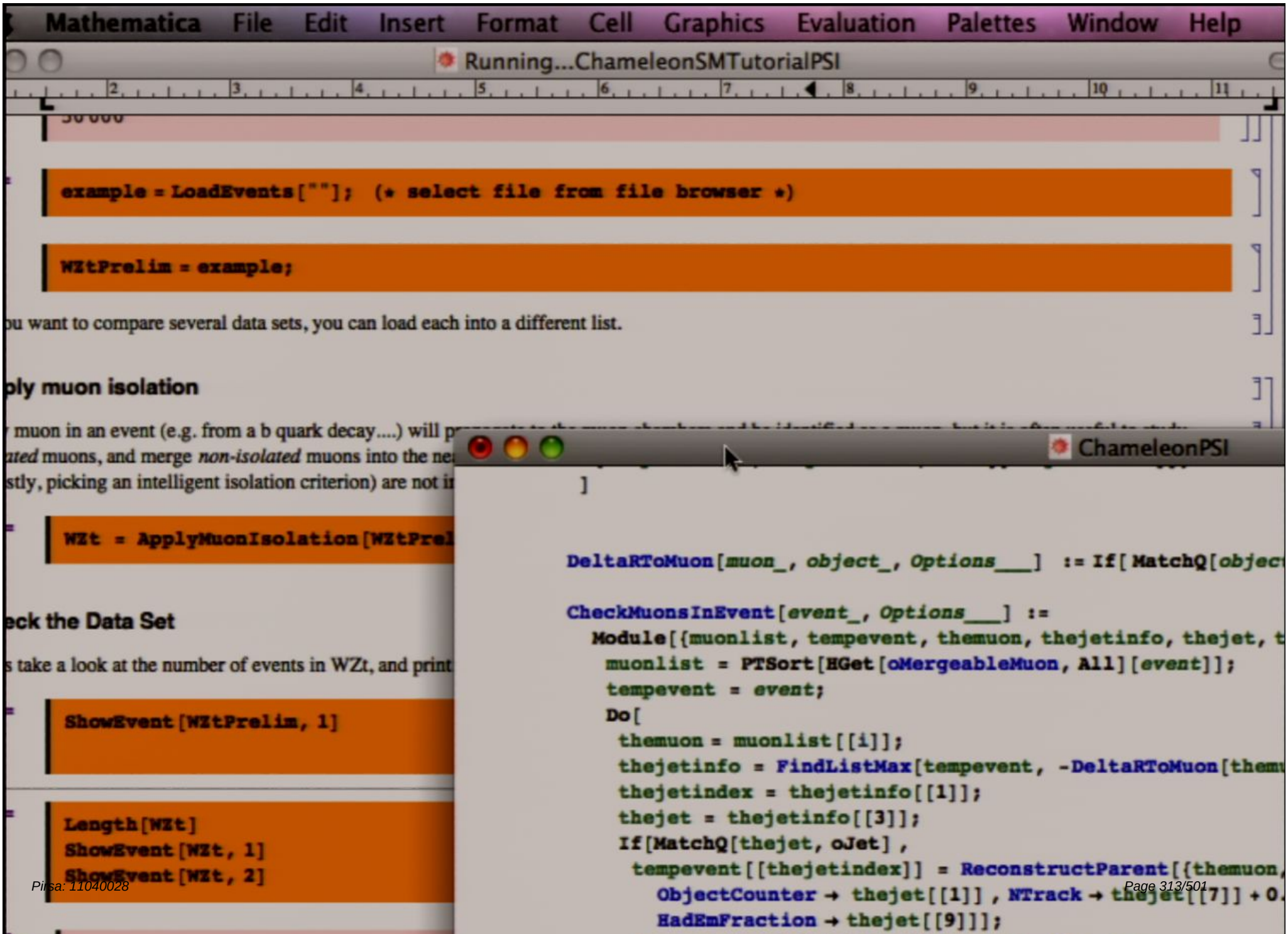
s take a look at the number of events in WZt, and print out the first two events

```
ShowEvent[WZtPrelim, 1]
```

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```


Mathematica
File
Edit
Insert
Format
Cell
Graphics
Evaluation
Palettes
Window
Help
New
Open... ⌘O
Open Recent
Close ⌘W
Save ⌘S
Save As... ⇧⌘S
Save Selection As...
Revert...
Install...
Printing Settings
Print... ⌘P
Print Selection... ⇧⌘P
.ChameleonSMTutorialPSI
example = Load
rom file browser *)
WZtPrelim = ex
u want to compare severa
nt list.
ply muon isolation
muon in an event (e.g. fr
e muon chambers and be identified as a muon, but it is often useful to study
ated muons, and merge no
will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details
stly, picking an intelligent
WZt = ApplyMuonIsolation[WZtPrelim];
eck the Data Set
s take a look at the number of events in WZt, and print out the first two events
ShowEvent[WZtPrelim, 1]
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Running...ChameleonSMTutorialPSI
example = LoadEvents[""]; (* select file from file browser *)
WZtPrelim = example;
you want to compare several data sets, you can load each into a different list.
ply muon isolation
muon in an event (e.g. from a b quark decay.....) will
ated muons, and merge non-isolated muons into the ne
stly, picking an intelligent isolation criterion) are not i
WZt = ApplyMuonIsolation[WZtPrel
eck the Data Set
s take a look at the number of events in WZt, and print
ShowEvent[WZtPrelim, 1]
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
ChameleonPSI
DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[objec
CheckMuonsInEvent[event_, Options___] :=
Module[{muonlist, tempevent, themuon, thejetinfo, thejet, t
muonlist = PTSort[HGet[oMergeableMuon, All][event]];
tempevent = event;
Do[
themuon = muonlist[[i]];
thejetinfo = FindListMax[tempevent, -DeltaRToMuon[themu
thejetindex = thejetinfo[[1]];
thejet = thejetinfo[[3]];
If[MatchQ[thejet, oJet],
tempevent[[thejetindex]] = ReconstructParent[{themuon,
ObjectCounter → thejet[[1]], NTrack → thejet[[7]] + 0.
HadEmFraction → thejet[[9]]];

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

```
]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
   Do[
    themuon = muonlist[[i]];
    thejetinfo = FindListMax[tempevent, -DeltaRToMuon[themuon, #, Options] &];
    thejetindex = thejetinfo[[1]];
    thejet = thejetinfo[[3]];
    If[MatchQ[thejet, oJet] ,
     tempevent[[thejetindex]] = ReconstructParent[{themuon, thejet}, Type → 4,
       ObjectCounter → thejet[[1]] , NTrack → thejet[[7]] + 0.1, Btag → thejet[[8]],
       HadEmFraction → thejet[[9]]];
     tempevent = DeleteCases[tempevent, themuon],
     tempevent = DeleteCases[tempevent, themuon]
    ],
    {i, Length[muonlist], 1, -1}];
   tempevent
  ];

ApplyMuonIsolation[evtList_, Options___] := CheckMuonsInEvent[#, Options] & /@ evtList

RemoveTriggerObject[event_] :=
 DeleteCases[event, oTrigger]

ShowEvent[x_] := ShowEvent[{x}, 1]
```


- **Stripping soft objects (TO BE ADDED)**

etup functions (file-loading)

- **Suppress warnings**

```
]:= Off[General::spell1];
    Off[General::spell1];
```

- **Load packages**

```
]:= (*<<Graphics`Graphics`
     <<Graphics`MultipleListPlot`
     <<Statistics`DataManipulation`
     <<DiscreteMath`Combinatorica`*)
```

- **Function definition for version < 5.1 (for backwards-compatibility) added Oct 20**

```
If[$VersionNumber < 5.1, Except[p1_, p2_] := (p2?(Not[MatchQ[#, p1]] &));
 Except[p1_] := _?(Not[MatchQ[#, p1]] &);]
```

- **Check Chameleon Version Settings**

```
If[Or[$PGSVersion == 4, ! ValueQ[$PGSVersion]],
  Print[
   "Reading data as PGS Version 4...set $PGSVersion=3 for compatibility with
     older (6-column, no-trigger) data format"]; $PGSVersion = 4,
  If[$PGSVersion == 3,
   Print[
    "Reading data as PGS Version 3...set $PGSVersion=4 for compatibility with
      new (11-column, triggered) data format"]]];

Def1001[f_, fdef_] := If[$PGSVersion == 4, fdef, Clear[f]];
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

arvard Blackbox Team:
ima Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam
tzpatrick, Tom Hartman, Can Kilic, Aaron Pierce, Philip Schuster,
esse Thaler, Natalia Toro, Lian-Tao Wang

arvard University, Jefferson Laboratory
uly 9, 2006

etup functions (file-loading)

- **Suppress warnings**

```
Off[General::spell1];
Off[General::spell1];
```

- **Load packages**

```
(*<<Graphics`Graphics`
 <<Graphics`MultipleListPlot`
 <<Statistics`DataManipulation`
 <<DiscreteMath`Combinatorica`*)
```

- **Function definition for version < 5.1 (for backwards-compatibility) added Oct 20**

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

```
oB = oBJet = If[$PGSVersion == 4, oB1, oB1];
oNonBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonLooseBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonTightBJet = oNonB | oB1;
oMissingPT = oMPT = {_, 6, _, _, _, _, _, __};

oReconstructed = oRec = oR = {_, 7, _, _, _, _, _, __};

oAny = {_, _, _, _, _, _, _, __};

oNot[oType_] := Except[oType, oAny];
```

- Hardness-selecting patterns

```
oHard[oType_, pthard_] = oType?((ptOf[#] ≥ pthard) &);
oLessHard[oType_, pthard_] = oType?((ptOf[#] < pthard) &);

oTrigger = {0, _, __};
```

eaning functions

- Enforcing muon isolation

```
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[etratio]];
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
  tempmaxindex = 1;
```

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ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

- **Enforcing muon isolation**

```
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[etratio]];
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
  tempmaxindex = 1;
  tempmaxvalue = function[list[[1]]];
  Do[
   tempfunctionvalue = function[list[[i]]];
   If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalue = tempfunctionvalue,
    Null]
   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
```

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ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

- **Enforcing muon isolation**

```
ptIsoOf[{x_}] := ptIsoOf[x]
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ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[etr
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRa
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etR

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue,
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  tempmaxvalue = function[list[[1]]];
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   If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalu
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   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


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CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
```

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Clear Formatting
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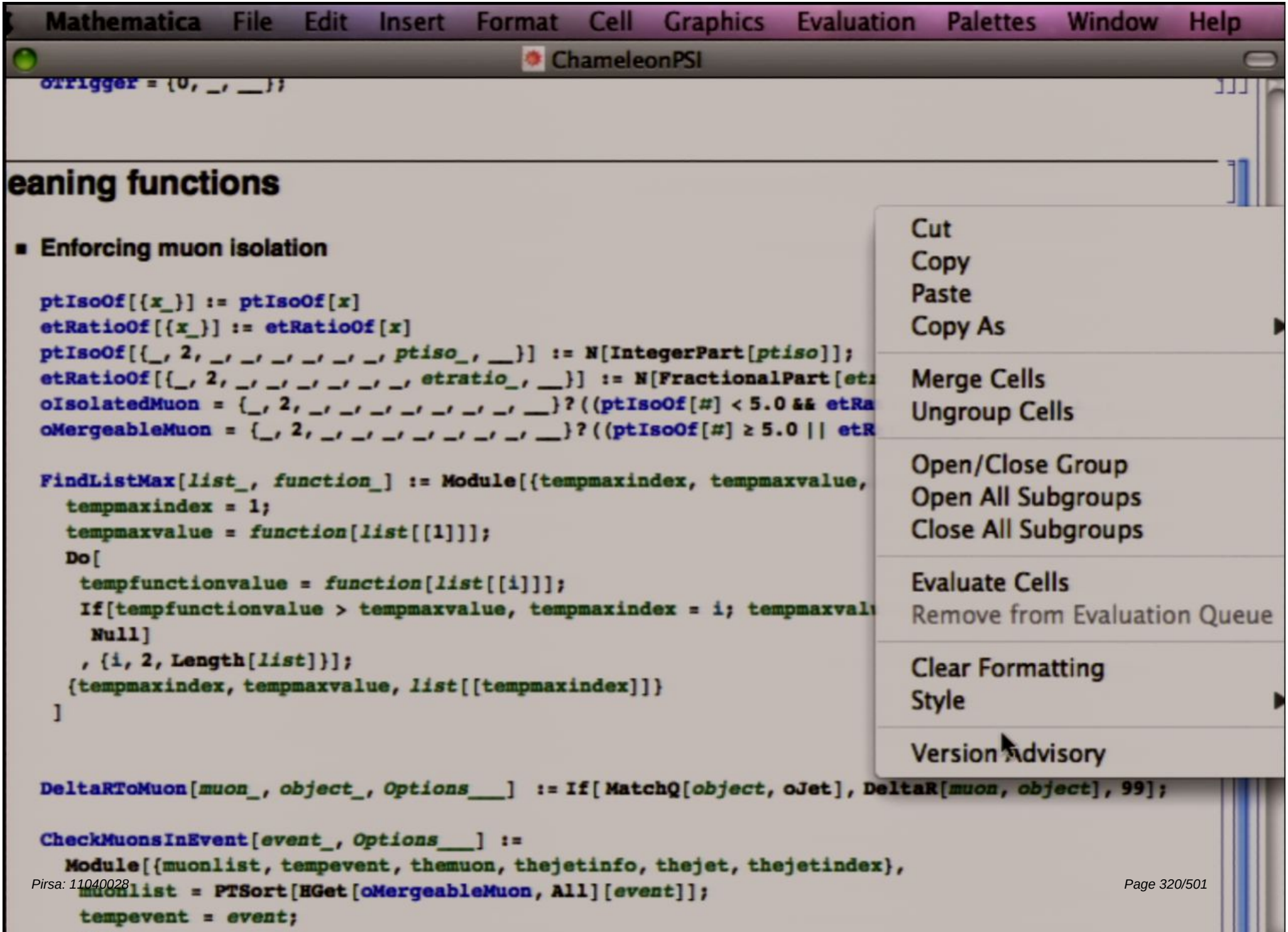
Version Advisory


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
oTrigger = {0, _, __};
eaning functions
Enforcing muon isolation
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[et
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FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue,
tempmaxindex = 1;
tempmaxvalue = function[list[[1]]];
Do[
tempfunctionvalue = function[list[[i]]];
If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxval
Null]
, {i, 2, Length[list]}];
{tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
]
DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];
CheckMuonsInEvent[event_, Options___] :=
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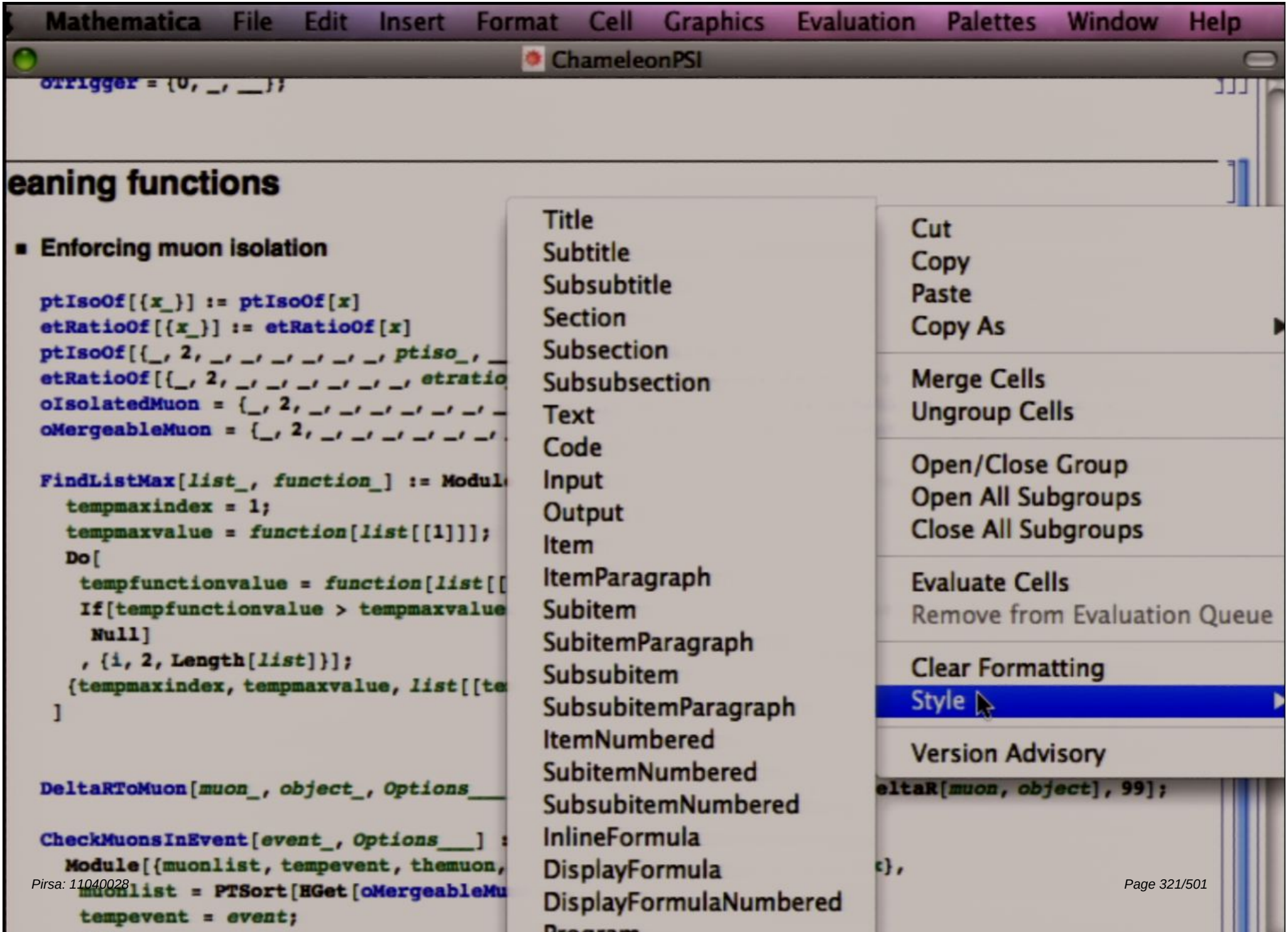
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
oTrigger = {0, _, __};
eaning functions
Enforcing muon isolation
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __
etRatioOf[{_, 2, _, _, _, _, _, _, etratio
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _
oMergeableMuon = {_, 2, _, _, _, _, _, _,
FindListMax[list_, function_] := Modul
tempmaxindex = 1;
tempmaxvalue = function[list[[1]]];
Do[
tempfunctionvalue = function[list[[
If[tempfunctionvalue > tempmaxvalue
Null]
, {i, 2, Length[list]}];
{tempmaxindex, tempmaxvalue, list[[te
]
DeltaRToMuon[muon_, object_, Options___
CheckMuonsInEvent[event_, Options___] :
Module[{muonlist, tempevent, themuon,
muonlist = PTSort[HGet[oMergeableMu
tempevent = event;
Title
Subtitle
Subsubtitle
Section
Subsection
Subsubsection
Text
Code
Input
Output
Item
ItemParagraph
Subitem
SubitemParagraph
Subsubitem
SubsubitemParagraph
ItemNumbered
SubitemNumbered
SubsubitemNumbered
InlineFormula
DisplayFormula
DisplayFormulaNumbered
Cut
Copy
Paste
Copy As
Merge Cells
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Open/Close Group
Open All Subgroups
Close All Subgroups
Evaluate Cells
Remove from Evaluation Queue
Clear Formatting
Style
Version Advisory
eltaR[muon, object], 99];
{},

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ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

- **Enforcing muon isolation**

```
ptIsoOf[{x_}] := ptIsoOf[x]
etRatioOf[{x_}] := etRatioOf[x]
ptIsoOf[{_, 2, _, _, _, _, _, _, ptiso_, __}] := N[IntegerPart[ptiso]];
etRatioOf[{_, 2, _, _, _, _, _, _, etratio_, __}] := N[FractionalPart[etratio]];
oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
  tempmaxindex = 1;
  tempmaxvalue = function[list[[1]]];
  Do[
   tempfunctionvalue = function[list[[i]]];
   If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalue = tempfunctionvalue,
    Null]
   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

- **Enforcing muon isolation**

```
ptIsoOf[{x_}] := ptIsoOf[x]
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oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
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   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
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   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
```

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ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

▪ Enforcing muon isolation

```
ptIsoOf[{x_}] := ptIsoOf[x]
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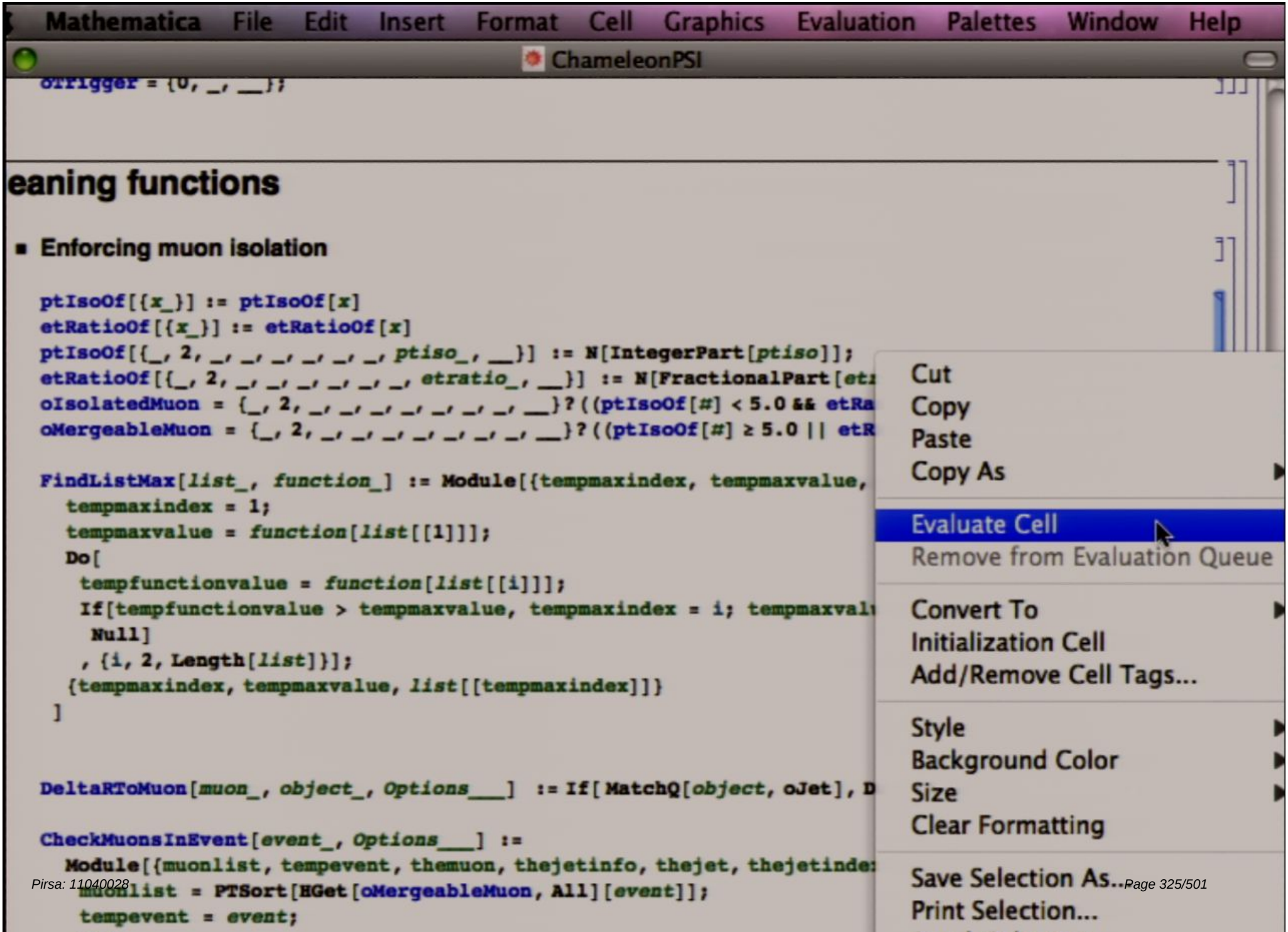
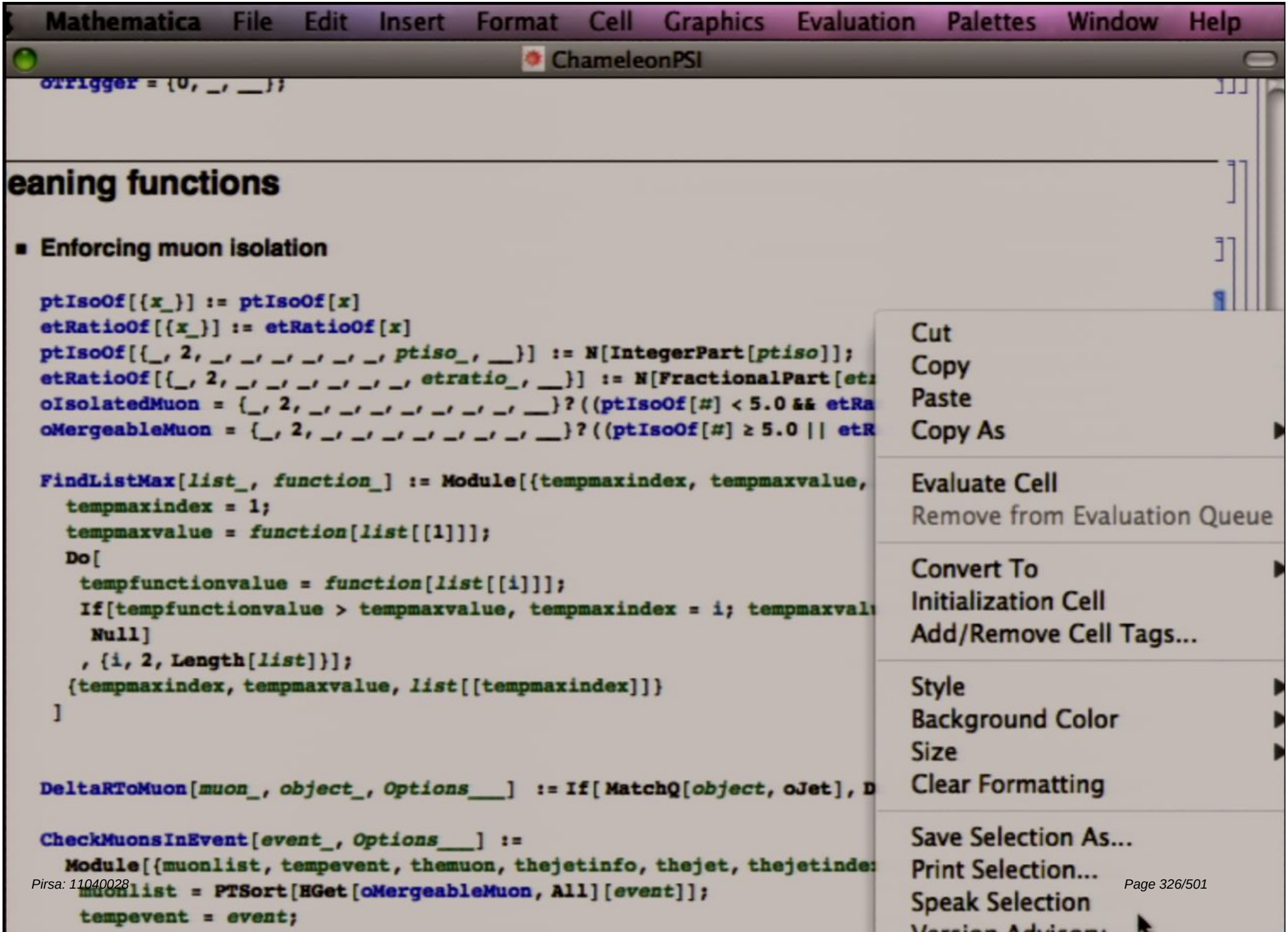
```

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, {i, 2, Length[list]}];
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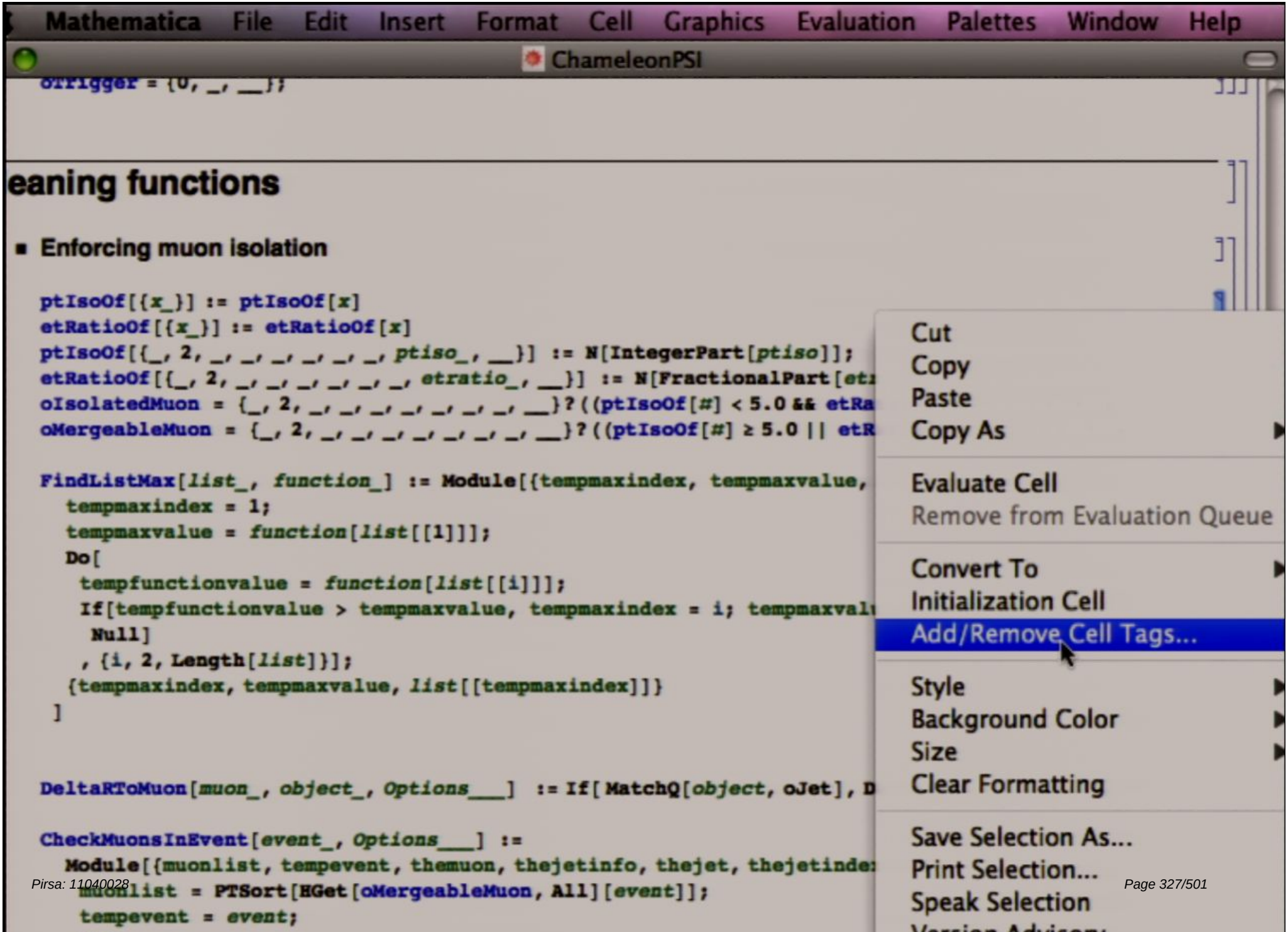
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, {i, 2, Length[list]}];
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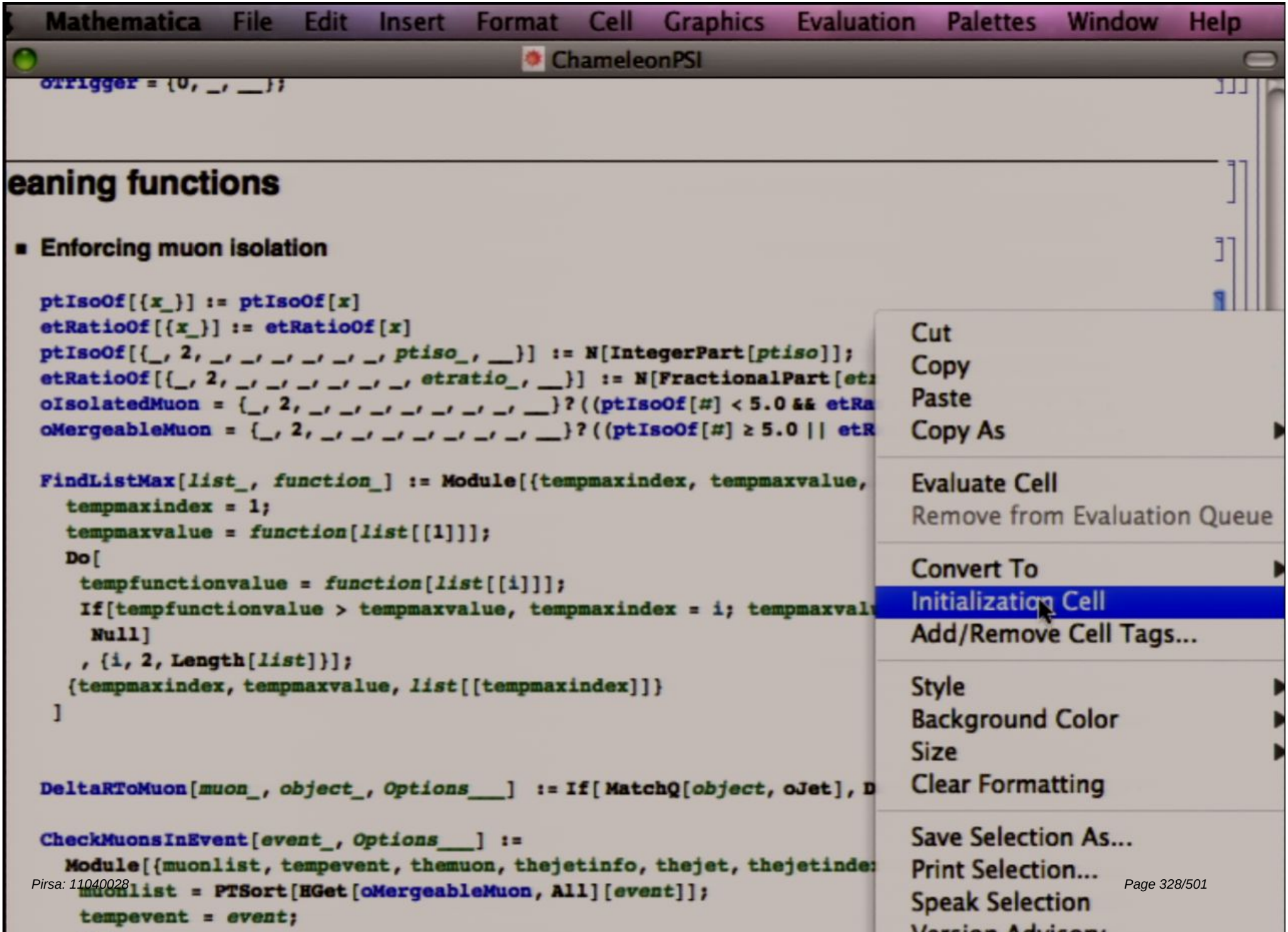
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ChameleonPSI

```
oTrigger = {0, _, __};
```

eaning functions

- **Enforcing muon isolation**

```
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oIsolatedMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] < 5.0 && etRatioOf[#] < .1*9/8) &);
oMergeableMuon = {_, 2, _, _, _, _, _, _, _, __}?((ptIsoOf[#] ≥ 5.0 || etRatioOf[#] ≥ .1*9/8) &);

FindListMax[list_, function_] := Module[{tempmaxindex, tempmaxvalue, tempfunctionvalue},
  tempmaxindex = 1;
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   If[tempfunctionvalue > tempmaxvalue, tempmaxindex = i; tempmaxvalue = tempfunctionvalue,
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   , {i, 2, Length[list]}];
  {tempmaxindex, tempmaxvalue, list[[tempmaxindex]]}
 ]


DeltaRToMuon[muon_, object_, Options___] := If[MatchQ[object, oJet], DeltaR[muon, object], 99];

CheckMuonsInEvent[event_, Options___] :=
  Module[{muonlist, tempevent, themuon, thejetinfo, thejet, thejetindex},
   muonlist = PTSort[HGet[oMergeableMuon, All][event]];
   tempevent = event;
```

```
oLeptonMinus = oLM = (oElectronMinus | oMuonMinus | oTauMinus);
oLightLeptonMinus = oLLM = (oElectronMinus | oMuonMinus);

oLeptonType[-3] = oTauMinus;
oLeptonType[-2] = oMuonMinus;
oLeptonType[-1] = oElectronMinus;
oLeptonType[0] = object_ /; False;
oLeptonType[1] = oElectronPlus;
oLeptonType[2] = oMuonPlus;
oLeptonType[3] = oTauPlus;

oPhoton = oγ = {_, 0, _, _, _, _, _, __};
oJet = {_, 4, _, _, _, _, _, __};
oBJetTight = oBT = oBJet2 = oB2 = {_, 4, _, _, _, _, _, 2.0, ___};
oBJetLoose = oBL = oBJet1 = oB1 = {_, 4, _, _, _, _, _, 1.0, ___} | oB2;
oB = oBJet = If[$PGSVersion == 4, oB1, oB1];
oNonBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonLooseBJet = oNonB = {_, 4, _, _, _, _, _, 0.0, ___};
oNonTightBJet = oNonB | oB1;
oMissingPT = oMPT = {_, 6, _, _, _, _, _, __};

oReconstructed = oRec = oR = {_, 7, _, _, _, _, _, __};

oAny = {_, _, _, _, _, _, _, __};

oNot[oType_] := Except[oType, oAny];
```

- Hardness-selecting patterns

```
oHard[oType_, pthard_] = oType?((ptOf[#] ≥ pthard) &);
oLessHard[oType_, pthard_] = oType?((ptOf[#] < pthard) &);
oTrigger = {0, _, __};
```

```
        new (11-column, triggered) data format"]]];

DefPGS4[f_, fdef_] := If[$PGSVersion == 4, fdef, Clear[f]];
```

Pre-Processing Function Definitions

- Split into events (automatically delete comment line, if there is one)

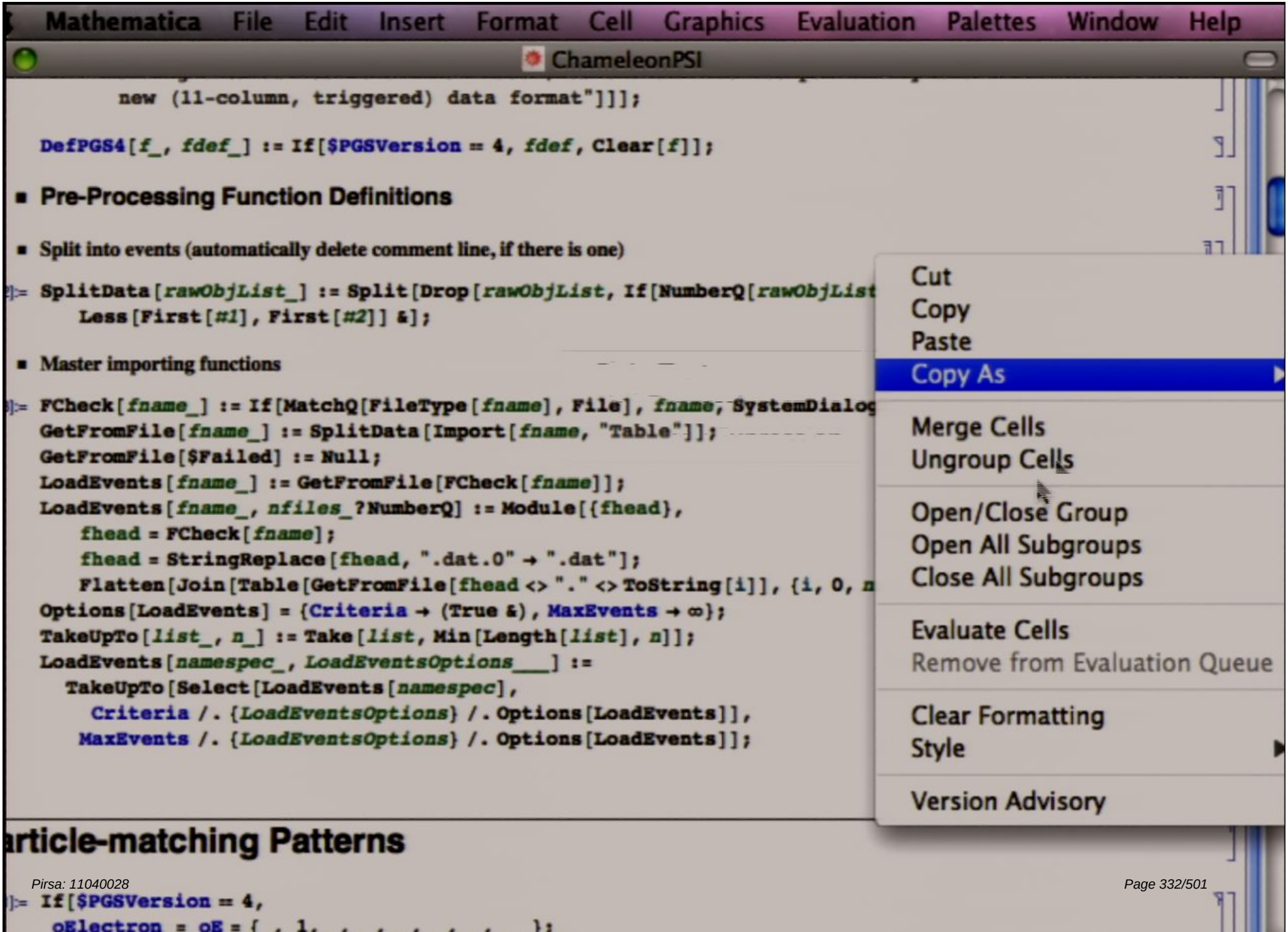
```
SplitData[rawObjList_] := Split[Drop[rawObjList, If[NumberQ[rawObjList[[1, 1]]], 0, 1]],
   Less[First[#1], First[#2]] &];
```

- Master importing functions

```
FCheck[fname_] := If[MatchQ[FileType[fname], File], fname, SystemDialogInput["FileOpen"]]
GetFromFile[fname_] := SplitData[Import[fname, "Table"]];
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
   fhead = FCheck[fname];
   fhead = StringReplace[fhead, ".dat.0" → ".dat"];
   Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]], {i, 0, nfiles - 1}]], 1]];
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec_, LoadEventsOptions___] :=
  TakeUpTo[Select[LoadEvents[namespec],
    Criteria /. {LoadEventsOptions} /. Options[LoadEvents]],
   MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
```

article-matching Patterns


```
If[$PGSVersion == 4,
  oElectron = oE = {  , 1,
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
new (11-column, triggered) data format"]]];
DefPGS4[f_, fdef_] := If[$PGSVersion == 4, fdef, Clear[f]];
Pre-Processing Function Definitions
Split into events (automatically delete comment line, if there is one)
SplitData[rawObjList_] := Split[Drop[rawObjList, If[NumberQ[rawObjList
Less[First[#1], First[#2]] &];
Master importing functions
FCheck[fname_] := If[MatchQ[FileType[fname], File], fname, SystemDialog
GetFromFile[fname_] := SplitData[Import[fname, "Table"]];
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
fhead = FCheck[fname];
fhead = StringReplace[fhead, ".dat.0" → ".dat"];
Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]], {i, 0, n
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec_, LoadEventsOptions___] :=
TakeUpTo[Select[LoadEvents[namespec],
Criteria /. {LoadEventsOptions} /. Options[LoadEvents]],
MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
Cut
Copy
Paste
Copy As
Merge Cells
Ungroup Cells
Open/Close Group
Open All Subgroups
Close All Subgroups
Evaluate Cells
Remove from Evaluation Queue
Clear Formatting
Style
Version Advisory
article-matching Patterns
If[$PGSVersion == 4,

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

```
        new (11-column, triggered) data format"]]];

DefPGS4[f_, fdef_] := If[$PGSVersion == 4, fdef, Clear[f]];
```

Pre-Processing Function Definitions

- Split into events (automatically delete comment line, if there is one)

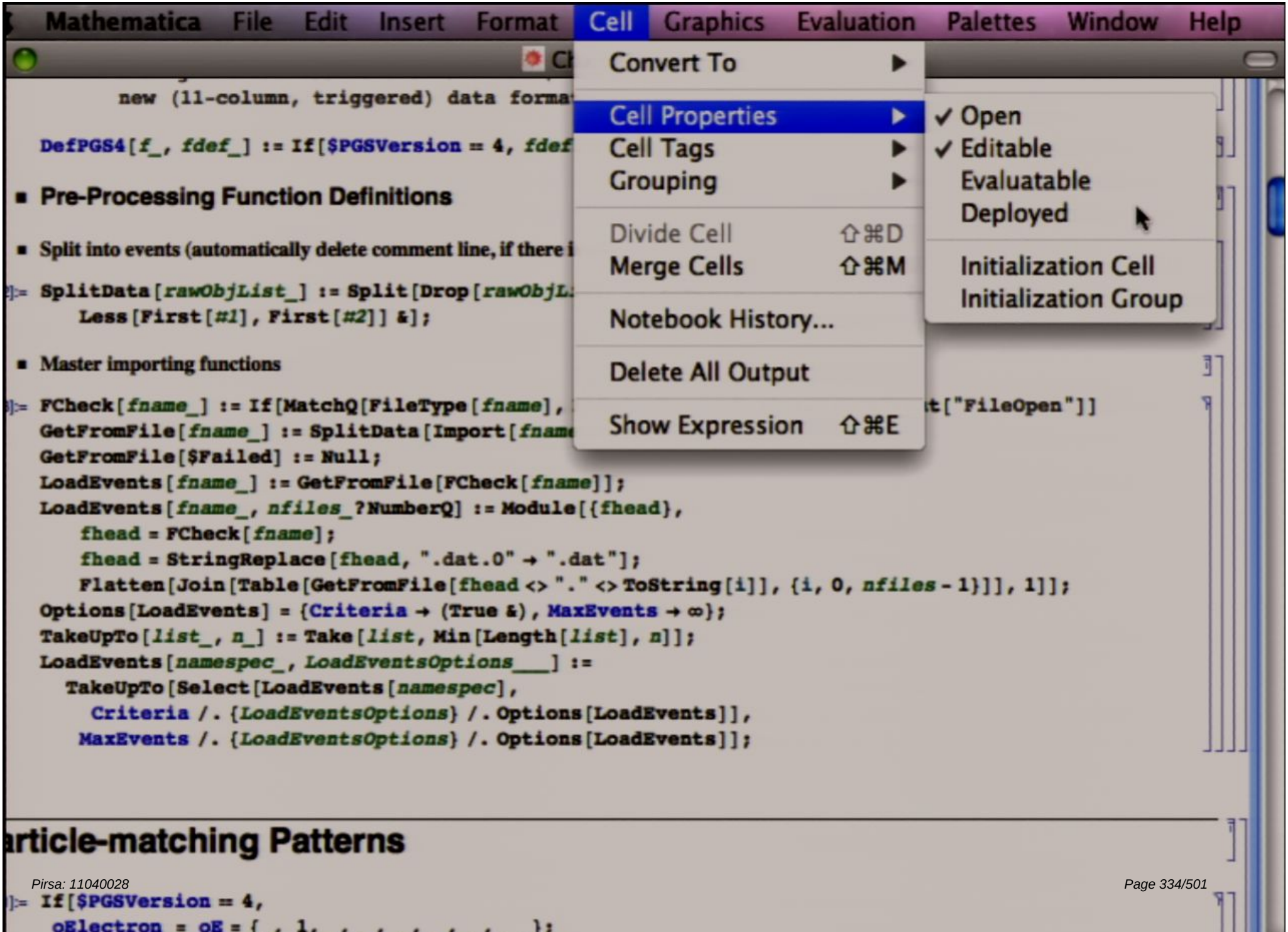
```
SplitData[rawObjList_] := Split[Drop[rawObjList, If[NumberQ[rawObjList[[1, 1]]], 0, 1]],
   Less[First[#1], First[#2]] &];
```

- Master importing functions

```
FCheck[fname_] := If[MatchQ[FileType[fname], File], fname, SystemDialogInput["FileOpen"]]
GetFromFile[fname_] := SplitData[Import[fname, "Table"]];
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
   fhead = FCheck[fname];
   fhead = StringReplace[fhead, ".dat.0" → ".dat"];
   Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]], {i, 0, nfiles - 1}]], 1]];
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
LoadEvents[namespec_, LoadEventsOptions___] :=
  TakeUpTo[Select[LoadEvents[namespec],
    Criteria /. {LoadEventsOptions} /. Options[LoadEvents]],
   MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
```

article-matching Patterns


```
If[$PGSVersion == 4,
  oElectron = oE = {
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Convert To
Cell Properties
Cell Tags
Grouping
Divide Cell ⇧⌘D
Merge Cells ⇧⌘M
Notebook History...
Delete All Output
Show Expression ⇧⌘E
✓ Open
✓ Editable
Evaluatable
Deployed
Initialization Cell
Initialization Group
new (11-column, triggered) data forma
DefPGS4[f_, fdef_] := If[$PGSVersion == 4, fdef
Pre-Processing Function Definitions
Split into events (automatically delete comment line, if there i
SplitData[rawObjList_] := Split[Drop[rawObjL
Less[First[#1], First[#2]] &];
Master importing functions
FCheck[fname_] := If[MatchQ[FileType[fname],
t["FileOpen"]]
GetFromFile[fname_] := SplitData[Import[fname
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
fhead = FCheck[fname];
fhead = StringReplace[fhead, ".dat.0" → ".dat"];
Flatten[Join[Table[GetFromFile[fhead <> "." <> ToString[i]], {i, 0, nfiles - 1}]], 1]];
Options[LoadEvents] = {Criteria → (True &), MaxEvents → ∞};
TakeUpTo[list_, n_] := Take[list, Min[Length[list], n]];
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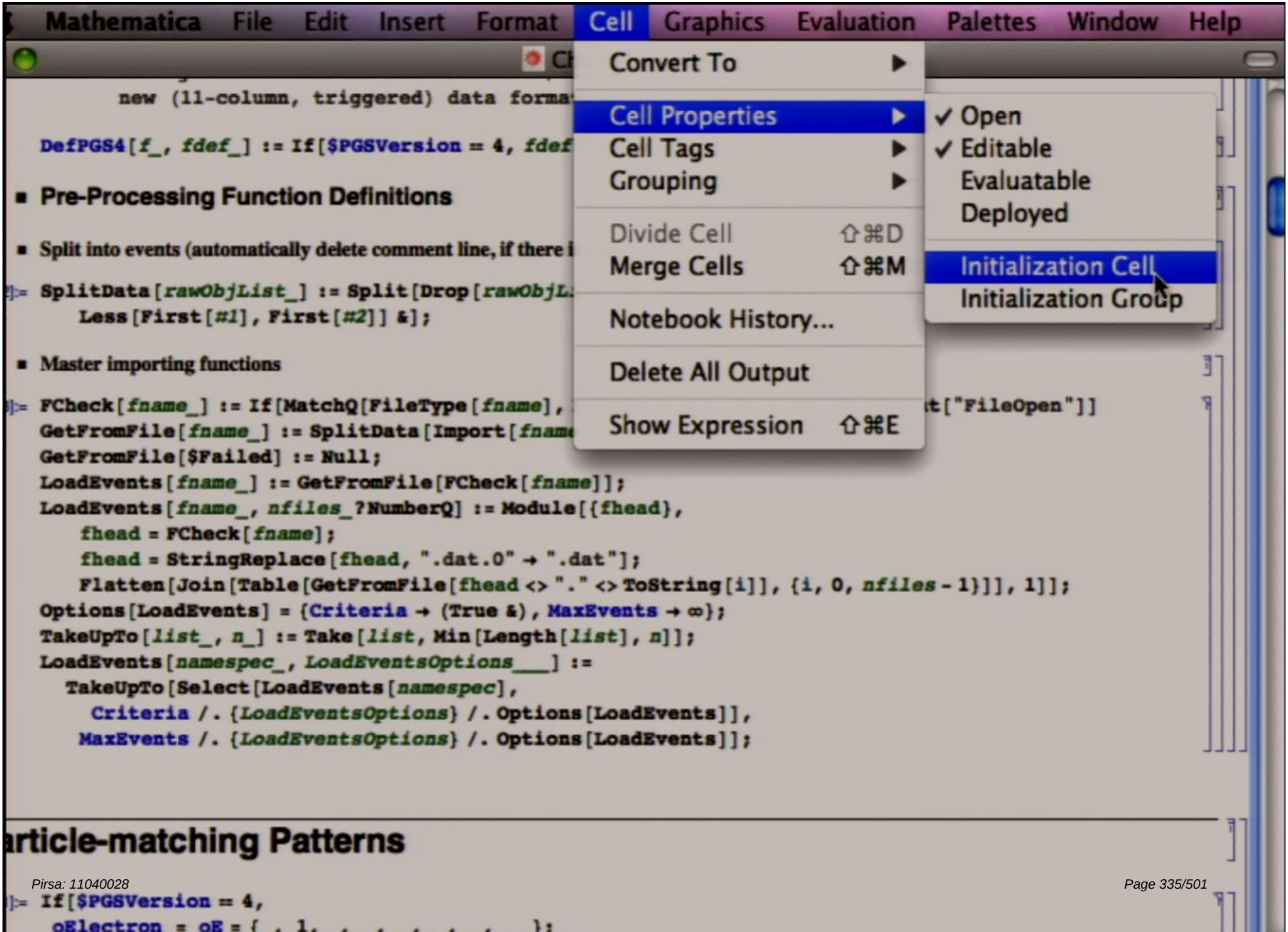
Criteria /. {LoadEventsOptions} /. Options[LoadEvents]],
MaxEvents /. {LoadEventsOptions} /. Options[LoadEvents]];
rticle-matching Patterns
If[$PGSVersion == 4,


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Convert To
Cell Properties
Cell Tags
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Divide Cell ⇧⌘D
Merge Cells ⇧⌘M
Notebook History...
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GetFromFile[fname_] := SplitData[Import[fname
GetFromFile[$Failed] := Null;
LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
fhead = FCheck[fname];
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If[$PGSVersion == 4,

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

```
      new (11-column, triggered) data format"]]];

DefPGS4[f_, fdef_] := If[$PGSVersion == 4, fdef, Clear[f]];
```

- **Pre-Processing Function Definitions**

- Split into events (automatically delete comment line, if there is one)

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SplitData[rawObjList_] := Split[Drop[rawObjList, If[NumberQ[rawObjList[[1, 1]]], 0, 1]],
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- Master importing functions

```
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LoadEvents[fname_] := GetFromFile[FCheck[fname]];
LoadEvents[fname_, nfiles_?NumberQ] := Module[{fhead},
    fhead = FCheck[fname];
    fhead = StringReplace[fhead, ".dat.0" → ".dat"];
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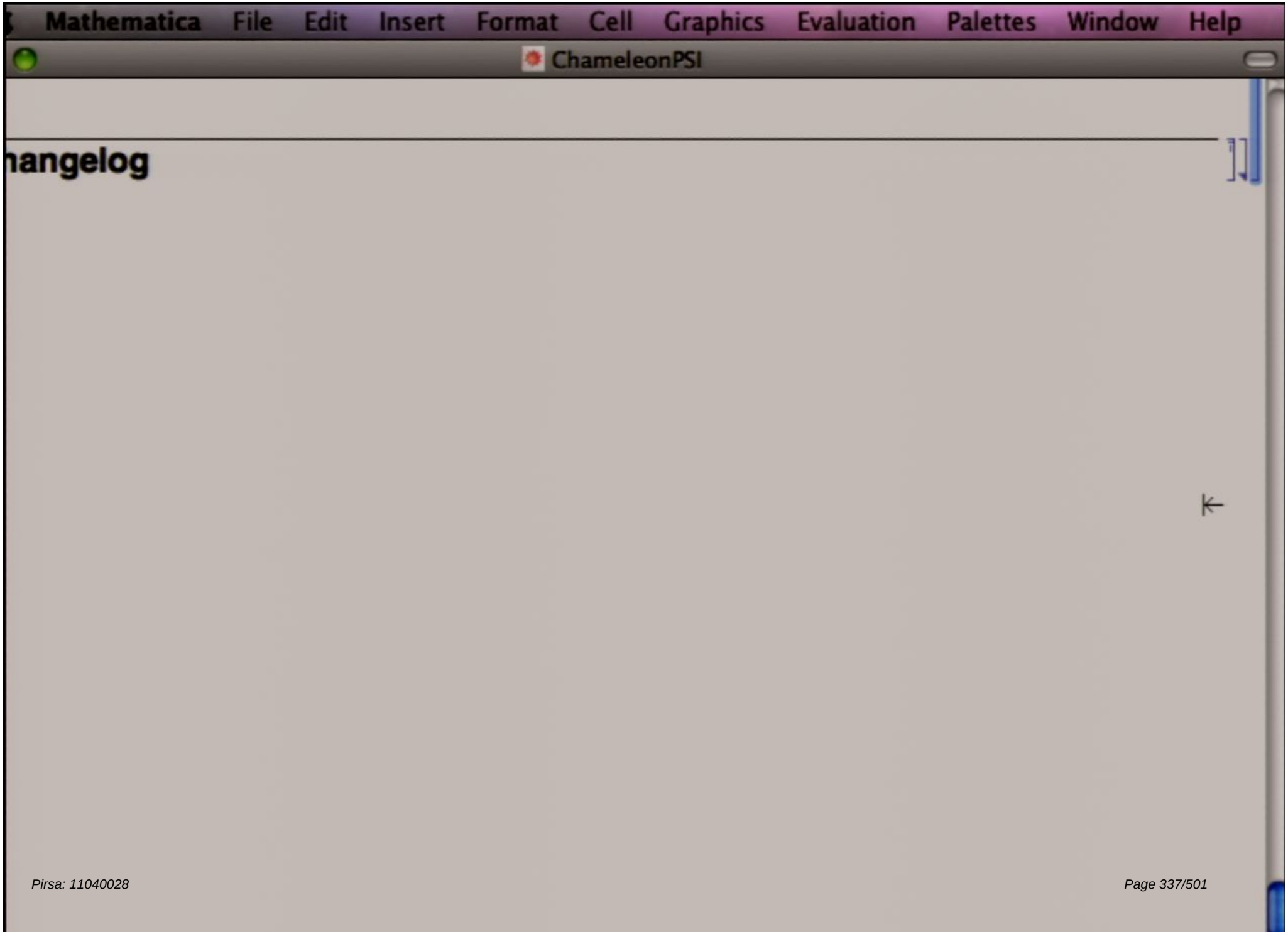
```

article-matching Patterns


```
If[$PGSVersion == 4,
 oElectron = oE = { , 1, , , , , , , };
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
hangelog

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

hameleon 1.02 -- A black-box analysis ackage in *Mathematica* for the LHC lympics

arvard Blackbox Team:
ima Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam tzpatrick, Tom Hartman, Can Kilic, Aaron Pierce, Philip Schuster, esse Thaler, Natalia Toro, Lian-Tao Wang

arvard University, Jefferson Laboratory
uly 9, 2006

etup functions (file-loading)

- **Suppress warnings**

from other files.

Working Directory and Load the Chameleon Package

command sets *Mathematica*'s working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").

```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

uld appear. PGS version 4 is what you want unless you are using an obsolete version of PGS.

```
<< "ChameleonPSI.m"
```

nfigure the "master" cuts (optional)

ad One or More Data Files with the LoadEvents Command

command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail "master" cuts defined above, and any events that are empty after this filtering.

ke sure you end this call with a semicolon, or *Mathematica* will try to print the whole event record to your screen!

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```
WZtPrelim = LoadEvents["WZt.lhco"];
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```

```
?Lo
```

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
<< "ChameleonPSI.m"
```

```
?ApplyMuonIsolation
```

```
Global`ApplyMuonIsolation
```

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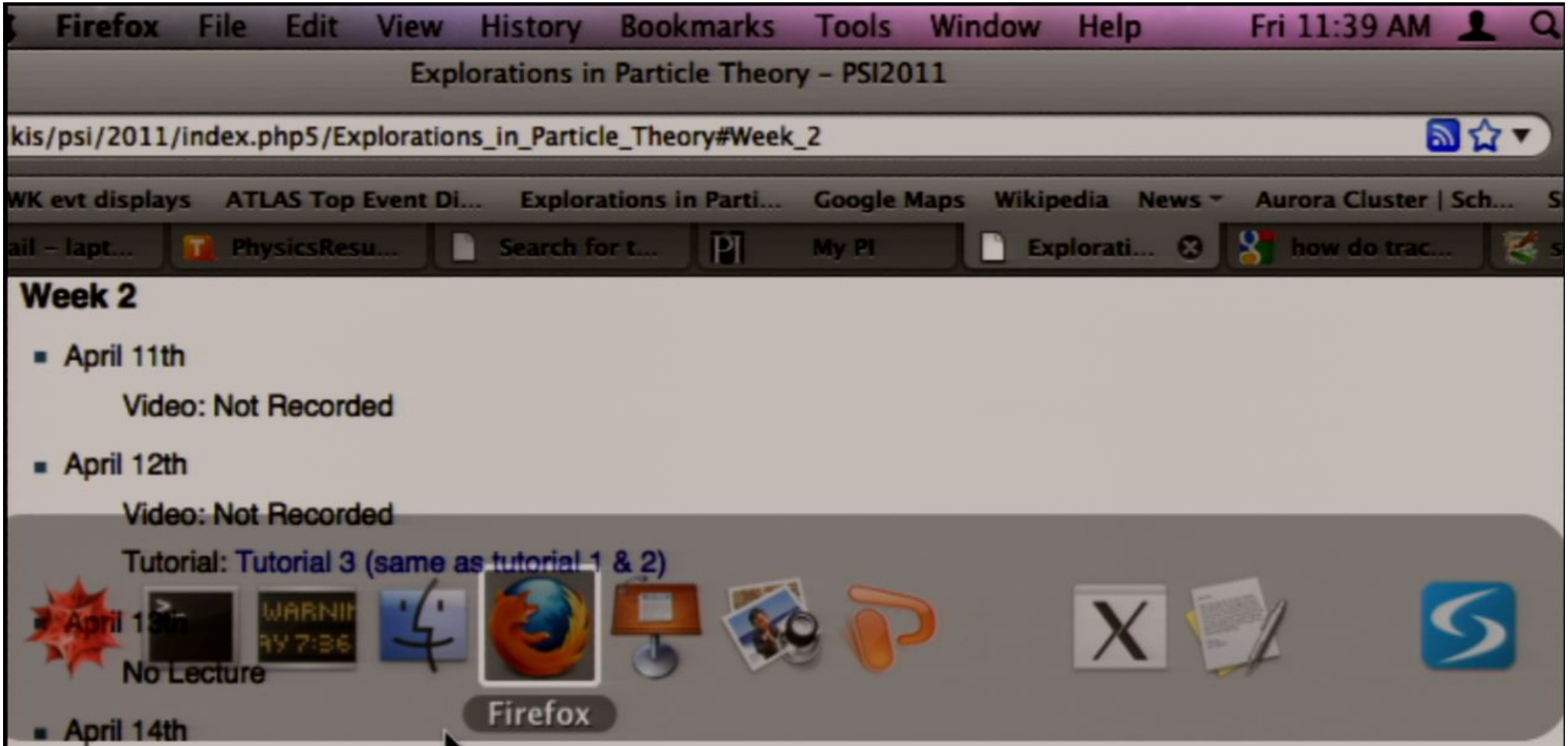
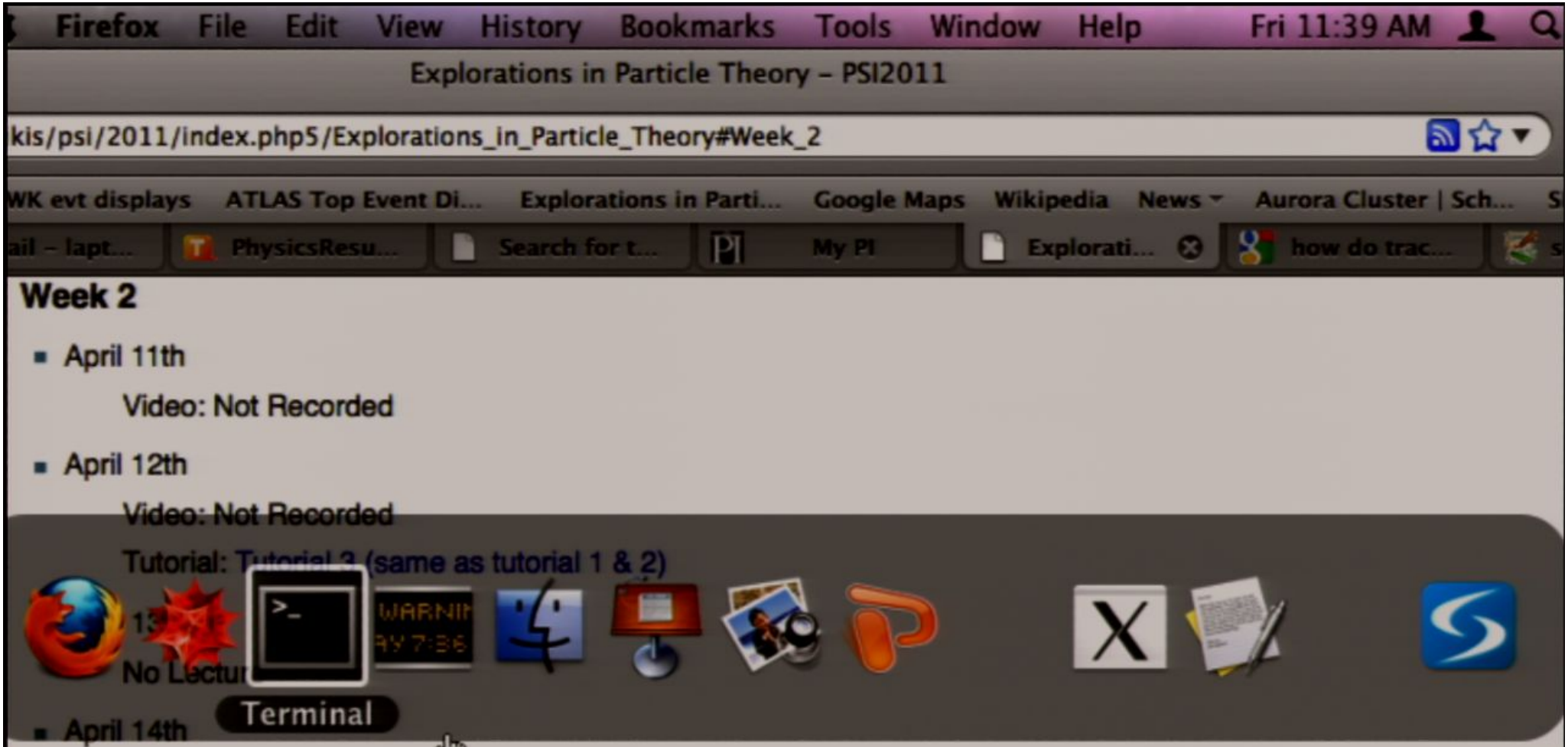
```


Firefox File Edit View History Bookmarks Tools Window Help Fri 11:39 AM
Explorations in Particle Theory - PSI2011
kis/psi/2011/index.php5/Explorations_in_Particle_Theory#Week_2
WK evt displays
ATLAS Top Event Di...
Explorations in Parti...
Google Maps
Wikipedia
News
Aurora Cluster | Sch...
PhysicsResu...
Search for t...
My PI
Explorati...
how do trac...
Week 2
April 11th
Video: Not Recorded
April 12th
Video: Not Recorded
Tutorial: Tutorial 3 (same as tutorial 1 & 2)
No Lecture
April 14th
No Lecture
April 15th
Files for kinematics/analysis tutorial: I link to tarball of example files
Video: Lecture 8
Video: Lecture 9
Firefox



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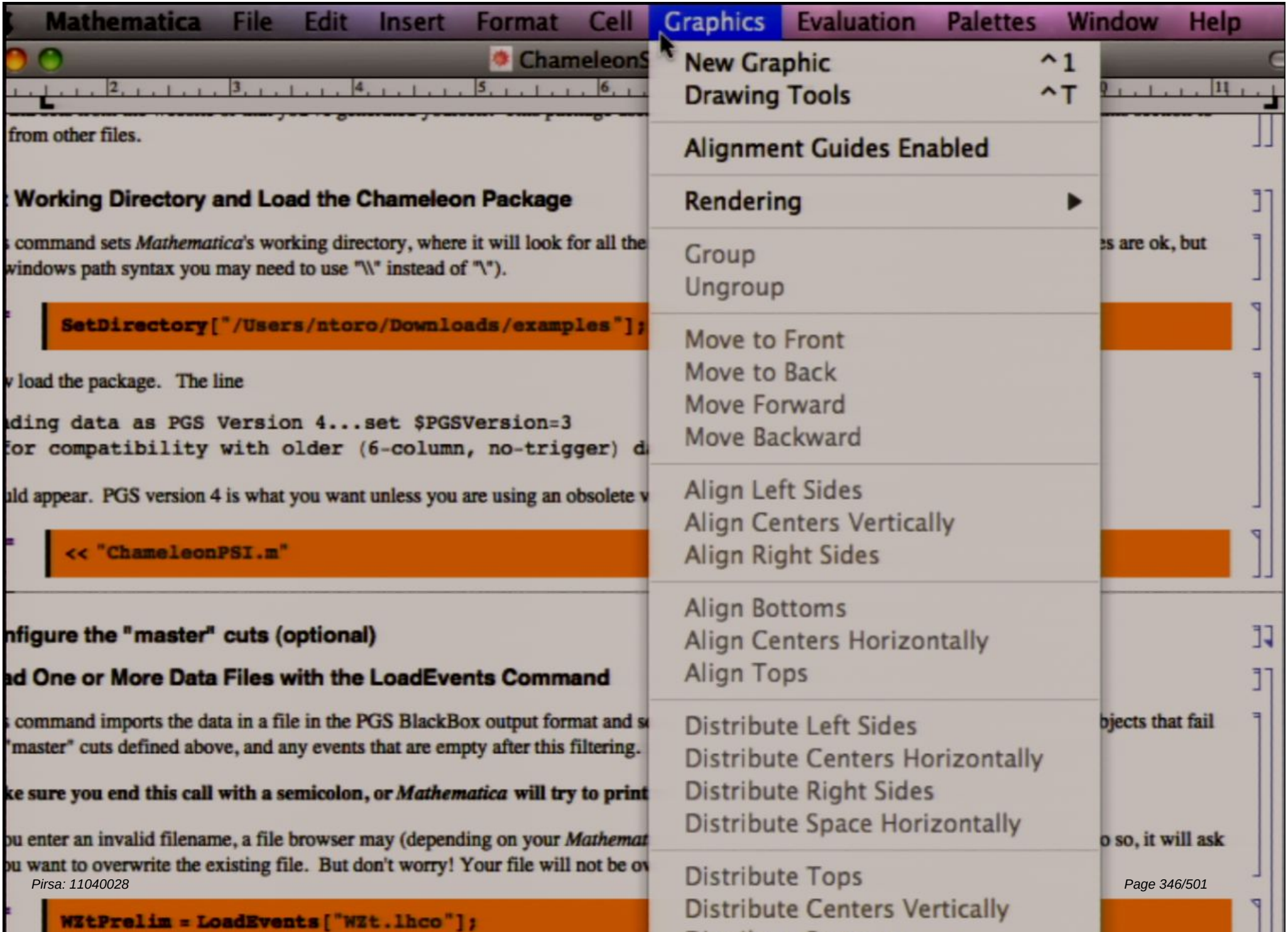
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
New Graphic ^1
Drawing Tools ^T
Alignment Guides Enabled
Rendering
Group
Ungroup
Move to Front
Move to Back
Move Forward
Move Backward
Align Left Sides
Align Centers Vertically
Align Right Sides
Align Bottoms
Align Centers Horizontally
Align Tops
Distribute Left Sides
Distribute Centers Horizontally
Distribute Right Sides
Distribute Space Horizontally
Distribute Tops
Distribute Centers Vertically
from other files.
Working Directory and Load the Chameleon Package
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windows path syntax you may need to use "\\" instead of "\").
SetDirectory["/Users/ntoro/Downloads/examples"];
load the package. The line
ading data as PGS Version 4...set $PGSVersion=3
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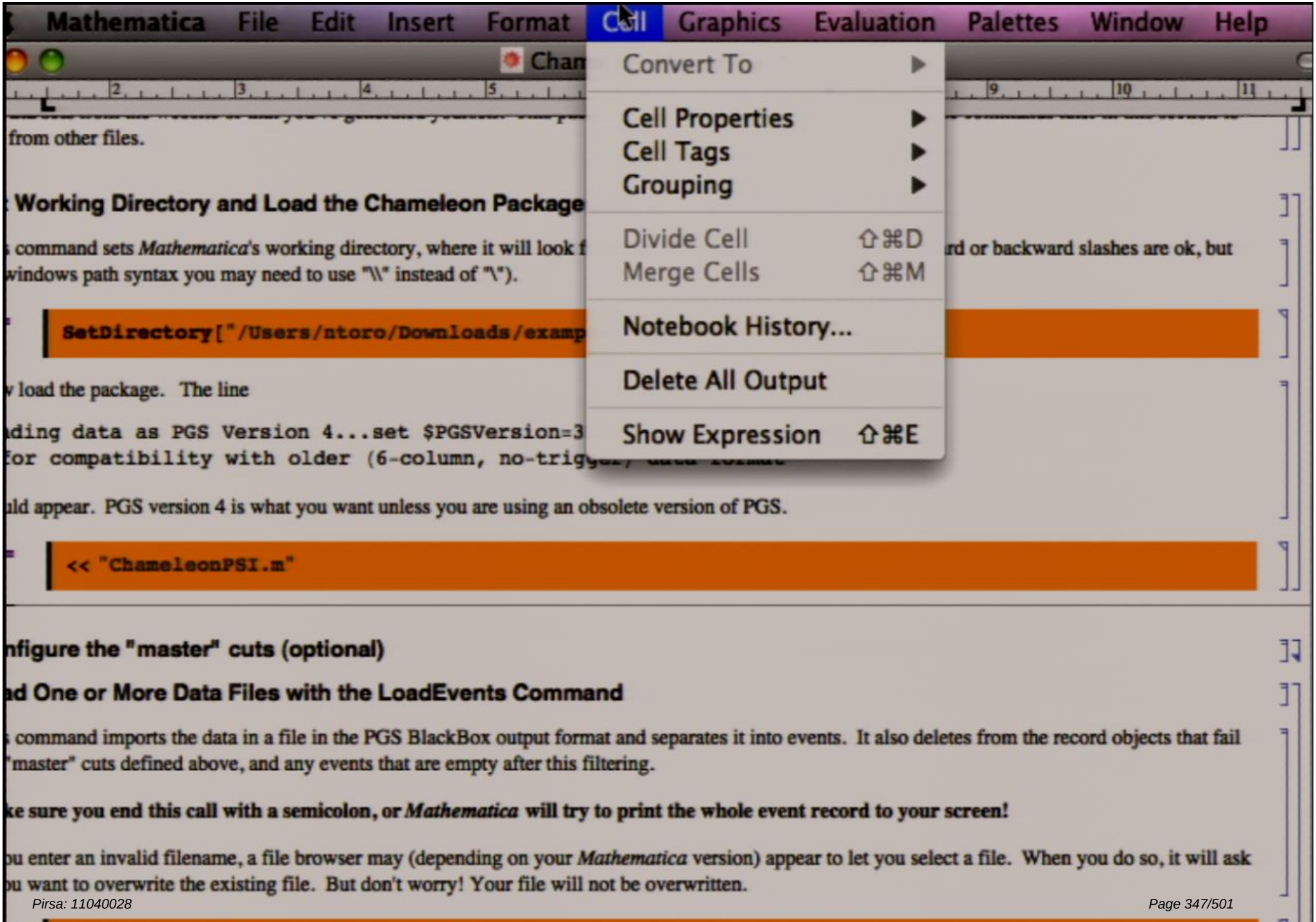
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Convert To
Cell Properties
Cell Tags
Grouping
Divide Cell ⇧⌘D
Merge Cells ⇧⌘M
Notebook History...
Delete All Output
Show Expression ⇧⌘E
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Working Directory and Load the Chameleon Package
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SetDirectory["/Users/ntoro/Downloads/examp
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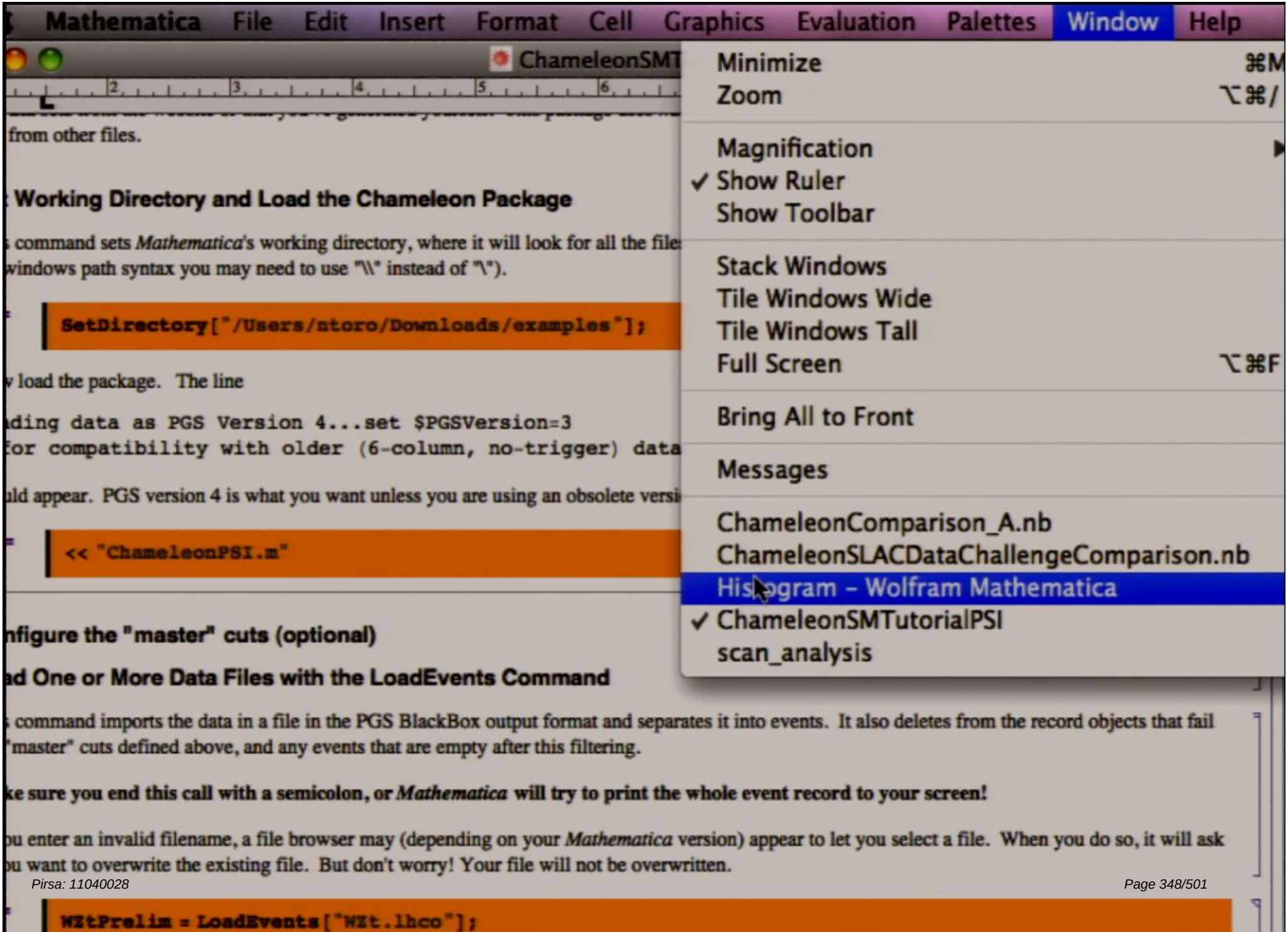
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMT
Minimize ⌘M
Zoom ⌥⌘/
Magnification
✓ Show Ruler
Show Toolbar
Stack Windows
Tile Windows Wide
Tile Windows Tall
Full Screen ⌥⌘F
Bring All to Front
Messages
ChameleonComparison_A.nb
ChameleonSLACDataChallengeComparison.nb
Histogram - Wolfram Mathematica
✓ ChameleonSMTutorialPSI
scan_analysis
from other files.
Working Directory and Load the Chameleon Package
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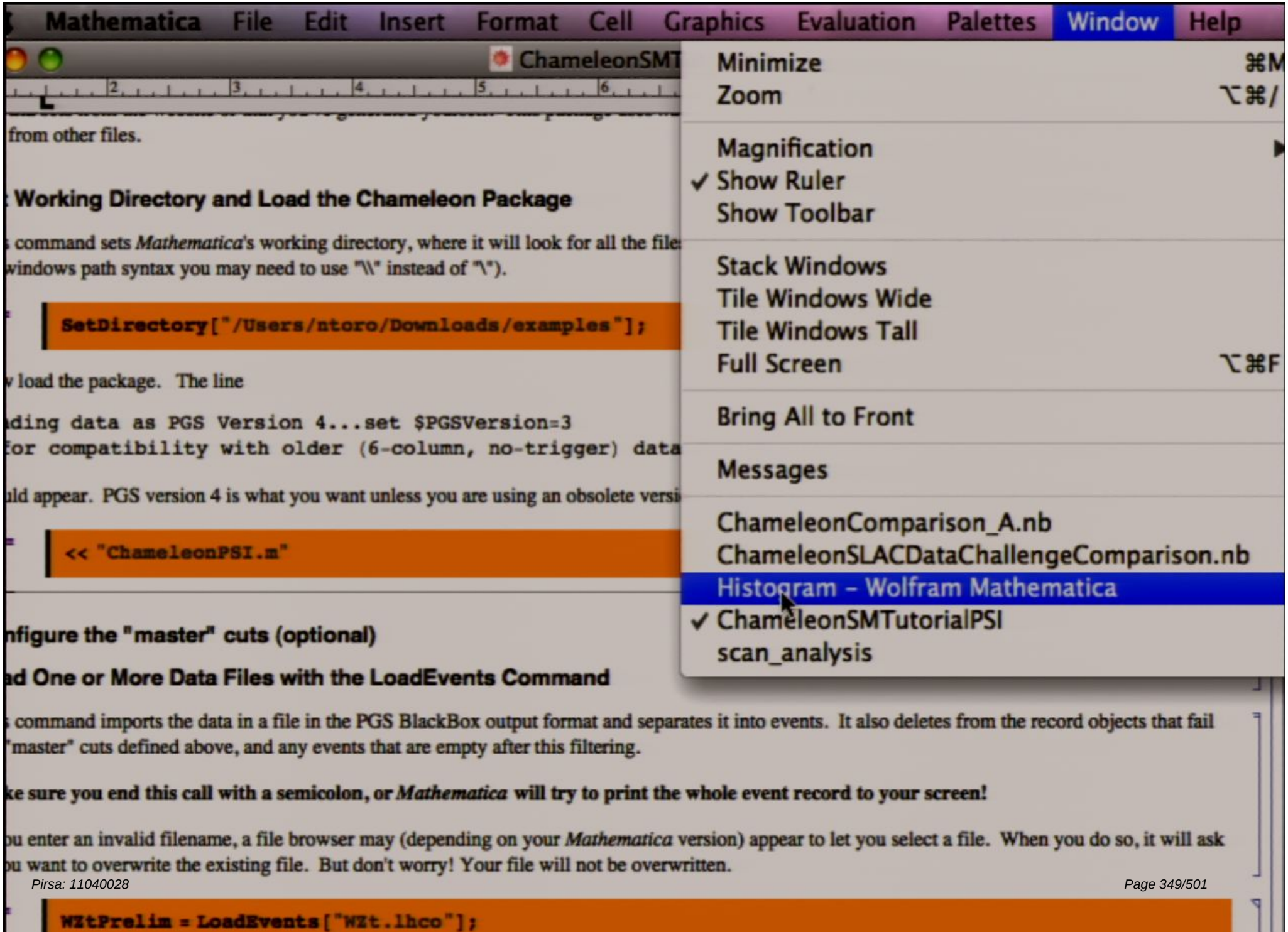
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMT
Minimize ⌘M
Zoom ⌥⌘/
Magnification
✓ Show Ruler
Show Toolbar
Stack Windows
Tile Windows Wide
Tile Windows Tall
Full Screen ⌥⌘F
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Messages
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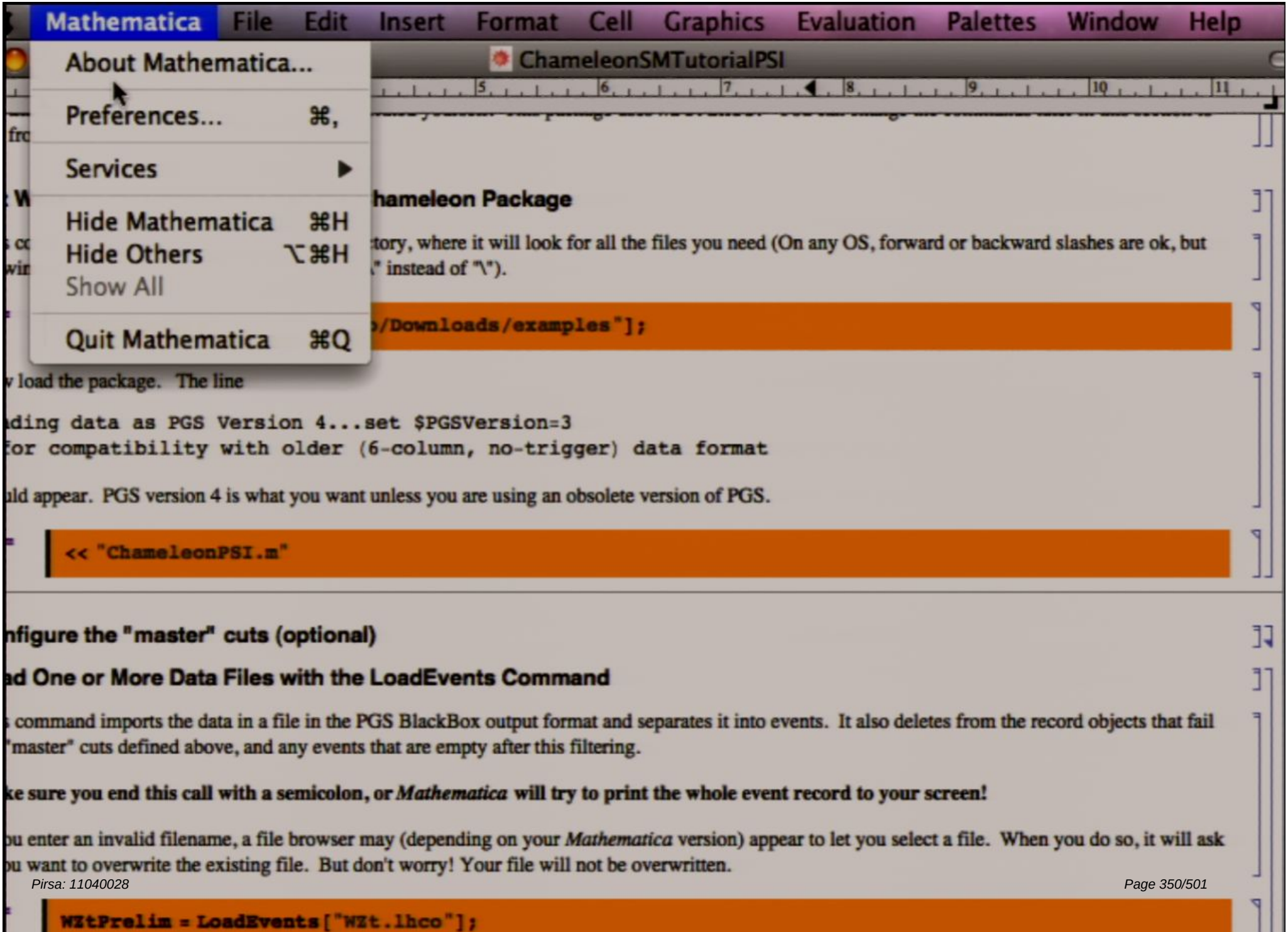
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
About Mathematica...
Preferences... ⌘,
Services
Hide Mathematica ⌘H
Hide Others ⌥⌘H
Show All
Quit Mathematica ⌘Q
ChameleonSMTutorialPSI
hameleon Package
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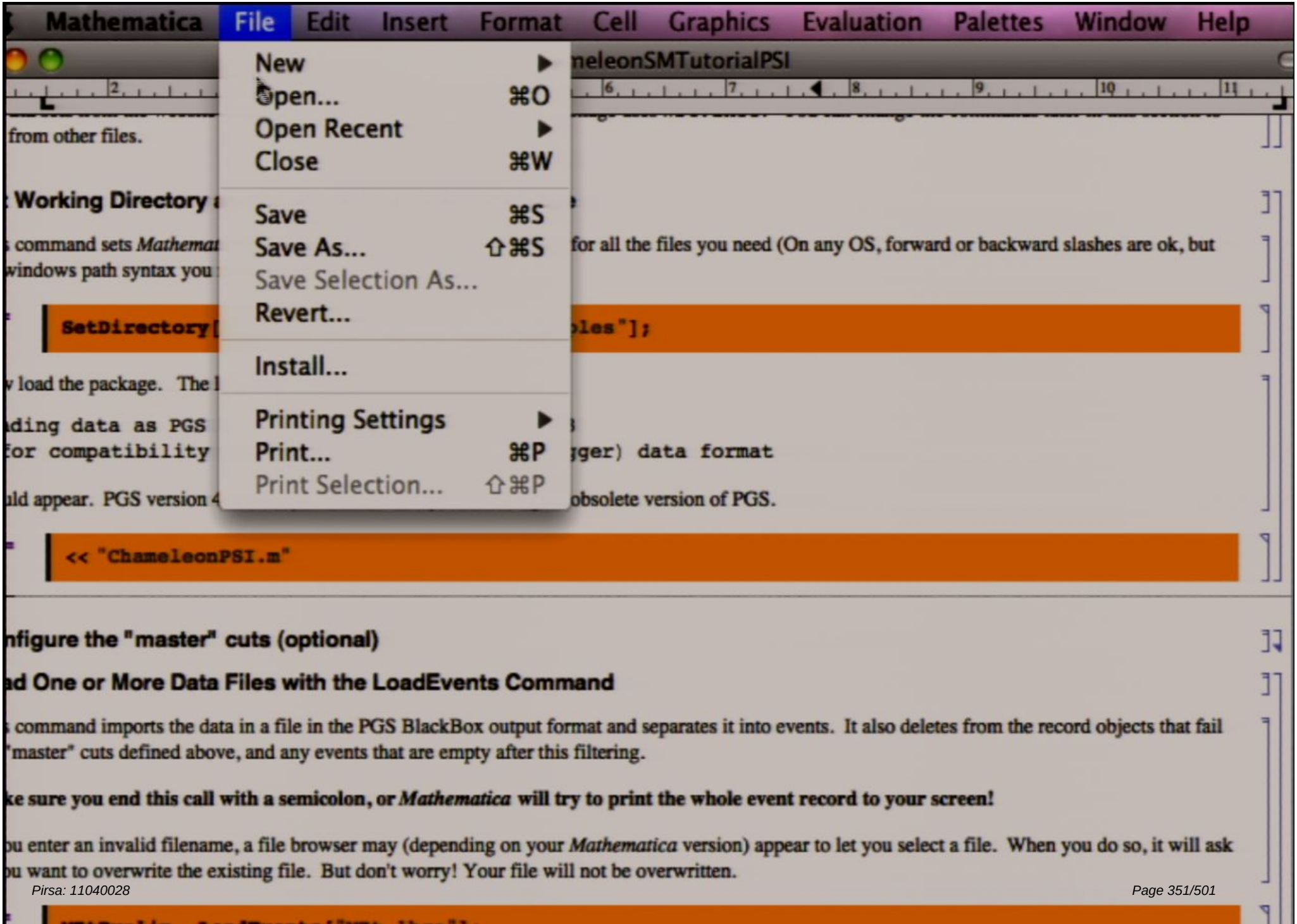
Mathematica
File
Edit
Insert
Format
Cell
Graphics
Evaluation
Palettes
Window
Help
New
Open... ⌘O
Open Recent
Close ⌘W
Save ⌘S
Save As... ⇧⌘S
Save Selection As...
Revert...
Install...
Printing Settings
Print... ⌘P
Print Selection... ⇧⌘P
neleonSMTutorialPSI
from other files.
Working Directory
command sets Mathemat
for all the files you need (On any OS, forward or backward slashes are ok, but
windows path syntax you
SetDirectory[
les"];
load the package. The
ding data as PGS
or compatibility
ger) data format
uld appear. PGS version 4
obsolete version of PGS.
<< "ChameleonPSI.m"
nfigure the "master" cuts (optional)
d One or More Data Files with the LoadEvents Command
command imports the data in a file in the PGS BlackBox output format and separates it into events. It also deletes from the record objects that fail
"master" cuts defined above, and any events that are empty after this filtering.
ke sure you end this call with a semicolon, or Mathematica will try to print the whole event record to your screen!
u enter an invalid filename, a file browser may (depending on your Mathematica version) appear to let you select a file. When you do so, it will ask
u want to overwrite the existing file. But don't worry! Your file will not be overwritten.
WZtPrelim = LoadEvents["WZt.lhco"];

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonPSI

Chameleon 1.02 -- A black-box analysis package in *Mathematica* for the LHC Olympics

Harvard Blackbox Team:
Nima Arkani-Hamed, Matthew Baumgart, Clifford Cheung, Liam Fitzpatrick, Tom Hartman, Can Kilic, Aaron Pierce, Philip Schuster, Jesse Thaler, Natalia Toro, Lian-Tao Wang

Harvard University, Jefferson Laboratory
July 9, 2006

Setup functions (file-loading)

- Suppress warnings

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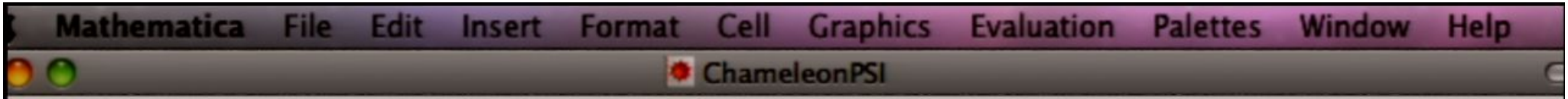
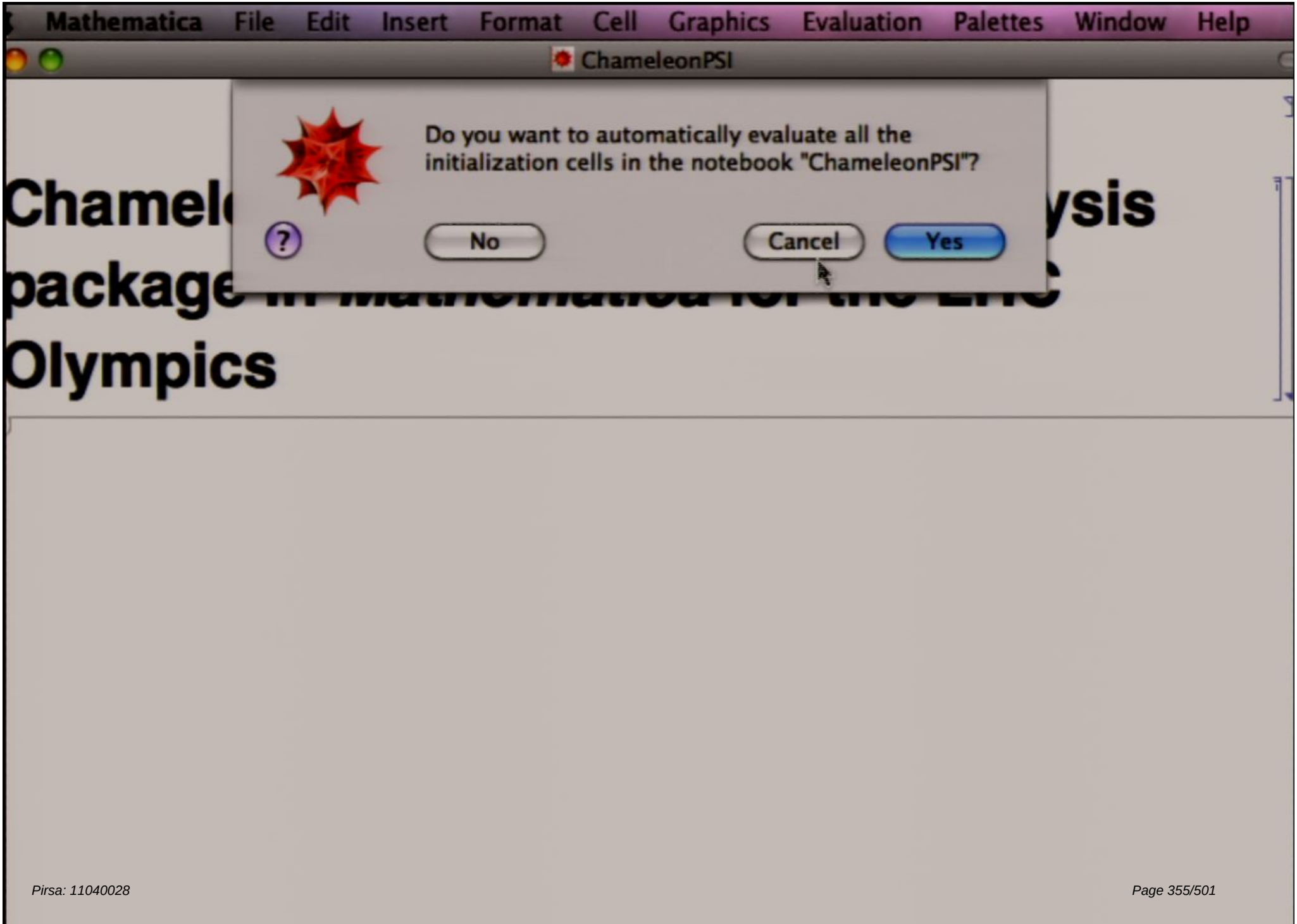


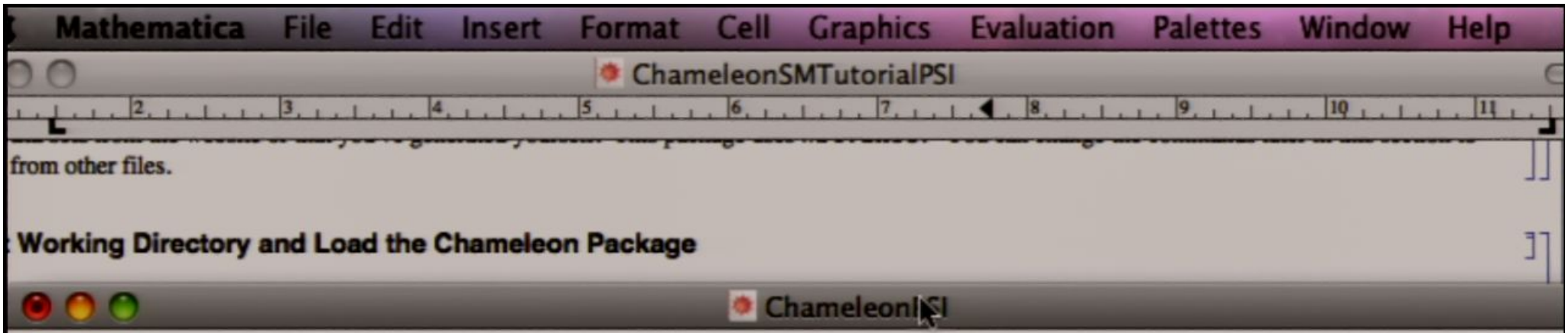
Chameleon 1.02 -- A black-box analysis package in *Mathematica* for the LHC Olympics


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
Do you want to automatically evaluate all the initialization cells in the notebook "ChameleonPSI"?
No
Cancel
Yes
Olympics

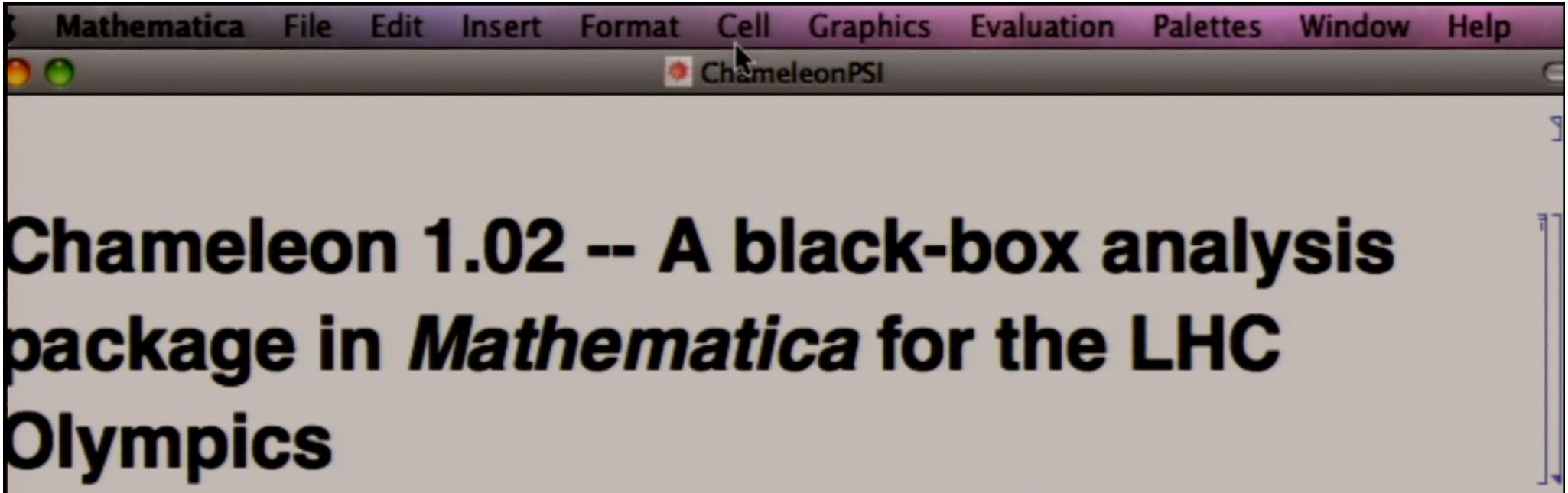
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Running...ChameleonPSI

Chameleon 1.02 -- A black-box analysis package in *Mathematica* for the LHC Olympics



Chameleon 1.02 -- A black-box analysis package in *Mathematica* for the LHC Olympics



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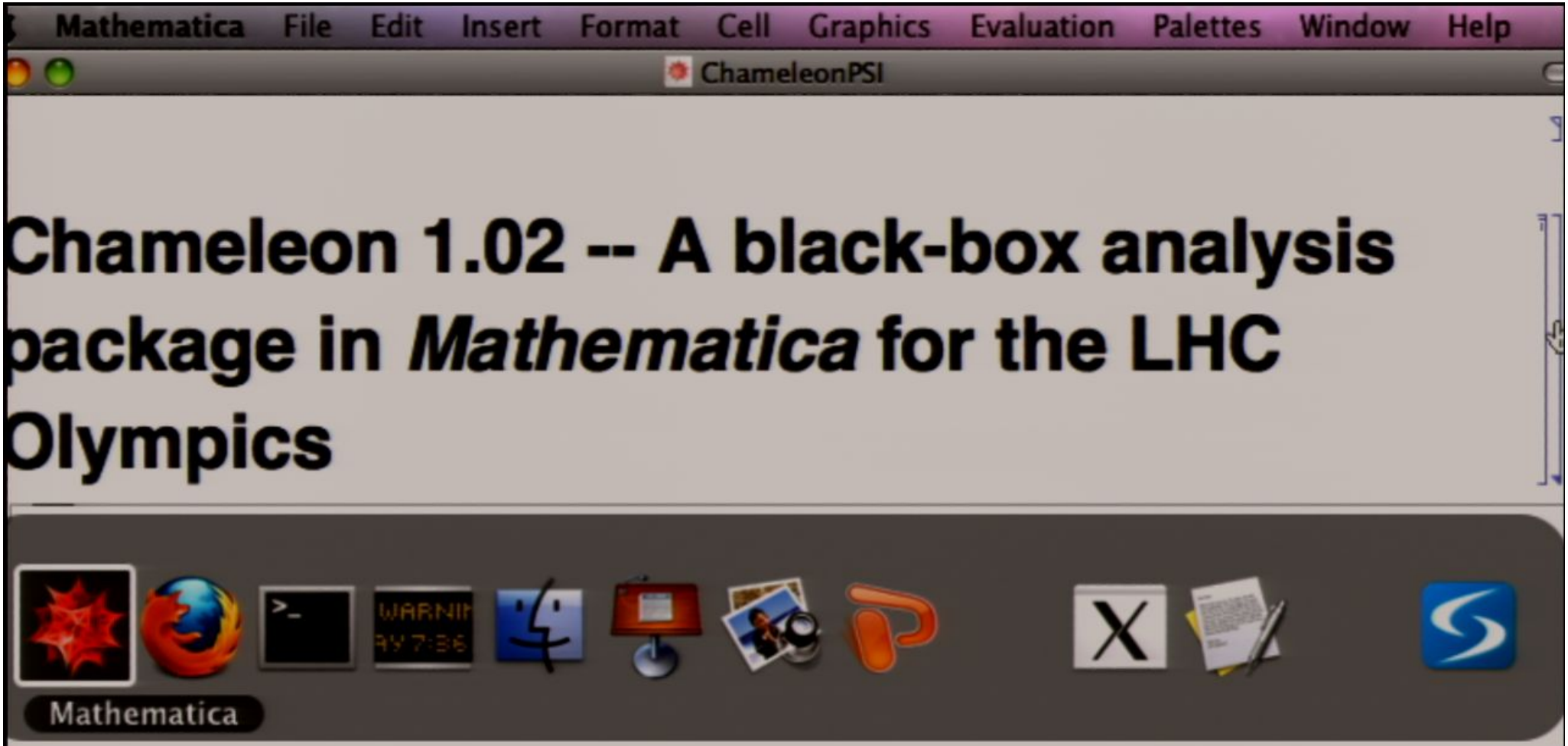
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ChameleonPSI
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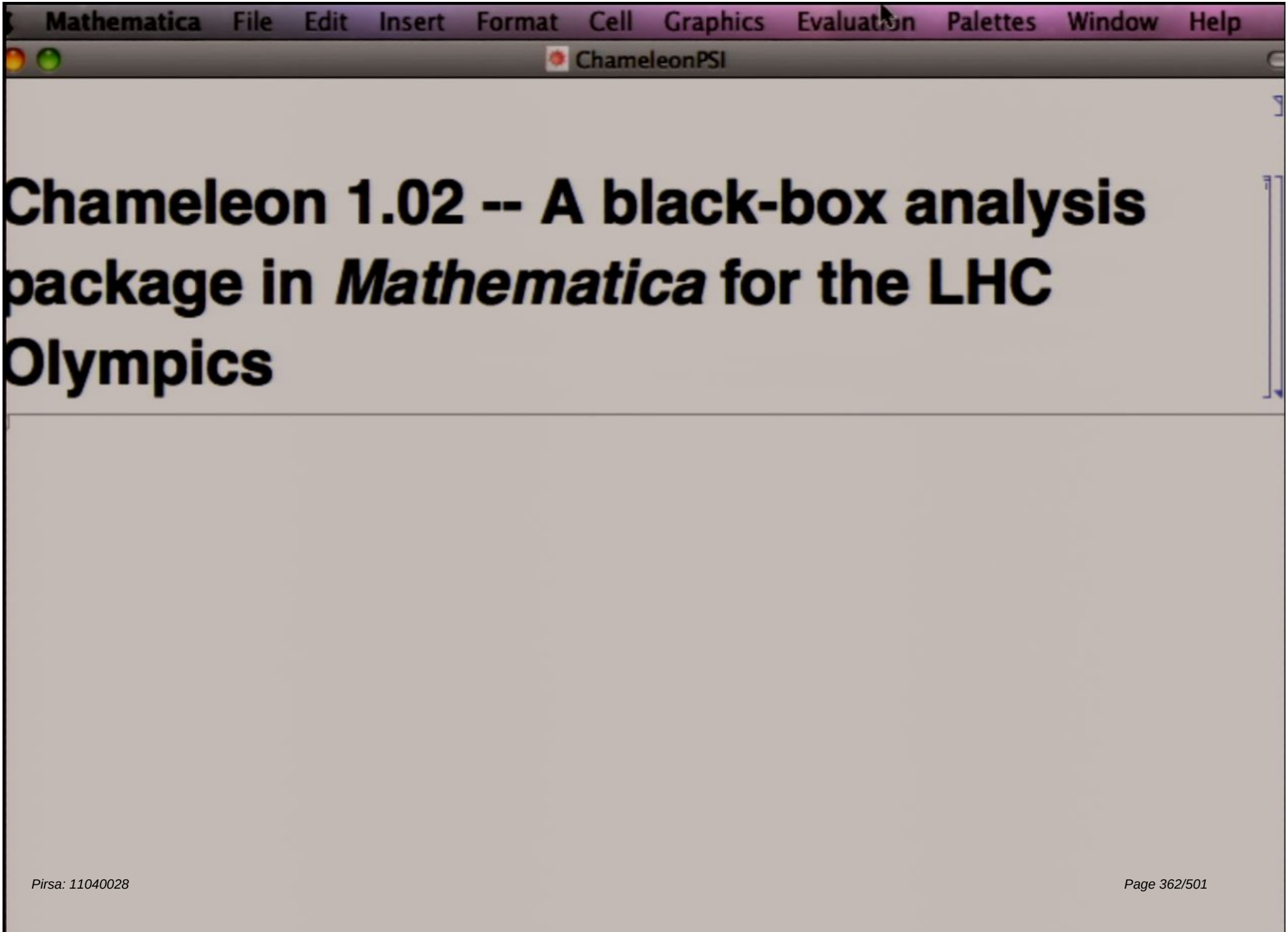
Mathematica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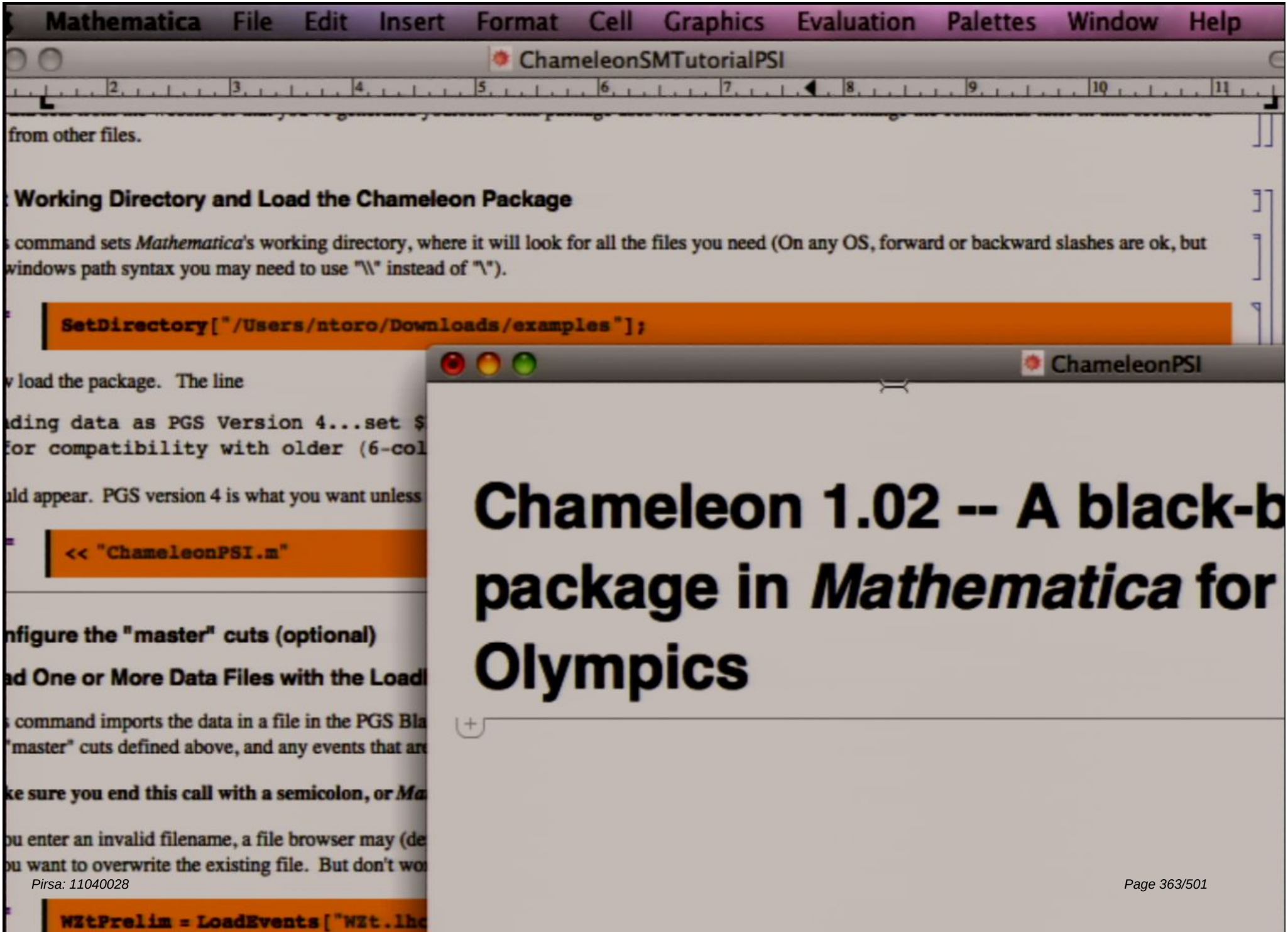
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
from other files.
Working Directory and Load the Chameleon Package
command sets Mathematica's working directory, where it will look for all the files you need (On any OS, forward or backward slashes are ok, but windows path syntax you may need to use "\\" instead of "\").
SetDirectory["/Users/ntoro/Downloads/examples"];
load the package. The line
ading data as PGS Version 4...set $
for compatibility with older (6-col
uld appear. PGS version 4 is what you want unless
<< "ChameleonPSI.m"
nfigure the "master" cuts (optional)
ad One or More Data Files with the Loadl
command imports the data in a file in the PGS Bla
"master" cuts defined above, and any events that ar
ke sure you end this call with a semicolon, or Ma
u enter an invalid filename, a file browser may (de
u want to overwrite the existing file. But don't wo
WZtPrelim = LoadEvents["WZt.lhc
ChameleonPSI
Chameleon 1.02 -- A black-b
package in Mathematica for
Olympics

from other files.

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```
SetDirectory["/Users/ntoro/Downloads/examples"];
```

load the package. The line

```
ading data as PGS Version 4...set $PGSVersion=3
for compatibility with older (6-column, no-trigger) data format
```

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
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```
WZtPrelim = LoadEvents["WZt.lhco"];
```

```
Length[WZtPrelim]
```

```
50 000
```

```
example = LoadEvents[""]; (* select file from file browser *)
```

```
WZtPrelim = example;
```

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Running...ChameleonSMTutorialPSI

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```
ShowEvent[WZtPrelim, 1]
```

A very large output was generated. Here is a sample of it:

```
example = LoadEvents[""]; (* select file from file browser *)
```

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WZtPrelim = example;
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```
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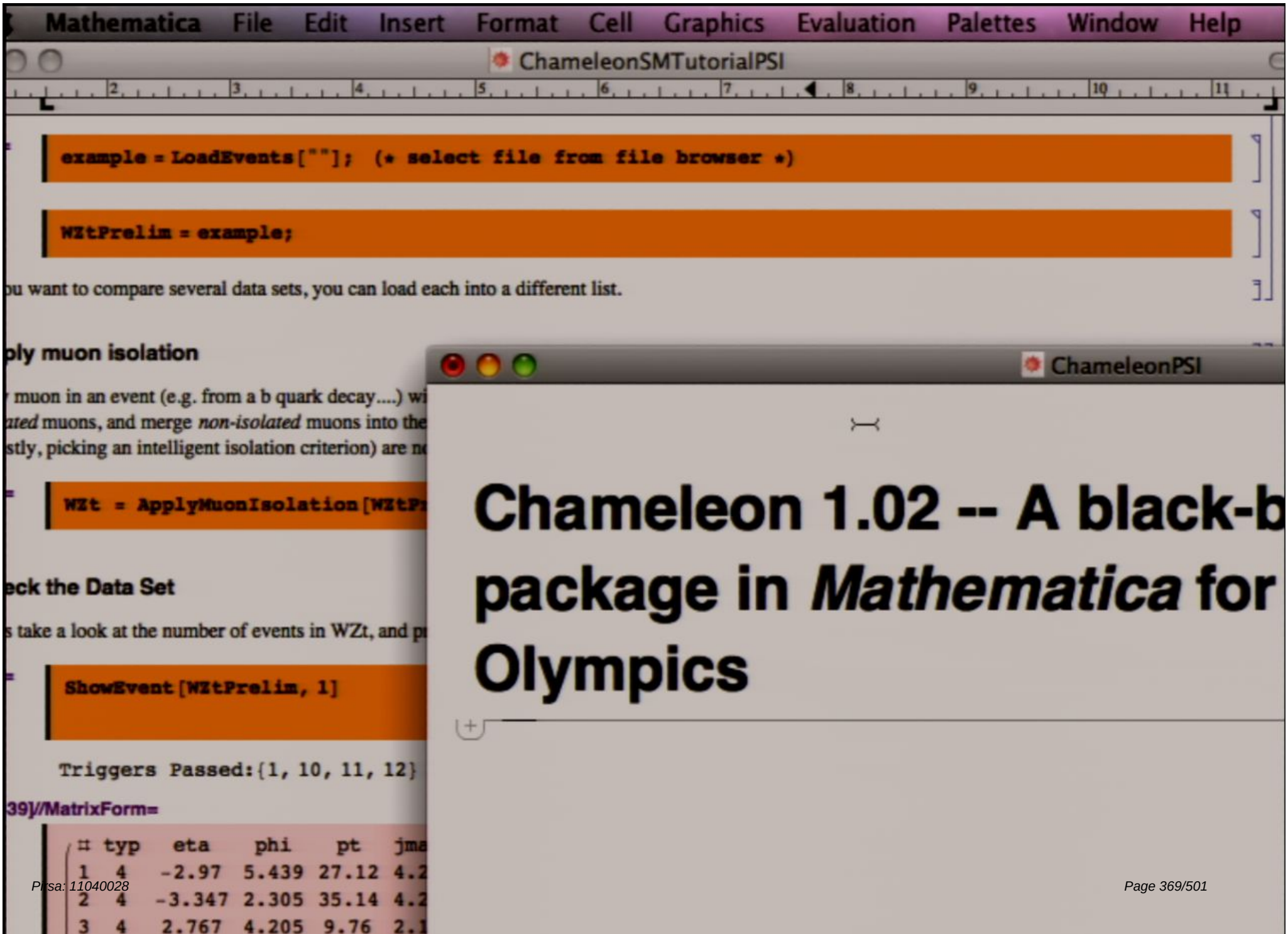
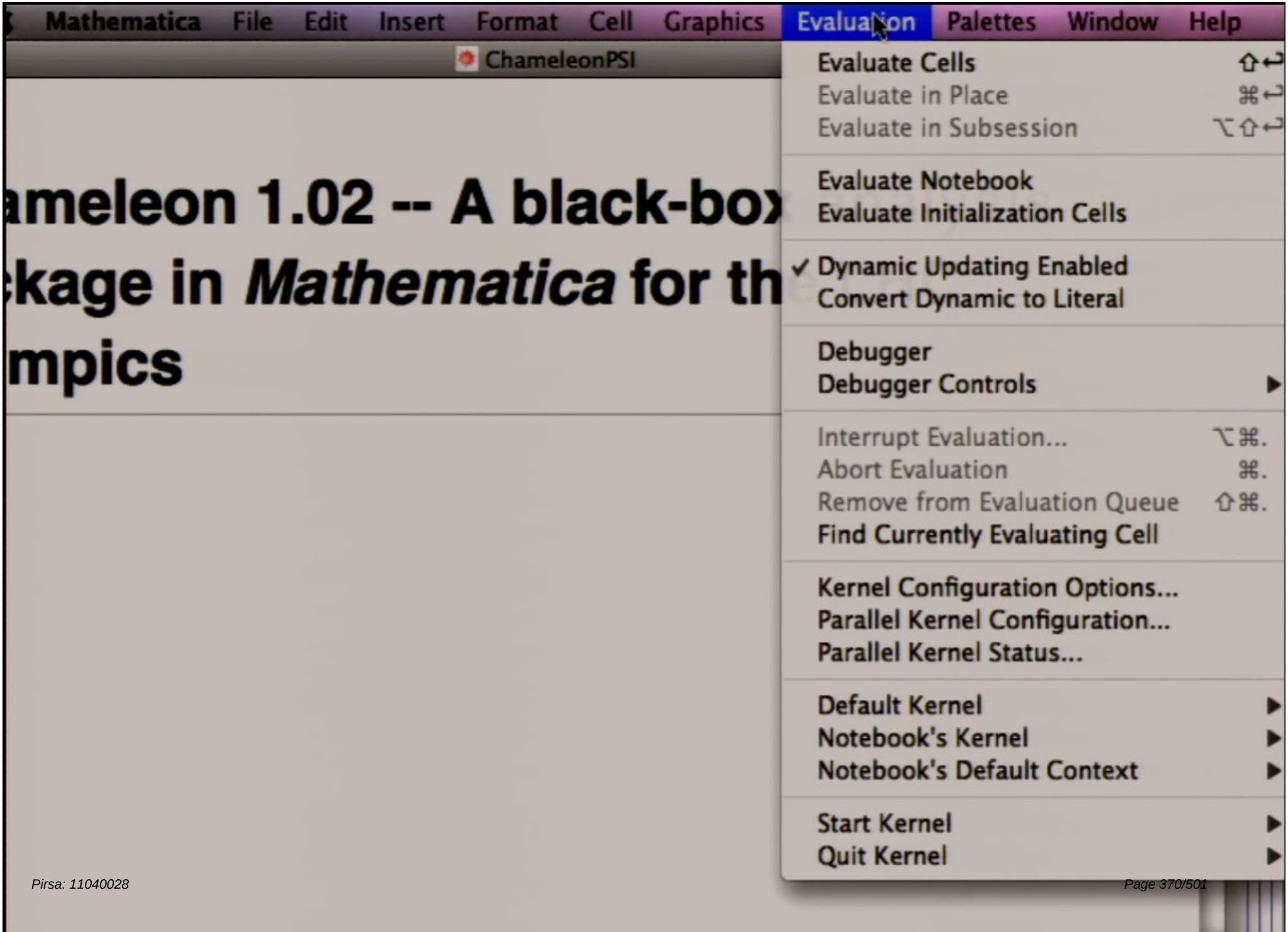
```

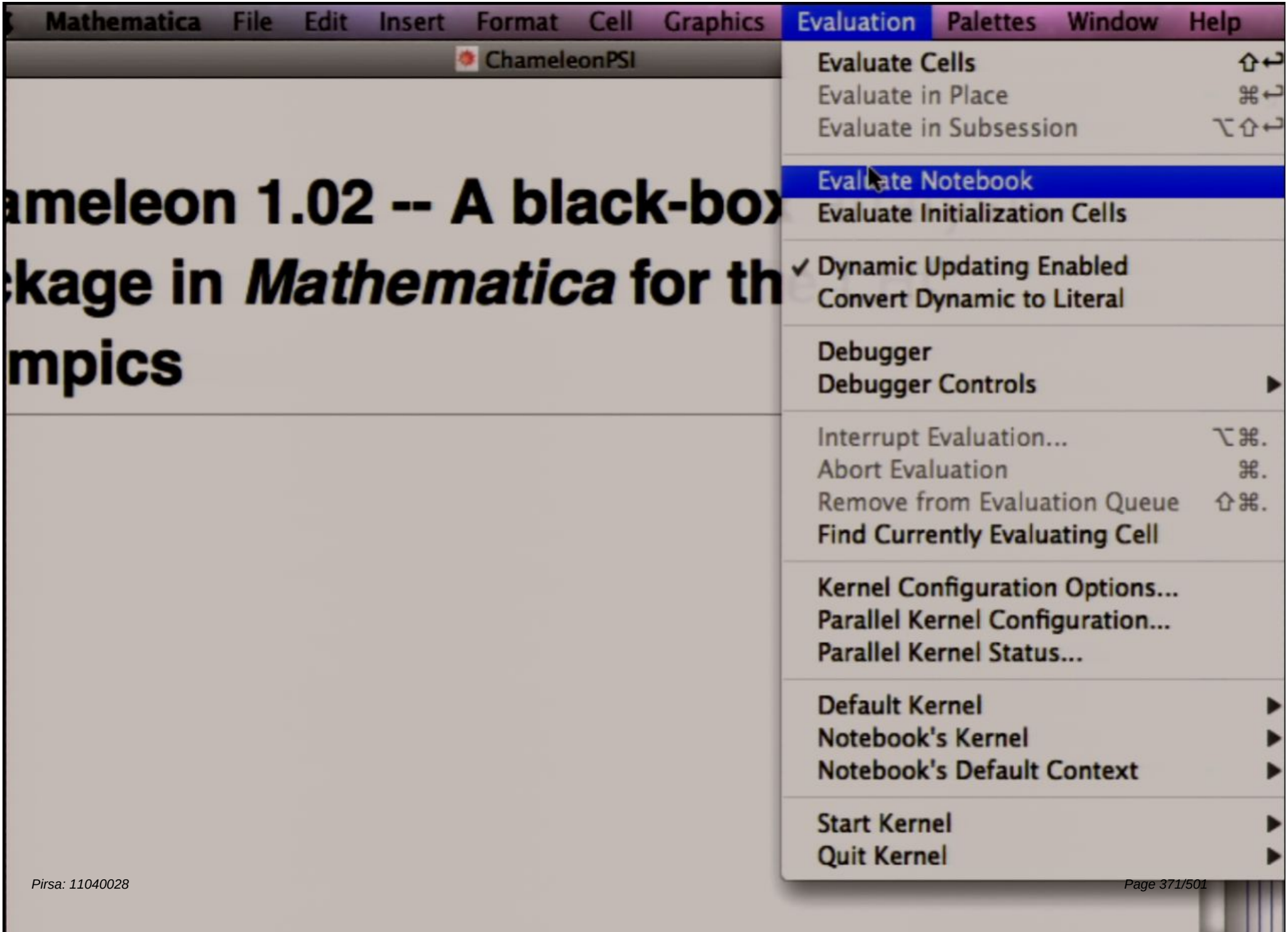
```
Triggers Passed:{1, 10, 11, 12}
```

39]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonSMTutorialPSI
example = LoadEvents[""]; (* select file from file browser *)
WZtPrelim = example;
ChameleonPSI
Chameleon 1.02 -- A black-b
package in Mathematica for
Olympics
ShowEvent[WZtPrelim, 1]
Triggers Passed:{1, 10, 11, 12}


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
ameleon 1.02 -- A black-box
kage in Mathematica for th
mpics
Evaluate Cells
Evaluate in Place
Evaluate in Subsession
Evaluate Notebook
Evaluate Initialization Cells
Dynamic Updating Enabled
Convert Dynamic to Literal
Debugger
Debugger Controls
Interrupt Evaluation...
Abort Evaluation
Remove from Evaluation Queue
Find Currently Evaluating Cell
Kernel Configuration Options...
Parallel Kernel Configuration...
Parallel Kernel Status...
Default Kernel
Notebook's Kernel
Notebook's Default Context
Start Kernel
Quit Kernel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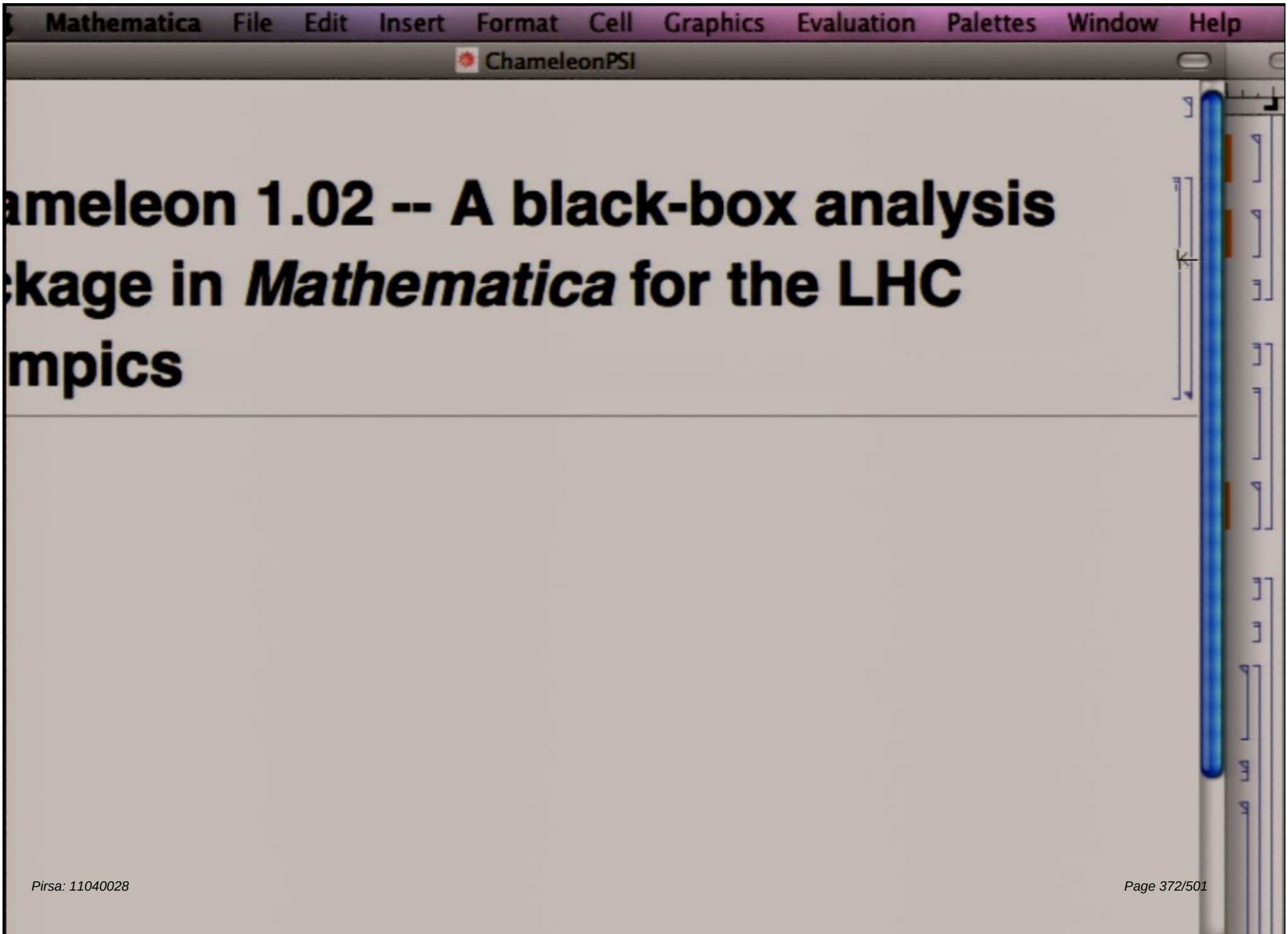
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
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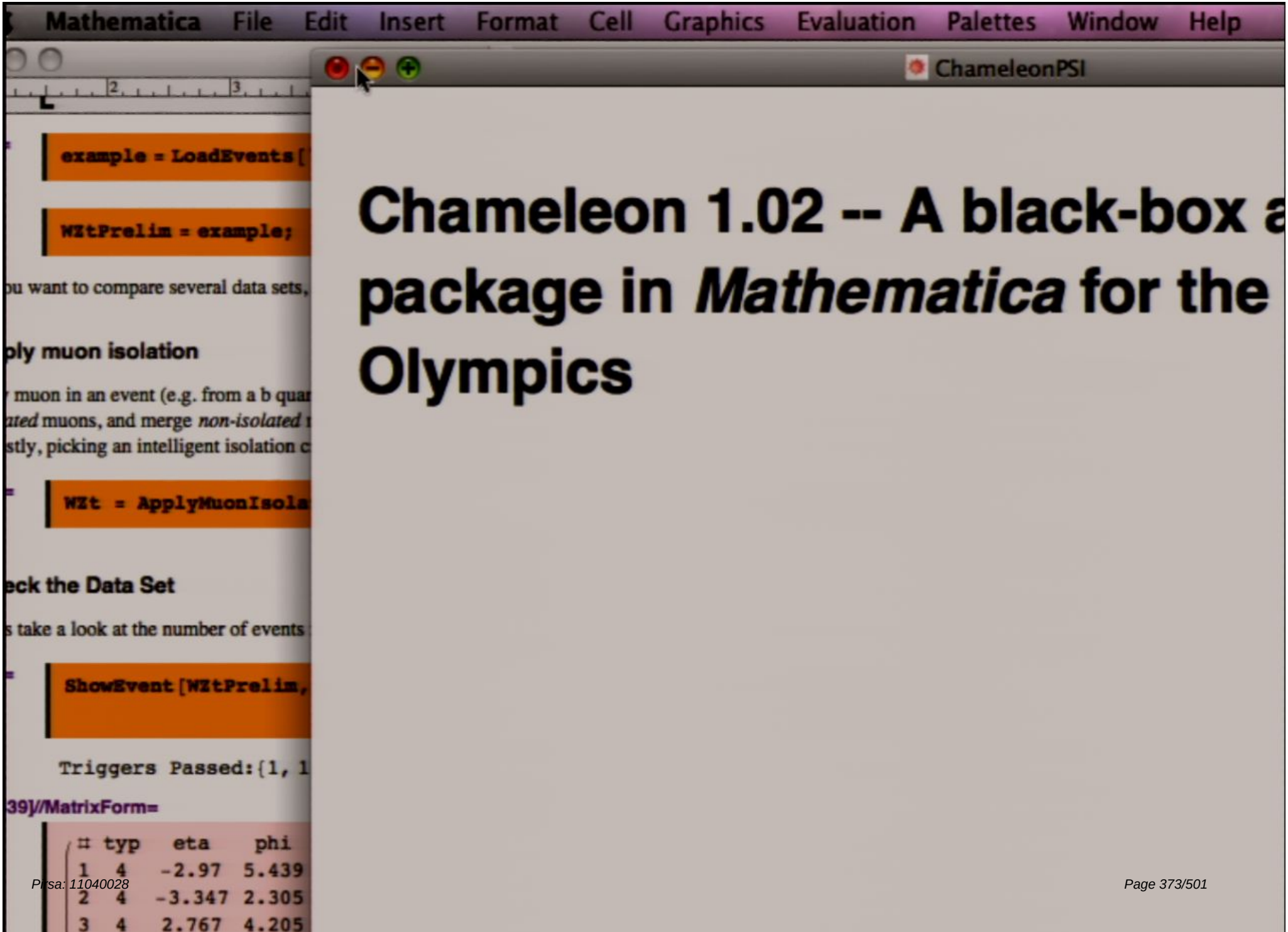
Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
ChameleonPSI
example = LoadEvents[
WZtPrelim = example;
Chameleon 1.02 -- A black-box a
package in Mathematica for the
Olympics
u want to compare several data sets,
ply muon isolation
muon in an event (e.g. from a b quar
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stly, picking an intelligent isolation c
WZt = ApplyMuonIsola
eck the Data Set
s take a look at the number of events
ShowEvent[WZtPrelim,
Triggers Passed:{1, 1
39]//MatrixForm=
typ eta phi
1 4 -2.97 5.439
2 4 -3.347 2.305
3 4 2.767 4.205

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WZt = ApplyMuonIsolation[WZtPrelim];
```

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s take a look at the number of events in WZt, and print out the first two events

```
ShowEvent[WZtPrelim, 1]
```

```
Triggers Passed:{1, 10, 11, 12}
```

39]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

]=

```
1
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
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2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
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```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

]=

```
1
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

]=

```
1
```

]=

```
$Aborted[]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
ShowEvent[WZtPrelim, 1]
```

```
Triggers Passed:{1, 10, 11, 12}
```

39]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

=

```
Length[WZt]
ShowEvent[WZt, 1]
ShowEvent[WZt, 2]
```

]=

```
50 000
```

```
Triggers Passed:{1, 10, 11, 12}
```

42]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	4	-2.97	5.439	27.12	4.22	3.	0.	2.29	0.	0.	265.04	-263.615	18.0169	-20.270
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```
Triggers Passed:{1}
```

43]//MatrixForm=

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ChameleonSMTutorialPSI

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43]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

ead these lists, you need to know the basic types in the lhco event format:

hoton

lectron: charge in ntrk column

uon: charge in ntrk column

au (hadronic): ntrk sign = charge of tau, 1 or 3 indicates 1- or 3-prong decay

et

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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Using Event Selections

ne of the events in this sample aren't very interesting (for example, producing a Z that decays invisibly). Let's make a few subsets, using the Select ction:

ll consider events with one lepton (e or mu):

```
OneLepton = Select[WZt, NumOf[oLightLepton]==1];
Length[OneLepton]
```

```
5749
```

d events with two leptons:

```
TwoLepton = Select[WZt, NumOf[oLightLepton]==2];
Length[TwoLepton]
```

```
435
```

ther interesting sample: events with at least one b-tagged jet

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ChameleonSMTutorialPSI

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```
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```
BTag = Select[WZt, NumOf[oBJet]~ge~1];
Length[BTag]
```

```
1087
```

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ChameleonSMTutorialPSI

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1087
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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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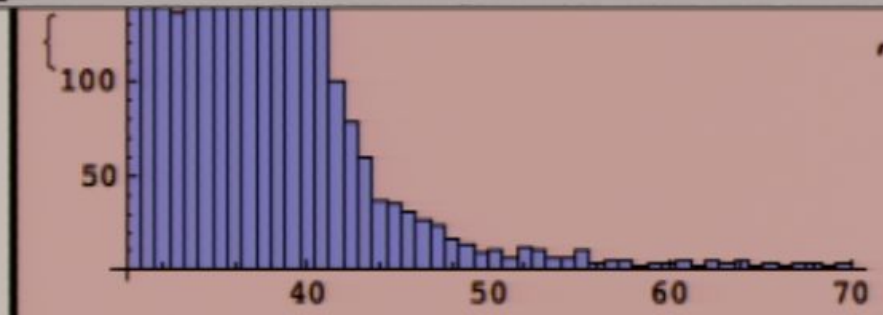
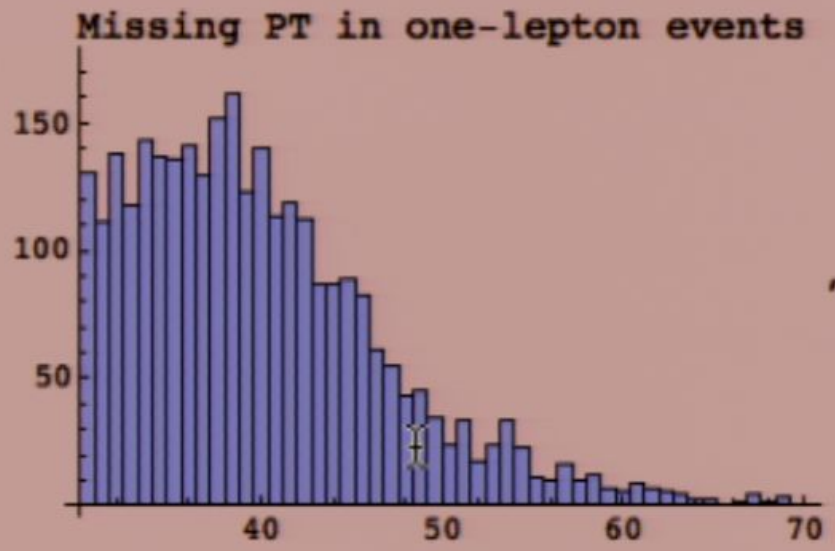
ther interesting sample: events with at least one b-tagged jet

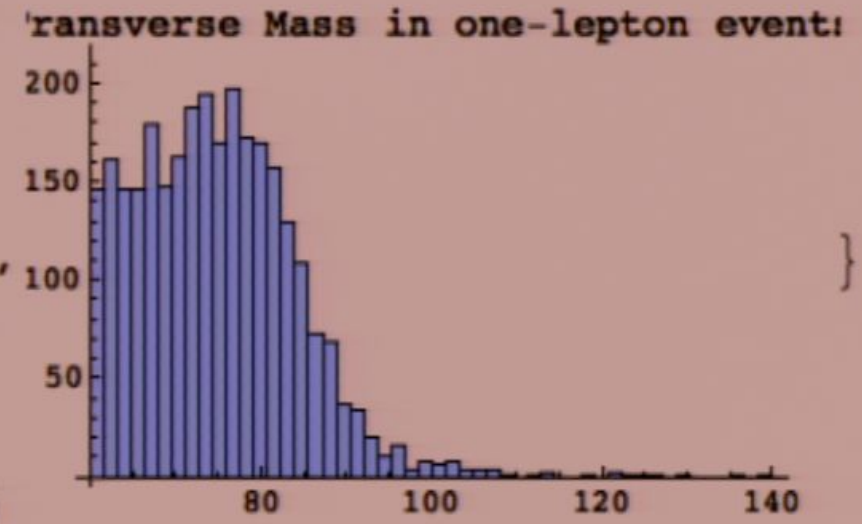
```
BTag = Select[WZt, NumOf[oBJet]~ge~1];
Length[BTag]
```

```
1087
```


could instead have selected events with one **hard** lepton, with pT > 20 GeV, say.








```
Hist[Bin[OneLepton, all, GetAll, EffMass], {0, 300, 50},
 PlotLabel → "HT (scalar sum of all pTs)"]
```

HT (scalar sum of all pTs)

ents where some of the missing energy is actually jet energy that wasn't properly accounted for.

FUNCTION REFERENCE LIST (may be out of date)

eptonic events where one lepton is missed (but both neutrinos contribut to MET)

ents where some of the missing energy is actually jet energy that wasn't properly accounted for.

FUNCTION REFERENCE LIST (may be out of date)

ject Types (patterns)

Built-in patterns

meleon uses *Mathematica* pattern-matching to determine the (purported) identities of objects in an event listing. Each pattern can be given in a g or short form.

lepton patterns are:

oElectron=oE (matches e+or e-)

oElectronPlus=oEP (matches only e+)

oElectronMinus=oEM (matches only e-)

oMuon=oμ (matches μ+or μ-)

oMuonPlus=oμP (matches only μ+)

oMuonMinus=oμM (matches only μ-)

oTau=oτ (matches τ+or τ-)

oTauPlus=oτP (matches only τ+)

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ChameleonSMTutorialPSI

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oMuonMinus=oμM (matches only μ-)

oTau=oτ (matches τ+or τ-)

oTauPlus=oτP (matches only τ+)

oTauMinus=oτM (matches only τ-)

oLepton=oL(matches any lepton)

oLeptonPlus=oLP(matches any l+)

oLeptonMinus=oLM(matches any l-)

oLightLepton=oLL (matches any e or mu)

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

oLepton=oL(matches any lepton)

oLeptonPlus=oLP(matches any l+)

oLeptonMinus=oLM(matches any l-)

oLightLepton=oLL (matches any e or mu)

oLightLeptonPlus=oLLP (matches any e+ or μ+)

oLightLeptonMinus=oLLM (matches any e- or mu-)

tons can also be referred to by a number between -3 and +3 (generation number × charge), as

oLeptonType[-1] = oElectronMinus;

oLeptonType[1] = oElectronPlus;

oLeptonType[-2] = oMuonMinus;

oLeptonType[2] = oMuonPlus;

oLeptonType[-3] = oTauMinus;

oLeptonType[3] = oTauPlus;

tons and jet patterns are

oPhoton = oγ (matches photons)

oJet (matches any jet)

oBJet =oBJetLoose=oB=oB1=oBJet1=oBL (matches a b-tagged jet)

oBJetTight=oBJet2=oBT=oB2 (matches a *tight* b-tagged jet)

oNonBJet = oNonB=oNonLooseBJet (matches a jet that was not tagged as a b)

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oNonBJet = oNonB=oNonLooseBJet (matches a jet that was not tagged as a b)

oNonTightBJet (matches a jet that was not tagged as a b with the tight tagger)

also includes as an object the missing PT of an event. If it is greater than MISSINGPTCUT, this object remains in the listing processed by meleon, and matches

oMissingPT=oMPT

w additional patterns are

oAny (matches any properly formed object, including missing pt)

oNot[oType] (matches any object that doesn't match type *oType*. For example,oNot[oLepton] matches jets,photons,and missing pt)

oHard[*oType*, *pthard*] (matches an object of type *oType* with pt ≥ *pthard*)

oLessHard[*oType*, *pthard*] (matches an object of type *oType* with pt < *pthard*)

reating your own kinematically constrained patterns

oHard function above creates a kinematically constrained pattern from an unconstrained pattern (e.g. the pattern "electron with pT>30 GeV" from pattern "electron").

possible to create your own constrained patterns using *Mathematica*'s *pattern*?*criterion* construction, which matches only things that match *pattern* satisfy the Boolean function *criterion*. Thus, for example, if you are interested in looking at particles well separated from the beamline, you can ne the function

```
EtaRestrict[etaMax_][obj_]:=(etaOf[obj]>0 && etaOf[obj]<etaMax)
```

then use `oJet?EtaRestrict[1.5]` the same way you would use any other pattern.

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ther documentation may be added later. For now, please see the examples above.

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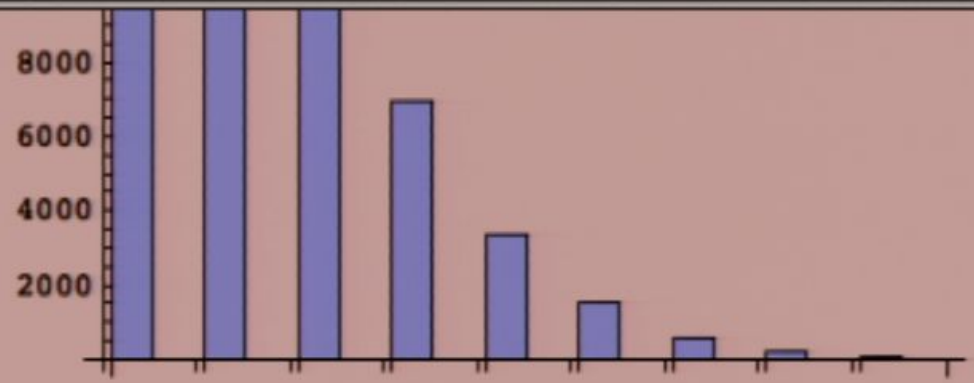

nts number from 0 to 5 of oBJet= B Jet objects in the OneLepton region

```
SpeciesCount[OneLepton, oB, 5]
```

```
{0  1  2  3  4  5}
```

```
SpeciesCount[OneLepton, oB, 5]
```

0	1	2	3	4	5
5699	50	0	0	0	0

gleLeptonCount picks out events with **exactly one lepton**, and counts how the frequency of each lepton type. The arguement is the event list:

```
SingleLeptonCount[WZt]
```

e-	μ-	τ-	e+	μ+	τ+
1247	936	2500	1840	1364	2665

RunInclusiveCount function displays several inclusive signatures.

```
RunInclusiveCounts[WZt]
```

Photons:

0	1	2	3	4
48175	1745	76	4	0

Jets:

0	1	2	3	4	5	6
10669	12456	14056	6969	3381	1559	574

BJets:

0	1	2	3	4
48913	1037	50	0	0

Lepton:

0	1	2	3	4
38238	10552	1142	67	1

(OSDL: 603, SSDL: 182)

Single- and Di- Lepton Counts

e-	μ-	τ-	e+	μ+	τ+
1247	936	2500	1840	1364	2665

-	e-	μ-	τ-	e+	μ+	τ+
e-	0	0	34	212	5	48
μ-	0	0	37	5	187	26
τ-	0	0	87	71	35	204
e+	0	0	0	1	0	55
μ+	0	0	0	0	0	41
τ+	0	0	0	0	0	94

Single- and Di-Lepton Counts (events with no jets):

e-	μ-	τ-	e+	μ+	τ+
658	510	356	986	747	398

-	e-	μ-	τ-	e+	μ+	τ+
e-	0	0	15	114	4	21
μ-	0	0	15	2	107	9
τ-	0	0	28	24	11	52
e+	0	0	0	0	0	12
μ+	0	0	0	0	0	11
τ+	0	0	0	0	0	22

re Simple Counting

Single- and Di- Lepton Counts

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μ+	0	0	0	0	0	11
τ+	0	0	0	0	0	22

re Simple Counting

ow, we explicitly construct several inclusive counts, many of which are included in the set produced by RunInclusiveCounts. They are included here how you how to generate them yourself or generalize them, and to introduce the notation used in the remainder of the program.

ciesCount tabulates the number of events in which a given species of object appears *n* times. All object types begin with o, and most have long and rt forms (a list of all object types is below (click on this link)). For example, oLL (or oLightLepton) matches a leptons of type e or μ. Thus, the mand below counts events with 0, 1, 2, 3, 4, or 5 leptons.

```
SpeciesCount[OneLepton, oLL, 5]
```

0	1	2	3	4	5
0	57849	0	0	0	0

ou want to compare several data sets, you can load each into a different list.

ply muon isolation

muon in an event (e.g. from a b quark decay....) will propagate to the muon chambers and be identified as a muon, but it is often useful to study *ated* muons, and merge *non-isolated* muons into the nearest jet. We will use an algorithm for PGS written by A. Pierce and J. Thaler -- the details stly, picking an intelligent isolation criterion) are not important here.

```
WZt = ApplyMuonIsolation[WZtPrelim];
```

eck the Data Set

s take a look at the number of events in WZt, and print out the first two events

```
ShowEvent[WZtPrelim, 1]
```

```
Triggers Passed:{1, 10, 11, 12}
```

39]//MatrixForm=

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
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2	4	-3.347	2.305	35.14	4.26	3.	0.	1.9	0.	0.	499.929	-498.675	-23.5437	26.086
3	4	2.767	4.205	9.76	2.12	5.	0.	15.41	0.	0.	77.9804	77.3381	-4.74235	-8.530
4	6	0.	5.875	5.3	0.	0.	0.	0.	0.	0.	5.3	0.	4.86457	-2.1038

```
Length[WZt]
ShowEvent[WZt, 1]
```

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#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
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ead these lists, you need to know the basic types in the lhco event format:

hoton

lectron: charge in ntrk column

nuon: charge in ntrk column

au (hadronic): ntrk sign = charge of tau, 1 or 3 indicates 1- or 3-prong decay

et

nissing energy: one per event, always assumed to have eta=0

Jsing Event Selections

ne of the events in this sample aren't very interesting (for example, producing a Z that decays invisibly). Let's make a few subsets, using the Select tion:

ll consider events with one lepton (e or mu):

```
OneLepton = Select[WZt, NumOf[oLightLepton]~eq~1];
Length[OneLepton]
```

]=

```
5749
```


d events with two leptons:

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

#	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

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et

issing energy: one per event, always assumed to have eta=0

Using Event Selections

EXAMPLES OF BASIC ANALYSIS

FUNCTION REFERENCE LIST (may be out of date)

ject Types (patterns)

uilt-in patterns

meleon uses *Mathematica* pattern-matching to determine the (purported) identities of objects in an event listing. Each pattern can be given in a
or short form.

lepton patterns are:

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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1	6	0.	4.656	13.6	0.	0.	0.	0.	0.	0.	13.6	0.	-0.766484	-13.5784

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t

issing energy: one per event, always assumed to have eta=0

sing Event Selections

XAMPLES OF BASIC ANALYSIS

UNCTION REFERENCE LIST (may be out of date)

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uilt-in patterns

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

⌗	typ	eta	phi	pt	jmas	ntrk	btag	had/em	dum1	dum2	E	pz	px	py
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sing Event Selections

XAMPLES OF BASIC ANALYSIS

UNCTION REFERENCE LIST (may be out of date)

ll consider events with one lepton (e or mu):

```
OneLepton = Select[WZt, NumOf[oLightLepton]~eq~1];
Length[OneLepton]
```

```
5749
```

d events with two leptons:

```
TwoLepton = Select[WZt, NumOf[oLightLepton]~eq~2];
Length[TwoLepton]
```

```
435
```

ther interesting sample: events with at least one b-tagged jet

```
BTag = Select[WZt, NumOf[oBJet]~ge~1];
Length[BTag]
```

```
1087
```

could instead have selected events with one **hard** lepton, with pT > 20 GeV, say.

```
OneHardLepton = Select[WZt, NumOf[oHard[oLightLepton, 15]]~eq~1];
Length[OneHardLepton]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

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Length[OneHardLepton]
```

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

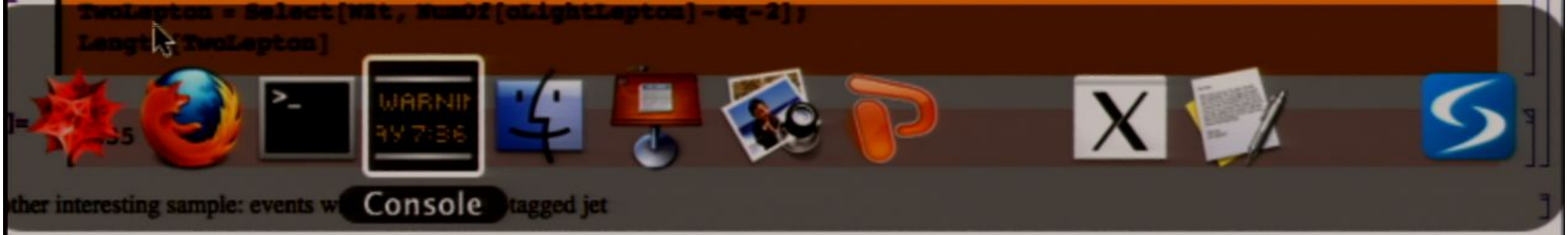
ll consider events with one lepton (e or mu):

```
OneLepton = Select[WZt, NumOf[oLightLepton]==1];
Length[OneLepton]
```

```
5749
```

d events with two leptons:

```
TwoLepton = Select[WZt, NumOf[oLightLepton]==2];
Length[TwoLepton]
```



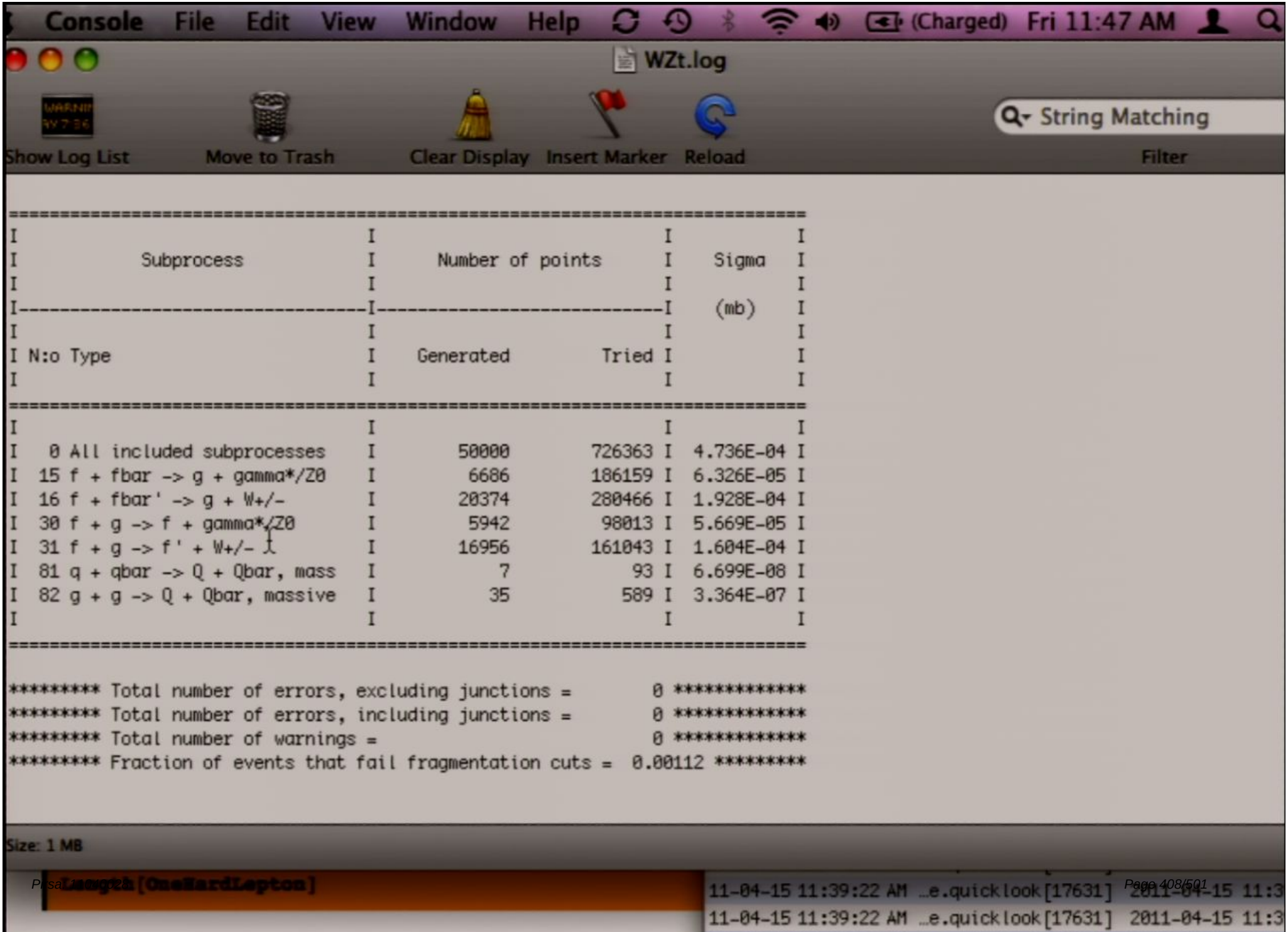
ther interesting sample: events w tagged jet

```
BTag = Select[WZt, NumOf[oBJet]>=1];
Length[BTag]
```

```
1087
```

could instead have selected events with one **hard** lepton, with pT > 20 GeV, say.

```
OneHardLepton = Select[WZt, NumOf[oHard[oLightLepton, 15]]==1];
Length[OneHardLepton]
```



Subprocess		Number of points		Sigma
N:o	Type	Generated	Tried	(mb)
0	All included subprocesses	50000	726363	4.736E-04
15	f + fbar -> g + gamma*/Z0	6686	186159	6.326E-05
16	f + fbar' -> g + W+/-	20374	280466	1.928E-04
30	f + g -> f + gamma*/Z0	5942	98013	5.669E-05
31	f + g -> f' + W+/-	16956	161043	1.604E-04
81	q + qbar -> Q + Qbar, mass	7	93	6.699E-08
82	g + g -> Q + Qbar, massive	35	589	3.364E-07

********* Total number of errors, excluding junctions = 0 **********
********* Total number of errors, including junctions = 0 **********
********* Total number of warnings = 0 **********
********* Fraction of events that fail fragmentation cuts = 0.00112 *********

[OneHardLepton]

11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3

$\ell\nu$ (ℓ = e or μ) 20%.

$\tau\nu$ 10%.

"jj" 70%.

$W^+ W^-$

$t\bar{t} \to (\ell^+\nu)(\ell^-\nu) b\bar{b}$ $0.2 \times 2 = 4\%$.

$(\ell^+\nu)(jj) b\bar{b}$ $0.7 \times 0.2 = 0.14$ } 28%.

$(jj)(\ell^-\nu) b\bar{b}$ }

$(jj)(jj) b\bar{b}$ 0.7×0.7 50%.

* involve a τ, ν_τ ↓ hadronic decay

~10%?

20%.

10^7 Hz → 10^5 Hz

↓

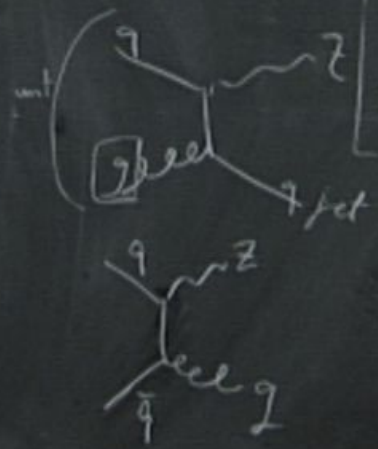
1000 computers

→ 100 Hz

37K W's

20% → e or μ

6K ℓ



Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

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Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

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```
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```

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```

```
]= 435
```

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= BTag = Select[WZt, NumOf[oBJet]~ge~1];
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```

```
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```

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```
= OneHardLepton = Select[WZt, NumOf[oHard[oLightLepton, 15]]~eq~1];
  Length[OneHardLepton]
```

```
= 4949
```

Console File Edit View Window Help (Charged) Fri 11:48 AM

WZt.log

Show Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==============================================================================
I                                  I                            I            I
I            Subprocess            I      Number of points      I    Sigma   I
I                                  I                            I            I
I----------------------------------I----------------------------I    (mb)    I
I                                  I                            I            I
I N:o Type                         I    Generated         Tried I            I
I                                  I                            I            I
==============================================================================
I                                  I                            I            I
I   0 All included subprocesses    I        50000        726363 I  4.736E-04 I
I  15 f + fbar -> g + gamma*/Z0    I         6686        186159 I  6.326E-05 I
I  16 f + fbar' -> g + W+/-        I        20374        280466 I  1.928E-04 I
I  30 f + g -> f + gamma*/Z0       I         5942         98013 I  5.669E-05 I
I  31 f + g -> f' + W+/-           I        16956        161043 I  1.604E-04 I
I  81 q + qbar -> Q + Qbar, mass   I            7            93 I  6.699E-08 I
I  82 g + g -> Q + Qbar, massive   I           35           589 I  3.364E-07 I
I                                  I                            I            I
==============================================================================

********* Total number of errors, excluding junctions =       0 *************
********* Total number of errors, including junctions =       0 *************
********* Total number of warnings =                          0 *************
********* Fraction of events that fail fragmentation cuts =  0.00112 *********
```

Size: 1 MB

11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3

11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

ChameleonSMTutorialPSI

```
Length[OneLepton]
```

```
]= 5749
```

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```

```
]= 435
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```
= 4949
```

Console File Edit View Window Help (Charged) Fri 11:49 AM

WZt.log

Show Log List | Move to Trash | Clear Display | Insert Marker | Reload | String Matching | Filter

```
==============================================================================
I                                  I                            I            I
I            Subprocess            I      Number of points      I    Sigma   I
I                                  I                            I            I
I----------------------------------I----------------------------I    (mb)    I
I                                  I                            I            I
I N:o Type                         I    Generated        Tried I            I
I                                  I                            I            I
==============================================================================
I                                  I                            I            I
I   0 All included subprocesses    I        50000       726363 I  4.736E-04 I
I  15 f + fbar -> g + gamma*/Z0    I         6686       186159 I  6.326E-05 I
I  16 f + fbar' -> g + W+/-        I        20374       280466 I  1.928E-04 I
I  30 f + g -> f + gamma*/Z0       I         5942        98013 I  5.669E-05 I
I  31 f + g -> f' + W+/-           I        16956       161043 I  1.604E-04 I
I  81 q + qbar -> Q + Qbar, mass   I            7           93 I  6.699E-08 I
I  82 g + g -> Q + Qbar, massive   I           35          589 I  3.364E-07 I
I                                  I                            I            I
==============================================================================

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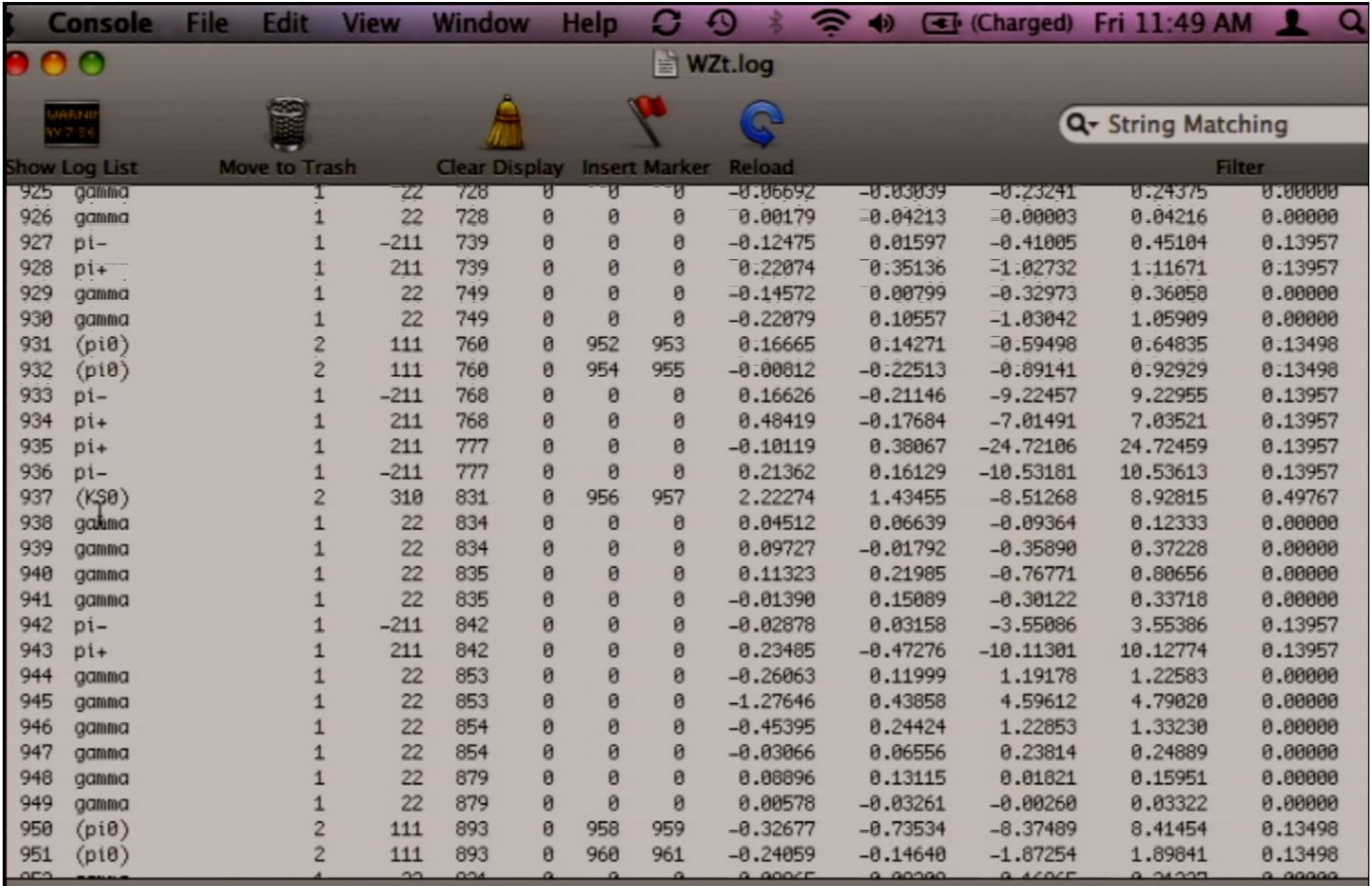
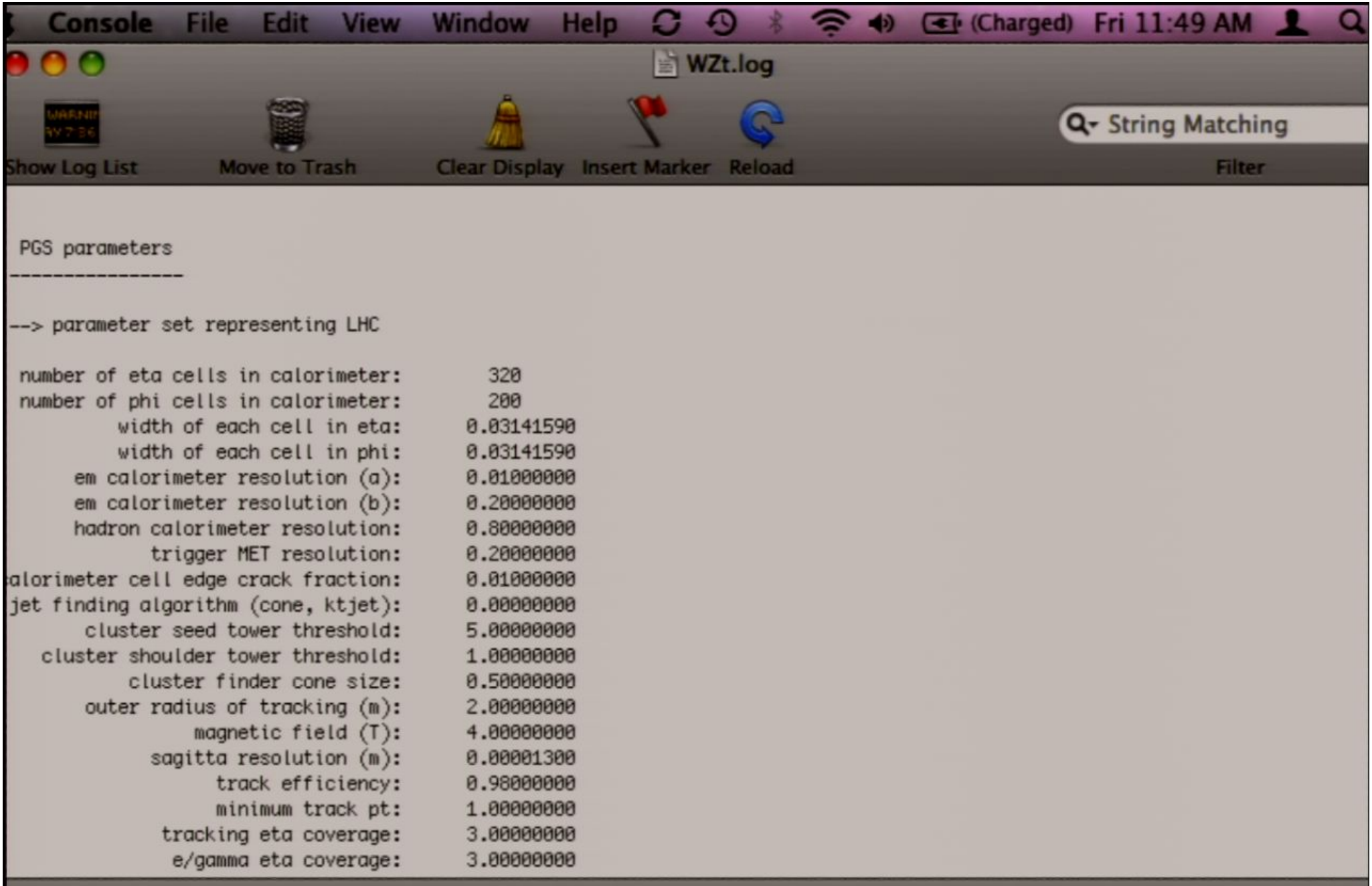
Size: 1 MB

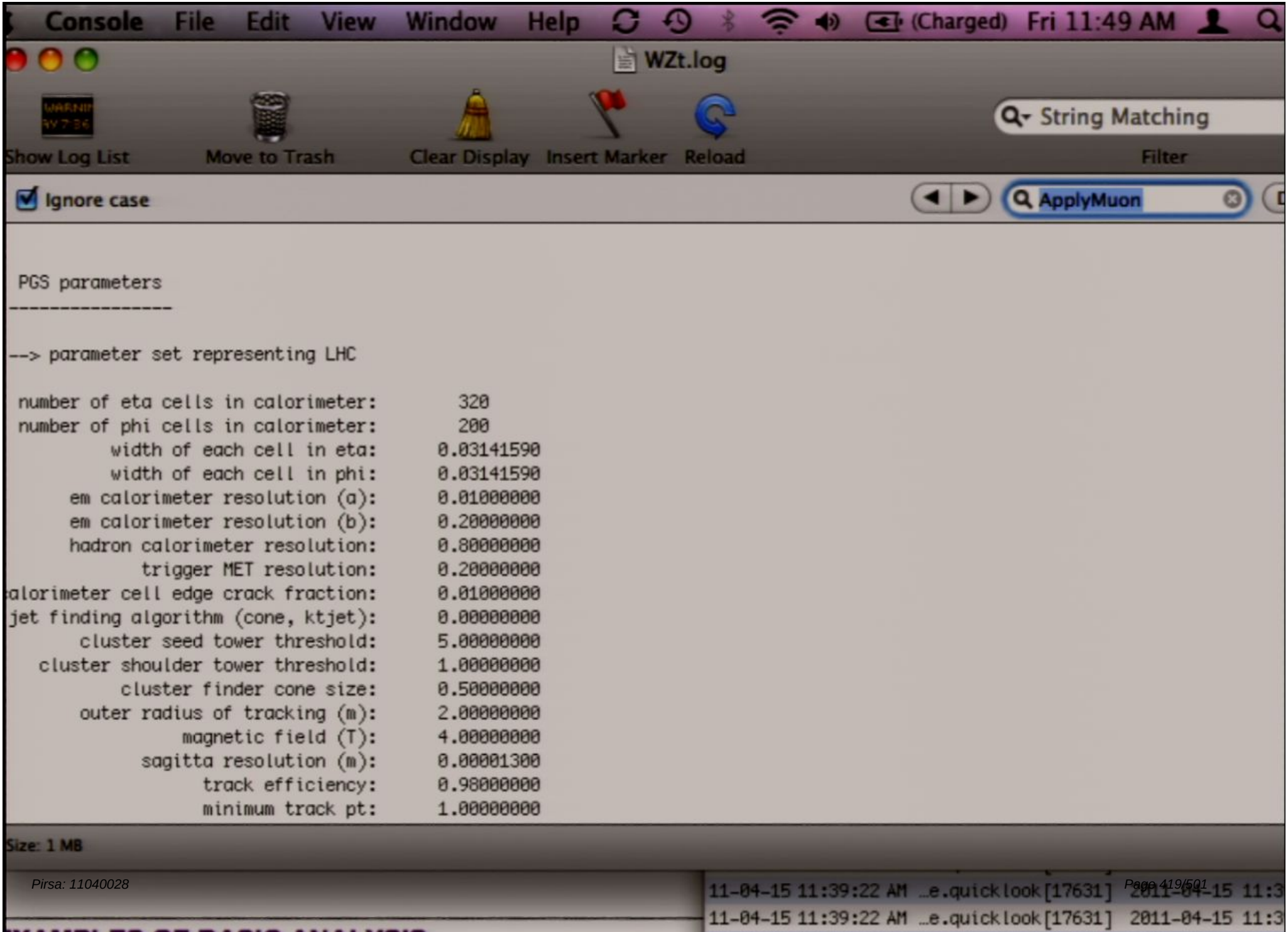
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3



11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3


Console File Edit View Window Help (Charged) Fri 11:49 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
3684 1 53 0.000000 nu_e s
3685 1 53 0.000000 e- c
3686 1 53 0.000000 nu_e b
3687 1 53 0.000000 e- t
3688 1 53 0.000000 nu_mu d
3689 1 53 0.000000 mu- u
3690 1 53 0.000000 nu_mu s
3691 1 53 0.000000 mu- c
3692 1 53 0.000000 nu_mu b
3693 1 53 0.000000 mu- t
3694 1 53 0.000000 nu_tau d
3695 1 53 0.000000 tau- u
3696 1 53 0.000000 nu_tau s
3697 1 53 0.000000 tau- c
3698 1 53 0.000000 nu_tau b
3699 1 53 0.000000 tau- t
3700 1 53 0.000000 ubar sbar
3701 1 53 0.000000 ubar bbar
3702 1 53 0.000000 cbar sbar
3703 1 53 0.000000 cbar bbar
3704 1 53 0.000000 tbar sbar
3705 1 53 0.000000 tbar bbar
2000002 318 ~u_R ~u_Rbar 2 1 1 500.00000 1.00000 10.00000 0.00000E+00 1
3706 1 53 0.000000 ~Gravitino u
3707 1 53 0.000000 ~chi_1+ d
3708 1 53 0.000000 ~chi_2+ d
Size: 1 MB


Console File Edit View Window Help (Charged) Fri 11:49 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
PGS parameters
--> parameter set representing LHC
number of eta cells in calorimeter: 320
number of phi cells in calorimeter: 200
width of each cell in eta: 0.03141590
width of each cell in phi: 0.03141590
em calorimeter resolution (a): 0.01000000
em calorimeter resolution (b): 0.20000000
hadron calorimeter resolution: 0.80000000
trigger MET resolution: 0.20000000
alorimeter cell edge crack fraction: 0.01000000
jet finding algorithm (cone, ktjet): 0.00000000
cluster seed tower threshold: 5.00000000
cluster shoulder tower threshold: 1.00000000
cluster finder cone size: 0.50000000
outer radius of tracking (m): 2.00000000
magnetic field (T): 4.00000000
sagitta resolution (m): 0.00001300
track efficiency: 0.98000000
minimum track pt: 1.00000000
tracking eta coverage: 3.00000000
e/gamma eta coverage: 3.00000000
Size: 1 MB


Console File Edit View Window Help (Charged) Fri 11:49 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
Ignore case
ApplyMuon
PGS parameters
--> parameter set representing LHC
number of eta cells in calorimeter: 320
number of phi cells in calorimeter: 200
width of each cell in eta: 0.03141590
width of each cell in phi: 0.03141590
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hadron calorimeter resolution: 0.80000000
trigger MET resolution: 0.20000000
alorimeter cell edge crack fraction: 0.01000000
jet finding algorithm (cone, ktjet): 0.00000000
cluster seed tower threshold: 5.00000000
cluster shoulder tower threshold: 1.00000000
cluster finder cone size: 0.50000000
outer radius of tracking (m): 2.00000000
magnetic field (T): 4.00000000
sagitta resolution (m): 0.00001300
track efficiency: 0.98000000
minimum track pt: 1.00000000
Size: 1 MB
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3

Console File Edit View Window Help (Charged) Fri 11:49 AM

WZt.log

Show Log List | Move to Trash | Clear Display | Insert Marker | Reload | Filter: String Matching

Ignore case — Search: Z0

```
I                                  I                            I            I
I            Subprocess            I      Number of points      I   Sigma    I
I                                  I                            I            I
I----------------------------------I----------------------------I    (mb)    I
I                                  I                            I            I
I N:o Type                         I    Generated         Tried I            I
I                                  I                            I            I
==============================================================================
I                                  I                            I            I
I   0 All included subprocesses    I        50000        726363 I  4.736E-04 I
I  15 f + fbar -> g + gamma*/Z0    I         6686        186159 I  6.326E-05 I
I  16 f + fbar' -> g + W+/-        I        20374        280466 I  1.928E-04 I
I  30 f + g -> f + gamma*/Z0       I         5942         98013 I  5.669E-05 I
I  31 f + g -> f' + W+/-           I        16956        161043 I  1.604E-04 I
I  81 q + qbar -> Q + Qbar, mass   I            7            93 I  6.699E-08 I
I  82 g + g -> Q + Qbar, massive   I           35           589 I  3.364E-07 I
I                                  I                            I            I
==============================================================================

********* Total number of errors, excluding junctions =       0 *************
********* Total number of errors, including junctions =       0 *************
********* Total number of warnings =                          0 *************
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```

Size: 1 MB

11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
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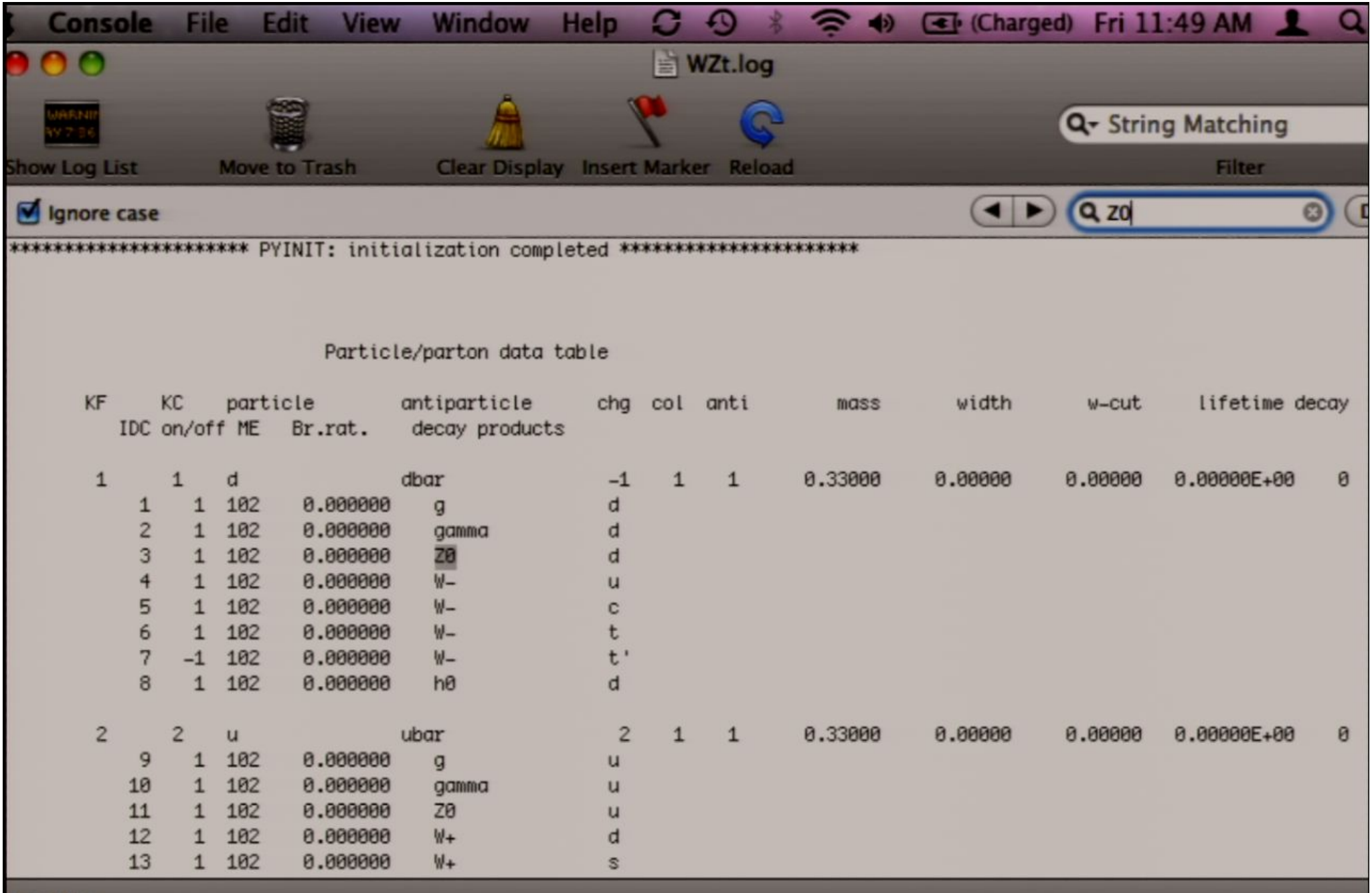
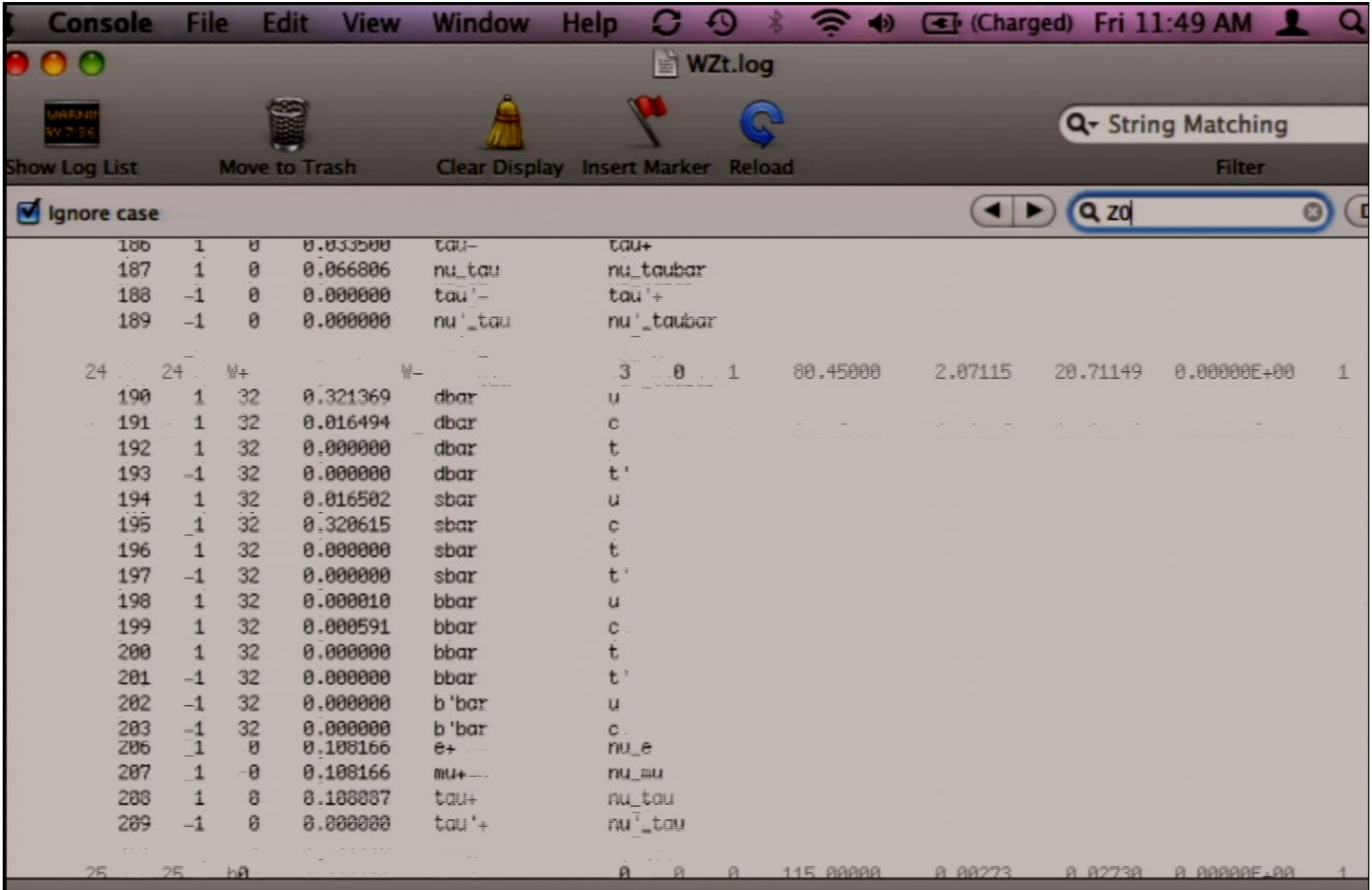
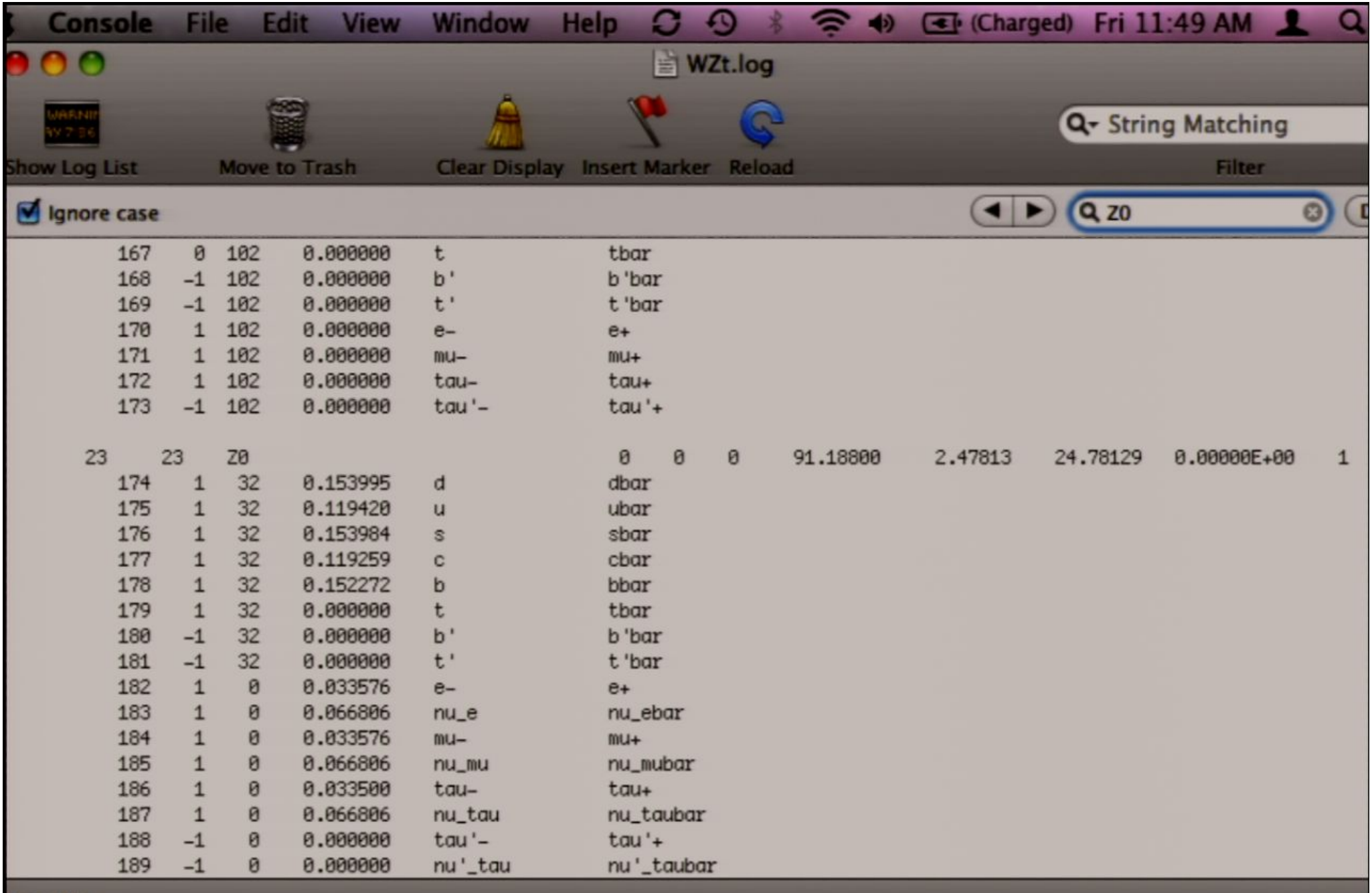

Console File Edit View Window Help (Charged) Fri 11:49 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
Ignore case
Z0
********** PYINIT: initialization completed **********
Particle/parton data table
KF IDC KC on/off particle ME Br.rat. antiparticle decay products chg col anti mass width w-cut lifetime decay
1 1 d dbar -1 1 1 0.33000 0.00000 0.00000 0.00000E+00 0
1 1 102 0.000000 g d
2 1 102 0.000000 gamma d
3 1 102 0.000000 Z0 d
4 1 102 0.000000 W- u
5 1 102 0.000000 W- c
6 1 102 0.000000 W- t
7 -1 102 0.000000 W- t'
8 1 102 0.000000 h0 d
2 2 u ubar 2 1 1 0.33000 0.00000 0.00000 0.00000E+00 0
9 1 102 0.000000 g u
10 1 102 0.000000 gamma u
11 1 102 0.000000 Z0 u
12 1 102 0.000000 W+ d
13 1 102 0.000000 W+ s
Size: 1 MB


Console File Edit View Window Help (Charged) Fri 11:49 AM
WZt.log
Show Log List
Move to Trash
Clear Display
Insert Marker
Reload
String Matching
Filter
Ignore case
z0
186 1 0 0.033500 tau- tau+
187 1 0 0.066806 nu_tau nu_taubar
188 -1 0 0.000000 tau'- tau'+
189 -1 0 0.000000 nu'_tau nu'_taubar
24 24 W+ W- 3 0 1 80.45000 2.07115 20.71149 0.00000E+00 1
190 1 32 0.321369 dbar u
191 1 32 0.016494 dbar c
192 1 32 0.000000 dbar t
193 -1 32 0.000000 dbar t'
194 1 32 0.016502 sbar u
195 1 32 0.320615 sbar c
196 1 32 0.000000 sbar t
197 -1 32 0.000000 sbar t'
198 1 32 0.000010 bbar u
199 1 32 0.000591 bbar c
200 1 32 0.000000 bbar t
201 -1 32 0.000000 bbar t'
202 -1 32 0.000000 b'bar u
203 -1 32 0.000000 b'bar c
206 1 0 0.108166 e+ nu_e
207 1 0 0.108166 mu+ nu_mu
208 1 0 0.108087 tau+ nu_tau
209 -1 0 0.000000 tau'+ nu'_tau
25 25 h0 0 0 0 115.00000 0.00223 0.02230 0.00000E+00 1
Size: 1 MB
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3



11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3
11-04-15 11:39:22 AM ...e.quicklook[17631] 2011-04-15 11:3

$\ell\nu$ (ℓ = e or μ) 20%.

$\tau\nu$ 10%.

jj 70%.

$W^+ W^-$

$t\bar{t} \to (\ell^+\nu)(\ell^-\nu) b\bar{b}$ $0.2 \times 0.2 = 4\%$.

$(\ell^+\nu)(jj)\, b\bar{b}$ $0.7 \times 0.2 = 0.14$ } 28%.

$(jj)(\ell^-\nu)\, b\bar{b}$

$(jj)(jj)\, b\bar{b}$ 0.7×0.7 50%.

* involve a τ, ν_τ ↓ hadronic decay

~10%?

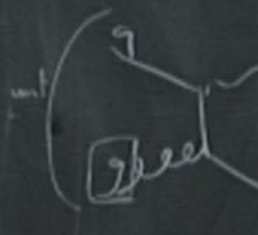
20%

10^7 Hz → 10^5 Hz

↓

1000 computers

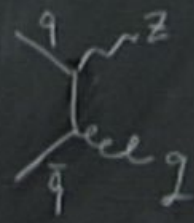
→ 100 Hz



37K W's

20% → e or μ

6K $\ell\nu$



12K Z's

6% $\ell^+\ell^-$

720

1800 $b\bar{b}$ evts

50% 16

25% 26

EXAMPLES OF BASIC ANALYSIS

lusive Signatures

RunInclusiveCount function displays several inclusive signatures.

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RunInclusiveCounts[WZt]
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BJets:

0	1	2	3	4
48913	1037	50	0	0

Lepton:

0	1	2	3	4
38238	10552	1142	67	1

(OSDL: 603, SSDL: 182)

Single- and Di- Lepton Counts

e-	μ-	τ-	e+	μ+	τ+
1247	936	2500	1840	1364	2665

-	e-	μ-	τ-	e+	μ+	τ+
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τ-	0	0	87	71	35	204
e+	0	0	0	1	0	55
μ+	0	0	0	0	0	41
τ+	0	0	0	0	0	94

Single- and Di-Lepton Counts (events with no jets):

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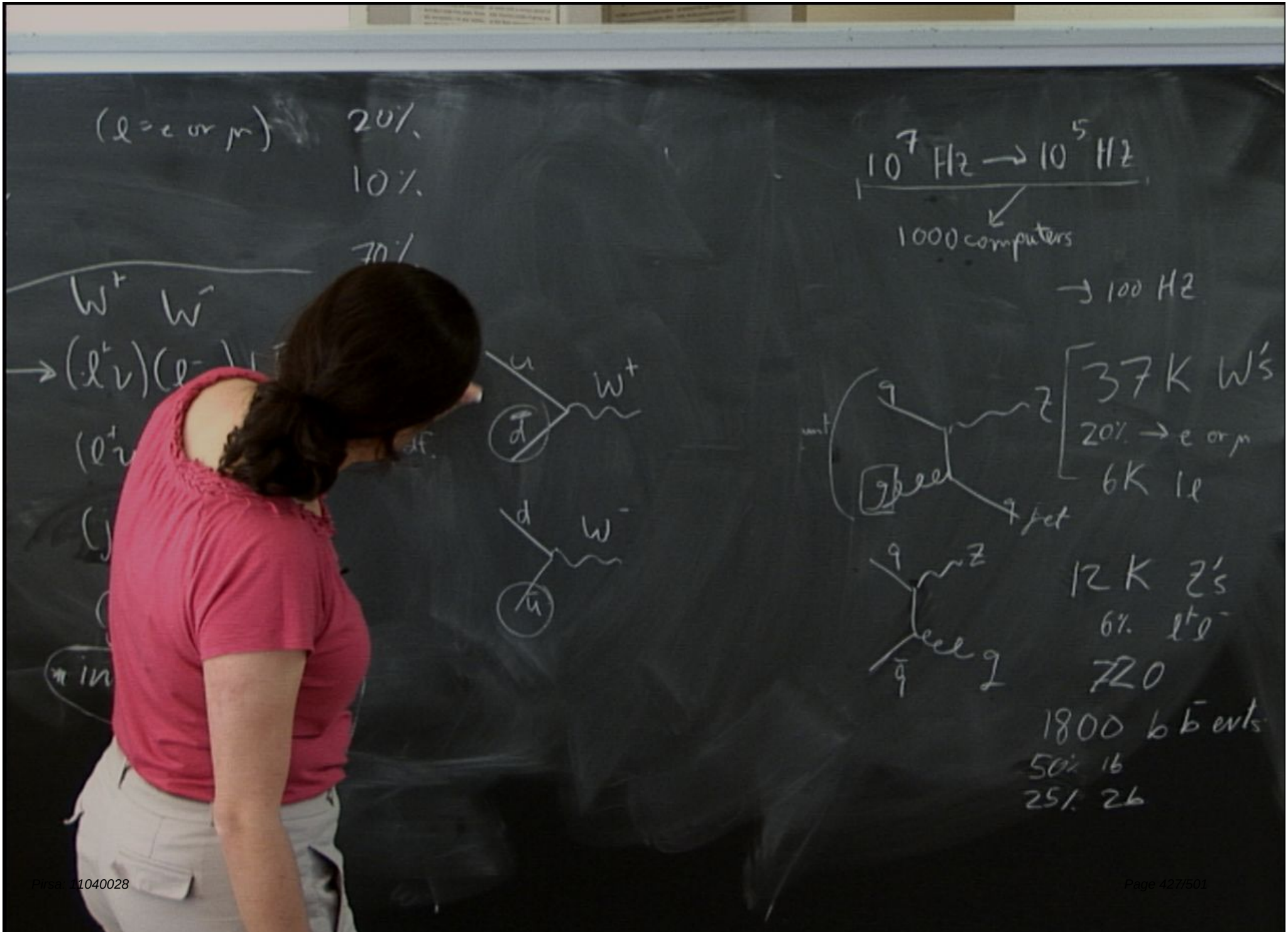
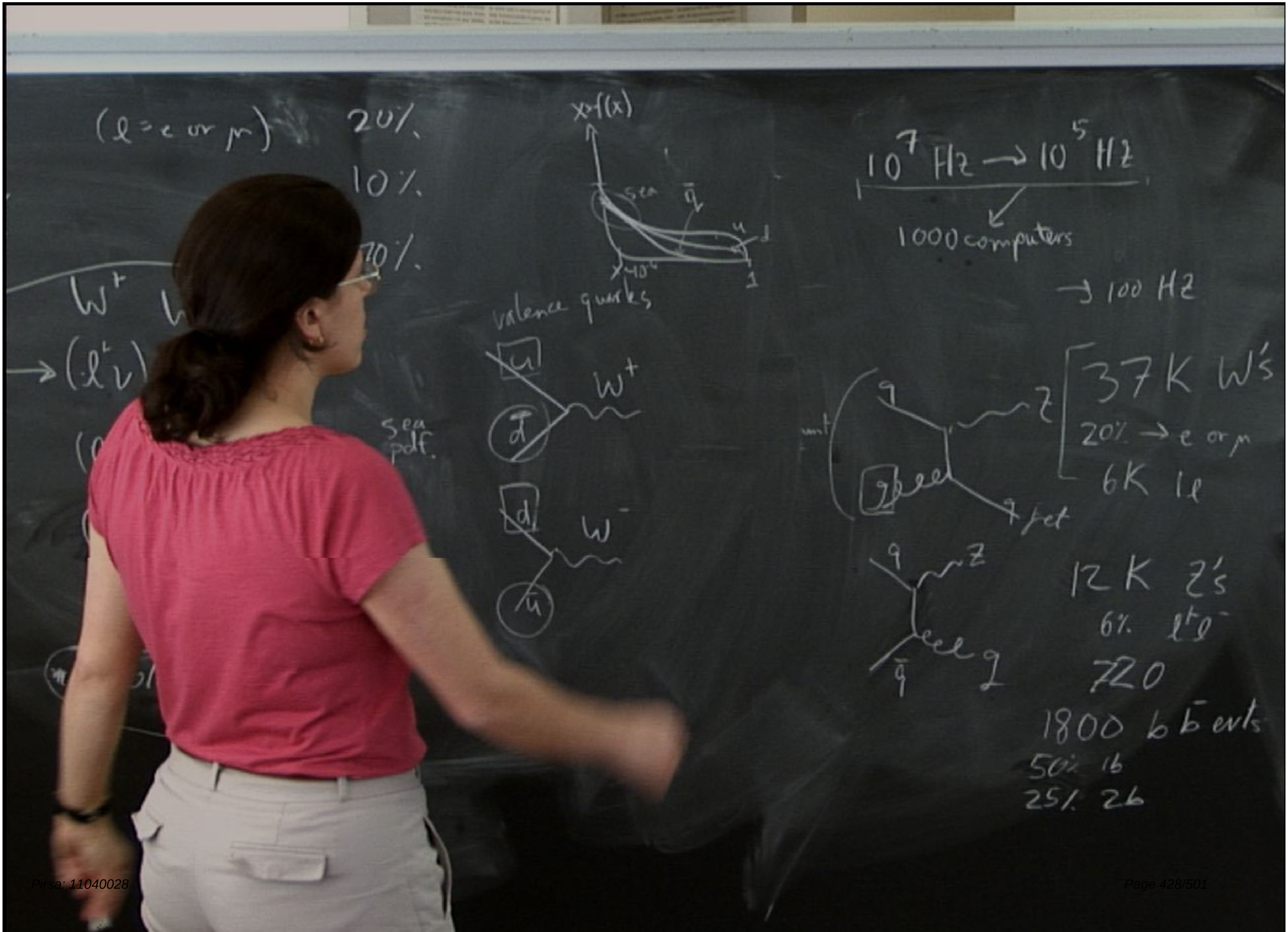

(ℓ = e or μ) 20%
10%
70%
W+ W-
→ (ℓ+ν)(ℓ-)
u
W+
d
d
W-
ū
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
37K W's
20% → e or μ
6K lℓ
q
Z
q
jet
q
Z
q̄
q
12K Z's
6% ℓ+ℓ-
ZZ0
1800 bb̄ evts
50% 16
25% 26


(l = e or μ)
20%
10%
70%
W+
sea pdf
x·f(x)
sea
q̄
u
d
1
valence quarks
u
d̄
W+
d
ū
W−
10^7 Hz → 10^5 Hz
1000 computers
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37K W's
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q
Z
q
q jet
q
Z
q̄
q
12K Z's
6% l+l−
720
1800 b b̄ evts
50% 1b
25% 2b

$(\ell = e \text{ or } \mu)$ 20%

10%

70%

$W^+ W^-$

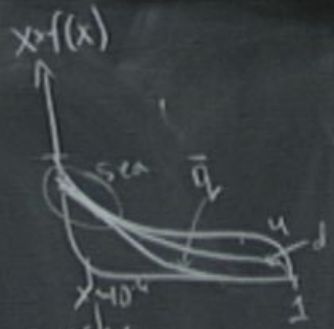
$\rightarrow (\ell^+\nu)(\ell^-\nu) b\bar{b}$

$(\ell^+\nu)(jj) b\bar{b}$

$(jj)(\ell^-\nu) b\bar{b}$

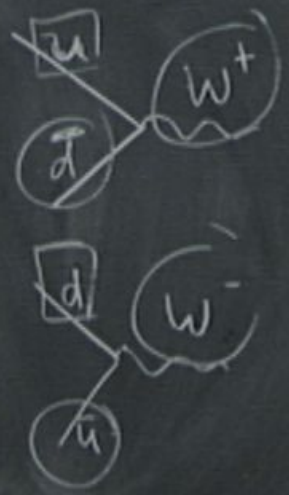
$(jj)(jj) b\bar{b}$

* involve a τ, ν_τ → hadronic decay



valence quarks

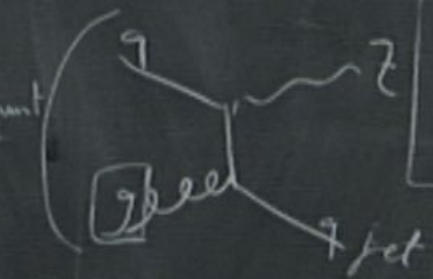
sea pdf.



10^7 Hz → 10^5 Hz

→ 1000 computers

→ 100 Hz



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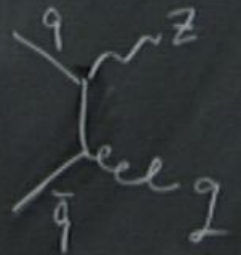
6K lℓ



12K Z's

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1800 $b\bar{b}$ evts

50% 16

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EXAMPLES OF BASIC ANALYSIS

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RunInclusiveCount function displays several inclusive signatures.

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(OSDL: 603, SSDL: 182)

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re Simple Counting

ow, we explicitly construct several inclusive counts, many of which are included in the set produced by RunInclusiveCounts. They are included here how you how to generate them yourself or generalize them, and to introduce the notation used in the remainder of the program.

ciesCount tabulates the number of events in which a given species of object appears *n* times. All object types begin with o, and most have long and rt forms (a list of all object types is below (click on this link)). For example, oLL (or oLightLepton) matches a leptons of type e or μ. Thus, the mand below counts events with 0, 1, 2, 3, 4, or 5 leptons.

```
SpeciesCount[OneLepton, oLL, 5]
```

0	1	2	3	4	5
0	5749	0	0	0	0

s is guaranteed by our selection) Of course some events also have taus

```
SpeciesCount[OneLepton, oTau, 5]
```

0	1	2	3	4	5
5387	347	15	0	0	0

the number of oLepton is higher than the number of oLightLepton:

```
{{0, 1, 2, 3, 4, 5}, {0, 5387, 347, 15, 0, 0}}
```

ore interesting place to count leptons is in the b-tag sample:

```
SpeciesCount[BTag, oL, 5]
```

```
{{0, 1, 2, 3, 4, 5}, {870, 197, 19, 1, 0, 0}}
```

nts number from 0 to 4 of oγ (oPhoton) objects in WZt.

```
SpeciesCount[OneLepton, oγ, 4]
```

```
{{0, 1, 2, 3, 4}, {5593, 154, 2, 0, 0}}
```

nts number from 0 to 8 of oJet objects.

```
SpeciesCount[WZt, oJet, 8]
```

```
{{0, 1, 2, 3, 4, 5, 6, 7, 8}, {10669, 12456, 14056, 6969, 3381, 1559, 574, 213, 79}}
```

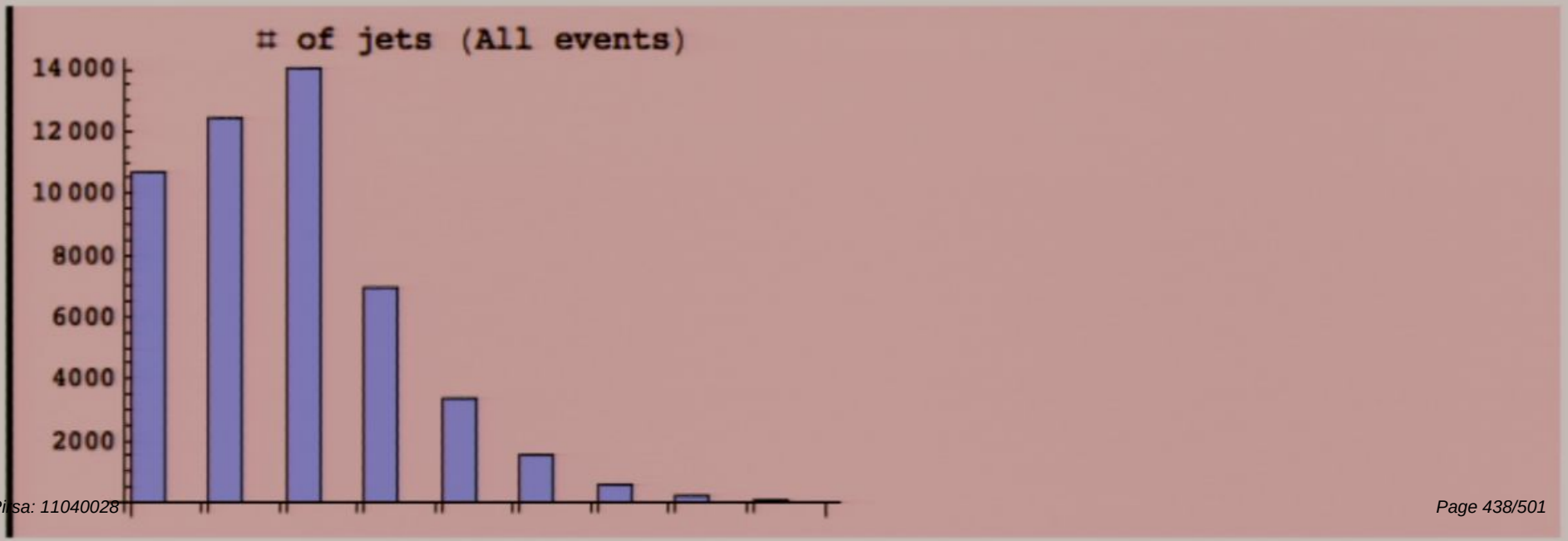
nts number from 0 to 8 of oJet objects.

```
SpeciesCount[WZt, oJet, 8]
```

0	1	2	3	4	5	6	7	8
10669	12456	14056	6969	3381	1559	574	213	79

s look at a bar chart :

```
BarChart[Transpose[Reverse[SpeciesCount[WZt, oJet, 8][[1]]]],
 PlotLabel → "# of jets (All events)"]
```



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nts number from 0 to 5 of oBJet= B Jet objects in the OneLepton region

```
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```

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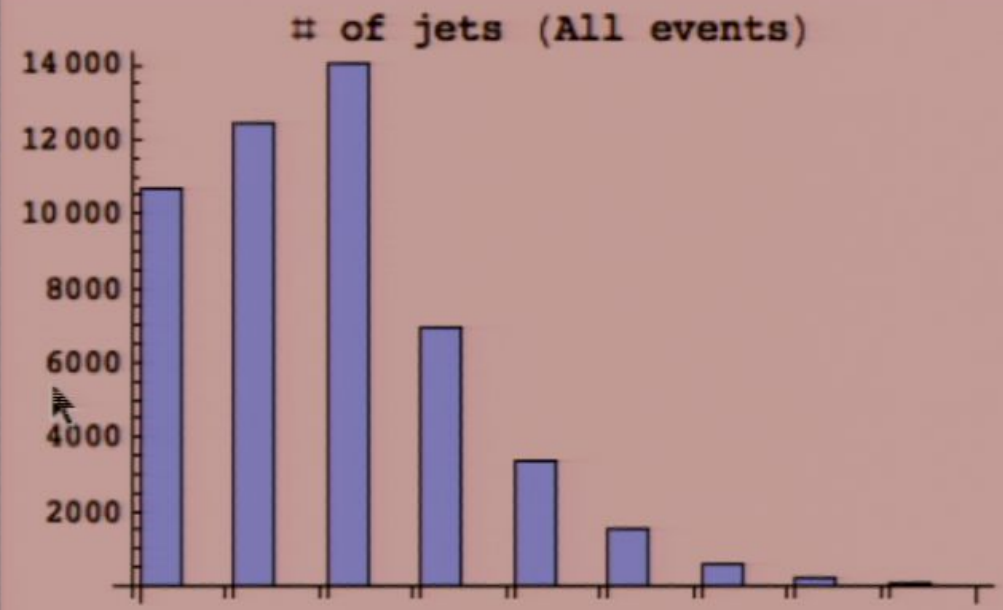

nts number from 0 to 5 of oBJet= B Jet objects in the OneLepton region


```
SpeciesCount[OneLepton, oB, 5]
```

0	1	2	3	4	5
5699	50	0	0	0	0

gleLeptonCount picks out events with **exactly one lepton**, and counts how the frequency of each lepton type. The arguement is the event list:

```
SingleLeptonCount[WZt]
```

e-	μ-	τ-	e+	μ+	τ+
1247	936	2500	1840	1364	2665

e that there's a charge asymmetry -- more e+ and mu+ than e- and mu- by a factor of ~1.5. This could be a detector effect (different efficiencies for d - leptons), in this case it's probably physical. The same discrepancy isn't seen for taus...let's come back to this.

ere a similar discrepancy in the one-btag subset? We don't really have the statistics to say...

```
SingleLeptonCount[BTag]
```

e-	μ-	τ-	e+	μ+	τ+
13	3	82	14	14	71

eptonCount tabulates a matrix of di-lepton counts in the event list (again restricting to events with exactly two leptons).

```
DiLeptonCount[WZt]
```

-	e-	μ-	τ-	e+	μ+	τ+
e-	0	0	34	212	5	48
μ-	0	0	37	5	187	26
τ-	0	0	87	71	35	204

τ-	0	0	87	71	35	204
e+	0	0	0	1	0	55
μ+	0	0	0	0	0	41
τ+	0	0	0	0	0	94

e that the **only** same-sign events involve taus. This suggests that the taus may be fakes (it happens often).

unting with Preselection

e want to count events satisfying a more complicated criterion, we can use CriterionCount. This counts all events with at least one e or mu, and sing PT of at least 50.

```
CriterionCount[WZt, (NumOf[oLL]~ge~1)~and~(MissingPT~ge~50)]
```

```
340
```

can also use the Select function to consider only those events that satisfy a criterion, and use the counts above. Here are some examples:

jets (NumOf[oJet]~eq~0):

```
SingleLeptonCount[Select[WZt, NumOf[oJet]~eq~0]]
```

e-	μ-	τ-	e+	μ+	τ+
658	510	356	986	747	398

east 2 jets (NumOf[oJet]~ge~2)

```
DiLeptonCount[Select[WZt, NumOf[oJet]~ge~2]]
```

τ+	0	0	0	0	0	94

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```
340
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```

e-	μ-	τ-	e+	μ+	τ+
658	510	356	986	747	398

east 2 jets (NumOf[oJet]~ge~2)

```
DiLeptonCount[Select[WZt, NumOf[oJet]~ge~2]]
```

-	e-	μ-	τ-	e+	μ+	τ+
e-	0	0	8	35	1	15

0	1	2	3	4	5
63	13	0	0	0	0

e's a more complicated example. oHard[*patt*, *pThard*] is a pattern that matches only objects of type *patt* with pT>*pThard*.

he case below, Select picks out events that have at least one jet with pt greater than 200 GeV.

```
SpeciesCount[Select[WZt, NumOf[oHard[oJet, 50]]-gt-0], oL, 4]
```

0	1	2	3	4
1848	472	50	4	0

nstructing Histograms at the Event Level (building up basic notation from simple histograms)

ograms in Chameleon can be generated with the command `Hist`. The arguments to `Hist` are:

Event sample

Selection criterion (a boolean function) -- only events for which the criterion is true are included in the histogram.

Object selection: an object or set of objects from which kinematic variable is computed

Kinematic variable, e.g. invariant mass of two particles, or sum pT of all particles.

Range specification of histogram: {*min*, *max*, *nbins*}

historical reasons, you will see many histograms in this notebook specified as

`HistPlot[`*evtList*, *criterion*, *objectSelection*, *kinematicVariable*`], {`*min*, *max*, *nbins*`}]`. This is completely equivalent to

`Hist[`*evtList*, *criterion*, *objectSelection*, *kinematicVariable*, {*min*, *max*, *nbins*}`]`

Kinematic variable, e.g. invariant mass of two particles, or sum pT of all particles.

Range specification of histogram: {*min*, *max*, *nbins*}

historical reasons, you will see many histograms in this notebook specified as

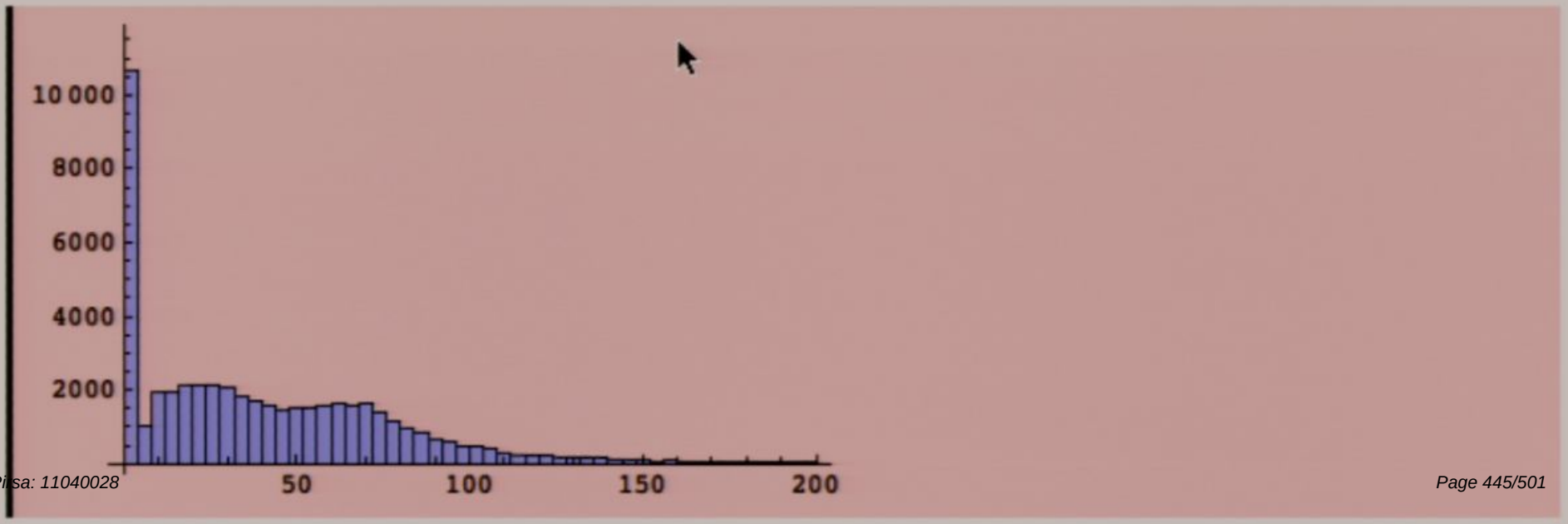
`Hist[Bin[`*evtList*, *criterion*, *objectSelection*, *kinematicVariable*`], {`*min*, *max*, *nbins*`}]` . This is completely equivalent to

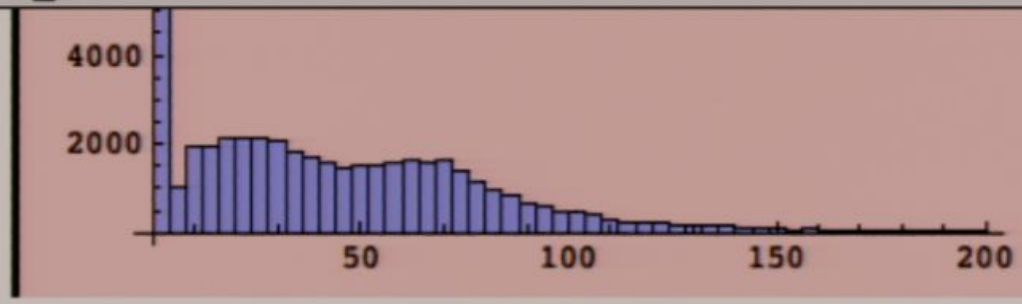
`Hist[`*evtList*, *criterion*, *objectSelection*, *kinematicVariable*, `{`*min*, *max*, *nbins*`}]`

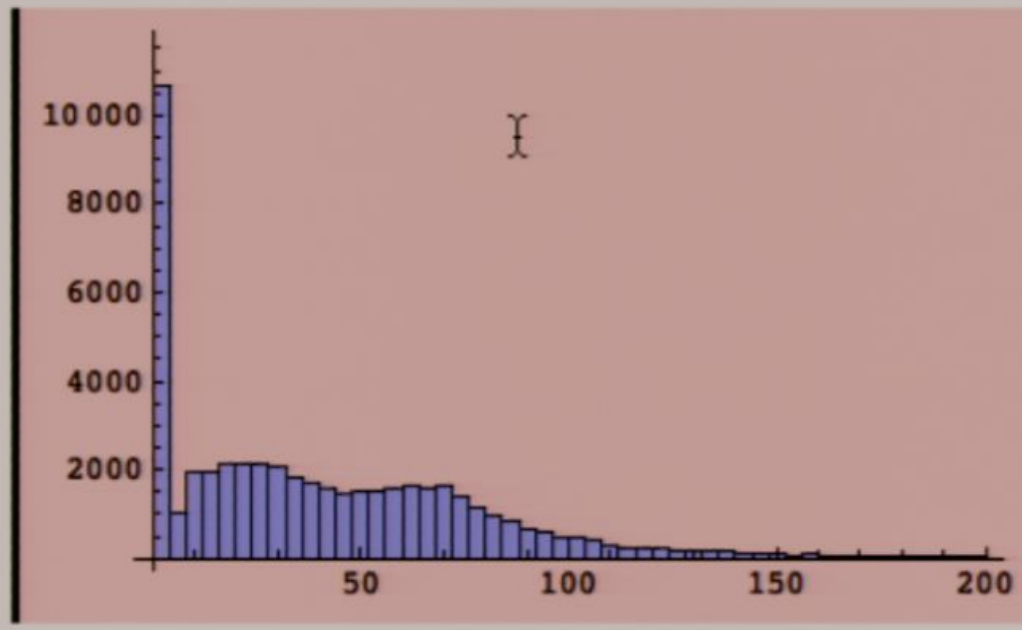
ow are a few examples. We construct several frequency data lists using `Freq`, then plot histograms with them.

se are the same histogram entered in two formats. They are calculating the effective mass (sum pT of all the objects selected --in this case, the jets).

```
Hist[Bin[WZt, all, HGet[oJet, All], EffMass], {0, 200, 50}]
Hist[WZt, all, HGet[oJet, All], EffMass, {0, 200, 50}]
```








```
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
```

historical reasons, you will see many histograms in this notebook specified as

`Hist[Bin[evtList, criterion, objectSelection, kinematicVariable], {min, max, nbins}]` . This is completely equivalent to

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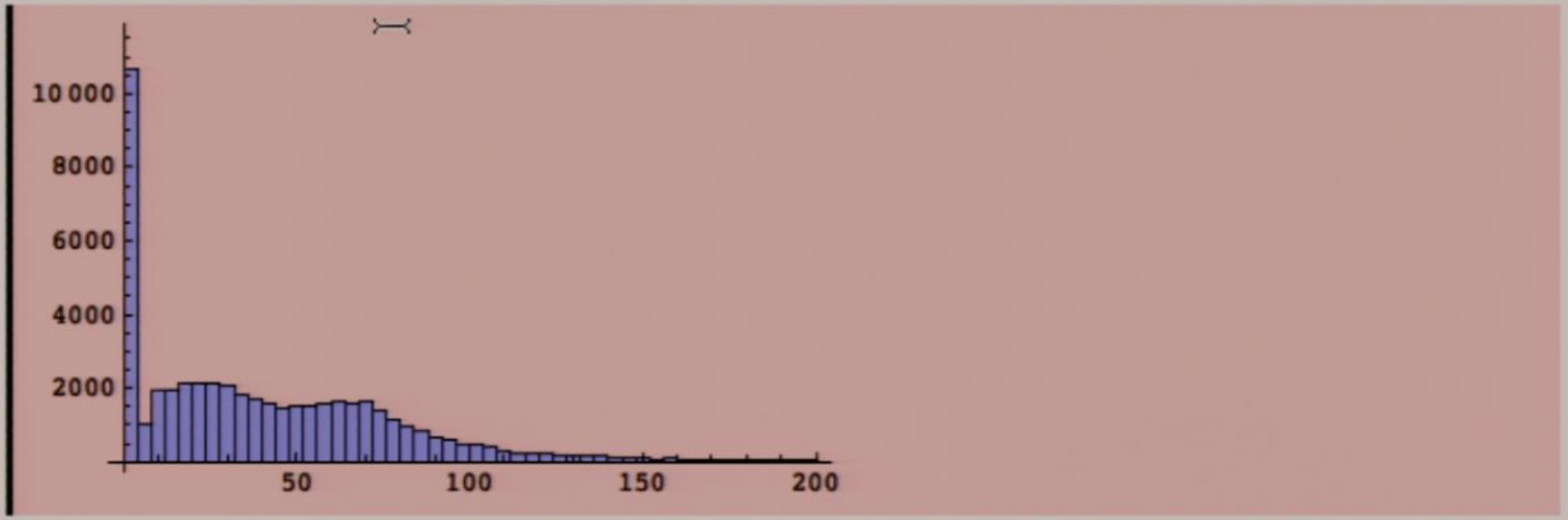
Hist[WZt, all, HGet[oJet, All], EffMass, {0, 200, 50}]
```



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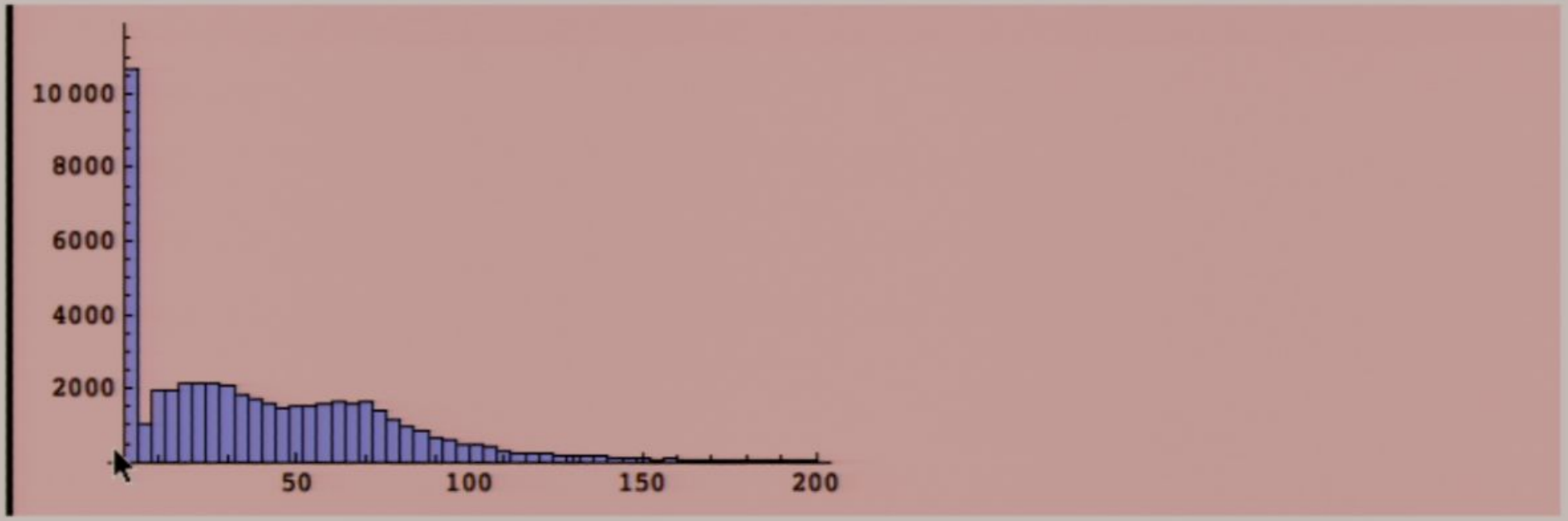
```



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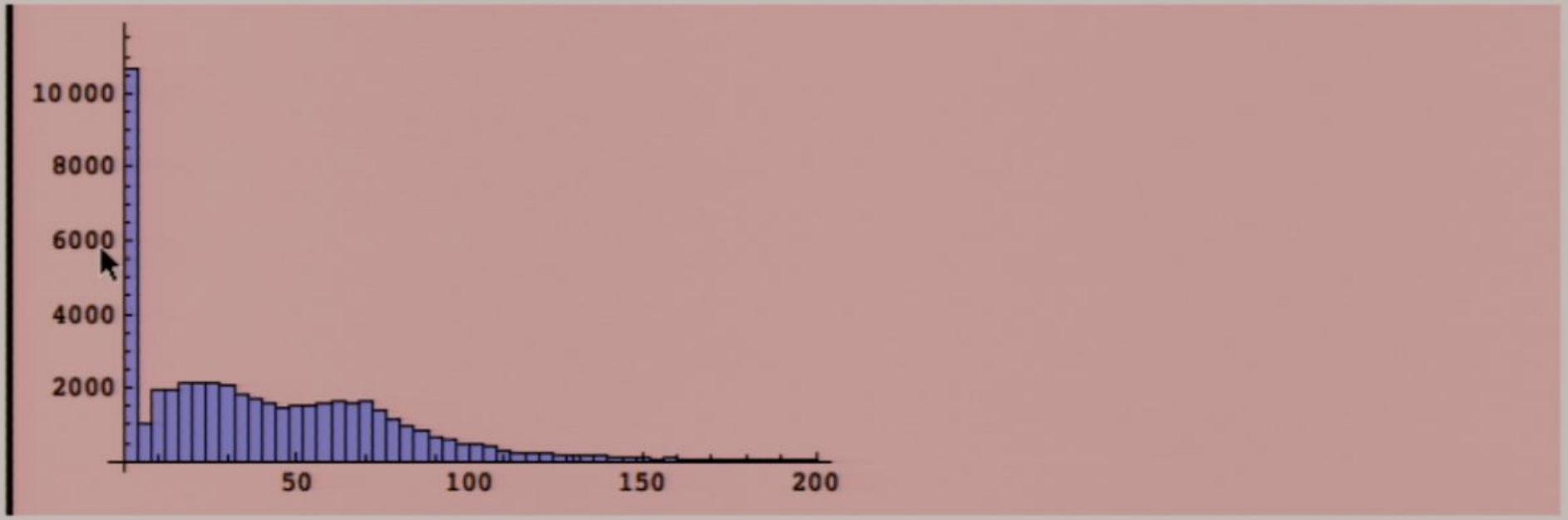
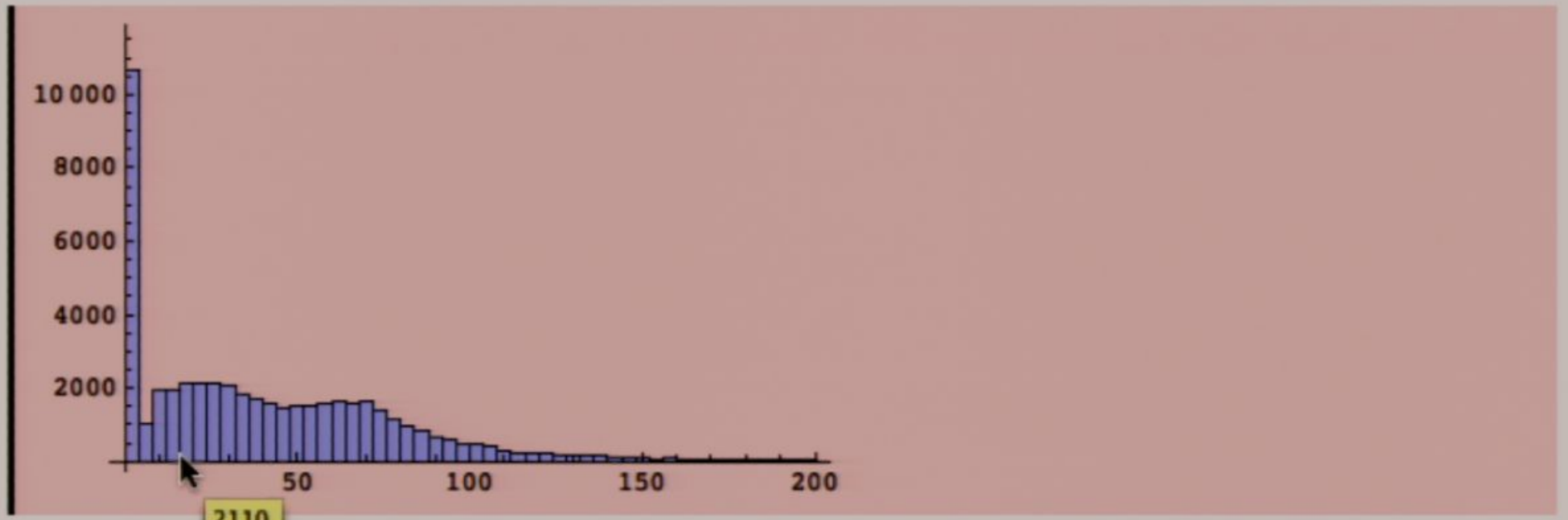
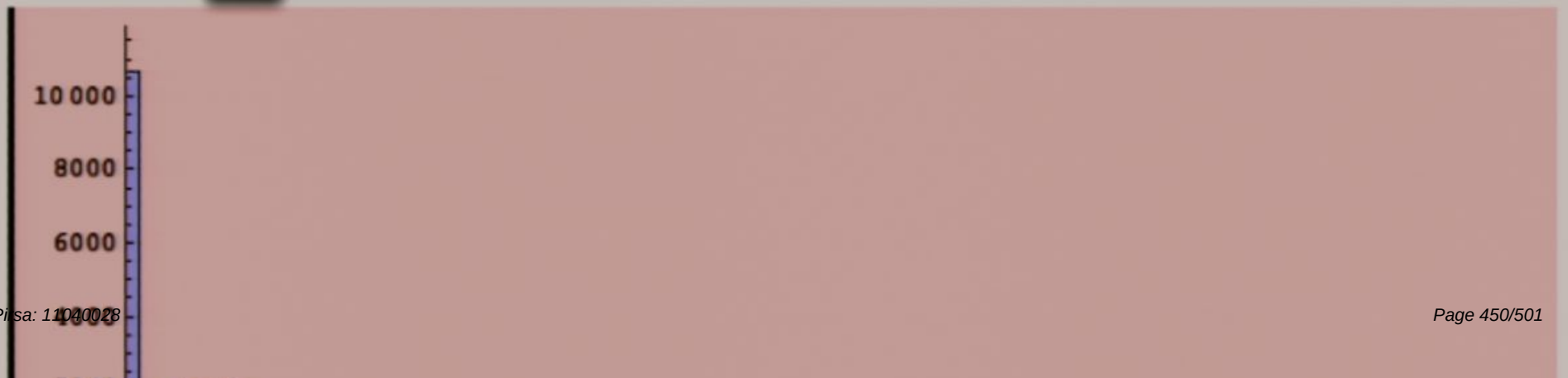


```
Hist[Bin[WZt, all, HGet[oJet, All], EffMass], {0, 200, 50}]
Hist[WZt, all, HGet[oJet, All], EffMass, {0, 200, 50}]
```





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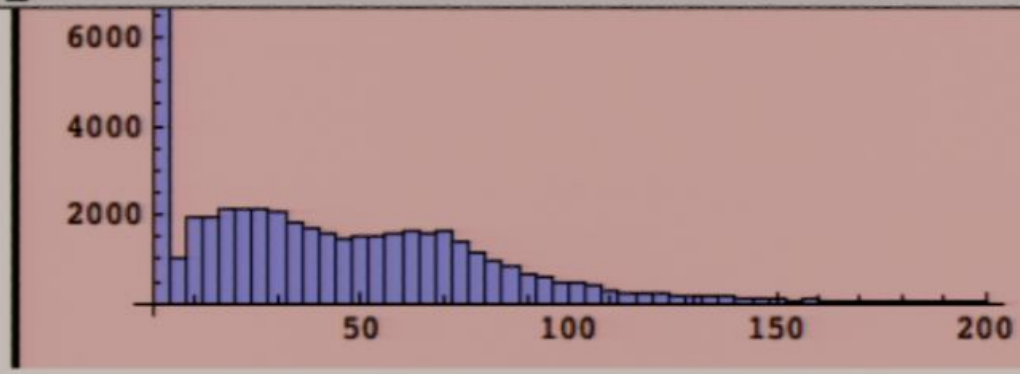
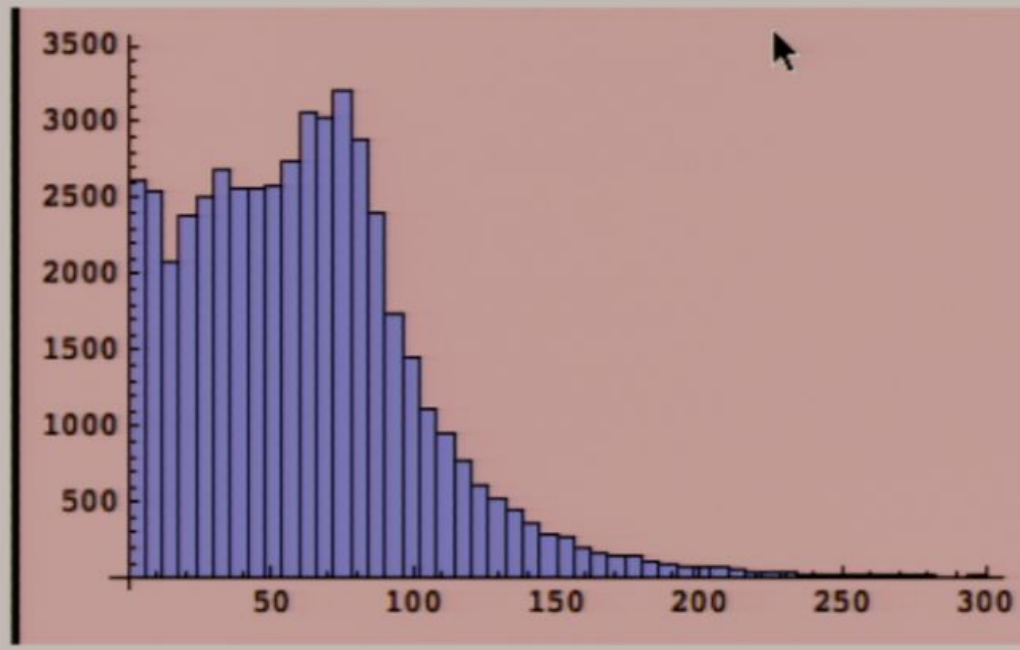
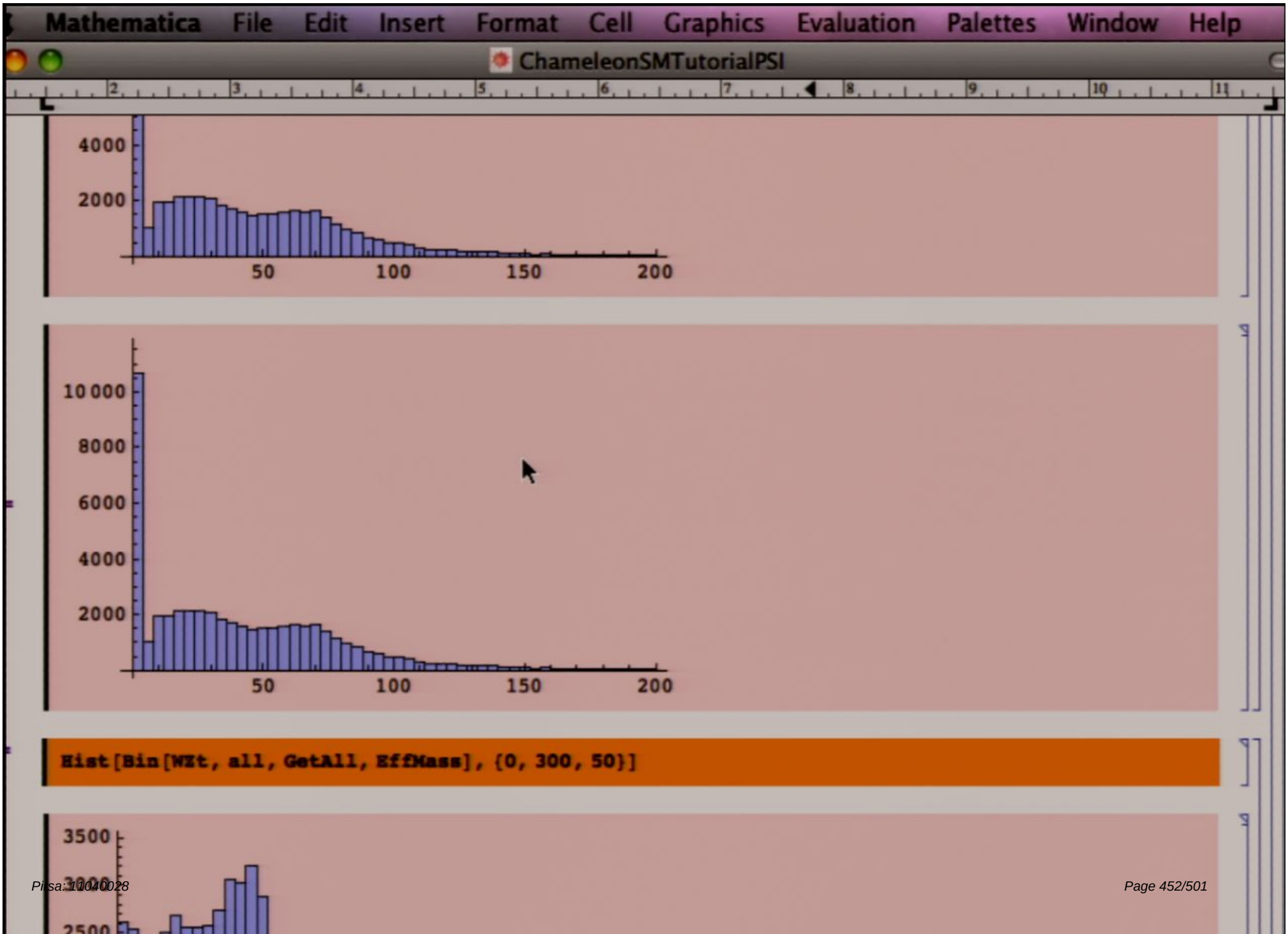



```
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
```



tograms for Z's: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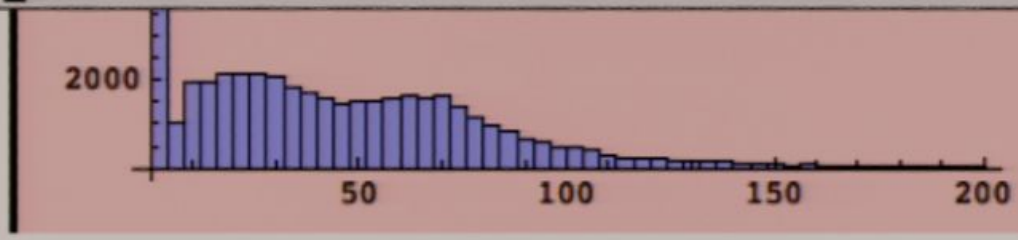
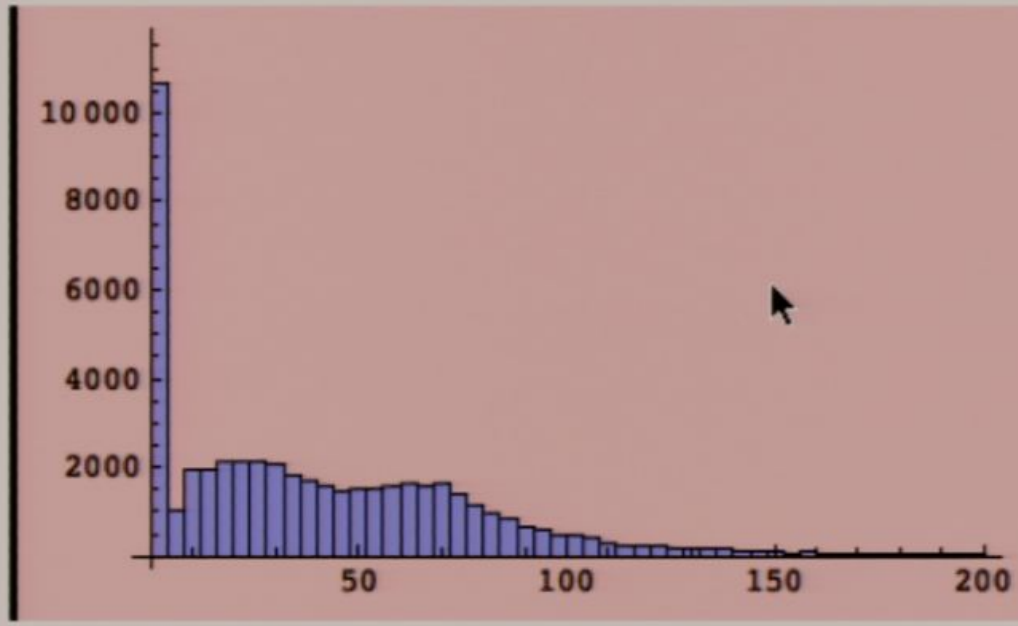
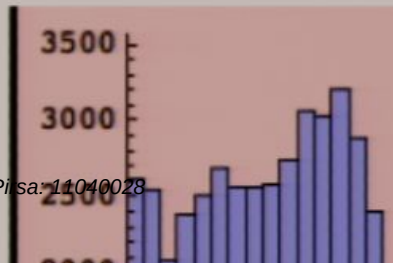
ChameleonSMTutorialPSI
4000
2000
50 100 150 200
10 000
8000
6000
4000
2000
50 100 150 200
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
3500






```
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
```



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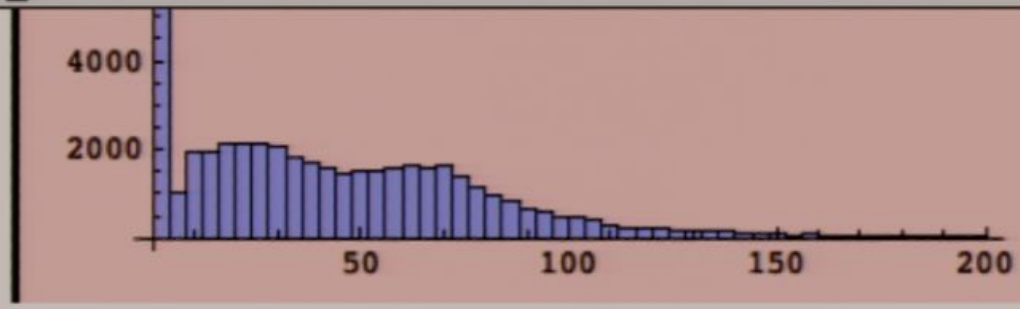
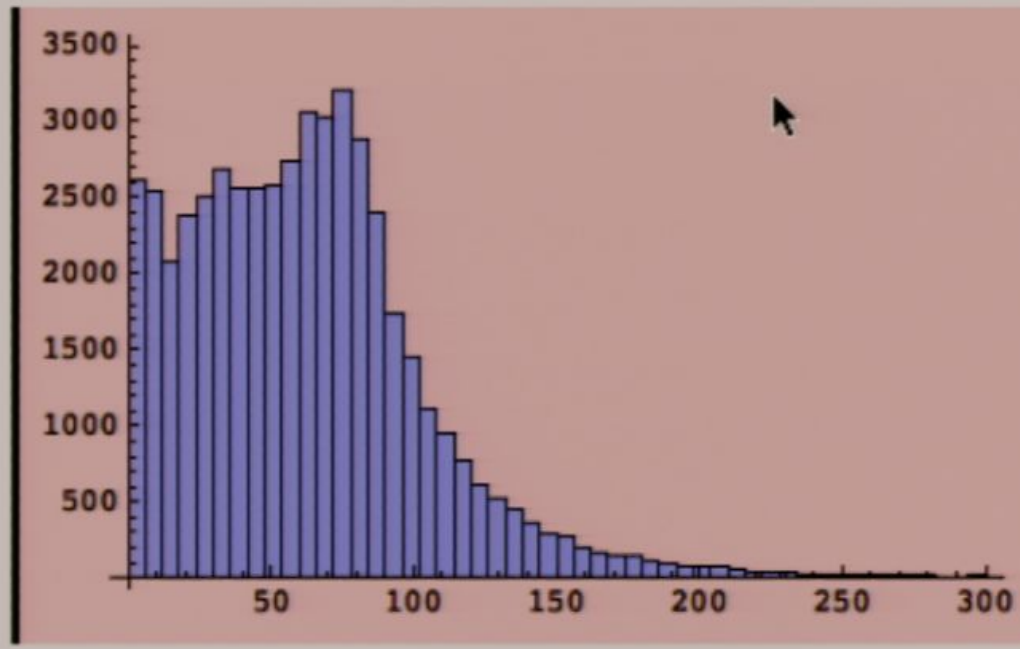



```
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
```



tograms for Z's:

e+e-

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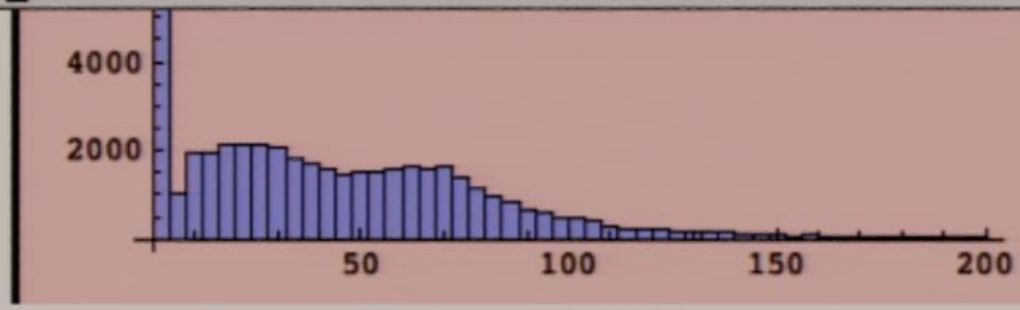


```
Hist[Bin[WZt, all, GetAll, EffMass], {0, 300, 50}]
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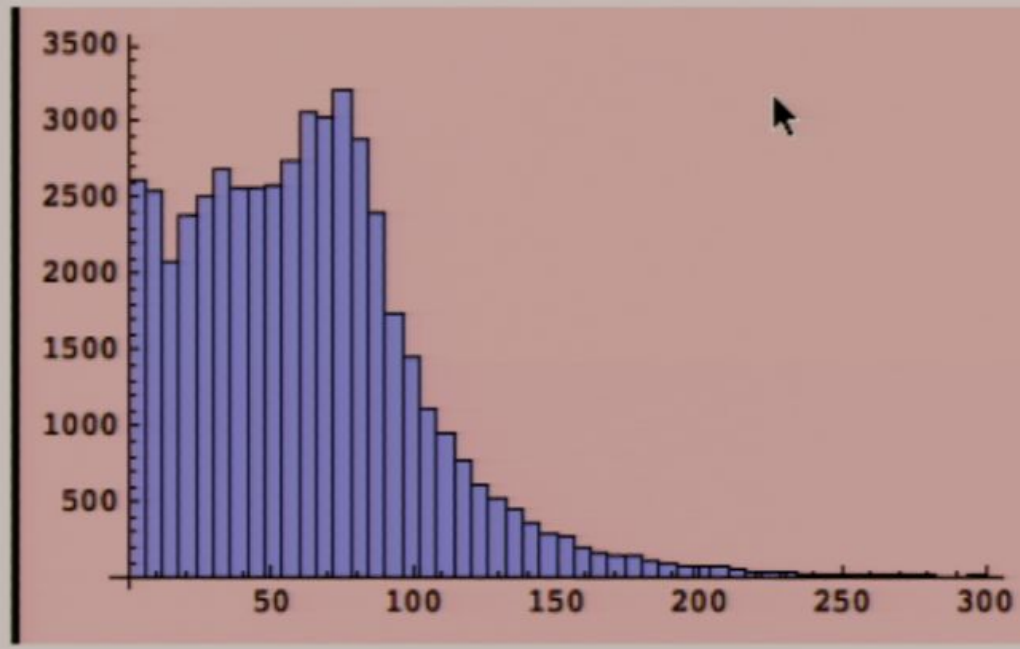

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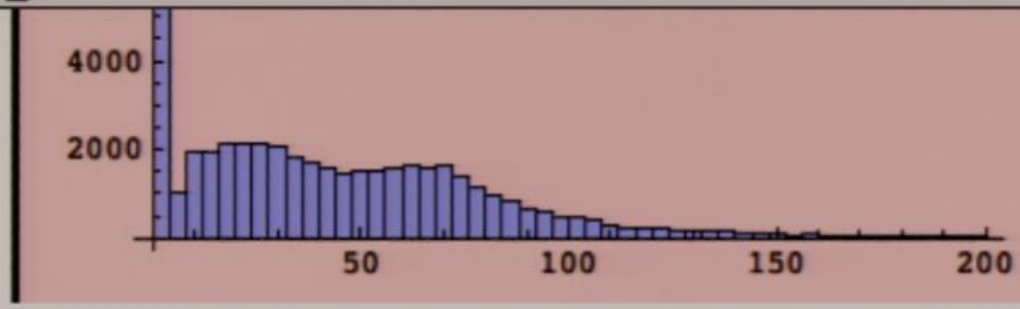


```
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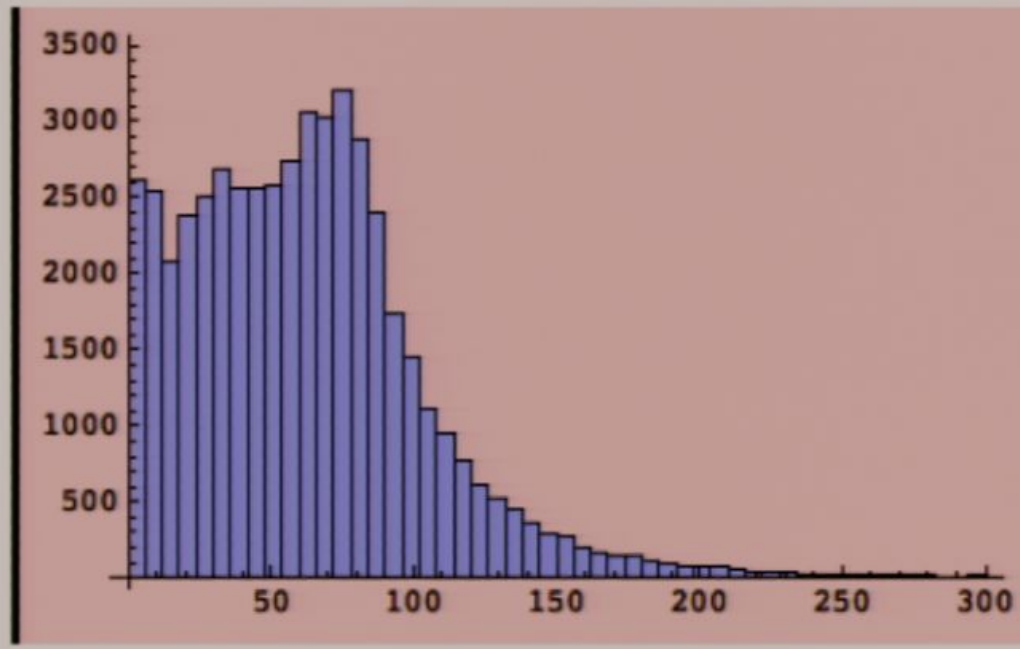

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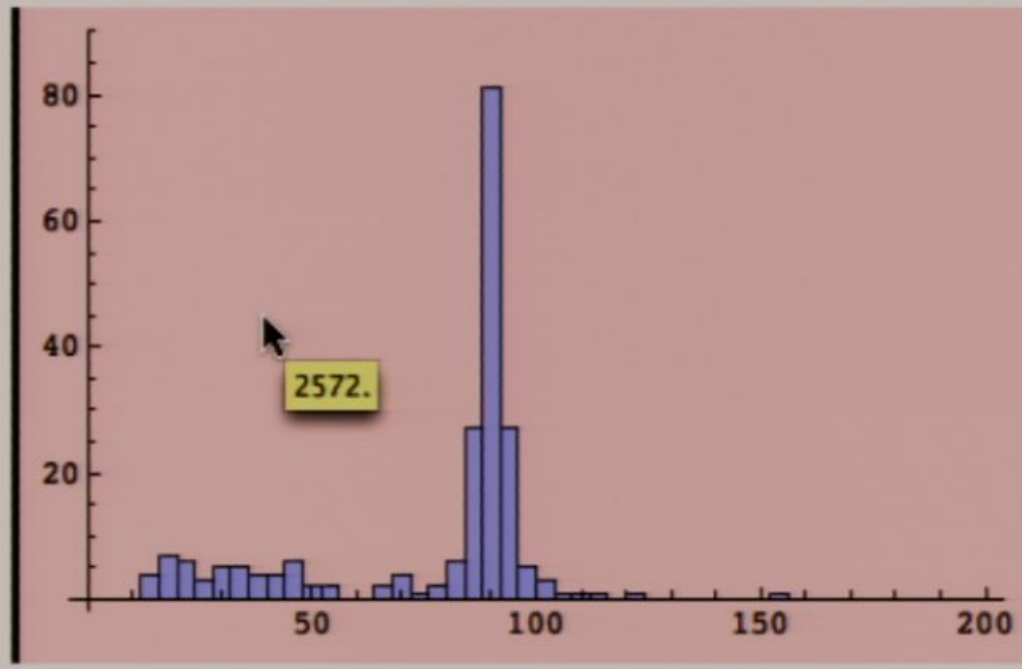
e+e-

```
Hist[Bin[WZt, LeptonContent[{1, -1}], HGet[oL, 2], InvMass], {0, 200, 50}]
```



mu+mu-

```
Hist[Bin[WZt, LeptonContent[{2, -2}], HGet[oL, 2], InvMass], {0, 200, 50}]
```

tograms for Z's:

e+e-

```
Hist[Bin[WZt, LeptonContent[{1, -1}], HGet[oL, 2], InvMass], {0, 200, 50}]
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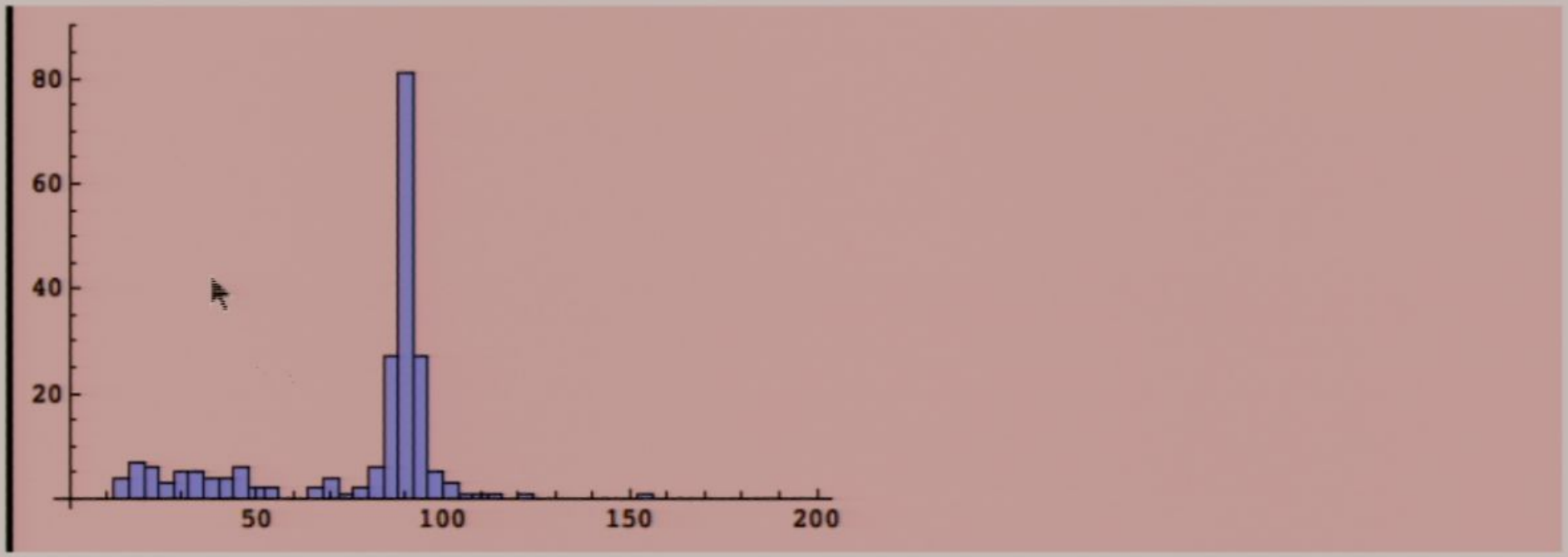

mu+mu-

```
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```

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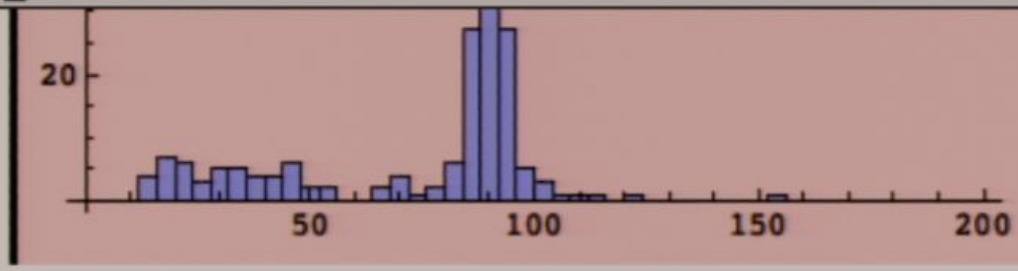

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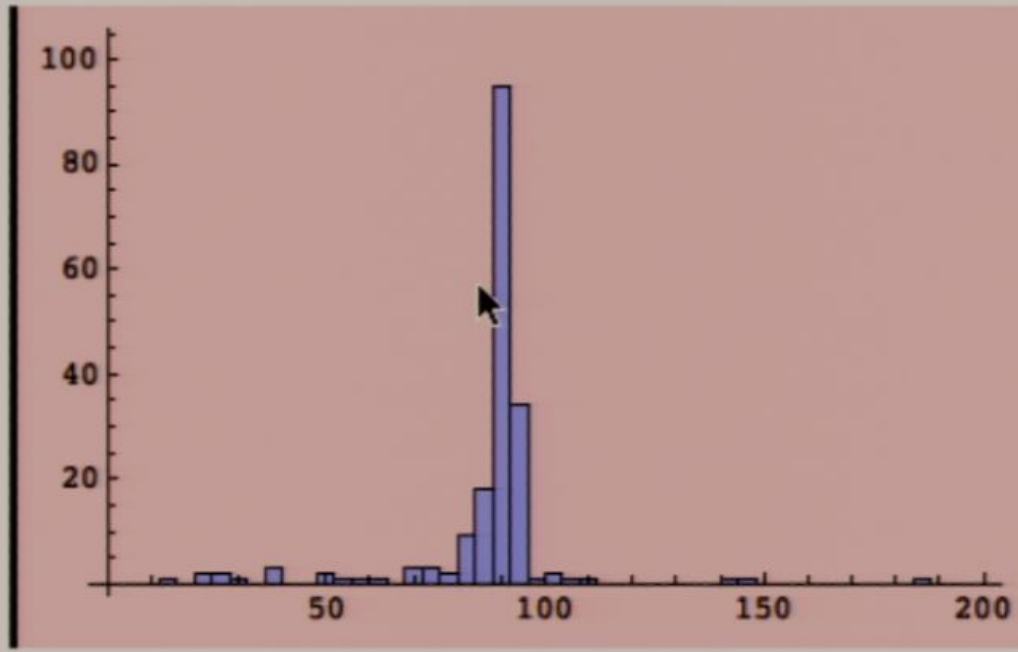
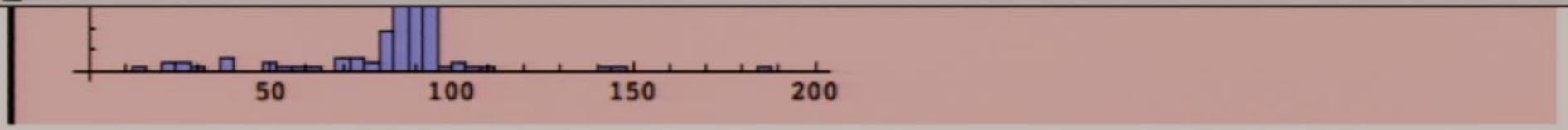


tau+tau- (tau decays always produce at least one neutrino, so the reconstructed tau (the hadronic decay products) has lower energy than the original on)



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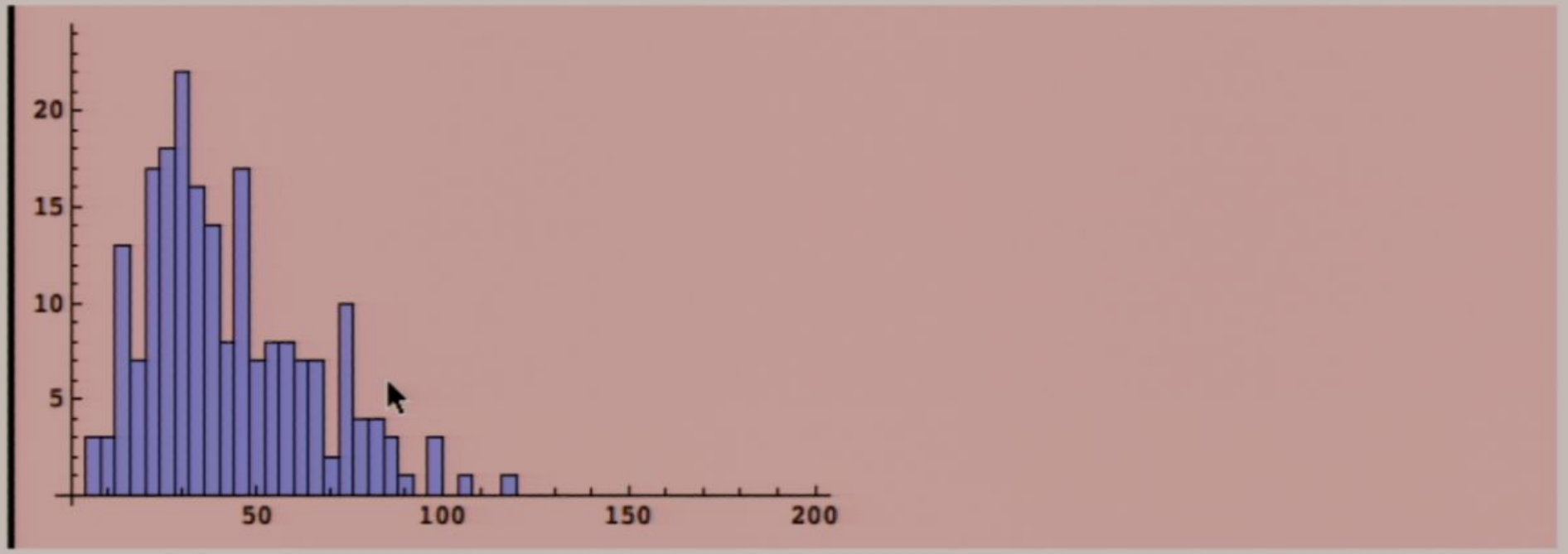
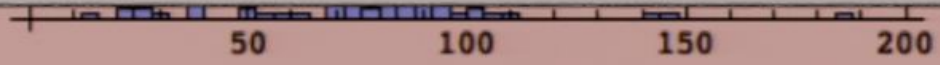
```
Hist[Bin[WZt, LeptonContent[{3, -3}], HGet[oL, 2], InvMass], {0, 200, 50}]
```



TE: The Z in b-tagged jets below is actually quite hard to see, because QCD production of b bbar is much stronger. But here since we
en't included that process in our sample, we can reconstruct the Z easily.

```
Hist[Bin[WZt, NumOf[oBJet]==2, HGet[oB, 2], InvMass], {0, 200, 50}]
```



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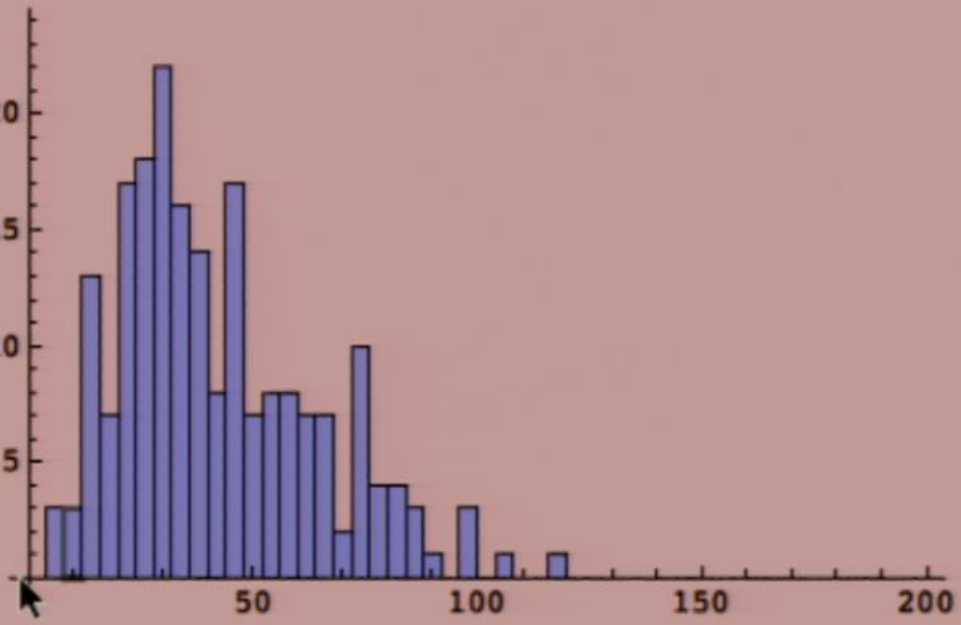
```



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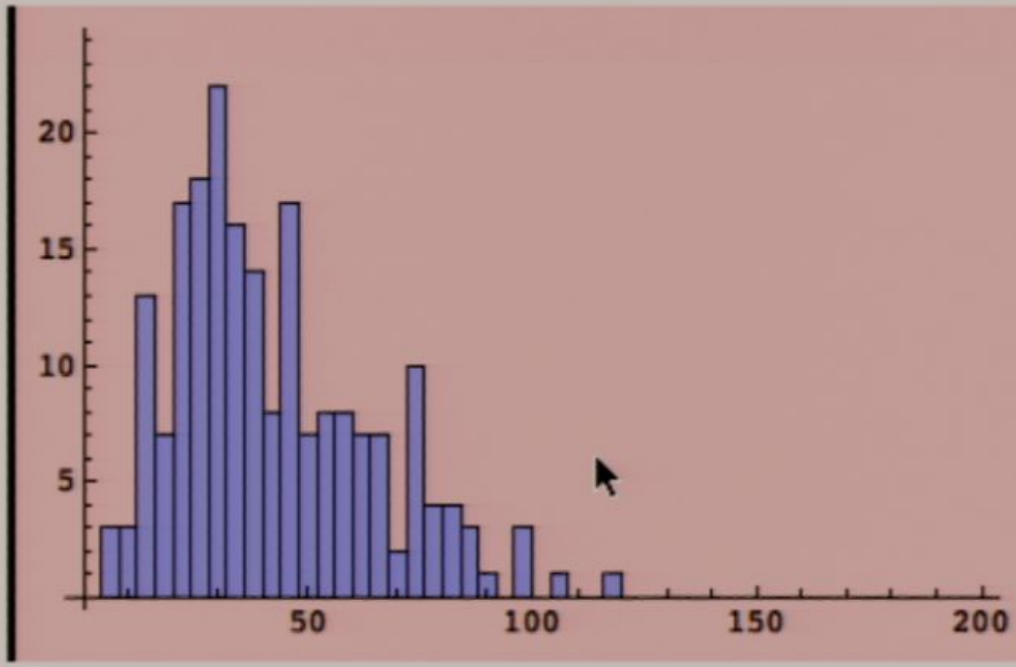

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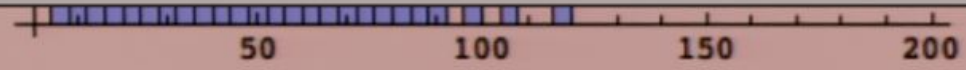

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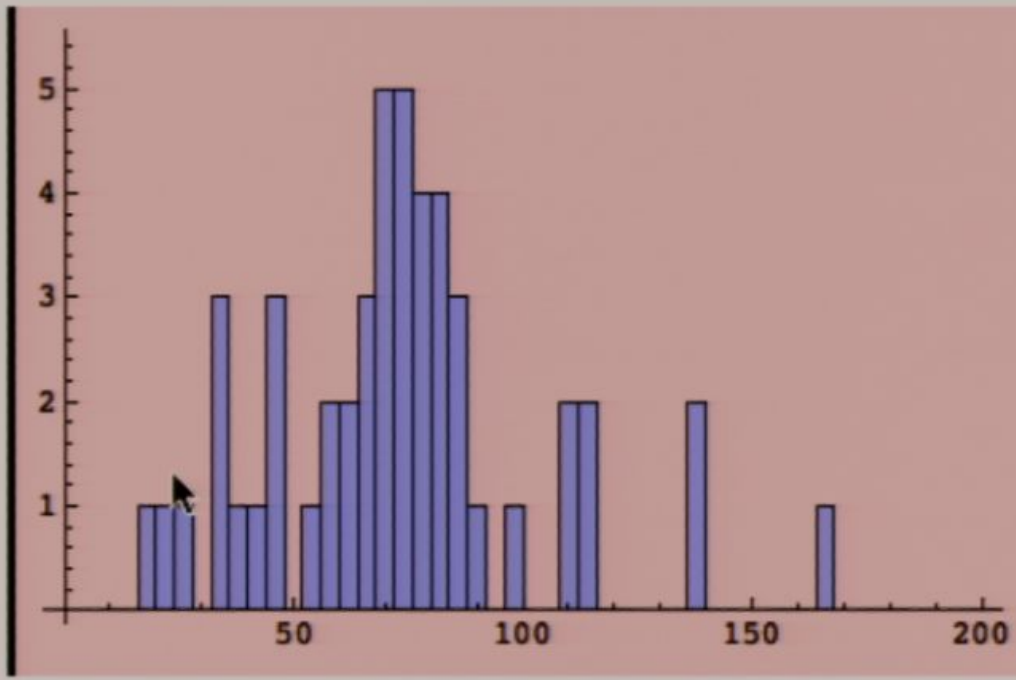
```



istograms that we do NOT trust Pythia for:

```
Zll = Select[WZt, LeptonContent[{1, -1}]~or~LeptonContent[{2, -2}]];
```

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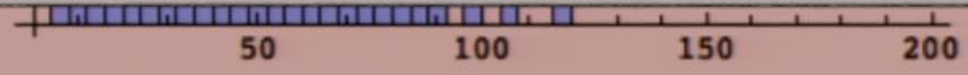

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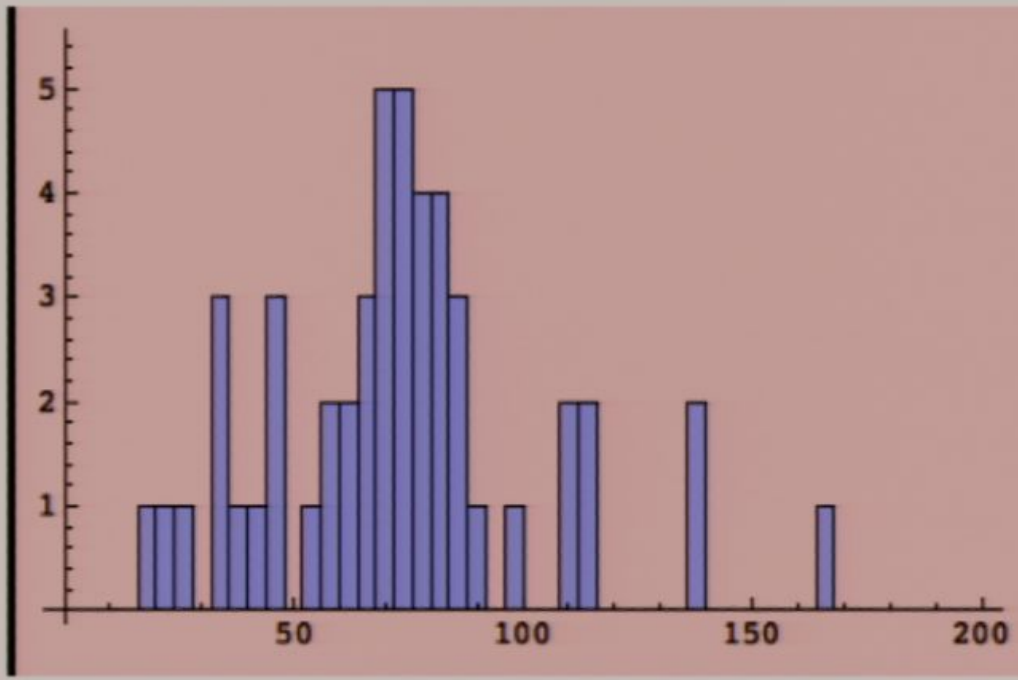
```
Hist[Bin[WZt, NumOf[oBJet]~eq~2, HGet[oB, 2], InvMass], {0, 200, 50}]
```



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Software Update

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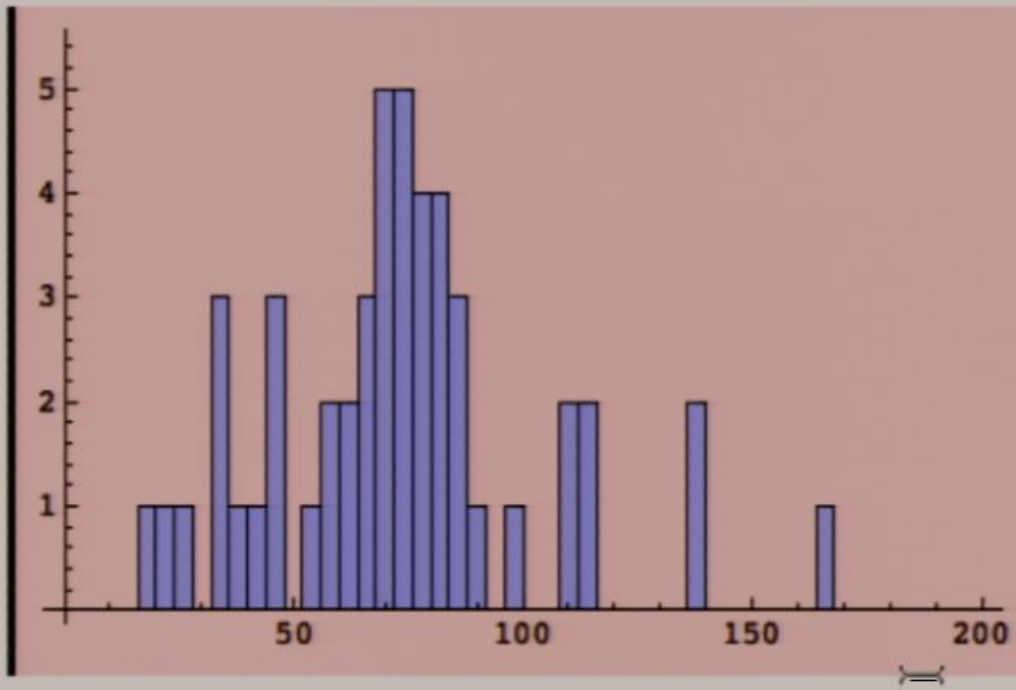
```



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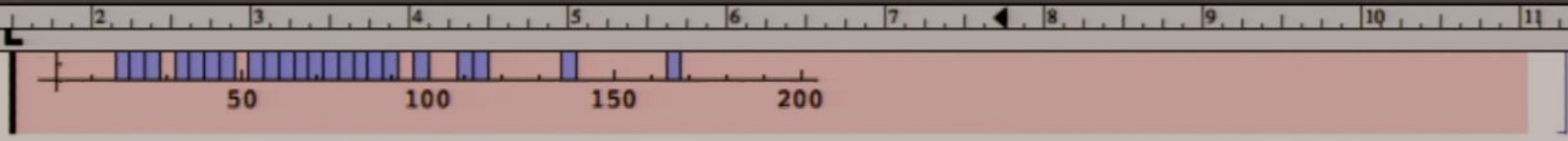

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```
Length[Zll]
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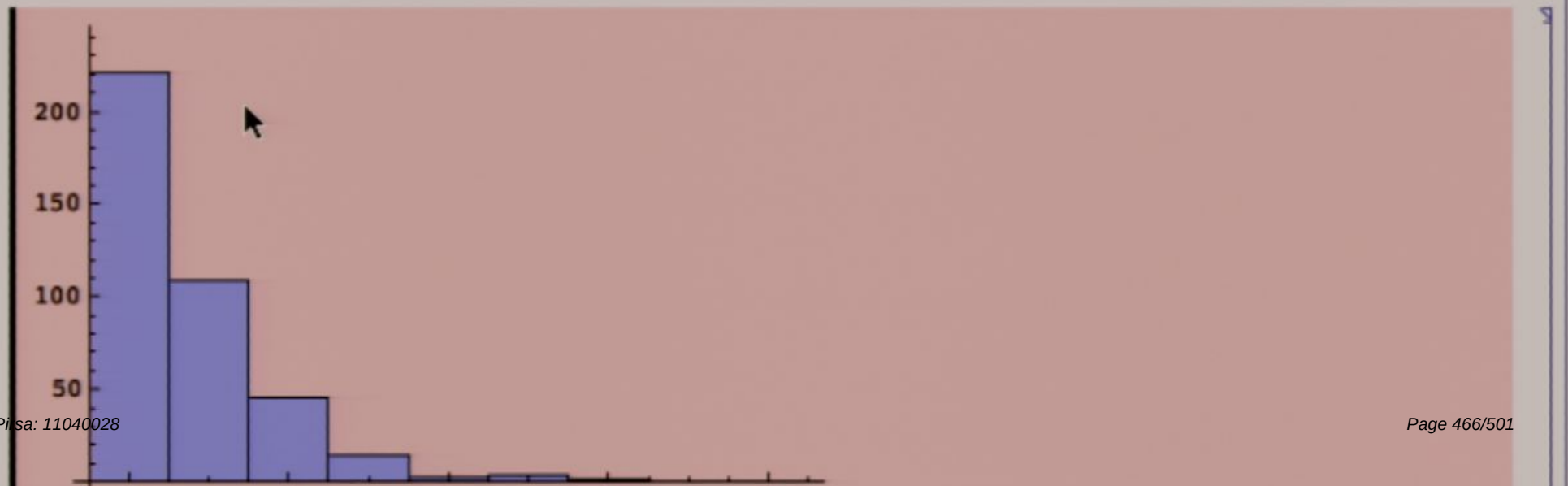
```
399
```

```
Hist[Bin[Zll, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```



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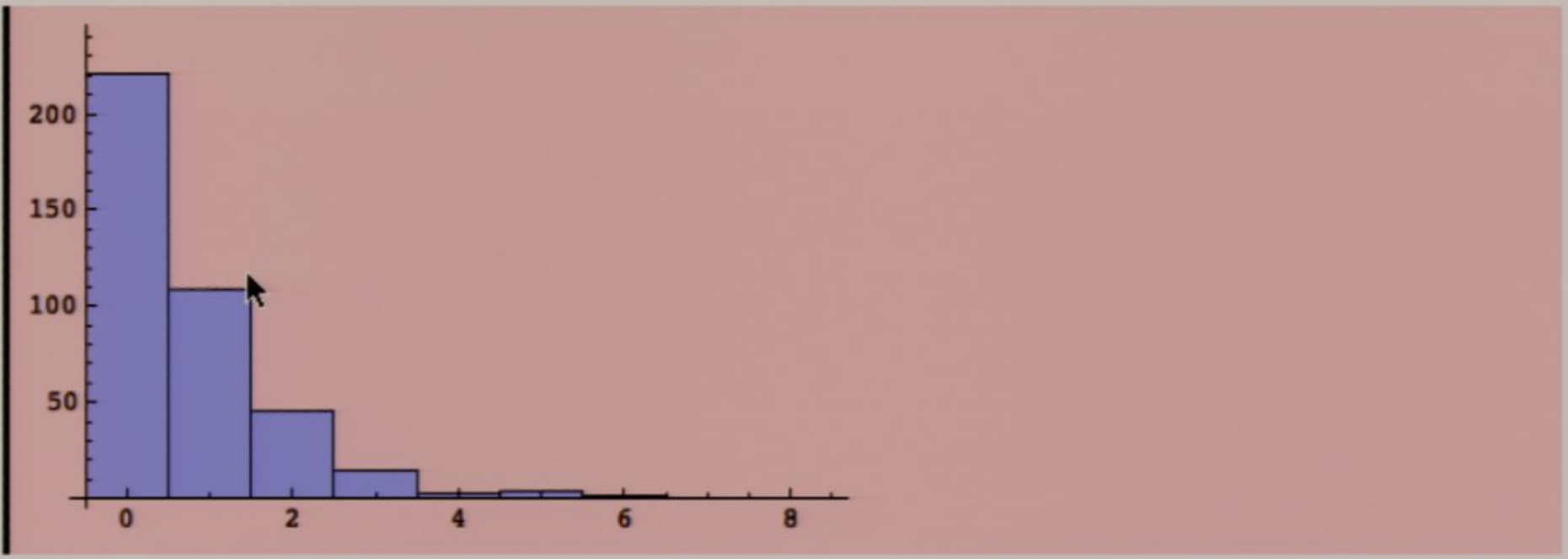

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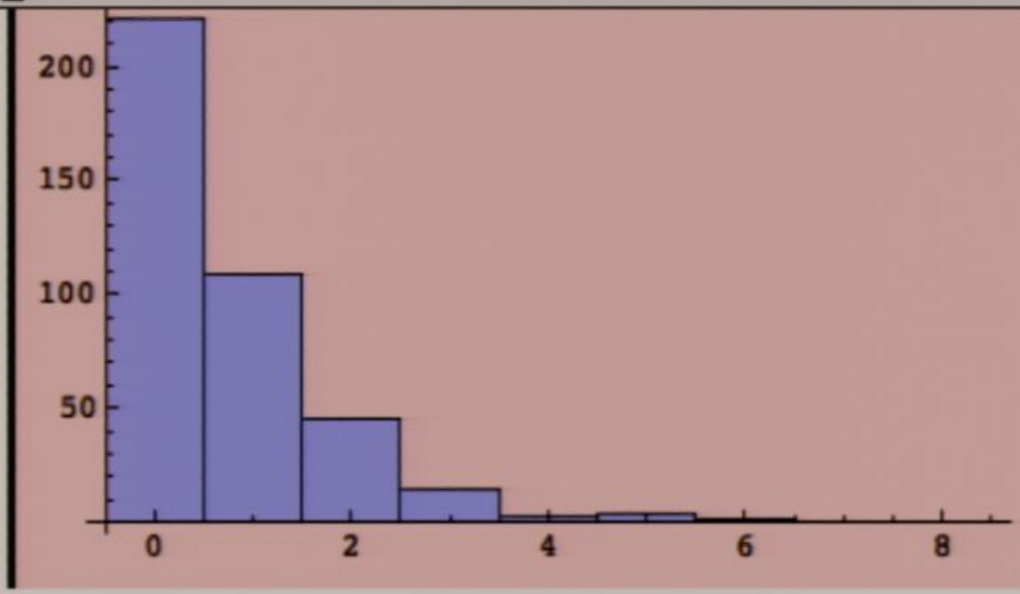

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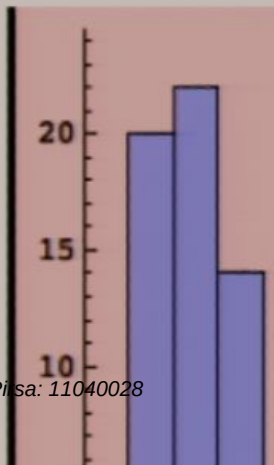
```
Hist[Bin[Zll, NumOf[oJet]-ge-2, HGet[oJet, {2}], EffMass], {0, 100, 20}]
```



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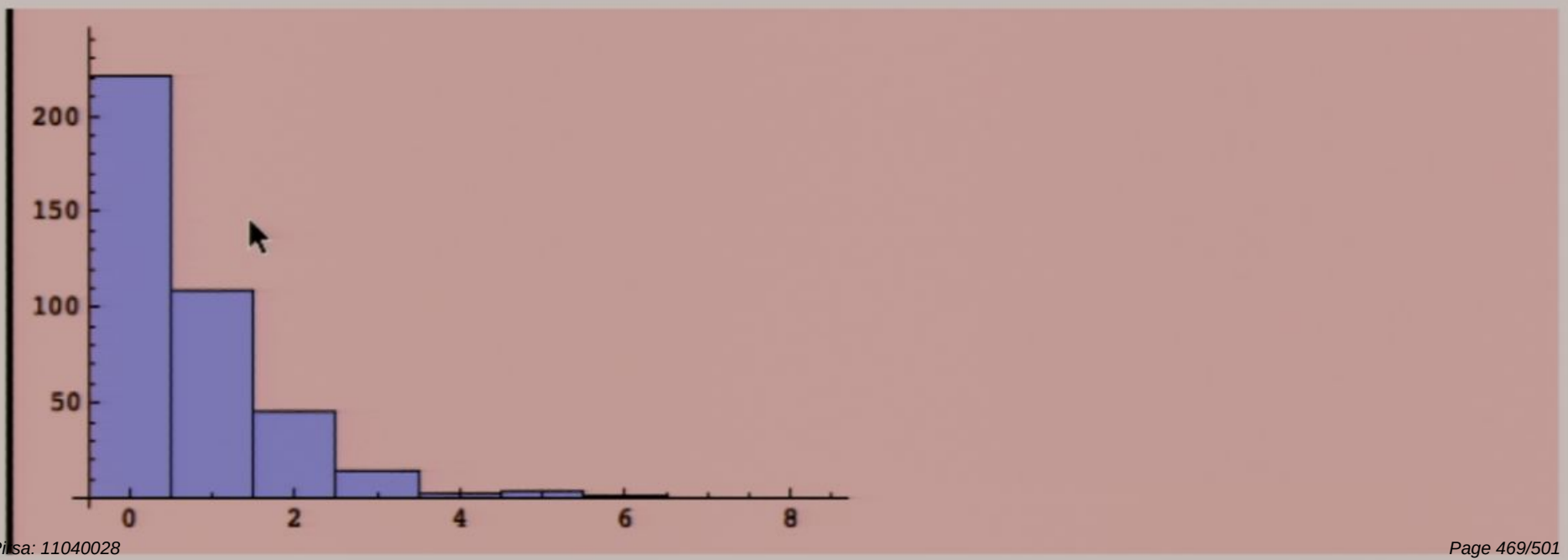

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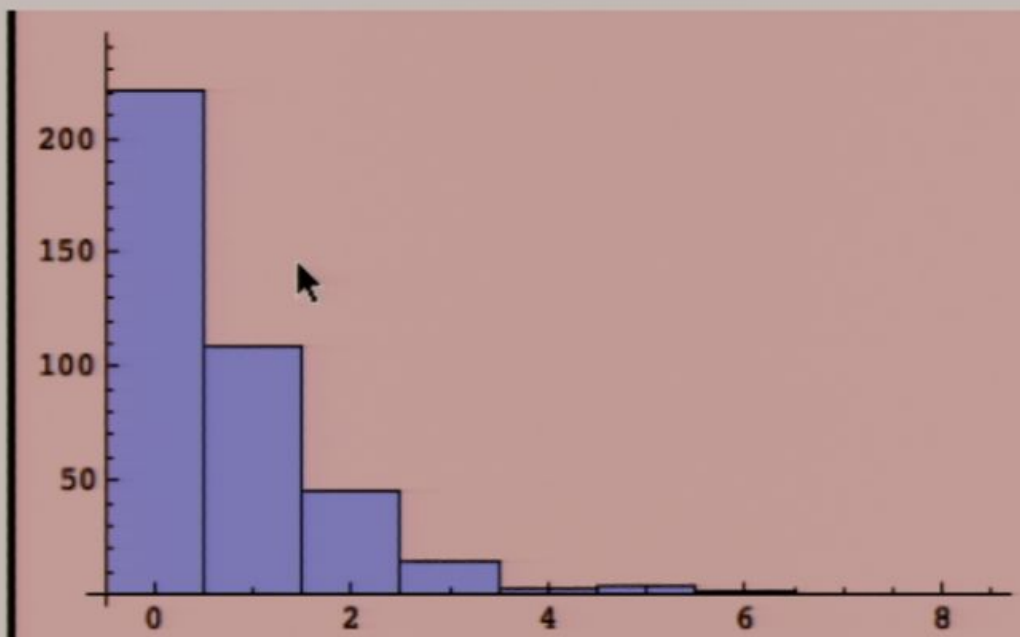

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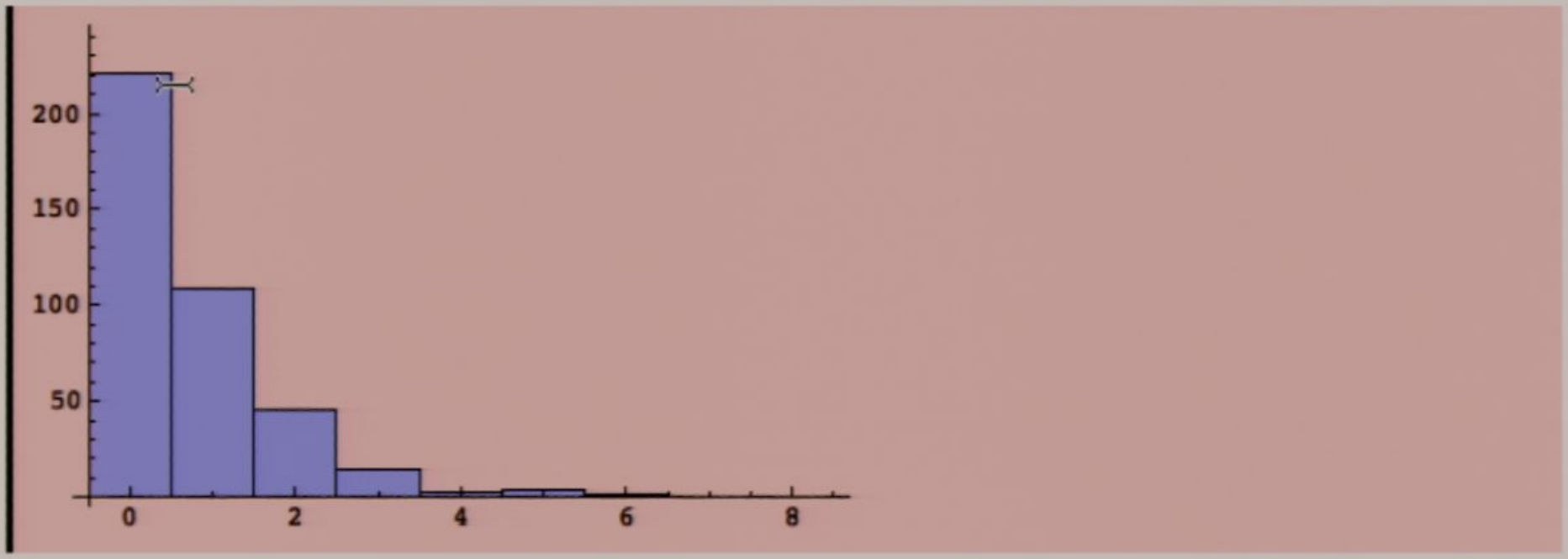

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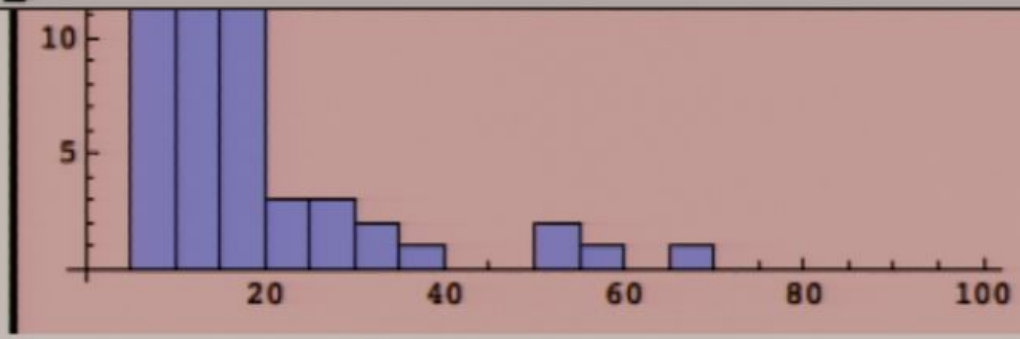

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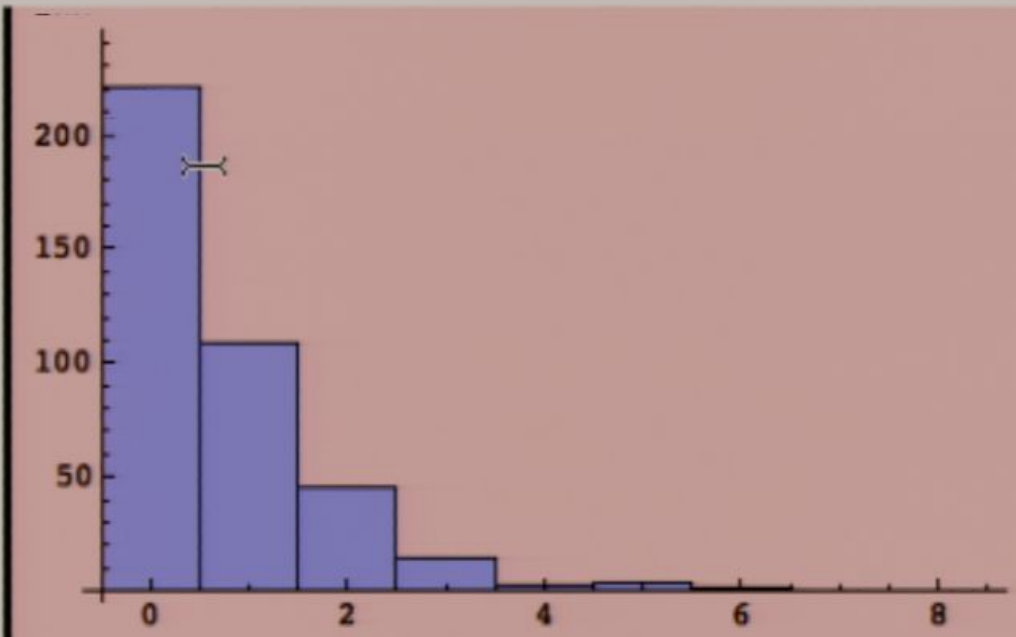

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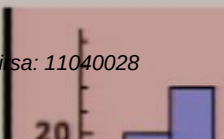

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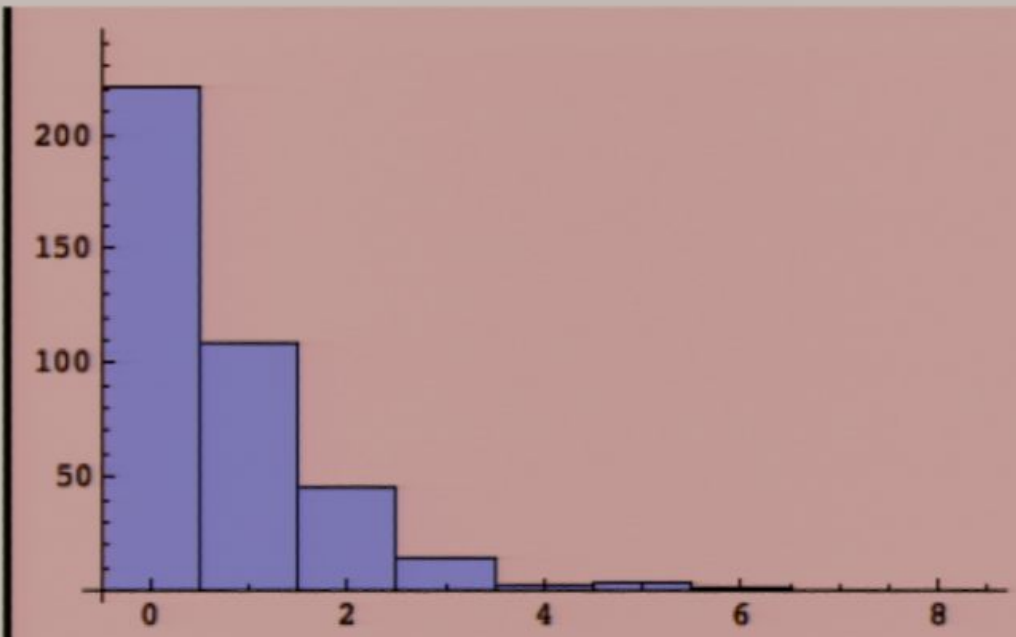

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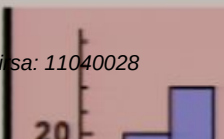

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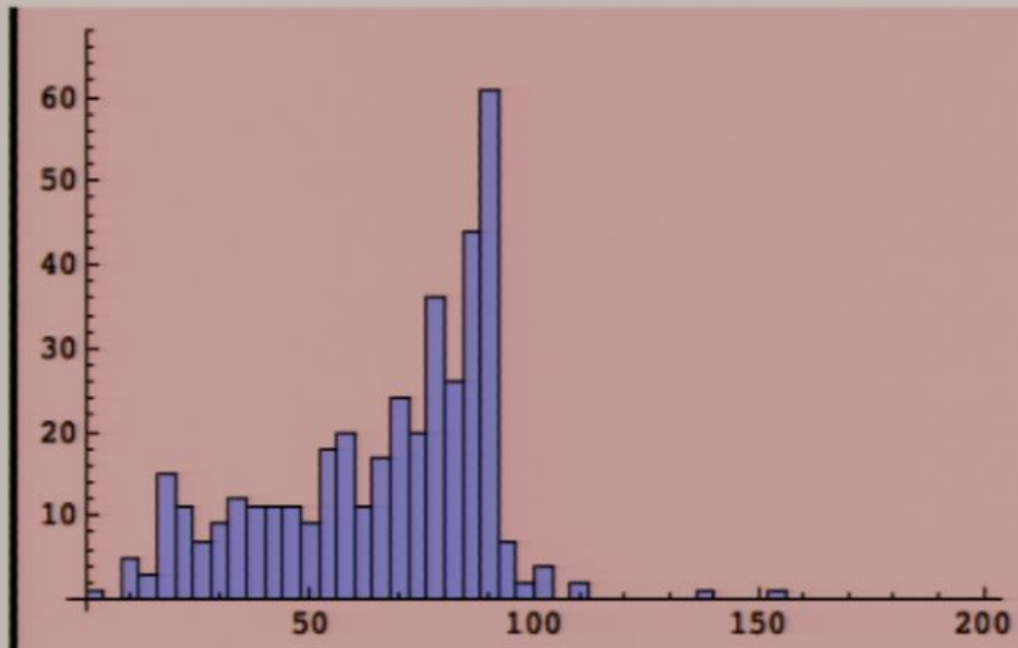

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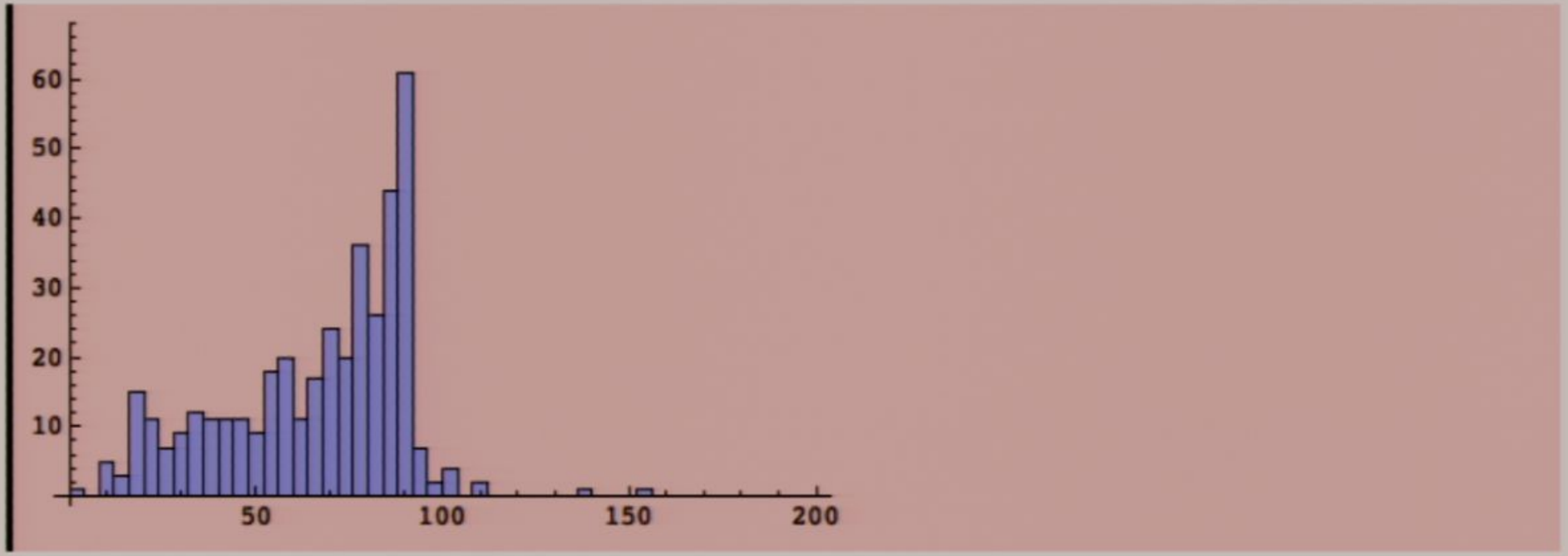


```
Hist[Bin[OneLepton, all, HGet[{{oL, 1}, {oMPT, 1}}], TransMass], {0, 200, 50}]
```

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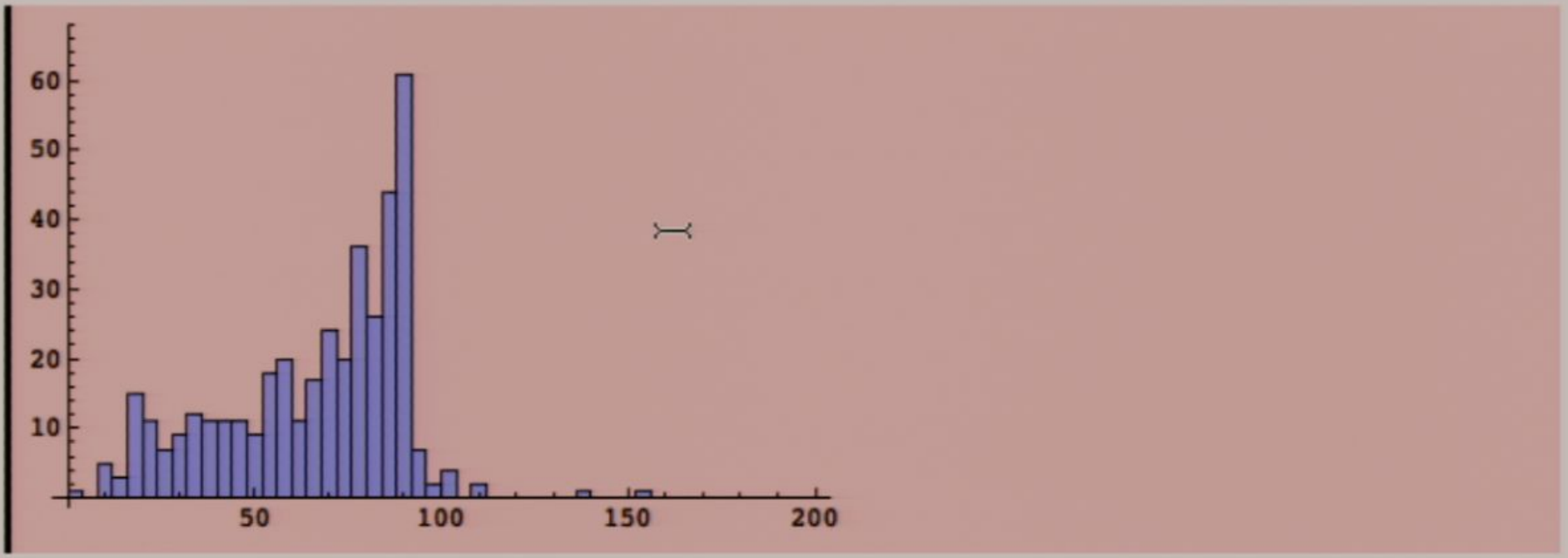


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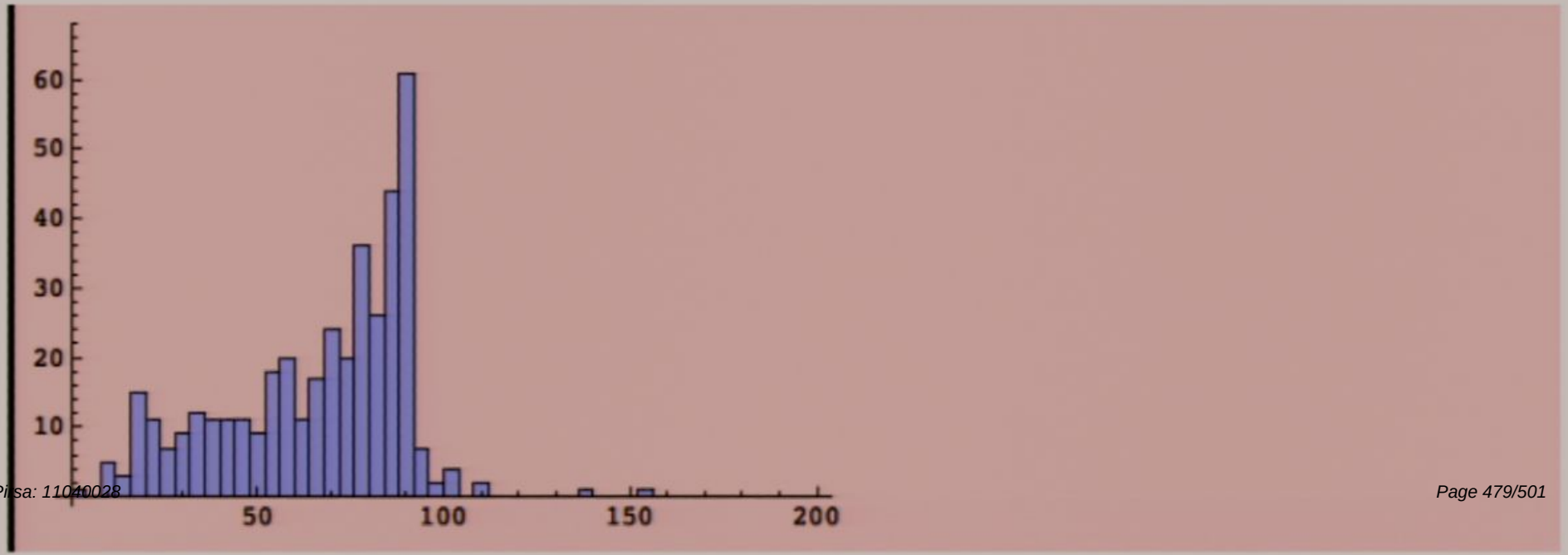

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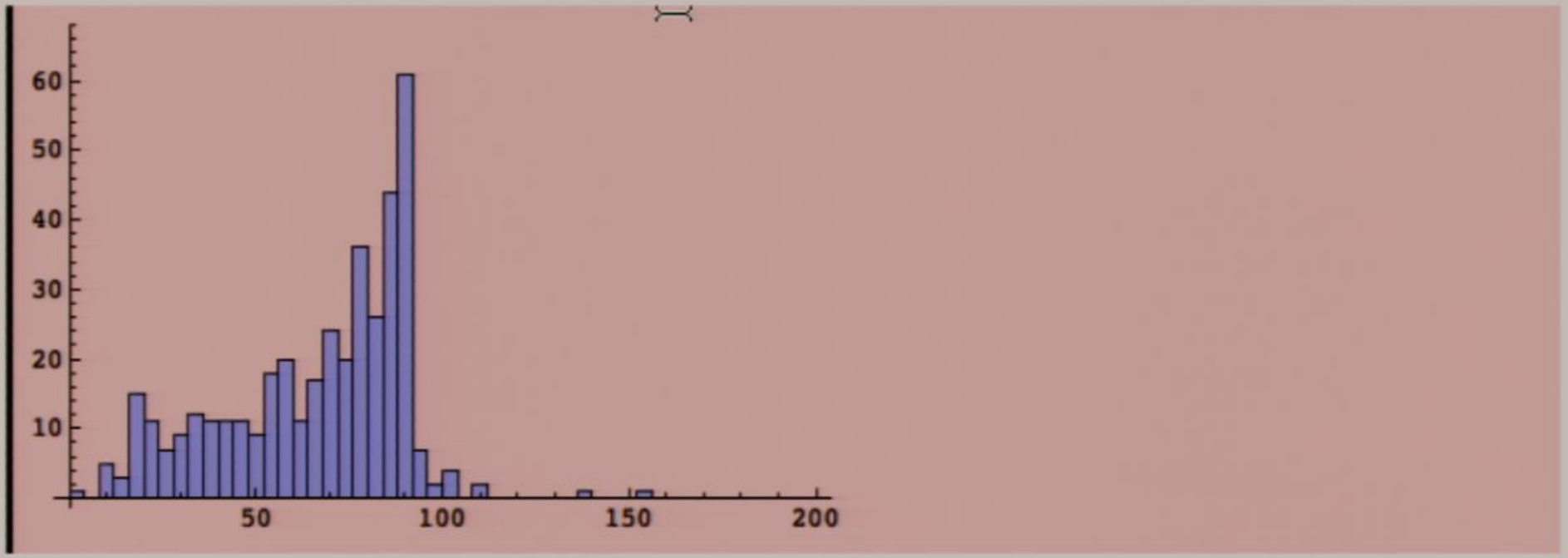


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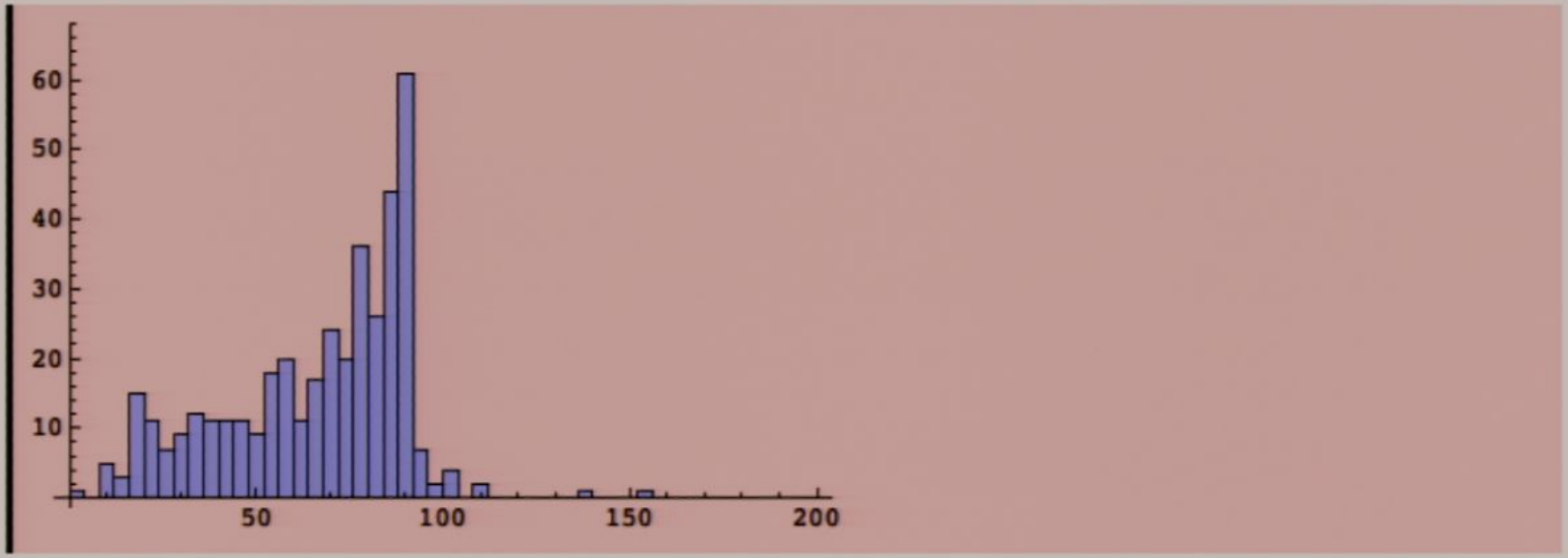


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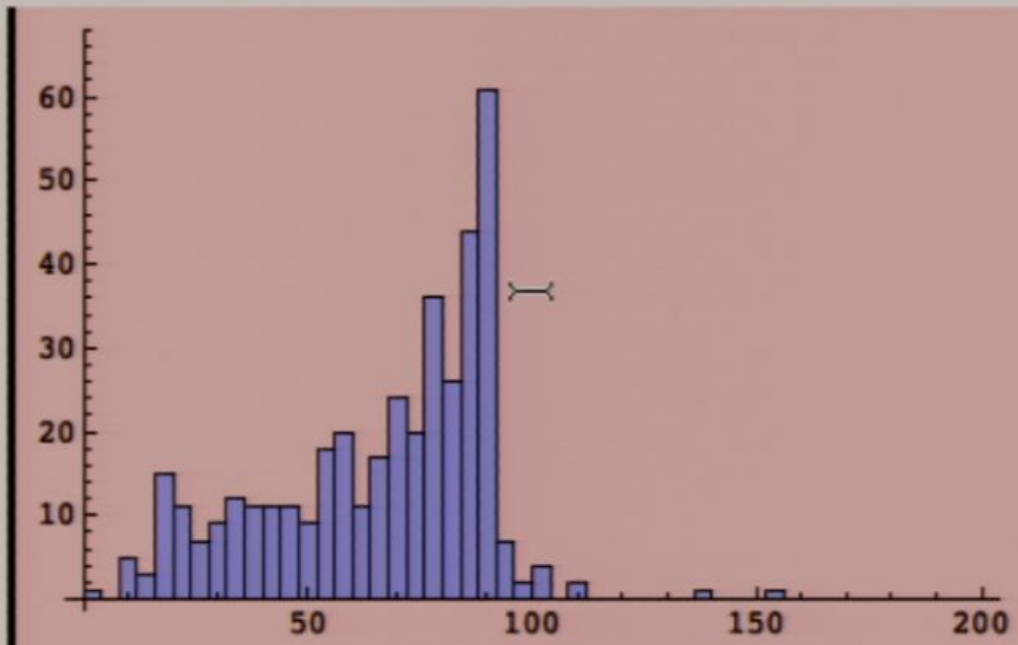


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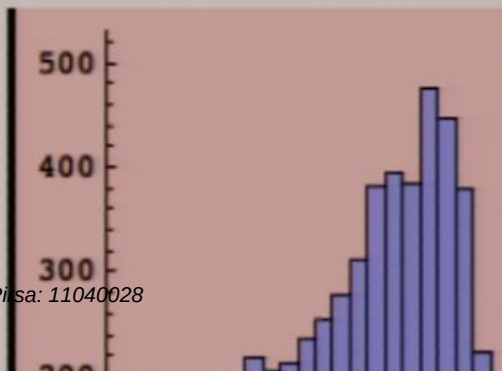

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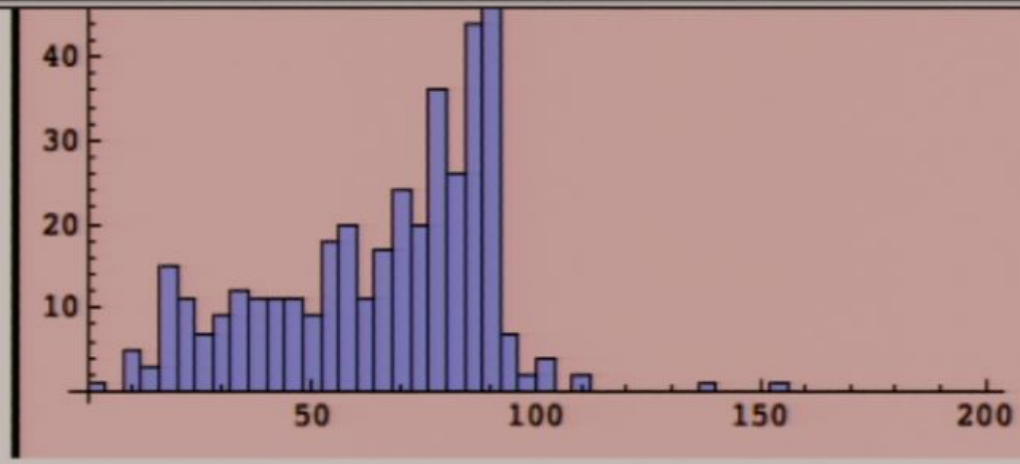
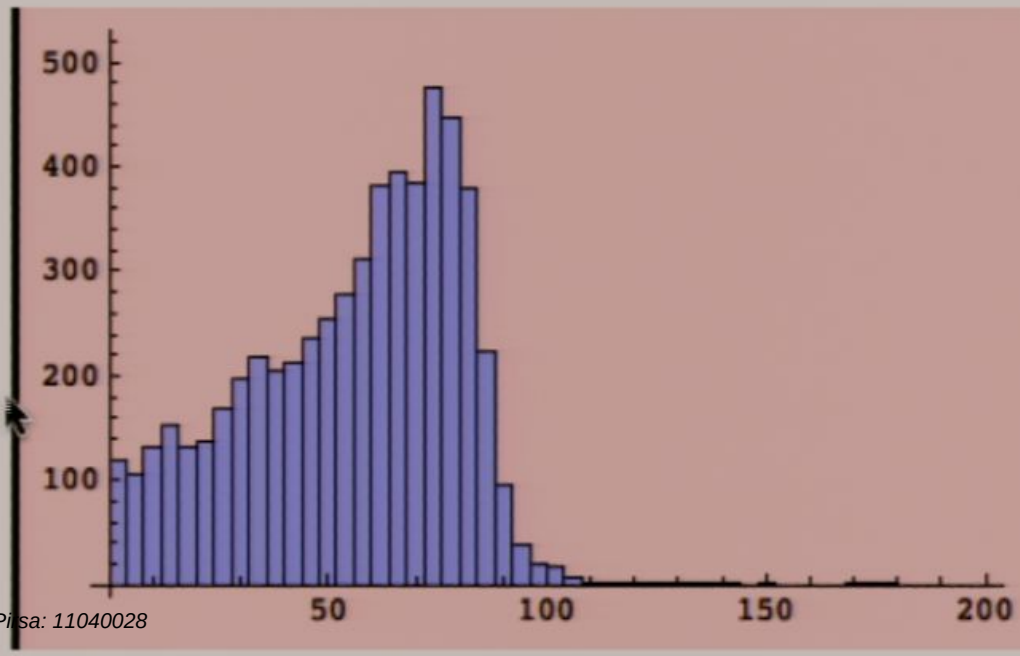
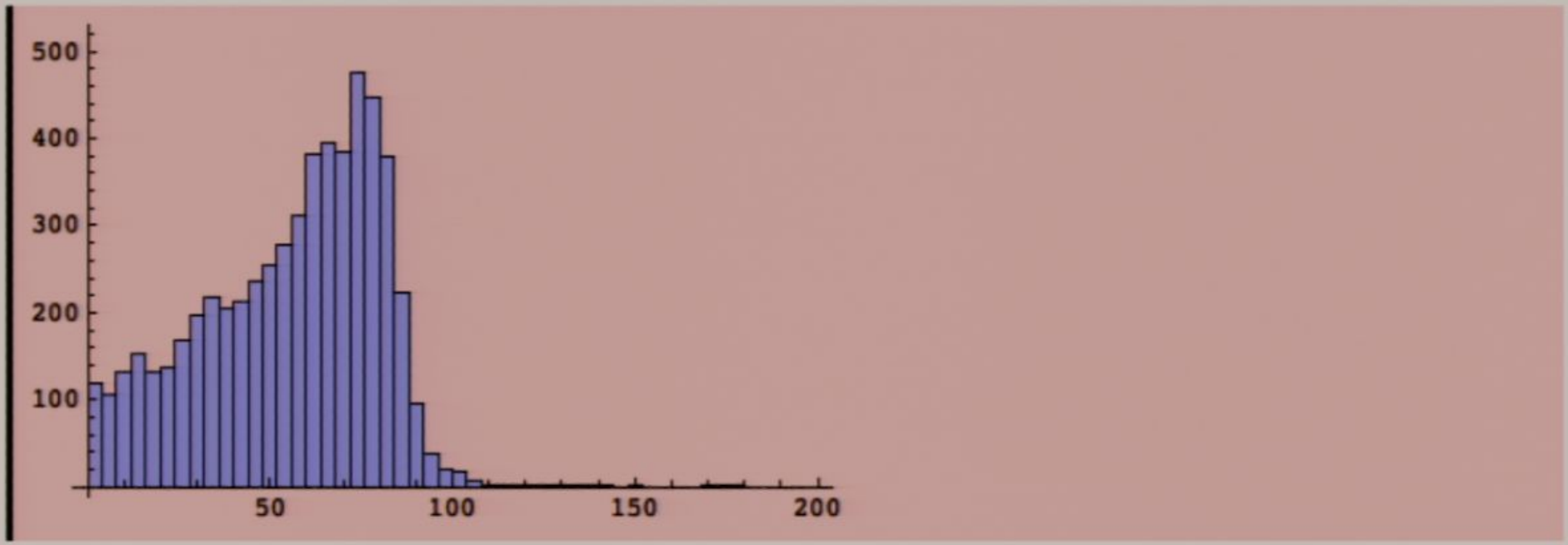



```
Hist[Bin[OneLepton, all, EGet[{{oL, 1}, {oMPT, 1}}], TransMass], {0, 200, 50}]
```

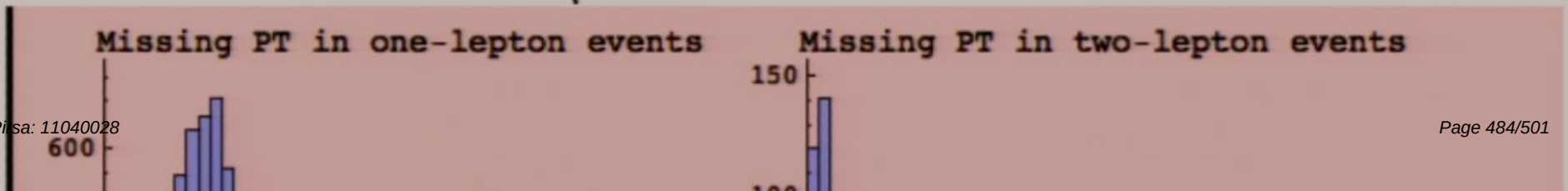


```
Hist[Bin[OneLepton, all, GetAll[{{dL, 1}, {dMPT, 1}}], TransMass], {0, 200, 50}]
```



nparison of missing energy in one-lepton and two-lepton events:

```
{Hist[Bin[OneLepton, all, GetAll, MissingPT], {0, 200, 50},
  PlotLabel → "Missing PT in one-lepton events", ImageSize → 300],
 Hist[Bin[TwoLepton, all, GetAll, MissingPT], {0, 200, 50},
  PlotLabel → "Missing PT in two-lepton events", ImageSize → 300]}
```



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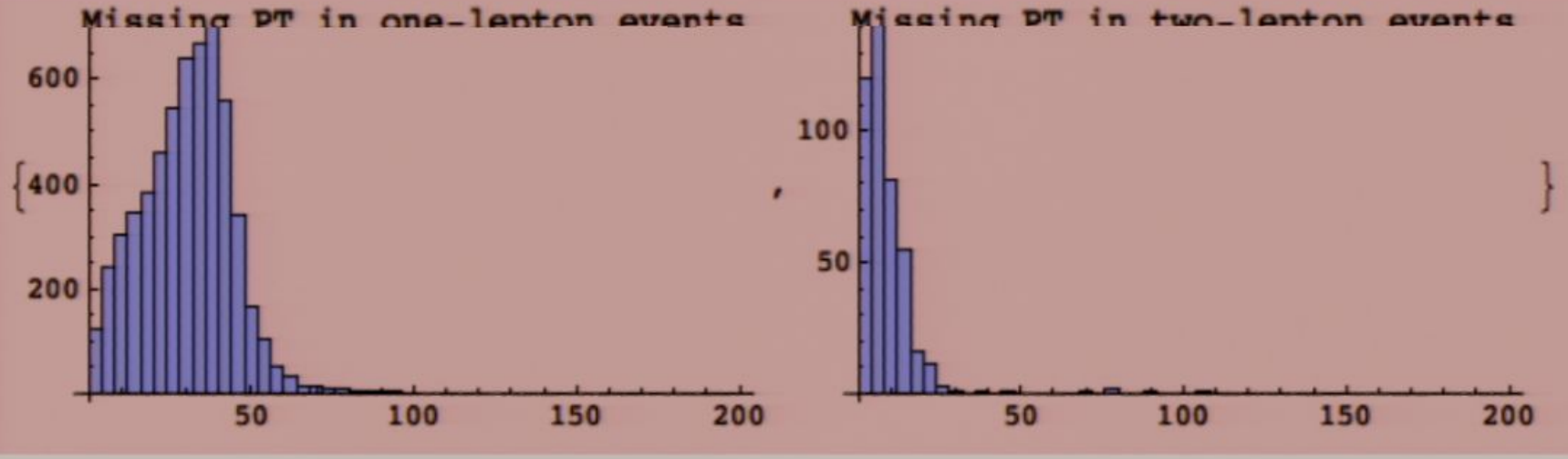
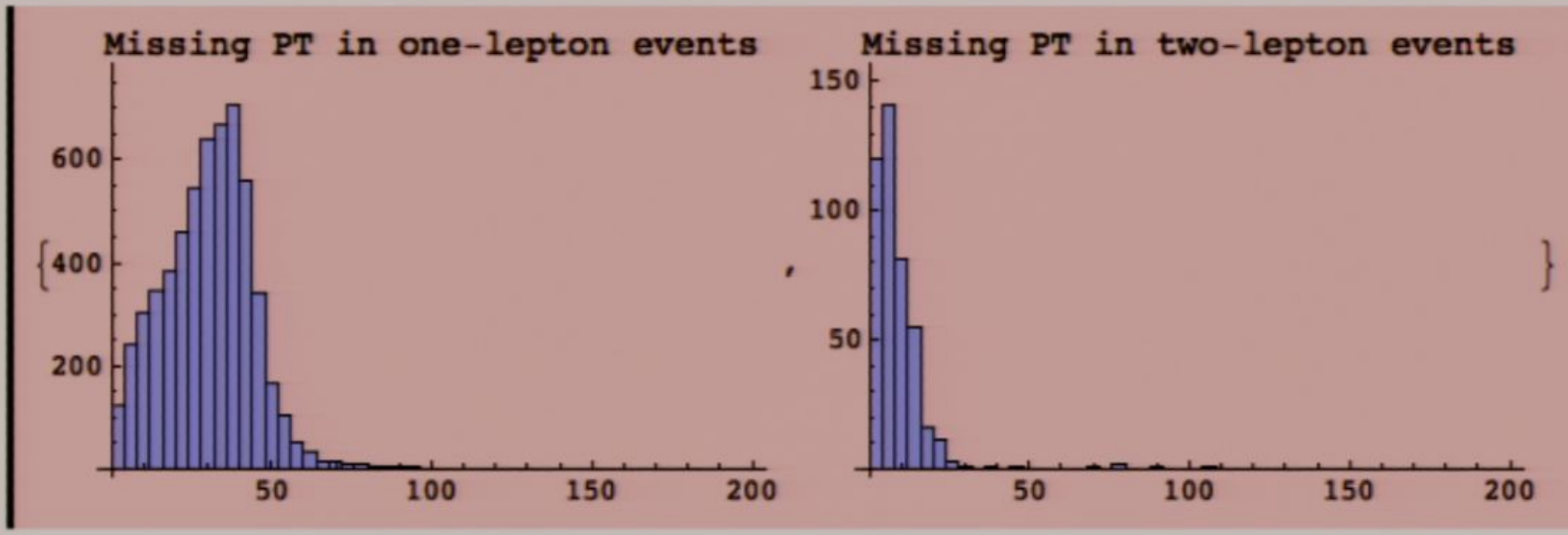



```
{Hist[Bin[OneLepton, all, HGet[oL, 1], EffMass], {0, 100, 50},
  PlotLabel → "Lepton PT in one-lepton events", ImageSize → 300],
 Hist[Bin[OneLepton, all, GetAll, MissingPT], {0, 100, 50},
  PlotLabel → "Missing PT in one-lepton events", ImageSize → 300],
 Hist[Bin[OneLepton, all, HGet[{{oL, 1}, {oMPT, 1}}], TransMass], {0, 200, 50},
  PlotLabel → "Transverse Mass in one-lepton events", ImageSize → 300]}
```


```
  PlotLabel → "Missing PT in two-lepton events", ImageSize → 300]}
```

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{Hist[Bin[OneLepton, all, HGet[oL, 1], EffMass], {0, 100, 50},
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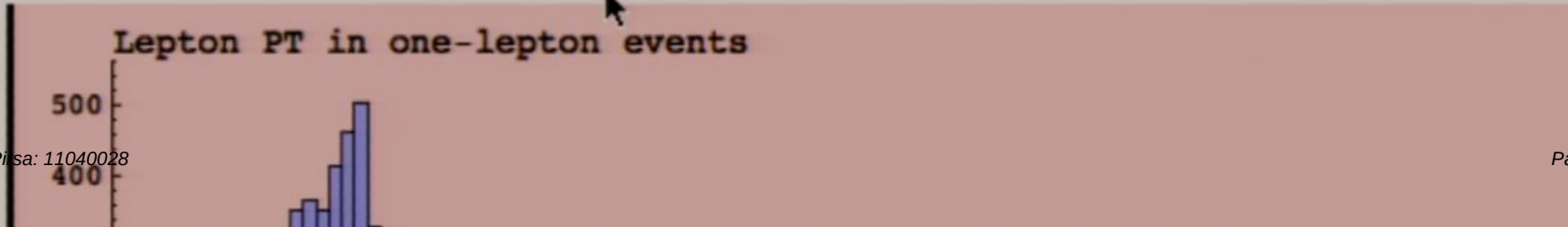

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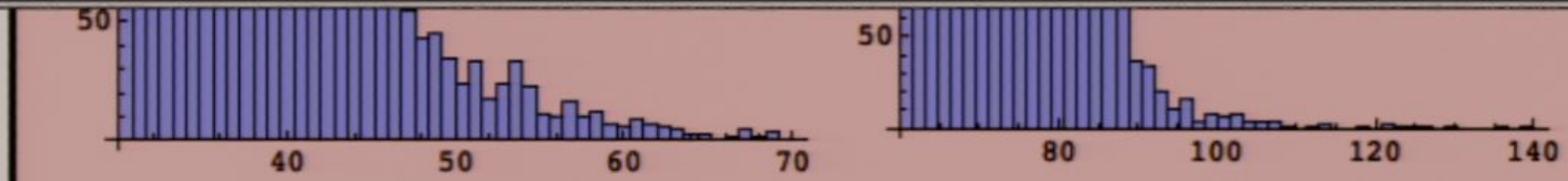
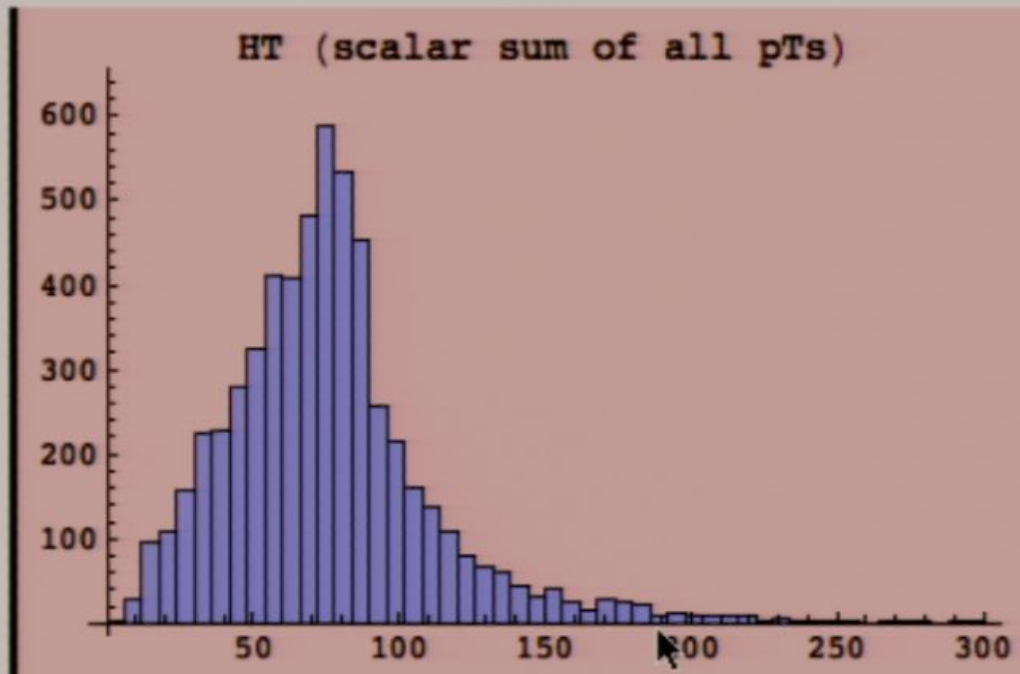
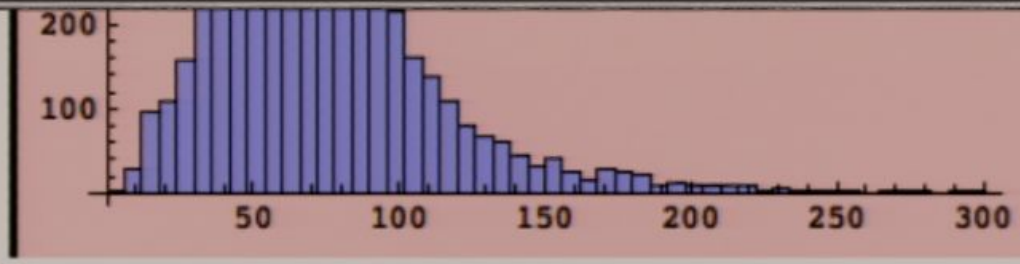



```
Hist[Bin[OneLepton, all, GetAll, EffMass], {0, 300, 50},
 PlotLabel → "HT (scalar sum of all pTs)"]
```



dence for top?


```
Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```



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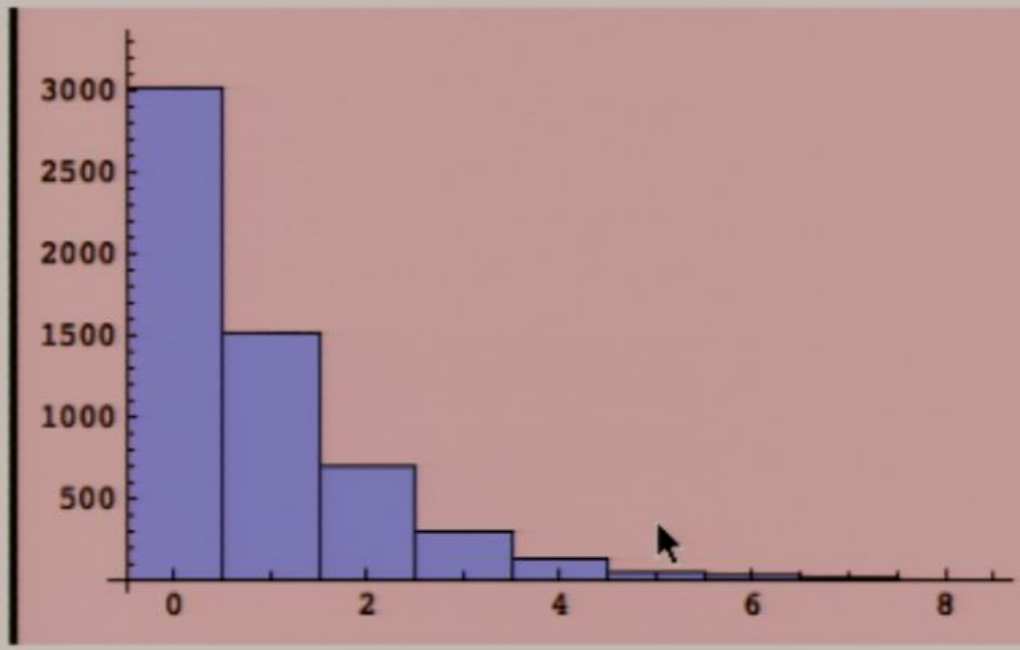
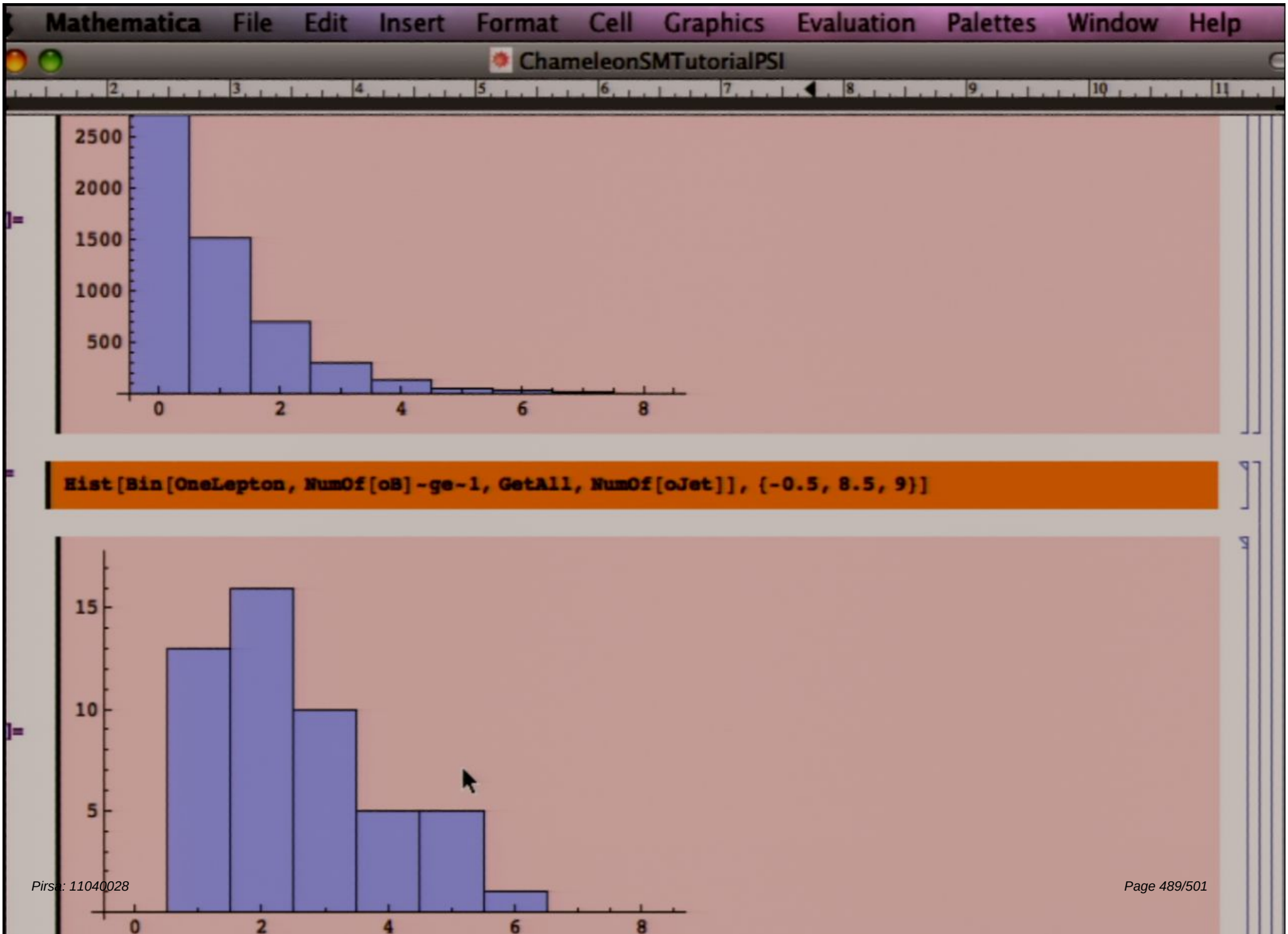



```
Hist[Bin[OneLepton, NumOf[oB]-ge-1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```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2500
2000
1500
1000
500
0
2
4
6
8
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
15
10
5
0
2
4
6
8

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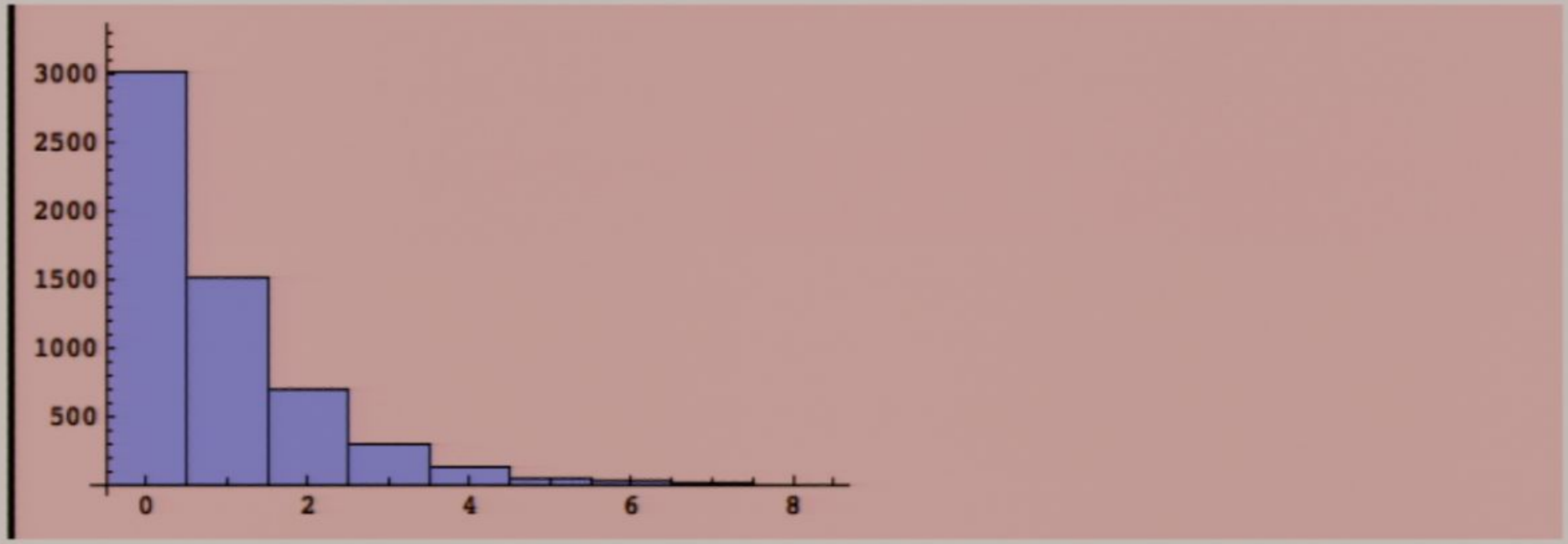


```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```

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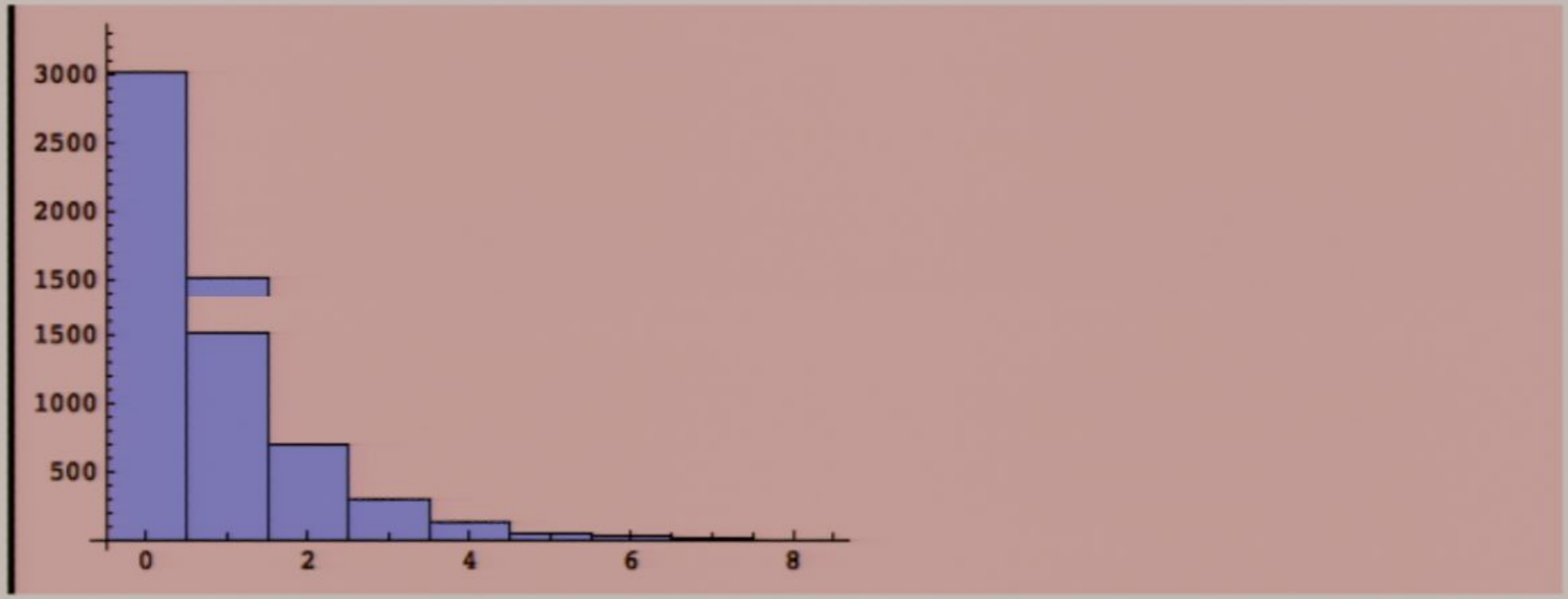
```
Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```




```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```

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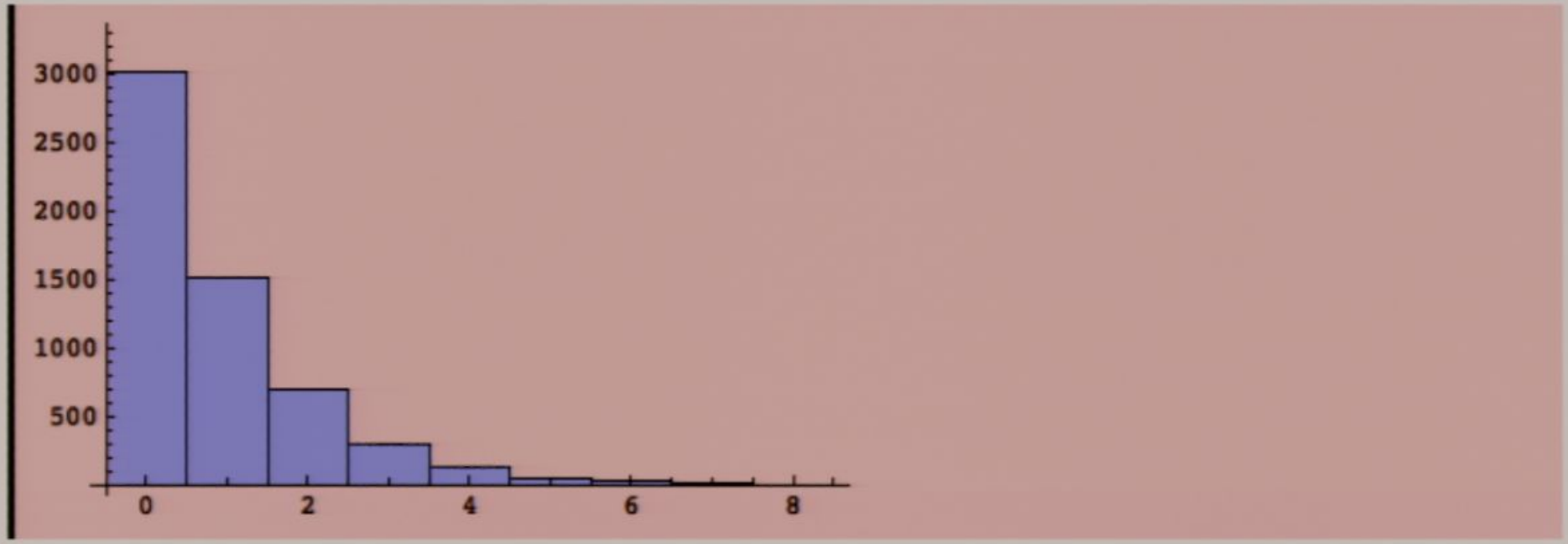
```
Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```




```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```

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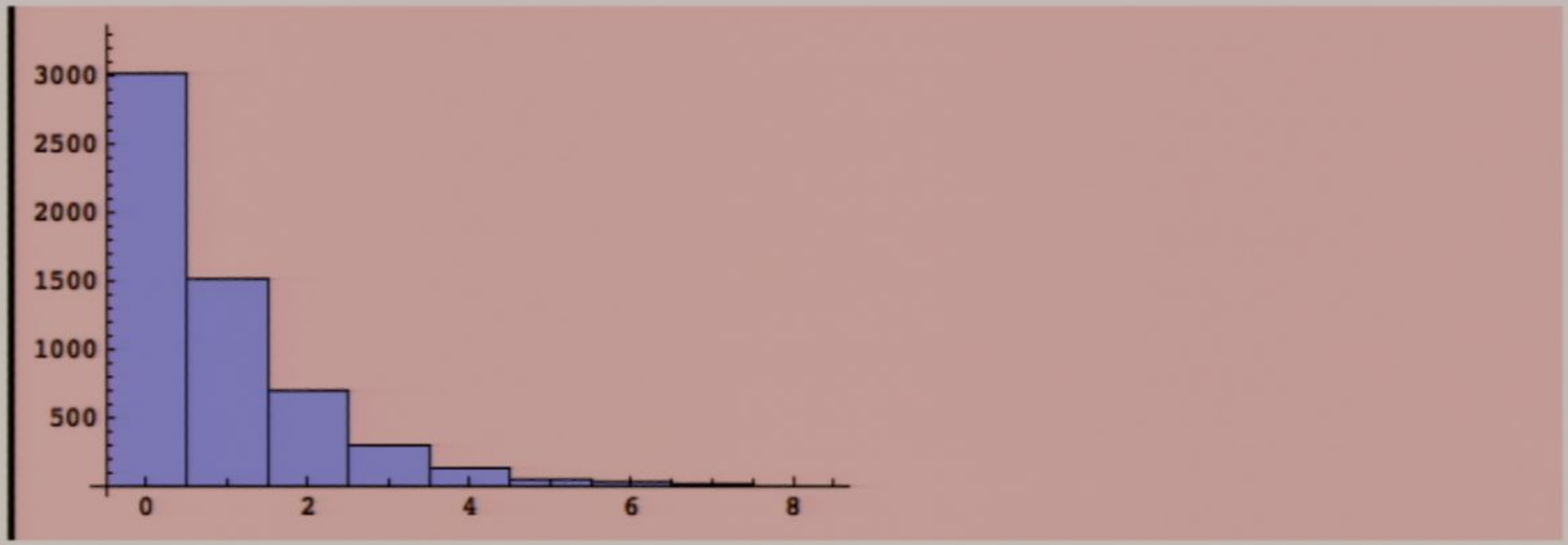
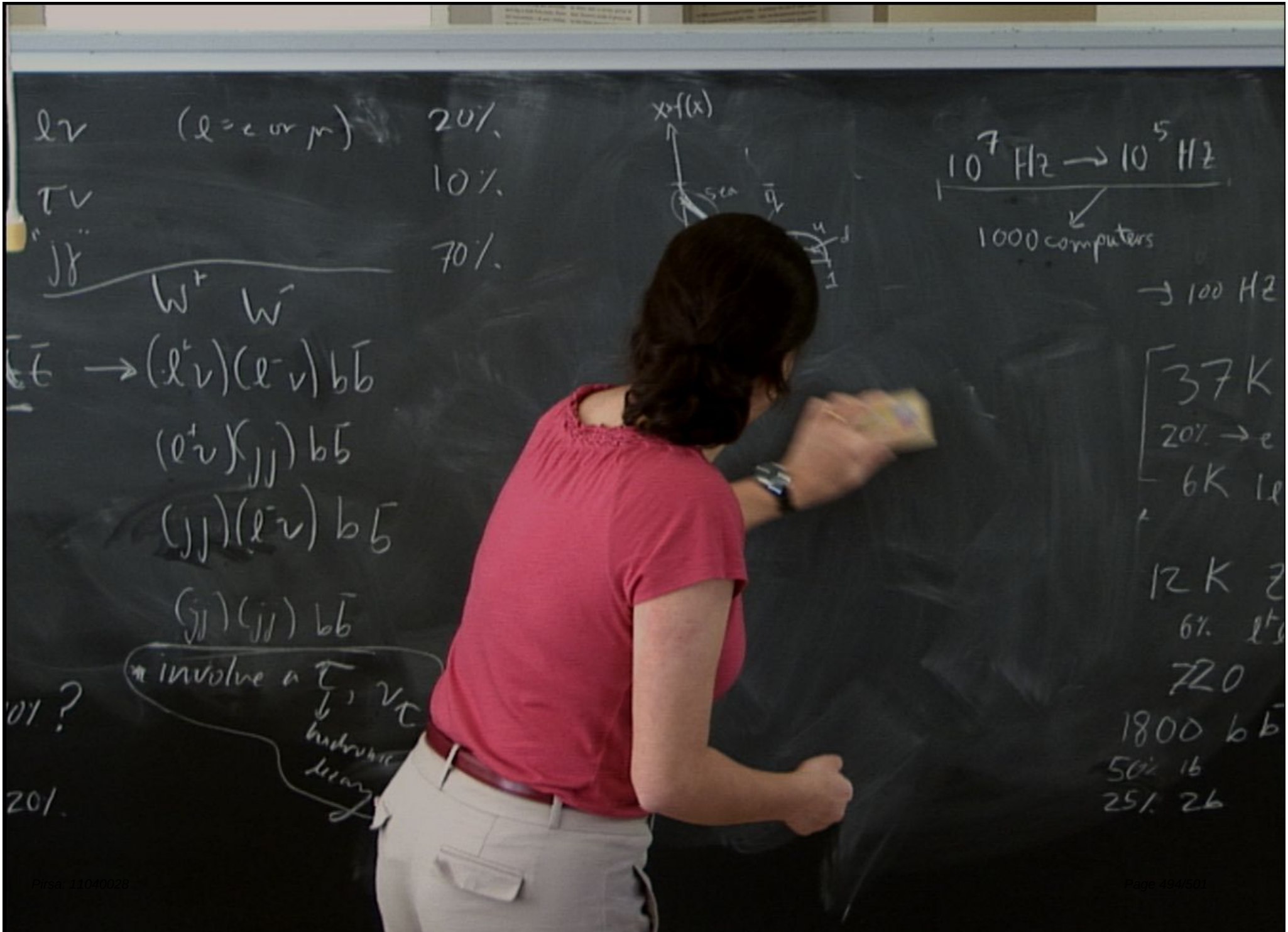
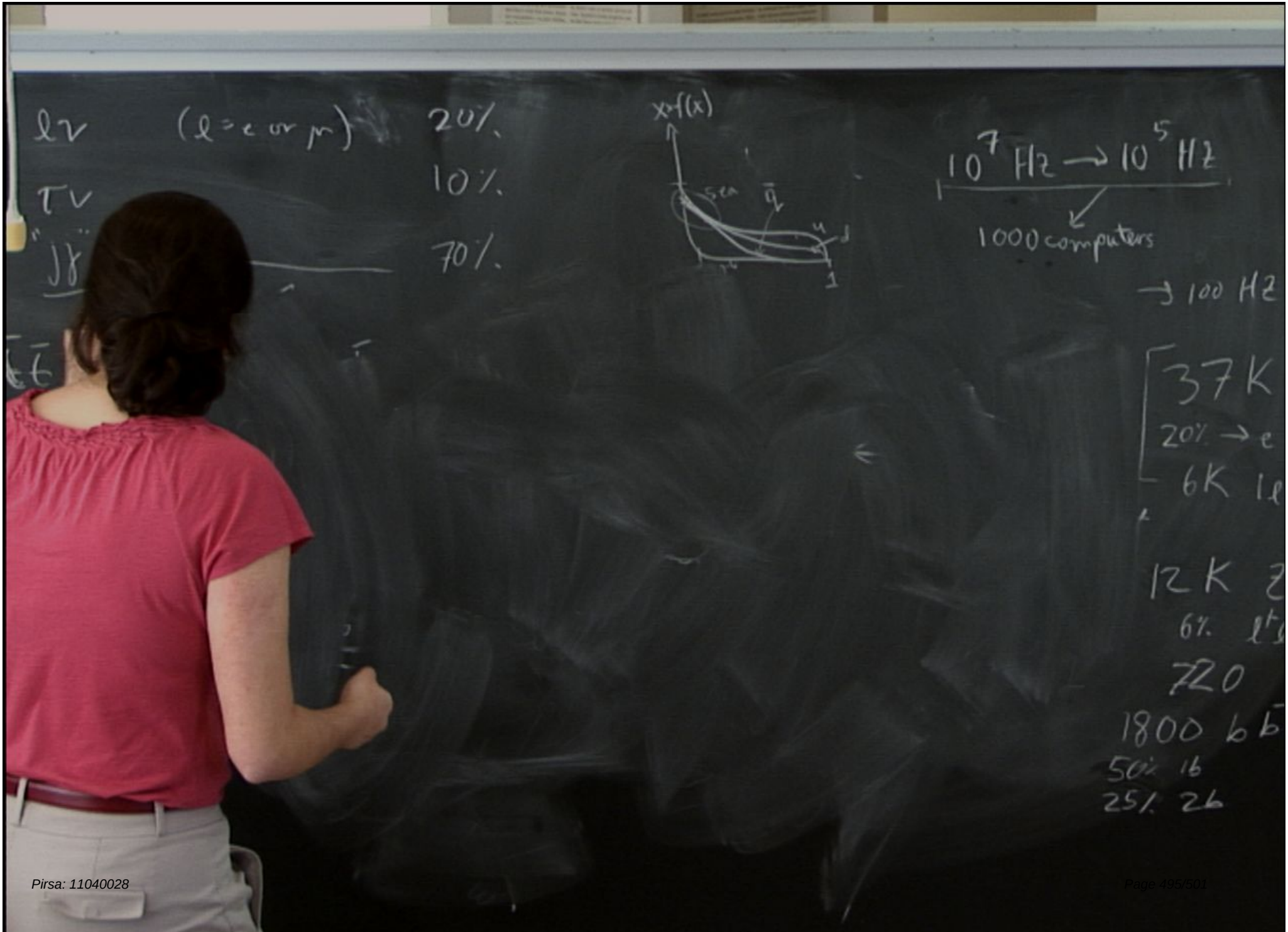
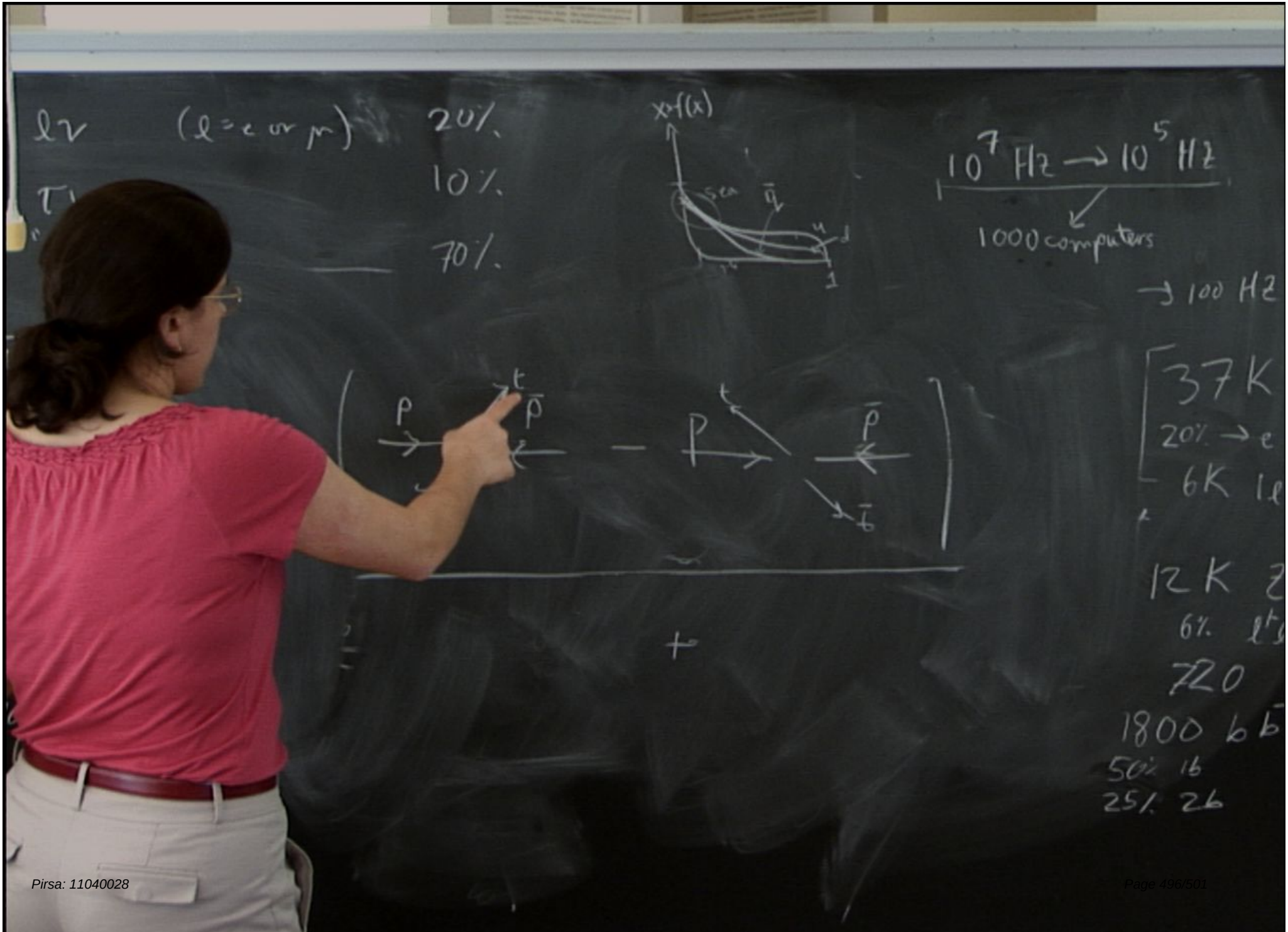
```
Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```

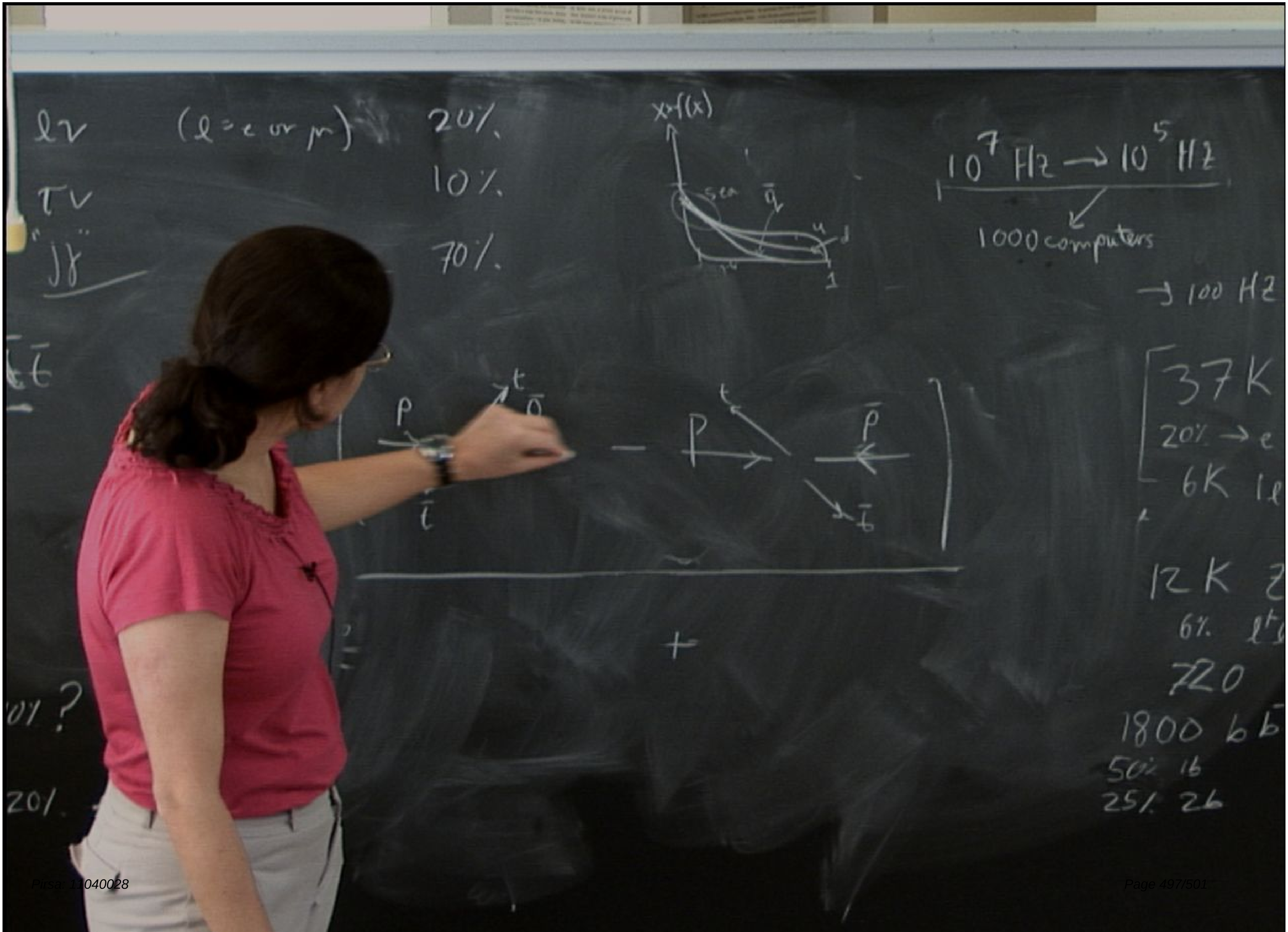


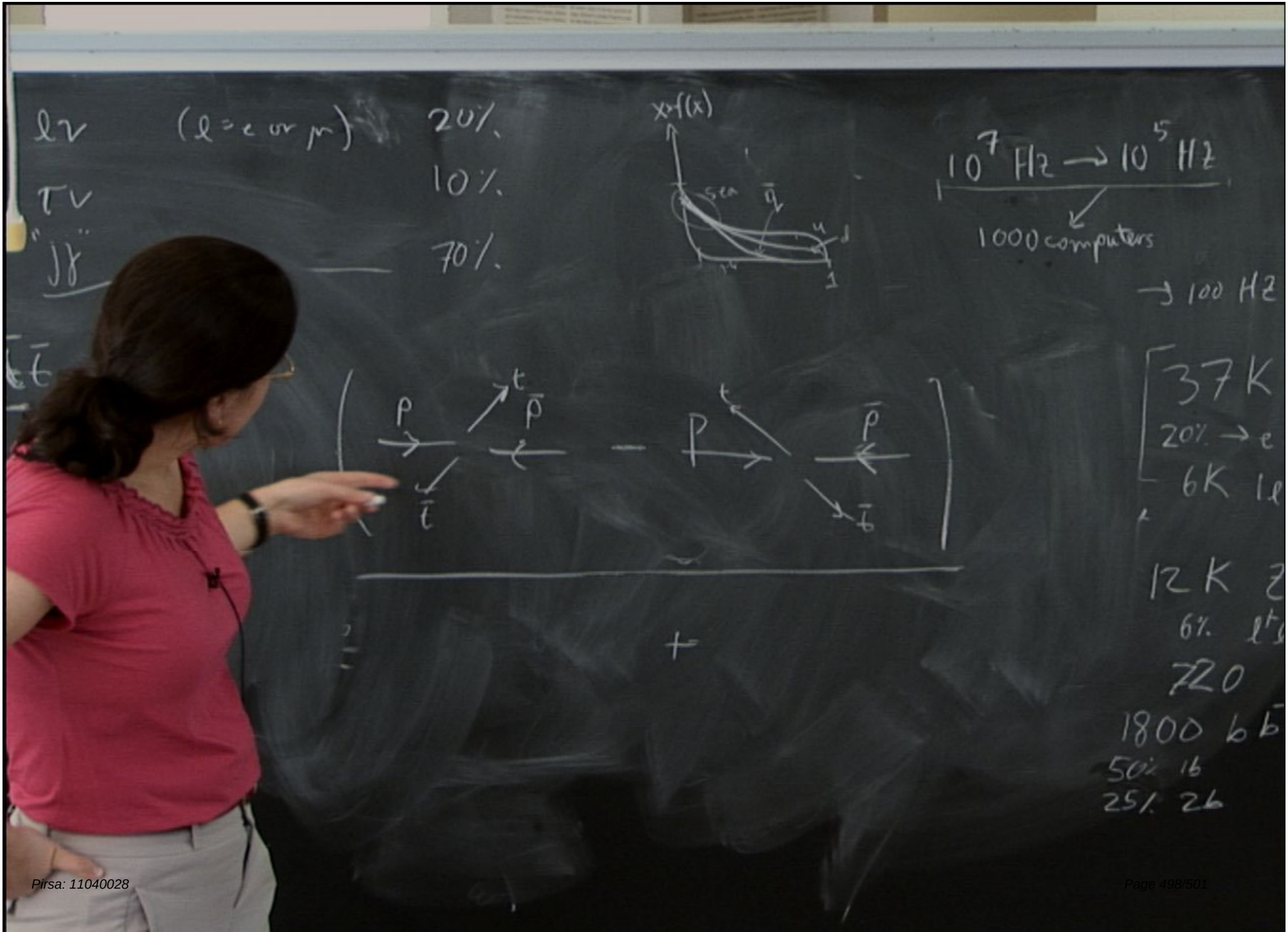

```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```


lν (ℓ = e or μ) 20%.
τν 10%.
"jj" 70%.
W⁺ W⁻
tt̄ → (ℓ⁺ν)(ℓ⁻ν) bb̄
(ℓ⁺ν)(jj) bb̄
(jj)(ℓ⁻ν) bb̄
(jj)(jj) bb̄
involve a τ, ν_τ
x→f(x)
sea q̄
10⁷ Hz → 10⁵ Hz
1000 computers
→ 100 Hz
37K
20% → e
6K
12K
6%
720
1800 bb̄
50% 16
25% 26
01?
201.


lν (ℓ = e or μ) 20%.
τν 10%.
70%.
x→f(x)
sea q̄
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
37K
20% → e
6K
12K
6%
720
1800
50% 16
25% 26


lν (ℓ = e or μ) 20%.
10%.
70%.
x f(x)
sea
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
37K
20% → e
6K
12K
6%
720
1800
50%
25%


lν (l = e or μ) 20%
τν 10%
"jj" 70%
x·f(x)
sea
q̄
u
d
1
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
tt̄
p
t
t̄
p
t
p̄
b̄
37K
20% → e
6K
12K
6%
720
1800 bb̄
50% 1b
25% 2b
20%


lν (ℓ = e or μ) 20%
τν 10%
jj 70%
x→f(x)
sea q̄
10^7 Hz → 10^5 Hz
1000 computers
→ 100 Hz
37K
20% → e
6K
12K
6%
720
1800 bb̄
50% 16
25% 26

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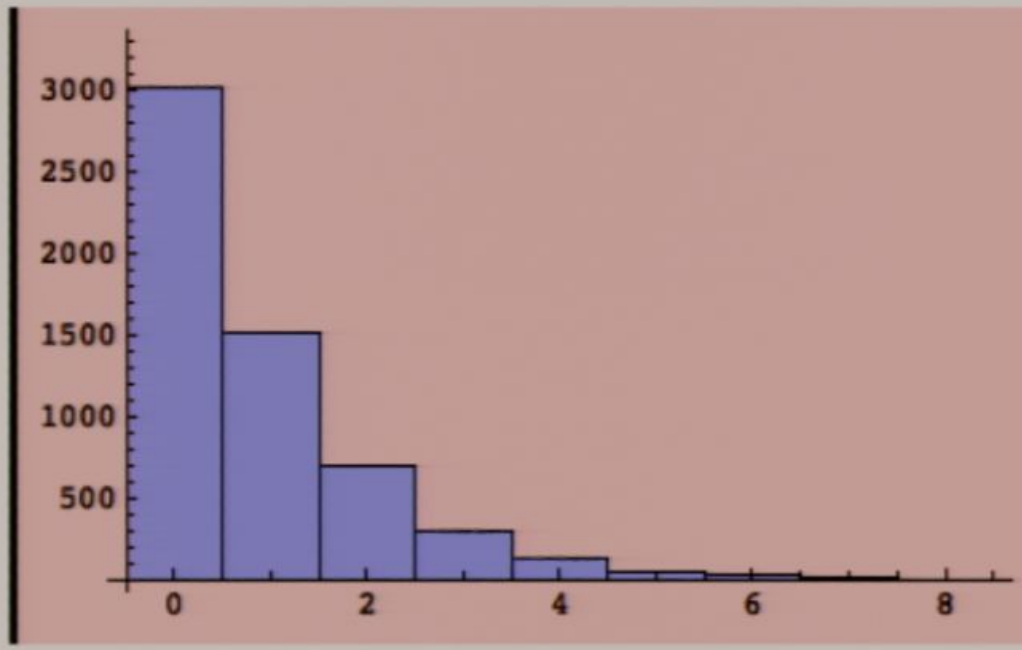
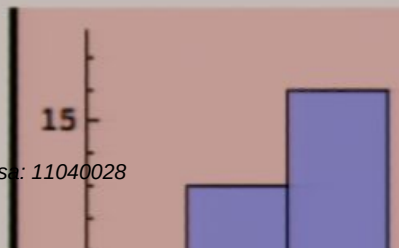
```
Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```




```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```



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Hist[Bin[OneLepton, all, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
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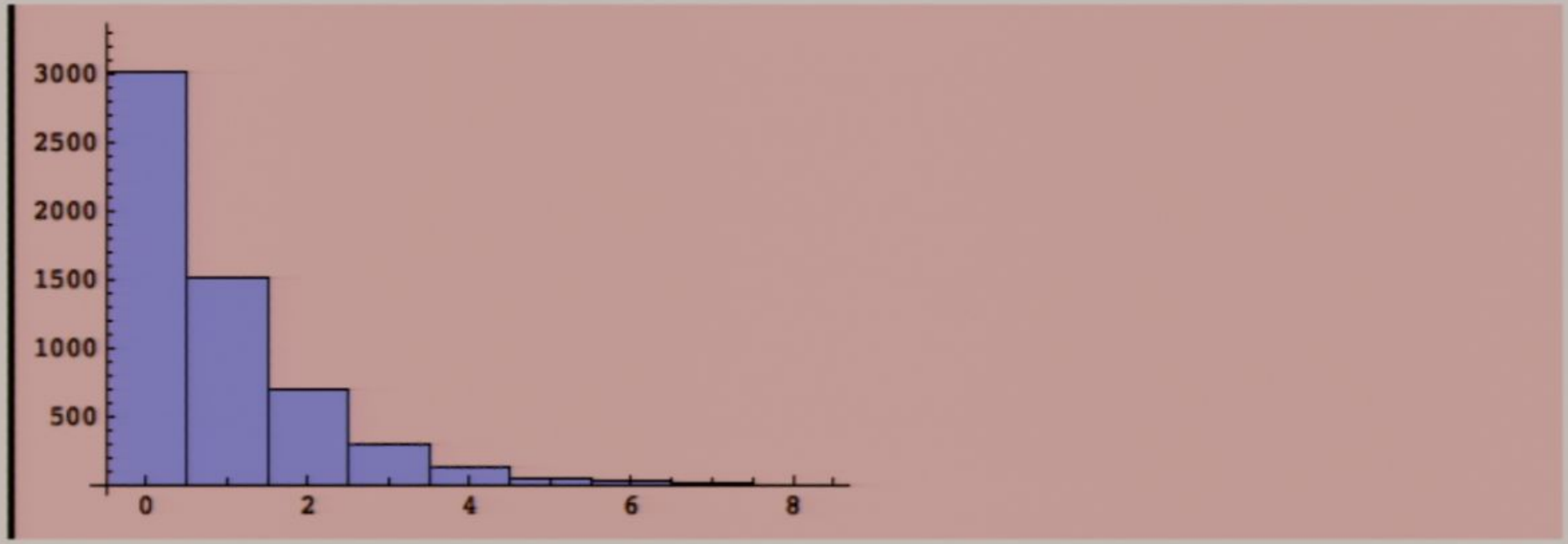


```
Hist[Bin[OneLepton, NumOf[oB]~ge~1, GetAll, NumOf[oJet]], {-0.5, 8.5, 9}]
```