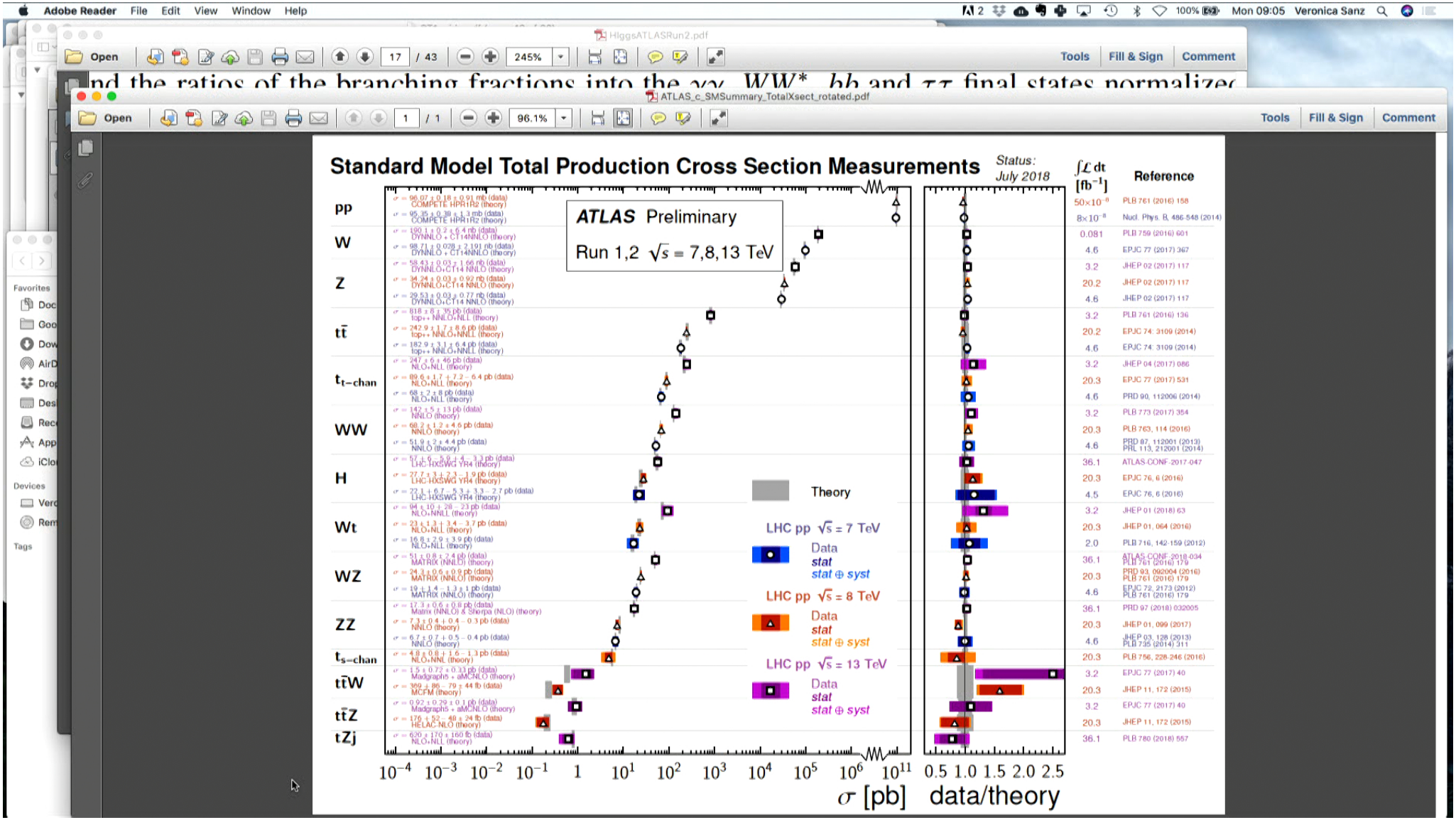
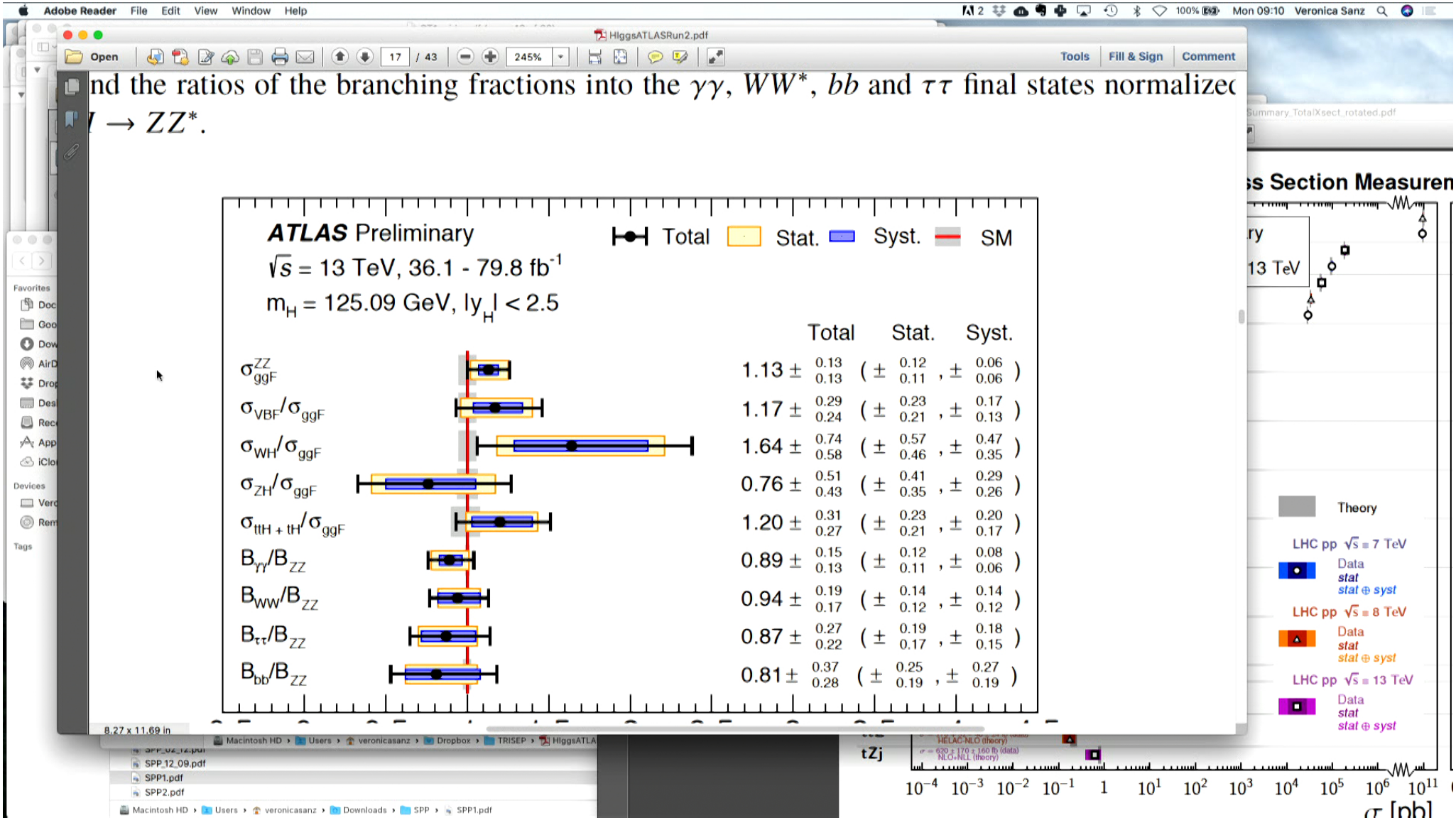
Title: Standard Model Theory 1

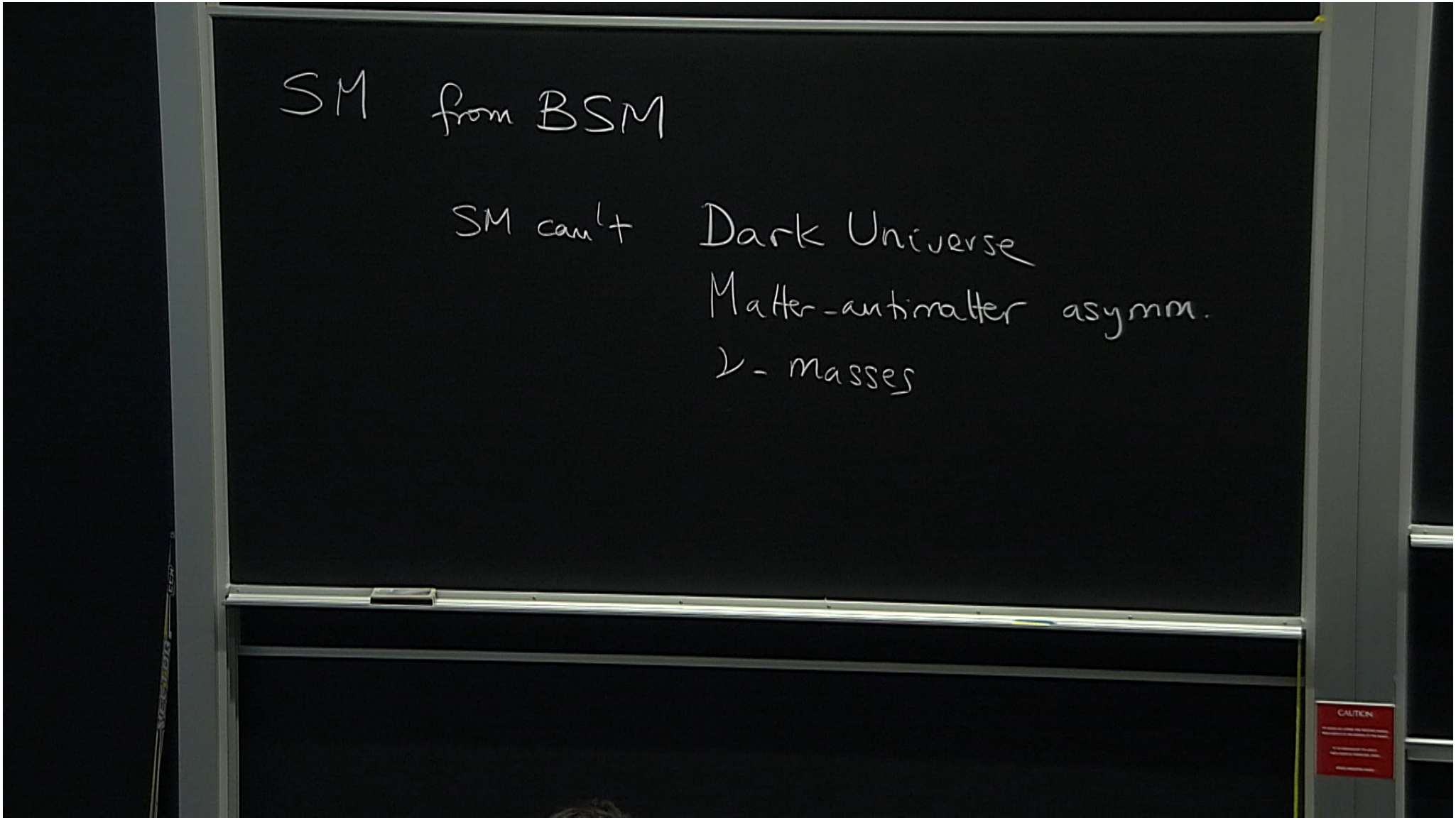
Date: Jul 09, 2018 09:00 AM

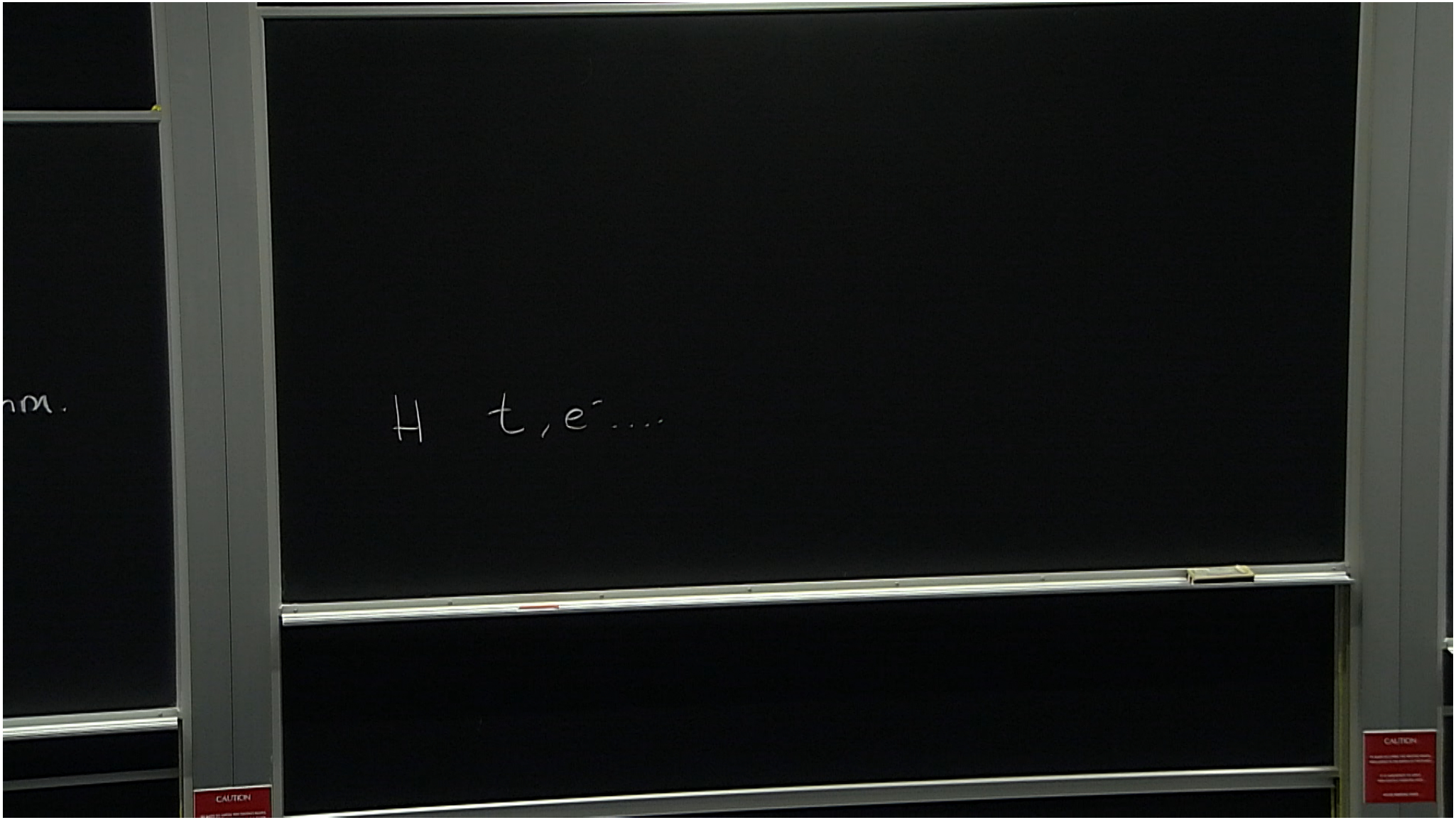
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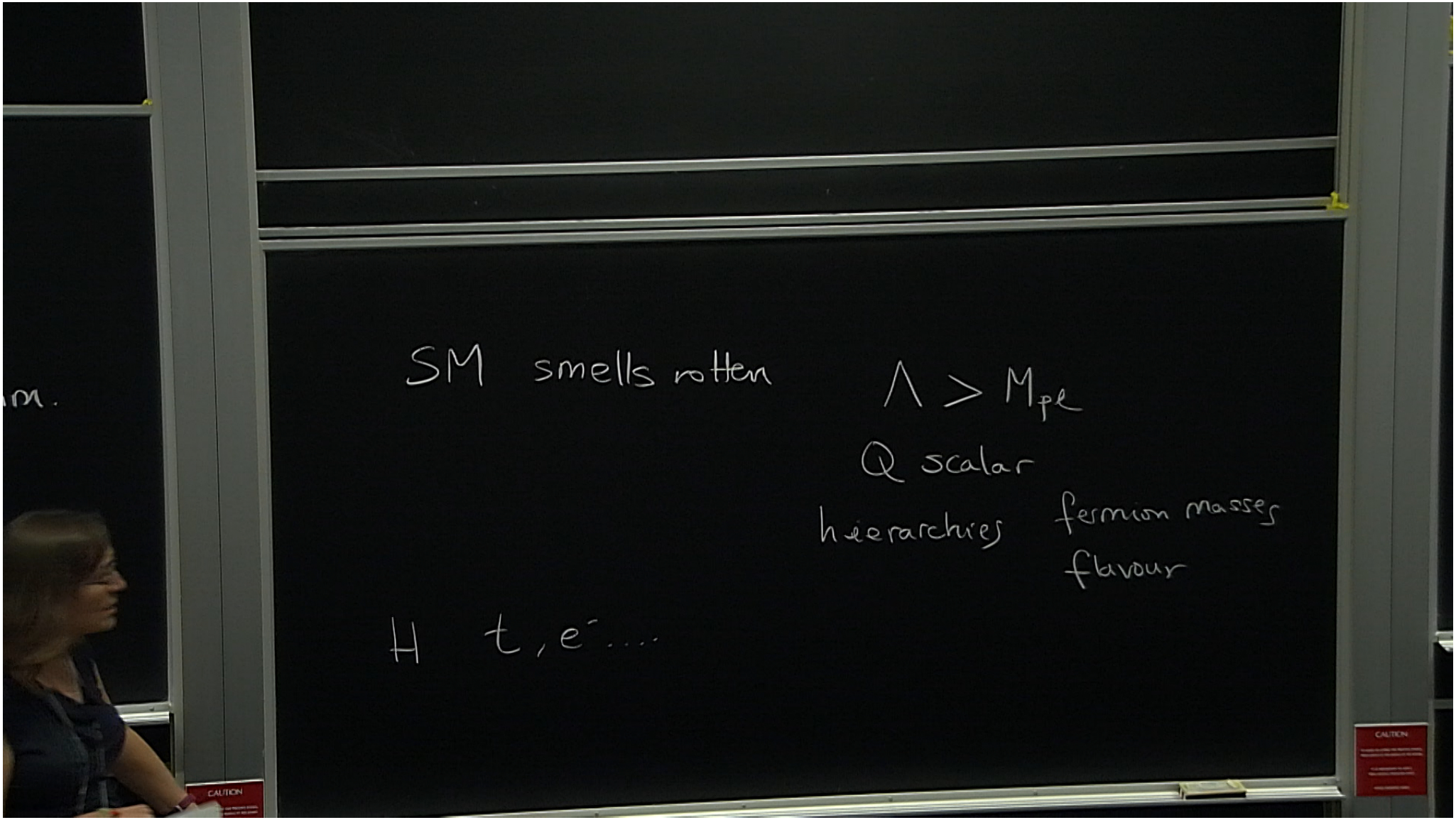
Abstract:

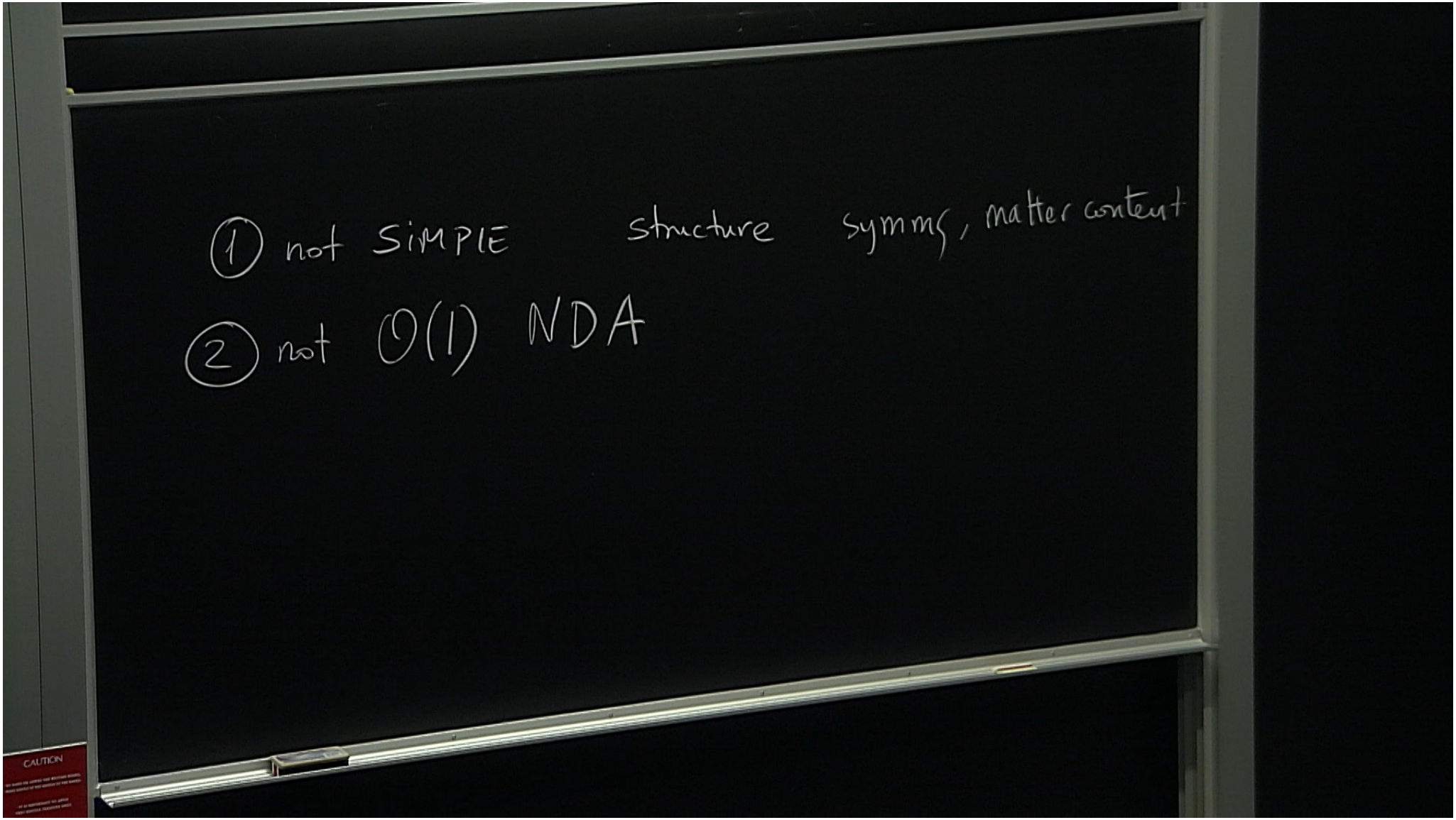

Standard Model Total Production Cross Section Measurements
Status: July 2018
ATLAS Preliminary
Run 1,2 $\sqrt{s}$ = 7,8,13 TeV
Theory
LHC pp $\sqrt{s}$ = 7 TeV
Data
stat
stat ⊕ syst
LHC pp $\sqrt{s}$ = 8 TeV
Data
stat
stat ⊕ syst
LHC pp $\sqrt{s}$ = 13 TeV
Data
stat
stat ⊕ syst
pp
W
Z
$t\bar{t}$
t_{t-chan}
WW
H
Wt
WZ
ZZ
t_{s-chan}
$t\bar{t}W$
$t\bar{t}Z$
tZj
$\int \mathcal{L}\,dt$ [fb^{-1}]
Reference
10^{-4} 10^{-3} 10^{-2} 10^{-1} 1 10^{1} 10^{2} 10^{3} 10^{4} 10^{5} 10^{6} 10^{11}
σ [pb]
0.5 1.0 1.5 2.0 2.5
data/theory

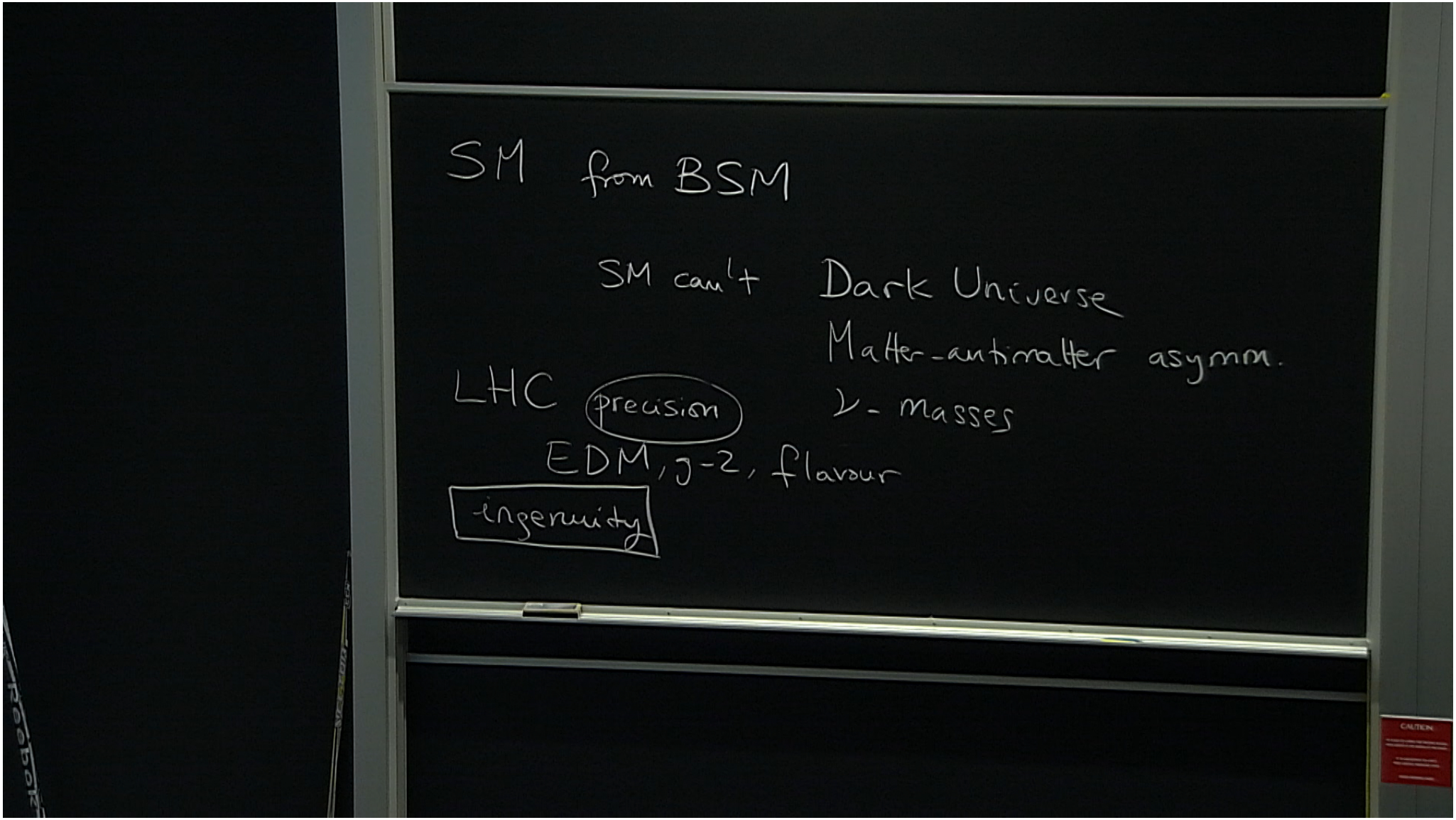

Adobe Reader File Edit View Window Help
Mon 09:10 Veronica Sanz
HIggsATLASRun2.pdf
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17 / 43
245%
Tools Fill & Sign Comment
nd the ratios of the branching fractions into the γγ, WW*, bb and ττ final states normalized
→ ZZ*.
ATLAS Preliminary
√s = 13 TeV, 36.1 - 79.8 fb-1
mH = 125.09 GeV, |yH| < 2.5
Total
Stat.
Syst.
SM
Total Stat. Syst.
σggFZZ 1.13 ± 0.13 0.13 (± 0.12 0.11 , ± 0.06 0.06)
σVBF/σggF 1.17 ± 0.29 0.24 (± 0.23 0.21 , ± 0.17 0.13)
σWH/σggF 1.64 ± 0.74 0.58 (± 0.57 0.46 , ± 0.47 0.35)
σZH/σggF 0.76 ± 0.51 0.43 (± 0.41 0.35 , ± 0.29 0.26)
σttH + tH/σggF 1.20 ± 0.31 0.27 (± 0.23 0.21 , ± 0.20 0.17)
Bγγ/BZZ 0.89 ± 0.15 0.13 (± 0.12 0.11 , ± 0.08 0.06)
BWW/BZZ 0.94 ± 0.19 0.17 (± 0.14 0.12 , ± 0.14 0.12)
Bττ/BZZ 0.87 ± 0.27 0.22 (± 0.19 0.17 , ± 0.18 0.15)
Bbb/BZZ 0.81 ± 0.37 0.28 (± 0.25 0.19 , ± 0.27 0.19)
Theory
LHC pp √s = 7 TeV
Data
stat
stat ⊕ syst
LHC pp √s = 8 TeV
Data
stat
stat ⊕ syst
LHC pp √s = 13 TeV
Data
stat
stat ⊕ syst
tZj
σ [pb]

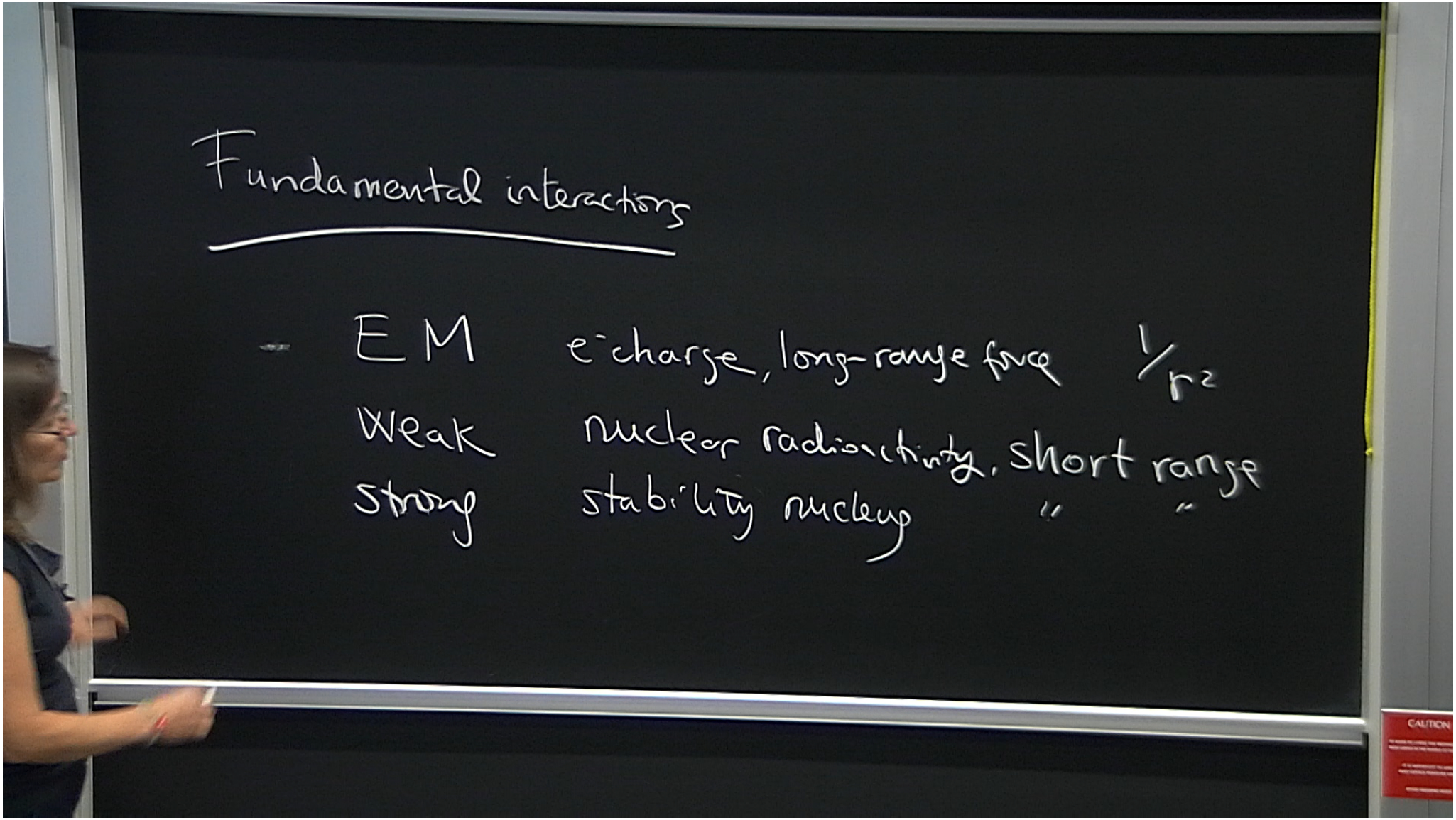

SM from BSM
SM can't
Dark Universe
Matter-antimatter asymm.
ν - masses
CAUTION

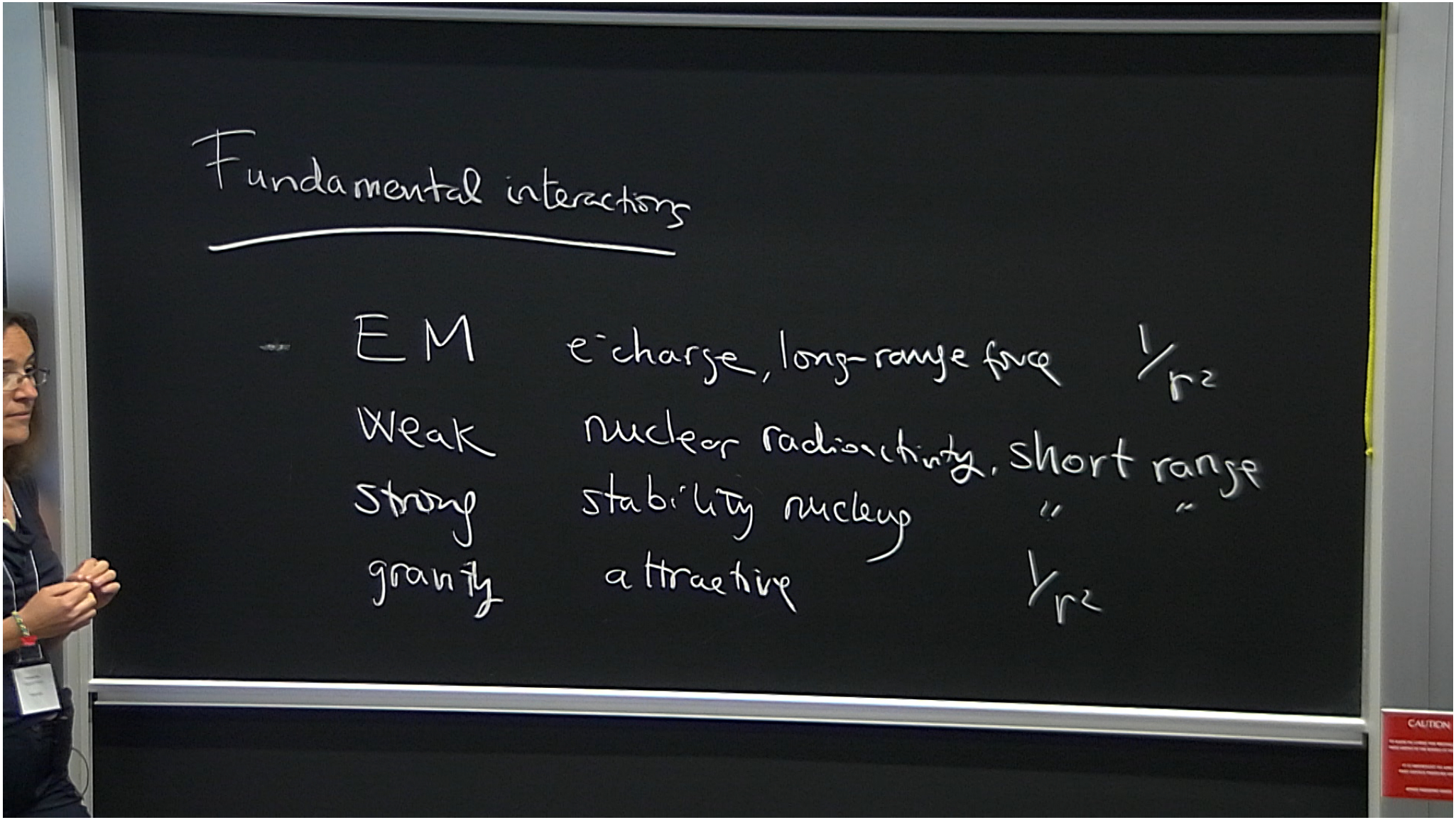

H t, e⁻...
CAUTION
CAUTION


SM smells rotten
$\Lambda > M_{pl}$
Q scalar
hierarchies
fermion masses
flavour
H t, e⁻ ...

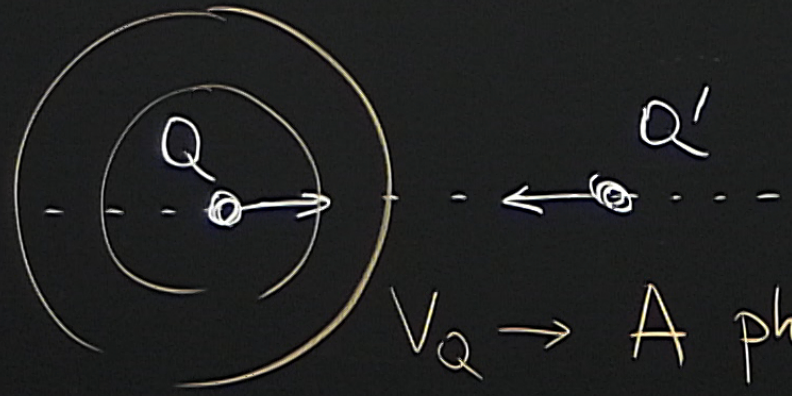

① not SIMPLE structure symms, matter content
② not O(1) NDA
CAUTION


SM from BSM
SM can't
Dark Universe
Matter-antimatter asymm.
LHC
precision
ν - masses
EDM, g-2, flavour
ingenuity

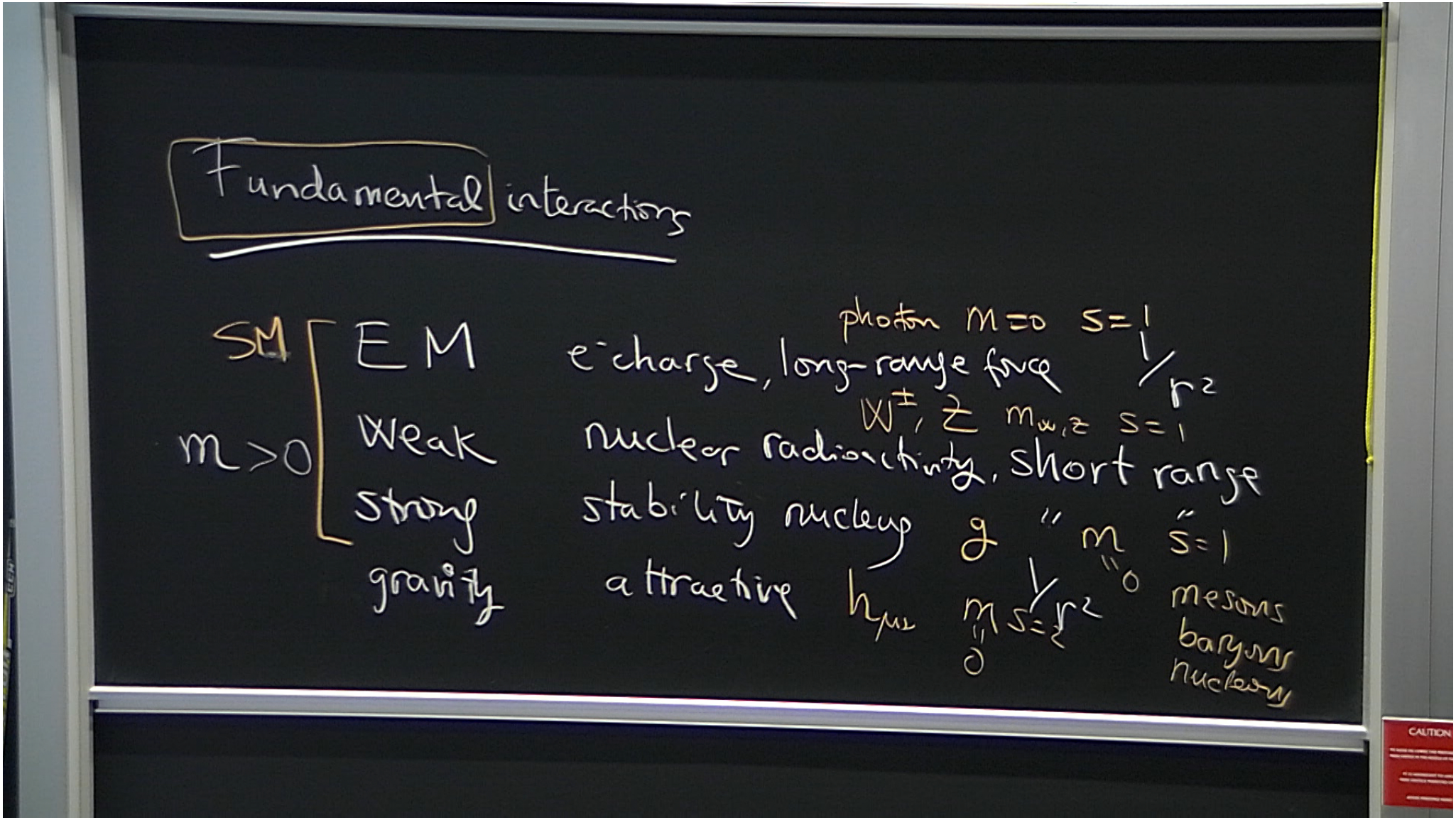

Fundamental interactions
- EM e⁻ charge, long-range force 1/r²
Weak nuclear radioactivity, short range
Strong stability nucleus " "
CAUTION

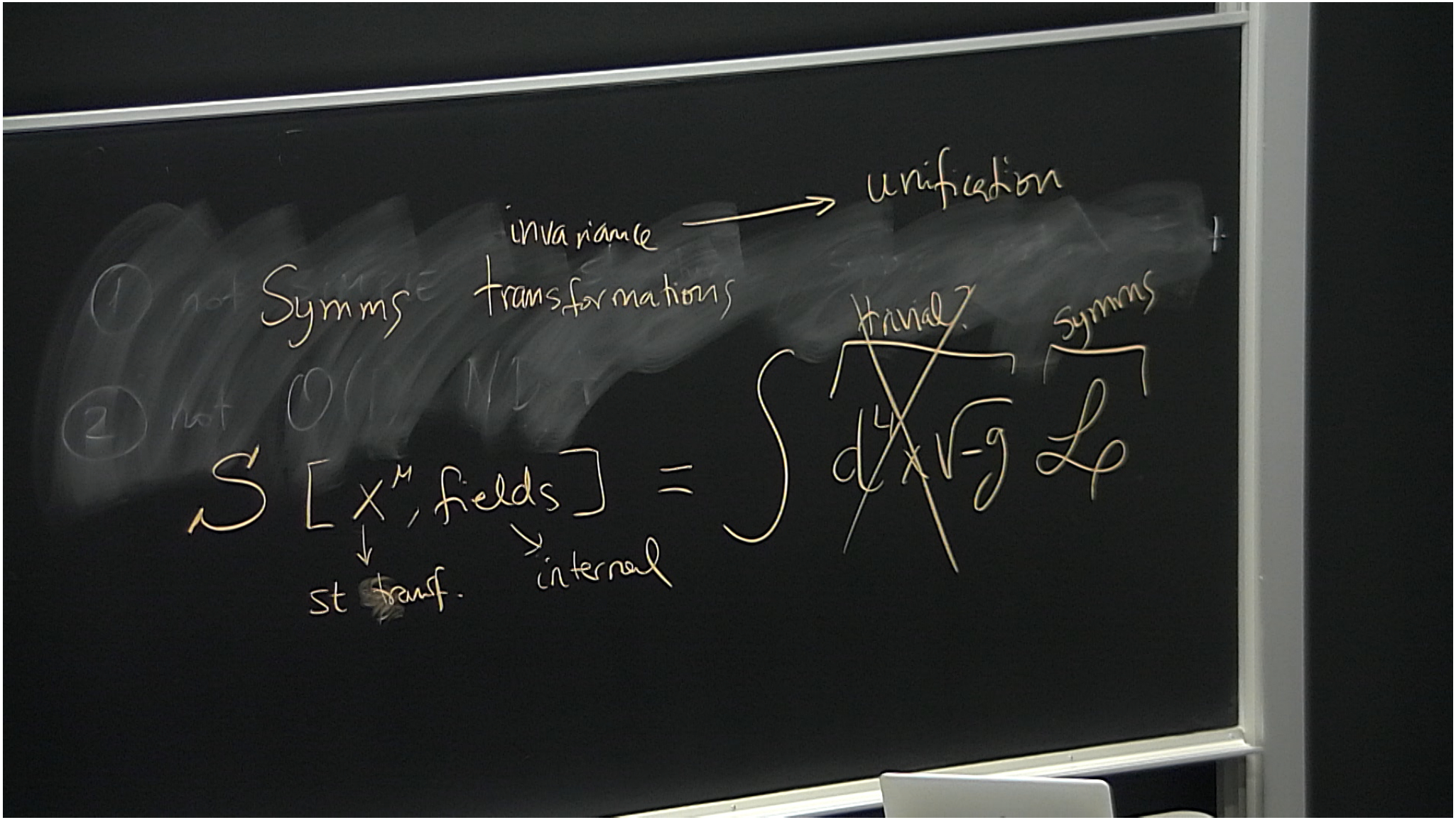

Fundamental interactions
EM e⁻ charge, long-range force 1/r²
Weak nuclear radioactivity, short range
Strong stability nucleus " "
gravity attractive 1/r²
CAUTION

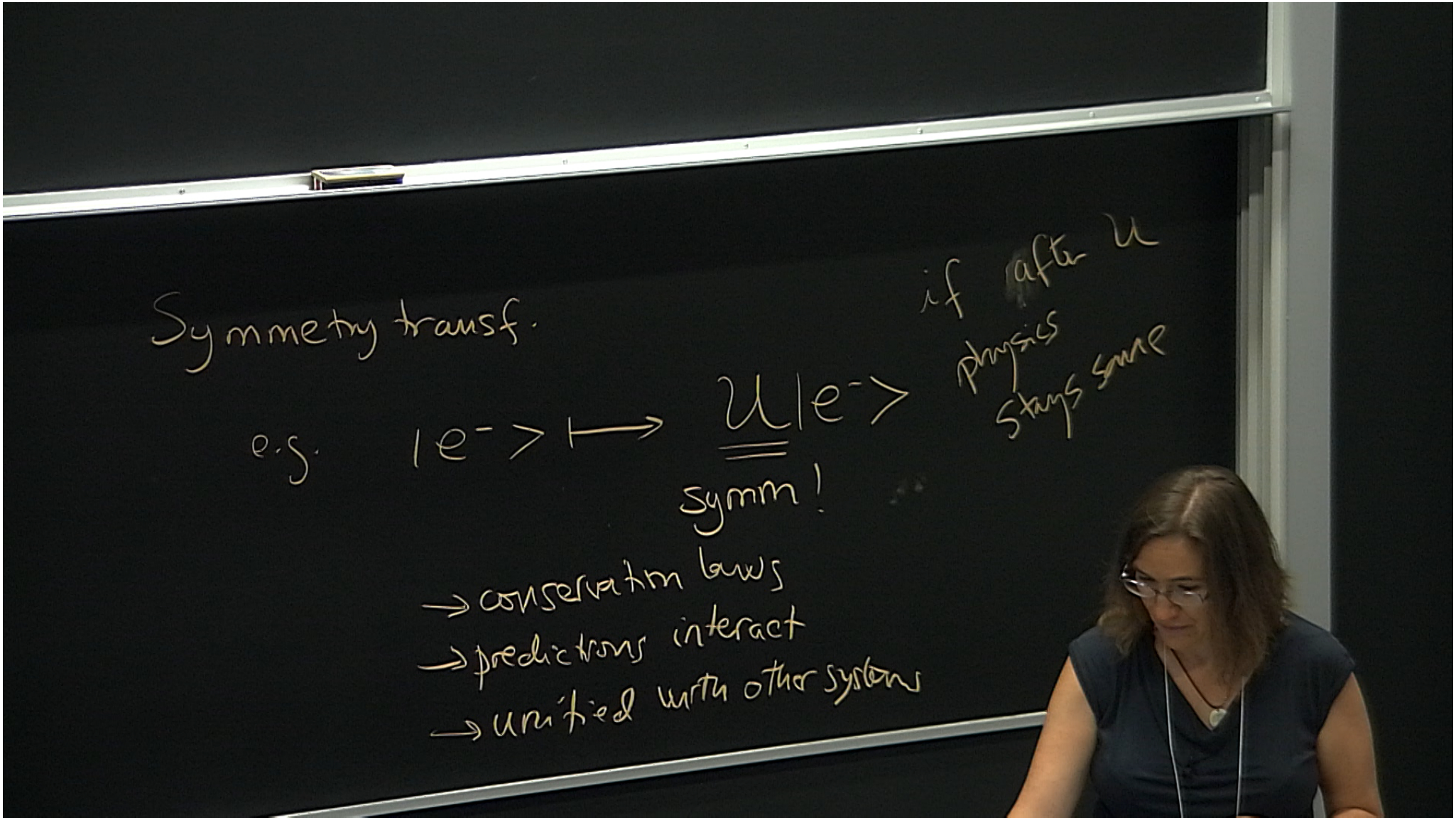
forces → force mediators

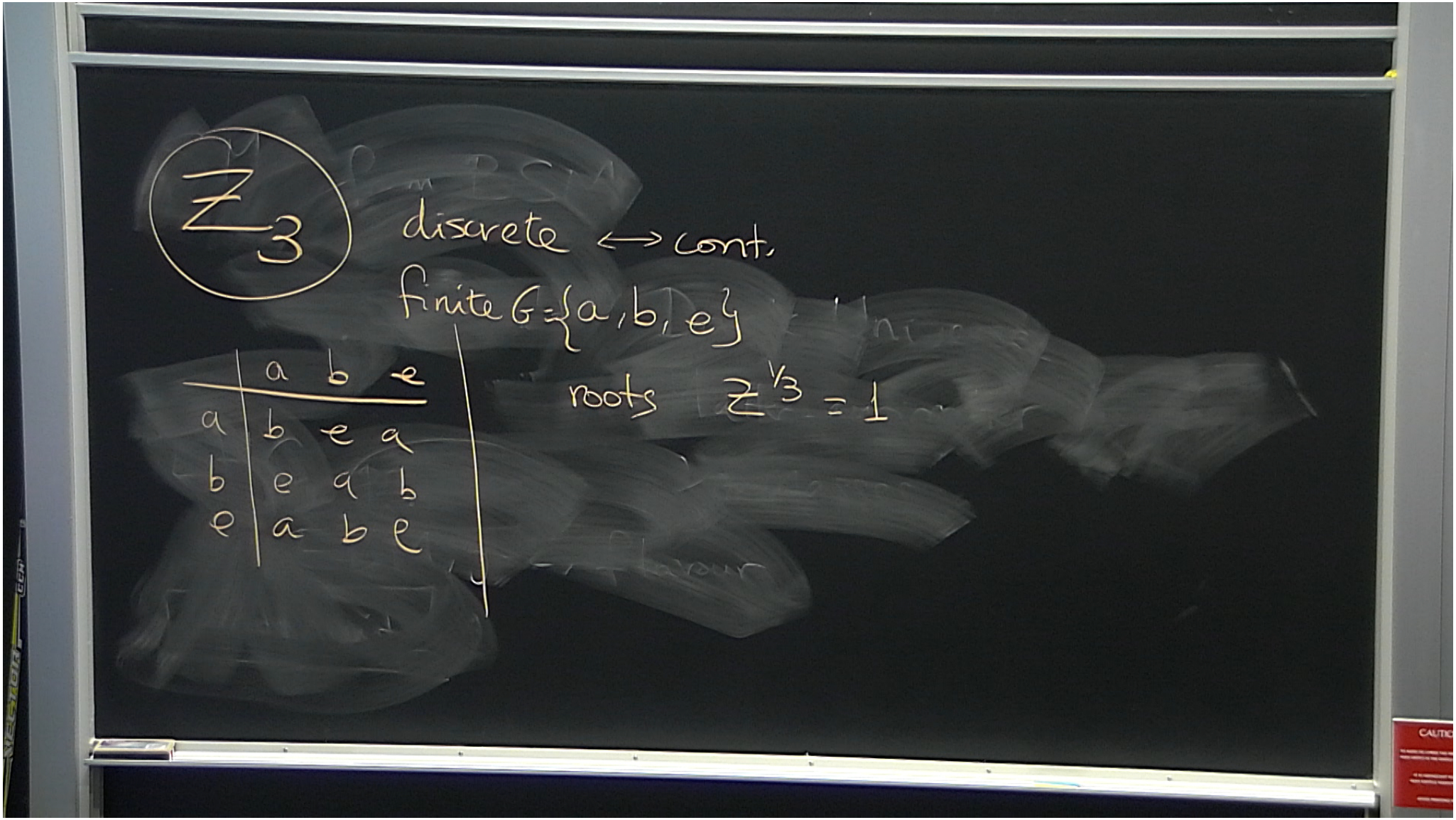


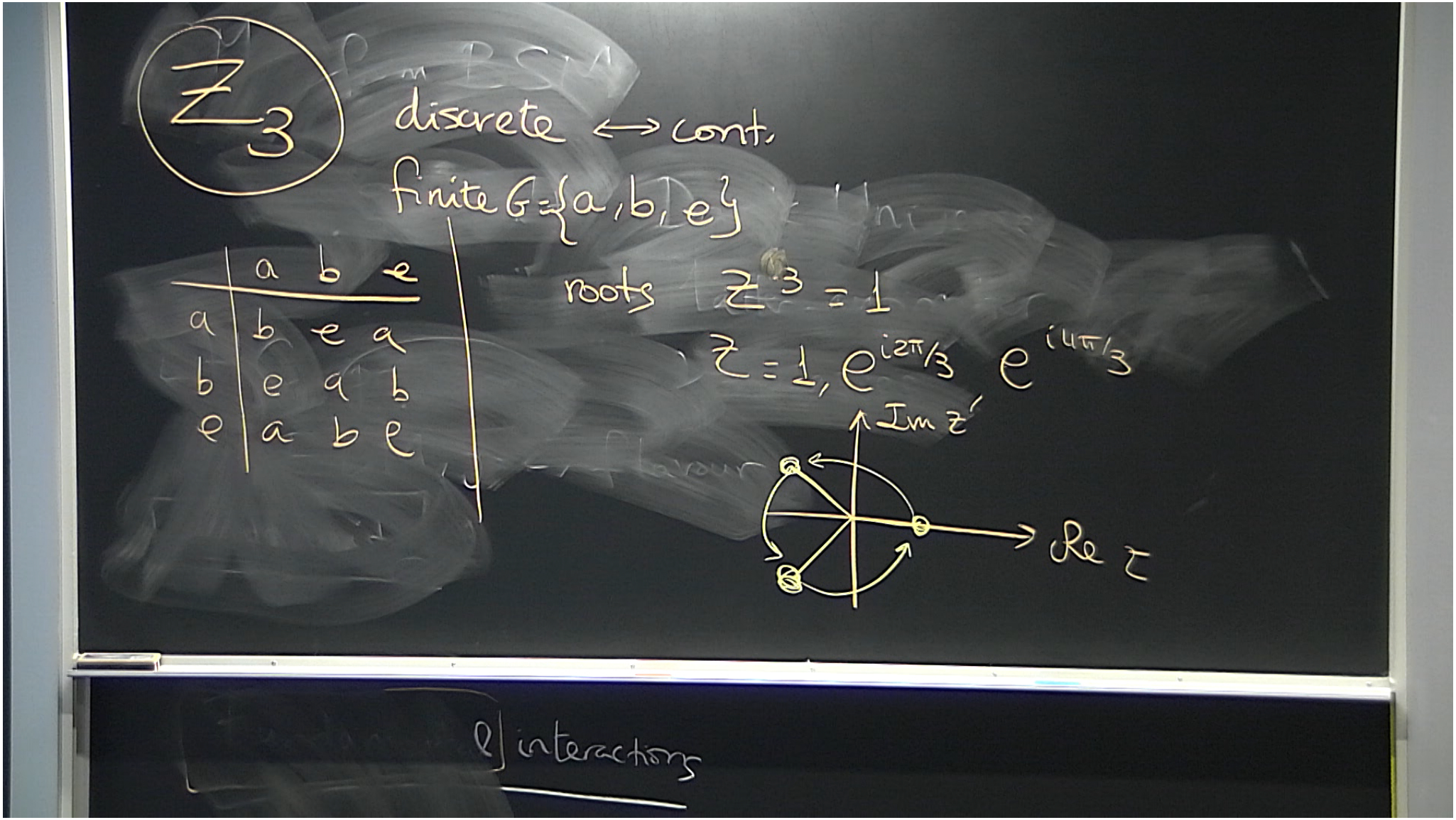
V_Q → A photon

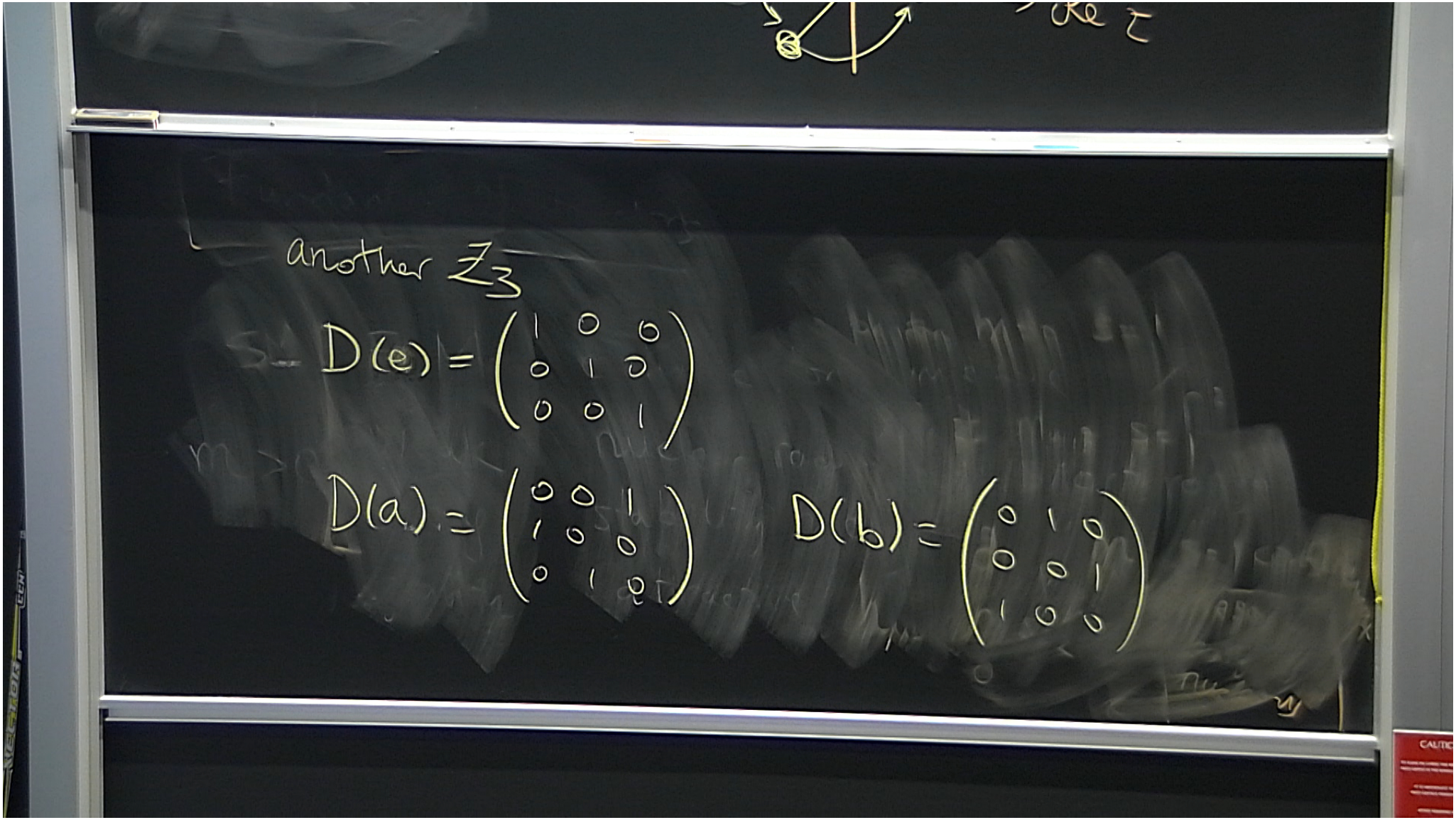

Fundamental interactions
SM
m>0
EM
Weak
strong
gravity
e⁻ charge, long-range force
photon m=0 s=1
1/r²
W±, Z m_W,Z s=1
nuclear radioactivity, short range
stability nucleus
attractive
g m=0 s=1
h_μν m=0 s=2 1/r²
mesons
baryons
nucleons


invariance
unification
Symms
transformations
trivial
symms
$S[x^\mu, \text{fields}] = \int d^4x \sqrt{-g}\, \mathcal{L}$
st transf.
internal


Symmetry transf.
e.g. $|e^-\rangle \longmapsto U|e^-\rangle$
if after U physics stays same
symm!
→ conservation laws
→ predictions interact
→ unified with other systems


$\mathbb{Z}_3$
discrete ↔ cont.
finite $G=\{a,b,e\}$
roots $z^{1/3}=1$
a b e
a b e a
b e a b
e a b e


Z_3
discrete ↔ cont.
finite $G=\{a,b,e\}$
roots $z^3=1$
$z=1, e^{i2\pi/3}, e^{i4\pi/3}$
Im z
Re z
	a	b	e
a	b	e	a
b	e	a	b
e	a	b	e
8 interactions


another Z_3
$D(e) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$
$D(a) = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$
$D(b) = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$

element of group $g(\alpha)$

α cont.

define $g(\alpha=0) = 1$

e.g. rotations in 3D $J_x(\theta)$ $J_y(\theta)$ $J_z(\theta)$