Title: Substructures within substructures

Date: Jun 07, 2008 05:15 PM

URL: http://pirsa.org/08060012

Abstract:

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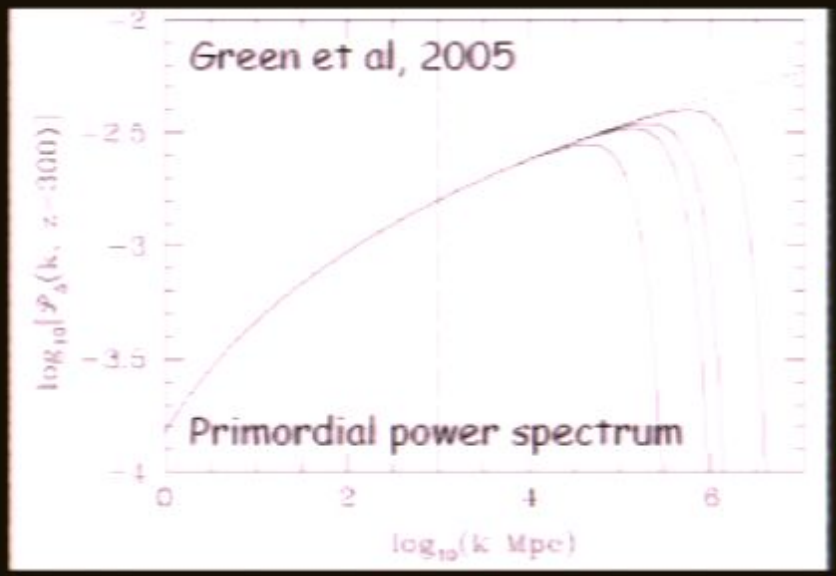
**Theory:** Damping of the primordial power spectrum due to CDM free streaming gives
$M_{fs}=10^{-6}M_{sun}$ @ $M_{CDM}=100$ GeV

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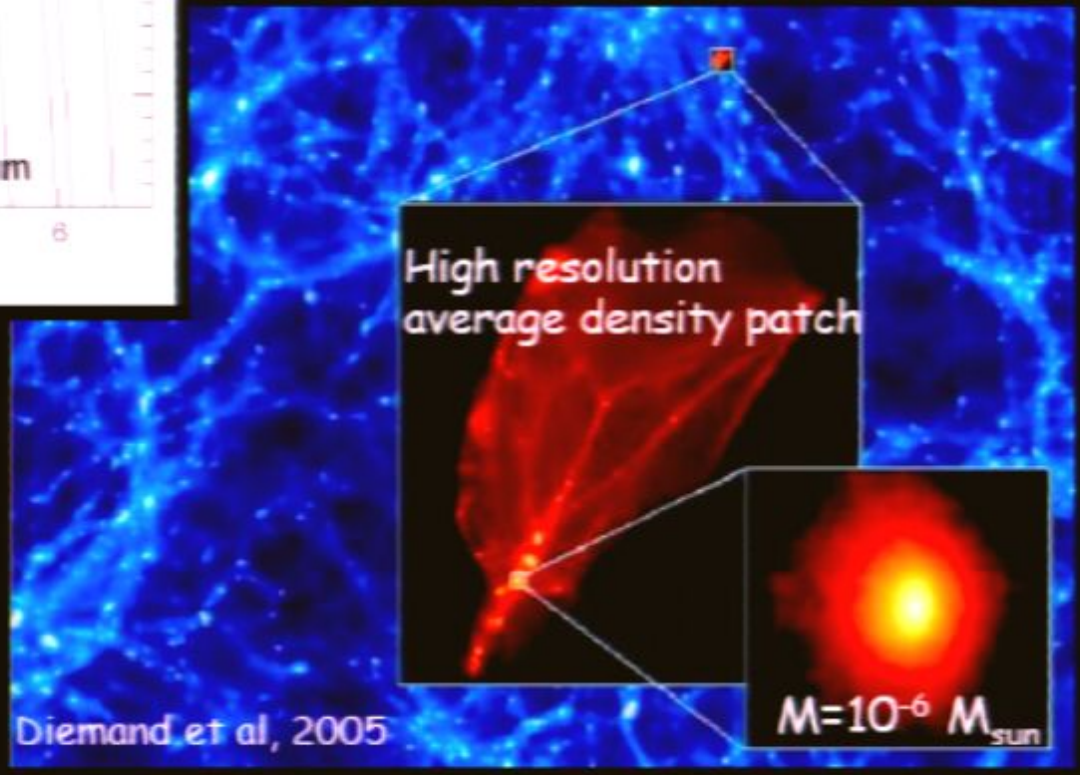
Multiscale tecnique stopping at z=26 can resolve halos as small as $10^{-6}M_{sun}$



# Subhalos within subhalos

Lidia Pieri

Università & INFN – Padova
Consorzio Interuniversitario di Fisica Spaziale

June 7th 2008, Small scale structure of DM @ PI – Waterloo, Canada

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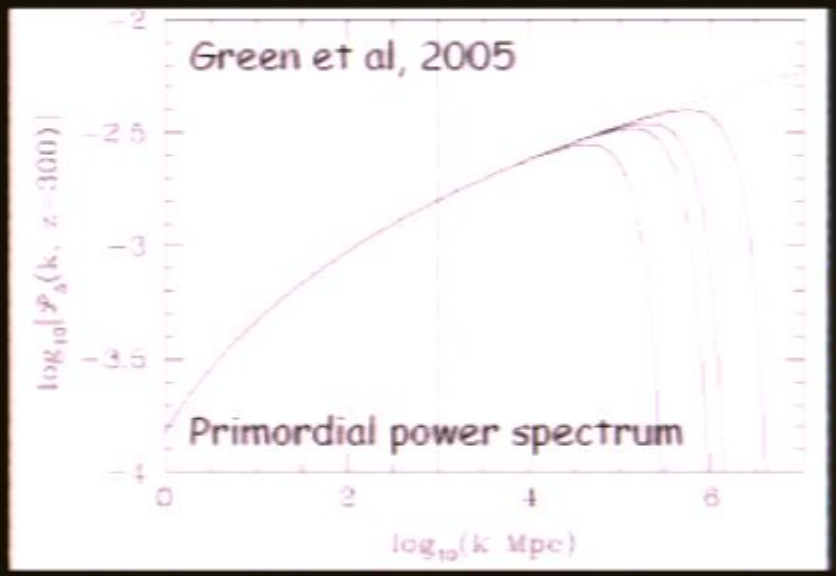


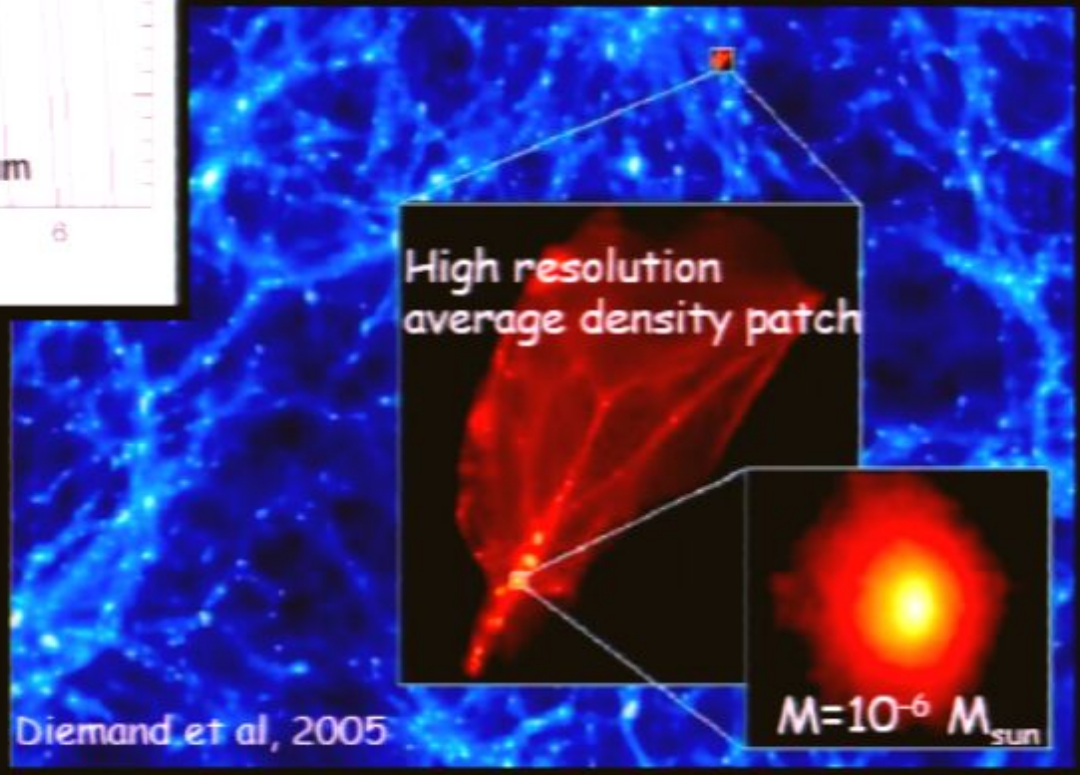


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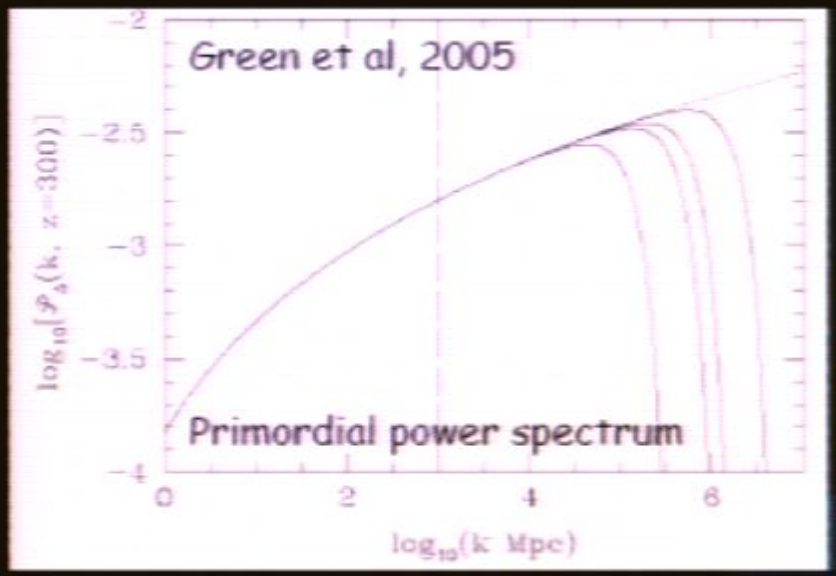


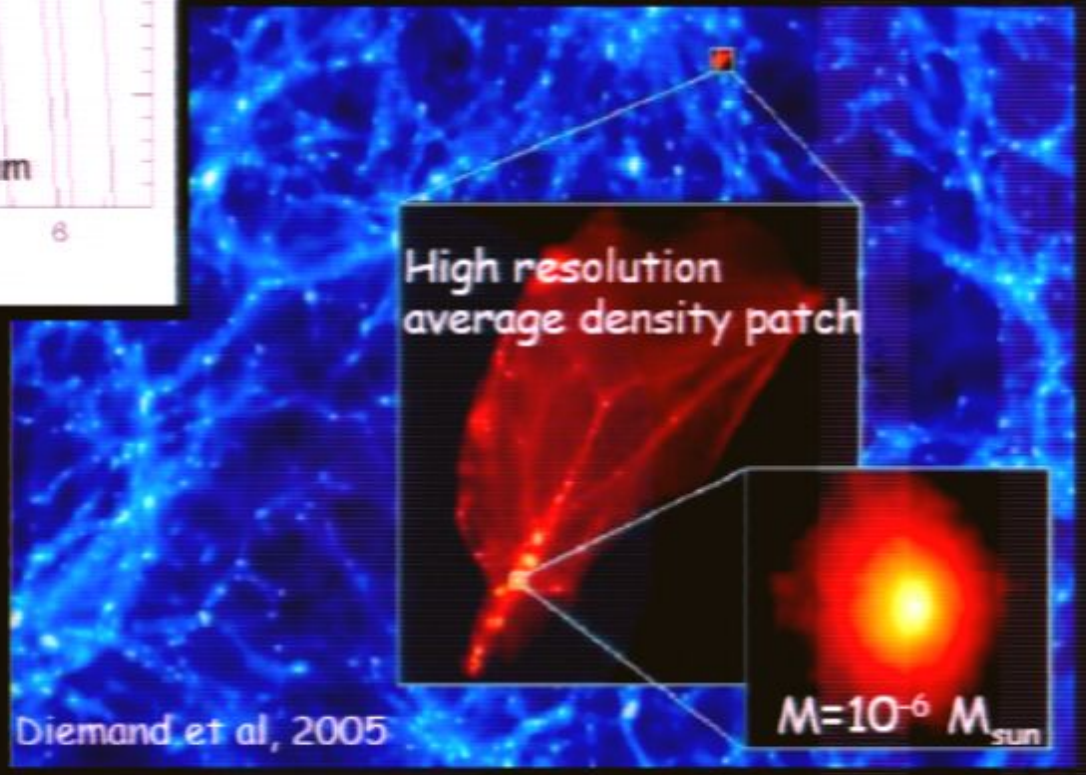


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# Results on subhalo models

## HUGE UNCERTAINTIES

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Pieri, Bertone, Branchini, MNRAS 2007

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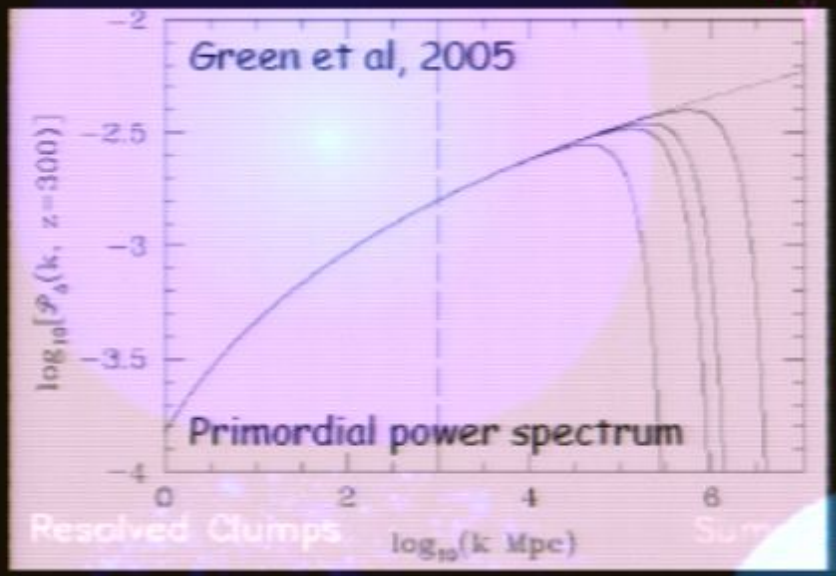


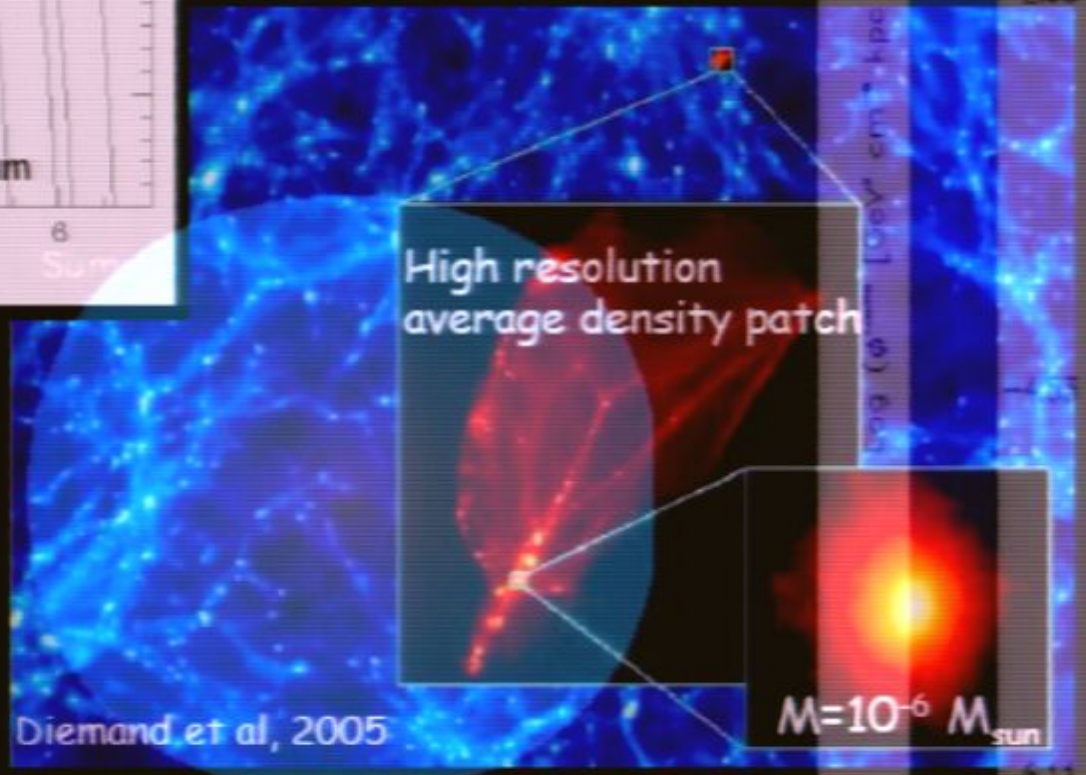


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# Subhalos within subhalos

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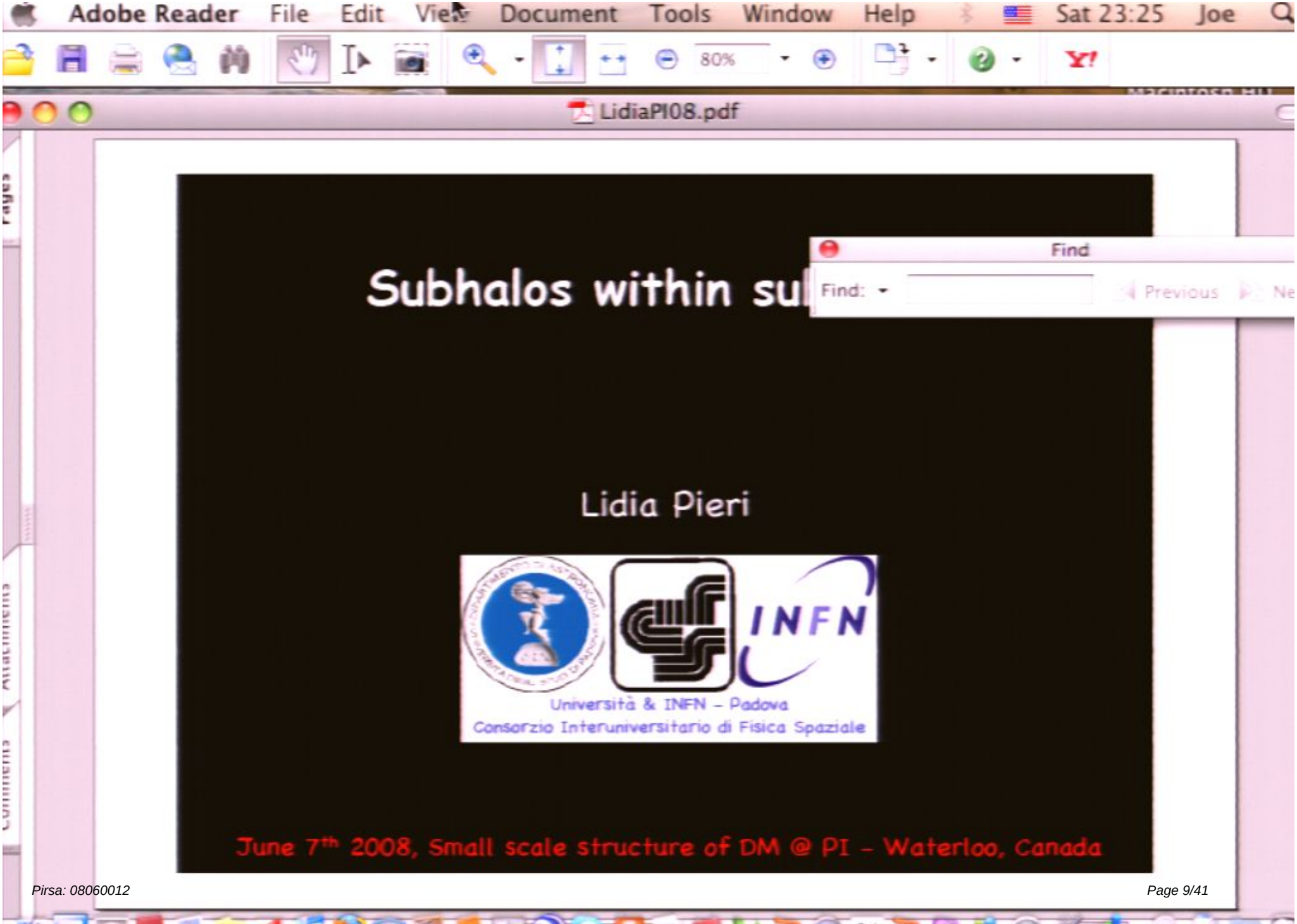
June 7th 2008, Small scale structure of DM @ PI – Waterloo, Canada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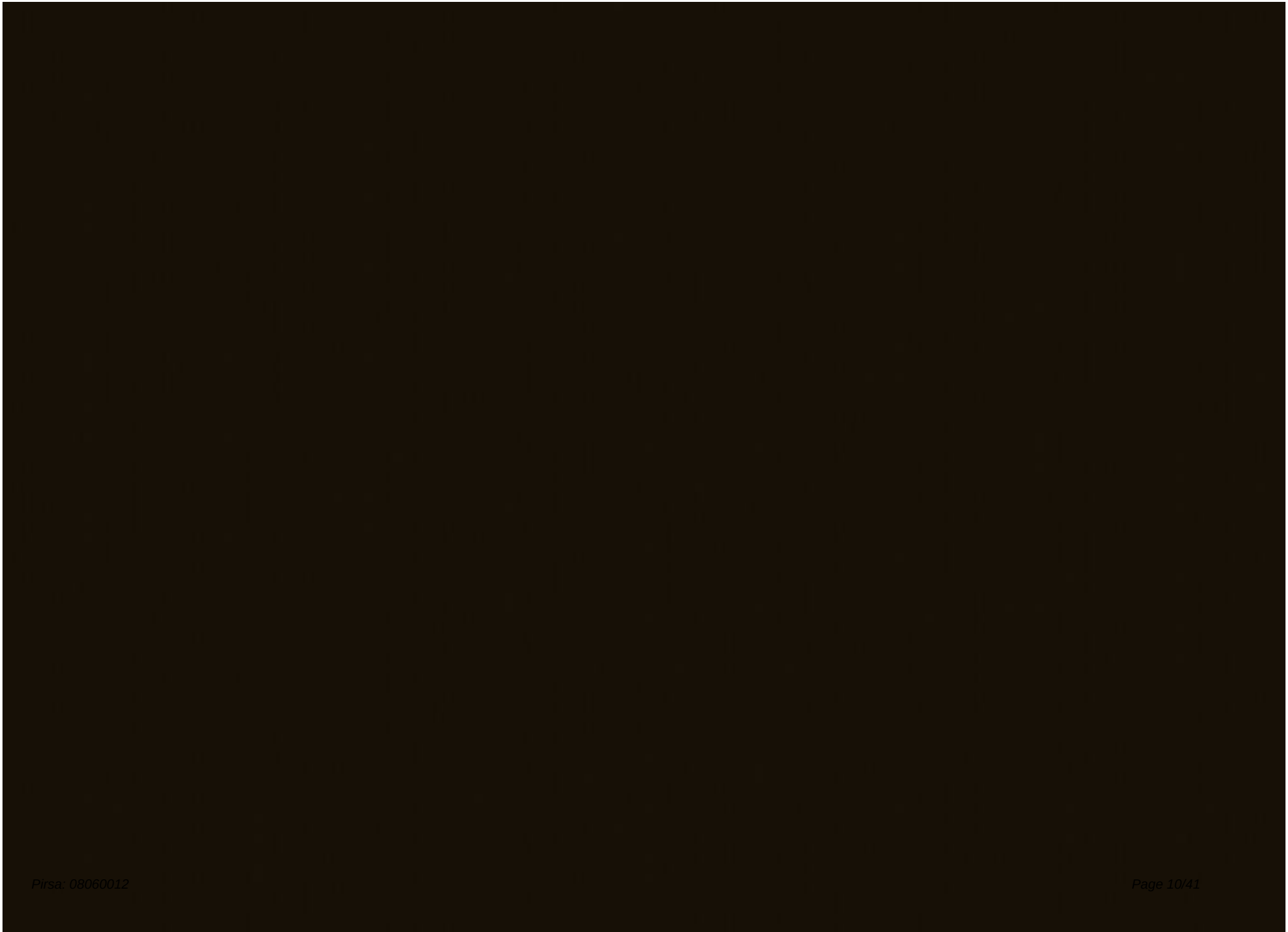

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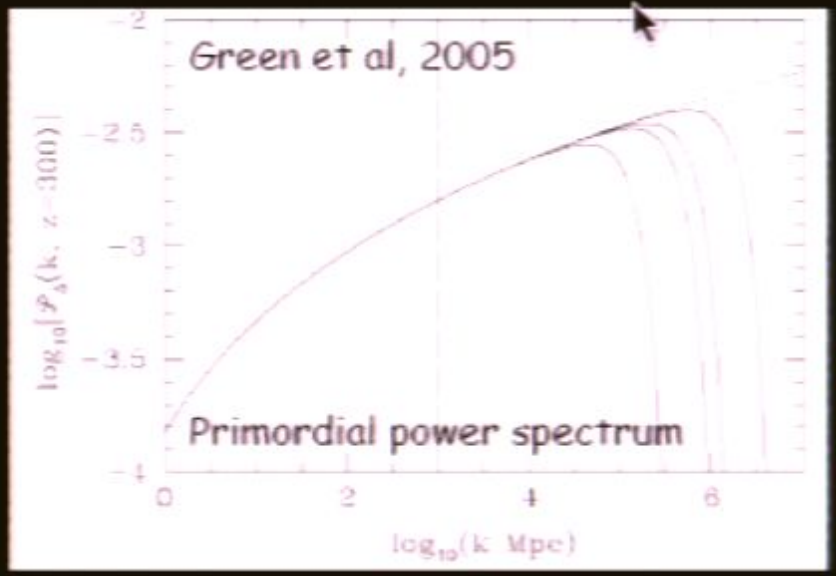


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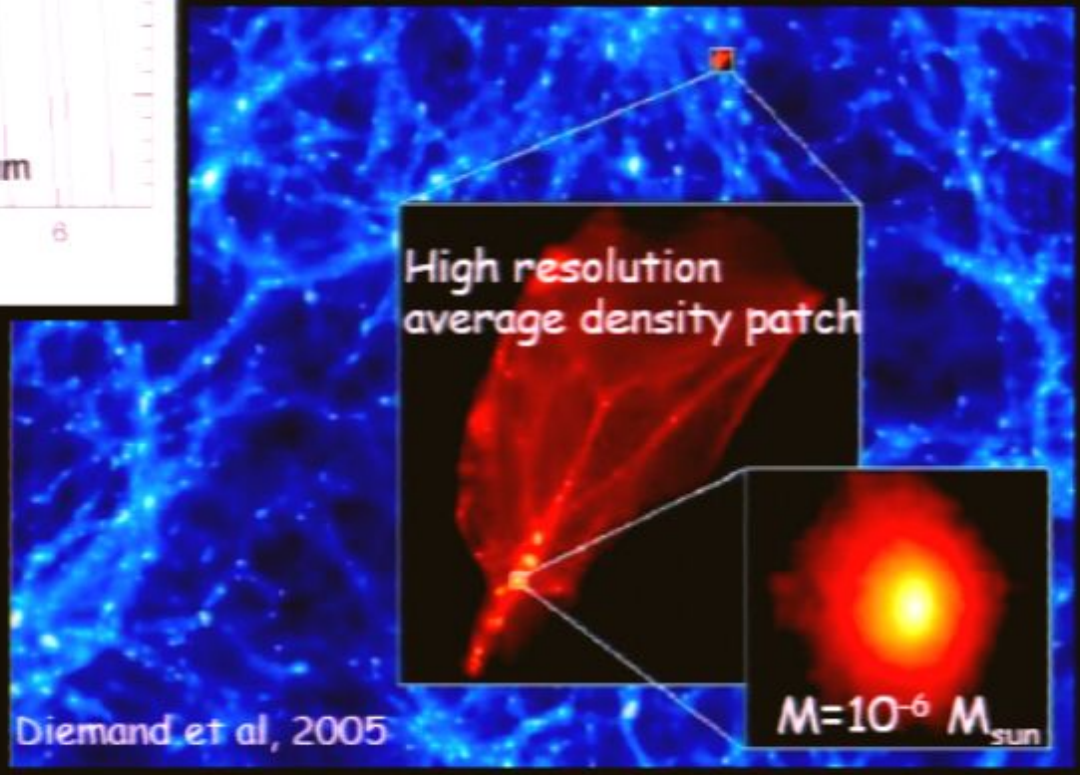

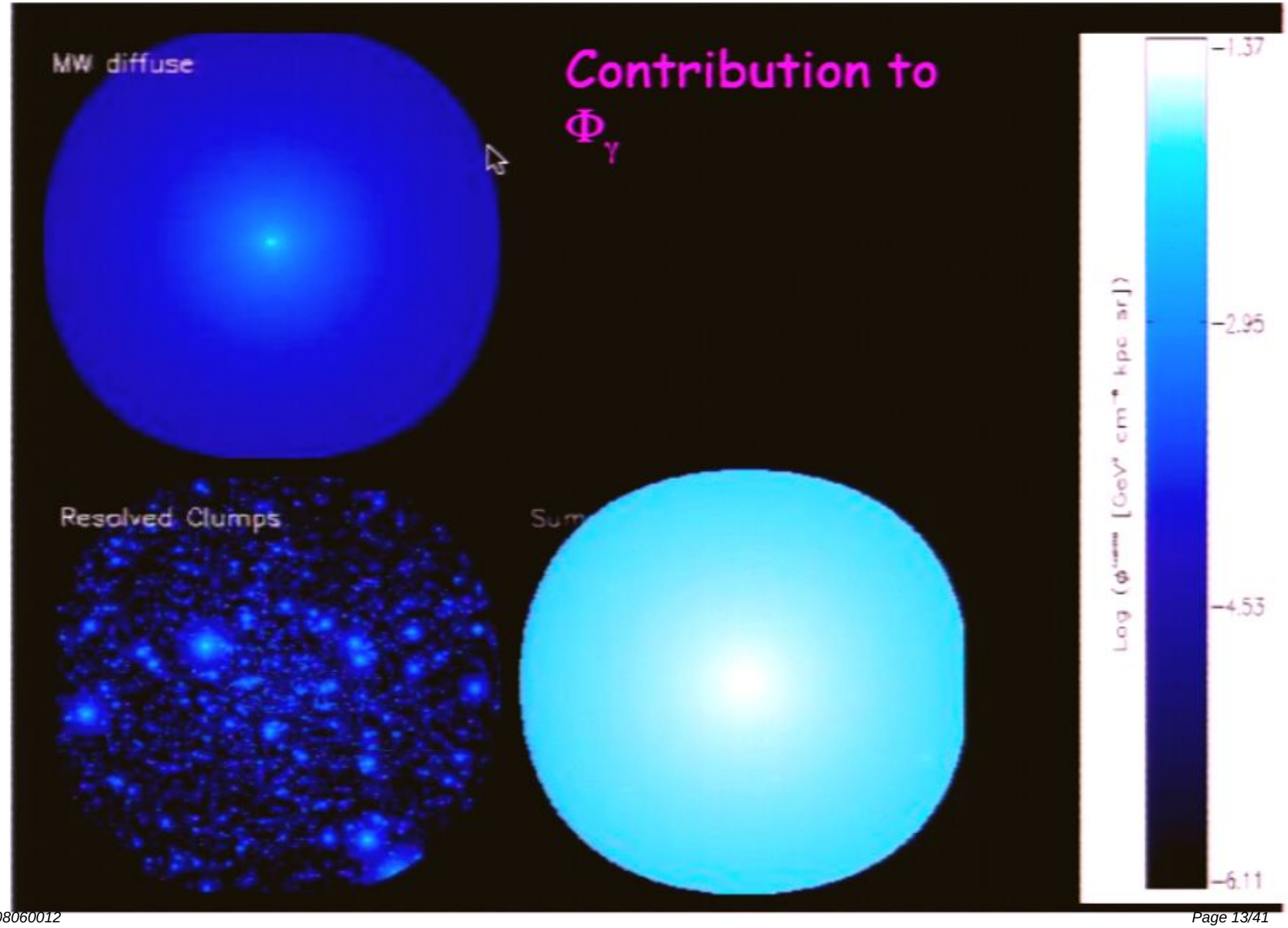
MW diffuse
Contribution to
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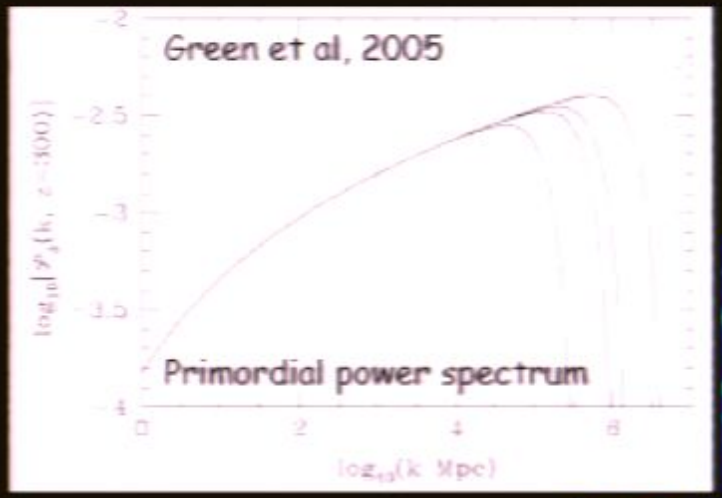




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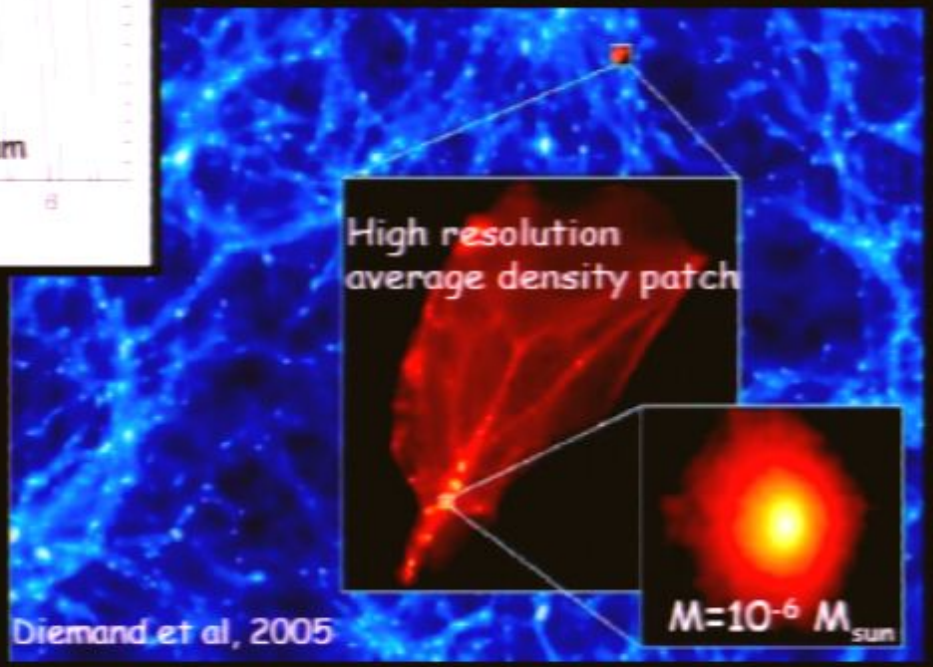

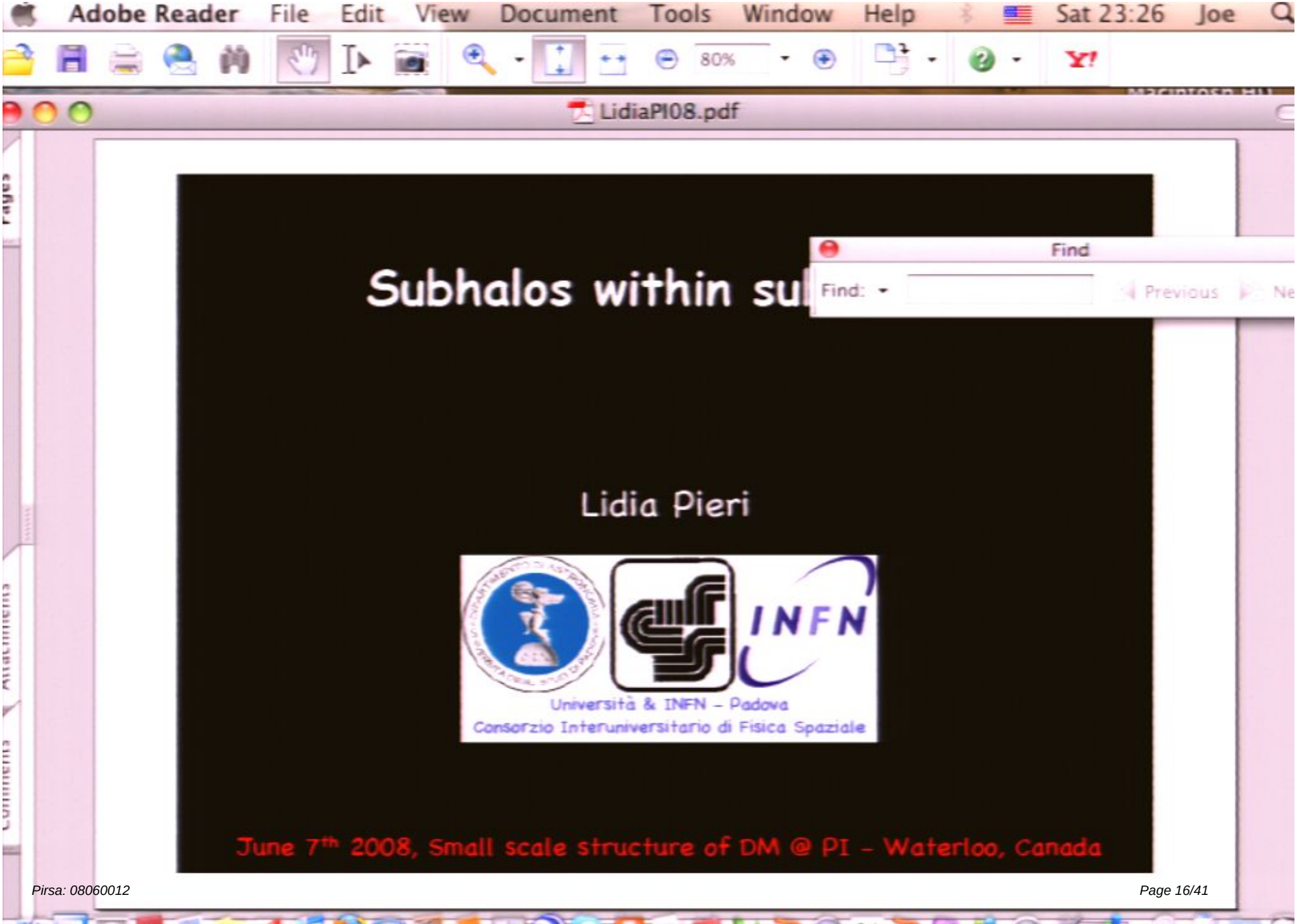
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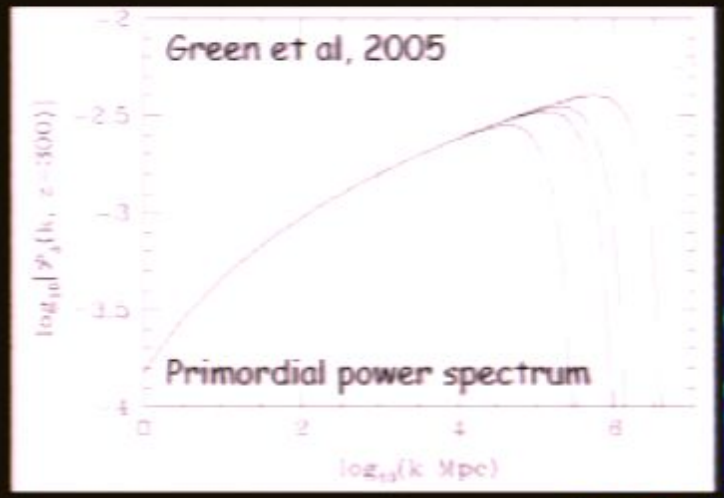


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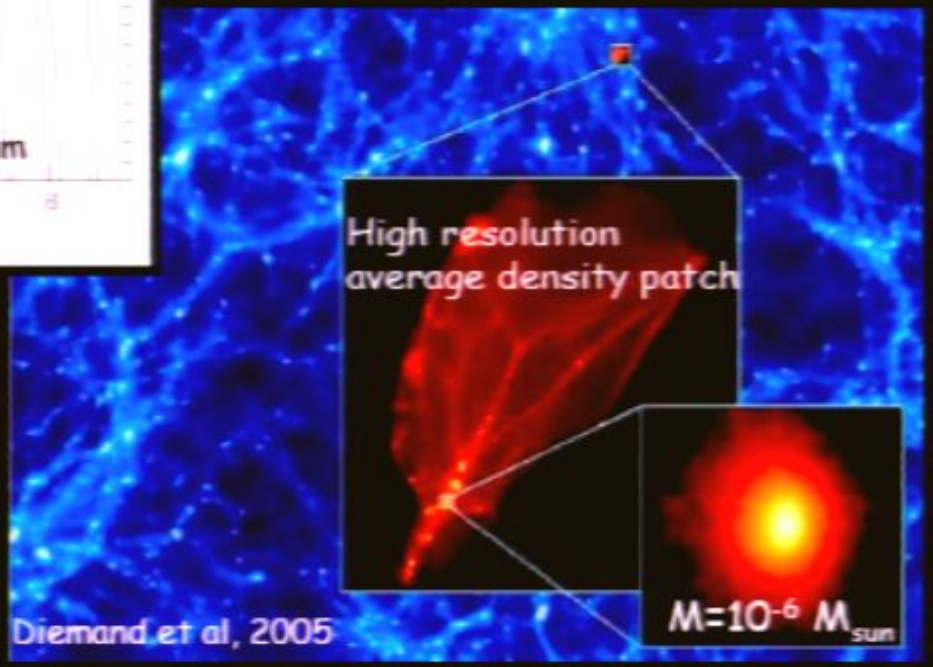
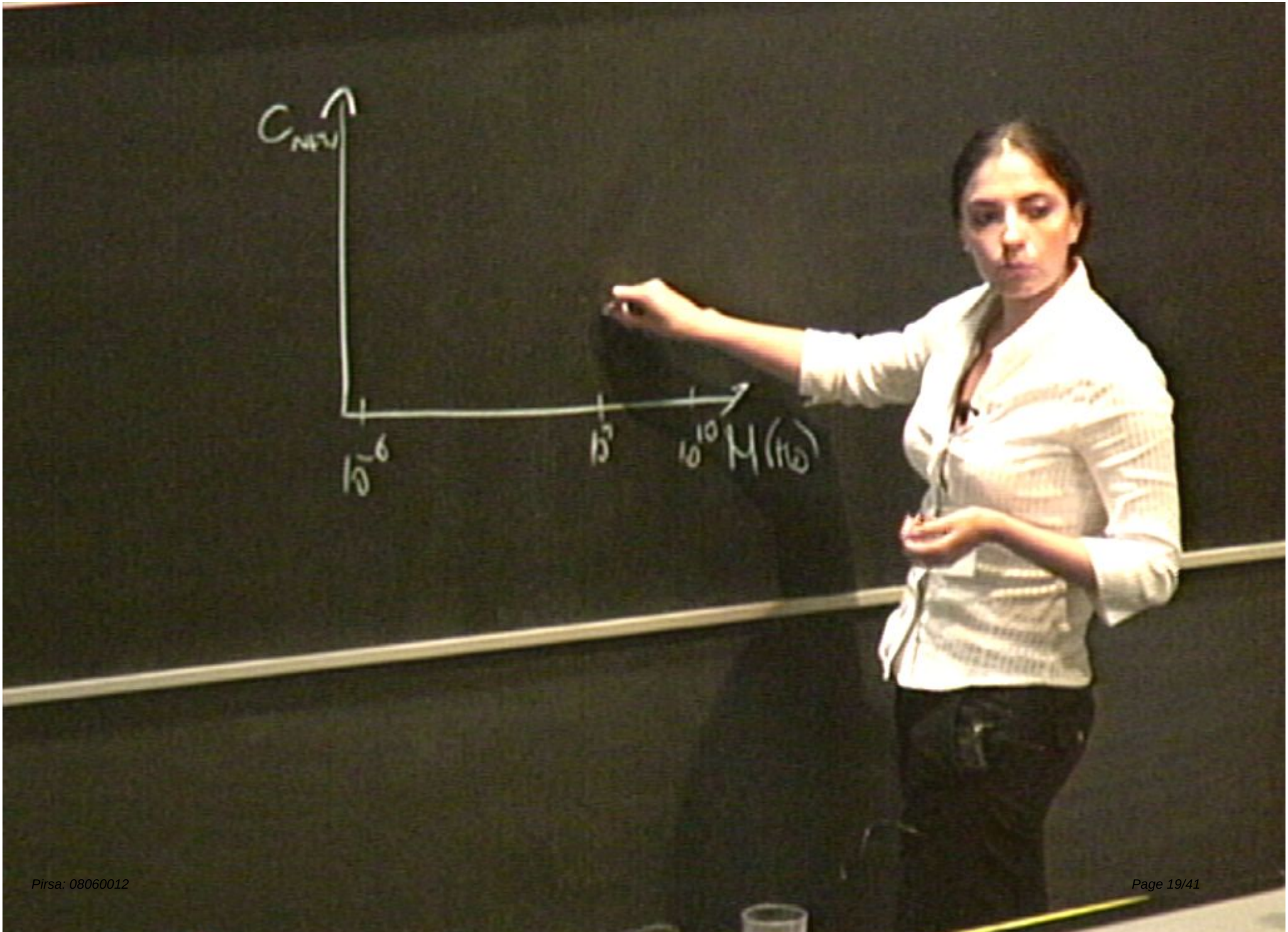
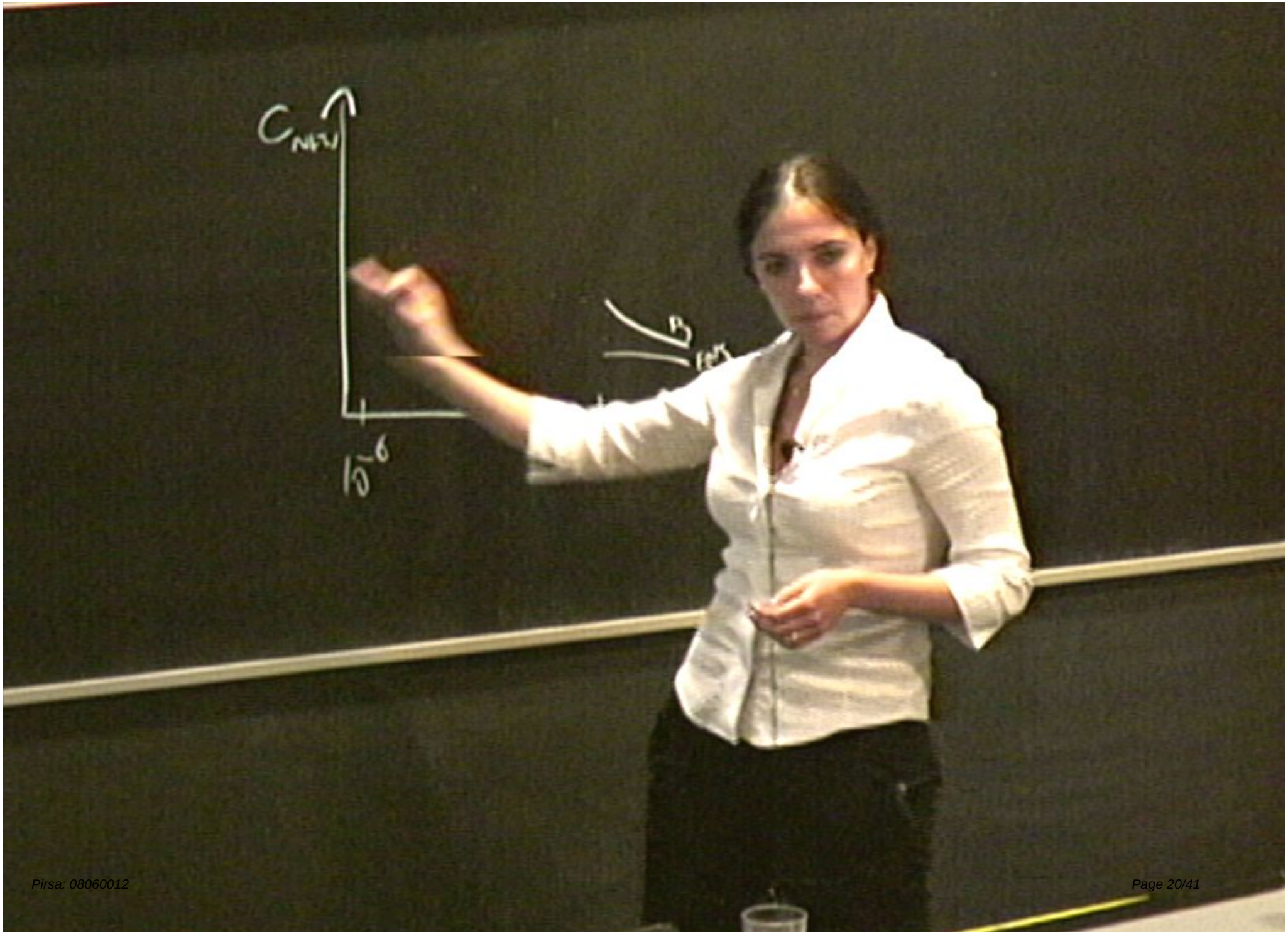
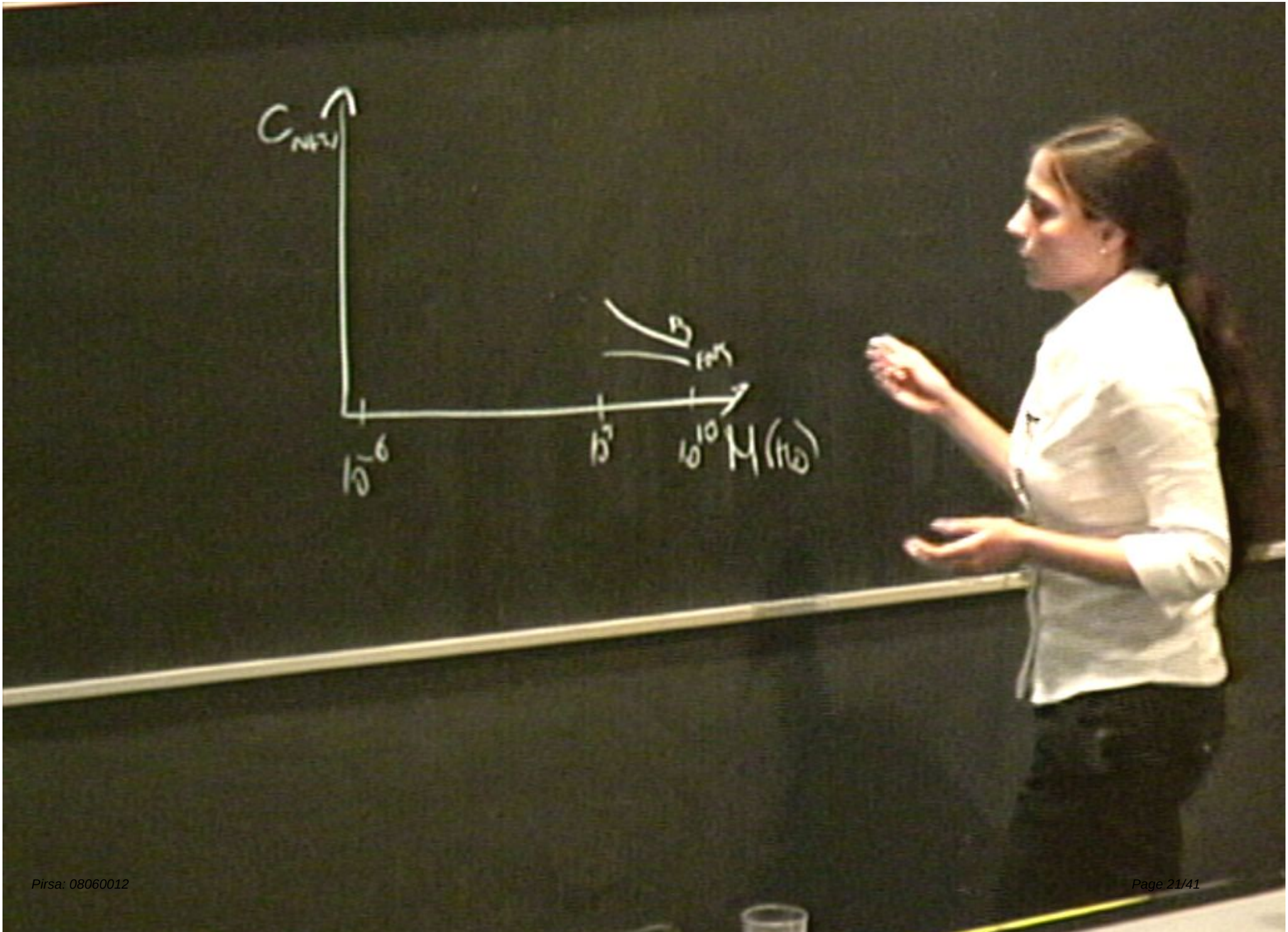



$C_{NEW}$
$10^{-6}$
$10^{5}$
$10^{10}$
$M_{(H_2O)}$


B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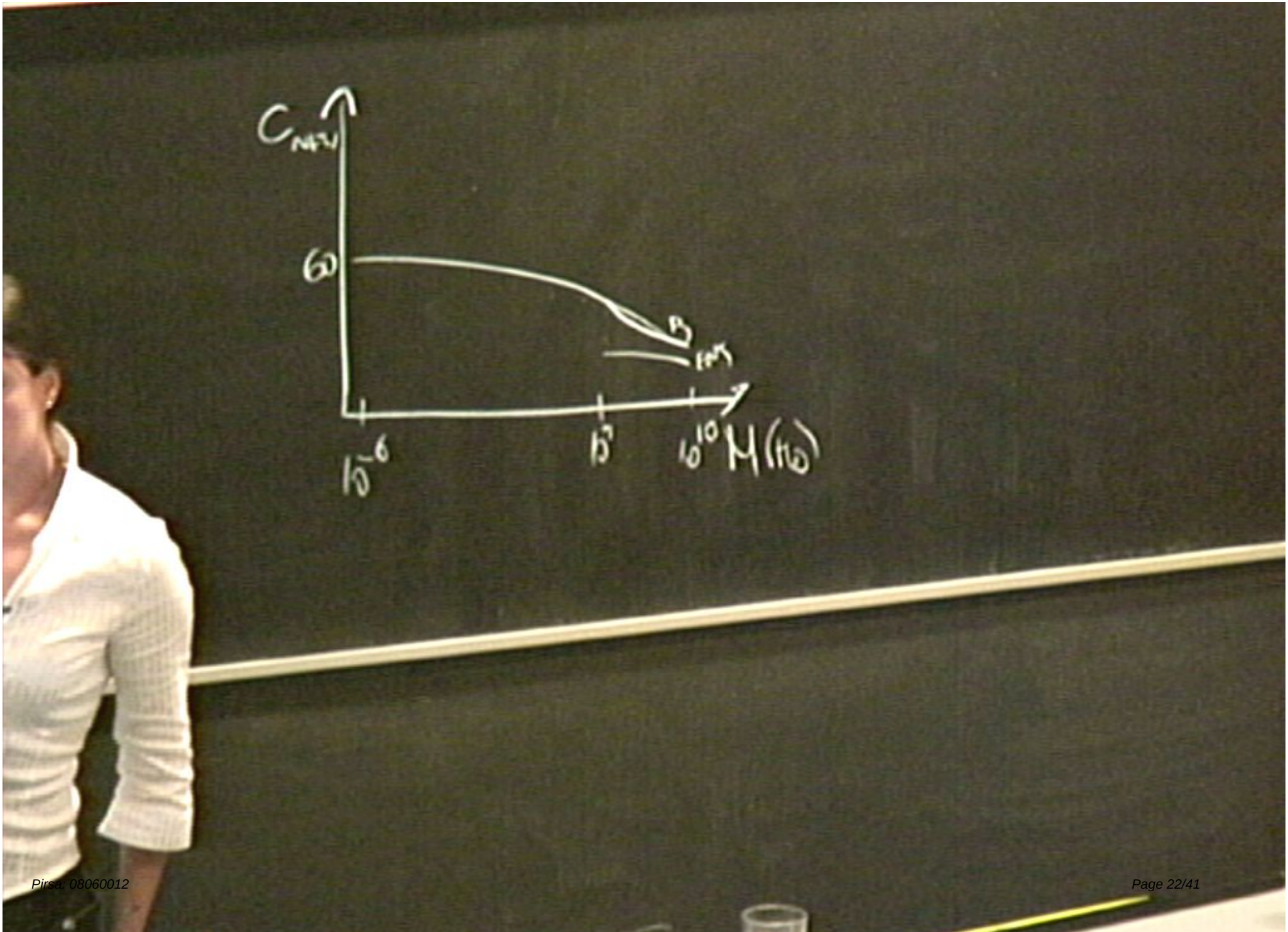
C
60
M (H2O)

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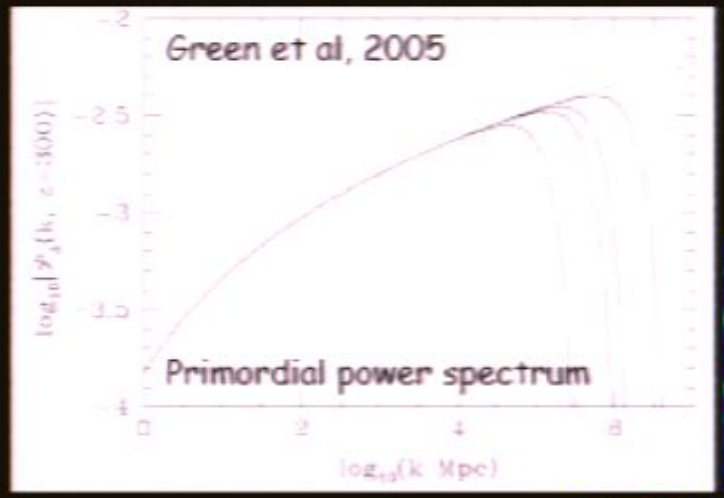


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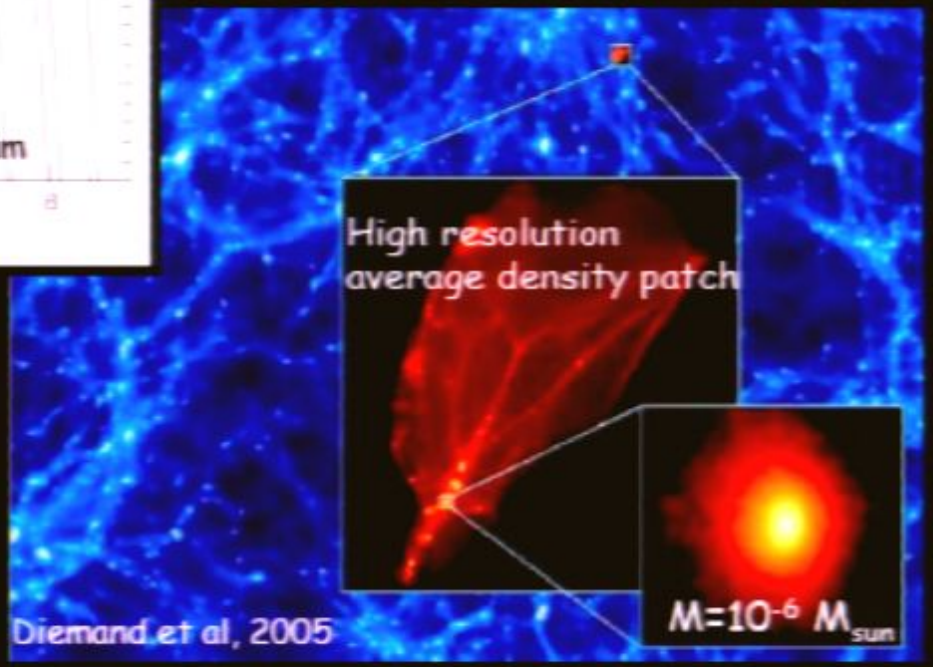

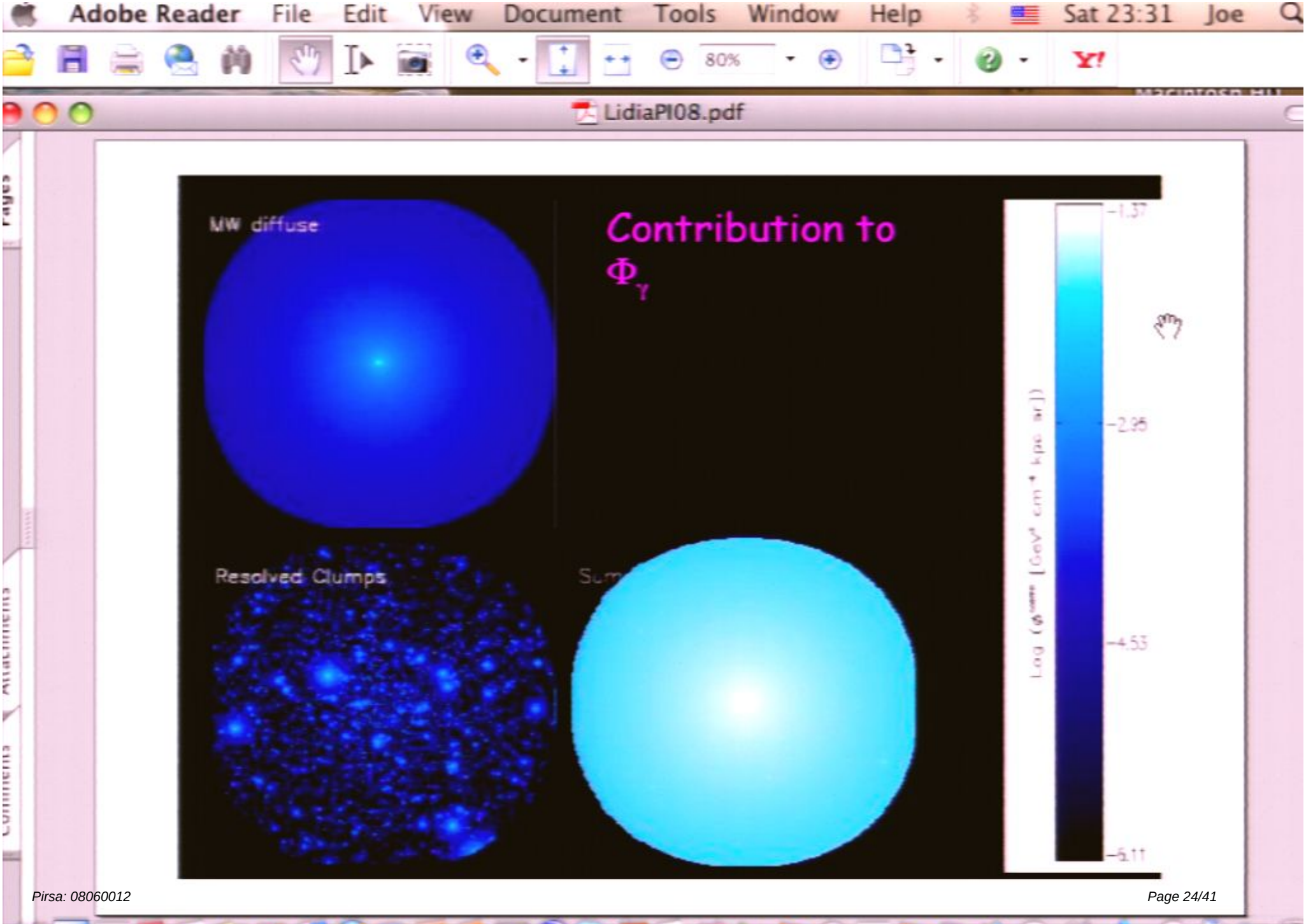
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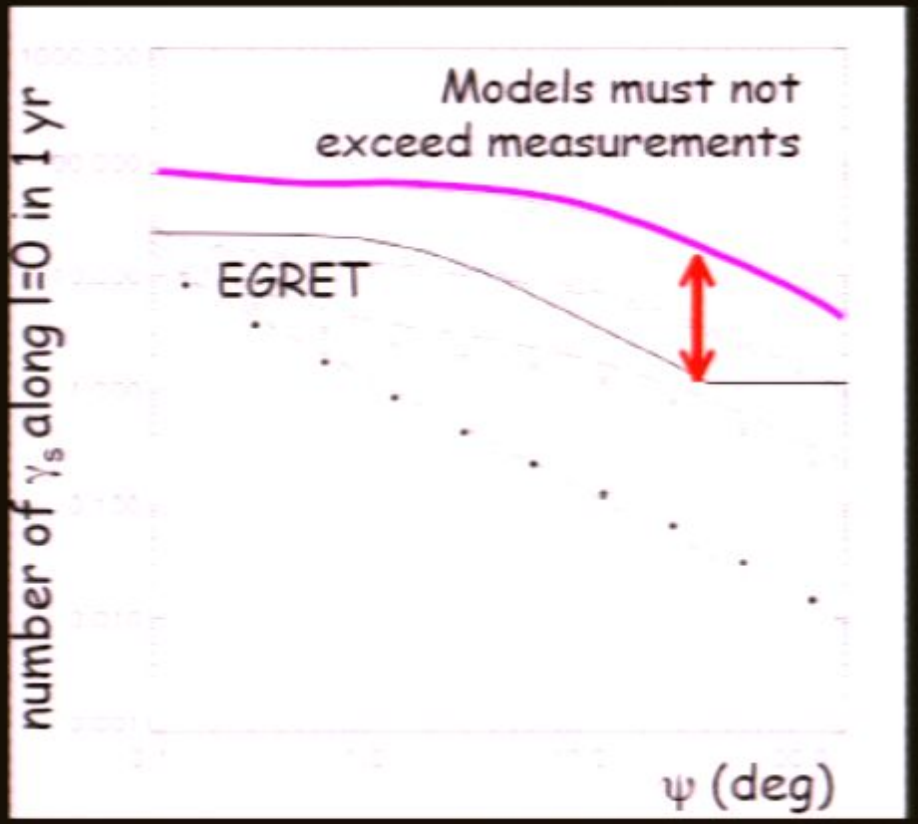
Pieri, Bertone, Branchini, MNRAS 2007

## ( A multi-wavelength analysis was necessary

The 130 halos could have been thousands if..

**...EGRET EGB data were not used to constrain dark matter phenomenology...**

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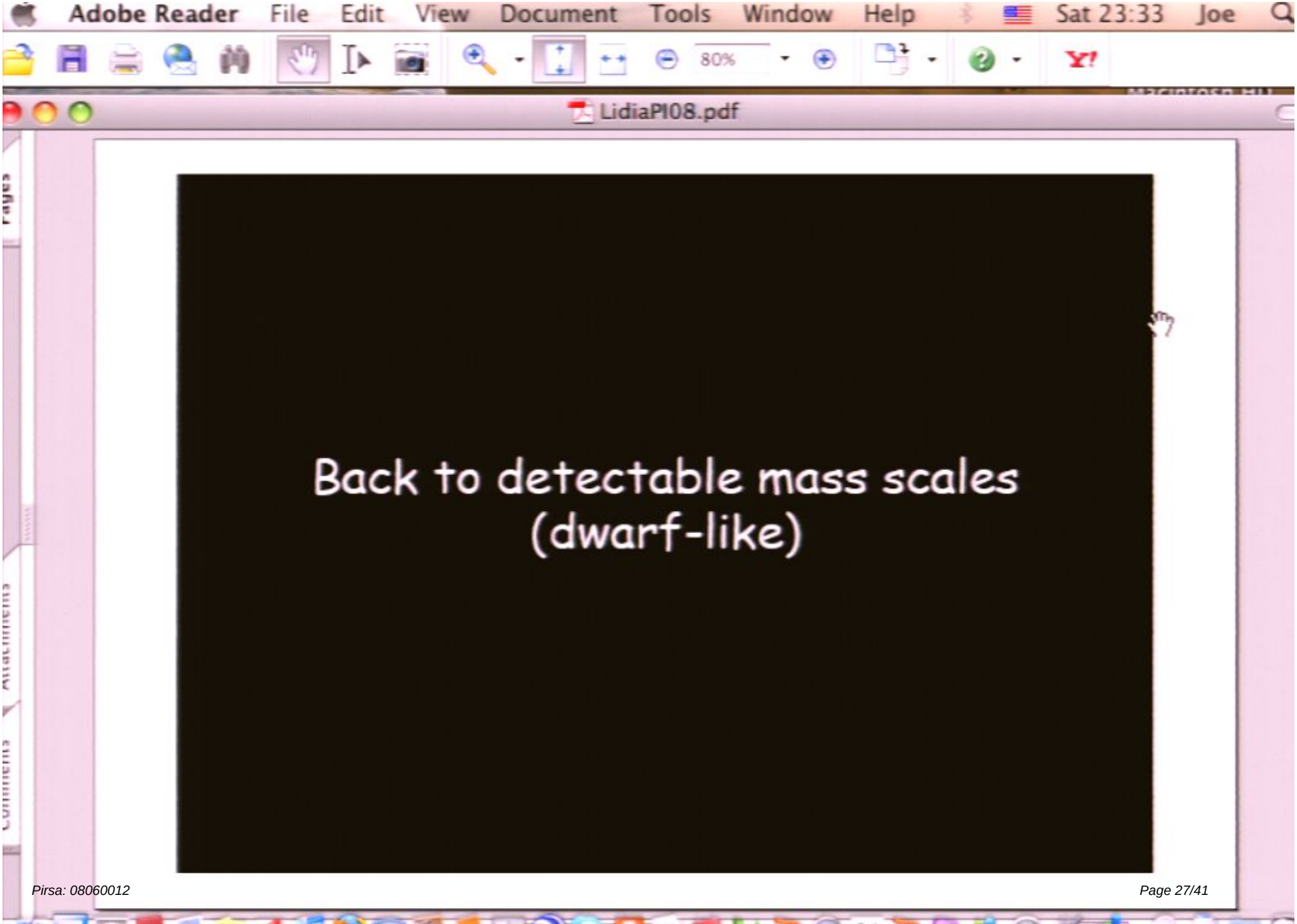
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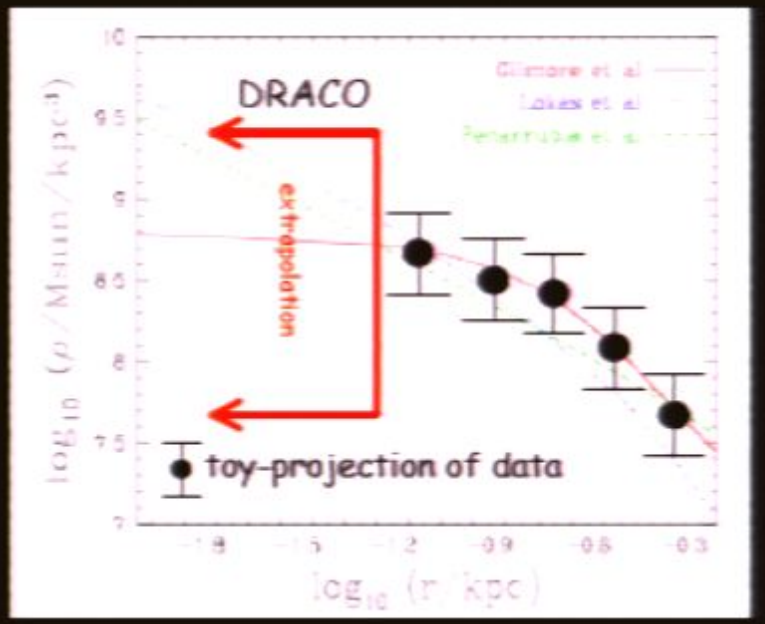
Back to detectable mass scales
(dwarf-like)

The dwarf galaxies are in the range of masses detectable with GLAST with our universal NFW...

What happens if we use profiles derived by astronomical data?

cuspy or cored density profiles are not disentagled by available dispersion velocity measurement

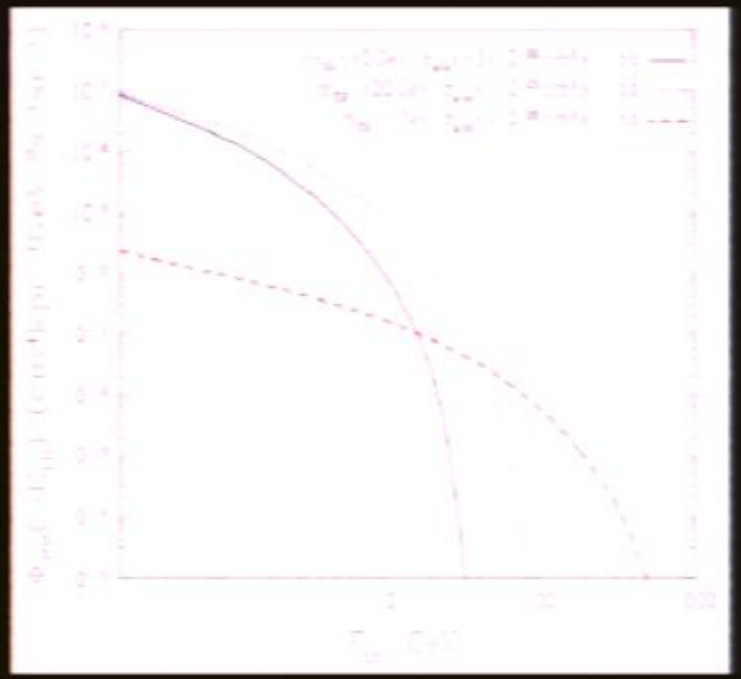
$$\frac{\Delta\sigma_v}{\sigma_v} \sim 10\% \rightarrow \frac{\Delta\rho}{\rho} \sim 20\% \rightarrow \frac{\Delta\phi_\gamma}{\phi_\gamma} \sim 33\%$$

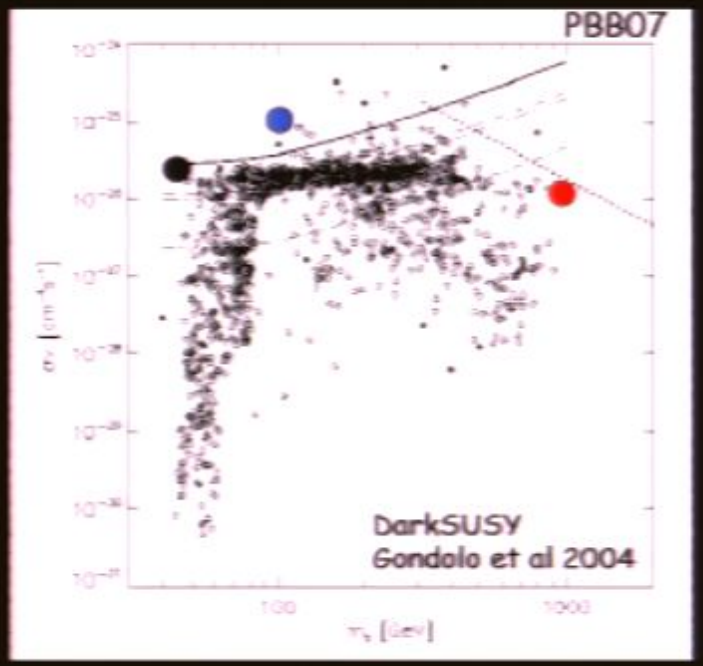



Pieri et al, 2008, MNRAS submitted

## Computing $\Phi_\gamma = \Phi_{\text{particle physics}} \times \Phi_{\text{cosmology}}$

$$\phi_{pp} = \frac{1}{4\pi} \frac{\sigma_{ann} v}{2m_\chi^2} \int_{E_{th}}^{m_\chi} \sum_f \frac{dN_f^\gamma}{dE_\gamma} BR_f \, dE_\gamma$$



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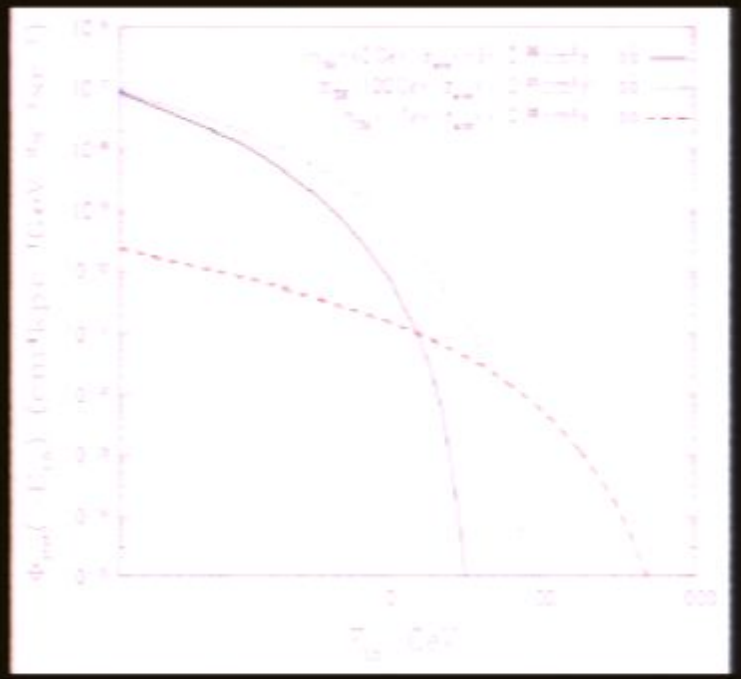
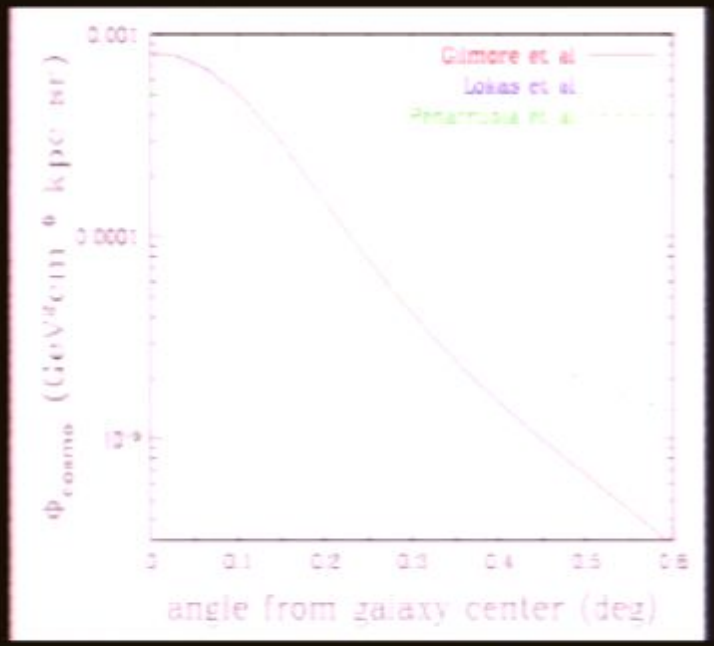


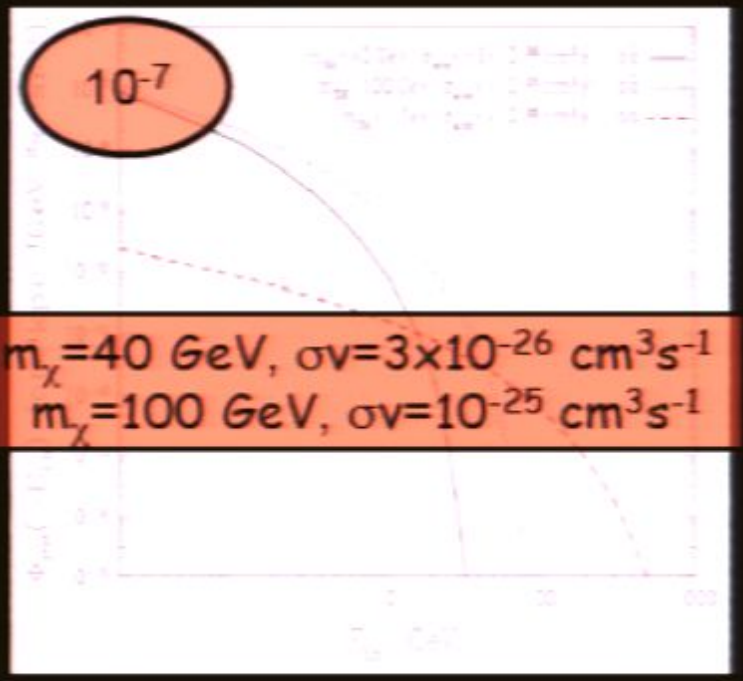


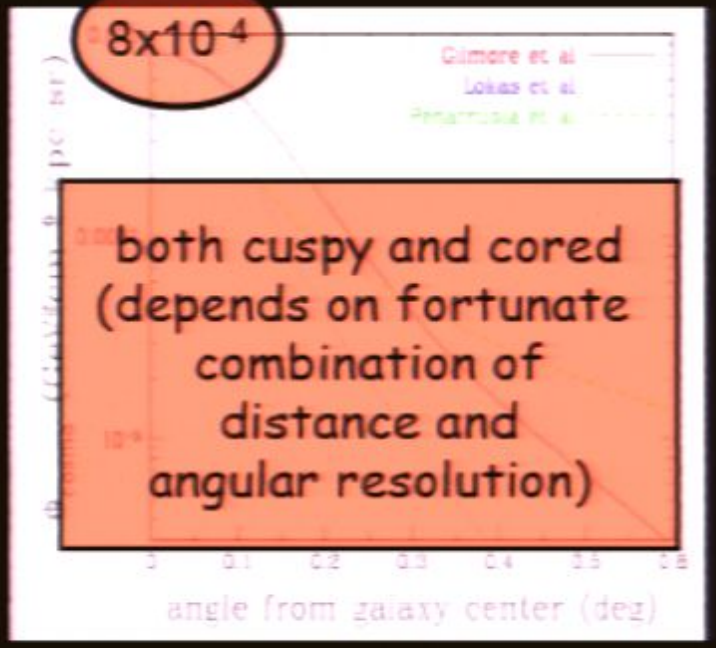

$$\phi_{cosmo} = \int_{\Delta\Omega,\lambda} \frac{\rho^2(r(\Delta\Omega,\lambda))}{\lambda^2} \, dV$$

Petal, 2008

DRACO $\Phi_\gamma^{max} = \Phi_{particle\ physics} \times \Phi_{cosmology} = (8 \pm 2.7) \times 10^{-11}\ cm^{-2}\ s^{-1}$

$$\phi_{pp} = \frac{1}{4\pi} \frac{\sigma_{ann} v}{2m_\chi^2} \int_{E_0}^{m_\chi} \sum_f \frac{dN_f^\gamma}{dE_\gamma} BR_f\, dE_\gamma$$



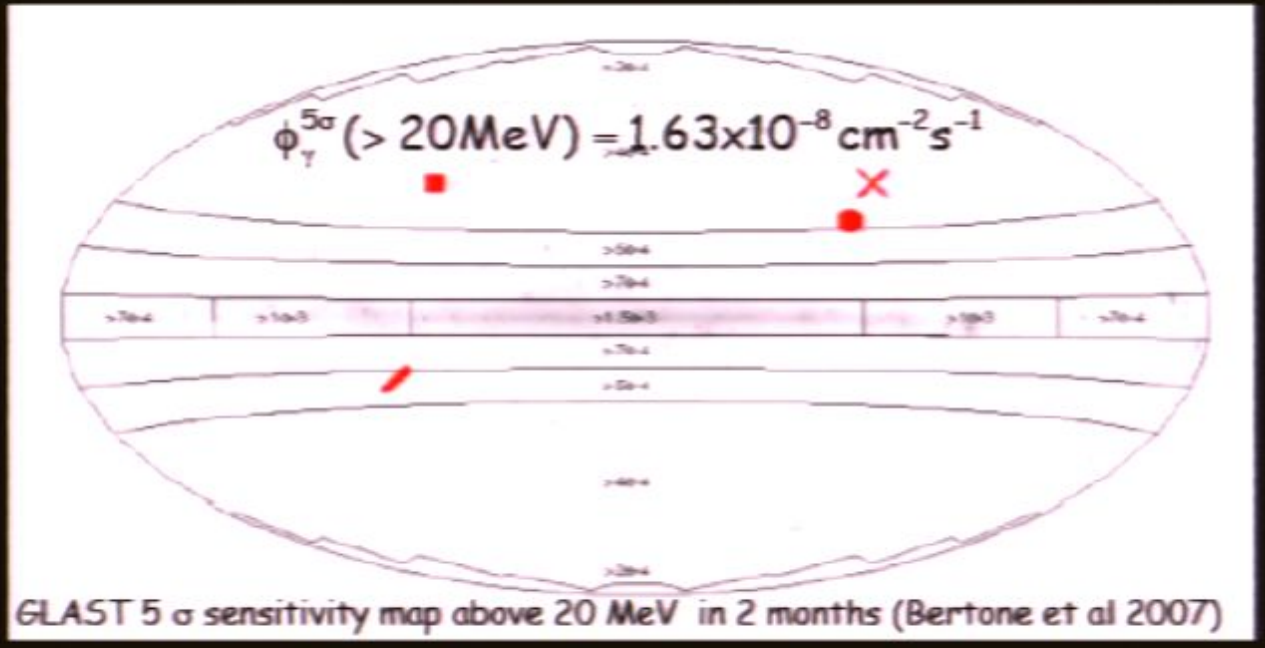

both cuspy and cored (depends on fortunate combination of distance and angular resolution)

$$\phi_{cosmo} = \int_{\Delta\Omega\lambda} \frac{\rho^2(r(\Delta\Omega,\lambda))}{\lambda^2}\, dV$$

Petal, 2008

## Comparing predictions with GLAST performances

DRACO $\Phi_\gamma^{max} = (8 \pm 2.7) \times 10^{-11}\ cm^{-2}\ s^{-1}$

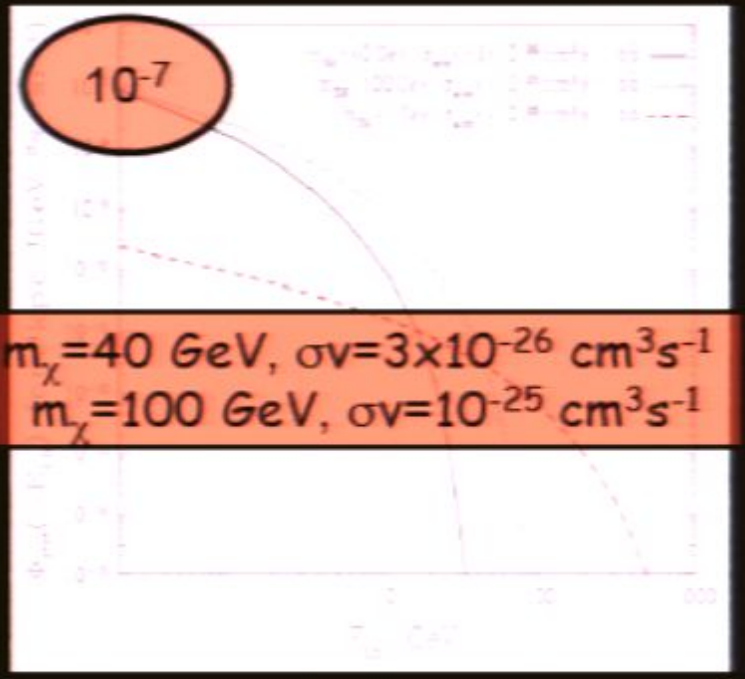


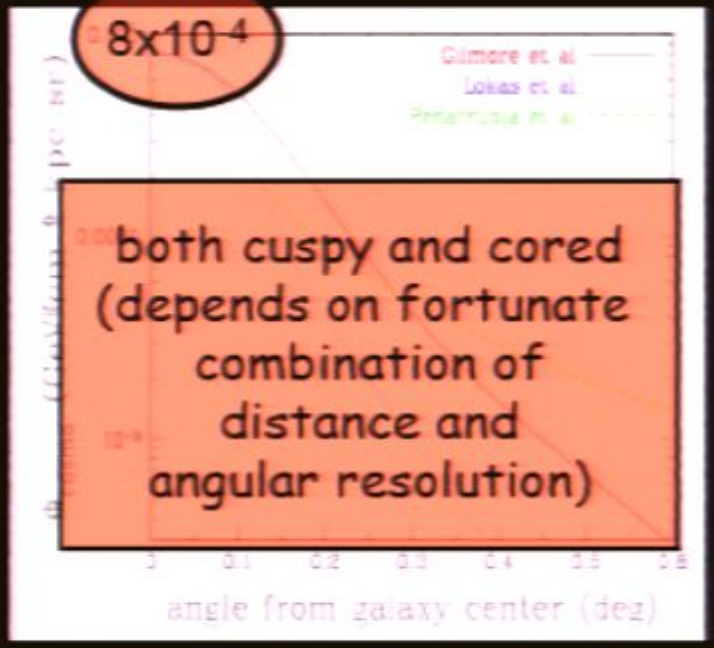

GLAST 5 σ sensitivity map above 20 MeV in 2 months (Bertone et al 2007)

DRACO and other dwarfs
are well below the detection limit
Boost factors are needed to hope for detection

DRACO $\Phi_\gamma^{max} = \Phi_{particle\ physics} \times \Phi_{cosmology} = (8 \pm 2.7) \times 10^{-11}\ cm^{-2}\ s^{-1}$

$$\phi_{pp} = \frac{1}{4\pi} \frac{\sigma_{ann} v}{2m_\chi^2} \int_{E_0}^{m_\chi} \sum_f \frac{dN_f^\gamma}{dE_\gamma} BR_f\, dE_\gamma$$



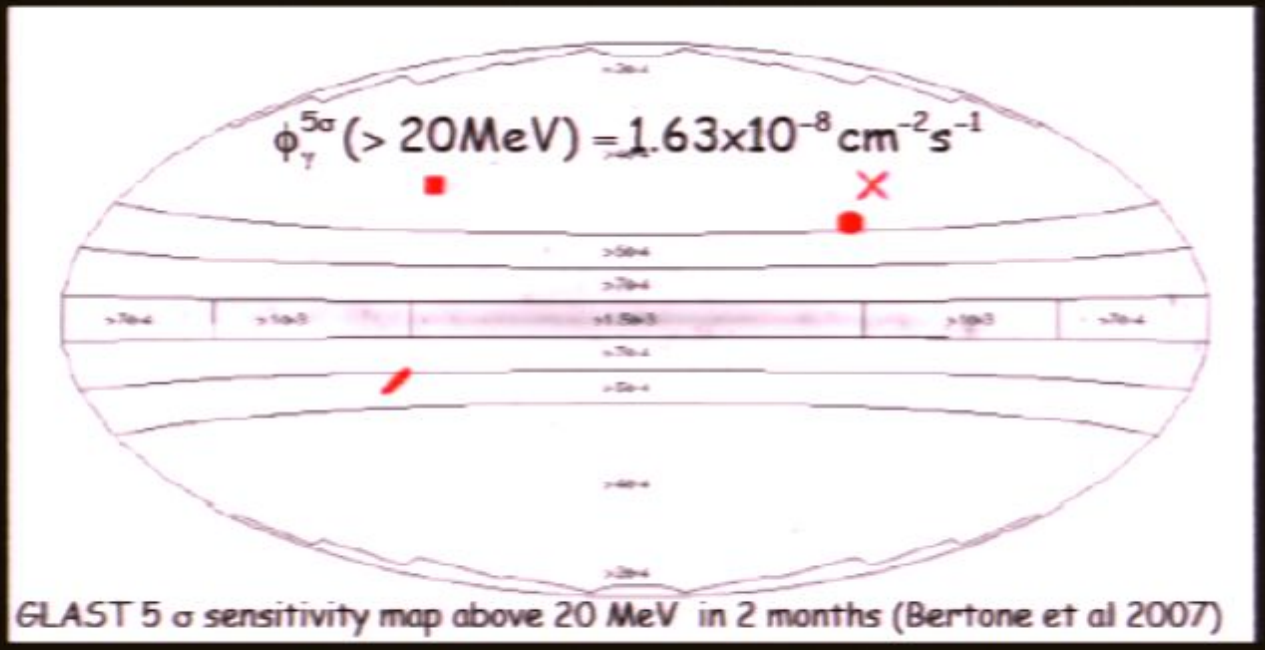




$$\phi_{cosmo} = \int_{\Delta\Omega\lambda} \frac{\rho^2(r(\Delta\Omega,\lambda))}{\lambda^2}\, dV$$

Petal, 2008

## Comparing predictions with GLAST performances

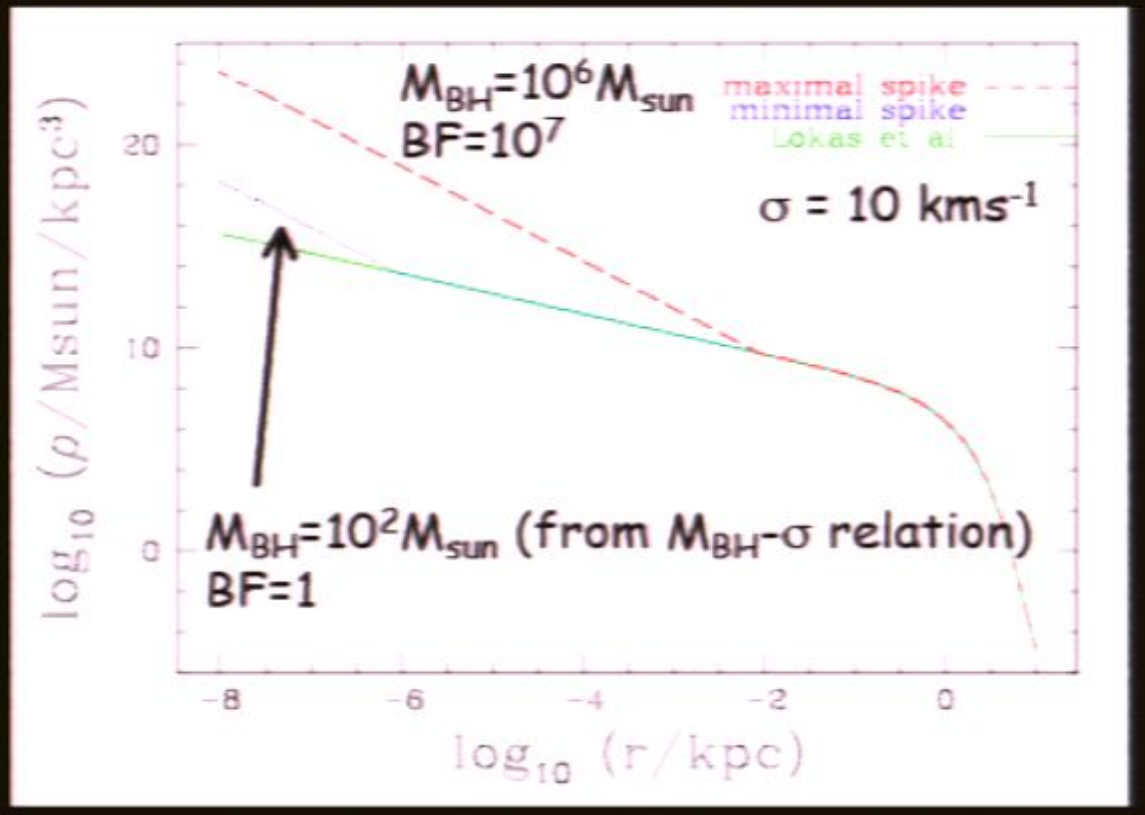
DRACO $\Phi_\gamma^{max} = (8 \pm 2.7) \times 10^{-11}\ cm^{-2}\ s^{-1}$




GLAST 5 σ sensitivity map above 20 MeV in 2 months (Bertone et al 2007)

DRACO and other dwarfs
are well below the detection limit
Boost factors are needed to hope for detection

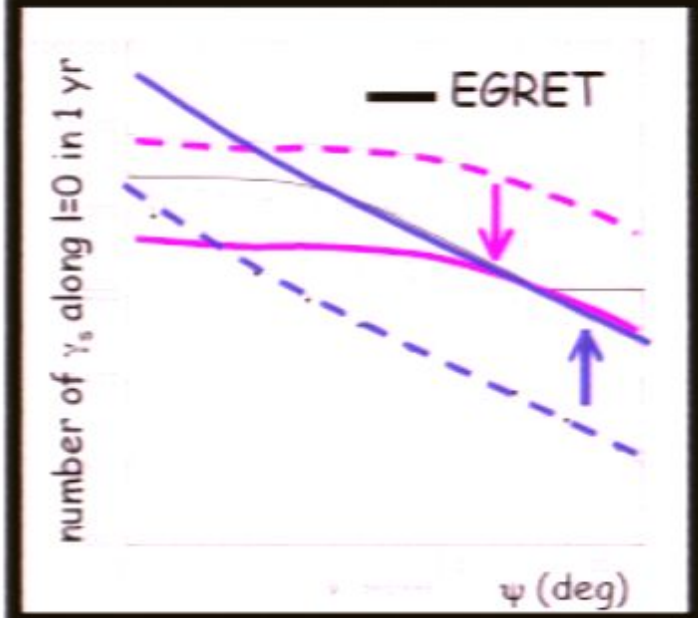
## BF due to the presence of a Black Hole?




A Black Hole, if any, is not likely to be significant for detection

## BF due to the presence of a subhalos inside the dwarfs?

Use the toy model where the same subhalo properties hold for both the Milky Way and its satellites...
(much work in progress on it)
... and use the models of PBB07, normalized to EGRET EGB, and without exceeding MSSM predictions




**BOOST FACTOR**

$$\frac{\int_{gal} dV \rho^2_{gal,sm} + \int_{gal} \int_{M_{sh}} dV dM \, \rho_{sh} \int_{halo} dV \, \rho^2_{halo}}{\int_{gal} dV \rho^2_{gal,sm}}$$

**Maximum boost factor after normalization to EGRET EGB ~ 70 → detectability in 8 years...**

## Conclusions

Large halos are most likely to be observed, for some subhalo models

Yet, when considering dwarf galaxies
(whose masses are in the range of detectability)
with astronomy-derived profiles and optimistic (MSSM) susy parameters
they are well below threshold for detection with GLAST

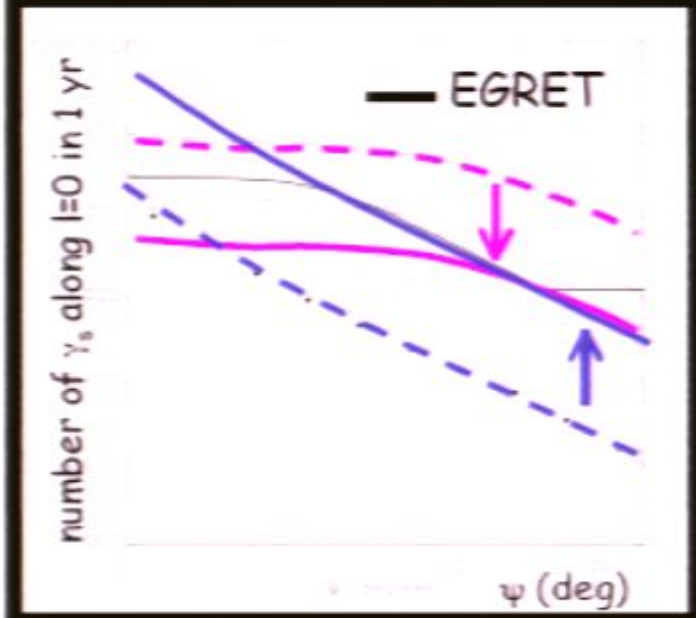
Kinematics does not allow Black Holes which can give
significant boost factors

If we assume MSSM, then the only way to get observability for the dwarfs
(in 8 years...)
is to assume a population of sub-subhalos.

A careful study of sub-subhalos parameters is needed NOW.

## BF due to the presence of a subhalos inside the dwarfs?

Use the toy model where the same subhalo properties hold for both the Milky Way and its satellites...
(much work in progress on it)
... and use the models of PBB07, normalized to EGRET EGB, and without exceeding MSSM predictions

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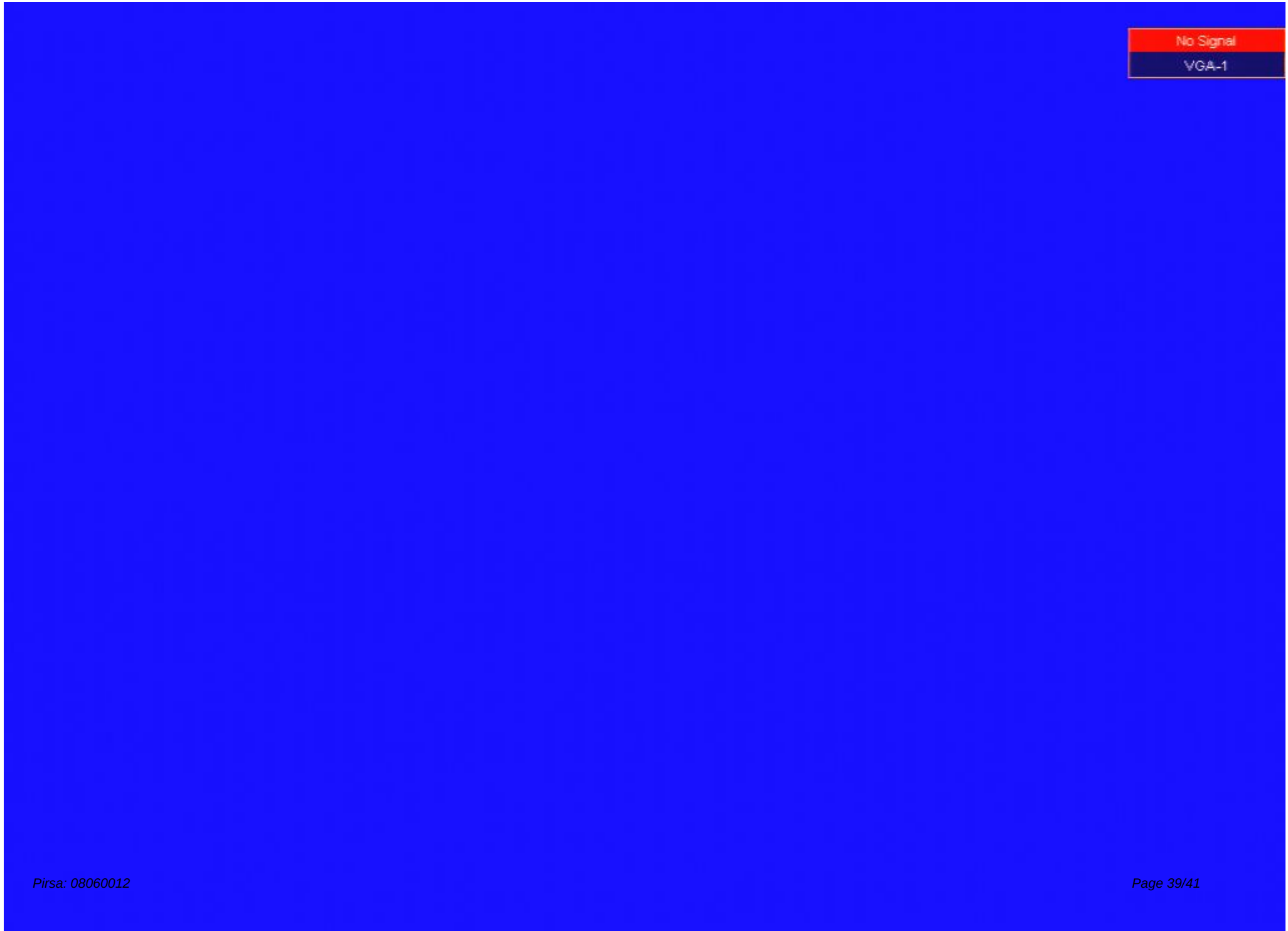
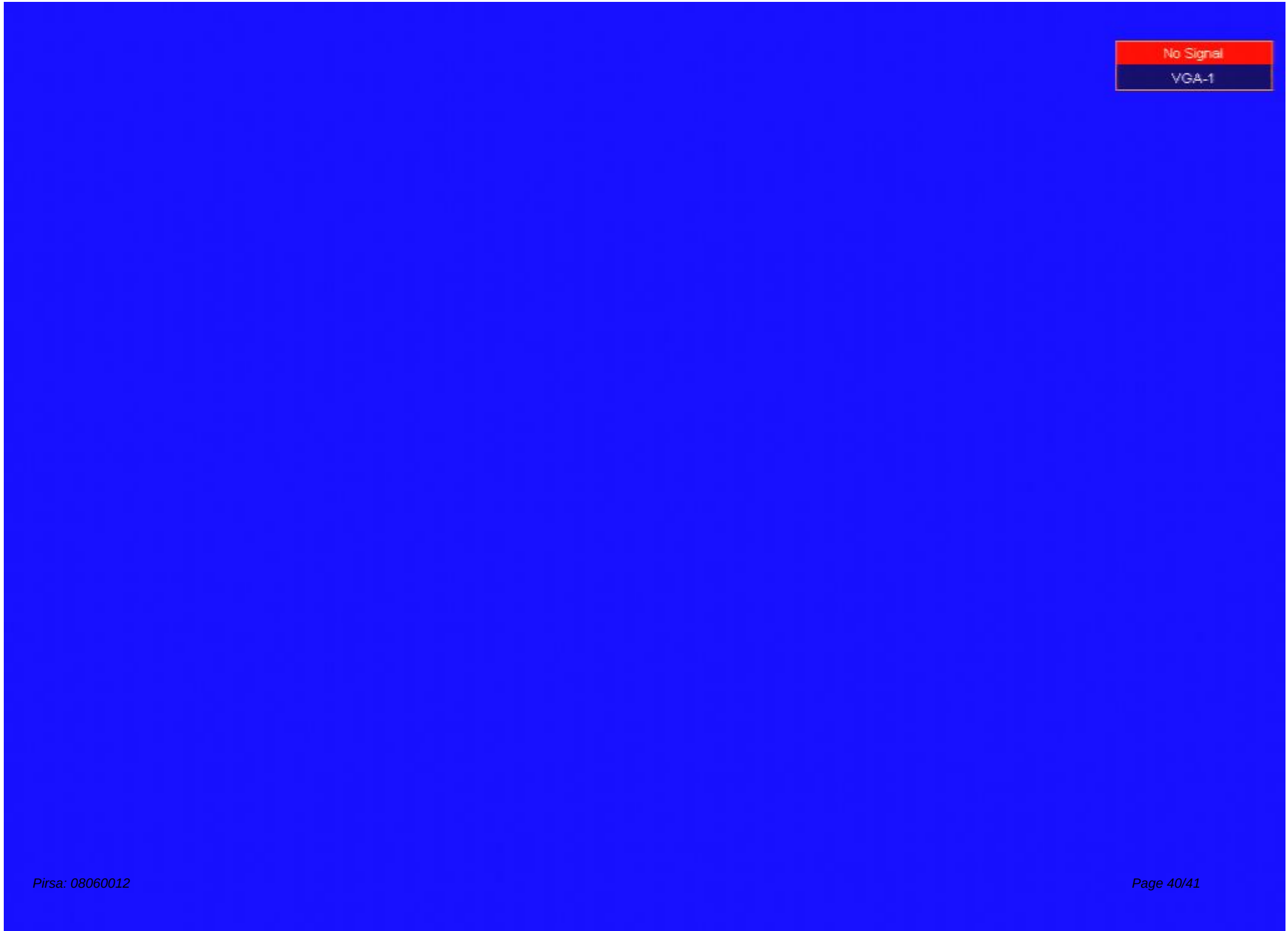
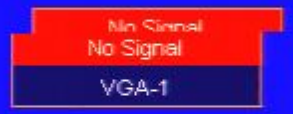
**Maximum boost factor after normalization to EGRET EGB ~ 70 → detectability in 8 years...**


No Signal
VGA-1


No Signal
VGA-1


No Signal
VGA-1