

Test 1

- Test 2

Test III

...

...

...

The DARK

side



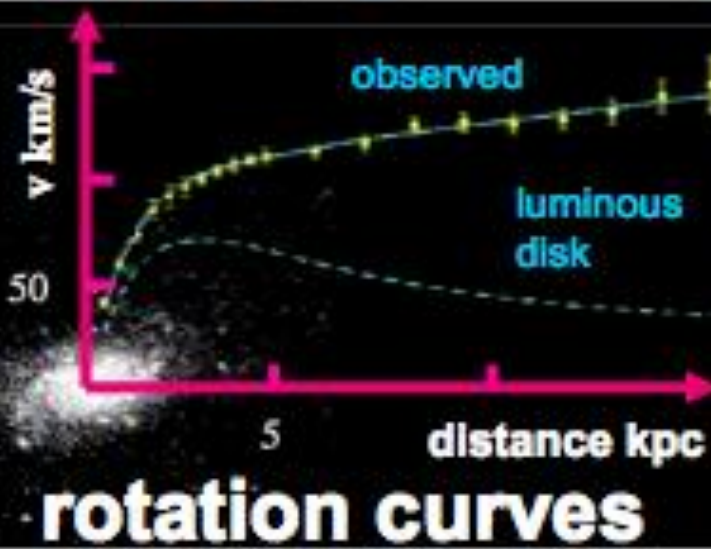
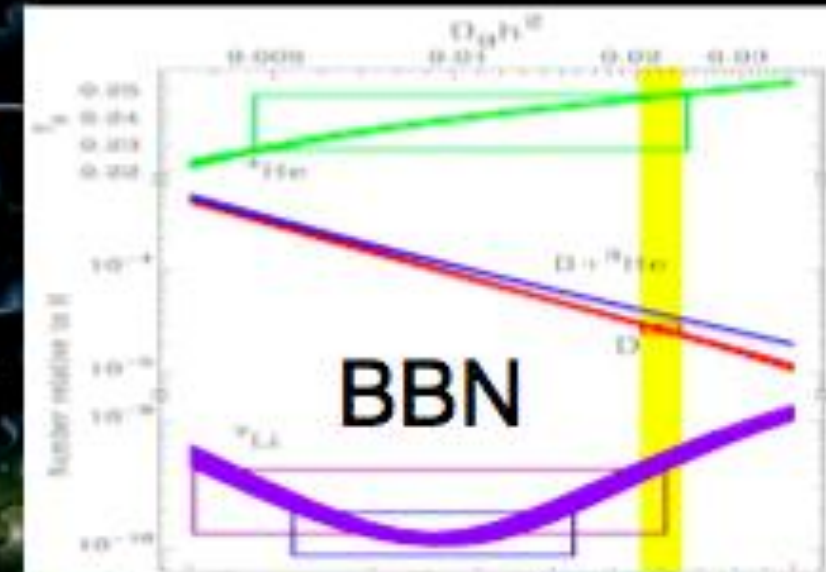
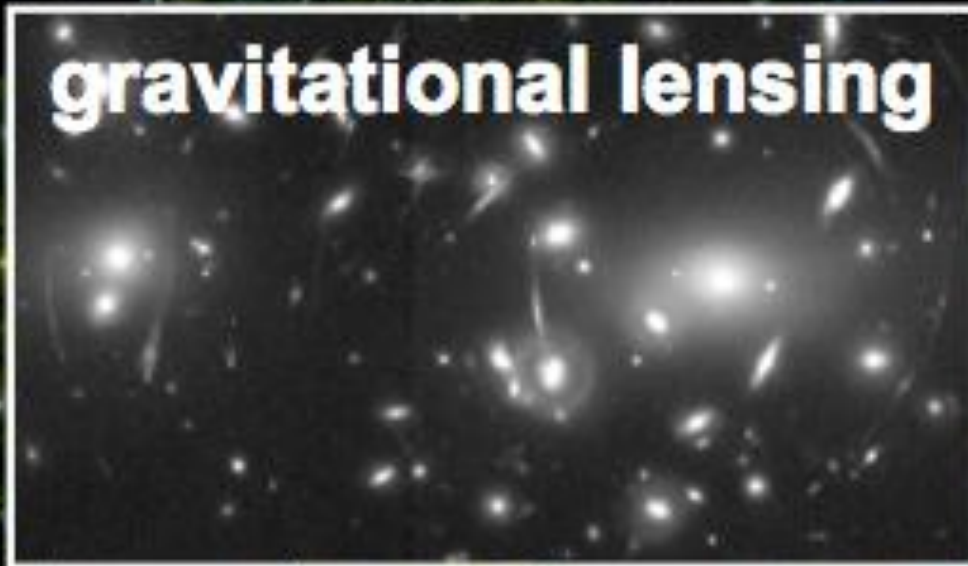
Dark Matter

Courtesy of

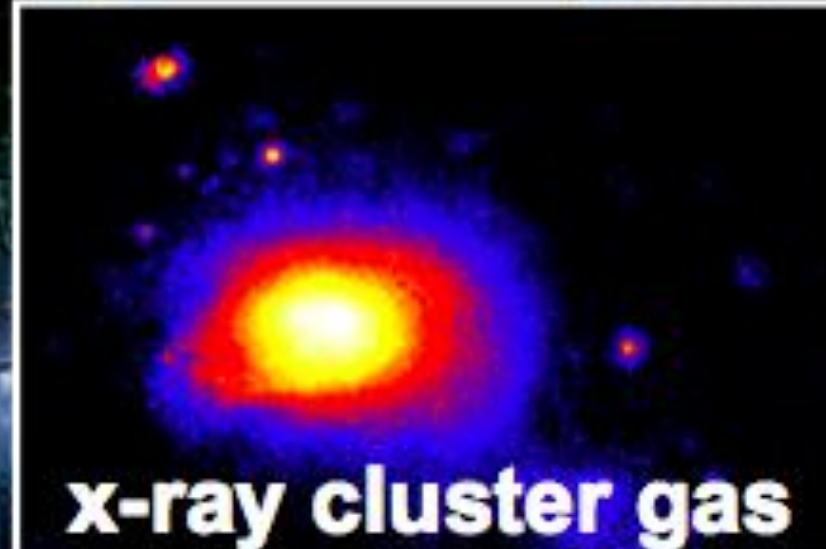
cluster dynamics



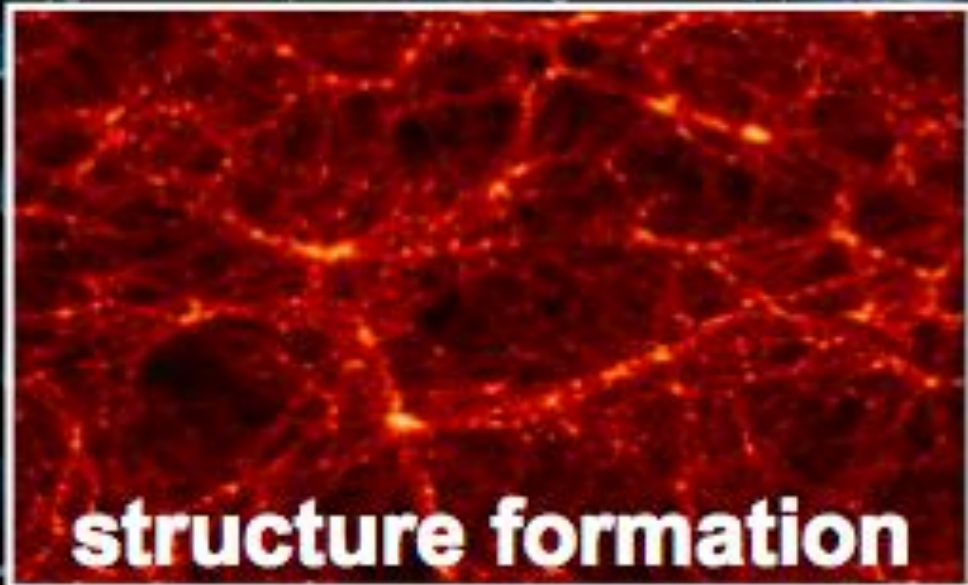
gravitational lensing



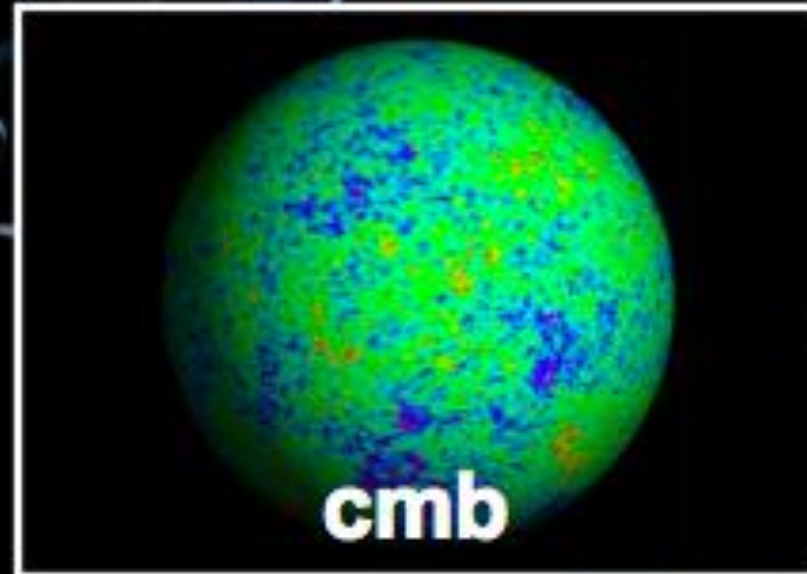
rotation curves



x-ray cluster gas



structure formation



cmb



cluster collisions

Rocky Kolb

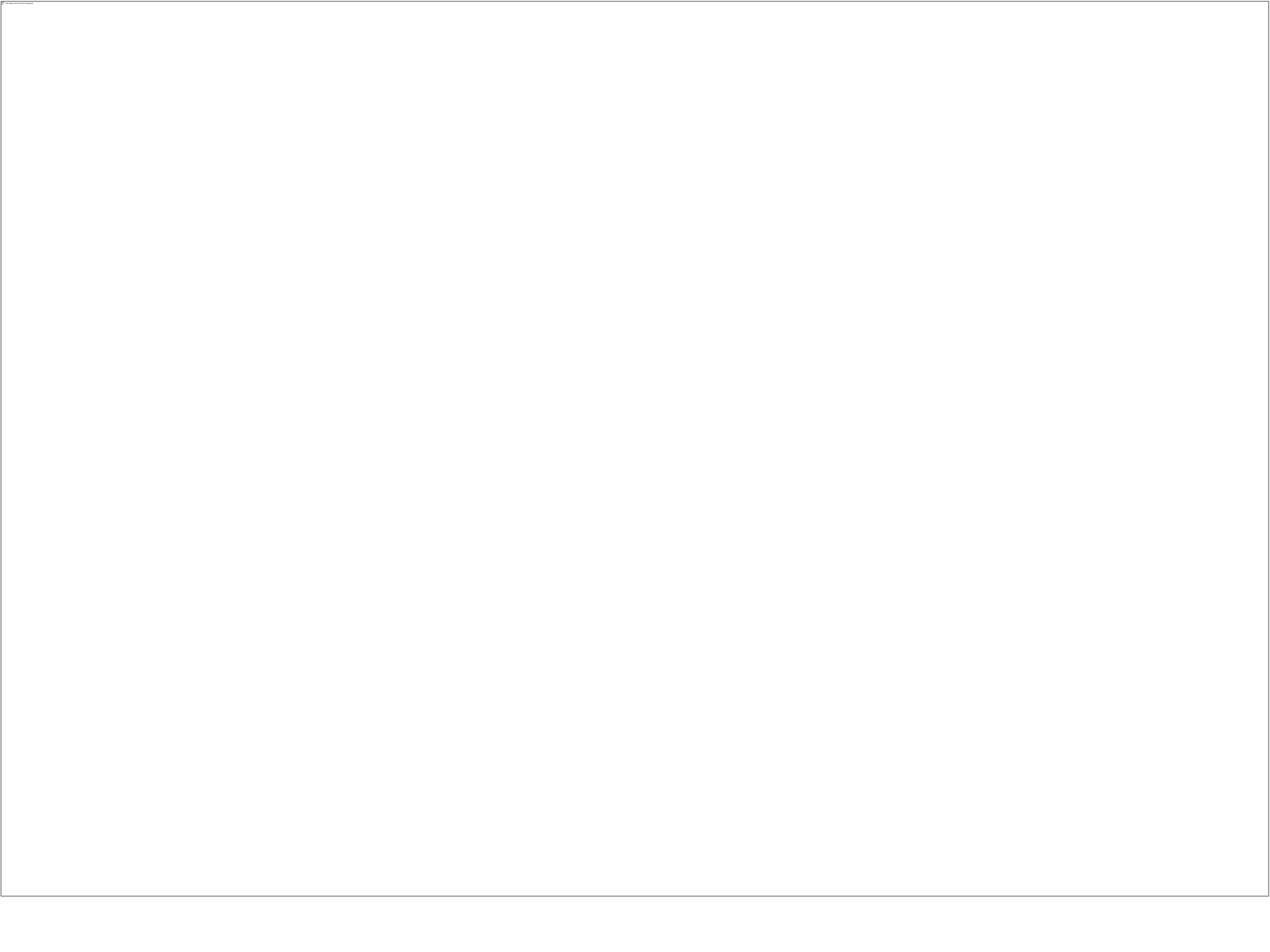
Bullet Cluster

Dark Matter
Lensing-modeled



Ordinary Gas
Chandra X-rays

Galaxies, Magellan and HS
Telescopes





LHC magnet: Solar Axion Search

Axions keV neutrinos

WIMPS: Most LHC-related

Standard Local Dark Matter

$$\rho_{\odot} \sim 0.01 M_{\odot}/\text{pc}^3 \sim 0.38 \text{ GeV}/\text{cm}^3$$

Motions of 412 nearby stars above galactic disk
(Moni Bidin et al.)

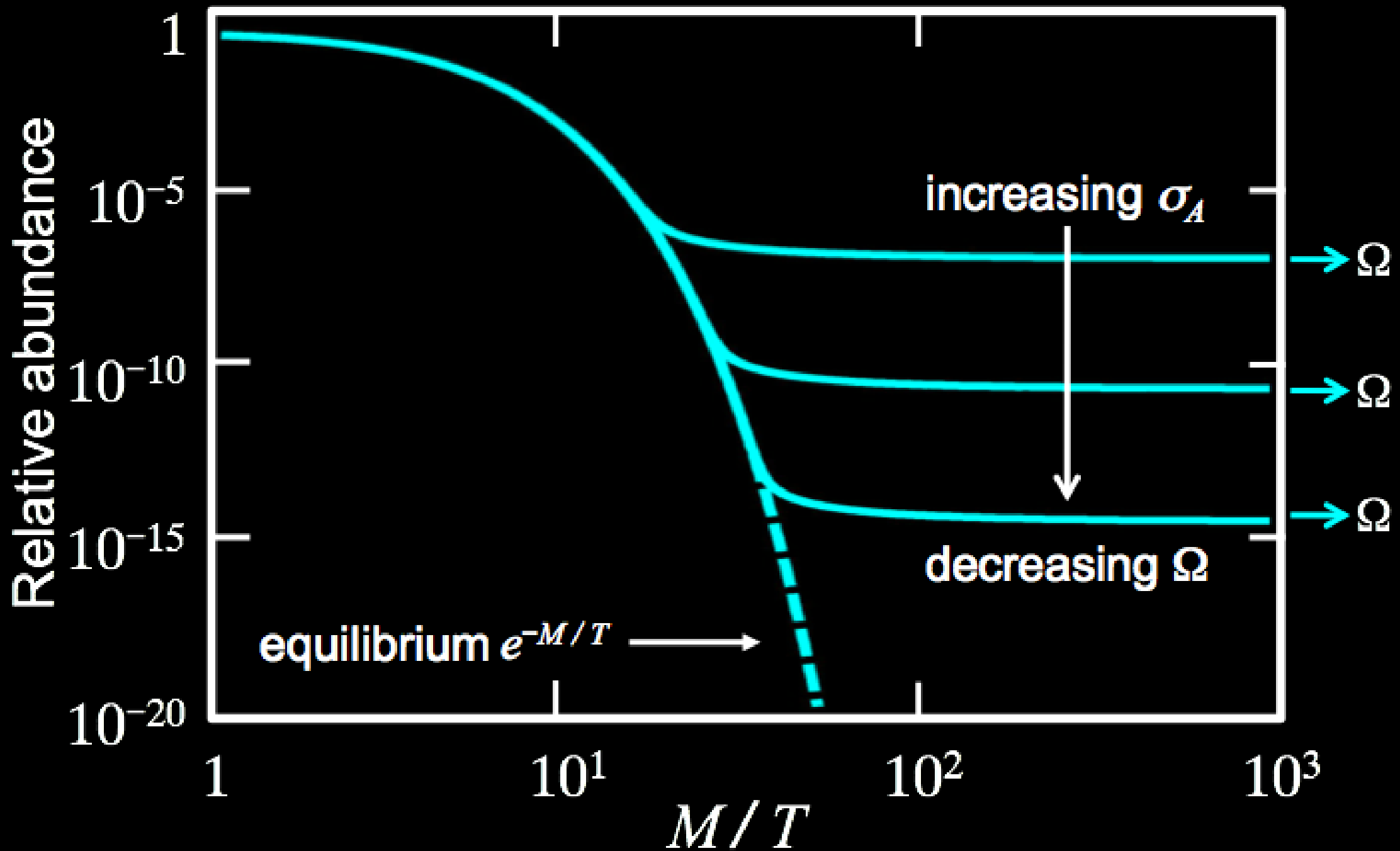
$$\rho_{\odot} \sim (0 \pm 1) m M_{\odot}/\text{pc}^3$$

every direct DM detection experiment is doomed to fail

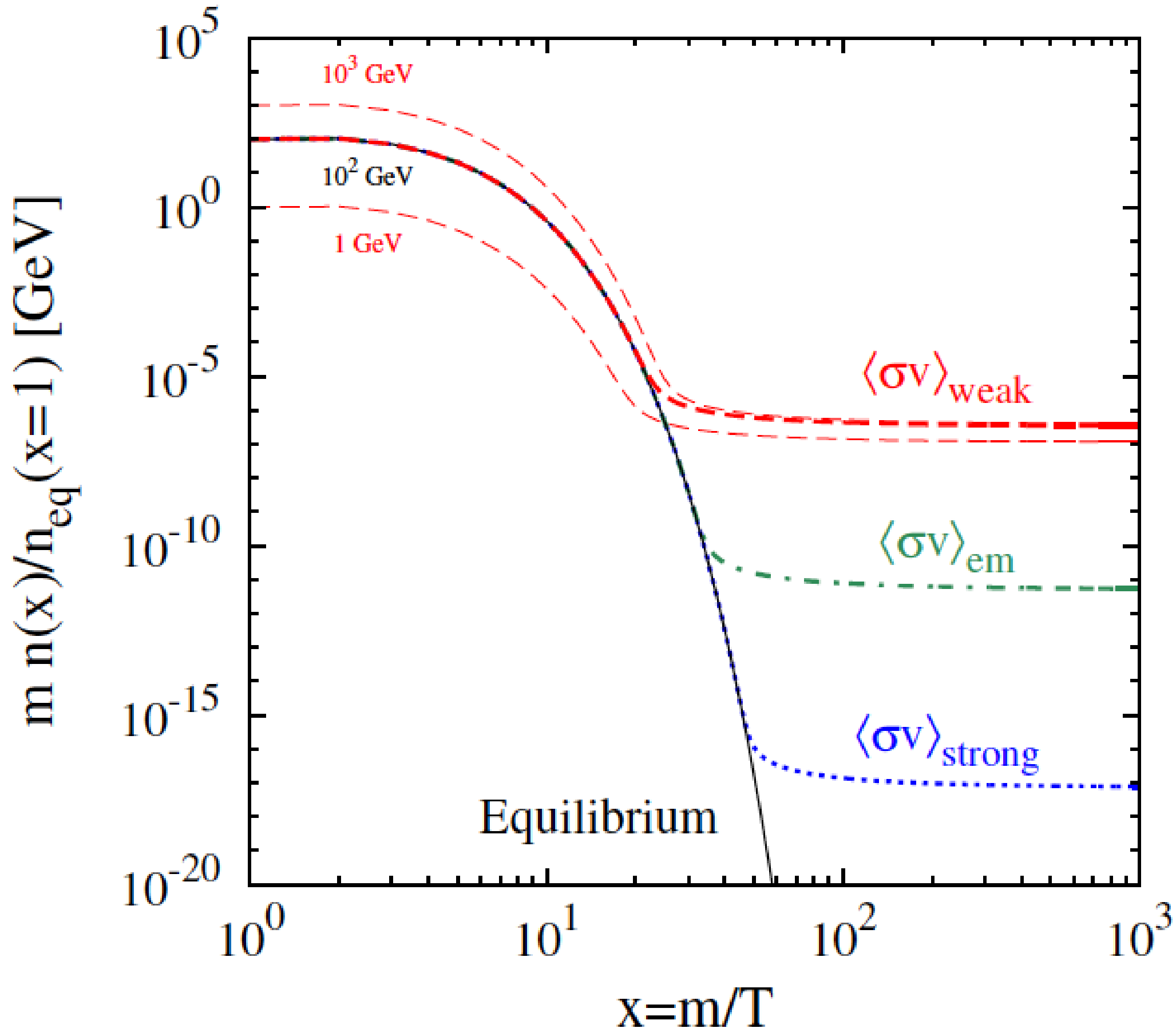
Reanalysis by Bovi &

Tremaine

$$\rho_{\odot} \sim (0.3 \pm 0.1) \text{ GeV}/\text{cm}^3$$



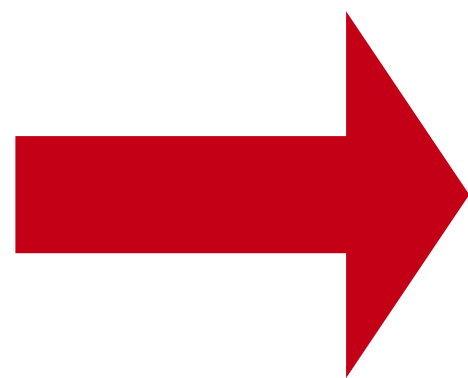
g_{eff} types of standard species of $M < T$ \longleftrightarrow dark matter species



Steigman, Dasgupta & Beacon, 2012

$$\Omega_M = (0.1120 \pm 0056) \times \left[\frac{100 \text{ km/s/Mpc}}{H_0} \right]^2 \approx 20\%$$

+ ONE SPECIES OF WIMP



$$\langle \sigma_{\text{Ann}} v \rangle \simeq 1 \text{ pb } c$$

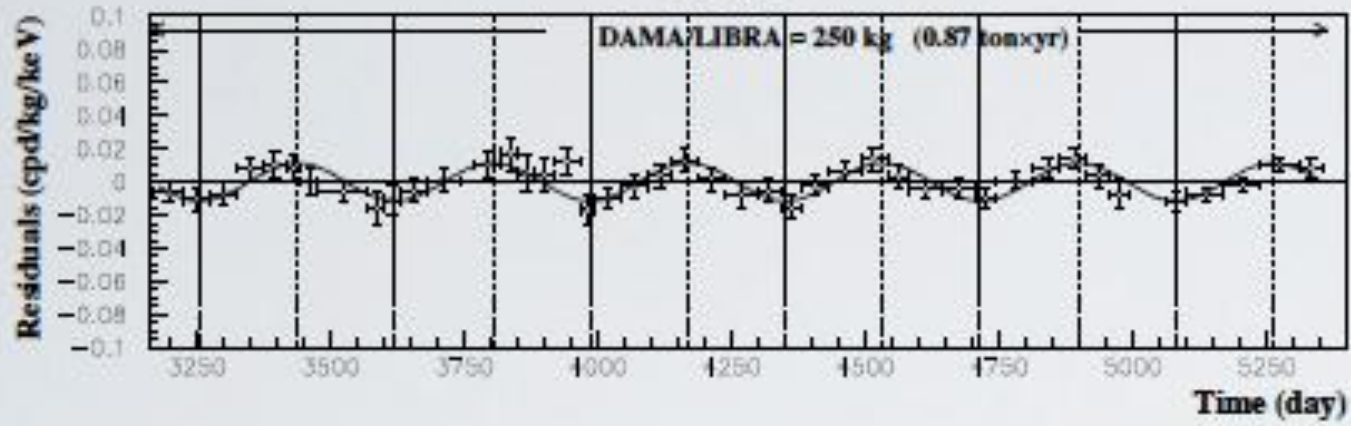
WRONG

**For “Light” WIMPS
the results of**

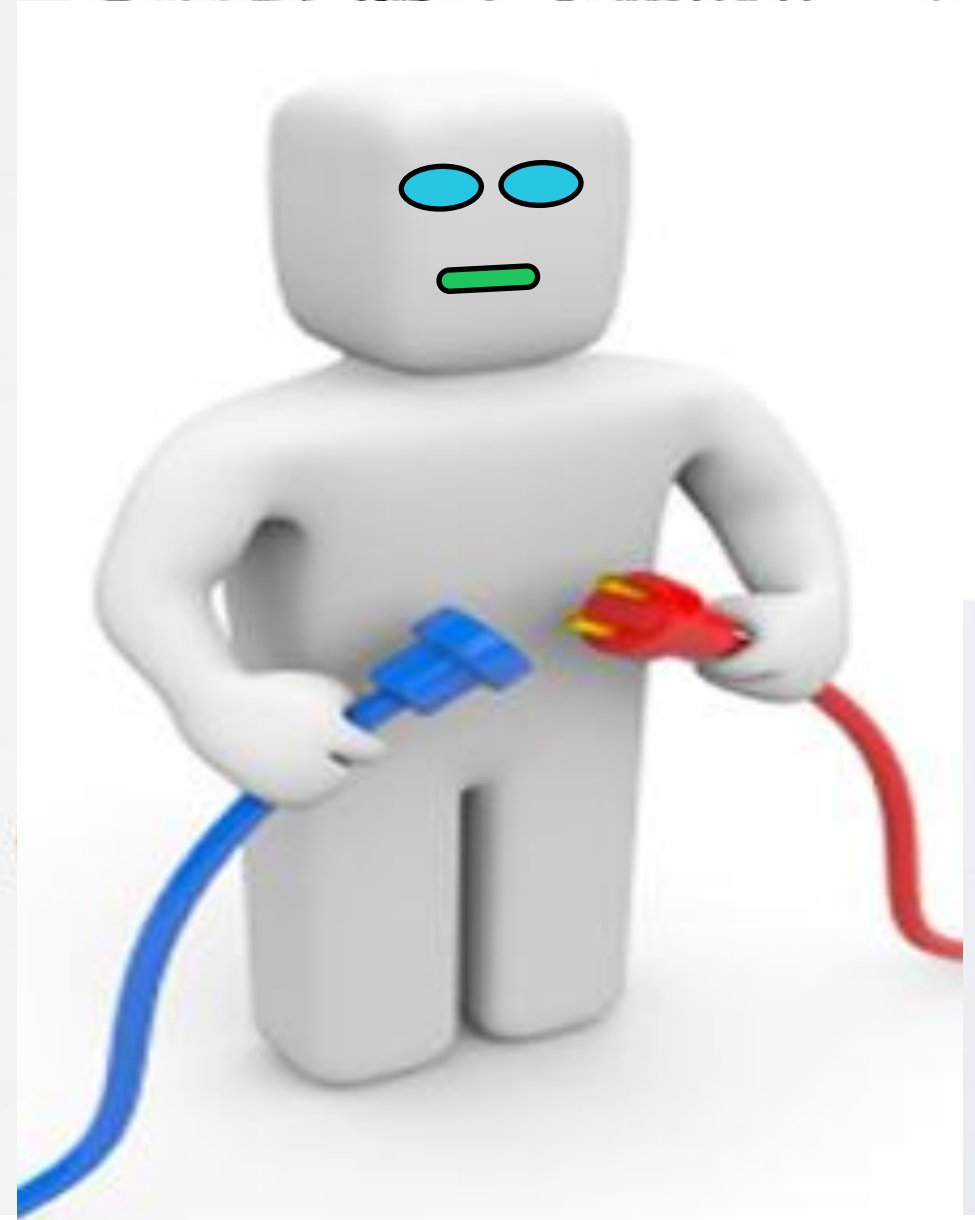
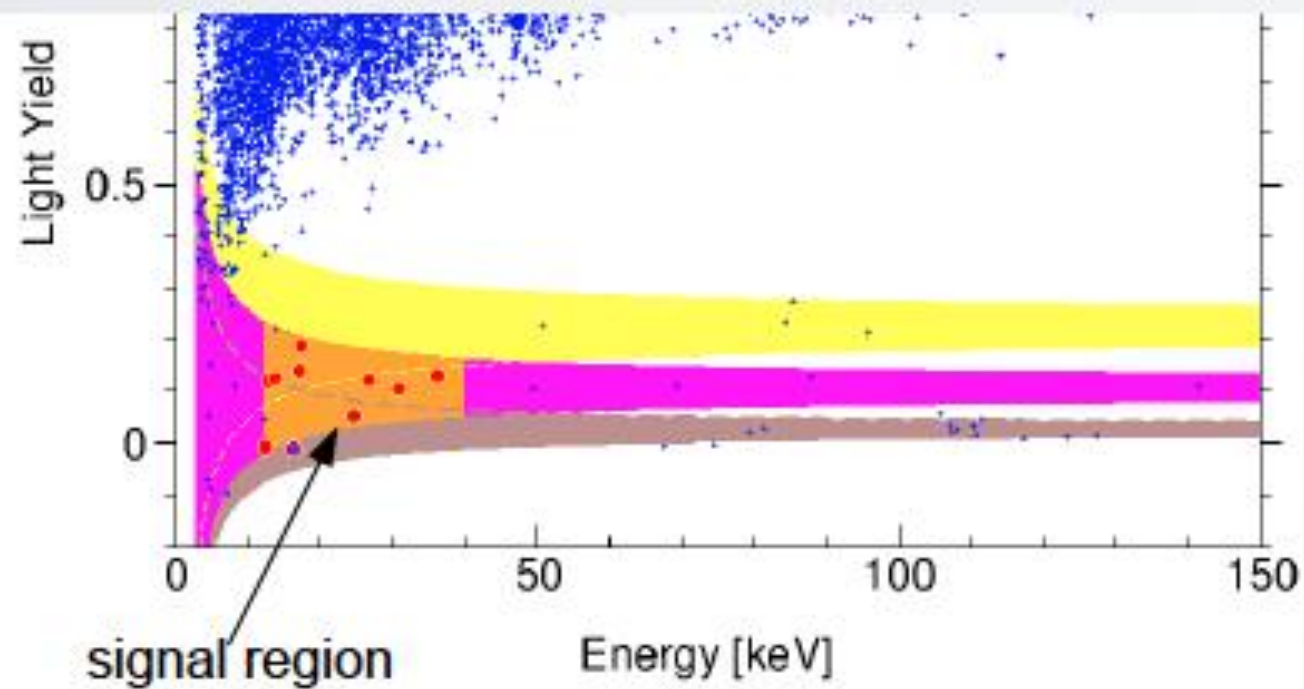
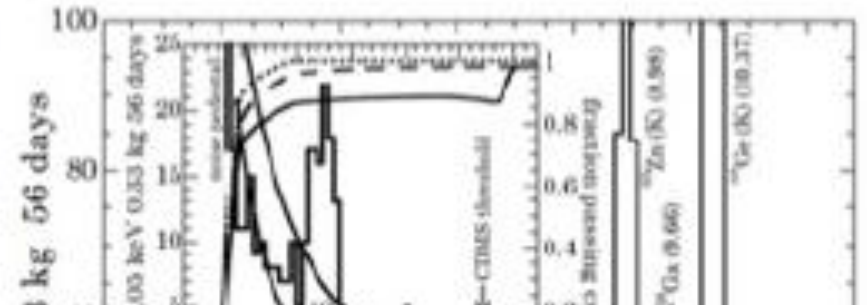
**“DIRECT SEARCHES”:
DM Interactions “here”
(about to be reviewed)**

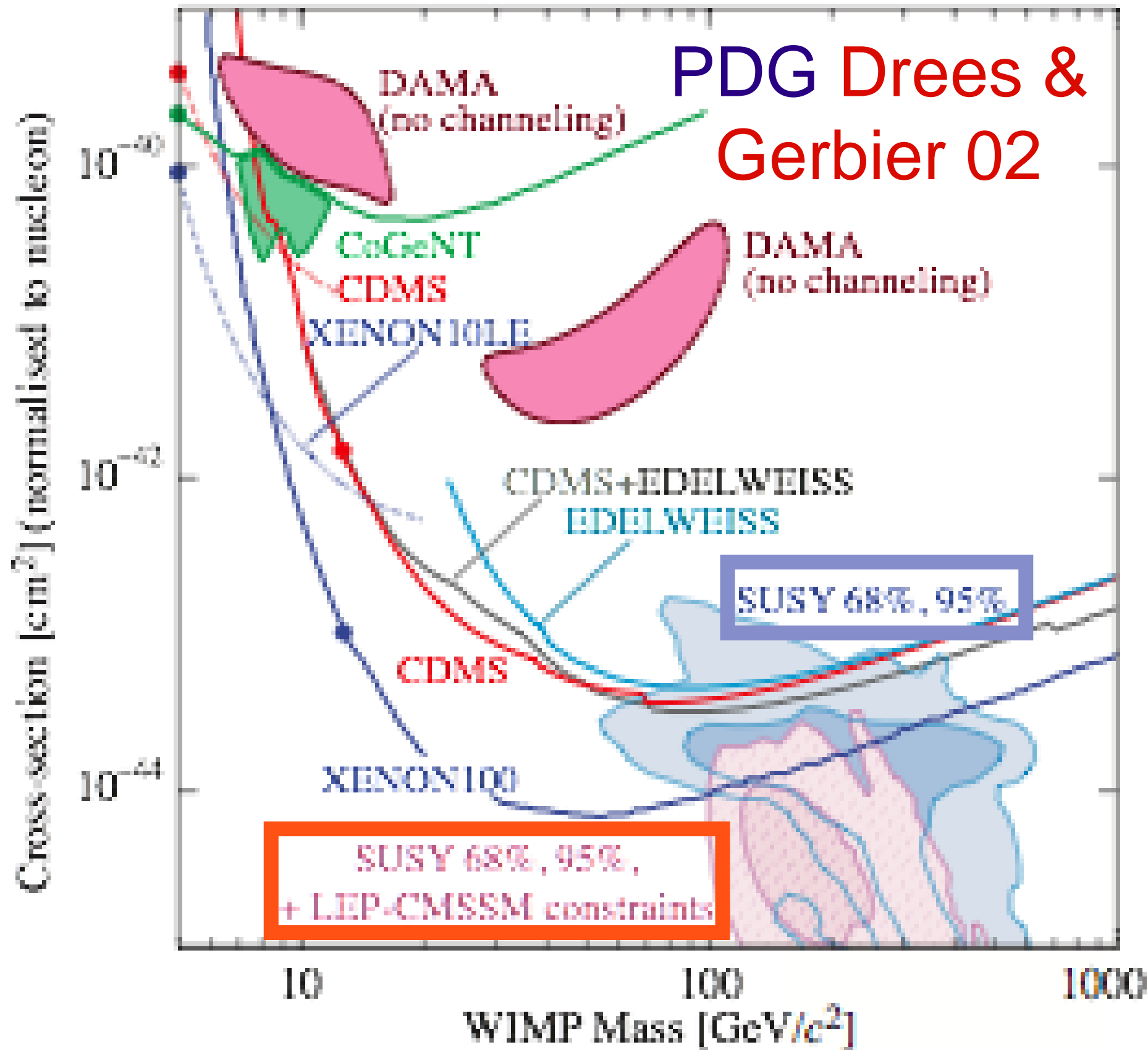
need to be re-analyzed

2-6 keV

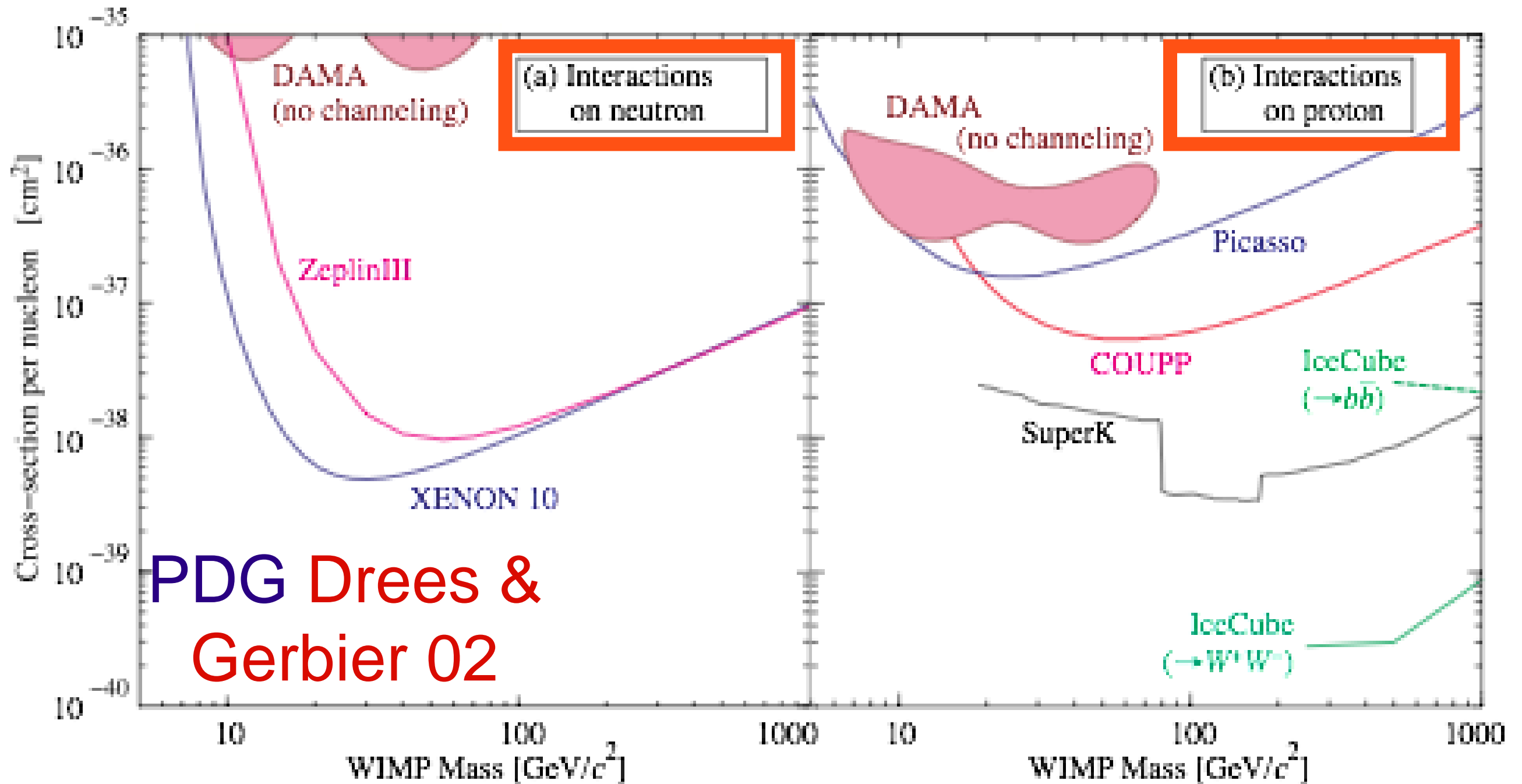


“Anomalies”.
Courtesy
of Neil
Weiner



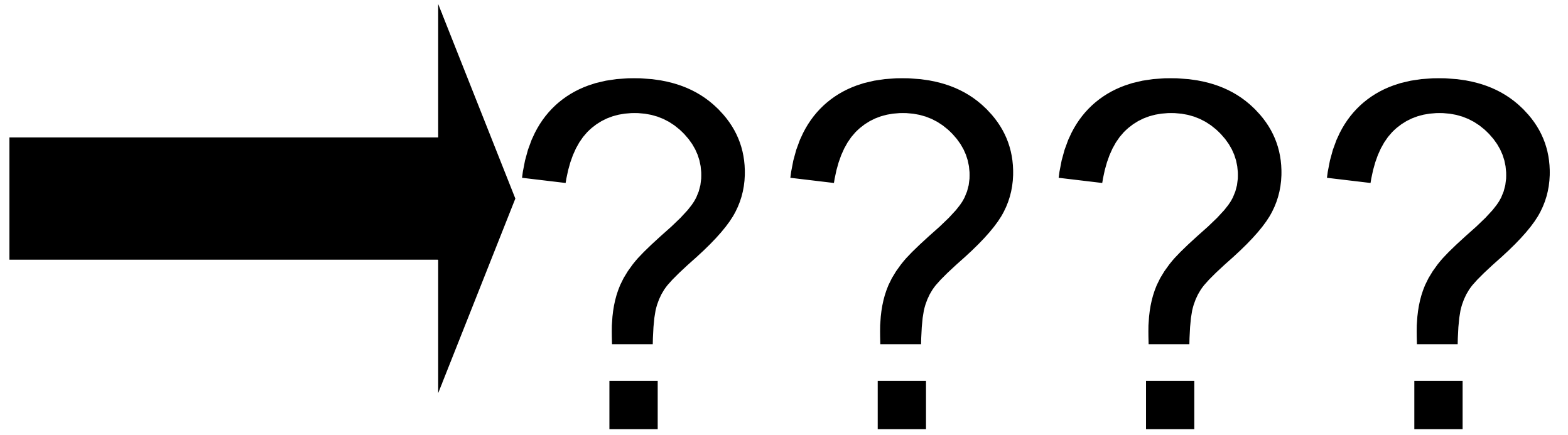


Assume : Spin indep $\sigma_n = \sigma_p$



**PDG Drees &
 Gerbier 02**

Spin dependent



Could DAMA

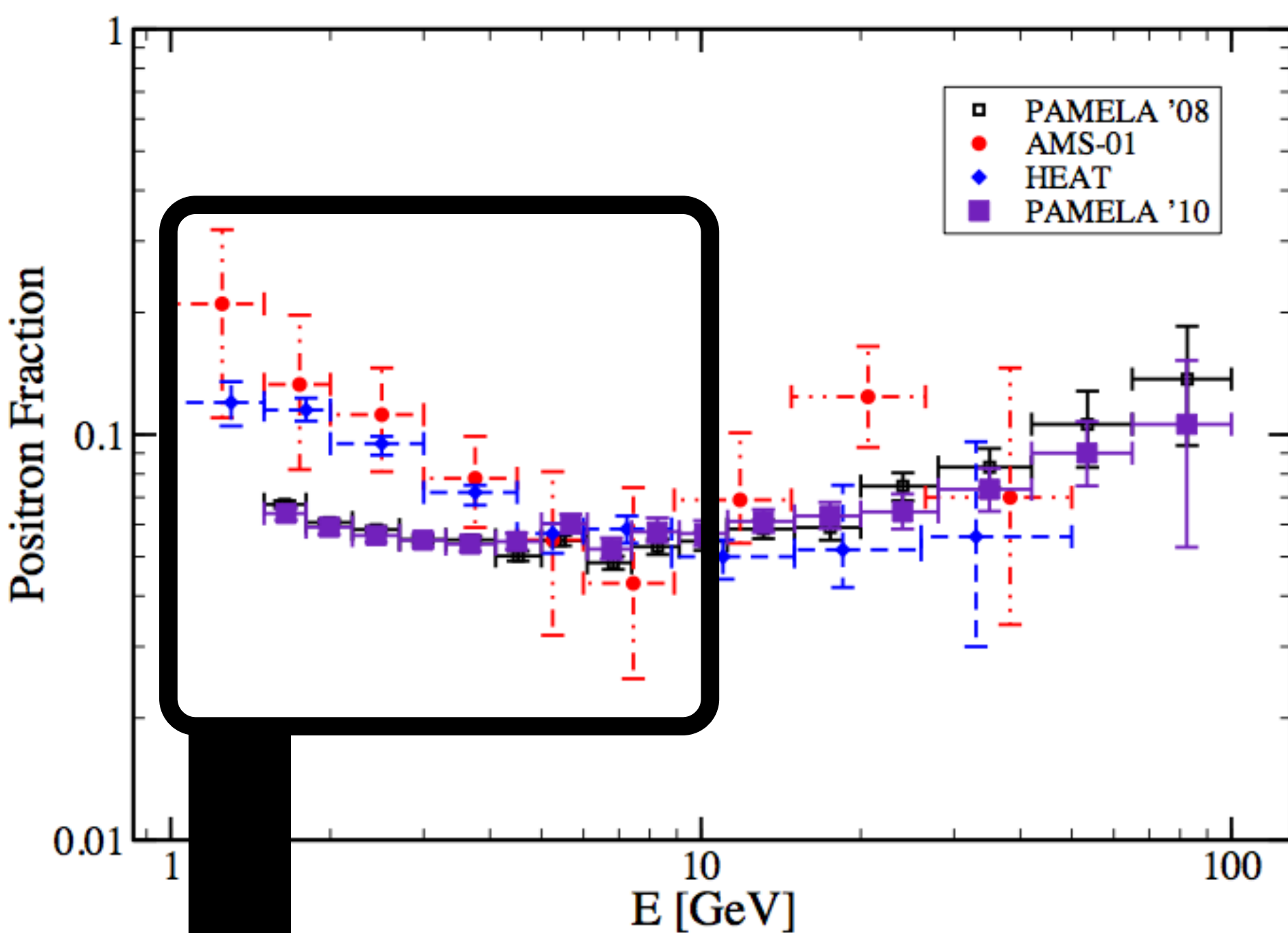
diminish its

background rejection ?

“Indirect”

DM Searches

**Signatures of distant
DM annihilations or decays**



At least one experiment has an energy-dependent systematic error

Consensus?: It isn't

PAMELA

$$\Phi[e^+]/\Phi[e^-] \propto E^\rho$$

PAMELA above 10 GeV

$$\rho = 0.388 \pm 0.006$$

Nature, 458, 607 (2009)

$$\rho = 0.23 \pm 0.04$$

Astropart. Phys. 34,1(2010)

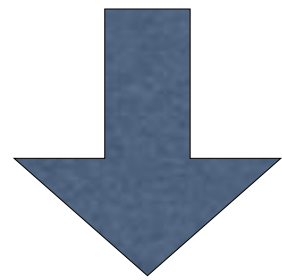
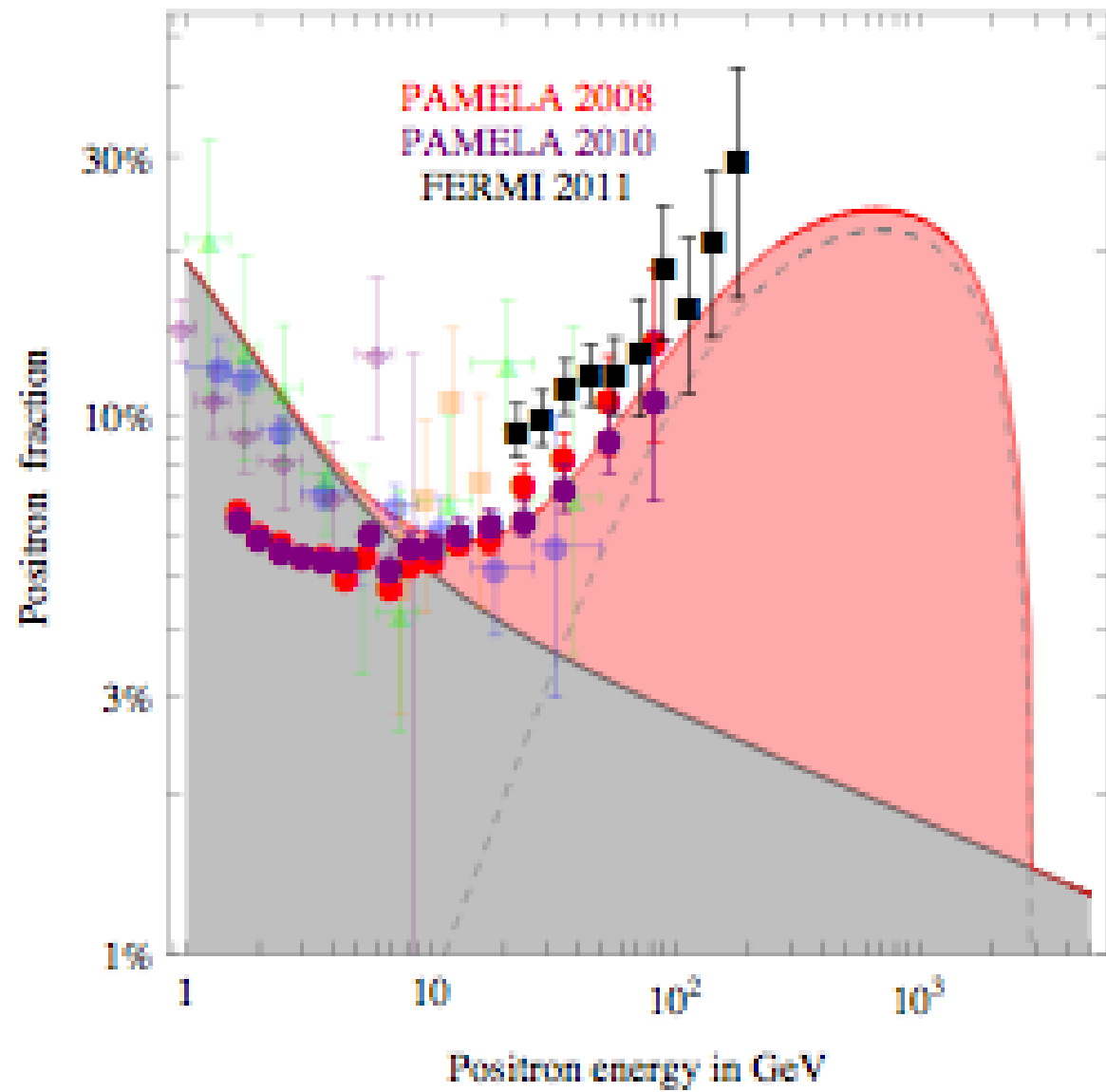
PDG: 0.15

Systematic error in

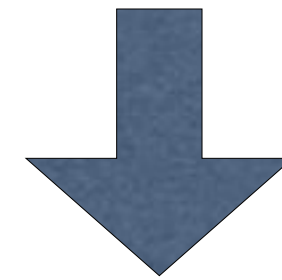
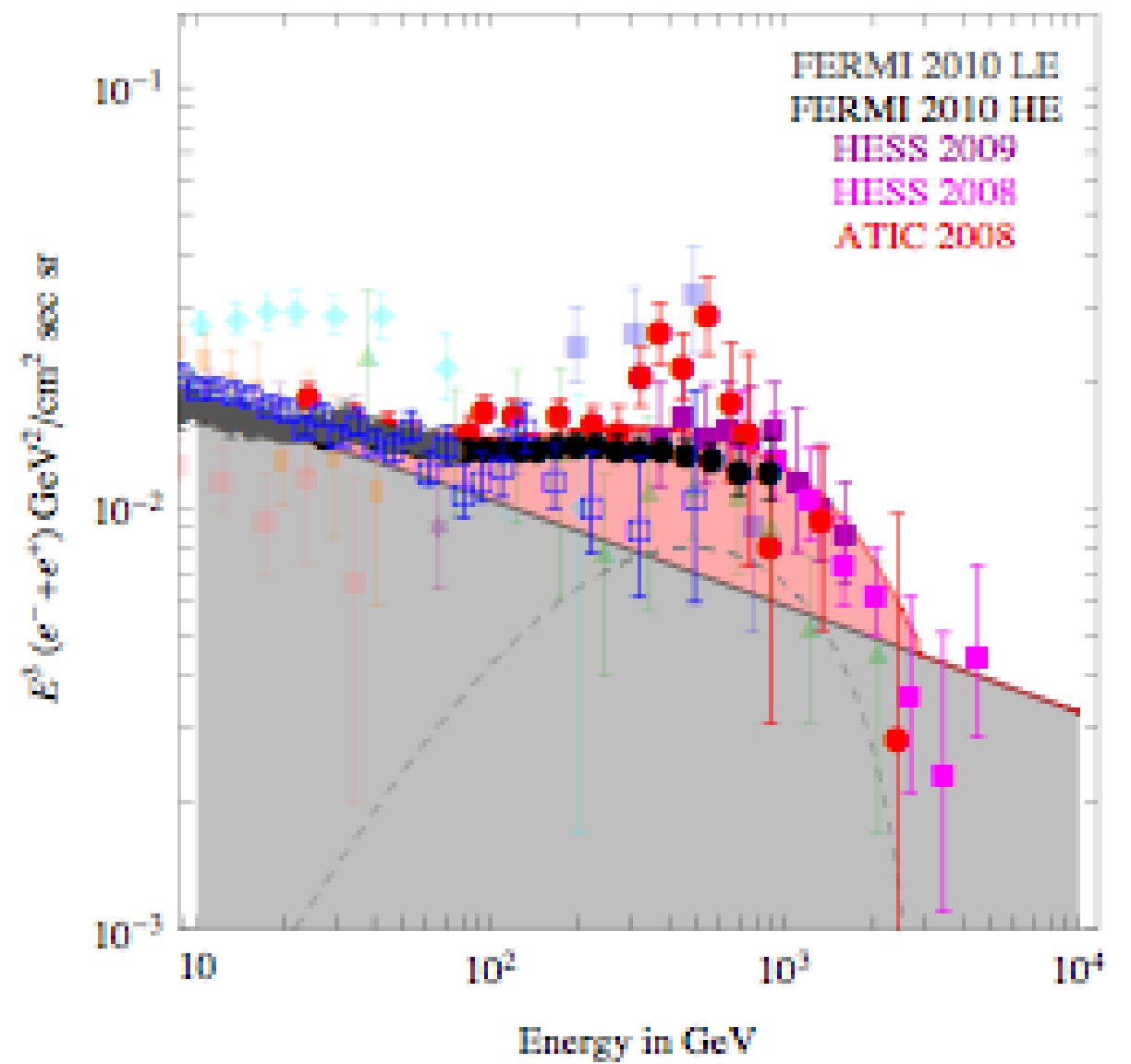
slope

Consensus?: Don't trust

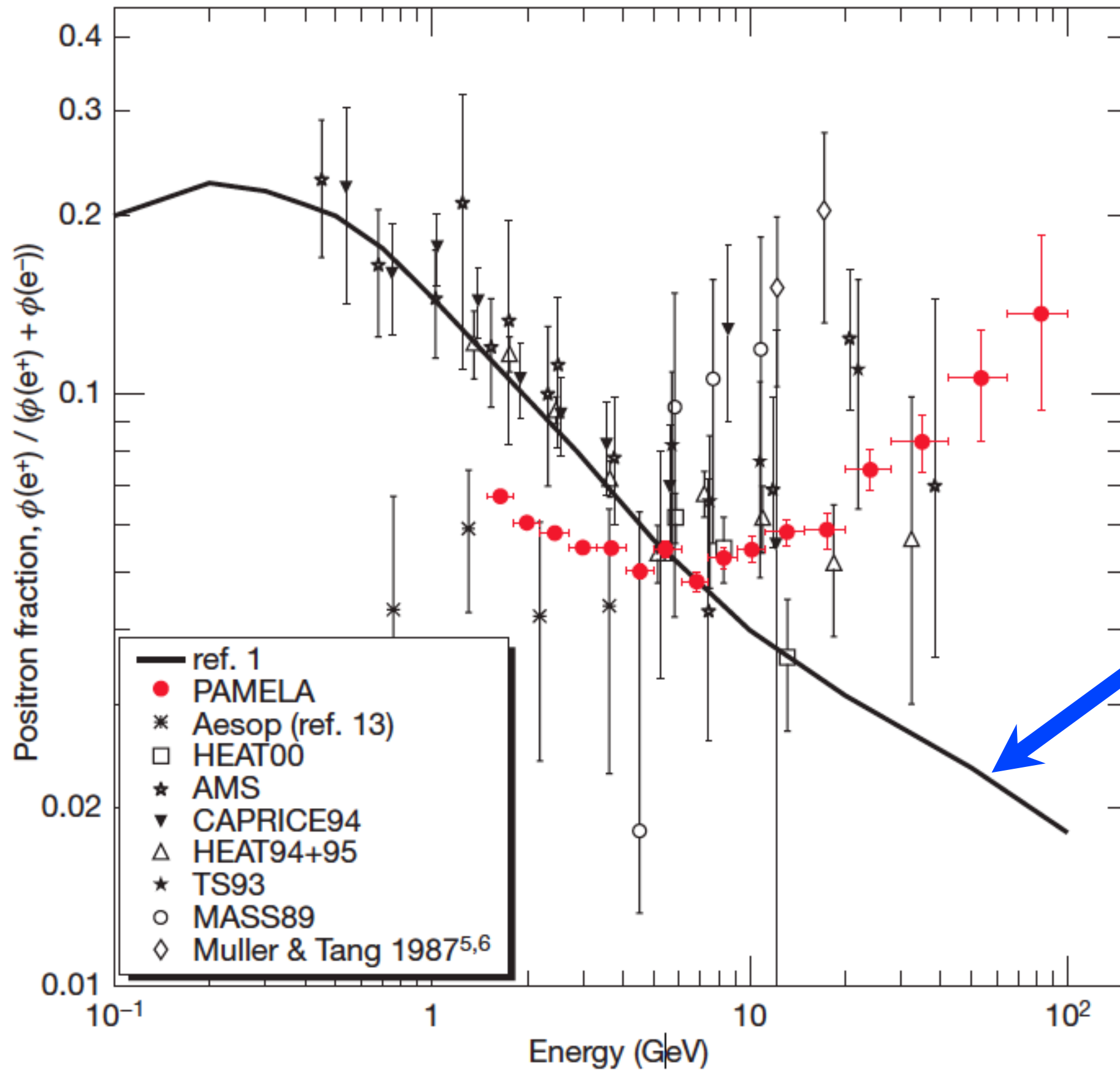
Nature



**The spectra
are NOT
power laws**



**The deviation from
a power law is a
FACTOR OF 2**



Moskalenko
& Strong
AstroPhys. J.
493, 694 (98)

Dozens of theoretical papers
(some of them most ingenious)
explain the 'signal' positron
excess

~ 2 theoretical papers
discuss the
background

[1] Katz *et al.*, arXiv:0907.1686

“The radiative positron energy loss...
is **not** understood theoretically”

“The claims that the positron fraction measured by PAMELA requires new primary positron sources are based on **assumptions** not supported by observations”

[2] Serpico, arXiv:1108.4827

The only “theoretical” argument is **to assume** that ...
there is no mechanism [consistent with cosmic ray astrophysics...] to explain the PAMELA data

If you use a background
Monte Carlo [e.g. GALPROP]
that you have not understood
[and should not blindly trust]
you are doing a disservice
to the faithful community of
poor innocent theorists + ...

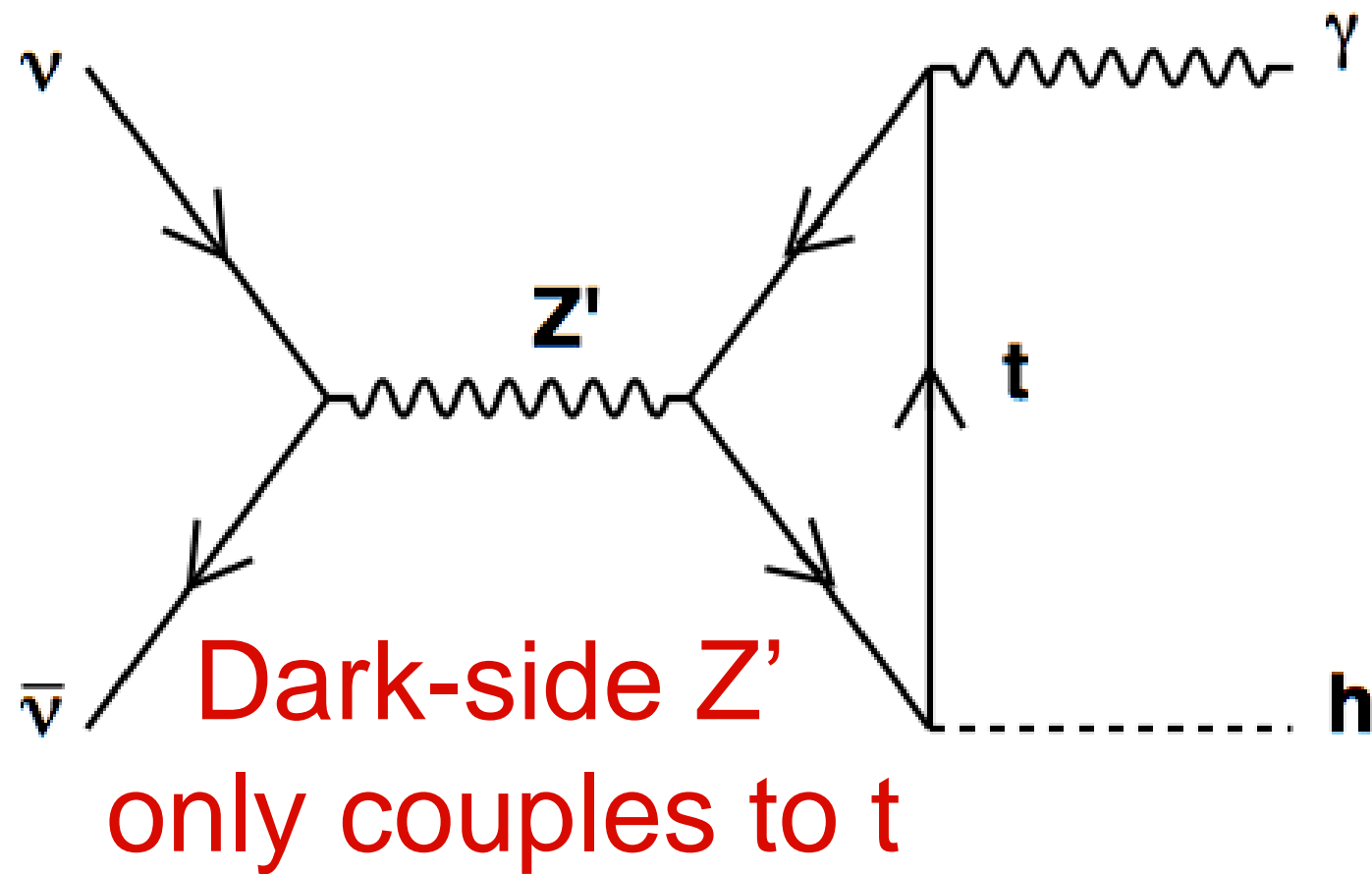
HEP ????

A monochromatic γ line
(but for e^+e^- annihilation)
is not expected from
“astrophysical” sources

Example Prediction: “Higgs in Space!”

Jackson et al., arXiv:0912.0004

WIMP = Dark Heavy ν
with conventional DM abundance



**Unsuppressed
Branching
Ratio**

Random $M_h = 125 \text{ GeV}$
Example $M_\nu = 310.35 \text{ GeV}$ \rightarrow $E_\gamma = 130 \text{ GeV}$

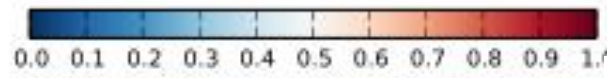
A γ -ray line from the Galactic Center?

Publically-available data from the

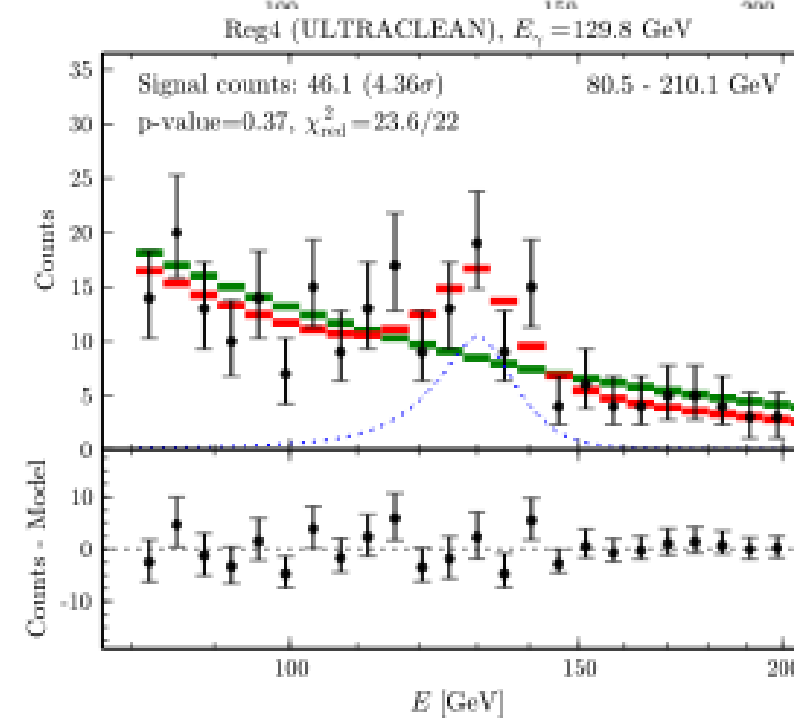
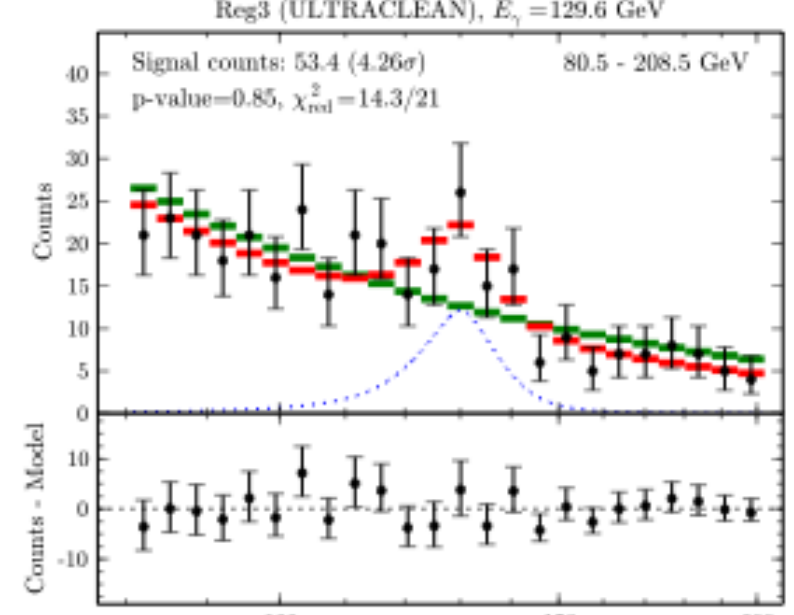
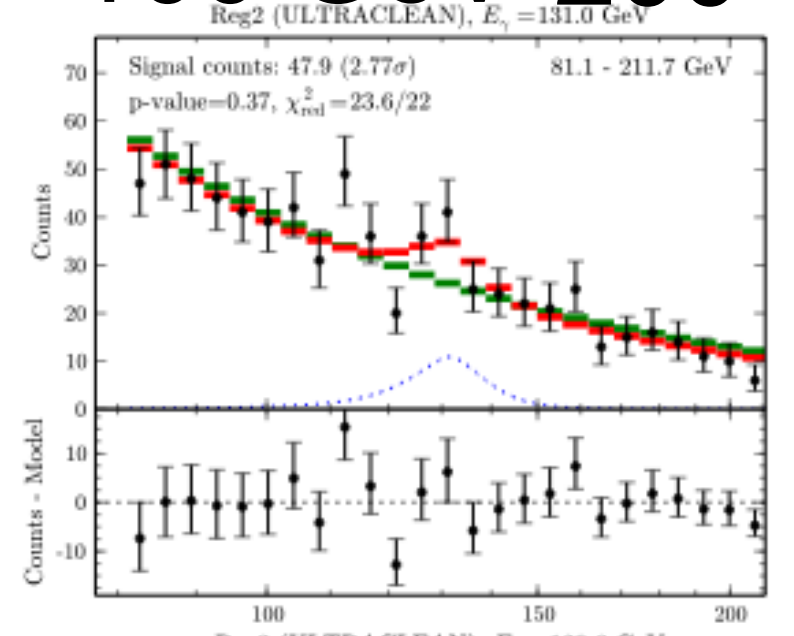
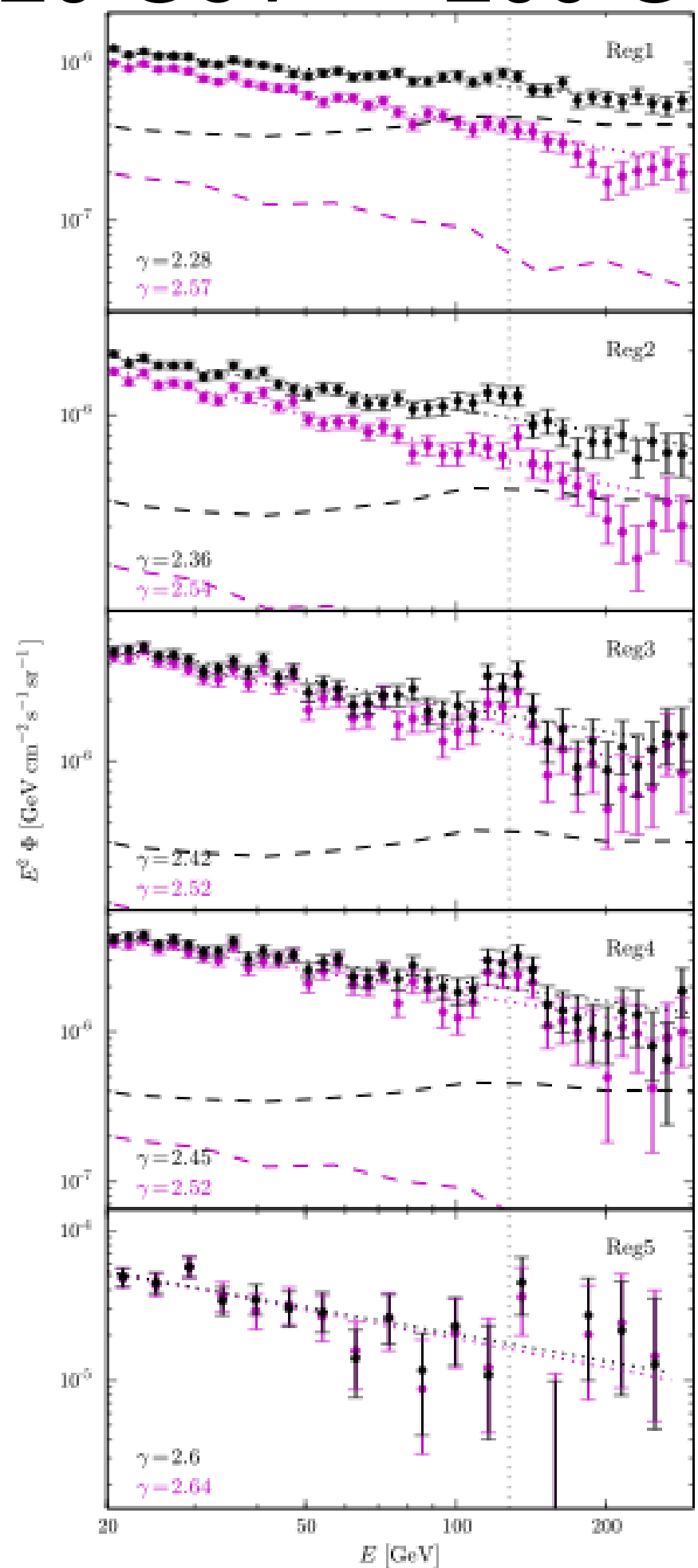
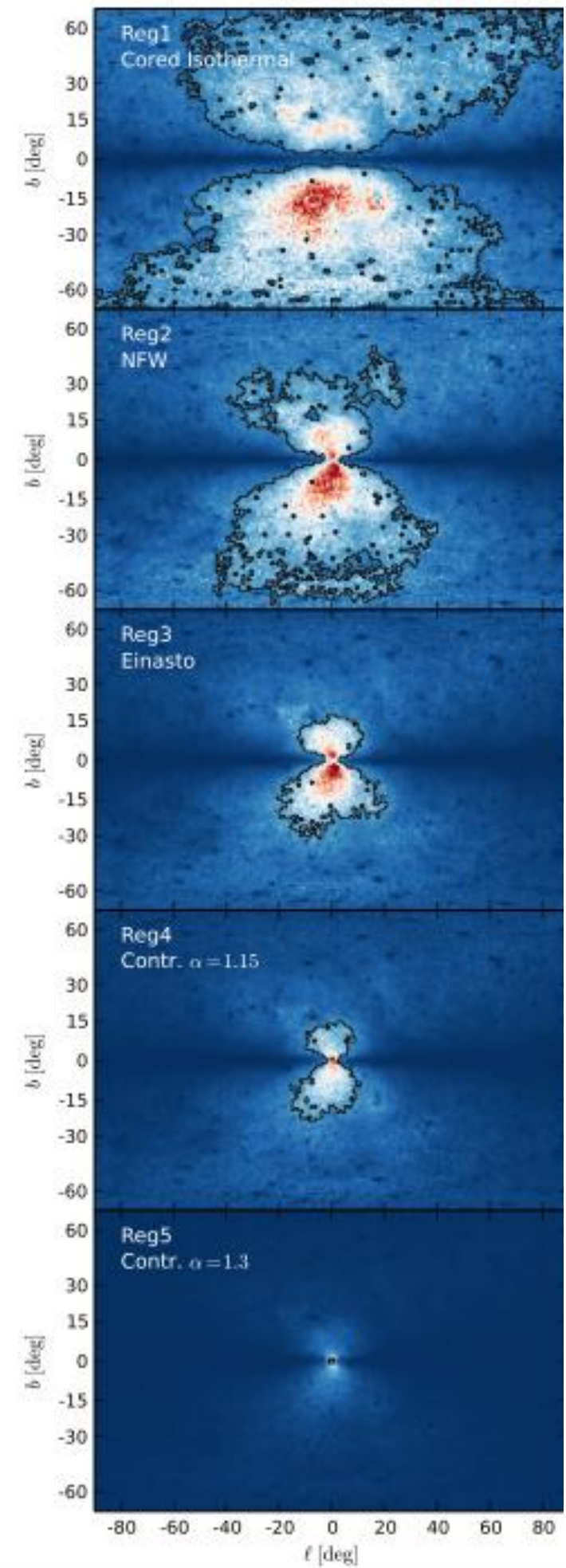
Large Area Telescope in Fermi (ex-GLAST)

Intensely analysed
by Christoph
Weniger,

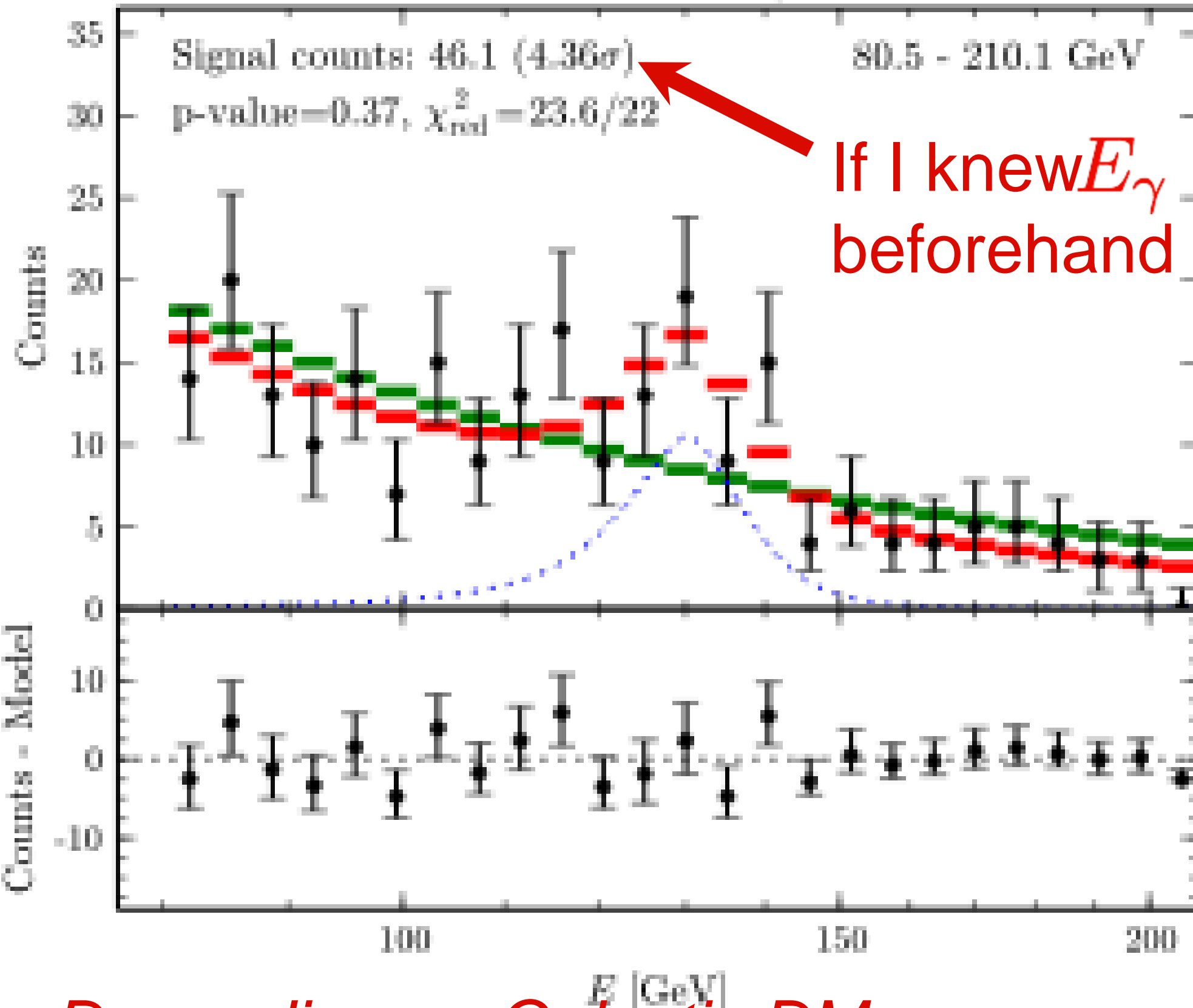
arXiv:1204.2797



20 GeV 200 GeV 100 GeV 200 GeV



Reg4 (ULTRACLEAN), $E_\gamma = 129.8$ GeV



If I knew E_γ
beforehand

“LEE”

3.3σ



Depending on Galactic DM

profile

B.R. \sim 4-8 % (1/20 of “H in space”)

Boyarski, Malyshev & Ruchayskiy *counterattack*

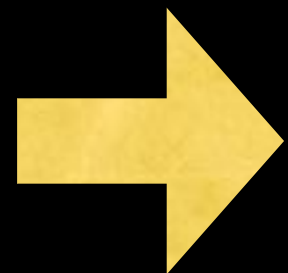
The backgrounds are NOT power laws

~~3.86~~ line at 115 GeV in “Region 1”

~~2.86~~ line at 80 GeV in “Region 3”

~~- 4.7~~ dip at 95 GeV in “Region 2”

It is an SLEE



“Should Look Everywhere
Else Effect”

Profumo & Linden, arXiv:1204.6047

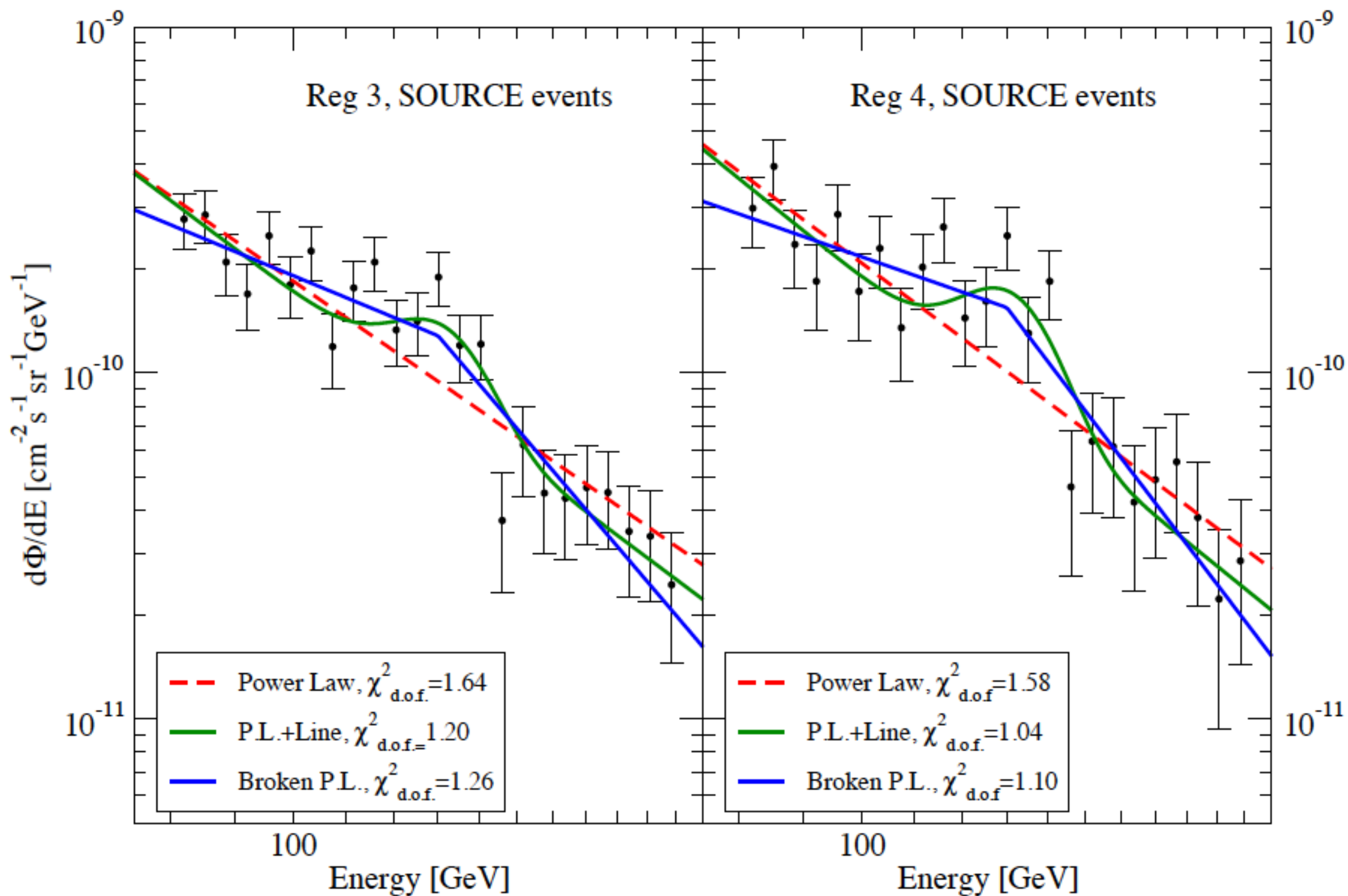


FIG. 2.— The gamma-ray spectrum in Regions 3 (Einasto Profile, left) and 4 ($r^{-1.15}$ profile, right), from the analysis of [Weniger \(2012\)](#), and the best-fit power-law (red dashed), power-law plus monochromatic line at $E_\gamma = 130$ GeV, smeared by the LAT energy resolution (green), and a broken power-law (blue) similar to the spectrum observed in the Fermi bubbles regions.

Weniger's cautions:

Based only on publically available data (Systematics?)

Evidence based on ~ 50 photons.

“It will require a few more years of data to settle its [the line's] existence on statistical grounds”

 a few more years of TH's fun

OTHER OBSERVATIONS ???

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"LET ME THROUGH, I'M AN OPPORTUNIST."

Search ID: min1107

The Standard

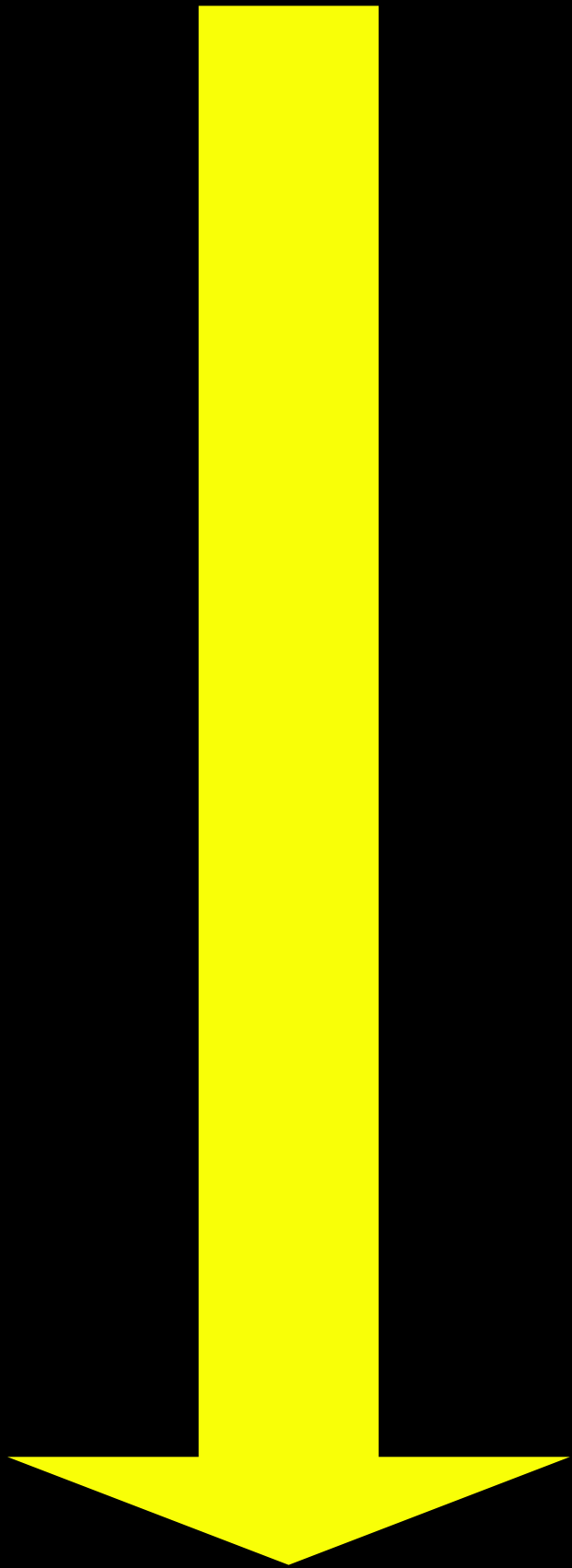
Λ CDM

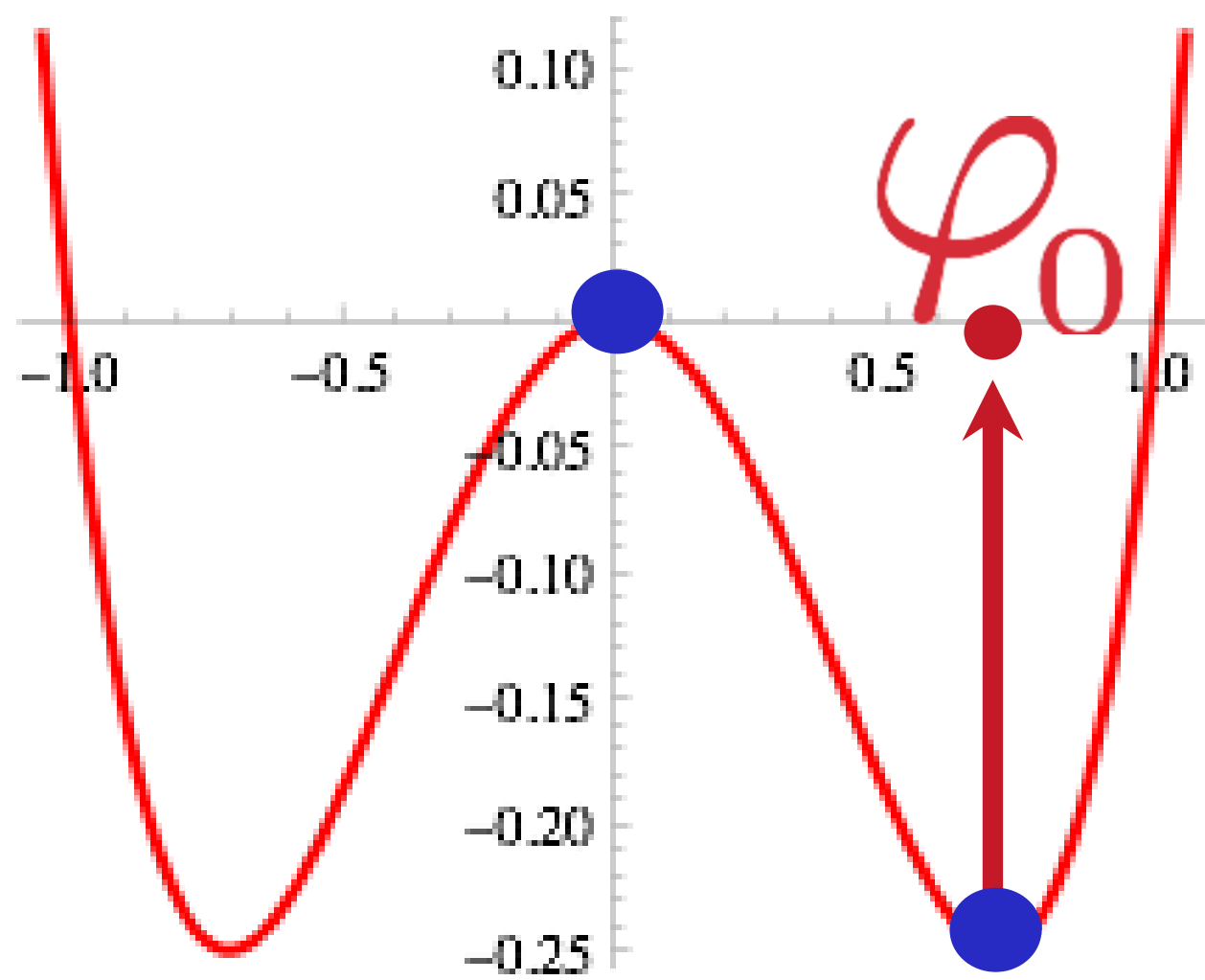
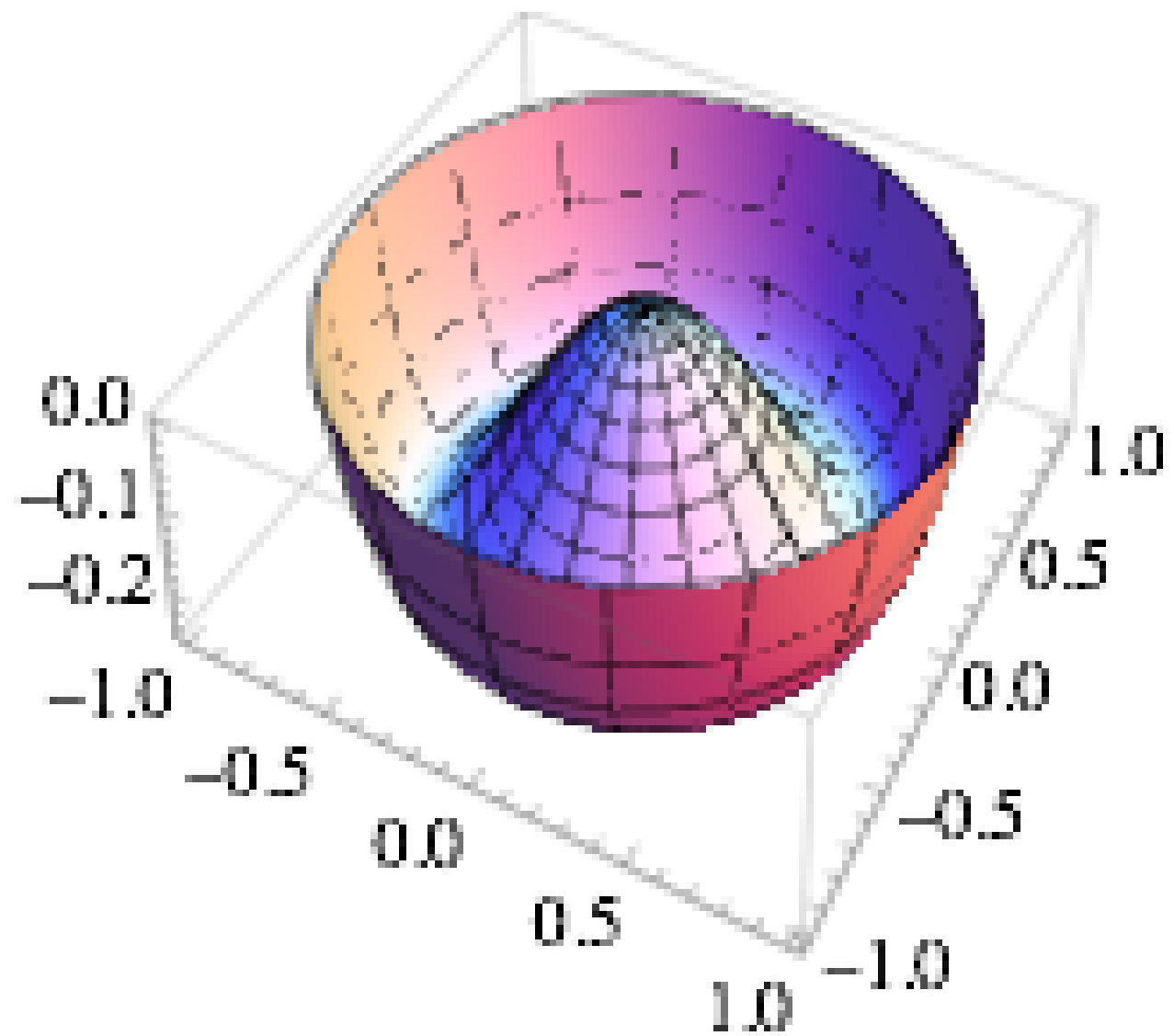
Cosmo-Model

is unchallenged

Correct

???

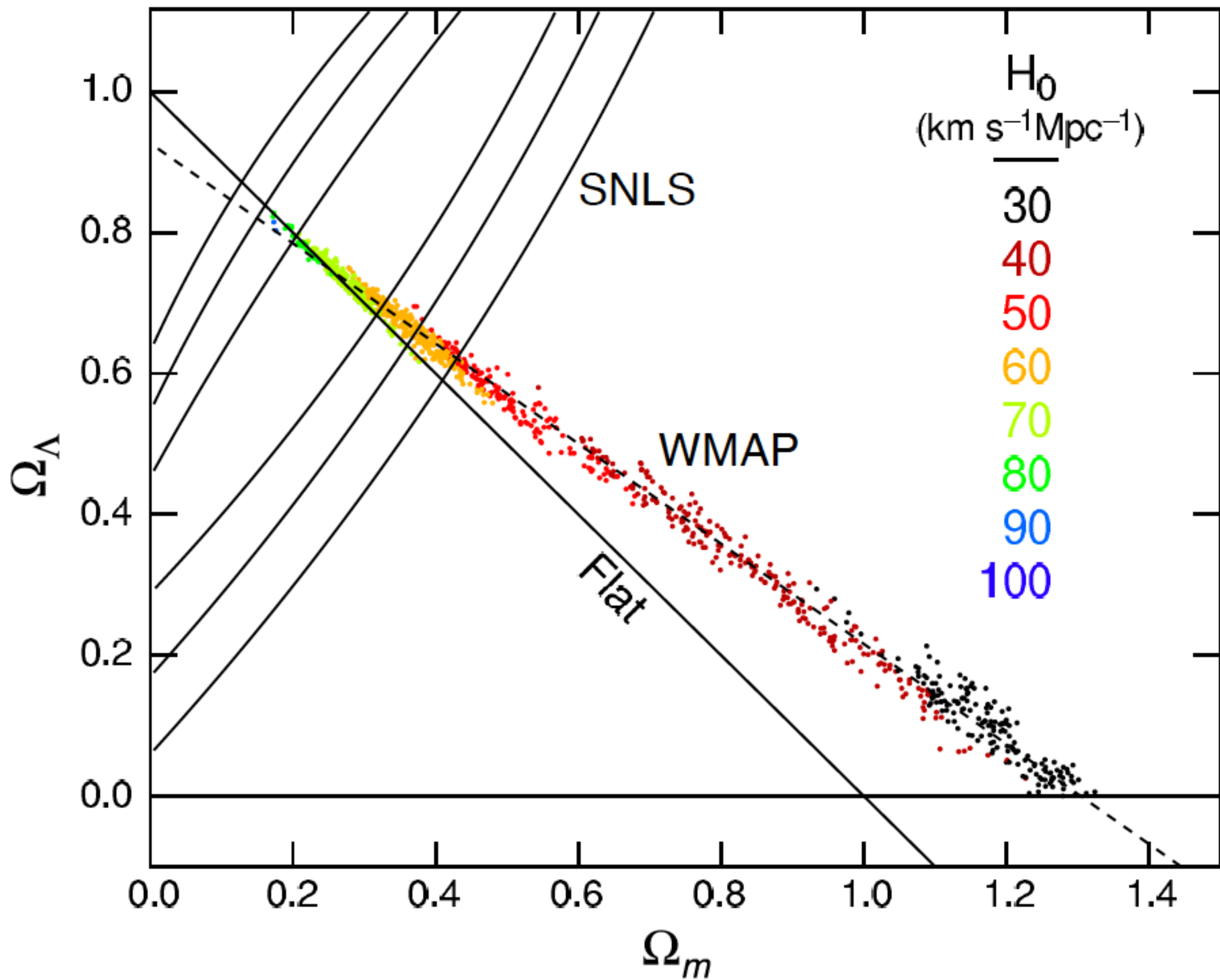




Jump in vacuum energy at EWPT by

$$\Delta\Lambda \approx 10^{54} \Lambda_{\text{Obs}}$$

The discovery of
the Higgs Boson
would be a significant
step *{sideways}* in
our understanding of
the Universe



Heretical

Views

Doubt SNe Standard
Candle

P.L. Kelly *et al.*

HUBBLE RESIDUALS OF NEARBY
TYPE Ia SNe ARE CORRELATED
WITH HOST GALAXY MASSES

$$1 + \omega = (p + \rho) / \rho$$

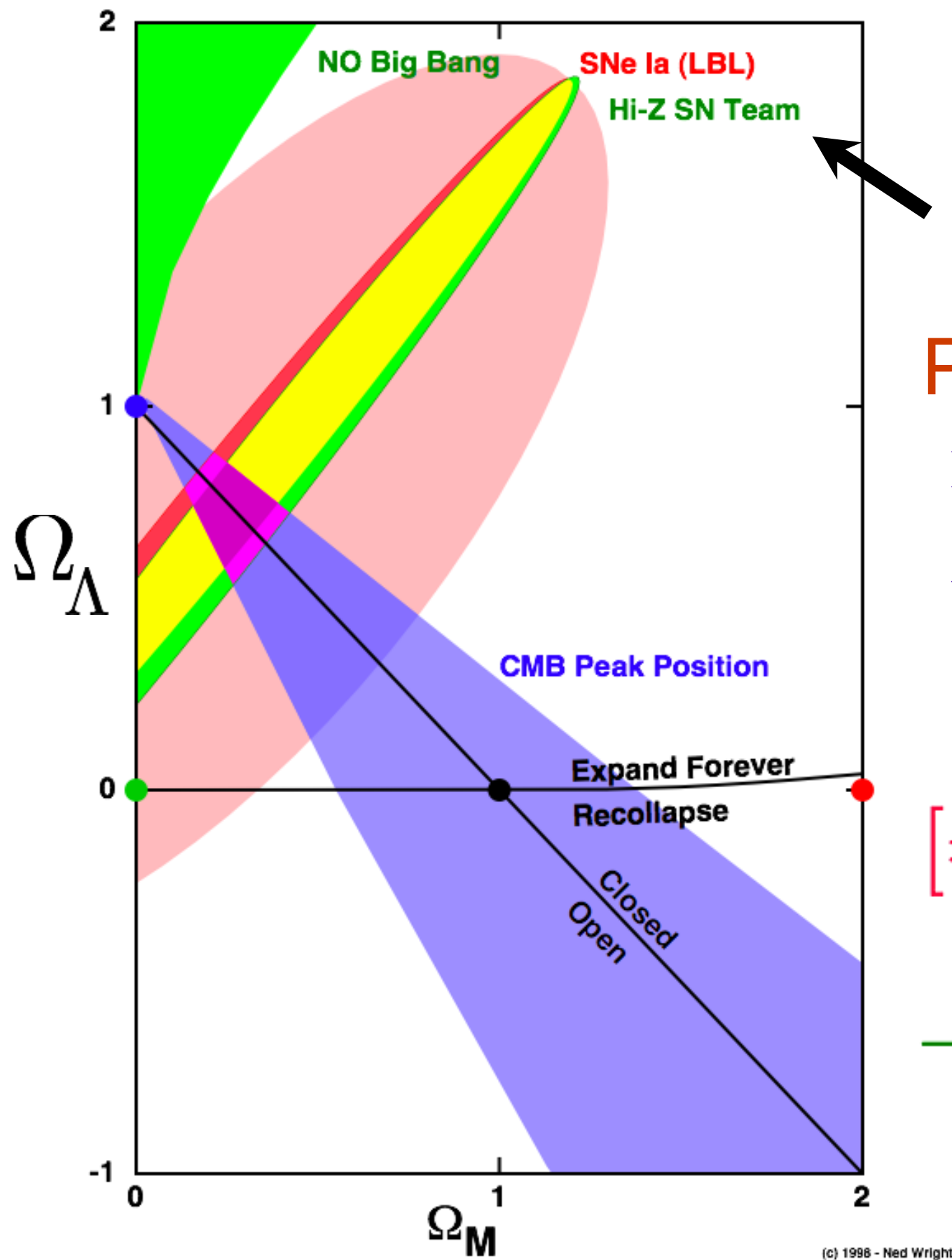
[= 0; for Λ dominance]

+0.217 *Large near*

-0.03 *Galaxies*

+0.152 *Small near*

0.22 *Galaxies*

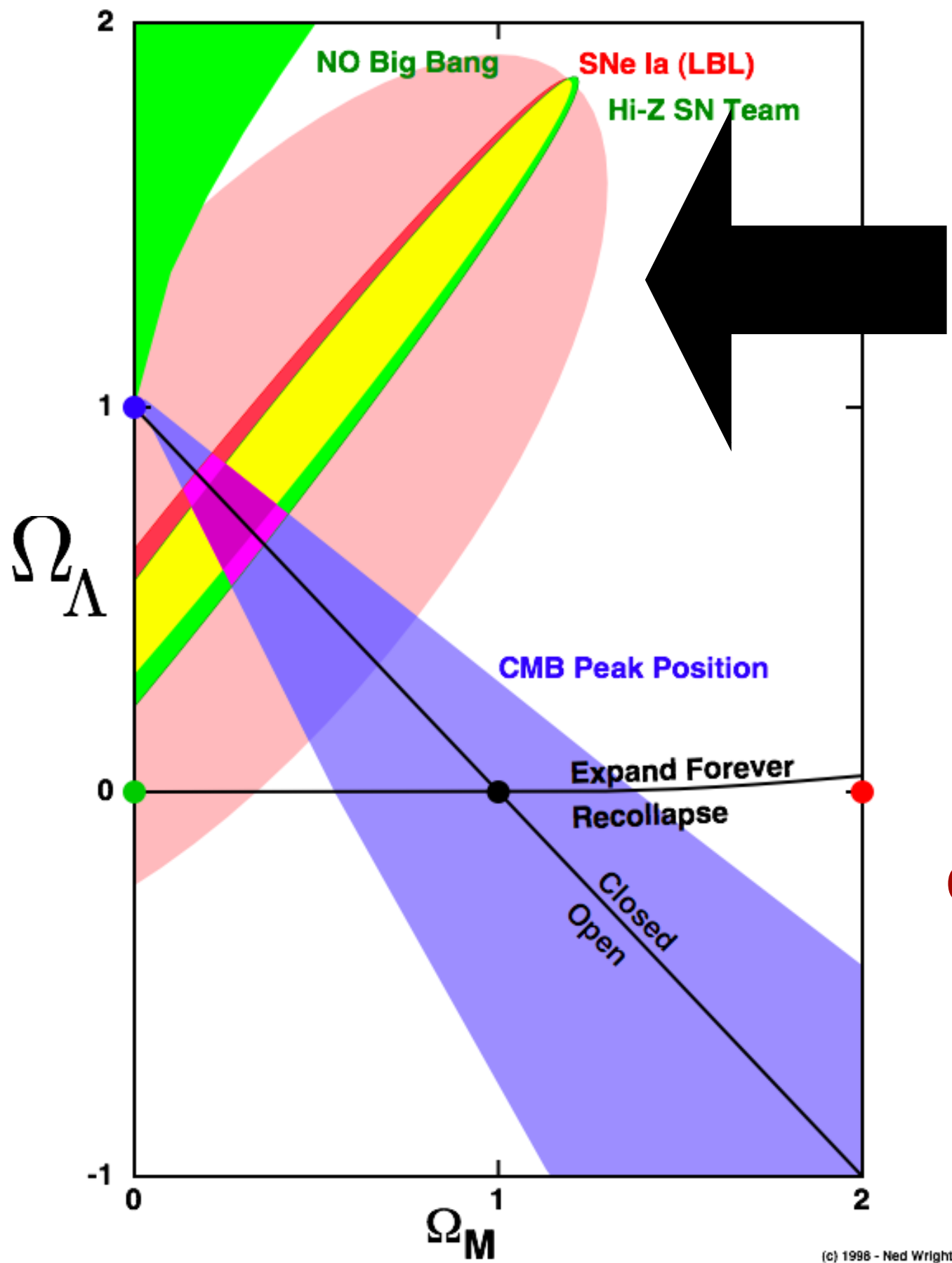


Heretical Views

“Small” deviations from Standard CosmoModel

C.G. Tsagas, PRD 84, 063503

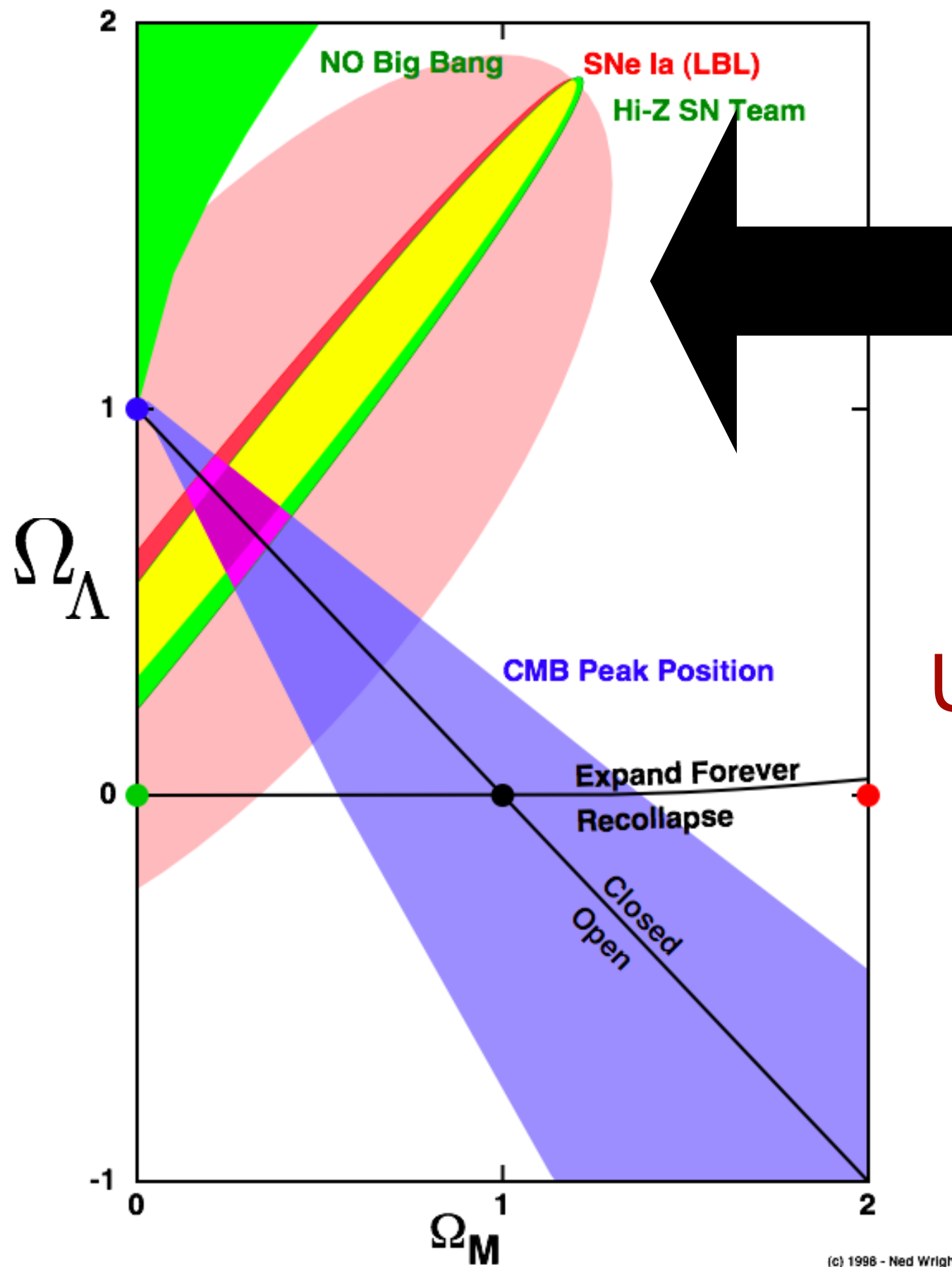
Observers with small peculiar motions (in e.g. Milky Way) can experience accelerated expansion within a globally decelerating universe



Heretical

Views

“Small” deviations from Standard CosmoModel



Homogeneous and
IN-Homogeneous
Universes with the same
average density need
NOT have the same
expansion rate

Buchert & Ellis, Ellis, Barause
& Bushert, C el erier, R as anen,
Kolb *et al.*, Schwartz...

A CHANGE IN THE ANSWER
IS A SIGN OF EVOLUTION.

A CHANGE OF THE QUESTION
IS A SIGN OF REVOLUTION

We need a
RRRRRREVOLUTION

