Constraining the distribution of dark matter in inner galaxy: The case of 130 GeV line

(arXiv:1304.7986)

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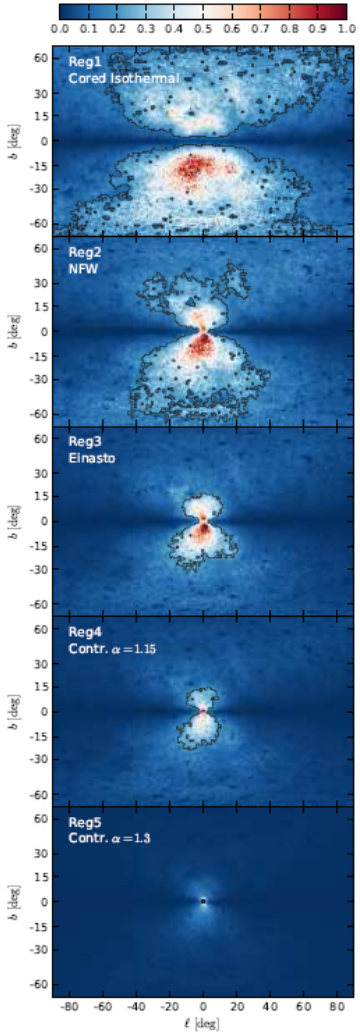
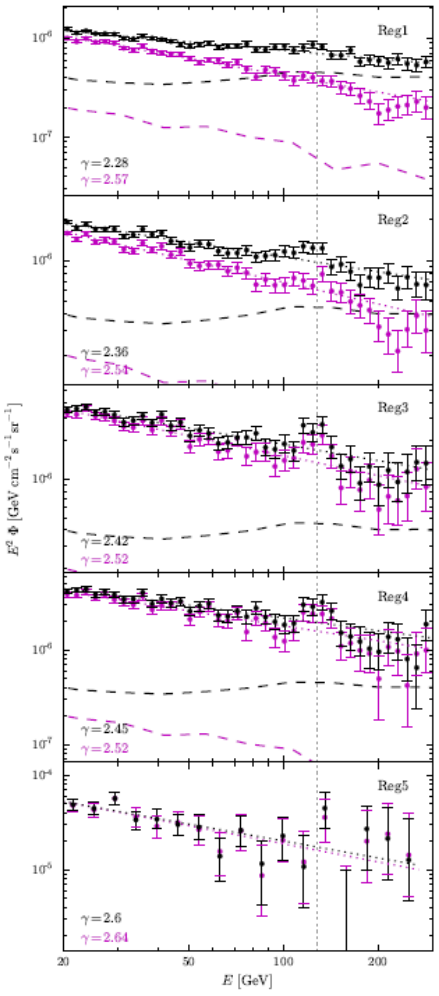
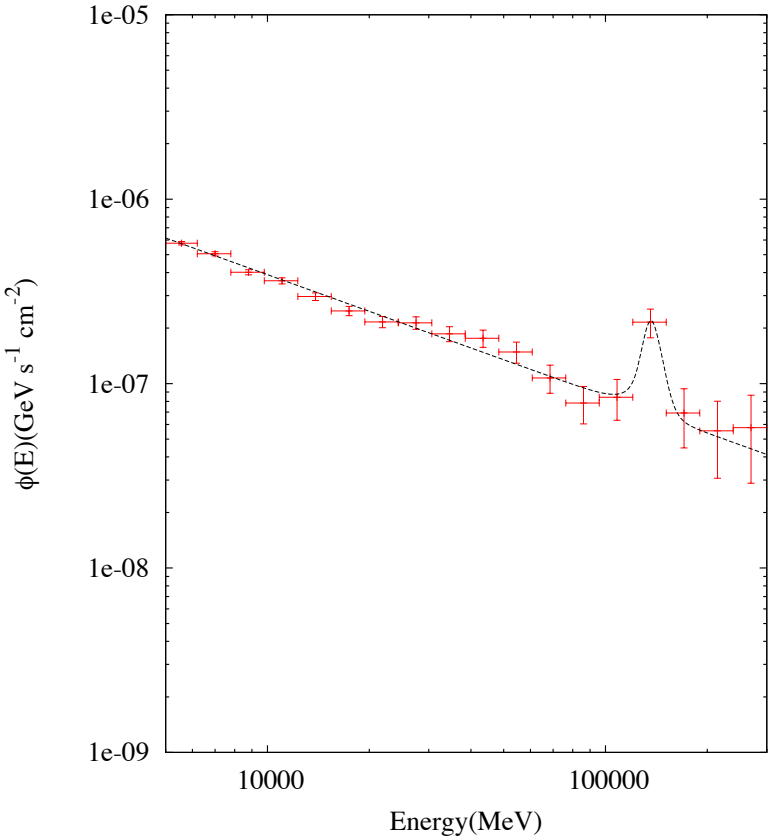
PMO

Tentative Line Signal





SED in optimized region suggested by Tempel et al. 2012



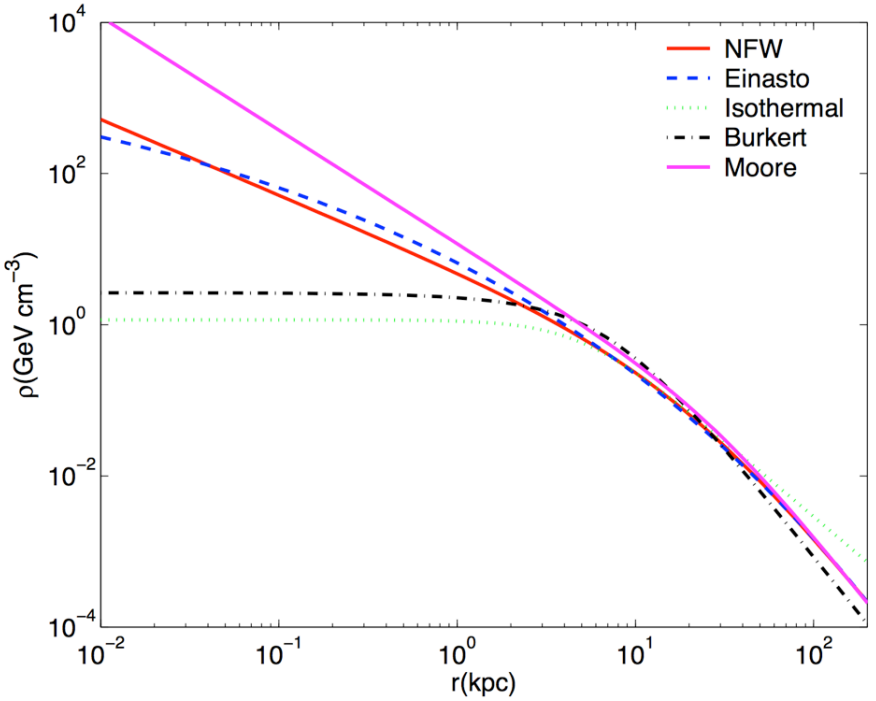
Weniger 2012

Dark matter distribution

Isothermal $\rho(r) = \dfrac{\rho_s}{1 + (r/r_s)^2}$

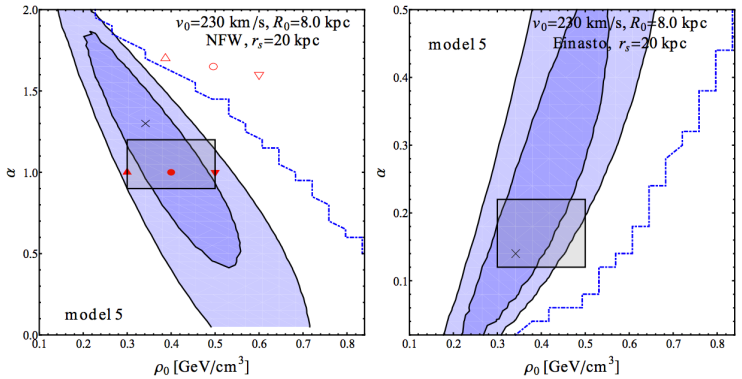
NFW $\rho(r) = \dfrac{\rho_s}{(r/r_s)(1 + r/r_s)^2}$

Einasto $\rho(r) = \rho_s \exp\left(-\dfrac{2}{\alpha}\left[\left(\dfrac{r}{r_s}\right)^{\alpha} - 1\right]\right)$



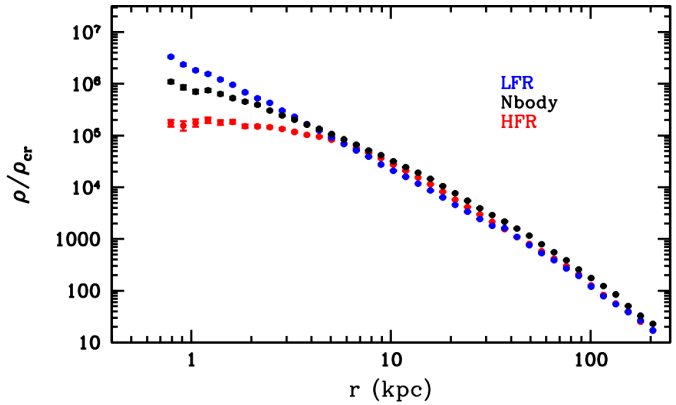
Inner Galaxy

- Dominated by baryons, hard to constrain by lensing and rotation curve



Iocco 2011

- Uncertainty in simulations.

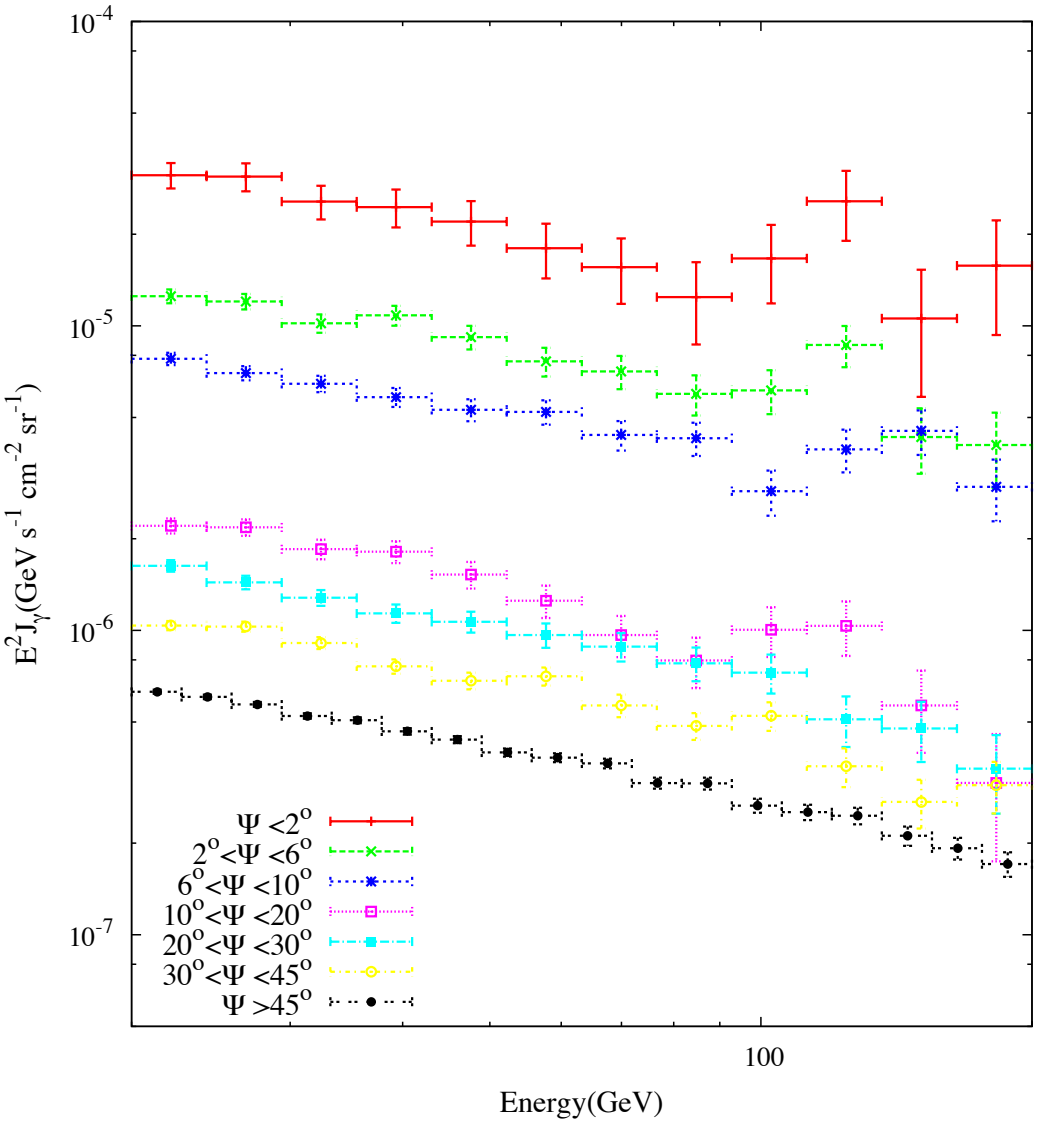


Maccio 2012

- Testing the consistence between the line signal and upper limits in other regions?

$$< \sigma v >_{\lim it} \geq < \sigma v >_{signal}$$

- Signal in different regions



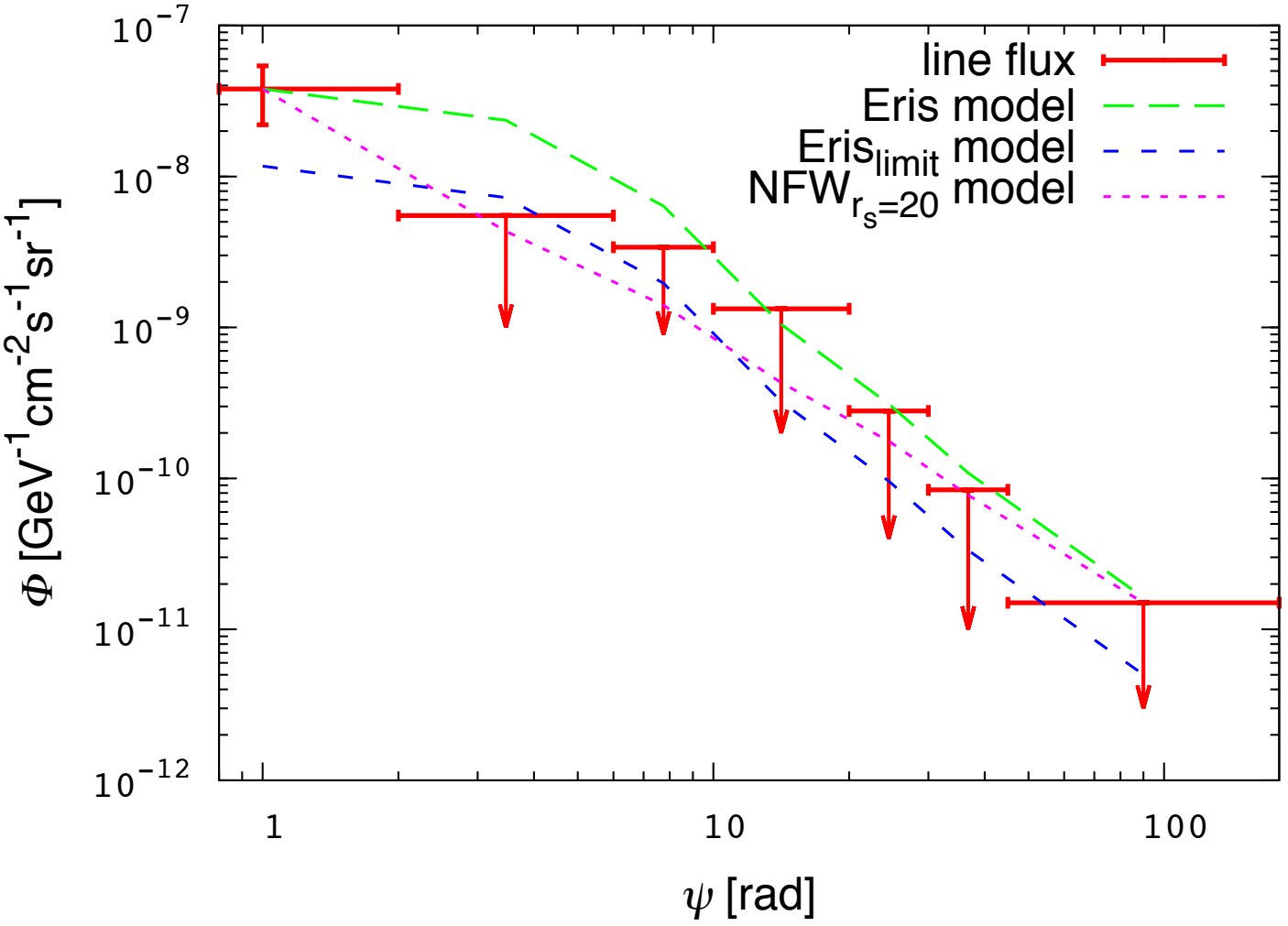
Unbinned Analysis

$$\mathcal{L} = \prod_i f S(E_i) + (1 - f) B(E_i),$$

i runs over all the photons in ROI, Signal function is derived by convolving delta function with the energy dispersion of LAT.

$$B(E_i) \sim E_i^{-\Gamma} \epsilon(E_i),$$

The MINOS asymmetric error at the level Δ lnL = 1.35 is adopted to get upper limit corresponding to a coverage probability of 95%.

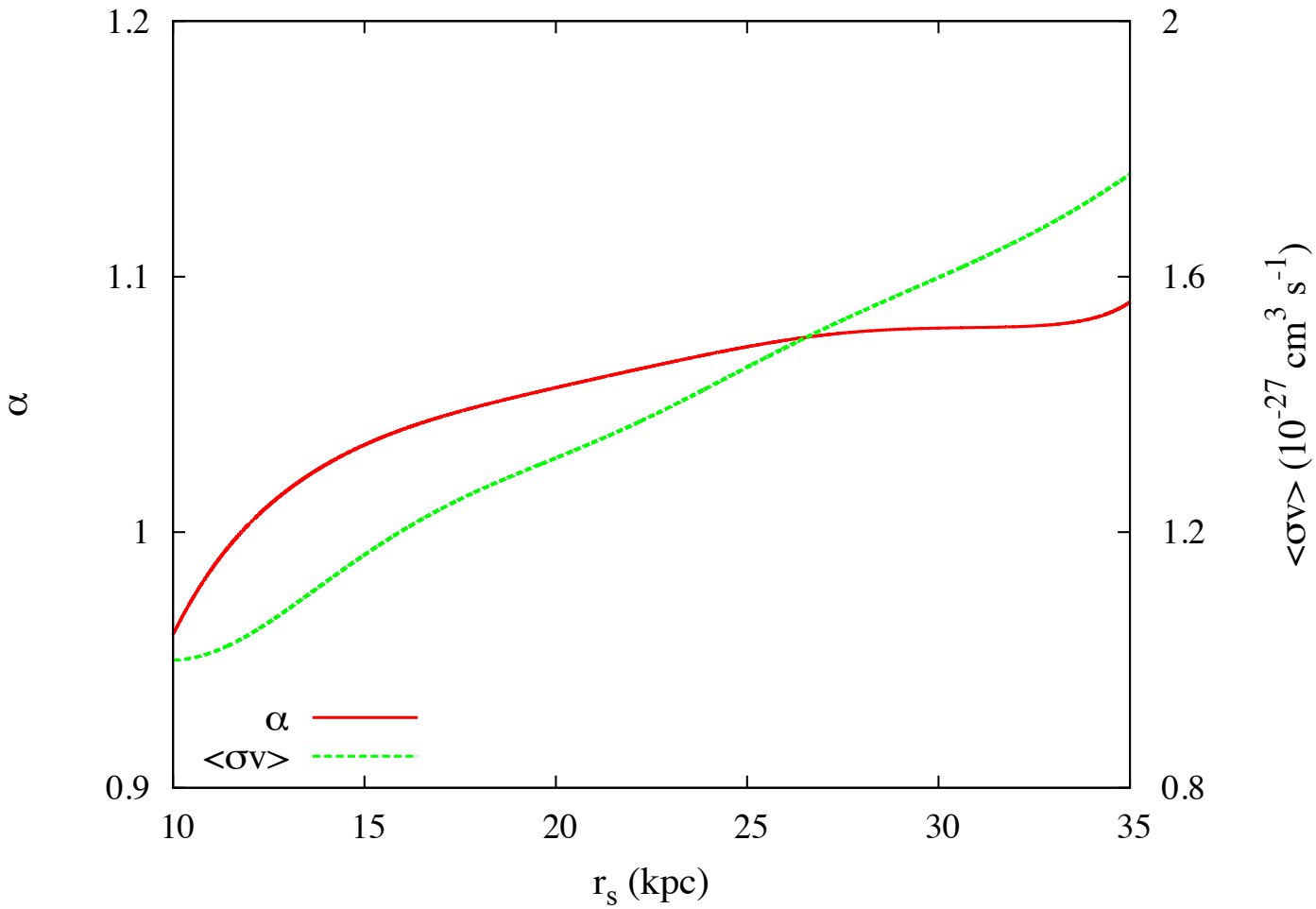

line flux
Eris model
Eris$_{limit}$ model
NFW$_{r_s=20}$ model
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
Φ [GeV^{-1}cm^{-2}s^{-1}sr^{-1}]
1
10
100
ψ [rad]

Combined likelihood to derive the constraints

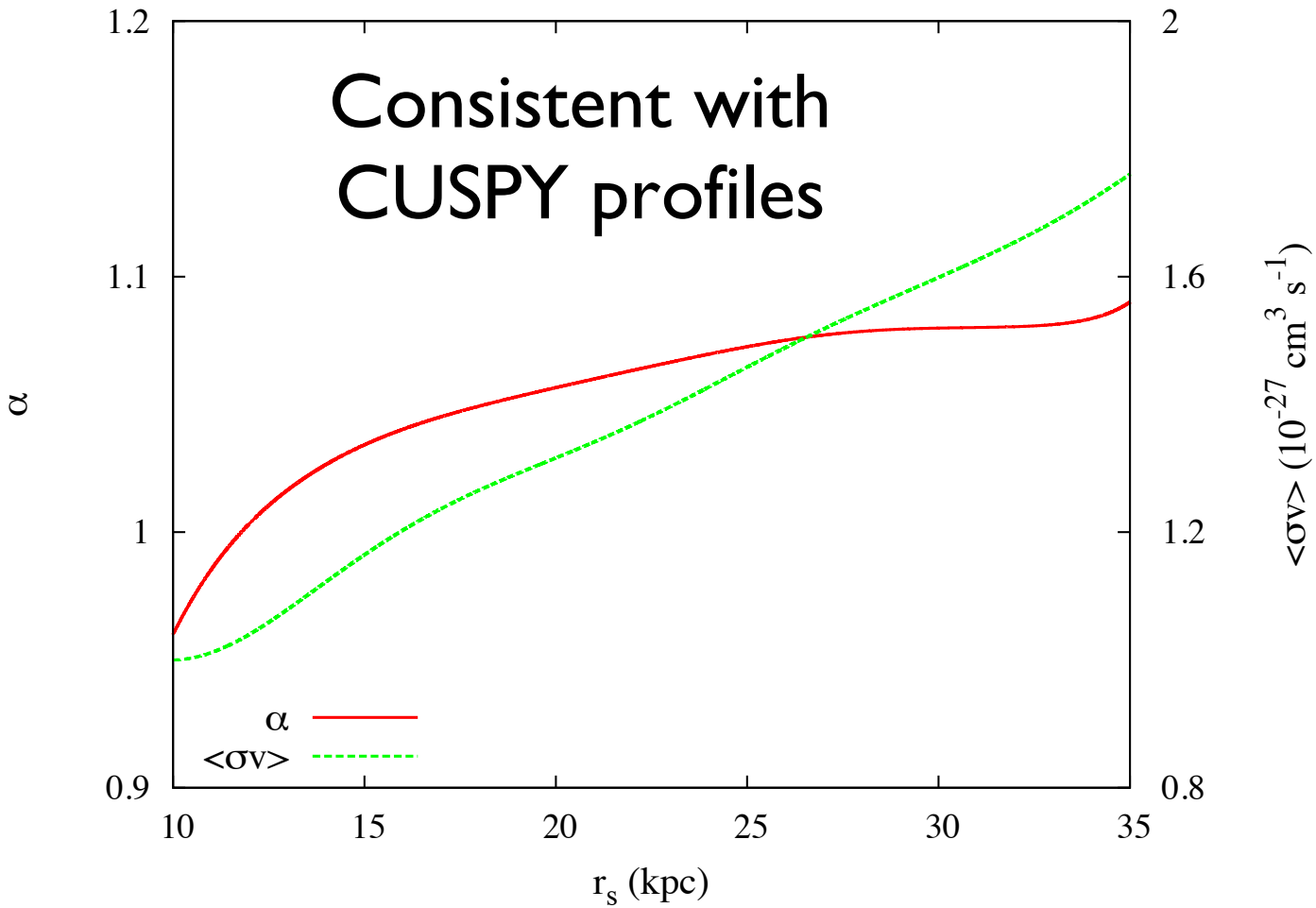
- Combined likelihood $L_c = \Pi L_i$
- i runs over the regions here
- Signal function now related to J- factor and cross section.

$$\Phi(\Delta\Omega, E_\gamma) = \frac{1}{4\pi} \times \frac{\langle\sigma v\rangle_{\chi\chi\to\gamma\gamma}}{2m_\chi^2} \frac{\mathrm{d}N_\gamma}{\mathrm{d}E_\gamma} \times \bar{J}(\Delta\Omega)\Delta\Omega,$$

- Profile likelihood method to derive the upper limits on parameters.

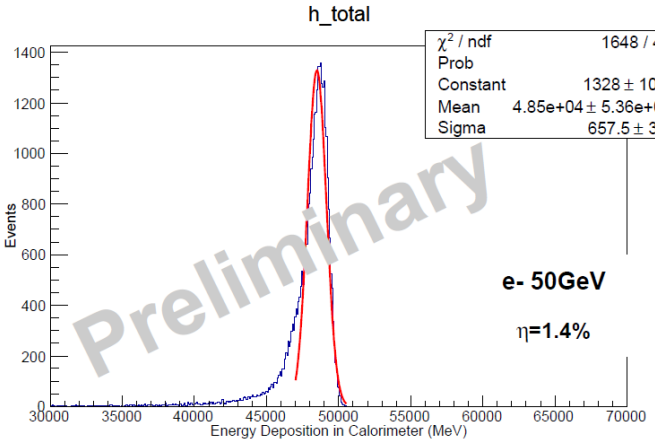


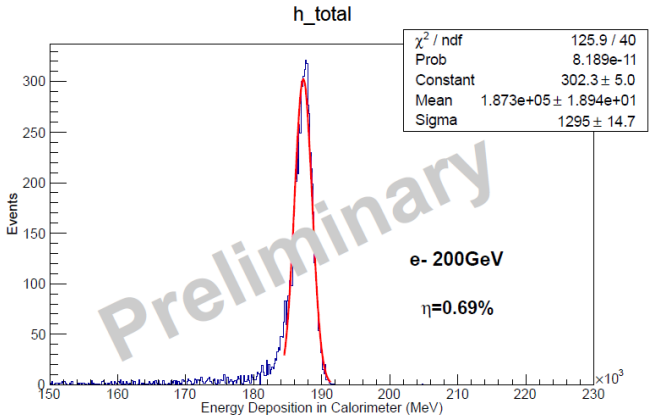
$$\rho_{\mathrm{DM}(r)} = \rho_{\mathrm{s}}(r/r_{\mathrm{s}})^{-\alpha}(1 + r/r_{\mathrm{s}})^{-3+\alpha}$$

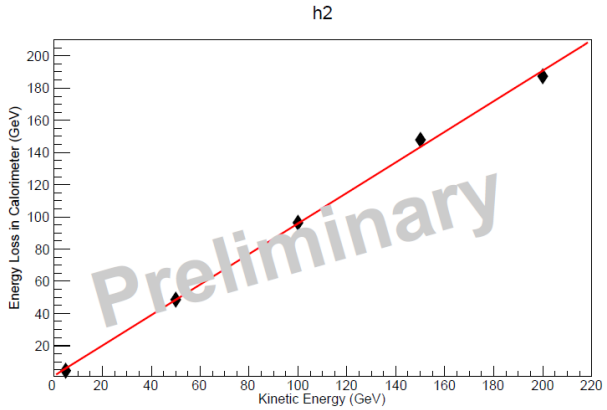


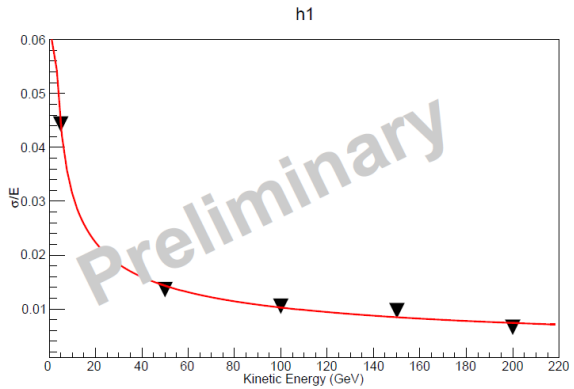
$$\rho_{\rm DM}(r) = \rho_{\rm s}(r/r_{\rm s})^{-\alpha}(1+r/r_{\rm s})^{-3+\alpha}$$

Testing line signal with DAMPE?









Thanks for
Attention!