



Vela as a source for galactic CR above 100 TeV and neutrinos and gamma rays below 100TeV

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This presentation is based on : [arXiv 1812.03522](https://arxiv.org/abs/1812.03522)
[arXiv 2001.00768](https://arxiv.org/abs/2001.00768)

Elbereth Conference

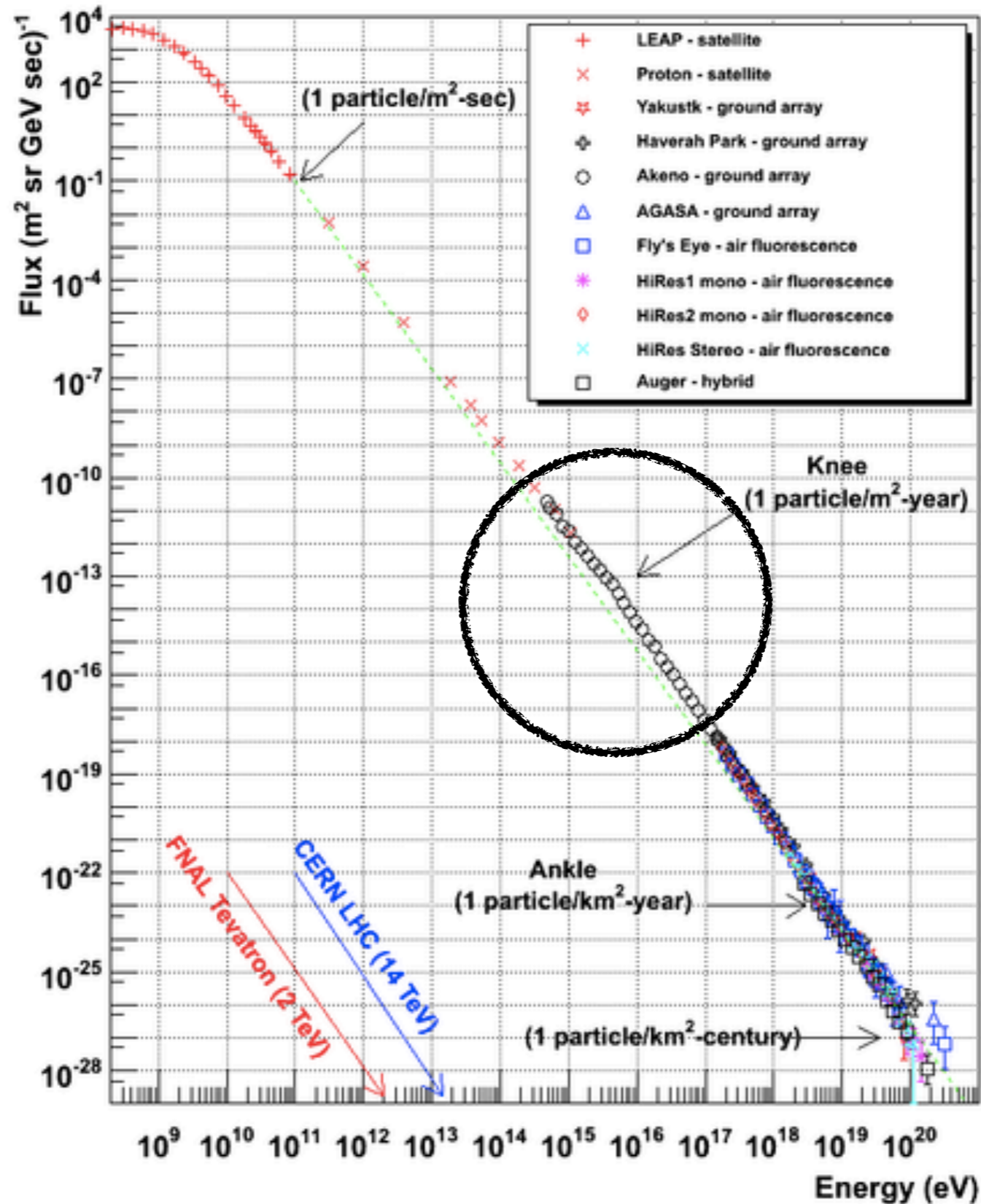
February 28th 2020



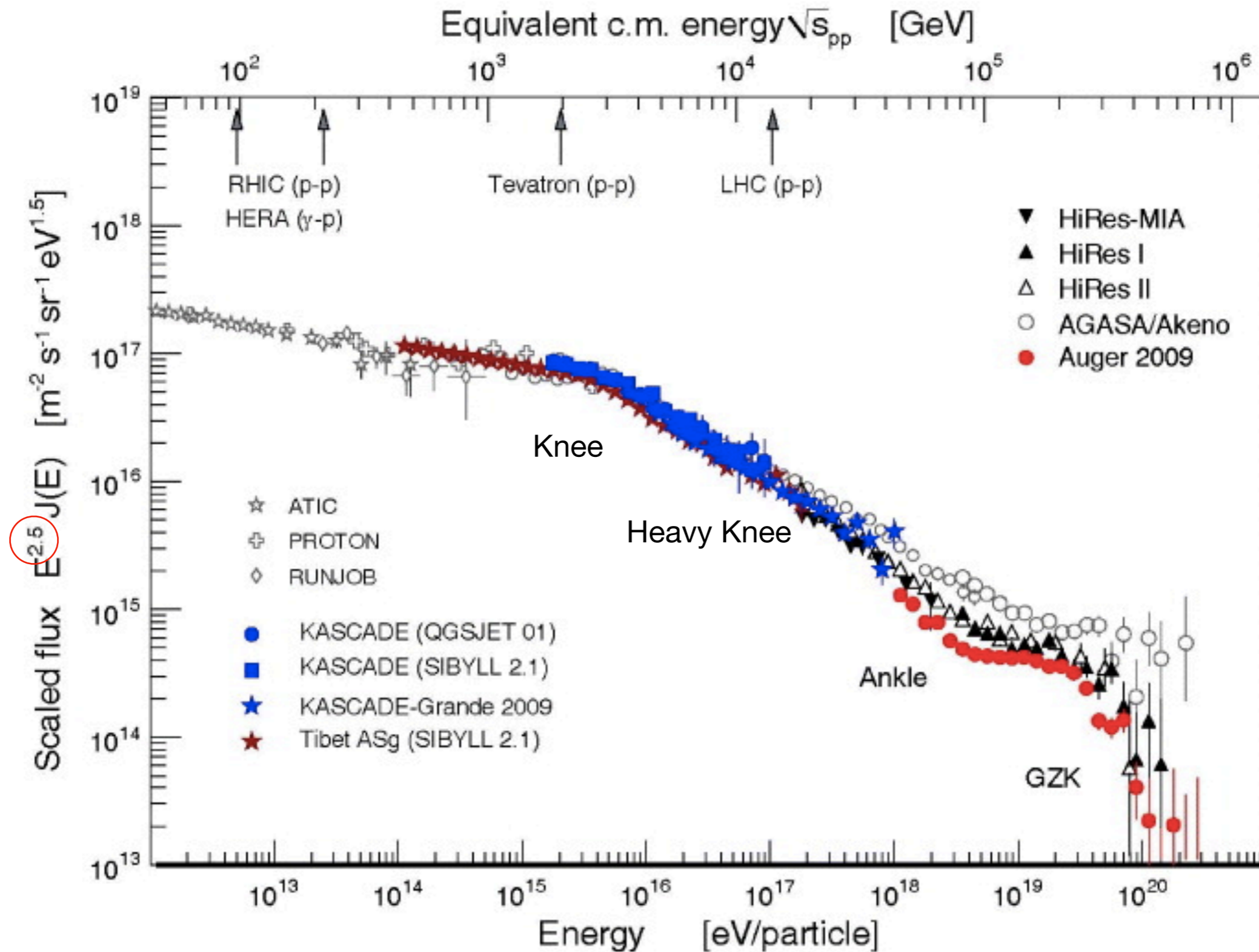
Part I

Cosmic rays

Introduction (Motivations)



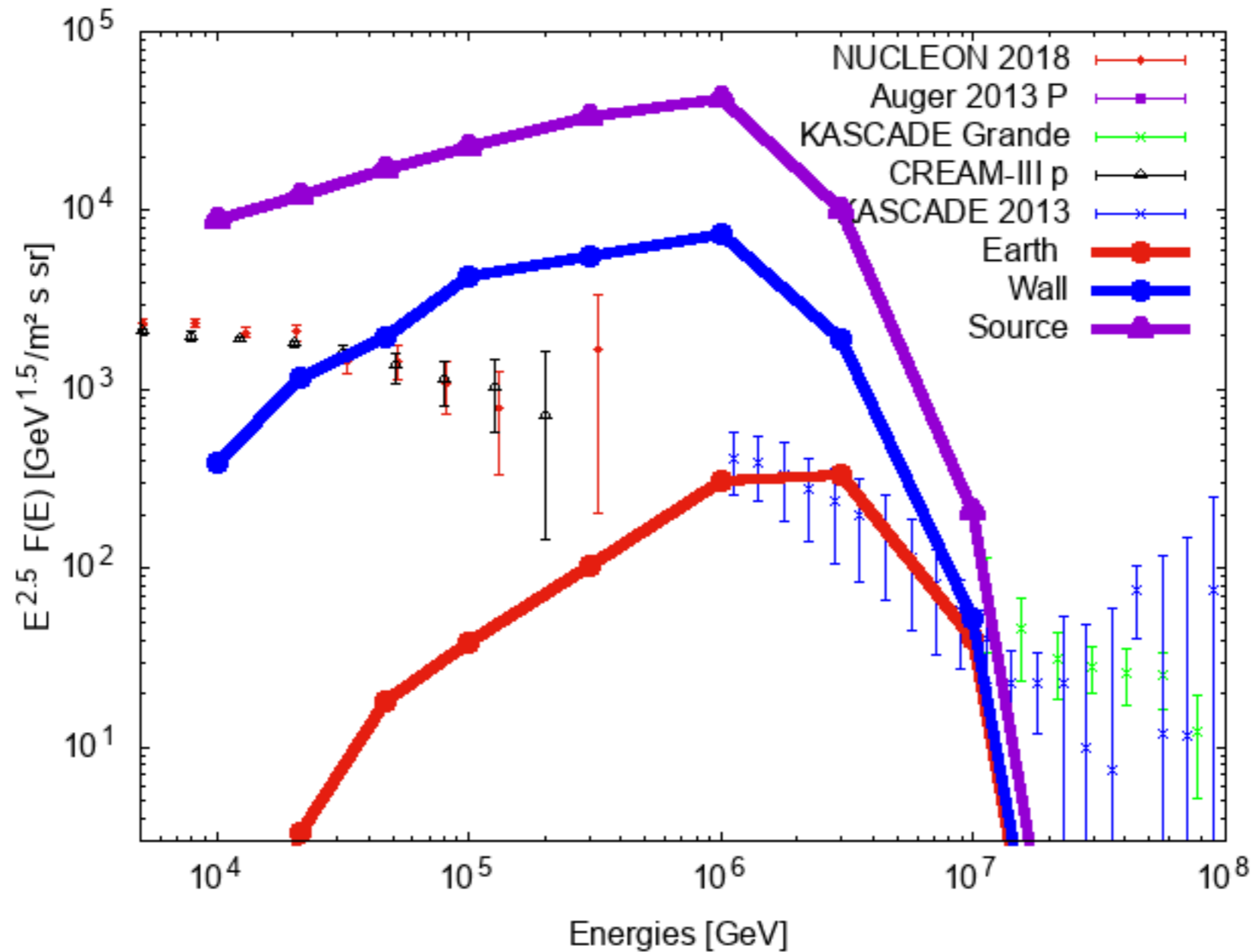
Introduction (Motivations)



Introduction (Explanations)

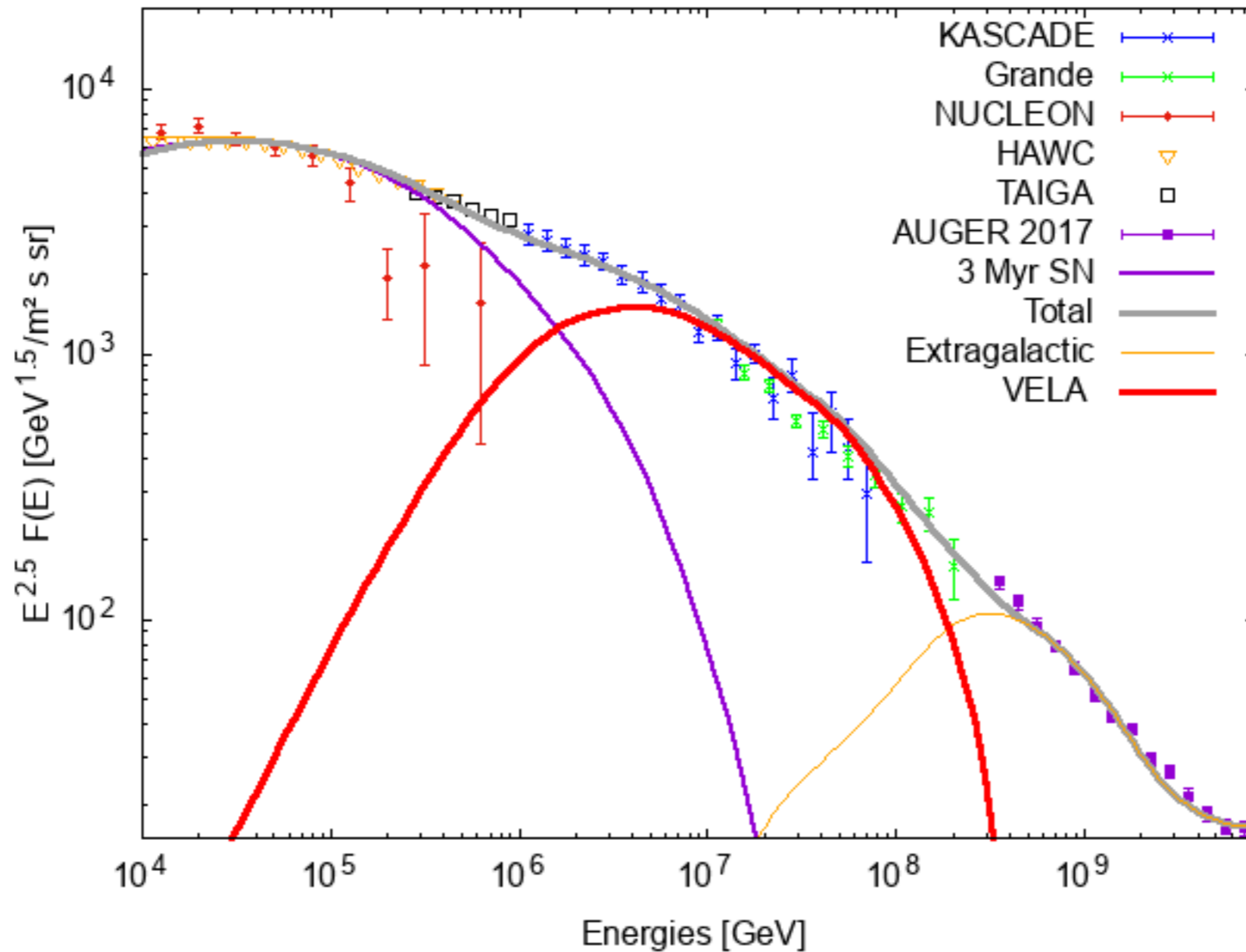
- Interaction changes in the multi-TeV region (excluded by LHC)
- Change of the diffusion properties of charged CR (V.L.Ginzburg and S.I.Syrovatskii 1964 , V.S.Ptuskin et al. 1993) (more on arXiv 1403.3380v2)
- Dominant contribution of one single nearby source (A.D. Erlykin and A. W. Wolfendale 1997)

Results (Proton flux on earth wall and source)



M.Kachelriess, D.Semikoz, B.M 2018 arXiv 1812.03522

Results (All particles)

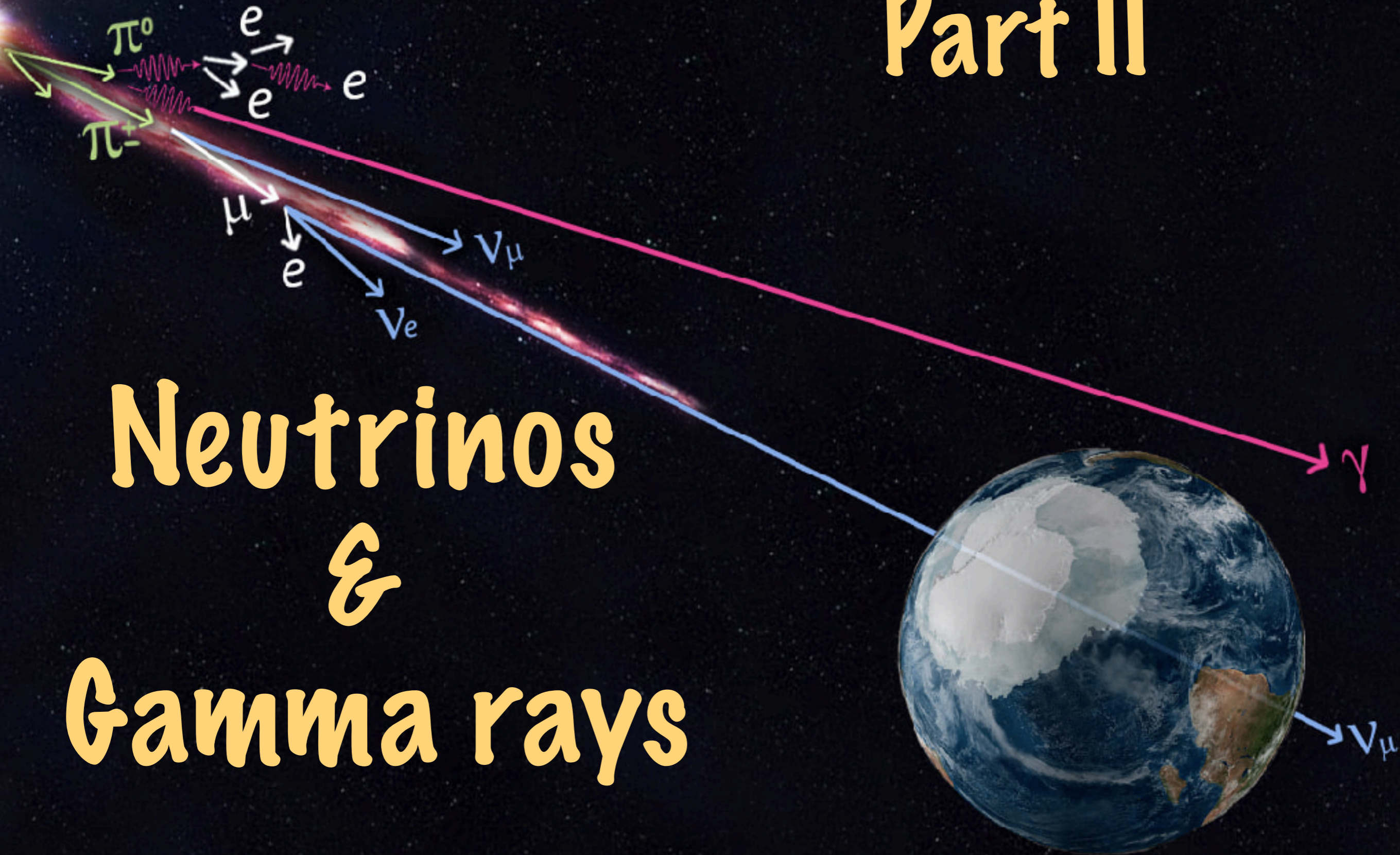


All particles

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Part II

Neutrinos & Gamma rays



Introduction (Motivation)

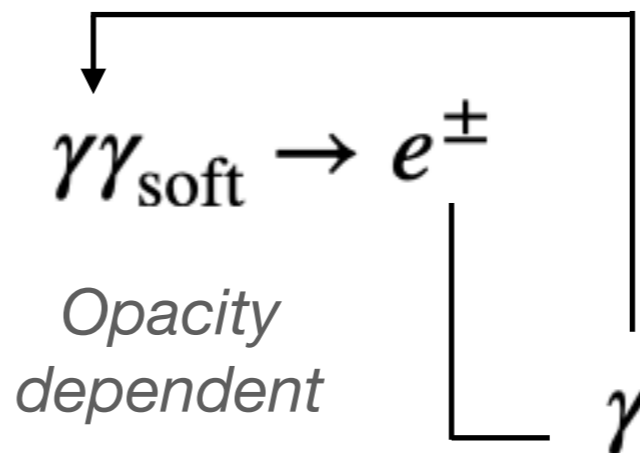
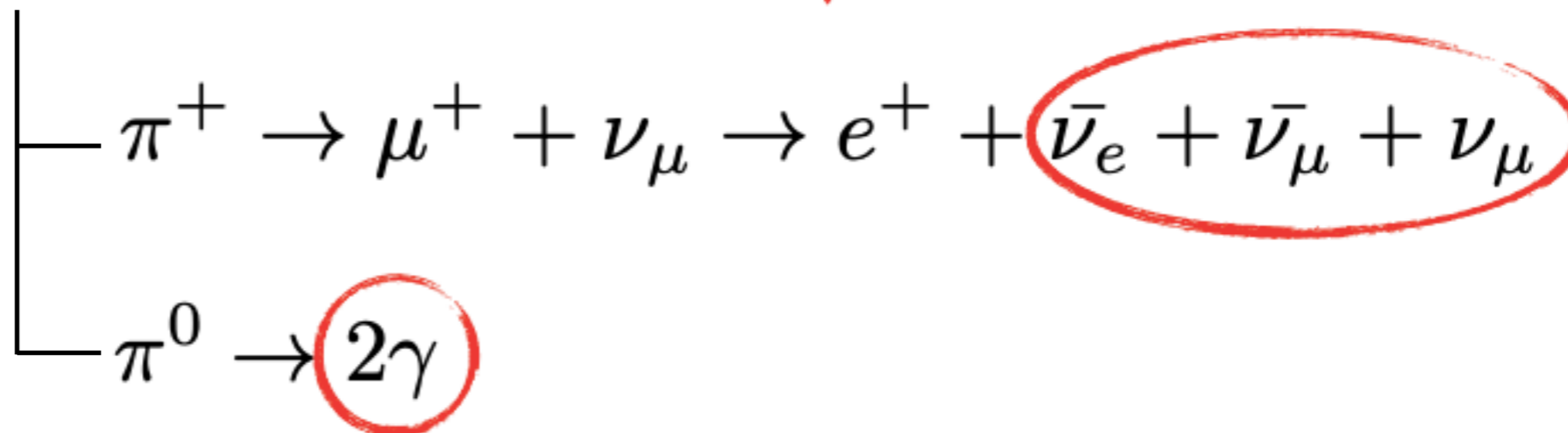
$$p + p \rightarrow \pi + X$$

$$E_{\nu 0} \approx E_p / 20$$

$$E_{\gamma 0} \approx E_p / 10$$

$$E_{\gamma 0} \approx 2 \times E_{\nu 0}$$

$$L_{\gamma} \approx L_{\nu}$$

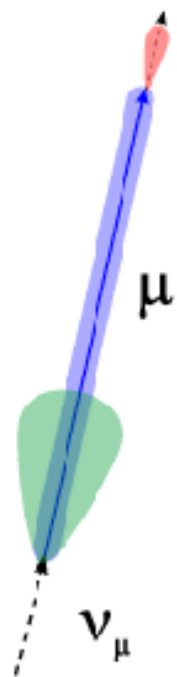


$$E_{\gamma} \leq E_{\gamma 0}$$

$$L_{\gamma} \approx L_{\nu}$$

Introduction (Motivation)

Track event



Energy resolution



Angular resolution

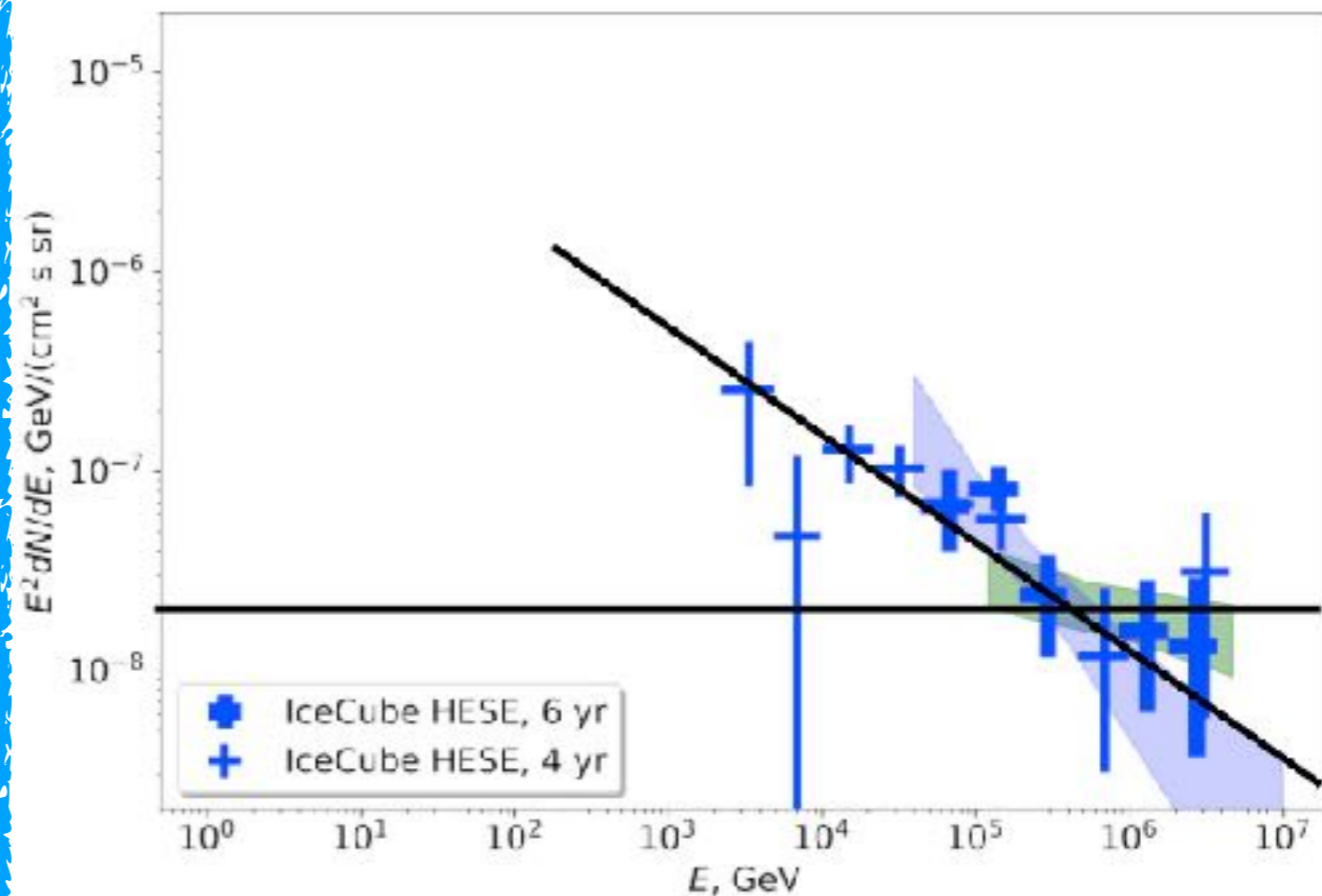
Cascade event



Energy resolution

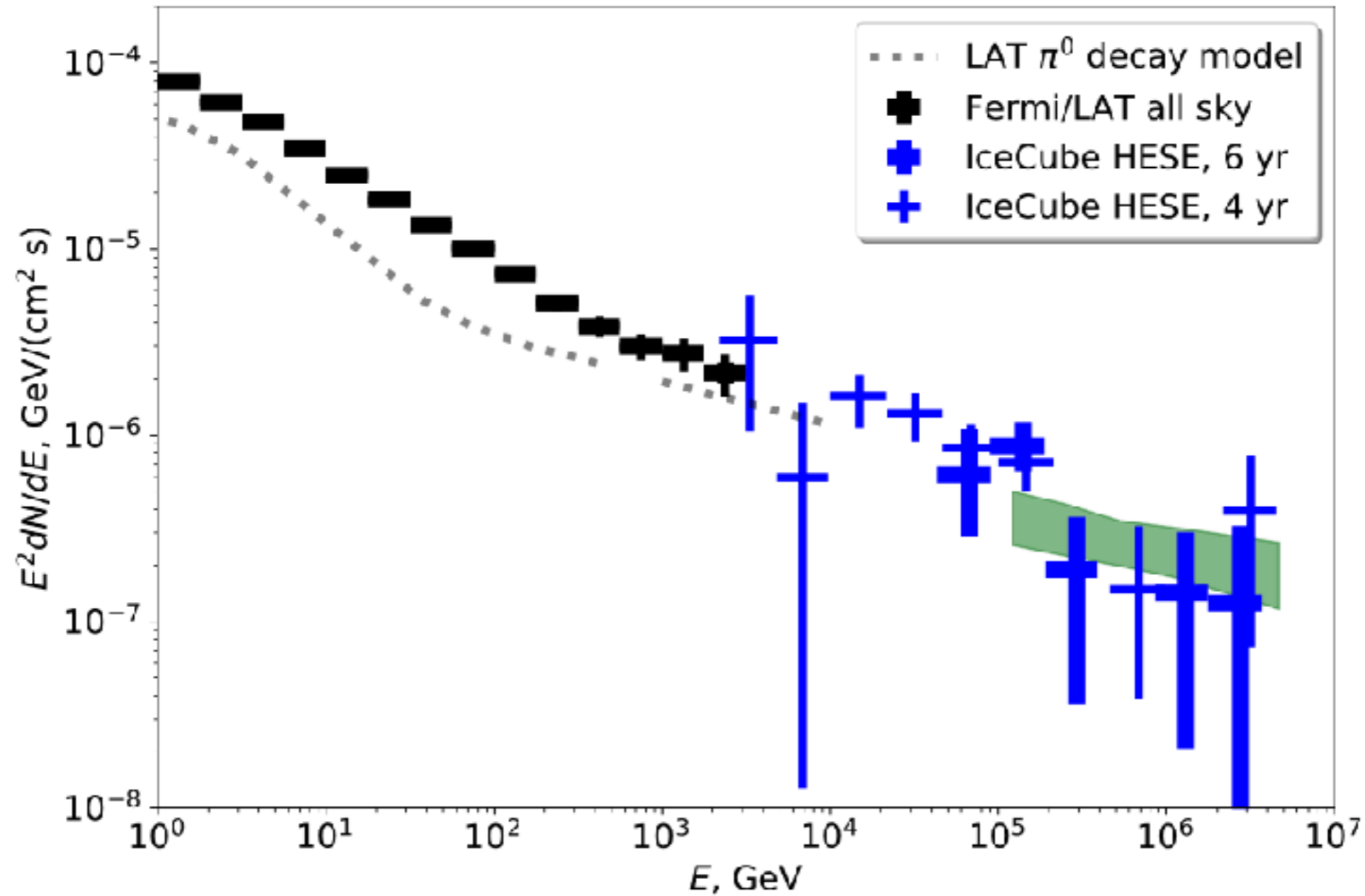


Angular resolution



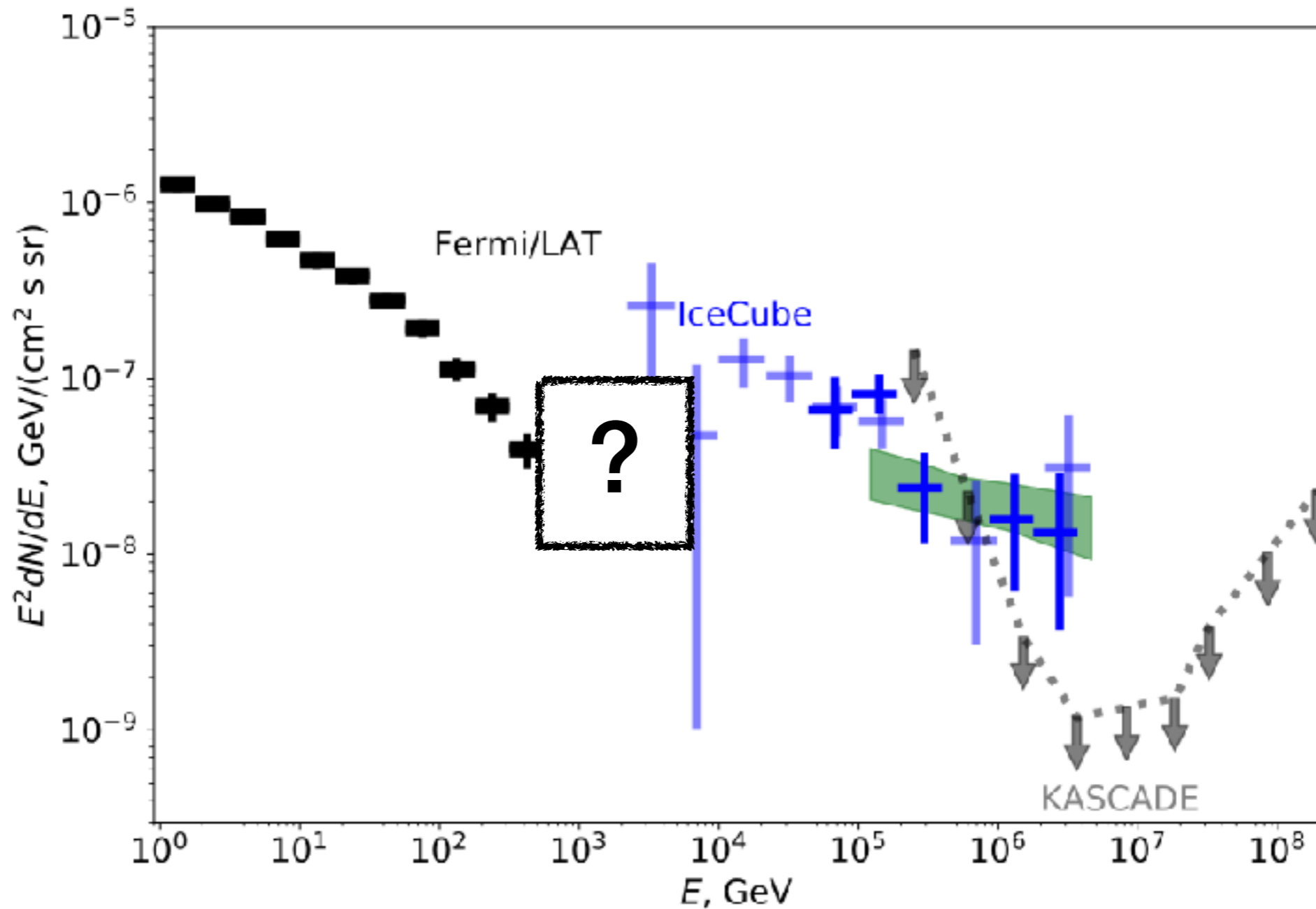
A.Neronov, M.Kachelriess and D.Semikoz.
arXiv:1802.09983

Introduction (Motivation)



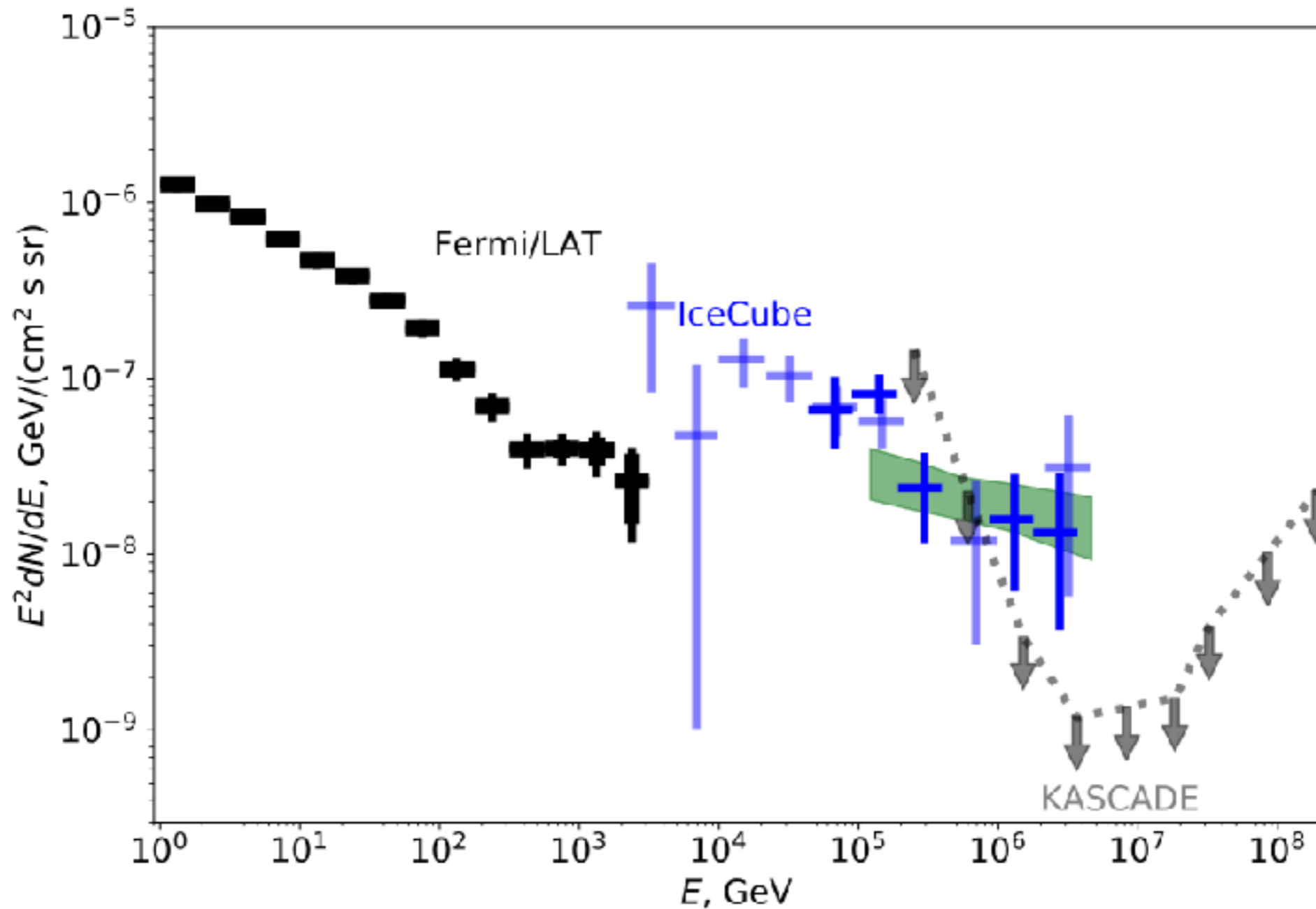
A.Neronov, M.Kacherlriess D.Semikoz arXiv 1802.09983v3

Introduction (Motivation)



A.Neronov, M.Kacherlriess D.Semikoz arXiv 1802.09983v3

Introduction (Motivation)

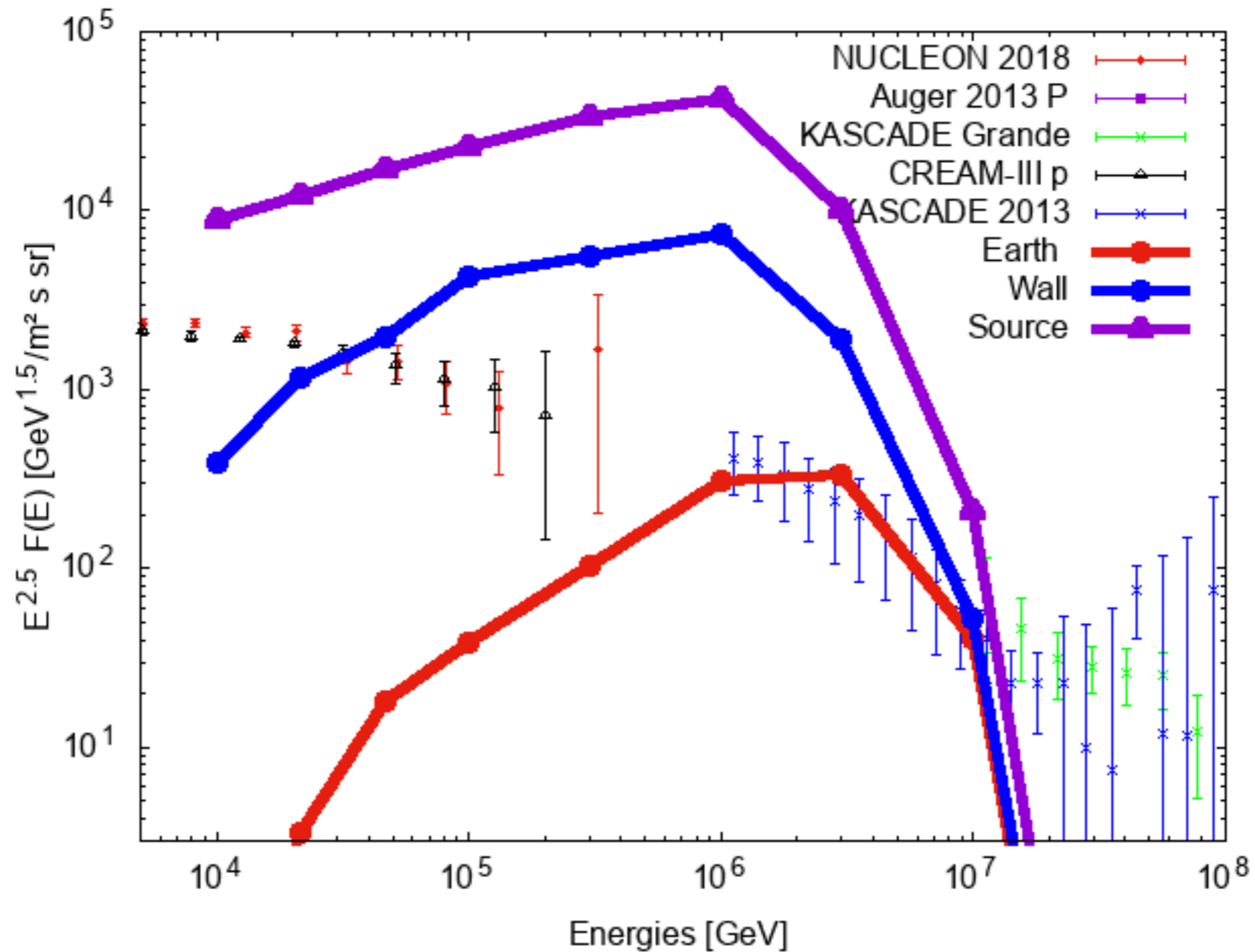


A.Neronov, M.Kacherlriess D.Semikoz arXiv 1802.09983v3

Introduction (Explanations)

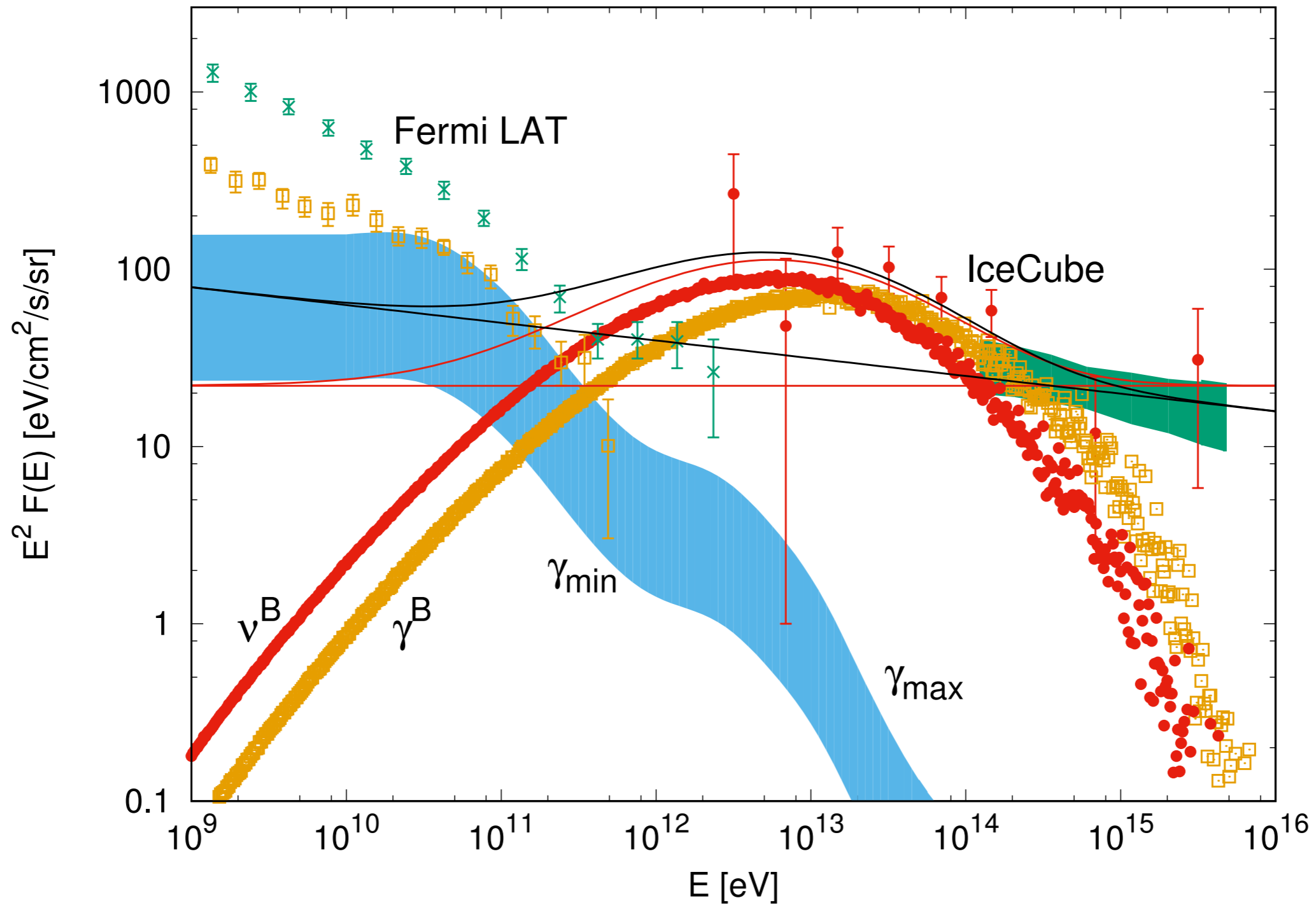
- **Decay of Dark Matter particles** (V. Berezhinsky, M. Kachelriess, A.Vilenkin arXiv:9708217)
- **Cosmic ray interaction in the large halo of MW** (A. M. Taylor, S. Gabici, F. Aharonian arXiv:1403.3206)
- **Interaction of cosmic rays injected by a young nearby supernova with local bubble**

Results (Proton flux on earth wall and source)



M.Kachelriess, D.Semikoz, B.M 2018 arXiv 1812.03522

Results (neutrinos and gamma rays)



M.Kachelriess, D.Semikoz, B.M 2018 arXiv 2001.00768

Summary

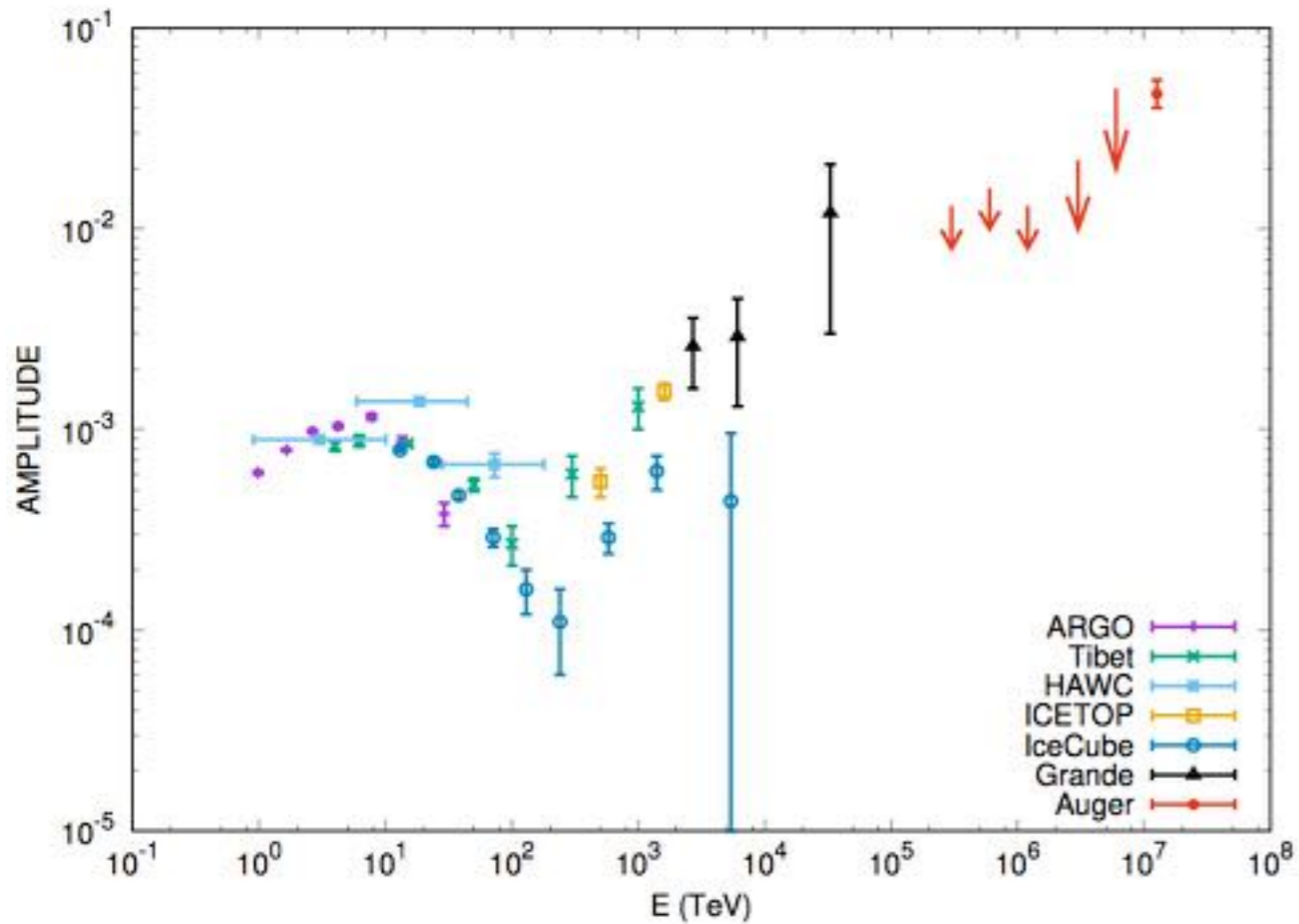
- In anisotropic diffusion model few sources contribute to CR local flux above TeV,
- Local super Bubble effect on CR spectrum is important
 - Flux reduction
 - Reduce anisotropy
 - Production of secondary neutrinos and gamma rays
- Studying the dependance on the properties of the bubble.

Summary

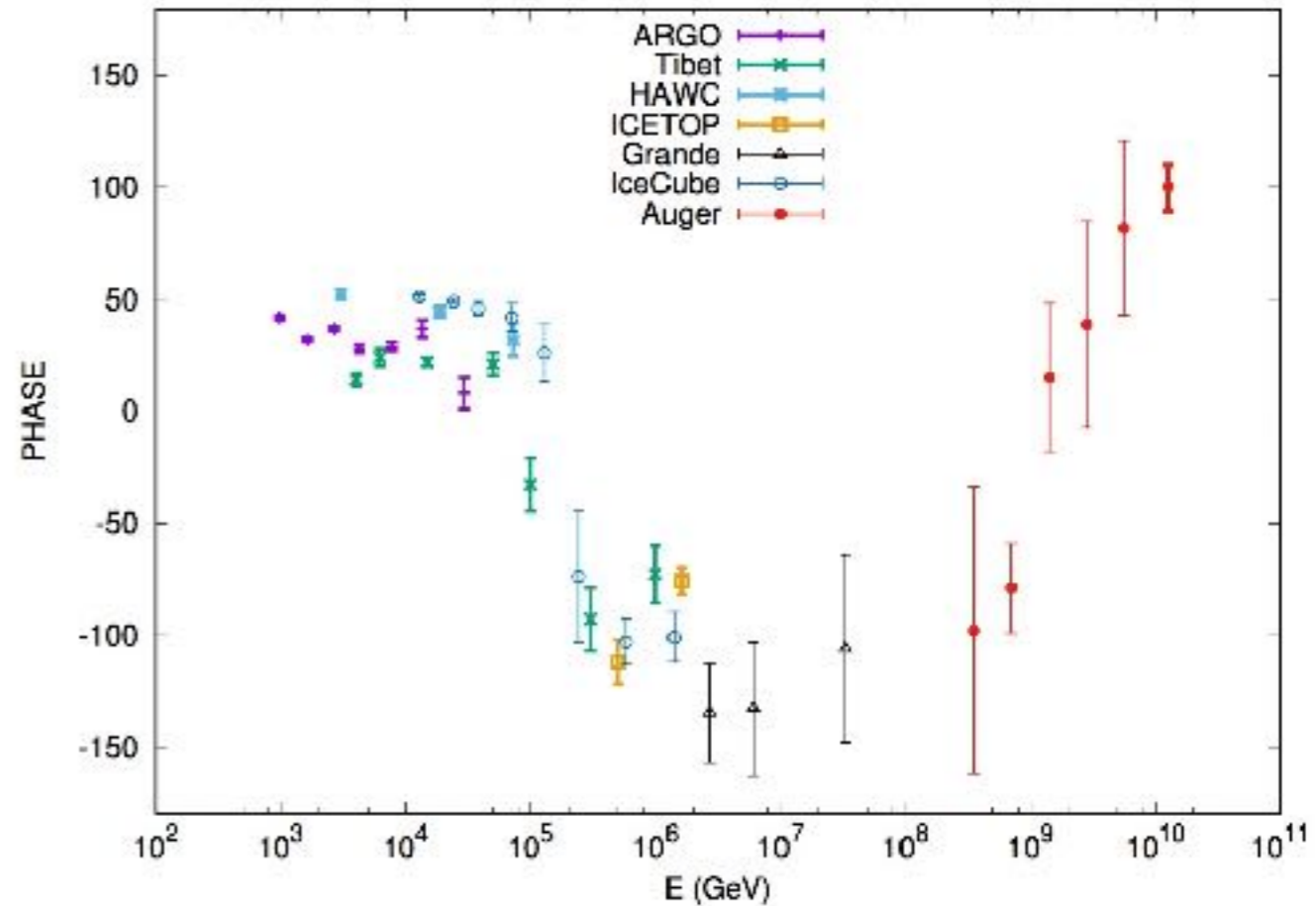
- Excess of gamma ray flux for $E > 1$ TeV outside the galactic plane
- Neutrino flux at $E < 100$ TeV should be galactic
- Multi-messenger signal from a young nearby SNR.
- Neutrino and Gamma ray flux could be explained by the interaction of Vela CR with the Local Bubble.

Thank you for your
attention

Prospect (Anisotropy constrains)



Anisotropy amplitude



Anisotropy phase

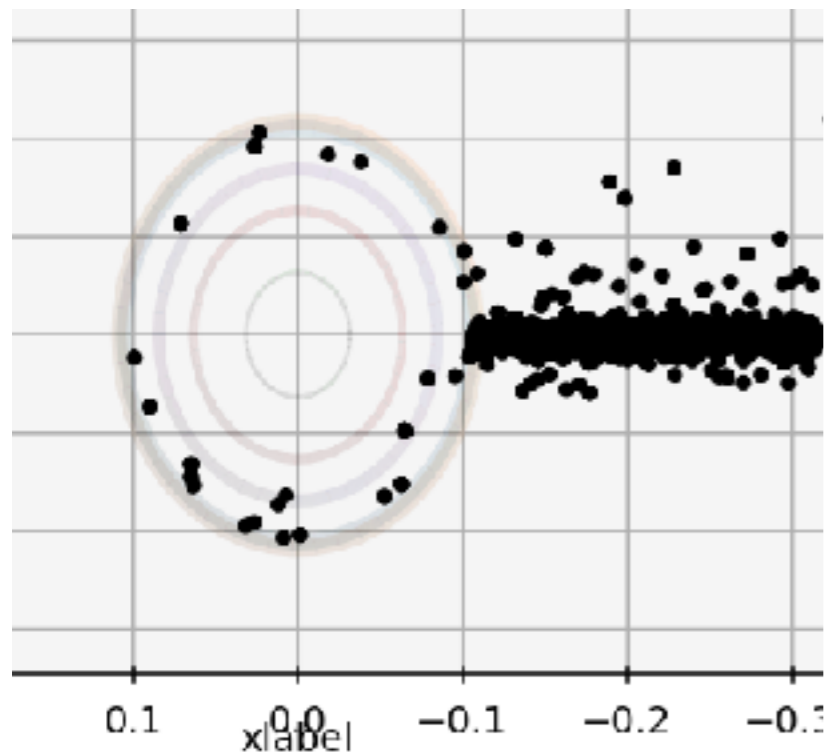
M.Kachelriess and D.Semikoz

BACKUP

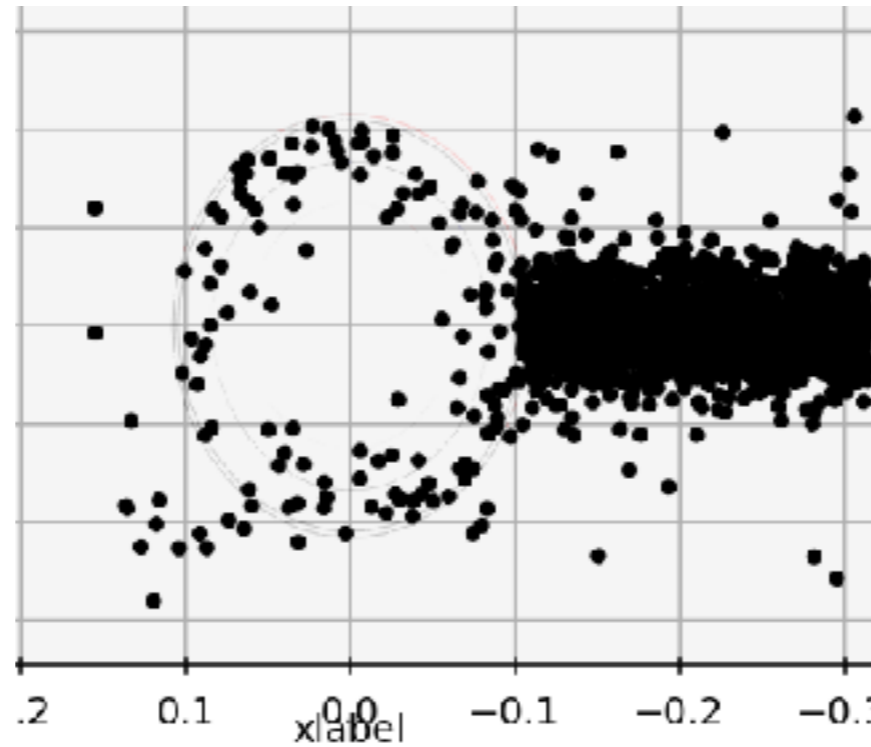
Cosmic Rays propagations

10^4 proton injected, 10^3 years ago, at 270 pc away from sun

(E = 100 TeV)



(E = 1 PeV)



(E = 10 PeV)

