

Study of structure of the primary cosmic ray energy spectrum around the knee

or

Does the GAMMA experiment detect the polar cap component at energies 70-80 PeV?

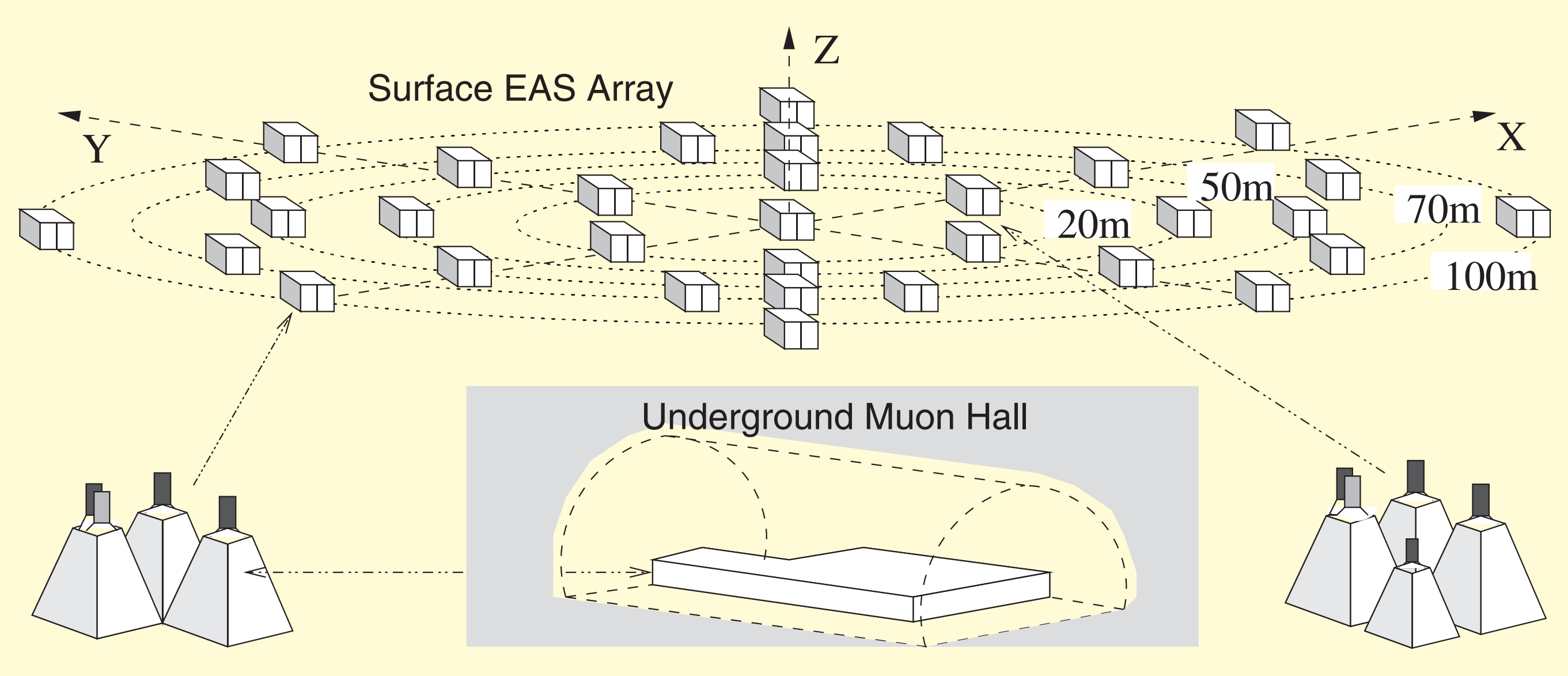
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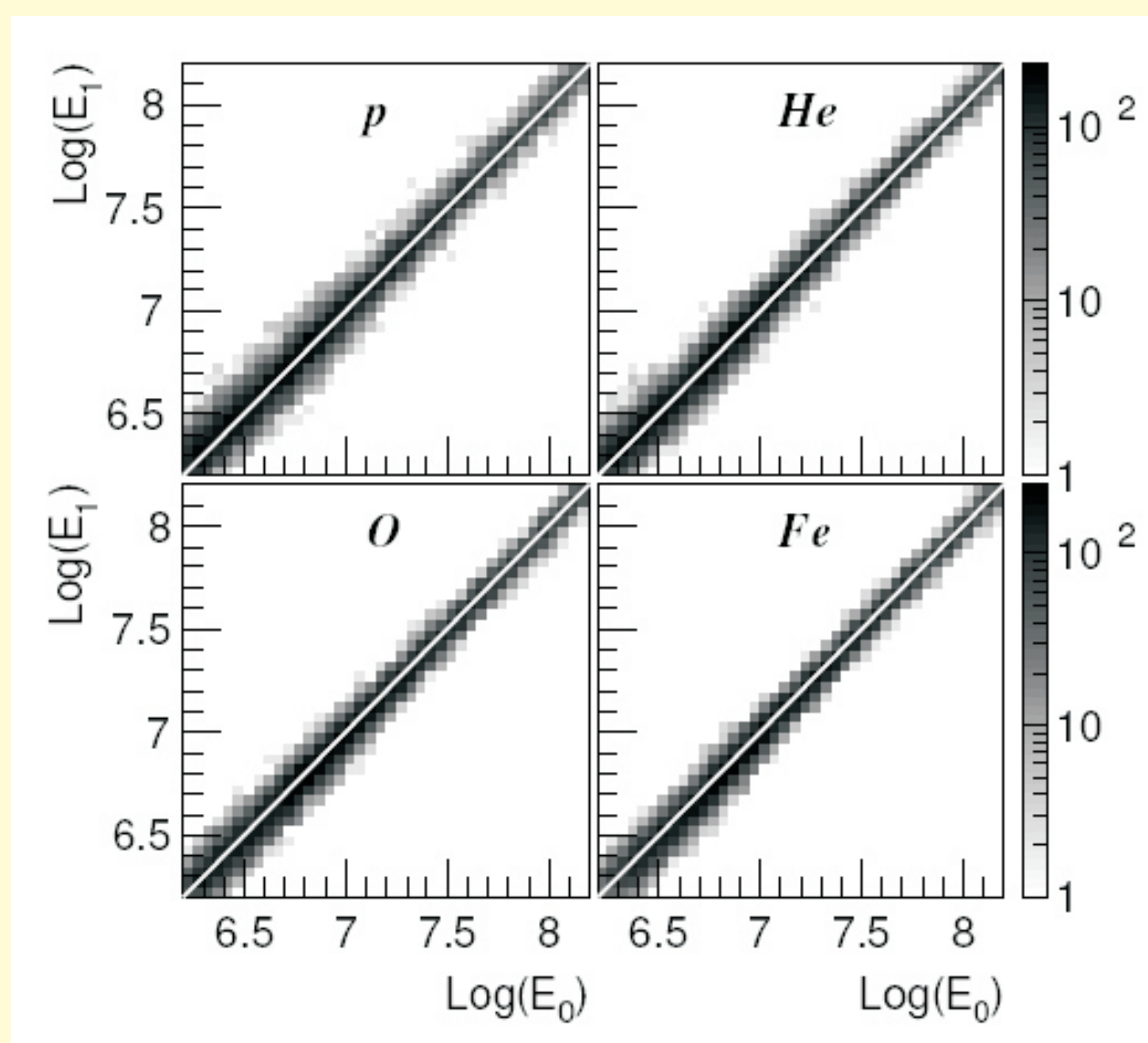
J. Phys. G.: Nucl. Part. Phys. **35** (2008) 11520

[arXiv:0808.1421v1](https://arxiv.org/abs/0808.1421v1) [astro-ph]

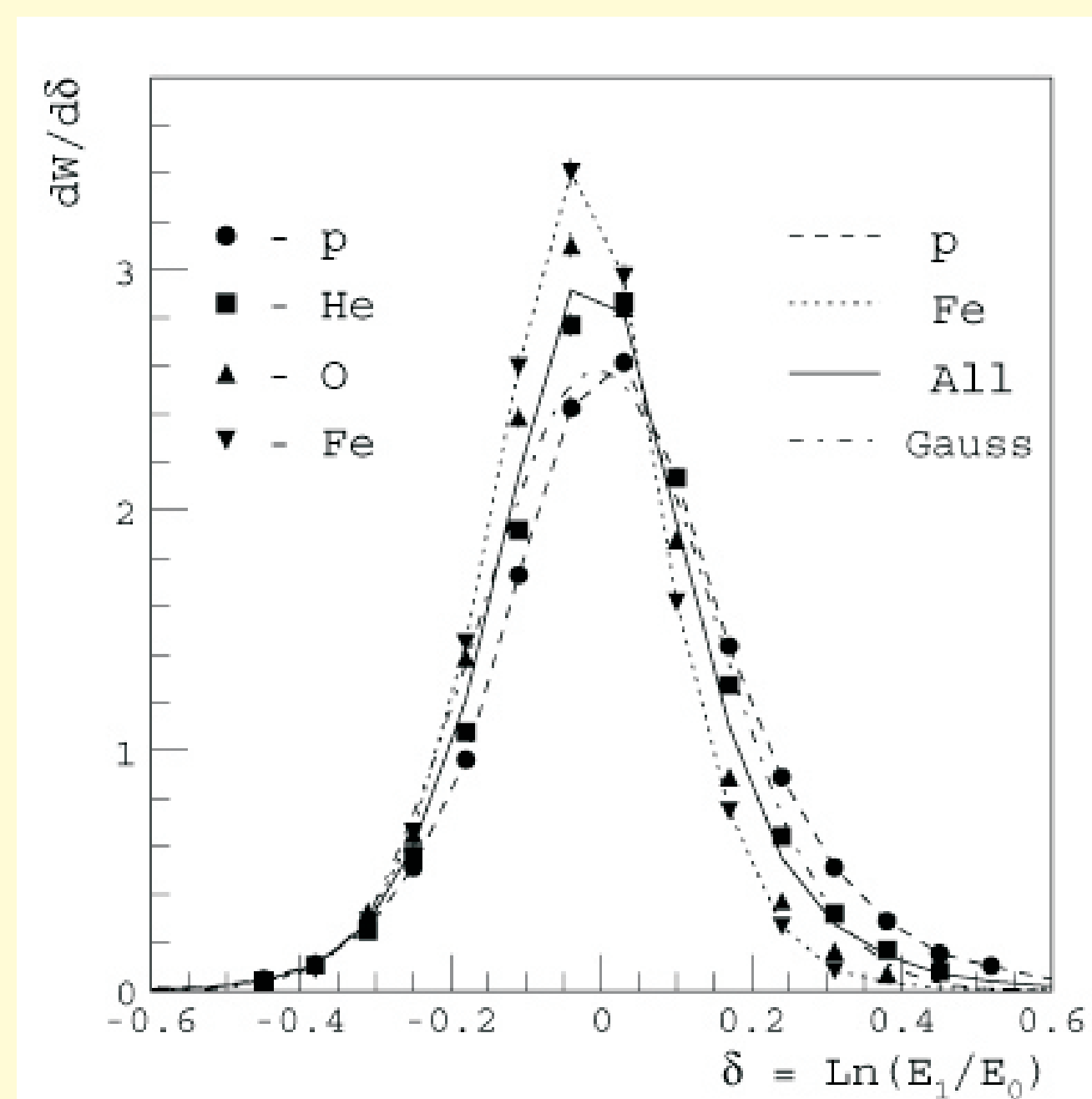


GAMMA experiment at Mt. Aragats (3200m a.s.l., Armenia)

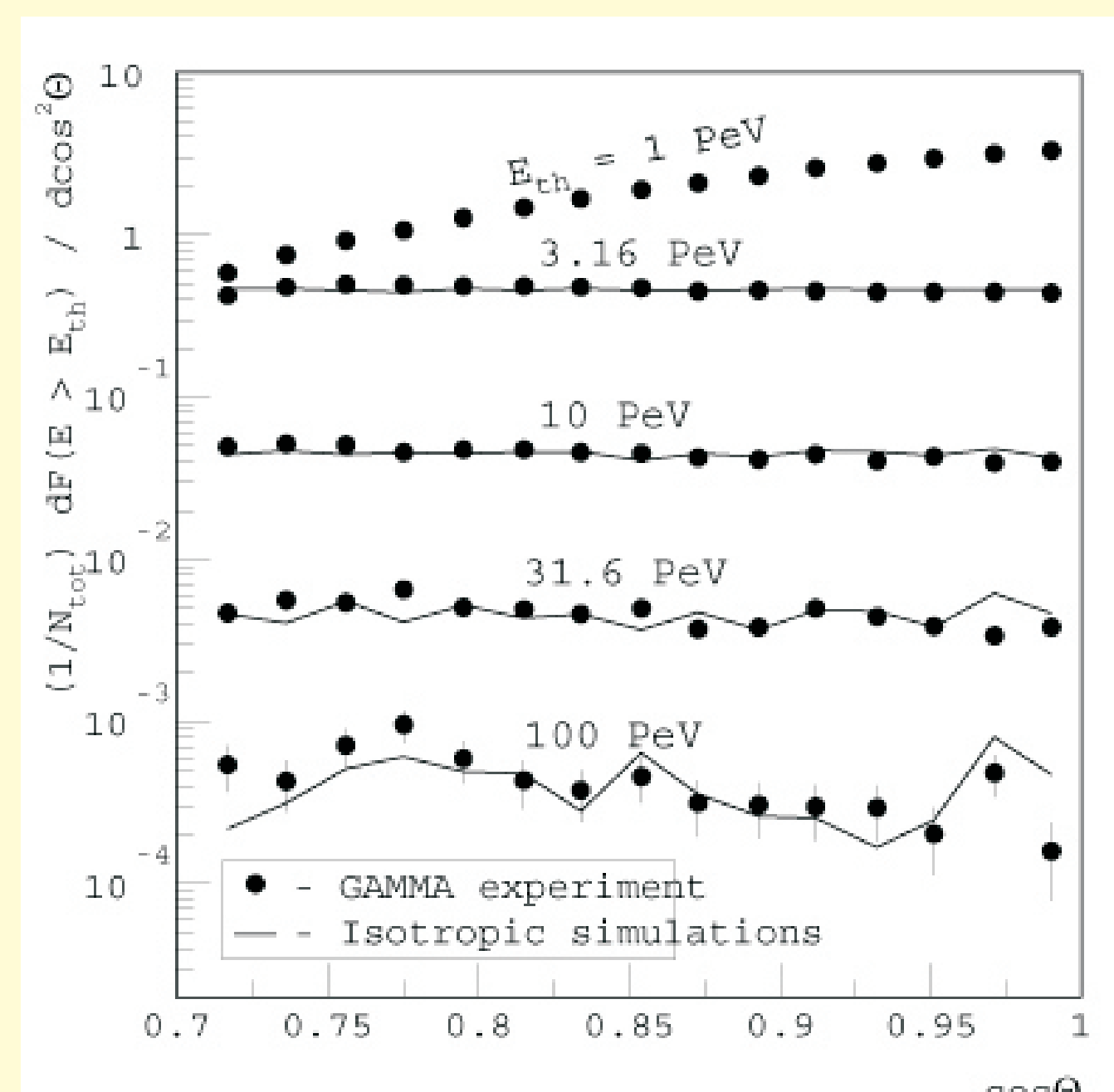
Energy estimator



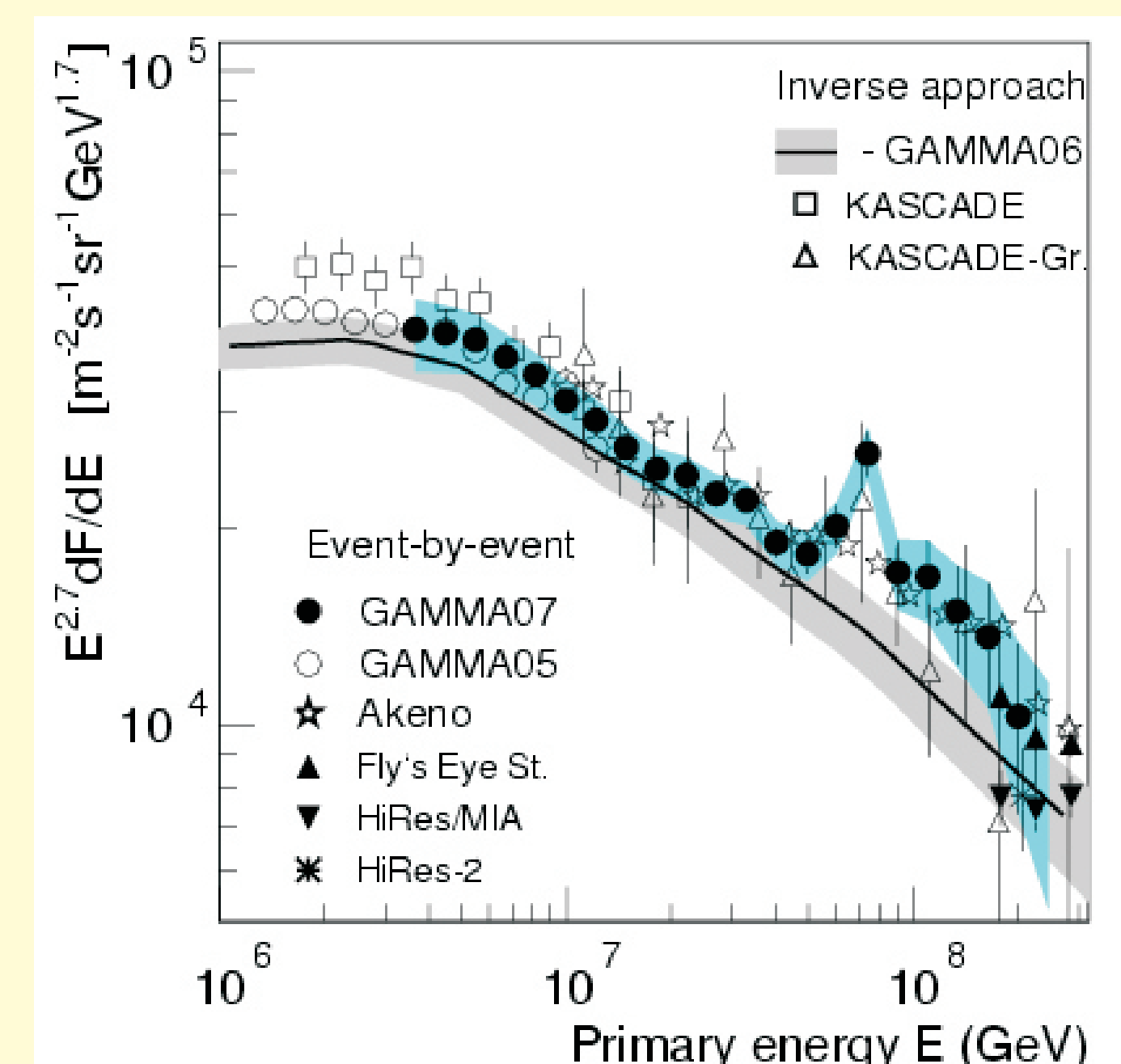
The distributions of errors are Gaussian



Zenith angular distributions



All-Particle Energy Spectrum



$$\ln(E_0) \approx \ln(E_1) = f(N_{ch}, N_{\mu}, s, \cos\theta)$$

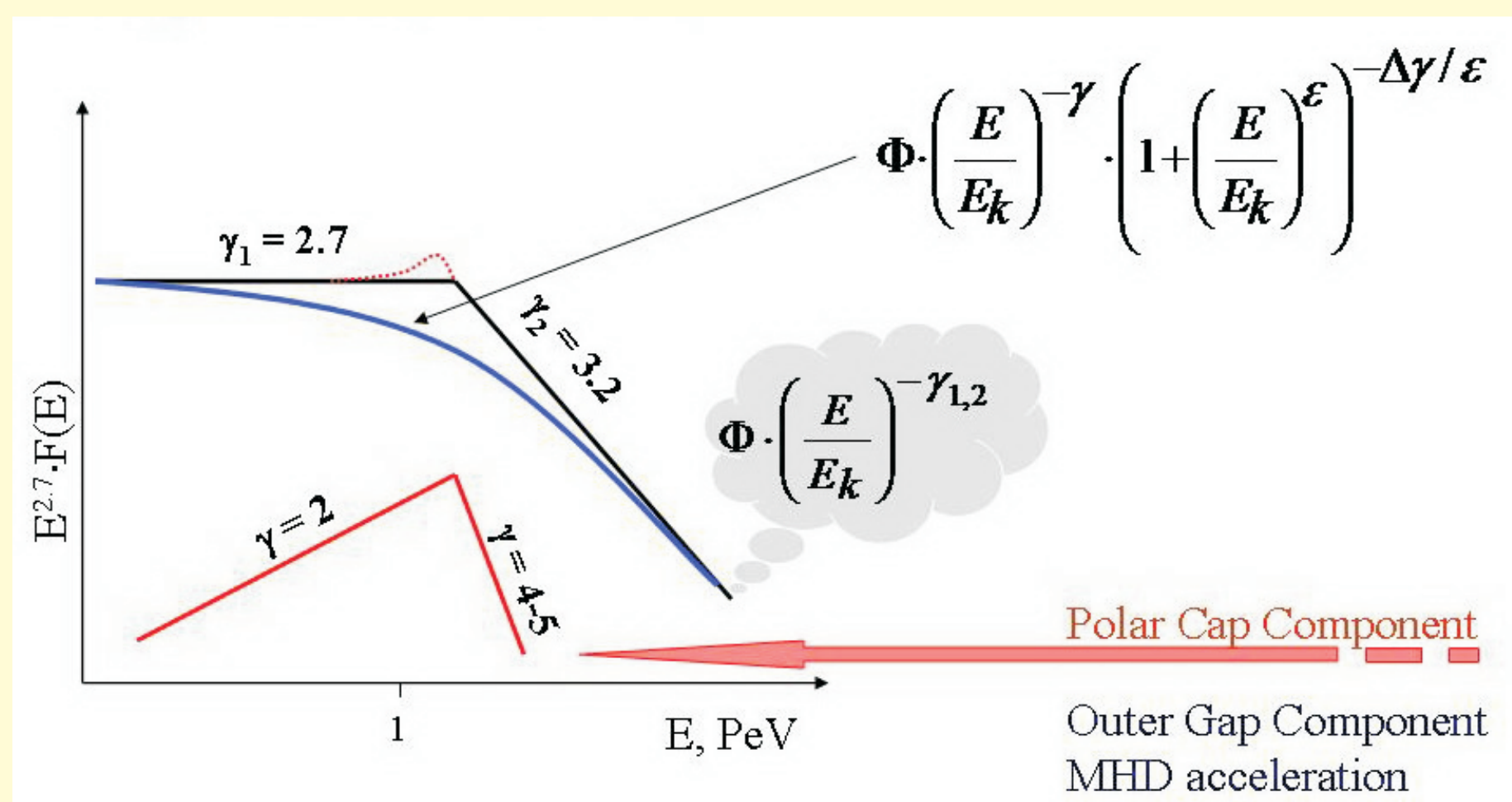
$$\ln E_1 = a_1 x + a_2 \sqrt{s}/c + a_3 c + a_4 + a_5/(x - a_6 y) + a_7 y e^s$$

$$x = \ln(N_{ch}), \quad y = \ln N_{\mu}, \quad c = \cos(\theta)$$

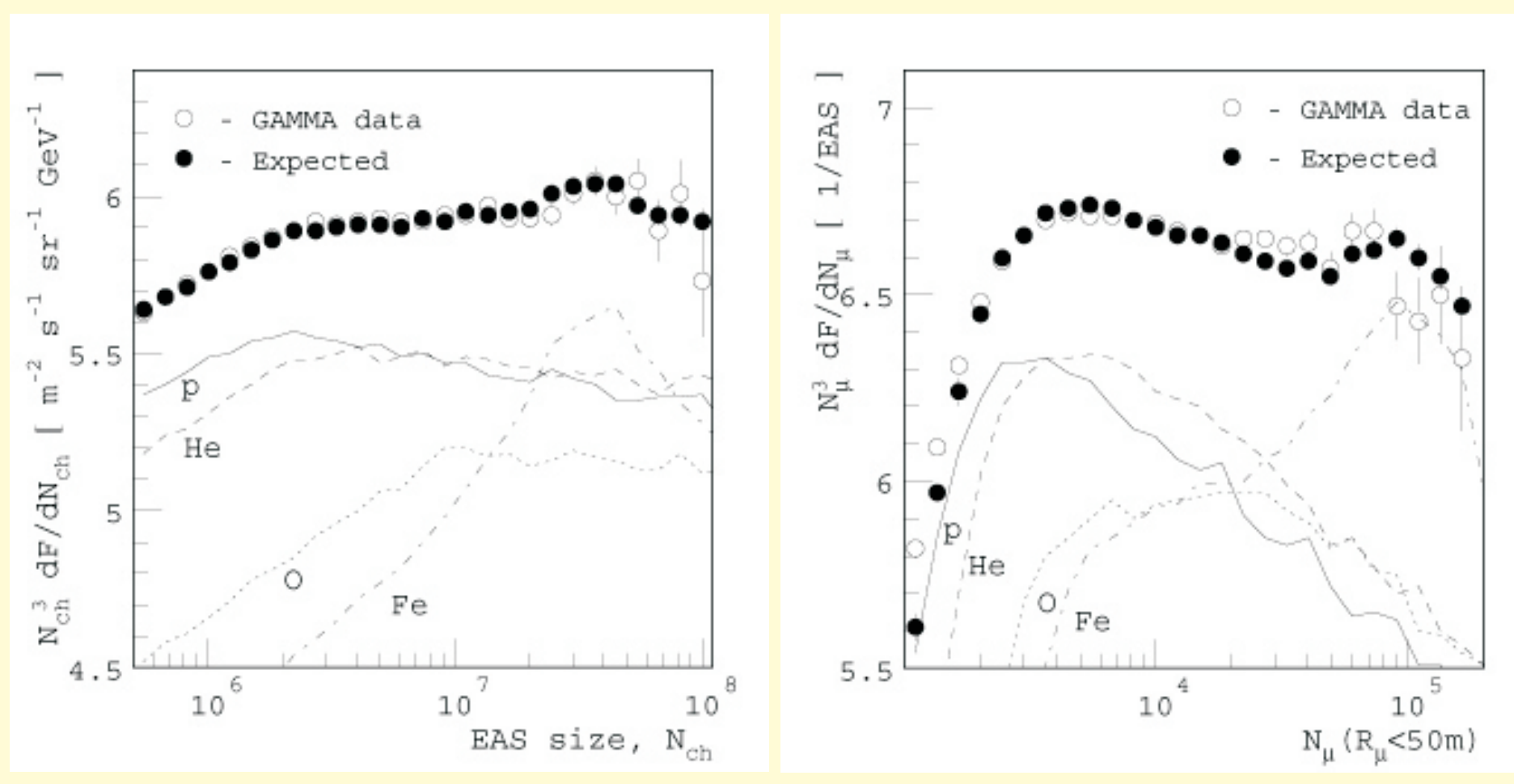
R<50m, θ<45°

GAMMA05: R < 25m; Q < 30°
GAMMA07: R < 50m; Q < 45°

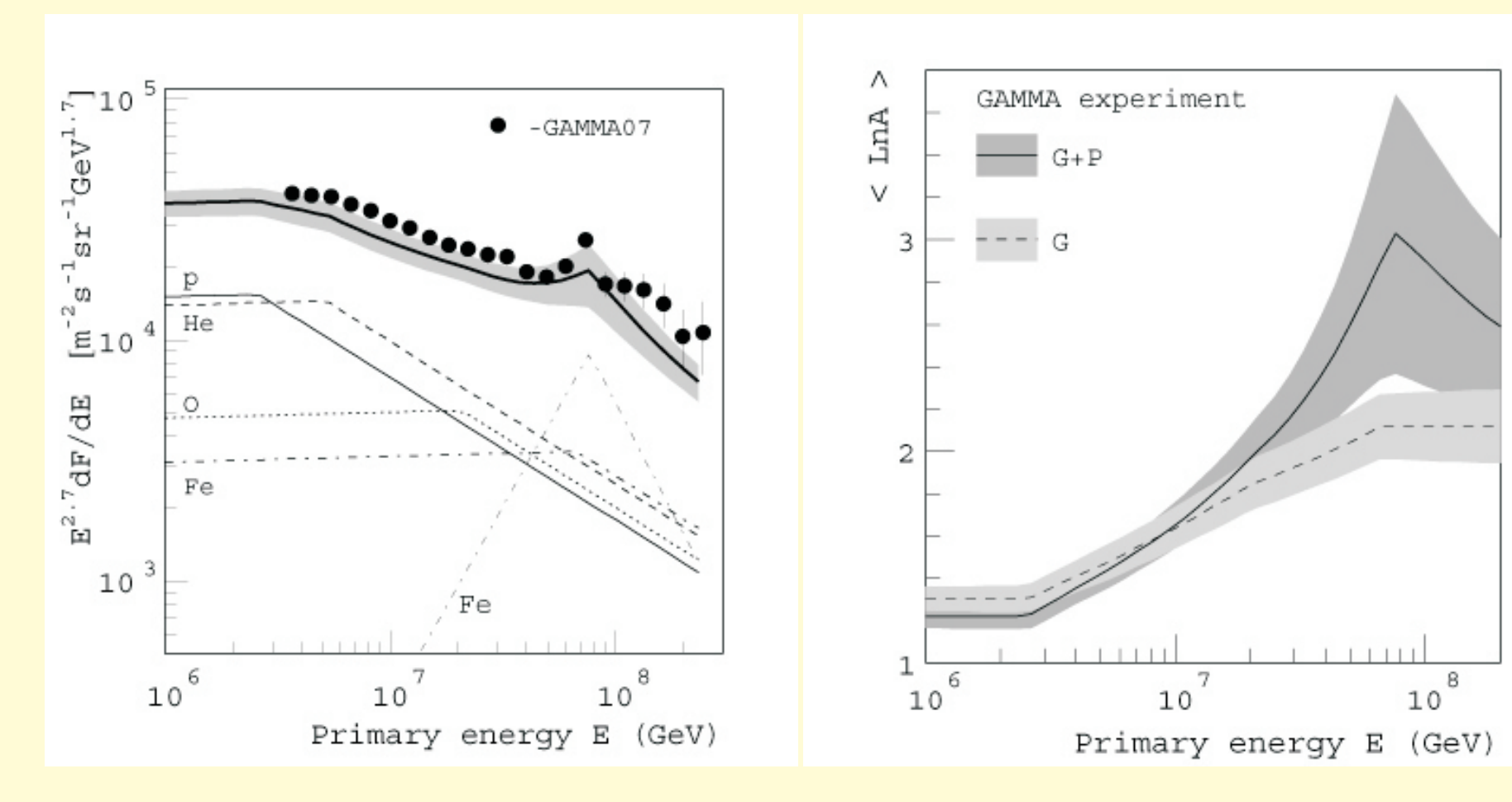
Sharpness of the knee



Shower spectra



All-particle energy spectrum and pulsar *Fe* component



Conclusion

- Multi-parametric event-by-event energy evaluation method provided high accuracies (10 - 15%) for energy evaluation of primary nuclei regardless of nuclei mass number in 5-200 PeV energy region;

- All-particle energy spectrum is obtained using GAMMA facility EAS database. The all-particle spectrum in the range of statistical and methodical errors agrees with the same spectrum obtained using EAS inverse approach in 5-70 PeV energy region. High accuracies of energy evaluations and small statistical errors point out to the existence of explicit irregularity (bump) of energy spectrum in the 60-80 PeV region.

- The bump can be associated with an additional *Fe* - component from magnetosphere of pulsar.

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