Muon deficit in simulations of air showers inferred from AGASA data

Executive Summary

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What is this contribution about?

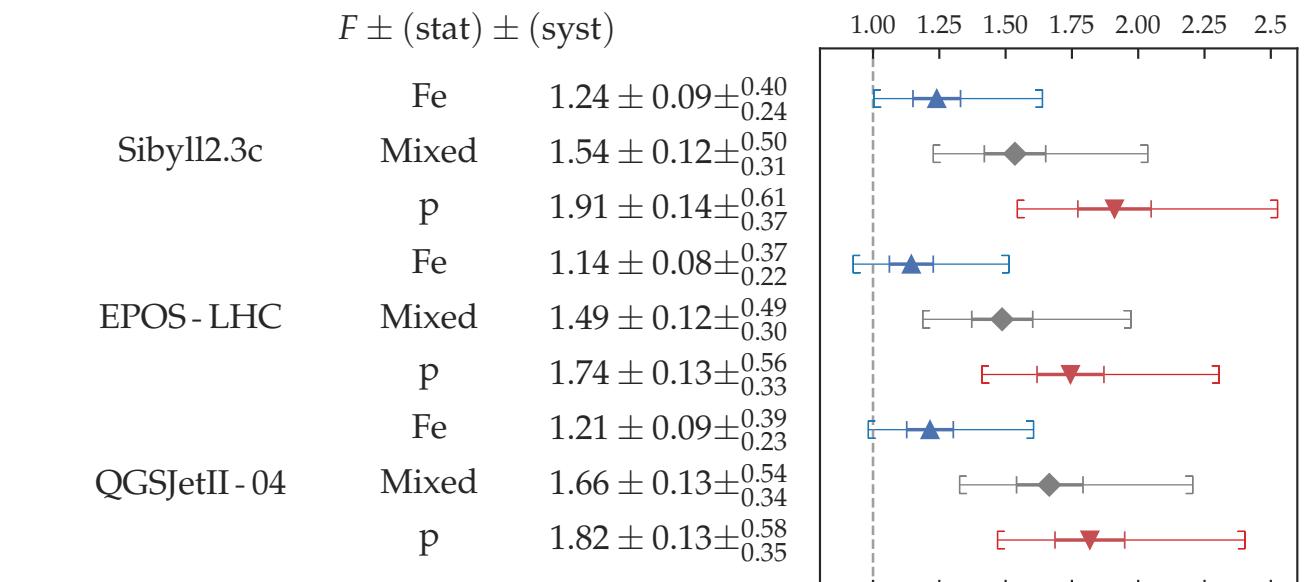- We analyze the **muon deficit** in air shower simulations using measurements of the muon density **from AGASA**.

$$F = \frac{\langle \rho_{\mu,\,\text{data}}/E_R \rangle}{\langle \rho_{\mu,\,\{\text{p,Fe,mix}\}}/E_R \rangle}$$

Why is it relevant/interesting?

- It adds information about the muon deficit at the **highest energies**.
- It shows that the data of past experiments are relevant and can be used for understanding current hadronic interaction models.

What has been done?

- We rescaled AGASA energies to a **cross-calibrated energy scale**.
- We **analytically computed the detector effects** in simulations of single-nuclei and mixed composition scenarios.

		$F \pm (\text{stat}) \pm (\text{syst})$
Sibyll2.3c	Fe	$1.24 \pm 0.09 \pm^{0.40}_{0.24}$
	Mixed	$1.54 \pm 0.12 \pm^{0.50}_{0.31}$
	p	$1.91 \pm 0.14 \pm^{0.61}_{0.37}$
EPOS‑LHC	Fe	$1.14 \pm 0.08 \pm^{0.37}_{0.22}$
	Mixed	$1.49 \pm 0.12 \pm^{0.49}_{0.30}$
	p	$1.74 \pm 0.13 \pm^{0.56}_{0.33}$
QGSJetII‑04	Fe	$1.21 \pm 0.09 \pm^{0.39}_{0.23}$
	Mixed	$1.66 \pm 0.13 \pm^{0.54}_{0.34}$
	p	$1.82 \pm 0.13 \pm^{0.58}_{0.35}$

What is the result?

- The muon densities of AGASA are greater than those of the mixed composition scenarios. This constitutes **further evidence of a muon deficit at the highest energies**.