On the muon scale of air showers and its application to the AGASA data

Executive Summary

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What is this contribution about?

We analyze the properties and systematics of two estimators of the muon scale ($z_{\ln\langle\cdot\rangle}$ and $z_{\langle\ln\cdot\rangle}$) and muon deficit scale, and compute them from AGASA data.

Why is it relevant/interesting?

We provide a general criterium to select the best estimator depending on the experimental conditions.

What has been done?

We quantified the effects of a mismodeled detector resolution and of shower-to-shower fluctuations in said estimators.

What is the result?

Computing the muon (deficit) scale based on $z_{\ln\langle\cdot\rangle}$ is always (typically) better.
The AGASA data support a muon deficit in simulations at the highest energies.

$$z_{\ln\langle\cdot\rangle} = \frac{\ln\langle N^{\mathrm{det}}_{\mu,\,\mathrm{data}}\rangle - \ln\langle N^{\mathrm{det}}_{\mu,\,\mathrm{p}}\rangle}{\ln\langle N^{\mathrm{det}}_{\mu,\,\mathrm{Fe}}\rangle - \ln\langle N^{\mathrm{det}}_{\mu,\,\mathrm{p}}\rangle} \qquad z_{\langle\ln\cdot\rangle} = \frac{\langle\ln N^{\mathrm{det}}_{\mu,\,\mathrm{data}}\rangle - \langle\ln N^{\mathrm{det}}_{\mu,\,\mathrm{p}}\rangle}{\langle\ln N^{\mathrm{det}}_{\mu,\,\mathrm{Fe}}\rangle - \langle\ln N^{\mathrm{det}}_{\mu,\,\mathrm{p}}\rangle}$$