

A combined fit of energy spectrum, shower depth distribution and arrival directions to constrain astrophysical models of UHECR sources

Executive Summary



Teresa Bister^a for the Pierre Auger Collaboration^b

^a Physics Institute IIIA, RWTH Aachen University, Otto-Blumenthal-Str., 52074 Aachen, Germany

^b Observatorio Pierre Auger, Av. San Martín Norte 304, 5613 Malargüe, Argentina

What is this contribution about?

We present a method to describe the UHECR **energy spectrum, shower depth distribution and arrival directions** all in one model.

For that, we use **catalogs of starburst galaxies (SBGs) & active galactic nuclei (AGNs)**.

Why is it relevant/interesting?

- **First** presentation of a combined fit using all three UHECR observables as complementary information
- Can determine source emission spectrum & composition, energy-dependent **signal fraction & size of the rigidity-dependent turbulent magnetic field smearing**

What has been done?

Construction of a universe model, presentation of benchmark simulation resembling Auger data, likelihood fit with MCMC sampler, parameter estimation, significance determination

What is the result?

- Sensitivity of the fit to **discriminate between the different source catalogs** increases significantly compared to an analysis using only the arrival directions (*on benchmark simulation*)
- Significance driven by **energy-dependent arrival directions**
→ arrival patterns depend on source catalog, injection spectrum & composition, propagation effects

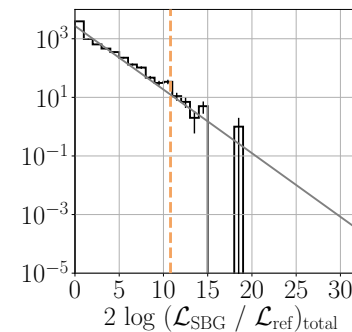
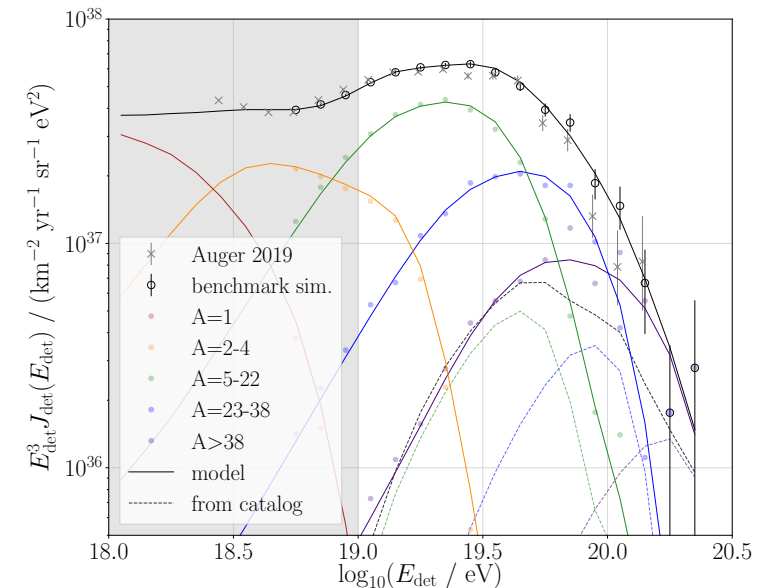


Figure 1: *Upper panel:* energy spectrum of the benchmark simulation, contribution by SBG catalog as dashed lines. *Lower panel:* Likelihood ratio compared to isotropic simulations. Red (orange): model catalog equal (not equal) to simulated catalog.