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Sensitivity of the combined fit of energy spectrum, shower depth distributions, and arrival directions at the Pierre Auger Observatory

The Pierre Auger Observatory measures several characteristics of ultra-high-energy cosmic rays (UHECRs), most importantly the energy spectrum, the distribution of maximum shower depths and the arrival directions. We use all three observables for a combined fit, in which the parameters of possible UHECR sources can be constrained.

The astrophysical model used in the fit consists of homogeneously distributed background sources as well as an adaptable contribution from a nearby source population. For this, the catalogs of starburst galaxies and active galactic nuclei are used which show an indication for a correlation with the UHECR arrival directions. The signal fraction, as well as the size of a rigidity-dependent magnetic field blurring, are part of the fit parameters, along with the parameters describing the source emission.

In this work, we present an astrophysical simulation containing an energy-dependent contribution from starburst galaxies, which simultaneously describes the energy spectrum, shower depth distributions and arrival directions measured by the Pierre Auger Observatory.

On this simulation, the discrimination power of the method regarding the differentiation of source catalogs is demonstrated, and the expected statistical significance of the result is investigated.

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