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Rigidity spectrum of cosmic-ray anisotropy observed by Global Muon Detector Network (GMDN)

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Anisotropy of galactic cosmic-rays (GCRs) represents their momentum-space distribution in the interplanetary plasma, playing a key role in revealing the solar modulation of GCRs. The Global Muon Detector Network (GMDN; http://hdl.handle.net/10091/0002001448) has been a unique means to observe the anisotropy, thanks to its excellent angular resolution, angular acceptance, and statistics. However, quantitative analysis of rigidity dependence of the anisotropy has been difficult because of the broad rigidity responses of such ground-based cosmic-ray counters. To overcome this situation and derive the rigidity dependence from geomagnetic- and atmospheric-effect differences in the network's directional channels, we are developing a new analysis method based on the Bayesian estimation approach. The Gaussian process is introduced as a prior distribution of the Bayesian estimation. It allows us to confine the smoothness of the rigidity spectrum, which is required to derive the spectrum from the broad rigidity responses, while being tolerant of spectrum shapes without assuming any analytical function. A focused analysis of the North-South (NS) anisotropy demonstrates the usefulness of this new method and revealed its rigidity spectrum on yearly basis for the first time (M. Kozai et al., 2024; https://doi.org/10.3847/1538-4357/ad8577). We are now attempting to generalize this Bayesian estimation approach to three-dimensional anisotropy and will report on its application to short-term events, such as Forbush decreases.

Collaboration(s)

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