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TeV-PeV Cosmic-Ray Anisotropy and Local Interstellar Turbulence

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The shape of the large-scale cosmic-ray (CR) anisotropy depends on (and therefore contains information on) the local interstellar turbulence within ~ 10 pc from Earth. We calculate the TeV-PeV CR anisotropies predicted for a range of Goldreich-Sridhar (GS) and isotropic models of interstellar turbulence, and compare them with IceTop and IceCube data. The narrow deficits in the 400TeV and 2PeV data sets of IceTop can be fitted with a GS model that contains a smooth deficit of parallel-propagating waves and a broad resonance function, although some other models cannot, as yet, be ruled out. In particular, isotropic fast magnetosonic wave turbulence can match the observations at high energy, but cannot accommodate an energy dependence in the shape of the CR anisotropy. We discuss the impact of possible anisotropies in the power-spectrum of fast modes. Our findings suggest that data on the large-scale CR anisotropy could provide a new probe of the properties of the local turbulence. Finally, we compare our constraints with those (on bigger scales) from Planck's dust-polarization measurements.

Primary authors: Dr GIACINTI, Gwenael (MPIK Heidelberg); KIRK, John

Presenter: Dr GIACINTI, Gwenael (MPIK Heidelberg)

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