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Low-Energy Cosmic-Ray Electron and Nuclei from Discrete Stochastic Sources

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Data from the Voyager probes have provided us with the first measurement of cosmic ray intensities at MeV energies, an energy range that had previously not been explored. Simple extrapolations of models that fit data at GeV energies, e.g., from AMS-02, however, fail to reproduce the Voyager data in that the predicted intensities are too high. Oftentimes, this discrepancy is addressed by adding a break to the source spectrum or the diffusion coefficient in an ad hoc fashion, with a convincing physical explanation yet to be provided. In this talk, we will show that the discrete nature of cosmic-ray sources, which is usually ignored, is instead a more likely explanation. We model the distribution of intensities expected from a statistical model of discrete sources and show that its expectation value is not representative but has a spectral shape different from that for a typical configuration of sources. The Voyager proton and electron data are however compatible with the median of the intensity distribution. We will also discuss some preliminary results concerning the implications of this model for the spectrum of iron and the ionization rate induced by low-energy cosmic rays in molecular clouds.

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Cosmic rays

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