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Status and Future Simulation Prospects of Cosmic-Ray Ensembles Generated by Synchrotron Radiation

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Cosmic rays are anticipated to give rise to cascades of product particles during their journey through space, resulting from interactions with fields, radiation, and matter. These phenomena, collectively known as cosmic-ray ensembles (CRE), are expected to exhibit variations in shapes, sizes, and constituents. Comprehensive studies of CRE necessitate an alternative approach to cosmic ray detection that considers their spatial and temporal correlations on a global scale. Despite the technical challenges, the potential observation of portions of CRE at Earth could significantly contribute to contemporary cosmic ray astrophysics. One prevalent scenario for CRE formation involves the synchrotron radiation of charged particles moving through ubiquitous magnetic fields. We present updated results from CRE simulations in this context, exploring the favorable physics conditions for observing such particle cascades and discussing the practical prospects of this research direction.

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