Formation and propagation of cosmic-ray ensembles

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Executive summary

During their propagation through the Universe, cosmic rays interact with matter, fields and background radiation, initiating particle cascades of different types and spatial extent. These astrophysical phenomena are referred to as cosmic-ray ensembles (CRE). Their potential observation at Earth is possible when at least two CRE constituents arrive at its surface, being correlated in space and time (or both). The focus of this work is made on ultra-high energy (UHE) electron primaries, which emit synchrotron photons during their propagation in magnetic field. We propose a method of estimation of the maximum observer distances two-photon CRE can be originated at. We apply this method to the analysis of two astrophysical scenarios (toy models of the distribution of UHE electrons sources over the Galaxy) and show that one might expect to observe a two-photon CRE on the Earth-sized area originated at distances comparable or even exceeding the Galaxy size (up to 1 Mpc).