

Probing the CMB-cosmic ray connection: ultra-local and extragalactic effects

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The interaction of cosmic rays with the cosmic microwave background (CMB) has been the subject of extensive research in the past 50 years or so. These studies have concentrated on the impact of such interactions on cosmic ray physics while neglecting the potential influence on the CMB itself due to its presumed minimal amplitude. However, the prospects of ultra-high-precision measurements of the CMB, together with recent advancements in cosmic ray propagation simulations, motivate a reevaluation of this influence, both for local effects and for potential signatures on cosmological scales. In this contribution, we present a first estimate of the ultra-local CMB spectral distortion caused by interactions with cosmic ray protons trapped within environments typical of a starburst or active galaxy, which is capable of accelerating particles to the highest energies. Additionally, we provide a preliminary analysis of the large-scale impact of extragalactic protons on the CMB, using catalogs of potential ultra-high-energy cosmic ray (UHECR) sources.

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