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Effect of diffusion on the propagation of UHECRs in the f(R) theory of gravity

Although the sources of ultra-high energy cosmic rays (UHECRs) are unknown, the high-quality data acquired by the most modern CR observatories indicate that these CRs are of extragalactic origin. As the intergalactic media are predicted to be filled with turbulent magnetic fields (TMFs), these intergalactic magnetic fields may profoundly impact how UHECRs travel throughout the expanding Universe. Thus, incorporating these ideas into the theory is critical for comprehending the experimental findings on UHECRs. In this work, we investigate the effect of diffusion of ultra-high energy (UHE) particles in the presence of TMFs using the f(R) theory of gravity. To this end, we consider one of the most studied f(R) gravity models, that is the Starobinsky model. For this model, we study the diffusive character of the propagation of UHECR protons in terms of their density enhancement. We compare the computed UHECR protons spectra for the considered f(R) gravity model to the data from the AKENO, HiRes, and AUGER experiments. We can see that the Starobinsky f(R) gravity model produces the energy spectra of UHECRs with all experimentally observed features, which are substantially within the range of combined data from all experiments across the whole energy range of interest. These results suggest that the f(R) theory of gravity is a promising framework for understanding the propagation of UHECRs.

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