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Unveiling the origin of UHECR: the role of local sources

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Cosmic rays are charged relativistic particles of extraterrestrial origin. In particular, particles belonging to the highest energy end ($E > 10^{18}\,\mathrm{eV}$) of the energy spectrum of cosmic rays are commonly named ultra-high energy cosmic rays (UHECR). There are several open questions involving these fascinating particles. For instance, a mystery that remains in Astrophysics is the origin of UHECR. Due to interactions with the radiation and magnetic fields that permeate the Universe, the detection of these particles does not provide direct information about their original energy spectrum, distribution of arrival directions and abundance. UHECR energy losses via photopion production and photodisintegration cause a suppression in the energy spectrum, which highlight the relevant role that local sources play to describe the spectrum. (1) Furthermore, the flux of cosmic rays drops orders of magnitude with increasing energy, which results in a low statistic for the range in which UHECR belong to. While the aforementioned features make the study of UHECR quite challenging, it is possible to notice that there is plenty of space for important discoveries to come out. In the last years, the Pierre Auger Observatory, the largest cosmic ray detector ever built, has measured the first indications of anisotropy in the distribution of arrival directions of such particles, which has raised the expectation of solving this decades-long question in the upcoming years. (2) Therefore, the aim of this work is to further develop the understanding about the impact of astrophysical hypotheses in modeling the main anisotropy measurements used to search for the origin of UHECR. The goal is to calculate an upper limit on the density of sources without making too strong hypotheses by analyzing the dipole amplitude provided by the Pierre Auger Observatory. (3) It is worth mentioning that having such information about the sources is extremely important, since it can help us to eliminate a huge space of possibilities of existing models in highly energetic cosmic ray research.

Palavras-chave: Cosmic rays. UHECR. Local sources.

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