

A new break near 10 TeV in the energy spectrum of protons according to data from space-based instruments: astrophysical interpretation

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Recent experimental data from space-based instruments of the DAMPE and CALET collaborations have shown that the energy spectrum of protons has a new feature, a break in the ~ 10 TeV region. In this energy range, the spectrum index of the observed particles varies from -2.6 to -2.9 .

The purpose of this work is to establish the location zone of the sources that determine this break, the index of the proton generation spectrum in them, as well as the astrophysical interpretation of the results obtained in the DAMPE and CALET experiments.

Within the framework of the model of nonclassical diffusion of cosmic rays developed by the authors, which has break due to the propagation of particles in a sharply inhomogeneous (fractal type) galactic medium, it is shown that break in this energy range is formed by sources located at a distance of $300 - 400$ pc from the Earth. These sources, whose age is $\sim (5 - 10) \cdot 10^4$ years, generate particles with a spectrum index ~ 2.8 .

The power-law behavior of the proton spectrum before and after the break, first obtained in the DAMPE and CALET experiments, confirms the conclusion made earlier by the authors that cosmic ray diffusion is nonclassical. The results of these experiments should also be considered as an indication of the need to revise the standard paradigm accepted today about the sources of cosmic rays and the mechanisms of particle acceleration in them.

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