

Interpretation of the spectral inhomogeneity in the 10TV region in terms of a close source

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The results of cosmic ray measuring experiments such as NUCLEON, HAWC, CREAM-III, DAMPE indicate a change in the index of the cosmic ray spectra near the magnetic rigidity of 10 TV.

Such an inhomogeneity in the regular CR spectra can be explained by several possible reasons: features of CR acceleration, specific features of CR propagation, or a contribution to the CR flux from a nearby source. In this work, the latter interpretation is considered.

The NUCLEON space experiment measured the structure of this spectral feature for each of the abundant primary CR components separately - which is important for understanding the nature of this feature. The DAMPE and the CREAM experiments significantly increased the amount of experimental statistics for light nuclei, and the ground-based HAWC experiment, which has a high statistical reliability of the result, measured a total spectrum of all particles in this area.

To test the hypothesis of the effect of a single source on the spectra, a mathematical model was created that takes into account the contribution of cosmic rays from a hypothetical close source to the total CR flux. The model is based on solving the problem of CR propagation in the diffusion approximation.

The result of the calculation is the area of localization of a possible source on the age-distance surface and its expected power as well as its chemical composition. A feature of the model is the use of the penalty function method to correctly take into account the systematic error of the ground experiment.

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Theoretical Results

Primary authors: KUDRYASHOV, Ilya (SINP MSU); Mr YUROVSKY, Vladimir (sinp msu)

Co-authors: Mr GASRATOV, Farid (sinp msu); PANOV, Alexander (SINP MSU); Dr LATONOV, Vasilii (msu)

Presenter: Mr YUROVSKY, Vladimir (sinp msu)

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