Average value of the cosmic ray injection spectrum at the Galactic sources

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Experimental data and theoretical calculations show that the interstellar medium (ISM) is highly non-homogeneous on the scales of hundreds of parsecs. Filaments, shells, clouds are entities widely spread in the ISM. Spatial structure of these entities changes with time. The particles emitted by galactic sources, propagating in such a medium en route to the Solar system pass through the regions of the Galaxy, that have the different diffusion coefficients.

In this paper we analyze the effect of the variations of the ISM characteristics during the diffusion of the particles from the sources to the Solar system on the observed energy spectra of cosmic rays. Using Ginzburg-Syrovatskii normal diffusion model, we show that the different scenarios of the spatial irregularities distribution lead to diffusion models that demonstrate anomalous properties.

Our calculations show that the agreement of the new anomalous diffusion models with the experimental data is reached with the average value of the Galactic sources spectrum index $p \sim (2.7\text{-}2.9)$.

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