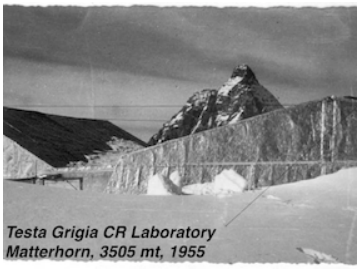

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Nonlocal relativistic diffusion (NORD) model covering diffusive, superdiffusive and ballistic regimes of cosmic ray transport in the Galaxy

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Many modern calculations of galactic cosmic rays propagation (GalProp, Dragon, Usine and other codes) are based on the use of the local diffusion model acceptable for the Brownian motion (Bm) of a heavy particle through the system of uniformly distributed uncorrelated (i.e. non-interacting) with each other molecules. However, about 60 years ago it has been found that the Bm model is unable to adequately describe the diffusion in turbulent media [1-3]. Without doubt, interstellar medium belongs to this class, and for this reason we began to develop the nonlocal transport theory on the base of fractional calculus fifteen years ago [4]. The long series of calculations performed to 2010 confirmed the effectiveness of the approach, improved parameters and led eventually to involving the relativistic speed limit [5]. The obtained model was described in [5,6] and called NoRD in [7].

In this report, we present an improved version (NoRD+) of this model obtained by specifying the Kolmogorov spectra of turbulence near the inertial interval edges. It required to pass from fractional differential operators to their tempered generalizations and as a result to tempered power law of distributions for free path lengths. We coordinate energy dependent diffusion coefficient and truncation factor. For energies small enough for interested temporal and spatial scales, diffusion is normal. Extrapolating this dependence on large energies, we observe superdiffusive motion and tendency to ballistic motion. NoRD+ propagators are calculated and analyzed. The 'leaky-box' approximation to NoRD+ is considered in details.

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