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Transport of magnetic turbulence in supernova remnants

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Supernova remnants are known as sources of galactic
cosmic rays by their nonthermal emission of radio waves, X rays, and gamma rays.
However, many theoretical models fail to reproduce the observed
soft spectra and the spectral breaks. We model cosmic-ray acceleration in
a time-dependent and self consistent way by simultaneously solving
the CR transport equation and a transport equation for isotropic Alfvenic
turbulence. The CR transport equation is solved in a test-particle approach
combined with 1-D hydrodynamical simulations of the remnant evolution,
as described in Telezhinsky et al. (2012). In the transport equation for scattering
turbulence we only consider upstream and downstream moving Alfven waves, and their spectral
power density determines the spatial diffusion coefficient of cosmic rays. Our shock
centered, expanding grid extends upstream to several shock radii. Thus we
are not limited by a free escape boundary and are able to self-consistently
study the escape of CR from the acceleration side.
We demonstrate that the system is typically not in a steady state. In fact, even after
several thousand years of evolution, no equilibrium situation is reached. The resulting time-dependent
particle spectra calculated by us differ strongly from those derived assuming a steady state.
Our results further indicate that the escape of particles is crucial
for the formation of soft spectra and spectral breaks, as observed.

Collaboration

– not specified –

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