NUMERICAL STUDIES OF COSMIC RAY INJECTION AND ACCELERATION

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We have developed a numerical scheme that incorporates a self-consistent cosmic-ray (CR hereafter) injection model into the combined gas dynamics and CR diffusion-convection code. Our hydro/CR code is designed to follow in a very cost-effective way the evolution of CR modified shocks by adopting subzone shock-tracking and multi-level adaptive mesh refinement techniques.
The injection model is based on recent calculations of Malkov (1998) which considered the interactions of the suprathermal particles with self-generated magneto-hydrodynamic waves in quasi-parallel shocks.
In this model, the particle injection is realized by filtering the diffusive flux of suprathermal particles across the shock to upstream region according to a transparency function, which represents the fraction of leaking particles.
Thus, with this new code, we can eliminate a need to assume an injection rate as a free parameter. We have studied the CR injection and acceleration efficiencies for a wide range of shock Mach numbers and will discuss the preliminary results.