ABSTRACT ONLY

PARTICLE ACCELERATION IN THE HELIOSPHERE AND IN SUPERNOVA REMNANTS

L. R. Magalhães [1], C. N. Koshikumo [1], M. V. del Valle [1] and R. Santos-Lima [1]

Cosmic rays are charged particles that permeate astrophysical environments with energies much higher than the ambient thermal particles. The bulk of the galactic cosmic-ray protons and heavier nucleus, with energies up to PeV, are most probably energized in shocks resulting from supernova remnants (SNR) expansion in the interstellar medium, although the process is not yet fully understood. In the interplanetary medium, directly detected ions with energies in the tens of MeV range are correlated with shock fronts. This research aims to develop a one-dimensional model to study the confinement and injection of energized protons in the heliosphere, using magnetohydrodynamic (MHD) simulations, that can be compared with direct particle observations and also with previous models. Furthermore, this modified model, including a kinetic representation of the relativistic particles (Particle-In-Cell-MHD), was applied in SNR scenarios. Our models were able to reproduce the evolution of shock events observed in the heliosphere, in accordance with previous MHD models in the literature, with the advantage of providing the energy distribution of the energetic particles, which can be used to better constrain the acceleration and diffusion processes. In the SNR case, our simulations produced the instabilities believed to regulate the self-confinement of the particles which affect the acceleration efficiency. In the future, we intend to apply it to construct non-thermal emission models of SNR that can be compared to observations. This approach will contribute to the understanding of the cosmic ray acceleration process, as certain open questions, such as the development of instabilities near the shock, can be tested in the interplanetary medium, where direct observations are available.

[1] Instituto de Astronomia, Geofísica e Ciências Atmosféricas da Universidade de São Paulo (larissa.magalhaes@usp.br).