Modeling of Particle Acceleration in Shocks

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By current understanding, large gradual solar energetic particle (SEP) events are caused by shock waves driven by coronal mass ejections (CMEs). While analytical solutions of particle distribution functions around shocks exist for one-dimensional steady-state theory, time-dependent and/or multi-dimensional systems cannot generally be solved analytically, motivating investigation of numerical models. We will showcase the self-consistent proton acceleration and Alfvén wave generation model SOLar Particle Acceleration in Coronal Shocks (SOLPACS) [Afanasiev et al. 2015] and a Monte Carlo simulation modeling electron acceleration by stochastic shock drift acceleration (SSDA).

We evaluate the significance of energetic particle injection in self-consistent proton acceleration modeling by comparing simulation results to observations, outline ideas for improving the accuracy and performance of self-consistent numerical models of particle acceleration in shocks, and inspect capabilities of SSDA in accelerating electrons and forming an electron beam.

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References:

Afanasiev, A., Battarbee, M., & Vainio, R. 2015: Astronomy & Astrophysics 584, id. A81