Contribution ID: **992** Type: **Talk**

Time-dependent Acceleration and Escape of Charged Particles at Traveling Shocks in the near-Sun environment: the case of the Sept 5th 2022 Parker Solar Probe event

Friday 18 July 2025 18:20 (15 minutes)

The Parker Solar Probe (PSP) approaches to the Sun in the past 6 years unveiled a broad variety of Traveling shocks (Ts) in the near-Sun environment, from the very weak Ts that would have been unlikely classified as shocks at 1 AU and are not associated with significant enhancement of energized particles, to the fastest ever Ts in-situ measured in the heliosphere, with unprecedented early-on signatures of particle (ions and electrons) acceleration. The interpretation of these measurements requires incorporating in particle acceleration models the time-evolution, and the escape from the accelerating source, before a steady-state is reached. We present the time-dependent version of a recently proposed 1D transport model that incorporates particle escape at all supra-thermal energies (not only the highest energies) into the diffusive shock acceleration (DSA) model via an energy- and position- dependent escape time; two cases of negligible (or not) self-excited magnetic field fluctuations in the upstream of the shock are solved. In the former case the scattering is dominated by pre-existing solar wind turbulence and the average time scale for particle acceleration at various heliocentric distances, from 1 AU down to the inner heliosphere (< 0.1 AU), is shorter than in the no-escape case as higher energy particles have a shorter time to accelerate before leaking out into the upstream and never return. A simple scaling with time of the time-dependent energy spectrum is provided. We present also the solution of the case of a non-negligible self-excited turbulence. Finally we compare the “nose” structure at a few hundreds keV protons first measured in situ by PSP in crossing the very fast September 5th 2022 Ts at 0.07 AU; we find that the nose is reasonably well explained by a lack of the highest energy particles not yet produced by the young shock by both our model and the no-escape DSA version. A larger sample of such events by PSP will help identify the conditions in the Ts lifetime of an escape-dominated regime.

Collaboration(s)

Authors: FRASCHETTI, Federico (Center for Astrophysics | Harvard & Smithsonian); Mr DO, Thomas (Michigan University); KOTA, Jozsef (University of Arizona); GIACALONE, Joe (University of Arizona); COHEN, Christina; Prof. MCCOMAS, David (Princeton University)

Presenter: FRASCHETTI, Federico (Center for Astrophysics | Harvard & Smithsonian)

Session Classification: CRD

Track Classification: Cosmic-Ray Direct & Acceleration