Contribution ID: **754** Type: **Talk**

On the effect of turbulence on large-scale drifts of solar energetic particles

Friday 18 July 2025 15:20 (15 minutes)

The propagation of the Solar Energetic Particles (SEPs) in the heliosphere is guided by the large-scale Parker spiral magnetic field. The gradient and the curvature of the magnetic field give rise to drift of the particles' guiding centres in the direction perpendicular to the magnetic field, leading the SEPs to gradually move away from their initial Parker spiral field lines. SEP propagation is also affected by solar wind turbulence, which scatters particles in pitch angle and spreads them across the average magnetic field due to field line meandering. It has been suggested that turbulence reduces the gradient and curvature drifts associated to the Parker spiral, however it is unclear to what extent they are reduced. We use our new analytic heliospheric turbulence model (Laitinen et al, ApJ 143,908 (2023)) to investigate the magnitude of drift reduction for particles injected close to the Sun. The turbulence model reproduces the dominant feature of plasma turbulence in the heliosphere, with the transverse 2D component having both wave and magnetic field vectors normal to the Parker spiral magnetic field: such a model provides an ideal tool to improve our understanding of turbulent drift reduction. We use full-orbit test particle simulations of 10, 100 and 1000 MeV protons within the modelled heliospheric turbulence, and present a method to evaluate their drift in the spatially-evolving heliospheric configuration. We assess the reduction of the drifts by turbulence by comparing the heliospheric turbulence simulations with a configuration without turbulence. Our findings show that the drifts are reduced by a factor 0.2-0.9 compared to a turbulence-free heliospheric configuration, varying as a function of proton energy and relative turbulence amplitude. The values obtained differ from theoretically predicted estimates particularly at low proton energies and indicate considerably weaker reduction of drift due to turbulence than previously assumed. Our results suggest that the guiding centre drifts remain a significant factor for the SEP intensity evolution in the heliosphere.

Collaboration(s)

Author: LAITINEN, Timo (University of Central Lancashire, UK)

Co-author: DALLA, Silvia (University of Central Lancashire, UK)

Presenter: LAITINEN, Timo (University of Central Lancashire, UK)

Session Classification: SH

Track Classification: Solar & Heliospheric Physics