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Perpendicular Transport in the Inner Heliosphere

F. Lampa and M.-B. Kallenrode
University of Osnabrueck, Department of Physics, Osnabrueck, Germany (flampa@uni-osnabrueck.de)

In previous studies, transport of solar energetic particles in the inner heliosphere has been regarded as one dimensional along the archimedian field spiral; any perpendicular transport is neglected. We have extended Ruffolo's equation of focused transport for solar energetic particles to accommodate perpendicular transport in the plane of ecliptic. Numerically, this additional term is solved with the implicit and stable Laasonen scheme. For typical ratios $\kappa_\perp/\kappa_\parallel$ between 0.02 and 0.1 at 1 AU as suggested in non linear guiding center theory and a scaling of $\kappa_\perp$ with r^2 as suggested from the random walk of field lines we find that (a) azimuthal spread over some ten degrees occurs within a few hours, (b) the variation of maximum intensities with longitude is comparable to the ones inferred from multi-spacecraft observations, and (c) on a given field line intensity- and anisotropy-time profiles are modified such that fits with the 2D transport model give different combinations of injection profiles and mean free paths.

Implications for the interpretation of intensity and anisotropy time profiles observed in interplanetary space and consequences for our understanding of particle propagation and acceleration in space will be discussed. We will also address the question whether and how the modeling of flux dropouts and propagation channels is possible in the presence of perpendicular diffusion as the ultimate leveler.