SPACE AND COSMIC RAY PHYSICS SEMINAR

University of Maryland
Computer & Space Sciences Building, Rm 2400
4:30 PM Monday, March 15, 2004
Tea & cookies 4:00-4:30 PM

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Transverse Anisotropies of 40-90 MeV Solar Energetic Protons: A Re-interpretation

Zhang et al., [Astrophys. J., 595, 493-499, 2003; J. Geophys. Res., 108, A4, 1154, SSH 4-1, 4-13, 2003] report strong anisotropies of 40-90 MeV protons transverse to the local magnetic field in two solar energetic particle events (2000:196 and 2000:256) observed by Ulysses/COSPIN/HET. They interpret their results in the context of diffusive transport and consequently conclude these events constitute strong evidence for the existence of transverse diffusion in the helisosphere. We see three difficulties with this interpretation. 1) The magnetic field was unusually well ordered during the periods of transverse anisotropies. Theories of transverse diffusion require the presence of irregularities in the magnetic field. 2) Fourier analysis of the angular distribution reveals a second harmonic whose amplitude is comparable to that of the first harmonic. This is inconsistent with diffusive transport (Fick's law) that predicts a dominant first harmonic. 3) Only two such intervals have been identified in a search of the mission-long Ulysses COSPIN data set. The paucity of such intervals is inconsistent with this being a pervasive mode of transport.

We have independently analyzed the COSPIN/HET channel H45 data and we confirm the data analysis of Zhang et al. for both events. However, we find that the data are much more consistent with interpretation in terms of weak scattering with field-aligned streaming and the presence of a gradient anisotropy. The above-mentioned three points are thus explained as follows. 1) Weak-scattering is expected in regions of quiet fields. 2) The pitch-angle distribution in both events eventually becomes predominantly bi-directional . Consequently the significant second harmonic is immediately explained. 3) The conditions for observing a strong gradient anisotropy at these energies is restricted to a special class of structures, and hence should be a relatively rare occurrence.

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