SPACE AND COSMIC RAY PHYSICS SEMINAR

University of Maryland
Computer & Space Sciences Building, Room 2400
4:30 PM Monday, April 4th, 2005
Coffee, Tea & cookies 4:00-4:30 PM

William H. Matthaeus

Bartol Research Institute, University of Delaware

Geometrical Properties of Turbulence and Its Effect on Field Line and Charged Particle Transport

The scattering and transport of heliospheric and astrophysical energetic charged particles depends upon the properties of the turbulence encountered by the particles as well as the nature and statistical properties of the interaction of particles with turbulence. The present talk will focus on the second of these issues, and in particular on recent developments in the theory of both parallel and perpendicular scattering of charged test particles in models of turbulent magnetic fields. The standard quasilinear theory sometimes gives a very good account of parallel scattering, but accounting for both low energy particles and large amplitude turbulence requires extensions. The standard theory of perpendicular scattering, the so-called Field Line Random Walk model, requires significant modification to include the nonlinear effect of parallel scattering on perpendicular transport. Here we review these developments including the onset of subdiffusion and the recovery of diffusion due to magnetic field complexity. Understanding the phenomenon of "dropouts" may require that we look at a nonuniform approach to the diffusive limit. In particular, using conditional statistics, one can show that some field lines or particles, those subject to temporary topological trapping, may experience a delayed approach to the diffusive limit. A new theory of suppressed diffusion and topological trapping (due to P. Chuychai, Chulalongkorn University) is summarized.

Collaborators: J.W. Bieber, G. Qin, D. Ruffolo and P. Chuychai. Research supported by NASA NAG5-11603 and NSF ATM-9977692.

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