TURBULENT CASCADE OF MAGNETIZED TURBULENCE IN A COLLISIONLESS ISM

D.B. Melrose[1], and Q. Luo[1]

[1]*School of Physics, The University of Sydney, NSW 2006, Australia*

The evolution of turbulence in the interstellar medium (ISM) is usually treated in the incompressible MHD approximation in which the only waves are Alfvén (A) waves. A turbulent cascade of Alfvén waves results from three-wave interactions, with one wave having zero frequency, leading to an anisotropic evolution parallel and perpendicular to the mean magnetic field. However, the ISM is compressible, and the neglect of the fast (F) mode is not well justified. Moreover, a fluid description requires that the waves having frequencies below the relevant collision frequency, and this condition is not satisfied except for the very low frequency end of the turbulent spectrum. The wave modes in the collisionless regime are closely analogous to those in compressible MHD. We find that including the F mode leads to separation of turbulence into two regimes: at small wave numbers three-wave processes involving a F wave dominate, and at large wave numbers the three-wave interaction involving only A waves dominates. Two implications will be discussed: scintillation in the ISM requires density perturbations which are associated only with the F mode; the conventional Fermi acceleration mechanism for cosmic rays by turbulence in the ISM also applies only to F waves and not to A waves.