Geophysical Research Abstracts, Vol. 6, 01638, 2004
SRef-ID: 1607-7962/gra/EGU04-A-01638

ANALYSIS OF INCOMPRESSIBLE ISOTROPIC 3D MHD TURBULENCE AS APPLIED TO THE SOLAR WIND

J. A. Merrifield(1), W.-C. Müller(2), S. C. Chapman(1), R. O. Dendy(3,1)

(1) Space And Astrophysics Group, Department of Physics, University of Warwick, Coventry, CV4 7AL, England, (2) Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany, (3) UKAEA Culham Division, Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB, England

The spatial characteristics and time evolution of current carrying structures (sheets, filaments) in Magnetohydrodynamic (MHD) turbulence are of key importance to the turbulent scaling properties.

The direct numerical simulation (DNS) of 3D incompressible isotropic MHD turbulence is relevant to the study of solar wind turbulence, which is thought to be approximately incompressible in regions without shocks. The DNS studied here is that of Biskamp and Müller [Phys. Plasmas **7**, 4889 (2000)]. This employs the incompressible resistive MHD equations to simulate decaying isotropic turbulence, with finite magnetic helicity and initially equal magnetic and kinetic energy densities. It has a spatial resolution of 512^3 Fourier modes.

A central question is the nature (including dimensionality) of the localised turbulent structures that give rise to intermittency in the local rate of dissipation, and the relation of their role to that of less strongly dissipative but more widely distributed turbulent structures. In parallel, there is the question of the extent and nature of any universal scaling properties of the turbulent fluctuations.

Here we report progress based on analysis of the variation with distance of differences in the Elsässer field variables $z^{\pm} = E \pm B$, and of dissipation rates. The scaling of the local rate of dissipation (both viscous and Ohmic), and of its one-dimensional surrogate, are compared with the picture gained from the study of the Elsässer field variables. Intermittency in these measures is analysed in the framework of the gen-

eralised theory of the intermittency correction proposed by She and Leveque [Phys. Rev. Lett. **72**, 336 (1994)]. A range of techniques is used to characterise any universal scaling behaviour that arises from the relatively low Reynolds number flows obtainable by DNS. These include extended self-similarity (ESS), which extends a variant of inertial range scaling into the dissipative range. ESS assumes that within the dissipative range, the energy flux through length scale (l) varies with l in the same way for structure functions of all orders, so that $\langle \delta z^{(\pm)p} \rangle \propto \langle \delta z^{(\pm)q} \rangle^{\zeta_q/\zeta_p}$ where $\langle \delta z^{(\pm)} \rangle = \langle | z(x,t) - z(x,t) | \rangle$ and $\langle \delta z^{(\pm)p} \rangle \propto l^{\zeta_q}$. This allows the ratio of scaling exponents (ζ_q/ζ_p) to be accurately determined, since scaling is extended into the dissipation range.