BP8.00119 Solar Coronal Heating and Magnetic Energy Build-Up in a Tectonics Model[1]

, M. GILSON, C.S. NG, A. BHATTACHARJEE, Center for Integrated Computation and Analysis of Reconnection and Turbulence and Center for Magnetic Self-Organization, University of New Hampshire — Observations from SOHO and TRACE have shown that the solar surface is covered with a so-called "magnetic carpet," in which small-scale magnetic flux loops are continually emerging and interacting. The magnetic flux at the photosphere is thus being replaced in every 10-40 hours. This magnetic carpet has important implications for the problem of coronal heating. We have extended a tectonics model of coronal heating [E. Priest, J. Heyvaerts and A. Title, Astrophys. J. **576**, 533 (2002)] and shown, based on analysis and numerical simulations, that the heating rate is independent of the Lundquist number as well as the photospheric coherence time, if the magnetic footpoints are subject to random photospheric motion. We have also found that magnetic energy can be built up to a statistically high level before the energy is released by some mechanisms, such as instabilities and/or magnetic reconnection. We have also shown that even if such processes limit the build-up of magnetic energy, the overall heating rate is still independent of the Lundquist number.

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BP8.00120 The Effect of Magnetic Turbulence Energy Spectral Scaling on the Heating of the Solar Wind[1]

, D. MUNSI, C.S. NG, A. BHATTACHARJEE, P.A. ISENBERG, Center for Integrated Computation and Analysis of Reconnection and Turbulence, Center for Magnetic Self-Organization, University of New Hampshire — Recently, a phenomenological solar wind heating model based on a turbulent energy cascade prescribed by the Kolmogorov theory has produced reasonably good agreement with observations on proton temperatures out to distances of the order of 70 AU, provided the effect of turbulence generation due to pickup ions is included in the model. Without the inclusion of pickup ions, the Kolmogorov scaling law appears to predict a proton temperature profile that drops off too rapidly with radial distance from the Sun. In this study, we have incorporated in the heating model the energy cascade rate based on Iroshnikov-Kraichnan (IK) scaling, derivable from incompressible magnetohydrodynamics. We show that the model can produce significantly higher proton temperatures, within the range of observations, with or without the inclusion of pickup ions. Moreover, the turbulence correlation lengths prescribed by IK scaling seem to follow better the trend of observations, as compared with previous results based on Kolmogorov scaling, which showed a qualitatively different trend.

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BP8.00121 Alignment of Velocity and Magnetic Fluctuations in Simulations of Anisotropic MHD Turbulence[1]

, C.S. NG, A. BHATTACHARJEE, Center for Integrated Computation and Analysis of Reconnection and Turbulence (CICART), University of New Hampshire, Durham, NH 03824 — There has been recent theoretical interest in the effect of the alignment of velocity and magnetic fluctuations in three-dimensional (3D) MHD turbulence with a large-scale magnetic field [Boldyrev 2005, 2006]. This theory predicts that the angle θ between the velocity and magnetic fluctuation vectors has a scaling of $\theta \propto \lambda^{1/4}$, where λ is the spatial scale of the fluctuations. There have also been simulations on 3D forced MHD turbulence that supports this prediction [Mason *et al.* 2006, 2007]. The scaling has also been tested against observations of solar wind turbulence [Podesta *et al.* 2007]. We report here simulation results based on decaying 2D turbulence. The scaling of $\theta \propto \lambda^{1/4}$ and Iroshnikov-Kraichnan scaling has also been observed within a range of time interval and spatial scales, despite the fact that Boldyrev's theory was developed for fully 3D turbulence in the presence of a strong external field. As the external field is reduced in magnitude and becomes comparable to the magnitude of magnetic fluctuations or lower, the scale-dependent alignment is weakened. Implications for observations of solar wind turbulence will be discussed.

[1] This work is supported by NASA.

BP8.00122 Scattering of Suprathermal Electrons in the Solar Wind: Particle-in-Cell Simulations

, S. PETER GARY, SHINJI SAITO, Los Alamos National Laboratory — Properties of the narrow, magnetic-field-aligned strahl electron velocity distributions are sensitive indicators of collisionless processes in the solar wind. Three distinct signatures have been observed in the characteristics of this suprathermal (70 eV < Energy < 1 keV) component: 1) Pitch-angle widths that decrease with increasing energy, 2) Pitch-angle widths that increase with increasing energy, and 3) Pitch-angle widths that have a distinct maximum as a function of energy. This presentation describes results from particle-in-cell simulations which have used three different sources of enhanced fluctuations to demonstrate how each of these signatures can arise. Signature 1) is well-known as being due to scattering by Coulomb collisions, but the simulations have shown that it may also arise as a consequence of scattering by the whistler anisotropy instability driven by a $T_\perp/T_\| > 1$ condition on the electron core component. Signature 2) has been shown by quasilinear theory to arise due to scattering by a broadband spectrum of whistler fluctuations; our simulations confirm that conclusion. Signature 3) arises from scattering due to the electrostatic electron/electron instability. The simulations demonstrate how the latter two signatures change with various plasma parameters.

BP8.00123 Remote Measurements of Ion Temperatures in the Terrestrial Magnetotail

, AMY KEESEE, EARL SCIME, West Virginia University — The plasma in the terrestrial magnetotail plays a central role in magnetospheric storms and substorms. Reconnection in the magnetotail yields flows in the tailward and earthward directions, redistribution of energetic particles throughout the inner magnetosphere, and possibly direct ion heating by waves. The magnetotail, out to 30-40 Earth radii, lies in the field of view of the instruments on the Imager for Magnetopause-to-Aurora Global Explorer (IMAGE) satellite when the spacecraft is in a favorable position in its orbit. *McComas et al.* (2002) showed that the Medium Energetic Neutral Atom (MENA) imager onboard IMAGE measures significant neutral flux from this region during periods of intense magnetospheric activity, i.e., when the plasmasheet density is enhanced by plasma injections from the solar wind and ionospheric outflows. We present remote ion temperature measurements calculated from MENA neutral flux measurements from 1 – 60 Earth radii during a substorm on 4-5 October 2000 (DOY 278-279). During the evolution of the substorm, a wave of increasing ion temperature appears to propagate earthward through the magnetotail.

BP8.00124 Hybrid Simulations of Mini Magnetospheres in the Laboratory

, LUIS GARGATE, Instituto Superior Tecnico, Portugal, RUTH BAMFORD, ROBERT BINGHAM, Rutherford Appleton Laboratory, UK, RICARDO FONSECA, LUIS SILVA, Instituto Superior Tecnico, Portugal — We use a massively parallel 3D hybrid particle code, dHybrid, to simulate the deflection of plasma beams by a dipole like magnetic field in a laboratory environment. Dipole magnetic fields, along with a plasma injection source to inflate the magnetic field, are now being studied as means of deflecting solar wind and Energetic Particles away from spacecrafts [1,2,3]. We have considered three setups, consistent with the experiments, with a plasma beam fired at i) a dipole field with no plasma injection, ii) a plasma injection source with no dipole field and iii) a dipole field with a plasma injection source. The hybrid simulations help understand the relevant physical phenomena, and enable extrapolation to space plasma scenarios, where setups are similar but plasma parameters differ significantly. The simulation results consistently show the plasma beam being deflected by the dipole field, in the first scenario, with the deflecting distance determined by the magnetic field intensities. The other two scenarios are also studied via hybrid simulations and the main physical differences between setups are highlighted. Comparisons with experimental results are discussed. [1] D. Winske et al, Phys. Plasmas 12 (2005) [2] Hai-Bin Tang et al, Phys. Plasmas 14 (2007) [3] http://www.ukssdc.ac.uk/twiki/bin/viewauth/Minimag/WebHome