SH32A-1103 1330h POSTER

Variations of Solar Radius Observed with RHESSI

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The Solar Aspect System (SAS) of the rotating (at 15 rpm) RHESSI spacecraft has three subsystems. Each of these measures the position of the limb by sampling the full solar chord profile with a linear CCD using a narrow bandwidth filter at 670 nm. With a resolution of each CCD of 1.7 arcsec/pixel, the accuracy of each of the 6 limb positions is theoretically better than 50 mas using 4 pixels at each limb. Since the launch of RHESSI early 2002, solar limbs are sampled with at least 100 Hz. That provides a database of currently 4 x 10^9 single radius measurements. The main function of SAS is to determine the RHESSI pointing relative to Sun center. The observed precision of this determination has a typical instantaneous (16 Hz) value of about 200 mas (rms). We show and discuss first results of variations of solar radius observed with RHESSI.

SH32A-1104 1330h POSTER

Coronal heating and the appearance of the solar corona

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The details of the dependence of coronal heating on the conditions within the corona determine the appearance of the corona as viewed by different instruments. For example, strong fields at the base of short loops cause relatively hot, X-ray bright loops, whereas the much weaker fields over the quiet Sun result in cooler, EUV bright loops. Any dependence of the volume heating rates on local conditions (such as height or field strength) has a signature in the thermal profiles along the loops, translating into an appearance that depends on the instrumental pass band. In this preliminary study, we explore how such dependences of coronal heating on coronal conditions affect the appearance of the solar corona, and investigate the consequences for the global EUV and X-ray spectral irradiance. These results will eventually be used to compute the solar spectral irradiance in the EUV and X-rays for quiescent conditions throughout the solar cycle.

SH32B MCC: 2000 Wednesday 1340h

Roles of Electromagnetic Waves in Reconnecting Space and Laboratory Plasmas II *(joint with SM)*

Presiding: **G Lapenta,** Los Alamos National Laboratory**; T Lui,** Applied Physics Laboratory, Johns Hopkins University

SH32B-01 1340h INVITED

The Importance of Electrostatic Instabilities in Magnetic Reconnection

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Recent simulation studies of kinetic instabilities in reconnecting plasmas suggests that investigation of electromagnetic waves, such as the drift-kink-instability (DKI) and the Kelvin Helmholtz instability (KHI), may yield a theory of reconnection. However, the combined results of linear theory, and explicit and implicit plasma simulations fail to support a direct link between kinking and reconnection. Instead, the surprise has been the unexpected importance of the lower-hybrid-drift instability (LHDI). This electrostatic instability, which simulations suggest saturates at a level that is too low to provide the anomalous resistivity necessary for reconnection, alters current sheets in several important ways. The LHDI causes velocity shear, current sheet thinning, and anisotropic heating of electrons. The velocity shear drives a KHI mode, which explains current sheet kinking at high mass ratios, and the current sheet thinning and anisotropic heating significantly enhance the growth rate of the tearing instability, which may explain onset. Clearly, there is strong motivation for studies of the LHDI under magnetotail conditions.

SH32B-02 1400h INVITED

Reconnection in Thin Current Sheets With Sheared Magnetic Field: Three-Dimensional Particle Simulations

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Reconnection in thin current sheets is investigated by means of three-dimensional full particle simulations. Reconnection is allowed to develop out of the numerical noise. We do not impose symmetry about the midplane and we use a relatively high mass ratio of $m_i/m_e = 160$. The initial state is a Harris current sheet with a superimposed guide field. The lower hybrid drift instability develops at the boundary of the current layer with wave vectors perpendicular to the local magnetic field. This leads to an interference pattern of the inductive electric field in the center of the current sheet. Acceleration of the electrons by the inductive electric field leads to a patchy appearance of localized neutral lines on a time scale of about 10 inverse ion gyro-frequencies. These neutral lines merge and reconnection becomes eventually two-dimensional. Only in the case of exactly 90 degree shear reconnection is essentially two-dimensional from the beginning. We have determined the dependence of the reconnection onset time on the amount of shear, and we will present a run with a small initial magnetic field component normal to the current sheet.

SH32B-03 1415h

Lower-hybrid-drift and modified-two-stream instabilities in current sheet equilibrium

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The present paper discusses the stability of thin current sheet against lower-hybrid-drift (LHDI) and modified-two-stream (MTSI) instabilities. It is demonstrated that MTSI is driven by the cross-field current, implying that MTSI should also be most effective at the neutral sheet, while LHDI is driven by the density gradient. It is shown that under a normal Harris current sheet condition, $V_i/|V_e| = T_i/T_e$, LHDI completely dominates the MTSI, which implies that current-driven instability cannot penetrate to the center of the Harris current sheet. However, if the Harris current sheet condition is relaxed to $V_i/|V_e| > T_i/T_e$, then MTSI is shown to gradually overtake LHDI. The present finding demonstrates the potentially more important role of MTSI in the ion-dominated thin current sheets.

SH32B-04 1435h INVITED

Magnetic fluctuations and fine magnetic structure in MRX

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In the Magnetic Reconnection Experiment (MRX), reconnection has been observed to proceed at a rate much faster than the predictions of the Sweet-Parker model. The two leading explanations for this phenomenon are based on either two dimensional laminar structures due to Hall terms in the generalized Ohm's Law or enhanced resistivity perhaps caused by three dimensional turbulent wave particle interactions. In an attempt to explore these two possibilities, new diagnostics have been developed on MRX. A "Hodogram" probe, which measures all three components of the fluctuating magnetic field with high time resolution ($\approx$ 40 MHz), and a fine structure probe with pickup coils spaced 1.25 mm apart have been constructed. The hodogram probe has measured electromagnetic fluctuations in the lower hybrid frequency range within the reconnecting current sheet (in contrast to previously detected electrostatic fluctuations which occur outside the current sheet). The fluctuation amplitude correlates with the enhanced resistivity and reconnection rate, and the fluctuations have been identified as obliquely propagating whistler waves. The fine structure probe has a spatial resolution which is less than the electron skin depth ($\approx 2 - 3$ mm). It has been installed, and is taking data. Details of the electromagnetic fluctuations and new measurements from the fine structure probe will be presented. MRX is jointly supported by DOE, NASA, and NSF.

SH32B-05 1450h

Comparison of Laboratory Measurement of Electromagnetic Waves during Reconnection with Theory, Simulations and Space Observations

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Magnetic reconnection plays an important role in determining the topology of magnetic fields in solar flares, solar wind interactions with Earth magnetosphere, and relaxation processes in laboratory plasmas. A major puzzle of magnetic reconnection concerns why the observed reconnection rates are much faster than predictions by classical theories such as the Sweet-Parker model. Recently new measurements in MRX (Magnetic Reconnection Experiment) have revealed presence of strong electromagnetic waves during fast reconnection in the low-collisionality regime. In this paper, the measured wave characteristics are compared to linear theories based on either simple models (e.g., local and two-fluid models) or more complete models (e.g., global and full kinetic models). Initial assessments suggest that the observed waves are consistent with the so-called Modified Two-Stream Instability driven by large drift speeds compared to the Alfven speed in high-beta plasmas. Comparisons with 3D nonlinear simulations as well as recent measurements by space satellites will be presented. This work is supported by DOE, NASA, and NSF.

URL: http://mrx.pppl.gov

SH32B-06 1505h

The Effect of the Guide Field on the Developement of Turbulence in 3-D Reconnection

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Recent 3-D simulations of magnetic reconnection have shown that the presence of a guide field (a component perpendicular to the reconnection plane) strongly effects the development of turbulence. With no guide field the inflowing electrons become demagnetized inside the current layer, leading to an effective heating that suppresses shear flow instabilities even in the limit of small asymptotic temperature [Zeiler et al., 2001]. Drake et al. (2003) showed that a large guide field magnetizes the electrons and stops this thermalization, allowing the Buneman instability to drive turbulence (in the form of electron holes) at the X-line and along the separatrices. We show that, in fact, quite small values of the guide field are sufficient to keep the electrons magnetized and hence allow the development of turbulence. An examination of the distribution functions at the X-line of a series of 2-D simulations shows a clear transition when the guide field is about one-tenth the asymptotic reconnection field, a result consistent with both analytic arguments and further 3-D simulations. These results imply that electron hole turbulence may be ubiquitous at reconnection sites in nature.