BP8.00113 A Plasma, Magnetorotational Instability Experiment , C. COLLINS, C.B. FOREST, R. KENDRICK, University of Wisconsin, Madison, A. SELTZMAN, NUF, Georgia Institute of Technology — A new experiment is underway at the University of Wisconsin to investigate the magnetorotational instability in a plasma. Magnetorotational instability (MRI) is a likely mechanism that could account for the observed accretion rates in astrophysical objects. The instability occurs when a weak magnetic field is present, so that tension in perturbed field lines transfers angular momentum outward while mass moves towards the center. In the Plasma Dynamo Experiment Prototype, a cylindrical, axisymmetric, ring cusp confinement geometry is used to produce a large unmagnetized plasma, confined by a highly localized magnetic field at the plasma boundary. The plasma is stirred by a novel axisymmetric electrode set that can control the rotation (angular momentum profile). The feasibility of observing the MRI will be discussed and initial results from a protoype experiment will be presented.

BP8.00114 A Plasma Dynamo Experiment based upon Ring Cusp Confinement and Electrostatic Stirring , CARY FOREST, UW Madison, GENNADY FIKSEL, NOAH HERSHKOWITZ, ROCH KENDRICK, STEVE COWLEY, UCLA, ERIK SPENCE, ETH Zurich — A new plasma experiment to investigate the self-generation of magnetic fields is proposed. The experiment consists of a spherical vacuum chamber with a series of permanent magnetics, with electrically insulated pole faces, in a ring cusp geometry (poles facing inward with alternating polarity along the vessel wall). The resulting field is axisymmetric and decays quickly away from the walls providing a large, magnetic field free region in the central region of the device. To stir the plasma, cathodes positioned between the magnet rings are biased such that the resulting electric field induces plasma rotation through the ExB drift. The flow drive principle is quite general and by controlling the poloidal profile of the toroidal rotation, high magnetic Reynolds number plasmas flows can in principle be generated that result in magnetic field self-generation or plasma flows unstable to the magnetorotational instability. Use of a plasma for such an experiment may allow the magnetic Reynolds number (the dimensionless parameter governing self-excitation of magnetic fields) to be approximately a factor of 10 larger than in liquid metal experiments and will be the first experiment to investigate self-excited dynamos in a plasma,the state of matter that makes up most naturally occuring astrophysical dynamos.

BP8.00115 Measuring and imaging bulk flows in laboratory plasma loops[1] , E.V. STENSON, P.M. BELLAN, California Institute of Technology — Arched plasmas similar to solar coronal loops are made in the lab by means of a magnetized plasma gun. These plasma structures are created in a process resembling that used to make spheromaks, exhibit behavior that is also seen in the sun, and demonstrate some very general flow phenomena. It has been proposed that in a current-carrying flux tube with nonuniform cross-section, plasma jets flow from more constricted to less constricted regions (P. M. Bellan, Phys. Plasmas 10, 1999 (2003)). By making arched plasmas from two different gas species - one at each of the two footpoints of the arch - we see that this is indeed the case. High-speed imaging with optical filters reveals a jet emanating from each footpoint. With velocities on the order of the Alfven speed, these jets move much faster than both the sound speed of the neutral gas and the thermal velocity of the ions. The technique of using two gases will next be used for experiments wherein two adjacent plasma arches merge. Each will be made of a different gas, so that the process by which the two combine can be resolved.

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BP8.00116 Observing Energetic Bursts in the Caltech Solar Coronal Loop Simulation[1] , R.J. PERKINS, G.S. YUN, P.M. BELLAN, California Institute of Technology — X-ray bursts have previously been observed in a solar coronal loop experiment (J.F. Hansen, S.K.P. Tripathi, and P.M. Bellan, Phys. Plasma 2, 3177(2004)) where two parallel plasma-filled flux tubes merged in either a co-helicity or counter-helicity arrangement. These x-ray bursts were observed with a set of x-ray photo-diodes. We are developing means to observe these bursts with additional diagnostics. A low cost photo-electric detector was thoroughly tested on a test chamber using a xenon flashlamp. The detector utilizes the low work function of magnesium to measure ultraviolet radiation. A photo-scintillator is being developed to detect hard x-ray emission down to 10 keV. A smaller photo-scintillator was previously constructed and used in the Caltech spheromak experiment; we have enlarged the scintillating volume in hopes of increasing sensitivity. Finally, in a single loop experiment, spectroscopic measurements detect the onset of oxygen impurity lines at the loop apex; the onset is simultaneous with the formation of a bright spot at the same location. Future spectroscopic measurements are planned to investigate the apex region during merging.

[1]Sponsored by USDOE

BP8.00117 Measurement of Electrical Currents in the Solar Corona , STEVEN SPANGLER, University of Iowa — Some theories for heating of the solar corona invoke Joule heating by electrical currents. Observations of spatially-extended radio sources through the corona show times when there is a difference in the Faraday rotation between two lines of sight separated by about 33,000 km in the corona. Ampere's Law is used to relate these observations to the presence of electrical current flowing between the two lines of sight. I infer a current of 2.5×10^9 Amperes in the case of the strongest signal, and a current of 2.3×10^8 Amperes in another, marginally significant detection. A model of coronal current sheets is used to interpret the current measurements, and estimate the volumetric heating rate due to Joule dissipation. The model uses the Spitzer resistivity. The model heating rate is approximately 6 orders of magnitude less than independent, observational estimates in the relevant part of the corona. Either the currents detected play a negligible role in coronal heating, or the effective resistivity in the corona is 6 orders of magnitude larger than the Spitzer value.

BP8.00118 Lagrangian Simulations of Current Sheet Formation During Relaxation of an Unstable Line-Tied Equilibrium[1] , LIWEI LIN, C.S. NG, A. BHATTACHARJEE, Center for Integrated Computation and Analysis of Reconnection and Turbulence, Center for Magnetic Self-Organization, University of New Hampshire — Our recent theory, based on reduced MHD equations, predicts the formation of current sheets (tangential discontinuities) in an ideal line-tied plasma when an unstable equilibrium relaxes to a state of minimum energy [C. S. Ng and A. Bhattacharjee, Phys. Plasmas **5**, 4028 (1998)]. This mechanism has important implications for the heating of the solar corona, first envisioned by E. N. Parker. Testing of this prediction using conventional Eulerian simulations is subjected to the intrinsic numerical difficulty that the magnetic field line mapping is not kept fixed explicitly, as required by the line-tied condition. In fact, field line mapping can change substantially by reconnection due to numerical resistivity. To overcome this obstacle, we have developed a Lagrangian relaxation algorithm to simulate the evolution of an unstable equilibrium by following the movement of magnetic field lines explicitly. Preliminary simulation results will be presented.

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