GP8.00148 Magnetohydrodynamics inside a rotating sphere. DAVID MONTGOMERY¹, Dartmouth College, Hanover, NH 03755, PABLO MININNI², NCAR, Boulder, Colorado 80307, LEAF TURNER³, Cornell University, Ithaca, NY 14853 — The equations of incompressible MHD are solved inside a uniformly rotating rigid spherical shell. The method of solution is a Galerkin expansion for the vector fields involved. The normal components of these fields vanish at the spherical boundary. The expansion basis functions are the spherical Chandrasekhar-Kendall eigenfunctions of the curl. A prescribed mechanical forcing excites a wide variety of dynamo behavior, all (so far) at unit magnetic Prandtl number. Key control parameters seem to be mechanical and magnetic Reynolds numbers, the Rossby and Ekman numbers (which we vary by varying the rotation rate of the sphere), and the amount of mechanical helicity injected. Magnetic energy levels and magnetic dipole behavior fluctuate strongly in a few eddy turnover times, but seem to stabilize as the rotation rate is increased, until the limit of the code resolution is reached. The detailed geometry of the mechanical forcing appears to be important. [P.D.Mininni et al, Phys. Fluids 18, 116602 (2006) and New Journ. of Physics (to appear, 2007).]¹

GP8.00149 Plasma Wave Echoes in a Weakly Collisional Plasma¹, C. BLACK, K. GERMASCHEWSKI, C.S. NG, A. BHATTACHARJEE, Center for the Integrated Computation and Analysis of Reconnection and Turbulence (CICART), University of New Hampshire, Durham, NH 03824 — It has been shown recently that weak collisions, which are a singular perturbation on the collisionless Vlasov equation, have a profound effect on the underlying spectrum for linear plasma waves by eliminating the Case-Van Kampen continuous spectrum and replacing it with a complete class of discrete eigenmodes [C.S. Ng, A. Bhattacharjee, F. Skiff, Phys. Rev. Lett. 83, 1974 (1999); 92, 065002 (2004)]. This discovery has important consequences for the validity of the classical theory of C. H. Su and C. Oberman [Phys. Rev. Lett. 20, 427 (1968)] on the collisional decay of plasma wave echoes. We have developed a parallel one-dimensional Vlasov-Poisson system solver including the Lenard-Bernstein collision operator, and benchmarked this code with our earlier numerical results on the discrete spectrum. We have also completed simulations of plasma wave echoes in the collisionless system. We will report our results on the effect of collisions on the echoes, testing the theory of Su and Oberman, and present some novel features in echo dynamics caused by the discrete spectrum of collisional eigenmodes.

¹This research is supported by NSF and DOE.

GP8.00150 Driven, autoresonant three-oscillator interactions¹, ODED YAAKOBI, LAZAR FRIEDLAND, Hebrew University of Jerusalem, ZOHAR HENIS, Soreq Research Center — An efficient control scheme of resonant three-oscillator interactions (R3OI) using an external chirped frequency drive is suggested. The approach is based on formation of a double phase-locked (autoresonant) state in the system, as the driving oscillation passes the linear resonance with one of the interacting oscillators. When double phase-locked, the amplitudes of the oscillators increase with time in proportion to the driving frequency deviation from the linear resonance. The stability of this phase-locked state, the effects of dissipation and of the initial three-oscillator frequency mismatch on the autoresonance are analyzed. The associated autoresonance threshold phenomenon on the driving amplitude is also discussed. In contrast to other nonlinear systems, driven, autoresonant three-oscillator excitations are independent of the sign of the driving frequency chirp rate.

¹Supported by the US-Israel Binational Science Foundation, grant No. 2004033

GP8.00151 MH4D Benchmarking and Atomic Physics Implementation, ERIC MEIER, University of Washington, PSI-CENTER COLLABORATION — Two key benchmarks of MH4D have been made: 1) Screw pinch kink and spheromak tilt modes have been simulated in MH4D with non-linear ideal MHD. Linear growth rates are compared to results from linear stability computations. 2) MH4D has been used to simulate the ZaP Flow Z-Pinch experiment, and benchmarked against results from a well-developed 2-D MHD code, MACH2. Periodic boundary conditions are used in MH4D to allow quasi-2D simulation. Resistivity and ohmic heating are included in these simulations. Beyond these benchmarks, the 3-D capability of MH4D has been explored by simulating gas injection in ZaP. Also, the accuracy of the implicit and semi-implicit features of MH4D have been assessed. First order atomic physics have been implemented in MH4D. A cold static neutral fluid is tracked, and the applicable temperature-dependent ionization, recombination, and charge exchange terms are included in each of the MHD equations and in the neutral fluid density equation. A significant background density of neutral fluid is shown to cause the expected slowing of spheromak tilt mode growth. The effect of ionization (delayed plasma generation) on ZaP plasma dynamics is explored.

GP8.00152 OPTIMAL HELICON SOURCE PERFORMANCE –

GP8.00153 Cross-correlation diagnostics of electrostatic fluctuations in a helicon source, MICHAEL KRAEMER, Ruhr University Bochum — The absorption of helicon waves was observed to be intimately connected with the excitation of short-scale electrostatic fluctuations [1]. Cross-correlation techniques using microwave back-scattering at the upper-hybrid resonance as well as electrostatic probes enable measurements of their frequency and wavenumber spectra. The low-frequency band can be attributed to ion-sound fluctuations, while the high-frequency fluctuations obey the dispersion relation of Trivelpiece-Gould waves. The fluctuations satisfy the matching conditions for the parametric decay instability of the helicon wave. Operating the helicon discharge in a pulsed mode, the growth rates and the thresholds of the fluctuations can be deduced from their temporal growth in a wide parameter range. Good agreement with a theory that accounts for the non-zero axial wavenumber of the helicon pump was achieved. The close relationship between the rf absorption and the excitation of the fluctuations is studied in more detail by performing time- and space-resolved measurements of the helicon field and the electrostatic fluctuations. In particular, the role of the radial plasma inhomogeneity on the parametric excitation of the fluctuations is examined.- Supported by the Deutsche Forschungsgemeinschaft (SFB 591, Project A7).- [1] B. Lorenz, M. Krämer, V.L. Selenin, Yu.M. Aliev, Plasma Sources Sci. Technol. 14, 623 (2005).

GP8.00154 Slow wave measurement using the WVU 300 GHz collective scattering diagnostic, ROBERT HARDIN, West Virginia University, EARL SCIME, ALEX HANSEN — Recent experiments in helicon plasma sources by Krämer et al. [2006] and Kwak et al. [2006] have employed mm-wave technology to investigate electron densities in a pulsed source and density fluctuations due to ion-acoustic waves, respectively. Measurement of the temporal and spatially resolved electron densities by Kramer was accomplished with a mm-wave interferometer. The ion-acoustic waves measured by Kwak employed a collective scattering system with a heterodyne detection scheme. The WVU 300 GHz quasi-optical collective scattering diagnostic, uses a homodyne detection method similar to the interferometer, designed to measure the “slow” wave. Experimental parameters observed to heat ions in the plasma edge in conjunction with theoretically calculated wave numbers associated with the slow wave, as seen in Kline et al. [2002], were examined for evidence of the slow wave using the mm-scattering diagnostic. Here we present initial wave number spectrum measurements of the slow wave in a helicon plasma source. M. Krämer, B. Clarenbach, and W. Kaiser, Plasma Sources Sci. Technol. 15, 332 (2006). J.G. Kwak, S.J. Wang, S.K. Kim, and S. Cho, Phys. Plasmas 13, 074503 (2006). J.L. Kline, E.E. Scime, R.F. Boivin, A.M. Keesee, and X. Sun, Plasma Sources Sci. Technol. 11, 413 (2002).