Abstract Submitted
for the APR09 Meeting of
The American Physical Society

Ideal Magnetohydrodynamic Simulations of Magnetic Bubble Expansion as a Model for Extragalactic Radio Lobes[1] WEI LIU, SCOTT HSU, HUI LI, SHENGTAI LI, LANL, ALAN LYNN, University of New Mexico — Recent astronomical observations indicate that radio lobes are gigantic relaxed magnetized plasmas with kilo-to-megaparsec scale jets providing a source of magnetic energy from the galaxy to the lobes. Therefore we are conducting a laboratory plasma experiment, the Plasma Bubble Expansion Experiment (PBEX) in which a higher pressure magnetized plasma bubble (i.e., the lobe) is injected into a lower pressure background plasma (i.e., the intergalactic medium) to study key nonlinear plasma physics issues. Here we present detailed ideal magnetohydrodynamic (MHD) three-dimensional simulations of PBEX. First, the direction of bubble expansion depends on the ratio of the bubble toroidal to poloidal magnetic field, with a higher ratio leading to expansion predominantly in the direction of propagation and a lower ratio leading to expansion predominantly normal to the direction of propagation. Second, a leading MHD shock and a trailing slow-mode compressible MHD wave front are formed ahead of the bubble as it propagates into the background plasma. Third, the bubble expansion and propagation develop asymmetries about its propagation axis due to reconnection arising from numerical resistivity and to inhomogeneous angular momentum transport due to the background magnetic field. These results will help guide the initial experiments and diagnostic measurements on PBEX.

[1]Supported by LANL LDRD

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Date submitted: 24 Dec 2008 Electronic form version 1.4