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Ideal Magnetohydrodynamical Simulations of Magnetic Bubble Expansion as a model for extragalactic radio lobes WEI LIU, SCOTT HSU, HUI LI, SHENGTAI LI, LANL, ALLAN 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. Given reasonably low injection speeds of the magnetic bubble, its expansion due to the Lorentz force leads to one perpendicular MHD shock and one compressible reversal MHD wavefront, where three-dimensional reconnection results due to numerical resistivity. With the expansion, some angular momentum is transported from the rotating magnetic bubble to the background plasma mainly due to advection. The discovery of MHD shocks in the simulations shows that PBEX provides a rare opportunity to study MHD shocks in a laboratory experiment. Comparison of models and measurements will be used to validate the theoretical tools, which we will apply to nonlinear relaxation of magnetized plasmas in astrophysical systems.

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