Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

3D MHD simulation of Caltech plasma jet experiment: First results[1] XIANG ZHAI, Applied Physics, Caltech, HUI LI, Theoretical Division, Los Alamos National Laboratory, PAUL BELLAN, Applied Physics, Caltech, SHENG-TAI LI, Theoretical Division, Los Alamos National Laboratory, BELLAN PLASMA GROUP TEAM, LANL THEORETICAL DIVISION COLLABORATION — We present a 3D ideal MHD simulation of the Caltech plasma jet experiment using an adaptive mesh refinement code previously developed by H. Li and S. Li for simulating magnetically driven AGN jets. Initially, plasma and a poloidal magnetic field are placed at the simulation domain center. A toroidal magnetic flux is injected into the system continuously near the electrodes. In both the simulation and the experiment the Lorentz force is observed to squeeze the plasma radially and lengthen it axially to form a jet. The Lorentz force also transports magnetic energy and helicity and converts magnetic energy into kinetic energy. The simulation agrees quantitatively with the experiments in numerous aspects, such as magnetic/kinetic energy, current, jet radius, and propagation velocity. Specifically, the simulation shows, in agreement with both the experiment and analytical theory, that the jet is an MHD Bernoulli flow and the jet velocity is proportional to the poloidal current divided by the square root of the jet density. This simulation study provides a new and quantitative method for understanding the nature of plasma jets and also for relating experiments, numerical simulations and astrophysical observations.

[1]DOE, NSF

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Date submitted: 10 Jul 2013 Electronic form version 1.4