LABORATORY SIMULATIONS OF ASTROPHYSICAL JETS AND THEORETICAL MODELS MOTIVATED BY THESE SIMULATIONS

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An experimental program underway at Caltech has produced plasmas where the shape is not fixed by the vacuum chamber nor imposed by an external coil set, but instead is determined by self-organization. Boundary conditions relevant to astrophysical jets and to solar corona loops are used.

The experimental dynamics are highly reproducible and so can be studied in considerable detail even though the morphology is both complex and dynamically changing. A surprising result has been the observation that these self-organizing magnetized plasmas involve self-collimating MHD-driven plasma jets. A theoretical model has been developed to show that collimation results from an accumulation of frozen-in magnetic flux in the jet frame.

The experimental work has also motivated development of:

1. a Hamiltonian-orbit model showing how the jet electric currents in an actual accretion disk could be driven by a dusty-plasma, gravitationally powered dynamo,

2. a dust/gas differential slowing-down model showing that the dust-to-gas mass ratio in a molecular cloud can be sufficiently enriched over the 1% ISM mass ratio for this dynamo to have enough power.