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Laboratory-produced MHD plasma jets[1]

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Because space plasmas are neither confined by vacuum chamber walls nor have magnetic fields produced by physical coils, space plasmas have shapes that are much less determinate than lab plasmas. An experimental program underway at Caltech produces plasmas where the shape is neither fixed by a vacuum chamber wall nor imposed by an external coil set, but rather is allowed to be determined by self-organizing MHD processes subject to the constraint of imposed boundary conditions analogous to the boundary conditions of space plasmas. These self-organizing processes are believed to be fundamental to astrophysical jets, solar coronal loops, and MHD turbulence (e.g. Taylor relaxation). The experimental dynamics are sufficiently reproducible to allow detailed study despite the morphology being complex and dynamic. A surprising result has been the observation that instead of the plasma uniformly filling up the available volume, the plasma is spatially localized in a highly collimated, small diameter magnetic flux tube, the length and axis of which change in time in response to MHD forces. A model shows that the collimation results from stagnation of linked magnetic flux frozen into a MHD-driven jet that accelerates plasma from the wall into the flux tube, filling the flux tube with plasma. Jet flow has been imaged with a high-speed multi-frame camera, diagnosed via Doppler spectroscopy, and most recently (i) the collision between two opposing, *color-coded* jets flowing from opposite ends of a flux tube has been observed, and (ii) the collision of a jet with a target cloud has been observed.

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