Abstract Submitted
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Experimental investigation of multi-scale non-equilibrium plasma dynamics[1] PAUL BELLAN, Caltech — Lab experiments at Caltech resolve complex, detailed MHD dynamics spatially and temporally. Unbalanced forces drive fast plasma flows which tend to self-collimate via self-pinching. Collimation results from flow stagnation compressing embedded magnetic flux and so amplifying the magnetic field responsible for pinching. Measurements show that the collimated flow is essentially a dense plasma jet with embedded axial and azimuthal magnetic fields, i.e., a magnetic flux tube (flux rope). The measured jet velocity is in good agreement with an MHD acceleration model. Depending on how flux tube radius varies with axial position, jets flow into a flux tube from both ends or from just one end. Jets kink when the flux tube in which they are embedded breaches the Kruskal-Shafranov stability limit. The lateral acceleration of a sufficiently strong kink can produce an enormous effective gravity which provides the environment for an observed fine-scale, extremely fast Rayleigh-Taylor (RT) instability. The RT can erode the jet current channel to be smaller than the ion skin depth so there is a cascade from the ideal MHD scale of the kink to the non-MHD ion skin depth scale. This process can result in a magnetic reconnection whereby the jet and its embedded flux tube break.

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