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Dynamics of an Arched Magnetically-Twisted Current-Carrying Plasma: Dip, Cavity, Shock, and Instability[1] PAKORN WONGWAITAYAKORNKUL, University of California, San Diego, PAUL M. BELLAN, California Institute of Technology — The Caltech solar loop experiment replicates solar corona loops because of similarity in geometry, beta (low), and Lundquist number (high). Understanding loop dynamics gained from this experiment provides insight regarding solar eruption events. By exploring a large experimental parameter space, we have studied the dynamics of the arched magnetically-twisted current-carrying flux rope in regimes which have not been previously accessed. Adjustment of the initial footpoint gas injection creates a controlled density perturbation along the loop and shows that heavier loop segments have less acceleration than lighter segments, leading to dip in the loop profile. A prefilled background gas enables study of the density cavity and shock created by a rapidly expanding magnetically-driven flux rope pushing against a flux-conserving background plasma. Variation of the bias magnetic field reveals the onset of MHD instability and its role as a magnetic reconnection driver. These experimental investigations with supporting numerical and analytic methods provide a comprehensive model showing how a magnetically-twisted current-carrying flux rope exhibits a density dip, induces a magnetic cavity, drives a shock, and undergoes MHD instability leading to magnetic reconnection.

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Pakorn Wongwaitayakornkul
University of California, San Diego

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