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3D Laboratory Measurements of Forces, Flows, and Collimation in Arched Flux Tubes[1] MAGNUS HAW, PAUL BELLAN, Caltech — Fully 3D, vector MHD force measurements from an arched, current carrying flux tube (flux rope) are presented. The experiment consists of two arched plasma-filled flux ropes each powered by a capacitor bank. The two loops are partially overlapped, as in a Venn diagram, and collide and reconnect during their evolution. B-field data is taken on the lower plasma arch using a 54 channel B-dot probe. 3D volumetric data is acquired by placing the probe at 2700 locations and taking 5 plasma shots at each location. The resulting data set gives high resolution (2cm, 10ns) volumetric B-field data with high reproducibility (deviation of 3% between shots). Taking the curl of the measured 3D B-field gives current densities (J) in good agreement with measured capacitor bank current. The JxB forces calculated from the data have a strong axial component at the base of the current channel and are shown to scale linearly with axial gradients in current density. Assuming force balance in the flux tube minor radius direction, we infer near-Alfvenic axial flows from the footpoint regions which are consistent with the measured axial forces. Flux tube collimation is observed in conjunction with these axial flows. These dynamic processes are relevant to the stability and dynamics of coronal loops.

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