ASTROPHYSICS

Determining the Acceleration Mechanism and Topological Structure of Solar Jets: Evidence of Multiple Acceleration Mechanisms in Coronal Jets

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Solar coronal jets are small-scale, energetic eruptions, characterized by a column-like spire and a bright, dome-shaped base. Jets are thought to be driven by magnetic reconnection when opposite polarity photospheric flux elements emerge, cancel, flyby, or otherwise interact. Extreme Ultraviolet (EUV) and X-rays jets are thought to be primarily driven by magnetic reconnection, however the relationship between jet initiation and plasma properties during their eruption is not well understood. Recent magnetohydrodynamic models show that jets may be accelerated through three primary mechanisms; chromospheric evaporation, the untwisting motion of the field lines or by traveling Alfven waves. Each of these mechanisms could work independently or in tandem with the magnetic tension released during magnetic reconnection. For the first time, we apply two novel techniques to investigate the acceleration mechanism of six coronal jets. First, we employ observations from Hinode's X-ray Telescope (XRT), Solar Dynamics Observatory's Atmospheric Imaging Assembly (SDO-AIA), and the Interface Region Imaging Spectrograph (IRIS), to capture the plane-of-sky velocities, plamsa temperature, Doppler velocity and non-thermal line broadening (when available). We look for evidence of chromospheric evaporation by examining temperature as a function of velocity and examine spectroscopic data for regions of strong non-thermal broadening which we infer as possible locations of magnetic reconnection. We find clear evidence of chromospheric evaporation in one jet, possible evidence in two jets, and no evidence in three of the jets. Next, we use a Non-Linear Force Free Field (NLFFF) model and flux insertion method to examine the evolution of the magnetic topology where we identify the topological features responsible for jet generation. We find that the primary reconnection regions in two of the jets are located *beneath* the jet dome, while the region is located *above* the jet dome in another jet, where highly twisted field lines appear to impart additional energy. In this work, for the first time, we apply two novel techniques to investigate solar coronal jets and find evidence that multiple mechanisms are responsible for jet acceleration.

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