"Flows in an Expanding Coronal Loop"

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Abstract

Coronal loop models, in both quiescent and flaring simulations, have typically assumed that the cross-sectional area of the loop is uniform along its length. While observations of loop widths have generally supported this assumption, it is seemingly at odds with the conservation of magnetic flux, since the magnetic field strength decreases with height from the solar surface. In recent work, we have dropped this assumption to better understand how a non-uniform cross-section impacts the hydrodynamic and radiative evolution of a coronal loop. We will discuss the fluid dynamics for a compressible flow in a non-uniform tube with a large temperature gradient. We will then show the impacts on chromospheric evaporation into and draining out of a coronal loop. We have found that an impulsive heating event drives a long-duration steady flow into the corona, sustained by thermal conduction. The cooling timescale of the coronal loop is thus lengthened significantly as flows supply energy to the corona, and effectively suppress draining from the corona. This flow would be apparent as a long-lasting blue-shift in hot spectral lines, which has likely been observed by NASA's IRIS satellite. The Doppler shifts might place a constraint on the area expansion, and thus the magnetic field strength.