Fine structures and dynamics of prominences and filaments

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Abstract

We review recent observations of prominence and filament fine structure and dynamics made with the Hinode/Solar Optical Telescope (SOT), the Solar Dynamics Observatory/Atmospheric Imaging Assembly (AIA), and ground-based telescopes. The 2006 launch of the Hinode/SOT revitalized the study of prominence dynamics by showing that even the most quiescent prominences are in constant motion with filamentary downflows, large-scale vortex motions, fine-scale oscillations, and occasional Rayleigh-Taylor buoyancy instabilities triggering turbulent upflows. The (re)discovery of the prominence Rayleigh-Taylor instabiltiy in particular has led to vigorous debate on the nature of flows in prominences, the role of the magnetic field in structuring those flows, and the origin of the buoyancy in the generating "bubbles". We focus on the nature of these prominence bubbles, using AIA observations to explore the hypothesis that they are due to emerging magnetic flux that undergoes rapid heating to create a "magneto-thermal" buoyancy instabilty (Berger et al. 2011 Nature). Together with the observations of apparent runaway radiative cooling leading to prominence condensation from the corona (Liu et al. 2012, Berger et al. 2012 ApJL) and new theoretical developments on spontaneous current sheet formation leading to prominence downflows (Low et al. 2012a,b ApJ), these observations imply the possibility of a novel form of convection that transports hot plasma and magnetic flux upwards into the corona while the cool prominence plasma downflows represent the return flow of the system.

Keywords: Prominence, filament, flows, instabilities, convection, radiative cooling

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