SDO/AIA Observations of Coronal Condensation in Funnel Prominences as Return Flows of the Chromosphere-Corona Mass Cycle

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Abstract

It has recently been proposed that prominences are manifestations of a magneto-thermal convection process that involves ever-present dynamic descents of cool material threads and upflows of hot bubbles (Berger et al. 2011 Nature). On global scales, prominences may play an important role as the return flows of the chromosphere-corona mass cycle. A critical step in this cycle is the condensation of million-degree coronal plasma into T< 10,000 K prominence material by radiative cooling instability. Direct observational evidence has been lacking for decades, a situation recently changed. We present here SDO/AIA observations of runaway cooling in coronal loops leading to condensation at magnetic dips and formation of funnel-shaped prominences (Liu et al. 2012; Berger et al. 2012 ApJL). We find that a macroscopically quiescent prominence is microscopically dynamic, involving the passage (through condensation and drainage) of a significant mass of typically 10ˆ15 gram/day (comparable to a CME mass). This picture is further supported by the recent theoretical development on spontaneous formation of current sheets and condensations (Low et al. 2012a, b). Such funnel prominences, usually small in size, can constitute a new type of prominences. We suggest that similar processes could produce elementary building blocks of large-scale quiescent prominences in filament channels.

Keywords: prominence formation, coronal condensation, radiative cooling instability, drainage, downflow, magnetic dips or funnels, prominence bubbles, chromosphere, corona mass cycle, magneto, thermal convection

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