First High-resolution Spectroscopic Observations by IRIS of a Fast Prominence Eruption Associated with a CME on 2014-May-09

Liu, Wei (1,2), weiliu@lmsal.com; Bart DePontieu (1), Takenori Okamoto (3), Jean-Claude Vial (4); Alan Title (1); Patrick Antolin (5); Thomas Berger (6); and Han Uitenbroek (7).
(1) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA
(2) Stanford University, Stanford, CA, USA
(3) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Yoshinodai, Sagamihara, Japan
(4) Institut d'Astrophysique Spatiale, Universite Paris XI/CNRS, Orsay Cedex, France
(5) National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan
(6) NOAA Space Weather Prediction Center, Boulder, CO, USA
(7) National Solar Observatory, Sunspot, NM, USA

Spectroscopic observations of prominence eruptions and associated coronal mass ejections (CMEs) are rare but can provide valuable plasma and energy diagnostics. We report the first result of such joint IRIS-Hinode observations of a spectacular prominence eruption occurring on 2014-May-09. IRIS detected a maximum redshift of 450 km/s, which, combined with the plane-of-sky speed of 800 km/s, gives a large velocity vector of 920 km/s at 30-deg from the sky plane. This direction agrees with the source location at 30-deg behind the limb indicated by STEREO-A. There are two branches of redshifts separated by 200 km/s appearing in all strong lines including Mg II k/h, C II, and Si IV, indicating a hollow, rather than solid, cone in the velocity space of ejected material. Opposite blue- and redshifts on the two sides of the prominence exhibit corkscrew variations both in space and time, suggestive of unwinding rotation of a left-handed helical flux rope. Some erupted material returns as nearly streamline flows, exhibiting distinctly narrow line widths (~10 km/s), about 50% of those of the nearby coronal rain at the apexes of coronal loops where the rain material is initially formed out of cooling condensation. We estimate the mass and kinetic energy of the ejected and returning material and compare them with those of the associated CME. We will discuss the implications of these observations for CME initiation mechanisms.