Coordinated Observations of Prominences with SUMER/CDS and Ground Observatories

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Abstract. An international campaign for the observation of prominences and filaments was successfully accomplished between June 3 and 9 1996. Several ground observatories took part in the campaign which included the space observatories SOHO and Yohkoh.

The main objective of this campaign was to study the dynamics of prominences and the prominence-corona interface, the formation of filaments and the fine structures at different temperatures. We will reported on two Joint Observing Programmes of SUMER and CDS aboard SOHO (JOP 12 and JOP 17), which have been achieved. Finally we will present as an exemple a prominence observed on May 1, 1996 during the tests of the programme JOP 12. This prominence was associated with a CME (observed with LASCO). Very active parts with Dopplershifts up to ± 36 km s\(^{-1}\) were measured in the SUMER spectra of the prominence, indicating the presence of twisted ropes during the eruption. Mean electron densities have spatial and temporal dispersion of one order of magnitude (10\(^9\) – 10\(^{10}\) cm\(^{-3}\)).

1. Introduction

To understand the physics of prominences it is important to have observations in many wavelengths simultaneously. New campaigns, including ground observatories and the coronal experiments on SOHO, have made this possible.

Two joint observing programmes (JOP12: “Limb prominences” and JOP17: “Dynamics of solar active structures”) were run with SUMER and CDS during the international campaign in June 1996. The campaign which lasted from 6 to 11 UT observed filaments from 6 to 8 UT (JOP17) and prominences from 8

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Coordinated Observations of Prominences

279

to 11 UT (JOP12). Several prominences and filaments were observed (see also Wiik et al. 1996a). In this paper we shall concentrate on two prominences: one observed during the campaign, and a quiescent one observed during the tests of JOP12 on May 1 1996.

Figure 1. The prominence observed on May 1 1996 (SE 20–40) as seen in the Ca II K3 line at 07:25 UT. SUMER and CDS cover only the southernmost part of the prominence (to the left). (Meudon spectroheliogram, courtesy of Z.Mouradian.)

2. Observations

The following observatories have reported that they participated in the campaign: Pic du Midi (MSDP, Coro IR and Hα), Meudon (spectroheliograms), Debrecen (WL), Wroclaw (MSDP, Coro) (see Wiik et al. 1996), Ondřejov (spectra), Izmiran (magnetograms), Irkutsk (radio, Hα and Ca II K), Crimea (10830 and Hα), Ratan (radio), and Hida (Japan).

In addition, the imager SXT aboard Yohkoh supported the campaign and a long list of observations are available. During the filament and prominence campaign, full disk images (SFR) were obtained. Partial frame images (SPR) covered the nearby active region target.

2.1. SUMER

SUMER observed in staggering mode, which means that the region of interest is scanned four times with a large stepsize (12") shifted by a certain amount each time, such that the final spatial resolution is smaller (3"). This mode of observation was proposed to detect high velocity events occurring in a large field of view in a reasonable time (~ 8 minutes). One 3" spatial resolution image is built up in approximately 32 minutes. The spatial resolution along the slit is ~ 1".
The programme JOP12 observed the following lines: Si IV 1393 and 1402, O IV 1399, 1401, 1404, and 1407. The spectral resolution at these wavelengths is \( \sim 0.043 \AA \). The O IV lines were chosen for density diagnostics in the prominence-corona interface at \( 1.7 \times 10^5 \) K (Wiik et. al. 1993). The nearby Si IV lines are formed at a lower temperature \( T \sim 6.3 \times 10^4 \) K and therefore closer to the cooler plasma observed in H\( \alpha \).

2.2. CDS

The CDS spectrograph observed 5 lines with JOP17 and 15 lines with JOP12. The lines covered a large range of temperatures. Large rasters (240″ \( \times \) 240″) were first obtained then smaller rasters (120″ \( \times \) 240″). A step size of 2″ were used to obtain these rasters. The spatial resolution along the slit is 1″.

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<th>JOP 17 Filament programme CDS</th>
<th>JOP 12 Prominence programme CDS</th>
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3. Prominence Observed on May 1

The prominence was situated on the east limb, between 20 and 40 degrees south. It was very huge on May 1, as can be seen on the Ca II K3 Meudon spectroheliogram taken at 07:25 UT (Fig. 1). We have estimated its projected altitude to \( \sim 85 \) 000 km. The SUMER and CDS observations covered approximately 10 degrees between 30 to 40 degrees south.

The constructed images from the SUMER Si IV 1393 profiles show considerable evolution of the loops closest to the limb (two lower panels of Fig. 2). The loops seem to open up and form a cavity. This is confirmed by the electron density measurements obtained from the ratio of O IV 1401/1399 (CHIANTI, Dere et al 1997), giving higher values in the closed loops, \( N_e \sim 5 - 8 \times 10^9 \) cm\(^{-3}\), than in the newly formed cavity, \( N_e \sim 1 - 3 \times 10^9 \) cm\(^{-3}\). Around the cavity high Doppler velocities of the order of 30 - 40 km s\(^{-1}\) are observed indicating the plasma motions which are taking place at this location.

The CDS panels (Fig. 3) show the different aspects of the prominence at different temperatures.
Figure 2. SUMER: prominence observed on May 1 1996. North is up, the right corner in the low panels shows the disk. The dimension of the panels is 132" × 100". The SUMER field of view is centered in the CDS field of view.
CDS NIS Raster, 1-May-1996 08:06:33

POBS1_2 -- JOP12 Prominence -- s825r00.fits
Center = (-778",-609"),  Size = 122"x240"

Figure 3. CDS: prominence observed on May 1 1996 at 08:06 UT. The part of the prominence visible on the disk in cooler lines escapes with ascending velocities and could be responsible of the destabilization of coronal structures. Note the absorption in hotter lines at the location of the prominence. North is up.

4. Conclusion

The multi-wavelength campaigns with SOHO and Yohkoh are very promising. We have shown one example of an event observed with SUMER and CDS, the partial eruption of a filament/prominence which led to a CME (LASCO), observed in several wavelengths. This event is not a catastrophic one but certainly destabilizes a large coronal streamer. The prominence is located close to the south part of the CME which is offset equatorward from the prominence. This relationship has already been observed (Webb et al 1994).

References
