SOME ERUPTIVE EVENTS OF SUMMER 2000 OBSERVED AT WROCŁAW OBSERVATORY

I. N. Garczyńska*, E. Szuszakiewicz*, P. Rudawy*,
B. Rompolt*, and B. Cader-Sroka*

Abstract

A number of energetic ejection events of the present maximum of Solar activity were observed with the Small Cononagraph (SC), the Large Coronagraph (LC) and the MSDP at the Wrocław Astronomical Institute during summer 2000. We observed the Eruptive Prominences (EPLs), which gained considerable velocities and heights and showed also the connection with intensive flares and Coronal Mass Ejections (CMEs). The most interesting of them are presented, and possible relations to the respective CMEs are discussed.

1 Introduction

Observations of quiescent prominences and, first of all, active prominences have been carried out in Hα at the Astronomical Institute of the Wrocław University since 1965. The routine observations were performed by means of the Small Coronagraph [Rompolt and Kraus, 1969] and are continued up to now. This coronagraph has been developed especially for observing fast moving events in the Solar corona. It is equipped with a broadband Hα filter enabling observations of even such prominences which possess a rather large line–of–sight velocity component. In 1980 observations with the Large Coronagraph [Rompolt and Rudawy, 1985] started giving high spatial resolution ($\sim$0.3 arc second) of prominence images. In 1987 the Solar Horizontal Telescope came into operation. Spectral observations of prominences, filaments and flares started with the MSDP (Multi–channel Subtractive Double–Pass spectrograph) in 1993 [Rompolt et al., 1993]. The observations taken by all these instruments are collected in the Solar data archives. The most interesting active phenomena have been delivering to the World Data Center and published in the "Mass Ejection Events" SGD table and later in the "Active Prominences and Filaments" SGD table.

*Astronomical Institute of Wrocław University, ul. Kopernika 11, 51-622 Wrocław, Poland

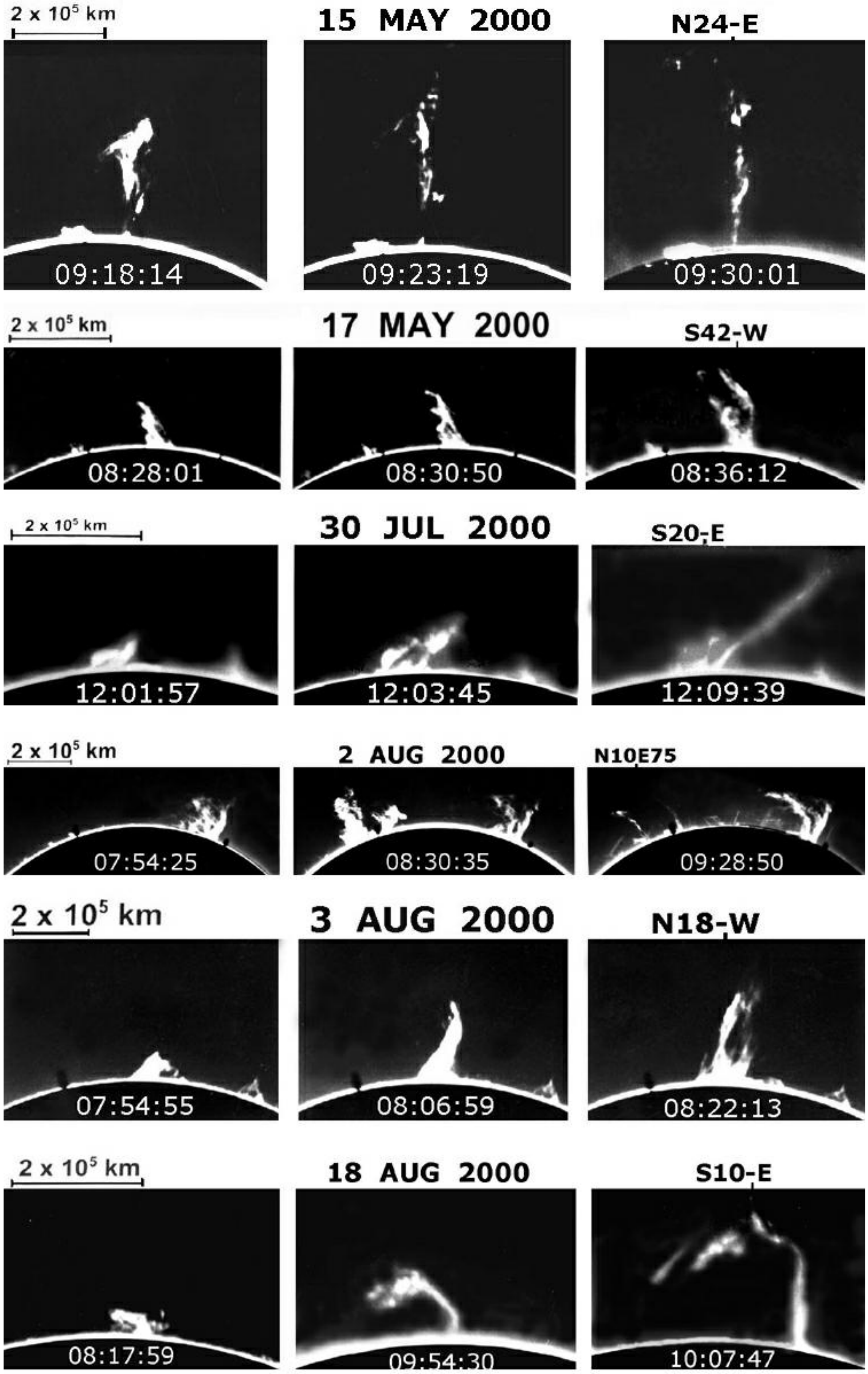


Figure 1: EPLs observed in Hα line with the Small Coronagraph of the Wrocław University.

2 Observations

During the summer–season 2000 when the Sun came into the phase of maximum activity, we succeeded to record a lot of active events at the limb. In this report we discuss such EPLs observed in Hα line with the Wrocław instruments, which were associated in time and space with the CMEs recorded by the SOHO/LASCO C2 and C3 coronagraphs. We used also some data from the Pic du Midi Coronagraph (PdMC) and Ondrejov Multichannel Flare Spectrograph (OS) (see Figures 2 and 3).

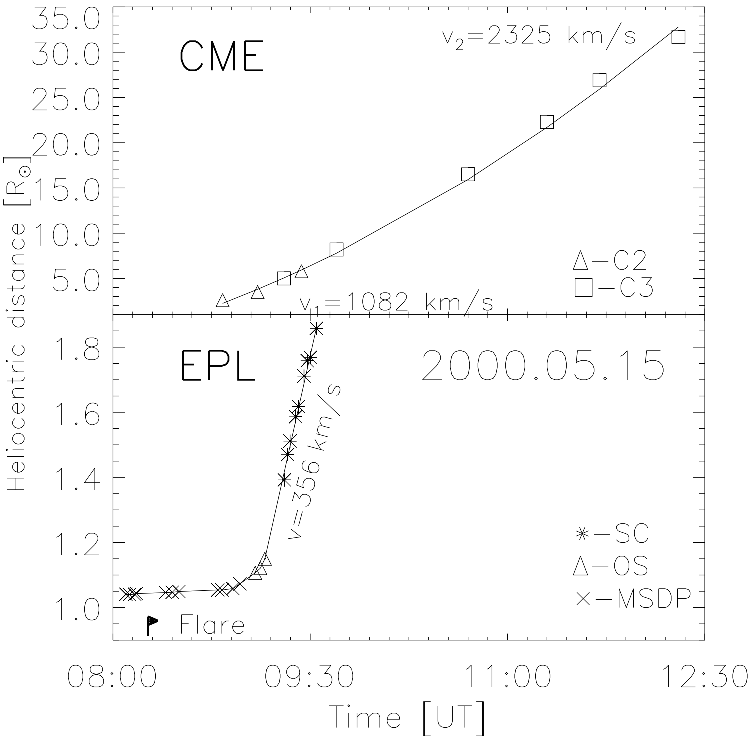
In Table 1 the basic data concerning the eruptive prominences observed with the Small Coronagraph at the Wrocław Observatory are collected. The date, the location on the limb, the estimated time of the start, the maximum prominence height above the limb and its maximum velocity (both measured in the sky plane) are presented in the first section of the table. In the second section there are the data concerning the associated flares, taken from the GOES Satellite X–ray Data (e.g. time of the X–ray flare start and its X–ray GOES class). In the third section the associated Coronal Mass Ejections recorded in the white light by the SOHO/LASCO coronagraphs C2 and C3 are given: the estimated start time (the onset of every CME, evaluated by the back–extrapolation of the CME leading edge motion above the limb in the corresponding time–distance diagram), the time of the first CME image and the maximum velocity, also measured in the sky plane, reached by the uppermost part of the CME.

Table 1: Eruptive prominences and associated events (explanation in text; Start means estimated time of significant increase of an EPL velocity).*

Eruptive Prominences					Associated Flares		Coronal Mass Ejection		
Date	Location	Estimated *Start** (UT)	H_{max} (10^3km)	V_{max} (km/s)	Start (UT)	GOES class	Estimated onset time (UT)	First image time (UT)	Leading edge velocity (km/s)
05.15	N24-E	08:53	600	360	08:16	M4.4	08:30±10	08:50	2300
05.17	S42-W	08:09	240	135			07:20±10	08:50	1400
07.30	S20-E	12:01	190	300	11:59	C7.8	11:55±5	12:30	900
08.02	N10E75	08:06	250	130	08:05	C7.9	08:02±10	08:54	470
08.03	N18-W	07:50	350	180	08:08	C1.4	08:25±5	08:54	900
08.18	S10-E	09:30	190	200			10:00±5	10:55	1000

3 Discussion and conclusion

The results of the analysis of the observational material being at our disposal are summarised in Table 1 and in the Figures 2, 3 and 4.



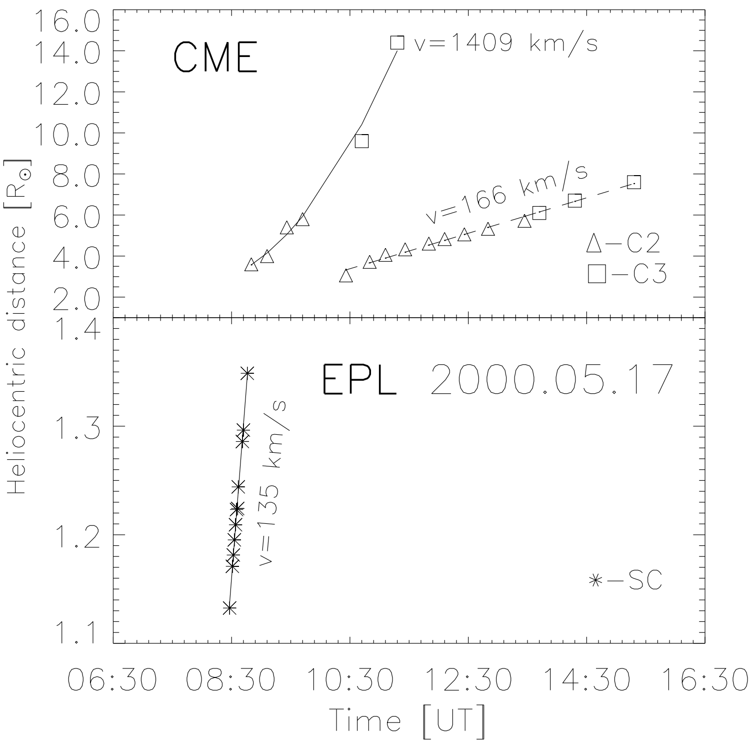


Figure 2: Time–distance diagrams for EPLs and CMEs on 15 and 17 May 2000.

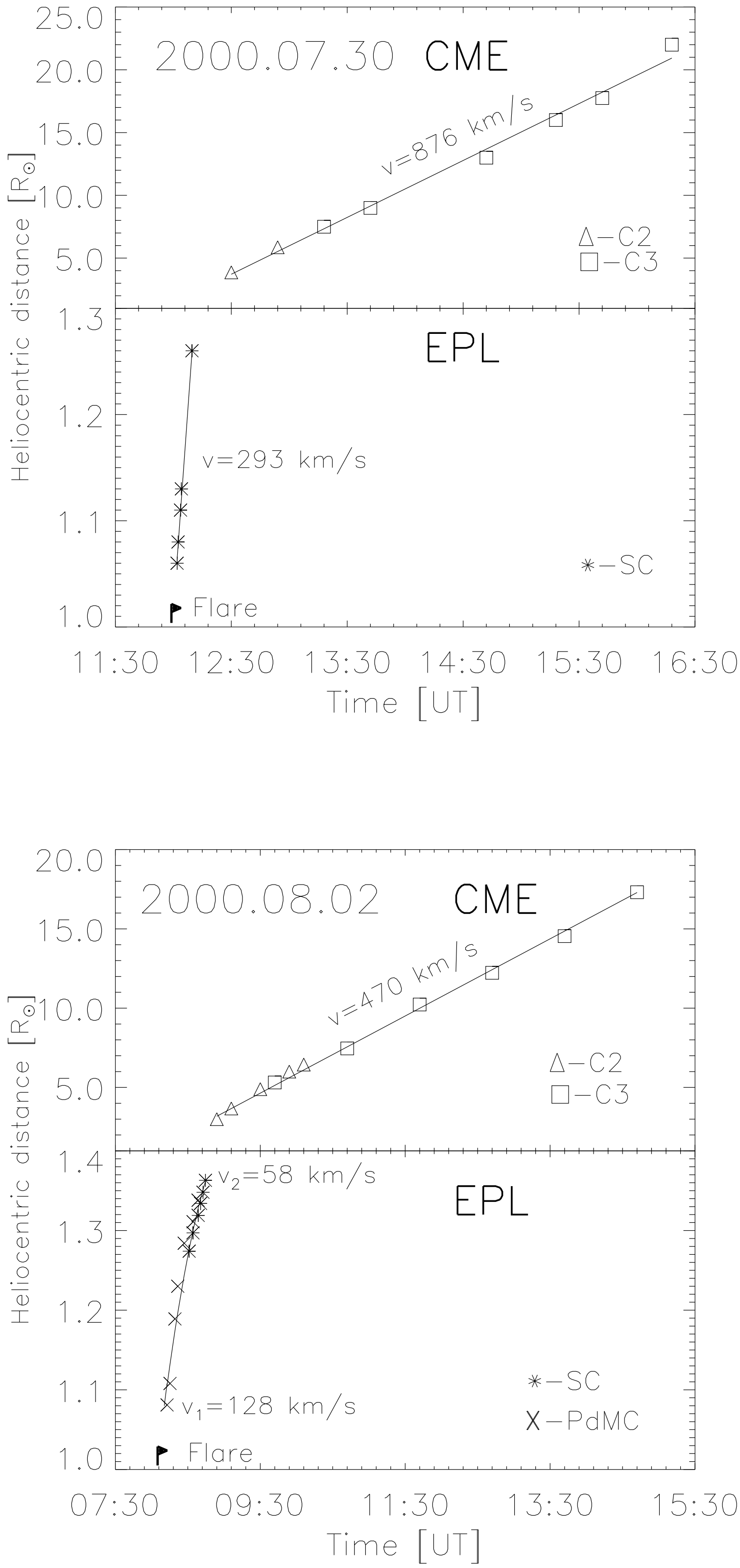


Figure 3: Time–distance diagrams for EPLs and CMEs on 30 July and 2 August 2000.

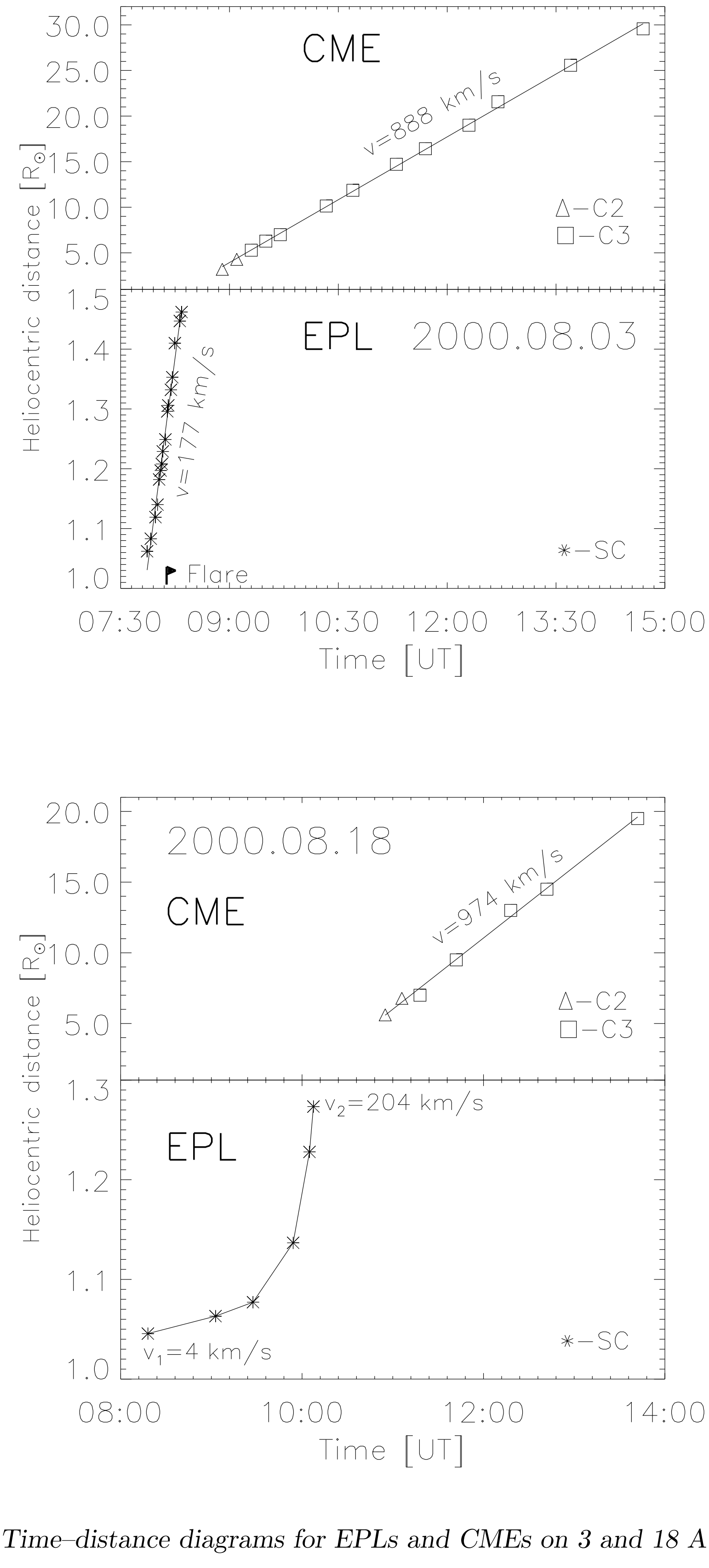


Figure 4: Time–distance diagrams for EPLs and CMEs on 3 and 18 August 2000.

For most of the analysed EPLs, the associated CMEs were moving in the field of view of the C2 and C3 coronagraphs with more or less constant velocities in the range of 470–2300 km/s. In two cases, on 15 and 17 May, CMEs were moving with clear acceleration. Only these two cases are in agreement with the conclusion of Andrews and Howard [2001] that a CME moving with acceleration is often associated with prominence eruptions. In other cases CMEs had constant velocities although they were also associated with prominence eruptions.

In two cases (events of 3 and 18 August) estimated onsets of the EPLs were earlier than CMEs' onsets, in two cases (events of 15 and 17 May) estimated onsets of CMEs were earlier than EPLs' onsets and in two cases (events of 30 July and 2 August) EPLs and CMEs seemed to start simultaneously.

Four analyzed cases out of six were coincident in time and in space with X–ray flares (marked in Figures 2–4). On 3 August flare started after EPL but before the correspondent CME. The flare on 15 May started before both, the CME and the EPL. On 30 July and 2 August flares started simultaneously with the CMEs and the EPLs (in the range of measurement and estimation method errors).

All the analyzed events were not associated with type II and IV radio bursts despite high observed velocities of the material.

Acknowledgements: The SOHO/LASCO data used here were produced by the consortium of the Naval Research Laboratory (U.S.A.), Max–Planck–Institute für Aeronomie (Germany), Laboratoire d'Astronomie (France) and the University of Birmingham (U.K.). SOHO is the international project of ESA and NASA. We acknowledge also the staffs of the Pic du Midi and Ondrejov Observatories for making the data available to us.

References

Andrews, M. D., and R. A. Howard, A two–type classification of LASCO Coronal Mass Ejection, *Space Science Reviews*, **95**, 147, 2001.

Rompolt, B., and T. Kraus, The Wrocław Observatory Coronograph, *Acta Univ. Vratislaviensis* **No. 77**, Mat.–Fiz.–Astr. VIII, 171, 1969.

Rompolt, B., and P. Rudawy, The Coronograph 530 mm of the Wrocław University, *Postępy Astronomii*, **XXXIII**, 141, 1985.

Rompolt, B., P. Mein, N. Mein, P. Rudawy, and A. Berlicki, The MSDP recently installed at the Spectrograph of the Large Coronagraph of the Wrocław Astronomical Institute, in *JOSO Annual Report' 93*, edited by A. v. Alvensleben, 87–91, 1993.