New Perspectives on Solar Prominences, IAU Colloquium 167
ASP Conference Series, Vol. 150, 1998
David Webb, David Rust, and Brigitte Schmieder (eds.)

Small-Scale Structure in Loops and Prominence Threads

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Abstract. Preliminary results of the morphology of prominence fine structure are presented. Long time series of three post–flare loops, a spray and an eruptive prominence were digitalized and analyzed. The length-to-width ratio of the blobs was determined and, in some threads, a continuous movement of separate blobs of matter was detected.

1. Introduction

The photo–archive of the Large Coronagraph of Wroclaw University consists of many high resolution (better than 1 arcsec) observations of various types of prominences. On the basis of digitization of this material, we analysed the morphology of small–scale prominence structures. In this paper we present preliminary results concerning prominence fine structures.

2. Observational Material

For our analysis we chose a long time series of Hα filtergrams of three post–flare loops (August 18, 1990, June 27, 1992 and July 6, 1991), one spray (October 8, 1991) and one eruptive prominence (June 29, 1994). The observational material was digitized with the Joyce Loebl microdensitometer of the National Astronomical Observatory at Rozhen, Bulgaria. The two-dimensional scans were taken with a pixel size of 25×25 μ^2 and a step of 25 μ between the pixels in both directions.

3. Morphological Analysis

The analysis of the filtergrams shows that all analyzed prominences have a thread–like structure. The diameters of the threads vary from a few arc sec to less than the resolving power of the observations ($\approx$0.5 arc sec). The prominence matter is organized inside the threads in blobs of dense matter separated by less dense matter and nonuniformly spread along the threads (Figure 1). Following the blobs' positions with respect to the solar limb, a continuous movement of the blobs was observed. The more precise analysis of these motions is

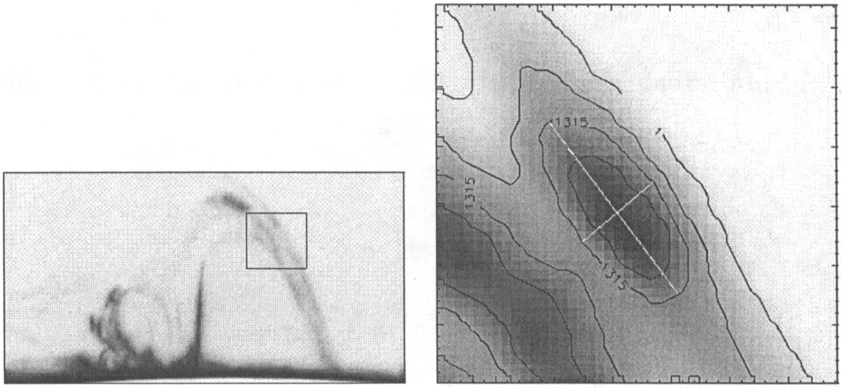

Figure 1. Top: Thread-like structure of the loop prominence on August 18, 1990. Bottom: Enlarged part of the top image with overplotted contours of the blobs and lines marking the blobs' length and width.

under way.

As a parameter to describe the shape of a separate blob we chose its length (L) to width (W) ratio. The filtergrams are not calibrated, but the L/W ratio of the more or less oval blobs may be defined from the optical density contours taken for the middle value of the whole density range. We measured the well-separated blobs only, carefully avoiding the emission enhancements caused by crossing or overlapping of the loops or threads. Even inside the densest parts of some loops, we found some discontinuities of the brightness, which may be signatures of blobs or may be caused by the overlapping of some unresolved, very thin loops. The blobs of the eruptive prominence of June 29, 1994 were measured in the outer parts of the prominence only, because the individual threads were packed too tightly in the central part of this prominence. In Table 1 the minimum, maximum, mean and standard deviations, σ, of the L/W ratios are presented.

Table 1. L/W ratio determined for different types of prominences

Date	Time [UT]	Type	No. of blobs	L/W ratio			
				min	max	mean	σ
Aug. 18, 1990	06 40 20	Loops	26	1.6	5.3	3.1	1.2
	06 52 48	Loops	53	1.1	7.4	2.8	1.1
Oct. 8, 1991	08 48 31	Loops	58	1.2	5.7	2.4	0.9
Oct. 8, 1991	14 24 23	Spray	37	1.1	6.8	22	1.2
	14 35 47		35	1.1	6.9	2.1	1.4
June 27, 1992	08 09 08	Loops	46	1.1	3.8	2.0	0.7
	08 17 19		44	1.0	4.9	1.8	0.7
June 29, 1994	10 20 27	Eruptive	30	1.1	4.5	2.0	0.5
	11 44 25		27	1.1	3.2	1.8	0.5

https://doi.org/10.1017/S0252921100047291 Published online by Cambridge University Press

The L/W ratios vary from nearly 1:1 (round blobs) up to 7:1 (very elongated blobs). The mean L/W ratios were between 1.8:1 and 3:1. The loops and spray blobs have generally a higher L/W ratio than in eruptive prominences.

4. Discussion

The present achievements of multi-dimensional modelling of non-LTE radiation transfer make it possible to build new, more accurate models of post-flare loops. In the framework of this new approach, the loops should be considered as inclined, elongated, rope-like structures instead of over–simplified models of one-dimensional, plane–parallel slabs placed over the solar surface. One of the most crucial problems in post–flare loop modelling is an accurate description of the internal structure of the individual loops.

It is generally known that loops and threads of prominences are filled by the "blobs", separated by some less dense matter. This means that the calculations of radiation transfer and the physical parameters of prominences should be performed for the very complicated, three-dimensional structure of many threads filled with relatively dense blobs and less dense interblob space.

Acknowledgments. This work was partially supported by the Polish Committee of Scientific Research under the Grant No. 2.PO3D.025.09, by the bilateral Polish-Bulgarian scientific co-operation project and by the National Scientific Foundation (Bulgaria) under Grant F-623/96.