Catalogue of Solar Flare Spectra Observed at Ondřejov in 1998-2007

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Accepted: 27 February 2010

Abstract We present a catalogue of solar flare data observed with two Ondřejov optical spectrographs during 1998-2007 years. This database was created to enable the data processing more convenient for users interested in the study of the energy release and transport in solar flares. The spectra and Hα filtergrams were obtained both at the Multichannel Flare Spectrograph (MFS) and at the Large Horizontal Spectrograph (HSFA2). The catalogue contains basic information about time of observation of solar flares, their location in AR, importance, availability of related data at the selected X-ray, EUV and radio instruments. The catalogue is available at www.asu.cas.cz/~sos/flare_archive.html.

Keywords: spectrograph, CCD camera, solar flare, chromospheric lines, catalogue

Introduction

Solar flares are still considered as enigmatic phenomena that strongly effect the interplanetary environment. Moreover, analysis of flare radiation makes it possible to study plasma in very extreme conditions. It is accepted that the high-energy flare processes are triggered in the corona. Later on, in time scale depending on the type of the energy transfer, the flare is observed in the chromosphere and photosphere as a response to the primary energy transfer from coronal levels. However, the role of lower atmospheric layers is not minor but quite a substantial one. Thus all observations in chromospheric lines could be the principal or at least an important contribution to solar phenomena study.

Current catalogue is based on the chromospheric line spectra and Hα filtergrams obtained both at the Multichannel Flare Spectrograph (MFS) and at the Large Horizontal Spectrograph (HSFA2). The main target was to enable the data processing more convenient for users interested in the study of the energy release and transport in solar flares.

Instruments

The main part of presented original data was obtained by Multichannel Flare Spectrograph (MFS). A brief historical and technical description of the Ondřejov solar optical spectrographs and their observations can be found at [1]. The first solar optical spectrograph at Ondřejov is dated 1958 when the MFS was put into operation [2]. It recorded spectra of solar flares and prominences on photographic plates sized 13 x 18 cm in spectral bands from the Hα line through D3, Hβ, Hγ, CaII and K and the higher members of the Balmer series up to the Balmer limit. The device was modernized several times [3] (from electronic tubes to integrated circuits, from photographic plates through 35 mm film to first analogue and then digital CCD video cameras). At its last period, the MFS was able to record solar spectra and slit-jaw images with frequency of 25 composed images per second. For an example of resultant images, see Figure 1.

A small series of five Large Horizontal Spectrograph (HSFA) telescopes designed by the Carl Zeiss Jena company was delivered to Czechoslovakia in the 1980's. The first two of the series (HSFA1, HSFA2) were installed in the new part of the Ondřejov observatory, other two in Slovakia and the last one (HSFA5) at Moscow University station in Kazakhstan [4]. The HSFA2 was recently rebuilt to a multichannel spectrograph [5, 6] equipped with 12 bit CCD cameras. All observed data can be found at the site http://helios.asu.cas.cz/spectra and looked at by a browser or downloaded upon permission. For an example of the images see Figure 2.

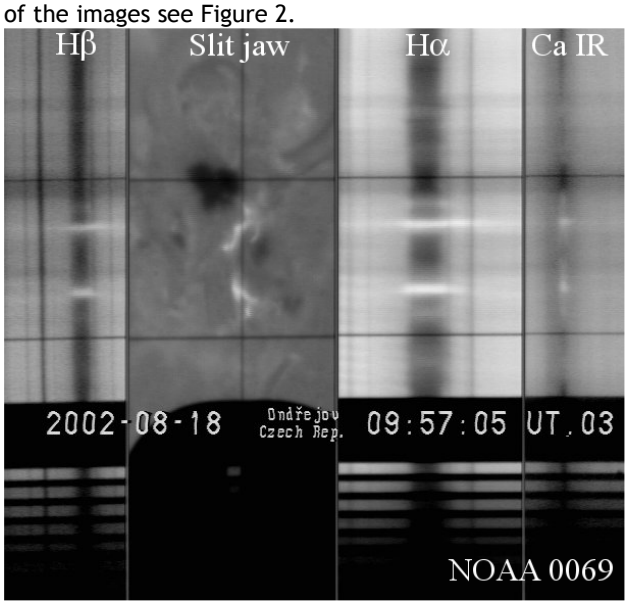

Fig.1. mages from the MFS are composed from signals of 4 CCD videocameras

Catalogue of solar flares: description, brief results and discussion

We compiled a catalogue of solar flare data observed with the Multichannel Flare Spectrograph (MFS) since 05.1998 till 05.2004 year and with the Large Horizontal Spectrograph (HSFA2) since 06.2004 till 08.2007 year. A part of the catalogue can be seen as an example in Table 1.

The catalogue of all solar flares observed with the Ondřejov during 1998-2007 years can be found at webpage:
http://www.asu.cas.cz/~sos/flare_archive.html.

The catalogue contains basic information about times of start, maximum and end of observation of solar flares according to NOAA. Times of start and end of the flare observation at MFS or HSFA2 are in columns 5, 6 of the table. In column 7 is shown the importance of the flare according to GOES classification. We put the NOAA number of active region in the column 8. If this information was absent we used the flare coordinates calculated from our observations.

Availability of related data TRACE, Yohkoh, RESIK, GOES/RHESSI and OSR (Ondřejov solar radio observations) are marked in columns 9-12. We linked these columns of catalogue with website catalogues of corresponding

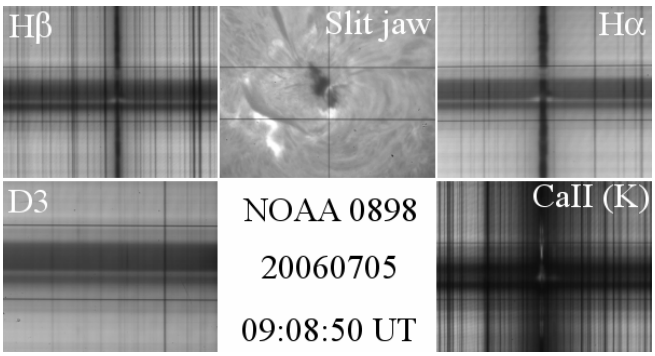

Fig.2. The Hα, Hβ, D3 and Ca II (K) spectral regions and a Hα slit-jaw image of a flaring AR.

Date	Start NOAA	Max NOAA	End NOAA	Start MFS	End MFS	Type	AR	Trace	RESIK	GOES/ RHESSI	OSR	Remark
20020104	0924	0952	1035	0904	1004	C3.7	N38E87					
20020407	0814	0824	0830	0824	0832	C6.0	9893	+	+	+		
20020424	0730	0735	0744	0735	0737	C1.7	9913	+		+	+	
20020430	1106	1118	1135	1118	1133	C3.2	9914		+	+		
20020501	1202		1242	1227	1231	B.0A	9932	+	+	+		
20020507	0846	0852	0855	0830	0856	C2.8	9937		+	+		
20020508	1258	1327	1359	1317	1323	C4.2	9934	+	+	+	+	
20020509	0712	0725	0720	0717	0720	B9.5	9937	+	+	+		
20020514	0539	0603	0609	0531	0549	C2.2	9948	+		+		
20020515	0800	0813	0825	0824	0834	M1.0	9948	+	+	+	+	*
20020516	0451	0521	0601	0516	0608	C5.0	9950		+	+		*
20020516	0624	0627	0655	0627	0643	SF	9950	+	+	+		
20020517	0516	0523	0528	0516	0525	C7.0	9957	+	+	+		[8,9,10]
20020529	1021	1026	1030	1028	1029	C3.4	9973	+	+	+		
20020601	1044	1049	1052	1053	1055	M1.1	9979		+	+	+	
20020623	0819	0824	0827	0820	0827	C1.9	0005	+	+	+	+	
20020626	0624	0631	0636	0628	0640	C1.5	0000	+	+	+		*

instruments. An asterisk (*) in the last column means that data were processed, while [r,q] means references where processed data were already published.

Altogether 179 flares were compiled to the catalogue in 1998 – 2007 years with following numbers and importance: 4 of class X, 45 - class M, 113 – class C and 17 flares of class B. The main part of the flares was observed by Yohkoh, RESIK, RHESSI or OSR. This demonstrates that the catalogue of flare observations is very convenient for study of energy transport processes in solar flares. The catalogue is further under construction and we plan to improve its structure and find new fields of its application. For example, simultaneous observations of our spectrograph and TRACE permit us to investigate the dynamics of erupting phenomena like CME. The spectra allow evaluating of the Doppler velocity and parameters of acceleration of early stages of CME evolution. We plan to add information about erupting events concurred with the flares observed by our instruments in order to attract new users. We hope that new cycle of solar activity allow adding new interesting events into our catalogue.

We plan to prolong this catalogue for current solar cycle using observations of HSFA2. We will include information from the other instruments involved in the solar flare observations like HINODE, KORONAS etc. Any suggestion concerning the catalogue will be appreciated at kupry@asu.cas.cz and pkotrc@asu.cas.czdensity.

Acknowledgements

PK appreciates a support of the grant GACR 205/09/1705 and the Astronomical Institute research project AV0Z10030501.

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