Solar Hα and white light telescope at Hvar Observatory

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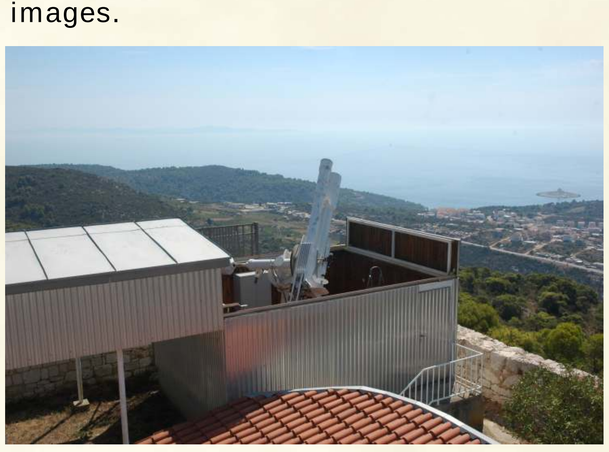
Abstract

Recently, the double solar telescope at Hvar Observatory was equipped with the fourth generation of acquisition hardware and software. It provides a valuable tool to study rapid changes of chromospheric and photospheric features in great detail. The telescope consists of two Carl Zeiss refractors mounted as one unit on a German parallax mounting. Using a field of view of about 7 and 11 arcmin (chromosphere and photosphere), it aims to produce high-resolution high-cadence imaging of active regions on the Sun. New Pulnix TM-4200GE 12-bit CCD cameras allow to obtain time series with a cadence up to 30 images per minute.

Introduction

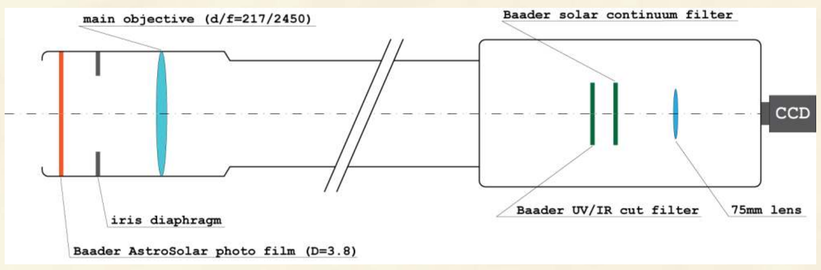
The double solar telescope was installed in 1972 at Hvar Observatory based on an agreement between the Faculty of Geodesy of the University of Zagreb and the Astronomical Institute of the Czechoslovak Academy of Sciences. Since that time, continuous development on the telescope and its acquisition system followed the rapid evolution of the electronics and computers. In 1997 the original photographic material acquisition system was replaced by a video-recording system, and then in 2004 with 1MPix 10-bit CCD camera. In 2010, the fourth generation of acquisition hardware and software was installed and some improvements on the optical telescope design were made. As a result of tight collaboration between the Faculty of Geodesy and the Institute of Physics (IGAM) of the University of Graz, Hvar Observatory implemented identical acquisition system as the Kanzelhöhe Solar Observatory. The aim is to complement Kanzelhöhe full-disc images by Hvar active-region high-resolution images.



Instrumentation

The Photospheric Telescope

The main objective of the Hvar photospheric telescope is an achromatic doublet with a diameter of 217 mm and the focal length of 2450 mm. The optical system consists of Baader AstroSolar photo film, iris diaphragm, Baader solar continuum and UV/IR cut filter, 75mm lens and CCD camera. The adjustable iris diaphragm controls the amount of light in the telescope together with AstroSolar photo film which reduces sunlight intensity to about 0.001%. The Solar Continuum Filter is designed to enhance the visibility of solar granulation and sunspot details by transmitting a specific spectral region around 540 nm, free of emission and absorption lines thus boosting the contrast and reducing the effects of atmospheric turbulence. The field of view of the corresponding system is about 11 arcmin.

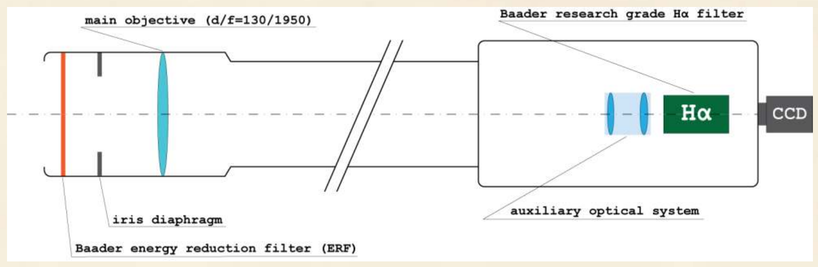


The Acquisition system

Both telescopes are equipped with the 4Mpix Pulnix TM-4200GE 12-bit CCD cameras, connected by a gigabit internet cable to 2 windows PC sited in the control room below the dome. The acquisition software is almost identical to that at Kanzelhöhe Observatory, which allows watching the real-time images, and making the data time-series saved in the FITS and JPEG picture-format with corresponding information headers. The software also regulates the exposure time automatically and performs the frame selection (the camera is recording seven frames per second), which is employed to select moments of good seeing. A standard time series uses the image cadence of four images per minute for the chromosphere and one image per minute for the photosphere. However, a resolution up to 30 images per minute is available for specific purposes.

The Chromospheric Telescope

The optical system of the chromospheric telescope consists of an energy reduction filter, adjustable iris diaphragm, main objective, auxiliary lens, Ha filter and CCD camera. The main objective is achromatic doublet with diameter of 130 mm and focal length of 1950 mm. The energy reduction filter blocks most of the sunlight, thus decreasing the heating and turbulence inside the telescope. The Baader research grade Ha filter with 0.2 Å passband is used and the corresponding field of view is about 7 arcmin.



Data storage

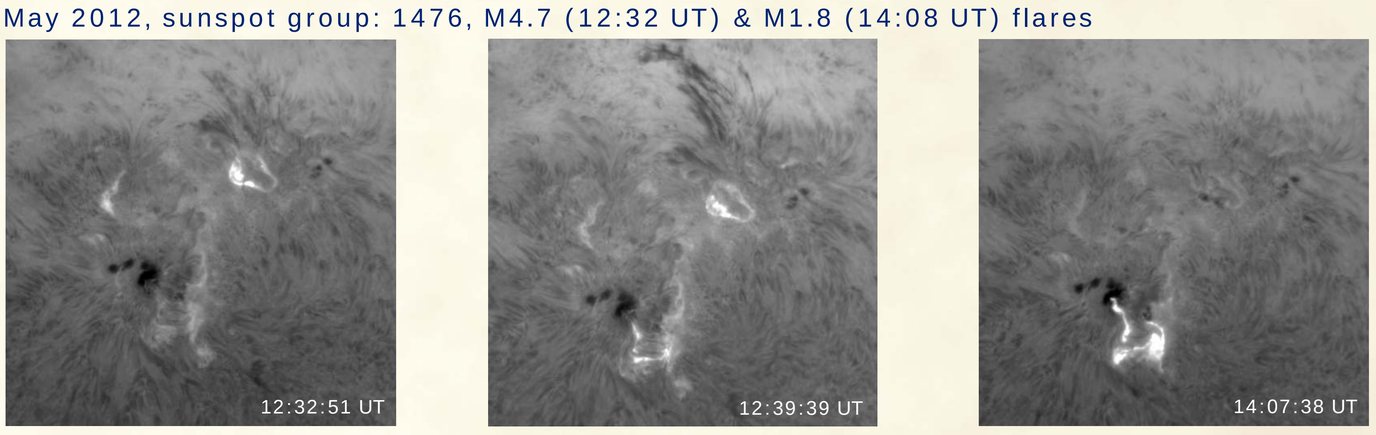
During the operation of the telescope, the data are stored first on local computers in the control room. After each observational session, the data are transferred by internet with FTP protocol to the central data archive on the server located in Zagreb (http://oh.geof.hr). From that server data are open to public. A user-friendly web interface to access the data is currently under the development.

Observations

Ha

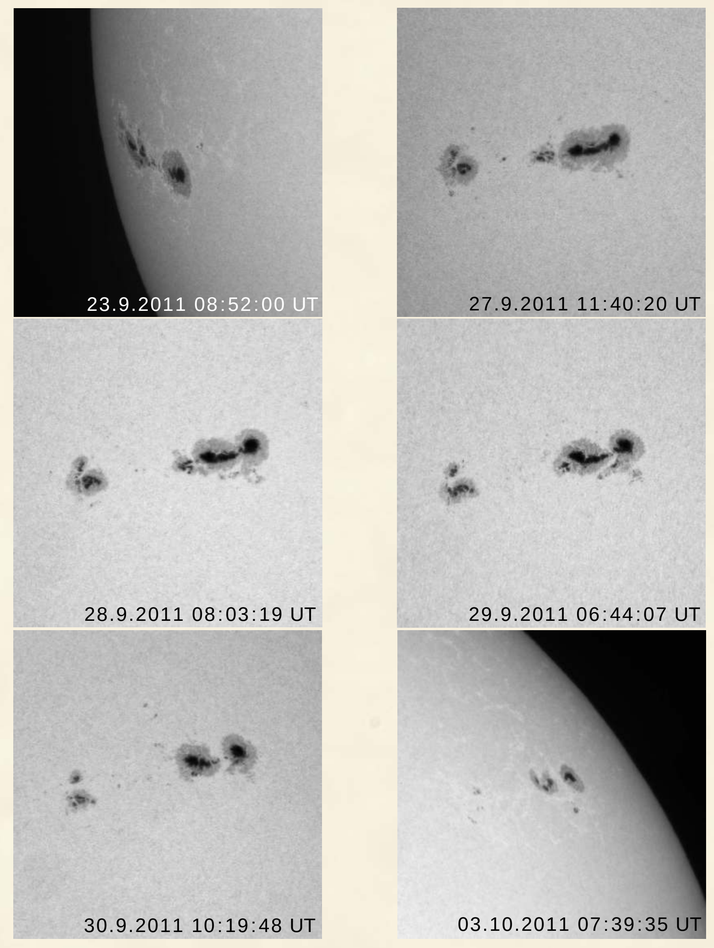
22 September 2011, sunspot group: 1302, X1.4 flare

09 May 2012, sunspot group: 1476, M4.7 (12:32 UT) & M1.8 (14:08 UT) flares



White light

sunspot group: 1302



Acknowledgements
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