Development of New Solar Optical Observation Systems at Mitaka, NAOJ

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Abstract

We briefly describe three optical observation systems of the Sun being developed at Mitaka, NAOJ.

Key words: Sun: full-disk data — Sun: He I 10830Å observations — Sun: sunspot sketch — Sun: tridimensional spectroscopy

1. He I 10830Å Filter Telescope

The He I 10830Å line is very useful for a study of solar coronal activity and we are developing a full-disk observation system with this line. The optical system consist of a 15cm aperture refractor, telecentric optics, a Lithium Niobate etalon of 5cm aperture, and a 2k×2k CCD camera. The etalon, whose bandpass is about 0.5Å in the telecentric beam of F/30, can be tuned around 10830 Å by changing the voltage applied. The performance of the etalon was confirmed to be good enough and images of the solar disk center (Figure 1) and prominences were obtained at Hida Observatory, Kyoto University, using the DST and the vertical spectrograph.

2. New Sunspot Telescope

A new data acquisition and processing system of solar full-disk digital images went into operation@in April 1998. The system is made of a ND filter/diffuser switching unit, a 10 cm refractor, a green filer, and a CCD camera of 2k × 2k pixels. This is aimed at an automated detection and reduction of sunspots and faculae and at replacing the conventional hand drawing observation being continued since 1930's at Mitaka (Imai et al. 1998; Sakurai, Suematsu 1998). We show in Figure 2 an example of full-disk contrast image, which is a subtracted image of limb darkening from an original solar image, and in Figure 3 an automated sunspot/facula sketch. The original and contrast image are posted in daily bases at the URL: http://solarwww.mtk.nao.ac.jp/~monochro. We will also use the system for a surface photometry to continue the study of the solar irradiance variation (Nishikawa 1990).

3. Tridimensional Spectroscopy of Hα line with MLA Spectrograph

A solar tridimensional spectroscopic observation system for the Hα line has just been installed (Suematsu 1999). Tridimensional spectroscopy is a technique to produce a spectrum of each spatial element in an extended, two-dimensional field. The scientific advantages of this technique for studies of localized and transient solar surface phenomena such as flares are obvious, because light from the full extent of the structures is sampled simultaneously. We used the technique of a microlens-array spectrograph, in which pupils made by the microlenses works as multi-slit of a tiny aperture (e.g. Ohtani et al. 1994). The microlens-array spectrograph at Mitaka can give the Hα spectra of 20Å wide sampled at 0.13Å for a 1.4"×1.4" region simultaneously over a 57"×57" field of view (Figure 4 and 5). With this system, we will elucidate the Hα spectra of the flare kernels to know energy transfer mechanism from the corona with the help of hard X-ray data from YOHKOH (e.g. Wülser et al. 1994).

References

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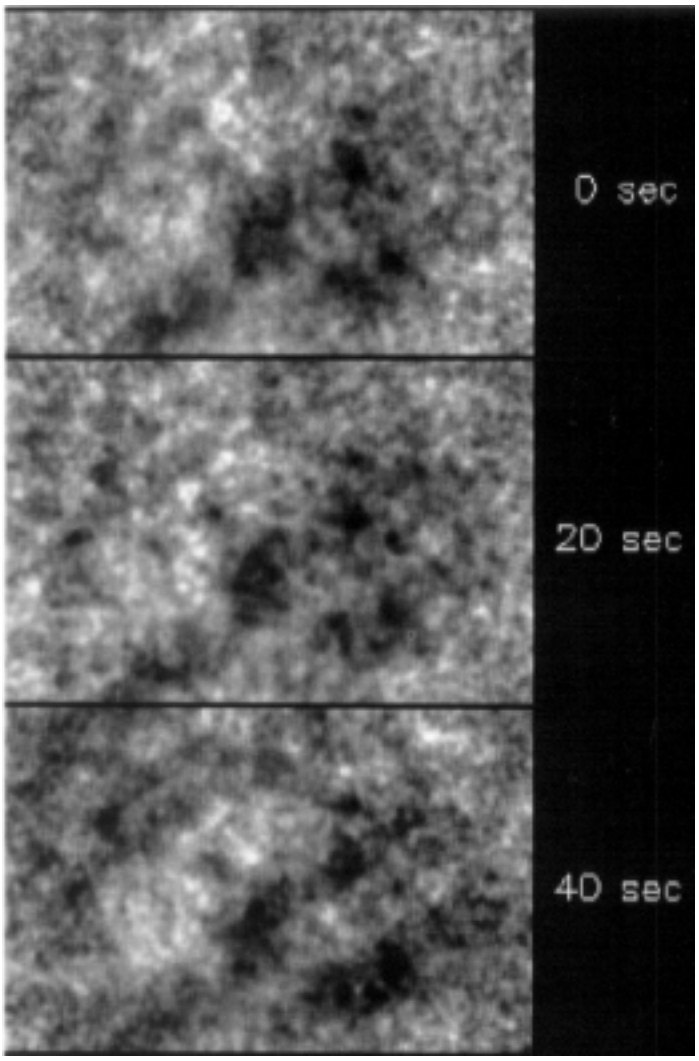

Fig. 1.. Time series of solar disk center images through the Lithium Niobate etalon for He I 10830 Å line. The images were taken with the Domeless Solar Telescope at Hida Observatory, Kyoto University.

Suematsu Y. 1999, in High Resolution Solar Physics: Theory, Observations, and Techniques, 19th NSO/SP Workshop, ASP Conf. Ser., in press
Wülser J.-P. et al. 1994, ApJ 424, 459

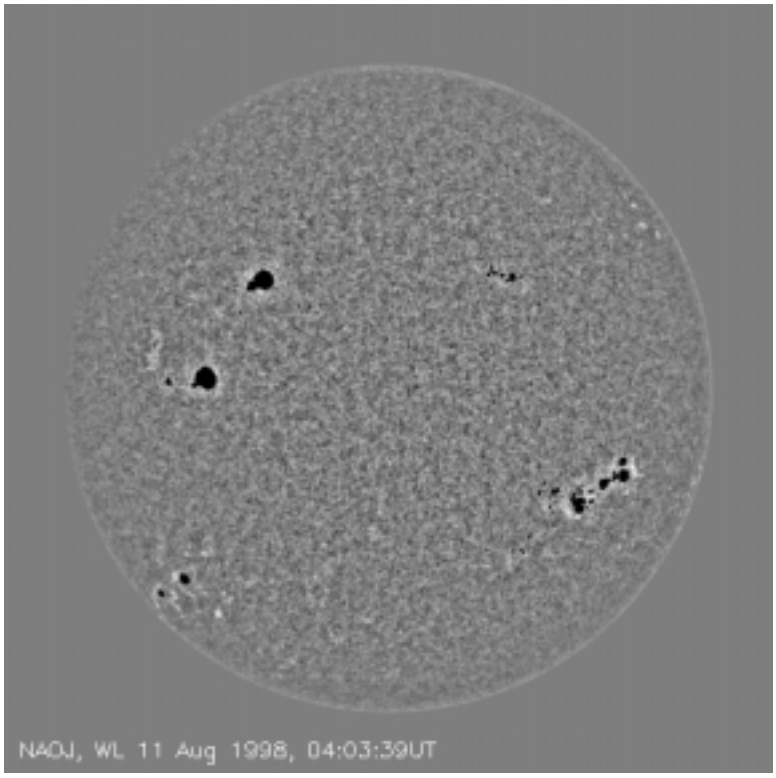

Fig. 2.. A solar image after subtraction of limb darkening.

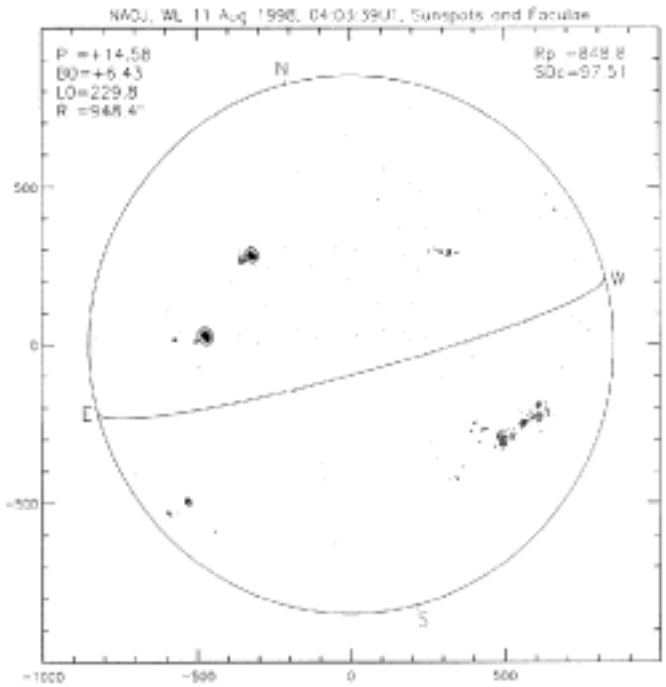

Fig. 3.. Example of automated sunspot/facula sketch.

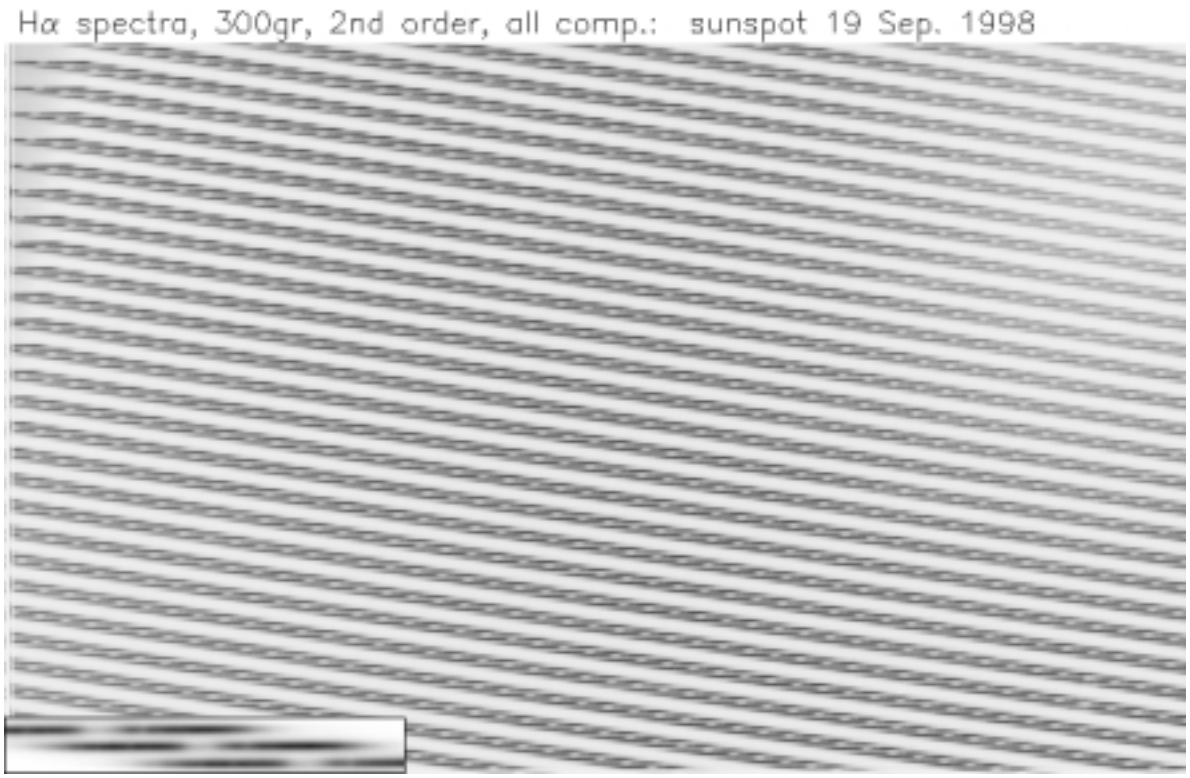

Fig. 4.. 2D Hα spectra (negative image) of the sun with the MLA spectrograph. Dark area on the right corresponds to a sunspot. Enlarged spectra are shown in the lower-left corner; we can see Hα and a few atmospheric absorption lines.

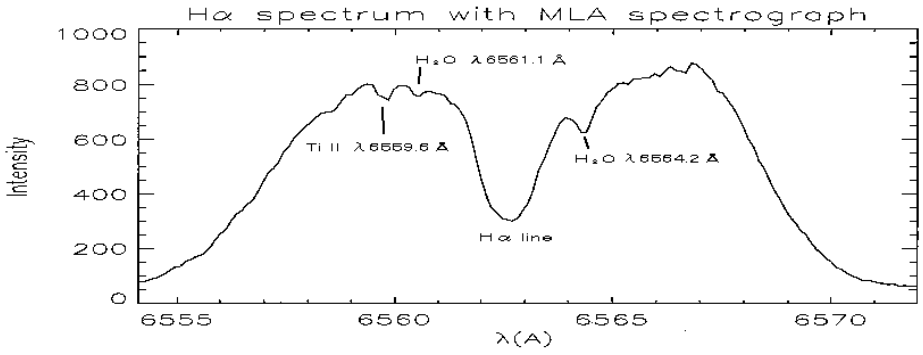

Fig. 5.. Example of Hα spectrum with MLA spectrograph.