Solar Observation Instruments at Yunnan Observatory

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Abstract

Beside the telescopes used for solar rotine observation, two new instruments were installed since 1991. A brief introduction is presented.

I, The telescopes used for solar routine observation at Yunnan Observatory are as followings.

1, White light sunspot drawing and photography with a 5 inch refractor.

2, H_α flare patrol with a 14 cm refractor. $\Delta\lambda$=0.5 A.

3, 26 cm binocular vacuum telescopes with one tube work on H_α band and another on white light.

4, Horizontal telescope and multi-band spectrograph with 40 cm coelostats and 30 cm primary mirror.

5, A group of solar radio telescopes. The working wavelengths of these telescopes are at 7. 5 cm, 10. 7 cm, 15 cm, and 21 cm respectively. Beside a radio acoustic-optical spectrograph is working at 230-300 MHz with a 10 m dish antenna. The time-resolution of the receivers of these telescopes are about 1 ms.

II, Two instruments were installed since the first Japan-China Solar Physics Workshop in Kunming , 1991 , and now are in testing and calibrating.

1, Specta-spectroheliograph and scanning Stokes polarimeter. A telescope consisting of spectra-spectroheliograph (SSHG) and Stokes polarimeter (SP) , which was made in Nanjing Astronomical Instrument Factory, has been installed at Yunnan

Observatory. Fig 1 is the optical system of the telescopes. The part SSHG can be used to scan two lines simultaneously from 3600A to 11000A by rotating the grating, with a spectral resolution 1.2A/mm and a spatial resolution up to 1–2″.

When the polarimeter package enters the light way, the scanning of magneto-sensitive line will yield profiles of all four Stokes parameters orderly by mechanical modulation. The SSHG, SP and observing system are computer cotrolled. The parameters of the optical system is as follows.

(1),Telescope

Objective:—500 mm aperture
—cervit mirror
—focal length 12.5 m

Image size :—solar diameter 116 mm

Entrance slit:—length 14.4 mm

(2),Spectrograph

Grating: —630 lines/mm,size 320x300 mm
—blaze 22° 17′
—focal length 12.5 m
—average dispersion 0.8 mm/A
—solar image : 116 mm, 125 mm

Spatial resolution: —solar image 0.5″
—spectrum 1–2″

Scanning time for an AR: 20 S

(3),Polarimeter package

Content: —Three quarter wave plates (2,3,4 see Fig 2) and an empty window 1 and a Richion prism 5.

Mechanical modulation :

(i) 1,4(0°),5(± 45°) ⟶ 1/2 (I± V)
(ii) 2(0°),4(0°),5(± 45°) ⟶ 1/2 (I± U)
(iii) 3(45°),4(0°),5(± 45°) ⟶ 1/2(I± Q)

(4),Electronic system

Computer system —AST/386

CCD array —size 6 mm x 6 mm

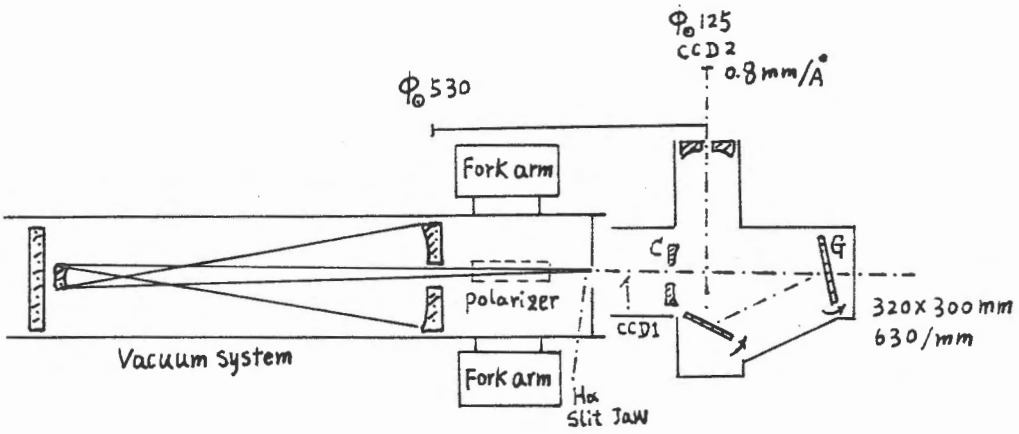

Fig 1, The optical system of the SSHG telescope

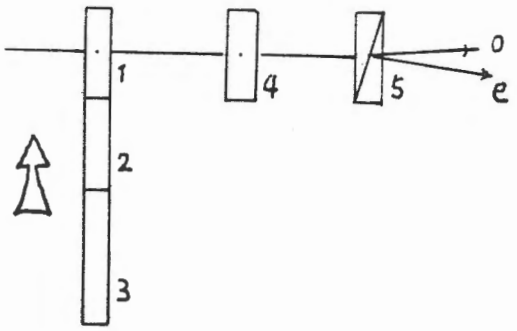

Fig 2, The polarimeter package

—pixel 512 x 512

—sensitivity 0.2 lux

2, Photometric solar seismograph

According to a cooperative agreement between the University of Arizona and Yunnan Observatory,a photometric solar seismograph was installed at Yunnan Observatory in 1991, and was put into testing operation in last year. The instrument was developed by SCLERA, the Santa Catalina Laboratory for Experimental Relativity by Astrometry, lead by prof H.A.Hill.

The seismograph is used to observe solar oscillations by determining changes in the intensity of the continuum on the solar disk with a spatial resolution of about 50 arcsec.

The optical system of the instrument consist of a coelostat, a primary mirror and a detector system, as shown in Fig 3. Sunlight passes through a window to the 20 cm diameter coelostat mirror and then to the primary with an aperture of 7.0 cm and a focal length of 200 cm. After the sunlight passes through the primary focus, two solar image are formed in the optical system. One of them has a diameter of 19 mm for measurement at the disk center and the other has 28 mm for measurement at the solar limb.

The solar images are scanned across three diode of Ge 1 x 16 pixel at 0.55 μm and across a second set of Ge array at 1. 6 μm. In front of each linear array is a mask which is designed to yield to a spatial resolution approximately 3° / pixel for two orthogonal directions in the heliocentric coordinates. Scanning is utilized to give a coverage of $\pm 90°$ in the longitude and $\pm 60°$ in the latitude.

The operating system and data acquisition system of the telescope are controlled with a Masscomp 5500 on-line computer. The signals received by the detectors are sampled every 50 msec with a 12-bit A/D system and the A/D signals for a given location on the solar disk are filtered by a

digital triangle filter with a width of 16 sec. This output of the tringle filter is sampled every 4 sec and recorded. This data-acquisition system can produce 31 mbytes of data in 10 hours, and the data is recorded on 1/4-inch cartrige type. The data are exchanged between Yunnan Observatory and SCLERA.

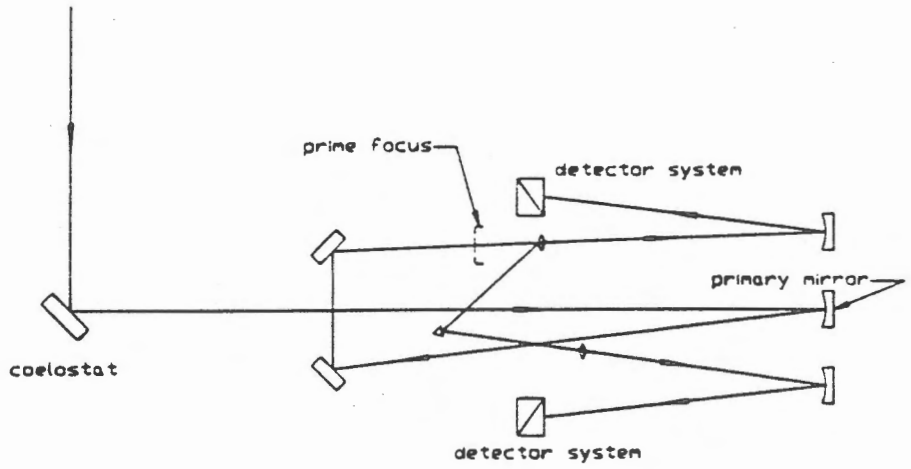

Fig 3, The optical system of the photometric solar seismograph