Slicers for the BTA Main Stellar Spectrograph

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Abstract. Three kinds of slicers have been developed and tested: a multifiber slicer (7 fibers), Bowen-Walraven double image slicer and a lamellar slicer.

The image size of a star is generally several times larger than the slit width of a high-resolution spectrograph. This causes losses of light.

Image slicers increase the efficiency of spectral observations with resolution being preserved. The star light, which fails to fall within the spectrograph slit, is cut by the slicer into stripes which are transferred then by optical elements above or below the central part of the star image.

We have tested three kinds of slicers intended to increase the efficiency of magnetic field measurements. The Main Stellar Spectrograph (camera 2), whose slit is normally set to be 0.5 arcsec (0.45 mm), was used in the observations.

1. A fibre bundle slicer

Seven fibres of 30 m in length, each having a diameter of 110 μm, form a rosette at one end and are arranged in a row at the other. The former is placed at the BTA prime focus to receive light from a star through the matching optics. The latter is fastened on the balcony of the Nasmyth-2 focus, and the light emerging from its fibres is fed via the matching optical element into the spectrograph through the slit. The block diagram of this type slicer is shown in Fig. la. In Fig. lb a fragment of the spectrum is represented in the form of seven dark stripes. The cross-section of the star spectrum is given in Fig. lc. The radiation being well chaotic, the gain in efficiency with this scheme is not large (as shown in Fig. la, only four fibres left and right of the three vertical fibres add to efficiency, but the area of the space between the fibres accounts for no less than 15 % of the total). The manufacture and installation of such bundles appeared to be involved.

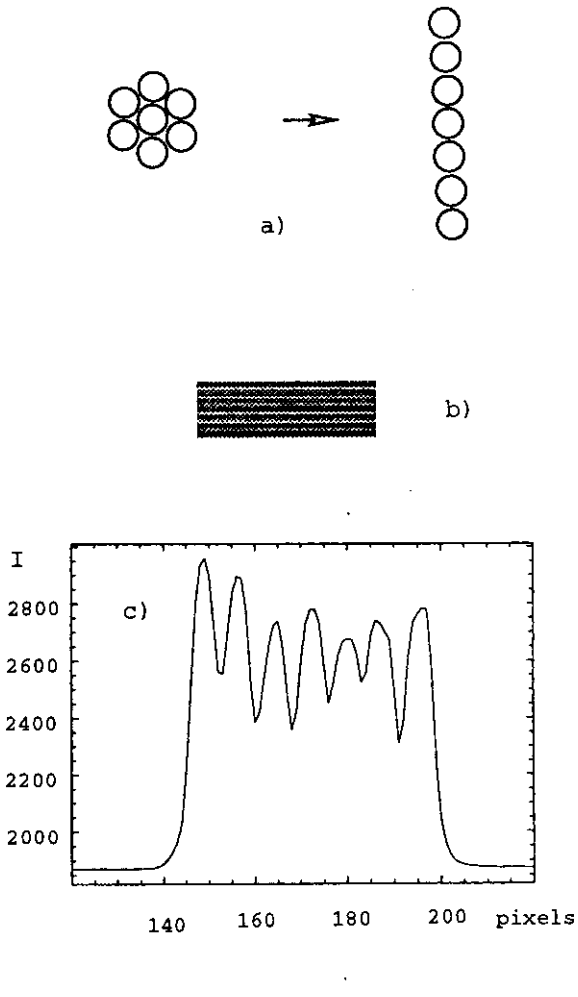

Figure 1: *a) The block diagram of the fibre slicer. b) The fragment of the star spectrum. c) The cross-section of the fragment.*

2. Double Bowen-Walraven type slicer

The slicer (Fig. 2) is used for stellar magnetic field measurement. The star light coming from the BTA prime focus, after having been divided by a liquid-crystal polarization prism, is directed to the

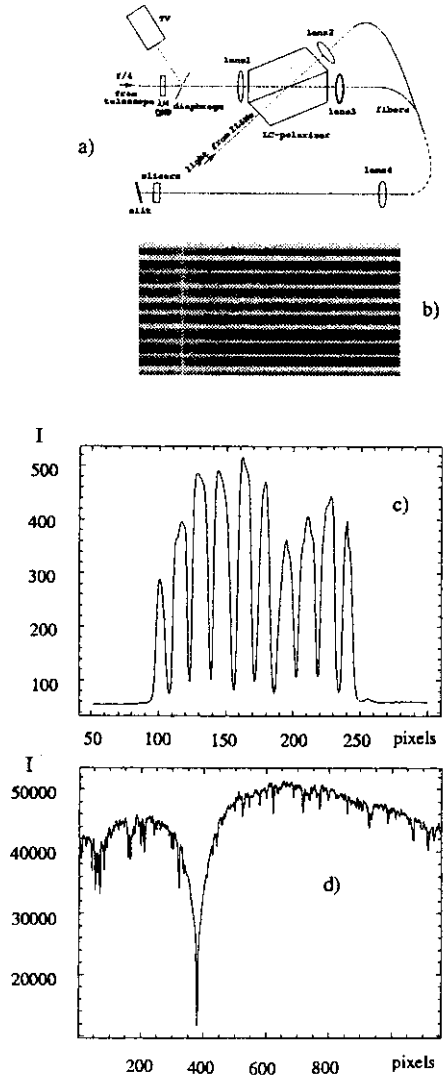

Figure 2: *a) The block diagram of the double Bowen-Walraven type slicer. b) The spectrum of the star γ Equ. c) The vertical section of the spectrum. d) The horizontal section of the spectrum.*

balcony of the Nasmyth-2 focus through two fibres 30 m in length and 305 μm in diameter. There the light, emerging from the fibre ends, enters the spectrograph slit. A double Bowen-Walraven type slicer installed ahead of the slit cuts each of the images of the fibre end faces into five stripes and arranges them along the slit.

In Fig. 2b is demonstrated the spectrum of the star γ Equ in the H_α region as 10 dark stripes: the upper five stripes correspond to the left circular polarization, the lower five to the right circular polarization. Fig. 2c,d shows the vertical and horizontal sec-

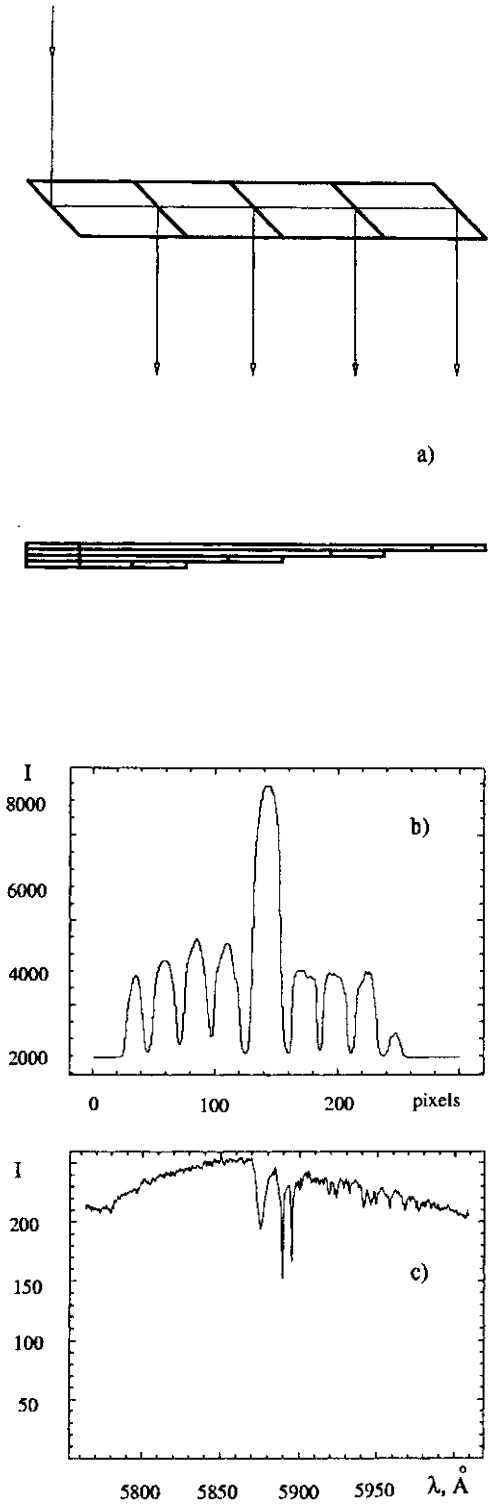

Figure 3: *a) The block diagram of the laminated slicer. b) The section of the star spectrum across the dispersion. c) The composed spectrum of CV Cep.*

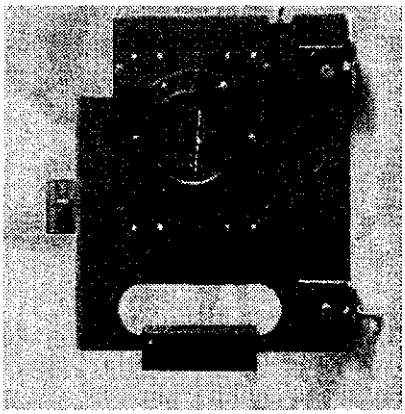

Figure 4: *The photograph of the laminated slicer.*

tions, respectively. The disadvantage of the Bowen-Walraven type slicer is the defocusing of the image while the light is being transferred from the inlet face of the slicer to the slit, which is about 0.1 second of arc for our slicer.

3. A laminated slicer

The slicer is a set of glass plates 0.45 mm thick, representing parallelepipeds of different length (Fig. 3a). The plates are stacked up into two blocks spaced by 0.45 mm, so that the light of the central part of the star image enters the spectrograph unimpeded. The distinguishing feature of this slicer is that the spectra of the side elements turn out to be displaced with respect to the central spectrum along the dispersion by the value corresponding to the multiple thickness of the plate. In Fig. 3b is shown the section of the star spectrum across the dispersion. Fig. 3c represents the net spectrum composed from 9 spectra of CV Cep reduced preliminary to the central one. In Fig. 4 the photograph of the laminated slicer is shown.

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