SLITLESS DIGITAL TV SPECTROPHOTOMETER OF THE CRIMEAN ASTROPHYSICAL OBSERVATORY

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ABSTRACT. The original slitless spectrograph are created in the Crimean Astrophysical Observatory for 0.5-m meniscus telescope. It has three replaceable transparent diffraction gratings with the distance control. The highsensitive TV tube intensified isocon is used as detector. The digital videodata are collected in the memory of the computer PC AT 286. The spectrophotometric observations may be done in wave range of 3700-7400Å with spectral resolution 80Å, 60Å, 30Å. Exposure time for stars $10-12^m$ is 2-5 minutes. The relative photometric accuracy of one such record is about 3-5 %. Absolute photometric accuracy is comparable with it because the artificial photometric standard used for absolute calibration of records.

Key words: spectrophotometry, spectrograph.

Introduction

The spectrophotometrical observations of different astronomical objects are significantly more important then the photometric investigation. Spectrophotometry of faint sources get real when highsensitive detector is employed. On the base of digital TV complex of 0.5-m meniscus telescope of the Crimean Astrophysical Observatory (Abramenko et al. 1982, 1988) the modern afocal slitless spectrophotometer was developed.

The goal of this development was creation apparatus on small telescope for routine observation of different peculiar objects that need many hours monitoring. The cheap telescope and apparatus allow such investigations.

Spectrograph

Slitless afocal spectrograph contains plan-concave negative and plan-convex positive lenses, diffraction grating put between them and prism having small refracting angle. The prism permits to eliminate aberration from inclined beams. Spectrograph is displaced in the convergence beam before the focal plane of the telescope. Collimator lens and prism are made from the single whole block of the glass. Transparent diffraction grating is placed over the flat surface of the positive lens (Pronik, Sharipova 1993). Three grating are employed having 50, 100 and 150 grooves per mm. Their replacement has distantional control.

TV and record devices

The detector of light is an Isocon image tube with one-stage intensifier. Its temperature is held within the range $0-5°$ C during observation by cold dry air. The stellar spectrum is projected on the photocathode perpendicular to the TV line direction. TV analog videosignal is sent to special interface where it is digitized. The digital information of many (50 - 100) TV scans is integrated in the memory of the computer (PC AT 286).

The spectral resolution depend not only from apparatus but from atmospheric seeing also. Under condition of good seeing we have spectral resolution of 80Å, 60Å or 30Å using different gratings.

Observation method

The spectrophotometrical standards having well known distribution of energy may be observed for the absolute calibration of the ordinary spectrophotometrical observations. The differential method is applied. Using the artificial standard calibrated by special observations we can estimate absolute spectral distribution of investigated objects when atmospheric extinction is known.

Reduction method

Reduction of spectrophotometrical data consist of two stage. At the first stage all spectral data are calculated in the common scale of artificial standard. At the second stage the absolute distributions of energy of the investigated objects are calculated. The value of extinction for observational nights may be estimated using data of standard stars. Synthetic stellar magnitudes in passband V and colour indices $B-V$ may be calculated also.

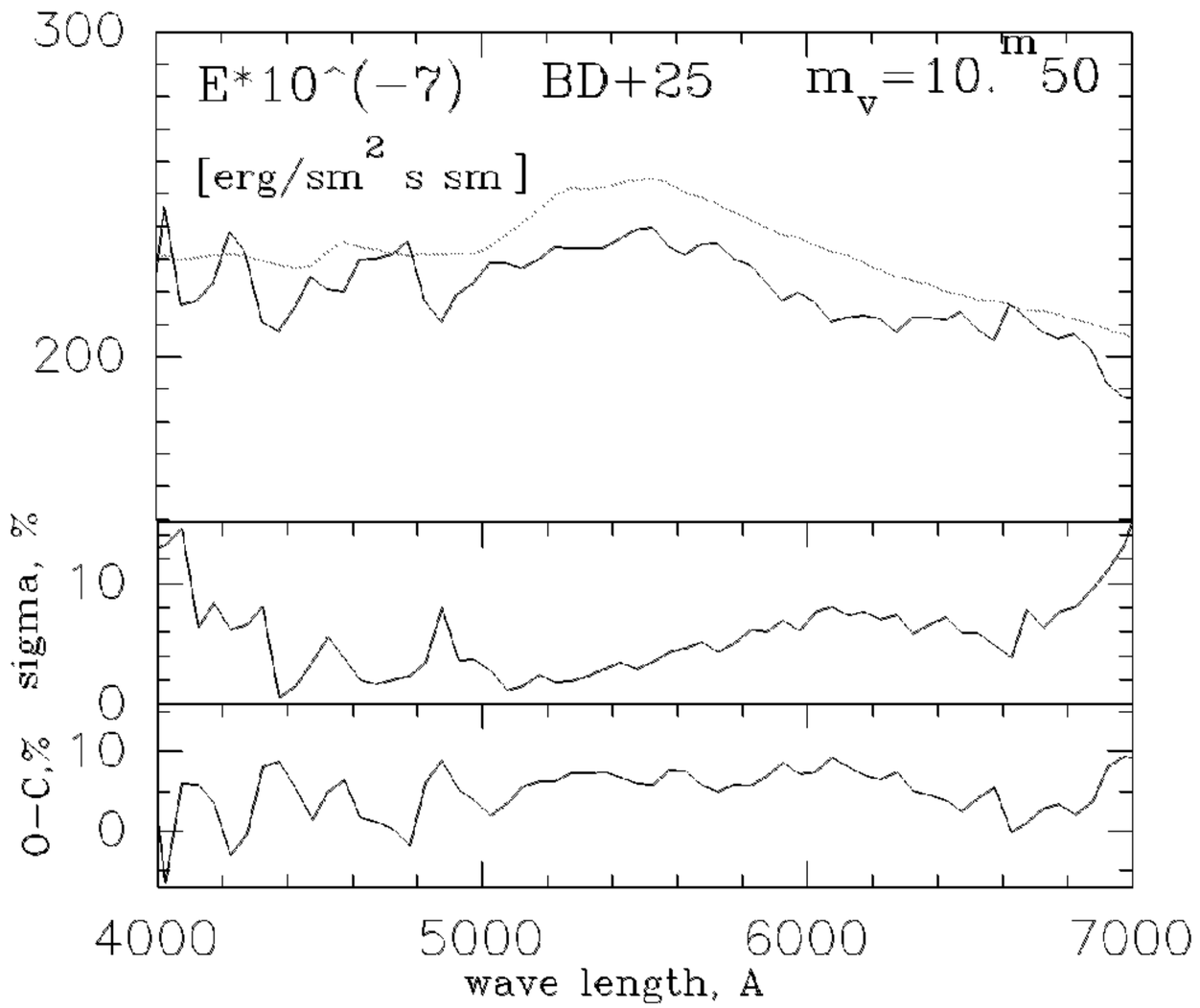

Figure 1:

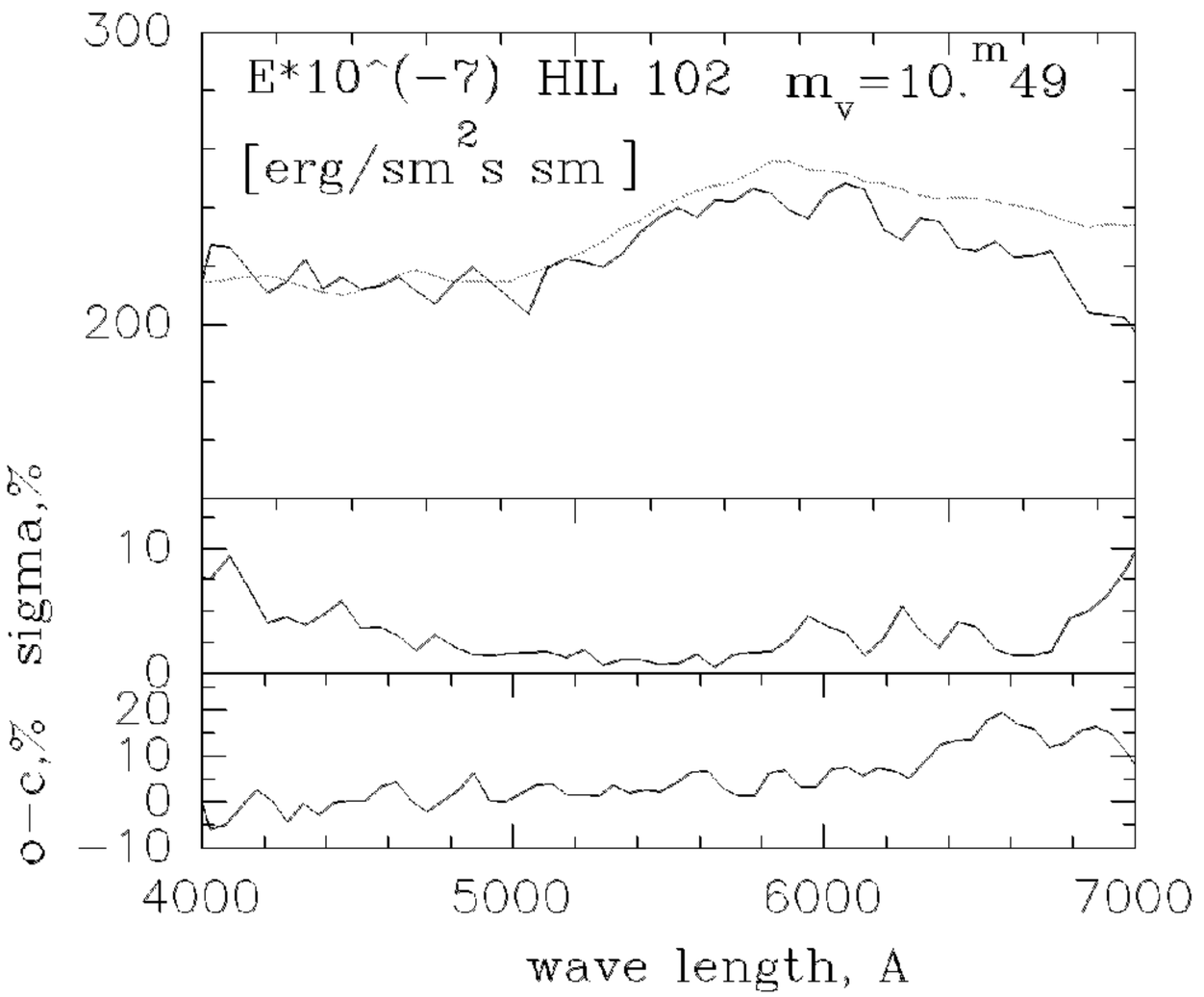

Figure 2:

Precision of the TV spectrophometrical observations

The examples of our spectrophotometric data in comparing with catalog data are given on the Fig. 1, 2. Absolute distributions of energy in the spectra of the stars with brightness about $10^m.5$ BD+25 and HIL 102 are shown on the Fig. 1a, 2a by solid lines for our observations and by dashed lines for the the Kitt-Pick observatory data (Barnes, Hayes 1984). Spectral dependencies of the internal and external accuracy are presented on the Fig. 1b, 1c, 2b, 2c accordingly. The absolute energy distributions with our apparatus were obtained for twelve stars near the North Pole. The standard deviations of distribution data energy were estimated as 2-3 % for stars of $9 - 10^m$. and 3-4 % for stars of $11 - 12^m$.

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