Spectrophotometric support of spectral observations with the telescope BTA

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Abstract. We report on the development of the medium–resolution spectrophotometer to accompany (in real time) spectral observations performed with the high resolution spectrographs on the 6-m telescope BTA.

1. Description of the spectrophotometer

We report on the development of the medium–resolution spectrophotometer to accompany (in real time) spectral observations performed with the high resolution spectrographs (Panchuk et al 2009a, 2014) on the 6–meter telescope BTA of the Special Astrophysical Observatory. The spectrophotometer uses a 0.7–meter optics of the BTA guide telescope and have a separate system for object positioning. The spectrophotometer is managed via the Internet.

In high resolution (R) spectral observations on the BTA the size of the spectral region simultaneously recorded depends mainly on the format of CCD used. For example, the spectral region simultaneously recorded with the Nasmyth echelle spectrograph (NES) is equal approximately to 1000, 1500, 3000 Å at the CCD format 1K×1K, 2K×2K, 2K×4K. Spectral lines measured in these regions are used for modeling of stellar atmospheres by comparing of theoretical and observational parameters of lines. Adequacy of the model could be checked through comparison both theoretical and observational spectral energy distribution. But for such a procedure a photospheric continuum must be registered in broader spectral region, i.e. we need low resolution spectrophotometric observations. For example, spectrophotometric data for stars in Pleiades were obtained within 3200÷7900 Å region with R = 130 (Kharitonov & Klochkova 1972). Auxilliary spectrophotometric observations of nonstationary stars must be performed in the equal time with the high and low resolution spectroscopy. Howerever such a regime it is difficult to organize in practice.
BTA was equipped with the auxiliary reflector having focus 12 m and diameter of the mirror 0.7 m (Fig. 1), which has worked before middle 80-th as a guide system (Malarev 1977). We analysed the suitability of this reflector for spectrophotometric observations making simultaneous with high resolution spectroscopy with a main mirror of the BTA.

![Figure 1. Optics of the guiding telescope of BTA: 1 – main mirror $D_1 = 0.7$ m, 2 – secondary mirror $D_2 = 0.21$ m, 3 – lenses corrector, F – focal surface.](image)

The spectrophotometer has to provide the following properties. First, registration time at the 0.7–m telescope can not exceed time registration of high resolution spectrum at the BTA. This condition limits a value of spectral resolution of the spectrophotometer. Second, the optics of the 0.7–m telescope has to be achromatic. Therefore we removed the two-lenses corrector, after that the effective focal distance of the new layout is equal to 7.8 m. Third, the spectrophotometer has to have an autonomous system to positioning of the star at the input, which has to being independent of the actions of the observer at the BTA. The layout developed is shown in Fig. 2.

The dekker’s size was selected aiming to catch a star image distorted by atmospheric dispersion. The diameter of the collimated beam is equal to 32 mm. As a cross–disperser the Abbe prism is used which allows to place main elements of the spectrophotometer in the plane parallel to back plane of reflector mirror. We used the echelle grating R2 with grooves density 75 gr/mm and the objective $f = 120$ mm.

As a local corrector a plane parallel detail ruled by bending in two perpendicular axes is used (Panchuk et al 2009b). When a star image wholly get into the dekker, the spectrophotometer works as slitless and spectral resolution is determined mainly by accuracy of the star retention on the dekker. Therefore we use a second layout of guiding – inside the spectrophotometer (Panchuk & Yushkin 2006). Optical elements of this second layout of guiding are not shown in Fig. 2.

Results of experiences of the spectrophotometer and guiding systems will be published separately.

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Figure 2. Optical layout of 0.7–meter reflector in combination with the spectrophotometer. 1 – 0.7–m mirror, 2 – dekker at the focus of the reflector, 3 – optics for guiding of the dekker, 4 – TV–camera, 5 – optics of the collimator, 6 – the cross–disperser prism, 7 – echelle, 8 – lenses camera, 9 – CCD chip. The secondary mirror is not shown.

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