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Spectrophotometric Support of Spectral Observations with the BTA Telescope

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

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

In high-resolution spectral observations at the BTA, the size of the simultaneously recorded spectral region depends mainly on the format of the CCD used. For example, the spectral region simultaneously recorded with the Nasmyth echelle spectrograph (NES) is approximately equal to 1000, 1500, 3000 Å for the CCD format of 1K × 1K, 2K × 2K, 2K × 4K respectively. The spectral lines measured in these regions are used for modeling the stellar atmospheres by comparing the theoretical and observed line parameters. Adequacy of the model could be checked comparing both theoretical and observational spectral energy distributions. But for such a procedure, the photospheric continuum must be registered in a broader spectral region, i.e., we need low-resolution spectrophotometric observations. For example, spectrophotometric data for the stars in the Pleiades was obtained within the 3200 ÷ 7900 Å region with $R = 130$ (Kharitonov & Klochkova 1972). Auxiliary spectrophotometric observations of non-stationary stars must be performed at the same time for the high and low resolution spectroscopy. However, it is difficult to organize such a mode in practice.

The BTA is equipped with an auxiliary reflector having the focus of 12 m and the mirror diameter of 0.7 m (Fig. 1), which had been working before the middle 80s as a guide system (Malarev 1977). We have analyzed the suitability of this reflector for the simultaneous spectrophotometric observations and the high resolution spectroscopy with the main mirror of the BTA.

The spectrophotometer should meet the following requirements. Firstly, the exposure time at the 0.7-m telescope cannot exceed the exposure time for a high resolution spectrum at the BTA. This condition limits the spectral resolution of the spectrophotometer. Secondly, the optics of the 0.7-m telescope should be achromatic. Therefore, we removed the two-lens corrector, after what the effective focal distance of the new

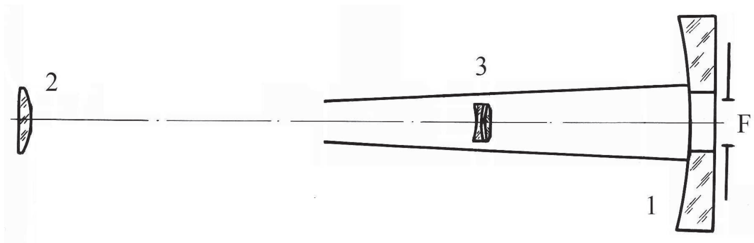

Figure 1. The optics of the guiding telescope of the BTA: (1) main mirror, D_1 = 0.7 m; (2) secondary mirror, D_2 = 0.21 m; (3) corrector lens; (F) focal surface.

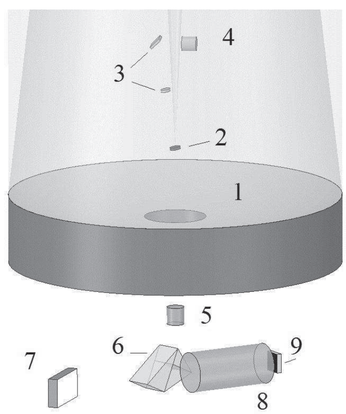

Figure 2. Optical layout of the 0.7-meter reflector in combination with the spectrophotometer: (1) 0.7-m mirror, (2) decker at the focus of the reflector, (3) optics for guiding the decker, (4) TV-camera, (5) optics of the collimator, (6) cross-disperser prism, (7) echelle, (8) lens camera, (9) CCD chip.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

layout is equal to 7.8 m. Third, the spectrophotometer should have an autonomous system of star positioning at the entrance, which should be independent of the observer's actions at the BTA. The layout developed is shown in Fig. 2.

The decker size was selected to catch a stellar image distorted by the atmospheric dispersion. The diameter of the collimated beam is equal to 32 mm. The Abbe prism is used as a cross disperser that allows to place the main elements of the spectrophotometer in the plane parallel to the back plane of the reflector. We used the echelle grating R2 with the groove density of 75 gr/mm and the lens f = 120 mm.

A plane parallel glass, operated by tilting in two perpendicular directions is used as a local corrector (Panchuk et al. 2009b). When a stellar image wholly gets into the decker, the spectrophotometer works as a slitless one, and spectral resolution is then mainly determined by the accuracy of star retention on the decker. Therefore, we use the second layout of guiding—inside the spectrophotometer (Panchuk & Yushkin 2006). The optical elements of this second layout are not shown in Fig. 2.

The results of testing of the spectrophotometer and guiding systems will be published separately.

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