High-Resolution Spectrograph for Moderate-Diameter Telescopes

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Abstract.   A basic model of a high-resolution fiber-fed spectrograph has been developed. In combination with the SAO RAS 1-meter telescope, the spectrograph has the following parameters: spectral resolution $R = 45\,000$, the number of simultaneously registered orders is 86 within the spectral region of 3850–10 850 Å, the echelle orders are overlapping for $\lambda < 9000$ Å.

A basic model of a high-resolution fiber-fed spectrograph for moderate-diameter telescopes has been developed. Its stationary part (Fig. 1) is performed under the white pupil layout, which was proposed by Baranne (1972).

The moving part consists of a polarimetric unit (Fig. 2), a guiding system, and three fibers.

There are two schemes of the observations: spectropolarimetric and Doppler, each one uses two optical fibers only. In the spectropolarimetric mode, two spectra with different circular polarizations are registered simultaneously; and in the Doppler mode—the stellar and Th-Ar lamp spectra.

The comparison spectrum contains bright lines (see Fig. 3); therefore, the simultaneous registration of stellar and lamp spectra will distort both of them. A special device for removing the distortions caused by bright lines and for regulating the flux from the Th-Ar lamp was developed. This device provides parallel and simultaneous registration of stellar and Th-Ar lamp spectra with exposures of reasonable duration.

The control system of the spectrograph is based on the National Instruments technology and consists of the controller NI CompactRIO 9073, which includes five modules. The program code is written within the LabView graphical programming environment.
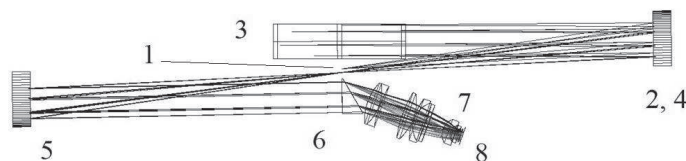

Figure 1.   The stationary part of the spectrograph. Legend: (1) fiber input, (2) collimator, (3) echelle, (4) the first collector which generates an intermediate spectrum, (5) the second collector, (6) cross-disperser grism, (7) lens camera, (8) CCD.
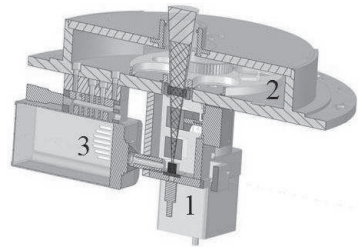
Figure 2.   The layout of the moving part of the spectrograph. Legend: (1) fiber inputs, (2) polarimetric turret, (3) TV-camera of the autoguiding system.

Figure 3.   A spectrum of the Th-Ar lamp registered with the ARGES spectrograph (Wang et al. 2003).

In combination with the SAO 1-m telescope, the spectrograph provides the following parameters: spectral resolution $R = 45\,000$, the number of simultaneously registered orders is 86 within the spectral region $3850 \div 10850$ Å (moreover, each echelle order is registered twice). On the CCD 2048×2048 pixels, echelle orders are overlapping for $\lambda < 9000$ Å.

The spectrograph is designed for the observations of the objects whose regular monitoring at the BTA is not possible. A spectrum image of a heavily reddened star ($V = 11\overset{m}{.}7$, $B = 14\overset{m}{.}0$) obtained when testing a budget version of the spectrograph (Panchuk et al. 2011) is presented in Fig. 4.
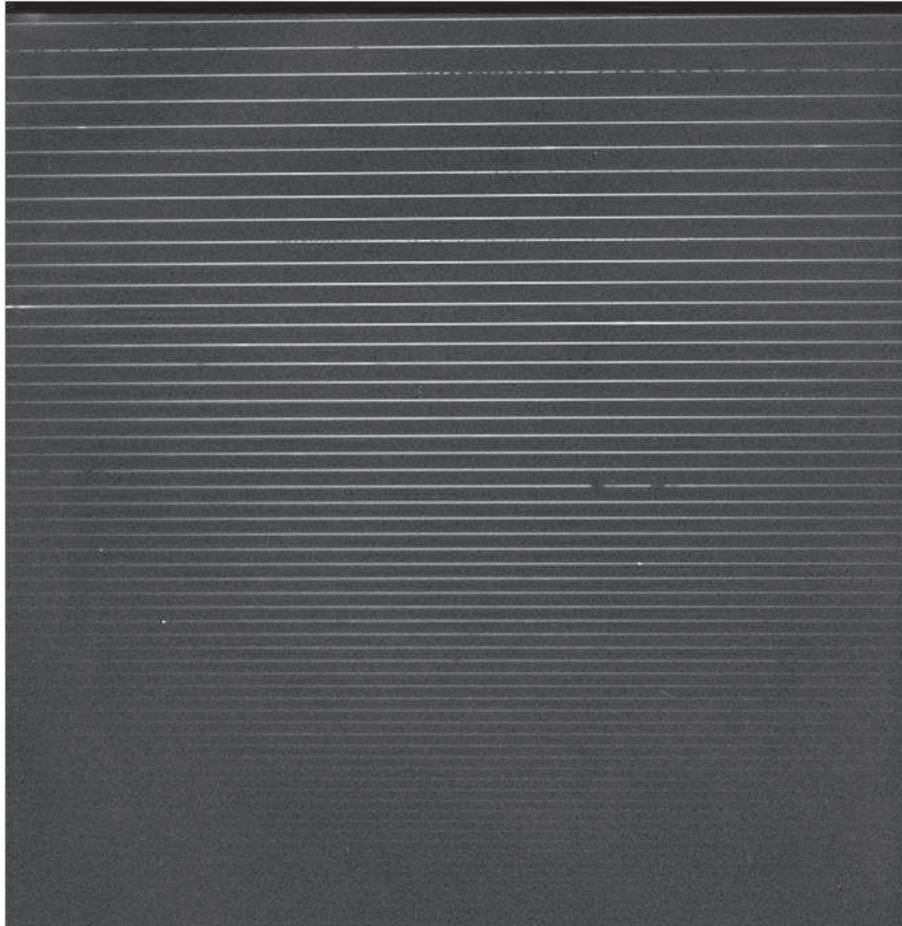
Figure 4.   A spectrum of V1302 Aql ($V = 11\overset{m}{.}7$, $B = 14\overset{m}{.}0$) registered with the spectrograph at the SAO 1-meter telescope. Long-wavelength orders are on top.

References

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