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The iodine absorption cell for the BTA Nasmyth–2 focus spectrometers

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The accuracy of classical radial velocity measurement procedures is restricted by three instrumental effects: a) different filling of the spectrograph collimator with the light of a star and that of a comparison spectrum source, b) different illumination of the slit by the disk of the star and by the projection of the comparison spectrum channel diaphragm, c) different positions of the centres of gravity of monochromatic images of the star on the slit (due to atmospheric dispersion). These difficulties can partly be overcome by fiber–optics connection of the telescope and the spectrograph. This, however, will essentially reduce the throughput and makes it impossible to do some kinds of work, e.g. spectropolarimetry as a whole and observations with Zeeman analyzer in particular. The optimum fiber–optics connection of the telescope and the spectrometer implies the creation of a specialized fiber–optics spectrometer, which in the case of BTA is an isolated problem. That is why for definition of the problems at BTA, which call for a radial velocity measurement accuracy of tens of m/s, we have turned to application of an absorption cell. A specimen of the sell filled with vapour of I_2 has been made and tested on the echelle spectrometer LYNX placed at the BTA Nasmyth–2 focus. A fragment of one of the echelle orders of the iodine vapour spectrum is displayed in Fig. 1. The technique of determination of radial velocity of a star is as follows: a) the continuous echelle spectrum is recorded through the iodine cell; b) the echelle spectrum of the star under investigation is recorded with the iodine cell removed; c) the echelle spectrum of the star is recorded through the iodine cell; d) all echelle images are reduced in a conventional manner (extraction of orders); e) a synthetic vector "the star through iodine with a shift" is formed from the vector "iodine" and the vector "star" with introduction of the relative shift of the vectors, which, using the cross–correlation technique, is compared with the similar vector "the star through iodine" obtained from observations; f) procedure (e) is repeated once again but with a different shift etc.; g) from the correlation function thus obtained the shift of the iodine spectrum with respect to the stellar one is estimated; h) ordinary reductions of the measurement results to the centre of the Sun are performed.

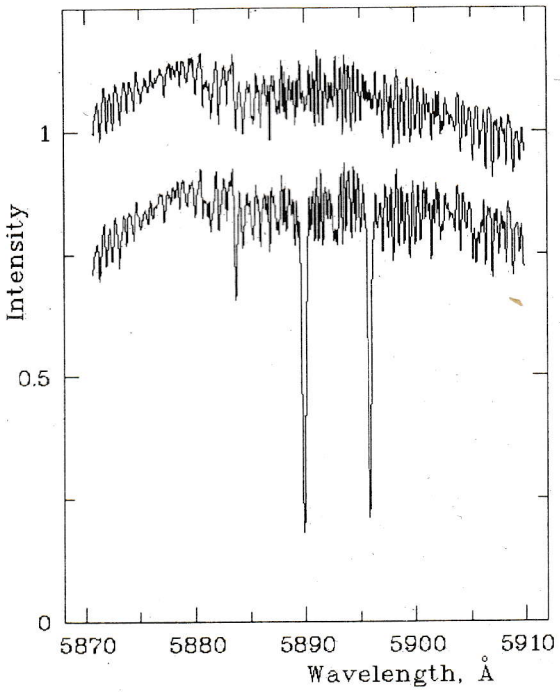

Figure 1: *The continuous echelle spectrum exposed through the iodine cell (top) and the same for the star under investigation (bottom) (fragment of one of the echelle orders).*

Work is now under way over both the algorithmic aspect of the procedure and the improvement of technology of such observations. It should be emphasized that the preslit part installed in the N2 focus, which includes (apart from the TV guides and ordinary calibration means) Zeeman analyzer unit, Fabry Perot unit and iodine cell unit, is common for the Main Stellar Spectrograph, the echelle spectrograph LYNX and an echelle spectrograph with a large collimated beam diameter being developed. That is why the use of the absorption cell bears a direct relation to all the above system.

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