Aurélie for detecting double-line eclipsing binaries

The high S/N ratio which can be obtained with the *Aurélie* spectrometer allows the study of extremely faint spectral features. We have used this instrument to observe a group of eclipsing binaries that were considered single-spectrum systems up to now, because of the very low relative luminosity of the secondary component.

A successful detection of the secondary spectrum allows a determination of the complete set of absolute parameters for these stars, and in particular their masses from the two radial-velocity curves. The total number of double-spectrum eclipsing binaries studied in the literature is only a few dozen.

First detection in 10 binaries.

The survey in the northern hemisphere was prepared by selecting all single-spectrum eclipsing binaries, up to the magnitude V=10, found in the "Catalogue of modern light curve-synthesis photometric solutions of close binary systems" (Cester et al.: 1989, *Memorie Soc. Astron. Italiana*). The resulting list contained 20 binary systems to be observed at OHP during 1990. Observations were carried out with the 600 l/mm grating in the spectral range from 4080 to 4510 Å, with a resolution R = 7000. Such a dispersion, although relatively-low, allows to keep the exposure time within a sufficiently small fraction of the orbital periods of these binaries (1-2 d).

The recognition of the secondary spectral lines is based on their different radial velocity, with respect to the primary's, at opposite quadrature phases. The selected spectral range (containing H δ, Hγ, the high-excitation line Mg II 4481 and a large number of metallic lines) is suitable for the spectral classification of the secondary. Giving observing priority to the most luminous objects, the presence of the secondary spectrum has been revealed, for the first time, in the following systems : TW Cas, DO Cas, XX Cep, AI Dra, S Equ, RW Mon, IZ Per, X Tri.

Extraction of the secondary spectrum

The high quality of the spectra obtained makes it possible to go beyond the simple recognition of the presence of the secondary lines. The stability of the instrumental response of *Aurélie* allows to compare quantitatively the spectra of a given binary system at opposite quadratures, dealing with variations of about 1% of the continuum. From these variations, it has been possible to reconstruct mathematically the complete spectrum of the secondary star. The procedure, which uses an iterative method, succeeds in putting in evidence some features that, otherwise, would be unrecognizable by visual inspection (see Fig 4a). In principle, this method of extraction (Ferluga and Floreano: 1991, *Rapp. Interno Dipart. Astronomia Trieste*, in prep.) could be applied to all the spectroscopic binaries, provided they do not show intrinsic variability.

The positive results of our survey – and the encouraging first applications of the extraction technique – suggest an extension of this research program to spectroscopic binaries in general.

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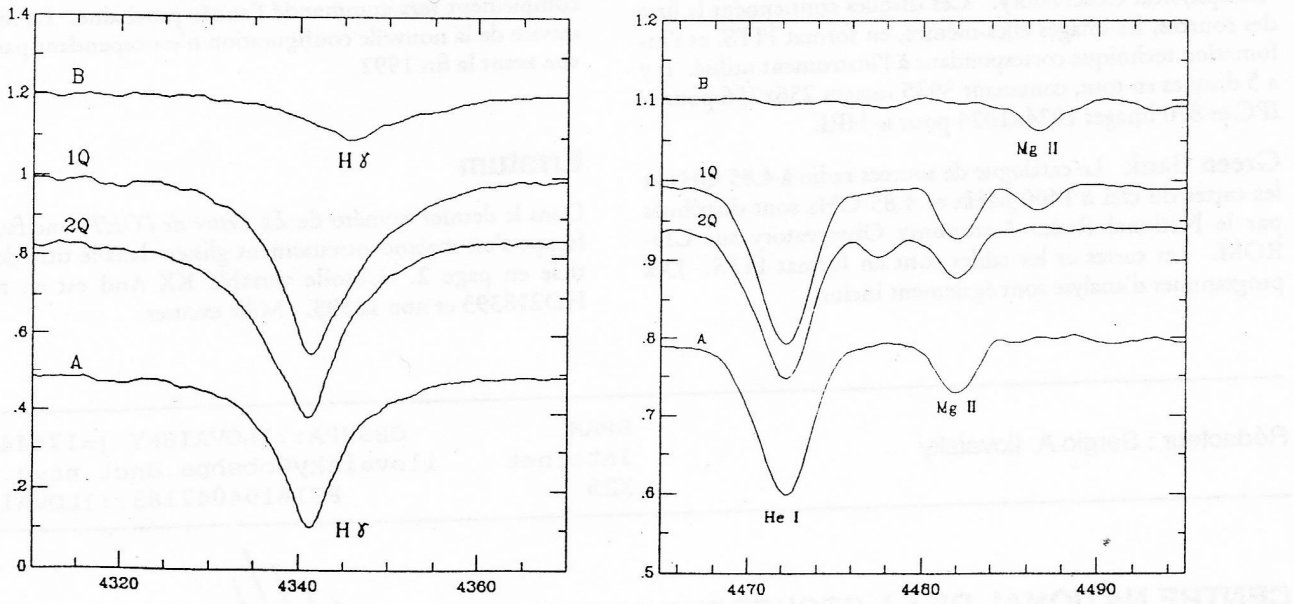

Figure 4 : Separation of the 2 components of *I Z Per*, for the Hγ line (a) and the Mg II 4481 line (b). The tracings show : the secondary spectrum B, extracted at 1st quadrature (1Q), the observed spectrum at 2nd quadrature (2Q), the extracted primary spectrum A. The intensity level 1.0 corresponds to the continuum level at 1st quadrature: all the other spectra are plotted at the same scale, vertically shifted by a suitable quantity. The radial velocities of all spectra are reduced to that of the primary at 2nd quadrature.
Note : in (a) the resulting wide Hγ wings of the secondary, unpredictable by simple visual inspection of the quadratures; in (b) the total absence of the He I line in the cooler secondary, and the different position of Mg II secondary line at the two quadratures.