THE IUE SPECTRAL ATLAS OF TWO NORMAL B STARS: πCet and νCap (125-200 nm)

M.-C. Arttu, J. Borsenberger
Observatoire de Paris,
Section de Meudon
92190 Meudon, France

T. Lanz
Institut d'Astronomie de Lausanne,
Chavannes-des-Bois,
CH 1290, Switzerland

ABSTRACT

An atlas for two normal B stars, πCet (HD17081, B7V) and νCap (HD192432, B9.5V) is prepared in the range 125-200 nm. By means of an improved software to process the IUE images and by the coaddition of about ten available high-resolution images, the best possible resolution and signal/noise ratio are obtained. The identification of the lines is based on updated laboratory lists with a selection of the dominant contributors for each absorption line. About 80% of the measured lines have a definite identification.

Keywords: Atlas, Line identification, Ultra-violet spectra. Stars: main-sequence B-type. Stars: πCet, νCap

1. INTRODUCTION

Until now, only a few lists of identified lines are available for the far-ultraviolet spectrum of early-type stars, which contains so many absorption lines. Some have been published by Rogerson and Upson for five stars, from Copernicus data (see e.g. Ref.1). They do not include late main-sequence B stars, and the wavelength coverage is not complete. Other line lists were prepared by Ramella et al. (Ref.2) from IUE data in the short-wavelength region, for seven normal B stars. But their automatic procedure allowing a quick identification of prominent features, leaves a lot of weaker lines unidentified or not even detected. A reference atlas with detailed identifications appears to be indispensable, especially since the Hubble Space Telescope will provide high-resolution ultraviolet spectra. So we decided to prepare an atlas for πCet (B7V) and νCap (B9.5V), two slowly rotating stars, and to identify the spectral lines with the most recent laboratory line lists, instead of starting from the Kurucz and Peytremann (Ref.3) list as did Ramella et al. (Ref.2). We also intend to take benefit from the several available SWP images of these stars to extract IUE spectra of the best possible quality.

2. PROCESSING OF THE IUE IMAGES AND COADDITION OF THE SPECTRA

The spectra were derived directly from the photometrically corrected images of IUE (9 and 11 archives available in the new software, for πCet and νCap). We used the FASMII software of Borsenberger (Ref.4) which proceeds by a non-linear minimization to fit the data at the pixel level. Compared to the standard extraction, it gains the ability to use the data partly affected by saturation and a significant increase of the signal/noise ratios at the ends of each order. A weighted sum is made on rebinned oversampled spectra, adjusted in wavelength by an iterative procedure.
Figure 1
Identified IUE spectra of the stars π Cet and ν Cap, in the range 147-148.8 nm
3. LINE IDENTIFICATIONS

The coadded stellar spectra were measured independently by fitting each observed line with a gaussian curve, between two limits chosen visually on the wings of each line. A total of about 2000 lines are measured for each star, most of them appearing on the spectra of the two stars with a wavelength agreement better than 0.004 nm.

The atomic data were taken primarily from the laboratory line list compiled by Kelly and Palumbo (Ref.5) and Kelly (Refs.6-7), with updated data, mainly for Fe II (Johansson, Ref. 8 and Adam et al., Ref.9), Cr II (Johansson, Ref.10), and for heavy elements (Z=37 to 82) from Reader et al. (Ref.11). The list was then reduced to about 9000 lines by a careful limitation of the number of weak lines for each ion, on the basis of the observed intensities for the strongest ones.

The identification process is initiated by an intersection of the observed line list and the laboratory line list, with a tolerance of 0.01 nm. Among the multiple assignments, often found by the wavelength coincidence, we determined the principal contributor for each line, by a systematic comparison of the observed intensities in the two stars, together with the laboratory data for each detected ion. When several contributors appear equally probable, a selection of the dominant ones is done by comparison of their theoretical equivalent widths. These have been computed using gf data from Kurucz and Peytermann (Ref.3) and a typical Kurucz model atmosphere (T\textsubscript{eff}=12000 K, logg=4). For a number of ions it happens that all theoretical equivalent widths are so weak that their lines could surely not be detected; so they have been eliminated in case of wavelength coincidence.

The following species are clearly found to be present: C I, C II, C IV, N I, O I, Mg II, Al II, Al III, Si I, Si II, Si III, Si IV, S I, S II, Ca II, Ti II, Ti III, Mn II, Cr II, Cr III, Fe II, Fe III, Ni II, Ni III. Several other species are possibly present: B II, N II, O II, P III, Cl I, Cl II, V II, Ga II, Ga III.

About 50% of the observed lines are identified to a single atomic transition. Other 30% of the lines could be attributed to blends of two or more components.

A tracing of the spectra and a complete list of the measured lines will be given elsewhere (Ref.12) both including the line identifications. An example of the identified spectra is displayed in Fig.1 for the limited range 147.0-148.8 nm.

4. CONCLUSION

By combining the IUE high-quality spectra of the normal B stars π Cet and ν Cap with an updated selection of the best laboratory line data, we intend to provide an identified atlas in the range 125-200 nm, where the line identification is an essential preliminary step to many further investigations based on the ultraviolet spectra of early-type stars.

5. REFERENCES

2- Ramella M., Castelli F., Malagnini M. L., Morosi C., Pasian F. 1987, Astron. Astrophys. Suppl. Ser. 69,1
3- Kurucz R L., Peytermann E 1975, SAO Special Report 362
4- Borsenberger J 1985, IUE ESA Newsletter 24,25
7- Kelly R L 1983 (updated line list on magnetic tape)
8- Johansson S 1978, Physica Scripta 18,217