SPECTROGRAMS OF α LYRA AND β CEN IN THE REGION OF 2000–3800 Å

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During the flight of the spaceship 'Salyut', manned by the spacemen G. T. Dobrovolsky, V. N. Volkov, and V. I. Patsaev*, nine spectrograms of α Lyra and six spectrograms of β Cen were obtained with the help of the 'Orion' system, in the range of wavelengths 2000–3800 Å and with a spectral resolution of about 5 Å near 2600 Å.

The 'Orion' system is a telescope of the Mersenn system, with a large mirror of 280 mm diameter, and a slitless spectrograph of the Wadsworth system with a diffraction grating (Figure 1). The dispersion is 32 Å mm^{-1}. The spectrograms were recorded on a perforated photographic film, 16 mm wide, covered with emulsion of the UFSH-4 type.

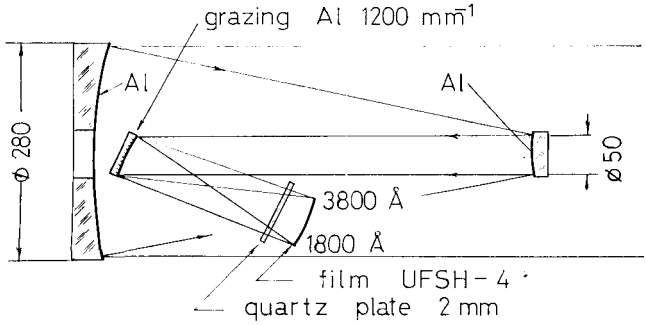

Fig. 1. The optical scheme of the sliteless short-wave stellar spectrograph 'Orion' (region 2000–3800 Å).

The 'Orion' has a biaxial pointing control system ensuring an accuracy of 0.5′ in pointing at a given star. The 'Orion', which was installed on the external surface of 'Salyut', was electrically controlled with the help of another tracking system of lesser accuracy, consisting of small visual telescope, located within the spacecraft by one of its windows. With the aid of this the spacemen sight the star whose spectra are to be obtained. This is effected with an accuracy of one degree which is sufficient for the star to be transferred into the three-degree field of the fine pointing control of the 'Orion'. The transfer of the star under investigation into the centre of the field is effected by lighting a special lamp on the control desk of the 'Orion'. At the same time one of the crew presses the button of the program system which provides a series of spectrograms of various exposures for the given star, from 10 s up to 6 min. Upon completing the program the cassette containing the exposed film was detached from

* The three spacemen were killed in a tragic accident during re-entry after this flight.

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the apparatus of the 'Orion' and taken into the spacecraft through a small hatch specially fitted to the body of the spacecraft for this purpose.

Thus in the 'Orion' system the role of the spacemen is of great importance in recognising the proper object (the star) in the sky and in pointing the telescope at it. Star guiding with a given accuracy, exposure, as well as programming the work of the telescope-spectrograph are effected automatically, i.e. without the intervention of the spacemen.

One of the basic tasks set during the first flight of the space observatory 'Orion' was to check in natural conditions the accuracy and efficiency of the above method of operation of the space astrophysical observatory, handled by a spaceman who is not a professional astronomer. It was essential to secure the required accuracy of the data derived and reliability of the automatic systems and the kinematic units.

An analysis of data obtained from the first flight of the 'Orion' on board the 'Salyut' shows that the general concept underlying the 'Orion', as well as the crew of the spacecraft have demonstrated its complete viability in practice and that it can be used in future in devising more powerful space observatories.

Prior to installing the 'Orion' in the 'Salyut', an energy calibration of its spectrograph was made with the help of synchrotron radiation.

Development and further treatment of the film is carried out upon landing, after the film in the cassette, detached from 'Orion', has been brought back to Earth by the spacemen, with the help of the landing device.

It is important to note that the spectrograms needed to plot the characteristic curve were taken on those parts of the film that were left intact within the 'Orion' cassette. The spectrograms were taken in the laboratory soon after the landing of the 'Orion' film on Earth. This ensured a complete uniformity of the physical parameters (the degree of fogging, spectral sensitivity, contrast, etc.) of the main and standard films.

This requirement, namely obtaining standard spectrograms on film brought back from space, should presumably be considered essential in similar experiments since, as the 'Orion' showed, fogging of the film in space is an inescapable phenomenon. After two months of orbiting the film of the 'Orion' became quite fogged; the density of photon blackening (background) of the film UFSH-4 was about 0.8–0.9. The source of fogging is not quite clear but the part played by γ radiation is obvious; such radiation may originate as a by-product following the interaction of primary cosmic rays and matter.

The complete results and, most important, the curves of the distribution of the continuous energy in the spectrum of α Lyra and β Cen in the region of 2000–3800 Å will be given later. Here, in Figure 2 are given examples of the spectrograms of α Lyra and β Cen, while in Figure 3 are shown their microphotograms. On the right of the spectrograms of α Lyra, the two last members of the Balmer absorption lines of hydrogen (H 8 and H 9) and the Balmer jump near 3650 Å are visible. Also, clearly visible at 2800 Å is a broad absorption line – the doublet of ionized magnesium (2796 Mg II and 2803 Mg II). A relatively intense absorption line near 2500 Å is also clearly seen as well as some faint lines to the short-wave side of the spectrum.

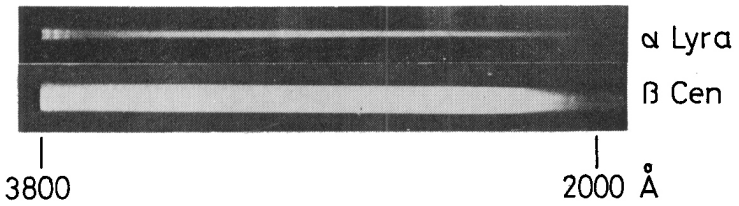

Fig. 2. Examples of the spectrograms of α Lyra and β Cen.

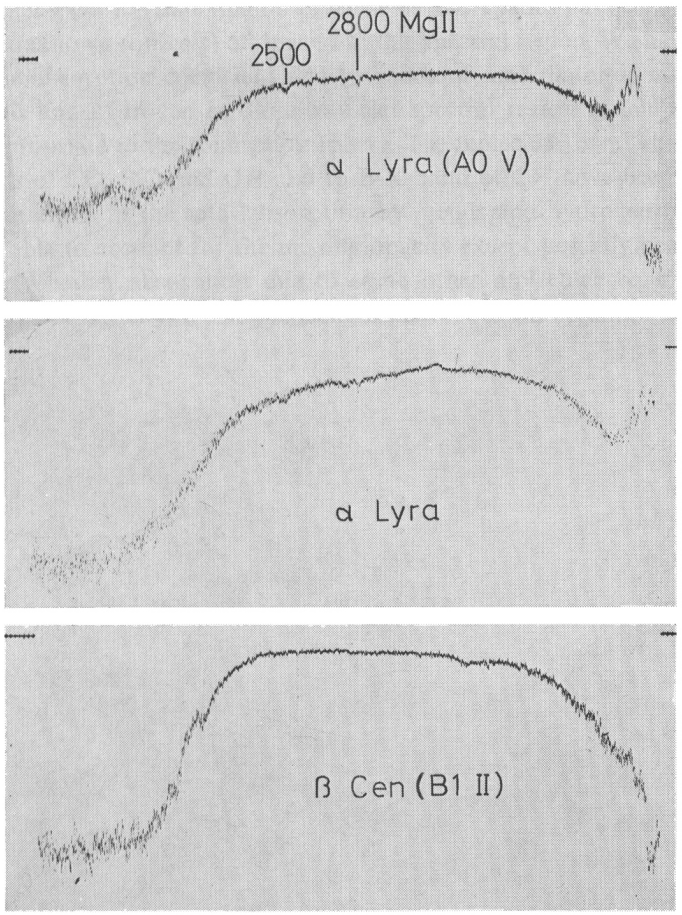

Fig. 3. The microphotometric tracings of the spectrograms of α Lyra and β Cen.

E. A. Arutynian, M. N. Krmoyan, A. L. Kashin, G. M. Loretsian, A. Z. Zakharian, and Sh. A. Arutynian cooperated in devising and elaborating the equipment of the 'Orion' and preparing it for experiments in space.

DISCUSSION

L. Houziaux: Did you compare your observations of α Lyra with fluxes derived from model atmospheres for this star ?

G. A. Gurzadyan: Such a comparison will be made when we have completed all measurements of our spectrograms.

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