HIGH RESOLUTION ULTRAVIOLET SOLAR SPECTRA IN
THE REGION 2765–2822 Å

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Abstract. Wavelengths and identifications of the near ultraviolet solar spectrum are presented. The data were obtained during the rocket flight of an interferometer spectrograph with a spectral resolution of 0.03 Å.

1. Introduction

A collaborative programme in high spectral resolution solar studies between the Astrophysics Research Unit (Culham Laboratory) and the Queen's University of Belfast has resulted in the successful flights of two Skylark rockets (SL 601, SL 603) carrying echelle-interferometer spectrographs. More recently the two groups in collaboration with the Air Force Cambridge Research Laboratories have flown a similar instrument aboard a stabilized platform suspended from a $3 \times 10^5$ m$^3$ balloon. The main objective in all three flights was to record the profiles of the solar Mg II resonance lines at 2795.5 and 2802.7 Å with both high spectral and spatial resolution, and to investigate their variation over the solar disk. Preliminary results from the two rocket flights have been reported (Bates et al., 1969, 1971a).

The high spectral resolution and excellent stray light characteristics of the Fabry-Perot spectrograph also enabled detailed spectra to be recorded over the wavelength region from 2765–2822 Å. A typical interferogram obtained in the first rocket flight (SL 601, December 1968) with a spectral resolution of 0.03 Å is shown in Figure 1. The advantages of the interferometer (Bradley et al., 1967; Bates et al., 1971b) were exploited more fully in the later flights whereby the spectral resolution was increased to 0.016 Å by increasing the plate separation, and additional spectral information was simultaneously obtained in the doubling of the number of fringes recorded across the solar disk. Many of the weaker absorption lines evident in the earlier interferograms are well resolved with the increased resolution of the later flights, and a number of additional spectral features are revealed.

This paper presents the reduction and identification of the Fraunhofer lines recorded in the flight of SL 601. The observations were made at altitudes in excess of 100 km on both sides of the 187 km apogee. The data of the second flight is currently being reduced and the results will be correlated later with those obtained from the balloon flight. In the region from 2765–2822 Å an average of 8 lines per Å have been observed

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Figure 1. Solar interferogram covering a wavelength region of approximately 60 Å around the Mg II H and K lines at 2802.7 and 2795.5 Å, with wavelength increasing from left to right. The lower bound of the fringes corresponds to the end cut-off of the spectrograph slit near the southern limb of the solar disk, while the upper fringes extend right to the northern limb.

with the spectral resolution of 0.03 Å. Although the Fraunhofer line spectrum in this region and to shorter wavelengths has been reported previously, the observations were made with instrumentation whose spectral resolution was not better than 0.15 Å (Wilson et al., 1954; Kachalov and Jakovleva, 1962; McAllister, 1960). The echelle spectrographs of the Naval Research Laboratory (Washington) group have since produced spectra over most of the middle UV with a much improved resolution of 0.03 Å (Purcell et al., 1963; Tousey et al., 1967). The detailed analysis of these spectra and their wavelength identifications have not yet been published but Dr Tousey has made the data available to us for comparison with our own identifications.

2. The Interferograms

Brief descriptions of the spectrograph have been given previously (Bradley, 1968; Bates et al., 1971a). The echelle and interferometer dispersions are crossed, that of the latter being along the direction of the spectrograph slit. With an 8° angle of incidence on to the interferometer, the resulting parabolic channels (Fabry and Buisson, 1910) are linear to a good approximation. Their horizontal width is determined by the spectral width of the echelle slit (Treanor, 1949). The interferogram in Figure 1 shows about 66 such channels over a region of some 60 Å centred roughly on the Mg II doublet.

Along each heterochromatic channel there is a positional as well as a wavelength variation. The slit orientation was approximately along the solar N–S direction and each channel covers a spatial region extending from the solar southern hemisphere across to the northern limb.

This channel length corresponds to roughly 7 Å of spectrum, but the value varies because of differences in limb darkening for different spectral regions. For example, the enhanced limb darkening clearly apparent in the region of the Mg II doublet in Figure 1 causes several absorption lines to be recorded on only a few channels.