

**WAVELENGTHS OF SOLAR LINES  
IN THE 50–380 Å REGION  
AND THEIR IDENTIFICATIONS**

U. FELDMAN

*Dept. of Physics and Astronomy, Tel-Aviv University, Israel*

and

W. BEHRING and L. COHEN

*Goddard Space Flight Center, Greenbelt, Md., U.S.A.*

In this work we decided to concentrate on the region 50–380 Å for which the grazing incidence grating spectrograph is the most suitable instrument. This portion of the spectrum contains many rather intense lines lying very close together which arise primarily from very highly ionized atoms in the solar corona. Wavelength measurements and identifications have been made for a portion of the lines, but for many of them, especially the weaker ones, the situation was not completely clear and many doubts existed. Therefore we decided to build a rocket spectrograph which would significantly improve the resolution and wavelength accuracy for lines in the solar spectrum. Thus, we attempted to achieve wavelength accuracy of 0.003 Å and to limit the instrumental broadening of the lines to 0.03 Å.

A grazing-incidence (88°) spectrograph was built using a gold coated replica grating having a 3 m radius of curvature. The grating has 1200 lines mm<sup>-1</sup> with a 4° 8' blaze angle. The fixed slit was 32 mm long and 3 × 10<sup>-3</sup> mm wide.

In order to achieve the requisite accuracy it was clear that glass plates would be needed instead of plastic film, which had been used in previous rocket flights. To reduce the amount of scattered long wavelength radiation reaching the film, earlier workers used filters. While this succeeded in eliminating the problem, it introduced the absorption characteristics of the filter. No material was available that would absorb wavelengths longer than say 500 Å, but transmit most of the intensity below this. We decided to attempt to design our spectrograph so that it could also be used without a filter, and thus avoid absorption problems.

On 16 May 1969, the spectrograph was flown White Sands Missile range, New Mexico. Many spectral lines (≈ 400) were recorded between 50–390 Å and accurately measured to the accuracy of laboratory measured standard lines appearing in the solar spectrum. We were able to identify only 50% of the lines. Most of the lines we have identified arise from levels of the ion which can be excited directly from either the ground state or from a low lying metastable state.

The He lines are the broadest lines observed on our plates. The width of the 304 Å line is particularly easy to observe. The second member at 256 Å is even broader. Apparently this line is blended with a Si line lying at a slightly longer wavelength.

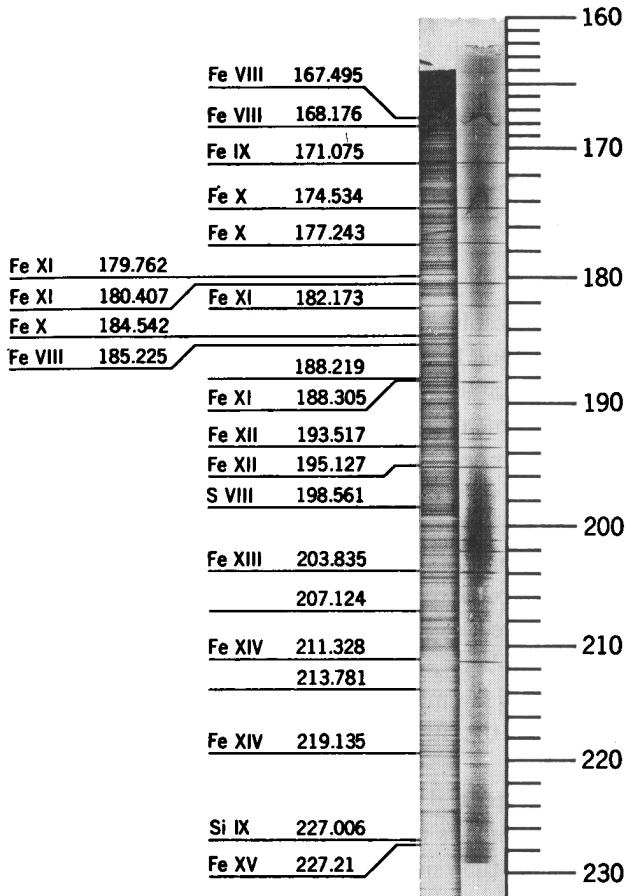


Fig. 1. A section of the solar spectrum in the region 160–230Å. The comparison Fe spectrum on the left was produced by vacuum sparks and was recorded by the same flight spectrograph.

## DISCUSSION

*A. Franks:* You quote figures for wavelength to 1 part in 200 000. A temperature change of 1°C will produce dimensional changes of 1 part in  $10^5$ . Related to this question is the one of the measurement of radius of curvature and surface form of the spectrograph. Has this been done with any precision?

*U. Feldman:* The wavelength calibration of the plates is not absolute, but dependent upon reference standards. Temperature changes in the instrument should therefore have an effect smaller than does the uncertainty in the wavelengths used as standards.

The radius of curvature of the plate holder with plates is constant to  $\pm 0.01$  mm. The plate holder itself is somewhat better than this figure, but thickness variation in the glass plate and in the emulsion, and irregularities in the bending, especially at the ends, limit the constancy achievable.

*B. Woodgate:* Do you have profiles of the He II 304 Å and 256 Å lines, and if so what do they look like?

*U. Feldman:* The profiles of the He II 304 Å and 256 Å lines have not been examined in great detail. Microdensitometer tracings reveal a full width at half maximum of about 0.17 Å for the 304 Å line. It does not appear at all unusual in shape. The 256 Å line appears to be blended with a Si IX line, on the long wavelength side.