MEASUREMENTS OF MASS FLOW IN THE TRANSITION REGION AND INNER CORONA

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ABSTRACT A recent sounding rocket experiment has provided high spectral resolution line profiles across the solar disk. The objective of this experiment is to provide information on the systematic velocity fields at the base of the corona by observing the displacement, width and shape of EUV emission lines.

A new solar rocket experiment was launched on June 5, 1979. The instrument consists of a small telescope providing moderate spatial resolution ($\lesssim$ 1 arc minute) and a spectrograph with stability and high spectroscopic resolution ($\simeq$ .028A at 600A). The CODACON detector system developed by G.M. Lawrence of this laboratory uses a microchannel plate array to provide 1024 simultaneous measurements spanning approximately 30A of the solar spectrum. The spectrograph uses a 3600 l/mm grating and the spectral range 609-634A is recorded in second order overlapping 1218-1268A in first order. Figure 1 is a typical limb spectra obtained during this experiment.

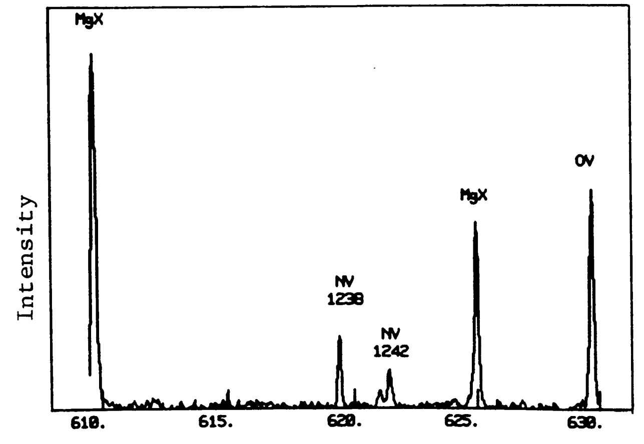

Figure 1

M. Dryer and E. Tandberg-Hanssen (eds.), Solar and Interplanetary Dynamics, 375-378.

The instrument does not contain an internal wavelength standard and it is not possible to assign an absolute wavelength scale to the observations. In future experiments a platinum hollow cathode source will provide this standard. In flight the wavelength scale of the spectrograph is extremely stable and the relative position of the lines can be accurately measured. Velocity shifts of the emission lines can then be analyzed two ways. First, a relative velocity field is estabished by recording the position of a particular line as the instrument field of view sweeps from limb to limb across the solar disc. In this way a systematic flow within a particular feature, for example a coronal hole, can be measured relative to the quiet corona. A second analysis will compare the positions of high temperature coronal lines with positions of certain low temperature lines, for example SiII. Such low temperature lines have been studied extensively by OSO-8 to provide information of the velocity fields in the chromosphere.

The launch opportunity requires a coronal hole near disc center and the most reliable information on such features is the Kitt Peak 10830 spectroheliogram. Examination of these data in mid-May revealed the development of a low latitude hole which was projected forward one solar rotation to establish a launch date near June 5th. This coronal hole was again identified at the east limb from the Kitt Peak data of May 31st and subsequent spectroheliograms through June 3rd enabled an accurate projection forward to the launch time on June 5th. The roll angle of the pointed rocket instrument was set to give a scan plane inclined $\sim 15^{\circ}$ to the solar equator passing through the coronal hole. Analysis of the intensity of the MgX lines verifies that data were obtained in the coronal hole, in the quiet corona and in an active flaring region at the limb.

A preliminary analysis of the data has been completed. The data were corrected for instrumental effects and a background signal was removed. The position of the emission lines was determined by a "center-of-mass" routine and velocity shifts are evident. The routine is somewhat inaccurate due to weak blinds in the solar emission lines as well as noise in the data and background. Because of these deficiencies in the first analysis the results are only qualitative, but they are in general agreement with the results of Cushman and Rense (1976).

A more detailed analysis is presently being conducted using a least-squares Gaussian fitting routine. Figure 2 shows a typical fit to the OV 629A line at two positions on the solar disc. It is apparent that the emission lines are accurately approximated by a Gaussian profile and that velocity shifts are clearly present.

The observations reported here provide important new constraints for studying the solar wind at its place of origin in the upper transition region and inner corona. An overall major goal of this rocket research program is to provide measurements relevant to the physical processes by which both momentum and energy are deposited into the expanding corona.

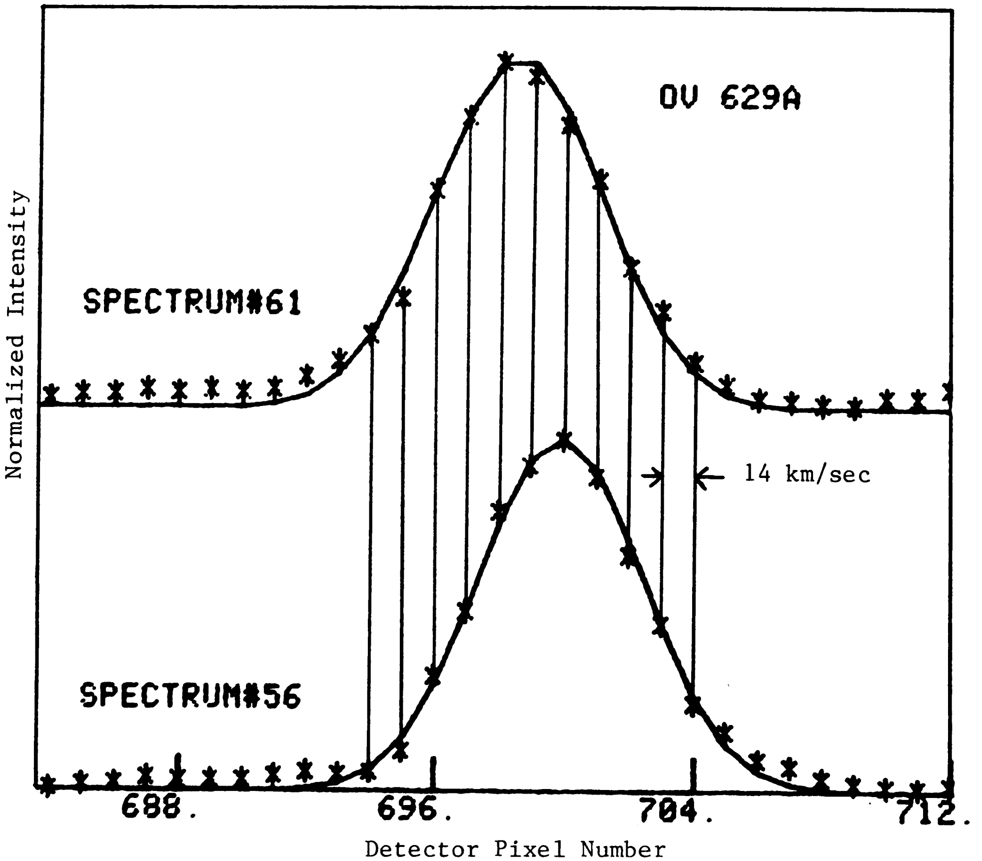

Figure 2

ACKNOWLEDGEMENTS

The assistance and guidance of Frank Orrall, a co-investigator on this rocket research program, are gratefully acknowledged. This work is supported by NASA contract NAS-5178.

REFERENCE

Cushman, G.W., and Rense, W.A.: 1976, Astrophys. J. Letters 207, No. 1, Part II, L-61.

DISCUSSION

Dryer: The velocities (as noted by the blue shift) above the west limb flare appeared to be roughly the same as those coming from the coronal hole. Would you care to comment on their magnitudes?

Rottman: Since this is only a first moment analysis of the line position, I caution you not to put too much faith in the magnitude of the shifts. Your general impression is probably correct and I might add, regarding the coronal hole measurements, my impression is that our data is in basic agreement with the Rense-Cushman result.

Porsche: I cannot see the Ly α line in your spectra. Did you suppress it?

Rottman: The wavelength range was selected to exclude the Ly-α line. If we had included the line we felt the large radiance would likely saturate the detector. If we refly the same grating we will likely move the short wavelength cut-off further into the red wing of the Ly-α line.

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