SPATIAL IMAGING OF UV EMISSION FROM JUPITER AND SATURN

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Spatial imaging with the IUE can be accomplished both by moving one of the apertures in a series of exposures and within the large aperture in a single exposure. The image of the field of view subtended by the large aperture is focussed directly onto the detector camera face at each wavelength; since the spatial resolution of the instrument is 5 - 6 arc sec and the aperture extends 23.0 by 10.3 arc sec, imaging both parallel and perpendicular to dispersion is possible in a single exposure. The correction for the sensitivity variation along the slit at 1216 Å has been obtained from exposures of diffuse geocoronal H Ly α emission. Details of this technique will be presented in a separate paper (ref. 1) in the data reduction session of this symposium. Fig. 1 shows the relative size of the aperture superimposed on the apparent discs of Jupiter and Saturn in typical observations.

By moving the planet image 10 - 20 arc sec along the major axis of the aperture (which is constrained to point roughly north-south) maps of the discs of these planets are obtained with 6 arc sec spatial resolution.

The spatial imaging properties of the telescope are illustrated in the photowrite image of one exposure (SWP 5307) of Jupiter (Fig. 2); the aperture was positioned half on and half off the south pole of the planet in this exposure. The H Ly α (1216 Å) emission shows clearly the outline of that portion of the aperture positioned on the Jovian disc; the remainder of the aperture is dimly illuminated by geocoronal Ly α emission, and the sharp drop in planetary emission at the edge of the planet shows up clearly at Ly α. Furthermore, it happens that longer wavelength grating-scattered light extends along the dispersion line past the Ly α image and drops off rapidly perpendicular to dispersion at the edge of the planet, providing a check on the north-south positioning of the aperture on the planet.

As an example of this north-south scanning at Ly α, Fig. 3 shows the north-south distribution of the Lyα emission from Jupiter derived from three exposures taken on 10 December 1978. The apparent limb darkening and equatorial bulge in emission have also been observed by the Voyager flybys (ref. 2) and a recent sounding rocket (ref. 3). The limb darkening is real, i.e. more than would be produced by the spatial resolution of the instrument on a uniformly emitting disc. The equatorial hot spot is also localized longitudinally: note that the second exposure (taken $\sim 40°$ longitude away from the first) appears to match up to a lower equatorial level of emission. Jupiter rotates with a 10 hour period, and these exposures can be repeated approximately every 50 minutes, providing a longitudinal separation of about 30° between exposures.

A single large aperture SWP exposure of Saturn is shown in Fig. 4. The long wavelength continuum is solar radiation Rayleigh-scattered by H_2 in

Saturn's upper atmosphere. The Rayleigh-scattering cross section increases as λ^4 toward shorter wavelengths, and some absorbers must be present in the planet's upper atmosphere to produce the observed drop in emission. The spectrum of the banded structure $\sim$ 1650 - 1850 Å is plotted in Fig. 5 and shown to correspond to a series of absorption bands of C_2H_2. The presence of this molecular species in Saturn's atmosphere was discovered using the IUE. Note also the north-south asymmetry in both continuum emission and the grating-scattered light in Fig. 5. The northern half of Saturn was occulted by the rings in this observation (as drawn in Fig. 1). The north-south ratio of emission (i.e. on the rings to off the rings) appears to be roughly constant with wavelength, indicating simple extinction by ring particles rather than scattering by gas around the rings.

REFERENCES

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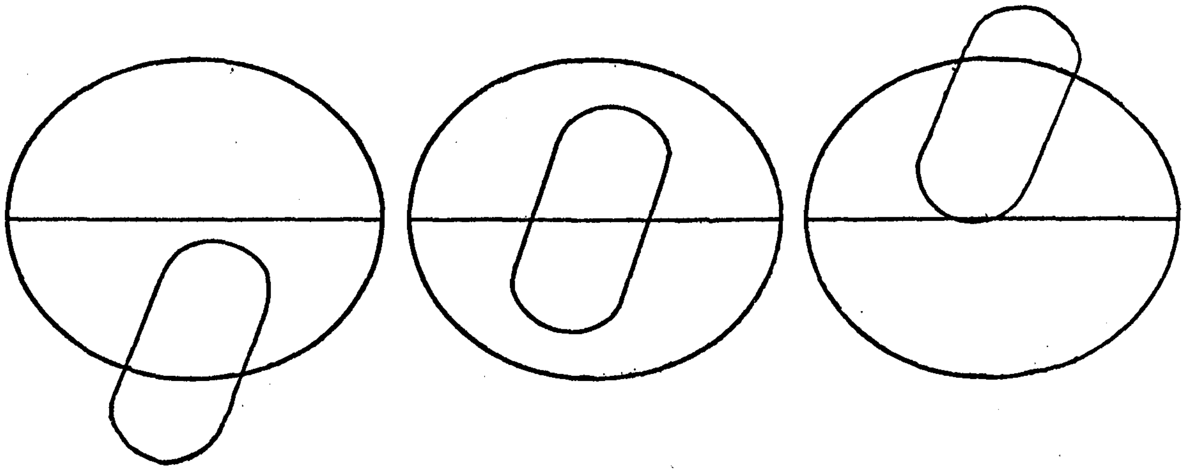
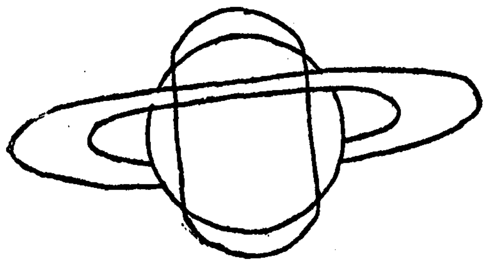
3. Clarke, J. T., Weaver, H. A., Feldman, P. D., Moos, H. W., Fastie, W. G., and Opal, C. B.: Spatial Imaging of Hydrogen Lyman α Emission from Jupiter. Astrophys. J., in press, 1980.



JUPITER



SATURN

Figure 1

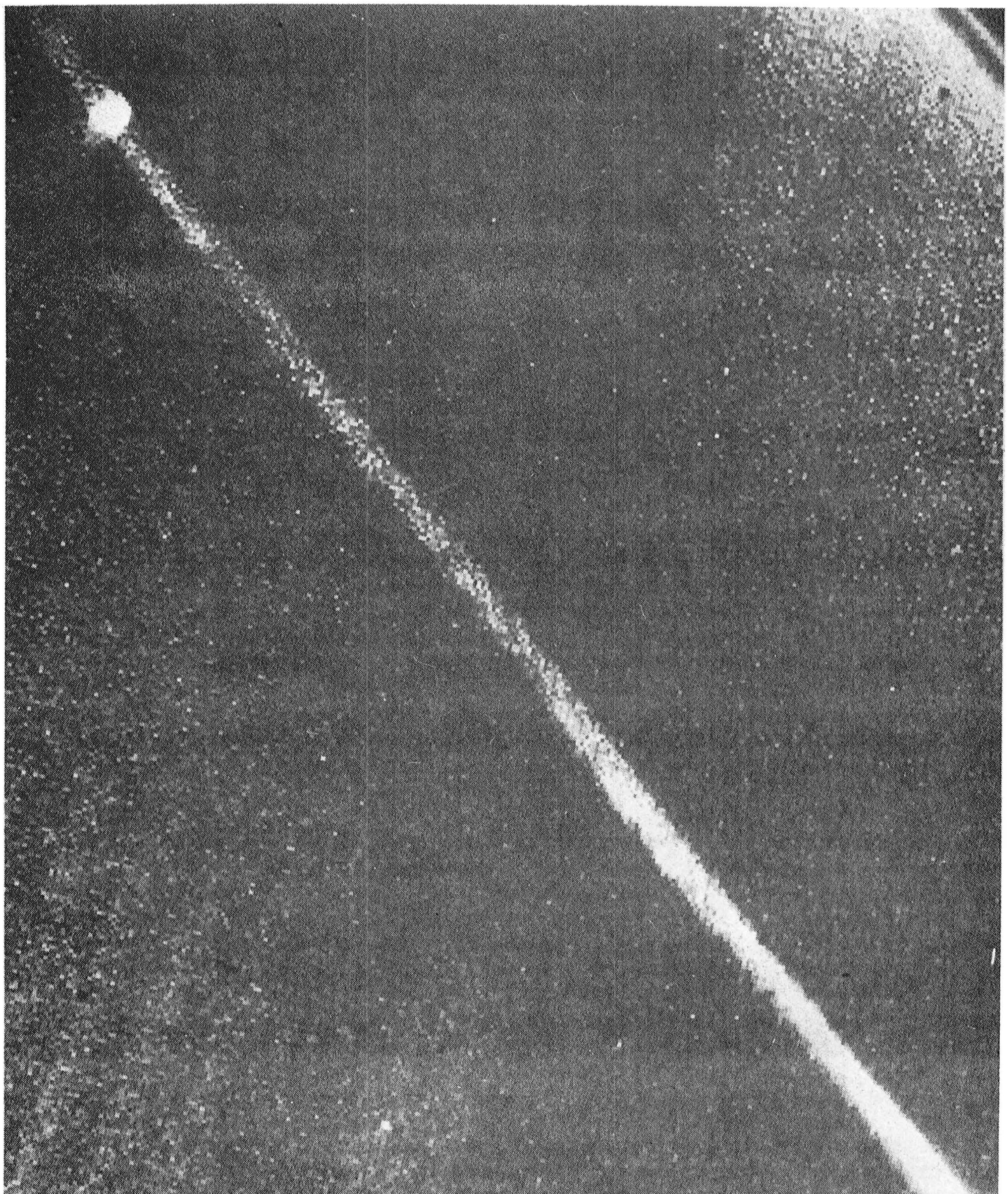


Figure 2

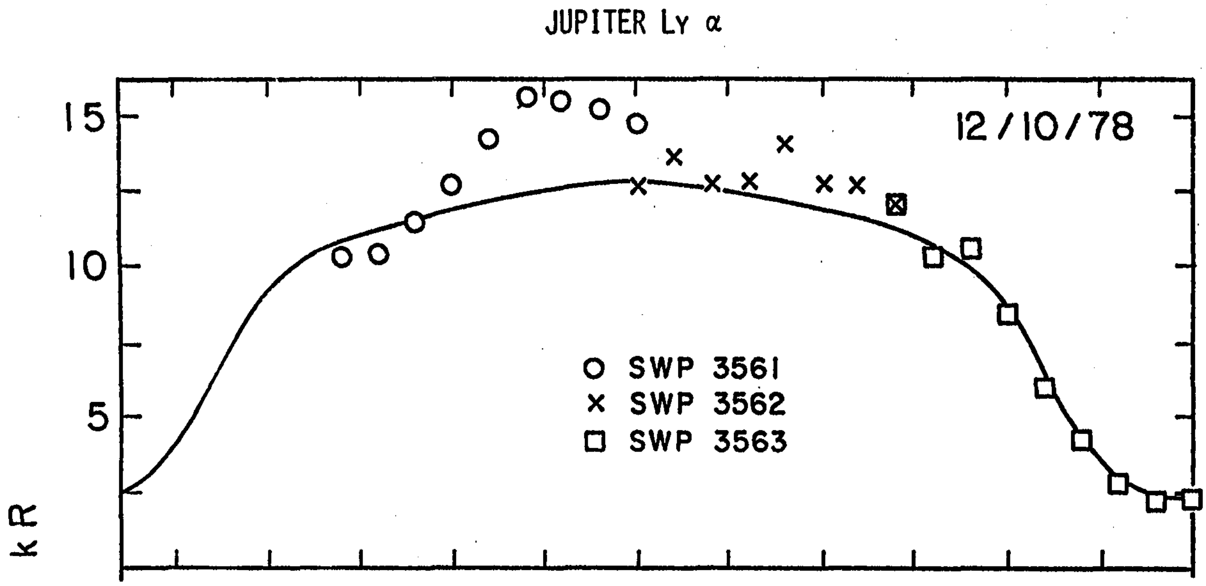


Figure 3

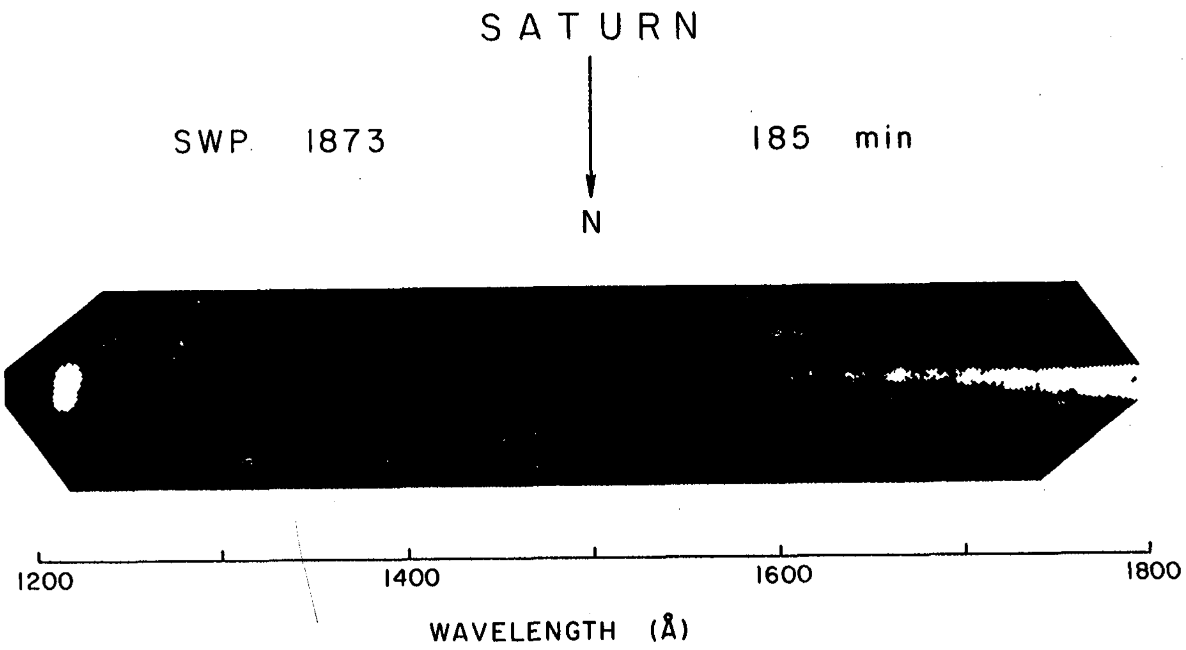


Figure 4

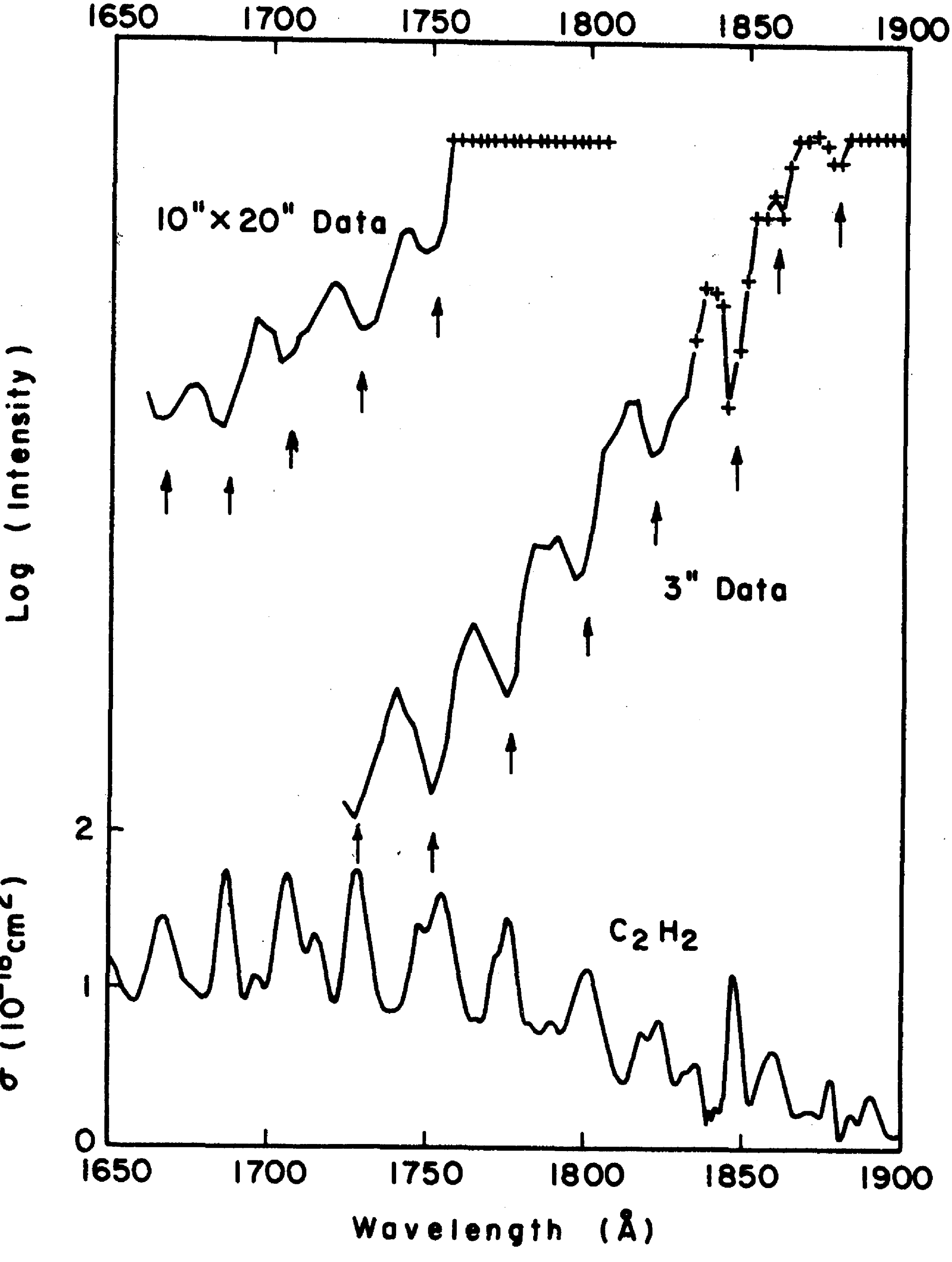

1650
1700
1750
1800
1850
1900
10"×20" Data
3" Data
C_2H_2
Log (Intensity)
σ ($10^{-18}cm^2$)
2
1
0
Wavelength (Å)

Figure 5