OBSERVATIONS OF POLAR AURORA ON JUPITER

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ABSTRACT

North-south spatial maps of Jupiter were obtained with the SWP camera in IUE observations on 10 December 1978, 19 May 1979, and 7 June 1979. Bright auroral emissions were detected from the north and south polar regions at H Ly α (1216 Å) and in the H_2 Lyman bands (1250-1608 Å) on 19 May 1979; yet no enhanced polar emission was detected on the other days. The relationship between the IUE observing geometry and the geometry of the Jovian magnetosphere will be discussed.

The discovery more than a decade ago of radio emission from Jupiter, which appeared to be modulated both by the rotation of the planet and the orbital position of the moon Io, opened the door for speculation on the distribution of charged particles in the probably Jovian magnetic field and the possibility of polar aurora on Jupiter. Searches for visible and radio-frequency auroral emissions have been hampered by poor sensitivity and spatial resolution, respectively. Sounding rocket and Earth-satellite (Copernicus) ultraviolet observations tentatively identified H_2 Lyman band emission (ref. 1,2) and an H Ly α hot spot (ref. 3), each of which was expected to result from charged particle excitation of H and H_2 in Jupiter's upper atmosphere. The Voyager flybys (ref. 4) positively identified polar auroral emissions both in the visible and at H Ly α and the H_2 Lyman and Werner bands in the ultraviolet. We will describe here a north-south mapping of Jupiter, performed with the IUE SWP camera under low dispersion, which shows strong polar brightening at H Ly α (1216 Å) and in the H_2 Lyman and Werner bands (1150 - 1608 Å).

The photowrite images of three spectra of Jupiter's south pole, central region, and north pole, taken 19 May 1979, are shown in Fig. 1. North-south imaging in this method of mapping has been described in the previous paper (ref. 5). The central spectrum shows the expected bright Ly α line and progressively stronger Rayleigh-scattered continuum at longer wavelengths. In addition, the polar spectra show marked emission features at 1608 Å

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and around 1570 Å. These emissions appear at the edge of the grating-scattered light from the respective northern and southern edges of the planet, and have been identified as H_2 Lyman band emission. Fig. 2 shows the whole-slit spectra from the three exposures, and the Lyman-band emission appears in the polar images well above the level of continuum seen in the equatorial spectrum.

The north-south distribution of the Ly α emission derived from these three exposures is shown in Fig. 3, along with the positions of the aperture on the planet. A pronounced brightening appears at both poles, trailing off away from the planet to the level of background geocoronal emission (1-2 kR). The north-south width of the 1216 Å and 1608 Å features is 5 - 7 arc sec at both poles. This is comparable to the 6 arc sec instrumental resolution, hence the north-south extent of the Jovian auroral oval is not measureable. However, the polar Ly α brightening in SWP 5309 of the north pole shows a marked east-west asymmetry, indicating that the emitting region was smaller than the 10 arc sec aperture width. This asymmetry may be explained either by a point source aurora or by a diffuse source partially filling the aperture. The south pole emission appears diffuse east-west.

It is estimated that emission 1/8 the measured brightness at 1608 Å in these exposures could be detected with the IUE in a 15 min. exposure. The potential thus exists for monitoring these aurora as a function of both the orbital position of Io and the 10° tilt of Jupiter's magnetic pole toward or away from the Earth.

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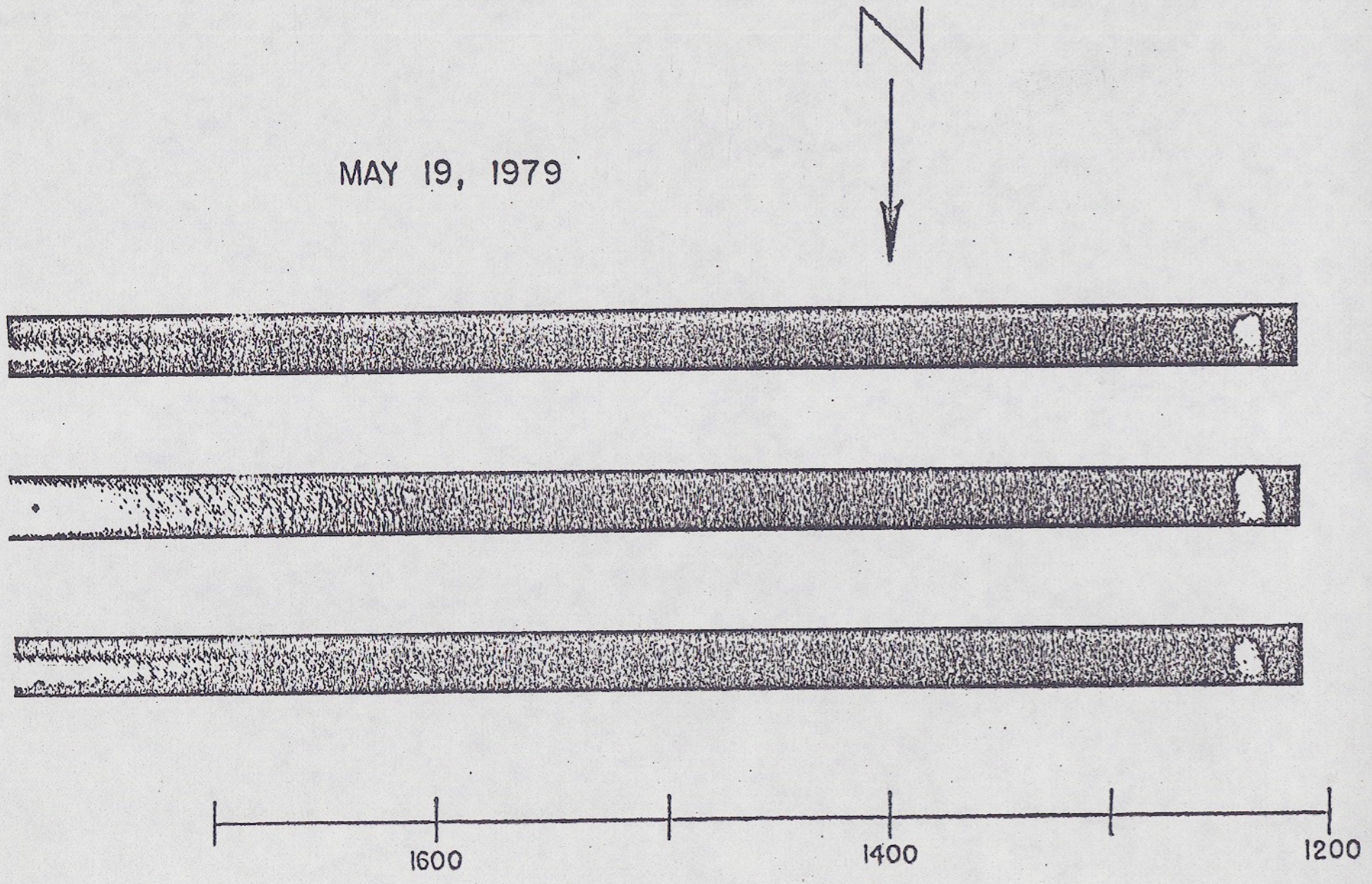

Fig. 1

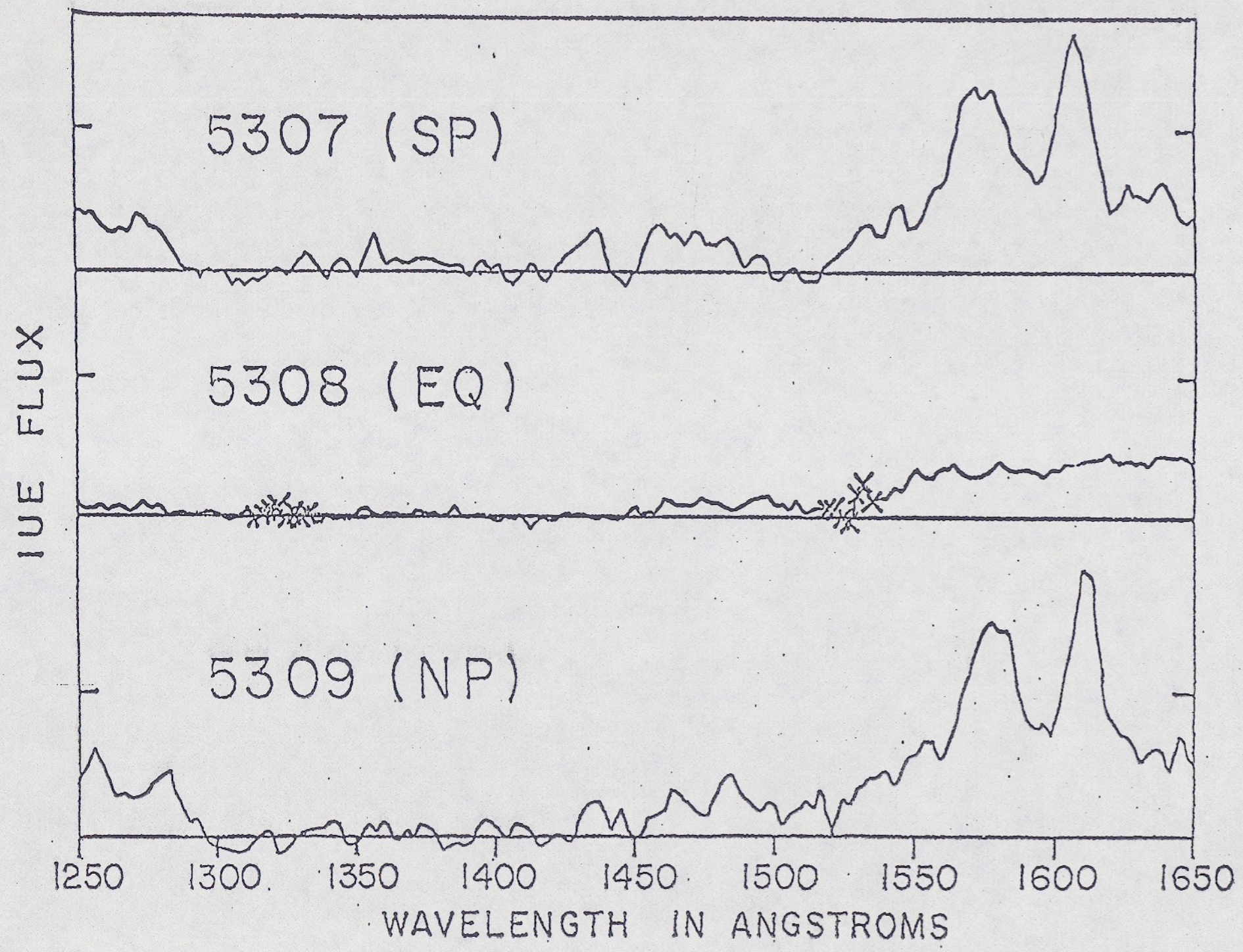
5307 (SP)
5308 (EQ)
5309 (NP)
IUE FLUX
1250
1300
1350
1400
1450
1500
1550
1600
1650
WAVELENGTH IN ANGSTROMS

Fig. 2

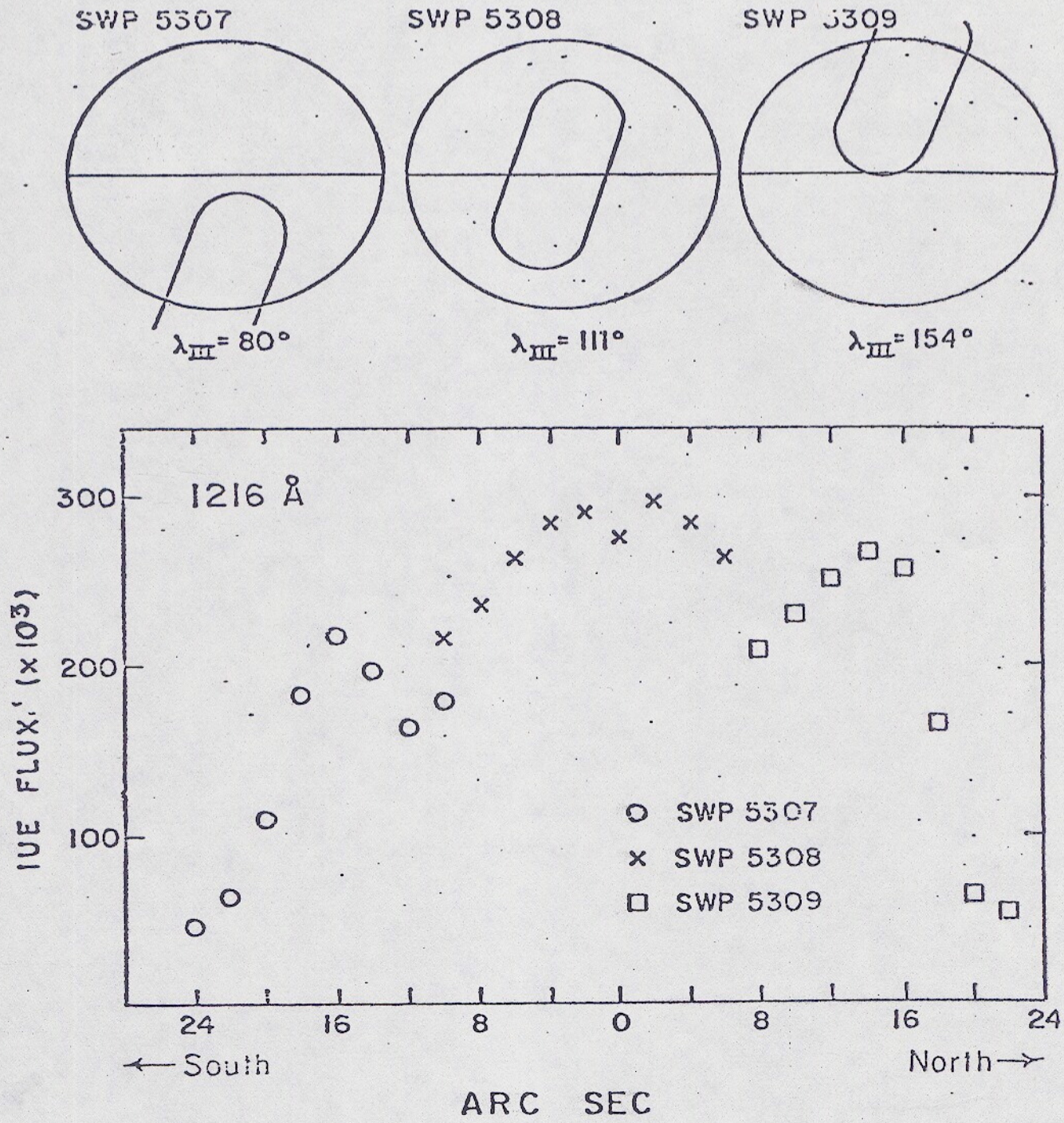
SWP 5307
SWP 5308
SWP 5309
λIII= 80°
λIII= 111°
λIII= 154°
1216 Å
IUE FLUX, (x10³)
300
200
100
SWP 5307
SWP 5308
SWP 5309
24
16
8
0
8
16
24
← South
North →
ARC SEC

Fig. 3