FUTURE POSSIBILITIES FOR ULTRAVIOLET OBSERVATIONS OF INTERSTELLAR MOLECULES

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Ultraviolet observations of interstellar molecules are currently being obtained primarily with two astronomical satellites, *Copernicus* (OAO-3) and *International Ultraviolet Explorer* (IUE). The former covers the wavelength range down to 900 Å with 0.05 or 0.2 Å resolution. IUE can observe fainter or more highly reddened stars than *Copernicus*, with 0.1 Å resolution, but its wavelength range does not include the resonance absorptions of the important interstellar molecules H_2, HD, and N_2.

The only currently approved future investigation which will make a major contribution to ultraviolet observations of interstellar molecules is the High Resolution Spectrograph (HRS) on the Space Telescope, currently planned for launch in late 1983. The HRS will have spectral resolution modes of 2×10^4 (equivalent to *Copernicus*) and 1×10^5 (five times better than *Copernicus*). The wavelength range accessible to the HRS is 1100-3200 Å. It will be able to observe much more distant and/or more highly reddened stars than previously accessible (about V=15 at medium resolution, and V=12 at high resolution, unreddened A0 V stars at 2400 Å). The HRS will be able to observe interstellar CO, OH, and at least the (0,0) and (1,0) Lyman bands of H_2. Other molecules which may be observable include H_2O, C_2, SiO, CS, and CH_2. The high-resolution mode will allow study of the absorption line profiles and velocity shifts, and of the rotational distributions in the bands of the heavier molecules. The high sensitivity in the medium-resolution mode will allow observations of some stars with color excesses as large as E(B-V)=2, vs a maximum of about 0.4 for *Copernicus*.

Improvements in the wavelength range 900-1100 Å, which includes most of the H_2, HD, and N_2 transitions, will require a spectrograph and telescope which have optical reflective coatings optimized for this wavelength range, and the use of windowless detectors. Two possibilities are (a) a high-resolution Rowland spectrograph with the *Starlab* telescope for Spacelab, which has been studied by NASA; and (b) an objective-echelle-grating, high-resolution spectrograph proposed for Spacelab by Princeton University. The former instrument would have

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R $\sim$ 4 x 10^4 and, with the 1-meter aperture of *Starlab*, and integration times of 30 minutes, could observe (with comparable S/N) stars at least 4 magnitudes fainter than *Copernicus*. The latter instrument could obtain at resolution 1.3 x 10^5 spectra over the 925-1315 Å range of stars as faint or fainter than observable with *Copernicus*. This improvement in resolution would allow studies of line profiles, and permit detection of weaker lines than possible with *Copernicus*. An alternative, low-resolution (R=1000) mode using only the concave cross-dispersing grating Wadsworth mode, could reach stars as faint as V=12. This would allow, for example, measurements of interstellar H_2 toward the brighter early-type stars in the Magellanic Clouds.

Finally, the possibility of wide-field, objective-grating surveys of interstellar atomic and molecular hydrogen at low (R=500 to 1000) resolution with a far-ultraviolet Schmidt camera in Spacelab missions is discussed elsewhere in this volume.

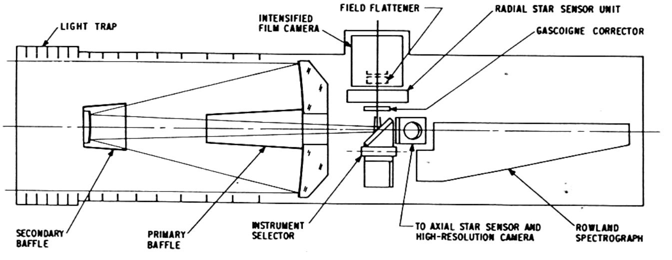

Fig. 1. The *Starlab* 1-meter UV/Optical Facility Telescope for Spacelab.

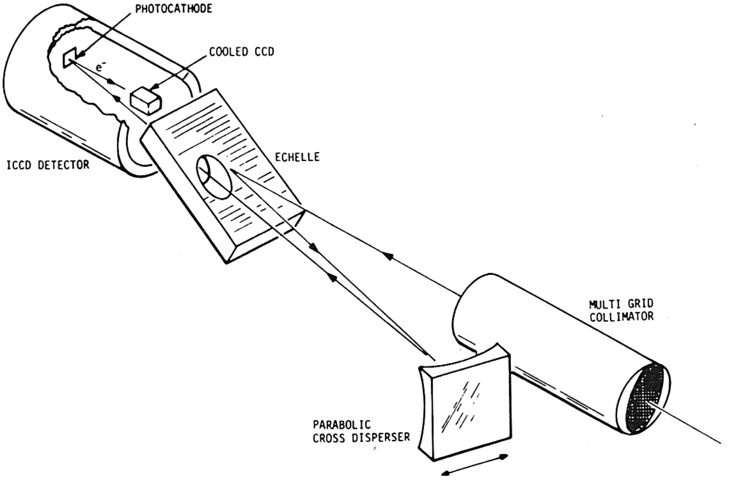

Fig. 2. The Princeton IMAPS (Interstellar Medium Absorption Profile Spectrograph) proposed for Spacelab.