OBSERVATIONS OF INTERSTELLAR HI TOWARD NEARBY LATE-TYPE STARS

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ABSTRACT

High-dispersion Copernicus and IUE observations of chromospheric Ly α emission are used to study the distribution of HI in the local interstellar medium. Interstellar parameters are derived toward 3 stars within 5 pc of the sun, and upper limits are given for the Ly α flux from 9 other stars within 10 pc.

INTRODUCTION

Interstellar HI may be detected as an absorption feature cutting into the chromospheric Ly α emission of nearby late-type stars. McClintock et al. (1978) have detailed methods for deriving interstellar parameters from Copernicus Ly α data. Landsman et al. (1984) have applied these methods to high-dispersion IUE observations of ζ Cen A. Further discussion of the results in this paper is given by Landsman (1984).

RESULTS

Copernicus Upper Limits

The Copernicus data consist of repeated scans with the high-resolution Ul tube of the central 1.2 Å of the Ly α emission. Listed in Table 1 are those observations for which the hypothesis of a featureless spectrum cannot be rejected at a confidence level greater than 90%. Upper limits have been expressed in terms of a typical solar flux of F$_{\odot}$ = 4.3 x 10$^{11}$ ph cm$^{-2}$ s$^{-1}$ Å$^{-1}$ at 1 Å.

70 Oph A (KOV, d=5.0 pc, lII=30°, bII=11°, V$_{r}$=-7 km s$^{-1}$)

Reduced spectra from Copernicus observations of 70 Oph A in 1976 and 1978 are shown in Figure 1 along with typical error bars. Definite structure is seen longward of the expected emission center at 1215.67 Å. The asymmetric emission is not

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unexpected, since 70 Oph is only 5° from the direction of the incoming gas as defined by Crutcher (1982). To further model this low signal-to-noise data, the following assumptions were made; (1) a gaussian intrinsic stellar profile with a total flux less than 100 times solar, (2) a fixed ratio D/H = 2.0 x 10⁻⁵, and (3) a velocity dispersion b_H < 20 km s⁻¹. With these constraints, and acceptable fit to the data can be made if the intervening gas has a volume density 0.04 cm⁻³ < n_HI < 0.45 cm⁻³, and a heliocentric bulk velocity v_H < -14 km s⁻¹.

**Altair** (=α Aql, A7IV, d=5.0 pc, l=48°, b=-9°, v= -26 km s⁻¹)

The solid line in Figure 2 is from a large-aperture IUE observation (SWP 3427) of Altair, originally discussed from a chromospheric perspective by Blanco et al. (1980). Points contaminated by geocoronal emission have been deleted. The signal-to-noise is poor due to the existence of spectrograph scattered light. The dashed line in Figure 2 shows a Copernicus spectrum obtained on 20 Aug 1976, with the absolute flux level divided by a factor of two. After this scaling of the absolute flux, there is reasonable agreement between the two data sets. If the intrinsic stellar emission is modeled with a gaussian profile, then an upper limit can be set on the interstellar HI volume density of n_HI < 0.11 cm⁻³.

**Procyon** (=α CMi F5IV-V, d=5.0 pc, l=214°, b=13°, v= -3 km s⁻¹)

Figure 3 shows a Ly α spectrum of Procyon derived from a large-aperture IUE observation (SWP 6660). The removal of the substantial geocoronal contribution and the estimation of uncertainties followed the procedure in Landsman et al. (1984) Modeling of the data yielded 90% confidence limits of 0.07 cm⁻³ < n_HI < 0.2, D/H > 0.8 x 10⁻⁵, and b_HI < 14 km s⁻¹. These values are consistent with determinations using Copernicus data by Anderson et al. (1978). It is expected that substantially improved limits on interstellar parameters may be derived using small-aperture observations and co-addition of IUE spectra.

References

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Table 1

Copernicus Ly α Upper Limits

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<th>Star</th>
<th>Sp.T.</th>
<th>dis (pc)</th>
<th>Day</th>
<th>Yr.</th>
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Figure 1: Copernicus spectra of 70 Oph A in 1976 and 1978.
Figure 2: IUE (solid line) and Copernicus (dashed line) spectra of Altair with a best model fit (dotted line).

Figure 3: IUE spectrum of Procyon with a best model fit.