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 α 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 U1 tube of the central 1.2Å 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 $F_{\odot} = 4.3 \times 10^{11}$ ph cm^{-2} s^{-1} Å^{-1} at 1 A. U..

70 Oph A (K0V, d=5.0 pc, l^{II}=30°, b^{II}=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 = 2.0×10^{-5}, and (3) a velocity dispersion $b_{HI} < 20$ 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} $\leq n_{HI} < 0.45$ cm^{-3}, and a heliocentric bulk velocity $v_{HI} < -14$ km s^{-1}.

Altair (=α Aql, A7IV, d=5.0 pc, $l^{II}=48°$, $b^{II}=-9°$, $V_r=-26$ 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, $l^{II}=214°$, $b^{II}=13°$, $V_r=-3$ km s^{-1})

Figure 3 shows a Ly α spectrum of Procyon derived from a large-aperture IUE observation (SWP6660). 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 > 0.8×10^{-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.

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McClintock, W. Henry, R.C., Linsky, J.L. and Moos, H.W. 1978, *Ap. J.*, *202*, 733.

Table 1

Copernicus Ly α Upper Limits

Star	Sp.T.	dis (pc)	Day	Year	Upper Limit Cts $(14\ s)^{-1}$	$F/F_{\odot}$
β Hyi	G2IV	6.3	197	1976	2.1	2.8
δ Eri	K0IV	8.8	300	1976	1.6	4.3
δ Pav	G8V	5.7	199	1976	1.3	1.4
η Boo	G0IV	9.3	110	1976	1.3	1.4
ζ Her	G0IV	9.8	174	1976	1.0	3.3
η Cas	G0V	5.7	304	1976	1.5	1.6
			299	1978	1.0	3.5
μ Her	G5IV	7.5	213	1976	1.3	2.4
			197	1978	1.3	5.4
τ Cet	G8V	3.5	264	1976	1.4	0.6
			267	1977	1.3	0.7
40 Eri	K1V	4.8	198	1976	1.6	1.2
			297	1978	1.4	3.5

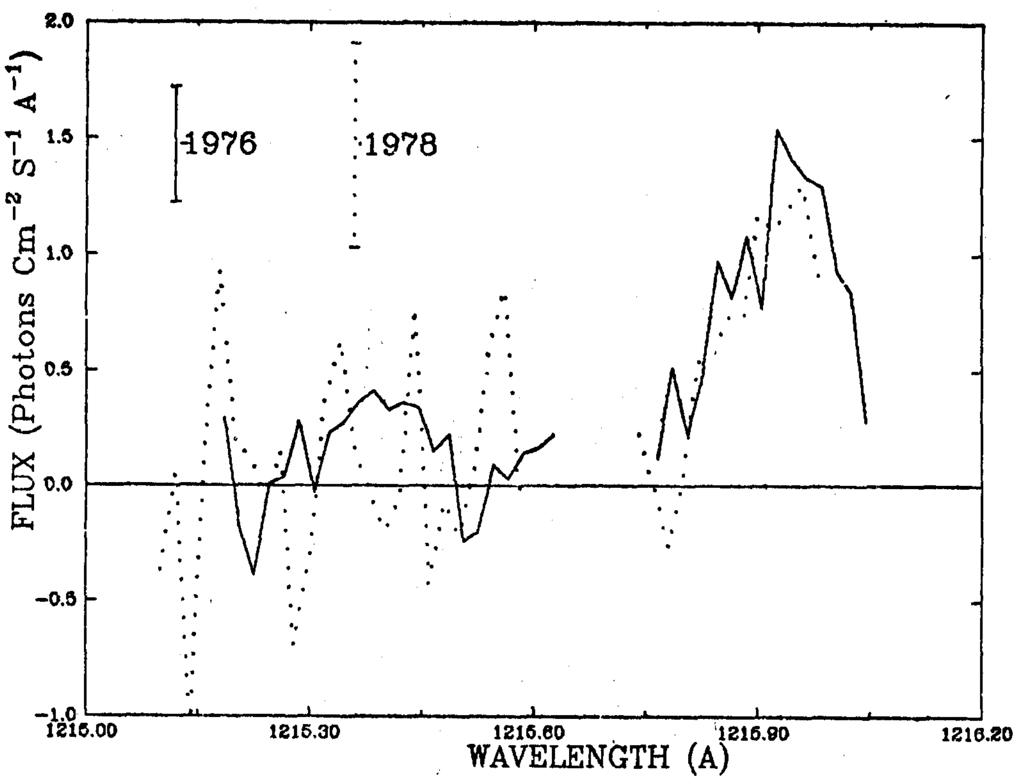

Figure 1: Copernicus spectra of 70 Oph A in 1976 and 1978.

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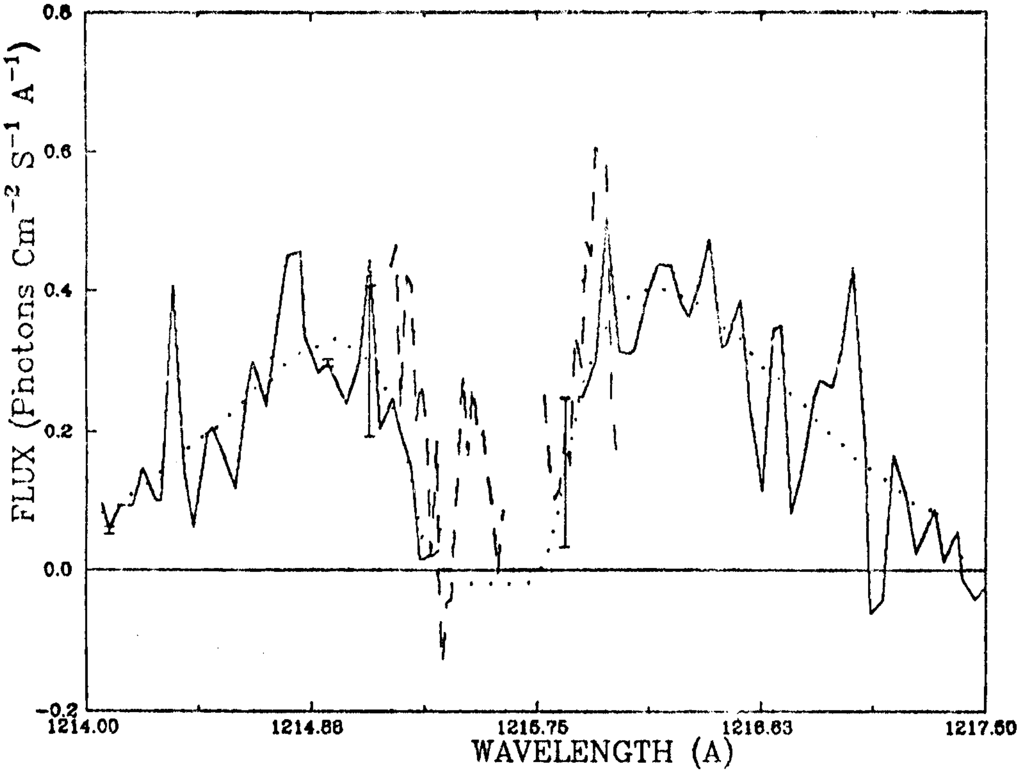

Figure 2: IUE (solid line) and Copernicus (dashed line) spectra of Altair with a best model fit (dotted line)

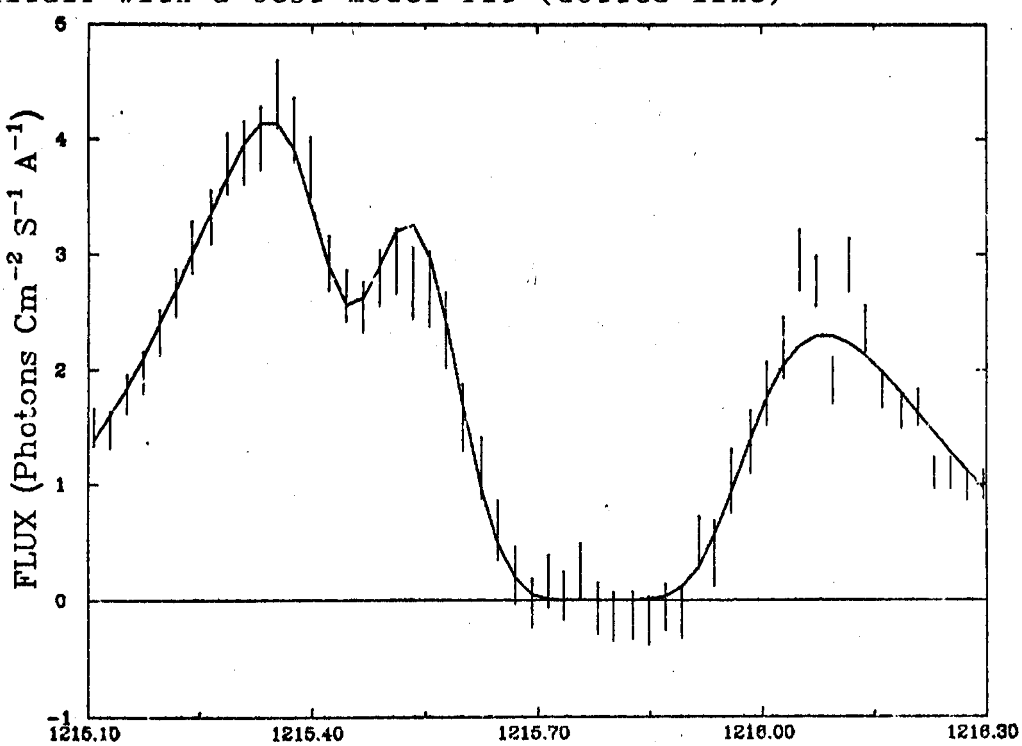

Figure 3: IUE spectrum of Procyon with a best model fit