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Work Summary
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"Nitrogen Abundances from UV Lines of HgMn and Standard Late-B Stars"

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A recent survey by Roby (1987) discovered that the relatively weak, high excitation lines of N I near 7468 and 8680Å were undetectable in the majority of HgMn stars (one type of the chemically-peculiar Ap stars), leading to upper limits on the N abundance of roughly ten times below that of the solar N abundance. Standard stars with similar temperatures (10,000-13,000K) did exhibit these same N I lines and were found to have roughly solar N abundances.

Our project for this summer (continuing from last summer) was to redetermine N abundances in two HgMn stars and four standard stars using the strong, low excitation lines of N I found in the ultraviolet. The observational data consisted of high quality, high resolution, co-added International Ultraviolet Explorer spectra which had been previously collected and reduced by D. Leckrone and S. Adelman.

Examination of the spectra plus considerations of signal/noise and severe line blending led to the choice of three promising N I lines located at 1742.7, 1745.3, and 1411.9Å. The atomic data for these lines (*gf* values, radiative damping, and Stark broadening) were calculated last summer using the best laboratory measurements found in a search of the relevant literature.

The chosen N lines turned out to be blended significantly with Fe II lines (blending is so severe in the UV that a typical "single" feature contains, on the average, three atomic lines). To obtain the abundances for N we computed synthetic spectra to match the observed spectra. The synthetic spectra were calculated using line-blanketed model atmospheres, stellar parameters, and abundances for the other elements based upon previous work by S. Adelman. The N abundance was then adjusted to give the best fit of the observed line profiles. In the 2 HgMn stars, we again find the N I lines to be undetectable, but the stronger intrinsic strength of the new lines yield more stringent upper limits than those obtained previously.

The following changes and improvements were made to the project started last summer. Model atmospheres and abundances were updated in two stars where new results had been reported. An additional N I line and an additional standard star were added to the program. More care was given to the placement of the continuum, including the tentative identification of 2 suspected lines of Fe II (not contained in our previous linelists). A line opacity model was developed for a missing feature adjacent to the N I line at 1745.2Å, leading to a 25% improvement in the N abundance determined from this line.

Figure 1 shows the N I fit at 1745.2A for the standard star, Theta Leo. The solid line shows the observed spectrum, the overlapping dashed line shows the best fit N I abundance, and the dotted line (where the N I abundance has been increased by a factor of 2, or 0.3 dex in log abundance) shows the sensitivity of the fit. In Fig. 2 we see that the same N I line is totally absent in the HgMn star, Iota CrB and only the Fe II blending feature remains. The solid line again represents the observed spectrum, while the three dashed lines from top to bottom represent, respectively, a calculation with no N I present, our new, formal upper limit to the N I abundance assuming a noise level of 2 %, and the previous N I result by Roby(1987).

The resulting N abundances are listed in Table 1 (the 1411.9Å N I abundances are not yet finished) and are on a logarithmic scale relative to the total abundance of all elements which is defined as zero. The log solar abundance of N/Total is -4.05. Thus we find that N is typically depleted by at least factors of 200-660 in the HgMn stars and by roughly 8 times in the standard stars. relative to the sun. The first result agrees with an earlier speculation by Roby that upward diffusion together with a modest stellar wind may totally deplete the surface N in HgMn stars. The second result is a surprise and and suggests the possibilities of non-LTE effects and/or diffusion processes in the standard stars, and we are still considering its implications. If non-LTE effects are present, the effect on both sets of stars should be similar and so we can still conclude that the N in the HgMn stars is at least depleted by factors of 25-85 relative to the standard stars.

Table 1: 1740 N I Abundances compared with other studies

	Current study		Roby, 1987		
	N I	N I	N I(IR)	N I(IR)	N I(IR)
Star	1742.7	1745.2	Roby[a]	Roby	Sadakane
Standard stars					
21 Aql	-4.60	-4.70	-3.94	-3.92	x
Theta Leo	-4.80	-5.20	-4.19	-4.04	-4.25
Pi Cet	-5.40	(-4.60)[b]	-4.40	-4.32	x
Nu Cap	-5.40	-5.05	X	X	x
o Peg	-4.55	-4.35	X	X	-3.65
HgMn Stars					
Kappa Cnc	<-6.50	<-6.20	<-5.19	<-5.02	x
I Crb	<-7.00	<-6.75	(-4.72)[c]	(-4.62)[c]	x

[a] Roby abundances adjusted to temperatures, gravitite, and microturbulence of Adelman models.

[b] Wavelength is shifted by unknown feature, abund. might not be right.

[c] The weak lines seen at 8680Å are most likely due to the secondary star in this binary system, as the UV lines do not show up at all.

Fig. 1

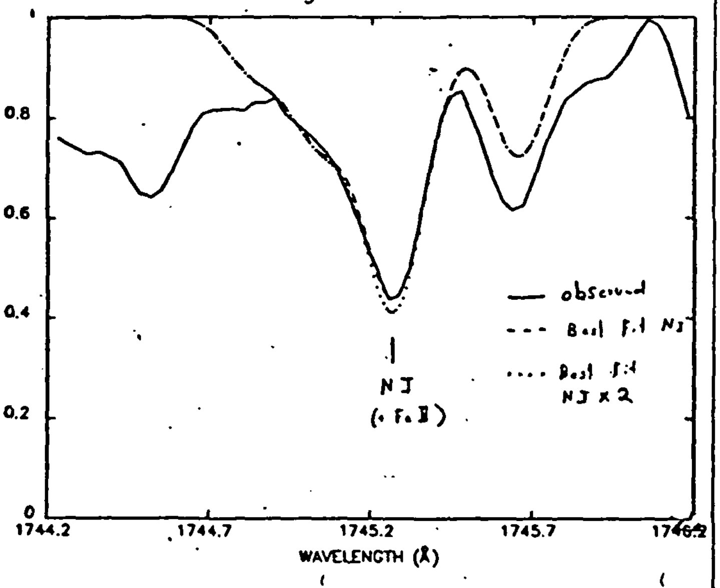
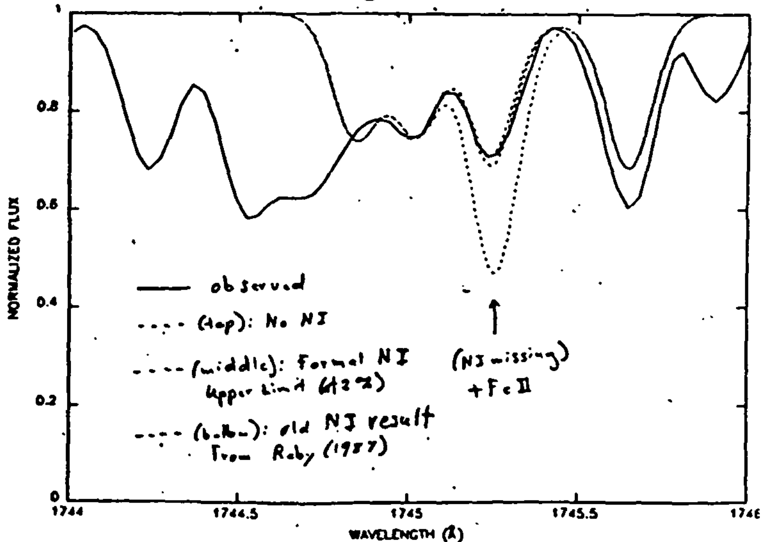


Fig. 2



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