The A-Star Puzzle
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Characteristics of our neighboring A-stars

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Abstract. We have a project, under the aegis of the Nearby Stars (NStars)/Space Interferometry Mission Preparatory Science Program to obtain the spectra, the spectral types, and, where feasible, the basic physical parameters for the 3600 dwarf and giant stars earlier than M0 within 40 parsecs of the Sun. There are 66 B-to-early-F stars among the first 664 stars analyzed in the Northern hemisphere, and 38 of the same among a similar number of Southern hemisphere stars. With these we can start looking at the statistics of Ap, Am, λ Boötis, and other A-type stars for a volume-limited sample, and we can find out just how well we know our neighbors. The project's data are available on our website, `http://stellar.phys.appstate.edu`

Keywords. Surveys, solar neighborhood, stars: fundamental parameters, stars: chemically peculiar

1. The Project

The Nearby Stars (NStars) Spectroscopy Project, carried out jointly at Appalachian State University, the Vatican Observatory and the David Dunlap Observatory is now in its final phases. In this project we have been engaged in obtaining spectroscopic observations of all 3600 dwarf and giant stars earlier than M0 within a radius of 40 parsecs. These blue-violet spectra, obtained at classification resolution, are being used to obtain homogeneous, precise MK spectral types.

In addition, these spectra are being used in conjunction with existing Strömgren *uvby* and Johnson-Cousins *BVRI* photometry and synthetic spectra to derive the basic astrophysical parameters for these stars ($T_{\rm eff}$, $\log g$ and [M/H]). Our spectra include the Ca II K & H lines, which we are using to measure chromospheric activity on the Mount Wilson system (Baliunas *et al.* 1995).

A full description of the methods used in this project are given in Gray *et al.* (2003) with this paper being a summary.

Table 1. Statistics for A-type stars in two subsets of data

Type	Northern		Southern	
Ap	8	12%	4	11%
Am	8	12%	3	8%
λ Bootis	4		0	
metal weak	4		1	
normal	42		29	
Total	66		37	

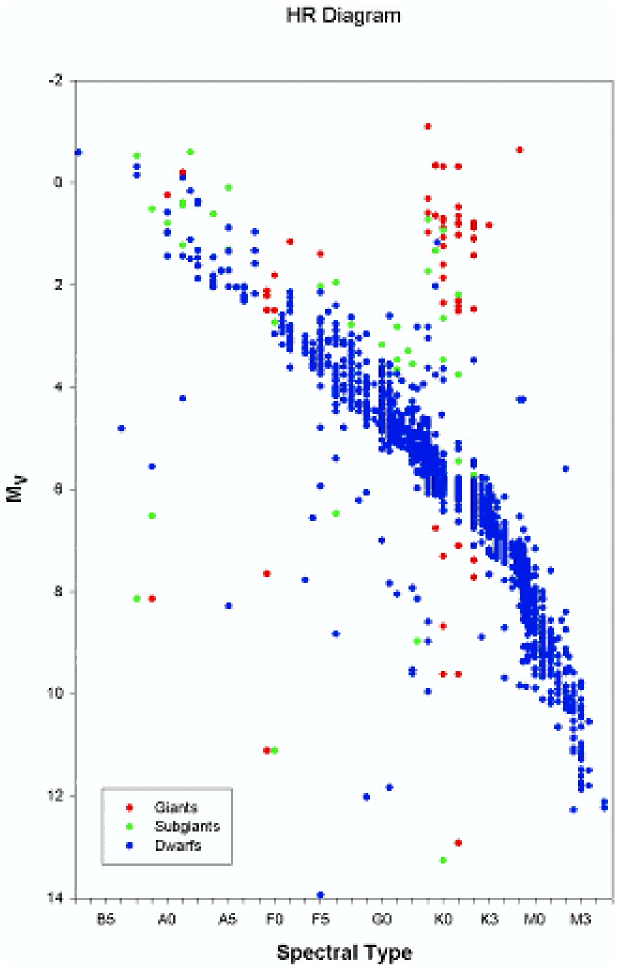

Figure 1. The HR diagram based on our spectral types and Hipparcos parallaxes. The stars that scatter below the Main Sequence all have, without exception, large parallax errors.

2. A-type stars in the Project

The accuracy and homogeneity of our data make possible a number of astrophysical investigations. Here we look at just those with spectral types ranging from B8 to F2 for a Northern set, derived for spectra from the 0.8-m telescope at the Dark Sky Observatory, North Carolina, and for a Southern set from the CTIO 1.5-m telescope. Table 1 summarizes of their statistics (percentages are of the total stars in the spectral range).

These results, representing a little more than one-third of the NStars in our survey, are preliminary. Even though the total number of stars in the two sets is about the same, we do expect the number of A-type stars to be larger in the Northern set since (1) this included a “legacy” group, already observed at DSO, that reflected an author’s interest in A stars, and (2) Eric Olsen’s preference in the Southern Hemisphere Strömgren set was for F- and G-type stars. However, the relative numbers of A-type stars in the four peculiar categories are not biased.

Johnson (2004) found 7% for the percentage of classical Ap/Bp to all equivalent Main Sequence stars. Like Wolff (1968), she found a sharp drop in percentage after A5, with

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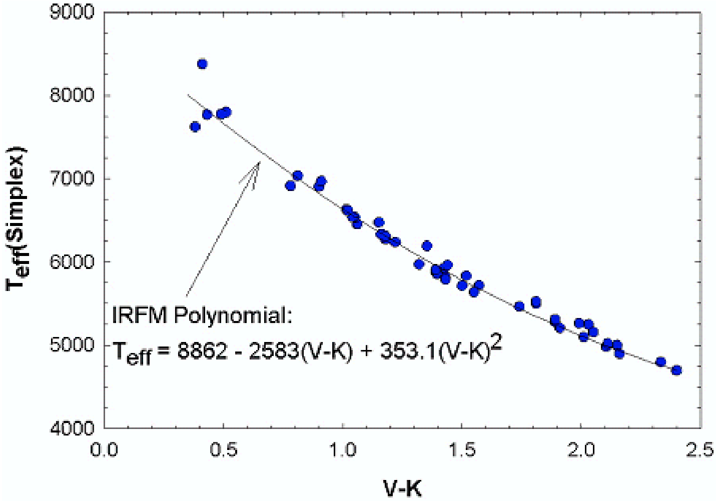

Figure 2. Our derived effective temperatures are in excellent agreement with the infrared flux method (IRFM).

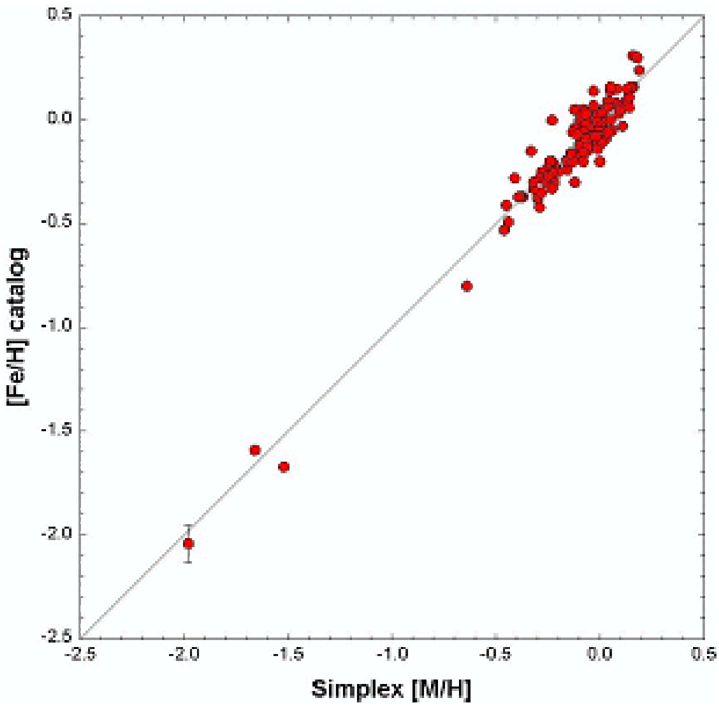

Figure 3. Our [M/H] values are in excellent agreement with the mean [F/H] values from C. de Strobel *et al.* (2002).

the bulk occurring at late-B type. In our volume-limited survey we have very few stars in this peak of the Ap/Bp distribution.

Abt & Morrell (1995) make the point that the better the spectra (both in signal-to-noise and in dispersion), the easier it is securely to spot peculiarities. Though the Northern spectra had both factors somewhat in their favor, these do not seem to be making a significant difference between the percentage of Ap stars detected in our Northern and in our Southern sample.

The four λ Boötis stars in the Northern set are the only ones within 40 pc. That none within this volume should be Southern stars must be due to the statistics of small numbers, always something to bear in mind.

The analysis of our survey of neighboring stars within 40 pc is not yet complete. Yet these preliminary results, just as those for metallicities and chromospheric activities (Gray *et al.* (2003)), are giving a tantalizing indication of what it will be like *really* to know our stellar neighbors.

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