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Properties of a volume-limited sample of Ap-stars

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Abstract. We have performed a complete volume limited survey of the evolutionary, rotational, mulitiplicity, and magnetic properties of all Ap stars within 100 pc of the Sun. Here we summarize our results for the fractional incidence and the magnetic field distribution.
Key words: stars: chemically peculiar – methods: spectropolarimetry

1. Introduction

The *Hipparcos Catalogue* was used to identify all intermediate mass stars within 100 pc of the Sun. From published catalogues and other literature sources, we have identified 57 *bona fide* magnetic Ap stars in this distance-selected sample. Effective temperature, luminosity, radius, and mass were determined for each of the sample stars using published photometry and photometric calibrations, energy distributions, and Hipparcos parallaxes. Using the MuSiCoS spectropolarimeter at the Pic du Midi Observatory and the Least Squares Deconvolution procedure, Stokes I and V profiles were obtained for all sample stars observable from this location. These observations were used in combination with previously published data to refine rotation periods, to determine projected rotational velocities, and to determine magnetic field strengths and geometries.

2. Mass incidence of Ap stars

The bulk fractional incidence of Ap stars in the sample volume (the number if Ap stars within the sample radius divided by the total number of stars within a similar mass range) is 1.7-2.8%.

The fraction of Ap stars with respect to all stars of the same mass was determined. The masses were determined for all intermediate mass stars within the sample radius. The number of intermediate-mass stars in the solar neighbourhood decreases steeply with increased mass. The mass distribution of Ap stars in the solar neighbourhood (Fig. 1: left panel) shows a clear maximum between 2.1 and 2.3 $M_\odot$. A lower mass cut off of 1.5 $M_\odot$ was selected based on the lowest mass Ap stars within the sample, which each have a derived mass of 1.6 ± 0.1 $M_\odot$. The distribution of stars displays a rapid decrease in frequency from 2.4 $M_\odot$ to the lower cut-off at 1.5 $M_\odot$.

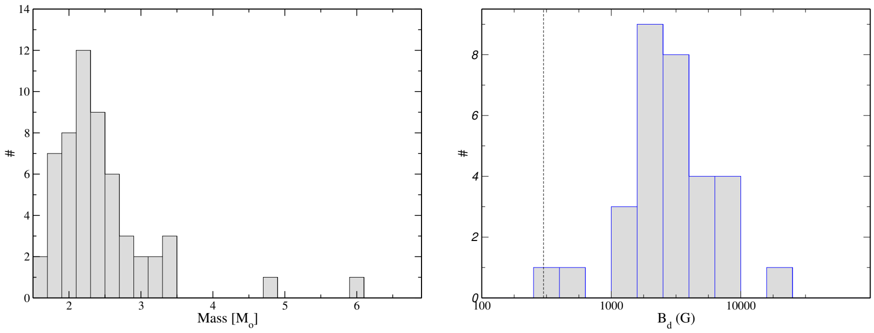

Figure 1. The left panel displays the mass distribution of all Ap stars within the sample radius. The right panel displays the distribution of magnetic dipole field strengths.

The fractional incidence of Ap stars as a function of mass was calculated by dividing the mass distribution of Ap stars by that of the non-Ap stars for identical bin sizes and positions. The incidence distribution as a function of mass to higher masses, to about 3.5 $M_\odot$ where the distribution is poorly sampled. Above 3.5 $M_\odot$, the number of stars in the sample is sufficiently small that the shape of the fractional incidence as a function of mass is completely uncertain.

2.1. Surface dipole field strength

Stokes V and Stokes I spectra were obtained for 26 of the 57 sample stars with the MuSiCoS spectropolarimeter at Télescope Bernard Lyot at Pic du Midi Observatory. The observations obtained were reduced using the ESpRIT data reduction package (Donati, 1997)

The distribution of surface dipole field strengths (Fig. 1: right panel) exhibits a plateau at 2.5+/-0.5 kG, dropping off to higher and lower field strengths. The results obtained agree with those obtained by Aurière *et al.* (2007), which focuses on the magnetic Ap stars with weak magnetic fields. This study includes magnetic Ap stars with a range of field strengths, allowing for a more complete distribution at higher field strengths than that reported by Aurière *et al.* (2007).

References

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