
James Sikora\textsuperscript{1,2}, Gregg Wade\textsuperscript{2}, Jennifer Power\textsuperscript{1,2}

\textsuperscript{1}Dept. of Physics, Queen’s University, Kingston, ON
\textsuperscript{2}Dept. Of Physics, Royal Military College of Canada, Kingston, ON

Survey Goals

Obtain a complete, unbiased spectropolarimetric survey of nearby Ap/Bp stars

- Test for the existence of the "magnetic desert"
- Derive self-consistent fundamental, chemical, and magnetic properties of these Ap/Bp stars
- Compare the samples of Ap/Bp and A/B ("normal")
The Sample

Catalogue of chemically peculiar stars with parallax angles $\geq 10$ mas

(Renson & Manfroid 2009)
(van Leeuwen 2007)

Candidate Ap/Bp Stars

1. Known to be magnetic?

2. Exhibits photometric variability?

3. Satisfies photometric peculiarity relations?

(Paunzen & Maitzen 2005)
The Sample

Hipparcos catalogue within 100 pc:

- ~19,000 stars
- ~3,000 MS A/B stars within 100 pc
Fundamental Parameters

- **LLmodels (Shulyak et al. 2004)**
  - Calculate model atmospheres (and synthetic SEDs) with chemical peculiarities and strong magnetic fields (Kochukhov et al. 2005)

- **Grid Search in Stellar Parameters (GSSP) (Tkachenko 2015)**
  \[ F = F(\log g, \nu \sin i, \xi_{mic}, X_i) \]
  1. Fit synthetic SEDs to available photometry
  2. Fit model spectra to averaged Balmer lines
  3. Generate new chemically peculiar atmospheric models/SEDs (e.g. Silvester et al. 2015)
Fundamental Parameters

\[ T_{\text{eff}} = 10500 \text{ K} \]
\[ \log(g) = 4.0 \text{ (cgs)} \]

HD140728

\[ T_{\text{eff}} = 10500 \text{ K} \]
\[ \log(g) = 4.0 \text{ (cgs)} \]

HD140728
**Fundamental Parameters**

- $T_{\text{eff}} = 8400$ K
- $\log(g) = 3.8$ (cgs)

![Graphs showing wavelength vs. intensity for HD148898 with $T_{\text{eff}} = 8400$ K and $\log(g) = 3.7$ (cgs).]
Fundamental Parameters

\[ T_{\text{eff}} = 7700 \text{ K} \]
\[ \log(g) = 4.5 \text{ (cgs)} \]

HD176232

\[ T_{\text{eff}} = 7700 \text{ K} \]
\[ \log(g) = 4.1 \text{ (cgs)} \]

HD176232
Fundamental Parameters
Fundamental Parameters

$M/M_\odot$

Incidence Rate

Non-Magnetic A/B

Magnetic Ap/Bp

James Sikora
# Magnetic Observations

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Known Ap/Bp Stars (d ≤ 100 pc)</td>
<td>52</td>
</tr>
<tr>
<td># of New ESPaDOnS Spectra Obtained</td>
<td>109</td>
</tr>
<tr>
<td># of New Narval Spectra Obtained</td>
<td>17</td>
</tr>
<tr>
<td># of Stars Observed</td>
<td>47</td>
</tr>
</tbody>
</table>

Target $B_z$ Uncertainty: $\leq 25$ G
Magnetic Observations

\[ i = 69^{+18}_{-9} \, ^\circ \quad \beta = 89^{+1}_{-22} \, ^\circ \quad B_p = 840^{+90}_{-70} \, G \]

Rauw et al. (2010)
Magnetic Observations

HD176232

HD187474
Magnetic Observations

HD203006

Phase (P = 1.0610 d)

HD203006

New ESP

Phase (P = 2.1206 d)
Rotational Properties

$0.52 \text{ d} \leq P_{\text{rot}} \lesssim 100 \text{ yrs}$
Dipole Field Strengths
Dipole Field Strengths

Critical field strength below which fields undergo rapid decay

(Auriere et al. 2007)
Dipole Field Strengths

![Graphs showing observed and predicted dipole field strengths]

- The left graph plots the number of observations ($N$) against the dipole field strength ($B_d$) in Gauss (G), with bins ranging from $10^1$ to $10^5$ G.
- The right graph plots the ratio of the dipole field to the critical field ($B_d/B_c$) against $N$, with bins ranging from 0.1 to 100.

Legend:
- Observed
- Predicted
- Initial
Magnetic Geometry

Rauw et al. (2010)

The diagram shows a histogram of the number of objects (N) as a function of the angle (β) in degrees. The x-axis represents the angle (β) ranging from 0 to 90 degrees, and the y-axis represents the number of objects (N) ranging from 0 to 20. The data is presented with error bars indicating variability. The title of the diagram is "Magnetic Geometry."
Summary & Conclusions

• We have completed a volume-limited survey of Ap/Bp stars within 100 pc
• Important to establish unbiased* statistical properties of Ap/Bp stars

1. Incidence rates of large-scale fields increase with mass
2. There exists a "magnetic desert" for $B_d < 300$ G
3. Moderate increase in number of Ap/Bp stars with large obliquity angles
Summary & Conclusions

![Graph showing log(L/Lo) vs log(T_{eff}/K) with isochrones and stellar masses](image)