*The A-Star Puzzle*
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# Panel discussion section A

Chair: W.W. Weiss

Section organizer & key-note speaker: Saul J. Adelman
Invited speakers: J. Kubát, D. Korčáková
Contribution speakers: J. Krtička, O. Kochukhov, S.J. Adelman, F. Royer

## Discussion

Cowley: For O. Kochukov: This concerns the $\lambda 5200$ feature which you could reproduce in the cooler Ap stars, but not in the hotter ones: 1) Do you know which atoms or ions cause the depression in the cooler stars?

2) In the hotter stars, can you suggest a cause for the observed depressions in these objects?

Kochukov: 1) The model atmosphere calculations for magnetic stars described in my talk were carried out for solar and for scaled solar compositions. In this case neutral iron lines are the main contributor to the $\lambda 5200$ feature.

2) As for the feature in hotter Ap stars, other effects related to the strong surface magnetic fields, for instance vertical abundance stratification, may be responsible. Indeed opacity sample model atmosphere calculations by Shulyak *et al.* (2004, A&A, in press) demonstrated that by introducing a fairly moderate increase at $\log \tau_{5000} = -1$) the vertical stratification of iron can reproduce the feature in the hot magnetic star CU Vir.

Breger: I would like to comment on the division into normal and abnormal stars by rotation. It was mentioned that the low-$v \sin i$ normal stars a really rapid rotators seen pole-on. Nonradial pulsation permits one to determine uniquely the angle of inclination of the rotation axis to the line of sight. For the $\delta$ Scuti star FY Vir we have determined the angle $i$ to be $20°$, making the true rotation 65 km s$^{-1}$. But the star is normal! Maybe the rotation rule is not absolute, as is also shown by a few other known stars.

Balona: Rapid rotation inhibits difusion and may explain why normal A stars are mostly fast rotators. Similarly a star born with a high magnetic field could end up as a slow rotator due to magnetic braking. Assuming that stars in a cluster have about the same angular momentum and magnetic field distribution one expects to see that A stars in open clusters would either be nearly all normal (fast rotation) or nearly all peculiar (slow rotation). Do observations confirm this?

Monier: In answer to the Balona's question to the audience: I will present tomorrow abundance results for A and F stars in various open clusters (*these Proceedings*, 209) and discuss the abundance patterns.

Mathys: If there was a signicant number of fast rotating stars with chemical peculiarities that have remained undetected so far in spectroscopic abundance studies, should we not expect a fraction of them at least to show photometric variations that could and should have been found, e.g., by the Hipparcos survey?

Adelman: Hipparcos photometry variability is dependent on its bandpass which is most of the optical region. What remains is the possibility of a) Stars which are low amplitude variables only in narrow wavelength regions, and b) Late B stars where the optical spectrum has few lines. But when the amplitude of variability drops below 0.02 mag., one cannot do much with this data.

Landstreet: I have two comments on using the Hipparcos photometry to find Ap photometric variables: 1) The Hipparcos photometry is not extremely accurate, with typical errors of more than 0.01 mag. Some known photometric variable Ap stars are not detected as such by Hipparcos. 2) I have search the Hipparcos variable star archive for all the A stars in several clusters (several tens of stars). No new photometric variables of Ap type were found.

Wade: Because most of these stars are probably magnetic, a relatively robust way to identify them, essentialy insensitive to rotation, is polarimetry within Balmer lines (using instruments like John Landstreet's photopolarimeter or FORS1 @ VLT).

Ryabchikova: Does including the magnetic field in line-blanketing calculations explain an inconsistency of about 1 dex in $\log g$, obtained for highly magnetic stars from optical spectrophotometry and from Balmer line profiles?

Kochukov: The model structure does not change dramatically when the magnetic field is included. Changes in the flux distribution and in the H-line profiles relatve to a nonmagnetic model are definitely too small to explain a 1 dex discrepancy of $\log g$. Including the indirect effects of magnetic field (i.e., chemical stratification) seem to be more promising for deriving a consistent $\log g$ from energy distributions and Balmer lines.

Cunha: Given the amount of physics that goes into model atmospheres, how much can we trust the global parameters derived through spectroscopic techniques, particularly $T_{\rm eff}$ in Ap stars? What are the main improvements needed for a more precise determination of these parameters?

Adelman: The temperature calibrations for normal stars from say Strömgren photometry are not correct for the CP stars. The models have to fit the observed energy distributions including the broad, continuum features and the Balmer line profiles. It is the features which have proven problematic. In part they are due to the stars being metal-rich, but not in a scaled solar sense. I believe that opacities which include the effects of auto-ionization will help. As soon as the ASTRA spectrophotometer begins to produce data (hopefully within two years) much better fluxes will become available and this should help. An effort will be made to get $T_{\rm eff}$ values for as many fundamental stars as possible.

Kupka: Two comments: 1) On O. Kochukov's answer to C. Cowley's question concerning the $\lambda 5200$ feature: I agree that Fe is the most important line opacity source in the cool mCP stars which have an important ifluence on the flux redistribution. Moreover, from analyses done with E. Paunzen & collaborators on the $\lambda 5200$ feature, we found Cr not to be evenly distributed throughout the feature in the wavelength range measured by the $\Delta$a-system. Cr is certainly a key contributor to the feature at least for the cool mCP stars and the feature and its variation over the HRD is more likely caused by several contributing species, even if Fe is much more important for the temperature structure and flux distribution of these stars as a whole.

2) About M. Cunha's question on $T_{\rm eff}$ determinations: Recently it has become popular to use a modified version of D. F. Gray's procedure based on line strength ratios to determine extremely accurate absolute $T_{\rm eff}$ values. However, these all have to rely on some calibration using model atmospheres and $T_{\rm eff}$ values based on fundamental methods. As a result these errors propagate into the determination: accurate $T_{\rm eff}$ values for fundamental stars are scarce and in the 100 K to 400 K range for the most cases. As trends over the H-R Diagram are not known well enough, it is in my opinion questionable to claim ABSOLUTE $T_{\rm eff}$ values to be more accurate than say 150 K.

Landstreet: Dave Gray's efforts to measure very accurate temperatures in cool stars (uncertainities of a few K) have been discussed. I simply want to remark that Dave's very high precision is claimed for detecting small CHANGES in temperature, not for absolute temperatures.

Wade: Theme introduced by L. Balona: Returning to the issue of open clusters, we find from our survey of magnetic stars in open clusters that there exists a tremendous HETEROGENEITY of magnetic and abundance characteristics amongst Ap stars in individual open clusters, even at very young ages (few $\times 10^6$ y). The situation is very complex indeed.

Weiss: I remember a conference in Bormio where C. Cowley mentioned in his talk that the influence of NLTE effects seem to be much overestimated and it is not really so important to do NLTE calculations in chemical peculiar stars. I also remember a comment of Sydney Wolff in the "The A-Type Stars: Problems and Perspective"(1983, NASA SP-463) and I asked her about Hydrogen line profiles and metallic line profiles and she answered she was also quite surprised. We have heard today quite a bit about NLTEs effects.

Cowley: Just to clarify my comments on the relative importance of NLTE vs. LTE. This comes from a time when those who firmly believed that NLTE was the ONLY way to compute spectra. They did not believe in ANY anomalous abundances in CP stars. Today the question for us to ask is which lines are the most sensitive to NLTE. Then those of us who still use LTE codes can avoid these features.