SPECTROPHOTOMETRY OF THE BROAD CONTINUUM FEATURES IN MAGNETIC AP STARS

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EFFECT OF THE λ5200 FEATURE ON PHOTOMETRIC COLORS

The strongest broad absorption feature in the peculiar energy distributions of the Ap stars is that centered at about 5200 Å, thus the Stromgren y band and the Geneva V1 band are most affected in stars in which this feature is strong. Fig. 1 shows bandpasses (full width at ½ intensity maximum) of three widely used photometric systems superimposed on two of our scans of Ap stars and two solar abundance line blanketed model atmospheres (Kurucz 1979). It is seen that both the y and V1 bands fall entirely within the λ5200 feature. The plot (Fig. 2a) of b-y vs. Tpc (the color temperature of the red end of the Paschen continuum), shows that the b-y colors for most of our sample of Ap stars are displaced to the blue of the b-y, Teff relationship of Relyea and Kurucz (1978). In Fig. 2b, Δ(b-y) = (model b-y) - (observed b-y), for a given temperature is plotted vs. $\Delta WS_2(5200)$, a spectrophotometric index measuring the equivalent width of the λ5200 feature. There is a strong correlation between Δ(b-y) and $\Delta WS_2(5200)$, indicating quantitatively the large effect of the λ5200 feature on the y band, previously discussed by Adelman (1979). The deviations in Ap star B2-G values from the normal star B2-G vs. T curve are much less than for b-y, as the Geneva G band is largely outside the λ5200 feature (Fig. 2c). Thus B2-G is a better temperature indicator for Ap stars than is b-y (also see Hauck and North 1982).

PROFILES OF THE λ5200 FEATURE

Our scans of the Ap stars enable us to look for trends in the shape of the λ5200 feature. We can detect structures found earlier at higher resolutions for smaller numbers of stars (Maitzen and Seggewiss 1980 and references thereir), such as a deep core at λ5200. We have made a preliminary classification of Ap stars based on the profiles of the λ5200 feature. Fig. 3 shows the characteristic profiles for the five groups of stars in relation to the bands used for two of the λ5200 photometric indices, Δa and Δ(V1-G). In general, only the

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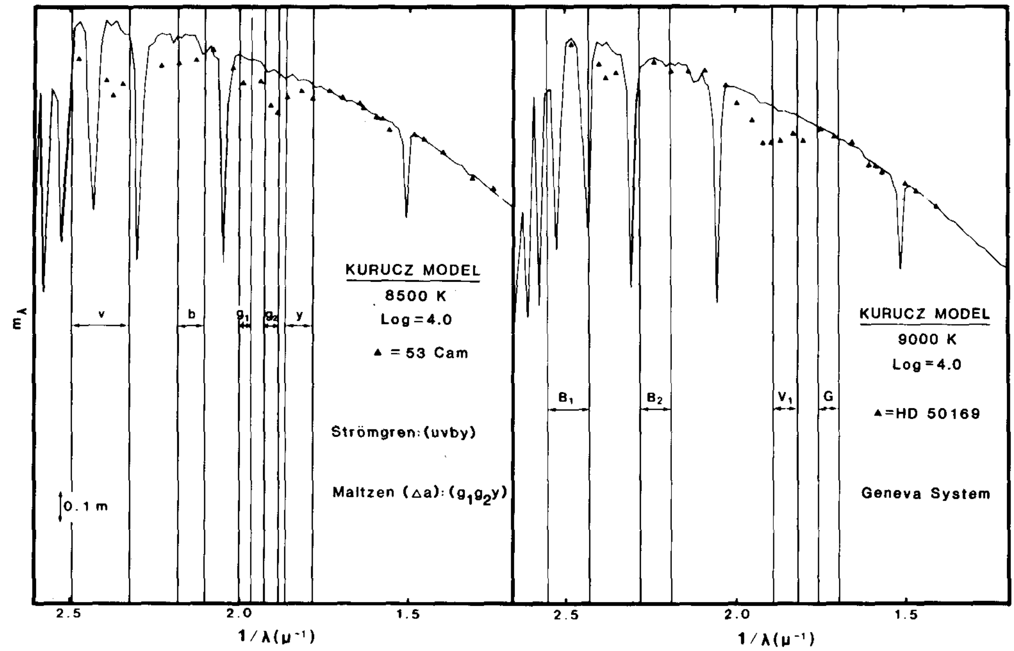

Figure 1. Photometric systems, normal star models and Ap star energy distributions in the visual spectral region.

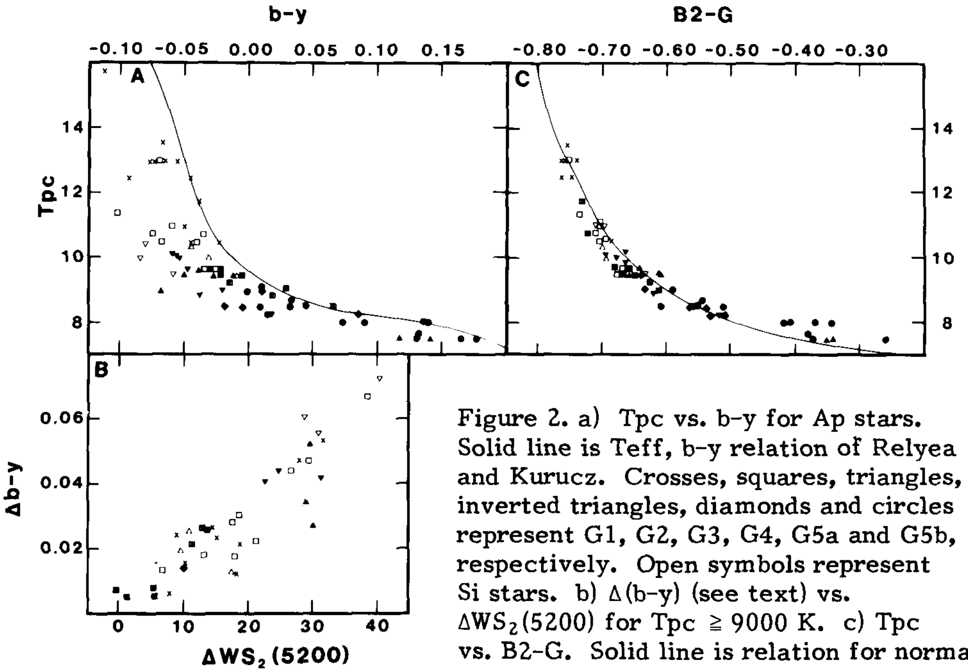

Figure 2. a) Tpc vs. b-y for Ap stars. Solid line is Teff, b-y relation of Relyea and Kurucz. Crosses, squares, triangles, inverted triangles, diamonds and circles represent G1, G2, G3, G4, G5a and G5b, respectively. Open symbols represent Si stars. b) Δ(b-y) (see text) vs. $\Delta WS_2(5200)$ for Tpc $\geq$ 9000 K. c) Tpc vs. B2-G. Solid line is relation for normal stars.

hotter Si stars of Group 1 (G1) show the very deep λ5200 core, while only the cooler SrCrEu stars of G5b show absorption minima at λ5000 and λ5556, with the central core shallower and shifted toward the red. In G3 and G4, which contain both Si and non-Si stars, the Si stars usually show more absorption at λ5360 and λ5470. In Fig. 4, (V1-G) is plotted vs. ΔWS$_2$(5200). The points for stars in G3, G4 and G5 in general fall below those in G1 and G2. This is because the V1 band measures only the red half of the feature, so in G3, G4 and G5, which have stronger redward absorption, Δ(V1-G) measures a stronger feature than in G1 and G2. In Fig. 5, our synthesized values of Δa (Adelman 1979 and references therein) are plotted vs. Δa', the photometric index that measures the absorption at λ5264 relative to points at λ4785 and λ5840, which are outside the feature. The plot shows the G1 stars to have the greatest slope and the G5 stars the smallest. This is due to the fact that the Δa index better detects the central core of the feature at λ5200, since the g$_2$ band covers most of it. However, neither the y nor the g$_1$ band is outside the broader shallow absorption, thus Δa values are stronger for stars in G1 and weakest for those in G5, where the central core is

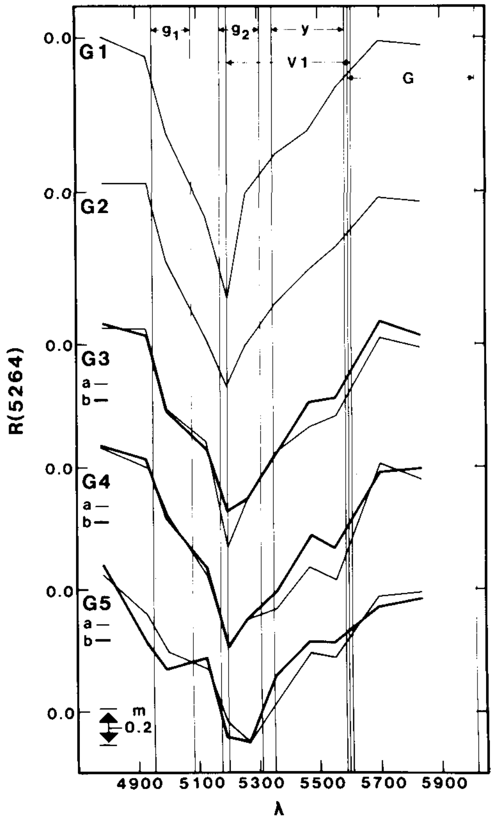

Figure 3. λ5200 profiles and Maitzen and Geneva photometric bands. R(5264) is the residual intensity normalized to λ5264.

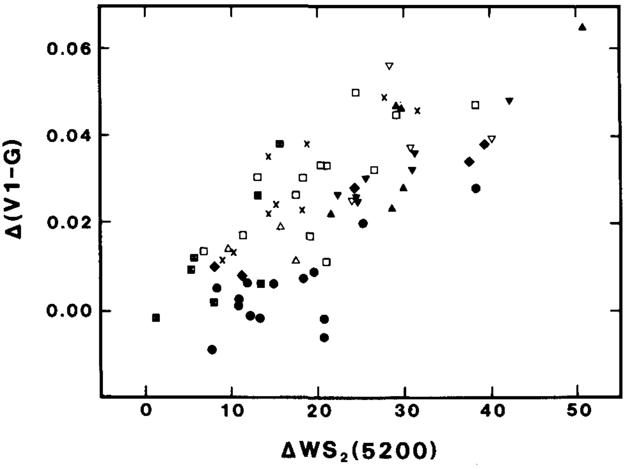

Figure 4. Δ(V1-G) vs. ΔWS$_2$(5200). Symbols are the same as in Fig. 2.

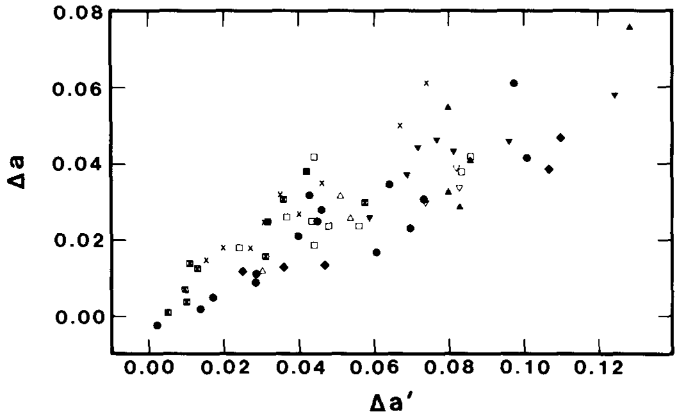

Figure 5. Synthesized Δa vs. Δa'. Symbols are the same as in Fig. 2.

weaker and absorption is stronger in both the g_1 and y bands.

CORRELATIONS

The spectrophotometric index $\Delta WS_2(5200)$ shows good correlations (r = 0.8) with the Geneva and Maitzen λ5200 indices, Δ(V1-G), Z and Δa. There is also a strong correlation (r = 0.8) between the spectrophotometric indices for the λ5200 and λ4200 broad absorption features, showing that both are strong in the same stars. A peculiarity index, PI, was calculated based on the presence of all four of the broad features, with PI = 8 if all four are definitely present. There is a good correlation between PI and $\Delta WS_2(5200)$, showing that stars peculiar in one feature tend to be peculiar in all. In addition, the cooler SrCrEu stars tend to have greater values of PI. We find that the average temperature decreases from G1 to G5, while the average PI value increases, however the correlation is not strong.

These investigations are part of a broader study which is in preparation.

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