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CONTRIBUTION OF INTERSTELLAR MATTER TO LINE WIDTHS OF Ca II LINES IN SPECTRA OF LATE-TYPE STARS

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Abstract. In this paper the contribution of interstellar matter to line widths of emission Ca II H and K lines in spectra of late-type stars is considered. We found that interstellar matter contribute to line widths of late-type Ca II H and K lines, and that in physical interpretation of Wilson-Bappu effect as well as in studies of stellar chromospheres in these lines, this effect should be taken into account.

1. INTRODUCTION

The strong emission Ca II and Mg II (H and K) lines are observed in spectra of late-type stars. These lines originate in chromospheres and are powerful diagnostic tool for studying stellar chromospheres. Also, a correlation between the Ca II and Mg II (H and K) emission line widths and the absolute visual magnitude of late-type stars was discovered (Wilson & Bappu 1957) and named as Wilson-Bappu effect. Using a sample of 155 late-type stars they found empirical linear dependence of Ca II emission lines width W and absolute visual magnitude M_V for G, K and M-type stars:

$$M_V = A + B\log(W),$$

where A and B are coefficients. Also, these relationship is valid for Mg II emission lines (McClintock et al. 1975, Weiler and Oegerle 1979, Vladilo et al. 1987, Gurzadyan 1991).

An attempt to explain this effect was made by Gurzadyan (1991) in the frame of influence of microturbulent motion on widths of these lines.

Also, it was noticed that Ca II lines are usually the true stellar profiles, while the Mg II lines are contaminated by interstellar absorption (see e.g. Böhm-Vitense 1981, Vladilo et al. 1987). In order to investigate other possible correlations between different physical parameters, here we consider the influence of interstellar matter on Ca II line widths. Our aim in this paper is to determine the importance of interstellar influence on line width of emission Ca II H and K lines.

2. RESULTS AND DISCUSSION

Based on data for Ca II H and K line widths of 155 late-type stars given by Wilson-Bappu (1957) we have considered correlation between distances from the stars and their spectral line equivalent widths. Taking into account that the density of interstellar matter is higher near the Galactic plane than further away, we have divided the stars into two groups: 1) the stars with Galactic latitude $b < 20°$ and 2) $b > 20°$. Then we have calculated the correlation between distance and line width for the whole sample and for both groups separately.

The correlation coefficient has been calculated using the following formula:

$$r = \frac{\sum_{i=1}^{n}(D_i - < D >)(W_i - < W >)}{\sqrt{\sum_{i=1}^{n}(D_i - < D >)^2 (W_i - < W >)^2}},$$

where D_i is the distance to the i^{th} star, $< D >$ an average distance to the sample stars, W_i the Ca II line width observed in the i^{th} star, $< W >$ an average line width of the sample stars.

First we have found coefficient of correlation for all (155) considered stars, $r = 0.76 \pm 0.05$ (Fig. 1). Then the coefficient of correlation for the stars near Galactic plane, $r = 0.79 \pm 0.08$ (Fig. 2) and for the stars with $b > 20°$, $r = 0.64 \pm 0.07$ (Fig. 3).

Similar colerration between hot (O, A and B) stars and widths of emission Mg II lines was found (see e.g. Kondo et al., 1976, Gurzadyan 1984).

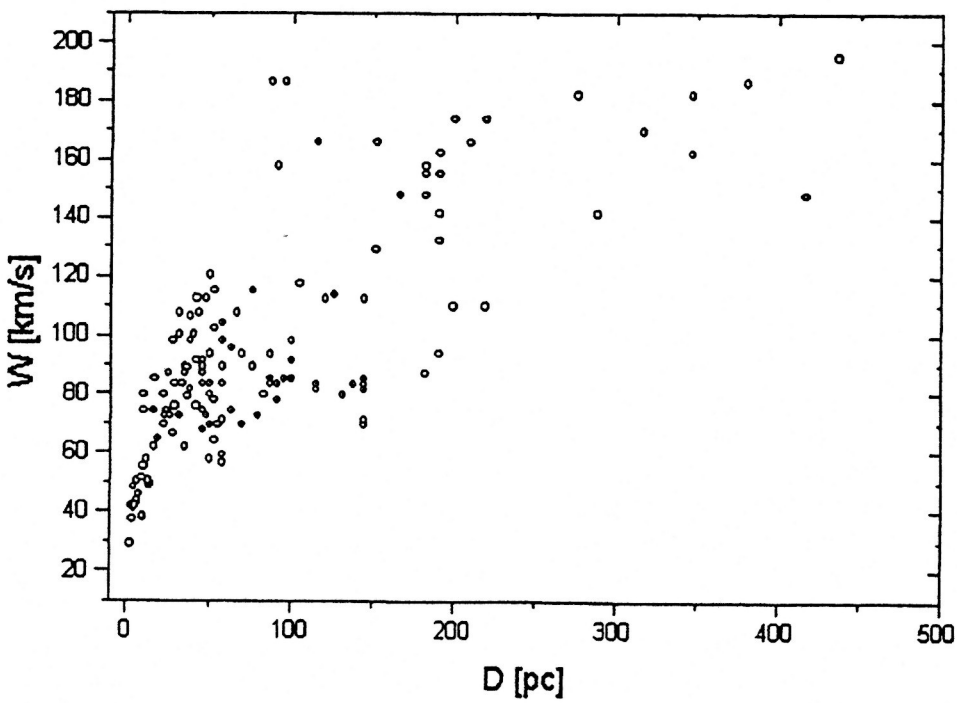

Fig. 1. The equivalent widths as a function of distance for a sample of 155 stars.

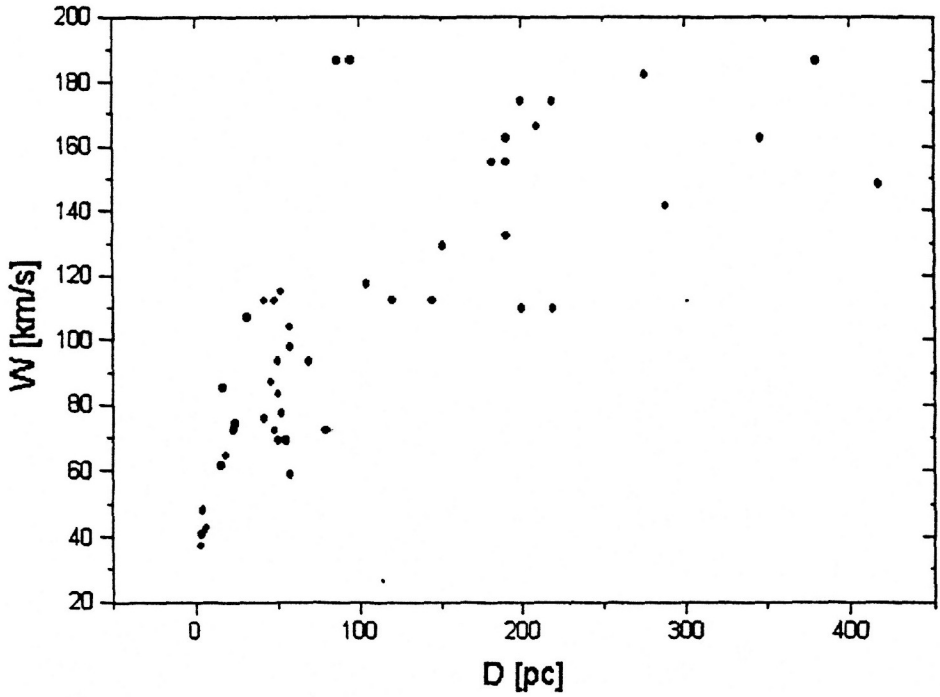

Fig. 2. The same as in Fig. 1, but for stars with $b < 20$.

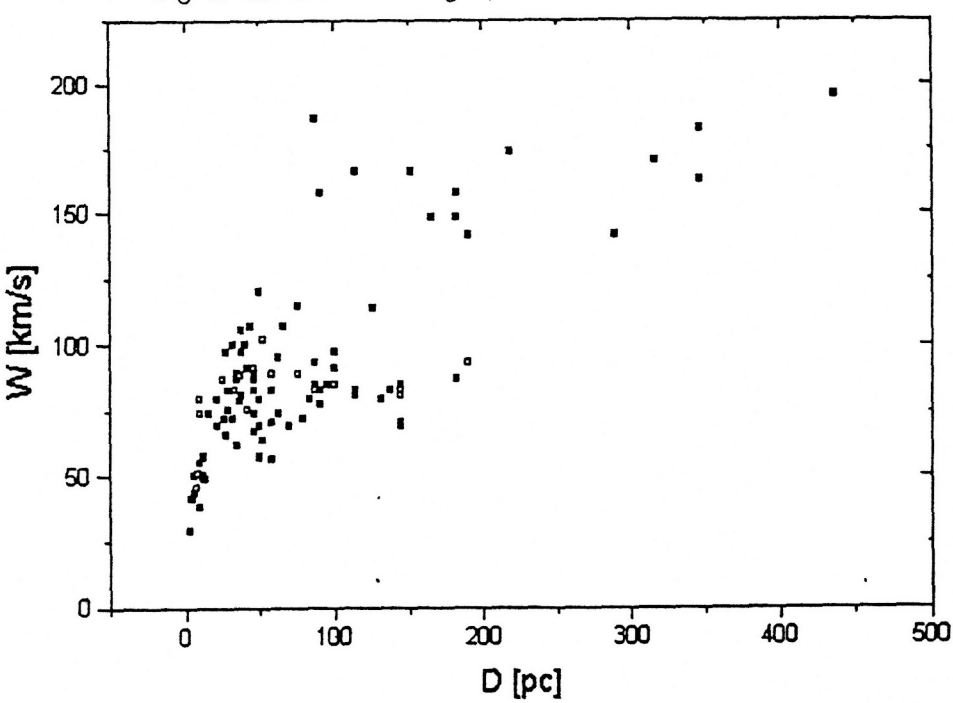

Fig. 3. The same as in Fig. 1, but for stars with $b > 20$.

3. CONCLUSION

From our analysis we can conclude that interstellar absorption is present in Ca II H and K emission lines. In consideration of Wilson-Bappu effect as well as in study of stellar chromospheres using these lines the contribution of interstellar matter should be taken into account. This contamination, especially for the stars near Galactic plane should be considered.

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