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STARK BROADENING OF Hg II LINES IN STELLAR ATMOSPHERES

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INTRODUCTION

Stark broadening data for some Hg II lines are of importance for investigation of stellar spectra. For example the $6s^2\ ^2D_{5/2} - 6p^2P^o_{3/2}$ 3983.9 Å Hg II line is a strong and characteristic feature in the spectrum of Hg Mn Bp stars, most of the Mn stars, and in some magnetic Ap stars (Dworetsky, 1980; Cowley and Aikman, 1975; White et al., 1976; Wolf, 1983). This line is used, e.g., for the Hg abundance determination in the atmosphere of ϕ Her (Ryabchikova and Piskunov, 1988). The significance of the resonance $6s^2S - 6p^2P^o$ 1942 Å Hg II line for the Hg stellar abundance determination has been pointed out in Dworetsky (1980). The mentioned Hg II multiplets, as well as the $6p^2P^o - 6d^2D$ and $6p^2P^o - 7s^2S$ transitions, have been observed in the α And spectrum (Aydin and Hack, 1978; Stalio, 1974).

RESULTS AND DISCUSSION

By using the semiclassical-perturbation formalism (Sahal-Bréchot, 1969ab) we have calculated electron-, proton-, and ionized-helium-impact line widths and shifts for 7 Hg II lines . A summary of the formalism is given in Dimitrijević et al. (1991). Tabulated Stark broadening parameters as a function of temperature will be published elsewhere (Dimitrijević, 1992). Here, we present and discuss the comparison with the experimental data (Murakava, 1966;

Djeniže et al., 1990).

For the most critical transitions, the values for log gf(3984 Å) = -1.85, log gf (1649.9 Å) = -0.06 and log gf (1942.3 Å) = -0.31, derived in Dworetsky (1980) on the basis of published laboratory and theoretical, data have been used. If we use the Coulomb approximation, we obtain log gf (3984 Å) = -0.25 and log gf (1649.9 Å) = +0.12. For our case, these differences are very important since, if we use Coulomb-approximation log gf values, the differences in line-width results may be as great as 50%.

TABLE I Comparison of the experimentally determined Stark full half widths of Hg II lines (W_M) with the present results (W_{SC}) and with calculations performed in Djeniže et al. (1990) by using the simple semiempirical method (Griem, 1968) (W_{SE}). The experimental data: a - Murakawa (1966); b -Djeniže et al (1990) and c - Djeniže et. al (1992).

λ(Å)	T(K)	$N/10^{16}$ (cm^{-3})	W_M (Å)	W_{SC} (Å)	W_{SE} (Å)	d_M (Å)	d_{SC} (Å)	Ref.
3983.9	6500	1	0.0238	0.0201	0.036	0.002	0.006	a
	37000	4.2	0.066	0.037	0.064			b
	48000	13.7	0.192	0.109		0.00	0.03	c
2847.7	37000	4.2	0.061	0.054	0.080			b
2224.7	42000	13.3	0.190	0.164	0.133*	-0.06	0.03	c

*Value at 40000 K.

In Table I we compare our results with experimental data (Murakava, 1966; Djeniže et al, 1990, 1992) and with calculations performed in Djeniže (1990, 1992) by using the simple semiempirical method (Griem, 1968). We must take into account the fact that for a heavy emitter with a complex spectrum, the accuracy of the semiclassical method is lower than it is for lighter atoms. However, the agreement with experimental data is satisfactory in the case of the 2847.3 Å as well as the 2224.7Å line width. In the case of the astrophysically important 3983.9 Å line, our results underestimate the real Stark width since, for broadening of the lower levels, only the most important transition $6s^2\ ^2D_{5/2}$ - $6p^2P^o_{3/2}$ has been taken into account. For this particular line, the accuracy may be improved by multiplying the semiclassical line widths by an averaged ratio of measured to calculated values. In this manner, we have a semiclassical temperature dependence, and the influence of neglected perturbing transitions is partly compensated for.

In the case of the shift a large disagreement exists, and in the case of 2224.7 line even the sign is different. However, one must take into account that shifts are considerably smaller than widths. Moreover, the theoretical shift accuracy is generally smaller than the width accuracy (see e. g. Dimitrijević, 1990).

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