ON THE STARK BROADENING OF
NEUTRAL SILVER SPECTRAL LINES

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Abstract. Within the semiclassical perturbation approach, we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 48 Ag I lines, for perturber densities $10^{12} - 10^{19}$ cm^{-3} and temperatures T = 2,500 − 50,000 K.

1. INTRODUCTION

Stark broadening contribution to neutral silver spectral line shapes has been considered experimentaly (Holtsmark and Trumpy 1925, Kitaeva 1956) and theoreticaly (Kitaeva 1956, Pichler 1972). In Pichler (1972) quadratic Stark broadening constants of neutral silver spectral lines, calculated in the Coulomb approximation, have been determined. Our objective here, is to continue efforts to provide to plasma physicists and astrophysicists Stark broadening parameters needed for investigation and modelling of various plasmas (see Dimitrijević and Sahal - Bréchot 1984, Dimitrijević 1996, and references therein). In this contribution, a part of our results for electron-, proton-, and ionized helium-impact line widths and shifts for 48 Ag I spectral lines is presented.

2. RESULTS AND DISCUSSION

A summary of the formalism is given e. g. in Dimitrijević and Sahal-Bréchot 1984. Energy levels have been taken from Moore (1971).

Our results for 48 neutral silver spectral lines as a function of the perturber density and temperature will be published in Dimitrijević and Sahal-Bréchot (1999).

As a sample of our results, the Stark broadening parameters for Ag I spectral lines broadened by electron and proton impacts, for a perturber density of 10^{16} cm^{-3}, are shown in Table 1.

The existing experimental data (Holtsmark and Trumpy 1925, Kitaeva 1956) are not included in the review of critically selected experimental Stark broadening data

(Konjević and Roberts 1976). In order to make a comparison of theory with reliable experimental data, the results of corresponding experiments to determine the Stark broadening of Ag I lines will be of interest for further development and rafinement of the theory.

Table 1

This table shows electron- and proton-impact broadening full half-widths (FWHM) and shifts for Ag I for a perturber density of 10^{16} cm^{-3} and temperatures from 2,500 up to 50,000 K. By deviding C with the full linewidth, we obtain an estimate for the maximum perturber density for which the line may be treated as isolated and tabulated data may be used (Dimitrijević and Sahal-Bréchot 1984). For each value given in Table 1, the collision volume (V) multiplied by the perturber density (N) is much less than one and the impact approximation is valid (Sahal–Bréchot, 1969ab). Values for NV > 0.5 are not given and values for $0.1 < NV \leq 0.5$ are denoted by an asterisk.

PERTURBER DENSITY = 1.E+16cm-3
PERTURBERS ARE :

TRANSITION	T(K)	ELECTRONS WIDTH(Å)	SHIFT(Å)	PROTONS WIDTH(Å)	SHIFT(Å)
AgI 5S - 5P	2500.	0.375E-02	0.179E-02	0.227E-02	0.482E-03
0.5 0.5	5000.	0.422E-02	0.208E-02	0.228E-02	0.548E-03
3383.9 Å	10000.	0.443E-02	0.225E-02	0.229E-02	0.622E-03
C= 0.15E+20	20000.	0.500E-02	0.218E-02	0.231E-02	0.700E-03
	30000.	0.567E-02	0.183E-02	0.232E-02	0.751E-03
	50000.	0.691E-02	0.142E-02	0.234E-02	0.819E-03
AgI 5S - 5P	2500.	0.385E-02	0.199E-02	0.230E-02	0.555E-03
1.5 0.5	5000.	0.437E-02	0.243E-02	0.232E-02	0.632E-03
3281.6 Å	10000.	0.465E-02	0.275E-02	0.233E-02	0.717E-03
C= 0.13E+20	20000.	0.523E-02	0.275E-02	0.235E-02	0.809E-03
	30000.	0.589E-02	0.240E-02	0.237E-02	0.867E-03
	50000.	0.707E-02	0.191E-02	0.239E-02	0.946E-03
AgI 5S - 6P	2500.	0.459E-01	0.312E-01	*0.116E-01	*0.723E-02
0.5 0.5	5000.	0.493E-01	0.303E-01	*0.128E-01	*0.912E-02
2070.5 Å	10000.	0.521E-01	0.268E-01	0.141E-01	0.110E-01
C= 0.19E+18	20000.	0.529E-01	0.221E-01	0.157E-01	0.128E-01
	30000.	0.525E-01	0.190E-01	0.168E-01	0.139E-01
	50000.	0.518E-01	0.149E-01	0.183E-01	0.154E-01
AgI 6S - 6P	2500.	3.07	1.94	*0.787	*0.490
0.5 0.5	5000.	3.34	1.67	*0.867	*0.616
17417.9 Å	10000.	3.73	1.23	0.957	0.738
C= 0.14E+20	20000.	4.02	0.900	1.06	0.861
	30000.	4.12	0.690	1.13	0.936
	50000.	4.23	0.453	1.24	1.03

Table 1 continued

PERTURBER DENSITY = 1.E+16cm-3

PERTURBERS ARE :		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
AgI 6S - 6P	2500.	3.90	2.22	*0.992	*0.617
1.5 0.5	5000.	4.21	1.75	*1.11	*0.799
16821.9 Å	10000.	4.44	1.32	*1.24	*0.973
C= 0.69E+19	20000.	4.49	0.877	1.40	1.15
	30000.	4.50	0.630	1.50	1.25
	50000.	4.50	0.384	1.67	1.38
AgI 5P - 6S	2500.	0.113	0.796E-01	0.265E-01	0.207E-01
0.5 0.5	5000.	0.132	0.954E-01	0.292E-01	0.242E-01
7689.9 Å	10000.	0.148	0.115	0.324E-01	0.279E-01
C= 0.34E+20	20000.	0.159	0.120	0.360E-01	0.318E-01
	30000.	0.170	0.121	0.383E-01	0.343E-01
	50000.	0.181	0.106	0.415E-01	0.376E-01
AgI 5P - 6S	2500.	0.129	0.914E-01	0.308E-01	0.237E-01
0.5 1.5	5000.	0.151	0.112	0.339E-01	0.278E-01
8275.8 Å	10000.	0.169	0.132	0.375E-01	0.320E-01
C= 0.39E+20	20000.	0.183	0.137	0.416E-01	0.365E-01
	30000.	0.197	0.138	0.443E-01	0.393E-01
	50000.	0.211	0.119	0.479E-01	0.431E-01
AgI 5P - 7S	2500.	0.163	0.113	0.348E-01	0.258E-01
0.5 0.5	5000.	0.190	0.137	0.391E-01	0.319E-01
4477.3 Å	10000.	0.209	0.162	0.439E-01	0.379E-01
C= 0.43E+19	20000.	0.226	0.152	0.492E-01	0.440E-01
	30000.	0.239	0.147	0.526E-01	0.477E-01
	50000.	0.262	0.125	0.573E-01	0.526E-01
AgI 5P - 7S	2500.	0.177	0.121	0.379E-01	0.281E-01
0.5 1.5	5000.	0.206	0.148	0.425E-01	0.347E-01
4669.8 Å	10000.	0.230	0.172	0.477E-01	0.412E-01
C= 0.47E+19	20000.	0.246	0.164	0.535E-01	0.478E-01
	30000.	0.260	0.159	0.572E-01	0.518E-01
	50000.	0.285	0.134	0.623E-01	0.571E-01
AgI 5P - 8S	2500.	0.346	0.226	*0.709E-01	*0.434E-01
0.5 0.5	5000.	0.398	0.274	*0.800E-01	*0.587E-01
3841.8 Å	10000.	0.438	0.298	*0.899E-01	*0.730E-01
C= 0.15E+19	20000.	0.497	0.287	*0.101	*0.870E-01
	30000.	0.533	0.252	*0.108	*0.952E-01
	50000.	0.603	0.215	0.118	0.106

Table 1 continued

PERTURBER DENSITY = 1.E+16cm-3

PERTURBERS ARE :		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
AgI 5P - 8S	2500.	0.372	0.243	*0.762E-01	*0.466E-01
0.5 1.5	5000.	0.428	0.302	*0.860E-01	*0.631E-01
3982.7 Å	10000.	0.470	0.319	*0.966E-01	*0.784E-01
C= 0.16E+19	20000.	0.531	0.308	*0.108	*0.934E-01
	30000.	0.573	0.270	*0.116	*0.102
	50000.	0.649	0.231	0.126	0.114
AgI 6P - 7S	2500.	8.95	-0.462	*1.41	-0.745
0.5 0.5	5000.	11.8	0.868	1.50	-0.905
27858.3 Å	10000.	14.0	2.09	1.61	-1.06
C= 0.35E+20	20000.	16.0	2.84	1.75	-1.23
	30000.	17.0	2.68	1.86	-1.33
	50000.	18.3	2.39	2.02	-1.46
AgI 6P - 7S	2500.	14.2	-1.73	*2.44	-1.52
0.5 1.5	5000.	17.1	0.652E-01	*2.71	-1.92
29531.5 Å	10000.	19.0	1.96	3.01	-2.31
C= 0.21E+20	20000.	20.5	3.08	3.38	-2.70
	30000.	21.3	3.00	3.65	-2.93
	50000.	22.4	2.92	4.08	-3.24

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