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Preliminary report

STARK BROADENING PARAMETER TABLES FOR Se I

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SUMMARY: Using a semiclassical approach, we have calculated electron−, proton−, and Ar II−impact line widths and shifts for 16 Se I multiplets as a function of temperature and perturber density.

1. INTRODUCTION

By using the semiclassical-perturbation formalism (Sahal-Bréchot 1969ab), we have calculated recently electron-, proton-, and ionized argon-impact line widths and shifts for 31 multiplets of neutral selenium for a perturber density of 10^{16} cm^{-3} (Dimitrijević and Sahal−Bréchot, 1996). Since due to Debye screening effect such data are not linear with perturber density for higher densities, we will present here tables for 16 Se I multiplets for perturber densities $10^{17}-10^{19}$ cm^{-3}.

2. RESULTS AND DISCUSSION

The analysis of obtained results, details of calculations and the comparison with other theoretical data will be published elsewhere (Dimitrijević and Sahal−Bréchot, 1996). Here, we present only tables of Stark broadening parameters. Our results for 16 Se I multiplets are shown in Table 1, for perturber densities $10^{17}-10^{19}$ and temperatures T = 2,500 − 50,000 K. We also specify a parameter c (Dimitrijević and Sahal−Bréchot 1984), which gives an estimate for the maximum perturber density for which the line may be treated as isolated when it is divided by the corresponding full width at half maximum. 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 ≤ 0.5 are denoted by an asterisk. Stark broadening parameters for densities lower than tabulated, are linear with perturber density. When the impact approximation is not valid, the ion broadening contribution may be estimated by using quasistatic approach (Sahal−Bréchot 1991 and Griem 1974). In the region between where neither of these two approximations is valid, a unified type theory should be used. For example in Barnard et al. (1974), a simple analytical formula for such a case is given. The accuracy of the results obtained decreases when broadening by ion interactions becomes important.

Table 1. This Table shows electron-, proton-, and ArII- impact broadening parameters for Se I, for perturber densities of $10^{17} - 10^{19}$ cm^{-3} and temperatures from 2,500 up to 50,000 K. Transitions and averaged wavelengths for the multiplet (in Å) are also given. By dividing c by the corresponding full width at half maximum (Dimitrijević *et al.*, 1991), we obtain an estimate for the maximum perturber density for which the line may be treated as isolated and tabulated data may be used. The asterisk identifies cases for which the collision volume multiplied by the perturber density (the condition for validity of the impact approximation) lies between 0.1 and 0.5. Stark broadening parameters for densities lower than tabulated in Dimitrijević and Sahal−Bréchot (1996) for a perturber density of 10^{16}cm^{-3}, are linear with perturber density.

PERTURBER DENSITY= 1. E+17cm-3

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED ARGON	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
4P - 5S	2500.	0.294E-01	0.245E-01	0.785E-02	0.573E-02	*0.453E-02	*0.261E-02
1997.9 Å	5000.	0.352E-01	0.289E-01	0.882E-02	0.714E-02	*0.512E-02	*0.364E-02
C= 0.39E+20	10000.	0.418E-01	0.344E-01	0.990E-02	0.851E-02	0.575E-02	0.458E-02
	20000.	0.466E-01	0.391E-01	0.111E-01	0.991E-02	0.645E-02	0.550E-02
	30000.	0.481E-01	0.405E-01	0.119E-01	0.108E-01	0.690E-02	0.603E-02
	50000.	0.508E-01	0.385E-01	0.129E-01	0.119E-01	0.751E-02	0.672E-02
4P - 6S	2500.	0.117	0.757E-01	*0.254E-01	*0.113E-01		
1522.6 Å	5000.	0.137	0.962E-01	*0.294E-01	*0.183E-01		
C= 0.69E+19	10000.	0.153	0.117	*0.331E-01	*0.245E-01		
	20000.	0.161	0.125	*0.372E-01	*0.304E-01		
	30000.	0.167	0.121	*0.398E-01	*0.337E-01		
	50000.	0.175	0.104	*0.433E-01	*0.380E-01		
4P - 7S	2500.	*0.410	*0.225				
1409.5 Å	5000.	*0.473	*0.298				
C= 0.23E+19	10000.	0.506	0.351				
	20000.	0.549	0.358				
	30000.	0.560	0.325				
	50000.	0.614	0.277				
4P - 4D	2500.	0.433E-01	-0.153E-01	*0.171E-01	-0.338E-02		
1553.6 Å	5000.	0.458E-01	-0.180E-01	*0.182E-01	-0.420E-02		
C= 0.10E+20	10000.	0.500E-01	-0.189E-01	0.187E-01	-0.501E-02		
	20000.	0.561E-01	-0.176E-01	0.190E-01	-0.582E-02		
	30000.	0.603E-01	-0.157E-01	0.191E-01	-0.632E-02	*0.185E-01	-0.355E-02
	50000.	0.656E-01	-0.134E-01	0.193E-01	-0.697E-02	*0.186E-01	-0.395E-02
4P - 5D	2500.	0.149	-0.577E-01				
1424.9 Å	5000.	0.168	-0.583E-01				
C= 0.31E+19	10000.	0.195	-0.422E-01				
	20000.	0.235	-0.308E-01				
	30000.	0.258	-0.276E-01	*0.670E-01	-0.254E-01		
	50000.	0.282	-0.217E-01	*0.683E-01	-0.285E-01		
4P - 6D	2500.	*0.766	*0.333				
1371.7 Å	5000.	*0.887	*0.403				
C= 0.73E+18	10000.	*1.04	*0.357				
	20000.	*1.24	*0.321				
	30000.	*1.32	*0.300				
	50000.	1.39	0.215				
5P - 5D	2500.	7.66	-3.21				
9556.1 Å	5000.	8.65	-3.68				
C= 0.14E+21	10000.	10.1	-3.73				
	20000.	12.2	-3.28				
	30000.	13.5	-2.99	*3.24	-1.34		
	50000.	15.0	-2.58	*3.32	-1.50		
5S - 5P	2500.	1.87	1.11	*0.737	*0.229		
10347.4 Å	5000.	2.07	1.35	*0.793	*0.296		
C= 0.50E+21	10000.	2.40	1.27	0.826	0.360		
	20000.	2.97	1.10	0.855	0.424		
	30000.	3.47	0.918	0.873	0.462	*0.781	*0.257
	50000.	4.17	0.734	0.899	0.511	*0.793	*0.288

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED ARGON	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
5S - 6P	2500.	3.02	1.72				
5372.3 Å	5000.	3.48	2.18				
C= 0.44E+20	10000.	3.90	2.40				
	20000.	4.41	2.35				
	30000.	4.76	2.05				
	50000.	5.29	1.74	*1.30	*0.868		
5S - 7P	2500.	*5.87	*2.82				
4534.9 Å	5000.	*6.81	*3.87				
C= 0.16E+20	10000.	*7.78	*4.01				
	20000.	8.97	3.87				
	30000.	9.83	3.28				
	50000.	10.8	2.85				
5S - 5P	2500.	1.30	0.837	*0.491	*0.171		
8972.6 Å	5000.	1.43	0.979	*0.527	*0.220		
C= 0.33E+21	10000.	1.65	0.916	0.551	0.268		
	20000.	2.02	0.756	0.575	0.315	*0.503	*0.172
	30000.	2.35	0.618	0.590	0.343	*0.511	*0.191
	50000.	2.79	0.486	0.612	0.380	*0.520	*0.214
5S - 6P	2500.	2.74	1.58				
4737.1 Å	5000.	3.11	2.12				
C= 0.25E+20	10000.	3.41	2.07				
	20000.	3.75	1.90				
	30000.	4.00	1.65				
	50000.	4.33	1.40	*1.11	*0.792		
5S - 7P	2500.	*7.26	*3.13				
4013.9 Å	5000.	*8.13	*4.37				
C= 0.73E+19	10000.	*8.81	*4.70				
	20000.	*9.58	*3.93				
	30000.	*10.1	*3.45				
	50000.	10.6	3.00				
5P - 6S	2500.	9.39	5.60	*2.10	*0.939		
15010.7 Å	5000.	11.1	7.11	*2.38	*1.40		
C= 0.74E+21	10000.	12.9	8.40	*2.63	*1.81		
	20000.	15.4	8.63	*2.90	*2.20		
	30000.	16.9	7.81	*3.07	*2.43		
	50000.	19.4	6.48	3.30	2.72	*2.16	*1.50
5P - 7S	2500.	9.88	5.51				
8122.8 Å	5000.	11.4	7.50				
C= 0.96E+20	10000.	12.4	8.26				
	20000.	13.9	8.35				
	30000.	15.0	7.43				
	50000.	17.2	6.34				
5P - 5D	2500.	8.84	-4.26				
9038.9 Å	5000.	9.61	-5.06				
C= 0.90E+20	10000.	10.4	-5.26				
	20000.	11.3	-4.81				
	30000.	11.8	-4.46	*2.97	-1.82		
	50000.	12.3	-3.85	*3.14	-2.06		
PERTURBER DENSITY= 1. E+18cm-3							
4P - 5S	2500.	0.294	0.208	*0.708E-01	*0.212E-01		
1997.9 Å	5000.	0.352	0.263	*0.868E-01	*0.455E-01		
C= 0.39E+21	10000.	0.418	0.326	*0.987E-01	*0.668E-01		
	20000.	0.466	0.380	*0.111	*0.861E-01		
	30000.	0.481	0.399	*0.119	*0.970E-01		
	50000.	0.508	0.381	0.129	0.110	*0.751E-01	*0.590E-01
4P - 6S	2500.	*1.15	*0.456				
1522.6 Å	5000.	*1.37	*0.748				
C= 0.69E+20	10000.	1.52	1.02				
	20000.	1.61	1.12				
	30000.	1.67	1.12				
	50000.	1.75	1.01				

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED ARGON	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
4P - 7S	2500.						
1409.5 Å	5000.						
C= 0.23E+20	10000.						
	20000.	*5.35	*2.80				
	30000.	*5.48	*2.67				
	50000.	*6.05	*2.50				
4P - 4D	2500.	0.429	-0.132				
1553.6 Å	5000.	0.457	-0.165				
C= 0.10E+21	10000.	0.500	-0.178				
	20000.	0.560	-0.169				
	30000.	0.603	-0.151	*0.188	-0.570E-01		
	50000.	0.656	-0.131	*0.191	-0.649E-01		
4P - 5D	2500.	*1.32	-0.351				
1424.9 Å	5000.	*1.62	-0.423				
C= 0.31E+20	10000.	*1.92	-0.306				
	20000.	*2.33	-0.214				
	30000.	*2.57	-0.212				
	50000.	2.81	-0.190				
PERTURBER DENSITY= 1. E+19cm-3							
4P - 5S	2500.	2.75	0.908				
1997.9 Å	5000.	3.49	1.80				
C= 0.39E+22	10000.	4.17	2.67				
	20000.	4.66	3.37				
	30000.	4.81	3.66				
	50000.	5.08	3.68				
4P - 6S	2500.						
1522.6 Å	5000.						
C= 0.69E+21	10000.						
	20000.						
	30000.	*15.9	*8.16				
	50000.	*16.8	*7.81				
4P - 4D	2500.	*2.67	-0.597				
1553.6 Å	5000.	*3.96	-1.14				
C= 0.10E+22	10000.	*4.81	-1.42				
	20000.	5.53	-1.43				
	30000.	5.98	-1.30				
	50000.	6.52	-1.16				

The analysis of present results and comparison with existing theoretical data will be published elsewhere (Dimitrijević and Sahal−Bréchot, 1996).

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ТАБЕЛЕ ПАРАМЕТАРА ШТАРКОВОГ ШИРЕЊА СПЕКТРАЛНИХ ЛИНИЈА Se I

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Претходно саопштење

Користећи семикласичан прилаз, израчунате су ширине и помераји спектралних линија, проузроковани сударима са електронима, протонима и јонима аргона, за 16 мултиплета Se I. Резултати су дати у функцији температуре и концентрације пертурбера.