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Preliminary report

STARK BROADENING PARAMETER TABLES FOR In III, Tl III AND Pb IV

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SUMMARY: Using a semiclassical approach, we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 20 In III multiplets for perturber densities $10^{14}-10^{20}$ cm^{-3} and 2 Tl III multiplets for perturber densities $10^{17}-10^{20}$ cm^{-3}, and temperatures T = 20,000 − 500,000 K, in both cases. We have calculated as well, electron-, proton-, and He III-impact line widths and shifts for 2 Pb IV multiplets, for perturber densities $10^{17}-10^{20}$ cm^{-3} and temperatures T = 50,000 − 1,000,000 K.

1. INTRODUCTION

In astrophysics, as well as in physics and plasma technology, a number of problems depend on very extensive list of elements and line transitions with their atomic and line broadening parameters. One may mention as examples calculation of stellar opacities, stellar atmospheres modelling and investigations, abundance determinations, interpretation and modelling of stellar spectra, laboratory plasma diagnostic, research and modelling, radiative transfer calculations and investigation of laser produced plasmas (not only in laboratory but as well in industry during the laser welding, melting and evaporation of different targets), and plasmas created in fusion research (particularly inertial confinement and pellet compression fusion), development and modelling of lasers, as well as of light sources.

As a continuation of our project to provide an as much as possible large set of reliable Stark broadening data needed for the consideration and modeling of astrophysical, laboratory, laser produced and fusion plasmas, we have calculated within the semiclassical-perturbation formalism (Sahal–Bréchot 1969ab, see also Sahal–Bréchot, 1974, Fleurier *et al.* 1977, Dimitrijević and Sahal–Bréchot, 1984, Dimitrijević *et al.* 1991, Dimitrijević and Sahal-Bréchot, 1996) electron-, proton-, and ionized helium-impact line widths and shifts for 20 In III and 2 Tl III as well as electron-, proton-, and He III-impact line widths and shifts for 2 Pb IV multiplets.

Table 1. This table shows electron-, proton-, and ionized helium-impact broadening parameters for In III for perturber densities of $10^{14} - 10^{16}$ cm^{-3} and $10^{18} - 10^{20}$ cm^{-3} and temperatures from 20,000 up to 500,000 K. The complete list of transitions is for the electron density of 10^{16} cm^{-3}. For lower electron densities, only transitions where Stark broadening parameters deviate from the linear dependence with the electron density, are listed. The data for the electron density of 10^{17} cm^{-3}, will be published in Dimitrijević and Sahal−Bréchot (1998). Stark broadening parameters for densities lower than tabulated, are linear with perturber density. Transitions and averaged wavelengths for the multiplet (in Å) are also given in the Table. 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.

PERTURBER DENSITY = 1.E+14cm^{-3}							
PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
In III 5D 7F	20000.	0.108E-02	0.302E-03	0.326E-03	0.288E-03	0.259E-03	0.237E-03
1295.2 Å	50000.	0.920E-03	0.215E-03	0.397E-03	0.345E-03	0.335E-03	0.276E-03
C = 0.22E+15	100000.	0.810E-03	0.170E-03	0.437E-03	0.392E-03	0.371E-03	0.306E-03
	200000.	0.695E-03	0.126E-03	0.608E-03	0.452E-03	0.408E-03	0.341E-03
	300000.	0.629E-03	0.103E-03	0.601E-03	0.462E-03	0.527E-03	0.379E-03
	500000.	0.549E-03	0.785E-04	0.713E-03	0.473E-03	0.515E-03	0.437E-03
In III 5G 7F	20000.	0.183E-01	0.523E-02	0.522E-02	0.464E-02	0.421E-02	0.382E-02
5178.3 Å	50000.	0.155E-01	0.377E-02	0.633E-02	0.557E-02	0.533E-02	0.441E-02
C = 0.34E+16	100000.	0.136E-01	0.299E-02	0.708E-02	0.638E-02	0.594E-02	0.490E-02
	200000.	0.116E-01	0.223E-02	0.968E-02	0.726E-02	0.668E-02	0.550E-02
	300000.	0.105E-01	0.184E-02	0.971E-02	0.747E-02	0.854E-02	0.607E-02
	500000.	0.918E-02	0.142E-02	0.113E-01	0.765E-02	0.845E-02	0.703E-02
PERTURBER DENSITY = 1.E+15cm^{-3}							
In III 5S 5P	20000.	0.287E-03	-0.261E-05	0.670E-05	-0.811E-06	0.977E-05	-0.801E-06
1664.5 Å	50000.	0.186E-03	-0.264E-05	0.126E-04	-0.182E-05	0.156E-04	-0.168E-05
C = 0.17E+19	100000.	0.139E-03	-0.267E-05	0.168E-04	-0.280E-05	0.182E-04	-0.243E-05
	200000.	0.110E-03	-0.282E-05	0.190E-04	-0.385E-05	0.204E-04	-0.315E-05
	300000.	0.993E-04	-0.267E-05	0.203E-04	-0.427E-05	0.215E-04	-0.351E-05
	500000.	0.888E-04	-0.254E-05	0.217E-04	-0.492E-05	0.222E-04	-0.400E-05
In III 5S 6P	20000.	0.124E-03	-0.108E-06	0.107E-04	-0.538E-06	0.129E-04	-0.514E-06
687.4 Å	50000.	0.923E-04	-0.608E-06	0.142E-04	-0.104E-05	0.154E-04	-0.892E-06
C = 0.80E+17	100000.	0.782E-04	0.400E-06	0.160E-04	-0.144E-05	0.170E-04	-0.121E-05
	200000.	0.685E-04	-0.301E-07	0.173E-04	-0.177E-05	0.178E-04	-0.144E-05
	300000.	0.639E-04	0.755E-07	0.178E-04	-0.196E-05	0.182E-04	-0.160E-05
	500000.	0.590E-04	0.182E-06	0.182E-04	-0.222E-05	0.185E-04	-0.181E-05
In III 5D 6F	20000.	0.679E-02	0.158E-02	0.197E-02	0.179E-02	0.163E-02	0.143E-02
1431.3 Å	50000.	0.560E-02	0.116E-02	0.256E-02	0.214E-02	0.208E-02	0.173E-02
C = 0.32E+16	100000.	0.486E-02	0.936E-03	0.313E-02	0.243E-02	0.239E-02	0.191E-02
	200000.	0.414E-02	0.709E-03	0.365E-02	0.272E-02	0.251E-02	0.210E-02
	300000.	0.374E-02	0.591E-03	0.434E-02	0.302E-02	0.288E-02	0.229E-02
	500000.	0.327E-02	0.454E-03	0.492E-02	0.355E-02	0.348E-02	0.241E-02
In III 5D 7F	20000.	0.108E-01	0.292E-02	0.326E-02	0.286E-02	*0.259E-02	*0.235E-02
1295.2 Å	50000.	0.920E-02	0.214E-02	0.397E-02	0.345E-02	*0.335E-02	*0.276E-02
C = 0.22E+16	100000.	0.810E-02	0.169E-02	0.437E-02	0.392E-02	0.371E-02	0.306E-02
	200000.	0.695E-02	0.126E-02	0.608E-02	0.452E-02	0.408E-02	0.341E-02
	300000.	0.629E-02	0.103E-02	0.601E-02	0.462E-02	0.527E-02	0.379E-02
	500000.	0.549E-02	0.785E-03	0.713E-02	0.473E-02	0.515E-02	0.437E-02
In III 5F 5G	20000.	5.14	-1.30	0.615	-0.513	0.576	-0.418
63439.3 Å	50000.	4.21	-1.02	0.798	-0.648	0.726	-0.525
C = 0.63E+20	100000.	3.68	-0.857	0.940	-0.744	0.797	-0.591
	200000.	3.20	-0.677	1.14	-0.850	0.893	-0.674
	300000.	2.94	-0.582	1.22	-0.909	0.989	-0.716
	500000.	2.62	-0.484	1.40	-1.000	1.04	-0.799
In III 5G 6F	20000.	0.259	0.649E-01	0.678E-01	0.617E-01	0.564E-01	0.493E-01
8352.3 Å	50000.	0.212	0.492E-01	0.878E-01	0.737E-01	0.718E-01	0.596E-01
C = 0.11E+18	100000.	0.183	0.394E-01	0.109	0.830E-01	0.830E-01	0.653E-01
	200000.	0.155	0.302E-01	0.131	0.955E-01	0.856E-01	0.742E-01
	300000.	0.140	0.253E-01	0.148	0.105	0.988E-01	0.782E-01
	500000.	0.122	0.197E-01	0.176	0.121	0.122	0.835E-01

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
In III 5G 7F	20000.	0.183	0.506E-01	0.522E-01	0.461E-01	*0.421E-01	*0.379E-01
5178.3 Å	50000.	0.155	0.375E-01	0.633E-01	0.557E-01	*0.533E-01	*0.441E-01
C = 0.34E+17	100000.	0.136	0.298E-01	0.708E-01	0.638E-01	0.594E-01	0.490E-01
	200000.	0.116	0.223E-01	0.968E-01	0.726E-01	0.668E-01	0.550E-01
	300000.	0.105	0.184E-01	0.971E-01	0.747E-01	0.854E-01	0.607E-01
	500000.	0.918E-01	0.142E-01	0.113	0.765E-01	0.845E-01	0.703E-01
PERTURBER DENSITY = 1.E+16cm^{-3}							
In III 5S 5P	20000.	0.288E-02	-0.209E-04	0.670E-04	-0.806E-05	0.977E-04	-0.796E-05
1664.5 Å	50000.	0.186E-02	-0.284E-04	0.126E-03	-0.182E-04	0.156E-03	-0.168E-04
C = 0.17E+20	100000.	0.139E-02	-0.267E-04	0.168E-03	-0.280E-04	0.182E-03	-0.243E-04
	200000.	0.110E-02	-0.282E-04	0.190E-03	-0.385E-04	0.204E-03	-0.315E-04
	300000.	0.993E-03	-0.267E-04	0.203E-03	-0.427E-04	0.215E-03	-0.351E-04
	500000.	0.888E-03	-0.254E-04	0.217E-03	-0.492E-04	0.222E-03	-0.400E-04
In III 5S 6P	20000.	0.124E-02	-0.756E-06	0.107E-03	-0.534E-05	0.129E-03	-0.511E-05
687.4 Å	50000.	0.923E-03	-0.658E-05	0.142E-03	-0.104E-04	0.154E-03	-0.891E-05
C = 0.80E+18	100000.	0.782E-03	0.400E-05	0.160E-03	-0.144E-04	0.170E-03	-0.121E-04
	200000.	0.685E-03	-0.301E-06	0.173E-03	-0.177E-04	0.178E-03	-0.144E-04
	300000.	0.639E-03	0.755E-06	0.178E-03	-0.196E-04	0.182E-03	-0.160E-04
	500000.	0.590E-03	0.182E-05	0.182E-03	-0.222E-04	0.185E-03	-0.181E-04
In III 5S 7P	20000.	0.188E-02	-0.427E-04	0.264E-03	-0.574E-04	0.286E-03	-0.498E-04
562.8 Å	50000.	0.156E-02	-0.730E-04	0.311E-03	-0.805E-04	0.329E-03	-0.661E-04
C = 0.22E+18	100000.	0.144E-02	-0.567E-04	0.339E-03	-0.963E-04	0.344E-03	-0.789E-04
	200000.	0.133E-02	-0.545E-04	0.358E-03	-0.114E-03	0.359E-03	-0.909E-04
	300000.	0.126E-02	-0.435E-04	0.360E-03	-0.123E-03	0.364E-03	-0.985E-04
	500000.	0.118E-02	-0.326E-04	0.377E-03	-0.133E-03	0.370E-03	-0.110E-03
In III 6S 6P	20000.	0.998E-01	-0.827E-02	0.675E-02	-0.264E-02	0.806E-02	-0.225E-02
5376.2 Å	50000.	0.758E-01	-0.715E-02	0.913E-02	-0.397E-02	0.967E-02	-0.321E-02
C = 0.49E+20	100000.	0.657E-01	-0.694E-02	0.105E-01	-0.475E-02	0.108E-01	-0.387E-02
	200000.	0.583E-01	-0.618E-02	0.116E-01	-0.565E-02	0.114E-01	-0.460E-02
	300000.	0.547E-01	-0.575E-02	0.123E-01	-0.615E-02	0.118E-01	-0.498E-02
	500000.	0.504E-01	-0.534E-02	0.130E-01	-0.687E-02	0.122E-01	-0.550E-02
In III 6S 7P	20000.	0.256E-01	-0.163E-02	0.326E-02	-0.909E-03	0.351E-02	-0.776E-03
1969.0 Å	50000.	0.215E-01	-0.179E-02	0.386E-02	-0.124E-02	0.405E-02	-0.101E-02
C = 0.27E+19	100000.	0.198E-01	-0.164E-02	0.421E-02	-0.148E-02	0.426E-02	-0.120E-02
	200000.	0.184E-01	-0.149E-02	0.445E-02	-0.171E-02	0.437E-02	-0.139E-02
	300000.	0.175E-01	-0.132E-02	0.465E-02	-0.189E-02	0.447E-02	-0.152E-02
	500000.	0.163E-01	-0.113E-02	0.471E-02	-0.205E-02	0.461E-02	-0.162E-02
In III 7S 7P	20000.	1.21	-0.342	0.134	-0.713E-01	0.140	-0.578E-01
12146.8 Å	50000.	1.08	-0.262	0.165	-0.917E-01	0.165	-0.747E-01
C = 0.10E+21	100000.	1.02	-0.203	0.185	-0.109	0.178	-0.879E-01
	200000.	0.952	-0.160	0.199	-0.124	0.188	-0.993E-01
	300000.	0.906	-0.144	0.208	-0.133	0.199	-0.110
	500000.	0.841	-0.117	0.233	-0.150	0.207	-0.116
In III 5P 6S	20000.	0.480E-02	0.112E-02	0.129E-03	0.193E-03	0.137E-03	0.165E-03
1497.0 Å	50000.	0.328E-02	0.722E-03	0.268E-03	0.292E-03	0.247E-03	0.237E-03
C = 0.42E+19	100000.	0.266E-02	0.659E-03	0.359E-03	0.350E-03	0.315E-03	0.286E-03
	200000.	0.225E-02	0.550E-03	0.447E-03	0.415E-03	0.382E-03	0.338E-03
	300000.	0.205E-02	0.481E-03	0.508E-03	0.456E-03	0.421E-03	0.365E-03
	500000.	0.185E-02	0.446E-03	0.573E-03	0.509E-03	0.470E-03	0.410E-03
In III 5P 7S	20000.	0.348E-02	0.173E-02	0.242E-03	0.318E-03	0.233E-03	0.262E-03
914.5 Å	50000.	0.289E-02	0.130E-02	0.401E-03	0.415E-03	0.336E-03	0.338E-03
C = 0.69E+18	100000.	0.260E-02	0.101E-02	0.505E-03	0.498E-03	0.426E-03	0.395E-03
	200000.	0.232E-02	0.798E-03	0.616E-03	0.569E-03	0.495E-03	0.451E-03
	300000.	0.216E-02	0.713E-03	0.669E-03	0.610E-03	0.573E-03	0.489E-03
	500000.	0.196E-02	0.588E-03	0.765E-03	0.662E-03	0.590E-03	0.545E-03
In III 6P 7S	20000.	0.912E-01	0.355E-01	0.680E-02	0.668E-02	0.677E-02	0.551E-02
4174.6 Å	50000.	0.777E-01	0.264E-01	0.984E-02	0.870E-02	0.885E-02	0.710E-02
C = 0.14E+20	100000.	0.715E-01	0.205E-01	0.122E-01	0.104E-01	0.106E-01	0.832E-02
	200000.	0.653E-01	0.160E-01	0.142E-01	0.120E-01	0.119E-01	0.951E-02
	300000.	0.615E-01	0.145E-01	0.151E-01	0.128E-01	0.134E-01	0.102E-01
	500000.	0.566E-01	0.120E-01	0.170E-01	0.139E-01	0.137E-01	0.115E-01

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
In III 5P 5D	20000.	0.396E-02	0.248E-03	0.195E-03	0.846E-04	0.242E-03	0.775E-04
1458.7 Å	50000.	0.269E-02	0.222E-03	0.308E-03	0.140E-03	0.327E-03	0.120E-03
C = 0.36E+19	100000.	0.215E-02	0.251E-03	0.359E-03	0.175E-03	0.373E-03	0.144E-03
	200000.	0.180E-02	0.219E-03	0.413E-03	0.210E-03	0.415E-03	0.171E-03
	300000.	0.165E-02	0.213E-03	0.440E-03	0.233E-03	0.425E-03	0.189E-03
	500000.	0.151E-02	0.198E-03	0.472E-03	0.260E-03	0.444E-03	0.205E-03
In III 5D 6P	20000.	0.111	-0.311E-02	0.955E-02	-0.163E-02	0.113E-01	-0.148E-02
5935.2 Å	50000.	0.837E-01	-0.343E-02	0.124E-01	-0.264E-02	0.133E-01	-0.224E-02
C = 0.59E+20	100000.	0.717E-01	-0.337E-02	0.139E-01	-0.329E-02	0.147E-01	-0.269E-02
	200000.	0.635E-01	-0.318E-02	0.150E-01	-0.393E-02	0.153E-01	-0.319E-02
	300000.	0.595E-01	-0.308E-02	0.155E-01	-0.433E-02	0.156E-01	-0.353E-02
	500000.	0.551E-01	-0.281E-02	0.158E-01	-0.479E-02	0.159E-01	-0.388E-02
In III 5D 7P	20000.	0.264E-01	-0.887E-03	0.360E-02	-0.844E-03	0.389E-02	-0.727E-03
2039.3 Å	50000.	0.220E-01	-0.130E-02	0.424E-02	-0.117E-02	0.448E-02	-0.955E-03
C = 0.29E+19	100000.	0.202E-01	-0.117E-02	0.462E-02	-0.140E-02	0.471E-02	-0.114E-02
	200000.	0.188E-01	-0.109E-02	0.483E-02	-0.163E-02	0.484E-02	-0.132E-02
	300000.	0.179E-01	-0.943E-03	0.500E-02	-0.175E-02	0.496E-02	-0.142E-02
	500000.	0.167E-01	-0.776E-03	0.519E-02	-0.195E-02	0.496E-02	-0.153E-02
In III 5D 5F	20000.	0.270E-01	0.393E-02	0.331E-02	0.270E-02	0.318E-02	0.221E-02
1775.6 Å	50000.	0.228E-01	0.359E-02	0.438E-02	0.352E-02	0.395E-02	0.283E-02
C = 0.50E+18	100000.	0.204E-01	0.322E-02	0.514E-02	0.405E-02	0.459E-02	0.332E-02
	200000.	0.182E-01	0.267E-02	0.620E-02	0.469E-02	0.502E-02	0.369E-02
	300000.	0.168E-01	0.230E-02	0.653E-02	0.498E-02	0.505E-02	0.390E-02
	500000.	0.152E-01	0.191E-02	0.744E-02	0.533E-02	0.610E-02	0.444E-02
In III 5D 6F	20000.	0.678E-01	0.143E-01	*0.198E-01	*0.171E-01		
1431.3 Å	50000.	0.560E-01	0.111E-01	*0.256E-01	*0.212E-01	*0.207E-01	*0.172E-01
C = 0.32E+17	100000.	0.485E-01	0.929E-02	*0.313E-01	*0.243E-01	*0.239E-01	*0.191E-01
	200000.	0.414E-01	0.709E-02	*0.365E-01	*0.272E-01	*0.251E-01	*0.210E-01
	300000.	0.374E-01	0.591E-02	*0.434E-01	*0.302E-01	*0.288E-01	*0.229E-01
	500000.	0.327E-01	0.454E-02	0.492E-01	0.355E-01	*0.348E-01	*0.241E-01
In III 5D 7F	20000.	0.107	0.260E-01				
1295.2 Å	50000.	0.917E-01	0.202E-01				
C = 0.22E+17	100000.	0.808E-01	0.167E-01	*0.437E-01	*0.392E-01		
	200000.	0.694E-01	0.124E-01	*0.608E-01	*0.452E-01		
	300000.	0.628E-01	0.103E-01	*0.601E-01	*0.462E-01		
	500000.	0.548E-01	0.785E-02	*0.713E-01	*0.473E-01	*0.515E-01	*0.437E-01
In III 4F 5D	20000.	0.271E-01	-0.654E-03	0.184E-02	-0.468E-03	0.225E-02	-0.418E-03
2998.8 Å	50000.	0.200E-01	-0.672E-03	0.251E-02	-0.749E-03	0.270E-02	-0.629E-03
C = 0.78E+19	100000.	0.169E-01	-0.633E-03	0.285E-02	-0.924E-03	0.301E-02	-0.752E-03
	200000.	0.148E-01	-0.572E-03	0.314E-02	-0.110E-02	0.317E-02	-0.892E-03
	300000.	0.139E-01	-0.525E-03	0.327E-02	-0.122E-02	0.323E-02	-0.977E-03
	500000.	0.128E-01	-0.449E-03	0.341E-02	-0.134E-02	0.331E-02	-0.109E-02
In III 4F 5G	20000.	0.129	-0.277E-01	0.143E-01	-0.113E-01	0.140E-01	-0.928E-02
4073.7 Å	50000.	0.968E-01	-0.215E-01	0.188E-01	-0.146E-01	0.175E-01	-0.119E-01
C = 0.26E+19	100000.	0.805E-01	-0.183E-01	0.224E-01	-0.172E-01	0.196E-01	-0.138E-01
	200000.	0.680E-01	-0.145E-01	0.261E-01	-0.196E-01	0.216E-01	-0.159E-01
	300000.	0.620E-01	-0.126E-01	0.284E-01	-0.210E-01	0.235E-01	-0.169E-01
	500000.	0.553E-01	-0.106E-01	0.327E-01	-0.236E-01	0.255E-01	-0.195E-01
In III 5G 6F	20000.	2.59	0.599	*0.684	*0.587		
8352.3 Å	50000.	2.12	0.472	*0.877	*0.732	*0.718	*0.591
C = 0.11E+19	100000.	1.83	0.391	*1.09	*0.830	*0.830	*0.653
	200000.	1.55	0.299	*1.31	*0.955	*0.856	*0.742
	300000.	1.40	0.253	*1.48	*1.05	*0.988	*0.782
	500000.	1.22	0.197	1.76	1.21	*1.22	*0.835
In III 5G 7F	20000.	1.82	0.454				
5178.3 Å	50000.	1.55	0.355				
C = 0.34E+18	100000.	1.36	0.296	*0.708	*0.638		
	200000.	1.16	0.220	*0.968	*0.726		
	300000.	1.05	0.184	*0.971	*0.747		
	500000.	0.916	0.142	*1.13	*0.765	*0.845	*0.703

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
PERTURBER DENSITY = 1.E+18cm^{-3}							
In III 5S 5P	20000.	0.288	-0.200E-02	0.662E-02	-0.707E-03	0.960E-02	-0.698E-03
1664.5 Å	50000.	0.186	-0.260E-02	0.126E-01	-0.176E-02	0.156E-01	-0.162E-02
C = 0.17E+22	100000.	0.139	-0.256E-02	0.168E-01	-0.278E-02	0.182E-01	-0.241E-02
	200000.	0.110	-0.280E-02	0.190E-01	-0.385E-02	0.204E-01	-0.314E-02
	300000.	0.993E-01	-0.266E-02	0.203E-01	-0.427E-02	0.215E-01	-0.350E-02
	500000.	0.888E-01	-0.254E-02	0.217E-01	-0.492E-02	0.222E-01	-0.400E-02
In III 5S 6P	20000.	0.124	0.110E-03	0.103E-01	-0.466E-03	*0.123E-01	-0.442E-03
687.4 Å	50000.	0.923E-01	-0.596E-03	0.141E-01	-0.999E-03	*0.152E-01	-0.852E-03
C = 0.80E+20	100000.	0.782E-01	0.450E-03	0.159E-01	-0.143E-02	*0.169E-01	-0.119E-02
	200000.	0.685E-01	-0.149E-04	0.173E-01	-0.177E-02	0.178E-01	-0.144E-02
	300000.	0.639E-01	0.815E-04	0.178E-01	-0.195E-02	0.182E-01	-0.159E-02
	500000.	0.590E-01	0.184E-03	0.182E-01	-0.222E-02	0.185E-01	-0.181E-02
In III 5S 7P	20000.	0.188	-0.302E-02				
562.8 Å	50000.	0.156	-0.633E-02	*0.307E-01	-0.738E-02		
C = 0.22E+20	100000.	0.144	-0.496E-02	*0.339E-01	-0.933E-02		
	200000.	0.133	-0.524E-02	*0.358E-01	-0.114E-01		
	300000.	0.126	-0.418E-02	*0.360E-01	-0.123E-01	*0.364E-01	-0.981E-02
	500000.	0.118	-0.323E-02	*0.377E-01	-0.133E-01	*0.370E-01	-0.110E-01
In III 6S 6P	20000.	9.99	-0.771	0.655	-0.219	*0.768	-0.181
5376.2 Å	50000.	7.58	-0.690	0.909	-0.371	*0.956	-0.296
C = 0.49E+22	100000.	6.57	-0.673	1.05	-0.463	*1.08	-0.375
	200000.	5.83	-0.610	1.16	-0.563	*1.14	-0.458
	300000.	5.47	-0.568	1.23	-0.613	1.18	-0.496
	500000.	5.04	-0.533	1.30	-0.687	1.22	-0.550
In III 6S 7P	20000.	2.56	-0.141				
1969.0 Å	50000.	2.15	-0.164	*0.382	-0.112		
C = 0.27E+21	100000.	1.98	-0.153	*0.421	-0.143		
	200000.	1.84	-0.145	*0.445	-0.170		
	300000.	1.75	-0.129	*0.465	-0.189	*0.446	-0.151
	500000.	1.63	-0.112	*0.471	-0.205	*0.461	-0.162
In III 5P 6S	20000.	0.480	0.109	0.129E-01	0.161E-01	0.136E-01	0.133E-01
1497.0 Å	50000.	0.328	0.703E-01	0.268E-01	0.273E-01	0.247E-01	0.218E-01
C = 0.42E+21	100000.	0.266	0.643E-01	0.360E-01	0.342E-01	0.315E-01	0.278E-01
	200000.	0.225	0.544E-01	0.447E-01	0.414E-01	0.382E-01	0.337E-01
	300000.	0.205	0.476E-01	0.508E-01	0.455E-01	0.421E-01	0.364E-01
	500000.	0.185	0.445E-01	0.573E-01	0.509E-01	0.470E-01	0.410E-01
In III 5P 7S	20000.	0.348	0.165	*0.241E-01	*0.239E-01	*0.231E-01	*0.184E-01
914.5 Å	50000.	0.289	0.124	*0.399E-01	*0.369E-01	*0.335E-01	*0.291E-01
C = 0.69E+20	100000.	0.260	0.969E-01	*0.507E-01	*0.477E-01	*0.421E-01	*0.373E-01
	200000.	0.232	0.784E-01	0.616E-01	0.565E-01	*0.495E-01	*0.448E-01
	300000.	0.216	0.701E-01	0.669E-01	0.607E-01	*0.573E-01	*0.486E-01
	500000.	0.196	0.586E-01	0.765E-01	0.662E-01	*0.590E-01	*0.545E-01
In III 6P 7S	20000.	9.13	3.38	*0.668	*0.502		
4174.6 Å	50000.	7.77	2.53	*0.980	*0.775	*0.881	*0.612
C = 0.14E+22	100000.	7.15	1.97	*1.22	*0.999	*1.06	*0.789
	200000.	6.53	1.57	*1.42	*1.19	*1.19	*0.943
	300000.	6.15	1.43	1.51	1.27	*1.34	*1.02
	500000.	5.66	1.19	1.70	1.39	*1.37	*1.15
In III 5P 5D	20000.	0.396	0.238E-01	0.192E-01	0.724E-02	0.235E-01	0.652E-02
1458.7 Å	50000.	0.269	0.214E-01	0.307E-01	0.132E-01	0.325E-01	0.113E-01
C = 0.36E+21	100000.	0.215	0.244E-01	0.359E-01	0.172E-01	0.373E-01	0.141E-01
	200000.	0.180	0.217E-01	0.413E-01	0.210E-01	0.415E-01	0.171E-01
	300000.	0.165	0.211E-01	0.440E-01	0.233E-01	0.425E-01	0.188E-01
	500000.	0.151	0.198E-01	0.472E-01	0.260E-01	0.444E-01	0.205E-01
In III 5D 6P	20000.	11.1	-0.279	*0.925	-0.139	*1.07	-0.123
5935.2 Å	50000.	8.37	-0.326	1.23	-0.251	*1.31	-0.210
C = 0.59E+22	100000.	7.17	-0.324	1.39	-0.323	*1.46	-0.263
	200000.	6.35	-0.314	1.50	-0.392	*1.53	-0.318
	300000.	5.95	-0.304	1.55	-0.432	1.56	-0.352
	500000.	5.51	-0.280	1.58	-0.479	1.59	-0.388

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
In III 5D 7P	20000.	2.64	-0.701E-01				
2039.3 Å	50000.	2.20	-0.116	*0.418	-0.106		
C = 0.29E+21	100000.	2.02	-0.107	*0.459	-0.135		
	200000.	1.88	-0.106	*0.483	-0.162		
	300000.	1.79	-0.918E-01	*0.500	-0.175	*0.495	-0.142
	500000.	1.67	-0.771E-01	*0.519	-0.195	*0.496	-0.153
In III 5D 5F	20000.	2.69	0.285				
1775.6 Å	50000.	2.28	0.289				
C = 0.50E+20	100000.	2.04	0.274				
	200000.	1.81	0.249	*0.620	*0.464		
	300000.	1.68	0.216	*0.653	*0.495		
	500000.	1.52	0.188	*0.744	*0.533		
In III 5D 6F	20000.	*5.09	*0.447				
1431.3 Å	50000.	*4.58	*0.434				
C = 0.32E+19	100000.	4.14	0.425				
	200000.	3.63	0.474				
	300000.	3.33	0.399				
	500000.	2.95	0.405				
In III 5D 7F	20000.						
1295.2 Å	50000.	*6.95	*0.683				
C = 0.22E+19	100000.	*6.52	*0.669				
	200000.	*5.84	*0.787				
	300000.	5.38	0.642				
	500000.	4.79	0.681				
In III 4F 5D	20000.	2.71	-0.564E-01	0.179	-0.398E-01	*0.215	-0.348E-01
2998.8 Å	50000.	2.00	-0.634E-01	0.249	-0.709E-01	*0.268	-0.588E-01
C = 0.78E+21	100000.	1.69	-0.601E-01	0.285	-0.906E-01	*0.300	-0.734E-01
	200000.	1.48	-0.559E-01	0.314	-0.110	0.317	-0.889E-01
	300000.	1.39	-0.513E-01	0.326	-0.121	0.323	-0.975E-01
	500000.	1.28	-0.447E-01	0.341	-0.134	0.331	-0.109
In III 4F 5G	20000.	12.9	-2.37				
4073.7 Å	50000.	9.66	-1.89				
C = 0.26E+21	100000.	8.04	-1.65	*2.25	-1.62		
	200000.	6.80	-1.39	*2.61	-1.94		
	300000.	6.19	-1.20	*2.84	-2.09		
	500000.	5.53	-1.05	*3.27	-2.36	*2.55	-1.95
PERTURBER DENSITY = 1.E+19cm^{-3}							
In III 5S 5P	20000.	2.88	-0.175E-01	0.599E-01	-0.517E-02	*0.837E-01	-0.508E-02
1664.5 Å	50000.	1.86	-0.243E-01	0.124	-0.161E-01	*0.151	-0.147E-01
C = 0.17E+23	100000.	1.39	-0.248E-01	0.167	-0.267E-01	*0.181	-0.230E-01
	200000.	1.10	-0.270E-01	0.190	-0.379E-01	0.204	-0.309E-01
	300000.	0.993	-0.259E-01	0.203	-0.426E-01	0.215	-0.350E-01
	500000.	0.888	-0.251E-01	0.217	-0.491E-01	0.222	-0.400E-01
In III 5S 6P	20000.	*1.24	*0.303E-02				
687.4 Å	50000.	0.923	-0.492E-02				
C = 0.80E+21	100000.	0.782	0.539E-02	*0.157	-0.135E-01		
	200000.	0.685	0.452E-03	*0.173	-0.173E-01		
	300000.	0.639	0.130E-02	*0.177	-0.195E-01		
	500000.	0.590	0.205E-02	*0.182	-0.222E-01		
In III 5S 7P	20000.	*1.87	*0.586E-02				
562.8 Å	50000.	*1.56	-0.428E-01				
C = 0.22E+21	100000.	1.44	-0.367E-01				
	200000.	1.33	-0.411E-01				
	300000.	1.26	-0.342E-01				
	500000.	1.18	-0.283E-01				
In III 5P 6S	20000.	4.80	0.996	0.122	0.996E-01	0.122	0.719E-01
1497.0 Å	50000.	3.28	0.652	0.265	0.223	0.242	0.168
C = 0.42E+22	100000.	2.66	0.608	0.356	0.309	0.312	0.243
	200000.	2.25	0.516	0.449	0.399	0.380	0.320
	300000.	2.05	0.457	0.508	0.452	0.421	0.361
	500000.	1.85	0.435	0.573	0.506	0.470	0.407

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
In III 5P 7S	20000.	*3.47	*1.41				
914.5 Å	50000.	*2.89	*1.11				
C = 0.69E+21	100000.	2.60	0.878				
	200000.	2.32	0.711				
	300000.	2.16	0.651				
	500000.	1.96	0.558				
In III 5P 5D	20000.	3.96	0.204	*0.166	*0.487E-01		
1458.7 Å	50000.	2.69	0.193	*0.297	*0.113		
C = 0.36E+22	100000.	2.15	0.232	*0.356	*0.159		
	200000.	1.80	0.206	*0.412	*0.203	*0.414	*0.164
	300000.	1.65	0.204	*0.440	*0.232	*0.424	*0.187
	500000.	1.51	0.194	0.472	0.259	*0.443	*0.204
PERTURBER DENSITY = 1.E+20cm^{-3}							
In III 5S 5P	20000.	*28.7	-0.627E-01	*0.237	-0.173E-01		
1664.5 Å	50000.	18.6	-0.191	*1.09	-0.122		
C = 0.17E+24	100000.	13.9	-0.212	*1.60	-0.233		
	200000.	11.0	-0.245	*1.88	-0.356		
	300000.	9.93	-0.237	*2.02	-0.413		
	500000.	8.88	-0.233	*2.17	-0.490	*2.22	-0.398
In III 5S 6P	20000.						
687.4 Å	50000.	*9.19	-0.147E-02				
C = 0.80E+22	100000.	7.81	0.838E-01				
	200000.	6.84	0.258E-01				
	300000.	6.39	0.289E-01				
	500000.	5.89	0.350E-01				
In III 5S 7P	20000.						
562.8 Å	50000.						
C = 0.22E+22	100000.						
	200000.	*12.9	-0.103				
	300000.	*12.3	-0.689E-01				
	500000.	*11.5	-0.455E-01				

Table 2. This table shows electron-, proton-, and ionized helium-impact broadening parameters for Tl III for perturber densities of $10^{18} - 10^{20}$ cm^{-3} and temperatures from 20,000 up to 500,000 K. Stark broadening parameters for densities lower than tabulated, are linear with perturber density. Transitions and averaged wavelengths for the multiplet (in Å) are also given in the Table. 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.

PERTURBERS ARE:		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
PERTURBER DENSITY = 1.E+18cm^{-3}							
Tl III 6S 6P	20000.	0.170	-0.341E-03	0.431E-02	-0.962E-04	0.627E-02	-0.961E-04
1350.7 Å	50000.	0.110	-0.554E-03	0.821E-02	-0.263E-03	0.102E-01	-0.256E-03
C = 0.12E+22	100000.	0.820E-01	-0.533E-03	0.109E-01	-0.480E-03	0.119E-01	-0.443E-03
	200000.	0.650E-01	-0.724E-03	0.123E-01	-0.730E-03	0.133E-01	-0.637E-03
	300000.	0.584E-01	-0.658E-03	0.132E-01	-0.887E-03	0.140E-01	-0.755E-03
	500000.	0.523E-01	-0.656E-03	0.141E-01	-0.105E-02	0.145E-01	-0.867E-03
Tl III 6S 7P	20000.	0.999E-01	0.629E-03	0.889E-02	-0.760E-04	*0.105E-01	-0.753E-04
618.6 Å	50000.	0.746E-01	0.226E-03	0.120E-01	-0.194E-03	*0.129E-01	-0.179E-03
C = 0.59E+20	100000.	0.634E-01	0.102E-02	0.135E-01	-0.315E-03	*0.144E-01	-0.269E-03
	200000.	0.556E-01	0.654E-03	0.147E-01	-0.438E-03	*0.151E-01	-0.364E-03
	300000.	0.520E-01	0.662E-03	0.151E-01	-0.493E-03	0.154E-01	-0.406E-03
	500000.	0.481E-01	0.745E-03	0.154E-01	-0.566E-03	0.156E- 01	-0.460E-03
PERTURBER DENSITY = 1.E+19cm^{-3}							
Tl III 6S 6P	20000.	1.70	-0.301E-02	0.390E-01	-0.704E-03	*0.547E-01	-0.703E-03
1350.7 Å	50000.	1.10	-0.522E-02	0.806E-01	-0.242E-02	*0.988E-01	-0.234E-02
C = 0.12E+23	100000.	0.820	-0.519E-02	0.109	-0.465E-02	*0.118	-0.429E-02
	200000.	0.650	-0.722E-02	0.123	-0.723E-02	0.133	-0.630E-02
	300000.	0.584	-0.649E-02	0.132	-0.886E-02	0.140	-0.754E-02
	500000.	0.523	-0.654E-02	0.141	-0.105E-01	0.145	-0.866E-02
Tl III 6S 7P	20000.	*0.999	*0.654E-02				
618.6 Å	50000.	0.746	0.244E-02				
C = 0.59E+21	100000.	0.634	0.105E-01				
	200000.	0.556	0.660E-02	*0.146	-0.433E-02		
	300000.	0.520	0.673E-02	*0.150	-0.492E-02		
	500000.	0.481	0.749E-02	*0.154	-0.565E-02		
PERTURBER DENSITY = 1.E+20cm^{-3}							
Tl III 6S 6P	20000.	*17.0	-0.179E-01	*0.154	-0.240E-02		
1350.7 Å	50000.	11.0	-0.437E-01	*0.710	-0.189E-01		
C = 0.12E+24	100000.	8.19	-0.470E-01	*1.04	-0.420E-01		
	200000.	6.49	-0.679E-01	*1.22	-0.691E-01		
	300000.	5.84	-0.621E-01	*1.31	-0.868E-01		
	500000.	5.23	-0.627E-01	*1.40	-0.105	*1.44	-0.863E-01
Tl III 6S 7P	20000.						
618.6 Å	50000.	*7.43	*0.370E-01				
C = 0.59E+22	100000.	*6.32	*0.111				
	200000.	5.55	0.719E-01				
	300000.	5.20	0.706E-01				
	500000.	4.80	0.782E-01				

Table 3. This table shows electron-, proton-, and ionized helium-impact broadening parameters for Pb IV for perturber densities of 10^{18} – 10^{20} cm^{-3} and temperatures from 50,000 up to 1,000,000 K. Stark broadening parameters for densities lower than tabulated, are linear with perturber density. Transitions and averaged wavelengths for the multiplet (in Å) are also given in the Table. 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.

PERTURBER DENSITY = 1.E+18cm^{-3}							
PERTURBERS ARE:		ELECTRONS		PROTONS		He III	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
Pb IV 6S 6P	50000.	0.737E-01	-0.526E-03	0.290E-02	-0.263E-03	0.573E-02	-0.494E-03
1108.7 Å	100000.	0.534E-01	-0.625E-03	0.449E-02	-0.503E-03	0.894E-02	-0.983E-03
C = 0.11E+22	200000.	0.404E-01	-0.737E-03	0.595E-02	-0.807E-03	0.119E-01	-0.160E-02
	300000.	0.352E-01	-0.787E-03	0.641E-02	-0.977E-03	0.128E-01	-0.196E-02
	500000.	0.304E-01	-0.722E-03	0.699E-02	-0.120E-02	0.140E-01	-0.241E-02
	1000000.	0.259E-01	-0.687E-03	0.768E-02	-0.144E-02	0.154E-01	-0.289E-02
Pb IV 6S 7P	50000.	0.347E-01	0.364E-03	0.388E-02	0.119E-03	*0.761E-02	*0.224E-03
464.8 Å	100000.	0.276E-01	0.169E-03	0.469E-02	0.211E-03	*0.933E-02	*0.410E-03
C = 0.63E+20	200000.	0.228E-01	0.360E-03	0.530E-02	0.307E-03	*0.106E-01	*0.609E-03
	300000.	0.208E-01	0.258E-03	0.562E-02	0.367E-03	*0.112E-01	*0.735E-03
	500000.	0.188E-01	0.269E-03	0.586E-02	0.423E-03	0.117E-01	0.846E-03
	1000000.	0.166E-01	0.272E-03	0.610E-02	0.503E-03	0.122E-01	0.101E-02
PERTURBER DENSITY = 1.E+19cm^{-3}							
Pb IV 6S 6P	50000.	0.737	-0.474E-02	0.285E-01	-0.233E-02	*0.540E-01	-0.393E-02
1108.7 Å	100000.	0.534	-0.601E-02	0.447E-01	-0.478E-02	*0.877E-01	-0.895E-02
C = 0.11E+23	200000.	0.404	-0.725E-02	0.595E-01	-0.796E-02	*0.118	-0.154E-01
	300000.	0.352	-0.770E-02	0.641E-01	-0.976E-02	*0.128	-0.192E-01
	500000.	0.304	-0.717E-02	0.699E-01	-0.120E-01	0.140	-0.241E-01
	1000000.	0.259	-0.686E-02	0.768E-01	-0.144E-01	0.154	-0.288E-01
Pb IV 6S 7P	50000.	0.347	0.349E-02	*0.372E-01	*0.105E-02		
464.8 Å	100000.	0.276	0.155E-02	*0.463E-01	*0.199E-02		
C = 0.63E+21	200000.	0.228	0.351E-02	*0.528E-01	*0.302E-02		
	300000.	0.208	0.251E-02	*0.562E-01	*0.366E-02		
	500000.	0.188	0.266E-02	*0.586E-01	*0.422E-02		
	1000000.	0.166	0.271E-02	*0.610E-01	*0.503E-02		
PERTURBER DENSITY = 1.E+20cm^{-3}							
Pb IV 6S 6P	50000.	7.37	-0.362E-01	*0.236	-0.157E-01		
1108.7 Å	100000.	5.34	-0.526E-01	*0.430	-0.416E-01		
C = 0.11E+24	200000.	4.04	-0.677E-01	*0.587	-0.740E-01		
	300000.	3.52	-0.721E-01	*0.638	-0.929E-01		
	500000.	3.04	-0.679E-01	*0.698	-0.118		
	1000000.	2.59	-0.661E-01	*0.768	-0.144		
Pb IV 6S 7P	50000.	*3.47	*0.296E-01				
464.8 Å	100000.	*2.75	*0.123E-01				
C = 0.63E+22	200000.	2.28	0.326E-01				
	300000.	2.08	0.237E-01				
	500000.	1.88	0.244E-01				
	1000000.	1.66	0.259E-01				

2. RESULTS AND DISCUSSION

The complete discussion of the obtained results and the details of calculation procedure will be published in Dimitrijević and Sahal−Bréchot (1998). Here, we present only tables of the corresponding Stark broadening parameters.

Energy levels have been taken from Bhatia (1978) for In III and from Gutmann and Crooker (1973) for Tl III and Pb IV.

Our results for electron-, proton-, and ionized helium-impact line widths and shifts for tventy In III multiplets for perturber densities of $10^{14} - 10^{16}$ cm^{-3} and $10^{18} - 10^{20}$ cm^{-3}, and for two Tl III multiplets, for perturber densities $10^{18} - 10^{20}$ cm^{-3}, are shown in Tables 1 and 2 respectively. In both cases T = 20,000 − 500,000 K. Data for electron-, proton-, and He III-impact line widths and shifts for two Pb IV multiplets, for perturber densities $10^{18} - 10^{20}$ cm^{-3} and temperatures T = 50,000 − 1,000,000 K, are presented in Table 3. Data for perturber density of 10^{17} cm^{-3} will be published in Dimitrijević and Sahal−Bréchot (1998). For In III, the complete list of transitions is for the electron density of 10^{16} cm^{-3}. For lower electron densities, only transitions where Stark broadening parameters deviate from the linear dependence with the electron density, are listed. Stark broadening parameters for densities lower than tabulated, are linear with perturber density.

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 or 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 formulas for such a case are given. The accuracy of the results obtained decreases when broadening by ion interactions becomes important.

There is not experimental results concerning In III, Tl III and Pb IV. There are however theoretical results (Purić *et al.* 1978) for In III $5s^2S$-$5p^2P^o$ and Tl III $6s^2S$-$6p^2P^o$ multiplets, obtained within the semiempirical approach (Griem, 1968). We will compare our results with them in Dimitrijević and Sahal−Bréchot (1998).

The present data contribute to the creation of a large set of reliable semiclassical Stark broadening data of significance for astrophysical and laboratory plasma research.

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ТАБЕЛЕ ПАРАМЕТАРА ШТАРКОВОГ ШИРЕЊА СПЕКТРАЛНИХ ЛИНИЈА In III, Tl III И Pb IV

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Претходно саопштење

Користећи семикласичан прилаз, израчунате су ширине и помераји спектралних линија, проузроковани сударима са електронима, протонима и јонима хелијума за 20 мултиплета In III и 2 мултиплета Tl III, као и ширине и помераји спектралних линија, проузроковани сударима са електронима, протонима и двоструко наелектрисаним јонима хелијума, за 2 мултиплета Pb IV. Резултати су дати у функцији температуре и концентрације пертурбера.