

On the Stark broadening of some Cr II spectral lines in a plasma

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Outline

- Introduction: Atomic structure of the Cr II ion
- Stark broadening of spectral lines in plasma

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Plasma constituents

Line profile-width and shift of a spectral line

Line broadening

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 - SE approach
 - MSE approach

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Introduction: Atomic structure of the Cr II ion

Location of Chromium in the Periodic Table

The image shows a standard periodic table of elements. The element Chromium (Cr) is highlighted with a red border. It is located in the 4th period and the 6th group. Below the main table, the Lanthanide Series and Actinide Series are shown in a separate row.

1																	18	
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg										Al	Si	P	S	Cl	Ar	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

Lanthanide Series*
Actinide Series**

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Fundamental configuration of Cr II



Introduction: Atomic structure of the Cr II ion

Location of Chromium in the Periodic Table

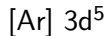
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1	2											13	14	15	16	17	18	
1	H	He											B	C	N	O	F	Ne
2	Li	Be																
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

Lanthanide Series*
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Fundamental configuration of Cr II



Singly ionized chromium Cr II

Singly ionized chromium is important for technology applications.

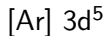
It is also important for investigation in plasma physics, fusion research and plasma technologies.

Introduction: Atomic structure of the Cr II ion

Location of Chromium in the Periodic Table

The image shows a standard periodic table of elements. Chromium (Cr) is highlighted in red and is located in the 4th period, 6th group. Below the main table, the Lanthanide Series and Actinide Series are shown in purple boxes. The Lanthanide Series includes elements from La to Lu, and the Actinide Series includes elements from Ac to Lr. The source 'ChemistryLearner.com' is noted at the bottom.

Fundamental configuration of Cr II



Singly ionized chromium Cr II Singly ionized chromium is important for technology applications.

It is also important for investigation in plasma physics, fusion research and plasma technologies.

Introduction: Atomic structure of the Cr II ion

$$3d^4 4p \quad {}^2F_{5/2} \quad E = 74436.10\text{cm}^{-1}$$

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Introduction: Atomic structure of the Cr II ion

$$3d^4 4p \quad x^2 F_{5/2} \quad E = 74436.10 \text{cm}^{-1}$$

$$3d^4 4p \quad y^2 F_{5/2} \quad E = 70584.39 \text{cm}^{-1}$$

$$3d^4 4p \quad z^2 F_{5/2} \quad E = 68583.31 \text{cm}^{-1}$$

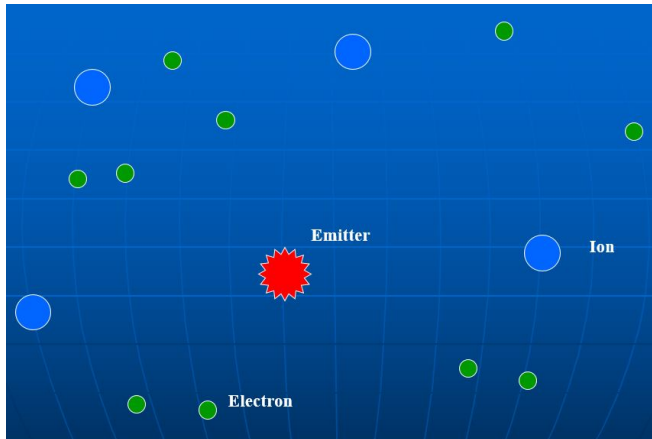
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Stark broadening of spectral lines in plasma:

Plasma constituents

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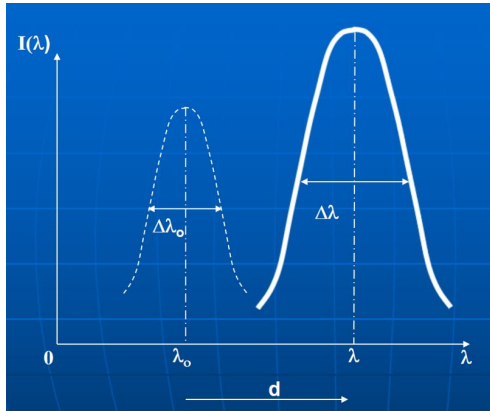


Stark broadening of spectral lines in plasma:

Line profile-width and shift of a spectral line

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Spectral Line Broadening in Plasma

- Natural width
- Doppler width
- Collisional width

$$L(x) = \frac{1}{\pi \gamma_L} \frac{\gamma_L^2}{x^2 + \gamma_L^2}$$

$$J_{\lambda,R}(x) = \frac{1}{\pi} \int_0^{\infty} \frac{W_R^2(\beta)}{1 + (x - A^{4/3} \beta^2)^2} d\beta$$

$$G(x) = \sqrt{\frac{\ln(2)}{\pi}} \frac{\exp\left[-\ln(2) \left(\frac{x}{\gamma_G}\right)^2\right]}{\gamma_G}$$

Stark broadening of spectral lines in plasma:

General expression for the width of an isolated ion line

According to the impact approximation (Baranger, 1958), the full half-width (FWHM) of an isolated ion line is given by:

$$W = N \left\{ v \left[\sum_{i'} \sigma_{i'i} + \sum_{f'} \sigma_{f'f} \right] \right\}_{av} + W_{el}$$

where N is the electron density, $\sigma_{j'i}$ the inelastic cross sections for collisional transitions, $\{.\}_{av}$ is the average over the electron velocity v distribution and W_{el} is the line width induced by elastic collisions.

Baranger, Michel. "General impact theory of pressure broadening." *Physical Review* 112.3 (1958): 855.

Stark broadening of spectral lines in plasma:

SCP approach

According to the semiclassical perturbation approach (SSB 1969 and SSB et al. 2014):

$$W = N \int v f(v) \left(\sum_{i' \neq i} \sigma_{i'i}(v) + \sum_{f' \neq f} \sigma_{f'f}(v) + \sigma_{el} \right)$$

where $f(v)$ is the Maxwellian velocity distribution function for electrons,

$$\sum_{j' \neq j} \sigma_{j'j}(v) = \frac{1}{2} R_1^2 + \int_{R_1}^{R_D} 2\pi \rho d\rho \sum_{j'j} P_{jj'}(\rho, v)$$

is the inelastic cross section and the elastic cross section is given by:

$$\sigma_{el} = 2\pi R_2^2 + \int_{R_2}^{R_D} 2\pi \rho d\rho \sin^2 \delta + \sigma_r$$

Sahal-Bréchet, S. "Impact theory of the broadening and shift of spectral lines due to electrons and ions in a plasma." *Astronomy and Astrophysics* 1 (1969): 91 and 2 (1969): 322.

Sahal-Bréchet, S., Dimitrijević, M. and Ben Nessib, N. "Widths and shifts of isolated lines of neutral and ionized atoms perturbed by collisions with electrons and ions." *Atoms* 2.2 (2014): 225-252.

Stark broadening of spectral lines in plasma:

SE approach

According to the semiempirical approach (Griem, 1968), the full half-width (FWHM) of an isolated ion line is given by:

$$W = N \frac{8\pi}{3} \frac{\hbar^2}{m^2} \left(\frac{2m}{\pi kT} \right)^{1/2} \frac{\pi}{\sqrt{3}} \left[\sum_{i'} R_{i'i}^2 g \left(\frac{E}{\Delta E_{i'i}} \right) + \sum_{f'} R_{f'f}^2 g \left(\frac{E}{\Delta E_{f'f}} \right) \right]$$

where $E = 3kT/2$ is the energy of the perturbing electron, $\Delta E_{j'j} = |E_{j'} - E_j|$ is the energy difference between levels j' and j , $R_{j'j}^2$ is the square of the coordinate operator matrix element and $g(x)$ the Gaunt factor function for width.

Griem, Hans R. "Semiempirical formulas for the electron-impact widths and shifts of isolated ion lines in plasmas." *Physical Review* 165.1 (1968): 258.

Stark broadening of spectral lines in plasma:

MSE approach

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According to the modified semiempirical approach (Dimitrijević and Konjević, 1980), the full half-width (FWHM) of an isolated ion line is given by:

$$\begin{aligned} W = N \frac{8\pi}{3} \frac{\hbar^2}{m^2} \left(\frac{2m}{\pi kT} \right)^{1/2} \frac{\pi}{\sqrt{3}} & \left[R_{l_i, l_i+1}^2 \tilde{g} \left(\frac{E}{\Delta E_{l_i, l_i+1}} \right) \right. \\ & \left. + R_{l_i, l_i-1}^2 \tilde{g} \left(\frac{E}{\Delta E_{l_i, l_i-1}} \right) \right. \\ & \left. + R_{l_f, l_f+1}^2 \tilde{g} \left(\frac{E}{\Delta E_{l_f, l_f+1}} \right) + R_{l_f, l_f-1}^2 \tilde{g} \left(\frac{E}{\Delta E_{l_f, l_f-1}} \right) \right. \\ & \left. + \sum_{i'} (R_{ii'}^2)_{\Delta n \neq 0} g \left(\frac{3kTn_i^3}{4Z^2 E_H} \right) + \sum_{f'} (R_{ff'}^2)_{\Delta n \neq 0} g \left(\frac{3kTn_f^3}{4Z^2 E_H} \right) \right] \end{aligned}$$

$E = 3kT/2$ is the energy of the perturbing electron, $\Delta E_{j'j} = |E_{j'} - E_j|$ is the energy difference between levels j' and j , $R_{j'j}^2$ is the square of the coordinate operator matrix element, $\tilde{g}(x) = 7 - \frac{1.1}{Z} + g(x)$ and $g(x)$ are the Gaunt factor functions for width.

Dimitrijević, M. S., and Konjević, N. "Stark widths of doubly-and triply-ionized atom lines." Journal of Quantitative Spectroscopy and Radiative Transfer 24 (1980): 451-459.

Stark broadening of Cr II spectral lines:

Precedent calculations (Dimitrijević et al. 2007 & Simić et al. 2013)

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Stark broadening parameters for Cr II 4s–4p multiplets.

Transition	T (K)	Electrons			Protons			Helium ions		
		<i>F</i> (Å)	<i>F</i> (Å)	<i>S</i> (Å)	<i>F</i> (Å)	<i>F</i> (Å)	<i>S</i> (Å)	<i>F</i> (Å)	<i>F</i> (Å)	<i>S</i> (Å)
Cr II 3d ⁴ -3P 3483.7 Å C = 0.36E+18	10000	0.131E-03	0.034E-03	0.035E-03	0.033E-03	0.078E-05	0.004E-05	0.004E-05	0.004E-05	0.004E-05
	20000	0.224E-03	-0.804E-04	0.134E-04	-0.973E-05	0.139E-04	-0.823E-05			
	30000	0.182E-03	-0.786E-04	0.154E-04	-0.111E-04	0.154E-04	-0.915E-05			
	50000	0.152E-03	-0.669E-04	0.178E-04	-0.127E-04	0.172E-04	-0.104E-04			
	100000	0.133E-03	-0.583E-04	0.212E-04	-0.151E-04	0.195E-04	-0.123E-04			
Cr II 3d ⁴ -D 3355.5 Å C = 0.33E+18	5000	0.396E-03	-0.105E-03	0.462E-05	-0.378E-05	0.659E-05	-0.354E-05			
	10000	0.285E-03	-0.847E-04	0.845E-05	-0.616E-05	0.101E-04	-0.534E-05			
	20000	0.199E-03	-0.742E-04	0.126E-04	-0.856E-05	0.131E-04	-0.728E-05			
	30000	0.160E-03	-0.676E-04	0.143E-04	-0.985E-05	0.144E-04	-0.819E-05			
	50000	0.132E-03	-0.568E-04	0.165E-04	-0.113E-04	0.161E-04	-0.927E-05			
Cr II 3d ⁴ -D 3355.5 Å C = 0.33E+18	10000	0.113E-03	-0.488E-04	0.196E-04	-0.135E-04	0.184E-04	-0.110E-04			
	5000	0.330E-03	-0.822E-04	0.437E-05	-0.389E-05	0.609E-05	-0.359E-05			
	10000	0.249E-03	-0.749E-04	0.570E-05	-0.607E-05	0.913E-05	-0.524E-05			
	20000	0.185E-03	-0.641E-04	0.115E-04	-0.834E-05	0.116E-04	-0.692E-05			
	30000	0.156E-03	-0.652E-04	0.129E-04	-0.932E-05	0.128E-04	-0.770E-05			
Cr II 3d ⁴ -D 3412.3 Å C = 0.18E+18	50000	0.133E-03	-0.567E-04	0.149E-04	-0.107E-04	0.144E-04	-0.882E-05			
	100000	0.120E-03	-0.479E-04	0.177E-04	-0.127E-04	0.159E-04	-0.102E-04			
	5000	0.413E-03	-0.105E-03	0.485E-05	-0.527E-05	0.671E-05	-0.488E-05			
	10000	0.310E-03	-0.957E-04	0.884E-05	-0.800E-05	0.103E-04	-0.705E-05			
	20000	0.230E-03	-0.829E-04	0.136E-04	-0.111E-04	0.134E-04	-0.910E-05			
Cr II 3d ⁴ -F 3128.8 Å C = 0.19E+18	30000	0.193E-03	-0.840E-04	0.155E-04	-0.123E-04	0.150E-04	-0.102E-04			
	50000	0.164E-03	-0.735E-04	0.180E-04	-0.142E-04	0.168E-04	-0.116E-04			
	100000	0.147E-03	-0.621E-04	0.217E-04	-0.169E-04	0.194E-04	-0.138E-04			
	5000	0.441E-03	-0.115E-03	0.497E-05	-0.734E-05	0.695E-05	-0.474E-05			
	10000	0.331E-03	-0.101E-03	0.922E-05	-0.809E-05	0.108E-04	-0.695E-05			
Cr II 3d ⁴ -P 3391.5 Å C = 0.28E+18	20000	0.466E-03	-0.866E-04	0.140E-04	-0.111E-04	0.142E-04	-0.926E-05			
	30000	0.201E-03	-0.857E-04	0.161E-04	-0.124E-04	0.157E-04	-0.103E-04			
	50000	0.172E-03	-0.736E-04	0.188E-04	-0.145E-04	0.177E-04	-0.117E-04			
	100000	0.155E-03	-0.620E-04	0.226E-04	-0.172E-04	0.204E-04	-0.137E-04			
	5000	0.147E-03	-0.135E-04	0.272E-05	-0.445E-06	0.404E-05	-0.440E-06			
Cr II 3d ⁴ -P 2756.2 Å C = 0.26E+18	10000	0.111E-03	-0.101E-04	0.485E-05	-0.840E-06	0.608E-05	-0.790E-06			
	20000	0.846E-04	-0.802E-05	0.691E-05	-0.386E-05	0.782E-05	-0.120E-05			
	30000	0.732E-04	-0.686E-05	0.780E-05	-0.167E-05	0.844E-05	-0.144E-05			
	50000	0.636E-04	-0.597E-05	0.858E-05	-0.212E-05	0.918E-05	-0.174E-05			
	100000	0.568E-04	-0.510E-05	0.961E-05	-0.254E-05	0.999E-05	-0.209E-05			
Cr II 3d ⁴ -D 2672.7 Å C = 0.24E+18	5000	0.159E-03	-0.146E-06	0.268E-05	-0.127E-06	0.397E-05	-0.127E-06			
	10000	0.135E-03	-0.736E-06	0.474E-05	-0.251E-06	0.594E-05	-0.242E-06			
	20000	0.837E-04	-0.744E-06	0.671E-05	-0.455E-06	0.718E-05	-0.421E-06			
	30000	0.766E-04	-0.630E-06	0.754E-05	-0.606E-06	0.858E-05	-0.534E-06			
	50000	0.592E-04	-0.828E-06	0.827E-05	-0.777E-06	0.888E-05	-0.678E-06			
100000	0.503E-04	-0.807E-06	0.922E-05	-0.103E-05	0.965E-05	-0.844E-06				

Electronic, proton, and He II most broadening parameters for Cr II 3d⁴-3p spectral lines, for a particular density of 10¹⁷ cm⁻³ and temperature from 5000 to 100 000 K. The calculated wavelengths of the transitions (*λ*) and the corresponding Stark widths (*W*) for a particular density (*C*) are also given. This parameter when divided by the corresponding Stark width gives an estimate for the maximal perturbation density for which the line may be treated as isolated. WIDTH is FWHM. We note that for the first four lines, electronic and proton impact broadening parameters are presently computed at *C* = 10 and 0.18E+18, respectively, as in the accompanying proceedings (Simić et al. 2013).

Perturbator density is 1.0E+17 cm⁻³

Transition	T (K)	Electrons		Protons		Helium ions	
		<i>W</i> (Å)	<i>λ</i> (Å)	<i>W</i> (Å)	<i>λ</i> (Å)	<i>W</i> (Å)	<i>λ</i> (Å)
Cr II 3d ⁴ -P 3483.7 Å C = 0.36E+18	5000	0.982	0.1170E-03	0.1170E-03	0.1470E-03	0.1470E-03	0.1470E-03
	10000	0.820	0.1020E-03	0.1020E-03	0.1230E-03	0.1230E-03	0.1230E-03
	20000	0.672	0.0870E-03	0.0870E-03	0.1040E-03	0.1040E-03	0.1040E-03
	30000	0.535	0.0720E-03	0.0720E-03	0.0850E-03	0.0850E-03	0.0850E-03
	50000	0.398	0.0570E-03	0.0570E-03	0.0680E-03	0.0680E-03	0.0680E-03
Cr II 3d ⁴ -D 3355.5 Å C = 0.33E+18	5000	1.204	0.1430E-03	0.1430E-03	0.1710E-03	0.1710E-03	0.1710E-03
	10000	1.036	0.1240E-03	0.1240E-03	0.1480E-03	0.1480E-03	0.1480E-03
	20000	0.868	0.1050E-03	0.1050E-03	0.1260E-03	0.1260E-03	0.1260E-03
	30000	0.700	0.0860E-03	0.0860E-03	0.1040E-03	0.1040E-03	0.1040E-03
	50000	0.532	0.0670E-03	0.0670E-03	0.0800E-03	0.0800E-03	0.0800E-03
Cr II 3d ⁴ -D 3412.3 Å C = 0.18E+18	5000	1.040	0.1260E-03	0.1260E-03	0.1510E-03	0.1510E-03	0.1510E-03
	10000	0.882	0.1070E-03	0.1070E-03	0.1280E-03	0.1280E-03	0.1280E-03
	20000	0.724	0.0880E-03	0.0880E-03	0.1060E-03	0.1060E-03	0.1060E-03
	30000	0.566	0.0690E-03	0.0690E-03	0.0840E-03	0.0840E-03	0.0840E-03
	50000	0.408	0.0500E-03	0.0500E-03	0.0610E-03	0.0610E-03	0.0610E-03
Cr II 3d ⁴ -F 3128.8 Å C = 0.19E+18	5000	1.040	0.1260E-03	0.1260E-03	0.1510E-03	0.1510E-03	0.1510E-03
	10000	0.882	0.1070E-03	0.1070E-03	0.1280E-03	0.1280E-03	0.1280E-03
	20000	0.724	0.0880E-03	0.0880E-03	0.1060E-03	0.1060E-03	0.1060E-03
	30000	0.566	0.0690E-03	0.0690E-03	0.0840E-03	0.0840E-03	0.0840E-03
	50000	0.408	0.0500E-03	0.0500E-03	0.0610E-03	0.0610E-03	0.0610E-03
Cr II 3d ⁴ -P 3391.5 Å C = 0.28E+18	5000	1.210	0.1490E-03	0.1490E-03	0.1740E-03	0.1740E-03	0.1740E-03
	10000	1.030	0.1290E-03	0.1290E-03	0.1530E-03	0.1530E-03	0.1530E-03
	20000	0.850	0.1090E-03	0.1090E-03	0.1300E-03	0.1300E-03	0.1300E-03
	30000	0.670	0.0890E-03	0.0890E-03	0.1070E-03	0.1070E-03	0.1070E-03
	50000	0.490	0.0690E-03	0.0690E-03	0.0840E-03	0.0840E-03	0.0840E-03

Dimitrijević, M. S., et al. "The influence of Stark broadening on Cr II spectral line shapes in stellar atmospheres." *Astronomy & Astrophysics* 469.2 (2007): 681-686.

Simić, Z., M. S. Dimitrijević, and S. Sahal-Břechot. "Stark broadening of resonant Cr II 3d₅-3d4_{4p} spectral lines in hot stellar atmospheres." *Monthly Notices of the Royal Astronomical Society* 432.3 (2013): 2247-2251.

Stark broadening of Cr II spectral lines:

Recent experimental work (Aguilera et al. 2014)

Table 1. Stark widths (FWHM) w (pm) and shifts d (pm) at electron density 10^{17} cm^{-3} of Cr II spectral lines, compared to experimental and theoretical values reported in the literature. The temperature range is 12 000–16 300 K. The relative error of w is 15 per cent. The relative error of d is 11 per cent, with a minimum absolute error of 0.1 pm.

No.	Transition	Multiplet	λ (Å)	w	Experimental				Theoretical		
					d	w^a	d^a	w^b	w^c	d^b	d^c
1	$3d^5-3d^4(^5D)4p$	$a^6S-z^6P^*$	2055.596	3.7	1.4				3.42		-0.0402
			2061.575	3.4	1.4			3.42		-0.0402	
2	$3d^4(^5D)4s-3d^4(^5D)4p$	$a^6D-z^6F^*$	2835.629	5.0	0.1						
			2843.249	5.1	0.0						
			2849.837	5.1	-0.1						
			2855.670	5.0							
			2860.934	5.0	-0.2						
			2862.571	4.7							
3	$a^6D-z^6P^*$	$a^6D-z^6P^*$	2766.531	4.4	-0.1			10.0		-0.927	
			2762.589	4.5			10.0		-0.927		
			2757.720	4.7	-0.1		10.0		-0.927		
			2751.864	4.8	-0.1		10.0		-0.927		
			2750.727	5.1	-0.1		10.0		-0.927		
			2748.980	5.0			10.0		-0.927		
4	$a^6D-z^4P^*$	$a^6D-z^4P^*$	2743.641	5.1			10.0		-0.927		
			2672.826	5.4	-0.2						
			2712.303	5.9	-0.2						
			2653.578	5.3	-0.1						
5	$a^6D-z^6D^*$	$a^6D-z^6D^*$	2691.040	4.3	0.3		10.2		-0.0738		
			2671.803	4.6	0.2		10.2		-0.0738		
			2668.707	4.6	0.1		10.2		-0.0738		
			2666.020	4.8	0.3		10.2		-0.0738		
			2678.789	5.0			10.2		-0.0738		
6	$a^6D-z^4F^*$	$a^6D-z^4F^*$	2534.333	5.3							

Stark broadening of Cr II spectral lines:

Recent experimental work (Aguilera et al. 2014)

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7		$a^4D-z^4P^*$	3368.041	9.1	-0.2		29.7	-9.52	
			3422.732	8.5			29.7	-9.52	
			3342.576	8.7	-0.2		29.7	-9.52	
			3421.202	8.9			29.7	-9.52	
8		$a^4D-z^4F^*$	3132.053	7.2	-0.1	34	-10	27.8	-9.06
			3124.973	7.4	-0.1	26	-12	27.8	-9.06
			3120.359	7.5	-0.2	22.6	-11	27.8	-9.06
			3118.646	7.6	-0.2			27.8	-9.06
			3147.220	7.5	-0.2			27.8	-9.06
			3128.692	7.1	-0.2			27.8	-9.06
9		$a^4D-z^4D^*$	2870.432	6.5	0.4			22.3	-7.06
			2880.863	6.9	0.3			22.3	-7.06
10	$3d^4(^5D)4s-3d^4(^3F)4p$	$a^4D-y^4F^*$	2107.944	4.1					
11	$3d^5-3d^4(^5D)4p$	$a^4G-z^4F^*$	3180.693	10.7			10.8	1.97	
			3209.176	10.9			10.8	1.97	
12	$3d^5-3d^4(^3H)4p$	$a^4G-z^4H^*$	2297.169	4.7	1.6				
			2314.721	5.0	1.5				
13	$3d^5-3d^4(^5D)4p$	$b^4D-z^4D^*$	3360.291	12.1			10.8	0.392	
14	$3d^5-3d^4(a^3P)4p$	$b^4D-y^4P^*$	2397.748	5.9	1.6				
15	$3d^4(^3P)4s-3d^4(a^3P)4p$	$b^4P-y^4D^*$	2935.132	6.6					
			2930.847	6.6	-0.1				
			2976.709	6.0	-0.1				
			2961.721	6.2	-0.2				
16	$3d^5-3d^4(^1I)4p$	$a^2I-w^2H^*$	2121.257	4.7					
17	$3d^4(^3H)4s-3d^4(^3H)4p$	$a^4H-z^4H^*$	2971.899	7.1					
			2979.736	7.0	-0.4				
			2989.190	6.8					
18		$a^4H-z^4I^*$	2840.013	5.4	0.1				
			2851.354	5.6					
19		$a^4H-y^4G^*$	2693.528	4.9	0.2				
20	$3d^4(^3H)4s-3d^4(^3G)4p$	$a^4H-y^4H^*$	2584.107	4.0					
21	$3d^4(^3F)4s-3d^4(a^3P)4p$	$a^4F-y^4D^*$	2966.038	5.5	0.2				
			3003.911	6.2					
22	$3d^4(^3F)4s-3d^4(a^3F)4p$	$a^4F-z^4G^*$	2936.933	7.2	0.0				
23		$a^4F-x^4D^*$	2727.254	5.5					
24	$3d^4(^3G)4s-3d^4(^3H)4p$	$b^4G-z^4H^*$	3295.423	7.9	-0.4				

Stark broadening of Cr II spectral lines:

Recent experimental work (Aguilera et al. 2014)

No.	Transition	Multiplet	λ (Å)	Experimental				Theoretical			
				w	d	w^a	d^a	w^b	w^c	d^b	d^c
25	$3d^4(^3G)4s-3d^4(a^3F)4p$	$b^4G-z^4G^*$	3122.596	6.3	0.1						
26	$3d^4(^3G)4s-3d^4(^3G)4p$	$b^4G-y^4H^*$	2800.758	6.4							
27		$b^4G-^4F^*$	2792.151	5.4	0.0						
			2785.692	5.7							
28	$3d^4(^3H)4s-3d^4(^3H)4p$	$a^2H-z^2I^*$	3050.130	7.5	1.0						
			3040.924	8.0							
29	$3d^4(^3H)4s-3d^4(a^3F)4p$	$a^2H-y^2G^*$	2832.452	6.2	0.9						
30	$3d^4(^3P)4s-3d^4(a^3P)4p$	$a^2P-z^2S^*$	3291.763	9.2							
31		$a^2P-z^2P^*$	3172.070	7.8	-0.1						
32	$3d^4(^3P)4s-3d^4(a^3F)4p$	$a^2P-y^4F^*$	3152.213	7.2	-0.2						
33	$3d^4(^3F)4s-3d^4(a^3F)4p$	$b^2F-y^4F^*$	3183.326	8.5							
34		$b^2F-z^2F^*$	3028.124	7.7							
35	$3d^5-3d^4(^3H)4p$	$b^2H-z^2H^*$	3041.720	9.2							
36	$3d^5-3d^4(^1I)4p$	$b^2H-^2I^*$	2575.788	5.7							
37	$3d^5-3d^4(a^1G)4p$	$b^2H-x^2H^*$	2573.532	7.8							
38	$3d^5-3d^4(^1I)4p$	$b^2H-w^2H^*$	2416.393	6.2							
39	$3d^5-3d^4(a^1D)4p$	$a^2G-w^2F^*$	2215.065	5.3							
40	$3d^4(^3D)4s-3d^4(^3D)4p$	$c^4D-w^4D^*$	2838.778	5.5	0.2						
41	$3d^4(^3G)4s-3d^4(^3G)4p$	$b^2G-x^4G^*$	3107.563	7.9							
42		$b^2G-x^2G^*$	2927.083	6.9							
43	$3d^4(a^1G)4s-3d^4(a^1G)4p$	$c^2G-w^2G^*$	2774.430	6.3	1.3						
44	$3d^5-3d^4(a^3F)4p$	$c^2F-y^2G^*$	3306.955	7.8	0.0						
45	$3d^4(^3D)4s-3d^4(^3D)4p$	$b^2D-w^2F^*$	2941.957	6.6	0.7						

^aRathore et al. (1984). Temperature 13 700 K.

^bDimitrijević et al. (2007). Data interpolated to a temperature of 14 000 K.

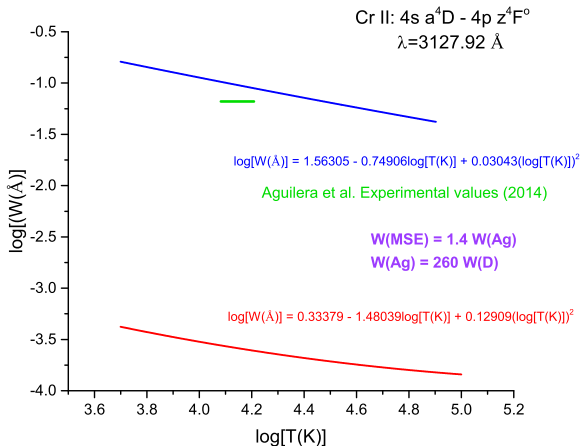
^cSimić et al. (2013). Data interpolated to a temperature of 14 000 K.

Stark broadening of Cr II spectral lines:

Present calculations

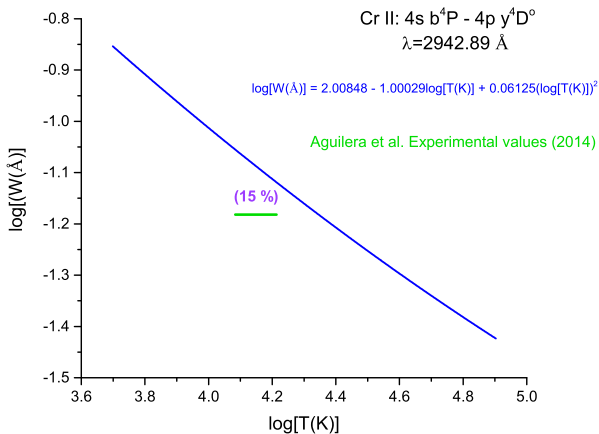
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Stark broadening of Cr II spectral lines:

Present calculations



In this work, we calculate the spectral line widths of some Cr II lines at an electron density of 10^{17} cm^{-3} and electron temperatures from 5000 K to 80000K using the modified semi-empirical (MSE) approach. The needed atomic data are taken from NIST database.

The obtained widths are compared to Dimitrijević et al. (2007), Simić et al. (2013) and Aguilera et al. (2014) values.

Thank you for your attention

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