Studies on the Electron-Correlation and Relativistic Effects in **Target Representation and Low-Energy Collision Calculation** V. Stancalie, C. lorga and V. Pais

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**Exploring the importance of including CI wave functions in the target** -state expansion and in the (N+1)-electron quadratically integrable function expansion

**Fe-peak CoIV (Cr-like) : Z=24 : 3p**<sup>6</sup>(<sup>2</sup>**D**<sup>e</sup>)

The accuracy of a series of models for the target terms has been investigated including all of the 136 LS-coupled states, arising from the three manifolds 3d<sup>6</sup>, 3d<sup>5</sup>4s, 3d<sup>5</sup>4p in the *R*-matrix expansion.

**Exploring the importance of including relativistic effects in the target** representation and low-energy electron collision calculation

Fe-peak Cr-like Co IV I.

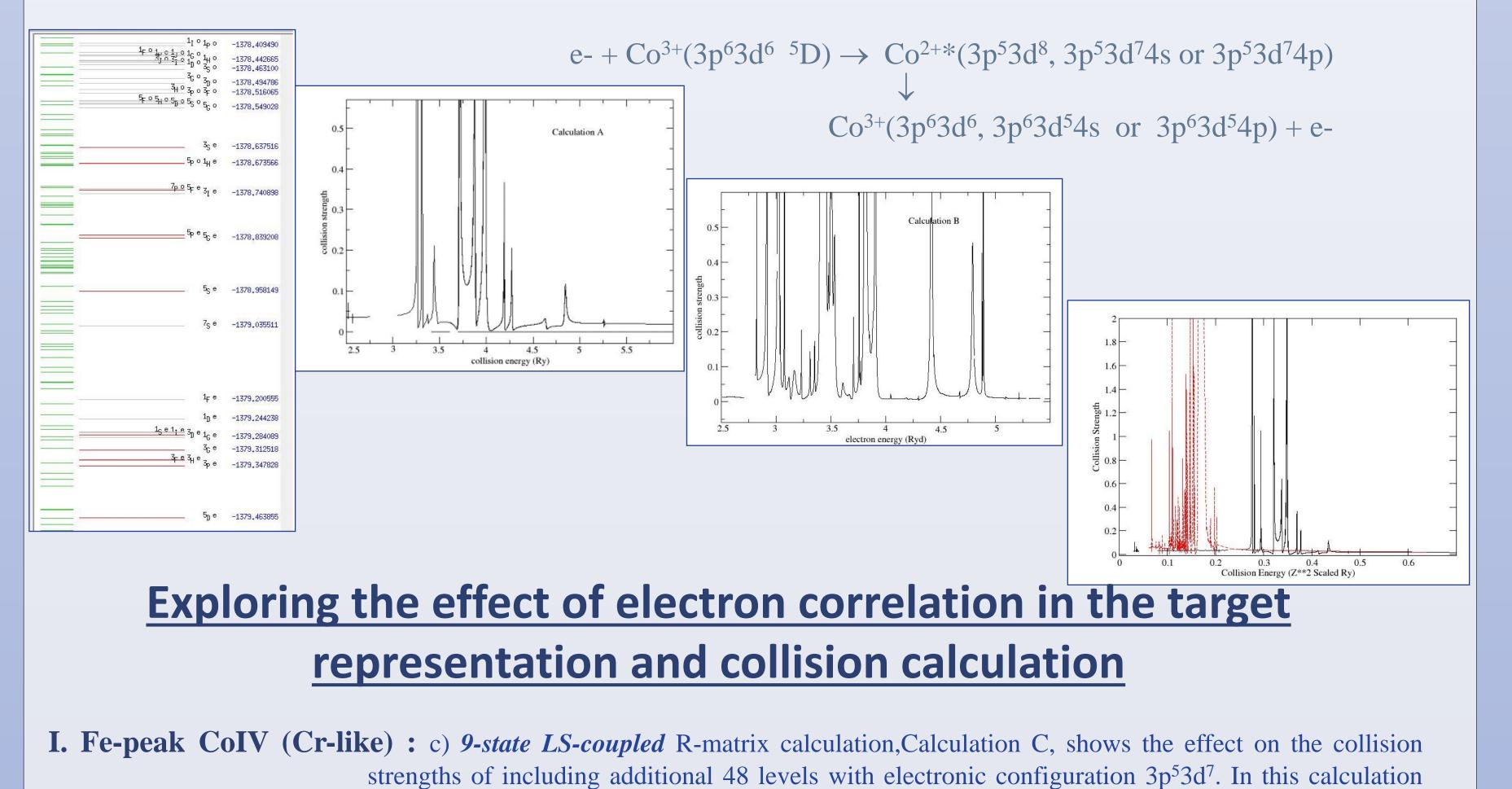
ADNDT107(2016)140-220

FAC1: 1334 levels among the 3d<sup>6</sup>, 3d<sup>5</sup>4*l*, 3p<sup>5</sup>3d<sup>7</sup>, 3p<sup>4</sup>3d<sup>8</sup>, 3p<sup>3</sup>3d<sup>9</sup>, and 3p<sup>2</sup>3d<sup>10</sup> *levels* FAC2: 21.992 levels of the 3d<sup>6</sup>, 3d<sup>5</sup>4*l*, 3d<sup>5</sup>5*l*, 3p<sup>6</sup>3d<sup>4</sup>4*l*4*l*',3p<sup>5</sup>3d<sup>7</sup> and 3p<sup>4</sup>3d<sup>7</sup>4*l* configurations FAC3: FAC2+37 198 levels of the 3p<sup>4</sup>3d<sup>8</sup>, 3p<sup>3</sup>3d<sup>9</sup>, 3p<sup>2</sup>3d<sup>10</sup>, 3p<sup>6</sup>3d<sup>4</sup>5*l*5*l*' and 3p<sup>4</sup>3d<sup>7</sup>5*l* configurations FAC4: FAC3 +12 338 levels of the 3p<sup>5</sup>3d<sup>6</sup>4*l* and 3p<sup>5</sup>3d<sup>6</sup>5*l configurations* 

a) 3-state LS –coupled R-matrix calculation, Calculation A. First, we have included in the R-matrix expansion all 136 LS coupled states which arise from the three target configurations 3d<sup>6</sup>, 3d<sup>5</sup>4s and 3d<sup>5</sup>4p.

b) 6 -state LS -coupled R-matrix calculation, Calculation B, retains also 136 LS terms arising from the three configurations above augmented with 3p<sup>4</sup>3d<sup>8</sup>, 3p<sup>4</sup>3d<sup>7</sup>4s and 3p<sup>4</sup>3d<sup>7</sup>4p in the target state expansion and the configurations 3p<sup>5</sup>3d<sup>8</sup>, 3p<sup>4</sup>3d<sup>9</sup>, 3p<sup>5</sup>3d<sup>8</sup>,  $3p^43d^9$ ,  $3p^43d^84s$  and  $3p^63d^54s^2$  in the (N+1)-electron quadratically integrable function expansion.

c) New target states to represent the 136 Co IV energies from the 3d<sup>5</sup>, 3d<sup>4</sup>4s, 3d<sup>4</sup>4p levels by allowing double electron promotions from the 3p-shell into the 3d-shell and single electron promotion into the 4s, 4p and 4d –shell: 272 LS terms of the four configurations 3d<sup>6</sup>, 3d<sup>5</sup>4s, 3d<sup>5</sup>4p and 3d<sup>5</sup>4d are included in the *R*-matrix expansion.



FAC5: FAC4 + 4610 levels of the  $3p^33d^84l$ ,  $3p^23d^94l$ , and  $3p3d^{10}4l$  configurations.

76 138 levels included in CI: Discrepancies with NIST up to 35% for the majority of levels

GRASP: 21 configurations  $3d^{6}$ ,  $3d^{5}4l$ ,  $3d^{5}5l$ ,  $3d^{4}4l^{2}$ ,  $3d^{4}4l4l$  and  $3p^{5}3d^{7}$ : 14 732 levels

14.732 levels included in CI: Significant discrepancies with NIST up to 26% for some levels

QRHF : radial orbitals (RO) are calculated quasi-relativistic Hartree -Fock and are supplemented with the transformed radial orbitals (TRO) for  $5 \le n \le 8$  and all possible *l* (Bogdanovich et al. CPC 2002,2005).

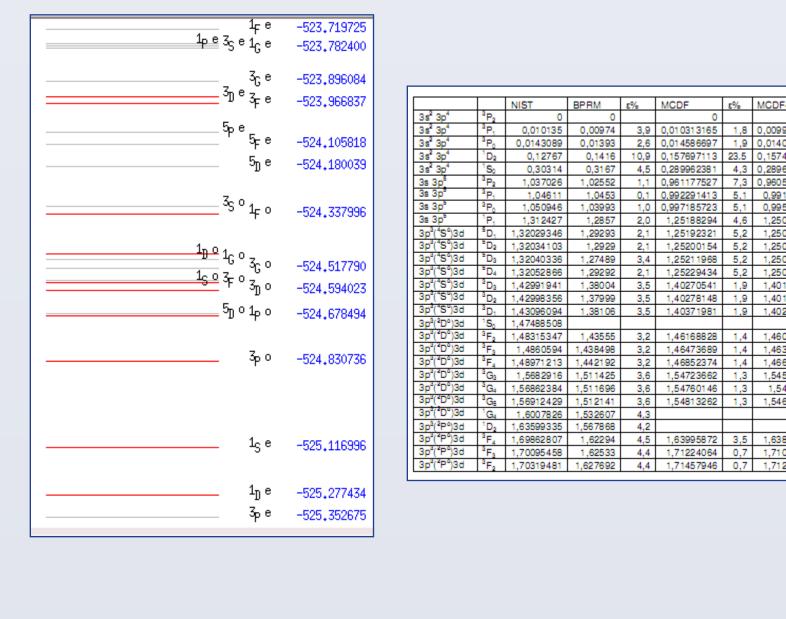
<u>1 563 846 levels included in CI with the QRHF code: Discrepances with NIST less than <u>3%</u> for some levels</u>

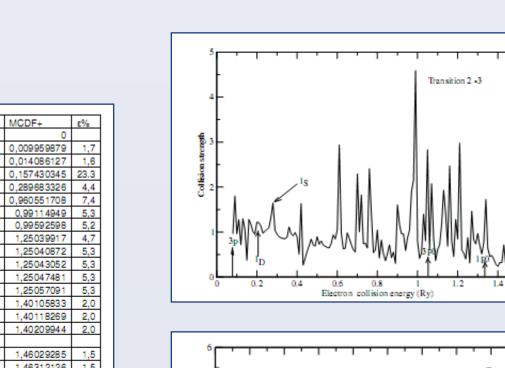
S-like Ar<sup>2+</sup> II.

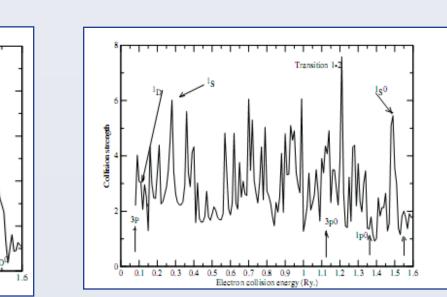
Eur. Phys. J. D 66(2012) 84

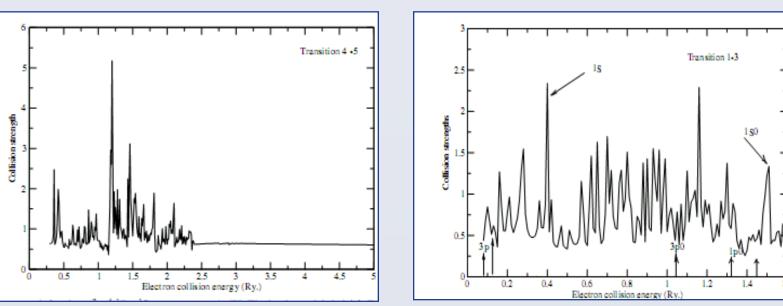
BPRM: CI limited to single and double excitations within n=3 complex; GRASP: J<sup> $\pi$ </sup>: 0<sup>±</sup>, 1<sup>±</sup>, 2<sup>±</sup>, 3<sup>-</sup>, 4<sup>-</sup>, 5<sup>-</sup>. 24 terms arising from the configurations: 3s<sup>2</sup>3p<sup>4</sup>, 3s3p<sup>5</sup>, 3s<sup>2</sup>3p<sup>3</sup>3d and 3p<sup>6</sup> for both BPRM and MCDF calculations

> $e^{-}$  + Ar<sup>2+</sup>(3s<sup>2</sup>3p<sup>2</sup> <sup>3</sup>P)  $\rightarrow$  Ar<sup>2+\*</sup>(3s<sup>2</sup>3p<sup>5</sup>, 3s<sup>2</sup>3p<sup>4</sup>3d, 3s3p<sup>6</sup>, 3s3p<sup>5</sup>3d, 3s<sup>2</sup>3p<sup>3</sup>3d<sup>2</sup>, or 3s3p<sup>4</sup>3d<sup>2</sup>) Ar<sup>2+</sup>(3s<sup>2</sup>3p<sup>4</sup>, 3s3p<sup>5</sup>, 3s<sup>2</sup>3p<sup>3</sup>3d, or 3s3p<sup>4</sup>3d)

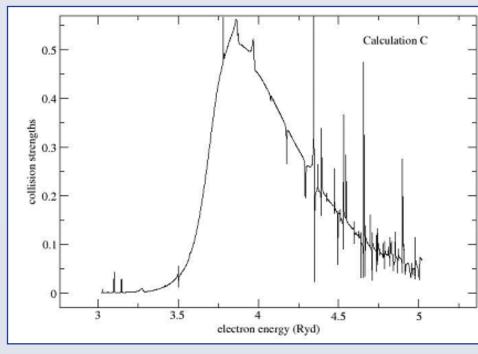








the target states were represented by 3d<sup>6</sup>, 3d<sup>5</sup>4s, 3d<sup>5</sup>4p, 3p<sup>4</sup>3d<sup>8</sup>, 3p<sup>4</sup>3d<sup>7</sup>4s and 3p<sup>4</sup>3d<sup>7</sup>4p, 3p<sup>5</sup>3d<sup>7</sup>,  $3d^44s^2$  and  $3d^44s4p$ , and correspondingly the (N+1)-electron configurations  $3p^63d^7$ ,  $3p^63d^64s$ ,  $3p^{6}3d^{6}4p$ ,  $3p^{6}3d^{6}4s^{2}$ ,  $3p^{6}3d^{5}4s4p$ ,  $3p^{6}3d^{5}4p^{2}$ ,  $3p^{5}3d^{8}$ ,  $3p^{4}3d^{9}$ ,  $3p^{4}3d^{8}4p$ ,  $3p^{4}3d^{7}4s4p$ ,  $3p^{5}3d^{7}4p$ , 3p<sup>4</sup>3d<sup>7</sup>4p<sup>2</sup>, 3p<sup>5</sup>3d<sup>6</sup>4s<sup>2</sup>, 3p<sup>5</sup>3d<sup>6</sup>4s4p and 3p<sup>5</sup>3d<sup>6</sup>4p<sup>2</sup>



Single Excitation from 3d	Double Excitation from 3d	Single Excitation from 3p	Double Excitation from 3p
3d <sup>5</sup> 4s	$3d^44s^2$	3p <sup>5</sup> 3d <sup>7</sup>	3p <sup>4</sup> 3d <sup>8</sup>
3d <sup>5</sup> 4p	$3d^44s4p$	$3p^53d^64s$	$3p^43d^74s$
3d <sup>5</sup> 4d	-	3p <sup>5</sup> 3d <sup>6</sup> 4p	3p43d74p

## II. Mg-like $S^{4+}: 2p^6 3s^2 ({}^1S_0)$

### ADNDT: http://dx.doi.org/10.1016/j.adt.2016.06.002

Phys. Scr. 83 (2011)025301

Ch. F.Fisher (2006)

I. Reference configurations:  $1s^22s^22p^6(3s^2, 3s^3p)$ : single and double excitation from the valence electrons to account for the valence correlation effect

II. Reference configurations  $2s^22p^6\{3s^2, 3p^2, 3d^2\}$  and  $2s^22p^6\{3s^3p, 3p3d\}$  allowing one 2p electron and one valence electron excitation

III. Similar but allows one 2s electron to be excited

II + III account for 2p and 2s <u>core-valence correlation</u> effect

### **B.** Present

 $1s^22s^22p^6(3snl, 3pnl, 3dnl)$   $1 \le n \le 7, 0 \le l \le 4 \rightarrow 567$  fine-structure levels  $1s^2 2s^2 2p^5 3s^2 nl$ ,

 $1s^2 2s^2 2p^5 3s 3p nl$ ,  $1 \le n' \le 5, 0 \le l \le 4 \rightarrow 2580$  fine-structure levels  $1s^2 2s^2 2p^5 3p^2 nl$ 

Level	NIST	FAC0 (%)	FAC1 (%)	FAC2 (%)	FM14 (%)	SI10 (%)	FF	<sup>5</sup> 06 (%)	GM00 (%)
3s2 <sup>1</sup> S <sub>0</sub>	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	) 0.	00000	0.00000
3s3p <sup>3</sup> P <sub>0</sub>	0.75657	0.74751 (1.20)	0.75621(0.05)	0.75328 (0.44)	0.74634(1.	35) 0.75580	0 (0.10) 0.1	75719(0.08)	0.75756 (0.13)
3s3p <sup>3</sup> P <sub>1</sub>	0.75994	0.75073 (1.21)	0.75947 (0.06)	0.75650 (0.45)	0.74978(1.	34) 0.75914	4(0.10) 0.	76061(0.09)	0.76092 (0.13)
3s3p 3P2	0.76688	0.75739 (1.24)	0.76621(0.09)	0.76317 (0.48)				76758 (0.09)	0.76784 (0.13)
3s3p <sup>1</sup> P <sub>1</sub>	1.15868	1.17785 (1.65)	1.17770 (1.64)	1.17631 (1.52)				16115 (0.21)	1.16063 (0.17)
252p P1									
3p2 <sup>1</sup> D <sub>2</sub>	1.76548	1.75676 (0.49)	1.76809 (0.15)	1.76411 (0.08)				76733 (0.10)	1.76059 (0.28)
3p2 <sup>3</sup> P <sub>0</sub>	1.82224	1.82597 (0.21)	1.83175 (0.52)	1.83143 (0.50)				82191(0.02)	1.82337 (0.06)
3p2 <sup>3</sup> P1	1.82591	1.82912 (0.18)	1.83585 (0.54)	1.83460 (0.48)	1.82751(0.	09) 1.82475	5 (0.06) 1.	82576 (0.01)	1.82704 (0.06)
3p2 <sup>3</sup> P <sub>2</sub>	1.83298	1.83590 (0.16)	1.84249 (0.52)	1.84142 (0.46)	1.83468 (0.	09) 1.83179	0(0.06) 1.	83289 (0.00)	1.83410 (0.06)
3s3d <sup>3</sup> D <sub>3</sub>	2.14094	2.14307 (0.10)	2.15622 (0.71)	2.15014 (0.43)				14865 (0.36)	2.142.09 (0.05)
3s3d <sup>3</sup> D <sub>2</sub>	2.14100	2.14311 (0.10)	2.15620 (0.71)	2.15014 (0.43)				14847 (0.35)	2.14201 (0.05)
3s3d <sup>3</sup> D <sub>1</sub>	2.14108	2.14316 (0.10)	2.15620 (0.71)	2.15017 (0.42)				14853 (0.35)	2.14196 (0.04)
3p2 1S0	2.14467	2.17209 (1.28)	2.17220(1.28)	2.17559 (1.44)	,	· · · · · · · · · · · · · · · · · · ·		14803 (0.16)	2.14787 (0.15)
3s3d 1D2	2.46680	2.50860 (1.69)	2.51502(1.95)	2.51452 (1.93)				47564 (0.36)	2.47442 (0.31)
3s4s <sup>3</sup> S <sub>1</sub>	2.83946	2.82126 (0.64)	2.84344 (0.14)	2.82771 (0.41)				84570(0.22)	2.84028 (0.03)
3s4s <sup>1</sup> So	2.91704	2.91052 (0.22)	2.93085 (0.47)	2.91572 (0.05)	2.90282 (0.	49) 2.91606	5(0.03) 2.	92337 (0.22)	2.91786 (0.03)
3p3d <sup>3</sup> F <sub>2</sub>	2.94460	2.93556 (0.31)	2.95296 (0.28)	2.94435 (0.01)				95347 (0.30)	2.94569 (0.04)
3p3d <sup>3</sup> F <sub>3</sub>	2.94838	2.94008 (0.28)	2.95626 (0.27)	2.94889 (0.02)				95746 (0.31)	2.94947 (0.04)
3p3d <sup>3</sup> F <sub>4</sub>	2.94838	2.94392 (0.32)	2.96112 (0.27)	2.95276 (0.02)				96257 (0.32)	2.95431 (0.04)
								, ,	
3p3d 1 D2	2.99310	2.98628 (0.23)	3.00193 (0.30)	2.99468 (0.05)				00109(0.27)	2.99411 (0.03)
3p3d <sup>3</sup> P <sub>2</sub>	3.14695	3.15252 (0.18)	3.16498 (0.57)	3.16001 (0.41)				15592 (0.29)	3.14829 (0.04)
3p3d <sup>3</sup> P <sub>1</sub>	3.15037	3.15517(0.15)	3.16819 (0.57)	3.16257 (0.39)				15950 (0.29)	3.15172 (0.04)
3p3d <sup>3</sup> P <sub>0</sub>	3.15256	3.15738 (0.15)	3.16997 (0.55)	3.16471 (0.39)	3.17067 (0.	57) 3.15256	6 (0.00) 3.	16177 (0.29)	3.15398 (0.05)
3s4p <sup>1</sup> P <sub>1</sub>	3.18144	3.16960 (0.37)	3.19113 (0.30)	3.17584 (0.18)				18814 (0.21)	3.18453 (0.10)
3s4p <sup>3</sup> P <sub>0</sub>	3.18179	3.17051 (0.35)	3.19147 (0.30)	3.17694 (0.15)				18865 (0.22)	3.18192 (0.00)
3s4p <sup>3</sup> P <sub>1</sub>	3.18468	3.17163 (0.41)	3.19358 (0.28)	3.17788 (0.21)				19163 (0.22)	3.18200 (0.08)
3s4p <sup>3</sup> P <sub>2</sub>	3.18519	3.17258 (0.40)	3.19413 (0.28)	3.17884 (0.20)				19224 (0.22)	3.18528 (0.00)
3p3d <sup>3</sup> D <sub>1</sub>	3.16976	3.17718 (0.23)	3.18867 (0.60)	3.18422 (0.46)				17840 (0.27)	3.17078 (0.03)
3p3d <sup>3</sup> D <sub>2</sub>	3.17130	3.17880 (0.24)	3.18995 (0.59)	3.18589 (0.46)				17996 (0.27)	3.17241 (0.03)
3p3d <sup>3</sup> D <sub>3</sub>	3.17241	3.17935 (0.22)	3.19132 (0.60)	3.18647 (0.44)	3.18792 (0.	49) 3.1718	I (0.02) 3.	18106(0.27)	3.17351 (0.03)
3p3d <sup>1</sup> F <sub>3</sub>	3.34309	3.37477 (0.95)	3.38537 (1.26)	3.38162 (1.15)	,	· · · · · · · · · · · · · · · · · · ·	· ·	35542 (0.37)	3.34631 (0.10)
E1 E2	3s2 <sup>1</sup> S <sub>0</sub> 3s3p <sup>3</sup> P <sub>0</sub>								
E2 E3	3s3p <sup>3</sup> P <sub>1</sub>	7.987E-06	7.257E-06	7.557E-06	4.977E-06	6.059E-06			
E4	3s3p <sup>3</sup> P <sub>2</sub>	1.553E+01	1.357E+01	1.382E+01	10776-00				
E5		1.0000-01				$1.341E \pm 0.1$			
23	2 6 2 10 10	19965 10			1 809 F- 10	1.341E+01	3 120E 10		2 8 AF 10
	3s3p <sup>1</sup> P <sub>1</sub>	1.886E-10	1.914E-10	1.918E-10	1.898E-10	2.036E-10	2.130E-10		2.80E-10
E6	3p2 1 D2	5.787E-09	1.914E-10 5.459E-09	1.918E-10 5.655E-09	4.996E-09	2.036E-10 4.818E-09	6.530E-09	)	
E6 E7	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub>	5.787E-09 2.250E-10	1.914E-10 5.459E-09 2.316E-10	1.918E-10 5.655E-09 2.294E-10	4.996E-09 2.369E-10	2.036E-10 4.818E-09 2.440E-10	6.530E-09 2.180E-10		2.80E-10
E6 E7 E8	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10	4.996E-09 2.369E-10 2.356E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10	6.530E-09 2.180E-10 2.420E-10		2.80E-10 2.80E-10
E6 E7	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10	6.530E-09 2.180E-10		2.80E-10
E6 E7 E8	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10	4.996E-09 2.369E-10 2.356E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10	6.530E-09 2.180E-10 2.420E-10		2.80E-10 2.80E-10
E6 E7 E8 E9	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10		2.80E-10 2.80E-10 2.60E-10
E6 E7 E8 E9 E10 E11	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10
E6 E7 E8 E9 E10 E11 E12	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10		2.80E-10 2.80E-10 2.60E-10 2.00E-10
E6 E7 E8 E9 E10 E11 E12 E13	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>3</sup> S <sub>1</sub>	5.787E-09 2.250E-10 2.221E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16	$\begin{array}{c} 3p2  {}^1D_2 \\ 3p2  {}^3P_0 \\ 3p2  {}^3P_1 \\ 3p2  {}^3P_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_1 \\ 3p2  {}^1S_0 \\ 3s3d  {}^1D_2 \\ 3s3d  {}^1D_2 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^1S_0 \end{array}$	5.787E-09 2.250E-10 2.221E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10 9.800E-11		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17	$\begin{array}{c} 3p2  {}^1D_2 \\ 3p2  {}^3P_0 \\ 3p2  {}^3P_1 \\ 3p2  {}^3P_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_1 \\ 3p2  {}^1S_0 \\ 3s3d  {}^1D_2 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^1S_0 \\ 3p3d  {}^3F_2 \end{array}$	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10 9.800E-11		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub>	5.787E-09 2.250E-10 2.221E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10 9.800E-11		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17	$\begin{array}{c} 3p2  {}^1D_2 \\ 3p2  {}^3P_0 \\ 3p2  {}^3P_1 \\ 3p2  {}^3P_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_1 \\ 3p2  {}^1S_0 \\ 3s3d  {}^1D_2 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^1S_0 \\ 3p3d  {}^3F_2 \end{array}$	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10 9.800E-11		2.80E-10 2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19	$\begin{array}{c} 3p2  {}^1D_2 \\ 3p2  {}^3P_0 \\ 3p2  {}^3P_1 \\ 3p2  {}^3P_2 \\ 3s3d  {}^3D_3 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_1 \\ 3p2  {}^1S_0 \\ 3s3d  {}^1D_2 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^1S_0 \\ 3p3d  {}^3F_2 \\ 3p3d  {}^3F_3 \\ 3p3d  {}^3F_4 \end{array}$	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20	$\begin{array}{c} 3p2  {}^1D_2 \\ 3p2  {}^3P_0 \\ 3p2  {}^3P_2 \\ 3s3d  {}^3D_3 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^3D_2 \\ 3s3d  {}^1D_2 \\ 3s3d  {}^1D_2 \\ 3s4s  {}^3S_1 \\ 3s4s  {}^1S_0 \\ 3p3d  {}^3F_2 \\ 3p3d  {}^3F_3 \\ 3p3d  {}^3F_4 \\ 3p3d  {}^1D_2 \end{array}$	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>1</sup> D <sub>2</sub> 3p3d <sup>3</sup> P <sub>2</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10 1.227E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10 1.224E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.400E-10		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.207E-10 1.186E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.544E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.490E-09 2.010E-10 1.400E-10 1.390E-10		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 1.206E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.207E-10 1.186E-10 1.184E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.400E-10		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.2716E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10 2.404E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.297E-09 1.297E-09 1.297E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.54E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10 2.009E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.490E-09 2.010E-10 1.400E-10 1.390E-10		2.80E-10 2.80E-10 2.60E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.225E-10 1.214E-10 2.557E-10 7.340E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 1.206E-10 2.716E-10 7.310E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10 2.404E-10 7.030E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.297E-09 1.297E-09 1.297E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 7.532E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.490E-09 2.010E-10 1.400E-10 1.390E-10	6.100E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.226E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.2716E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.365E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10 2.404E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.297E-09 1.297E-09 1.297E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.54E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10 2.009E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.490E-09 2.010E-10 1.400E-10 1.390E-10		2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.226E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.381E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 1.206E-10 2.716E-10 7.310E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.487E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10 2.404E-10 7.030E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.297E-09 1.297E-09 1.297E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 7.532E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.490E-09 2.010E-10 1.400E-10 1.390E-10	6.100E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>0</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub>	5.787E-09 2.250E-10 2.221E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.376E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 1.482E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.716E-10 7.310E-10 2.578E-10 5.324E-10	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09 1.368E-09 1.368E-09 1.955E-10 1.224E-10 1.211E-10 1.227E-10 2.404E-10 7.030E-10 3.280E-10 6.434E-10	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 7.532E-10 3.572E-10 6.961E-10	2.036E-10 4.818E-09 2.440E-10 2.424E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10	6.530E-09 2.180E-10 2.420E-10 1.640E-10 1.630E-10 1.620E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.400E-10 1.390E-10	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 10 7.20E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>3</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> D <sub>1</sub>	5.787E-09 2.250E-10 2.221E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.369E-09 1.368E-09 1.368E-09 1.955E-10 1.224E-10 1.227E-10 2.404E-10 7.030E-10 3.280E-10 6.434E-10 9.040E-11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 7.532E-10 3.572E-10 6.961E-10 8.830E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 10 10 7.20E-10 1.00E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> D <sub>1</sub> 3p3d <sup>3</sup> D <sub>2</sub>	5.787E-09 2.250E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.891E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.27E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11	1.9 18E - 10 5.655E - 09 2.294E - 10 2.283E - 10 2.267E - 10 1.511E - 10 1.497E - 10 1.497E - 10 2.316E - 10 8.063E - 11 9.076E - 11 1.557E - 10 1.369E - 09 1.368E - 09 1.368E - 09 1.368E - 09 1.224E - 10 1.224E - 10 1.227E - 10 2.404E - 10 7.030E - 10 3.280E - 10 6.434E - 10 9.040E - 11 8.878E - 11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.860E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 5.274E-10 9.027E-11 9.043E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.300E-11	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 1.00E-10 1.30E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29 E30	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> D <sub>1</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>3</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.891E-11 8.699E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11 8.672E-11	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09 1.368E-09 1.368E-09 1.368E-09 1.224E-10 1.224E-10 1.227E-10 2.404E-10 7.030E-10 3.280E-10 6.434E-10 9.040E-11 8.878E-11 8.706E-11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.850E-11 8.850E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11 9.043E-11 9.008E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.260E-11	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 10 10 7.20E-10 1.00E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29 E30 E31	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>3</sub> 3p3d <sup>1</sup> F <sub>3</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.699E-11 8.669E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.368E-09 1.381E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11 8.672E-11	1.918E - 10 5.655E - 09 2.294E - 10 2.283E - 10 2.267E - 10 1.511E - 10 1.497E - 10 1.497E - 10 2.316E - 10 8.063E - 11 9.076E - 11 1.557E - 10 1.369E - 09 1.368E - 09 1.368E - 09 1.955E - 10 1.224E - 10 1.227E - 10 2.404E - 10 7.030E - 10 3.280E - 10 6.434E - 10 9.040E - 11 8.706E - 11 8.699E - 11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.850E-11 9.480E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11 9.043E-11 9.008E-11 8.868E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.260E-11 9.260E-11 1.030E-10	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 1.00E-10 1.30E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29 E30	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>3</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3s4s <sup>1</sup> S <sub>0</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> D <sub>1</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>3</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 1.485E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.891E-11 8.699E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.360E-09 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11 8.672E-11	1.918E-10 5.655E-09 2.294E-10 2.283E-10 2.267E-10 1.511E-10 1.497E-10 1.497E-10 2.316E-10 8.063E-11 9.076E-11 1.557E-10 1.369E-09 1.368E-09 1.368E-09 1.368E-09 1.368E-09 1.224E-10 1.224E-10 1.227E-10 2.404E-10 7.030E-10 3.280E-10 6.434E-10 9.040E-11 8.878E-11 8.706E-11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.850E-11 8.850E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11 9.043E-11 9.008E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.260E-11	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 1.00E-10 1.30E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29 E30 E31	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>3</sub> 3p3d <sup>1</sup> F <sub>3</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.699E-11 8.669E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.368E-09 1.381E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11 8.672E-11	1.918E - 10 5.655E - 09 2.294E - 10 2.283E - 10 2.267E - 10 1.511E - 10 1.497E - 10 1.487E - 10 2.316E - 10 8.063E - 11 9.076E - 11 1.557E - 10 1.369E - 09 1.368E - 09 1.368E - 09 1.955E - 10 1.224E - 10 1.227E - 10 2.404E - 10 7.030E - 10 3.280E - 10 6.434E - 10 9.040E - 11 8.706E - 11 8.699E - 11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.850E-11 9.480E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11 9.043E-11 9.008E-11 8.868E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.260E-11 9.260E-11 1.030E-10	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 1.00E-10 1.30E-10
E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E22 E23 E24 E25 E26 E27 E28 E29 E30 E31	3p2 <sup>1</sup> D <sub>2</sub> 3p2 <sup>3</sup> P <sub>1</sub> 3p2 <sup>3</sup> P <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>2</sub> 3s3d <sup>3</sup> D <sub>1</sub> 3p2 <sup>1</sup> S <sub>0</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s3d <sup>1</sup> D <sub>2</sub> 3s4s <sup>3</sup> S <sub>1</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>2</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> F <sub>4</sub> 3p3d <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>1</sub> 3p3d <sup>3</sup> P <sub>0</sub> 3s4p <sup>1</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>0</sub> 3s4p <sup>3</sup> P <sub>1</sub> 3s4p <sup>3</sup> P <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>2</sub> 3p3d <sup>3</sup> D <sub>3</sub> 3p3d <sup>1</sup> F <sub>3</sub>	5.787E-09 2.250E-10 2.241E-10 2.223E-10 1.509E-10 1.494E-10 2.280E-10 8.115E-11 9.211E-11 1.606E-10 1.378E-09 1.393E-09 1.393E-09 1.376E-09 1.953E-10 1.223E-10 1.206E-10 1.214E-10 2.557E-10 7.340E-10 3.054E-10 6.241E-10 9.088E-11 8.699E-11 8.669E-11	1.914E-10 5.459E-09 2.316E-10 2.299E-10 2.284E-10 1.505E-10 1.491E-10 1.491E-10 2.334E-10 8.082E-11 8.556E-11 1.475E-10 1.368E-09 1.368E-09 1.381E-09 1.360E-09 1.360E-09 1.951E-10 1.227E-10 1.208E-10 2.716E-10 2.716E-10 2.578E-10 5.324E-10 8.917E-11 9.022E-11 8.672E-11	1.918E - 10 5.655E - 09 2.294E - 10 2.283E - 10 2.267E - 10 1.511E - 10 1.497E - 10 1.487E - 10 2.316E - 10 8.063E - 11 9.076E - 11 1.557E - 10 1.369E - 09 1.368E - 09 1.368E - 09 1.955E - 10 1.224E - 10 1.227E - 10 2.404E - 10 7.030E - 10 3.280E - 10 6.434E - 10 9.040E - 11 8.706E - 11 8.699E - 11	4.996E-09 2.369E-10 2.356E-10 2.341E-10 1.634E-10 1.615E-10 1.603E-10 2.296E-10 8.540E-11 9.570E-11 1.579E-10 1.304E-09 1.314E-09 1.297E-09 1.956E-10 1.207E-10 1.186E-10 1.184E-10 1.682E-10 3.572E-10 6.961E-10 8.830E-11 8.850E-11 9.480E-11	2.036E-10 4.818E-09 2.440E-10 2.424E-10 2.409E-10 1.569E-10 1.554E-10 1.554E-10 2.483E-10 8.825E-11 8.962E-11 1.563E-10 1.393E-09 1.411E-09 1.390E-09 2.037E-10 1.372E-10 1.355E-10 1.364E-10 2.009E-10 5.304E-10 3.788E-10 5.274E-10 9.027E-11 9.043E-11 9.008E-11 8.868E-11	6.530E-09 2.180E-10 2.420E-10 2.230E-10 1.640E-10 1.630E-10 2.430E-10 2.430E-10 9.800E-11 1.460E-09 1.490E-09 1.470E-09 2.010E-10 1.390E-10 1.390E-10 9.260E-11 9.260E-11 9.260E-11 1.030E-10	6.100E- 4.150E- 5.870E-	2.80E-10 2.60E-10 2.00E-10 2.09E-10 1.80E-10 9.80E-11 1.20E-09 2.70E-10 1.40E-10 10 3.70E-10 1.00E-10 1.30E-10

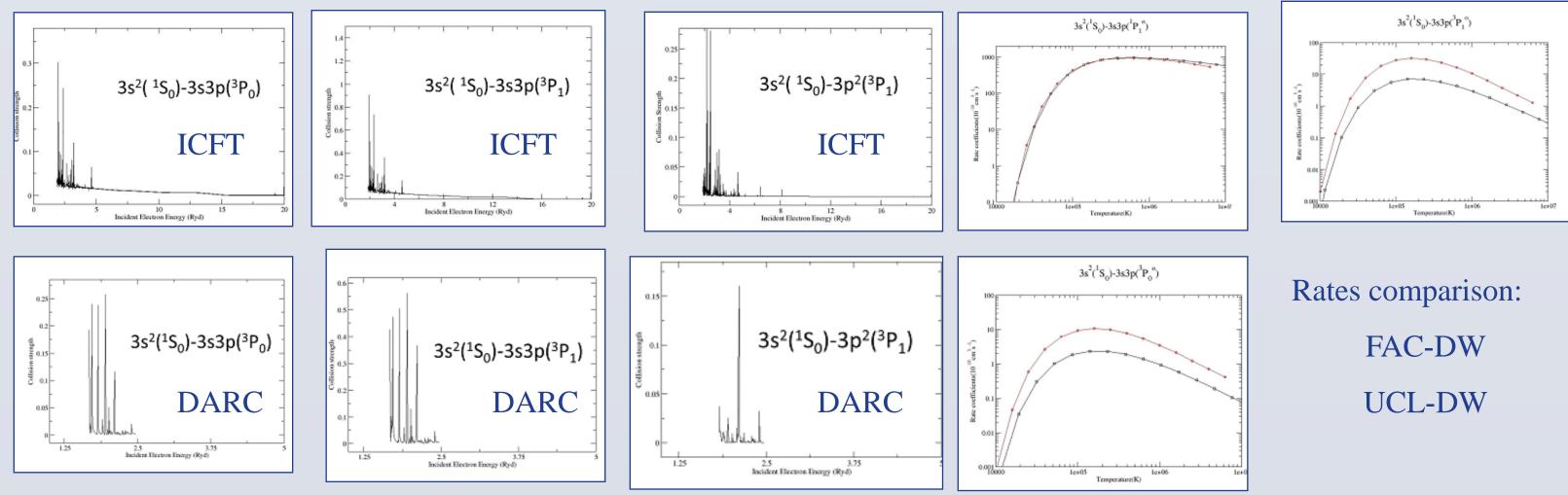
3	valence-valence	valence-valence + valence-2p core correlation
ελ	0.43%	0.28%
ε <sub>A</sub>	3.7%	3.1%
ε <sub>I</sub>	4.1%	3.4%

## $R_{ul} = \frac{I_{obs} \times N_E \times \lambda_{ul}}{\left(N_{ul} / N_S^{4+}\right) \times A_u}$ SUMER 96 June 25(21:28 UT)-26(02:47 UT), S V, Log T<sub>E</sub>[K]=5

#### III. Mg-like S<sup>4+</sup>

### AIP Conf. Proc, APiP Conf. Aprile 2016, Paris

Collision calculation has been performed keeping constant the target states number in the R-matrix expansion (the lowest 17 target states) for the ICFT and MCDF/DARC approaches



## **Detailed quantitative description of the level population kinetics in**

## plasmas

### Can. J. Phys. 93 (2015) 1413-19

Total radiative AI rate

2.94×1013 2.31x1013

5.31x10<sup>11</sup>

6.84×101

2.69x101

3.52×1013

3.62×1013

1,05×10<sup>1</sup>

4.09×10<sup>11</sup>

1,24×10<sup>11</sup>

6.98×10<sup>11</sup>

3,18×10<sup>12</sup>

3,25x1012

decay rate (s-1) (s-1)

> XUV emission from the autoionizing levels in Al XI observed at the interaction of high intensity, short pulse laser with Al target at nhelix test-bed facility at GSI;

HT2  $1s2p({}^{3}P_{2}^{o})4f({}^{2}D_{3/2}) = 1s^{2}5p({}^{2}P_{1/2}^{o})$ 

HT2  $1s2p(^{3}P_{1}^{o})4s(^{2}P_{1}^{o}) = 1s^{2}5d(^{2}D_{2})$ 

HT3  $1s2s({}^{1}S_{n})4s({}^{2}S_{v_{2}}) = 1s^{2}5p({}^{2}P_{v_{2}}^{o})$ 

HT3  $1s2s({}^{1}S_{0})4s({}^{2}S_{1/2}) = 1s^{2}5p({}^{2}P_{1}^{0})$ 

HT4  $1s2p(^{1}P_{r}^{0})3p(^{2}D_{r}) = 1s^{2}4p(^{2}P_{r}^{0})$ 

HT4  $1s2s({}^{1}S_{0})3d({}^{2}D_{w_{2}}) = 1s^{2}4f({}^{2}F_{w_{2}})$ 

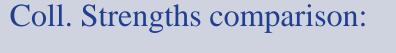
HT4  $1s2s({}^{1}S_{o})3d({}^{2}D_{o}) = 1s^{2}4f({}^{2}F_{o})$ 

HT4  $152s({}^{1}S_{0})3s({}^{2}S_{12}) = 1s^{2}4p({}^{2}P_{32})$ 

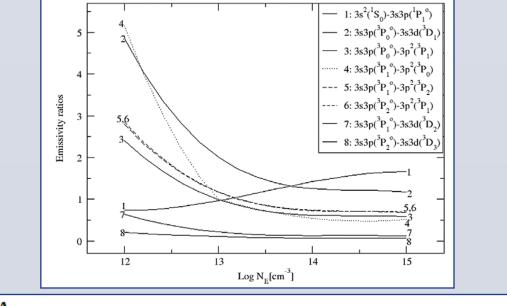
HT4  $1s2s({}^{1}S_{0})3p({}^{2}P_{3/2}^{0}) = 1s^{2}4s({}^{2}S_{1/2})$ 

HT4  $1s2p(^{1}P_{1}^{0})3p(^{2}D_{5(2)}) = 1s^{2}4f(^{2}F_{72}^{0})$ 

High ord







#### Table A

The transition dependent scattered electron energy for different transitions concerning the excitation from the first four fine-structure levels.  $\epsilon$  is given in Rvdberg units.

	Ryuberg units.			
	Lower level	Upper levels		
	ε	0.00012	0.022	0.089
	1 2 3 4	3-4 4	2-6 5-14 5-14 5-14	7-567 15-567 15-567 15-567
0.1	$3s2({}^{1}S_{0})-3s3p({}^{3}P_{0}^{o})$	] []	3s2( <sup>1</sup> S <sub>0</sub> )-3s3p( <sup>3</sup>	<sup>3</sup> P <sub>1</sub> <sup>o</sup> )
C 0.01	* 1-2 * °	0.1 * *	0 * * *	1-3
0.001	0 5 10 15 20 25 Scattered electron energy(Ryd)		5 10 15 Scattered electron ene	20 25 ergy(Ryd)
	3s2( <sup>1</sup> S <sub>0</sub> )-3s3p( <sup>3</sup> P <sub>2</sub> <sup>o</sup> )		3s2( <sup>1</sup> S <sub>0</sub> )-3p2( <sup>1</sup>	D <sub>2</sub> )
0.1 C		a *	* * * 0	* * -
0.01	* * *		1 . 1 . 1	
	0 5 10 15 20 25 Scattered electron energy(Ryd)	0.1 0	5 10 15 Scattered electron ene	20 25 ergy(Ryd)

### > Modeling of radiative decay rates for the high order intercombination transitions

### 1s2l2l'autoionizing levels

FAC1 MZ HFR MCDF FAC1 MZ HFR MCDF

Decay rate Total radiative

1.43×10<sup>10</sup>

2,02×10<sup>10</sup>

Decay rate Total radiative AI rate

1.27×10<sup>12</sup>

3.78×10<sup>10</sup>

4.61×1010

decay rate (s<sup>-1</sup>) (s<sup>-1</sup>)

1,06×10<sup>10</sup>

2,04x10<sup>11</sup>

4.00×10

3.62×10<sup>8</sup>

1.61×1010

2a 1s(2s2p <sup>3</sup>P) <sup>4</sup>P<sub>5/2</sub> = 1s<sup>2</sup>2s <sup>2</sup>S<sub>1/2</sub> 7.9400 7.9299 7.9333 7.9412 1.97 ---

**Intercombination transitions** 

 $1s[2p^{2}(^{3}P_{2})](^{4}P_{32}) = 1s^{2}2p(^{2}P_{32}^{0})$  7.92993 1.89×10<sup>10</sup>

λ (Å)

7.80153

High order intercombination

 $1s2p(^{3}P_{1}^{0})4d(^{4}D_{5/2}^{0}) = 1s^{2}3d(^{2}D_{3/2})$ 

 $1s[2p^{2}(^{3}P_{0})](^{4}P_{1/2}) = 1s^{2}2p(^{2}P_{1/2}^{o})$ 

 $1s[2p^{2}(^{3}P_{1})](^{4}P_{3/2}) = 1s^{2}2p(^{2}P_{3/2}^{0})$ 

 $1s2p(^{3}P_{1}^{0})4d(^{4}D_{32}^{0}) = 1s^{2}3d(^{2}D_{32})$ 

transitions

Transition

HI1  $1s2p(^{1}P_{1}^{0})4d(^{4}D_{mn}^{0}) = 1s^{2}4d(^{2}D_{mn})$ 

 $1s2p(^{3}P_{a}^{0})3d(^{4}F_{a}^{0}) = 1s^{2}3d(^{2}D_{a})$ 

HI2  $1s2p({}^{3}P_{0}^{0})3d({}^{4}F_{3/2}^{0}) = 1s^{2}3d({}^{2}D_{3/2})$ 

2b  $1s(2s2p^{-3}P)^{-4}P_{av} = 1s^{2}2s^{-2}S_{av}$  7.9425 7.9323 7.9359 7.9437 1.60 1.57 1.18  $1.57\times10^{10}$ 

2c 1s(2s2p 3P) 4P = 1s2zs 2S = 7.9434 7.9333 7.9374 7.9446 6.17 5.95 4.48 6.06x10°

2d  $1s(2s^{21}S)^{2}S_{12} = 1s^{2}2p^{2}P_{12}$  8,0610 8,0764 8,0784 8,0873 5,43 4,17 5,53 4,66×10<sup>11</sup>

2e  $1s(2s^{2} S)^{2}S_{12} = 1s^{2}2p^{2}P_{32}$  8.0649 8.0802 8.0821 8.0910 9.78 7.68 1.02 8.57×10<sup>11</sup>

7.89744 2.15×104

7.93142 1.27x10<sup>10</sup>

7.94939 9.84×10<sup>7</sup>

(S<sup>-1</sup>)

7.82601 2.49×10<sup>10</sup>

7.82564 3.30×1010

4.59×10<sup>11</sup>

7.93017

### 1s2l3l' autoionizing levels

		oniz								m . 1 . 11 . 1
_		(Å)		Decay rate (s <sup>-1</sup> )			Transition	λ(Å)	Decay rate (s-1)	Total radiative decay rate (s-1
	-					T1	$1s2p({}^{1}P_{1}^{0})5p({}^{2}D_{5/2}) = 1s^{2}5f({}^{2}F_{72}^{0})$	7.74021	3.61×1012	3.33×10 <sup>13</sup>
		AC <sup>1</sup> MZ	HFR MCDI		IFR MCDF	T1	$1s2p(^{1}P_{1}^{0})5p(^{2}D_{3/2}) = 1s^{2}5f(^{2}F_{5/2}^{0})$	7.73966	2.89×1012	3.06×1013
3a			5 7.8304 7.833		1.48 1.31×10 <sup>11</sup>	T2	$1s2p({}^{3}P_{2}^{0})3d({}^{2}P_{3/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2})$	7.77643	1.86×10 <sup>12</sup>	4.40×1012
3a 3a	$(1s2p {}^{3}P)3d {}^{2}D_{3 2} = 1s^{2}3d {}^{2}D_{3 2} = 7.$ $(1s2p {}^{3}P)3d {}^{2}D_{3 2} = 1s^{2}3d {}^{2}D_{3 2} = 7.$	8215 7,8247	7,8308 7,833	5 2.58 2.25 3 5 3.94 1.80 3	3.14 3.01×10 <sup>11</sup> 3.06 2.96×10 <sup>11</sup>	T2	$1s2s({}^{1}S_{0})3p({}^{2}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2})$	7.77607	3.99×1011	2.12×1012
3b	$(1s2p {}^{3}P)3p {}^{2}P_{m} = 1s^{2}3p {}^{2}P_{m} = 7$		7.8403 7.843		0.9 8.96×10 <sup>11</sup>	T3	$1s2s({}^{1}S_{0})4p({}^{2}P_{1/2}^{0}) = 1s^{2}4s({}^{2}S_{1/2})$	7.78425	5.06×10 <sup>11</sup>	5,52×1012
зb	$(1s2p^{3}P)3p^{2}P_{a} = 1s^{2}3p^{2}P_{a} = 7$	8542 7.8349	7.8402 7.843	6 6.39 4.92 4	4.32 3.42×10 <sup>11</sup>	T3	$1s2s({}^{1}S_{0})4p({}^{2}P_{3'2}^{0}) = 1s^{2}4s({}^{2}S_{1'2})$	7.78331	2,31×10 <sup>11</sup>	1,14×10 <sup>12</sup>
3b	$(1s2p P)3p P_{1/2} = 1s^{2}3p P_{3/2} = 7.$		7.8414 7.844		3.94 2.87×10 <sup>11</sup>	T3	$1s2s({}^{1}S_{0})5p({}^{2}P_{1/2}^{o}) = 1s^{2}5s({}^{2}S_{1/2})$	7.78511	4.42×1011	1,79×1012
3b	$(1s2p^{-}P)3p^{-}P_{3/2} = 1s^{-}3p^{-}P_{3/2} = 7.$	8558 7,8360	0 7.8412 7.844	6 26,1 13,3 13	3.7 11.2×10 <sup>11</sup>	T3	$1s2s({}^{1}S_{0})5p({}^{2}P_{3/2}^{0}) = 1s^{2}5s({}^{2}S_{1/2})$	7.78446	1.67×10 <sup>11</sup>	1.47×10 <sup>12</sup>
						T4	$1s2s(^{3}S_{1})3p(^{2}P_{3/2}^{0}) = 1s^{2}3s(^{2}S_{1/2})$	7.88267	4.71×10 <sup>11</sup>	3.65×1012
							1-2-(30) 2-(200) 1-2-2-(20)	7.88226	1.70×10 <sup>11</sup>	1.50×10 <sup>12</sup>
						T4	$1s2s({}^{3}S_{1})3p({}^{2}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2})$	7.00220	1.7 0 4 10	1.00010
						T4 T4	$1s2s({}^{3}S_{1})3p({}^{4}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2})$	7.88135	5.01×10 <sup>11</sup>	4.43×10 <sup>12</sup>
							$\begin{array}{l} 1s2s({}^{3}S_{1})3p({}^{4}P_{1 2}^{0}) = 1s^{2}3s({}^{2}S_{1 2}) \\ 1s2s({}^{3}S_{1})3p({}^{4}P_{3 2}^{0}) = 1s^{2}3s({}^{2}S_{1 2}) \end{array}$			
		•		• 4 •	,	T4 T4 T5	$\begin{array}{l} 1s2s({}^{3}S_{1})3p({}^{4}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2}) \\ 1s2s({}^{3}S_{1})3p({}^{4}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2}) \\ 1s2s({}^{3}S_{1})3p({}^{4}P_{3/2}^{0}) = 1s^{2}3p({}^{2}P_{3/2}^{0}) \\ 1s2s({}^{3}S_{1})3d({}^{2}D_{5/2}) = 1s^{2}3p({}^{2}P_{3/2}^{0}) \end{array}$	7.88135 7.88128 7.88628	5.01×10 <sup>11</sup> 3.07×10 <sup>11</sup> 3.29×10 <sup>10</sup>	4.43×10 <sup>12</sup> 2.43×10 <sup>12</sup> 1.39×10 <sup>12</sup>
0	order two-e	lect	ron tı	ansiti	ons	T4 T4 T5 T5	$\begin{array}{l} 1s2s({}^3S_1)3p({}^4P_{12}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3p({}^4P_{3 2}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3q({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^3S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^2S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \end{array}$	7.88135 7.88128 7.88628 7.88612	5.01×10 <sup>11</sup> 3.07×10 <sup>11</sup> 3.29×10 <sup>10</sup> 7.11×10°	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
0	order two-e	lect	ron ti	ransiti	ons	T4 T4 T5	$\begin{array}{l} 1s2s({}^{3}S_{1})3p({}^{4}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2}) \\ 1s2s({}^{3}S_{1})3p({}^{4}P_{1/2}^{0}) = 1s^{2}3s({}^{2}S_{1/2}) \\ 1s2s({}^{3}S_{1})3p({}^{4}P_{3/2}^{0}) = 1s^{2}3p({}^{2}P_{3/2}^{0}) \\ 1s2s({}^{3}S_{1})3d({}^{2}D_{5/2}) = 1s^{2}3p({}^{2}P_{3/2}^{0}) \end{array}$	7.88135 7.88128 7.88628	5.01×10 <sup>11</sup> 3.07×10 <sup>11</sup> 3.29×10 <sup>10</sup>	4.43×10 <sup>12</sup> 2.43×10 <sup>12</sup> 1.39×10 <sup>12</sup>
0	order two-e	lect	ron ti	ransiti	ons	T4 T4 T5 T5	$\begin{array}{l} 1s2s({}^3S_1)3p({}^4P_{12}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3p({}^4P_{3 2}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3q({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^3S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^2S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \end{array}$	7.88135 7.88128 7.88628 7.88612	5.01×10 <sup>11</sup> 3.07×10 <sup>11</sup> 3.29×10 <sup>10</sup> 7.11×10°	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
0	order two-e	lect	ron ti	<b>Cansiti</b>	<b>ONS</b> AI rate	T4 T4 T5 T5	$\begin{array}{c} 1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12}^{-}) \\ 1s2s(^{3}S_{1})3p(^{4}P_{312}^{0}) = 1s^{2}3s(^{2}S_{12}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ 1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ \end{array}$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
0	order two-e					T4 T4 T5 T5	$\begin{array}{l} 1s2s({}^3S_1)3p({}^4P_{12}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3p({}^4P_{3 2}^0) = 1s^23s({}^2S_{12}) \\ 1s2s({}^3S_1)3q({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^3S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \\ 1s2s({}^2S_1)3d({}^2D_{3 2}) = 1s^23p({}^2P_{3 2}^0) \end{array}$	7.88135 7.88128 7.88628 7.88612	5.01×10 <sup>11</sup> 3.07×10 <sup>11</sup> 3.29×10 <sup>10</sup> 7.11×10°	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
	Transition		Decay rate	Total radiative	AI rate	T4 T4 T5 T5	$\begin{array}{c} 1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12}^{-}) \\ 1s2s(^{3}S_{1})3p(^{4}P_{312}^{0}) = 1s^{2}3s(^{2}S_{12}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ 1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ \end{array}$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
 T1		λ(Å)	Decay rate (s <sup>-1</sup> )	Total radiative decay rate (s <sup>-1</sup> )	AI rate (s <sup>-1</sup> )	T4 T4 T5 T5 T6	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
	Transition $1s2p(^{1}P_{1}^{0})4d(^{2}F_{7 2}^{0}) - 1s^{2}5d(^{2}D_{5 2})$	λ(Å) 7.95656	Decay rate (s <sup>-1</sup> ) 1.66×10 <sup>30</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup>	T4 T4 T5 T5 T6	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
T1 T1	$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	λ(Å) 7.95656 7.95600	Decay rate (s <sup>-1</sup> ) 1.66×10 <sup>10</sup> 1.59×10 <sup>10</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup> 3.29×10 <sup>13</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup> 8.06×10 <sup>12</sup>	T4 T4 T5 T5 T6	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
T1 T1 T1 T1 T1	$\frac{\text{Transition}}{1s2p(^{1}P_{1}^{0})4d(^{2}F_{7 2}^{0}) - 1s^{2}5d(^{2}D_{5 2})} \\ 1s2p(^{1}P_{1}^{0})4d(^{2}F_{5 2}^{0}) - 1s^{2}5d(^{2}D_{5 2})}$	λ(Å) 7.95656 7.95600 7.96106	Decay rate (s <sup>-1</sup> ) 1.66×10 <sup>10</sup> 1.59×10 <sup>10</sup> 7.50×10 <sup>10</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup> 3.29×10 <sup>13</sup> 3.17×10 <sup>13</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup> 8.06×10 <sup>12</sup> 6.65×10 <sup>12</sup>	T4 T4 T5 T5 T6	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
	$eq:started_st$	λ(Å) 7.95656 7.95600 7.96106 7.96910	Decay rate (s <sup>-1</sup> ) 1.66x10 <sup>10</sup> 1.59x10 <sup>10</sup> 7.50x10 <sup>10</sup> 1.66x10 <sup>10</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup> 3.29×10 <sup>13</sup> 3.17×10 <sup>13</sup> 3.32×10 <sup>13</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup> 8.06×10 <sup>12</sup> 6.65×10 <sup>12</sup> 2.03×10 <sup>13</sup>	T4 14 15 16 Feotons/s)	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
	$\label{eq:starting} \begin{split} \hline Transition \\ \hline 1s2p(^1P_1^0)4d(^2F_{7 2}^0) &= 1s^25d(^2D_{5 2}) \\ 1s2p(^1P_1^0)4d(^2F_{5 2}^0) &= 1s^25d(^2D_{5 2}) \\ 1s2p(^1P_1^0)4p(^2P_{1 2}) &= 1s^25p(^2P_{5 2}^0) \\ 1s2p(^1P_1^0)4p(^2D_{5 2}) &= 1s^25p(^2P_{5 2}^0) \\ 1s2p(^1P_1^0)4p(^2D_{5 2}) &= 1s^25p(^2P_{5 2}^0) \\ 1s2p(^1P_1^0)4p(^2D_{5 2}) &= 1s^25p(^2P_{5 2}^0) \end{split}$	λ(Å) 7.95656 7.95600 7.96106 7.96910 7.96891	Decay rate (s <sup>-1</sup> ) 1.66×10 <sup>30</sup> 1.59×10 <sup>10</sup> 7.50×10 <sup>10</sup> 1.66×10 <sup>30</sup> 1.59×10 <sup>10</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup> 3.29×10 <sup>13</sup> 3.17×10 <sup>13</sup> 3.32×10 <sup>13</sup> 3.32×10 <sup>13</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup> 8.06×10 <sup>12</sup> 6.65×10 <sup>12</sup> 2.03×10 <sup>13</sup> 2.24×10 <sup>13</sup>	T4 14 15 16 Feotons/s)	$\begin{array}{c} 1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12}^{-}) \\ 1s2s(^{3}S_{1})3p(^{4}P_{312}^{0}) = 1s^{2}3s(^{2}S_{12}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}3p(^{2}P_{312}^{0}) \\ 1s2s(^{3}S_{1})3d(^{2}D_{312}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ 1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{312}^{0}) \\ \end{array}$	7.88135 7.88128 7.88628 7.88612	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43x10 <sup>12</sup> 2.43x10 <sup>12</sup> 1.39x10 <sup>12</sup> 1.44x10 <sup>12</sup>
T1 T1 T1	$\label{eq:starting} \begin{split} \hline Transition \\ \hline 1s2p(^1P_1^0)4d(^2F_{7 2}^0) &= 1s^25d(^2D_{5 2}) \\ 1s2p(^1P_1^0)4d(^2F_{5 2}^0) &= 1s^25d(^2D_{5 2}) \\ 1s2p(^1P_1^0)4p(^2P_{1 2}) &= 1s^25p(^2P_{5 2}^0) \\ 1s2p(^1P_1^0)4p(^2D_{5 2}) &= 1s^25p(^2P_{5 2}^0) \\ 1s2p(^1P_1^0)4p(^2D_{5 2}) &= 1s^25p(^2P_{1 2}^0) \\ 1s2p(^3P_2^0)4d(^2F_{7 2}^0) &= 1s^25d(^2D_{5 2}) \end{split}$	λ(Å) 7.95656 7.95600 7.96106 7.96910 7.96891 8.01152	Decay rate (s <sup>-1</sup> ) 1.65×10 <sup>10</sup> 1.59×10 <sup>10</sup> 7.50×10 <sup>10</sup> 1.66×10 <sup>10</sup> 1.59×10 <sup>10</sup> 3.52×10 <sup>10</sup>	Total radiative decay rate (s <sup>-1</sup> ) 3.34×10 <sup>13</sup> 3.29×10 <sup>13</sup> 3.17×10 <sup>13</sup> 3.32×10 <sup>13</sup> 3.32×10 <sup>13</sup> 3.27×10 <sup>13</sup> 1.24×10 <sup>12</sup>	AI rate (s <sup>-1</sup> ) 1.02×10 <sup>13</sup> 8.06×10 <sup>12</sup> 6.65×10 <sup>12</sup> 2.03×10 <sup>13</sup> 2.24×10 <sup>13</sup> 7.25×10 <sup>11</sup>	T4 T4 T5 T5 T6	$1s2s(^{3}S_{1})3p(^{4}P_{12}^{0}) = 1s^{2}3s(^{3}S_{12})$ $1s2s(^{3}S_{1})3p(^{4}P_{32}^{0}) = 1s^{2}3s(^{2}S_{12})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{3}S_{1})3d(^{2}D_{32}) = 1s^{2}3p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$ $1s2s(^{4}S_{0})4s(^{2}S_{12}) = 1s^{2}2p(^{2}P_{32}^{0})$	7.88135 7.88128 7.88628 7.88612 7.91646	5,01×10 <sup>11</sup> 3,07×10 <sup>11</sup> 3,29×10 <sup>10</sup> 7,11×10° 6,03×10 <sup>10</sup>	4.43×10 <sup>12</sup> 2.43×10 <sup>12</sup> 1.39×10 <sup>12</sup> 1.44×10 <sup>12</sup>

3.22×101

8.79×1011

2.19x1012

2.73×1012

7.49×10<sup>12</sup>

1.32x10<sup>13</sup>

6.81x1012

1.76×10<sup>13</sup>

1.76×10<sup>13</sup> 6.23×10<sup>13</sup>

6.11x1012

4.62×10<sup>13</sup>

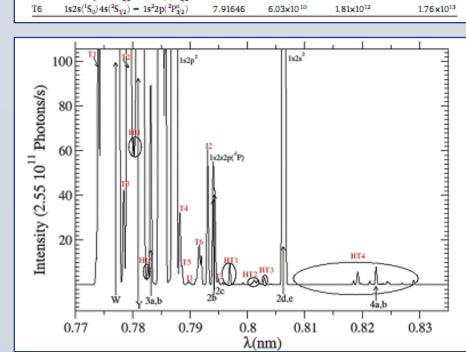
6.48×1013

3.37x1013

3.37×10<sup>13</sup>

6.23x1013

9.11x1012



Acknowledgments. These works have been partly supported by the Institute of Atomic Physics under Euratom-RO and FAIR-RO research programs.

8,01912 8,16x10<sup>9</sup>

8.22361 2.52×1010

8.21276 1.56×10<sup>10</sup>

8.18507 8.4×10°

8.02926

8.22444

HT4  $1s2p({}^{1}P_{1}^{0})3p({}^{2}D_{3/2}) = 1s^{2}4p({}^{2}P_{1/2}^{0}) = 8.19119 = 2.72\times10^{10} = 2.54\times10^{13}$ 

HT4  $1s2s({}^{1}S_{0})3p({}^{2}P_{3/2}^{0}) = 1s^{2}4d({}^{2}D_{3/2}) = 8.22364 = 1.48\times10^{10} = 7.49\times10^{12}$ 

1.89×1010

2.19×10<sup>10</sup>

2.97×1010

2.02×10<sup>10</sup>







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