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Fine structure calculations of atomic data for Ar XVI

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Abstract- Fine structure energy levels, wavelengths, log gf and allowed transition probabilities (E1) have been calculated for Lithium-like Ar XVI. The optimized electrostatic parameters by a least square approach, have been used in the calculation to include the configuration interaction and relativistic effects. A total number of 69 Ar XVI levels having total angular momenta, $1/2\leq J \leq 9/2$ of even and odd parities, orbital angular momenta $2\leq l \leq 4$, with 546 E1 transitions for $6\leq n\leq 10$ are considered using the relativistic effect in the Breit-Pauli method, where n is the principal quantum number. A comparison is made with the available results in literature.

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1. INTRODUCTION

Identification of X-rays and EUV fine structure lines of Lithium-like Argon is needed in laboratory and in astrophysical plasma. The X-rays emitted from highly ionized atoms are proved to be important in determining the various plasma parameters [Schlesser *et al.* (2013); Natarajan (2013)].

Experimental data [Guerra *et al.* (2013); Saloman (2010); Lepson *et al.* (2003)] have been obtained in order to be compared with the theoretical predictions. Theoretical calculations of the energy levels, radiative rates and electron impact excitation rates for transitions in Li-like ions with $12\leq Z \leq 20$ and $2\leq n\leq 5$ were performed [Aggarwal (2013)]. Electron self-energy screening approximations have been used in multi-electron atoms [Lowe *et al.* (2013)]. Relativistic configuration-interaction calculation of the energy levels of the core-excited states of lithium-like ions was presented [Yerokhin and Surzhykov (2012)]. The energies, transition probabilities and oscillator strengths for the electric dipole transitions between the levels of the ground and the low-lying excited states have been calculated using the multi-configuration Dirac-Hartree-Fock method [Liu *et al.* (2012)]. Theoretical calculations were performed for the K_β satellite X-rays in the active space approximation using multiconfiguration Dirac-Fock wave functions with the inclusion of the finite nuclear size effect, the Breit interaction and the quantum electrodynamic corrections [Natarajan *et al.* (2010)]. The Breit-Pauli R-matrix method has been used to compute the transitions from the upper configurations (n=4, 5) [Nahar (2002)]. The dipole-length, dipole-velocity and dipole-acceleration absorption oscillator strengths were calculated using the energies and the multiconfiguration interaction wave functions obtained from a full core plus the correlation method, in which relativistic and mass-polarization effects on the energy, as a first-order perturbation corrections, are included [Mu-Hong and Zhi-Wen (2009)].

The relativistic energies, fine structures, hyperfine structures, Auger rates and widths of the core-excited states for the Li isoelectronic sequence were studied using the saddle-point variational method and the saddle-point complex-rotation method [Zhu *et al.* (2008)]. Electron-impact excitation for Li-like isoelectronic sequence has been obtained using the radiation and Auger damped intermediate-coupling frame transformation R-matrix approach [Liang and Badnell (2011)].

In the present work, fine structure energy levels, wavelengths, log gf and radiative allowed transition probabilities are presented for Ar XVI. The calculations have been performed using the Breit-Pauli (BP) approximation, for

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describing the relativistic interaction between electrons. The interpretation of the configuration level structures is made by least-squares fit of the observed levels. The total number of considered Ar XVI levels is found to be 69, with 546 allowed transition rates. The configuration $1s^2$ 2s of Li-like ions is taken as the ground state. The energy of the other electronic configurations n_il_i are obtained by adjusting the scaling parameters E_{av} and $\zeta_i(r_i)$ and are listed in table (1). The calculated fine structure energy levels have been tabulated and compared with the experimental and theoretical data [NIST, Tipbase]. The allowed electric dipole transition probabilities have been also compared with reference [Tipbase] using Breit-Pauli R-matrix (BPRM) method and no corresponding experimental data have been found in the literature.

2. Calculation Method

2.1. *Atomic structure theory*

In nonrelativistic LS coupling calculations, the normal starting point is Schrödinger's equation where the Hamiltonian for a multi-electron system, in atomic units is given as [Sobel'man (1979)]

$$H = \sum_{i=1}^{N}\left(-\frac{1}{2}\nabla_i^2 - \frac{Z}{r_i}\right) + \sum_{i>j}^{N}\frac{1}{r_{ij}} \tag{1}$$

A stationary state of N-electrons is described by a wave function $\psi\,(q_1, \ldots \ldots, q_N)$, where q_i= (r_i, si) represents the space and spin coordinates of the electron i.

$$H\,\psi\,(q_1, \ldots \ldots., q_N) = E\,\psi\,(q_1, \ldots \ldots., q_N)$$

The wave function is assumed continuous with respect to the space variables and is the solution of the wave equation.

In the multiconfiguration approximation, the wave functions for a state labeled αJM_J are expanded in terms of the configuration state functions

$$\psi\,(\alpha JM_J) = \sum_{i=1}^{M} c_i\,\phi(\alpha_i L_i S_i J M_j) \tag{2}$$

Where α representing the configuration and also the set of quantum numbers both required to specify the state.

2.2. *The relativistic effects*

Breit-Pauli approximation, for describing the relativistic interaction between electrons in an approximate form is [Fischer *et al.* (2000)]

$$H_{BP} = H_{NR} + H_{FS} + H_{RS} \tag{3}$$

H_{NR} is the non-relativistic multi- electron system hamiltonian. The fine-structure operator H_{FS} is

$$H_{FS} = H_{SO} + H_{SOO} + H_{SS} \tag{4}$$

where H_{SO} is the nuclear spin-orbit term, H_{SOO} is the spin-other-orbit term and H_{SS} is the spin-spin term.
The relativistic shift operator H_{RS} commutes with L and S and can be written

$$H_{RS} = H_{MC} + H_{D_1} + H_{D_2} + H_{OO} + H_{SSC} \tag{5}$$

where H_{MC} is the mass correction term, H_{D_1} and H_{D_2} are the one and two body Darwin terms, H_{OO} is the orbit –orbit term and H_{SSC} is the spin-spin contact term.
The radial wave functions have been generated using the Relativistic Hartree-Fock (RHF) method introduced, using the computer codes (Cowan ATOMIC STRUCTURE PACKAGE) [Cowan (1981)] by Cowan et al [Cowan].The relativistic corrections included in the differential equations are derived from the Pauli-approximation to the Dirac-Hartree – Fock equations. The mass-velocity and the Darwin operators are included in the calculations. The radial parameters have been fitted in the least square optimizing program fitting the eigen-values of the hamiltonian to the

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available experimental energy levels. These optimized integrals have been used to compute both the wavelengths and the transition rates.

2.3. *Electric Dipole Decay Rates*

The strength of a line is defined as the square of the reduced dipole matrix element [Sobel'man (1979)]

$$S\,(\gamma J;\gamma' J') = \sum_{MM'} \left|\langle\, \gamma J M \,\|\boldsymbol{D}\|\, \gamma' J' M' \,\rangle\right|^2 \qquad (6)$$

where ψ and ψ\` are the wave functions composed of many basis states, the sum runs over all N electrons of the atom (or ion) and r^i is the radial position of the i^th electron.

The transition probability is related to S according to

$$A_{u,l} = \frac{64\,\pi^4\, e^2\, a_o^2}{3\,h\,g_u}\, S\,(\Delta E)^3 \qquad (7)$$

where u and *l* represent the upper and lower levels, respectively, g_u is the statistical weight of the upper level of the transition, a_o is the Bohr radius and Δ E is the wave number of the spectral line in cm^{-1}.

The weighted oscillator strength for the transition between ψ and ψ\` is defined as 4

$$g_u f = \frac{2}{3}\,(\Delta\, E) S \qquad (8)$$

3. RESULTS AND DISCUSSIONS

3.1. *Magnetopause variation with time*

The diagonalization of the energy matrices with HFR values for the energy parameters leads to the theoretical predictions for the energy levels of the configurations. The computer code [Cowan] is used to calculate energy levels, wavelengths, log gf and electric dipole transition probabilities. For even parity, the configurations $1s^2$ ns, nd and ng (n=6-10) have been considered while $1s^2$ np and nf (n=6-10) are considered for the odd parity configurations. They correspond to total angular momenta $1/2 \leq J \leq 9/2$ of even and odd parities with n=6-10 while total angular momenta $0 \leq L \leq 4$ and spin multiplicity (2S+1)=2.

The mentioned configurations for the experimental energy levels taken from NIST are used in the fitting procedure for Ar XVI. For $1s^2$ns there is only one parameter (E_{av}) which is determined from the observed term $^2S_{1/2}$, for $1s^2$nd there are two parameters (E_{av}, ζ_2) which are determined from the observed terms $^2D_{3/2}$ and $^2D_{5/2}$, for $1s^2$ng there are two parameters (E_{av}, ζ_2) which are determined from the observed terms $^2G_{7/2}$ and $^2G_{9/2}$, for $1s^2$np there are two parameters (E_{av}, ζ_1) which are determined from the observed terms $^2P_{1/2}$ and $^2P_{3/2}$ and for $1s^2$nf there are two parameters (E_{av}, ζ_2) which are determined from the observed terms $^2F_{5/2}$, $^2F_{7/2}$.

The energy of the other electronic configurations are obtained by adjusting the scaling parameters E_{av} and $\zeta_i(r_i)$ are listed in Table (1).

A total of 69 fine structure energy levels for Ar XVI are listed in Table 2, as well as the values compiled by NIST and those calculated in references [Nahar (2002); Tipbase].

The calculated fine structure energy levels of the Ar XVI ion agree with the observed and calculated values within the range of 0.15% for most levels. However, ab. initio calculations including relativistic effects in the Breit-Pauli R-matrix (BPRM) method by Nahar [Nahar (2002)] show a good agreement with the present calculations of fine structure energy levels.

4. CONCLUSIONS

Calculations have been carried out for fine structure energy levels, wavelengths and allowed transition probabilities in lithium-like Ar XVI including the relativistic effect using the Breit-Pauli approximation. Fine structure energy levels obtained from Breit-Pauli are assessed to be more accurate by 0.15% than the observed and calculated values.

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The transition probabilities show a good agreement in the soft x-rays, EUV and far UV regions with almost all available calculated values. A slight discrepancy appears in the near infrared and mid infrared regions in the calculated results. No experimental data for the transition probabilities exist in literatures for comparison. However, the present results show that there is an urgent need for experimental data in order to identify the spectral lines from astrophysics and the controlled thermonuclear fusion research.

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Table 1. Radial function parameters for Ar XVI ion in units of 1000 cm^{-1}

Configuration	Parameter		Configuration	Parameter	
$1s^22s$	E_{av}	0	$1s^22p$	E_{av}	275.186
$1s^23s$	E_{av}	4181.68		ζ	17.034
$1s^24s$	E_{av}	5612.472	$1s^23p$	E_{av}	4258.086
$1s^25s$	E_{av}	6267.466		ζ	5.036
$1s^26s$	E_{av}	6620.889	$1s^24p$	E_{av}	5643.965
$1s^27s$	E_{av}	6833.028		ζ	2.12
$1s^28s$	E_{av}	6970.261	$1s^25p$	E_{av}	6283.403
$1s^29s$	E_{av}	7064.112		ζ	1.084
$1s^210s$	E_{av}	7131.113	$1s^26p$	E_{av}	6630.048
$1s^23d$	E_{av}	4288.028		ζ	0.626
	ζ	0.949	$1s^27p$	E_{av}	6838.769
$1s^24d$	E_{av}	5656.564		ζ	0.394
	ζ	0.4	$1s^28p$	E_{av}	6974.095
$1s^25d$	E_{av}	6289.829		ζ	0.264
	ζ	0.205	$1s^29p$	E_{av}	7066.799
$1s^26d$	E_{av}	6633.758		ζ	0.185
	ζ	0.118	$1s^210p$	E_{av}	7133.067
$1s^27d$	E_{av}	6841.101		ζ	0.135
	ζ	0.075	$1s^24f$	E_{av}	5658.302
$1s^28d$	E_{av}	6975.655		ζ	0.143
	ζ	0.05	$1s^25f$	E_{av}	6290.68
$1s^29d$	E_{av}	7067.894		ζ	0.073
	ζ	0.035	$1s^26f$	E_{av}	6634.243
$1s^210d$	E_{av}	7133.865		ζ	0.043
	ζ	0.025	$1s^27f$	E_{av}	6841.404
$1s^25g$	E_{av}	6291.053		ζ	0.027
	ζ	0.034	$1s^28f$	E_{av}	6975.858
$1s^26g$	E_{av}	6634.46		ζ	0.018
	ζ	0.02	$1s^29f$	E_{av}	7068.036
$1s^27g$	E_{av}	6841.541		ζ	0.013
	ζ	0.013	$1s^210f$	E_{av}	7133.969
$1s^28g$	E_{av}	6975.949		ζ	0.009
	ζ	0.008			
$1s^29g$	E_{av}	7068.1			
	ζ	0.006			
$1s^210g$	E_{av}	7134.016			
	ζ	0.004			

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Table 2. The calculated energy levels in cm^{-1} for Ar XVI in comparison with literatures.

Configuration	E_{cal}	E [NIST]	E [Nahar]
$1s^22s\ ^2S_{1/2}$	0	0	0
$1s^22p\ ^2P_{1/2}$	1920620	1920590	1920622
$1s^22p\ ^2P_{3/2}$	2002380	2002060	2002377
$1s^23s\ ^2S_{1/2}$	2388872	2388872	2388861
$1s^23p\ ^2P_{1/2}$	2441940	2441532	2441941
$1s^23p\ ^2P_{3/2}$	2444335	2443937	2444322
$1s^23d\ ^2D_{3/2}$	2463791	2463771	2463789
$1s^23d\ ^2D_{5/2}$	2464481	2464521	2464470
$1s^24s\ ^2S_{1/2}$	3202101	3202101	3202025
$1s^24p\ ^2P_{1/2}$	3223450	3223425	3223446
$1s^24p\ ^2P_{3/2}$	3224555	3224438	3224543
$1s^24d\ ^2D_{3/2}$	3232733	3232673	3232642
$1s^24d\ ^2D_{5/2}$	3233089	3232989	3232861
$1s^24f\ ^2F_{5/2}$	3239433	3233483	3233662
$1s^24f\ ^2F_{7/2}$	3239591	3233641	3233827
$1s^25s\ ^2S_{1/2}$	3573450	3573451	3573442
$1s^25p\ ^2P_{3/2}$	3584656	3584616	3584646
$1s^25d\ ^2D_{3/2}$	3588906	3588878	3588849
$1s^25d\ ^2D_{5/2}$	3589068	3589004	3589036
$1s^25p\ ^2P_{1/2}$	3590099	3584099	3584141
$1s^25f\ ^2F_{5/2}$	3595165	3589275	3589255
$1s^25f\ ^2F_{7/2}$	3595247	3589357	3589354
$1s^25g\ ^2G_{7/2}$	3595383	3589318	3589343
$1s^25g\ ^2G_{9/2}$	3595432	3589367	3589409
$1s^26s\ ^2S_{1/2}$	3771342	3771342	3771342
$1s^26p\ ^2P_{1/2}$	3779502	3779471	3779145
$1s^26p\ ^2P_{3/2}$	3779801	3779770	3779507
$1s^26d\ ^2D_{3/2}$	3782704	3782726	3782173
$1s^26d\ ^2D_{5/2}$	3782750	3782820	3782283
$1s^26f\ ^2F_{5/2}$	3788420	3794320	3782426
$1s^26f\ ^2F_{7/2}$	3788467	3794367	3782481
$1s^26g\ ^2G_{7/2}$	3788549	3782481	3782481
$1s^26g\ ^2G_{9/2}$	3788577	3782509	3782513
$1s^27s\ ^2S_{1/2}$	3891943	3891943	3891943

Configuration	E_{cal}	E [NIST]	E [Nahar]
$1s^27p\ ^2P_{1/2}$	3897153	3897133	3896838
$1s^27p\ ^2P_{3/2}$	3897351	3897321	3897068
$1s^27d\ ^2D_{3/2}$	3899149	3899119	3898747
$1s^27d\ ^2D_{5/2}$	3899158	3899178	3898813
$1s^27f\ ^2F_{5/2}$	3904946	3898946	3898901
$1s^27f\ ^2F_{7/2}$	3904975	3898975	3898934
$1s^27g\ ^2G_{7/2}$	3905027	3898934	3898934
$1s^27g\ ^2G_{9/2}$	3905045	3898952	3898956
$1s^28s\ ^2S_{1/2}$	3969857	3969857	3969857
$1s^28d\ ^2D_{3/2}$	3974870	3974842	3974400
$1s^28d\ ^2D_{5/2}$	3974870	3974881	3974444
$1s^28p\ ^2P_{1/2}$	3979347	3973160	3973127
$1s^28p\ ^2P_{3/2}$	3979473	3973286	3973281
$1s^28f\ ^2F_{5/2}$	3980573	3974543	3974510
$1s^28f\ ^2F_{7/2}$	3980593	3974562	3974532
$1s^28g\ ^2G_{7/2}$	3980627	3974530	3974532
$1s^28g\ ^2G_{9/2}$	3980639	3974542	3974543
$1s^29s\ ^2S_{1/2}$	4023079	4023079	4023080
$1s^29d\ ^2D_{5/2}$	4026707	4026737	4026295
$1s^29d\ ^2D_{3/2}$	4026709	4026709	4026262
$1s^29p\ ^2P_{1/2}$	4031561	4025371	4025373
$1s^29p\ ^2P_{3/2}$	4031649	4025459	4025483
$1s^29f\ ^2F_{5/2}$	4032421	4026341	4026339
$1s^29f\ ^2F_{7/2}$	4032435	4026355	4026361
$1s^29g\ ^2G_{7/2}$	4032459	4026361	4026361
$1s^29g\ ^2G_{9/2}$	4032467	4026369	4026372
$1s^210s\ ^2S_{1/2}$	4061048	4061048	4061049
$1s^210d\ ^2D_{3/2}$	4063337	4063363	4063364
$1s^210d\ ^2D_{5/2}$	4063339	4063383	4063386
$1s^210p\ ^2P_{1/2}$	4068879	4062709	4062717
$1s^210p\ ^2P_{3/2}$	4068944	4062774	4062794
$1s^210f\ ^2F_{5/2}$	4069505	4063445	4063419
$1s^210f\ ^2F_{7/2}$	4069516	4063455	4063430
$1s^210g\ ^2G_{7/2}$	4069533	4063450	4063430
$1s^210g\ ^2G_{9/2}$	4069539	4063456	4063441

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Table 3. Wavelengths (in Å) and the transition rates (in sec^{-1}) is compared with Tipba

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
14.019	$1s^22s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-2.61	4.161E+10	4.000E+10
14.019	$1s^22s\ ^2S_{1/2} - 1s^210p\ ^2P_{3/2}$	-2.309	4.163E+10	3.972E+10
14.15	$1s^22s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-2.164	5.713E+10	5.442E+10
14.151	$1s^22s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-2.465	5.710E+10	5.483E+10
14.339	$1s^22s\ ^2S_{1/2} - 1s^28p\ ^2P_{1/2}$	-2.3	8.130E+10	7.795E+10
14.339	$1s^22s\ ^2S_{1/2} - 1s^28p\ ^2P_{3/2}$	-1.999	8.133E+10	7.733E+10
14.544	$1s^22p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	-2.119	5.995E+10	5.942E+10
14.55	$1s^22p\ ^2P_{1/2} - 1s^210s\ ^2S_{1/2}$	-3.539	4.559E+09	4.468E+09
14.598	$1s^22p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-2.82	1.186E+10	1.167E+10
14.598	$1s^22p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	-1.865	7.113E+10	7.037E+10
14.604	$1s^22p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-3.239	9.015E+09	9.165E+09
14.622	$1s^22s\ ^2S_{1/2} - 1s^27p\ ^2P_{3/2}$	-1.808	1.213E+11	1.150E+11
14.623	$1s^22s\ ^2S_{1/2} - 1s^27p\ ^2P_{1/2}$	-2.109	1.213E+11	1.160E+11
14.685	$1s^22p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	-1.969	8.305E+10	8.230E+10
14.693	$1s^22p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-3.389	6.300E+09	6.171E+09
14.74	$1s^22p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-2.67	1.643E+10	1.616E+10
14.74	$1s^22p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	-1.715	9.855E+10	9.748E+10
14.748	$1s^22p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-3.09	1.246E+10	1.266E+10
14.887	$1s^22p\ ^2P_{1/2} - 1s^28d\ ^2D_{3/2}$	-1.797	1.200E+11	1.188E+11
14.898	$1s^22p\ ^2P_{1/2} - 1s^28s\ ^2S_{1/2}$	-3.221	9.030E+09	8.879E+09
14.943	$1s^22p\ ^2P_{3/2} - 1s^28d\ ^2D_{3/2}$	-2.498	2.373E+10	2.334E+10
14.943	$1s^22p\ ^2P_{3/2} - 1s^28d\ ^2D_{5/2}$	-1.544	1.424E+11	1.407E+11
14.955	$1s^22p\ ^2P_{3/2} - 1s^28s\ ^2S_{1/2}$	-2.922	1.786E+10	1.822E+10
15.082	$1s^22s\ ^2S_{1/2} - 1s^26p\ ^2P_{3/2}$	-1.58	1.926E+11	1.815E+11
15.084	$1s^22s\ ^2S_{1/2} - 1s^26p\ ^2P_{1/2}$	-1.882	1.925E+11	1.832E+11
15.191	$1s^22p\ ^2P_{1/2} - 1s^27d\ ^2D_{3/2}$	-1.597	1.829E+11	1.809E+11
15.209	$1s^22p\ ^2P_{1/2} - 1s^27s\ ^2S_{1/2}$	-3.025	1.361E+10	1.347E+10
15.25	$1s^22p\ ^2P_{3/2} - 1s^27d\ ^2D_{3/2}$	-2.297	3.615E+10	3.555E+10
15.25	$1s^22p\ ^2P_{3/2} - 1s^27d\ ^2D_{5/2}$	-1.343	2.168E+11	2.143E+11
15.269	$1s^22p\ ^2P_{3/2} - 1s^27s\ ^2S_{1/2}$	-2.726	2.690E+10	2.760E+10
15.685	$1s^22p\ ^2P_{1/2} - 1s^26d\ ^2D_{3/2}$	-1.354	3.000E+11	2.965E+11
15.717	$1s^22p\ ^2P_{1/2} - 1s^26s\ ^2S_{1/2}$	-2.79	2.190E+10	2.188E+10
15.748	$1s^22p\ ^2P_{3/2} - 1s^26d\ ^2D_{3/2}$	-2.055	5.930E+10	5.830E+10
15.748	$1s^22p\ ^2P_{3/2} - 1s^26d\ ^2D_{5/2}$	-1.1	3.558E+11	3.512E+11
15.78	$1s^22p\ ^2P_{3/2} - 1s^26s\ ^2S_{1/2}$	-2.491	4.328E+10	4.483E+10
33.882	$1s^23s\ ^2S_{1/2} - 1s^210p\ ^2P_{3/2}$	-2.038	1.329E+10	1.294E+10
33.884	$1s^23s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-2.34	1.329E+10	1.309E+10
34.66	$1s^23s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-1.882	1.821E+10	1.772E+10
34.663	$1s^23s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-2.183	1.821E+10	1.793E+10
34.713	$1s^23p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	-1.81	2.141E+10	2.134E+10
34.746	$1s^23p\ ^2P_{1/2} - 1s^210s\ ^2S_{1/2}$	-2.973	2.943E+09	2.720E+09
34.803	$1s^23p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	-1.556	2.550E+10	2.545E+10
34.804	$1s^23p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-2.511	4.248E+09	4.235E+09
34.837	$1s^23p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-2.673	5.840E+09	5.560E+09
35.12	$1s^23d\ ^2D_{3/2} - 1s^210f\ ^2F_{5/2}$	-1.613	2.198E+10	2.196E+10
35.13	$1s^23d\ ^2D_{3/2} - 1s^210p\ ^2P_{3/2}$	-4.08	1.123E+08	1.090E+08
35.133	$1s^23d\ ^2D_{3/2} - 1s^210p\ ^2P_{1/2}$	-3.381	1.123E+09	1.137E+09
35.149	$1s^23d\ ^2D_{5/2} - 1s^210f\ ^2F_{7/2}$	-1.458	2.349E+10	2.343E+10
35.15	$1s^23d\ ^2D_{5/2} - 1s^210f\ ^2F_{5/2}$	-2.759	1.566E+09	1.556E+09
35.16	$1s^23d\ ^2D_{5/2} - 1s^210p\ ^2P_{3/2}$	-3.127	1.008E+09	9.924E+08
35.527	$1s^23p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	-1.649	2.963E+10	2.951E+10
35.574	$1s^23p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-2.811	4.074E+09	3.775E+09
35.621	$1s^23p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	-1.395	3.525E+10	3.520E+10
35.622	$1s^23p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-2.35	5.875E+09	5.858E+09
35.67	$1s^23p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-2.511	8.085E+09	7.719E+09
35.81	$1s^23s\ ^2S_{1/2} - 1s^28p\ ^2P_{3/2}$	-1.701	2.588E+10	2.516E+10
35.815	$1s^23s\ ^2S_{1/2} - 1s^28p\ ^2P_{1/2}$	-2.002	2.587E+10	2.546E+10
35.953	$1s^23d\ ^2D_{3/2} - 1s^29f\ ^2F_{5/2}$	-1.441	3.117E+10	3.113E+10
35.968	$1s^23d\ ^2D_{3/2} - 1s^29p\ ^2P_{3/2}$	-3.914	1.570E+08	1.526E+08
35.971	$1s^23d\ ^2D_{3/2} - 1s^29p\ ^2P_{1/2}$	-3.215	1.570E+09	1.591E+09
35.983	$1s^23d\ ^2D_{5/2} - 1s^29f\ ^2F_{7/2}$	-1.286	3.330E+10	3.322E+10
35.984	$1s^23d\ ^2D_{5/2} - 1s^29f\ ^2F_{5/2}$	-2.587	2.220E+09	2.206E+09
35.998	$1s^23d\ ^2D_{5/2} - 1s^29p\ ^2P_{3/2}$	-2.961	1.409E+09	1.389E+09
36.731	$1s^23p\ ^2P_{1/2} - 1s^28d\ ^2D_{3/2}$	-1.462	4.268E+10	4.249E+10
36.802	$1s^23p\ ^2P_{1/2} - 1s^28s\ ^2S_{1/2}$	-2.622	5.875E+09	5.466E+09

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36.831	$1s^23p\ ^2P_{3/2} - 1s^28d\ ^2D_{5/2}$	-1.208	5.078E+10	5.069E+10
36.833	$1s^23p\ ^2P_{3/2} - 1s^28d\ ^2D_{3/2}$	-2.162	8.463E+09	8.438E+09

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
36.905	$1s^23p\ ^2P_{3/2} - 1s^28s\ ^2S_{1/2}$	-2.323	1.165E+10	1.118E+10
37.186	$1s^23d\ ^2D_{3/2} - 1s^28f\ ^2F_{5/2}$	-1.238	4.648E+10	4.644E+10
37.208	$1s^23d\ ^2D_{3/2} - 1s^28p\ ^2P_{3/2}$	-3.719	2.298E+08	2.235E+08
37.213	$1s^23d\ ^2D_{3/2} - 1s^28p\ ^2P_{1/2}$	-3.02	2.297E+09	2.330E+09
37.218	$1s^23d\ ^2D_{5/2} - 1s^28f\ ^2F_{5/2}$	-2.384	3.312E+09	3.293E+09
37.218	$1s^23d\ ^2D_{5/2} - 1s^28f\ ^2F_{7/2}$	-1.083	4.968E+10	4.957E+10
37.24	$1s^23d\ ^2D_{5/2} - 1s^28p\ ^2P_{3/2}$	-2.766	2.063E+09	2.034E+09
37.632	$1s^23s\ ^2S_{1/2} - 1s^27p\ ^2P_{3/2}$	-1.486	3.848E+10	3.733E+10
37.641	$1s^23s\ ^2S_{1/2} - 1s^27p\ ^2P_{1/2}$	-1.787	3.846E+10	3.781E+10
38.641	$1s^23p\ ^2P_{1/2} - 1s^27d\ ^2D_{3/2}$	-1.237	6.475E+10	6.443E+10
38.751	$1s^23p\ ^2P_{3/2} - 1s^27d\ ^2D_{5/2}$	-0.983	7.705E+10	7.688E+10
38.754	$1s^23p\ ^2P_{3/2} - 1s^27d\ ^2D_{3/2}$	-1.937	1.284E+10	1.280E+10
38.76	$1s^23p\ ^2P_{1/2} - 1s^27s\ ^2S_{1/2}$	-2.396	8.925E+09	8.364E+09
38.874	$1s^23p\ ^2P_{3/2} - 1s^27s\ ^2S_{1/2}$	-2.096	1.769E+10	1.709E+10
39.143	$1s^23d\ ^2D_{3/2} - 1s^27f\ ^2F_{5/2}$	-0.989	7.445E+10	7.432E+10
39.178	$1s^23d\ ^2D_{5/2} - 1s^27f\ ^2F_{7/2}$	-0.834	7.955E+10	7.933E+10
39.179	$1s^23d\ ^2D_{3/2} - 1s^27p\ ^2P_{3/2}$	-3.484	3.565E+08	3.476E+08
39.179	$1s^23d\ ^2D_{5/2} - 1s^27f\ ^2F_{5/2}$	-2.135	5.303E+09	5.271E+09
39.188	$1s^23d\ ^2D_{3/2} - 1s^27p\ ^2P_{1/2}$	-2.785	3.564E+09	3.625E+09
39.216	$1s^23d\ ^2D_{5/2} - 1s^27p\ ^2P_{3/2}$	-2.53	3.200E+09	3.165E+09
40.838	$1s^23s\ ^2S_{1/2} - 1s^26p\ ^2P_{3/2}$	-1.217	6.063E+10	5.864E+10
40.854	$1s^23s\ ^2S_{1/2} - 1s^26p\ ^2P_{1/2}$	-1.518	6.055E+10	5.947E+10
42.007	$1s^23p\ ^2P_{1/2} - 1s^26d\ ^2D_{3/2}$	-0.952	1.054E+11	1.047E+11
42.136	$1s^23p\ ^2P_{3/2} - 1s^26d\ ^2D_{5/2}$	-0.698	1.254E+11	1.251E+11
42.141	$1s^23p\ ^2P_{3/2} - 1s^26d\ ^2D_{3/2}$	-1.653	2.089E+10	2.084E+10
42.233	$1s^23p\ ^2P_{1/2} - 1s^26s\ ^2S_{1/2}$	-2.109	1.456E+10	1.378E+10
42.368	$1s^23p\ ^2P_{3/2} - 1s^26s\ ^2S_{1/2}$	-1.809	2.885E+10	2.817E+10
42.598	$1s^23d\ ^2D_{3/2} - 1s^26f\ ^2F_{5/2}$	-0.665	1.324E+11	1.322E+11
42.638	$1s^23d\ ^2D_{5/2} - 1s^26f\ ^2F_{7/2}$	-0.511	1.414E+11	1.411E+11
42.641	$1s^23d\ ^2D_{5/2} - 1s^26f\ ^2F_{5/2}$	-1.812	9.427E+09	9.380E+09
42.667	$1s^23d\ ^2D_{3/2} - 1s^26p\ ^2P_{3/2}$	-3.182	6.023E+08	5.893E+08
42.684	$1s^23d\ ^2D_{3/2} - 1s^26p\ ^2P_{1/2}$	-2.483	6.015E+09	6.145E+09
42.71	$1s^23d\ ^2D_{5/2} - 1s^26p\ ^2P_{3/2}$	-2.228	5.405E+09	5.365E+09
65.761	$1s^24s\ ^2S_{1/2} - 1s^210p\ ^2P_{3/2}$	-1.803	6.068E+09	5.950E+09
65.77	$1s^24s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-2.104	6.065E+09	6.039E+09
67.025	$1s^24p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	-1.577	9.823E+09	9.805E+09
67.147	$1s^24p\ ^2P_{1/2} - 1s^210s\ ^2S_{1/2}$	-2.579	1.948E+09	2.130E+09
67.165	$1s^24p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	-1.323	1.171E+10	1.174E+10
67.168	$1s^24p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-2.277	1.952E+09	1.957E+09
67.291	$1s^24p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-2.279	3.871E+09	4.338E+09
67.66	$1s^24d\ ^2D_{3/2} - 1s^210f\ ^2F_{5/2}$	-1.256	1.348E+10	1.345E+10
67.697	$1s^24d\ ^2D_{3/2} - 1s^210p\ ^2P_{3/2}$	-3.475	1.219E+08	1.242E+08
67.704	$1s^24d\ ^2D_{5/2} - 1s^210f\ ^2F_{7/2}$	-1.101	1.441E+10	1.437E+10
67.705	$1s^24d\ ^2D_{5/2} - 1s^210f\ ^2F_{5/2}$	-2.402	9.610E+08	9.563E+08
67.706	$1s^24d\ ^2D_{3/2} - 1s^210p\ ^2P_{1/2}$	-2.776	1.218E+09	1.288E+09
67.743	$1s^24d\ ^2D_{5/2} - 1s^210p\ ^2P_{3/2}$	-2.521	1.095E+09	1.129E+09
67.751	$1s^24f\ ^2F_{5/2} - 1s^210g\ ^2G_{7/2}$	-1.269	9.786E+09	9.779E+09
67.756	$1s^24f\ ^2F_{5/2} - 1s^210d\ ^2D_{5/2}$	-4.398	9.677E+06	9.517E+06
67.759	$1s^24f\ ^2F_{5/2} - 1s^210d\ ^2D_{3/2}$	-3.252	2.032E+08	2.032E+08
67.773	$1s^24f\ ^2F_{7/2} - 1s^210g\ ^2G_{9/2}$	-1.156	1.014E+10	1.012E+10
67.774	$1s^24f\ ^2F_{7/2} - 1s^210d\ ^2D_{5/2}$	-2.7	4.828E+08	1.918E+08
67.774	$1s^24f\ ^2F_{7/2} - 1s^210g\ ^2G_{7/2}$	-2.7	3.621E+08	3.605E+08
68.756	$1s^24s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-1.628	8.308E+09	8.120E+09
68.769	$1s^24s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-1.929	8.300E+09	8.246E+09
70.126	$1s^24p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	-1.398	1.357E+10	1.352E+10
70.279	$1s^24p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	-1.144	1.617E+10	1.620E+10
70.283	$1s^24p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-2.098	2.695E+09	2.701E+09
70.31	$1s^24p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-2.396	2.714E+09	2.964E+09
70.468	$1s^24p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-2.095	5.390E+09	6.039E+09
70.819	$1s^24d\ ^2D_{3/2} - 1s^29f\ ^2F_{5/2}$	-1.065	1.907E+10	1.903E+10
70.867	$1s^24d\ ^2D_{5/2} - 1s^29f\ ^2F_{7/2}$	-0.911	2.040E+10	2.034E+10
70.869	$1s^24d\ ^2D_{5/2} - 1s^29f\ ^2F_{5/2}$	-2.212	1.360E+09	1.353E+09
70.875	$1s^24d\ ^2D_{3/2} - 1s^29p\ ^2P_{3/2}$	-3.285	1.722E+08	1.756E+08
70.889	$1s^24d\ ^2D_{3/2} - 1s^29p\ ^2P_{1/2}$	-2.586	1.721E+09	1.821E+09

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70.918	$1s^24f\ ^2F_{5/2}$ - $1s^29g\ ^2G_{7/2}$	-1.058	1.450E+10	1.448E+10
70.926	$1s^24d\ ^2D_{5/2}$ - $1s^29p\ ^2P_{3/2}$	-2.331	1.547E+09	1.596E+09
70.926	$1s^24f\ ^2F_{5/2}$ - $1s^29d\ ^2D_{5/2}$	-4.198	1.402E+07	1.378E+07
70.931	$1s^24f\ ^2F_{5/2}$ - $1s^29d\ ^2D_{3/2}$	-3.052	2.943E+08	2.942E+08

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
70.942	$1s^24f\ ^2F_{7/2}$ - $1s^29g\ ^2G_{9/2}$	-0.946	1.502E+10	1.500E+10
70.944	$1s^24f\ ^2F_{7/2}$ - $1s^29g\ ^2G_{7/2}$	-2.49	5.364E+08	5.341E+08
70.952	$1s^24f\ ^2F_{7/2}$ - $1s^29d\ ^2D_{5/2}$	-2.897	2.800E+08	2.777E+08
73.435	$1s^24s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{3/2}$	-1.419	1.178E+10	1.146E+10
73.456	$1s^24s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{1/2}$	-1.72	1.177E+10	1.165E+10
74.977	$1s^24p\ ^2P_{1/2}$ - $1s^28d\ ^2D_{3/2}$	-1.183	1.948E+10	1.939E+10
75.15	$1s^24p\ ^2P_{3/2}$ - $1s^28d\ ^2D_{5/2}$	-0.928	2.322E+10	2.323E+10
75.157	$1s^24p\ ^2P_{3/2}$ - $1s^28d\ ^2D_{3/2}$	-1.883	3.870E+09	3.875E+09
75.278	$1s^24p\ ^2P_{1/2}$ - $1s^28s\ ^2S_{1/2}$	-2.174	3.947E+09	4.307E+09
75.458	$1s^24p\ ^2P_{3/2}$ - $1s^28s\ ^2S_{1/2}$	-1.874	7.835E+09	8.776E+09
75.766	$1s^24d\ ^2D_{3/2}$ - $1s^28f\ ^2F_{5/2}$	-0.834	2.837E+10	2.832E+10
75.82	$1s^24d\ ^2D_{5/2}$ - $1s^28f\ ^2F_{7/2}$	-0.68	3.034E+10	3.027E+10
75.823	$1s^24d\ ^2D_{5/2}$ - $1s^28f\ ^2F_{5/2}$	-1.981	2.022E+09	2.015E+09
75.857	$1s^24d\ ^2D_{3/2}$ - $1s^28p\ ^2P_{3/2}$	-3.054	2.558E+08	2.610E+08
75.878	$1s^24f\ ^2F_{5/2}$ - $1s^28g\ ^2G_{7/2}$	-0.798	2.308E+10	2.306E+10
75.88	$1s^24d\ ^2D_{3/2}$ - $1s^28p\ ^2P_{1/2}$	-2.356	2.554E+09	2.707E+09
75.89	$1s^24f\ ^2F_{5/2}$ - $1s^28d\ ^2D_{5/2}$	-3.952	2.157E+07	2.116E+07
75.898	$1s^24f\ ^2F_{5/2}$ - $1s^28d\ ^2D_{3/2}$	-2.806	4.528E+08	4.517E+08
75.904	$1s^24f\ ^2F_{7/2}$ - $1s^28g\ ^2G_{9/2}$	-0.685	2.391E+10	2.387E+10
75.906	$1s^24f\ ^2F_{7/2}$ - $1s^28g\ ^2G_{7/2}$	-2.229	8.538E+08	8.504E+08
75.915	$1s^24d\ ^2D_{5/2}$ - $1s^28p\ ^2P_{3/2}$	-2.101	2.296E+09	2.373E+09
75.919	$1s^24f\ ^2F_{7/2}$ - $1s^28d\ ^2D_{5/2}$	-2.651	4.307E+08	4.264E+08
81.533	$1s^24s\ ^2S_{1/2}$ - $1s^27p\ ^2P_{3/2}$	-1.158	1.744E+10	1.685E+10
81.573	$1s^24s\ ^2S_{1/2}$ - $1s^27p\ ^2P_{1/2}$	-1.459	1.741E+10	1.715E+10
83.393	$1s^24p\ ^2P_{1/2}$ - $1s^27d\ ^2D_{3/2}$	-0.911	2.940E+10	2.917E+10
83.601	$1s^24p\ ^2P_{3/2}$ - $1s^27d\ ^2D_{5/2}$	-0.657	3.502E+10	3.497E+10
83.615	$1s^24p\ ^2P_{3/2}$ - $1s^27d\ ^2D_{3/2}$	-1.612	5.835E+09	5.836E+09
83.95	$1s^24p\ ^2P_{1/2}$ - $1s^27s\ ^2S_{1/2}$	-1.891	6.080E+09	6.624E+09
84.175	$1s^24p\ ^2P_{3/2}$ - $1s^27s\ ^2S_{1/2}$	-1.591	1.206E+10	1.350E+10
84.361	$1s^24d\ ^2D_{3/2}$ - $1s^27f\ ^2F_{5/2}$	-0.539	4.517E+10	4.509E+10
84.425	$1s^24d\ ^2D_{5/2}$ - $1s^27f\ ^2F_{7/2}$	-0.384	4.828E+10	4.821E+10
84.432	$1s^24d\ ^2D_{5/2}$ - $1s^27f\ ^2F_{5/2}$	-1.685	3.218E+09	3.210E+09
84.496	$1s^24f\ ^2F_{5/2}$ - $1s^27g\ ^2G_{7/2}$	-0.455	4.091E+10	4.084E+10
84.519	$1s^24f\ ^2F_{5/2}$ - $1s^27d\ ^2D_{5/2}$	-3.634	3.612E+07	3.534E+07
84.527	$1s^24f\ ^2F_{7/2}$ - $1s^27g\ ^2G_{9/2}$	-0.343	4.239E+10	4.229E+10
84.531	$1s^24d\ ^2D_{3/2}$ - $1s^27p\ ^2P_{3/2}$	-2.76	4.060E+08	4.152E+08
84.531	$1s^24f\ ^2F_{7/2}$ - $1s^27g\ ^2G_{7/2}$	-1.887	1.514E+09	1.507E+09
84.533	$1s^24f\ ^2F_{5/2}$ - $1s^27d\ ^2D_{3/2}$	-2.488	7.583E+08	7.540E+08
84.555	$1s^24f\ ^2F_{7/2}$ - $1s^27d\ ^2D_{5/2}$	-2.333	7.215E+08	7.119E+08
84.573	$1s^24d\ ^2D_{3/2}$ - $1s^27p\ ^2P_{1/2}$	-2.061	4.054E+09	4.306E+09
84.602	$1s^24d\ ^2D_{5/2}$ - $1s^27p\ ^2P_{3/2}$	-1.806	3.645E+09	3.775E+09
98.243	$1s^24s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{3/2}$	-0.804	2.710E+10	2.590E+10
98.333	$1s^24s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{1/2}$	-1.106	2.703E+10	2.642E+10
100.833	$1s^24p\ ^2P_{1/2}$ - $1s^26d\ ^2D_{3/2}$	-0.541	4.718E+10	4.661E+10
101.127	$1s^24p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{5/2}$	-0.287	5.613E+10	5.598E+10
101.158	$1s^24p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{3/2}$	-1.241	9.348E+09	9.349E+09
102.14	$1s^24p\ ^2P_{1/2}$ - $1s^26s\ ^2S_{1/2}$	-1.499	1.013E+10	1.104E+10
102.229	$1s^24d\ ^2D_{3/2}$ - $1s^26f\ ^2F_{5/2}$	-0.128	7.915E+10	7.893E+10
102.318	$1s^24d\ ^2D_{5/2}$ - $1s^26f\ ^2F_{7/2}$	0.026	8.459E+10	8.442E+10
102.334	$1s^24d\ ^2D_{5/2}$ - $1s^26f\ ^2F_{5/2}$	-1.275	5.637E+09	5.624E+09
102.418	$1s^24f\ ^2F_{5/2}$ - $1s^26g\ ^2G_{7/2}$	0.039	8.699E+10	8.684E+10
102.461	$1s^24f\ ^2F_{7/2}$ - $1s^26g\ ^2G_{9/2}$	0.152	9.010E+10	8.993E+10
102.47	$1s^24f\ ^2F_{7/2}$ - $1s^26g\ ^2G_{7/2}$	-1.392	3.216E+09	3.207E+09
102.473	$1s^24p\ ^2P_{3/2}$ - $1s^26s\ ^2S_{1/2}$	-1.2	2.005E+10	2.251E+10
102.474	$1s^24f\ ^2F_{5/2}$ - $1s^26d\ ^2D_{5/2}$	-3.186	6.893E+07	6.761E+07
102.505	$1s^24f\ ^2F_{5/2}$ - $1s^26d\ ^2D_{3/2}$	-2.04	1.446E+09	1.442E+09
102.526	$1s^24f\ ^2F_{7/2}$ - $1s^26d\ ^2D_{5/2}$	-1.886	1.376E+09	1.362E+09
102.628	$1s^24d\ ^2D_{3/2}$ - $1s^26p\ ^2P_{3/2}$	-2.348	7.103E+08	7.214E+08
102.727	$1s^24d\ ^2D_{3/2}$ - $1s^26p\ ^2P_{1/2}$	-1.649	7.085E+09	7.485E+09
102.733	$1s^24d\ ^2D_{5/2}$ - $1s^26p\ ^2P_{3/2}$	-1.394	6.373E+09	6.558E+09
115.518	$1s^25s\ ^2S_{1/2}$ - $1s^210p\ ^2P_{3/2}$	-1.571	3.353E+09	3.231E+09

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115.545	$1s^25s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-1.873	3.350E+09	3.286E+09
117.439	$1s^25p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	-1.355	5.335E+09	5.304E+09
117.655	$1s^25p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	-1.101	6.368E+09	6.367E+09
117.663	$1s^25p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-2.055	1.061E+09	1.063E+09
117.814	$1s^25p\ ^2P_{1/2} - 1s^210s\ ^2S_{1/2}$	-2.241	1.380E+09	1.472E+09
118.04	$1s^25p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-1.941	2.745E+09	2.997E+09
118.423	$1s^25d\ ^2D_{3/2} - 1s^210f\ ^2F_{5/2}$	-0.991	8.095E+09	8.085E+09

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
118.491	$1s^25d\ ^2D_{5/2} - 1s^210f\ ^2F_{7/2}$	-0.836	8.659E+09	8.648E+09
118.495	$1s^25d\ ^2D_{5/2} - 1s^210f\ ^2F_{5/2}$	-2.137	5.772E+08	5.760E+08
118.538	$1s^25d\ ^2D_{3/2} - 1s^210p\ ^2P_{3/2}$	-3.029	1.111E+08	1.139E+08
118.558	$1s^25f\ ^2F_{5/2} - 1s^210g\ ^2G_{7/2}$	-0.844	8.498E+09	8.488E+09
118.566	$1s^25d\ ^2D_{3/2} - 1s^210p\ ^2P_{1/2}$	-2.33	1.110E+09	1.177E+09
118.574	$1s^25f\ ^2F_{5/2} - 1s^210d\ ^2D_{5/2}$	-3.726	1.486E+07	1.462E+07
118.583	$1s^25f\ ^2F_{5/2} - 1s^210d\ ^2D_{3/2}$	-2.58	3.120E+08	3.116E+08
118.591	$1s^25f\ ^2F_{7/2} - 1s^210g\ ^2G_{9/2}$	-0.731	8.805E+09	8.791E+09
118.594	$1s^25f\ ^2F_{7/2} - 1s^210g\ ^2G_{7/2}$	-2.275	3.144E+08	3.135E+08
118.61	$1s^25d\ ^2D_{5/2} - 1s^210p\ ^2P_{3/2}$	-2.075	9.978E+08	1.034E+09
118.61	$1s^25f\ ^2F_{7/2} - 1s^210d\ ^2D_{5/2}$	-2.425	2.968E+08	2.944E+08
118.622	$1s^25g\ ^2G_{7/2} -1s^210f\ ^2F_{7/2}$	-4.545	1.690E+06	1.664E+06
118.626	$1s^25g\ ^2G_{7/2} -1s^210f\ ^2F_{5/2}$	-3.114	6.082E+07	6.044E+07
118.643	$1s^25g\ ^2G_{9/2} -1s^210f\ ^2F_{7/2}$	-3.001	5.911E+07	5.853E+07
125.09	$1s^25s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-1.366	4.585E+09	4.402E+09
125.133	$1s^25s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-1.668	4.580E+09	4.481E+09
127.304	$1s^25p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	-1.146	7.355E+09	7.297E+09
127.554	$1s^25p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	-0.891	8.775E+09	8.766E+09
127.568	$1s^25p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-1.846	1.462E+09	1.464E+09
127.911	$1s^25p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-2.022	1.940E+09	2.069E+09
128.178	$1s^25p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-1.721	3.855E+09	4.214E+09
128.454	$1s^25d\ ^2D_{3/2} - 1s^29f\ ^2F_{5/2}$	-0.771	1.143E+10	1.141E+10
128.531	$1s^25d\ ^2D_{5/2} - 1s^29f\ ^2F_{7/2}$	-0.616	1.222E+10	1.221E+10
128.539	$1s^25d\ ^2D_{5/2} - 1s^29f\ ^2F_{5/2}$	-1.917	8.145E+08	8.132E+08
128.609	$1s^25f\ ^2F_{5/2} - 1s^29g\ ^2G_{7/2}$	-0.604	1.255E+10	1.253E+10
128.635	$1s^25f\ ^2F_{5/2} - 1s^29d\ ^2D_{5/2}$	-3.485	2.197E+07	2.162E+07
128.639	$1s^25d\ ^2D_{3/2} - 1s^29p\ ^2P_{3/2}$	-2.801	1.592E+08	1.630E+08
128.647	$1s^25f\ ^2F_{7/2} - 1s^29g\ ^2G_{9/2}$	-0.491	1.300E+10	1.298E+10
128.649	$1s^25f\ ^2F_{5/2} - 1s^29d\ ^2D_{3/2}$	-2.339	4.613E+08	4.606E+08
128.651	$1s^25f\ ^2F_{7/2} - 1s^29g\ ^2G_{7/2}$	-2.035	4.644E+08	4.630E+08
128.677	$1s^25f\ ^2F_{7/2} - 1s^29d\ ^2D_{5/2}$	-2.185	4.390E+08	4.353E+08
128.685	$1s^25d\ ^2D_{3/2} - 1s^29p\ ^2P_{1/2}$	-2.103	1.590E+09	1.685E+09
128.686	$1s^25g\ ^2G_{7/2} -1s^29f\ ^2F_{7/2}$	-4.285	2.611E+06	2.573E+06
128.693	$1s^25g\ ^2G_{7/2} -1s^29f\ ^2F_{5/2}$	-2.854	9.400E+07	9.345E+07
128.711	$1s^25g\ ^2G_{9/2} -1s^29f\ ^2F_{7/2}$	-2.741	9.135E+07	9.050E+07
128.724	$1s^25d\ ^2D_{5/2} - 1s^29p\ ^2P_{3/2}$	-1.848	1.430E+09	1.481E+09
141.491	$1s^25s\ ^2S_{1/2} - 1s^28p\ ^2P_{3/2}$	-1.109	6.480E+09	6.189E+09
141.57	$1s^25s\ ^2S_{1/2} - 1s^28p\ ^2P_{1/2}$	-1.41	6.470E+09	6.307E+09
144.246	$1s^25p\ ^2P_{1/2} - 1s^28d\ ^2D_{3/2}$	-0.882	1.052E+10	1.041E+10
144.559	$1s^25p\ ^2P_{3/2} - 1s^28d\ ^2D_{5/2}$	-0.628	1.254E+10	1.251E+10
144.585	$1s^25p\ ^2P_{3/2} - 1s^28d\ ^2D_{3/2}$	-1.582	2.089E+09	2.090E+09
145.361	$1s^25p\ ^2P_{1/2} - 1s^28s\ ^2S_{1/2}$	-1.742	2.859E+09	3.050E+09
145.705	$1s^25p\ ^2P_{3/2} - 1s^28s\ ^2S_{1/2}$	-1.442	5.675E+09	6.216E+09
145.709	$1s^25d\ ^2D_{3/2} - 1s^28f\ ^2F_{5/2}$	-0.491	1.692E+10	1.689E+10
145.804	$1s^25d\ ^2D_{5/2} - 1s^28f\ ^2F_{7/2}$	-0.336	1.809E+10	1.807E+10
145.818	$1s^25d\ ^2D_{5/2} - 1s^28f\ ^2F_{5/2}$	-1.637	1.206E+09	1.204E+09
145.901	$1s^25f\ ^2F_{5/2} - 1s^28g\ ^2G_{7/2}$	-0.295	1.986E+10	1.984E+10
145.948	$1s^25f\ ^2F_{7/2} - 1s^28g\ ^2G_{9/2}$	-0.182	2.058E+10	2.055E+10
145.949	$1s^25f\ ^2F_{5/2} - 1s^28d\ ^2D_{5/2}$	-3.176	3.483E+07	3.429E+07
145.956	$1s^25f\ ^2F_{7/2} - 1s^28g\ ^2G_{7/2}$	-1.726	7.348E+08	7.331E+08
145.975	$1s^25f\ ^2F_{5/2} - 1s^28d\ ^2D_{3/2}$	-2.03	7.310E+08	7.304E+08
146.003	$1s^25g\ ^2G_{7/2} -1s^28f\ ^2F_{7/2}$	-3.947	4.419E+06	4.356E+06
146.004	$1s^25f\ ^2F_{7/2} - 1s^28d\ ^2D_{5/2}$	-1.875	6.958E+08	6.903E+08
146.016	$1s^25g\ ^2G_{7/2} -1s^28f\ ^2F_{5/2}$	-2.516	1.590E+08	1.582E+08
146.036	$1s^25g\ ^2G_{9/2} -1s^28f\ ^2F_{7/2}$	-2.403	1.545E+08	1.532E+08
146.048	$1s^25d\ ^2D_{3/2} - 1s^28p\ ^2P_{3/2}$	-2.511	2.412E+08	2.467E+08
146.133	$1s^25d\ ^2D_{3/2} - 1s^28p\ ^2P_{1/2}$	-1.812	2.408E+09	2.550E+09
146.158	$1s^25d\ ^2D_{5/2} - 1s^28p\ ^2P_{3/2}$	-1.557	2.166E+09	2.241E+09
174.978	$1s^25s\ ^2S_{1/2} - 1s^27p\ ^2P_{3/2}$	-0.759	9.493E+09	8.971E+09

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175.159	$1s^25s\ ^2S_{1/2} - 1s^27p\ ^2P_{1/2}$	-1.06	9.465E+09	9.163E+09
178.996	$1s^25p\ ^2P_{1/2} - 1s^27d\ ^2D_{3/2}$	-0.521	1.569E+10	1.544E+10
179.459	$1s^25p\ ^2P_{3/2} - 1s^27d\ ^2D_{5/2}$	-0.267	1.868E+10	1.859E+10
179.519	$1s^25p\ ^2P_{3/2} - 1s^27d\ ^2D_{3/2}$	-1.221	3.110E+09	3.108E+09
181.216	$1s^25d\ ^2D_{3/2} - 1s^27f\ ^2F_{5/2}$	-0.105	2.658E+10	2.652E+10
181.353	$1s^25d\ ^2D_{5/2} - 1s^27f\ ^2F_{7/2}$	0.05	2.843E+10	2.839E+10
181.384	$1s^25d\ ^2D_{5/2} - 1s^27f\ ^2F_{5/2}$	-1.251	1.893E+09	1.893E+09
181.496	$1s^25f\ ^2F_{5/2} - 1s^27g\ ^2G_{7/2}$	0.137	3.473E+10	3.468E+10
181.562	$1s^25f\ ^2F_{7/2} - 1s^27g\ ^2G_{9/2}$	0.25	3.598E+10	3.593E+10
181.581	$1s^25f\ ^2F_{7/2} - 1s^27g\ ^2G_{7/2}$	-1.294	1.285E+09	1.282E+09
181.584	$1s^25p\ ^2P_{1/2} - 1s^27s\ ^2S_{1/2}$	-1.353	4.491E+09	4.796E+09
181.606	$1s^25f\ ^2F_{5/2} - 1s^27d\ ^2D_{5/2}$	-2.741	6.118E+07	6.022E+07
181.661	$1s^25g\ ^2G_{7/2} - 1s^27f\ ^2F_{7/2}$	-3.468	8.600E+06	8.471E+06
181.667	$1s^25f\ ^2F_{5/2} - 1s^27d\ ^2D_{3/2}$	-1.595	1.284E+09	1.282E+09
181.691	$1s^25f\ ^2F_{7/2} - 1s^27d\ ^2D_{5/2}$	-1.44	1.222E+09	1.212E+09
181.691	$1s^25g\ ^2G_{7/2} - 1s^27f\ ^2F_{5/2}$	-2.037	3.095E+08	3.075E+08
181.711	$1s^25g\ ^2G_{9/2} - 1s^27f\ ^2F_{7/2}$	-1.924	3.008E+08	2.979E+08
182.002	$1s^25d\ ^2D_{3/2} - 1s^27p\ ^2P_{3/2}$	-2.105	3.953E+08	4.032E+08
182.122	$1s^25p\ ^2P_{3/2} - 1s^27s\ ^2S_{1/2}$	-1.053	8.900E+09	9.777E+09
182.172	$1s^25d\ ^2D_{5/2} - 1s^27p\ ^2P_{3/2}$	-1.151	3.548E+09	3.663E+09
182.198	$1s^25d\ ^2D_{3/2} - 1s^27p\ ^2P_{1/2}$	-1.407	3.939E+09	4.170E+09
195.219	$1s^26s\ ^2S_{1/2} - 1s^210p\ ^2P_{3/2}$	-1.322	2.086E+09	1.988E+09
195.296	$1s^26s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-1.623	2.084E+09	2.025E+09
198.253	$1s^26p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	-1.116	3.248E+09	3.208E+09
198.598	$1s^26p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	-0.862	3.877E+09	3.861E+09
198.623	$1s^26p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-1.816	6.460E+08	6.451E+08
199.326	$1s^26p\ ^2P_{1/2} - 1s^210s\ ^2S_{1/2}$	-1.907	1.039E+09	1.095E+09
199.7	$1s^26p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-1.607	2.067E+09	2.229E+09
199.852	$1s^26d\ ^2D_{3/2} - 1s^210f\ ^2F_{5/2}$	-0.734	5.137E+09	5.130E+09
199.957	$1s^26d\ ^2D_{5/2} - 1s^210f\ ^2F_{7/2}$	-0.579	7.327E+09	5.492E+09
199.97	$1s^26d\ ^2D_{5/2} - 1s^210f\ ^2F_{5/2}$	-1.88	3.663E+08	3.661E+08
200.061	$1s^26f\ ^2F_{5/2} - 1s^210g\ ^2G_{7/2}$	-0.524	6.239E+09	6.233E+09
200.107	$1s^26f\ ^2F_{5/2} - 1s^210d\ ^2D_{5/2}$	-3.205	1.733E+07	1.709E+07
200.113	$1s^26f\ ^2F_{7/2} - 1s^210g\ ^2G_{9/2}$	-0.411	6.464E+09	6.458E+09
200.121	$1s^26f\ ^2F_{7/2} - 1s^210g\ ^2G_{7/2}$	-1.955	2.309E+08	2.304E+08
200.132	$1s^26f\ ^2F_{5/2} - 1s^210d\ ^2D_{3/2}$	-2.059	3.638E+08	3.636E+08
200.166	$1s^26f\ ^2F_{7/2} - 1s^210d\ ^2D_{5/2}$	-1.904	3.463E+08	3.439E+08
200.171	$1s^26g\ ^2G_{7/2} - 1s^210f\ ^2F_{7/2}$	-3.791	3.365E+06	3.322E+06
200.178	$1s^26d\ ^2D_{3/2} - 1s^210p\ ^2P_{3/2}$	-2.625	9.860E+07	1.006E+08
200.184	$1s^26g\ ^2G_{7/2} - 1s^210f\ ^2F_{5/2}$	-2.36	1.211E+08	1.205E+08
200.207	$1s^26g\ ^2G_{9/2} - 1s^210f\ ^2F_{7/2}$	-2.247	1.177E+08	1.168E+08
200.259	$1s^26d\ ^2D_{3/2} - 1s^210p\ ^2P_{1/2}$	-1.927	9.850E+08	1.037E+09
200.297	$1s^26d\ ^2D_{5/2} - 1s^210p\ ^2P_{3/2}$	-1.671	8.858E+08	9.131E+08
224.214	$1s^26s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-1.066	2.848E+09	2.701E+09
224.354	$1s^26s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-1.368	2.842E+09	2.755E+09
228.092	$1s^26p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	-0.856	4.463E+09	4.397E+09
228.536	$1s^26p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	-0.602	5.323E+09	5.296E+09
228.582	$1s^26p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-1.556	8.868E+08	8.853E+08
230.048	$1s^26p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-1.629	1.479E+09	1.560E+09
230.186	$1s^26d\ ^2D_{3/2} - 1s^29f\ ^2F_{5/2}$	-0.463	7.223E+09	7.211E+09
230.32	$1s^26d\ ^2D_{5/2} - 1s^29f\ ^2F_{7/2}$	-0.308	1.030E+10	7.722E+09
230.343	$1s^26d\ ^2D_{5/2} - 1s^29f\ ^2F_{5/2}$	-1.609	5.148E+08	5.148E+08
230.453	$1s^26f\ ^2F_{5/2} - 1s^29g\ ^2G_{7/2}$	-0.234	9.168E+09	9.157E+09
230.518	$1s^26f\ ^2F_{7/2} - 1s^29g\ ^2G_{9/2}$	-0.121	9.499E+09	9.490E+09
230.532	$1s^26f\ ^2F_{7/2} - 1s^29g\ ^2G_{7/2}$	-1.665	3.391E+08	3.387E+08
230.536	$1s^26f\ ^2F_{5/2} - 1s^29d\ ^2D_{5/2}$	-2.9	2.632E+07	2.595E+07
230.547	$1s^26p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-1.329	2.939E+09	3.178E+09
230.583	$1s^26f\ ^2F_{5/2} - 1s^29d\ ^2D_{3/2}$	-1.754	5.523E+08	5.521E+08
230.604	$1s^26g\ ^2G_{7/2} - 1s^29f\ ^2F_{7/2}$	-3.463	5.394E+06	5.325E+06
230.615	$1s^26f\ ^2F_{7/2} - 1s^29d\ ^2D_{5/2}$	-1.599	5.258E+08	5.222E+08
230.627	$1s^26g\ ^2G_{7/2} - 1s^29f\ ^2F_{5/2}$	-2.032	1.942E+08	1.932E+08
230.651	$1s^26g\ ^2G_{9/2} - 1s^29f\ ^2F_{7/2}$	-1.919	1.886E+08	1.872E+08
230.781	$1s^26d\ ^2D_{3/2} - 1s^29p\ ^2P_{3/2}$	-2.337	1.440E+08	1.467E+08
230.929	$1s^26d\ ^2D_{3/2} - 1s^29p\ ^2P_{1/2}$	-1.639	1.437E+09	1.513E+09
230.939	$1s^26d\ ^2D_{5/2} - 1s^29p\ ^2P_{3/2}$	-1.384	1.293E+09	1.332E+09

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275.562	$1s^25s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{3/2}$	-0.196	1.398E+10	1.289E+10
276.277	$1s^25s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{1/2}$	-0.498	1.387E+10	1.324E+10
283.016	$1s^26s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{3/2}$	-0.717	3.990E+09	3.752E+09
283.333	$1s^26s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{1/2}$	-1.019	3.977E+09	3.836E+09
284.688	$1s^25p\ ^2P_{1/2}$ - $1s^26d\ ^2D_{3/2}$	0.065	2.392E+10	2.327E+10
285.77	$1s^25p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{5/2}$	0.319	2.838E+10	2.812E+10
286.012	$1s^25p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{3/2}$	-0.636	4.718E+09	4.710E+09
288.885	$1s^26p\ ^2P_{1/2}$ - $1s^28d\ ^2D_{3/2}$	-0.5	6.320E+09	6.197E+09
289.566	$1s^26p\ ^2P_{3/2}$ - $1s^28d\ ^2D_{5/2}$	-0.246	7.532E+09	7.477E+09
289.671	$1s^26p\ ^2P_{3/2}$ - $1s^28d\ ^2D_{3/2}$	-1.2	1.254E+09	1.251E+09
290.162	$1s^25d\ ^2D_{3/2}$ - $1s^26f\ ^2F_{5/2}$	0.526	4.433E+10	4.418E+10
290.468	$1s^25d\ ^2D_{5/2}$ - $1s^26f\ ^2F_{7/2}$	0.68	4.735E+10	4.734E+10

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
290.593	$1s^25d\ ^2D_{5/2}$ - $1s^26f\ ^2F_{5/2}$	-0.621	3.152E+09	3.160E+09
290.802	$1s^25f\ ^2F_{5/2}$ - $1s^26g\ ^2G_{7/2}$	0.851	7.003E+10	6.990E+10
290.943	$1s^25f\ ^2F_{7/2}$ - $1s^26g\ ^2G_{9/2}$	0.964	7.251E+10	7.246E+10
291.019	$1s^25f\ ^2F_{7/2}$ - $1s^26g\ ^2G_{7/2}$	-0.58	2.588E+09	2.588E+09
291.254	$1s^25f\ ^2F_{5/2}$ - $1s^26d\ ^2D_{5/2}$	-2.02	1.252E+08	1.230E+08
291.257	$1s^25g\ ^2G_{7/2}$ -$1s^26f\ ^2F_{7/2}$	-2.67	2.103E+07	2.071E+07
291.384	$1s^25g\ ^2G_{7/2}$ -$1s^26f\ ^2F_{5/2}$	-1.239	7.558E+08	7.517E+08
291.388	$1s^25g\ ^2G_{9/2}$ -$1s^26f\ ^2F_{7/2}$	-1.126	7.348E+08	7.283E+08
291.472	$1s^25f\ ^2F_{7/2}$ - $1s^26d\ ^2D_{5/2}$	-0.719	2.498E+09	2.476E+09
291.505	$1s^25f\ ^2F_{5/2}$ - $1s^26d\ ^2D_{3/2}$	-0.874	2.623E+09	2.620E+09
292.191	$1s^26d\ ^2D_{3/2}$ - $1s^28f\ ^2F_{5/2}$	-0.09	1.058E+10	1.056E+10
292.391	$1s^26d\ ^2D_{5/2}$ - $1s^28f\ ^2F_{7/2}$	0.064	1.508E+10	1.131E+10
292.444	$1s^26d\ ^2D_{5/2}$ - $1s^28f\ ^2F_{5/2}$	-1.237	7.537E+08	7.544E+08
292.594	$1s^26f\ ^2F_{5/2}$ - $1s^28g\ ^2G_{7/2}$	0.168	1.433E+10	1.431E+10
292.689	$1s^26f\ ^2F_{7/2}$ - $1s^28g\ ^2G_{9/2}$	0.28	1.484E+10	1.483E+10
292.721	$1s^26f\ ^2F_{7/2}$ - $1s^28g\ ^2G_{7/2}$	-1.264	5.299E+08	5.296E+08
292.785	$1s^26f\ ^2F_{5/2}$ - $1s^28d\ ^2D_{5/2}$	-2.475	4.345E+07	4.286E+07
292.848	$1s^26g\ ^2G_{7/2}$ -$1s^28f\ ^2F_{7/2}$	-3.003	9.660E+06	9.541E+06
292.892	$1s^26f\ ^2F_{5/2}$ - $1s^28d\ ^2D_{3/2}$	-1.329	9.115E+08	9.115E+08
292.902	$1s^26g\ ^2G_{7/2}$ -$1s^28f\ ^2F_{5/2}$	-1.571	3.477E+08	3.460E+08
292.913	$1s^26f\ ^2F_{7/2}$ - $1s^28d\ ^2D_{5/2}$	-1.174	8.680E+08	8.621E+08
292.925	$1s^26g\ ^2G_{9/2}$ -$1s^28f\ ^2F_{7/2}$	-1.459	3.379E+08	3.353E+08
293.393	$1s^26p\ ^2P_{1/2}$ - $1s^28s\ ^2S_{1/2}$	-1.241	2.223E+09	2.348E+09
293.393	$1s^25d\ ^2D_{3/2}$ - $1s^26p\ ^2P_{3/2}$	-1.429	7.208E+08	7.322E+08
293.559	$1s^26d\ ^2D_{3/2}$ - $1s^28p\ ^2P_{3/2}$	-1.936	2.244E+08	2.284E+08
293.815	$1s^26d\ ^2D_{5/2}$ - $1s^28p\ ^2P_{3/2}$	-0.982	2.014E+09	2.074E+09
293.835	$1s^25d\ ^2D_{5/2}$ - $1s^26p\ ^2P_{3/2}$	-0.476	6.458E+09	6.655E+09
293.901	$1s^26d\ ^2D_{3/2}$ - $1s^28p\ ^2P_{1/2}$	-1.237	2.236E+09	2.357E+09
294.204	$1s^26p\ ^2P_{3/2}$ - $1s^28s\ ^2S_{1/2}$	-0.941	4.409E+09	4.786E+09
294.205	$1s^25d\ ^2D_{3/2}$ - $1s^26p\ ^2P_{1/2}$	-0.732	7.150E+09	7.586E+09
295.359	$1s^25p\ ^2P_{1/2}$ - $1s^26s\ ^2S_{1/2}$	-0.698	7.665E+09	8.220E+09
296.785	$1s^25p\ ^2P_{3/2}$ - $1s^26s\ ^2S_{1/2}$	-0.399	1.511E+10	1.680E+10
333.214	$1s^27s\ ^2S_{1/2}$ - $1s^210p\ ^2P_{3/2}$	-1.028	1.407E+09	1.330E+09
333.439	$1s^27s\ ^2S_{1/2}$ - $1s^210p\ ^2P_{1/2}$	-1.33	1.405E+09	1.358E+09
338.464	$1s^27p\ ^2P_{1/2}$ - $1s^210d\ ^2D_{3/2}$	-0.833	2.141E+09	2.102E+09
339.07	$1s^27p\ ^2P_{3/2}$ - $1s^210d\ ^2D_{5/2}$	-0.578	2.555E+09	2.535E+09
339.143	$1s^27p\ ^2P_{3/2}$ - $1s^210d\ ^2D_{3/2}$	-1.532	4.255E+08	4.240E+08
341.342	$1s^27d\ ^2D_{3/2}$ - $1s^210f\ ^2F_{5/2}$	-0.442	3.445E+09	3.438E+09
341.522	$1s^27d\ ^2D_{5/2}$ - $1s^210f\ ^2F_{7/2}$	-0.288	3.685E+09	3.683E+09
341.559	$1s^27d\ ^2D_{5/2}$ - $1s^210f\ ^2F_{5/2}$	-1.589	2.455E+08	2.456E+08
341.603	$1s^27p\ ^2P_{1/2}$ - $1s^210s\ ^2S_{1/2}$	-1.539	8.255E+08	8.653E+08
341.7	$1s^27f\ ^2F_{5/2}$ - $1s^210g\ ^2G_{7/2}$	-0.202	4.489E+09	4.483E+09
341.787	$1s^27f\ ^2F_{7/2}$ - $1s^210g\ ^2G_{9/2}$	-0.089	4.654E+09	4.646E+09
341.81	$1s^27f\ ^2F_{7/2}$ - $1s^210g\ ^2G_{7/2}$	-1.633	1.661E+08	1.659E+08
341.833	$1s^27f\ ^2F_{5/2}$ - $1s^210d\ ^2D_{5/2}$	-2.706	1.870E+07	1.846E+07
341.908	$1s^27f\ ^2F_{5/2}$ - $1s^210d\ ^2D_{3/2}$	-1.56	3.925E+08	3.923E+08
341.912	$1s^27g\ ^2G_{7/2}$ -$1s^210f\ ^2F_{7/2}$	-3.169	4.829E+06	4.769E+06
341.943	$1s^27f\ ^2F_{7/2}$ - $1s^210d\ ^2D_{5/2}$	-1.405	3.737E+08	3.713E+08
341.949	$1s^27g\ ^2G_{7/2}$ -$1s^210f\ ^2F_{5/2}$	-1.738	1.738E+08	1.729E+08
341.978	$1s^27g\ ^2G_{9/2}$ -$1s^210f\ ^2F_{7/2}$	-1.625	1.689E+08	1.676E+08
342.294	$1s^27p\ ^2P_{3/2}$ - $1s^210s\ ^2S_{1/2}$	-1.239	1.641E+09	1.762E+09
342.295	$1s^27d\ ^2D_{3/2}$ - $1s^210p\ ^2P_{3/2}$	-2.206	8.858E+07	9.008E+07
342.514	$1s^27d\ ^2D_{5/2}$ - $1s^210p\ ^2P_{3/2}$	-1.252	7.958E+08	8.175E+08

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342.532	$1s^27d\,^2D_{3/2} - 1s^210p\,^2P_{1/2}$	-1.507	8.840E+08	9.275E+08
427.599	$1s^27s\,^2S_{1/2} - 1s^29p\,^2P_{3/2}$	-0.68	1.907E+09	1.789E+09
428.108	$1s^27s\,^2S_{1/2} - 1s^29p\,^2P_{1/2}$	-0.981	1.901E+09	1.830E+09
435.794	$1s^27p\,^2P_{1/2} - 1s^29d\,^2D_{3/2}$	-0.478	2.918E+09	2.852E+09
436.752	$1s^27p\,^2P_{3/2} - 1s^29d\,^2D_{5/2}$	-0.224	3.478E+09	3.445E+09
436.919	$1s^27p\,^2P_{3/2} - 1s^29d\,^2D_{3/2}$	-1.179	5.790E+08	5.767E+08
440.487	$1s^27d\,^2D_{3/2} - 1s^29f\,^2F_{5/2}$	-0.077	4.800E+09	4.789E+09
440.764	$1s^27d\,^2D_{5/2} - 1s^29f\,^2F_{7/2}$	0.078	5.133E+09	5.132E+09
440.849	$1s^27d\,^2D_{5/2} - 1s^29f\,^2F_{5/2}$	-1.223	3.420E+08	3.425E+08
441.044	$1s^27f\,^2F_{5/2} - 1s^29g\,^2G_{7/2}$	0.182	6.521E+09	6.513E+09
441.175	$1s^27f\,^2F_{7/2} - 1s^29g\,^2G_{9/2}$	0.295	6.757E+09	6.752E+09
441.227	$1s^27f\,^2F_{7/2} - 1s^29g\,^2G_{7/2}$	-1.249	2.413E+08	2.412E+08
441.349	$1s^27f\,^2F_{5/2} - 1s^29d\,^2D_{5/2}$	-2.287	2.943E+07	2.906E+07
441.413	$1s^27g\,^2G_{7/2} - 1s^29f\,^2F_{7/2}$	-2.721	8.130E+06	8.033E+06
441.499	$1s^27g\,^2G_{7/2} - 1s^29f\,^2F_{5/2}$	-1.29	2.925E+08	2.912E+08

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441.519	$1s^27f\,^2F_{5/2} - 1s^29d\,^2D_{3/2}$	-1.141	6.175E+08	6.175E+08
441.524	$1s^27g\,^2G_{9/2} - 1s^29f\,^2F_{7/2}$	-1.177	2.844E+08	2.823E+08
441.532	$1s^27f\,^2F_{7/2} - 1s^29d\,^2D_{5/2}$	-0.987	5.880E+08	5.844E+08
442.669	$1s^27d\,^2D_{3/2} - 1s^29p\,^2P_{3/2}$	-1.807	1.327E+08	1.349E+08
442.993	$1s^27p\,^2P_{1/2} - 1s^29s\,^2S_{1/2}$	-1.152	1.198E+09	1.258E+09
443.035	$1s^27d\,^2D_{5/2} - 1s^29p\,^2P_{3/2}$	-0.853	1.191E+09	1.224E+09
443.214	$1s^27d\,^2D_{3/2} - 1s^29p\,^2P_{1/2}$	-1.109	1.322E+09	1.389E+09
444.156	$1s^27p\,^2P_{3/2} - 1s^29s\,^2S_{1/2}$	-0.852	2.377E+09	2.563E+09
458.554	$1s^26s\,^2S_{1/2} - 1s^27p\,^2P_{3/2}$	-0.154	5.558E+09	5.114E+09
459.8	$1s^26s\,^2S_{1/2} - 1s^27p\,^2P_{1/2}$	-0.457	5.510E+09	5.256E+09
472.662	$1s^26p\,^2P_{1/2} - 1s^27d\,^2D_{3/2}$	0.081	8.993E+09	8.711E+09
474.351	$1s^26p\,^2P_{3/2} - 1s^27d\,^2D_{5/2}$	0.335	1.068E+10	1.055E+10
474.771	$1s^26p\,^2P_{3/2} - 1s^27d\,^2D_{3/2}$	-0.62	1.775E+09	1.768E+09
481.299	$1s^26d\,^2D_{3/2} - 1s^27f\,^2F_{5/2}$	0.52	1.588E+10	1.582E+10
481.769	$1s^26d\,^2D_{5/2} - 1s^27f\,^2F_{7/2}$	0.674	2.262E+10	1.696E+10
481.987	$1s^26d\,^2D_{5/2} - 1s^27f\,^2F_{5/2}$	-0.627	1.129E+09	1.133E+09
482.272	$1s^26f\,^2F_{5/2} - 1s^27g\,^2G_{7/2}$	0.822	2.381E+10	2.378E+10
482.486	$1s^26f\,^2F_{7/2} - 1s^27g\,^2G_{9/2}$	0.935	2.467E+10	2.466E+10
482.618	$1s^26f\,^2F_{7/2} - 1s^27g\,^2G_{7/2}$	-0.609	8.803E+08	8.812E+08
483.011	$1s^26g\,^2G_{7/2} - 1s^27f\,^2F_{7/2}$	-2.242	2.049E+07	2.022E+07
483.049	$1s^26f\,^2F_{5/2} - 1s^27d\,^2D_{5/2}$	-1.771	8.065E+07	7.938E+07
483.221	$1s^26g\,^2G_{9/2} - 1s^27f\,^2F_{7/2}$	-0.698	7.160E+08	7.105E+08
483.23	$1s^26g\,^2G_{7/2} - 1s^27f\,^2F_{5/2}$	-0.811	7.363E+08	7.332E+08
483.397	$1s^26f\,^2F_{7/2} - 1s^27d\,^2D_{5/2}$	-0.471	1.610E+09	1.597E+09
483.485	$1s^26f\,^2F_{5/2} - 1s^27d\,^2D_{3/2}$	-0.626	1.689E+09	1.689E+09
486.887	$1s^26d\,^2D_{3/2} - 1s^27p\,^2P_{3/2}$	-1.267	3.803E+08	3.861E+08
487.591	$1s^26d\,^2D_{5/2} - 1s^27p\,^2P_{3/2}$	-0.313	3.408E+09	3.508E+09
488.293	$1s^26d\,^2D_{3/2} - 1s^27p\,^2P_{1/2}$	-0.569	3.771E+09	3.992E+09
491.144	$1s^26p\,^2P_{1/2} - 1s^27s\,^2S_{1/2}$	-0.588	3.572E+09	3.789E+09
493.421	$1s^26p\,^2P_{3/2} - 1s^27s\,^2S_{1/2}$	-0.289	7.045E+09	7.743E+09
613.972	$1s^28s\,^2S_{1/2} - 1s^210p\,^2P_{3/2}$	-0.645	1.003E+09	9.395E+08
614.735	$1s^28s\,^2S_{1/2} - 1s^210p\,^2P_{1/2}$	-0.946	9.990E+08	9.616E+08
625.015	$1s^28p\,^2P_{1/2} - 1s^210d\,^2D_{3/2}$	-0.457	1.490E+09	1.454E+09
626.314	$1s^28p\,^2P_{3/2} - 1s^210d\,^2D_{5/2}$	-0.203	1.777E+09	1.759E+09
626.565	$1s^28p\,^2P_{3/2} - 1s^210d\,^2D_{3/2}$	-1.157	2.958E+08	2.945E+08
631.432	$1s^28d\,^2D_{3/2} - 1s^210f\,^2F_{5/2}$	-0.063	2.410E+09	2.405E+09
631.802	$1s^28d\,^2D_{5/2} - 1s^210f\,^2F_{7/2}$	0.091	2.576E+09	2.579E+09
631.93	$1s^28d\,^2D_{5/2} - 1s^210f\,^2F_{5/2}$	-1.21	1.717E+08	1.721E+08
632.178	$1s^28f\,^2F_{5/2} - 1s^210g\,^2G_{7/2}$	0.193	3.251E+09	3.249E+09
632.351	$1s^28f\,^2F_{7/2} - 1s^210g\,^2G_{9/2}$	0.305	3.368E+09	3.369E+09
632.428	$1s^28f\,^2F_{7/2} - 1s^210g\,^2G_{7/2}$	-1.239	1.203E+08	1.204E+08
632.635	$1s^28f\,^2F_{5/2} - 1s^210d\,^2D_{5/2}$	-2.145	1.990E+07	1.969E+07
632.694	$1s^28g\,^2G_{7/2} - 1s^210f\,^2F_{7/2}$	-2.522	6.260E+06	6.201E+06
632.822	$1s^28g\,^2G_{7/2} - 1s^210f\,^2F_{5/2}$	-1.091	2.252E+08	2.247E+08
632.846	$1s^28g\,^2G_{9/2} - 1s^210f\,^2F_{7/2}$	-0.978	2.190E+08	2.178E+08
632.886	$1s^28f\,^2F_{7/2} - 1s^210d\,^2D_{5/2}$	-0.844	3.977E+08	3.959E+08
632.89	$1s^28f\,^2F_{5/2} - 1s^210d\,^2D_{3/2}$	-0.999	4.175E+08	4.181E+08
634.701	$1s^28d\,^2D_{3/2} - 1s^210p\,^2P_{3/2}$	-1.704	8.183E+07	8.317E+07
635.204	$1s^28d\,^2D_{5/2} - 1s^210p\,^2P_{3/2}$	-0.75	7.345E+08	7.546E+08
635.518	$1s^28d\,^2D_{3/2} - 1s^210p\,^2P_{1/2}$	-1.006	8.150E+08	8.557E+08
635.802	$1s^28p\,^2P_{1/2} - 1s^210s\,^2S_{1/2}$	-1.077	6.905E+08	7.230E+08

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λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
637.406	$1s^28p\ ^2P_{3/2} - 1s^210s\ ^2S_{1/2}$	-0.777	1.371E+09	1.473E+09
708.221	$1s^27s\ ^2S_{1/2} - 1s^28p\ ^2P_{3/2}$	-0.115	2.550E+09	2.345E+09
710.211	$1s^27s\ ^2S_{1/2} - 1s^28p\ ^2P_{1/2}$	-0.418	2.528E+09	2.411E+09
728.835	$1s^27p\ ^2P_{1/2} - 1s^28d\ ^2D_{3/2}$	0.1	3.955E+09	3.823E+09
731.321	$1s^27p\ ^2P_{3/2} - 1s^28d\ ^2D_{5/2}$	0.354	4.698E+09	4.636E+09
731.988	$1s^27p\ ^2P_{3/2} - 1s^28d\ ^2D_{3/2}$	-0.6	7.808E+08	7.772E+08
741.661	$1s^27d\ ^2D_{3/2} - 1s^28f\ ^2F_{5/2}$	0.522	6.730E+09	6.711E+09
742.343	$1s^27d\ ^2D_{5/2} - 1s^28f\ ^2F_{7/2}$	0.677	7.191E+09	7.198E+09
742.688	$1s^27d\ ^2D_{5/2} - 1s^28f\ ^2F_{5/2}$	-0.624	4.787E+08	4.809E+08
743.066	$1s^27f\ ^2F_{5/2} - 1s^28g\ ^2G_{7/2}$	0.808	9.715E+09	9.706E+09
743.376	$1s^27f\ ^2F_{7/2} - 1s^28g\ ^2G_{9/2}$	0.921	1.006E+10	1.007E+10
743.585	$1s^27f\ ^2F_{7/2} - 1s^28g\ ^2G_{7/2}$	-0.623	3.590E+08	3.598E+08
744.187	$1s^27g\ ^2G_{7/2} - 1s^28f\ ^2F_{7/2}$	-1.984	1.561E+07	1.543E+07
744.3	$1s^27f\ ^2F_{5/2} - 1s^28d\ ^2D_{5/2}$	-1.596	5.082E+07	5.013E+07
744.501	$1s^27g\ ^2G_{9/2} - 1s^28f\ ^2F_{7/2}$	-0.44	5.455E+08	5.421E+08
744.534	$1s^27g\ ^2G_{7/2} - 1s^28f\ ^2F_{5/2}$	-0.553	5.610E+08	5.592E+08
744.82	$1s^27f\ ^2F_{7/2} - 1s^28d\ ^2D_{5/2}$	-0.296	1.014E+09	1.008E+09
744.992	$1s^27f\ ^2F_{5/2} - 1s^28d\ ^2D_{3/2}$	-0.451	1.064E+09	1.066E+09
750.54	$1s^27d\ ^2D_{3/2} - 1s^28p\ ^2P_{3/2}$	-1.143	2.128E+08	2.160E+08
751.592	$1s^27d\ ^2D_{5/2} - 1s^28p\ ^2P_{3/2}$	-0.19	1.907E+09	1.962E+09
752.776	$1s^27d\ ^2D_{3/2} - 1s^28p\ ^2P_{1/2}$	-0.446	2.109E+09	2.230E+09
758.232	$1s^27p\ ^2P_{1/2} - 1s^28s\ ^2S_{1/2}$	-0.499	1.838E+09	1.940E+09
761.646	$1s^27p\ ^2P_{3/2} - 1s^28s\ ^2S_{1/2}$	-0.2	3.627E+09	3.963E+09
1034.869	$1s^28s\ ^2S_{1/2} - 1s^29p\ ^2P_{3/2}$	-0.079	1.298E+09	1.194E+09
1037.853	$1s^28s\ ^2S_{1/2} - 1s^29p\ ^2P_{1/2}$	-0.381	1.287E+09	1.228E+09
1063.712	$1s^28p\ ^2P_{1/2} - 1s^29d\ ^2D_{3/2}$	0.122	1.950E+09	1.881E+09
1067.211	$1s^28p\ ^2P_{3/2} - 1s^29d\ ^2D_{5/2}$	0.375	2.317E+09	2.283E+09
1068.208	$1s^28p\ ^2P_{3/2} - 1s^29d\ ^2D_{3/2}$	-0.579	3.850E+08	3.829E+08
1081.898	$1s^28d\ ^2D_{3/2} - 1s^29f\ ^2F_{5/2}$	0.531	3.223E+09	3.215E+09
1082.843	$1s^28d\ ^2D_{5/2} - 1s^29f\ ^2F_{7/2}$	0.685	3.444E+09	3.449E+09
1083.36	$1s^28d\ ^2D_{5/2} - 1s^29f\ ^2F_{5/2}$	-0.616	2.293E+08	2.305E+08
1083.849	$1s^28f\ ^2F_{5/2} - 1s^29g\ ^2G_{7/2}$	0.803	4.514E+09	4.512E+09
1084.274	$1s^28f\ ^2F_{7/2} - 1s^29g\ ^2G_{9/2}$	0.916	4.675E+09	4.680E+09
1084.586	$1s^28f\ ^2F_{7/2} - 1s^29g\ ^2G_{7/2}$	-0.628	1.669E+08	1.673E+08
1085.465	$1s^28g\ ^2G_{7/2} - 1s^29f\ ^2F_{7/2}$	-1.802	1.116E+07	1.105E+07
1085.693	$1s^28f\ ^2F_{5/2} - 1s^29d\ ^2D_{5/2}$	-1.463	3.250E+07	3.210E+07
1085.911	$1s^28g\ ^2G_{9/2} - 1s^29f\ ^2F_{7/2}$	-0.258	3.901E+08	3.882E+08
1085.985	$1s^28g\ ^2G_{7/2} - 1s^29f\ ^2F_{5/2}$	-0.371	4.012E+08	4.004E+08
1086.432	$1s^28f\ ^2F_{7/2} - 1s^29d\ ^2D_{5/2}$	-0.162	6.487E+08	6.455E+08
1086.725	$1s^28f\ ^2F_{5/2} - 1s^29d\ ^2D_{3/2}$	-0.317	6.808E+08	6.820E+08
1095.158	$1s^28d\ ^2D_{3/2} - 1s^29p\ ^2P_{3/2}$	-1.044	1.256E+08	1.275E+08
1096.656	$1s^28d\ ^2D_{5/2} - 1s^29p\ ^2P_{3/2}$	-0.09	1.126E+09	1.158E+09
1098.5	$1s^28d\ ^2D_{3/2} - 1s^29p\ ^2P_{1/2}$	-0.346	1.245E+09	1.315E+09
1107.647	$1s^28p\ ^2P_{1/2} - 1s^29s\ ^2S_{1/2}$	-0.425	1.022E+09	1.074E+09
1112.523	$1s^28p\ ^2P_{3/2} - 1s^29s\ ^2S_{1/2}$	-0.126	2.017E+09	2.194E+09
1448.806	$1s^29s\ ^2S_{1/2} - 1s^210p\ ^2P_{3/2}$	-0.045	7.163E+08	6.582E+08
1453.066	$1s^29s\ ^2S_{1/2} - 1s^210p\ ^2P_{1/2}$	-0.347	7.100E+08	6.775E+08
1487.797	$1s^29p\ ^2P_{1/2} - 1s^210d\ ^2D_{3/2}$	0.143	1.048E+09	1.009E+09
1492.551	$1s^29p\ ^2P_{3/2} - 1s^210d\ ^2D_{5/2}$	0.397	1.245E+09	1.226E+09
1493.972	$1s^29p\ ^2P_{3/2} - 1s^210d\ ^2D_{3/2}$	-0.557	2.070E+08	2.057E+08
1512.646	$1s^29d\ ^2D_{3/2} - 1s^210f\ ^2F_{5/2}$	0.542	1.692E+09	1.688E+09
1513.921	$1s^29d\ ^2D_{5/2} - 1s^210f\ ^2F_{7/2}$	0.696	1.809E+09	1.811E+09
1514.651	$1s^29d\ ^2D_{5/2} - 1s^210f\ ^2F_{5/2}$	-0.605	1.204E+08	1.210E+08
1515.277	$1s^29f\ ^2F_{5/2} - 1s^210g\ ^2G_{7/2}$	0.804	2.313E+09	2.312E+09
1515.845	$1s^29f\ ^2F_{7/2} - 1s^210g\ ^2G_{9/2}$	0.917	2.396E+09	2.398E+09
1516.29	$1s^29f\ ^2F_{7/2} - 1s^210g\ ^2G_{7/2}$	-0.628	8.549E+07	8.575E+07
1517.52	$1s^29g\ ^2G_{7/2} - 1s^210f\ ^2F_{7/2}$	-1.662	7.881E+06	7.807E+06
1517.904	$1s^29f\ ^2F_{5/2} - 1s^210d\ ^2D_{5/2}$	-1.355	2.130E+07	2.105E+07
1518.131	$1s^29g\ ^2G_{9/2} - 1s^210f\ ^2F_{7/2}$	-0.118	2.755E+08	2.742E+08
1518.254	$1s^29g\ ^2G_{7/2} - 1s^210f\ ^2F_{5/2}$	-0.231	2.833E+08	2.828E+08
1518.921	$1s^29f\ ^2F_{7/2} - 1s^210d\ ^2D_{5/2}$	-0.054	4.252E+08	4.232E+08
1519.375	$1s^29f\ ^2F_{5/2} - 1s^210d\ ^2D_{3/2}$	-0.209	4.460E+08	4.470E+08
1531.547	$1s^29d\ ^2D_{3/2} - 1s^210p\ ^2P_{3/2}$	-0.961	7.773E+07	7.884E+07
1533.602	$1s^29d\ ^2D_{5/2} - 1s^210p\ ^2P_{3/2}$	-0.008	6.965E+08	7.156E+08
1536.308	$1s^29d\ ^2D_{3/2} - 1s^210p\ ^2P_{1/2}$	-0.264	7.700E+08	8.122E+08

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1550.414	$1s^29p\ ^2P_{1/2}$ - $1s^210s\ ^2S_{1/2}$	-0.361	6.040E+08	6.332E+08
1557.121	$1s^29p\ ^2P_{3/2}$ - $1s^210s\ ^2S_{1/2}$	-0.062	1.192E+09	1.293E+09
10557.487	$1s^26s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{3/2}$	-0.379	6.250E+06	1.713E+07
11720.307	$1s^26s\ ^2S_{1/2}$ - $1s^26p\ ^2P_{1/2}$	-0.725	4.569E+06	1.313E+07
16839.408	$1s^27s\ ^2S_{1/2}$ - $1s^27p\ ^2P_{3/2}$	-0.31	2.880E+06	7.532E+06
18701.027	$1s^27s\ ^2S_{1/2}$ - $1s^27p\ ^2P_{1/2}$	-0.656	2.104E+06	5.746E+06
24047.416	$1s^26p\ ^2P_{1/2}$ - $1s^26d\ ^2D_{3/2}$	-0.768	4.920E+05	1.143E+06
25215.587	$1s^28s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{3/2}$	-0.25	1.473E+06	3.738E+06
28010.42	$1s^28s\ ^2S_{1/2}$ - $1s^28p\ ^2P_{1/2}$	-0.597	1.075E+06	2.841E+06
28449.899	$1s^26p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{5/2}$	-0.586	3.565E+05	8.673E+05
31068.444	$1s^26p\ ^2P_{3/2}$ - $1s^26d\ ^2D_{3/2}$	-1.578	4.563E+04	1.156E+05
35984.154	$1s^29s\ ^2S_{1/2}$ - $1s^29p\ ^2P_{3/2}$	-0.198	8.155E+05	2.025E+06
38252.606	$1s^27p\ ^2P_{1/2}$ - $1s^27d\ ^2D_{3/2}$	-0.688	2.339E+05	5.559E+05
39980.809	$1s^29s\ ^2S_{1/2}$ - $1s^29p\ ^2P_{1/2}$	-0.545	5.945E+05	1.536E+06
45258.064	$1s^27p\ ^2P_{3/2}$ - $1s^27d\ ^2D_{5/2}$	-0.506	1.695E+05	4.232E+05
49449.846	$1s^210s\ ^2S_{1/2}$ -$1s^210p\ ^2P_{3/2}$	-0.152	4.805E+05	1.175E+06
54948.074	$1s^210s\ ^2S_{1/2}$ -$1s^210p\ ^2P_{1/2}$	-0.499	3.503E+05	8.903E+05
57160.79	$1s^28p\ ^2P_{1/2}$ - $1s^28d\ ^2D_{3/2}$	-0.621	1.221E+05	2.919E+05
67636.072	$1s^28p\ ^2P_{3/2}$ - $1s^28d\ ^2D_{5/2}$	-0.439	8.840E+04	2.220E+05
81453.058	$1s^29p\ ^2P_{1/2}$ - $1s^29d\ ^2D_{3/2}$	-0.565	6.850E+04	1.644E+05

λ (Å)	Transition	Log gf	A_{ij} (Sec^{-1})	A_{ij} [Tipbase]
96394.741	$1s^29p\ ^2P_{3/2}$ - $1s^29d\ ^2D_{5/2}$	-0.382	4.960E+04	1.252E+05
111775.431	$1s^210p\ ^2P_{1/2}$ - $1s^210d\ ^2D_{3/2}$	-0.515	4.080E+04	9.796E+04
132266.211	$1s^210p\ ^2P_{3/2}$ - $1s^210d\ ^2D_{5/2}$	-0.333	2.955E+04	7.471E+04