Theoretical Transition Probabilities of some Lines of $5s^2(^1S)nl$ and $5s\ 5p^2$ Levels of Sn II

A. Alonso-Medina

C. Colón

C. Rivero

Abstract

Radiative transition probabilities and oscillator strengths for 164 lines arising from $5s^2ns$, $5s^2np$, $5s^2nd$, $5s^2nf$, $5s^2ng$ and $5s\ 5p^2$ configurations of Sn II have been calculated. These values were obtained in intermediate coupling (IC) and using *ab initio* relativistic Hartree-Fock (HFR) calculations. We use for the IC calculations the standard method of least square fitting of experimental energy levels by means of computer codes from Cowan. The results of calculations for radiative transition probabilities are presented and compared with the experimental result presents in the literature and with other theoretical values. These values, although in general agreement with the rare experimental data, do present some noticeable discrepancies.

1. Introduction

A knowledge of the radiative transition probabilities have applications in many fields. These values are relevant not only to spectroscopy, but these values are also of interest in a variety of other areas in physics and technology. In astrophysical applications this information can be used to determine elemental abundances from absorption spectra. These data are also essential to calculate the Stark width and shift parameters of spectral lines.

Some transition probabilities in Sn II have been subject of two previous works carried out by these authors [1, 2]. Transition probabilities for 36 lines of Sn II ratios for the $5s^2ns$, $5s^2np$, $5s^2nd$, $5s^2nf$, and $5s5p^2$ lines in Sn II, in the range 2000 to 7000 Å, were studied in [1]. Autoionized single-ionized tin states were studied in [7]. From this last study, transition probabilities for the $5s5p6s$, $5s5p5d$ and $5p^3$ were calculated and presented in [2]. In this work we present transition probabilities for 164 lines arising from $5s^2ns$, $5s^2np$, $5s^2nd$, $5s^2nf$, $5s^2ng$ and $5s\ 5p^2$ configurations of Sn II. Some of these lines are in the UV range with astrophysical relevance. There are 125 that have not published theoretical and experimental results. Our values, although in general agreement with the rare experimental and theoretical data [3–6], do present some noticeable discrepancies. This work completes the study of the experimental configurations of Sn II (Moore [8]).

The values were carried out using the relativistic Hartree-Fock calculations and configuration interaction in an intermediate coupling scheme. The Cowan [9] code (1981) was selected for this purpose. To provide level energies for our calculations, the table of Moore [8] has been used. The system considered is complex, with high Z were both relativistic and correlation effects are important. Least-square fitting of experimental energy levels partially account for correlation effects not explicitly calculated in our work. The relatively good agreement between experimental

and theoretical results shows that our IC mixing accounts for the correlation effects.

We shall first describe in Section 2 the theoretical considerations and then in Section 3 the results and discussion.

2. Theoretical Calculations

In most cases the single configuration and Russell-Saunders scheme is sufficient to describe Sn II. Nevertheless this scheme is not enough to describe the $5s5p^2$ configuration (Marcinek and Migdalek [10]) and to describe the autoionized states. In recent works [2, 7] we proposed a more detailed description. From Cowan code [9], relativistic Hartree-Fock (HFR) calculations and Interaction Configurations (IC) calculations were performed. The basis set used in these works consists in 3 configurations of even parity namely $5s5p^2$ - $5s^25d$ - $5s^26d$ and 6 configurations of odd parity namely $5s^25p$ - $5p^3$ - $5s5p5d$ - $5s5p6s$ - $5s^24f$ - $5s^25f$. A substantial improvement in the identification of the well-known levels [8] was reached.

The wavefunctions obtained in this description has been used in this work to obtain the matrix elements and the transition probability reported. Fig. 1 in reference [2] displays a complete scheme of the single ionized tin energy levels. Transitions studied in this work can be seen in this figure.

3. Results and Discussion

Oscillator strengths and Transition probabilities calculated for 164 lines of Sn II with wavelengths in the ultraviolet visible and near infrared and displayed in columns four and five, respectively, of Tables I–VI while columns one and two give the transitions and column three gives the corresponding vacuum experimental wavelengths. The remaining columns give the experimental transition probabilities values to be found in the bibliography.

In Table I we present results for transitions arising from $5s^2ns^2S_{1/2}$ ($n = 6–11$). One can conclude that our values are in good agreement with the existing experimental found in the literature. As was expected, no discrepancies were found. These transitions can be studied by using the simple LS coupling scheme.

Results for transitions arising from $5s^2np^2\ P_{1/2,3/2}$ ($n = 6–8$) are displayed in Table II. These values although in relative good agreement with the rare experimental data, present some discrepancies. The LS coupling scheme is not adequate to describe all Sn II configurations. Neither the position of the levels $5s5p^2$ and $5s^25d$ nor the inversion in the $5s^2nf$ multiplets could be explained by using the LS scheme [2, 7]. Where these

Table I. *Oscillator Strengths and Transition Probabilities of lines arising from $5s^2ns$ configurations of Sn II.*

Transition		Wavelength λ (Å)	f -values This work	Transition Probabilities (10^7 s $^{-1}$)			
Upper	Lower			This work	Ref. [1]	Ref. [3]	Ref. [6]
$5s^2$ 6s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	1757.9	0.159	34.3			
	$5s^25p$ $^2P_{3/2}$	1899.9	0.147	54.3			
$5s^2$ 7s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	1159.0	0.0240	11.9			
	$5s^25p$ $^2P_{3/2}$	1219.1	0.0227	20.4			
	$5s^26p$ $^2P_{1/2}$	6763.2	0.288	4.2	4.2 ± 1.0	$3.7 \pm 35\%$	3.2 ± 1.0
	$5s^26p$ $^2P_{3/2}$	7192.7	0.271	7.0			
$5s^2$ 8s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	1016.2	0.0091	5.9			
	$5s^25p$ $^2P_{3/2}$	1062.1	0.0088	10.4			
	$5s^26p$ $^2P_{1/2}$	3716.4	0.0331	1.6	1.8 ± 0.3		
	$5s^26p$ $^2P_{3/2}$	3842.5	0.0321	2.9	2.5 ± 0.5		
$5s^2$ 9s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	955.3	0.0045	3.3			
	$5s^25p$ $^2P_{3/2}$	995.7	0.0044	5.9			
	$5s^26p$ $^2P_{1/2}$	3013.3	0.0114	0.84			
	$5s^26p$ $^2P_{3/2}$	3095.5	0.0115	1.6			
$5s^2$ 10s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	922.9	0.0027	2.1			
	$5s^25p$ $^2P_{3/2}$	960.6	0.0026	3.7			
	$5s^26p$ $^2P_{1/2}$	2713.0	0.0056	0.51			
	$5s^26p$ $^2P_{3/2}$	2779.6	0.0054	0.94			
$5s^2$ 11s $^2S_{1/2}$	$5s^25p$ $^2P_{1/2}$	903.4	0.0017	1.4			
	$5s^25p$ $^2P_{3/2}$	939.5	0.0016	2.44			
	$5s^26p$ $^2P_{1/2}$	2551.0	0.0032	0.33			
	$5s^26p$ $^2P_{3/2}$	2609.7	0.0032	0.62			

Table II. *Oscillator Strengths and 45 Transition Probabilities of lines arising from $5s^2np$ configurations of Sn II.*

Transition		Wavelength λ (Å)	f -values This work	Transition Probabilities (10^7 s $^{-1}$)			
Upper	Lower			This work	Ref. [1]	Ref. [3]	Ref. [6]
$5s^26p$ $^2P_{1/2}$	$5s^2$ 6s $^2S_{1/2}$	6845.4	0,450	6.4	5.6 ± 1.1	$6.1 \pm 30\%$	6.6 ± 2.1
	5s $5p^2$ $^4P_{1/2}$	3995.2	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	4324.1	0,0001	0.011			
	5s $5p^2$ $^2D_{3/2}$	7904.8	0,126	2.7			
$5s^26p$ $^2P_{3/2}$	$5s^2$ 6s $^2S_{1/2}$	6455.2	0,950	7.6	5.2 ± 1.0	$6.6 \pm 35\%$	12.1 ± 3.6
	5s $5p^2$ $^4P_{1/2}$	3859.0	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	4165.0	0,0000	0.00			
	5s $5p^2$ $^4P_{5/2}$	4619.5	0,0020	0.096	0.059 ± 0.01	$0.054 \pm 30\%$	
	5s $5p^2$ $^2D_{3/2}$	7389.1	0,0270	0.33			
	5s $5p^2$ $^2D_{5/2}$	7743.6	0,156	2.6			
$5s^27p$ $^2P_{1/2}$	$5s^2$ 6s $^2S_{1/2}$	2855.7	0,0044	0.36			
	$5s^2$ 5d $^2D_{3/2}$	4878.7	0,0087	0.49	0.13 ± 0.05		
	5s $5p^2$ $^4P_{1/2}$	2200.8	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	2297.0	0,0000	0.0057			
	5s $5p^2$ $^2D_{3/2}$	3024.9	0,0072	1.05	0.29 ± 0.05		
$5s^27p$ $^2P_{3/2}$	$5s^2$ 6s $^2S_{1/2}$	2826.4	0,0091	0.38			
	$5s^2$ 5d $^2D_{3/2}$	4793.8	0,0018	0.052			
	$5s^2$ 5d $^2D_{5/2}$	4946.0	0,0117	0.48	0.11 ± 0.03		
	5s $5p^2$ $^4P_{1/2}$	2183.3	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	2278.0	0,0000	0.0029			
	5s $5p^2$ $^4P_{5/2}$	2407.5	0,0003	0.051			
	5s $5p^2$ $^4D_{3/2}$	2992.0	0,0015	0.11	0.074 ± 0.01		
	5s $5p^2$ $^2D_{5/2}$	3048.5	0,0086	0.93	0.29 ± 0.04		
$5s^28p$ $^2P_{1/2}$	$5s^2$ 6s $^2S_{1/2}$	2256.8	0,0006	0.082			
	$5s^2$ 5d $^2D_{3/2}$	3356.8	0,0448	5.3			
	5s $5p^2$ $^4P_{1/2}$	1827.1	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	1892.9	0,0001	0.054			
$5s^28p$ $^2P_{3/2}$	5s $5p^2$ $^2D_{3/2}$	2361.1	0,0288	6.9			
	$5s^2$ 6s $^2S_{1/2}$	2247.1	0,0013	0.083			
	$5s^2$ 5d $^2D_{3/2}$	3335.4	0,0090	0.54			
	$5s^2$ 5d $^2D_{5/2}$	3408.3	0,0569	4.9			
	5s $5p^2$ $^4P_{1/2}$	1820.7	0,0000	0.00			
	5s $5p^2$ $^4P_{3/2}$	1886.1	0,0001	0.027			
	5s $5p^2$ $^4D_{5/2}$	1974.1	0,0018	0.46			
	5s $5p^2$ $^2D_{3/2}$	2350.5	0,0057	0.69			
	5s $5p^2$ $^2D_{5/2}$	2385.3	0,0336	5.9			

Table III. *Oscillator Strengths and Transition Probabilities of lines arising from $5s^2nd$ configurations of Sn II.*

Transition		Wavelength λ (Å)	f -values This work	Transition Probabilities (10^7 s $^{-1}$)					
Upper	Lower			This work	Ref. [4]	Ref. [1]	Ref. [3]	Ref. [5]	Ref. [6]
$5s^2$ 5d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	1400.5	1,25	212.0	176.8 ± 8.8				
	$5s^2$ 5p $^2P_{3/2}$	1489.1	0,105	31.7	51.1 ± 4.1				
$5s^2$ 5d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	1475.0	0,970	198.3	216.6 ± 18.4				
$5s^2$ 6d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	1108.2	0,244	66.4					
	$5s^2$ 5p $^2P_{3/2}$	1162.9	0,0391	19.3					
	$5s^2$ 6p $^2P_{1/2}$	5333.9	0,930	10.9		5.8 ± 1.0	$12.0 \pm 30\%$		8.6 ± 3.1
	$5s^2$ 6p $^2P_{3/2}$	5597.6	0,0892	1.9		1.3 ± 0.2	$1.3 \pm 40\%$		1.5 ± 0.5
$5s^2$ 6d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	1161.4	0,227	75.0					
	$5s^2$ 6p $^2P_{3/2}$	5562.9	0,800	11.5		9.1 ± 1.9	$13.0 \pm 25\%$		11.8 ± 4.0
$5s^2$ 7d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	997.2	0,104	34.9					
	$5s^2$ 5p $^2P_{3/2}$	1041.3	0,0128	7.9					
	$5s^2$ 6p $^2P_{1/2}$	3473.4	0,174	4.8		1.4 ± 0.2	$1.0 \pm 40\%$	1.6 ± 3.0	
	$5s^2$ 6p $^2P_{3/2}$	3583.3	0,0169	0.88		0.35 ± 0.08			
$5s^2$ 7d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	1040.7	0,0933	38.3					
	$5s^2$ 6p $^2P_{3/2}$	3576.3	0,152	5.3		2.7 ± 0.5	$1.3 \pm 40\%$	1.3 ± 3.0	
$5s^2$ 8d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	945.8	0,0212	7.9					
	$5s^2$ 5p $^2P_{3/2}$	985.4	0,0020	1.4					
	$5s^2$ 6p $^2P_{1/2}$	2920.7	0,0537	2.1					
	$5s^2$ 6p $^2P_{3/2}$	2998.0	0,0053	0.39					
$5s^2$ 8d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	985.1	0,0181	8.3					
	$5s^2$ 6p $^2P_{3/2}$	2995.0	0,0484	2.4					
$5s^2$ 9d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	917.4	0,0119	4.7					
	$5s^2$ 5p $^2P_{3/2}$	954.6	0,0011	0.84					
	$5s^2$ 6p $^2P_{1/2}$	2665.7	0,0256	1.2					
	$5s^2$ 6p $^2P_{3/2}$	2730.0	0,0026	0.23					
$5s^2$ 9d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	954.4	0,0102	5.0					
	$5s^2$ 6p $^2P_{3/2}$	2728.6	0,0231	1.38					
$5s^2$ 10d $^2D_{3/2}$	$5s^2$ 5p $^2P_{1/2}$	899.9	0,0075	3.1					
	$5s^2$ 5p $^2P_{3/2}$	935.6	0,0007	0.55					
	$5s^2$ 6p $^2P_{1/2}$	2523.0	0,0151	0.79					
	$5s^2$ 5p $^2P_{3/2}$	2580.5	0,0015	0.15					
$5s^2$ 10d $^2D_{5/2}$	$5s^2$ 5p $^2P_{3/2}$	935.5	0,0065	3.3					
	$5s^2$ 6p $^2P_{3/2}$	2579.7	0,0133	0.89					

Table IV. *Oscillator Strengths and Transition Probabilities of lines arising from $5s^2nf$ configurations of Sn II.*

Transition		Wavelength λ (Å)	f -values This work	Transition Probabilities (10^7 s $^{-1}$)					
Upper	Lower			This work	Ref. [4]	Ref. [1]	Ref. [3]	Ref. [5]	Ref. [6]
$5s^2$ 4f $^2F_{5/2}$	$5s$ 5p 2 $^2D_{3/2}$	3284.3	0,604	24.9	7.0 ± 0.2	6.2 ± 1.2	$6.8 \pm 35\%$	10.0 ± 2.0	
	$5s$ 5p 2 $^2D_{5/2}$	3352.5	0,0286	1.7	6.3 ± 0.1	5.7 ± 1.0	$6.1 \pm 35\%$	10.0 ± 2.0	
	$5s^2$ 5d $^2D_{3/2}$	5590.8	0,408	5.8	7.2 ± 0.1	6.7 ± 1.2	$11.0 \pm 25\%$		8.5 ± 3.6
	$5s^2$ 5d $^2D_{5/2}$	5799.0	0,0191	0.38	0.87 ± 0.02				
	$5s$ 5p 2 $^4P_{3/2}$	2443.5	0,0007	0.055		0.13 ± 0.03			
	$5s$ 5p 2 $^4P_{5/2}$	2593.2	0,0004	0.039		0.14 ± 0.03			
$5s^2$ 4f $^2F_{7/2}$	$5s$ 5p 2 $^2D_{5/2}$	3353.2	0,560	24.9		6.0 ± 1.3			
	$5s^2$ 5d $^2D_{5/2}$	5801.0	0,383	5.7		8.1 ± 1.6	$7.4 \pm 35\%$		8.1 ± 2.9
	$5s$ 5p 2 $^4P_{5/2}$	2593.6	0,0078	0.58		0.33 ± 0.07			
$5s^2$ 5f $^2F_{5/2}$	$5s$ 5p 22 $^2D_{3/2}$	2449.8	0,128	9.5		2.2 ± 0.5			
	$5s$ 5p 2 $^2D_{5/2}$	2487.6	0,0158	1.7		1.0 ± 0.2			
	$5s^2$ 5d $^2D_{3/2}$	3538.9	0,0451	1.6		0.36 ± 0.07			
	$5s^2$ 5d $^2D_{5/2}$	3621.2	0,0024	0.12		0.62 ± 0.10			
	$5s$ 5p 2 $^4P_{3/2}$	1949.5	0,0006	0.066					
	$5s$ 5p 2 $^4P_{5/2}$	2043.6	0,0003	0.044					
$5s^2$ 5f $^2F_{7/2}$	$5s$ 5p 22 $^2D_{5/2}$	2487.8	0,0408	3.3		2.7 ± 0.5			
	$5s^2$ 5d $^2D_{3/2}$	3621.7	0,0377	1.44		0.17 ± 0.04	$0.2 \pm 40\%$		
	$5s$ 5p 2 $^4P_{5/2}$	2043.8	0,0013	0.16					
	$5s$ 5p 2 $^2D_{3/2}$	2149.5	0,0945	9.1					
$5s^2$ 6f $^2F_{5/2}$	$5s$ 5p 2 $^2D_{5/2}$	2178.5	0,0885	12.44					
	$5s^2$ 5d $^2D_{3/2}$	2944.5	0,0877	4.5					
	$5s^2$ 5d $^2D_{5/2}$	3001.2	0,0045	0.33					
	$5s$ 5p 2 $^4P_{3/2}$	1754.4	0,0005	0.076					
$5s^2$ 6f $^2F_{7/2}$	$5s$ 5p 2 $^4P_{5/2}$	1830.3	0,0002	0.050					
	$5s$ 5p 2 $^2D_{5/2}$	2178.5	0,0882	9.3					
	$5s^2$ 5d $^2D_{5/2}$	3001.2	0,0918	5.1					
	$5s$ 5p 2 $^4P_{5/2}$	1830.3	0,0049	0.74					

Table V. *Oscillator Strengths and Transition Probabilities of lines arising from $5s^2ng$ configurations of Sn II.*

Transition				Transition
Levels		Wavelength λ (Å)	f -values	Probabilities (10^7 s $^{-1}$)
Upper	Lower		This work	This work
$5s^2$ 6g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	6081.6	1.84	3.1
	$5s^2$ 4f $^2F_{7/2}$	6079.4	0.0942	0.11
	$5s^2$ 5f $^2F_{5/2}$	16469.0	3.14	1.3
	$5s^2$ 5f $^2F_{7/2}$	16458.2	1.26	0.048
$5s^2$ 6g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	6079.4	0.0076	3.2
	$5s^2$ 5f $^2F_{7/2}$	16458.2	0.660	1.4
$5s^2$ 7g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	5074.1	0.0025	2.8
	$5s^2$ 4f $^2F_{7/2}$	5072.5	0.123	0.10
	$5s^2$ 5f $^2F_{5/2}$	10710.1	0.321	1.3
	$5s^2$ 5f $^2F_{7/2}$	10705.5	0.481	0.047
$5s^2$ 7g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	5072.5	0.0048	2.9
	$5s^2$ 5f $^2F_{7/2}$	10705.5	0.279	1.3
$5s^2$ 8g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	4581.7	0.0020	1.4
	$5s^2$ 4f $^2F_{7/2}$	4580.4	0.0912	0.052
	$5s^2$ 5f $^2F_{5/2}$	8729.8	0.198	0.69
	$5s^2$ 5f $^2F_{7/2}$	8726.8	0.160	0.026
$5s^2$ 8g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	4580.4	0.0020	1.5
	$5s^2$ 5f $^2F_{7/2}$	8726.8	0.0985	0.72
$5s^2$ 9g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	4295.9	0.0009	0.85
	$5s^2$ 4f $^2F_{7/2}$	4294.8	0.0415	0.032
	$5s^2$ 5f $^2F_{5/2}$	7747.7	0.0864	0.44
	$5s^2$ 5f $^2F_{7/2}$	7745.3	0.0764	0.016
$5s^2$ 9g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	4294.8	0.0011	0.88
	$5s^2$ 5f $^2F_{7/2}$	7745.3	0.0495	0.45
$5s^2$ 10g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	4112.7	0.0005	0.56
	$5s^2$ 4f $^2F_{7/2}$	4111.7	0.0223	0.021
	$5s^2$ 5f $^2F_{5/2}$	7171.5	0.0463	0.30
	$5s^2$ 5f $^2F_{7/2}$	7169.5	0.0431	0.011
$5s^2$ 10g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	4111.7	0.0007	0.017
	$5s^2$ 5f $^2F_{7/2}$	7169.5	0.0289	0.031
$5s^2$ 11g $^2G_{7/2}$	$5s^2$ 4f $^2F_{5/2}$	3986.9	0.0003	0.40
	$5s^2$ 4f $^2F_{7/2}$	3986.0	0.0004	0.015
	$5s^2$ 5f $^2F_{5/2}$	6797.6	0.0029	0.21
	$5s^2$ 5f $^2F_{7/2}$	6795.8	0.0277	0.0078
$5s^2$ 11g $^2G_{9/2}$	$5s^2$ 4f $^2F_{7/2}$	3986.0	0.0004	0.41
	$5s^2$ 5f $^2F_{7/2}$	6795.8	0.0182	0.22

levels are involved, the transition probabilities can be strongly affected: As is well know a relatively small discrepancy between experimental and calculated energy levels in IC calculations can induce a relatively large discrepancy between experimental and calculated matrix elements.

In Table III we present results for transitions arising from $5s^2 nd^2 \mathbf{D}_{3/2,5/2}$ ($n = 5-10$). One can conclude that our values are in good agreement with the existing experimental found in the literature.

Results for transitions arising from $5s^2 nf^2 \mathbf{F}_{5/2,7/2}$ ($n = 4-6$) are displayed in Table IV. As it was expected, there is good agreement between our calculations and the experimental values except for the possible discrepancies commented above.

In Table V we present results for transitions arising from $5s^2 ng^2 \mathbf{G}_{7/2,9/2}$ ($n = 6-11$).

Lastly in Table VI we present results for transitions arising from $5s 5p^2$ configuration. The results are compared with the only experimental values present in the bibliography. The foreseen discrepancies are due to the presence of levels with heavy mixing [1], they can be appreciated.

Attempts to carry out a least-square fitting including many configurations, in order to correct the pointed discrepancies, resulted in no reasonable improvement while presenting difficulties due to the increase in the number of parameters above the number of experimentally observed energy levels. These discrepancies should not influence in great measure future calculations of Stark line broadening. Given the great quantity of levels involved in these calculations the contribution of the mentioned levels will be small.

4. Conclusions

This work provides theoretical transition probabilities for transitions arising from $5s^2 nl$ and $5s 5p^2$ of Sn II that complete our previous works. The obtained transition probabilities, in this and in the previous indexed works, are the base of the study in progress of the calculation of different parameters of Sn II of high interest for astrophysicists.

Table VI. *Oscillator Strengths and Transition Probabilities of lines arising from $5s 5p^2$ configurations of Sn II.*

Transition		Wavelength λ (Å)	f -values		Transition Probabilities ($10^7 s^{-1}$)	
Levels			This work		This work	Ref. [1]
Upper	Lower					
$5s 5p^2 {}^4P_{1/2}$	$5s^2 5p^2 {}^2P_{1/2}$	2152.2	0.0024	0.34	0.011 $\pm$ 0.008	
	$5s^2 5p^2 {}^2P_{3/2}$	2368.9	0.00034	0.082	0.055 $\pm$ 0.010	
$5s 5p^2 {}^4P_{3/2}$	$5s^2 5p^2 {}^2P_{1/2}$	2067.5	0.0000	0.00		
	$5s^2 5p^2 {}^2P_{3/2}$	2266.7	0.0006	0.082	0.0031 $\pm$ 0.0010	
$5s 5p^2 {}^4P_{5/2}$	$5s^2 5p^2 {}^2P_{3/2}$	2151.5	0.0010	0.095	0.0030 $\pm$ 0.0010	
$5s 5p^2 {}^2\mathbf{D}_{3/2}$	$5s^2 5p^2 {}^2P_{1/2}$	1699.4	0.0563	6.5		
	$5s^2 5p^2 {}^2P_{3/2}$	1831.6	0.0161	3.2		
$5s 5p^2 {}^2\mathbf{D}_{5/2}$	$5s^2 5p^2 {}^2P_{3/2}$	1811.2	0.0620	8.4		
$5s 5p^2 {}^2P_{3/2}$	$5s^2 5p^2 {}^2P_{1/2}$	1223.7	0.206	45.9		
	$5s^2 5p^2 {}^2P_{3/2}$	1290.9	0.952	381.0		

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