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EXTENDED ANALYSIS OF THE $5s^25p7d$ AND $5s^25p8s$ CONFIGURATIONS OF SINGLY IONIZED ANTIMONY: SbII

Tazeen Rana
Deanship of Educational Services, Qassim University, Al Qassim, Saudi Arabia

Abstract*- Almost all the data used in the present work is based on the plates taken on a 3-m normal incidence vacuum spectrograph, at the Physics Department, St. Francis Xavier University, Antigonish, Nova Scotia, Canada. The analysis is considerably extended to complete the 5p7d, and 5p8s configurations for the first time. Arcimowicz et al had classified 88 lines of Sb II for $5p^2$ - ($5s5p^3$ + 5p5d + 5p6s + 5p7s) array while presently I have identified more lines and have added two more configurations namely 5p7d, and 5p8s.The Hartree- Fock calculations with relativistic corrections using Cowan Codes for SbII to get ab- initio energy parameters used in the level fitting calculations are used.

Keywords - Singly ionized antimony atoms, Isoelectronic Sequence, triggered Spark source, Fitted and HFR energy parameter, Least Squares Fitted levels.

I. INTRODUCTION

The ground state configuration of singly ionized antimony (Sb II) is $5s^2$ $5p^2$. The configurations of odd parity lying very close to each other and overlapping, therefore, strong interaction is seen in the entire sequence Te III - La VIII [1 - 6]. The leading multiplet of this spectrum was first reported by Lang and Vestine [7], followed by two more papers one by Krishnamurty [8] and the other by Murakawa and Suwa [9]. The three term lists were discordant, to provide a satisfactory array of energy levels. Charlotte E. Moore [10] used the line list published by Lang and Vestine in the region 691Å to 7343Å and unpublished measurements by W.F. Meggers (1272 Å - 8742 Å) to improve the level values of the published multiplets. The agreement was not good with the tolerance between the observed and calculated wave numbers. With a few more tentative revisions, she compiled the data in A.E.L (10). The limit was adapted from Murakawa and Suwa‘s paper at 133327.5 cm^{-1}.Arcimowicz, Joshi and Kaufman [11] published the $5p^2$- ($5s5p^3$ + 5p5d + 5p6s + 5p7s) transition array with theoretical support. Since Sb II sequence has been studied very well recently [1-6], therefore, once again Sb II was undertaken to present even better picture.

The light source used for exciting the antimony ions plasma was mainly a triggered spark. The charging potential is applied to the spark electrodes by a 14.5 µF, Tobb Deutschman, low inductance (nano henry) capacitor bank. As the power supply was Sorensen (20kv, 30 milli amp) it had to be protected against back current in case of a misfire of the spark. Therefore, the condenser is charged to a requisite voltage, Due to the nature of the electrical circuit (capacitor discharge) the electrical energy is not imparted in a single voltage pulse and therefore this leads to high as well as low ionization stages being excited in each discharge. However, the major problem in experimental atomic spectroscopy is to identify/discriminate lines of various ionization stages

The data obtained from the 3-m normal incidence vacuum Spectrograph were supplemented by line list from a hollow cathode source exposures taken at the 6.65m normal incidence spectrograph at the Zeeman Laboratory, University of Amsterdam, which existed at the Antigonish laboratory as well as NIST Plates.

The recorded plates at Zeeman lab Amsterdam using hollow cathode source, are the most suitable for singly ionized spectra as well as the plates recorded in Antigonish lab with triggered spark source using high inductance coil in the discharge circuit, also being quite good for Sb II lines.

The NIST hollow cathode plates were also available to us at the time of the analysis. This provided me very good data to analyze the spectrum of singly ionized antimony atoms.

All exposures were taken on Kodak SWR plates and the Spectrograms were measured on a grant comparator at the Antigonish laboratory in Canada and on an abbe comparator in Aligarh. The wavelengths were calculated by using internal standards of C, N, O, and Al [13]. The wavelength accuracy for the symmetric lines are +_0.005 Å in the wavelength region reported here.

Further experimental details can be found in our earlier publication [12].

RESULT AND DISCUSSION

Scaling the isoelectronic sequence members from Te III - La VIII [1-6] multi-configuration interaction calculations were performed to predict the $5p^2$- ($5s5p^3$ + 5p5d + 5p6d + 5p7d + 5p6s + 5p7s + 5p8s) transition array.

Independent analysis was performed for the resonance transitions without considering the published data [11]. All the ground levels reported by Arcimowicz [11] were confirmed.

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The analysis is considerably extended to complete the 5p7d, and 5p8s configurations for the first time. Arcimowicz et al had classified 88 lines of Sb II for $5p^2$ - ($5s5p^3$ + 5p5d + 5p6s + 5p7s) array while presently I have identified more lines in Sb II and have added two more configurations namely 5p7d, and 5p8s in the 446Å - 2076Å region and are given in table1.

II. 3M NORMAL INCIDENCE VACUUM SPECTROGRAPH

Fitted and HFR energy parameter values in cm^{-1} and scaling factors for odd parity configurations are given in table 2.The Least Squares Fitted levels of $5s5p^3$, 5p5d, 5p6d, 5p7d, 5p6s, 5p7s, and 5p8s configurations are given in table 3.

Table: 1 Classified lines of Sb II

λ(Å)	ν(cm^{-1})	Int.	Classifications	Diff.
832.75	120082.9	30	$5s^25p^2$ $^3P_1$ - 5p7d $^3P_1$	0.008
834.18	119878.0	67	$5s^25p^2$ $^3P_1$ -5p7d $^3P_0$	0.000
837.21	119443.9	15	$5s^25p^2$ $^3P_1$ - 5p7d $^1D_2$	0.004
850.42	117588.2	10	$5s^25p^2$ $^3P_2$ - 5p7d $^3P_2$	0.013
851.19	117481.5	30	$5s^25p^2$ $^3P_2$ - 5p7d $^3P_1$	-0.007
855.86	116841.4	5	$5s^25p^2$ $^3P_2$ - 5p7d $^1D_2$	-0.004
856.345	116775.4	30	$5s^25p^2$ $^3P_0$ - sp^3 $^1P_1$	-0.001
856.34	116774.9	12	$5s^25p^2$ $^3P_1$ - 5p8s $^3P_2$	-0.003
			$5s^25p^2$ $^3P_2$ - 5p7d $^3D_3$	0.000
875.881	114170.7	68	$5s^25p^2$ $^3P_2$ - 5p8s $^3P_2$	0.002
876.805	114050.5	49	$5s^25p^2$ $^3P_0$ - 5p8s $^3P_1$	-0.003
893.416	111929.9	25	$5s^25p^2$ $^3P_1$ - 5p7d $^3P_2$	-0.003
902.925	110751.2	20	$5s^25p^2$ $^3P_2$ - 5p7d $^3F_3$	0.007
903.003	110741.6	10	$5s^25p^2$ $^3P_1$ - 5p8s $^3P_0$	0.000
904.738	110529.2	25	$5s^25p^2$ $^1D_2$ - 5p7d $^1F_3$	0.000
905.307	110459.8	5	$5s^25p^2$ $^1D_2$- 5p7d $^3P_2$	-0.011
914.699	109325.6	8	$5s^25p^2$ $^3P_2$ - 5p7d $^3P_2$	0.003
914.896	109302.0	15	$5s^25p^2$ $^3P_1$ - 5p6d $^3P_0$	0.000
922.590	108390.5	12	$5s^25p^2$ $^3P_2$ -5p8s $^3P_1$	0.007
930.523	107466.4	58	$5s^25p^2$ $^3P_0$ - 5p6d $^3D_1$	0.004
944.486	105877.7	66	$5s^25p^2$ $^3P_2$ - 5p6d $^3D_3$	0.000
950.083	105254.0	23	$5s^25p^2$ $^3P_1$ - 5p7s $^1P_1$	-0.005
950.695	105186.2	45	$5s^25p^2$ $^3P_0$ - 5p6d $^1P_1$	0.017
954.467	104770.5	10	$5s^25p^2$ $^3P_1$-5p7s $^3P^2$	-0.004
957.742	104412.2	20	$5s^25p^2$ $^3P_1$ - 5p6d $^3D_1$	-0.006
965.054	103621.1	15	$5s^25p^2$ $^1D_2$ - 5p7d $^3F_3$	-0.006
978.786	102167.4	60	$5s^25p^2$ $^3P_2$ -5p7s $^3P_2$	-0.008
979.377	102105.7	60	$5s^25p^2$ $^1D_2$ - 5p7d $^3F_2$	0.000
983.614	101665.9	10	$5s^25p^2$ $^3P_1$ - 5p6d $^3F_2$	0.002
984.856	101537.7	50	$5s^25p^2$ $^3P_0$ - 5p7s $^3P_1$	0.001
997.404	100260.3	70	$5s^25p^2$ $^1D_2$ -5p6d $^1F_3$	0.000
997.450	100255.7	26	$5s^25p^2$ $^3P_2$ - 5p6d $^3F_3$	-0.006
997.755	100225.0	10	$5s^25p^2$ $^1S_0$ - 5p7d $^1P_1$	0.000
998.557	100144.5	70	`$5s^25p^2$ $^1D_2$ - 5p6d $^3P_2$	0.000
1001.435	99856.7	45	$5s^25p^2$ $^1D_2$ - 5p6d $^3P_1$	-0.002
1009.449	99063.9	19	$5s^25p^2$ $^3P_2$ - 5p6d $^3F_2$	-0.013
1011.901	98823.9	76	$5s^25p^2$ $^1D_2$ - 5p6d $^3D_2$	0.000
1015.407	98482.7	25	$5s^25p^2$ $^3P_1$ - 5p7s $^3P_1$	-0.001

Tabie :1 continued

1017.636	98267.0	10	$5s^25p^2$ $^3P_1$ - 5p7s $^3P_0$	0.000
1024.200	97637.2	71	$5s^25p^2$ $^3P_0$ - sp^3 $^3S_1$	-0.001
1040.476	96109.9	17	$5s^25p^2$ $^1S_0$ - 5p8s $^1P_1$	0.000
1042.98	95878.7	77	$5s25p^2$ $^3P_2$ -5p7s $^3P_1$	0.004
1043.813	95802.6	25	$5s^25p^2$ $^3P_1$ - sp^3 $^1D_2$	-0.009
1046.923	95518.0	26	$5s^25p^2$ $^1D_2$ - 5p7s $^1P_1$	0.004
1052.254	95034.1	30	$5s^25p^2$ $^1D_2$ - 5p7s ^{3}P2	0.010
1056.227	94676.6	54	$5s^25p^2$ $^1D_2$ - 5p6d $^3D_1$	-0.001
1057.279	94582.4	71	$5s^25p^2$ $^3P_1$ - sp^3 $^3S_1$	-0.006
1072.990	93197.5	27	$5s^25p^2$ $^3P_2$ - sp^3 $^1D_2$	0.009
1073.847	93123.1	27	$5s^25p^2$ $^1D_2$ - 5p6d $^3F_3$	0.005
1076.783	92869.2	25	$5s^25p^2$ $^1S_0$ - sp^3 $^1P_1$	0.001
1082.260	92399.2	40	$5s^25p^2$ $^1D_2$ - 5p6d $^1P_1$	-0.017
1087.211	91978.5	62	$5s^25p^2$ $^3P_2$ - sp^3 $^3S_1$	-0.002
1087.781	91930.3	60	$5s^25p^2$ $^1D_2$ - 5p6d $^3F_2$	0.009
1090.677	91686.2	15	$5s^25p^2$ $^1S_0$ - 5p7d $^1P_1$	0.000
1094.555	91361.3	67	$5s^25p^2$ $^3P_0$ - 5p5d $^3P_1$	-0.001
1107.135	90323.2	42	$5s^25p^2$ $^3P_0$ - 5p5d $^1P_1$	0.006
1109.331	90144.4	21	$5s^25p^2$ $^1S_0$ - 5p8s $^3P_1$	-0.003
1126.788	88747.8	35	$5s^25p^2$ $^1D_2$ - 5p7s $^3P_1$	-0.003
1126.879	88740.7	35	$5s^25p^2$ $^1S_0$- 5p6d $^3P_1$	0.002
1132.432	88305.5	50	$5s^25p^2$ $^3P_1$ - 5p5d $^3P_1$	0.006
1133.939	88188.2	47	$5s^25p^2$ $^3P_1$ - sp^3 $^3P_2$	-0.009
1135.440	88071.6	55	$5s^25p^2$ $^3P_1$ - 5p5d $^3P_0$	0.000
1145.888	87268.6	39	$5s^25p^2$ $^3P_1$ - 5p5d $^1P_1$	-0.003
1161.888	86066.8	61	$5s^25p^2$ $^1D_2$ - sp^3 $^1D_2$	-0.001
1166.827	85702.5	27	$5s^25p^2$ $^3P_2$ - 5p5d $^3P_1$	-0.001
1168.439	85584.3	69	$5s^25p^2$ $^3P_2$ - sp^3 $^3P_2$	-0.005
1168.675	85567.0	35	$5s^25p^2$ $^3P_2$ - 5p5d $^1F_3$	0.006
1175.172	85093.9	71	$5s^25p^2$ $^3P_0$ - 5p5d $^3D_1$	0.007
1178.589	84847.2	44	$5s^25p^2$ $^1D_2$ - sp^3 $^3S_1$	-0.005
1196.735	83560.7	58	$5s^25p^2$ $^1S_0$ - 5p6d $^3D_1$	0.003
1205.239	82971.1	76	$5s^25p^2$ $^3P_1$ - 5p5d $^3D_2$	-0.003
1210.638	82601.1	75	$5s^25p^2$ $^3P_2$ - 5p5d$^3D_3$	-0.008
1218.927	82039.4	68	$5s^25p^2$ $^3P_1$ - 5p5d $^3D_1$	-0.004
1230.286	81281.9	50	$5s^25p^2$ $^1S_0$ - 5p6d $^1P_1$	0.003
1244.292	80367.0	20	$5s^25p^2$ $^3P_2$ - 5p5d $^3D_2$	0.005
1258.867	79436.5	25	$5s^25p^2$ $^3P_2$ - 5p5d $^3D_1$	-0.015
1272.741	78570.6	72	$5s^25p^2$ $^1D_2$- 5p5d $^3P_1$`	0.005
1274.670	78451.7	55	$5s^25p^2$ $^1D_2$ - sp^3 $^3P_2$	0.012
1274.922	78436.2	75	$5s^25p^2$ $^1D_2$- 5p5d $^1F_3$	-0.005
1289.768	77533.3	65	$5s^25p^2$ $^1D_2$- 5p5d $^1P_1$	0.000
1296.358	77139.2	62	$5s^25p^2$ $^3P_0$ - sp^3 $^3P_1$	0.007
1317.540	75899.0	83	$5s^25p^2$ $^3P_0$ - 5p6s $^1P_1$	0.000
1325.054	75468.6	31	$5s^25p^2$ $^1D_2$ - 5p5d $^3D_3$	0.007
1327.394	75335.6	54	$5s^25p^2$ $^3P_1$ - 5p5d $^3F_2$	0.006
1349.810	74084.5	45	$5s^25p^2$ $^3P_1$ - sp^3 $^3P_1$	-0.003
1354.883	73807.1	68	$5s^25p^2$ $^3P_1$ - sp^3 $^3P_0$	0.000
1356.287	73730.7	44	$5s^25p^2$ $^1S_0$ - sp^3 $^3S_1$	0.009
1358.009	73637.2	50	$5s^25p^2$ $^3P_1$ - 5p6s $^3P_2$	0.036
1365.451	73235.9	29	$5s^25p^2$ $^1D_2$ - 5p5d $^3D_2$	-0.002
1372.808	72843.4	37	$5s^25p^2$ $^3P_1$ - 5p6s $^1P_1$	0.006
1374.913	72731.9	22	$5s^25p^2$ $^3P_2$ -5p5d $^3F_2$	0.009
1383.057	72303.6	45	$5s^25p^2$ $^1D_2$ - 5p5d $^3D_1$	0.009
1384.662	72219.8	72	$5s^25p^2$ $^3P_1$- 5p5d $^1D_2$	0.002
1387.565	72068.7	69	$5s^25p^2$ $^3P_2$ - 5p5d $^3F_3$	0.007
1398.969	71481.2	7	$5s^25p^2$ $^3P_2$ - sp^3 $^3P_1$	-0.008
1407.749	71035.4	68	$5s^25p^2$ $^3P_2$ - 5p6s $^3P_2$	0.005
1436.423	69617.4	74	$5s^25p^2$ $^3P_2$ - 5p5d $^1D_2$	-0.022
1438.110	69535.7	72	$5s^25p^2$ $^3P_0$ – 5p6s $^3P_1$	0.010
1442.271	69335.1	45	$5s^25p^2$ $^3P_1$- 5p5d $^1D_2$	-0.001
1482.457	67455.6	60	$5s^25p^2$ $^1S_0$ - 5p5d $^3P_1$	-0.006
1498.549	66731.2	68	$5s^25p^2$ $^3P_2$ - 5p5d $^1D_2$	0.007
1504.189	66481.0	72	$5s^25p^2$ $^3P_1$ – 5p6s $^3P_1$	-0.002
1505.623	66417.7	71	$5s^25p^2$ $^1S_0$ - 5p5d $^1P_1$	0.000
1508.446	66293.4	18	$5s^25p^2$ $^3P_0$ - sp^3 $^3D_1$	-0.027
1513.255	66082.7	72	$5s^25p^2$ $^3P_1$ -5p6s $^3P_0$	0.000
1524.358	65601.4	60	$5s^25p^2$ $^1D_2$ -5p5d ^{3}F2	-0.012
1539.935	64937.8	71	$5s^25p^2$ $^1D_2$ -5p5d $^3F_3$	-0.006
1554.018	64349.3	68	$5s^25p^2$ $^1D_2$ -sp^3 $^3P_1$	0.000
1564.813	63905.4	57	$5s^25p^2$ $^1D_2$ - 5p6s $^3P_2$	-0.031
1565.511	63876.9	75	$5s^25p^2$ $^3P_2$ –5p6s $^3P_1$	0.011

Tabie :1 continued

1576.114	63447.2	99	$5s^25p^2$ $^3P_1$ -sp^3 $^3D_2$	0.004
1581.365	63236.5	99	$5s^25p^2$ $^3P_1$ -sp^3 $^3D_1$	0.011
1584.578	63108.3	75	$5s^25p^2$ $^1D_2$- 5p6s $^1P_1$	0.009
1600.405	62484.2	72	$5s^25p^2$ $^1D_2$ -5p5d $^1D_2$	0.016
1606.973	62228.8	99	$5s^25p^2$ $^3P_2$ - sp^3 $^3D_3$	0.003
1634.297	61188.4	56	$5s^25p^2$ $^1S_0$ - 5p5d $^3D_1$	0.001
1643.550	60843.9	99	$5s^25p^2$ $^3P_2$- sp^3 $^3D_2$	-0.003
1649.270	60632.9	99	$5s^25p^2$ $^3P_2$ -sp^3 $^3D_1$	0.014
1677.847	59600.2	64	$5s^25p^2$ $^1D_2$ - 5p5d $^1D_2$	-0.005
1762.236	56746.1	75	$5s^25p^2$ $^1D_2$ –5p6s $^3P_1$	-0.008
1814.964	55097.5	99	$5s^25p^2$ $^1D_2$ - sp^3 $^3D_3$	-0.003
1861.771	53712.3	64	$5s^25p^2$ $^1D_2$ - sp^3 $^3D_2$	0.000
1869.086	53502.1	33	$5s^25p^2$ $^1D_2$ - sp^3 $^3D_1$	-0.008
1878.513	53233.6	54	$5s^25p^2$ $^1S_0$ - sp^3 $^3P_1$	0.003
1923.325	51993.3	66	$5s^25p^2$ $^1S_0$ - 5p6s $^1P_1$	-0.009
2054.717	48668.5	99	$5s^25p^2$ $^3P_1$ - sp^3 $5S^2$	-0.017
2170.860	46064.7	99	$5s^25p^2$ $^3P_2$ - sp^3 $5S_2$	-0.007
2191.526	45630.3	99	$5s^25p^2$ $^1S_0$ - 5p6s $^3P_1$	-0.003
2359.258	42386.2	10	$5s^25p^2$ $^1S_0$ - sp^3 $^3D_1$	0.004
2568.528	38932.8	15	$5s^25p^2$ $^1D_2$ - sp^3 $5S^2$	0.016

Table 2: Fitted and HFR energy parameteric values (cm^{-1}) and scaling factors for the odd parity configurations of Sb II

Parameter	LSF	Accu.	HF	LSF/HF
E_{av} (5s5p^3)	80053	213	78656	1.021
F^2 (5p,5p)	32038	1074	40013	0.801
α_{5p}	-233	-78		
ζ_{5p}	3660	464	3526	1.038
G1(5s,5p)	34147	316	53006	0.644
Eav(5s25p5d)	82787	140	83232	0.995
ζ5p	4145	268	3899	1.063
ζ5d	94	(fixed)	93	1.013
F2 (5p,5d)	18802	1611	21218	0.886
G1(5p,5d)	14980	493	20851	0.718
G3(5p,5d)	10815	1362	12859	0.841
Eav(5s25p6d)	109466	110	109909	0.997
ζ5p	4403	157	4071	1.082
ζ6d	34	(fixed)	34	1.000
F2(5p,6d)	5422	1051	5953	0.911
G1(5p,6d)	3165	679	4975	0.636
G3(5p,6d)	2261	1103	3237	0.699
Eav(5s25p7d)	120264	91	12078	0.996
ζ5p	4743	139	4102	1.156
ζ7d	17	(fixed)	17	1.000
F2(5p,7d)	2202	901	2634	0.836
G1(5p,7d)	1653	615	2141	0.772
G3(5p,7d)	922	(fixed)	1418	0.650
Eav(5s25p6s)	73944	187	74464	0.994
ζ5p	4220	233	3978	1.061
G1(5p,6s)	2745	881	4141	0.663
Eav(5s25p7s)	105787	145	106310	0.996
ζ5p	4331	195	4082	1.061
G1(5p,7s)	877	758	1101	0.797
Eav(5s25p8s)	117893	14	119000	0.991
ζ5p	3949	185	4106	0.962
G1(5p,8s)	362	(fixed)	482	0.750

Table :2 continued

Configuration	Parameter	LSF	Accu.	HF	LSF/HF
5s5p^3-5s^{2}5p5d	R^1(5p,5p; 5s,5d)	20549	339	30746	0.668
5s5p^3-5s^{2}5p6d	R^1(5p,5p; 5s,6d)	10273	170	15371	0.668
5s5p^3-5s^{2}5p7d	**R^1(5p,5p; 5s,7d)**	**6739**	**111**	**10084**	**0.668**
5s5p^3-5s^{2}5p6s	R^1(5p,5p; 5s,6s)	-1544	-25	-2309	0.668
5s5p^3-5s^{2}5p7s	R^1(5p,5p; 5s,7s)	-926	-15	-1385	0.668
5s5p^3-5s^2 5p8s	**R^1(5p,5p; 5s,8s)**	**-647**	**-11**	**-968**	**0.668**
5s^{2}5p5d-5s^{2}5p6d	R^0(5p,5d; 5p,6d)	0	0	0	
	R^2(5p,5d; 5p,6d)	5381	89	8052	0.668
	R^1(5p,5d; 6d,5p)	6609	109	9888	0.668
	R^3(5p,5d; 6d,5p)	4185	69	6262	0.668
5s^{2}5p5d-5s^{2}5p7d	**R^0(5p,5d; 5p,7d)**	**0**	**0**	**0**	
	R^2(5p,5d; 5p,7d)	**3245**	**54**	**4855**	**0.668**
	R^1(5p,5d; 7d,5p)	**4259**	**70**	**6372**	**0.668**
	R^3(5p,5d; 7d,5p)	**2713**	**45**	**4059**	**0.668**
5s^{2}5p5d-5s^{2}5p6s	R^2(5p,5d; 5p,6s)	-7308	-121	-1093	0.668
	R^1(5p,5d; 6s,5p)	-2985	-49	-4466	0.668
5s^{2}5p5d-5s^{2}5p7s	R^2(5p,5d; 5p,7s)	-3026	-50	-4528	0.668
	R^1(5p,5d; 7s,5p)	-1601	-26	-2395	0.668
5s^{2}5p5d-5s^{2}5p8s	**R^2(5p,5d; 5p,8s)**	**-1899**	**-31**	**-2841**	**0.668**
	R^1(5p,5d; 8s,5p)	**-1071**	**-18**	**-1602**	**0.668**
5s25p6d-5s25p7d	**R0(5p,6d;5 p,7d)**	**0**	**0**	**0**	
	R2(5p,6d;5 p,7d)	**2319**	**38**	**3469**	**0.668**
	R1(5p,6d;7 d,5p)	**2176**	**36**	**3256**	**0.668**
	R3(5p,6d;7 d,5p)	**1428**	**24**	**2136**	**0.668**
5s25p6d-5s25p6s	**R2(5p,6d;5 p,6s)**	**-1057**	**-17**	**-1581**	**0.668**
	R1(5p,6d;6 s,5p)	**-909**	**-15**	**-1360**	**0.668**
5s25p6d-5s25p7s	**R2(5p,6d;5 p,7s)**	**-2040**	**-34**	**-3052**	**0.668**
	R1(5p,6d;7 s,5p)	**-579**	**-10**	**-866**	**0.668**
5s25p6d-5s25p8s	**R2(5p,6d;5 p,8s)**	**-1385**	**(fixed)**	**-1732**	**0.800**
	R1(5p,6d;8 s,5p)	**-454**	**(fixed)**	**-605**	**0.750**
5s25p7d-5s25p6s	**R2(5p,7d;5 p,6s)**	**-271**	**(fixed)**	**-362**	**0.750**
	R1(5p,7d;6 s,5p)	**-537**	**(fixed)**	**-716**	**0.750**
5s25p7d-5s25p7s	**R2(5p,7d;5 p,7s)**	**-969**	**(fixed)**	**-1292**	**0.750**
	R1(5p,7d;7 s,5p)	**-367**	**(fixed)**	**-489**	**0.750**
5s25p7d-5s25p8s	**R2(5p,7d;5 p,8s)**	**-972**	**(fixed)**	**-1295**	**0.750**
	R1(5p,7d;8 s,5p)	**-261**	**(fixed)**	**-349**	**0.750**
5s25p6s-5s25p7s	**R0(5p,6s;5 p,7s)**	**0**	**(fixed)**	**0**	
	R1(5p,6s;7 s,5p)	**1541**	**(fixed)**	**2054**	**0.750**
5s25p6s-5s25p8s	**R0(5p,6s;5 p,8s)**	**0**	**(fixed)**	**0**	
	R1(5p,6s;8 s,5p)	**997**	**(fixed)**	**1329**	**0.750**
5s25p7s-5s25p8s	**R0(5p,7s;5 p,8s)**	**0**	**(fixed)**	**0**	
	R1(5p,7s;8 s,5p)	**545**	**(fixed)**	**727**	**0.750**
σ (mean error) = 268					

Table 3 : The experimental and fitted energy level values (cm^{-1}) and their LS- percentage compositions of Odd parity configurations of Sb II

E(obs)	E(LSF)	Diff.	LS-composition
J=0			
69137.0	69142.0	-5.0	98% 5s^{2}5p6s ^{3}P
76862.0	77039.0	-177.0	63% 5s5p^3 (^{2}P) ^{3}P +34% 5s^{2}5p5d ^{3}P
91125.0	91100.0	25.0	65% 5s^{2}5p5d ^{3}P + 34% 5s5p^3(^{2}P) ^{3}P
101321.0	101317.0	4.0	100% 5s^{2}5p7s ^{3}P
	112617.0		97% 5s^{2}5p6d ^{3}P
113796.0	113901.0	-105.0	99% 5s^{2}5p8s ^{3}P
122933.0n	**122999.0**	**-66.0**	**99% 5s^{2}5p7d ^{3}P**
J=1			
66291.0	66369.0	-78.0	65% 5s5p^3 (^{2}D) ^{3}D+ 27% 5s^{2}5p5d ^{3}D
69536.0	69530.0	6.0	74% 5s^{2}5p6s ^{3}P + 25% 5s^{2}5p6s ^{1}P
75898.0	75887.0	11.0	56% 5s^{2}5p6s ^{1}P + 16% 5s^{2}5p6s ^{3}P +11% 5s5p^3 (^{2}P) ^{3}P + 9% 5s^{2}5p5d ^{3}P
85094.0	85207.0	-113.0	48% 5s^{2}5p5d ^{3}D+ 20% 5s5p^3(^{2}D) ^{3}D +12% 5s^{2}5p5d ^{1}P + 9% 5s^{2}5p5d ^{3}P
90323.0	90004.0	319.0	59% 5s^{2}5p5d ^{1}P + 16% 5s^{2}5p5d ^{3}D +15%5s5p^3 (^{2}P) ^{1}P
91360.0	91223.0	137.0	51% 5s^{2}5p5d ^{3}P + 27% 5s5p^3 (^{2}P) ^{3}P+7% 5s^{2}5p5d ^{3}D + 4%5s 5p^3 (^{2}D) ^{3}D
97636.0	97558.0	78.0	85% 5s5p^3 (^{4}S) ^{3}S + 5% 5s^{2}5p5d ^{1}P
101531.0	101537.0	-6.0	70% 5s^{2}5p7s ^{3}P+29% 5s^{2}5p7s ^{1}P
	104942.0		34% 5s^{2}5p6d ^{1}P + 24% 5s5p^3 (^{2}P) ^{1}P +22% 5s^{2}5p6d ^{3}D + 8% 5s^{2}5p6d ^{3}P
107461.0	107642.0	-181.0	45% 5s^{2}5p6d ^{3}D + 35% 5s5p^3 (^{2}P)^{1}P +8% 5s^{2}5p 6d ^{3}P + 5% 5s^{2}5p5d ^{1}P
108309.0	108311.0	-2.0	68% 5s^{2}5p7s ^{1}P +28% 5s^{2}5p7s ^{3}P
112647.0	112525.0	122.0	78% 5s^{2}5p6d ^{3}P+19% 5s^{2}5p6d ^{3}D
114050.0	113905.0	145.0	61% 5s^{2}5p8s ^{3}P+30% 5s^{2}5p8s^{1}P+4% 5s^{2}5p6d ^{1}P
	114713.0		**38% 5s^{2}5p6d ^{1}P+20% 5s^{2}5p7d ^{1}P +11% 5s^{2}5p7d ^{3}D + 7% 5s^{2}5p6d ^{3}D**
116776.0n	**116796.0**	**-20.0**	**46% 5s^{2}5p7d ^{3}D+18% 5s^{2}5p6d ^{1}P+14% 5s^{2}5p7d ^{3}P + 8% 5s5p^3 (^{2}P) ^{1}P**
120013.0n	**120032.0**	**-19.0**	**67% 5s^{2}5p8s ^{1}P +30% 5s^{2}5p8s ^{3}P**
123138.0n	**122965.0**	**173.0**	**75% 5s^{2}5p7d ^{3}P+24% 5s^{2}5p7d ^{3}D**
124130.0n	**124193.0**	**-63.0**	**69% 5s^{2}5p7d ^{1}P+ 16% 5s^{2}5p7d ^{3}D+6% 5s^{2}5p7d ^{3}P**
J=2			
51723.0	51806.0	-83.0	98% 5s5p^3 (^{4}S) ^{5}S
66502.0	66459.0	43.0	63% 5s5p^3 (^{2}D) ^{3}D+ 25% 5s^{2}5p5d ^{3}D +6% 5s5p^3 (^{2}P) ^{3}P
72390.0	72386.0	4.0	54% 5s^{2}5p5d ^{1}D + 19% 5s^{2}5p5d ^{3}F +10% 5s5p^3 (^{2}D) ^{1}D + 7% 5s^{2}5p5d ^{3}P
75275.0	75259.0	16.0	81% 5s^{2}5p6s ^{3}P + 5% 5s^{2}5p5d ^{3}F +5% 5s5p^3 (^{2}P) ^{3}P + 5% 5s^{2}5p5d ^{3}P
76692.0	76737.0	-45.0	61% 5s^{2}5p5d ^{3}F +11% 5s^{2}5p6s ^{3}P +9% 5s^{2}5p5d ^{3}P + 6% 5s5p^3 (^{2}P) ^{3}P

Table 3 : Continued

E(obs)	E(LSF)	Diff.	LS-composition
78391.0	78265.0	126.0	31% 5s5p^3 (^{2}P) ^{3}P + 22% 5s^{2}5p5d ^{3}P + 21% 5s^{2}5p5d ^{1}D + 12% 5s^{2}5p5d ^{3}F
86025.0	85817.0	208.0	46% 5s^2 5p5d ^{3}D + 20% 5s^{2}5p5d ^{3}P +15% 5s5p^3 (^{2}P) ^{3}P +13% 5s5p^3 (^{2}D) ^{3}D
91243.0	91044.0	199.0	33% 5s^{2}5p5d ^{3}P + 26% 5s^{2}5p5d ^{3}D +25% 5s5p^3 (^{2}P) ^{3}P +11% 5s5p^3 (^{2}D) ^{3}D
98856.0	99147.0	-291.0	62% 5s5p^3 (^{2}D) ^{1}D +16% 5s^{2}5p5d ^{1}D+14% 5s^{2}5p6d ^{1}D
104723.0	104798.0	-75.0	80% 5s^{2}5p6d ^{3}F +10% 5s^{2}5p6d ^{3}D +4% 5s^{2}5p6d ^{1}D
105536.0	105881.0	-345.0	44% 5s^{2}5p6d ^{3}P +28% 5s^{2}5p6d ^{3}D+18% 5s^{2}5p6d ^{1}D+6% 5s5p^3 (^{2}D) ^{1}D
107825.0	107826.0	-1.0	99% 5s25p7s 3P
	111687.0		42% 5s^{2}5p6d ^{1}D + 35% 5s^{2}5p6d ^{3}D +17% 5s^{2}5p6d ^{3}F + 4% 5s5p^3 (^{2}D) ^{1}D
	112461.0		53% 5s^{2}5p6d ^{3}F +16% 5s^{2}5p7d ^{1}D +5% 5s^{2}5p7d ^{3}D
115820.0n	115774.0	46.0	47% 5s^{2}5p7d ^{3}P+33% 5s^{2}5p7d ^{3}D+18% 5s^{2}5p7d ^{1}D
119832.0	119812.0	20.0	100% 5s^{2}5p8s 3P
122499.0n	122488.0	11.0	57% 5s^{2}5p7d ^{1}D + 19% 5s^{2}5p7d ^{3}D
123248.0n	122909.0	339.0	49% 5s^{2}5p7d ^{3}P + 42% 5s^2 5p7d ^{3}D+7% 5s^{2}5p7d
J=3			
67885.0	67643.0	242.0	72% 5s5p^3 (^{2}D) ^{3}D+ 26% 5s^{2}5p5d ^{3}D
77727.0	77741.0	-14.0	92% 5s25p5d 3F
88259.0	88245.0	14.0	60% 5s^{2}5p5d ^{3}D + 20% 5s5p^3 (^{2}D) ^{3}D+13% 5s^{2}5p 5d ^{1}F +5% 5s^{2}5p5d ^{3}F
91226.0	91569.0	-343.0	80% 5s^{2}5p5d ^{1}F+ 12% 5s^{2}5p5d ^{3}D
	105580.0		59% 5s^{2}5p6d ^{3}F+ 21% 5s^{2}5p6d ^{3}D +18% 5s^{2}5p6d ^{1}F
	111606.0		60% 5s^{2}5p6d ^{3}D 34%5s^{2}5p6d ^{3}F
	113137.0		68% 5s^{2}5p6d ^{1}F + 17% 5s^{2}5p6d ^{3}D+5% 5s^{2}5p6d ^{3}F + 5% 5s^{2}5p7d ^{1}F
116410.0n	116008.0	402.0	50% 5s^{2}5p7d ^{3}F + 22% 5s^{2}5p7d ^{3}D+20% 5s^{2}5p7d ^{1}F + 6% 5s^{2}5p6d ^{1}F
122433.0n	122616.0	-183.0	59% 5s^{2}5p7d ^{3}D + 38% 5s^{2}5p7d ^{3}F
123319.0n	123534.0	-215.0	71% 5s^{2}5p7d ^{1}F +18%5s ^{2}5p7d ^{3}D +9% 5s^{2}5p7d ^{3}F
J=4			
81083.0	81226.0	-143.0	100% 5s^{2}5p5d ^{3}F
	111110.0		99% 5s^{2}5p6d ^{3}F
	122310.0		100% 5s^{2}5p7d ^{3}F

n = new levels

CONCLUSIONS

Using the scaling from the isoelectronic sequence members from Te III - La VIII [1-6] multi-configuration interaction calculations were performed to predict the 5p^2- (5s5p^3 + 5p5d + 5p6d + 5p7d + 5p6s + 5p7s + 5p8s) transition array. The analysis is considerably extended to complete the 5p7d, and 5p8s configurations for the first time. Arcimowicz et al had classified 88 lines of Sb II for 5p^2 - (5s5p^3 + 5p5d + 5p6s +

5p7s) array while presently I have identified more lines in Sb II and have added two more configurations namely 5p7d, and 5p8s in the 446Å - 2076Å region.

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