Analysis of the $5p^25d$, $5s^27d$ and $5s^27g$ configurations of doubly Ionized Antimony Atom (SbIII)

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Abstract: ***All the data used in this work is taken by 3m Normal Incidence Vacuum Spectrograph at the Physics Department, Saint Francis Xavier University, Antigonish, Nova Scotia, Canada. Three Configurations $5p^25d$ (j=5/2,7/2,9/2), $5s^27d$ and $5s^27g$ have been established in this paper using Hartree –Fock calculations which gives relativistic corrections and parametric levels fitting calculations to interpret the Spectrum satisfactorily.***

Keywords: NIST national institute of standard and technology, VOL volume, LSF- least square fitted, HFR- Hartree fock ratio, E(obs)-observed energy level, LS Composition- least square Composition, A.E.L atomic energy level

1. Introduction

Doubly ionized antimony atoms have energy structure as partly one electron simple doublets while the core excitation leads to three electron configuration $5s5p^2$. The excitation of the outer electron leads to 5s5pnl(n≥5) 5s to 5p forms $5p^3$ configurations and hence in all these three electron systems the energy level structure is quartets and doublets.

The electronic distribution for the ground state configurations of doubly ionized antimony is $5s^25p$. The earlier analysis of Sb III was reported in Atomic energy levels VOL III [1] was revised by Arcimowicz et al [5] who reported more accurate energy level values for $5s^2nl$ levels. Recently three configurations viz $5p^25d$ (j=5/2,7/2,9/2), $5s^27d$ and $5s^27g$ are investigated

2. Experiments

The most suitable device for recording the spectrum photographically is the Spectrograph. Better resolution spectrographs are grating spectrographs like 21 feet and 35 feet grating spectrographs of Aligarh Muslim University are good enough to record molecular spectra. There is also a verity of Vacuum Spectrograph giving a first order dispersion up to 0.2 Å per mm on the plates. The spectra of Sb were recorded on a 3m Normal incidence vacuum spectrograph at Saint Francis Xavier University Antigonish Nova Scotia Canada. The spectrograph contains a 3m osmium coated holographic concave grating with 2400 lines/mm. It is blazed at 1200Å. The inverse dispersion of the Spectrograph is 1.385 Å /mm in the first order. The dispersion is almost constant in the entire range, varying less than half a present from 250 Å - 2100 Å. The light source used for exciting the antimony ions plasma was mainly a triggered spark with different stages of ionization of Sb spectrum present on our spectrograms are separated out experimentally by observing the intensity variation of every individual line as a function of the inductance coil in the spark circuit.

3. Results and Discussions

Ground Configuration:
$5s^25p$: $^2P_{1/2}$, $^2P_{3/2}$,

Excited configurations:

$5s^2$ ns (n≥6):	**2S1/2**
$5s^2$ nd (n≥5) :	$^2D_{3/2}$, $^2D_{5/2}$
$5s^2$ nf (n≥4) :	$^2F_{5/2}$, $^2F_{7/2}$
$5s^2$ ng (n≥5) :	$^2G_{7/2}$, $^2G_{9/2}$

The internal excited configurations

$5s\,5p^2$	^4P, ^2S , ^2P, ^2D
$5p^3$	^4S, ^2P, ^2D
5s5p5d	$(^3P)\,^4D$, $(^3P)\,^4P$, $(^3P)\,^2P$, $(^3P)\,^4F$, $(^3P)\,^2D$ (3P) 2F, (1P) 2P, (1P) 2D, (1P) 2F,
5s5p6s	$(^3P)\,^4P$, $(^3P)\,^2P$, $(^1P)\,^2P$,
$5p^24f$	$(^3P)\,^4D$, $(^3P)\,^4F$, $(^3P)\,^4G$, $(^3P)\,^2D$, $(^3P)\,^2G$, (3P) 2F, (1D) 2P, (1D)2D,(1D) 2F, (1S) 2F **(1D) 2G,(1D 2H**
$5p^25d$	$(^3P)\,^4D$, $(^3P)\,^4F$, $(^3P)\,^2F$, $(^3P)\,^4P$, $(^3P)\,^2D$, (1D)2F,(1D) 2G,(1D) 2D,
5s5p4f	$(^3P)\,^4D$, $(^3P)\,^4F$, $(^3P)\,^2D$, $(^3P)\,^4G$, $(^3P)\,^2D$, (3P) 2F, (3P) 2G, (1P) 2D, (1P) 2F,(1P) 2G
$5p^26s$	$(^3P)\,^4P$, $(^3P)\,^2P$, $(^1S)\,^2S$, $(^1D)\,^2D$

Lang [1] published first work on this spectrum in 1930. After that Lang and Vestine [2] investigated Sb III. Murakawa and Suwa [3] used condensed low cathode discharge to observe Antimony spectra from 690 Å to 6930 Å. Chan [4] presented a detailed analysis in his thesis about Sb III but his analysis was not giving theoretical support.

Archimowicz, joshi and kaufman [5] published $5s^25p$ - ($5s5p^2$ + $5s^2nl$) transition. The major and complicated three electron system of configuration $5p^3$, 5s5p5d and 5s5p6s configurations of SbIII was published by Tazeen [12]. Consequently $5s^27p$, $5s^28p$, $5s^29p$ and $5s^25f$, for odd parity and $5p^25d$ [j= ½ , 3/2] and $5s^29s$ for even parity was published by tazeen [14]. My investigation for this paper are three Configurations $5p^25d$ (J = 5/2, 7/2, 9/2), $5s^27d$ and $5s^27g$ using Cowan Code [19] for SbIII to get ab initio energy parameters. The parameters used in the level fitting calculations (LSF) were estimated by extrapolating the parameters scaling factors (the ratio of the LSF and HF parameter values) from Te IV to Cs VII [3 - 6]. Some more papers appeared in the literature either in the form of compilation, review or theoretical work of astrophysical interest [8-10]. The configurations included for the odd parity matrix were $5s^2$ (5p, 6p, 7p, 8p, 9p), $5p^3$, 5s5p5d, 5s5p6s, $5s^2$ 4f, $5s^2$5f, $5p^2$4f and 5s5d4f. While for odd parity system are $5s5p^2$, $5s^2$ (6s, 7s, 8s, 9s), $5s^2$ (5d, 6d,7d) and $5s^2$ (5g, 6g, 7g) and $5p^2$ 5d. Total 19 levels have been investigated in this paper. The configuration $5p^2$4f and 5s5d4f though lie in very high region but they have strong interaction with 5s5p5d and $5p^3$ configuration. For the sake of completeness the calculated level values of the unobserved configuration are also included in the table.

Least Square Fitted parameters for odd and even parity configurations are given in table I and II. While observed levels of even configurations of Sb III along with the least square fitted (LSF) energy levels in cm^{-1} are given in table III. The parameters used in the present calculations for all odd parity configurations along with the HFR values and scaling factors are given in table I. The scaling factors of the parameters (both slater as well as interaction) of unknown configurations were fixed at the predetermined values in accordance with the values in other isoelectronic sequence spectra. The scaling factors for the known configurations are consistent with values in Te IV (13), I V (14), and Cs VII(16).

Table1: Least Square Fitted (LSF) parameters for odd parity configurations of Sb III

Configurations	Parameter	LSF	Accuracy	HF	LSF/HF
4f5s5d	E0(4f 5s 5d)	306821.9	(fixed)	306813.2	1.000
	zeta(4f)	226.5	(fixed)	226.6	1.000
	zeta(5d)	4.7	(fixed)	4.7	1.000
	F2(4f, 5d)	20613.7	(fixed)	24251.5	0.850
	F4(4f, 5d)	13214.2	(fixed)	15546.2	0.850
	G3(4f, 5s)	14446.1	(fixed)	19261.5	0.750
	G1(4f, 5d)	7432.2	(fixed)	9909.6	0.750
	G3(4f, 5d)	21812.8	(fixed)	29083.8	0.750
	G5(4f, 5d)	13537.2	(fixed)	18049.7	0.750
	G2(5s, 5d)	9536.0	(fixed)	12714.8	0.750
$5p^3$	E0($5p^3$)	163806.3	144.0	165153.3	0.991
	F2(5p, 5p)	34180.0	859.0	43077.6	0.793
	alfa(5p)	270.2	73.0		
	zeta(5p)	4113.0	(fixed)	4113.0	1.000
5s5p5d	E0(5s 5p 5d)	169042.4	42.0	166261.6	1.017
	zeta(5p)	4406.2	(fixed)	4406.2	1.000
	zeta(5d)	187.3	(fixed)	187.4	0.999
	F2(5p, 5d)	20736.0	686.0	28935	0.717
	G1(5s, 5p)	41169.9	141.0	57770.1	0.713
	G2(5s, 5d)	11720.0	567.0	17289.0	0.678
	G1(5p, 5d)	23002.0	509.0	31020.0	0.742
	G3(5p, 5d)	20734.4	299.0	19447.8	1.066
4f $5p^2$	E0(4f 5p2)	294244.0	23.0	294248.3	1.000
	F2(5p, 5p)	38124.6	(fixed)	44852.5	0.850
	alfa(5p)	1.0	24.0		
	zeta(4f)	4557.0	43.0	4555.6	1.000
	zeta(5p)	4.3	20.0	3.6	1.194
	F2(4f, 5p)	16287.4	312.0	19222.2	0.847
	G2(4f, 5p)	10243.2	166.0	13656.1	0.750
	G4(4f, 5p)	6765.3	285.0	9061.2	0.747
$5p^2$ 5f	E0($5p^2$ 5f)	319920.8	21.0	319926.8	1.000
	F2(5p, 5p)	38415.0	217.0	45254.9	0.849
	alfa(5p)	4.6	19.0		
	zeta(5p)	4622.8	82.0	4626.0	0.999
	zeta(5f)	3.3	17.0	2.8	1.179
	F2(5p, 5f)	7306.6	225.0	8610.0	0.849
	G2(5p, 5f)	4870.1	192.0	6506.9	0.748
	G4(5p, 5f)	3300.6	330.0	4445.0	0.743
$5s^2$ 5p	E0($5s^2$ 5p)	8221.9	73.0	8196.0	
	zeta(5p)	4130.1	93.0	4127.3	1.001
$5s^2$ 6p	E0($5s^2$ 6p)	120822.9	73.0	120852.3	**1.000**
	Zeta(6p)	1022.0	92.0	1022.8	**0.999**
$5s^2$ 7p	E0($5s^2$ 7p)	157392.7	188.0	157416.8	1.000
	zeta(7p)	677.2	245.0	444.4	1.524
$5s^2$ 8p	E0($5s^2$ 8p)	174553.2	75.0	174810.2	0.998

	zeta(8p)	267.3	93.0	237.5	1.125
$5s^2$ 9p	E0($5s^2$ 9p)	184253.3	74.0	184587.8	0.998
	zeta(9p)	133.3	93.0	142.1	0.938
5s5p6s	E0(5s 5p 6s)	169756.2	72.0	166404.3	1.021
	Zeta(5p)	5218.5	151.0	4549.1	1.147
	G1(5s, 5p)	41574.9	192.0	58320.2	0.713
	G0(5s, 6s)	2428.6	290.0	3219.1	0.754
	G1(5p, 6s)	2885.8	772.0	5151.9	0.560
	zeta(5f)	1.8	(fixed)	1.8	1.000
$5s^2$ 5p -5s 5p 6s	R0(5s, 5s; 5s, 6s)	2255.0	(fixed)	3006.7	0.750
	R1(5s, 5p; 5p, 6s)	1346.3	(fixed)	1795.1	0.750
	R0(5s, 5p; 6s, 5p)	144.5	(fixed)	192.6	0.750
$5s^2$ 5p -$5p^3$	R1(5s, 5s; 5p, 5p)	42513.7	(fixed)	56684.9	0.750
$5s^2$ 5p -5s 5p 5d	R1(5s, 5p; 5p, 5d)	30082.4	(fixed)	40109.9	0.750
	R2(5s, 5p; 5d, 5p)	20804.3	(fixed)	27739.1	0.750
$5s^2$ 5p -4f 5s 5d	R3(5s, 5p; 4f, 5d)	13944.6	(fixed)	18592.8	0.750
	R2(5s, 5p; 5d, 4f)	11311.9	(fixed)	15082.5	0.750
$5s^2$ 6p -5s 5p 6s	R1(5s, 6p; 5p, 6s)	15594.4	(fixed)	20792.6	0.750
	R0(5s, 6p; 6s, 5p)	2244.6	(fixed)	2992.8	0.750
$5s^2$ 6p -5s 5p 5d	R1(5s, 6p; 5p, 5d)	3749.8	(fixed)	4999.7	0.750
	R2(5s, 6p; 5d, 5p)	3044.0	(fixed)	4058.6	0.750
$5s^2$ 6p -4f 5s 5d	R3(5s, 6p; 4f, 5d)	2858.7	(fixed)	3811.6	0.750
	R2(5s, 6p; 5d, 4f)	658.8	(fixed)	878.4	0.750
$5s^2$ 7p -5s 5p 6s	R1(5s, 7p; 5p, 6s)	7476.5	(fixed)	9968.6	0.750
	R0(5s, 7p; 6s, 5p)	1341.0	(fixed)	1788.0	0.750
$5s^2$ 7p -5s 5p 5d	R1(s, 7p; 5p, 5d)	1921.9	(fixed)	2562.5	0.750
	R2(5s, 7p; 5d, 5p)	1301.2	(fixed)	1735.0	0.750
$5s^2$ 7p -4f 5s 5d	R3(5s, 7p; 4f, 5d)	1207.2	(fixed)	1609.6	0.750
	R2(5s, 7p; 5d, 4f)	664.5	(fixed)	886.0	0.750
$5s^2$ 8p -5s 5p 6s	R1(5s, 8p; 5p, 6s)	4874.7	(fixed)	6499.6	0.750
	R0(5s, 8p; 6s, 5p)	934.6	(fixed)	1246.2	0.750
$5s^2$ 8p -5s 5p 5d	R1(5s, 8p; 5p, 5d)	1326.2	(fixed)	1768.2	0.750
	R2(5s, 8p; 5d, 5p)	755.7	(fixed)	1007.6	0.750
$5s^2$ 8p -4f 5s 5d	R3(5s, 8p; 4f, 5d)	791.6	(fixed)	1055.5	0.750
	R2(5s, 8p; 5d, 4f)	535.7	(fixed)	714.2	0.750
$5s^2$ 9p -5s 5p 6s	R1(5s, 9p; 5p, 6s)	3555.6	(fixed)	4740.8	0.750
	R0(5s, 9p; 6s, 5p)	703.8	(fixed)	938.4	0.750
$5s^2$ 9p -5s 5p 5d	R1(5s, 9p; 5p, 5d)	1001.0	(fixed)	1334.7	0.750
	R2(5s, 9p; 5d, 5p)	508.6	(fixed)	678.1	0.750
$5s^2$ 9p -4f 5s 5d	R3(5s, 9p; 4f, 5d)	582.2	(fixed)	776.2	0.750
	R2(5s, 9p; 5d, 4f)	431.3	(fixed)	575.0	0.750
5s 5p 6s -$5p^3$	R1(5s, 6s; 5p, 5p)	1037.1	(fixed)	1382.8	0.750
5s 5p 6s -5s 5p 5d	R2(5p, 6s; 5p, 5d)	8907.3	(fixed)	11876.4	0.750
	R1(5p, 6s; 5d, 5p)	3645.7	(fixed)	4860.9	0.750
5s 5p 6s -4f 5s 5d	R2(5p, 6s; 4f, 5d)	6957.2	(fixed)	9276.2	0.750
	R3(5p, 6s; 5d, 4f)	7930.3	(fixed)	10573.7	0.750
$5p^3$ -5s 5p 5d	R1(5p, 5p; 5s, 5d)	29507.9	(fixed)	39343.8	0.750
$5p^3$ -4f $5p^2$	R2(5p, 5p; 4f, 5p)	17635.7	(fixed)	23514.2	0.750
$5p^3$ -$5p^2$ 5f	R2(5p, 5p; 5p, 5f)	12423.9	(fixed)	16565.2	0.750
5s 5p 5d -4f $5p^2$	R3(5s, 5d; 4f, 5p)	22016.2	(fixed)	29354.9	0.750
	R1(5s, 5d; 5p, 4f)	9163.7	(fixed)	12218.3	0.750
5s 5p 5d -$5p^2$ 5f	R1(5s, 5d; 5p, 5f)	11664.2	(fixed)	15552.3	0.750
	R3(5s, 5d; 5f, 5p)	6637.9	(fixed)	8850.6	0.750
5s 5p 5d -4f 5s 5d	R2(5p, 5d; 4f, 5d)	21947.2	(fixed)	29263.0	0.750
	R4(5p, 5d; 4f, 5d)	12963.4	(fixed)	17284.6	0.750
	R1(5p, 5d; 5d, 4f)	15840.7	(fixed)	21121.0	0.750
	R3(5p, 5d; 5d, 4f)	10392.4	(fixed)	13856.6	0.750
5s 5p 5d -4f $5s^2$	R2(5p, 5d; 4f, 5s)	20472.9	(fixed)	27297.2	0.750
	R1(5p, 5d; 5s, 4f)	10131.6	(fixed)	13508.8	0.750
5s 5p 5d -$5s^2$ 5f	R1(5p, 5d; 5s, 5f)	11695.4	(fixed)	15593.8	0.750
	R2(5p, 5d; 5f, 5s)	7354.6	(fixed)	9806.1	0.750
4f $5s^2$	E0(4f $5s^2$)	141569.4	73.0	141691.4	0.999
	zeta(4f)	0.0	41.0	2.4	0.000
$5s^2$ 5f	E0($5s^2$ 5f)	168158.2	77.0	166064.1	1.013
4f $5p^2$ -$5p^2$ 5f	R2(4f, 5p; 5p, 5f)	0.0	(fixed)	0.0	
	R4(4f, 5p; 5p, 5f)	7291.0	(fixed)	9721.4	0.750

	R0(4f, 5p; 5f, 5p)	6932.0	(fixed)	9242.6	0.750
	R2(4f, 5p; 5f, 5p)	4654.7	(fixed)	6206.3	0.750
4f 5p^2 -4f 5s 5d	R1(5p, 5p; 5s, 5d)	31439.3	(fixed)	41919.1	0.750
4f 5p^2 -4f 5s^2	R1(5p, 5p; 5s, 5s)	44058.0	(fixed)	58744.0	0.750
5p^2 5f -5s^2 5f	R1(5p, 5p; 5s, 5s)	0.0	(fixed)	0.0	
4f 5s 5d -4f 5s^2	R2(4f, 5d; 4f, 5s)	0.0	(fixed)	0.0	
4f 5s 5d -4f 5s^2	R3(4f, 5d; 5s, 4f)	0.0	(fixed)	0.0	
4f 5s 5d -5s^2 5f	R3(4f, 5d; 5s, 5f)	44377.3	(fixed)	59169.7	0.750
4f 5s 5d -5s^2 5f	R2(4f, 5d; 5f, 5s)	10587.1	(fixed)	14116.2	0.750
	Sigma =		97.0		

Table 2: Least square fitted (LSF) parameters in cm^{-1} for even Parity Configurations of Sb III

Configuration	Parameter	LSF	Accuracy	HF	LSF/HF
5s 5p^2	E0(5s 5p^2)	79606.2	141.0	77879.2	1.024
	F^2(5p, 5p)	36541.8	(fixed)	42990.4	0.850
	alfa(5p)	107.2	85.0		
	zeta(5p)	1980.6	265.0	4115.4	0.481
	G1(5s, 5p)	44979.2	409.0	56437.2	0.797
5s^2 8s	E0(5s^2 8s)	165302.6	259.0	169872.0	0.972
5s^2 9s	E0(5s^2 9s)	177767.7	259.0	181668.8	0.977
5s^2 5d	E0(5s^2 5d)	97394.7	309.0	100550.9	0.966
	zeta(5d)	173.0	(fixed)	173.1	0.999
5s^2 6d	E0(5s^2 6d)	144412.7	188.0	149515.7	0.964
	zeta(6d)	94.9	147.0	69.7	1.362
5s^2 7d*	**E0(5s^2 7d)**	**166023.1**	**187.0**	**170760.9**	**0.971**
	zeta(7d)	**46.4**	**147.0**	**35.6**	**1.303**
5s^2 5g	E0(5s^2 5g)	164302.1	183.0	168566.1	0.973
	zeta(5g)	0.3	(fixed)	0.3	1.000
5s^{2}6g	E0(5s^2 6g)	176540.0	183.0	180812.8	0.975
	zeta(6g)	0.1	(fixed)	0.2	0.500
5s^2 7g*	**E0(5s^2 7g)**	**183924.0**	**183.0**	**188198.1**	**0.976**
	zeta(7g)	**0.0**	**(fixed)**	**0.1**	**0.000**
5p^2 5d*	**E0(5p^2 5d)**	**249724.4**	**51.0**	**249749.8**	**1.000**
	F2(5p, 5p)	**37469.0**	**580.0**	**44140.0**	**0.849**
	alfa(5p)	**7.3**	**37.0**		
	zeta(5p)	**4411.5**	**138.0**	**4383.8**	**1.006**
	zeta(5d)	**222.9**	**79.0**	**203.8**	**1.094**
	F2(5p, 5d)	**25560.6**	**500.0**	**29897.3**	**0.855**
	G1(5p, 5d)	**24398.4**	**209.0**	**32591.1**	**0.749**
	G3(5p, 5d)	**15241.3**	**517.0**	**20437.7**	**0.746**
5s 5p^2-5s^2 6s	R1(5p,5p;5s, 6s)	1752.9	(fixed)	2337.1	0.750
5s 5p^2 -5s^2 7s	R1(5p, 5p; 5s, 7s)	1271.3	(fixed)	1695.1	0.750
5s 5p^2 -5s^2 8s	R1(5p, 5p; 5s, 8s)	952.2	(fixed)	1269.6	0.750
5s 5p^2 -5s^2 9s	R1(5p, 5p; 5s, 9s)	741.4	(fixed)	988.5	0.750
5s 5p^2 -5s^2 5d	R1(5p, 5p; 5s, 5d)	28808.6	(fixed)	38411.5	0.750
5s 5p^2 -5s^2 6d	R1(5p, 5p; 5s, 6d)	13802.4	(fixed)	18403.2	0.750
5s 5p^2 -5s^2 7d	R1(5p, 5p; 5s, 7d)	8866.3	(fixed)	11821.7	0.750
5s 5p^2-5p^2 5d	R1(5s, 5p; 5p, 5d)	30866.1	(fixed)	41154.7	0.750
	R2(5s, 5p;5d, 5p)	21353.5	(fixed)	28471.4	0.750
5s^2 5d-5p^2 5d	R1(5s, 5s; 5p, 5p)	43437.8	(fixed)	57917.0	0.750
	Sigma =		255.00		

Table 3: Observed and Least Square Fitted (LSF) Energy levels in cm^{-1} for Even Parity Configurations of Sb III

E(obs)	E(LSF)	diff.	LS-composition.
			J=1/2
57961	57927	34	99% 5s 5p^2 (<2>3P)^{4}P
	95871	-	72% 5s 5p^2 (<0>1S)^{2}S + 17% 5s 5p^2 (<2>3P)^{2}P+ 10% 5s^2 6s ^{2}S
	98827	-	84% 5s^2 6s ^{2}S + 12% 5s 5p^2 (<2>3P)^{2}P
	100492	-	73% 5s 5p^2 (<2>3P)2P + 19% 5s 5p^2 (<0>1S)^{2}S+ 6% 5s^2 6s ^{2}S
143131	143131	0	100% 5s^2 7s ^{2}S
165307	165307	0	100% 5s^2 8s ^{2}S
177770	177770	0	100% 5s^2 9s ^{2}S
238683	238830	147	83% 5p^2 5d (<2>3P)^{4}D + 14% 5p^2 5d (<2>3P)^{2}P
244470.5	244558	87.5	75% 5p^2 5d (<2>3P)^{2}P + 14% 5p^2 5d (<2>3P)^{4}D+ 8% 5p^2 5d (<2>1D)^{2}P
249031.7	248811	220.7	94% 5p^2 5d (<2>3P)^{4}P

264054.7	263899	155	88% 5p^2 5d (<2>1D)^{2}S + 10% 5p^2 5d (<2>1D)^{2}P
265643.4	265833	189.6	75% 5p^2 5d (<2>1D)^{2}P + 10% 5p^2 5d (<2>3P)^{2}P+ 11% 5p^2 5d (<2>1D)^{2}S
			J=3/2
60945	59028	-	100% 5s 5p^2 (<2>3P)^{4}P
76528	76025	503	73% 5s 5p^2 (<2>1D)^{2}D + 25% 5s^2 5d ^{2}D
98824	99397	575	69% 5s^2 5d ^{2}D + 23% 5s 5p^2 (<2>1D)^{2}D+ 7% 5s 5p^2 (<2>3P)^{2}P
101954	101914	40	91% 5s 5p^2 (<2>3P)^{2}P
144685	144685	0	99% 5s^2 6d ^{2}D
166081.0*	**166081**	**0**	**100% 5s^2 7d ^{2}D**
233164.8	233055	109.8	90% 5p^2 5d (<2>3P)4F + 4% 5p^2 5d (<2>3P)^{4}D
238216	238159	57	49% 5p^2 5d (<2>3P)^{2}P + 32% 5p^2 5d (<2>3P)^{4}D+ 8% 5p^2 5d (<2>1D)^{2}P + 8% 5p^2 5d (<2>3P)^{4}F
240998	240995	3	56% 5p^2 5d (<2>3P)^{4}D + 32% 5p^2 5d (<2>3P)^{2}P+ 5% 5p^2 5d (<2>1D)^{2}P
248166	248071	95	91% 5p^2 5d (<2>3P)^{4}P
255363	255291	72	66% 5p^2 5d (<2>1D)^{2}D + 15% 5p^2 5d (<2>3P)^{2}D+ 10% 5p^2 5d (<0>1S)^{2}D
258549.2	258543	6.2	54% 5p^2 5d (<2>3P)^{2}D + 29% 5p^2 5d (<2>1D)^{2}D+ 13% 5p^2 5d (<0>1S)^{2}D
268366	268361	5	78% 5p^2 5d (<2>1D)^{2}P + 14% 5p^2 5d (<2>3P)^{2}P
277299.8	277292	7.8	70% 5p^2 5d (<0>1S)^{2}D + 26% 5p^2 5d (<2>3P)^{2}D
			J=5/2
60562.3	60594	31.7	99% 5s 5p^2 (<2>3P)^{4}P
75808.5	76312	503.5	73% 5s 5p^2 (<2>1D)^{2}D + 25% 5s^2 5d ^{2}D
100386	99852	534	73% 5s^2 5d ^{2}D + 25% 5s 5p^2 (<2>1D)^{2}D
144921	144921	0	99% 5s^2 6d ^{2}D
166197.0*	166197	0	100% 5s^2 7d ^{2}D
234528.7*	234530	1.3	90% 5p^2 5d (<2>3P)^{4}F + 13% 5p^2 5d (<2>3P)^{4}D
238521.8*	238524.0	2.2	36% 5p^{2}5d (<2>1D)^{2}F +31% 5p^{2}5d (<2>3P)^{2}F+24% 5p^{2}5d (<2>3P)^{4}D +6% 5p^{2}5d (<2>3P)^{4}F
241382.7*	241345.0	37.7	54% 5p^{2}5d (<2>3P)^{4}D +17% 5p^{2}5d (<2>3P)^{2}F+14% 5p^{2}5d (<2>1D)2F +9% 5p^{2}5d (<2>3P)^{4}P
246259.0*	246595.0	336.0	82% 5p^2 5d (<2>3P)^{4}P + 9% 5p^2 5d (<2>3P)^{4}D+ 8% 5p^2 5d (<2>1D)^{2}D
254609.9*	254727.0	117.1	70% 5p^{2}5d (<2>1D)^{2}D +19% 5p^{2}5d (<2>3P)^{2}D+ 4% 5p^2 5d (<2>3P)^{4}P + 4% 5p^2 5d (<0>1S)^{2}D
261823.8*	261722.0	101.8	40% 5p^2 5d (<2>3P)^{2}D + 21% 5p^{2}5d (<2>3P)^{2}F+27% 5p^{2}5d (<2>1D)^{2}F+10% 5p^{2}5d (<2>1D)^{2}D
265610.6*	265674.0	63.4	35% 5p^{2}5d (<2>3P)^{2}D + 21% 5p^{2}5d (<2>1D)^{2}F+ 17% 5p^{2}5d (<0>1S)^{2}D + 17% 5p^{2}5d (<2>3P)^{2}F
275488.4*	275478.0	10.4	73% 5p^{2}5d (<0>1S)^{2}D + 16% 5p^{2}5d (<2>3P)^{2}D+ 5% 5p^{2}5d (<2>3P)^{2}F
			J=7/2
164302.0	164301.0	1.0	100% 5s^{2}5g ^{2}G
176540.0	176540.0	0.0	100% 5s^{2}6g ^{2}G
183924.0*	183924.0	0.0	100% 5s^{2}7g ^{2}G
236643.9*	236689.0	45.1	90% 5p^{2}5d (<2>3P)^{4}F + 9% 5p^2 5d (<2>3P)^{4}D
240005.2*	240080.0	74.8	50% 5p^{2}5d (<2>3P)^{4}D +26% 5p^{2}5d (<2>1D)^{2}F+ 17% 5p^{2}5d (<2>3P)^{2}F + 5% 5p^{2}5d (<2>3P)^{4}F
245492.2*	245513.0	20.8	42% 5p^{2}5d (<2>3P)^{4}D + 26% 5p^{2}5d (<2>3P)^{2}F+ 24% 5p^{2}5d (<2>1D)^{2}F + 4% 5p^{2}5d (<2>3P)^{4}F
251583.1*	251712.0	128.9	92% 5p^2 5d (<2>1D)^{2}G + 8% 5p^2 5d (<2>1D)^{2}F
264425.8*	264394.0	31.8	55% 5p^2 5d (<2>3P)^{2}F + 42% 5p^2 5d (<2>1D)^{2}F
			J=9/2
164302.0	164303.0	1.0	100% 5s^2 5g ^{2}G
176540.0	176540.0	0.0	100% 5s^2 6g ^{2}G
183924.0*	183924.0	0.0	100% 5s^2 7g ^{2}G
239298.9*	239128.0	170.9	95% 5p^2 5d (<2>3P)^{4}F + 5% 5p^2 5d (<2>1D)^{2}G
252986.4*	252715.0	271.4	95% 5p^2 5d (<2>1D)^{2}G + 5% 5p^2 5d (<2>3P)^{4}F
			*Shows newly established energy levels

4. Conclusions

One electron structure of Sb III has already been reported by Arcimowicz, Joshi and Kaufman [5] but its major and complicated three electron system 5p^3, 5s5p5d and 5s5p6s configurations published by tazeen [13]. Isoelectronic plots of the unperturbed levels were quite helpful to spot out the transition within 1Å. This provided the shift from the *ab initio* calculations. Consequently 5s^{2}7p, 5s^{2}8p, 5s^{2}9p and 5s^{2}5f, for odd parity and 5p^{2}5d [j= ½ , 3/2] and 5s^{2}9s for even parity was published by tazeen [14] . My investigation for this paper is three Configurations 5p^{2}5d (j=5/2, 7/2, 9/2), 5s^{2}7d and 5s^{2}7g and have been established in this paper

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