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Extended Analysis of the Spectrum of Triply-ionized Ytterbium (Yb IV) and Transition Probabilities

Jean-François Wyart[1]*, Wan-Ü Lydia Tchang-Brillet[2], Nissan Spector[3], Patrick Palmeri[4], Pascal Quinet[4] and Emile Biémont[4,5]

[1] Laboratoire Aimé Cotton (CNRS UPR 3321), Centre universitaire, F-91405 Orsay (France)
[2] Département DAMAP, Observatoire de Paris-Meudon, UMR 8588 du CNRS, F-92195, Meudon Cedex, France, also Université Pierre et Marie Curie, Paris 6, France
[3] Soreq Nuclear Research Centre, Yavne, Israel
[4] Astrophysique et Spectroscopie, Université de Mons-Hainaut, B-7000 Mons, Belgium
[5] I.P.N.E. (Bât. B15), Université de Liège, Sart Tilman, B-4000 Liège, Belgium

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Table I: full version included at end of file

Abstract

The spectrum of Yb IV has been reinvestigated and its analysis has been extended. The present work is supported by the comparison of line intensities with transition probabilities derived from the Cowan (1981) codes. Starting from the first analysis by Sugar, Kaufman and Spector (1978), the number of established levels has been increased from 111 to 193, including high excitation levels of the new $4f^{12}7s+4f^{12}6d$ even configurations. Of the 1023 classified lines about one half are new. Computed transition probabilities are given for selected lines.

1. Introduction

The Yb^{3+} ion has been studied in various crystal lattices, because the $^2F_{5/2}$–$^2F_{7/2}$ decay within its ground configuration $4f^{13}$ may lead to powerful diode-pumped lasers [1]. The free ion spectrum was first observed by Bryant [2,3], but the breakthrough in the analysis was achieved by Sugar, Kaufman and Spector [4] after new observations with the 10.7m normal incidence VUV spectrograph at NBS. All the 944 lines attributed to Yb IV in the wavelength region of 700-2200Å were tabulated and most of the strong lines were explained by transitions involving the lowest levels of the configurations $4f^{12}5d$, $4f^{12}6s$ and $4f^{12}6p$. A provisional step of this analysis had been compiled by Martin, Zalubas and Hagan [5].

Nevertheless a few prominent lines in the region of 800-1200Å, where $4f^{13}$-$4f^{12}5d$ transitions take place, were left unclassified and this led us to perform a parametric study of the energy levels by means of the Cowan codes [6]. The comparison of transition probabilities with experimental intensities showed a general agreement with a few striking exceptions. In particular, it was noticed that the transition from the level $4f^{12}(^3H_6)5d_{5/2}$ $J=9/2$ at 88112 cm^{-1} to the ground level was not identified in [4], in spite of its relatively large gA value. On the other hand, a strong line at 1134.426Å (88150.30 cm^{-1}) was unclassified. This led us to review the connection of the $4f^{12}$nl levels with $J > 9/2$, built on $4f^{12}$ $^3H_6$ and $^3H_5$ parent terms, to the ground doublet $4f^{13}$ $^2F_{5/2,\ 7/2}$. We found that if an upward shift of 31.8 cm^{-1} is applied to the previous energy values of 13 odd-parity and 21 even-parity levels, then several strong lines including the one at 1134.426Å could be identified and the analysis could be extended. In the present work, part of the spectral plates used in [4] and covering the wavelength range of 600–1530 Å, were remeasured at the Observatoire de Paris-Meudon in order to confirm, by means of weak lines, some levels based on only a few strong transitions. In addition, oscillator strengths and transition probabilities were calculated using a relativistic Hartree-Fock model including core-polarization corrections.

2. Results and discussion

2.1. *Classified lines and new energy levels*

The levels found in [4] were built on the parent terms ^3H, ^3F, ^1G, ^1D and ^1I of $4f^{12}$. All the transitions involving the $^1I_6$ parent form a subsystem that was connected to the main system by two lines only, but this connection was considered as tentative in [4]. The present study of transition probabilities by means of the Cowan codes [6] led us to search for an alternative connection. All the levels of the $4f^{12}(^1I)nl$ sub-configurations are now 170.2 cm^{-1} above their previous positions and the revision is supported by the classification of 4 lines from ref. [4] and several newly measured weak lines. The *J*-values of 3 levels have been changed by one unit. Six levels (99180, 102850, 102875, 106001, 106557, 113049 cm^{-1}) were given new energies, with more transitions and a better agreement of their observed intensities *vs.* transition probabilities. Most of the other new levels have a *J*-value of 3/2 or 5/2 and are built on the $4f^{12}$ ^3P parent term. The levels with $4f^{12}$ ^1S parent could not be located.

It had been pointed out in [3] that an observed transition array near 1580 Å should involve 6p-7s transitions. A few tentative levels were mentioned in [4] but remained unpublished, leaving 80% of the lines in the region 1550-1620 Å unclassified. In the present work, we established the lowest levels of $4f^{12}7s$ and $4f^{12}6d$. Owing to the predictions of intensities given by the RCG code [6], this classification was performed with the support of the IDEN package by Azarov [7] applied to an extended list of 1400 Yb IV lines. Table I[1] gives all the lines classified in the pre-

* wya@lac.u-psud.fr

[1] see end of PDF file

Table I. *Classified lines of Yb IV. In the columns are (1) the observed wavelengths in Å (wavelengths longer than 2000 Å are values in air), (2) the deviation λ_{obs}-λ_{RITZ}, λ_{RITZ} being calculated from the optimized energy level values, (3) the intensities according to ref.[4], or in the same scale for new lines, (4) a note explained in the bottom lines ot the Table, (5) the corresponding vacuum wavenumber σ_{obs} in cm^{-1}, (6) the odd parity level E^o J^o and (7) the even parity level E^e J^e of the transition. (See www.physica.org/digidata/v063p02a00113/tables/tableI.pdf).*

Table II. *Energy levels of Yb IV. In the columns are (1) the quantum number J, (2) the energy E_{obs} (in cm^{-1}), (3) a note explained in the bottom lines of the Table for the new or revised levels, (4) the calculated energy E_{cal}, (5) the electronic configuration, (6) the name and squared amplitude for the first components and (7) of the second components of the calculated eigenvector, (8) the difference $\Delta E = E_{obs} - E_{cal}$.*

Odd parity levels

(1)	(2)	(3)	(4)	(5)	- - - (6) - - -		- - - (7) - - -		(8)
J	E_{obs}		E_{cal}	conf.	1st component		2nd component		ΔE
7/2	0.00		0	$4f^{13}$	^2F	99.6			0
5/2	10213.86		10214	$4f^{13}$	^2F	99.6			0
11/2	152621.05	R	152643	$4f^{12}6p$	($^3H_6$,1/2)	96.7	($^3H_6$,3/2)	1.8	−22
13/2	153240.36	R	153242	$4f^{12}6p$	($^3H_6$,1/2)	98.7	($^3H_6$,3/2)	0.9	−2
7/2	158935.51		158940	$4f^{12}6p$	($^3F_4$,1/2)	61.5	($^1G_4$,1/2)	30.8	−5
9/2	158971.44	R	158977	$4f^{12}6p$	($^3F_4$,1/2)	56.6	($^1G_4$,1/2)	26.8	−5
15/2	161142.36	R	161128	$4f^{12}6p$	($^3H_6$,3/2)	99.0	($^1I_6$,3/2)	0.9	15
9/2	161851.88	R	161851	$4f^{12}6p$	($^3H_6$,3/2)	60.7	($^3H_5$,1/2)	28.5	0
11/2	162093.66	R	162085	$4f^{12}6p$	($^3H_6$,3/2)	55.6	($^3H_5$,1/2)	41.4	9
13/2	162666.91	R	162679	$4f^{12}6p$	($^3H_6$,3/2)	98.7	($^1I_6$,3/2)	0.9	−11
9/2	163023.68	R	163030	$4f^{12}6p$	($^3H_5$,1/2)	69.3	($^3H_6$,3/2)	28.3	−6
11/2	163034.43	R	163025	$4f^{12}6p$	($^3H_5$,1/2)	57.9	($^3H_6$,3/2)	39.9	9
9/2	167196.22		167198	$4f^{12}6p$	($^3H_4$,1/2)	37.5	($^3F_4$,3/2)	21.1	−1
7/2	167413.37		167416	$4f^{12}6p$	($^3H_4$,1/2)	47.5	($^3F_4$,1/2)	24.5	−3
5/2	167590.75		167566	$4f^{12}6p$	($^3F_4$,3/2)	39.9	($^1G_4$,3/2)	28.0	25
11/2	168053.40	R	168034	$4f^{12}6p$	($^3F_4$,3/2)	59.1	($^1G_4$,3/2)	30.8	19
9/2	168124.60	N	168140	$4f^{12}6p$	($^3F_4$,3/2)	43.6	($^3H_4$,1/2)	19.4	−15
7/2	168126.55	J	168120	$4f^{12}6p$	($^3F_4$,3/2)	45.5	($^1G_4$,3/2)	22.7	6
5/2	169279.75		169291	$4f^{12}6p$	($^3F_3$,1/2)	84.1	($^3F_2$,1/2)	10.7	−12
7/2	169417.43		169437	$4f^{12}6p$	($^3F_3$,1/2)	61.0	($^3F_4$,3/2)	15.3	−20
3/2	169733.24		169742	$4f^{12}6p$	($^3F_2$,1/2)	73.0	($^1D_2$,1/2)	23.6	−9
5/2	170669.58		170621	$4f^{12}6p$	($^3F_2$,1/2)	50.4	($^3F_4$,3/2)	16.2	49
13/2	171006.63	R	170992	$4f^{12}6p$	($^3H_5$,3/2)	99.9			15
7/2	171510.39		171512	$4f^{12}6p$	($^3H_5$,3/2)	76.0	($^3F_3$,1/2)	20.4	−2
9/2	171867.02		171851	$4f^{12}6p$	($^3H_5$,3/2)	96.2	($^3H_5$,1/2)	1.3	16
11/2	172243.23	R	172240	$4f^{12}6p$	($^3H_5$,3/2)	99.2	($^3H_5$,1/2)	0.5	3
5/2	175765.09		175769	$4f^{12}6p$	($^3H_4$,3/2)	55.9	($^3F_4$,3/2)	27.6	−4
11/2	176135.00	R	176146	$4f^{12}6p$	($^3H_4$,3/2)	56.5	($^3F_4$,3/2)	29.3	−11
9/2	176478.90		176490	$4f^{12}6p$	($^3H_4$,3/2)	43.8	($^3F_4$,3/2)	19.2	−11
7/2	176542.74		176549	$4f^{12}6p$	($^3H_4$,3/2)	51.1	($^3F_4$,3/2)	26.9	−6
9/2	177343.11		177341	$4f^{12}6p$	($^1G_4$,1/2)	41.0	($^3H_4$,1/2)	28.8	2
7/2	177796.25		177768	$4f^{12}6p$	($^1G_4$,1/2)	45.7	($^3H_4$,1/2)	31.7	29
7/2	178036.62		178052	$4f^{12}6p$	($^3F_3$,3/2)	83.3	($^1G_4$,1/2)	7.1	−15
5/2	178049.82		178050	$4f^{12}6p$	($^3F_3$,3/2)	65.8	($^3F_2$,3/2)	22.3	0
3/2			178180	$4f^{12}6p$	($^3F_3$,3/2)	58.8	($^3F_2$,3/2)	28.1	
9/2	178524.89		178546	$4f^{12}6p$	($^3F_3$,3/2)	93.4	($^3H_4$,3/2)	2.3	−21
5/2	178684.75		178697	$4f^{12}6p$	($^3F_2$,3/2)	46.9	($^3F_3$,3/2)	32.8	−13
1/2	178823.87	N	178779	$4f^{12}6p$	($^3F_2$,3/2)	76.0	($^1D_2$,3/2)	20.4	45
3/2			178975	$4f^{12}6p$	($^3F_2$,3/2)	47.4	($^3F_3$,3/2)	37.8	
7/2	179305.55		179280	$4f^{12}6p$	($^3F_2$,3/2)	67.0	($^1D_2$,3/2)	21.3	26
5/2	184355.37		184377	$4f^{12}6p$	($^1D_2$,1/2)	35.9	($^3P_2$,1/2)	29.2	−22
3/2	184467.39		184460	$4f^{12}6p$	($^3P_2$,1/2)	40.0	($^1D_2$,1/2)	35.8	8
5/2	185869.35		185871	$4f^{12}6p$	($^1G_4$,3/2)	45.7	($^3H_4$,3/2)	31.7	−2
11/2	185907.11		185900	$4f^{12}6p$	($^1G_4$,3/2)	54.0	($^3H_4$,3/2)	35.0	7
7/2	185972.22		185980	$4f^{12}6p$	($^1G_4$,3/2)	53.3	($^3H_4$,3/2)	36.8	−8
9/2	186462.00		186487	$4f^{12}6p$	($^1G_4$,3/2)	52.7	($^3H_4$,3/2)	38.2	−25
13/2	191837.18	I	191843	$4f^{12}6p$	($^1I_6$,1/2)	97.1	($^1I_6$,3/2)	2.0	−6
11/2	191978.97	I	191983	$4f^{12}6p$	($^1I_6$,1/2)	94.7	($^1I_6$,3/2)	3.1	−4
1/2			192038	$4f^{12}6p$	($^3P_1$,1/2)	41.1	($^3P_2$,1/2)	19.4	
5/2	192674.05		192729	$4f^{12}6p$	($^3P_2$,3/2)	39.7	($^1D_2$,3/2)	36.5	−55
1/2			193079	$4f^{12}6p$	($^3P_0$,1/2)	74.3	($^3P_1$,1/2)	12.2	
3/2			193117	$4f^{12}6p$	($^1D_2$,3/2)	33.5	($^3P_2$,3/2)	27.9	
7/2	193410.18		193462	$4f^{12}6p$	($^3P_2$,3/2)	40.7	($^1D_2$,3/2)	38.2	−52
3/2			194690	$4f^{12}6p$	($^3P_1$,1/2)	77.4	($^1D_2$,3/2)	8.4	

Table II. *Continued.*

Odd parity levels									
(1)	(2)	(3)	(4)	(5)	- - - (6) - - -		- - - (7) - - -		(8)
J	E_{obs}		E_{cal}	conf.	1st component		2nd component		ΔE
1/2			194845	$4f^{12}6p$	$(^3P_1,1/2)$	43.9	$(^1D_2,3/2)$	24.2	
3/2			196179	$4f^{12}6p$	$(^3P_2,1/2)$	49.0	$(^1D_2,1/2)$	37.7	
5/2	196270.33	N	196245	$4f^{12}6p$	$(^3P_2,1/2)$	56.8	$(^1D_2,1/2)$	36.4	26
9/2	199616.3	I	199606	$4f^{12}6p$	$(^1I_6,3/2)$	98.7	$(^3H_6,3/2)$	1.0	11
15/2	199896.9	I	199882	$4f^{12}6p$	$(^1I_6,3/2)$	99.0	$(^3H_6,3/2)$	0.9	15
3/2			201558	$4f^{12}6p$	$(^3P_0,3/2)$	85.7	$(^1S_0,1/2)$	5.7	
11/2	202063.3	I	202067	$4f^{12}6p$	$(^1I_6,3/2)$	96.0	$(^1I_6,3/2)$	2.0	−3
5/2			202394	$4f^{12}6p$	$(^3P_1,3/2)$	88.8	$(^1D_2,3/2)$	5.7	
13/2	202469.2	I	202482	$4f^{12}6p$	$(^1I_6,3/2)$	97.1	$(^1I_6,3/2)$	3.2	−12
1/2			202767	$4f^{12}6p$	$(^3P_1,3/2)$	96.5	$(^3P_1,1/2)$	1.9	
3/2			203592	$4f^{12}6p$	$(^3P_1,3/2)$	88.4	$(^1D_2,3/2)$	3.5	
5/2	204410.73	N	204390	$4f^{12}6p$	$(^3P_2,3/2)$	53.5	$(^1D_2,3/2)$	32.1	21
7/2	205224.69	N	205197	$4f^{12}6p$	$(^3P_2,3/2)$	56.6	$(^1D_2,3/2)$	38.2	28
3/2			205421	$4f^{12}6p$	$(^3P_2,3/2)$	56.1	$(^1D_2,3/2)$	28.7	
1/2			206396	$4f^{12}6p$	$(^3P_2,3/2)$	59.5	$(^1D_2,3/2)$	35.5	
1/2			235698	$4f^{12}6p$	$(^1S_0,1/2)$	92.9	$(^3P_0,1/2)$	6.7	
3/2			244343	$4f^{12}6p$	$(^1S_0,3/2)$	93.1	$(^3P_0,3/2)$	6.5	
Even parity levels									
9/2	78561.20	R	78718	$4f^{12}5d$	$(^3H)^4F$	78.7	$(^3H)^4G$	10.6	−157
15/2	82217.51	R	82217	$4f^{12}5d$	$(^3H)^2K$	53.6	$(^3H)^4K$	39.4	1
11/2	82705.07	R	82730	$4f^{12}5d$	$(^3H)^4G$	76.7	$(^3H)^4H$	13.6	−25
7/2	84347.15		84416	$4f^{12}5d$	$(^3H)^4F$	46.8	$(^3F)^4F$	15.4	−69
17/2	85156.82	R	85187	$4f^{12}5d$	$(^3H)^4K$	99.0	$(^1I)^2L$	1.0	−30
13/2	85577.64	R	85487	$4f^{12}5d$	$(^3H)^4I$	33.4	$(^3H)^4H$	30.1	90
9/2	88150.15	R	88109	$4f^{12}5d$	$(^3H)^4G$	30.3	$(^3H)^2G$	14.4	41
11/2	88207.24	R	88169	$4f^{12}5d$	$(^3H)^2H$	27.3	$(^3H)^4G$	15.3	38
5/2	88322.02		88284	$4f^{12}5d$	$(^3F)^4D$	22.1	$(^1G)^2F$	21.2	38
15/2	88909.21	R	88931	$4f^{12}5d$	$(^3H)^4I$	83.3	$(^3H)^2K$	14.8	−22
13/2	89454.46	R	89420	$4f^{12}5d$	$(^3H)^4H$	38.7	$(^3H)^4I$	17.5	35
7/2	89520.30		89575	$4f^{12}5d$	$(^3H)^4F$	20.3	$(^3H)^4G$	13.5	−54
9/2	90045.61		90124	$4f^{12}5d$	$(^3H)^4G$	23.7	$(^3F)^4F$	19.0	−78
11/2	90866.06	R	90820	$4f^{12}5d$	$(^3H)^2H$	20.4	$(^1G)^2I$	15.0	46
5/2	91482.25		91451	$4f^{12}5d$	$(^3H)^4F$	59.3	$(^3F)^4F$	16.0	31
7/2	91532.55		91605	$4f^{12}5d$	$(^3H)^2F$	54.7	$(^3H)^4G$	13.7	−72
13/2	91963.75	R	91964	$4f^{12}5d$	$(^3H)^4K$	49.2	$(^3H)^2I$	28.7	−1
11/2	93112.72	R	93215	$4f^{12}5d$	$(^3F)^4G$	47.9	$(^1G)^2H$	14.9	−103
3/2	93217.89	N	93038	$4f^{12}5d$	$(^3H)^4F$	29.3	$(^1G)^2D$	27.8	180
9/2	94387.08		94444	$4f^{12}5d$	$(^3F)^4F$	33.1	$(^3F)^2G$	17.3	−57
5/2	94498.37		94489	$4f^{12}5d$	$(^3F)^4P$	27.4	$(^3H)^4G$	21.8	10
7/2	94834.11		94740	$4f^{12}5d$	$(^3F)^4D$	20.5	$(^1G\ ^2G$	17.8	94
11/2	95109.97	R	95069	$4f^{12}5d$	$(^3H)^4I$	41.5	$(^3H)^2H$	36.8	41
9/2	95215.74		95161	$4f^{12}5d$	$(^3H)^2G$	45.9	$(^3H)^4H$	20.8	54
13/2	95348.81	R	95282	$4f^{12}5d$	$(^3F)^4H$	31.0	$(^1G)^2I$	29.3	66
15/2	95612.36	R	95611	$4f^{12}5d$	$(^3H)^4K$	59.4	$(^3H)^2K$	30.7	2
7/2	95977.05		95937	$4f^{12}5d$	$(^3H)^4G$	29.6	$(^3F)^4D$	17.7	40
3/2	96597.05	N	96675	$4f^{12}5d$	$(^3F)^4D$	35.6	$(^3F)^4F$	31.4	−78
11/2	97588.21		97612	$4f^{12}5d$	$(^3H)^4K$	39.6	$(^3F)^2H$	27.6	−24
9/2	97624.67	R	97599	$4f^{12}5d$	$(^3H)^4G$	24.2	$(^3H)^2G$	18.4	25
5/2	98222.84		98284	$4f^{12}5d$	$(^3H)^2F$	26.6	$(^3F)^4G$	19.7	−61
7/2	98502.45		98582	$4f^{12}5d$	$(^3F)^4G$	36.6	$(^3F)^4H$	17.6	−80
9/2	98971.68		99022	$4f^{12}5d$	$(^3H)^4I$	25.0	$(^3H)^2H$	21.9	−50
13/2	99197.48	R	99227	$4f^{12}5d$	$(^3H)^4I$	57.7	$(^3H)^2I$	23.2	−30
11/2	99236.42	N	99177	$4f^{12}5d$	$(^3H)^4H$	42.8	$(^3H)^2I$	16.7	59
5/2	99344.77		99391	$4f^{12}5d$	$(^3F)^4G$	44.8	$(^3H)^2F$	11.7	−46
3/2	100128.73	N	100038	$4f^{12}5d$	$(^3F)^2P$	34.0	$(^1D)^2D$	16.5	91
7/2	100350.27		100322	$4f^{12}5d$	$(^3F)^4H$	25.1	$(^3F)^2F$	21.6	28
1/2			100855	$4f^{12}5d$	$(^3F)^4D$	76.4	$(^1D)^2P$	7.2	
5/2	101318.22		101279	$4f^{12}5d$	$(^3H)^4G$	25.7	$(^3F)^4F$	23.7	39
13/2	101805.30	N	101816	$4f^{12}5d$	$(^3H)^2K$	37.8	$(^3F)^4H$	35.6	−11
9/2	101966.58		101921	$4f^{12}5d$	$(^3F)^4H$	35.8	$(^3F)^2G$	20.2	46
5/2	102158.11		102133	$4f^{12}5d$	$(^3F)^4P$	22.6	$(^3F)^4F$	19.9	25
3/2	102512.73		102460	$4f^{12}5d$	$(^3H)^4F$	35.2	$(^3F)^2P$	25.6	52
7/2	102542.47		102554	$4f^{12}5d$	$(^3F)^4F$	35.4	$(^3F)^4G$	12.9	−12
9/2	102790.11	N	102813	$4f^{12}5d$	$(^3F)^4F$	26.5	$(^3F)^4G$	18.6	−23
11/2	102875.41	N	102963	$4f^{12}5d$	$(^3H)^2I$	29.6	$(^1G)^2H$	26.0	−88
5/2	103484.02		103458	$4f^{12}5d$	$(^3F)^4D$	31.3	$(^3F)^2F$	25.4	26
7/2	104225.95		104201	$4f^{12}5d$	$(^3F)^2G$	59.2	$(^3H)^4H$	9.8	25

Table II. *Continued.*

Odd parity levels									
(1)	(2)	(3)	(4)	(5)	- - - (6) - - -		- - - (7) - - -		(8)
J	E_{obs}		E_{cal}	conf.	1st component		2nd component		ΔE
9/2	104613.47		104637	$4f^{12}5d$	$(^3F)^2H$	38.6	$(^3F)^4G$	19.6	−24
3/2	105154.50	N	105165	$4f^{12}5d$	$(^3F)^4P$	79.3	$(^3F)^4D$	7.4	−10
7/2	105685.33		105599	$4f^{12}5d$	$(^3F)^2F$	35.6	$(^3H)^2G$	16.9	86
1/2			105780	$4f^{12}5d$	$(^3F)^2P$	37.5	$(^3F)^4P$	28.3	
13/2	106010.72	R	105980	$4f^{12}6s$	$(^3H)^4H$	99.0	$(^1I)^2I$	0.9	31
7/2	106040.08		105987	$4f^{12}5d$	$(^1G)^2F$	18.7	$(^3F)^4H$	16.7	53
3/2	106299.67		106197	$4f^{12}5d$	$(^3F)^4F$	23.3	$(^3F)^2D$	21.9	103
11/2	106444.30	N	106488	$4f^{12}5d$	$(^3F)^4H$	53.6	$(^3H)^4H$	13.6	−44
1/2			106641	$4f^{12}5d$	$(^3F)^4P$	48.2	$(^3F)^2P$	41.3	
11/2	106833.65	R	106846	$4f^{12}6s$	$(^3H)^2H$	63.5	$(^3H)^4H$	31.9	−12
11/2	107117.94	N	107166	$4f^{12}5d$	$(^1G)^2I$	44.7	$(^3F)^2H$	23.8	−48
9/2	107566.36		107578	$4f^{12}5d$	$(^3F)^2H$	29.1	$(^1G)^2G$	19.7	−12
5/2	107873.37		107946	$4f^{12}5d$	$(^3F)^2D$	47.2	$(^3F)^2F$	15.8	−73
9/2	109025.19		109089	$4f^{12}5d$	$(^1G)^2H$	38.6	$(^3H)^4I$	20.7	−64
5/2	109413.50		109279	$4f^{12}5d$	$(^1G)^2D$	47.8	$(^3H)^2F$	16.3	135
7/2	110808.74		110738	$4f^{12}5d$	$(^1G)^2F$	31.1	$(^3H)^2G$	21.3	71
13/2	111528.16	N	111513	$4f^{12}5d$	$(^1G)^2I$	54.7	$(^3H)^2K$	18.0	15
7/2	111550.62		111540	$4f^{12}5d$	$(^3H)^4H$	30.0	$(^1G)^2G$	29.6	10
9/2	112221.27	R	112242	$4f^{12}6s$	$(^3F)^4F$	63.8	$(^1G)^2G$	28.6	−21
3/2	112675.11		112670	$4f^{12}5d$	$(^1G)^2D$	47.4	$(^3H)^4F$	15.8	5
5/2	112679.15		112741	$4f^{12}5d$	$(^1G)^2F$	23.1	$(^1D)^2F$	12.3	−62
7/2	112772.56		112771	$4f^{12}6s$	$(^3F)^2F$	41.1	$(^1G)^2G$	31.7	2
9/2	112812.61		112826	$4f^{12}5d$	$(^1G)^2G$	31.6	$(^3H)^4H$	18.3	−14
11/2	112923.66	N	113041	$4f^{12}5d$	$(^1G)^2H$	42.7	$(^3H)^2I$	23.7	−117
1/2			115055	$4f^{12}5d$	$(^3P)^4D$	44.0	$(^1D)^2P$	31.1	
3/2	115835.49	N	116012	$4f^{12}5d$	$(^3P)^4D$	40.7	$(^3F)^2D$	21.6	−177
11/2	115942.68	R	115909	$4f^{12}6s$	$(^3H)^4H$	66.3	$(^3H)^2H$	33.4	34
7/2	115984.90		116038	$4f^{12}5d$	$(^3P)^4D$	28.1	$(^1D)^2F$	16.2	−53
9/2	116006.51	R	115980	$4f^{12}6s$	$(^3H)^4H$	66.8	$(^3H)^2H$	32.4	26
5/2	117026.11		116920	$4f^{12}5d$	$(^3F)^2F$	29.3	$(^1G)^2F$	19.3	106
15/2	118402.05	I	118422	$4f^{12}5d$	$(^1I)^2L$	97.2	$(^1I)^2K$	1.7	−20
7/2	118717.65		118758	$4f^{12}5d$	$(^1D)^2G$	24.0	$(^3P)^2F$	19.2	−41
3/2	119702.5	N	119648	$4f^{12}5d$	$(^1D)^2D$	22.6	$(^1D)^2P$	21.3	55
5/2	120328.83		120468	$4f^{12}5d$	$(^1D)^2F$	23.0	$(^3P)^4D$	20.3	−139
9/2	120634.44		120794	$4f^{12}5d$	$(^1I)^2G$	54.7	$(^3P)^4F$	10.4	−160
7/2	120667.18		120653	$4f^{12}6s$	$(^3H)^4H$	56.4	$(^3F)^4F$	16.3	14
9/2	120773.77		120893	$4f^{12}6s$	$(^3H)^2H$	33.3	$(^3F)^4F$	21.4	−119
1/2			120986	$4f^{12}5d$	$(^1D)^2S$	38.3	$(^3P)^4P$	20.7	
9/2	121008.13		120976	$4f^{12}5d$	$(^3P)^4F$	29.3	$(^1D)^2G$	25.2	33
5/2	122476.28		122489	$4f^{12}6s$	$(^3F)^4F$	88.6	$(^1D)^2D$	6.5	−13
17/2	122483.43	N	122369	$4f^{12}5d$	$(^1I)^2L$	99.0	$(^3H)^4K$	1.0	114
7/2	122650.21		122663	$4f^{12}6s$	$(^3F)^4F$	63.8	$(^3F)^2F$	34.3	−13
3/2	122787.28		122811	$4f^{12}6s$	$(^3F)^4F$	75.3	$(^1D)^2D$	22.0	−24
5/2	123710.47		123663	$4f^{12}6s$	$(^3F)^2F$	79.6	$(^1D)^2D$	17.1	47
1/2			124245	$4f^{12}5d$	$(^3P)^2P$	29.1	$(^3P)^4D$	27.5	
3/2	124478.85	N	124340	$4f^{12}5d$	$(^3P)^4F$	29.6	$(^3P)^4D$	19.3	138
5/2	124939.60		124886	$4f^{12}5d$	$(^3P)^4D$	41.2	$(^1D)^2D$	35.6	53
11/2	125067.40	I	125061	$4f^{12}5d$	$(^1I)^2H$	74.1	$(^1I)^2I$	24.3	7
7/2	125110.59		125128	$4f^{12}5d$	$(^1I)^2G$	85.0	$(^3H)^2G$	9.6	−18
3/2			125610	$4f^{12}5d$	$(^3P)^4F$	50.3	$(^3P)^4D$	12.5	
5/2	126399.30		126253	$4f^{12}5d$	$(^3P)^4F$	64.3	$(^3P)^2D$	15.1	146
7/2	126867.20		126841	$4f^{12}5d$	$(^3P)^4D$	39.4	$(^1D)^2F$	37.3	26
13/2	127215.28	I	127109	$4f^{12}5d$	$(^1I)^2K$	64.7	$(^1I)^2I$	33.3	107
9/2	127602.68	N	127646	$4f^{12}5d$	$(^1I)^2H$	93.8	$(^1I)^2G$	4.4	−43
5/2	128901.39	J	129012	$4f^{12}5d$	$(^3P)^2D$	64.2	$(^1D)^2F$	14.0	−111
7/2	129052.23	N	128967	$4f^{12}5d$	$(^3P)^4F$	63.6	$(^1D)^2G$	20.9	85
1/2			130066	$4f^{12}5d$	$(^3P)^4P$	62.1	$(^1D)^2P$	17.5	
3/2			130257	$4f^{12}5d$	$(^3P)^2P$	50.3	$(^1D)^2P$	12.5	
11/2	130302.70	N	130300	$4f^{12}5d$	$(^1I)^2I$	73.3	$(^1I)^2H$	24.6	3
7/2	130523.98		130519	$4f^{12}6s$	$(^1G)^2G$	56.1	$(^3H)^4H$	32.4	5
9/2	130676.78		130704	$4f^{12}6s$	$(^1G)^2G$	53.5	$(^3H)^2H$	23.9	−27
15/2	131025.64	I	131064	$4f^{12}5d$	$(^1I)^2K$	97.4	$(^1I)^2L$	1.7	−38
13/2	131059.37	I	131108	$4f^{12}5d$	$(^1I)^2I$	64.4	$(^1I)^2K$	34.3	−49
7/2	131292.10	N	131317	$4f^{12}5d$	$(^3P)^2F$	62.0	$(^3P)^4F$	16.8	−25
5/2	131395.86	J	131402	$4f^{12}5d$	$(^3P)^2F$	62.7	$(^3P)^4P$	10.1	−6
5/2	132218.40	N	132205	$4f^{12}5d$	$(^3P)^4P$	78.0	$(^3P)^2F$	15.1	14
3/2	132342.10	N	132400	$4f^{12}5d$	$(^3P)^2D$	33.1	$(^3P)^4P$	29.3	−58
9/2	132780.51	N	132741	$4f^{12}5d$	$(^3P)^4F$	54.2	$(^1D)^2G$	37.7	39

Table II. *Continued.*

Odd parity levels								
(1)	(2)	(3)	(4)	(5)	- - - (6) - - -		- - - (7) - - -		(8)
J	E_{obs}		E_{cal}	conf. 1st component			2nd component		ΔE
3/2	134551.70	N	134673	$4f^{12}5d$	$(^3P)^2D$	24.8	$(^3P)^2P$	24.2	−120
1/2			135795	$4f^{12}5d$	$(^3P)^2P$	60.8	$(^1D)^2S$	16.5	
5/2	137501.61		137518	$4f^{12}6s$	$(^3P)^4P$	40.7	$(^1D)^2D$	37.5	−17
3/2	137762.29		137769	$4f^{12}6s$	$(^1D)^2D$	42.8	$(^3P)^2P$	29.0	−7
13/2	145287.39	I	145276	$4f^{12}6s$	$(^1I)^2I$	99.1	$(^3H)^4H$	0.9	12
11/2	145298.94	I	145285	$4f^{12}6s$	$(^1I)^2I$	99.0	$(^3H)^2H$	0.7	14
1/2			145757	$4f^{12}6s$	$(^3P)^4P$	85.4	$(^3P)^2P$	8.6	
3/2			146974	$4f^{12}6s$	$(^3P)^4P$	88.4	$(^3P)^2P$	10.5	
1/2			147841	$4f^{12}6s$	$(^3P)^2P$	88.9	$(^3P)^4P$	10.2	
5/2	149135.77	N	149089	$4f^{12}6s$	$(^3P)^4P$	56.8	$(^1D)^2D$	38.5	47
3/2	149750.15	N	149742	$4f^{12}6s$	$(^3P)^2P$	58.7	$(^1D)^2D$	33.8	9
3/2			166897	$4f^{12}5d$	$(^1S)^2D$	91.6	$(^3P)^4F$	3.2	
5/2			170807	$4f^{12}5d$	$(^1S)^2D$	92.4	$(^3P)^2F$	2.0	
1/2			188552	$4f^{12}6s$	$(^1S)^2S$	93.3	$(^3P)^2P$	4.3	
9/2			223241	$4f^{12}6d$	$(^3H)^4F$	81.7	$(^3H)^4G$	14.1	
15/2	223773.87	N	223763	$4f^{12}6d$	$(^3H)^2K$	56.7	$(^3H)^4K$	34.5	11
11/2	223806.40	N	223965	$4f^{12}6d$	$(^3H)^4G$	77.5	$(^3H)^4H$	17.1	−158
13/2	224479.70	N	224506	$4f^{12}6d$	$(^3H)^4I$	29.3	$(^3H)^4H$	27.8	−26
17/2	224635.47	N	224476	$4f^{12}6d$	$(^3H)^4K$	99.0	$(^1I)^2L$	1.0	159
13/2	224681.17	N	224732	$4f^{12}7s$	$(^3H)^4H$	87.5	$d(^3H)^2I$	5.5	−51
11/2	224946.33	N	225000	$4f^{12}7s$	$(^3H)^2H$	69.7	$(^3H)^4H$	29.2	−54
15/2	225379.94	N	225296	$4f^{12}6d$	$(^3H)^4I$	85.8	$(^3H)^2K$	13.2	84
7/2	225522.85	N	225607	$4f^{12}6d$	$(^3H)^2F$	55.5	$(^3H)^4F$	32.5	−84
11/2	225597.2	N	225577	$4f^{12}6d$	$(^3H)^2H$	62.4	$(^3H)^4H$	14.6	20
13/2	225902.0	N	225792	$4f^{12}6d$	$(^3H)^4H$	60.3	$(^3H)^2I$	34.0	110
9/2			226036	$4f^{12}6d$	$(^3H)^2G$	56.0	$(^3H)^4G$	22.4	
7/2			229950	$4f^{12}6d$	$(^3F)^4D$	24.0	$(^3F)^4F$	23.6	
5/2			230075	$4f^{12}6d$	$(^3F)^4P$	25.6	$(^3F)^4D$	21.7	
9/2	230031.6	N	230102	$4f^{12}6d$	$(^3F)^4G$	24.8	$(^1G)^2H$	21.1	−70
11/2	230172.6	N	230170	$4f^{12}6d$	$(^3F)^2H$	24.0	$(^1G)^2I$	23.6	3
9/2	230789.2	N	230840	$4f^{12}7s$	$(^3F)^4F$	62.1	$(^1G)^2G$	29.7	−51
7/2			231005	$4f^{12}7s$	$(^3F)^2F$	44.5	$(^1G)^2G$	30.9	
11/2	231132.5	N	231053	$4f^{12}6d$	$(^3F)^4G$	43.9	$(^1G)^2H$	21.7	79
13/2	231135.7	N	231200	$4f^{12}6d$	$(^3F)^4H$	59.6	$(^1G)^2I$	30.6	−64
9/2	231341.5	N	231402	$4f^{12}6d$	$(^3F)^4F$	37.5	$(^3F)^2G$	23.2	−61
3/2			231521	$4f^{12}6d$	$(^3F)^2P$	34.8	$(^1G)^2D$	32.7	
5/2			231712	$4f^{12}6d$	$(^3F)^2D$	22.4	$(^3F)^4P$	22.0	
7/2			231904	$4f^{12}6d$	$(^3F)^4D$	24.7	$(^3F)^2F$	22.9	
13/2	233294.9	N	233337	$4f^{12}6d$	$(^3H)^4K$	61.3	$(^3H)^2K$	28.1	−42
7/2			233792	$4f^{12}6d$	$(^3H)^4F$	40.3	$(^3H)^2F$	35.2	
11/2	233985.8	N	234089	$4f^{12}6d$	$(^3H)^4I$	52.9	$(^3H)^2H$	21.9	−103
9/2	234353.7	N	234257	$4f^{12}6d$	$(^3H)^2G$	36.4	$(^3H)^4G$	32.3	97
15/2			234304	$4f^{12}6d$	$(^3H)^4K$	65.1	$(^3H)^2K$	29.4	
11/2			234465	$4f^{12}7s$	$(^3H)^4H$	69.7	$(^3H)^2H$	29.2	
9/2			234515	$4f^{12}7s$	$(^3H)^2H$	60.1	$(^3H)^4H$	36.2	
5/2			234624	$4f^{12}6d$	$(^3H)^4F$	57.5	$(^3H)^2F$	24.0	
9/2	235030.9	N	235030	$4f^{12}6d$	$(^3H)^2H$	34.5	$(^3H)^4H$	30.4	1
13/2	235054.3	N	235082	$4f^{12}6d$	$(^3H)^4I$	61.3	$(^3H)^2I$	20.9	−27
7/2	235060.4	N	235003	$4f^{12}6d$	$(^3H)^4G$	38.6	$(^3H)^2G$	27.5	57
11/2	235359.8	N	235340	$4f^{12}6d$	$(^3H)^4H$	53.8	$(^3H)^2I$	24.9	20

Notes: R Revised energy (about +31.8 cm^{-1}) of a level found in [4].
I Revised energy (about +170.2 cm^{-1}) of a level found in [4].
N New energy level.
J Revised J−value.

sent work together with intensities made consistent with [4]. At wavelengths longer than 2187 Å (not reported in [4]), about fourty lines attributed to Yb IV in ref. [2] fit transitions predicted by the present energy scheme. They correspond mostly to the transitions with the largest probabilities in this spectral region and therefore, they have been included into Table I. In the region 2130-2187 Å where linelists of ref. [2] and [4] overlap, systematic deviations of -0.15 cm^{-1} are noticed and, for consistency reasons, the reported wavenumbers of [2] in the range 45650-42303 cm^{-1} have been increased by 0.15 cm^{-1} in Table I. Only the energies of both the lower and the upper levels of the transitions are given in this table.

Table II gives the established energy levels of Yb^{3+} along with their J values and calculated positions. The main components of the eigenfunctions in jj coupling scheme ($4f^{12}6p$) and LS coupling (even parity levels) are given in the last columns of Table II. In comparison with the whole structure

Table III. *Radial parameter values (in cm^{-1}) derived from a least-squares fit of 55 odd parity and 137 even parity levels in Yb IV. Parameter values are followed by thin standard deviation.*

Parameter	$4f^{13}$		$4f^{12}6p$		$4f^{12}5d$		$4f^{12}6s$		$4f^{12}6d$		$4f^{12}7s$	
E_{av}	5436	16	179118	3	106761	9	126458	18	244940	33	244975	57
F^2 f f			113588	52	112796	130	113150	r	113143	r	113143	r
F^4 f f			77517	159	78058	357	78303	r	78041	r	78041	r
F^6 f f			54510	388	53817	459	53986	r	54160	r	54160	r
α			22	1	22	1	22	r	22	r	22	r
β			−724	28	−660	70	−660	r	−660	r	−660	r
γ			2000		2000		2000		2000		2000	
ζ_f	2918	9	3063	2	3067	6	3060	10	3090	14	3090	r
ζ_d					1762	10			437	r		
ζ_p			5842	6								
F^1 f l			207	33	959	124						
F^2 f l			7954	52	24436	123			5164	312		
F^4 f l					15812	337			3433	777		
G^1 f l					8436	42			2006	1286		
G^2 f l			2438	34	2261	274						
G^3 f l			−124	101	9630	291	2932	189	1952	553	943	
G^4 f l			2275	83	2679	367						
G^5 f l					6220	292			1550	R		

C.I. Parameters: R^2(4f 5d , 4f 6s) = 996 R^3(4f 5d , 6s 4f) = 2314
R^2(4f 6d , 4f 7s) = 579 R^3(4f 6d , 7s 4f) = 664

Notes : r linked in a constant ratio with a parameter in the same row; R linked with G^3 fl.

of $4f^{12}$, the present energy corrections for $^3H_{5,6}$ and $^1I_6$ are small; therefore the wavefunctions associated with the levels are close to those given in ref. [4].

Table III contains the radial parameters derived from a least-squares fit of the experimental energies. In the odd parity, the unknown upper group $4f^{12}7p+4f^{12}5f$ was added to the known configurations $4f^{13}+4f^{12}6p$, whereas all the four known configurations $4f^{12}5d$, $4f^{12}6s$, $4f^{12}6d$ and $4f^{12}7s$ were studied together in the even parity. Configuration interaction has very limited effects and the relevant Slater parameters were fixed at 75% of their HFR value derived from the RCN/RCN2 codes [6]. The root mean squares deviations were 22 cm^{-1} in the odd parity (which means 1/2400 of the energy range interpreted for $4f^{12}6p$) and 77 cm^{-1} in the even parity (1/2000 of total range of known even levels).

2.2. *Transition probabilities*

The gA values obtained by means of the standard version of the code RCG [6] are reported in Table IV (the HFR entry) for transitions involving five selected levels which illustrate classification problems. Observed intensities from [4] and those of the newly measured lines estimated in the same scale, agree qualitatively with theoretical gA values and support the eigenfunctions in intermediate coupling, as detailed below. The new $4f^{12}5d$ ($J=11/2$) level at 99236 cm^{-1} replaces a previous one at 99180 cm^{-1}. This level is built from 8 lines and two of them are doubly classified. The unresolved line at 1280.284 Å results from two transitions for which optimized level values predict a separation of 0.024 Å. According to the Ritz principle only, three transitions would contribute to the line at 1369.726 Å (see Table IV), but the weakest gA value helps to reject the corresponding classification 205224–132218. By considering the theoretical transition probabilities, we have discarded the classifications based on wavenumber coincidences only, and the double classifications represent an acceptable 5% of all classified lines in Table I. The second level ($J=15/2$) given in the Table IV is the second lowest level for $4f^{12}6d$ whereas the very lowest one ($J=9/2$) stays undetected near 223240 cm^{-1}. The next two entries in the table are closely spaced $J=13/2$ levels, for which the calculated gA values lead to unambiguous designations: the first level of $4f^{12}7s$ is located at 224681 cm^{-1} and mixes slightly (11% of the eigenfunction) with $4f^{12}6d$. Finally, we have collected the lines classified by the last selected level ($4f^{12}6p$ 162094 cm^{-1}) in two respective sets, according to the upper or lower position of the level. It is noticed that, due to population dynamics, its transitions issued from $4f^{12}(6d+7s)$ have a much lower ratio Int/gA than its transitions towards $4f^{12}(5d+6s)$.

Table V collects all the observed transitions to the ground level $4f^{13}\ ^2F_{7/2}$. Their intensities support qualitatively the theoretical gA values (the HFR entries). An example is given by the three lines at 826.391, 827.994 and 828.957 Å corresponding to three even levels with $J=9/2$ at 120634, 120773 and 121008 cm^{-1}. These levels belong respectively to the $4f^{12}(^1I)5d$, $4f^{12}(^3H)6s$ and $4f^{12}(^1D)5d$ sub-configurations with a $4f^{12}6s$ character (sum of squared amplitudes) of respectively 7.6%, 81.5% and 10.7%. This is the largest $4f^{12}5d$-$4f^{12}6s$ mixing calculated for Yb IV, leading to a forbidden f-s transition. In addition to the line at 827.994 Å (0-120773), only three other weak lines are classified as $4f^{13}$-$4f^{12}6s$ transitions in Table V.

Table IV. *Comparison between observed intensities and computed transition probabilities for some Yb IV levels. The observed wavelengths λ_{exp} and deviation $\Delta\lambda = \lambda_{exp} - \lambda_{RITZ}$ are in Å, λ_{RITZ} being derived from the optimized level values, the intensities are taken from ref. [4], or in the same scale for new lines, a note is explained in the bottom lines of the Table, the wavenumbers and levels of the transitions are in cm^{-1}. In the last two columns, the weighted transition probabilities gA (in 10^8 s^{-1}) are calculated using the Cowan codes without and with core–polarization, respectively.*

λ_{exp} (Å)	$\Delta\lambda$	Int Note	σ_{exp} (cm^{-1})	classification			gA ($10^8 s^{-1}$) HFR	HFR+CP
Transitions to $4f^{12}(^3H_5)\ 5d_{5/2}\ J=11/2$ 99236.42								
1261.219	0.002	100	79288.36	178524.89	4.5–99236.42	5.5	11.2	8.9
1280.284	−0.016	1500	78107.67	177343.11	4.5–99236.42	5.5	1.7	1.3
- -	0.008	1500	78107.67	10213.84	2.5–88322.02	2.5	0.22	0.14
1300.416	0.002	10 N	76898.48	176135.00	5.5–99236.42	5.5	0.20	0.18
1369.726	−0.009	3000 b	73007.31	172243.23	5.5–99236.42	5.5	34.9	27.9
- -	0.012	3000 b	73007.31	171510.39	3.5–98502.45	3.5	16.3	12.9
- -	−0.019	3000 b	73007.31	205224.69	3.5–132218.40	2.5	0.6	0.5
1376.827	−0.003	1000	72630.74	171867.02	4.5–99236.42	5.5	35.5	28.3
1393.330	−0.006	2	71770.52	171006.63	6.5–99236.42	5.5	2.9	2.3
1567.452	0.005	1	63797.80	163034.43	5.5–99236.42	5.5	0.4	0.4
1674.059	−0.001	3	59735.05	158971.44	4.5–99236.42	5.5	0.4	0.3
Transitions from $4f^{12}(^3H_6)6d_{3/2}\ J=15/2$ 223773.87								
1417.763	−0.003	350 b	70533.66	153240.36	6.5–223773.87	7.5	378.	330.
1596.640	0.000	30	62631.52	161142.36	7.5–223773.87	7.5	23.6	20.4
1636.479	0.004	10	61106.80	162666.91	6.5–223773.87	7.5	19.6	17.2
Transitions from $4f^{12}(^3H_6)6d_{3/2}\ J=13/2$ 224479.70								
1391.622	0.002	2 N	71858.57	152621.05	5.5–224479.70	6.5	49.1	28.4
1403.717	−0.001	300	71239.41	153240.36	6.5–224479.70	6.5	233.	210.
1578.856	0.009	100	63336.99	161142.36	7.5–224479.70	6.5	0.7	0.1
1602.919	−0.004	30	62386.18	162093.66	5.5–224479.70	6.5	24.5	23.0
1617.795	0.007	250	61812.52	162666.91	6.5–224479.70	6.5	35.0	37.0
1627.458	−0.006	8	61445.51	163034.43	5.5–224479.70	6.5	13.3	13.2
Transitions from $4f^{12}(^3H_6)7s_{1/2}\ J=13/2$ 224681.17								
1387.714	−0.017	200	72060.95	152621.05	5.5–224681.17	6.5	143.	150.
1573.839	−0.002	200	63538.90	161142.36	7.5–224681.17	6.5	102.	101.
1612.535	0.003	80	62014.15	162666.91	6.5–224681.17	6.5	44.1	41.9
Transitions from $4f^{12}(^3H_6)6p_{3/2}\ J=11/2$ 162093.66								
1197.134	−0.006	250 C	83532.84	162093.66	5.5–78561.20	4.5	7.0	5.4
1259.626	0.000	20 C	79388.61	162093.66	5.5–82705.07	5.5	2.3	1.8
1306.915	0.000	600 C	76516.05	162093.66	5.5–85577.64	6.5	11.0	8.8
1352.382	−0.001	1000 C	73943.58	162093.66	5.5–88150.15	4.5	14.3	11.3
1353.428	−0.001	2000 Cb	73886.45	162093.66	5.5–88207.24	5.5	18.1	14.3
1376.666	−0.001	3000 C	72639.25	162093.66	5.5–89454.46	6.5	44.	34.6
1387.958	−0.005	450 R	72048.28	162093.66	5.5–90045.61	4.5	4.3	3.3
1403.951	0.001	1000 C	71227.55	162093.66	5.5–90866.06	5.5	17.7	14.0
1425.928	0.002	800 C	70129.79	162093.66	5.5–91963.75	6.5	9.0	7.5
1449.681	0.005	3 N	68980.69	162093.66	5.5–93112.72	5.5	1.9	1.6
1476.970	0.009	3 N	67706.19	162093.66	5.5–94387.08	4.5	0.6	0.5
1492.900	−0.001	500 C	66983.73	162093.66	5.5–95109.97	5.5	5.3	4.5
1498.242	−0.001	10 C	66744.89	162093.66	5.5–95348.81	6.5	1.3	1.1
1550.256	0.000	80	64505.47	162093.66	5.5–97588.21	5.5	2.3	1.9
1551.126	−0.007	20 C	64469.29	162093.66	5.5–97624.67	4.5	1.3	1.0
1589.913	−0.009	50 C	62896.52	162093.66	5.5–99197.48	6.5	0.3	0.2
1783.071	−0.002	200 C	56083.01	162093.66	5.5–106010.72	6.5	12.0	8.9
1809.626	−0.001	2500 C	55260.03	162093.66	5.5–106833.65	5.5	58.3	42.4
2004.472	0.004	8 C	49872.30	162093.66	5.5–112221.27	4.5	1.6	1.2
2166.119	−0.002	1000 C	46151.03	162093.66	5.5–115942.68	5.5	8.1	6.1
2169.116	−0.006	3000 C	46087.27	162093.66	5.5–116006.51	4.5	18.0	13.7
Transitions to $4f^{12}(^3H_6)6p_{3/2}\ J=11/2$ 162093.66								
1371.042	0.000	0 N	72937.21	162093.66	5.5–235030.89	4.5	6.6	5.9
1383.891	0.000	1 N	72260.04	162093.66	5.5–234353.70	4.5	22.8	6.9
1390.971	−0.001	1 N	71892.20	162093.66	5.5–233985.80	5.5	105.	61.8
1404.474	0.004	1000 Nb	71201.03	162093.66	5.5–233294.89	6.5	202.	114.
- -	0.003	1000 Nb	71201.03	158971.44	4.5–230172.60	5.5	239.	208.
1468.883	0.000	0 N	68078.94	162093.66	5.5–230172.60	5.5	3.1	2.8
1567.192	−0.001	300	63808.39	162093.66	5.5–225902.00	6.5	72.7	61.6
1574.715	0.000	150	63503.55	162093.66	5.5–225597.19	5.5	53.3	72.7
1591.025	0.003	80	62852.56	162093.66	5.5–224946.33	5.5	37.4	38.5
1602.919	−0.004	30	62386.18	162093.66	5.5–224479.70	6.5	24.5	23.0

Notes: N Line reported for the first time.
C Line classified in [4].
b Blend of two transitions or more.
R Revised classification.

Table V. *Observed resonance lines of Yb IV. The last columns give the emission transition probability in s^{-1} unit [a(b) means a.10^b] and the absorption log(gf)*

Wavelength (Å)	Int	Note	Classification odd	even		HFR gA	HFR log(gf)	HFR+CP gA	HFR+CP log(gf)
753.119	1	N	0.00	3.5−132780.51	4.5	2.09(7)	−2.75	1.40(7)	−2.93
756.324	1	N	0.00	3.5−132218.40	2.5	2.40(7)	−2.69	1.36(7)	−2.93
761.059	15	J	0.00	3.5−131395.86	2.5	2.87(8)	−1.60	1.80(8)	−1.81
761.661	1	N	0.00	3.5−131292.10	3.5	5.60(7)	−2.31	3.68(7)	−2.50
775.787	300	J	0.00	3.5−128901.39	2.5	3.46(9)	−0.51	2.22(9)	−0.70
783.687	10	N	0.00	3.5−127602.68	4.5	1.59(8)	−1.84	9.75(7)	−2.05
788.225	25	C	0.00	3.5−126867.20	3.5	2.85(8)	−1.58	1.76(8)	−1.78
791.143	10	C	0.00	3.5−126399.30	2.5	5.69(8)	−1.27	3.61(8)	−1.47
799.300	1	C	0.00	3.5−125110.59	3.5	3.37(7)	−2.49	2.21(7)	−2.68
800.386	40	C	0.00	3.5−124939.60	2.5	1.00(9)	−1.02	5.86(8)	−1.25
808.343	1	C	0.00	3.5−123710.47	2.5	2.20(6)	−3.67	2.21(6)	−3.66
816.492	2	C	0.00	3.5−122476.28	2.5	6.14(6)	−3.21	4.96(6)	−3.31
826.391	40	C	0.00	3.5−121008.13	4.5	2.12(9)	−0.66	1.09(9)	−0.95
827.994	20	C	0.00	3.5−120773.77	4.5	1.52(9)	−0.81	1.09(9)	−0.95
828.957	200	C	0.00	3.5−120634.44	4.5	5.15(9)	−0.28	3.36(9)	−0.46
831.056	40	C	0.00	3.5−120328.83	2.5	1.56(9)	−0.79	9.54(8)	−1.01
842.336	5	C	0.00	3.5−118717.65	3.5	2.14(8)	−1.64	1.38(8)	−1.83
854.513	40	C	0.00	3.5−117026.11	2.5	1.46(9)	−0.80	9.35(8)	−0.99
886.429	20	C	0.00	3.5−112812.61	4.5	8.42(8)	−1.00	5.27(8)	−1.21
887.474	5	C	0.00	3.5−112679.15	2.5	9.10(7)	−1.97	5.76(7)	−2.17
891.095	2	R	0.00	3.5−112221.27	4.5	3.69(6)	−3.36	3.69(6)	−3.36
896.455	40	C	0.00	3.5−111550.62	3.5	2.58(8)	−1.51	1.52(8)	−1.74
902.456	300	C	0.00	3.5−110808.74	3.5	3.51(9)	−0.37	2.29(9)	−0.55
917.221	2	C	0.00	3.5−109025.19	4.5	4.51(7)	−2.24	2.90(7)	−2.44
927.013	300	C	0.00	3.5−107873.37	2.5	2.39(9)	−0.51	1.50(9)	−0.71
929.660	50	C	0.00	3.5−107566.36	4.5	3.40(8)	−1.36	2.17(8)	−1.55
943.039	400	C	0.00	3.5−106040.08	3.5	1.76(9)	−0.63	1.40(9)	−0.73
946.205	400	C	0.00	3.5−105685.33	3.5	3.87(9)	−0.28	2.22(9)	−0.53
955.907	10	C	0.00	3.5−104613.47	4.5	3.70(7)	−2.30	2.41(7)	−2.41
959.454	100	C	0.00	3.5−104225.95	3.5	6.78(8)	−1.03	4.22(8)	−1.24
966.332	4	C	0.00	3.5−103484.02	2.5	6.23(7)	−2.06	3.91(7)	−2.26
972.859	40	I	0.00	3.5−102790.11	4.5	2.63(8)	−1.43	1.64(8)	−1.63
975.206	200	C	0.00	3.5−102542.47	3.5	6.39(8)	−1.04	3.81(8)	−1.27
978.879	30	C	0.00	3.5−102158.11	2.5	2.90(8)	−1.38	1.80(8)	−1.59
980.708	50	C	0.00	3.5−101966.58	4.5	8.29(7)	−1.92	5.48(7)	−2.10
986.983	50	C	0.00	3.5−101318.22	2.5	5.92(7)	−2.06	3.48(7)	−2.29
996.503	20	C	0.00	3.5−100350.27	3.5	3.19(7)	−2.32	1.84(7)	−2.56
1006.592	5	C	0.00	3.5−99344.77	2.5	1.58(7)	−2.62	9.52(6)	−2.84
1010.391	50	C	0.00	3.5−98971.68	4.5	2.46(8)	−1.42	1.56(8)	−1.62
1015.206	10	C	0.00	3.5−98502.45	3.5	8.87(7)	−1.86	5.71(7)	−2.06
1018.089	30	C	0.00	3.5−98222.84	2.5	1.97(8)	−1.51	1.26(8)	−1.71
1024.323	100	R	0.00	3.5−97624.67	4.5	5.56(8)	−1.06	3.53(8)	−1.26
1041.917	1	C	0.00	3.5−95977.05	3.5	2.97(6)	−3.32	1.98(6)	−3.49
1050.245	1000	C	0.00	3.5−95215.74	4.5	1.48(9)	−0.61	9.38(8)	−0.81
1054.463	1000	C	0.00	3.5−94834.11	3.5	6.25(8)	−0.98	3.98(8)	−1.18
1058.223	50	C	0.00	3.5−94498.37	2.5	7.39(7)	−1.91	4.69(7)	−2.10
1059.468	100	C	0.00	3.5−94387.08	4.5	5.36(7)	−2.05	3.15(7)	−2.28
1092.510	400	C	0.00	3.5−91532.55	3.5	3.93(8)	−1.15	2.44(8)	−1.36
1093.109	50	C	0.00	3.5−91482.25	2.5	4.30(7)	−2.11	2.71(7)	−2.31
1110.548	200	C	0.00	3.5−90045.61	4.5	1.07(8)	−1.71	6.85(7)	−1.90
1117.064	100	C	0.00	3.5−89520.30	3.5	6.44(7)	−1.92	4.24(7)	−2.10
1132.214	2	N	0.00	3.5−88322.02	2.5	1.12(6)	−3.67	8.20(5)	−3.80
1134.426	5000	R	0.00	3.5−88150.15	4.5	4.28(8)	−1.08	2.76(8)	−1.27
1185.583	6000	C	0.00	3.5−84347.15	3.5	1.17(8)	−1.61	7.41(7)	−1.81
1272.898	1	N	0.00	3.5−78561.20	4.5	2.83(5)	−4.17	1.89(5)	−4.34

Notes: N line reported for the first time.
C line classified in [4].
I Revised classification. In [4], the system of transitions built on $4f^{12}\,{}^1I_6$ was connected to the main system by means of two lines:
this one and the line at 1040.732 Å, interpreted now as the 10213 −106299 transition.
J The *J* – value of the upper level was revised.
R New classification of a line given in [4]. The previous value of the upper level was ∼31.8 cm^{-1} lower.

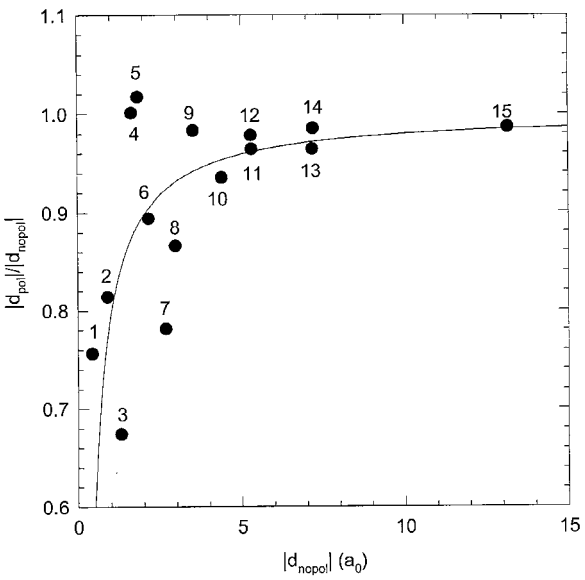

Fig. 1. Absolute value of the ratio between corrected (d_{pol}) and uncorrected transition matrix elements (d_{nopol}) of transitions not involving a 4f electron as a function of the absolute value of the uncorrected transition element (expressed in Bohr units). A smooth curve has been drawn showing the trend. The meaning of the numbers is as follows ($4f^{12}$ being the core): 1 : 7p-5d ; 2 : 6p-7d ; 3 : 6f-5d ; 4 : 6f-5d ; 5 : 6p-7s ; 6 : 6p-5d ; 7 : 5f-5d ; 8 : 6p-6s ; 9 : 6f-6d ; 10 : 6p-6d ; 11 : 7p-6d ; 12 : 7p-7s ; 13 : 5f-6d ; 14 : 7p-7d ; 15 : 6f-7d.

In Table IV and V, we have also reported transition probabilities and oscillator strengths obtained by a version of the Cowan codes in which we have incorporated the core-polarization effects (the HFR+CP entries). The technique has appeared adequate for accurately predicting radiative lifetimes for complex configurations observed in lanthanide spectra, see e.g. Refs [8-10]. The estimate of core-polarization contributions requires the knowledge of the dipole polarizability of the ionic core, a_d, and of the cut-off radius, r_c. For the first parameter, we have used the value of the static dipole polarizability computed by Fraga *et al.* [11] for Yb V, i.e. $a_d = 4.18\ a_0^3$. The cut-off radius has been chosen equal to $1.35\ a_0$ which corresponds to the HFR average value $< r >$ of the outermost core orbital ($5p^6$). Polarization corrections were not introduced in the atomic orbital calculations of the ground configuration, $4f^{13}$. For the 4f-5d transitions, polarization corrections to the dipole operator as described in Refs. [8-10] are no longer valid because 4f orbitals are deeply imbedded in the 5s and 5p orbitals of the Xe-like core. Instead, we have introduced a scaling factor, equal to 0.78, to the $<4f|r|5d>$ matrix element which is equal to $0.917\ a_0$ for the $4f^{13}$–$4f^{12}5d$ transitions. This correction factor has been deduced from Fig. 1 where is shown a curve fitting the general trend of the ratio between core-polarization corrected (d_{pol}) (see eq. (6) in Ref. [10]) and uncorrected (d_{nopol}) matrix elements of transitions not involving a 4f electron plotted as a function of the uncorrected matrix element. This procedure is justified by the good agreement found between calculated and observed lifetime values of $4f^{12}5d$ levels in the isoelectronic ion Tm III [12]. More details about this procedure will be given elsewhere [13]. The configuration sets retained for the calculations were $4f^{13}$, $4f^{12}np$ ($n = 6,7$) and $4f^{12}nf$ ($n = 5,6$) for the odd parity and $4f^{12}nd$ ($n = 5$-7) and $4f^{12}ns$ ($n = 6,7$) for the even parity. In addition, the average energies, E_{av}, the Slater parameters, F^k and G^k, and the spin-orbit integrals, z_{nl}, were adjusted with RCE [6] minimizing the discrepancies between the calculated and the experimental energy levels. This procedure allows to consider implicitly in the calculations the configurations which were not explicitly introduced in our model. A gA and log(gf) list for transitions between 1000 and 10000 Å will be available in the DREAM database (http://www.umh.ac.be/~astro/dream.shtml).

3. Conclusion

In this work, an improved set of energy levels for Yb IV is presented as well as the first estimates of transition probabilities. At wavelengths shorter than 685 Å, a dense array of lines with Yb IV character are present on the spectrograms. They should be mostly transitions from the mixed group $4f^{11}(5d^2+5d6s)+ 4f^{12}(5f+7p)$ to $4f^{12}(5d+6s)$, for which the lower levels are well described now. In this rich array, it was impossible to identify the three lines of the multiplet $4f^{13}\ ^2F$ - $4f^{12}(^1S)5d\ ^2D$, which leaves the first excited configurations incompletely known.

Not only for Nd^{3+} and Yb^{3+}, the ground configurations $4f^N$ of triply-charged lanthanides have a well-known interest for high-power lasers and for low-pressure discharge lamps [14]. Nevertheless free-ion spectra have been analyzed for Ce, Pr , Tb and Yb only [5]. The improved energy parameters derived from the core $4f^{12}$ of configurations in Yb IV should serve for better predictions of levels and radiative transition rates in other high-Z lanthanide ions.

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Table I. Classified lines of Yb IV. In the columns are (1) the observed wavelengths in Å (wavelengths longer than 2000 Å are values in air), (2) the deviation λ_{obs}-λ_{RITZ}, λ_{RITZ} being calculated from the optimized energy level values, (3) the intensities according to ref.[4], or in the same scale for new lines, (4) a note explained in the bottom lines ot the Table, (5) the corresponding vacuum wavenumber σ_{obs} in cm^{-1}, (6) the odd parity level E^o J^o and (7) the even parity level E^e J^e of the transition.

(1)	(2)	(3)	(4)	(5)	--- (6) ---	--- (7) ---
753.119	-0.003	1	N	132781.12	0.00 3.5	- 132780.51 4.5
756.324	0.000	1	N	132218.45	0.00 3.5	- 132218.40 2.5
761.059	0.000	15		131395.87	0.00 3.5	- 131395.86 2.5
761.661	0.000	1	N	131292.06	0.00 3.5	- 131292.10 3.5
775.787	0.000	300		128901.35	0.00 3.5	- 128901.39 2.5
783.687	0.004	10	N	127601.98	0.00 3.5	- 127602.68 4.5
788.225	-0.001	25		126867.32	0.00 3.5	- 126867.20 3.5
791.143	-0.001	10		126399.39	0.00 3.5	- 126399.30 2.5
799.300	0.007	1	N	125109.53	0.00 3.5	- 125110.59 3.5
800.386	-0.001	40		124939.71	0.00 3.5	- 124939.60 2.5
804.260	0.000	50	N	124337.87	10213.86 2.5	- 134551.70 1.5
808.343	0.004	1	N	123709.91	0.00 3.5	- 123710.47 2.5
816.492	0.007	2		122475.18	0.00 3.5	- 122476.28 2.5
818.811	0.000	20		122128.25	10213.86 2.5	- 132342.10 1.5
819.641	-0.001	3		122004.63	10213.86 2.5	- 132218.40 2.5
825.209	0.004	1	N	121181.40	10213.86 2.5	- 131395.86 2.5
826.391	0.000	40		121008.09	0.00 3.5	- 121008.13 4.5
827.994	0.000	20		120773.82	0.00 3.5	- 120773.77 4.5
828.957	0.006	200		120633.51	0.00 3.5	- 120634.44 4.5
831.056	0.000	40		120328.83	0.00 3.5	- 120328.83 2.5
841.480	0.001	1		118838.23	10213.86 2.5	- 129052.23 3.5
842.336	0.001	5		118717.47	0.00 3.5	- 118717.65 3.5
842.548	0.000	10		118687.60	10213.86 2.5	- 128901.39 2.5
854.513	0.003	40		117025.72	0.00 3.5	- 117026.11 2.5
857.243	0.002	10		116653.03	10213.86 2.5	- 126867.20 3.5
860.694	0.001	2		116185.31	10213.86 2.5	- 126399.30 2.5
870.352	0.005	200		114896.04	10213.86 2.5	- 125110.59 3.5
871.646	0.002	20		114725.47	10213.86 2.5	- 124939.60 2.5
875.159	0.000	20		114264.95	10213.86 2.5	- 124478.85 1.5
886.429	0.003	20		112812.19	0.00 3.5	- 112812.61 4.5
887.474	-0.002	5		112679.35	0.00 3.5	- 112679.15 2.5
891.095	-0.002	2		112221.47	0.00 3.5	- 112221.27 4.5
896.455	0.001	40		111550.49	0.00 3.5	- 111550.62 3.5
902.456	0.000	300		110808.72	0.00 3.5	- 110808.74 3.5
908.141	-0.001	10		110115.05	10213.86 2.5	- 120328.83 2.5
913.338	0.001	1		109488.49	10213.86 2.5	- 119702.50 1.5
917.221	0.002	2		109024.97	0.00 3.5	- 109025.19 4.5
921.630	0.007	1	N	108503.41	10213.86 2.5	- 118717.65 3.5
927.013	0.000	300		107873.35	0.00 3.5	- 107873.37 2.5
929.660	0.001	50		107566.20	0.00 3.5	- 107566.36 4.5

936.221	-0.001	300		106812.38	10213.86	2.5	-	117026.11	2.5
943.039	-0.001	400		106040.15	0.00	3.5	-	106040.08	3.5
945.440	0.002	10		105770.85	10213.86	2.5	-	115984.90	3.5
946.205	0.000	400		105685.34	0.00	3.5	-	105685.33	3.5
946.781	0.005	20		105621.04	10213.86	2.5	-	115835.49	1.5
955.907	0.007	10		104612.68	0.00	3.5	-	104613.47	4.5
959.454	0.000	100		104225.94	0.00	3.5	-	104225.95	3.5
966.332	-0.001	4		103484.10	0.00	3.5	-	103484.02	2.5
972.859	0.003	40		102789.81	0.00	3.5	-	102790.11	4.5
975.206	0.000	200		102542.43	0.00	3.5	-	102542.47	3.5
975.944	0.004	100		102464.89	10213.86	2.5	-	112679.15	2.5
975.979	0.000	100		102461.22	10213.86	2.5	-	112675.11	1.5
978.879	0.004	30		102157.67	0.00	3.5	-	102158.11	2.5
980.708	-0.005	50		101967.14	0.00	3.5	-	101966.58	4.5
986.808	-0.001	10		101336.83	10213.86	2.5	-	111550.62	3.5
986.983	-0.006	50		101318.86	0.00	3.5	-	101318.22	2.5
994.081	-0.005	100		100595.42	10213.86	2.5	-	110808.74	3.5
996.503	-0.006	20		100350.92	0.00	3.5	-	100350.27	3.5
1006.592	-0.003	5		99345.11	0.00	3.5	-	99344.77	2.5
1008.066	-0.002	40		99199.85	10213.86	2.5	-	109413.50	2.5
1010.391	0.001	50		98971.58	0.00	3.5	-	98971.68	4.5
1015.206	0.003	10		98502.17	0.00	3.5	-	98502.45	3.5
1018.089	-0.004	30		98223.23	0.00	3.5	-	98222.84	2.5
1024.323	-0.008	100		97625.45	0.00	3.5	-	97624.67	4.5
1033.455	0.004	1	N	96762.81	191978.97	5.5	-	95215.74	4.5
1040.732	-0.004	50		96086.21	10213.86	2.5	-	106299.67	1.5
1041.917	0.001	1		95976.93	0.00	3.5	-	95977.05	3.5
1043.558	0.002	40		95826.01	10213.86	2.5	-	106040.08	3.5
1047.433	0.000	3		95471.50	10213.86	2.5	-	105685.33	3.5
1050.245	-0.001	1000		95215.87	0.00	3.5	-	95215.74	4.5
1054.463	0.001	1000		94835.00	184355.37	2.5	-	89520.30	3.5
	-0.010				0.00	3.5	-	94834.11	3.5
1058.223	0.004	50		94498.03	0.00	3.5	-	94498.37	2.5
1059.468	0.001	100		94386.99	0.00	3.5	-	94387.08	4.5
1063.694	0.001	40		94011.99	10213.86	2.5	-	104225.95	3.5
1072.155	0.001	20		93270.09	10213.86	2.5	-	103484.02	2.5
1083.088	0.000	2		92328.60	10213.86	2.5	-	102542.47	3.5
1083.441	0.004	50		92298.52	10213.86	2.5	-	102512.73	1.5
1087.621	0.005	50		91943.79	10213.86	2.5	-	102158.11	2.5
1092.510	0.003	400		91532.34	0.00	3.5	-	91532.55	3.5
1093.109	0.001	50		91482.18	0.00	3.5	-	91482.25	2.5
1097.643	0.001	100		91104.30	10213.86	2.5	-	101318.22	2.5
1109.431	0.001	100		90136.29	10213.86	2.5	-	100350.27	3.5
1110.548	0.000	200		90045.63	0.00	3.5	-	90045.61	4.5
1112.161	-0.002	3	N	89915.03	10213.86	2.5	-	100128.73	1.5
1116.519	-0.009	1	N	89564.11	168124.60	4.5	-	78561.20	4.5
1117.064	-0.001	100		89520.38	0.00	3.5	-	89520.30	3.5
1121.943	-0.002	20		89131.08	10213.86	2.5	-	99344.77	2.5
1126.033	0.003	1	N	88807.31	199616.30	4.5	-	110808.74	3.5
1128.216	-0.006	3	N	88635.48	167196.22	4.5	-	78561.20	4.5
1132.214	-0.007	2	N	88322.54	0.00	3.5	-	88322.02	2.5
1132.489	0.006	1	N	88301.06	171006.63	6.5	-	82705.07	5.5

1132.648	-0.002	5	N	88288.71	10213.86	2.5	-	98502.45	3.5
1134.426	-0.002	5000		88150.30	0.00	3.5	-	88150.15	4.5
1136.237	-0.011	300		88009.80	10213.86	2.5	-	98222.84	2.5
1142.600	0.002	1	N	87519.80	171867.02	4.5	-	84347.15	3.5
1146.762	0.005	3	N	87202.09	178684.75	2.5	-	91482.25	2.5
1147.415	-0.003	1	N	87152.46	178684.75	2.5	-	91532.55	3.5
1155.330	-0.013	3		86555.35	178036.62	3.5	-	91482.25	2.5
1159.228	-0.008	1	N	86264.32	177796.25	3.5	-	91532.55	3.5
1159.481	-0.010	1	N	86245.52	175765.09	2.5	-	89520.30	3.5
1159.481	-0.013	1	N	86245.52	184467.39	1.5	-	98222.84	2.5
1161.017	0.016	1	N	86131.35	184355.37	2.5	-	98222.84	2.5
1166.012	0.011	500		85762.41	10213.86	2.5	-	95977.05	3.5
1168.044	-0.005	1	N	85613.18	176478.90	4.5	-	90866.06	5.5
1168.143	-0.007	3	N	85605.98	178823.30	0.5	-	93217.89	1.5
1177.216	0.002	1	N	84946.19	176478.90	4.5	-	91532.55	3.5
1177.605	0.005	1	N	84918.12	179305.55	3.5	-	94387.08	4.5
1178.796	-0.006	0	N	84832.33	178049.82	2.5	-	93217.89	1.5
1179.227	-0.009	2	N	84801.30	192674.05	2.5	-	107873.37	2.5
1181.749	-0.001	1000		84620.32	10213.86	2.5	-	94834.11	3.5
1182.718	0.002	1	N	84551.02	185869.35	2.5	-	101318.22	2.5
1183.552	-0.004	1	N	84491.41	167196.22	4.5	-	82705.07	5.5
1183.806	-0.001	10	b	84473.27	163034.43	5.5	-	78561.20	4.5
1183.956	-0.002	1	N	84462.63	163023.68	4.5	-	78561.20	4.5
1185.583	0.006	6000		84346.70	0.00	3.5	-	84347.15	3.5
1186.454	-0.004	5		84284.77	10213.86	2.5	-	94498.37	2.5
1187.843	0.003	0	N	84186.19	178684.75	2.5	-	94498.37	2.5
1189.154	-0.005	1		84093.43	172243.23	5.5	-	88150.15	4.5
1189.524	-0.001	2	N	84067.21	202469.20	6.5	-	118402.05	7.5
1189.964	-0.002	1	N	84036.14	172243.23	5.5	-	88207.24	5.5
1190.405	0.001	1	N	84005.04	184355.37	2.5	-	100350.27	3.5
	0.009				185972.22	3.5	-	101966.58	4.5
1193.636	-0.003	2		83777.65	168124.60	4.5	-	84347.15	3.5
1197.134	-0.006	250		83532.84	162093.66	5.5	-	78561.20	4.5
1198.820	-0.006	2	N	83415.36	178524.89	4.5	-	95109.97	5.5
1200.338	-0.010	1		83309.87	178524.89	4.5	-	95215.74	4.5
1201.294	0.000	1	N	83243.60	167590.75	2.5	-	84347.15	3.5
1201.696	-0.001	20		83215.76	178049.82	2.5	-	94834.11	3.5
1202.661	0.004	1	N	83148.92	184467.39	1.5	-	101318.22	2.5
1204.351	-0.008	1	N	83032.24	185907.11	5.5	-	102875.41	5.5
1204.486	-0.010	2	N	83023.00	176135.00	5.5	-	93112.72	5.5
1207.016	0.002	20		82848.94	167196.22	4.5	-	84347.15	3.5
1209.074	-0.003	1	N	82707.91	178684.75	2.5	-	95977.05	3.5
1211.425	0.006	3	b	82547.41	178524.89	4.5	-	95977.05	3.5
	-0.003				175765.09	2.5	-	93217.89	1.5
1212.484	0.006	200		82475.32	168053.40	5.5	-	85577.64	6.5
1213.808	-0.001	0	N	82385.37	185869.35	2.5	-	103484.02	2.5
1214.372	0.007	1	Nb	82347.06	170669.58	2.5	-	88322.02	2.5
	-0.005				171867.02	4.5	-	89520.30	3.5
1214.925	-0.005	0	N	82309.59	184467.39	1.5	-	102158.11	2.5
1216.581	0.000	2		82197.60	172243.23	5.5	-	90045.61	4.5
1218.065	0.000	0	N	82097.44	171006.63	6.5	-	88909.21	7.5
1218.428	-0.002	1	N	82072.93	178049.82	2.5	-	95977.05	3.5

1222.180	0.006	2	N	81821.02	171867.02	4.5	-	90045.61	4.5
1223.302	0.005	0	N	81745.94	185972.22	3.5	-	104225.95	3.5
1224.823	0.005	1		81644.47	176478.90	4.5	-	94834.11	3.5
1226.209	0.000	1		81552.17	171006.63	6.5	-	89454.46	6.5
1227.080	0.009	1	N	81494.30	199896.91	7.5	-	118402.05	7.5
1227.523	-0.002	0	N	81464.89	171510.39	3.5	-	90045.61	4.5
1228.065	0.000	2		81428.95	202063.30	5.5	-	120634.44	4.5
1228.329	-0.003	1		81411.42	169733.24	1.5	-	88322.02	2.5
1229.113	-0.011	0	N	81359.47	185972.22	3.5	-	104613.47	4.5
1229.732	0.003	1000		81318.51	10213.86	2.5	-	91532.55	3.5
1230.181	0.010	0	N	81288.82	202063.30	5.5	-	120773.77	4.5
1230.492	0.001	500		81268.33	10213.86	2.5	-	91482.25	2.5
1230.573	0.003	0	N	81262.97	176478.90	4.5	-	95215.74	4.5
1231.695	-0.001	1	N	81188.95	193410.18	3.5	-	112221.27	4.5
1232.689	-0.001	1	N	81123.48	192674.05	2.5	-	111550.62	3.5
1233.110	-0.006	2		81095.78	169417.43	3.5	-	88322.02	2.5
1234.557	0.004	1	N	81000.73	171867.02	4.5	-	90866.06	5.5
1234.840	0.018	3	3	80982.17	184467.39	1.5	-	103484.02	2.5
1235.529	-0.005	0	N	80937.02	178524.89	4.5	-	97588.21	5.5
1236.085	-0.005	0	N	80900.56	178524.89	4.5	-	97624.67	4.5
1237.571	-0.005	1		80803.45	179305.55	3.5	-	98502.45	3.5
1237.827	-0.009	6		80786.76	176135.00	5.5	-	95348.81	6.5
1237.975	-0.006	3		80777.04	186462.00	4.5	-	105685.33	3.5
1238.689	0.008	1	N	80730.53	193410.18	3.5	-	112679.15	2.5
1240.739	0.006	1	N	80597.15	193410.18	3.5	-	112812.61	4.5
1241.222	-0.001	1	N	80565.77	176542.74	3.5	-	95977.05	3.5
1242.209	0.001	1		80501.76	176478.90	4.5	-	95977.05	3.5
1243.018	-0.001	600		80449.45	162666.91	6.5	-	82217.51	7.5
1243.593	-0.003	10	Ns	80412.13	178036.62	3.5	-	97624.67	4.5
1243.620	-0.003	60	b	80410.42	158971.44	4.5	-	78561.20	4.5
1244.181	0.002	100		80374.19	158935.51	3.5	-	78561.20	4.5
1244.805	0.000	30		80333.87	179305.55	3.5	-	98971.68	4.5
	0.009				171867.02	4.5	-	91532.55	3.5
1244.864	-0.011	20	N3	80330.05	163034.43	5.5	-	82705.07	5.5
1245.542	0.008	2	N	80286.35	185972.22	3.5	-	105685.33	3.5
	-0.020				205224.69	3.5	-	124939.60	2.5
1245.650	0.002	200		80279.37	172243.23	5.5	-	91963.75	6.5
1247.978	-0.003	1	N	80129.62	184355.37	2.5	-	104225.95	3.5
1249.563	0.002	80		80027.98	171510.39	3.5	-	91482.25	2.5
1249.662	0.012	100		80021.64	178524.89	4.5	-	98502.45	3.5
1250.083	0.003	2	N	79994.68	192674.05	2.5	-	112679.15	2.5
1250.363	-0.006	40		79976.79	168126.55	3.5	-	88150.15	4.5
1250.597	0.000	1000		79961.83	162666.91	6.5	-	82705.07	5.5
1251.284	-0.008	15		79917.89	168124.60	4.5	-	88207.24	5.5
1251.510	-0.003	50		79903.46	168053.40	5.5	-	88150.15	4.5
1251.608	-0.002	0	N	79897.25	169417.43	3.5	-	89520.30	3.5
1252.403	-0.005	60		79846.51	168053.40	5.5	-	88207.24	5.5
1253.770	0.000	1	N	79759.47	169279.75	2.5	-	89520.30	3.5
1253.831	-0.010	0	N	79755.55	177343.11	4.5	-	97588.21	5.5
1256.691	-0.010	0	N	79574.03	177796.25	3.5	-	98222.84	2.5
1256.774	0.014	1	N	79568.78	185869.35	2.5	-	106299.67	1.5
1257.318	-0.003	1	N	79534.39	178036.62	3.5	-	98502.45	3.5

1258.449	-0.001	1	N	79462.89	185907.11	5.5	-	106444.30	5.5
1259.626	0.000	20		79388.61	162093.66	5.5	-	82705.07	5.5
1259.892	-0.001	1		79371.91	169417.43	3.5	-	90045.61	4.5
1260.340	0.006	60		79343.68	186462.00	4.5	-	107117.94	5.5
1260.932	0.001	0	N	79306.40	10213.86	2.5	-	89520.30	3.5
1261.219	0.002	100		79288.36	178524.89	4.5	-	99236.42	5.5
1261.533	0.002	400		79268.62	167590.75	2.5	-	88322.02	2.5
1263.142	0.006	80		79167.65	175765.09	2.5	-	96597.05	1.5
1263.160	-0.003	10	Nb	79166.54	191978.97	4.5	-	112812.61	4.5
1263.735	0.000	0	N	79130.52	172243.23	5.5	-	93112.72	5.5
1264.958	0.021	10	Nb	79054.02	191978.97	4.5	-	112923.66	5.5
1265.136	0.000	20		79042.91	171006.63	6.5	-	91963.75	6.5
1265.992	-0.007	1		78989.42	167196.22	4.5	-	88207.24	5.5
1266.541	0.001	1	N	78955.22	179305.55	3.5	-	100350.27	3.5
1267.034	0.006	300		78924.49	161142.36	7.5	-	82217.51	7.5
1267.129	-0.008	1	N	78918.59	176542.74	3.5	-	97624.67	4.5
1267.493	-0.004	8	Nb	78895.92	186462.00	4.5	-	107566.36	4.5
1267.568	-0.008	80	b	78891.21	176478.90	4.5	-	97588.21	5.5
1268.154	-0.009	1	N	78854.79	176478.90	4.5	-	97624.67	4.5
1268.371	-0.010	1	N	78841.27	177343.11	4.5	-	98502.45	3.5
1268.631	-0.009	1	N	78824.35	177796.25	3.5	-	98971.68	4.5
	0.004				205224.69	3.5	-	126399.30	2.5
1269.208	-0.002	3		78789.30	185907.11	5.5	-	107117.94	5.5
1269.772	0.000	1	N	78754.30	171867.02	4.5	-	93112.72	5.5
1270.559	-0.008	5	N	78705.53	178049.82	2.5	-	99344.77	2.5
1272.190	-0.005	5	Nb	78604.63	168124.60	4.5	-	89520.30	3.5
1272.283	0.001	400		78598.86	168053.40	5.5	-	89454.46	6.5
1272.898	0.005	1	N	78560.92	0.00	3.5	-	78561.20	4.5
1273.120	-0.006	6		78547.17	176135.00	5.5	-	97588.21	5.5
1275.415	0.000	0	N	78405.86	185972.22	3.5	-	107566.36	4.5
1276.199	-0.004	4		78357.71	205224.69	3.5	-	126867.20	3.5
1276.576	-0.001	2		78334.55	178684.75	2.5	-	100350.27	3.5
1276.892	0.003	1	N	78315.14	184355.37	2.5	-	106040.08	3.5
1279.190	0.003	1	N	78174.45	178524.89	4.5	-	100350.27	3.5
1279.302	0.001	1	N	78167.64	184467.39	1.5	-	106299.67	1.5
1280.278	0.002	1500		78108.05	10213.86	2.5	-	88322.02	2.5
1280.745	-0.009	1		78079.53	168124.60	4.5	-	90045.61	4.5
1280.891	-0.003	2		78070.64	167590.75	2.5	-	89520.30	3.5
1281.136	0.000	2	N	78055.70	184355.37	2.5	-	106299.67	1.5
1281.382	-0.007	6		78040.72	176542.74	3.5	-	98502.45	3.5
1281.922	-0.001	6	Nb	78007.88	168053.40	5.5	-	90045.61	4.5
1283.330	-0.019	2	N	77922.25	178049.82	2.5	-	100128.73	1.5
1283.801	0.004	1	N	77893.68	171006.63	6.5	-	93112.72	5.5
	-0.010				167413.37	3.5	-	89520.30	3.5
1283.943	-0.003	1	N	77885.07	169417.43	3.5	-	91532.55	3.5
1285.385	-0.003	15		77797.71	169279.75	2.5	-	91482.25	2.5
1286.220	0.000	0	N	77747.19	169279.75	2.5	-	91532.55	3.5
1287.002	-0.006	1		77699.94	178049.82	2.5	-	100350.27	3.5
1287.234	0.006	1	N	77685.98	178036.62	3.5	-	100350.27	3.5
1287.397	-0.004	4		77676.13	167196.22	4.5	-	89520.30	3.5
1289.126	-0.014	400		77571.91	176542.74	3.5	-	98971.68	4.5
1289.617	-0.002	1		77542.38	175765.09	2.5	-	98222.84	2.5

	0.019				204410.73	2.5	-	126867.20	3.5
1290.243	-0.001	2000		77504.81	161851.88	4.5	-	84347.15	3.5
1291.038	-0.004	1	N	77457.05	163034.43	5.5	-	85577.64	6.5
1291.122	-0.005	1	N	77451.98	170669.58	2.5	-	93217.89	1.5
1291.222	0.000	2	3	77446.00	177796.25	3.5	-	100350.27	3.5
1291.567	-0.001	25		77425.34	193410.18	3.5	-	115984.90	3.5
1291.765	0.000	400		77413.47	199896.90	7.5	-	122483.43	8.5
1291.953	-0.007	25		77402.21	202469.20	6.5	-	125067.40	5.5
1294.286	-0.001	150		77262.70	175765.09	2.5	-	98502.45	3.5
1294.351	-0.004	20		77258.79	168124.60	4.5	-	90866.06	5.5
1295.375	0.004	0	N	77197.74	176542.74	3.5	-	99344.77	2.5
1295.546	-0.003	400		77187.54	168053.40	5.5	-	90866.06	5.5
1295.932	-0.021	500		77164.56	176135.00	5.5	-	98971.68	4.5
1296.160	-0.006	20		77150.96	167196.22	4.5	-	90045.61	4.5
1296.456	-0.002	40		77133.38	172243.23	5.5	-	95109.97	5.5
1297.187	-0.010	300		77089.86	162666.91	6.5	-	85577.64	6.5
1298.149	0.003	100		77032.74	171867.02	4.5	-	94834.11	3.5
1298.233	-0.005	50		77027.79	172243.23	5.5	-	95215.74	4.5
1298.495	-0.004	20		77012.26	171510.39	3.5	-	94498.37	2.5
1299.587	-0.008	20		76947.50	185972.22	3.5	-	109025.19	4.5
1299.750	-0.006	1	N	76937.88	176135.00	5.5	-	99197.48	6.5
1300.416	0.002	10	N	76898.48	176135.00	5.5	-	99236.42	5.5
1300.484	-0.001	2		76894.47	172243.23	5.5	-	95348.81	6.5
1300.686	-0.010	1		76882.49	185907.11	5.5	-	109025.19	4.5
1301.424	-0.006	1	N	76838.92	192674.05	2.5	-	115835.49	1.5
1302.708	-0.001	20		76763.17	179305.55	3.5	-	102542.47	3.5
1302.811	-0.001	60		76757.10	171867.02	4.5	-	95109.97	5.5
1303.960	-0.005	2		76689.48	192674.05	2.5	-	115984.90	3.5
1304.180	-0.004	1	N	76676.51	171510.39	3.5	-	94834.11	3.5
1304.605	-0.005	1	N	76651.55	171867.02	4.5	-	95215.74	4.5
1304.730	0.001	250		76644.21	168126.55	3.5	-	91482.25	2.5
1305.581	-0.004	2000		76594.25	168126.55	3.5	-	91532.55	3.5
1306.187	0.000	800		76558.69	185972.22	3.5	-	109413.50	2.5
	-0.007				178524.89	4.5	-	101966.58	4.5
1306.731	-0.003	1		76526.82	178684.75	2.5	-	102158.11	2.5
1306.915	0.000	600		76516.05	162093.66	5.5	-	85577.64	6.5
	-0.010				179305.55	3.5	-	102790.11	4.5
	-0.012				169733.24	1.5	-	93217.89	1.5
1307.503	0.006	1	N	76481.65	184355.37	2.5	-	107873.37	2.5
1307.560	-0.005	1	N	76478.33	177796.25	3.5	-	101318.22	2.5
1307.940	-0.005	10		76456.13	185869.35	2.5	-	109413.50	2.5
1308.540	-0.013	100		76421.07	175765.09	2.5	-	99344.77	2.5
1310.095	-0.003	1	Nb	76330.36	167196.22	4.5	-	90866.06	5.5
1311.188	-0.006	100		76266.71	158971.44	4.5	-	82705.07	5.5
1312.466	0.001	150		76192.44	176542.74	3.5	-	100350.27	3.5
1313.332	0.001	1	N	76142.23	178684.75	2.5	-	102542.47	3.5
1313.562	-0.004	20		76128.87	176478.90	4.5	-	100350.27	3.5
1313.914	0.000	100		76108.51	167590.75	2.5	-	91482.25	2.5
1314.240	0.001	1		76089.60	168053.40	5.5	-	91963.75	6.5
1314.791	0.009	150		76057.71	167590.75	2.5	-	91532.55	3.5
1316.037	-0.003	9000		75985.73	161142.36	7.5	-	85156.82	8.5
1316.810	0.009	1	N	75941.08	196270.43	2.5	-	120328.83	2.5

1316.981	-0.002	800		75931.23	167413.37	3.5	-	91482.25	2.5
1317.582	0.001	20		75896.60	171006.63	6.5	-	95109.97	5.5
1317.703	0.006	100		75889.63	171867.02	4.5	-	95977.05	3.5
1317.852	-0.004	20		75881.07	167413.37	3.5	-	91532.55	3.5
1317.882	-0.014	6	b	75879.32	178036.62	3.5	-	102158.11	2.5
1318.646	0.002	1	N	75835.34	170669.58	2.5	-	94834.11	3.5
1320.405	0.007	1	N	75734.36	178524.89	4.5	-	102790.11	4.5
1321.827	0.007	80	Nb	75652.86	186462.00	4.5	-	110808.74	3.5
1321.883	-0.004	10		75649.68	178524.89	4.5	-	102875.41	5.5
1322.080	-0.005	1	Nb	75638.40	177796.25	3.5	-	102158.11	2.5
1322.116	0.001	1	Nb	75636.32	175765.09	2.5	-	100128.73	1.5
1323.366	-0.003	150		75564.90	161142.36	7.5	-	85577.64	6.5
1323.851	-0.002	1		75537.19	178049.82	2.5	-	102512.73	1.5
1323.920	0.001	300		75533.28	171510.39	3.5	-	95977.05	3.5
1324.373	-0.002	100		75507.45	178049.82	2.5	-	102542.47	3.5
1324.603	-0.003	20		75494.30	178036.62	3.5	-	102542.47	3.5
1326.003	0.004	1	N	75414.61	175765.09	2.5	-	100350.27	3.5
1326.360	-0.001	8000	b	75394.32	171006.63	6.5	-	95612.36	7.5
1328.831	-0.003	15		75254.10	202469.20	6.5	-	127215.28	6.5
	-0.006				177796.25	3.5	-	102542.47	3.5
1328.963	-0.002	80		75246.65	178036.62	3.5	-	102790.11	4.5
1329.169	-0.001	20		75234.95	169733.24	1.5	-	94498.37	2.5
1329.353	-0.001	80		75224.59	176542.74	3.5	-	101318.22	2.5
1329.772	-0.002	1		75200.87	178684.75	2.5	-	103484.02	2.5
1330.445	0.012	1	N	75162.82	185972.22	3.5	-	110808.74	3.5
1331.927	0.008	80		75079.16	179305.55	3.5	-	104225.95	3.5
1332.793	-0.001	20		75030.39	169417.43	3.5	-	94387.08	4.5
1333.121	-0.002	1000	b	75011.97	168124.60	4.5	-	93112.72	5.5
1333.221	-0.003	1	N	75006.31	177796.25	3.5	-	102790.11	4.5
1334.388	-0.001	1000		74940.74	168053.40	5.5	-	93112.72	5.5
1334.770	-0.003	1		74919.25	169417.43	3.5	-	94498.37	2.5
1334.919	0.009	600		74910.90	186462.00	4.5	-	111550.62	3.5
1335.390	-0.004	450		74884.49	163034.43	5.5	-	88150.15	4.5
1336.041	0.000	2		74848.02	202063.30	5.5	-	127215.28	6.5
1336.414	0.001	1000		74827.11	163034.43	5.5	-	88207.24	5.5
1336.606	0.002	1	N	74816.01	163023.68	4.5	-	88207.24	5.5
1337.235	0.003	2		74781.20	169279.75	2.5	-	94498.37	2.5
1338.831	0.001	60		74692.01	179305.55	3.5	-	104613.47	4.5
	0.009				170669.58	2.5	-	95977.05	3.5
	0.009				193410.18	3.5	-	118717.65	3.5
1340.054	0.008	2000		74623.85	158971.44	4.5	-	84347.15	3.5
1340.149	0.000	200		74618.56	172243.23	5.5	-	97624.67	4.5
1340.710	0.018	400	N3	74587.33	158935.51	3.5	-	84347.15	3.5
1341.101	0.003	600		74565.62	178049.82	2.5	-	103484.02	2.5
1341.329	0.001	50		74552.93	177343.11	4.5	-	102790.11	4.5
	-0.006				178036.62	3.5	-	103484.02	2.5
1341.439	0.019	1	Nb	74546.83	205224.69	3.5	-	130676.78	4.5
1342.072	0.012	1	N	74511.65	176478.90	4.5	-	101966.58	4.5
1342.186	0.007	300		74505.31	199616.30	4.5	-	125110.59	3.5
1342.865	0.001	40		74467.65	177343.11	4.5	-	102875.41	5.5
1343.009	0.000	800	b	74459.66	162666.91	6.5	-	88207.24	5.5
	0.017				202063.30	5.5	-	127602.68	4.5

	-0.015				178684.75 2.5 - 104225.95 3.5	
1343.242	0.002	150		74446.74	175765.09 2.5 - 101318.22 2.5	
1343.695	-0.001	600		74421.67	185972.22 3.5 - 111550.62 3.5	
1344.364	0.000	250		74384.61	176542.74 3.5 - 102158.11 2.5	
1344.466	0.000	1000		74378.97	185907.11 5.5 - 111528.16 6.5	
1344.574	-0.002	1000		74372.98	167590.75 2.5 - 93217.89 1.5	
1345.361	0.004	3000		74329.47	176135.00 5.5 - 101805.30 6.5	
1345.556	0.000	20		74318.72	185869.35 2.5 - 111550.62 3.5	
1345.676	0.002	100		74312.10	177796.25 3.5 - 103484.02 2.5	
1346.280	0.001	1	N	74278.75	171867.02 4.5 - 97588.21 5.5	
1346.941	0.001	600	b	74242.30	171867.02 4.5 - 97624.67 4.5	
1347.666	-0.012	300		74202.37	169417.43 3.5 - 95215.74 4.5	
1348.923	0.002	1000		74133.20	10213.86 2.5 - 84347.15 3.5	
1349.826	-0.002	1500		74083.60	167196.22 4.5 - 93112.72 5.5	
1350.269	0.009	9000		74059.34	152621.05 5.5 - 78561.20 4.5	
1352.147	-0.001	200		73956.44	192674.05 2.5 - 118717.65 3.5	
1352.382	-0.001	1000		73943.58	162093.66 5.5 - 88150.15 4.5	
1352.568	-0.015	1	N	73933.42	205224.69 3.5 - 131292.10 3.5	
1352.973	0.003	80		73911.28	178524.89 4.5 - 104613.47 4.5	
1353.428	-0.001	2000	b	73886.45	162093.66 5.5 - 88207.24 5.5	
	-0.013				171510.39 3.5 - 97624.67 4.5	
1354.577	0.001	10		73823.80	178049.82 2.5 - 104225.95 3.5	
1354.811	-0.007	800		73811.03	178036.62 3.5 - 104225.95 3.5	
1355.801	0.010	3000	Nb	73757.16	162666.91 6.5 - 88909.21 7.5	
1355.879	-0.005	2000	Nb	73752.88	176542.74 3.5 - 102790.11 4.5	
1356.125	-0.001	3000	b	73739.50	168126.55 3.5 - 94387.08 4.5	
1356.162	0.000	3000	b	73737.50	168124.60 4.5 - 94387.08 4.5	
1356.818	-0.003	1000		73701.88	161851.88 4.5 - 88150.15 4.5	
1357.059	0.000	500		73688.77	176478.90 4.5 - 102790.11 4.5	
1357.472	0.000	200		73666.32	168053.40 5.5 - 94387.08 4.5	
1357.785	0.000	250	b	73649.38	186462.00 4.5 - 112812.61 4.5	
1357.865	-0.007	10	N	73645.03	161851.88 4.5 - 88207.24 5.5	
1358.176	0.001	200		73628.14	168126.55 3.5 - 94498.37 2.5	
1358.315	-0.008	1		73620.63	179305.55 3.5 - 105685.33 3.5	
	-0.008				196270.43 2.5 - 122650.21 3.5	
1358.566	-0.001	80		73607.04	175765.09 2.5 - 102158.11 2.5	
1358.631	0.000	1000		73603.50	176478.90 4.5 - 102875.41 5.5	
1359.064	-0.001	1		73580.05	163034.43 5.5 - 89454.46 6.5	
1359.682	0.001	1		73546.59	184355.37 2.5 - 110808.74 3.5	
1359.836	0.002	800		73538.25	186462.00 4.5 - 112923.66 5.5	
1360.408	0.010	1	N	73507.37	161851.88 4.5 - 235359.80 5.5	
1361.646	-0.003	100		73440.52	169417.43 3.5 - 95977.05 3.5	
1361.747	0.001	2000		73435.10	191837.18 6.5 - 118402.05 7.5	
1361.967	-0.001	800		73423.22	178036.62 3.5 - 104613.47 4.5	
1363.054	-0.002	2		73364.66	171867.02 4.5 - 98502.45 3.5	
1363.414	-0.008	3	N	73345.30	176135.00 5.5 - 102790.11 4.5	
1364.204	-0.002	30		73302.80	169279.75 2.5 - 95977.05 3.5	
1364.398	0.001	1500		73292.38	168126.55 3.5 - 94834.11 3.5	
1364.487	-0.001	600		73287.62	171510.39 3.5 - 98222.84 2.5	
1365.008	-0.001	600		73259.64	176135.00 5.5 - 102875.41 5.5	
1365.143	-0.001	200		73252.41	175765.09 2.5 - 102512.73 1.5	
1365.696	-0.003	30		73222.76	175765.09 2.5 - 102542.47 3.5	

1365.887	-0.001	3000		73212.49	162666.91	6.5	-	89454.46	6.5
1366.228	0.001	150		73194.21	185869.35	2.5	-	112675.11	1.5
1366.304	0.001	100		73190.16	185869.35	2.5	-	112679.15	2.5
1366.435	-0.006	80		73183.11	177796.25	3.5	-	104613.47	4.5
1366.872	-0.002	400		73159.72	185972.22	3.5	-	112812.61	4.5
1367.307	-0.005	3		73136.47	169733.24	1.5	-	96597.05	1.5
1367.631	-0.010	300		73119.14	204410.73	2.5	-	131292.10	3.5
1368.092	0.000	10	Nb	73094.50	185907.11	5.5	-	112812.61	4.5
1368.132	0.000	600		73092.38	167590.75	2.5	-	94498.37	2.5
1368.346	0.008	0	N	73080.91	193410.18	3.5	-	120328.83	2.5
1368.762	0.000	1	N	73058.70	176542.74	3.5	-	103484.02	2.5
1369.005	0.000	300	N3	73045.73	172243.23	5.5	-	99197.48	6.5
1369.369	-0.001	1	N	73026.36	167413.37	3.5	-	94387.08	4.5
1369.585	-0.004	200		73014.82	168124.60	4.5	-	95109.97	5.5
	0.001				204410.73	2.5	-	131395.86	2.5
1369.726	0.012	3000	b	73007.31	171510.39	3.5	-	98502.45	3.5
	-0.009				172243.23	5.5	-	99236.42	5.5
1369.875	0.002	800		72999.34	178684.75	2.5	-	105685.33	3.5
1370.172	-0.002	400		72983.53	185907.11	5.5	-	112923.66	5.5
1370.266	-0.008	3	N	72978.51	163023.68	4.5	-	90045.61	4.5
1370.299	-0.012	0	N	72976.78	152621.05	5.5	-	225597.19	5.5
1371.824	-0.006	2		72895.65	171867.02	4.5	-	98971.68	4.5
	-0.006				178049.82	2.5	-	105154.50	1.5
1372.882	0.002	0	N	72839.48	178524.89	4.5	-	105685.33	3.5
1373.453	-0.001	800		72809.21	167196.22	4.5	-	94387.08	4.5
1373.526	-0.011	40		72805.33	184355.37	2.5	-	111550.62	3.5
1374.078	-0.006	0	N	72776.05	193410.18	3.5	-	120634.44	4.5
1374.442	-0.003	600		72756.81	167590.75	2.5	-	94834.11	3.5
1374.599	0.012	1	N	72748.49	199616.30	4.5	-	126867.20	3.5
1375.428	-0.001	4000		72704.65	168053.40	5.5	-	95348.81	6.5
1375.840	-0.003	400		72682.88	169279.75	2.5	-	96597.05	1.5
1376.556	-0.007	80		72645.04	178684.75	2.5	-	106040.08	3.5
1376.666	-0.001	3000		72639.25	162093.66	5.5	-	89454.46	6.5
1376.718	-0.002	1000	b	72636.54	193410.18	3.5	-	120773.77	4.5
1376.827	-0.003	1000		72630.74	171867.02	4.5	-	99236.42	5.5
1377.808	0.004	0	N	72579.05	167413.37	3.5	-	94834.11	3.5
1378.877	0.016	80		72522.78	178823.30	0.5	-	106299.67	1.5
1379.288	0.012	1		72501.17	161851.88	4.5	-	234353.70	4.5
1380.317	-0.007	10	N	72447.12	170669.58	2.5	-	98222.84	2.5
1380.373	0.000	150		72444.18	205224.69	3.5	-	132780.51	4.5
1381.177	0.001	150		72402.02	193410.18	3.5	-	121008.13	4.5
1381.464	0.008	30	N	72386.95	162666.91	6.5	-	235054.30	6.5
1381.502	0.002	50		72384.99	178684.75	2.5	-	106299.67	1.5
1381.881	-0.012	60		72365.12	178049.82	2.5	-	105685.33	3.5
1381.931	-0.008	80		72362.51	167196.22	4.5	-	94834.11	3.5
1382.255	-0.006	40		72345.55	192674.05	2.5	-	120328.83	2.5
1382.519	-0.003	1000		72331.73	161851.88	4.5	-	89520.30	3.5
1382.638	-0.002	1	N	72325.50	163034.43	5.5	-	235359.80	5.5
	-0.004				152621.05	5.5	-	224946.33	5.5
1382.801	-0.004	50		72316.98	176542.74	3.5	-	104225.95	3.5
1383.483	-0.005	8	N	72281.35	175765.09	2.5	-	103484.02	2.5
1383.891	0.000	1	N	72260.04	162093.66	5.5	-	234353.70	4.5

1384.407	0.001	2000		72233.07	161142.36	7.5	-	88909.21	7.5
1385.077	-0.010	30		72198.13	167413.37	3.5	-	95215.74	4.5
1385.642	-0.007	30		72168.71	163034.43	5.5	-	90866.06	5.5
1385.677	0.005	2		72166.88	170669.58	2.5	-	98502.45	3.5
	-0.007				202469.20	6.5	-	130302.70	5.5
1385.789	0.001	1	N	72161.04	158971.44	4.5	-	231132.51	5.5
1385.845	-0.010	20		72158.16	163023.68	4.5	-	90866.06	5.5
1386.010	-0.001	1	N	72149.56	168126.55	3.5	-	95977.05	3.5
1386.056	0.007	1	N	72147.17	168124.60	4.5	-	95977.05	3.5
1386.204	0.002	1	N	72139.46	153240.36	6.5	-	225379.94	7.5
1386.773	0.021	100	Nb	72109.84	177796.25	3.5	-	105685.33	3.5
1387.225	-0.002	1	N	72086.35	167196.22	4.5	-	95109.97	5.5
1387.334	-0.002	800		72080.69	178524.89	4.5	-	106444.30	5.5
1387.714	-0.017	200	b	72060.95	152621.05	5.5	-	224681.17	6.5
1387.958	-0.005	450		72048.28	162093.66	5.5	-	90045.61	4.5
1388.627	0.001	100		72013.56	199616.30	4.5	-	127602.68	4.5
1388.948	-0.007	10		71996.92	178036.62	3.5	-	106040.08	3.5
	-0.009				163034.43	5.5	-	235030.89	4.5
1389.254	-0.011	1	N	71981.06	167196.22	4.5	-	95215.74	4.5
1390.264	0.009	10	b	71928.79	176542.74	3.5	-	104613.47	4.5
1390.971	-0.001	1	N	71892.20	162093.66	5.5	-	233985.80	5.5
1391.482	-0.008	2		71865.84	176478.90	4.5	-	104613.47	4.5
1391.622	0.002	2	N	71858.57	152621.05	5.5	-	224479.70	6.5
1391.727	0.010	1		71853.16	158935.51	3.5	-	230789.20	4.5
1392.402	-0.011	1		71818.35	158971.44	4.5	-	230789.20	4.5
1392.579	-0.001	1000		71809.23	171006.63	6.5	-	99197.48	6.5
1392.632	-0.004	1500		71806.46	161851.88	4.5	-	90045.61	4.5
1392.725	-0.016	4		71801.68	162666.91	6.5	-	90866.06	5.5
1392.884	-0.014	400		71793.48	169417.43	3.5	-	97624.67	4.5
1392.976	-0.010	40		71788.74	184467.39	1.5	-	112679.15	2.5
1393.330	-0.006	2		71770.52	171006.63	6.5	-	99236.42	5.5
1393.522	-0.001	250		71760.63	202063.30	5.5	-	130302.70	5.5
1393.599	-0.010	3	N	71756.68	177796.25	3.5	-	106040.08	3.5
1393.935	-0.003	2500		71739.35	179305.55	3.5	-	107566.36	4.5
1394.578	-0.006	10		71706.29	153240.36	6.5	-	224946.33	5.5
1394.932	-0.004	30		71688.10	161142.36	7.5	-	89454.46	6.5
1395.093	0.009	1	N	71679.82	184355.37	2.5	-	112675.11	1.5
1395.159	-0.004	2		71676.41	184355.37	2.5	-	112679.15	2.5
1395.514	-0.008	1	N	71658.18	177343.11	4.5	-	105685.33	3.5
1396.375	-0.006	1		71614.02	167590.75	2.5	-	95977.05	3.5
1396.988	0.004	0	N	71582.58	184355.37	2.5	-	112772.56	3.5
1397.836	0.000	30		71539.14	175765.09	2.5	-	104225.95	3.5
1398.394	-0.004	2		71510.60	169733.24	1.5	-	98222.84	2.5
1398.775	0.000	3500		71491.12	163023.68	4.5	-	91532.55	3.5
1399.702	-0.004	300		71443.76	202469.20	6.5	-	131025.64	7.5
1399.846	-0.002	600		71436.41	167413.37	3.5	-	95977.05	3.5
1400.365	-0.003	250	b	71409.98	202469.20	6.5	-	131059.37	6.5
1400.420	-0.004	300	b	71407.15	178524.89	4.5	-	107117.94	5.5
1401.652	0.003	800		71344.40	191978.97	5.5	-	120634.44	4.5
1401.919	-0.015	10		71330.79	163023.68	4.5	-	234353.70	4.5
	0.001				196270.43	2.5	-	124939.60	2.5
1402.034	-0.003	60		71324.97	170669.58	2.5	-	99344.77	2.5

1402.160	0.007	1	N	71318.55	162666.91	6.5 - 233985.80 5.5
	0.014				163034.43	5.5 - 234353.70 4.5
1402.462	-0.003	5		71303.17	177343.11	4.5 - 106040.08 3.5
1403.717	-0.001	300		71239.41	153240.36	6.5 - 224479.70 6.5
1403.951	0.001	1000		71227.55	162093.66	5.5 - 90866.06 5.5
1404.116	0.000	80		71219.17	167196.22	4.5 - 95977.05 3.5
1404.474	0.003	1000	Nb	71201.03	158971.44	4.5 - 230172.60 5.5
	0.004				162093.66	5.5 - 233294.89 6.5
1404.596	-0.005	100		71194.87	169417.43	3.5 - 98222.84 2.5
1404.780	-0.004	200		71185.55	152621.05	5.5 - 223806.40 5.5
1405.276	-0.006	4		71160.40	171510.39	3.5 - 100350.27 3.5
	-0.011				196270.43	2.5 - 125110.59 3.5
1406.551	0.003	3		71095.90	158935.51	3.5 - 230031.57 4.5
1407.053	0.003	4000		71070.55	163034.43	5.5 - 91963.75 6.5
1407.257	-0.002	80		71060.24	158971.44	4.5 - 230031.57 4.5
1407.327	0.004	200		71056.70	169279.75	2.5 - 98222.84 2.5
1408.000	0.003	8000	N	71022.72	153240.36	6.5 - 82217.51 7.5
1408.373	0.001	80		71003.89	202063.30	5.5 - 131059.37 6.5
1408.580	0.004	60		70993.48	167590.75	2.5 - 96597.05 1.5
1408.735	0.003	800		70985.67	161851.88	4.5 - 90866.06 5.5
1409.035	0.005	2	N	70970.58	191978.97	5.5 - 121008.13 4.5
1409.208	0.006	2	N	70961.84	163023.68	4.5 - 233985.80 5.5
1409.421	0.005	1		70951.13	163034.43	5.5 - 233985.80 5.5
1410.135	-0.004	2		70915.18	169417.43	3.5 - 98502.45 3.5
1410.460	-0.001	300		70898.84	177343.11	4.5 - 106444.30 5.5
1411.284	-0.001	1	N	70857.45	176542.74	3.5 - 105685.33 3.5
1412.003	-0.002	1000		70821.37	158971.44	4.5 - 88150.15 4.5
1412.200	-0.002	500		70811.49	178684.75	2.5 - 107873.37 2.5
1412.716	-0.005	200		70785.63	158935.51	3.5 - 88150.15 4.5
1412.882	0.000	600		70777.32	169279.75	2.5 - 98502.45 3.5
1413.144	0.001	3000		70764.17	158971.44	4.5 - 88207.24 5.5
1414.358	-0.006	300		70703.46	162666.91	6.5 - 91963.75 6.5
1416.162	0.002	4000	b	70613.37	158935.51	3.5 - 88322.02 2.5
1416.225	0.007	8	b	70610.26	175765.09	2.5 - 105154.50 1.5
1417.113	0.000	6		70566.02	153240.36	6.5 - 223806.40 5.5
1417.620	0.002	250		70540.75	170669.58	2.5 - 100128.73 1.5
1417.724	0.016	4000	b	70535.59	168124.60	4.5 - 97588.21 5.5
	-0.006				153240.36	6.5 - 82705.07 5.5
1417.763	-0.003	350	b	70533.66	153240.36	6.5 - 223773.87 7.5
1418.249	0.000	0	N	70509.46	177343.11	4.5 - 106833.65 5.5
1418.388	0.002	50		70502.56	176542.74	3.5 - 106040.08 3.5
1419.530	-0.002	250		70445.85	169417.43	3.5 - 98971.68 4.5
1419.672	0.001	50		70438.78	176478.90	4.5 - 106040.08 3.5
1420.690	0.003	200		70388.32	169733.24	1.5 - 99344.77 2.5
1422.089	0.005	800		70319.09	170669.58	2.5 - 100350.27 3.5
1422.872	0.000	40		70280.37	179305.55	3.5 - 109025.19 4.5
1423.275	-0.001	20		70260.49	163034.43	5.5 - 233294.89 6.5
1423.893	-0.003	80		70230.01	177796.25	3.5 - 107566.36 4.5
1423.910	0.015	20	N	70229.17	177796.25	3.5 - 107566.36 4.5
1423.990	-0.001	2000		70225.21	177343.11	4.5 - 107117.94 5.5
1424.660	0.000	60		70192.16	171510.39	3.5 - 101318.22 2.5
1424.978	-0.001	0	N	70176.52	178049.82	2.5 - 107873.37 2.5

1425.250	0.002	0	N	70163.14	178036.62	3.5 - 107873.37 2.5
1425.928	0.002	800		70129.79	162093.66	5.5 - 91963.75 6.5
1426.948	0.002	1	N	70079.64	175765.09	2.5 - 105685.33 3.5
1427.093	0.003	30		70072.50	169417.43	3.5 - 99344.77 2.5
1427.864	-0.002	80		70034.69	176478.90	4.5 - 106444.30 5.5
1428.827	-0.003	0	N	69987.50	185972.22	3.5 - 115984.90 3.5
1429.900	0.000	500		69934.97	169279.75	2.5 - 99344.77 2.5
1430.294	0.006	3000		69915.71	152621.05	5.5 - 82705.07 5.5
1430.393	0.002	30		69910.87	163023.68	4.5 - 93112.72 5.5
1430.610	0.004	1500		69900.25	171867.02	4.5 - 101966.58 4.5
1430.935	0.002	2		69884.39	185869.35	2.5 - 115984.90 3.5
1431.208	0.002	2	N	69871.03	196270.43	2.5 - 126399.30 2.5
1432.891	-0.006	100		69788.99	167413.37	3.5 - 97624.67 4.5
1434.211	0.005	0	N	69724.77	175765.09	2.5 - 106040.08 3.5
1434.911	-0.001	1		69690.75	176135.00	5.5 - 106444.30 5.5
1436.293	0.009	1	N	69623.67	168126.55	3.5 - 98502.45 3.5
1436.313	-0.011	5	N	69622.71	168124.60	4.5 - 98502.45 3.5
1436.621	0.005	1000		69607.76	167196.22	4.5 - 97588.21 5.5
1436.691	0.002	100		69604.40	169733.24	1.5 - 100128.73 1.5
1437.363	-0.006	20		69571.83	167196.22	4.5 - 97624.67 4.5
1437.942	-0.001	800		69543.84	171510.39	3.5 - 101966.58 4.5
1438.854	-0.001	1	N	69499.77	178524.89	4.5 - 109025.19 4.5
1439.807	-0.013	2	N	69453.73	172243.23	5.5 - 102790.11 4.5
1439.867	0.006	30		69450.87	158971.44	4.5 - 89520.30 3.5
1440.609	0.002	2000		69415.10	158935.51	3.5 - 89520.30 3.5
1440.860	0.004	50		69403.02	196270.43	2.5 - 126867.20 3.5
1441.599	0.009	60	N	69367.41	172243.23	5.5 - 102875.41 5.5
	0.010				167590.75	2.5 - 98222.84 2.5
1441.733	0.000	4		69360.96	176478.90	4.5 - 107117.94 5.5
1441.932	0.018	50		69351.41	171510.39	3.5 - 102158.11 2.5
	-0.001				170669.58	2.5 - 101318.22 2.5
1442.501	0.011	1	N	69324.03	171867.02	4.5 - 102542.47 3.5
1442.732	0.014	6		69312.94	199616.30	4.5 - 130302.70 5.5
1442.975	0.002	60	N	69301.26	176135.00	5.5 - 106833.65 5.5
1445.291	0.007	30		69190.20	167413.37	3.5 - 98222.84 2.5
1446.067	-0.004	4000	N3	69153.10	168124.60	4.5 - 98971.68 4.5
1446.104	-0.006	100	Nb	69151.31	169279.75	2.5 - 100128.73 1.5
1447.563	0.002	1	N	69081.62	168053.40	5.5 - 98971.68 4.5
1447.670	0.009	1	N	69076.50	171867.02	4.5 - 102790.11 4.5
1447.867	0.001	8	N	69067.12	169417.43	3.5 - 100350.27 3.5
1448.910	-0.007	1	N	69017.41	176135.00	5.5 - 107117.94 5.5
1449.038	0.003	2		69011.31	178036.62	3.5 - 109025.19 4.5
1449.459	0.008	1	N	68991.24	171867.02	4.5 - 102875.41 5.5
1449.681	0.005	3		68980.69	162093.66	5.5 - 93112.72 5.5
1449.767	-0.005	1	N	68976.61	176542.74	3.5 - 107566.36 4.5
1449.950	0.000	0	N	68967.90	171510.39	3.5 - 102542.47 3.5
1450.411	0.003	0	N	68945.99	185972.22	3.5 - 117026.11 2.5
1450.545	-0.001	0	N	68939.59	199616.30	4.5 - 130676.78 4.5
1450.839	0.005	800		68925.61	158971.44	4.5 - 90045.61 4.5
1451.117	0.003	80		68912.41	176478.90	4.5 - 107566.36 4.5
1451.148	-0.001	80		68910.97	167413.37	3.5 - 98502.45 3.5
1451.593	0.002	1000		68889.83	158935.51	3.5 - 90045.61 4.5

1451.989	0.005	300		68871.03	199896.90 7.5 - 131025.64 7.5	
1452.311	0.003	4		68855.78	168053.40 5.5 - 99197.48 6.5	
1452.580	0.005	1	N	68843.01	185869.35 2.5 - 117026.11 2.5	
1452.705	0.009	2	N	68837.10	199896.90 7.5 - 131059.37 6.5	
1453.887	0.013	30	Nb	68781.15	168126.55 3.5 - 99344.77 2.5	
1454.100	0.000	100		68771.06	177796.25 3.5 - 109025.19 4.5	
1454.780	0.006	3		68738.90	161851.88 4.5 - 93112.72 5.5	
1455.732	-0.004	0	N	68693.95	167196.22 4.5 - 98502.45 3.5	
1456.255	0.002	0	N	68669.27	176542.74 3.5 - 107873.37 2.5	
1456.730	0.009	1	N	68646.92	163034.43 5.5 - 94387.08 4.5	
1457.047	-0.001	150		68631.94	184467.39 1.5 - 115835.49 1.5	
1457.234	-0.001	3		68623.15	178036.62 3.5 - 109413.50 2.5	
1458.388	-0.005	1	N	68568.87	176135.00 5.5 - 107566.36 4.5	
1459.427	-0.003	1	N	68520.03	184355.37 2.5 - 115835.49 1.5	
1459.612	0.002	20		68511.37	170669.58 2.5 - 102158.11 2.5	
1459.922	0.000	1	N	68496.81	179305.55 3.5 - 110808.74 3.5	
1461.100	0.002	600		68441.57	167413.37 3.5 - 98971.68 4.5	
1461.667	0.000	1	N	68415.02	169733.24 1.5 - 101318.22 2.5	
1462.357	0.000	200		68382.73	177796.25 3.5 - 109413.50 2.5	
1462.624	0.005	150		68370.28	184355.37 2.5 - 115984.90 3.5	
1463.745	0.001	800		68317.89	177343.11 4.5 - 109025.19 4.5	
1465.292	0.004	1	N	68245.80	167590.75 2.5 - 99344.77 2.5	
1465.752	0.003	800		68224.39	167196.22 4.5 - 98971.68 4.5	
1466.385	0.006	1	N	68194.90	192674.05 2.5 - 124478.85 1.5	
1466.506	0.006	400		68189.30	163023.68 4.5 - 94834.11 3.5	
1466.712	0.000	2	N	68179.70	161851.88 4.5 - 230031.57 4.5	
1467.204	0.000	1	N	68156.87	170669.58 2.5 - 102512.73 1.5	
1467.846	0.002	1	N	68127.02	170669.58 2.5 - 102542.47 3.5	
1468.317	0.004	1000		68105.17	158971.44 4.5 - 90866.06 5.5	
1468.883	0.000	0	N	68078.94	162093.66 5.5 - 230172.60 5.5	
1469.108	0.002	200		68068.51	167413.37 3.5 - 99344.77 2.5	
1471.422	0.002	2		67961.46	169279.75 2.5 - 101318.22 2.5	
1472.229	0.006	1000		67924.19	163034.43 5.5 - 95109.97 5.5	
1472.461	0.005	800		67913.49	163023.68 4.5 - 95109.97 5.5	
1472.928	-0.005	1	N	67891.96	175765.09 2.5 - 107873.37 2.5	
1473.278	0.003	2	N	67875.85	178684.75 2.5 - 110808.74 3.5	
1474.530	0.010	800		67818.22	163034.43 5.5 - 95215.74 4.5	
1474.746	-0.008	1500		67808.29	163023.68 4.5 - 95215.74 4.5	
1475.442	0.000	1	N	67776.30	168126.55 3.5 - 100350.27 3.5	
1476.970	0.009	3	N	67706.19	162093.66 5.5 - 94387.08 4.5	
1477.425	0.007	2	N	67685.32	163034.43 5.5 - 95348.81 6.5	
1477.918	-0.001	4000		67662.76	153240.36 6.5 - 85577.64 6.5	
1478.262	0.001	1	N	67647.01	167413.37 3.5 - 235060.40 3.5	
1478.639	0.000	1	N	67629.76	172243.23 5.5 - 104613.47 4.5	
1478.910	0.004	1	N	67617.35	167413.37 3.5 - 235030.89 4.5	
1479.833	-0.002	1	N	67575.21	169733.24 1.5 - 102158.11 2.5	
1480.228	-0.005	1	N	67557.15	162666.91 6.5 - 95109.97 5.5	
1482.264	0.010	2	N	67464.35	161851.88 4.5 - 94387.08 4.5	
1482.312	-0.003	2	N	67462.16	167590.75 2.5 - 100128.73 1.5	
1482.508	0.000	300		67453.24	158935.51 3.5 - 91482.25 2.5	
	0.010				176478.90 4.5 - 109025.19 4.5	
1482.561	0.000	400		67450.84	169417.43 3.5 - 101966.58 4.5	

1482.778	0.007	40	N	67440.96	184467.39	1.5 - 117026.11 2.5
1483.611	-0.003	2		67403.10	158935.51	3.5 - 91532.55 3.5
1484.365	0.004	2	N	67368.87	196270.43	2.5 - 128901.39 2.5
1485.243	0.005	100		67329.04	184355.37	2.5 - 117026.11 2.5
1485.487	0.002	600		67317.99	162666.91	6.5 - 95348.81 6.5
1486.781	-0.002	15	b	67259.39	169417.43	3.5 - 102158.11 2.5
1486.883	-0.005	40	b	67254.78	185972.22	3.5 - 118717.65 3.5
1486.918	0.008	20	b	67253.20	171867.02	4.5 - 104613.47 4.5
1487.203	0.004	2		67240.32	167590.75	2.5 - 100350.27 3.5
1487.479	0.001	30		67227.82	178036.62	3.5 - 110808.74 3.5
1487.645	0.004	15		67220.33	169733.24	1.5 - 102512.73 1.5
1487.696	0.004	50		67218.01	196270.43	2.5 - 129052.23 3.5
1489.163	-0.002	1		67151.81	185869.35	2.5 - 118717.65 3.5
1489.559	0.004	1	N	67133.97	178684.75	2.5 - 111550.62 3.5
1489.833	0.000	60		67121.63	169279.75	2.5 - 102158.11 2.5
1490.095	0.000	1	N	67109.81	176135.00	5.5 - 109025.19 4.5
1490.652	-0.010	2	N	67084.73	179305.55	3.5 - 112221.27 4.5
1491.135	0.002	1	N	67063.02	167413.37	3.5 - 100350.27 3.5
1491.571	0.000	3000		67043.39	152621.05	5.5 - 85577.64 6.5
1492.362	0.000	1	N	67007.89	163023.68	4.5 - 230031.57 4.5
1492.816	0.000	300		66987.50	177796.25	3.5 - 110808.74 3.5
1492.900	-0.001	500		66983.73	162093.66	5.5 - 95109.97 5.5
1494.512	0.002	500		66911.49	191978.97	5.5 - 125067.40 5.5
1494.629	0.001	1	N	66906.25	168124.60	4.5 - 235030.89 4.5
1494.664	-0.008	1	N	66904.68	168126.55	3.5 - 235030.89 4.5
1494.838	0.000	2		66896.90	171510.39	3.5 - 104613.47 4.5
1495.329	0.001	80		66874.89	169417.43	3.5 - 102542.47 3.5
1495.981	0.004	1	N	66845.79	167196.22	4.5 - 100350.27 3.5
1496.824	0.005	3	N	66808.11	168126.55	3.5 - 101318.22 2.5
1497.682	-0.002	80		66769.85	191837.18	6.5 - 125067.40 5.5
1497.742	-0.003	80		66767.17	169279.75	2.5 - 102512.73 1.5
1498.242	-0.001	10		66744.89	162093.66	5.5 - 95348.81 6.5
1498.302	-0.007	2	N	66742.21	161851.88	4.5 - 95109.97 5.5
1498.409	-0.004	10		66737.45	169279.75	2.5 - 102542.47 3.5
1500.675	-0.012	1	N	66636.67	161851.88	4.5 - 95215.74 4.5
1500.905	0.020	10	Nb	66626.45	169417.43	3.5 - 102790.11 4.5
	-0.016				158971.44	4.5 - 225597.19 5.5
1502.594	-0.003	1	N	66551.56	158971.44	4.5 - 225522.85 3.5
1502.796	0.008	1	N	66542.64	193410.18	3.5 - 126867.20 3.5
1502.975	-0.007	20		66534.70	177343.11	4.5 - 110808.74 3.5
1504.071	-0.005	1	N	66486.24	178036.62	3.5 - 111550.62 3.5
1505.035	0.000	50		66443.63	170669.58	2.5 - 104225.95 3.5
1508.871	0.001	1	N	66274.72	192674.05	2.5 - 126399.30 2.5
1509.466	0.014	10		66248.59	169733.24	1.5 - 103484.02 2.5
	-0.011				168053.40	5.5 - 101805.30 6.5
1510.980	-0.012	2		66182.21	171867.02	4.5 - 105685.33 3.5
1511.489	0.001	1	N	66159.93	168126.55	3.5 - 101966.58 4.5
1515.034	0.011	5	N	66005.11	178684.75	2.5 - 112679.15 2.5
1515.728	0.000	1	N	65974.88	158971.44	4.5 - 224946.33 5.5
1515.873	-0.003	1	N	65968.58	168126.55	3.5 - 102158.11 2.5
1516.682	0.000	1	N	65933.41	169417.43	3.5 - 103484.02 2.5
1519.125	0.005	10	N	65827.36	186462.00	4.5 - 120634.44 4.5

	-0.010				171867.02	4.5 - 106040.08 3.5
1519.567	-0.017	1	N	65808.24	193410.18	3.5 - 127602.68 4.5
1519.785	0.003	60		65798.78	172243.23	5.5 - 106444.30 5.5
1519.867	0.011	2	N	65795.24	169279.75	2.5 - 103484.02 2.5
1519.867	-0.010	2	Nb	65795.24	186462.00	4.5 - 120667.18 3.5
1519.908	0.002	30		65793.45	161142.36	7.5 - 95348.81 6.5
	-0.022				177343.11	4.5 - 111550.62 3.5
1521.283	0.000	1	N	65734.01	176542.74	3.5 - 110808.74 3.5
1522.758	-0.004	3	N	65670.32	176478.90	4.5 - 110808.74 3.5
1523.385	-0.007	2	Nb	65643.30	169417.43	3.5 - 235060.40 3.5
1523.518	0.004	80		65637.55	184355.37	2.5 - 118717.65 3.5
1524.078	0.001	2	N	65613.42	169417.43	3.5 - 235030.89 4.5
1524.804	-0.001	2		65582.19	168124.60	4.5 - 102542.47 3.5
1525.776	0.002	1	N	65540.44	185869.35	2.5 - 120328.83 2.5
1526.013	-0.006	1	N	65530.25	161142.36	7.5 - 95612.36 7.5
1527.410	0.000	10		65470.30	171510.39	3.5 - 106040.08 3.5
1527.791	-0.003	1	N	65453.98	186462.00	4.5 - 121008.13 4.5
1527.961	0.002	8		65446.69	167413.37	3.5 - 101966.58 4.5
1528.224	0.000	1	N	65435.45	163023.68	4.5 - 97588.21 5.5
1528.528	0.007	2		65422.41	171867.02	4.5 - 106444.30 5.5
1528.826	0.002	2		65409.66	163034.43	5.5 - 97624.67 4.5
	-0.002				172243.23	5.5 - 106833.65 5.5
1529.078	0.003	150		65398.88	163023.68	4.5 - 97624.67 4.5
1529.739	0.001	1		65370.62	178049.82	2.5 - 112679.15 2.5
1530.050	0.003	30		65357.34	178036.62	3.5 - 112679.15 2.5
1532.442	-0.001	10		65255.32	167413.37	3.5 - 102158.11 2.5
1535.698	0.003	40		65116.96	177796.25	3.5 - 112679.15 2.5
1537.676	0.004	20		65033.20	171867.02	4.5 - 106833.65 5.5
	-0.002				153240.36	6.5 - 88207.24 5.5
1538.968	-0.006	18		64978.60	196270.43	2.5 - 131292.10 3.5
1541.525	0.002	200		64870.82	167413.37	3.5 - 102542.47 3.5
1543.117	0.001	8		64803.90	169417.43	3.5 - 104613.47 4.5
1544.079	0.004	250		64763.52	191978.97	5.5 - 127215.28 6.5
1546.703	0.002	1		64653.65	167196.22	4.5 - 102542.47 3.5
	-0.019				184355.37	2.5 - 119702.50 1.5
1547.283	0.002	100		64629.41	170669.58	2.5 - 106040.08 3.5
1547.465	0.002	600		64621.81	191837.18	6.5 - 127215.28 6.5
1548.896	0.005	10		64562.11	171006.63	6.5 - 106444.30 5.5
1549.876	-0.001	40		64521.29	163023.68	4.5 - 98502.45 3.5
1550.256	0.000	80		64505.47	162093.66	5.5 - 97588.21 5.5
1551.126	-0.007	20		64469.29	162093.66	5.5 - 97624.67 4.5
1551.899	-0.001	50		64437.18	158935.51	3.5 - 94498.37 2.5
1552.462	0.000	10		64413.81	152621.05	5.5 - 88207.24 5.5
1553.377	0.010	6		64375.87	191978.97	5.5 - 127602.68 4.5
1553.928	0.003	2		64353.04	171006.63	6.5 - 235359.80 5.5
1554.484	0.027	4		64330.02	153240.36	6.5 - 88909.21 7.5
1555.222	0.028	40		64299.50	171867.02	4.5 - 107566.36 4.5
1556.717	-0.004	200		64237.75	161142.36	7.5 - 225379.94 7.5
1556.967	-0.005	20		64227.43	161851.88	4.5 - 97624.67 4.5
1558.960	-0.001	30		64145.32	167196.22	4.5 - 231341.51 4.5
1561.339	0.002	100		64047.58	171006.63	6.5 - 235054.30 6.5
1561.851	-0.001	2		64026.59	184355.37	2.5 - 120328.83 2.5

1564.059	0.002	100	63936.20	167196.22	4.5	-	231132.51	5.5
1564.246	0.019	1	63928.56	167413.37	3.5	-	103484.02	2.5
	-0.010			167413.37	3.5	-	231341.51	4.5
	-0.006			196270.43	2.5	-	132342.10	1.5
1565.888	-0.001	60	63861.52	158971.44	4.5	-	95109.97	5.5
1566.494	0.003	10	63836.82	163034.43	5.5	-	99197.48	6.5
1567.192	-0.001	300	63808.39	162093.66	5.5	-	225902.00	6.5
1567.452	0.005	1	63797.80	163034.43	5.5	-	99236.42	5.5
1567.745	0.000	4	63785.88	153240.36	6.5	-	89454.46	6.5
1568.742	-0.001	30	63745.34	161851.88	4.5	-	225597.19	5.5
1569.068	0.000	100	63732.10	169417.43	3.5	-	105685.33	3.5
1570.574	0.000	150	63670.98	161851.88	4.5	-	225522.85	3.5
1571.410	-0.002	10	63637.11	171510.39	3.5	-	107873.37	2.5
1572.463	-0.002	100	63594.50	169279.75	2.5	-	105685.33	3.5
1573.569	0.006	60	63549.80	171510.39	3.5	-	235060.40	3.5
1573.839	-0.002	200	63538.90	161142.36	7.5	-	224681.17	6.5
1574.301	0.006	10	63520.25	171510.39	3.5	-	235030.89	4.5
1574.715	0.000	150	63503.55	162093.66	5.5	-	225597.19	5.5
1574.892	-0.012	8	63496.41	185972.22	3.5	-	122476.28	2.5
1574.974	0.000	2000	63493.11	161142.36	7.5	-	224635.47	8.5
	-0.008			171867.02	4.5	-	235359.80	5.5
1577.453	-0.006	10	63393.33	185869.35	2.5	-	122476.28	2.5
1577.860	0.009	300	63376.97	169417.43	3.5	-	106040.08	3.5
1578.541	-0.005	40	63349.63	161851.88	4.5	-	98502.45	3.5
1578.856	0.009	100	63336.99	161142.36	7.5	-	224479.70	6.5
1581.403	0.003	400	63234.98	162666.91	6.5	-	225902.00	6.5
1581.856	0.001	80	63216.87	168124.60	4.5	-	231341.51	4.5
1581.901	-0.003	90	63215.08	168126.55	3.5	-	231341.51	4.5
1582.438	-0.006	60	63193.62	171867.02	4.5	-	235060.40	3.5
1583.181	-0.003	100	63163.97	171867.02	4.5	-	235030.89	4.5
1584.371	0.001	150	63116.53	172243.23	5.5	-	235359.80	5.5
1584.926	0.001	80	63094.42	161851.88	4.5	-	224946.33	5.5
1585.230	0.000	800	63082.32	168053.40	5.5	-	231135.72	6.5
1587.100	-0.002	600	63008.00	168124.60	4.5	-	231132.51	5.5
1588.072	0.021	60	62969.43	167196.22	4.5	-	104225.95	3.5
1589.067	0.007	80	62930.00	162666.91	6.5	-	225597.19	5.5
1589.913	-0.009	50	62896.52	162093.66	5.5	-	99197.48	6.5
1590.155	-0.019	80	62886.95	193410.18	3.5	-	130523.98	3.5
1590.641	-0.004	60	62867.73	163034.43	5.5	-	225902.00	6.5
1591.025	0.003	80	62852.56	162093.66	5.5	-	224946.33	5.5
1591.112	0.004	1	62849.12	178684.75	2.5	-	115835.49	1.5
1592.074	-0.002	400	62811.15	172243.23	5.5	-	235054.30	6.5
1592.456	0.003	200	62796.08	170669.58	2.5	-	107873.37	2.5
1592.670	0.001	10	62787.64	172243.23	5.5	-	235030.89	4.5
1594.005	0.019	300	62735.06	163034.43	5.5	-	230789.20	4.5
1594.569	0.004	800	62712.87	162666.91	6.5	-	225379.94	7.5
1595.819	0.022	30	62663.74	168124.60	4.5	-	230789.20	4.5
	-0.028			168126.55	3.5	-	230789.20	4.5
1596.640	0.000	30	62631.52	161142.36	7.5	-	223773.87	7.5
1597.892	0.008	1	62582.45	167196.22	4.5	-	104613.47	4.5
	-0.006			178524.89	4.5	-	115942.68	5.5
1598.077	0.006	600	62575.20	152621.05	5.5	-	90045.61	4.5

1598.390	-0.005	150	62562.95	163034.43 5.5 - 225597.19 5.5
1598.967	-0.010	100	62540.37	178524.89 4.5 - 115984.90 3.5
1600.022	0.001	15	62499.14	163023.68 4.5 - 225522.85 3.5
1601.556	0.000	10	62439.27	168124.60 4.5 - 105685.33 3.5
1602.919	-0.004	30	62386.18	162093.66 5.5 - 224479.70 6.5
1603.226	0.002	250	62374.23	153240.36 6.5 - 90866.06 5.5
1605.439	0.000	1	62288.25	171006.63 6.5 - 233294.89 6.5
1605.673	0.006	30	62279.18	162666.91 6.5 - 224946.33 5.5
	0.007			179305.55 3.5 - 117026.11 2.5
1609.806	-0.002	250	62119.28	168053.40 5.5 - 230172.60 5.5
1610.024	-0.010	100	62110.87	172243.23 5.5 - 234353.70 4.5
1610.660	0.003	50	62086.34	168126.55 3.5 - 106040.08 3.5
1611.795	0.002	8	62042.62	168053.40 5.5 - 106010.72 6.5
1612.119	-0.001	6	62030.16	178036.62 3.5 - 116006.51 4.5
1612.535	0.003	80	62014.15	162666.91 6.5 - 224681.17 6.5
1614.886	0.005	2	61923.87	169417.43 3.5 - 231341.51 4.5
1614.917	-0.001	6	61922.68	163023.68 4.5 - 224946.33 5.5
1615.197	-0.001	20	61911.95	163034.43 5.5 - 224946.33 5.5
1615.349	0.022	1	61906.12	168124.60 4.5 - 230031.57 4.5
1615.369	-0.009	1	61905.36	168126.55 3.5 - 230031.57 4.5
	0.002			167590.75 2.5 - 105685.33 3.5
1617.795	0.007	250	61812.52	162666.91 6.5 - 224479.70 6.5
1619.303	0.001	200	61754.96	152621.05 5.5 - 90866.06 5.5
1620.006	-0.003	100	61728.16	167413.37 3.5 - 105685.33 3.5
1621.833	0.001	4	61658.62	178684.75 2.5 - 117026.11 2.5
1624.851	-0.001	20	61544.10	169417.43 3.5 - 107873.37 2.5
1627.458	-0.006	8	61445.51	163034.43 5.5 - 224479.70 6.5
1629.107	-0.002	4	61383.32	158971.44 4.5 - 97588.21 5.5
1629.371	-0.002	2	61373.37	167413.37 3.5 - 106040.08 3.5
1631.578	0.016	1	61290.35	168124.60 4.5 - 106833.65 5.5
1631.941	-0.003	100	61276.72	153240.36 6.5 - 91963.75 6.5
1633.465	0.005	1	61219.55	168053.40 5.5 - 106833.65 5.5
1635.607	0.003	150	61139.38	162666.91 6.5 - 223806.40 5.5
1636.479	0.004	10	61106.80	162666.91 6.5 - 223773.87 7.5
1637.525	0.002	30	61067.77	163034.43 5.5 - 101966.58 4.5
1637.809	-0.002	500	61057.18	163023.68 4.5 - 101966.58 4.5
1637.952	-0.005	1	61051.85	172243.23 5.5 - 233294.89 6.5
1639.060	-0.002	2	61010.57	178036.62 3.5 - 117026.11 2.5
1643.071	0.000	1	60861.64	185972.22 3.5 - 125110.59 3.5
	-0.001			162666.91 6.5 - 101805.30 6.5
1644.426	0.001	1	60811.49	191837.18 6.5 - 131025.64 7.5
1645.542	-0.003	100	60770.25	177796.25 3.5 - 117026.11 2.5
1651.310	-0.003	2	60557.98	176542.74 3.5 - 115984.90 3.5
	0.007			168124.60 4.5 - 107566.36 4.5
1653.413	0.007	1	60480.95	163023.68 4.5 - 102542.47 3.5
1670.539	-0.002	2	59860.91	170669.58 2.5 - 110808.74 3.5
1674.059	-0.001	3	59735.05	158971.44 4.5 - 99236.42 5.5
1680.201	-0.001	3	59516.68	176542.74 3.5 - 117026.11 2.5
1685.294	0.007	10	59336.82	161142.36 7.5 - 101805.30 6.5
1695.592	0.001	10	58976.45	161851.88 4.5 - 102875.41 5.5
1700.755	0.009	5	58797.41	163023.68 4.5 - 104225.95 3.5
1705.367	-0.001	10	58638.40	179305.55 3.5 - 120667.18 3.5

1706.228	-0.003	15	58608.81	169417.43 3.5	110808.74 3.5
1717.217	0.006	1	58233.75	152621.05 5.5	94387.08 4.5
1721.681	0.006	1	58082.76	171006.63 6.5	112923.66 5.5
1723.616	0.000	15	58017.56	178684.75 2.5	120667.18 3.5
1727.200	-0.004	300	57897.17	170669.58 2.5	112772.56 3.5
1731.569	0.001	5	57751.09	178524.89 4.5	120773.77 4.5
1744.029	-0.004	1	57338.49	163023.68 4.5	105685.33 3.5
1748.366	-0.003	40	57196.26	169417.43 3.5	112221.27 4.5
1748.807	-0.001	800	57181.83	202469.20 6.5	145287.39 6.5
1749.161	0.000	40	57170.26	202469.20 6.5	145298.94 5.5
1753.658	0.002	60	57023.66	163034.43 5.5	106010.72 6.5
1754.892	0.001	8	56983.56	163023.68 4.5	106040.08 3.5
1759.659	0.002	15	56829.19	179305.55 3.5	122476.28 2.5
1761.310	0.000	2	56775.92	202063.30 5.5	145287.39 6.5
1761.670	0.001	500	56764.32	202063.30 5.5	145298.94 5.5
1764.412	-0.005	3	56676.10	177343.11 4.5	120667.18 3.5
1765.026	-0.006	4000	56656.38	162666.91 6.5	106010.72 6.5
1765.381	-0.004	60	56644.99	169417.43 3.5	112772.56 3.5
1767.740	-0.002	2	56569.40	177343.11 4.5	120773.77 4.5
1775.094	-0.002	2	56335.04	177343.11 4.5	121008.13 4.5
1776.185	0.003	2000	56300.44	172243.23 5.5	115942.68 5.5
1778.201	0.003	2000	56236.61	172243.23 5.5	116006.51 4.5
1779.335	0.000	2000	56200.77	163034.43 5.5	106833.65 5.5
1779.676	0.001	600	56190.00	163023.68 4.5	106833.65 5.5
1782.880	-0.003	200	56089.02	205224.69 3.5	149135.77 2.5
1783.071	-0.002	200	56083.01	162093.66 5.5	106010.72 6.5
1784.568	0.002	80	56035.97	178823.30 0.5	122787.28 1.5
1784.616	0.003	50	56034.46	178684.75 2.5	122650.21 3.5
1787.687	-0.006	200	55938.20	186462.00 4.5	130523.98 3.5
1788.130	0.000	250	55924.34	171867.02 4.5	115942.68 5.5
1788.644	0.001	600	55908.27	176542.74 3.5	120634.44 4.5
	0.010			193410.18 3.5	137501.61 2.5
1788.740	0.000	150	55905.27	168126.55 3.5	112221.27 4.5
1788.800	-0.002	500	55903.39	168124.60 4.5	112221.27 4.5
1788.993	0.004	40	55897.36	178684.75 2.5	122787.28 1.5
1789.700	0.009	1000	55875.28	176542.74 3.5	120667.18 3.5
1789.720	0.001	2000	55874.66	178524.89 4.5	122650.21 3.5
1790.178	0.005	1500	55860.36	171867.02 4.5	116006.51 4.5
1791.045	-0.002	2000	55833.32	162666.91 6.5	106833.65 5.5
1791.085	0.002	6000	55832.07	168053.40 5.5	112221.27 4.5
1791.736	0.000	400	55811.79	161851.88 4.5	106040.08 3.5
	-0.002			176478.90 4.5	120667.18 3.5
1792.582	-0.007	600	55785.45	186462.00 4.5	130676.78 4.5
1793.113	0.001	2	55768.93	176542.74 3.5	120773.77 4.5
1795.169	0.002	80	55705.06	176478.90 4.5	120773.77 4.5
1798.725	0.005	800	55594.93	179305.55 3.5	123710.47 2.5
1799.415	-0.002	200	55573.61	178049.82 2.5	122476.28 2.5
1799.844	-0.001	100	55560.37	178036.62 3.5	122476.28 2.5
1800.205	-0.008	10	55549.22	162666.91 6.5	107117.94 5.5
1800.679	0.000	1	55534.60	176542.74 3.5	121008.13 4.5
1801.668	-0.008	2000	55504.12	171510.39 3.5	116006.51 4.5
1802.752	0.001	80	55470.74	176478.90 4.5	121008.13 4.5

1803.486	0.002	600	55448.17	185972.22 3.5	130523.98 3.5
1805.067	0.000	20	55399.60	178049.82 2.5	122650.21 3.5
1805.500	0.003	200	55386.31	178036.62 3.5	122650.21 3.5
1806.318	0.000	1000	55361.23	176135.00 5.5	120773.77 4.5
1806.557	0.003	1500	55353.91	168126.55 3.5	112772.56 3.5
1806.618	0.000	1000	55352.04	168124.60 4.5	112772.56 3.5
1806.843	0.007	800	55345.15	185869.35 2.5	130523.98 3.5
1807.665	0.000	20	55319.98	177796.25 3.5	122476.28 2.5
1807.917	-0.009	15	55312.27	168124.60 4.5	112812.61 4.5
1808.469	0.002	25	55295.39	185972.22 3.5	130676.78 4.5
1809.140	0.003	4	55274.88	204410.73 2.5	149135.77 2.5
1809.549	0.005	100	55262.38	178049.82 2.5	122787.28 1.5
1809.626	-0.001	2500	55260.03	162093.66 5.5	106833.65 5.5
1810.263	0.007	20	55240.59	168053.40 5.5	112812.61 4.5
1810.602	0.003	1500	55230.24	185907.11 5.5	130676.78 4.5
1812.499	0.000	80	55172.44	192674.05 2.5	137501.61 2.5
1813.369	0.002	2	55145.97	177796.25 3.5	122650.21 3.5
1813.843	0.003	6000	55131.56	161142.36 7.5	106010.72 6.5
1813.997	0.000	1000	55126.88	176135.00 5.5	121008.13 4.5
1814.953	0.002	1000	55097.84	175765.09 2.5	120667.18 3.5
1816.071	0.001	4000	55063.92	171006.63 6.5	115942.68 5.5
1817.106	0.009	20	55032.56	152621.05 5.5	97588.21 5.5
1817.583	0.004	2500	55018.12	161851.88 4.5	106833.65 5.5
1818.140	-0.018	50	55001.26	176135.00 5.5	231135.72 6.5
1819.024	0.014	3000	54974.53	167196.22 4.5	112221.27 4.5
	-0.008			178684.75 2.5	123710.47 2.5
1821.101	-0.002	60	54911.83	192674.05 2.5	137762.29 1.5
1824.219	0.007	2000	54817.97	167590.75 2.5	112772.56 3.5
1827.021	0.001	10	54733.90	161851.88 4.5	107117.94 5.5
1828.395	0.004	5	54692.77	177343.11 4.5	122650.21 3.5
1829.480	0.008	3	54660.34	204410.73 2.5	149750.15 1.5
1831.184	0.001	1500	54609.47	199896.90 7.5	145287.39 6.5
1837.438	0.002	200	54423.60	167196.22 4.5	112772.56 3.5
1840.736	0.002	10	54326.09	178036.62 3.5	123710.47 2.5
1841.034	0.002	500	54317.30	199616.30 4.5	145298.94 5.5
1857.656	0.004	40	53831.27	184355.37 2.5	130523.98 3.5
1872.260	-0.016	10	53411.38	169417.43 3.5	116006.51 4.5
1876.558	-0.008	3	53289.05	175765.09 2.5	122476.28 2.5
1892.778	-0.004	1	52832.39	176542.74 3.5	123710.47 2.5
1915.155	-0.006	1	52215.09	163023.68 4.5	110808.74 3.5
1917.987	-0.007	50	52137.99	158971.44 4.5	106833.65 5.5
1918.639	-0.008	20	52120.27	168126.55 3.5	116006.51 4.5
1945.254	-0.011	80	51407.16	167413.37 3.5	116006.51 4.5
2004.472	0.004	8	49872.30	162093.66 5.5	112221.27 4.5
2014.236	0.001	3	49630.58	161851.88 4.5	112221.27 4.5
2036.870	0.007	10	49079.16	161851.88 4.5	112772.56 3.5
2046.004	0.004	30	48860.08	171510.39 3.5	122650.21 3.5
2056.424	0.001	2	48612.54	169279.75 2.5	120667.18 3.5
2081.832	0.002	10	48019.32	170669.58 2.5	122650.21 3.5
2086.616	0.020	3	47909.24	179305.55 3.5	131395.86 2.5
2087.788	-0.002	1000	47882.35	170669.58 2.5	122787.28 1.5
2106.484	0.000	3000	47457.42	168124.60 4.5	120667.18 3.5

2108.228	0.035	5	47418.17	168053.40 5.5 - 120634.44 4.5
2110.829	0.004	100	47359.74	178036.62 3.5 - 130676.78 4.5
2110.862	0.037	100	47359.00	178036.62 3.5 - 130676.78 4.5
2111.144	0.004	1	47352.68	168126.55 3.5 - 120773.77 4.5
2111.231	0.004	250	47350.73	168124.60 4.5 - 120773.77 4.5
2114.733	-0.002	200	47272.32	177796.25 3.5 - 130523.98 3.5
2115.423	0.002	250	47256.91	169733.24 1.5 - 122476.28 2.5
2116.647	0.003	9000	47229.58	153240.36 6.5 - 106010.72 6.5
2120.910	-0.004	800	47134.66	196270.33 2.5 - 149135.77 2.5
2121.592	-0.002	2000	47119.51	177796.25 3.5 - 130676.78 4.5
2122.844	0.001	2500	47091.73	163034.43 5.5 - 115942.68 5.5
2123.324	-0.004	8000	47081.08	163023.68 4.5 - 115942.68 5.5
2125.723	-0.002	6000	47027.96	163034.43 5.5 - 116006.51 4.5
2126.207	-0.004	1500	47017.25	163023.68 4.5 - 116006.51 4.5
2128.537	0.000	1500	46965.79	184467.39 1.5 - 137501.61 2.5
2128.840	0.000	1500	46959.10	170669.58 2.5 - 123710.47 2.5
2129.434	-0.002	800	46946.01	169733.24 1.5 - 122787.28 1.5
2129.651	-0.003	2000	46941.22	169417.43 3.5 - 122476.28 2.5
2133.626	-0.001	1500	46853.78	184355.37 2.5 - 137501.61 2.5
2135.207	0.002	5000	46819.09	177343.11 4.5 - 130523.98 3.5
2135.923	0.003	1500	46803.40	169279.75 2.5 - 122476.28 2.5
2137.575	0.000	3000	46767.23	169417.43 3.5 - 122650.21 3.5
2138.354	-0.001	5000	46750.20	158971.44 4.5 - 112221.27 4.5
2138.532	-0.005	2000	46746.31	167413.37 3.5 - 120667.18 3.5
2139.987	-0.013	8000	46714.53	158935.51 3.5 - 112221.27 4.5
2140.421	0.002	200	46705.06	184467.39 1.5 - 137762.29 1.5
2141.040	0.001	4000	46691.55	191978.97 5.5 - 145287.39 6.5
2141.570	0.001	40	46680.00	191978.97 5.5 - 145298.94 5.5
2142.195	-0.002	2000	46666.38	177343.11 4.5 - 130676.78 4.5
2143.425	0.000	3000	46639.61	167413.37 3.5 - 120773.77 4.5
2143.892	0.004	3000	46629.45	169279.75 2.5 - 122650.21 3.5
2144.769	-0.002	20000	46610.38	152621.05 5.5 - 106010.72 6.5
2145.560	-0.006	1000	46593.20	184355.37 2.5 - 137762.29 1.5
2147.562	0.001	1000	46549.77	191837.18 6.5 - 145287.39 6.5
2148.096	0.002	4000	46538.20	191837.18 6.5 - 145298.94 5.5
2148.516	-0.003	3000	46529.11	167196.22 4.5 - 120667.18 3.5
2148.928	0.005	150	46520.18	196270.43 2.5 - 149750.15 1.5
2150.206	-0.003	5	46492.54	169279.75 2.5 - 122787.28 1.5
2153.453	0.000	400	46422.44	167196.22 4.5 - 120773.77 4.5
2154.183	0.000	15000	46406.71	153240.36 6.5 - 106833.65 5.5
2154.249	-0.002	200	46405.29	167413.37 3.5 - 121008.13 4.5
2163.878	0.003	600	46198.82	158971.44 4.5 - 112772.56 3.5
2164.382	0.001	800	46188.06	167196.22 4.5 - 121008.13 4.5
2165.548	-0.011	2500	46163.19	158935.51 3.5 - 112772.56 3.5
2166.119	-0.002	1000	46151.03	162093.66 5.5 - 115942.68 5.5
2167.448	-0.015	8	46122.73	153240.36 6.5 - 107117.94 5.5
2169.116	-0.006	3000	46087.27	162093.66 5.5 - 116006.51 4.5
2172.158	0.002	2000	46022.73	169733.24 1.5 - 123710.47 2.5
2175.365	0.001	80	45954.89	176478.90 4.5 - 130523.98 3.5
2177.528	-0.002	3000	45909.25	161851.88 4.5 - 115942.68 5.5
2180.558	-0.004	2	45845.46	161851.88 4.5 - 116006.51 4.5
2182.622	0.000	2	45802.11	176478.90 4.5 - 130676.78 4.5

2183.324	0.000	4000		45787.39	152621.05 5.5	- 106833.65 5.5
2187.166	0.000	150		45706.97	169417.43 3.5	- 123710.47 2.5
2189.890	0.007	30	B	45650.13	168126.55 3.5	- 122476.28 2.5
2196.966	0.000	20	B	45503.11	152621.05 5.5	- 107117.94 5.5
2198.268	0.009	50	B	45476.16	168126.55 3.5	- 122650.21 3.5
2209.052	0.010	10	B	45254.19	169733.24 1.5	- 124478.85 1.5
2209.704	0.014	20	B	45240.83	175765.09 2.5	- 130523.98 3.5
2220.745	-0.010	20	B	45015.93	177796.25 3.5	- 132780.51 4.5
2224.495	0.024	20	B	44940.05	167590.75 2.5	- 122650.21 3.5
2224.636	-0.005	30	B	44937.20	167413.37 3.5	- 122476.28 2.5
2231.276	-0.001	50	B	44803.49	167590.75 2.5	- 122787.28 1.5
2233.291	0.005	30	B	44763.06	167413.37 3.5	- 122650.21 3.5
2244.189	0.016	30	B	44545.70	167196.22 4.5	- 122650.21 3.5
2250.735	-0.004	10	B	44416.16	168126.55 3.5	- 123710.47 2.5
2287.472	-0.004	15	B	43702.96	167413.37 3.5	- 123710.47 2.5
2287.726	0.018	25	B	43698.04	176478.90 4.5	- 132780.51 4.5
2318.851	0.019	8	B	43111.55	167590.75 2.5	- 124478.85 1.5
2320.837	0.036	8	B	43074.67	191978.97 5.5	- 235054.30 6.5
2323.312	-0.001	14	B	43028.78	158971.44 4.5	- 115942.68 5.5
2323.882	-0.005	6	B	43018.23	169417.43 3.5	- 126399.30 2.5
2323.982	-0.022	8	B	43016.37	168126.55 3.5	- 125110.59 3.5
2325.638	0.014	8	B	42985.75	168053.40 5.5	- 125067.40 5.5
2327.523	-0.014	12	B	42950.95	158935.51 3.5	- 115984.90 3.5
2328.697	-0.016	12	B	42929.29	158935.51 3.5	- 116006.51 4.5
2331.350	0.000	35	B	42880.45	169279.75 2.5	- 126399.30 2.5
2338.940	-0.055	8	B	42741.31	161142.36 7.5	- 118402.05 7.5
2354.538	-0.001	4	B	42458.18	171510.39 3.5	- 129052.23 3.5
2357.738	-0.032	8	B	42400.57	163034.43 5.5	- 120634.44 4.5
2358.332	-0.036	16	B	42389.89	163023.68 4.5	- 120634.44 4.5
2363.155	-0.033	6	B	42303.37	167413.37 3.5	- 125110.59 3.5
2474.527	0.014	-	B	40399.55	152621.05 5.5	- 112221.27 4.5
2550.164	0.018	-	B	39201.40	161851.88 4.5	- 122650.21 3.5
2607.631	-0.010	-	B	38337.53	169733.24 1.5	- 131395.86 2.5
2607.631	-0.036	-	B	38337.53	158971.44 4.5	- 120634.44 4.5
2612.345	-0.001	-	B	38268.35	158935.51 3.5	- 120667.18 3.5
2612.679	0.001	-	B	38263.46	175765.09 2.5	- 137501.61 2.5
2619.648	0.005	-	B	38161.67	158935.51 3.5	- 120773.77 4.5
2620.854	-0.009	-	B	38144.12	167196.22 4.5	- 129052.23 3.5
2630.600	0.000	-	B	38002.80	175765.09 2.5	- 137762.29 1.5
2676.977	-0.005	-	B	37344.47	186462.00 4.5	- 223806.40 5.5
2713.902	0.004	-	B	36836.40	185972.22 3.5	- 149135.77 2.5
2720.902	-0.025	-	B	36741.63	161851.88 4.5	- 125110.59 3.5
2730.358	0.011	-	B	36614.39	152621.05 5.5	- 116006.51 4.5
2741.983	0.005	-	B	36459.17	158935.51 3.5	- 122476.28 2.5
2764.940	0.002	-	B	36156.46	163023.68 4.5	- 126867.20 3.5
2821.481	-0.016	-	B	35431.95	163034.43 5.5	- 127602.68 4.5
2838.061	0.006	-	B	35224.96	158935.51 3.5	- 123710.47 2.5
2904.842	0.043	-	B	34415.20	167196.22 4.5	- 132780.51 4.5
3090.606	0.017	-	B	32346.72	163023.68 4.5	- 130676.78 4.5
3313.572	-0.049	-	B	30170.23	179305.55 3.5	- 149135.77 2.5

Notes: B line attributed to Yb IV by Bryant [2]
N line is given for the first time

b blend of two transitions or more
s on the side of a stronger line
3 Probably blend with a Yb III line