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Oscillator strength catalogues for iron and titanium lines

ABSTRACT

In order to obtain data on chemical composition and physical conditions in the atmospheres of stars on the basis of spectral analysis, it is necessary to know atomic constants, and transition probabilities in particular. At the Crimean Observatory we have been collecting and reducing the data available in the literature concerning oscillator strengths for lines of the iron group elements (neutral and first stages of ionization).

DATA REDUCTION

While analysing the published data on the gf-values of these elements, we first considered the problem of the absolute scale of the gf-values and then the effects of systematic errors on the published oscillator strengths. The best accuracy in the determination of the absolute gf-value scale is provided by measurements of the lifetimes of the atoms in excited states. If such measurements are rather numerous for neutral iron, for other elements and ions of the iron group they are rather scarce, and the determination of the zero-point of the oscillator strengths system is less accurate.

The errors connected with the interpretation of the measured values in terms of observed quantities like the intensities of emission lines, equivalent widths of absorption lines, distances between hooks in experiments on anomalous dispersion, etc, we take to be systematic. The main goal of our reductions is to reveal the following errors:

1. Errors in the zero-point of the gf-value system.
2. Errors due to the wavelength range.
3. Errors in the line intensities.
4. Self-absorption effects.
5. Temperature errors.

At present the problem of comparison of oscillator strengths is simplified due to the existence of the precise measurements obtained by Blackwell and his group in Oxford. The high accuracy of the oxford data is confirmed by the measurements of other authors and by theoretical computations. Unfortunately, these measurements have been carried out only for a limited number of the numerous lines which have been observed in the spectra of stars. In our analysis we adopt the Oxford system as the basic one (for those elements where data are available) assuming it is free from systematic errors.

Reducing all published measurements to the Oxford system (for the lines of ionized iron we use a system of theoretical gf-values due to Kurucz), we assign a priority to the various contributing authors. While collecting the catalogue of oscillator strengths, we adopted the mean value from the group of references with highest priority as recommended gf-value, assuming that such a treatment will not affect the accuracy of good measurements.

A description of the oscillator strengths catalogues which have been prepared for iron and titanium lines is given in Table I.

Table I

Elem.	N of lines	Wavelength range, A	Range of E_1	Num. ref.	Notes
1.FeI	3420	2084-9889	0-5.1	20	a
2.FeII	798	2029-7711	0-8.6	11	b
3.TiI	795	2272-8778	0-4.3	17	c
4.TiII	419	2440-5416	0-4.3	10	d

Notes

a. Boyarchuk, A.A. and Savanov, I.S., 1985 Bull. Crim. Astrophys. Obs. 70, 57.
b. Boyarchuk, A.A. and Savanov, I.S., 1986 Bull. Crim. Astrophys. Obs. 74, 49.
c. Vaculenko D.A. and Savanov, I.S., 1990 Bull. Crim. Astrophys. Obs. 82 (in press)
d. Savanov I.S., 1990 (in press)

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Table II: A portion of the Ti I catalogue (Ref. 3). The three quantities given are Wavelength (A), Multiplet number and Recommended gf-value.

2272.61		-0.73	2735.61		-1.14	3214.240	27	-1.13
2273.330	15	-1.03	2739.81		-0.59	3217.942	179	-0.20
2276.750	15	-0.48	2742.32		-0.20	3219.212	179	-0.18
2280.000	15	-0.46	2749.06		-1.03	3221.151	26	-2.60
2299.860	14	-0.74	2757.40		-0.78	3221.381	179	-0.17
2302.750	14	-0.67	2758.08		-0:26	3222.741	26	-2.11
2305.690	14	-0.60	2802.50		-0.20	3223.519	179	0.18
2380.81		-1.24	2805.70		-0.87	3226.128	179	0.88
2384.520	12	-1.46	2809.17		-1.07	3226.240	27	-2.57
2418.370	11	-1.52	2812.98		-0.93	3243.803	26	-2.18
2421.310	11	-1.24	2817.40		-0.92	3292.078	62	-0.20
2424.260	11	-1.05	2817.84		-0.79	3299.413	61	-0.81
2428.240	10	-1.51	2828.07		-0.99	3306.879	190	0.09
2433.22		-1.66	2912.08		-0.03	3308.391	87	-0.49
2434.10		-1.97	2928.34		0.18	3309.501	87	-0.13
2440.980	10	-1.33	2933.526	1	-1.17	3309.730	190	-0.39
2504.54		-1.90	2937.301	1	-1.16	3312.690	190	-0.13
2519.010	8	-1.73	2941.995	1	-0.24	3314.422	87	0.11
2520.543	8	-1.11	2948.255	1	-0.14	3314.523	87	-0.52
2527.991	8	-1.51	2956.133	30	-0.06	3321.588	87	-0.60
2529.866	8	-0.89	2956.18		-0.01	3341.875	24	-0.14
2541.917	8	-0.68	2956.799	30	-1.07	3342.151	23	-1.38
2590.265	7	-1.65	2959.71		-1.39	3342.707	25	-2.39
2593.647	6	-1.41	2959.99		-1.22	3348.535	25	-2.49
2596.596	6	-1.35	2965.707	94	-0.37	3352.937	25	-2.05
2599.910	6	-0.60	2967.225	30	-1.12	3354.634	24	0.04
2605.163	6	-0.45	2968.231	29	-2.20	3360.990	24	-1.21
2611.287	6	-0.34	2970.384	29	-1.40	3361.263	25	-1.12
2611.468	6	-0.90	2974.934	94	-1.31	3361.835	23	-1.55
2619.942	6	-0.97	2981.448	29	-2.21	3370.436	24	-0.49
2631.550	5	-1.04	2983.29		-0.94	3371.447	24	0.14
2632.424	5	-0.99	2983.306	29	-1.11	3377.485	25	-0.36
2641.116	5	-0.36	3000.868	29	-0.92	3377.577	23	-0.26
2644.275	5	-0.23	3100.666	92	-0.46	3379.216	24	-1.08
2646.650	5	-0.05	3106.806	92	-0.98	3382.312	86	-0.50
2654.93		-2.30	3112.482	92	-1.17	3385.664	24	-1.27
2657.186	3	-1.79	3119.725	137	0.46	3385.944	23	-0.25
2661.966	2	-1.33	3123.074	67	-0.50	3390.682	86	-0.65
2669.610	2	-1.15	3141.537	66	-0.64	3392.713	136	-0.59
2679.949	2	-0.96	3141.670	192	-0.15	3398.634	86	-1.26
2685.14		-1.90	3186.451	27	-0.11	3439.305	120	-1.00
2725.07		-0.59	3191.994	27	0.04	3467.260	84	-1.06
2727.42		-0.67	3199.515	27	0.17	3478.918	84	-1.33
2731.13		-1.37	3203.828	27	-1.20	3480.525	84	-0.52
2731.58		-1.02	3204.870	90	-0.79	3485.689	84	-1.33
2733.26		-0.16	3205.168	26	-2.63	3493.280	22	-2.34
2735.28		-0.60	3205.848	26	-2.16	3495.754	84	-1.34

3499.099	84	-1.08	3798.276	115	-0.88	4005.952	187	-0.84
3506.643	22	-1.95	3818.22		-0.26	4008.046	187	-0.48
3511.626	22	-2.53	3822.026	189	-0.11	4008.926	12	-1.07
3547.029	133	-0.50	3828.180	189	0.08	4009.653	11	-1.84
3574.245	247	-0.49	3833.68		-0.34	4013.587	187	-0.26
3598.714	59	-1.02	3836.78		-0.08	4015.377	185	-0.42
3603.845	20	-2.82	3846.45		-0.31	4016.264	186	-0.82
3606.786	20	-2.41	3853.038	176	-0.23	4017.771	185	-0.26
3610.154	58	-0.43	3853.719	176	-0.22	4021.812	185	-0.17
3626.085	20	-2.41	3858.133	176	-0.01	4024.573	12	-0.99
3634.202	20	-1.92	3866.446	176	0.05	4026.539	185	-0.17
3635.46	19	0.04	3868.397	175	-0.12	4027.48		-0.03
3637.966	18	-1.97	3873.203	176	-0.27	4030.512	185	0.14
3642.675	19	0.14	3875.262	15	-1.64	4032.628	297	-0.92
3646.198	18	-1.65	3881.399	15	-2.30	4033.883	208	-0.70
3653.497	19	0.22	3882.147	175	-0.12	4034.884	208	-0.87
3654.592	18	-1.33	3882.313	176	-0.12	4035.828	208	-0.24
3658.097	19	-1.11	3882.892	176	0.37	4040.310	185	-0.79
3660.631	18	-1.43	3888.020	175	-0.60	4055.011	80	-0.65
3668.965	18	-1.31	3889.948	15	-2.32	4057.612	254	-0.26
3671.672	19	-1.10	3895.243	176	-0.08	4058.139	254	-0.26
3685.964	117	-0.84	3898.487	13	-2.28	4060.263	80	-0.64
3687.354	19	-2.20	3900.958	15	-1.69	4064.203	80	-0.86
3689.916	18	-1.30	3904.785	56	0.27	4065.094	80	-0.82
3694.445	117	-0.75	3911.185	175	-0.49	4071.2	254	-0.06
3698.183	222	-1.03	3914.334	15	-1.38	4076.37	9	-2.84
3698.43		-1.23	3914.751	14	-2.31	4078.471	80	-0.27
3700.08		-1.22	3919.822	130	-1.14	4079.708	207	-0.72
3702.291	83	-0.93	3921.423	14	-1.61	4082.456	80	-0.81
3704.295	117	-0.60	3924.527	13	-0.95	4099.166	207	-0.31
3707.549	177	-0.92	3926.319	292	0.13	4112.708	9	-1.76
3709.963	83	-0.45	3929.875	13	-1.07	4122.143	296	-0.16
3715.40		-1.64	3934.228	15	-2.21	4123.287	302	-0.22
3717.393	17	-1.26	3938.005	246	-0.23	4123.559	296	0.01
3722.568	17	-1.25	3947.770	14	-1.08	4127.531	296	-0.05
3724.59	131	0.25	3948.670	13	-0.47	4131.244	253	-0.50
3725.155	83	-0.34	3956.336	13	-0.45	4137.284	253	-0.07
3729.806	17	-0.35	3958.206	13	-0.16	4142.480	296	-1.04
3735.67		-0.43	3962.851	12	-1.17	4143.048	253	-0.10
3738.901	166	-0.95	3964.27	12	-1.17	4143.280	253	-0.09
3741.059	17	-0.21	3981.761	12	-0.34	4149.445	296	-1.10
3748.101	166	-0.45	3982.478	11	-1.33	4150.963	206	0.09
3752.860	17	-0.02	3984.313	188	-0.56	4154.865	221	-0.74
3753.623	17	-1.10	3985.25		-0.84	4159.634	163	-0.23
3766.445	82	-1.36	3985.580	188	-0.58	4166.314	163	-1.00
3771.652	17	-1.05	3989.758	12	-0.19	4169.330	163	-0.64
3774.331	16	-3.21	3994.683	188	-0.84	4171.018	206	-0.24
3786.043	57	-0.07	3998.635	12	-0.05	4183.294	220	-0.75
3788.80	16	-3.26	3999.336	188	-0.49	4186.119	129	-0.31
3789.293	115	-0.50	4002.466	188	-0.37	4188.694	220	-0.36
3795.903	115	-0.92	4003.789	188	-0.30	4200.752	220	-0.38

4203.465	220	-0.34	4404.276	219	0.17	4527.305	42	-0.51
4211.729	279	-0.52	4404.911	161	-0.76	4533.238	42	0.48
4224.795	301	-0.20	4405.694	78	-1.95	4534.782	42	0.28
4227.654	278	-0.46	4416.535	161	-0.75	4535.574	42	0.08
4237.889	284	0.15	4417.274	161	-0.13	4535.920	42	-0.16
4249.114	252	-0.40	4421.754	218	-0.12	4536.051	42	-0.24
4256.025	252	-0.12	4422.823	78	-1.15	4539.10		0.06
4258.523	252	-0.40	4424.401	243	-0.88	4544.688	42	-0.53
4261.609	252	-0.35	4425.840	78	-1.93	4548.764	42	-0.35
4263.134	162	0.23	4426.054	161	-0.41	4552.453	42	-0.30
4265.723	162	-0.75	4427.098	128	0.18	4555.069	266	-0.73
4266.827	252	-0.61	4430.023	267	-0.83	4555.486	42	-0.46
4270.139	251	-0.39	4430.366	113	-0.97	4557.857	270	-0.79
4272.440	44	-1.46	4431.284	218	-0.53	4558.092	262	-0.93
4274.584	44	-1.20	4432.60		-0.77	4559.920	112	-1.12
4276.441	148	-0.46	4433.578	267	-0.77	4562.637	7	-2.66
4278.231	200	0.32	4434.003	113	-0.62	4563.427	266	-0.50
4278.829	252	-0.75	4436.586	160	-0.67	4570.906		-0.53
4281.371	44	-1.36	4438.232	218	-0.78	4599.23		-0.17
4282.702	162	-0.09	4440.345	159	-0.41	4609.37		0.12
4284.988	148	-0.39	4441.272	160	-0.86	4617.269	145	0.39
4286.006	44	-0.33	4444.267	218	-0.92	4619.525	261	-0.79
4287.405	44	-0.44	4449.143	160	0.45	4623.098	145	0.11
4288.161	43	-2.20	4450.896	160	-0.21	4629.336	145	-0.39
4289.068	44	-0.28	4453.312	113	-0.05	4634.87		-0.46
4290.933	44	-0.40	4453.708	160	-0.01	4637.877	261	-0.31
4291.14		-0.11	4455.321	113	0.12	4639.369	145	-0.14
4295.751	44	-0.42	4457.428	113	0.26	4639.669	145	-0.19
4298.664	44	-0.07	4462.099	8	-3.11	4639.944	145	-0.22
4299.229	148	-0.31	4463.391	160	-0.66	4645.193	145	-0.56
4299.636	43	-0.93	4463.539	160	-0.50	4650.016	145	-0.64
4300.566	44	0.12	4465.807	146	-0.16	4656.048	145	-1.37
4301.089	44	0.25	4471.238	146	-0.15	4656.468	6	-1.35
4305.910	44	0.44	4474.852	113	-0.87	4667.585	6	-1.19
4308.514	79	-1.87	4479.724	146	-0.62	4675.118	77	-1.39
4311.654	205	-0.74	4480.600	146	-0.98	4681.908	6	-1.07
4314.356	45	-1.60	4481.261	146	0.15	4686.921	203	-1.04
4314.801	43	-0.30	4482.688	113	-0.84	4688.392	306	-0.32
4318.631	235	0.29	4489.089	146	-0.08	4690.827	76	-2.03
4321.655	235	-0.07	4492.540	184	-1.04	4691.336	75	-0.95
4325.134	235	0.11	4495.01		-0.57	4693.670	6	-2.72
4326.356	43	-1.13	4496.146	146	-0.08	4696.923	203	-0.96
4334.840	43	-2.20	4497.709	184	-1.03	4698.766	75	-1.04
4346.104	234	-0.40	4503.762	184	-0.71	4710.186	75	-1.34
4354.094	204	-0.77	4506.36		-0.78	4715.295	6	-2.69
4360.487	204	-0.45	4511.17		0.37	4722.603	75	-1.30
4368.941	245	-0.91	4512.734	42	-0.48	4723.171	75	-1.62
4369.682	290	-0.27	4515.610	184	-1.15	4731.172	202	0.08
4372.383	277	-0.32	4518.022	42	-0.33	4733.426	202	-0.61
4388.077	219	-0.80	4518.700	112	-0.89	4734.682	233	-0.75
4393.92		0.03	4522.798	42	-0.35	4742.129	202	-1.20

4742.791	233	-1.17	4973.051	173	-0.65	5186.61	215	-0.99
4747.680	233	-1.20	4975.344	283	0.07	5192.971	4	-1.01
4758.120	233	0.43	4977.731	173	-0.41	5194.043	183	-0.55
4758.913	41	-2.25	4978.191	173	-0.32	5201.096	183	-0.75
4759.272	233	0.51	4981.732	38	0.50	5206.059	276	0.79
4766.330	233	-0.67	4989.140	173	-0.22	5207.852	183	-0.63
4769.775	233	-0.93	4991.067	38	0.38	5210.386	4	-0.88
4771.103	41	-2.48	4995.062	216	-0.90	5212.271	215	-0.55
4778.259	232	-0.47	4997.099	5	-2.12	5219.697	4	-2.29
4781.718	41	-2.04	4999.504	38	0.25	5222.685	183	-0.62
4783.306	41	-2.92	5000.991	173	-0.03	5223.623	183	-0.56
4789.803	41	-2.91	5007.209	38	0.11	5224.301	183	-0.03
4792.482	26	-0.21	5009.652	5	-2.26	5224.558	183	-0.49
4796.210	260	-0.57	5013.284	173	-0.08	5224.928	183	-0.16
4797.983	260	-0.73	5014.185	5	-1.20	5238.560	37	-1.68
4799.797	242	-0.20	5014.277	38	-0.02	5246.143	282	-0.97
4805.416	260	-0.12	5016.162	38	-0.57	5246.574	37	-2.00
4808.531	305	-0.06	5020.028	38	-0.41	5247.293	183	-0.73
4811.074	158	-1.42	5022.871	38	-0.43	5250.95	37	-2.30
4812.240	260	-0.64	5024.842	38	-0.60	5252.185	4	-2.45
4812.906	41	-3.53	5025.570	173	0.08	5255.811	183	-0.64
4820.410	126	-0.44	5035.908	110	0.19	5259.976	298	-0.27
4825.445	250	-1.01	5036.468	110	0.13	5263.483	183	-0.79
4827.597	250	-0.62	5038.400	110	0.01	5265.967	156	-0.42
4836.125	241	-0.65	5039.959	5	-1.14	5266.49	36	-4.19
4840.874	53	-0.51	5040.642	38	-1.74	5282.378	74	-1.76
4848.487	201	-0.47	5043.578	38	-1.70	5283.441	156	-0.39
4856.012	231	0.46	5044.27		-0.91	5284.380	74	-1.89
4864.187	201	-0.86	5045.400	38	-1.98	5289.28	36	-2.96
4868.264	231	0.04	5048.208	199	-1.09	5295.781	74	-1.52
4870.129	231	0.13	5052.879	199	-0.33	5297.236	156	-0.47
4880.922	201	-1.03	5054.070	294	-0.71	5298.429	281	-0.35
4882.326	231	-0.66	5062.112	199	-0.46	5323.958	36	-3.11
4885.082	157	0.36	5064.068	294	-0.41	5328.72		-2.05
4899.910	157	0.13	5064.654	5	-0.99	5338.326	35	-1.94
4908.46	295	-0.68	5065.985	110	-1.07	5340.68	36	-3.26
4913.616	157	0.16	5068.332	294	-0.32	5341.50	316	0.49
4915.236	157	-1.02	5069.351	199	-0.58	5351.072	300	-0.14
4919.867	200	-0.25	5070.48		-0.87	5361.724	35	-3.13
4921.768	200	-0.11	5071.47	110	-1.06	5366.651	35	-2.63
4925.396	157	-0.92	5085.333	109	-2.89	5384.634	35	-2.75
4926.148	39	-2.29	5087.055	109	-0.99	5389.180	35	-2.21
4928.342	200	-0.14	5103.15		-0.94	5389.996	155	-1.09
4937.719	39	-2.31	5109.427	109	-1.39	5396.600	3	-3.18
4938.283	289	-0.01	5113.448	109	-0.78	5397.093	155	-0.83
4941.562	200	-1.00	5120.420	288	0.28	5401.32	35	-2.90
4948.183	200	-1.18	5145.465	109	-0.57	5404.023	259	-0.90
4958.26	52	-2.34	5147.483	4	-2.01	5408.940	3	-3.84
4964.713	173	-0.86	5152.105	4	-2.02	5409.609	155	-0.76
4966.04		-1.19	5173.742	4	-1.12	5426.256	3	-3.01
4968.566	173	-0.67	5186.329	183	-0.94	5429.139	259	-0.53

5436.703	51	-2.65	5774.037	309	0.40	6556.066	102	-1.07
5438.310	108	-2.23	5780.778	214	-1.08	6575.18	286	-0.11
5446.593	3	-3.32	5785.67	309	0.31	6599.112	49	-2.05
5446.593	259	-0.83	5785.979	309	0.28	6650.38		-2.90
5448.882	259	-1.00	5804.265	309	0.17	6657.03		-2.56
5449.155	107	-2.07	5812.827	309	-0.33	6666.548	101	-1.86
5453.646	108	-1.78	5823.679	239	-0.96	6677.25	274	-0.86
5460.502	3	-2.89	5832.470	309	-0.23	6716.679	273	-0.66
5471.198	106	-1.35	5866.453	72	-0.84	6743.124	48	-1.59
5472.696	107	-1.78	5903.317	71	-1.96	6745.56	226	-1.01
5473.517	259	-0.83	5818.548	71	-1.54	6861.47		-0.69
5474.228	108	-1.17	5922.112	72	-1.47	6873.92		-1.12
5474.449	259	-0.98	5937.806	72	-1.94	6913.19		-0.96
5477.695	265	-0.21	5941.755	72	-1.46	6933.15		-0.48
5481.426	265	-0.24	5953.162	154	-0.33	6943.70		-0.43
5481.862	106	-1.12	5965.828	154	-0.41	6996.63	256	-0.94
5488.210	265	-0.45	5978.543	154	-0.50	7004.60	256	-1.18
5490.151	107	-0.93	5999.003	198	0.08	7008.35	256	-1.22
5490.840	3	-3.42	5999.668		-0.68	7010.94	256	-1.22
5497.92	51	-2.93	6013.42		-3.18	7035.86	307	-0.45
5503.897	287	-0.14	6017.00		-3.73	7038.80	256	-0.63
5511.795	108	-1.69	6064.631	69	-1.68	7050.65	256	-1.21
5512.529	106	-0.46	6085.228	69	-1.39	7069.11	307	-0.12
5514.350	106	-0.39	6091.175	238	-0.42	7084.25	99	-3.32
5514.536	106	-0.32	6092.814	153	-1.38	7138.91	99	-1.61
5530.49		-0.09	6098.655	304	-0.13	7188.55	99	-1.87
5562.74		-2.95	6121.008	153	-1.33	7189.89	285	-0.22
5565.476	229	-0.42	6126.217	69	-1.35	7209.44	99	-0.57
5600.05		-3.43	6138.38	197	-1.37	7216.20	98	-1.29
5644.137	240	0.06	6146.225	153	-1.38	7244.86	99	-0.97
5648.570	269	-0.39	6149.743	197	1.29	7251.74	99	-0.82
5662.154	249	-0.11	6186.14	197	-0.96	7266.29	143	-1.67
5662.891	269	-0.39	6215.212	293	-0.24	7271.41	97	-2.34
5673.42		-0.47	6220.460	293	-0.23	7299.67	97	-2.01
5675.413	249	-0.20	6221.41	293	-0.49	7315.56		-1.39
5679.908	269	-0.90	6258.103	104	-0.36	7318.39	212	-1.00
5689.465	249	-0.47	6258.706	104	-0.27	7344.72	97	-1.04
5702.666	249	-0.65	6261.101	104	-0.48	7352.16	272	-1.26
5708.199	249	-0.98	6303.754	104	-1.57	7357.74	97	-1.12
5711.852	249	-0.04	6312.240	104	-1.55	7364.11	97	-1.21
5713.895	249	-0.94	6318.027	103	-1.89	7423.17	97	-2.79
5715.123	228	-0.49	6336.104	103	-1.73	7440.60	225	-1.04
5716.450	249	-0.75	6358.66		-2.57	7474.94	142	-2.12
5720.445	249	-1.09	6366.354	103	-1.57	7489.61	225	-1.04
5739.464	228	-0.18	6395.47		-2.73	7696.12	225	-1.24
5739.975	228	-0.33	6419.15	196	-1.50	7580.55	211	-1.53
5741.192	280	-1.16	6497.689	102	-1.94	7614.50	211	-1.39
5752.89	214	-1.35	6499.92		-4.19	7654.44	211	-1.16
5756.45	228	-1.39	6508.135	102	-1.89	7938.53	151	-2.48
5762.295	309	0.25	6546.276	102	-1.25	7949.17	125	-1.35
5766.330	309	0.26	6554.226	102	-1.22	7961.58	308	-0.17

7978.88	151	-1.17	8377.90	33	-2.03	8468.46	150	-1.51
7978.88	308	-0.77	8382.54	33	-2.04	8496.03	209	-1.80
7996.53	308	-0.10	8382.82	33	-2.38	8518.05	182	-1.80
8024.84	151	-1.17	8396.93	33	-2.22	8518.37	150	-1.64
8066.05	151	-2.60	8412.36	33	-1.94	8539.36	209	-1.90
8068.24	151	-1.17	8416.97	224	-1.61	8548.07	150	-1.65
8100.1		-2.59	8424.41	182	-1.88	8569.72	209	-2.18
8306.31		-0.54	8426.50	33	-1.25	8598.18	236	-2.17
8307.41	33	-2.86	8434.98	33	-1.14	8675.38	68	-2.10
8311.76		-0.82	8435.68	33	-1.02	8682.99	68	-2.51
8312.85		-0.88	8438.93	224	-1.19	8692.34	68	-2.87
8334.37	33	-3.20	8450.89	224	-1.21	8734.70	68	-3.04
8353.15	33	-3.13	8457.10	141	-2.55	8766.64	68	-2.93
8364.24	33	-2.16	8467.15	182	-1.77	8778.66	140	-2.53