

STANDARDS OF THIRD ORDER OF WAVE-LENGTHS ON THE INTERNATIONAL SYSTEM

By H. KAYSER

The following table contains measurements of the arc spectrum of iron photographed in the second order with an excellent Rowland concave grating of twenty-one feet radius. The plates were made within the past five years, in part by Professor Konen, and in part by Professor Eversheim, Dr. Bachem, and myself. The measurements were made by myself, with a dividing engine constructed by Wolz.

I have employed as standards the arithmetical means of the measurements of Fabry and Buisson, Eversheim, and Pfund. The portions of spectrum measured were always between three or four successive standards, so that each line is referred to as many neighboring standard lines as possible. It turned out that measurements of the same sharp line on different plates yielded differences of not more than from 0.001 to 0.002 Å, when the same standards were employed; but if different standards were employed, differences as great as about 0.006 occurred. This proves that some of the standards still contain errors of from 0.004 to 0.005 Å, and that the measurements of the best plates in the second order give a greater degree of accuracy than that of the secondary standards. Each line was measured from ten to twenty times, and from all the measurements the arithmetical mean is taken, the probable error also being given.

This method of measurement has also yielded values for the standards themselves, which I regard as somewhat more accurate than the secondary international standards, inasmuch as they are adjusted. They are in general in good accord and only in a few cases is the difference large, in the case of λ 6430 reaching the amount of 0.012 Å. It remains to be investigated whether my value is more accurate than the other.

A comparison with Rowland's solar spectrum wave-lengths shows that the differences vary irregularly between 0.15 and 0.22 Å. By subtracting about 0.19 Å, all measurements on Rowland's system can be reduced to the international system with sufficient accuracy.

λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund
4118.553	3	I	.708	0.155			
21.807	I	I	.963	.156			
27.615	2	I	.767	.152			
32.064	6	I	.235	.171			
34.684	3	I	.840	.156	.685		
37.003	3	I	.156	.153			
43.421	4	I	.572	.151			
43.873	7	I	.038	.165			
47.674	2	I	.836	.162	.677		
54.506	2	I	.667	.161			
56.806	2	I	.970	.164			
70.906	2	I	.068	.162			
75.642	2	I	.806	.164			
84.804	2	I	.058	.164			
87.050	4	I	.204	.154			
87.807	4	I	.943	.136			
91.441	4	I	.595	.154	.441		
91.677	I	2	.843	.166			
98.307	4	2	.494	.187			
99.099	4	I	.267	.168			
4202.030	5	I	.198	.168			
10.357	2	I	.494	.137			
16.185	3	I	.351	.166			
19.365	3	I	.516	.151			
22.220	3	I	.382	.162			
27.440	2	I	.606	.166			
33.610	3	I	.772	.162	.615		
38.824	3	I	.970	.146			
47.437	3	I	.591	.154			
50.129	4	I	.287	.158			
50.789	5	I	.945	.156			
54.334	2	I	.505 Ca	.171			
60.484	7	I	.640	.156			
67.828	2	I	.985	.157			
71.163	6	I	.325	.162			
71.745	7R	I	.934	.189			
71.838	2	2	.045	.207			
82.404	4	I	.565	.161	.407	.408	.410
94.124	4	I	.301	.177			
99.243	5	I	.410	.167			
4307.872	6R	2	.907 Ca	.135			
07.945	4R	2	.081	.136			
15.089	4	I	.262	.173	.089	.089	.092
25.763	8R	..	.939	.176			
37.053	4	I	.216	.163			
52.740	4	I	.908	.168	.741	.741	.742
58.500	2	I	.670	.170			
69.767	3	2	.941	.174			
75.930	4	I	.107	.177	.935	.934	
83.552	10R	I	.720	.168			
90.950	2	I	.123	.173			
4404.753	8R	I	.927	.174			
15.125	6R	I	.293	.168			

TERTIARY STANDARDS OF WAVE-LENGTH

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λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund
4422.562	3	I	.741	0.179			
27.314	4	I	.482	.168	.314	.313	.314
30.618	3	I	.785	.167			
42.343	4	I	.510	.167			
47.723	4	I	.892	.169			
54.382	3	I	.552	.170			
59.120	3	I	.301	.181			
61.652	4	I	.818	.166			
66.553	4	I	.727	.174	.554	.557	
69.382	4	I	.545	.163			
82.163	3	I	.338	.175			
82.266	4	I	.438	.172			
89.744	3	I	.911	.167			
90.088	2	I	.253	.165			
94.571	4	I	.738	.167	.572	.571	.572
4514.192	I	I	.358	.166			
17.530	2	I	.702	.172			
25.152	3	I	.314	.162			
28.622	4	2	.798	.176		.622	
31.159	3	I	.327	.168	.155		.154
47.859	3	I	.024	.165	.854	.853	
56.127	3	I	.306	.179			
66.526	I	I	.693	.167			
74.729	I	I	.899	.170			
81.527	2	I	.693	.166			
87.135	I	I	.308	.173			
92.656	3	I	.840	.184	.658	.658	
98.136	2	3	.303	.167			
4602.004	2	2	.183	.179			
02.945	4	2	.126	.181	.944	.948	
11.295	3	I	.469	.174			
13.225	2	3	.386	.161			
19.295	3	3	.468	.173			
25.064	4	I	.227	.163			
32.917	3	I	.100	.183			
37.517	3	I	.685	.168			
38.010	3	I	.193	.174			
47.436	3	I	.617	.181	.437	.441	
54.495	3	I	.672	.177			
54.639	3	I	.800	.161			
67.457	3	2	.626	.169			
68.148	3	I	.331	.183			
73.167	3	2	.347	.180			
78.854	4	2	.027	.173	.855		
83.580	2	I	.745	.165			
91.415	3	I	.602	.187			
4707.289	3	I	.457	.168	.287	.292	
07.492	I	2	(.672)	.180			
10.280	2	I	.471	.191			
20.999	I	I	.179	.180			
27.438	I	I	.582	.144			
33.592	2	I	.779	.187			
36.787	4	2	.963	.176	.785	.787	

λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund	
4741.530	2	1	.718	0.188				
45.802	2	2	.992	.190				
54.049	..	1	.225	.176	.046	.049		Mn
57.576	2	1	.771	.195				
62.371	..	1	.567	.186				Mn
66.422	..	2	.621	.199				Mn
72.816	2	2	.007	.191				
79.439	1	2	.634	.195				
83.436	..	2	.613	.177				Mn
86.811	2	2	.003	.192				
89.651	2	1	.849	.198	.657	.658		
98.278	2	3	.453	.175				
4800.653	2	2	.842	.189				
02.886	1	2	.072	.186				
07.735	1	3	.900	.165				
23.523	..	1	.697	.174	.521	.523		Mn
32.734	2	1	.905	.171				
39.546	2	1	.735	.189				
43.161	2	1	.336	.175				
45.652	1	1	.843	.191				
55.693	1	1	.859	.166				
59.754	4	1	.928	.174	.756	.758	.755	
63.664	1	1	.833	.169				
71.333	5	1	.512	.179				
72.155	4	1	.332	.177				
78.229	4	1	.407	.178	.226	.224	.223	
81.724	2	2	.904	.180				
82.166	2	2	.336	.170				
85.445	3	1	.620	.175				
90.771	5	1	.948	.177				
91.510	6	1	.683	.173				
4903.323	4	1	.502	.179	.324	.327	.325	
10.031	2	1	.198	.167				
19.014	5	1	.174	.160	.006	.007	.005	
20.523	7	1	.685	.162				
24.777	2	1	.956	.179				
30.348	1	1	.486	.138				
38.195	2	1	.350	.155				
38.830	3	1	.997	.167				
46.408	2	1	.568	.160				
50.140	1	2	.291	.151				
57.303	4	1	.480	.177				
57.609	5	1	.785	.176				
66.105	3	1	.270	.165	.104	.105		
70.506	1	1	.671	.165				
78.620	2	1	.785	.165				
82.529	3	1	.682	.153				
85.274	3	1	.432	.158				
85.569	3	1	.730	.161				
94.139	2	1	.316	.177				
5001.884	3	1	.044	.160	.880	.885	.883	
05.732	3	1	.896	.164				
06.136	4	1	.306	.170				

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λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund
5012.070	3	2	.252	0.182	.072	.074	
14.958	3	2	.123	.165			
22.258	2	1	.414	.156			
28.136	2	2	.308	.172			
39.264	2	1	.428	.164			
41.079	2	1	.255	.176			
41.758	2	2	.936	.178			
49.825	3	3	.008	.183	.827	.827	
51.640	4	1	.825	.185			
68.786	3	1	.944	.158			
74.740	3	1	.932	.192			
79.231	2	1	.409	.178			
79.751	2	1	.921	.170			
83.346	2	1	.518	.172	.343	.346	
90.782	2	1	.954	.172			
96.999	2	1	.175	.176			
5107.462	3	1	.619	.157			
07.650	3	1	.823	.173			
10.412	3	1	.574	.162	.415	.414	
23.729	2	1	.899	.170			
27.366	2	1	.533	.167			
31.482	3	1	.642	.160			
33.675	1	1	.870	.195			
39.268	3	1	.427	.159			
39.482	4	1	.644	.162			
42.934	2	1	.111	.177			
50.841	2	1	.020	.179			
51.915	2	2	.087	.172			
62.310	3 ^u	2	.449	.139			
67.488	4	1	.678	.190	.492	.491	.493
74.184	1	1	....	....			
87.928	1	1	.079	.151			
91.477	3	1	.629	.152		.473	
92.362	4	1	.523	.161	.362		
94.946	3	1	.941	.195			
98.717	2	1	.888	.171			
5202.341	2	1	.516	.175			
08.619	1	1	.776	.157			
15.193	2	1	.353	.160			
16.275	2	1	.437	.162			
17.403	2	1	.552	.149			
26.874	3	1	.043	.169			
27.185	4	1	.362	.177			
29.843	2	1	.030	.187			
32.960	5	1	.122	.162	.958	.958	.956
42.495	2	1	.658	.163			
54.959	1	1	.121	.162			
59.740	1	1	(.912)	.172			
63.319	2	1	.486	.167			
66.574	4	1	.738	.164	.568	.569	
69.535	6	1	.723	.188			
70.354	4	2	.558	.204			
73.176	2	1	.339	.163			

λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund
5273.378	2	I	.558	0.180			
81.806	4	I	.971	.165			
83.635	4	I	.802	.167			
5302.314	3	I	.480	.166	.316	.316	
07.364	2	I	.541	.177			
24.197	5	2	.373	.176	.196	.196	
28.040	5	I	.236	.176			
28.532	4	I	.696	.189			
			.747				
32.904	3	I	.089	.185			
39.947	3	I	.121	.174			
41.027	4	I	.213	.186			
53.390	2	2	.571	.181			
64.862	3u	I	.069	.207			
65.404	2	I	.596	.192			
71.490	3	2	.734	.244	.498	.493	
79.583	2	2	.775	.192			
83.360	5	2u	.578	.218			
89.482	2	3u	.683	.201			
93.186	4	I	.375	.189			
5400.510	2	2	.711	.201			
05.778	5	I	.989	.211	.780	.780	
10.902	3	I	.124	.222			
15.184	4u	I	.416	.232			
24.050	5u	2	.290	.240			
29.701	5	I	.911	.211			
34.527	4	I	.740	.213	.530	.524	.529
45.037	2	I	.259	.222			
46.918	4	I	.130	.212			
55.439	2	I	.671	.232			
55.616	3	I	.834	.218	.616	.611	.615
62.964	2	I	.174	.210			
63.272	3	I	.494	.222			
66.424	2	I	.609	.185			
73.910	2	I	.113	.203			
76.294	2	I	.500	.206			
76.581	3	I	.778	.197			
87.768	2	2	.959	.191			
97.521	4	I	.735	.214			
5501.469	4	I	.683	.214			
06.783	4	I	.000	.217			
09.529	I	I	(.756)	.227			
25.559	2	I	.765	.206			
35.420	3	I	.644	.224	.418		
43.184	2	I	.414	.230			
43.944	2	2	.157	.213			
54.878	2	I	.122	.244			
63.608	3	I	.824	.216			
65.685	3	2	.931	.246			
69.630	4	I	.848	.218	.632	.636	
72.858	5	I	.075	.217			
76.102	3	I	.320	.218			
86.774	7	I	.991	.217	.770	.773	.770

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λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund	
5598.292	2	2	.524	0.232				
5602.962	3	2	.186	.224				
15.667	8	1	.877	.210	.658	.662	.657	
24.562	4	1	.769	.207				
38.289	2u	2	.488	.199				
48.323	2	1	(.503)	.180				
58.846	4	1	.052	.206	.835	.838		
62.537	3	2	.744	.207				
75.305	2u	2	.....	....				
82.222	1u	2	.427	.205				Ni
92.220	2	1	....	....				
5701.561	3	1	.772	.211				
09.394	4	1	.601	.207	.396			
09.584	..	1	.775	.191				Ni
15.111	3	1	.308	.197				
17.863	2	1	.055	.192				
31.774	3	3	.984	.210				
48.381	..	3	.576	.195				Ni
53.142	3	1	.344	.202				
54.687	..	1	.881	.194				Ni
63.014	4	1	.218	.204	.013	.013		
82.156	1	3	....	....				
91.044	1	3	.243	.199				
5805.212	..	3	.441	.228	.211			Ni
08.750	1u	2	....	....				
17.044	1u	3	....	....				
30.562	1u	3	....	....				
32.783	1u	3	....	....				
42.461	1u	3	....	....				
46.996	..	3	.221	.225				Ni
54.420	1u	3	....	....				
57.753	..	3	.976	.223	.760	.759		Ni
62.322	4	2	.582	.260				
72.897	1	3	....	....				
77.959	1	3	....	....				
83.822	2	3	.028	.206				
92.897	4	3	.097	.200	.882	.881		Ni
5905.661	3	3	.895	.234				
14.142	4u	3	.335	.193				
16.241	2	3	.475	.234				
30.152	3u	3	.406	.254				
34.668	3	3	.881	.213	.683			
52.739	3	3	.943	.204	.739			
56.695	2	3	.923	.228				
75.354	2	2	.575	.221				
76.800	2	2	.007	.207				
83.709	3	2	.908	.199				
84.795	4	1	.040	.245				
87.045	3	1	.290	.245				
6003.029	3	1	.239	.210	.039			
07.953	3	1	.186	.233				
08.580	4	1	.785	.205				
13.516	1	1	.715	.199				Mn

λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund	
6016.666	..	1	.861	0.195				<i>Mn</i>
20.167	4u	1	.401	.234				
21.821	..	1	.016	.195				<i>Mn</i>
24.047	5	1	.281	.234				
27.062	4	1	.274	.212	.059			
42.092	2	1	.315	.223				
55.992	3	1	.227	.235				
65.489	5	2	.709	.220	.493	.493		
78.476	3	2	.710	.234				
89.581	2	2	.787	.206				
90.229	..	2	.429	.200				
96.708	..	3	.880	.172				
6102.182	4	3	.392	.210				
03.192	3	1u	.400	.208				
27.927	2	1	.124	.197				
36.628	5	1	.829	.201				
37.012	1	1	.210	.198				
37.703	5	1	.915	.212	.700			
47.844	2	1	.040	.196				
51.633	3	1	.834	.201				
57.740	4	1	.945	.205				
65.387	1	2	.577	.190				
73.350	3	1	.553	.203				
80.230	3	1	.420	.190				
91.568	5	1	.779	.211	.569	.568	.566	
6200.330	5	1	.527	.197				
13.438	4	1	.644	.206				
15.153	3	1	.360	.207				
19.289	4	1	.494	.205				
29.251	2	2	.437	.186				
30.734	6	1	.943	.209	.732	.736	.729	
32.669	3	1	.856	.187				
40.666	2	1	.863	.197				
46.345	4	1	.535	.190				
52.567	5	1	.773	.206				
54.269	3	1	.456	.187				
56.377	3	1	.572	.195				
65.145	3	1	.348	.203	.147			
70.245	1u	3	.442	.197				
80.631	2u	3	.833	.202				
97.804	3	1	.007	.203				
6301.528	4	1	.718	.190				
02.522	3	1	.709	.187				
15.323	2	1	.517	.184				
15.822	2	1	.028	.206				
18.031	5	1	.239	.208	.029	.028		
22.198	2	1	.907	.209				
35.339	5	1	.554	.215	.343	.342		
36.850	5	1	.048	.198				
44.164	1u	2	.371	.207				
55.045	2	1	.246	.201				
58.693	2u	2	.808	.205				
75.206	1	3	(.455)	.249				

λ	Intensity	Probable Error	Rowland	Difference	Fabry and Buisson	Eversheim	Pfund
6376.198	1	2	(.385)	.187			
80.754	2	1	.958	.204			
93.612	6	1	.820	.208	.612	.613	.609
6400.036	8	3	.217	.181			
08.045	3	2	.233	.188			
11.673	4	1	.865	.192			
21.354	3	1	.570	.216			
30.848	4	3	.066	.217	.859	.862	
62.734	2	1	.965	.231			
72.631	1	1	(.823)	.192			
81.896	2	2	(.098)	.202			
94.994	7	..	.213	.219	.994	.994	.990

The observations will soon be published *in extenso*. I intend to continue the measurements as far as λ 7900.

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