Table 1. Energy levels in Rydbergs for the Ni III ion relative to the $3d^8(^3F)$ ground state. The present calculated energies are compared with experimentally determined energies and those calculated by Watts & Burke (WB). The spectroscopic and correlation configurations for Ni III, and the values of the scaling parameters λ_{nl} for each orbital in the Thomas-Fermi-Dirac potential used in Superstructure, are also given

	Level		Experimental	Present	WB		Level		Experimental	Present	WB
1	$3d^8$	^3F	0.00000	0.00000	0.0000	36	$3d^7(^4P)4p$	$^3D^o$	1.20764	1.17313	1.1591
2	$3d^8$	^1D	0.11881	0.15138	0.1530	37	$3d^7(^2G)4p$	$^3G^o$	1.21295	1.19463	1.1521
3	$3d^8$	^3P	0.14431	0.16910	0.1724	38	$3d^7(^2G)4p$	$^1H^o$	1.21402	1.15889	1.1499
4	$3d^8$	^1G	0.20152	0.23027	0.2333	39	$3d^7(^2G)4p$	$^1F^o$	1.22136	1.17331	1.1673
5	$3d^8$	^1S	0.46965	0.56320	0.5693	40	$3d^7(^4P)4p$	$^3P^o$	1.22660	1.17770	1.1857
6	$3d^7(^4F)4s$	^5F	0.49063	0.43192	0.4345	41	$3d^7(^2P)4p$	$^3D^o$	1.23933	1.21491	1.2093
7	$3d^7(^4F)4s$	^3F	0.55838	0.50696	0.5112	42	$3d^7(^2P)4p$	$^1D^o$	1.24510	1.21149	1.2057
8	$3d^7(^4P)4s$	^5P	0.64093	0.61541	0.6196	43	$3d^7(^2H)4p$	$^3I^o$	1.24696	1.19688	1.1866
9	$3d^7(^2G)4s$	^3G	0.67974	0.64029	0.6533	44	$3d^7(^2H)4p$	$^3G^o$	1.24677	1.15834	1.1864
10	$3d^7(^4P)4s$	^3P	0.70540	0.69345	0.6985	45	$3d^7(^2G)4p$	$^1S^o$	1.24983	1.21895	1.2131
11	$3d^7(^2G)4s$	^1G	0.71312	0.67760	0.6911	46	$3d^7(^2G)4p$	$^3D^o$	1.25616	1.22231	1.2161
12	$3d^7(^2P)4s$	^3P	0.71548	0.70220	0.7165	47	$3d^7(^4P)4p$	$^1I^o$	1.26338	1.20874	1.1989
13	$3d^7(^2H)4s$	^3H	0.73970	0.70229	0.7153	48	$3d^7(^2P)4p$	$^3F^o$	1.27101	1.23541	1.2299
14	$3d^7(a^2D)4s$	^3D	0.64256	0.72358	0.7390	49	$3d^7(^2H)4p$	$^3S^o$	1.27478	1.25482	1.2557
15	$3d^7(^2P)4s$	^1P	0.76191	0.73984	0.7550	50	$3d^7(^2H)4p$	$^1P^o$	1.27960	1.27078	1.2486
16	$3d^7(^2H)4s$	^1H	0.77312	0.73884	0.7526	51	$3d^7(^2G)4p$	$^1D^o$	1.28890	1.26425	1.2598
17	$3d^7(a^2D)4s$	^1D	0.78052	0.76212	0.7777	52	$3d^7(^2G)4p$	$^3H^o$	1.28986	1.24017	1.2364
18	$3d^7(^2F)4s$	^3F	0.88456	0.88604	0.9030	53	$3d^7(a^2D)4p$	$^1F^o$	1.30193	1.26710	1.2662
19	$3d^7(^2F)4s$	^1F	0.92002	0.92621	0.9430	54	$3d^7(a^2D)4p$	$^3P^o$	1.30394	1.27065	1.2702
20	$3d^7(^4F)4p$	$^5F^o$	1.00141	0.93138	0.9116	55	$3d^7(^2H)4p$	$^1G^o$	1.30456	1.26040	1.2616
21	$3d^7(^4F)4p$	$^5D^o$	1.01975	0.94546	0.9272	56	$3d^7(a^2D)4p$	$^1P^o$	1.32094	1.29308	1.2952
22	$3d^7(^4F)4p$	$^5G^o$	1.02468	0.94404	0.9341	57	$3d^7(^2H)4p$	$^1H^o$	1.32436	1.28011	1.2797
23	$3d^7(^4F)4p$	$^3G^o$	1.05115	0.98332	0.9650	58	$3d^6 4s^2$	^5D	1.39116	1.67319	—
24	$3d^7(^4F)4p$	$^3F^o$	1.05715	0.99140	0.9758	59	$3d^7(^2F)4p$	$^1D^o$	1.40405	1.39724	1.3949
25	$3d^7(^4F)4p$	$^3D^o$	1.07862	1.01563	1.0032	60	$3d^7(^2F)4p$	$^3G^o$	1.41372	1.40245	1.4011
26	$3d^7(^4F)4s$	^3D	1.09859	1.13533	0.9272	61	$3d^7(^2F)4p$	$^3F^o$	1.41870	1.40517	1.4049
27	$3d^7(^4P)4p$	$^5S^o$	1.10526	1.06400	1.0416	62	$3d^7(^2F)4p$	$^3D^o$	1.42190	1.40991	1.4100
28	$3d^7(^4P)4s$	^1D	1.13400	1.17534	1.2001	63	$3d^7(^2F)4p$	$^1G^o$	1.42505	1.41456	1.4113
29	$3d^7(^4P)4p$	$^5D^o$	1.17636	1.13882	1.1239	64	$3d^7(^2F)4p$	$^1F^o$	1.46496	1.45926	1.4607
30	$3d^7(^4P)4p$	$^3S^o$	1.18346	1.15889	1.1447	65	$3d^7(b^2D)4p$	$^3P^o$	1.59975	1.62133	1.6258
31	$3d^7(^2G)4p$	$^3H^o$	1.19329	1.14180	1.1322	66	$3d^7(b^2D)4p$	$^3F^o$	1.61895	1.64261	1.6492
32	$3d^7(^2G)4p$	$^3F^o$	1.20136	1.15002	1.1443	67	$3d^7(b^2D)4p$	$^1P^o$	1.64219	1.67025	1.6795
33	$3d^7(^4P)4p$	$^5P^o$	1.20340	1.16800	1.1562	68	$3d^7(b^2D)4p$	$^1F^o$	1.64633	1.67426	1.6796
34	$3d^7(^2G)4p$	$^1G^o$	1.20589	1.15878	1.1430	69	$3d^7(b^2D)4p$	$^3D^o$	1.66984	1.69755	1.7097
35	$3d^7(^2P)4p$	$^3P^o$	1.20688	1.17770	1.1694	70	$3d^7(b^2D)4p$	$^1D^o$	1.79860	1.69812	1.7088

Ni III configurations
Spectroscopic: $3p^6\ 3d^8$, $3p^6\ 3d^7\ 4s$, $3p^6\ 3d^7\ 4p$, $3p^6\ 3d^6\ 4s^2$
Correlation: $3p^6\ 3d^6\ 4p^2$, $3p^6\ 3d^7\ 4d$, $3p^6\ 3d^6\ 4s\ 4p$, $3p^5\ 3d^9$, $3p^5\ 3d^8\ 4s$, $3p^5\ 3d^8\ 4p$, $3p^5\ 3d^8\ 4d$
λ_{nl}: 1.43121(1s), 0.93950(2s), 1.28641(2p), 1.15714(3s), 1.02417(3p), 1.01626(3d), 0.97488(4s), 0.96711(4p), 1.26086(4d)

Table 2. Comparison between present and NIST radiative transition rates (A-values) for allowed transitions. A-values are given in units of 10^8 s^{-1}.

Transition	NIST	Present
$3d^7(^4F)4s\ ^5F_5 - 3d^7(^4F)4p\ ^5G^o_4$	0.038	0.0269
$3d^7(^4F)4s\ ^5F_5 - 3d^7(^4F)4p\ ^5G^o_6$	7.9	8.28
$3d^7(^4F)4s\ ^5F_4 - 3d^7(^4F)4p\ ^5G^o_5$	6.3	7.76
$3d^7(^4F)4s\ ^5F_2 - 3d^7(^4F)4p\ ^5G^o_3$	6.0	7.25
$3d^7(^4F)4s\ ^5F_1 - 3d^7(^4F)4p\ ^5G^o_2$	5.9	7.08
$3d^7(^4F)4s\ ^5F_1 - 3d^7(^4F)4p\ ^5D^o_0$	6.7	7.63
$3d^7(^4F)4s\ ^3F_4 - 3d^7(^4F)4p\ ^3D^o_3$	5.7	5.75
$3d^7(^4F)4s\ ^3F_3 - 3d^7(^4F)4p\ ^3D^o_2$	5.5	5.75
$3d^7(^4F)4s\ ^3F_2 - 3d^7(^4F)4p\ ^3D^o_1$	6.5	7.28
$3d^7(^4F)4s\ ^5F_5 - 3d^7(^4F)4p\ ^5F^o_5$	6.2	7.38
$3d^7(^4F)4s\ ^5F_1 - 3d^7(^4F)4p\ ^5F^o_1$	3.8	4.05
$3d^7(^4F)4s\ ^5F_2 - 3d^7(^4F)4p\ ^5F^o_2$	2.5	2.84
$3d^7(^4F)4s\ ^5F_3 - 3d^7(^4F)4p\ ^5F^o_3$	2.5	2.93
$3d^7(^4F)4s\ ^5F_4 - 3d^7(^4F)4p\ ^5F^o_4$	2.7	3.46
$3d^7(^4F)4s\ ^3F_4 - 3d^7(^4F)4p\ ^3F^o_4$	5.6	5.30
$3d^7(^4F)4s\ ^3F_3 - 3d^7(^4F)4p\ ^3F^o_3$	4.6	4.27
$3d^7(^4F)4s\ ^3F_2 - 3d^7(^4F)4p\ ^3F^o_2$	5.0	5.03
$3d^7(^4F)4s\ ^3F_3 - 3d^7(^4F)4p\ ^3G^o_4$	5.3	5.04
$3d^7(^4F)4s\ ^3F_4 - 3d^7(^4F)4p\ ^3G^o_5$	5.4	6.09

Table 3. Comparison of effective collision strengths in LS coupling at T=10^4 K for excitations from the ground term to the first 51 excited terms.

	Final state	$\Upsilon(52CC)$	$\Upsilon(70CC)$	$\frac{\Upsilon(70CC)}{\Upsilon(52CC)}$
2	$3d^8\ ^1D$	1.482	1.804	1.217
3	$3d^8\ 4s\ ^3P$	5.018	5.064	1.009
4	$3d^8\ 4s\ ^1G$	3.126	3.115	0.997
5	$3d^8\ 4s\ ^1S$	0.108	0.149	1.381
6	$3d^7\ 4s\ ^5P$	6.222	6.109	0.982
7	$3d^7\ 4s\ ^3F$	8.026	9.237	1.151
8	$3d^7\ 4s\ ^5P$	1.434	1.571	1.096
9	$3d^7\ 4s\ ^3G$	6.246	7.212	1.155
10	$3d^7\ 4s\ ^3P$	1.387	1.612	1.163
11	$3d^7\ 4s\ ^1G$	0.822	0.946	1.151
12	$3d^7\ 4s\ ^3P$	1.560	1.748	1.121
13	$3d^7\ 4s\ ^3H$	6.193	6.611	1.068
14	$3d^7\ 4s\ ^3D$	2.787	2.752	0.987
15	$3d^7\ 4s\ ^1P$	0.458	0.457	0.998
16	$3d^7\ 4s\ ^1H$	1.030	0.789	0.766
17	$3d^7\ 4s\ ^1D$	0.608	0.554	0.911
18	$3d^7\ 4s\ ^3F$	1.221	0.874	0.715
19	$3d^7\ 4s\ ^1F$	0.272	0.079	0.292
20	$3d^7\ 4p\ ^5F^o$	1.968	2.016	1.024
21	$3d^7\ 4p\ ^5D^o$	1.032	1.111	1.076
22	$3d^7\ 4p\ ^5G^o$	1.777	1.871	1.053
23	$3d^7\ 4p\ ^3G^o$	2.058	2.055	0.998
24	$3d^7\ 4p\ ^3F^o$	6.761	6.880	1.018
25	$3d^7\ 4p\ ^3D^o$	3.932	4.034	1.026
26	$3d^7\ 4s\ ^3D$	0.381	0.248	0.650
27	$3d^7\ 4p\ ^5S^o$	0.241	0.245	1.019
28	$3d^7\ 4s\ ^1D$	0.094	0.027	0.292
29	$3d^7\ 4p\ ^5D^o$	0.466	0.457	0.979
30	$3d^7\ 4p\ ^3S^o$	0.108	0.100	0.924
31	$3d^7\ 4p\ ^3H^o$	0.756	0.777	1.028
32	$3d^7\ 4p\ ^3F^o$	4.698	4.784	1.018
33	$3d^7\ 4p\ ^5P^o$	0.273	0.259	0.949
34	$3d^7\ 4p\ ^1G^o$	0.258	0.268	1.037
35	$3d^7\ 4p\ ^3P^o$	0.270	0.243	0.902
36	$3d^7\ 4p\ ^3D^o$	0.800	0.774	0.969
37	$3d^7\ 4p\ ^3G^o$	1.325	1.317	0.993
38	$3d^7\ 4p\ ^1H^o$	0.193	0.183	0.947
39	$3d^7\ 4p\ ^1F^o$	0.146	0.139	0.955
40	$3d^7\ 4p\ ^3P^o$	0.222	0.208	0.937
41	$3d^7\ 4p\ ^3D^o$	0.527	0.736	1.398
42	$3d^7\ 4p\ ^1D^o$	0.072	0.065	0.910
43	$3d^7\ 4p\ ^3I^o$	0.693	0.650	0.938
44	$3d^7\ 4p\ ^3G^o$	5.617	5.648	1.005
45	$3d^7\ 4p\ ^1S^o$	0.010	0.009	0.889
46	$3d^7\ 4p\ ^3D^o$	3.308	3.332	1.007
47	$3d^7\ 4p\ ^1I^o$	0.214	0.214	0.997
48	$3d^7\ 4p\ ^3F^o$	0.863	0.887	1.028
49	$3d^7\ 4p\ ^3S^o$	0.038	0.031	0.823
50	$3d^7\ 4p\ ^1P^o$	0.022	0.019	0.860
51	$3d^7\ 4p\ ^1D^o$	0.062	0.061	0.986
52	$3d^7\ 4p\ ^3H^o$	0.369	0.363	0.985

Table 4. Comparison of effective collision strengths in *LS* coupling from the present calculation and those of WB. The level indices refer to the entries in Table 1.

Trans.	5000K		10 000K		20 000K	
	Present	WB	Present	BW	Present	WB
1-2	1.25	1.37	1.48	1.48	1.70	1.56
1-3	5.17	4.03	5.02	4.19	4.69	4.19
1-4	2.80	2.24	3.13	2.52	3.30	2.71
1-5	0.126	0.137	0.110	0.118	0.109	0.112
1-6	6.29	5.49	6.14	5.83	5.60	5.52
1-7	8.09	7.75	7.99	7.86	7.65	7.54
1-8	1.47	1.43	1.38	1.32	1.28	1.22
1-9	7.05	5.25	6.21	5.08	5.31	4.59
1-10	1.34	1.68	1.39	1.54	1.34	1.40
1-11	0.830	1.03	0.814	0.972	0.774	0.876
1-12	1.67	1.23	1.54	1.27	1.32	1.17
1-13	7.03	6.39	6.24	6.00	5.37	5.13
1-14	2.82	2.28	2.86	2.45	2.57	2.31
1-15	0.589	0.504	0.442	0.413	0.329	0.320
1-16	0.967	1.03	1.03	1.09	0.978	1.03
1-17	0.682	0.677	0.615	0.624	0.520	0.531
1-18	1.01	0.843	1.21	1.13	1.27	1.25
1-19	0.262	0.292	0.266	0.302	0.240	0.270
1-26	0.337	0.374	0.389	0.416	0.375	0.392
1-28	0.105	0.096	0.096	0.091	0.079	0.078

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Table 5. Line emissivities for the strongest optical and IR Ni III lines. The emissivity per Ni^{2+} ion of the λ6000 line is given in erg/s. The emissivity of other lines is relative to that of λ6000.

T	N_e	$j(\lambda6000)$	$I(7.3\mu m)$	$I(11\mu m)$	$I(\lambda7889)$	$I(\lambda8499)$	$I(\lambda6533)$	$I(\lambda6401)$	$I(\lambda4326)$	$I(\lambda4596)$
5.0E+3	1.E+02	1.03E-20	8.46E+1	1.05E+1	3.53E+0	1.43E+0	2.19E+0	7.84E-1	6.18E-1	2.99E-1
	1.E+04	1.02E-18	8.35E+1	1.04E+1	3.54E+0	1.44E+0	2.19E+0	7.96E-1	6.22E-1	3.01E-1
	1.E+06	8.19E-17	3.96E+1	5.73E+0	4.54E+0	1.84E+0	2.19E+0	1.21E+0	8.51E-1	4.12E-1
	1.E+08	3.98E-16	1.26E+1	1.92E+0	1.36E+1	5.52E+0	2.19E+0	1.23E+0	2.49E+0	1.21E+0
	1.E+10	4.14E-16	1.22E+1	1.86E+0	1.57E+1	6.37E+0	2.19E+0	1.22E+0	2.73E+0	1.32E+0
1.0E+4	1.E+02	7.67E-20	1.12E+1	1.56E+0	3.23E+0	1.31E+0	2.19E+0	8.61E-1	1.82E+0	8.82E-1
	1.E+04	7.64E-18	1.11E+1	1.55E+0	3.25E+0	1.32E+0	2.19E+0	8.71E-1	1.83E+0	8.86E-1
	1.E+06	6.07E-16	5.63E+0	9.03E-1	3.93E+0	1.60E+0	2.19E+0	1.27E+0	2.35E+0	1.14E+0
	1.E+08	3.55E-15	1.42E+0	2.47E-1	9.38E+0	3.81E+0	2.19E+0	1.29E+0	6.24E+0	3.02E+0
	1.E+10	3.73E-15	1.35E+0	2.34E-1	1.08E+1	4.36E+0	2.19E+0	1.28E+0	6.90E+0	3.34E+0
1.5E+4	1.E+02	1.34E-19	6.14E+0	8.77E-1	3.26E+0	1.32E+0	2.19E+0	8.91E-1	2.69E+0	1.30E+0
	1.E+04	1.34E-17	6.08E+0	8.72E-1	3.27E+0	1.33E+0	2.19E+0	9.00E-1	2.70E+0	1.31E+0
	1.E+06	1.06E-15	3.22E+0	5.23E-1	3.88E+0	1.58E+0	2.19E+0	1.29E+0	3.37E+0	1.63E+0
	1.E+08	6.76E-15	6.98E-1	1.26E-1	8.35E+0	3.39E+0	2.19E+0	1.31E+0	8.46E+0	4.09E+0
	1.E+10	7.11E-15	6.46E-1	1.17E-1	9.48E+0	3.85E+0	2.19E+0	1.30E+0	9.40E+0	4.55E+0
2.0E+4	1.E+02	1.68E-19	4.68E+0	6.76E-1	3.31E+0	1.34E+0	2.19E+0	9.09E-1	3.30E+0	1.60E+0
	1.E+04	1.67E-17	4.64E+0	6.72E-1	3.32E+0	1.35E+0	2.19E+0	9.17E-1	3.32E+0	1.60E+0
	1.E+06	1.33E-15	2.54E+0	4.11E-1	3.90E+0	1.58E+0	2.19E+0	1.30E+0	4.07E+0	1.97E+0
	1.E+08	8.86E-15	4.94E-1	9.05E-2	7.90E+0	3.21E+0	2.19E+0	1.33E+0	9.85E+0	4.77E+0
	1.E+10	9.25E-15	4.48E-1	8.32E-2	8.91E+0	3.62E+0	2.19E+0	1.31E+0	1.10E+1	5.31E+0
3.0E+4	1.E+02	1.95E-19	3.66E+0	5.36E-1	3.40E+0	1.38E+0	2.19E+0	9.29E-1	4.05E+0	1.96E+0
	1.E+04	1.94E-17	3.63E+0	5.33E-1	3.41E+0	1.38E+0	2.19E+0	9.36E-1	4.07E+0	1.97E+0
	1.E+06	1.55E-15	2.09E+0	3.34E-1	3.94E+0	1.60E+0	2.19E+0	1.30E+0	4.89E+0	2.36E+0
	1.E+08	1.08E-14	3.62E-1	6.70E-2	7.55E+0	3.06E+0	2.19E+0	1.34E+0	1.15E+1	5.54E+0
	1.E+10	1.07E-14	3.14E-1	5.96E-2	8.40E+0	3.41E+0	2.19E+0	1.32E+0	1.28E+1	6.20E+0
4.0E+4	1.E+02	2.01E-19	3.27E+0	4.86E-1	3.46E+0	1.41E+0	2.19E+0	9.40E-1	4.44E+0	2.15E+0
	1.E+04	2.01E-17	3.25E+0	4.83E-1	3.47E+0	1.41E+0	2.19E+0	9.47E-1	4.45E+0	2.15E+0
	1.E+06	1.60E-15	1.94E+0	3.09E-1	3.99E+0	1.62E+0	2.19E+0	1.29E+0	5.28E+0	2.56E+0
	1.E+08	1.13E-14	3.22E-1	5.99E-2	7.46E+0	3.03E+0	2.19E+0	1.35E+0	1.23E+1	5.97E+0
	1.E+10	1.06E-14	2.68E-1	5.14E-2	8.20E+0	3.33E+0	2.19E+0	1.32E+0	1.38E+1	6.67E+0
5.0E+4	1.E+02	2.01E-19	3.07E+0	4.61E-1	3.50E+0	1.42E+0	2.19E+0	9.43E-1	4.61E+0	2.23E+0
	1.E+04	2.00E-17	3.05E+0	4.58E-1	3.51E+0	1.42E+0	2.19E+0	9.50E-1	4.63E+0	2.24E+0
	1.E+06	1.60E-15	1.88E+0	2.98E-1	4.01E+0	1.63E+0	2.19E+0	1.29E+0	5.45E+0	2.64E+0
	1.E+08	1.14E-14	3.09E-1	5.76E-2	7.47E+0	3.03E+0	2.19E+0	1.36E+0	1.28E+1	6.21E+0
	1.E+10	1.01E-14	2.49E-1	4.79E-2	8.13E+0	3.30E+0	2.19E+0	1.32E+0	1.44E+1	6.95E+0
6.0E+4	1.E+02	1.98E-19	2.96E+0	4.47E-1	3.53E+0	1.43E+0	2.19E+0	9.43E-1	4.71E+0	2.28E+0
	1.E+04	1.97E-17	2.94E+0	4.45E-1	3.54E+0	1.44E+0	2.19E+0	9.49E-1	4.72E+0	2.28E+0
	1.E+06	1.57E-15	1.85E+0	2.94E-1	4.04E+0	1.64E+0	2.19E+0	1.28E+0	5.54E+0	2.68E+0
	1.E+08	1.12E-14	3.07E-1	5.74E-2	7.53E+0	3.06E+0	2.19E+0	1.36E+0	1.32E+1	6.38E+0
	1.E+10	9.56E-15	2.41E-1	4.64E-2	8.11E+0	3.29E+0	2.19E+0	1.32E+0	1.47E+1	7.13E+0