Appendix A: Line lists and abundances

Table A.1. Abundances of HD 19400 from the ATLAS12 model with parameters $T_{\rm eff}$=13500 K, log g=3.9

HD 19400[13500,3.9,AT12]							
λ(Å)	log gf	Ref.[a]	χ_{low}	W(mÅ)	$log(N_Z)/N_{\rm tot})$	Remarks	
He I −2.17±0.07							
3867.4723	−2.038	NIST5	169086.766	profile	−2.155		
3867.4837	−2.260	NIST5	169086.843	"	"		
3867.6315	−2.737	NIST5	169087.631	"	"		
4009.2565	−1.447	NIST5	171134.897	profile	−2.155		
4026.1844	−2.628	NIST5	169086.766	profile	−2.155::	no fit	
4026.1859	−1.453	NIST5	169086.766	"	"		
4026.1860	−0.704	NIST5	169086.766	"	"		
4026.1968	−1.453	NIST5	169086.843	"	"		
4026.1983	−0.976	NIST5	169086.843	"	"		
4026.3570	−1.328	NIST5	169087.831	"	"		
4120.8108	−1.723	NIST5	169086.766	profile	−2.155		
4120.8237	−1.945	NIST5	169086.843	"	"		
4120.9916	−2.422	NIST5	169087.831	"	"		
4143.7590	−1.201	NIST5	171134.897	"	−2.155		
4387.9291	−0.887	NIST5	171134.897	"	−2.155:	no fit in red wing	
4437.5534	−2.015	NIST5	171134.897	"	−2.00		
4471.4704	−2.211	NIST5	169086.766	profile	−2.155	no fit in the core	
4471.4741	−1.036	NIST5	169086.766	"	"		
4471.4743	−0.287	NIST5	169086.766	"	"		
4471.4856	−1.035	NIST5	169086.843	"	"		
4471.4893	−0.558	NIST5	169086.843	"	"		
4471.6832	−0.910	NIST5	169087.831	"	"		
4713.1382	−1.276	NIST5	169086.766	profile	−2.155		
4713.1561	−1.499	NIST5	169086.483	"	"		
4713.3757	−1.976	NIST5	169087.831	"	"		
4921.9310	−0.443	NIST5	171134.897	profile	−2.301	no fit in red wing	
5015.6780	−0.820	NIST5	166277.440	profile	−2.155		
5047.7385	−1.587	NIST5	171134.897	profile	−2.155		
5875.5987	−1.516	NIST5	169086.766	profile	−2.301		
5875.6139	−0.339	NIST5	169086.766	"	"		
5875.6148	+0.409	NIST5	169086.766	"	"		
5875.6251	−0.339	NIST5	169086.843	"	"		
5875.6403	+0.138	NIST5	169086.843	"	"		
5875.9663	−0.214	NIST5	169087.831	"	"		
6678.1517	+0.329	NIST5	171134.897	profile	−2.301		
C II −4.12±0.02							
3918.968	−0.533	NIST5	131724.370	profile	−4.1	blend	
4267.001	+0.563	NIST5	145549.270	profile	−4.1	blend	
4267.261	+0.716	NIST5	145550.700	"	"		
4267.261	−0.584	NIST5	145550.700	"	"		
6578.052	−0.021	NIST5	116537.65	profile	−4.15		
O I −3.9							
6155.971	−1.011	NIST5	86625.757	profile	−3.9		
6155.989	−1.120	NIST5	86625.757	profile	"		
6156.755	−0.899	NIST5	86627.778	profile	−3.9		
6156.778	−0.694	NIST5	86627.778	profile	"		
Ne I −3.77±0.07							
5852.488	−0.455	NIST5	135888.717	14.1	−3.79		
6096.163	−0.297	NIST5	134458.287	17.7	−3.85		
6143.063	−0.098	NIST5	134041.840	20.9	−3.86		
6266.495	−0.357	NIST5	134810.740	19.6	−3.68		
6402.248	+0.345	NIST5	134041.840	36.7	−3.72		
6717.043	−0.356	NIST5	135888.717	15.3	−3.70		
Na I −5.71							
5889.950	+0.108	NIST5	0.00	38.2	profile	−5.71	blend
5895.924	−0.194	NIST5	0.00	19.3	profile	−5.71	blend

Table A.1. Continued.

HD 19400[13500,3.9,AT12]						
λ(Å)	log gf	Ref.[a]	χ_{low}	W(mÅ)	$log(N_Z)/N_{\rm tot})$	Remarks
Mg II −5.06						
4390.572	−0.523	NIST5	80650.020	profile	−5.06	blend
4390.514	−1.478	NIST5	80650.020	"	"	"
4427.994	−1.208	NIST5	80619.500	profile	−5.06	blend
4481.126	+0.749	NIST5	71490.190	profile	−5.06	blend
4481.150	−0.553	NIST5	71490.190	profile	"	"
4481.325	+0.594	NIST5	71491.063	profile	"	"
Al II≤ −6.77						
4663.046	−0.290	NIST5	85481.35	not obs	≤−6.77	blend
5593.300	+0.410	NIST5	106920.56	not obs	≤−6.77	blend
Si II −4.36±0.17						
3856.018	−0.406	NIST5	55325.180	123.7	−4.63	
3862.595	−0.757	NIST5	55309.350	114.7	−4.42	
4075.452	−1.400	NIST5	79355.020	22.6	−4.48	
5688.817	+0.126	NIST5	114414.580	12.4	−4.40	blend telluric
5701.37	−0.057	NIST5	11327.150	8.7	−4.42	blend telluric
5978.93	+0.084	NIST5	81251.32	71.0	−4.52	
6347.109	+0.149	NIST5	65500.47	164.7	−4.28	
6371.371	−0.082	NIST5	65500.47	131.3	−4.34	
6660.532	+0.162	NIST5	116978.38	15.5	−4.06	
6671.840	+0.409	NIST5	117178.06	19.7	−4.09	
Si III −4.37±0.02						
4552.622	+0.292	NIST5	153377.050	16.7	−4.39	
4567.840	+0.068	NIST5	153377.050	13.4	−4.35	
PII=−4.26±0.15						
4044.576	+0.669	K12	107360.25	68.5	−4.43	
4420.717	−0.330	NIST5	88893.22	52.9	−4.40	
4452.472	−0.083	K12	105302.37	34.0	−4.30	
4463.027	+0.164	K12	105549.67	38.2	−4.46	
4466.140	−0.560	NIST5	105549.67	21.1	−4.20	reversal ?
4475.270	+0.440	NIST5	105549.67	48.0	−4.51	
4499.230	+0.470	NIST5	107922.93	58.0	−4.16	
4530.823	+0.074	K12N	105302.37	37.0	−4.40	
4554.854	−0.084	K12	106001.25	33.9	−4.20	
4565.287	−0.520	NIST5	106001.25	20.9	−4.23	
4581.716	−1.121	K12	101635.69	15.5	−4.01	
4589.846	+0.400	NIST5	103165.61	55.2	−4.30	
4602.069	+0.740	NIST5	103667.86	62.7	−4.44	
4626.708	−0.320	NIST5	103339.14	29.8	−4.23	
4658.309	−0.320	NIST5	103667.86	21.0	−4.49	asymm ?, lambda ?
4679.028	−0.319	K12N	106001.25	19.3	−4.45	
4927.197	−0.799	K12N	103165.61	12.5	−4.33	
4935.631	−0.161	NIST5	111507.66	17.6	−4.37	
4943.497	+0.060	NIST5	103667.86	39.2	−4.27	
5344.729	−0.280	K12N	86597.55	55.4	−4.15	
5409.722	−0.390	NIST5	86743.96	60.5	−4.14	
5425.880	+0.288	K12N	87124.60	103.7	−4.08	
5499.697	−0.441	K12N	87124.60	49.1	−4.30	
5541.139	−0.515	K12N	105302.37	16.8	−4.23	
6024.178	+0.198	K12N	86743.96	106.5	−3.84	
6034.039	−0.151	K12N	86597.55	73.5	−4.00	
6043.084	+0.416	NIST5	87124.60	103.4	−4.07	
6055.504	+0.056	NIST5	107922.93	23.9	−4.27	
6087.837	−0.346	NIST5	86743.96	56.7	−4.13	
6165.600	−0.341	NIST5	87124.60	49.8	−4.25	
6232.297	−1.652	K12N	87124.60	7.8	−4.35	
6435.282	−1.043	K12	87804.10	21.2	−4.24	
6713.283	−1.257	K12	86743.96	18.8	−4.21	

Table A.1. Continued.

			HD 19400[13500,3.9,AT12]			
λ(Å)	log gf	Ref.[a]	χ_{low}	W(mÅ)	$log(N_Z)/N_{\rm tot})$	Remarks
			PIII=−4.44±0.09			
4059.312	−0.236	K13Ph	116885.87	22.5	−4.58	
4080.089	−0.494	K13Ph	116874.56	21.9	−4.35	
4222.198	+0.218	K13Ph	117835.95	30.8	−4.44	
4246.720	−0.120	NIST5	117835.95	23.3	−4.40	
			S II −5.82			
4162.665	0.777	NIST5	128559.160	6.2	−5.82	
			Ca II −5.50			
3933.663	+0.135	NIST5	0.000	profile	−5.50:	
			Ti II −6.35±0.07			
4163.644	−0.130	NIST5	20891.660	24.4	−6.28	
4290.215	−0.850	NIST5	9395.710	18.8	−6.36	
4294.094	−0.930	NIST5	8744.250	19.6	−6.29	
4300.042	−0.442	NIST5	9518.060	31.5	−6.40	
4399.765	−1.190	NIST5	9975.920	11.4	−6.27	
4443.801	−0.717	NIST5	8710.440	27.1	−6.28	
4501.270	−0.767	NIST5	8997.710	21.2	−6.38	
4563.757	−0.690	NIST5	9850.900	18.2	−6.51	
4571.971	−0.317	NIST5	12676.970	30.6	−6.37	
			Cr II −6.24±0.09			
4592.049	−1.217	NIST5	32854.950	9.4	−6.21	
4616.629	−1.291	NIST5	32844.760	5.9	−6.36	
4618.803	−0.860	SL	32854.950	10.7	−6.25	
4634.070	−0.990	SL	32844.760	8.1	−6.26	
4824.127	−0.980	SL	31219.350	13.6	−6.10	
			Mn II −4.94±0.18			
4206.367	−1.553	KSG	43258.640	30.4	−4.78	hfs,weak reversal
4292.237	−1.544	KSG	43394.439	23.6	−4.99	hfs, flat core
4363.255	−2.094	K11	44899.820	15.8	−4.61	hfs, bad continuum
4365.217	−1.328	K11	53017.160	11.6	−5.12	hfs, reversal
4478.637	−0.935	K11	53597.130	21.9	−5.09	hfs, reversal
4518.956	−1.322	K11	53597.130	13.0	−5.03	
			Fe II −3.80±0.14			
4122.659	−3.300	FW06	20830.553	36.4	−3.73	
4258.148	−3.480	FW06	21812.045	29.9	−3.68	
4273.320	−3.300	FW06	21812.045	29.7	−3.86	
4286.271	−1.578	K13Fe	62171.624	18.6	−3.76	
4296.566	−2.930	FW06	21812.045	45.4	−3.78	
4303.170	−2.610	FW06	21812.045	60.6	−3.63	
4369.400	−3.580	FW06	22409.818	24.5	−3.70	
4416.819	−2.600	FW06	22409.818	51.3	−3.91	
4449.611	−1.678	K13Fe	63948.803	10.3	−3.99	
4489.176	−2.970	FW06	22810.346	39.9	−3.85	
4491.397	−2.640	FW06	23031.283	47.9	−3.93	
4507.091	−1.909	K13Fe	62689.874	11.9	−3.65	
4508.280	−2.350	FW06	23031.283	62.9	−3.76	
4515.333	−2.360	FW06	22939.351	65.3	−3.61	
4520.218	−2.620	FW06	22637.195	52.9	−3.82	
4522.628	−1.990	FW06	22939.351	69.6	−3.92	
4541.516	−2.970	FW06	23031.283	43.3	−3.74	
4555.887	−2.250	FW06	22810.346	63.5	−3.84	
4576.333	−2.920	FW06	22939.351	40.5	−3.88	
4582.830	−3.062	FW06	22939.351	34.5	−3.90	
4583.829	−1.940	FW06	22637.195	85.7	−3.55	
4620.513	−3.190	FW06	22810.346	22.9	−4.11	

Table A.1. Continued.

				HD 19400[13870,3.8,AT9]		
λ(Å)	log gf	Ref.[a]	χ_{low}	W(mÅ)	$log(N_Z)/N_{\rm tot})$	Remarks
			Fe II cont.			
4629.331	−2.257	FW06	22637.195	64.6	−3.81	
4635.316	−1.476	K13FeF	48039.090	46.1	−3.75	
4913.296	+0.016	J07	82978.717	37.4	−3.63	
4923.921	−1.206	FW06	23317.635	97.0	−3.97	
4993.350	−3.680	FW06	22637.195	20.2	−3.71	
5001.953	+0.933	J07	82853.704	70.2	−3.68	
5018.436	−1.350	FW06	23317.635	105.2	−3.67	
5030.632	+0.431	FW06	82978.717	45.5	−3.81	
5169.028	−0.870	FW06	23317.635	104.3	−4.18	
5247.956	+0.550	FW06	84938.265	47.8	−3.70	
5493.831	+0.259	FW06	84685.245	33.5	−3.83	
5506.199	+0.923	J07	84863.382	60.1	−3.72	
			Fe III −3.82±0.10			
4022.330	−2.040	K10	93392.300	9.3	−3.74	
4371.345	−3.026	K10	66464.800	9.5	−3.86	
4382.501	−2.980	K10	66523.020	12.4	−3.72	
4419.596	−2.207	K10	89084.790	23.3	−3.98	
			Ni II −5.84			
4067.031	−1.847	K10Ni	32499.530	20.9	−5.84	
			Ga II −5.19±0.17			
4251.155	+0.350	RS94	113815.885	profile	−4.75	hfs,blend
4254.073	−0.230	RS94	113842.301	profile	−5.10	hfs
4255.720	+0.634	NKW	113842.301	profile	−5.25	hfs,blend
4255.936	−0.320	NKW	113842.301	"	"	
4261.488	−1.100	GUES	113883.193	profile	−5.15	hfs,blend
4262.014	+0.980	RS94	113883.193	profile	−5.15	hfs
4263.141	−0.500	GUES	113883.193	profile	−5.25	hfs
5219.658	+0.350	GUES	120550.431	profile	−5.20	blend
5338.240	+0.430	RS94	118429.967	profile	−5.40:	bad spectrum
5360.402	+0.420	RS94	118518.461	profile	−5.10	hfs, reversal ?
5363.585	+0.060	GUES	118518.461	profile	−5.30	hfs,blend
5416.318	+0.640	RS94	118727.870	profile	−5.20	hfs
5421.274	−0.050	NKW	118727.870	profile	−5.15	hfs
6334.07	+1.000	RS94	102944.595	profile	−5.40	hfs
6419.24	+0.570	RS94	102944.595	profile	−5.30	hfs
6455.92	−0.080	RS94	102944.595	profile	−5.30	hfs, blend
			Sr II −9.07			
4077.709	+0.148	NIST5	0.00	profile	−9.07	
			Xe II=−4.65±0.17			
4603.030	+0.018	NIST5	95064.38	29.1	−4.89	
4844.330	+0.491	NIST5	93068.44	48.4	−4.66	
5419.155	+0.215	NIST5	95064.38	37.8	−4.51	
6036.170	−0.609	NIST5	95396.74	17.8	−4.55	
6051.120	−0.252	NIST5	95437.67	26.0	−4.45	self-reversal ?
6097.570	−0.240	NIST5	95396.74	18.1	−4.88	
			HgII=−6.16±0.13			
3983.931	−1.510	NIST5	35514.624	profile	−6.35	
5677.102	+0.820	NIST5	105544.042	12.6	−6.07	
6149.470	+0.150	NIST5	95714.406	profile	−6.07	blend

[a]: NIST5: NIST Atomic Spectra Database,version 5 at http://physics.nist.gov/pml/data/asd.cfm;
FW06: Fuhr & Wiese (2006); J07: Johansson (2007);
GUES: Guessed values on the basis of the line intensity;
K10: http://kurucz.harvard.edu/atoms/2602/gf2602.pos;
K10Ni: http://kurucz.harvard.edu/atoms/2801/gf2801.pos;
K11 : Kurucz,R.L. 2011, private communication
K12: http://kurucz.harvard.edu/atoms/1501/gf1501.pos;
K12N: the NIST5 log gf values are replaced by the K12 values;