Useful Reference Tables of Stellar Properties

Table 3.1 Principal characteristics of spectral types

Spectral type	Spectral features
O	He II lines visible; lines from highly ionized species, for example, C III, N III, O III, Si IV; H lines relatively weak; strong UV continuum
B	He I lines strong, attain maximum at B2; He II lines absent; H lines stronger; lower-excitation ions, for example, CII, O II, Si III
A	H lines attain maximum strength at A0 and decrease towards later types; Mg II, Si II strong; Ca II weak and increasing in strength
F	H weaker, Ca II stronger; lines of neutral atoms and first ionization states of metals appear prominently
G	Solar-type spectra; Ca II lines extremely strong; neutral metals prominent, ions weaker; G band (CH) strong; H lines weakening
K	Neutral metallic lines dominate; H quite weak; molecular bands (CH, CN) developing; continuum weak in blue
M	Strong molecular bands, particularly TiO; some neutral lines, for example, CA I, quite strong; red continuum
C	Carbon stars; strong bands of carbon compounds C_2, CN, CO; TiO absent; temperatures in range types K and M
S	Heavy-element stars; bands of ZrO, YO, LaO; neutral atoms strong as in types K and M; overlaps these types in temperature range

Spectral type of stars in Harvard system and MK system = 0 A B F G K M
Defined by spectral features originally. Turns out to be a sequence in T_eff

Table 3.13 Physical properties of MS stars

Spectral type	$\mathcal{M}/\mathcal{M}_\odot$	$\log(L/L_\odot)$	M_{bol}	M_V	$R/R_\odot$	$\bar{\rho}/\bar{\rho}_\odot$
O3	120	6.15	−10.7	−6.0	15	0.035
O5	60	5.90	−10.1	−5.7	12	0.035
O8	23	5.23	−8.4	−4.9	8.5	0.037
B0	17.5	4.72	−7.1	−4.0	7.4	0.043
B3	7.6	3.28	−3.5	−1.6	4.8	0.069
B5	5.9	2.92	−2.7	−1.2	3.9	0.099
B8	3.8	2.26	−1.0	−0.2	3.0	0.14
A0	2.9	1.73	0.3	0.6	2.4	0.21
A5	2.0	1.15	1.7	1.9	1.7	0.41
F0	1.6	0.81	2.6	2.7	1.5	0.47
F5	1.3	0.51	3.4	3.5	1.3	0.59
G0	1.05	0.18	4.2	4.4	1.1	0.79
G5	0.92	−0.10	4.9	5.1	0.92	1.18
K0	0.79	−0.38	5.6	5.9	0.85	1.29
K5	0.67	−0.82	6.7	7.4	0.72	1.79
M0	0.51	−1.11	7.4	8.8	0.60	2.36
M5	0.21	−1.96	9.6	12.3	0.27	10.7
M7	0.12	−2.47	10.8	14.3	0.18	20.6
M8	0.06	−2.92	11.9	16.0	0.1	60

SOURCE: Data published in Schmidt-Kaler (1982)

Main Sequence Stars

Table 1.1 Stellar models with solar abundance, from Figure 1.4

Mass ($\mathcal{M}_\odot$)	L_{ZAMS} ($L_\odot$)	T_{eff} (K)	*Spectral type*	τ_{MS} (Myr)	τ_{red} (Myr)	$\int(Ld\tau)_{MS}$ (Gyr × $L_\odot$)	$\int(Ld\tau)_{pMS}$ (Gyr × $L_\odot$)
0.8	0.24	4860	K2	25 000	—	10	—
1.0	0.69	5640	G5	9800	3200	10.8	24
1.25	2.1	6430	—	3900	1650	11.7	38
1.5	4.7	7110	F3	2700	900	16.2	13
2	16	9080	A2	1100	320	22.0	18
3	81	12 250	B7	350	86	38.5	19
5	550	17 180	B4	94	14	75.2	23
9	4100	25 150	—	26	1.7	169	40
15	20 000	31 050	—	12	1.1	360	67
25	79 000	37 930	—	6.4	0.64	768	145
40	240 000	43 650	O5	4.3	0.47	1500	112
60	530 000	48 190	—	3.4	0.43	2550	9
85	1 000 000	50 700	—	2.8	—	3900	—
120	1 800 000	53 330	—	2.6	—	5200	—

Note: L and T_{eff} are for the zero age main sequence; spectral types are from Table 1.3; τ_{MS} is main-sequence life; τ_{red} is time spent later as a red star ($T_{eff} \lesssim 6000$ K); integrals give energy output on the main sequence (MS), and in later stages (pMS).

Lifetime and energy output on the Main Sequence and after the main sequence phase – Tab 1.1 GU.

Table 1.3 Average magnitudes and colors for main-sequence stars: class V (dwarfs)

	M_V	BC	$15-V$	$U-B$	$B-V$	$V-R$	$V-I$	$J-K$	$V-K$	T_{eff}
O3	−6	4.5	—	−1.22	−0.32	—	—	—	—	50 000
O5	−5.6	4.0	—	−1.19	−0.32	−0.14	−0.32	−0.25	−0.99	43 000
O8	−4.8	3.3	−4.1	−1.14	−0.32	−0.14	−0.32	−0.24	−0.96	35 000
B0	−4.0	2.9	−4.0	−1.07	−0.30	−0.13	−0.30	−0.23	−0.91	29 800
B3	−1.4	1.6	−2.9	−0.75	−0.18	−0.08	−0.20	−0.15	−0.54	18 750
B6	−1.0	1.2	−2.3	−0.50	−0.14	−0.06	−0.13	−0.09	−0.39	14 000
B8	−0.25	0.8	−1.7	−0.30	−0.11	−0.04	−0.09	−0.06	−0.26	11 600
A0	0.8	0.3	−0.4	0.0	0.0	0.0	0.0	0.0	0.0	9400
A5	1.8	0.1	3.3	0.08	0.19	0.13	0.27	0.08	0.38	7800
F0	2.4	0.1	6.0	0.06	0.32	0.16	0.33	0.16	0.70	7300
F5	3.3	0.1	—	−0.03	0.41	0.27	0.53	0.27	1.10	6500
G0	4.2	0.2	—	0.05	0.59	0.33	0.66	0.36	1.41	6000
Sun	4.83	0.07	—	0.14	0.65	0.36	0.72	0.37	1.52	5780
G5	4.93	0.2	—	0.13	0.69	0.37	0.73	0.41	1.59	5700
K0	5.9	0.4	—	0.46	0.84	0.48	0.88	0.53	1.89	5250
K5	7.5	0.6	—	0.91	1.08	0.66	1.33	0.72	2.85	4350
K7	8.3	1.0	—	—	1.32	0.83	1.6	0.81	3.16	4000
M0	8.9	1.2	—	—	1.41	0.89	1.80	0.84	3.65	3800
M2	10.2	1.6	—	—	1.52	1.00	2.16	0.86	4.11	3500
M4	12.7	2.6	—	—	1.60	1.23	2.86	0.89	5.28	3150
M6	16.6	4.4	—	—	2.06	1.91	4.13	1.04	7.37	2800
M7	18.6	5.5	—	—	—	2.18	4.50	1.22	8.55	2600

Note: The color $15-V$ is from a flux-based magnitude at 1550 Å, as defined by Equation 1.12, measured by the OAO and ANS satellites. BC is the bolometric correction, defined in Equation 1.15.

Stars with luminosity class V = Dwarfs = include Main Sequence Stars

Table 1.4 Average magnitudes and colors for red giant stars: class III

	M_V	BC	$U-B$	$B-V$	$V-R$	$V-I$	$J-K$	$V-K$	T_{eff}
G5	0.9	0.3	0.50	0.88	0.48	0.93	0.57	2.10	5000
K0	0.7	0.4	0.90	1.02	0.52	1.00	0.63	2.31	4800
K5	0.3	1.1	1.87	1.56	0.84	1.63	0.95	3.60	3900
M0	−0.4	1.3	1.96	1.55	0.88	1.78	1.01	3.85	3850
M3	−0.6	1.8	1.83	1.59	1.10	2.47	1.13	4.40	3700
M5	−0.4	3	1.56	1.57	1.31	3.05	1.23	5.96	3400
M7	v	5	0.94	1.69	3.25	5.56	1.21	8.13	3100

Note: M7 stars of class III are often variable.

Table 1.5 Average magnitudes and colors for supergiant stars: class I

	M_V	BC	$U-B$	$B-V$	$V-R$	$V-I$	$V-K$	T_{eff}
O8	−6.5	3.6	−1.07	−0.24	—	—	—	35 750
B0	−6.4	2.6	−1.03	−0.22	−0.08	−0.2	—	25 600
B6	−6.2	1.0	−0.72	−0.09	−0.01	−0.07	—	13 500
A0	−6.3	0.2	−0.44	0.02	0.05	0.11	0.9	9600
F0	−6.6	−0.1	0.16	0.17	0.12	0.25	—	7700
G5	−6.2	0.4	0.84	1.02	0.44	0.82	3	4850
K5	−5.8	1.0	1.7	1.60	0.81	1.50	—	3850
K0	−5.6	1.4	1.9	1.71	0.95	1.91	4	3650

Note: Supergiants have a large range in luminosity at any spectral type; Type Ia (luminous) and Ib (less luminous) supergiants can differ by 2 or 3 magnitudes.

Stars with luminosity class III = Normal giants
Stars with luminosity class I = Supergiants

Table 3.7 The effective-temperature and bolometric-correction scales

Spectral type	V $T_{\mathrm{eff}}/\mathrm{K}$	V BC_V	III $T_{\mathrm{eff}}/\mathrm{K}$	III BC_V	I $T_{\mathrm{eff}}/\mathrm{K}$	I BC_V
O3	52 500	−4.75	50 000	−4.58	47 300	−4.41
O5	44 500	−4.40	42 500	−4.05	40 300	−3.87
O7	38 000	−3.68	37 000	−3.58	35 700	−3.48
O9	33 000	−3.33	32 000	−3.13	32 600	−3.18
B0	30 000	−3.16	29 000	−2.88	26 500	−2.49
B2	22 000	−2.35	20 300	−2.02	18 500	−1.58
B3	18 700	−1.94	17 100	−1.60	16 200	−1.26
B5	15 400	−1.46	15 000	−1.30	13 600	−0.95
B7	13 000	−1.02	13 200	−0.97	12 200	−0.78
B8	11 900	−0.80	12 400	−0.82	11 200	−0.66
A0	9 520	−0.30	10 100	−0.42	9 730	−0.41
A5	8 200	−0.15	8 100	−0.14	8 510	−0.13
F0	7 200	−0.09	7 150	−0.11	7 700	−0.01
F5	6 440	−0.14	6 470	−0.14	6 900	−0.03
G0	6 030	−0.18	5 850	−0.20	5 550	−0.15
G2	5 860	−0.20	5 450	−0.27	5 200	−0.21
G5	5 770	−0.21	5 150	−0.34	4 850	−0.33
K0	5 250	−0.31	4 750	−0.50	4 420	−0.50
K5	4 350	−0.72	3 950	−1.02	3 850	−1.01
M0	3 850	−1.28	3 800	−1.25	3 650	−1.29
M5	3 240	−2.73	3 330	−2.48	2 800	−3.47
M8	2 640	−4.1				

SOURCE: From data published in Schmidt-Kaler (1982)

Bolometric correction (to go fro M_v to M_Bol) for stars with different spectral types and luminosity classes (V, III, I). F stars which peak near V-band, have small BC.