Table 3·2 The twenty nearest stars

star	apparent visible magnitude m_v	absolute visible magnitude M_v	spectral class	luminosity class	proper motion (arc sec per year)	distance (pc)	mass ($M_\odot$)	radius ($R_\odot$)
Proxima Centauri C	11·05	15·45	M5		3·85	1·31	0·1	
Alpha Centauri A	−0·01	4·3	G2	V	3·68	1·34	1·1	1·23
Alpha Centauri B	1·33	5·69	K5	V	3·68	1·34	0·89	0·87
Barnard's Star	9·54	13·25	M5	V	10·31	1·81		
Wolf 359	13·53	16·68	M8		4·71	2·33		
HD 95735	7·50	10·49	M2	V	4·78	2·49	0·35	
Sirius A	−1·45	1·41	A1	V	1·33	2·65	2·31	1·8
Sirius B	8.68	11·56	WD*	VII	1·33	2·65	0·98	0·022
UV Ceti A	12·45	15·27	M5		3·36	2·72	0·044	
UV Ceti B	12·95	15·8	M6		3·36	2·72	0·035	
Ross 154	10·6	13·3	M4		0·72	2·90		
Ross 248	12·29	14·8	M6		1·59	3·15		
ε Eridani	3·73	6·13	K2	V	0·98	3·30		0·98
L789–6	12·18	14·60	M7		3·26	3·30		
Ross 128	11·10	13·50	M5		1·37	3·32		
61 Cygni A	5·22	7·58	K5	V	5·21	3·40	0·63	
61 Cgyni B	6·03	8·39	K7	V	5·21	3·40	0·60	
ε Indi	4·68	7·00	K5	V	4·69	3·44		
Procyon A	0·35	2·65	F5	IV	1·25	3·50	1·77	1·7
Procyon B	10·7	13·0	WD*	VII	1·25	3·50	0·63	0·01

*white dwarf

sufficient orbital parameters can be determined, the two star masses may be deduced.

There are two distinct classes of binary star appearing to us as observers. In **visual binaries**, the stars are sufficiently close and bright so that their individual orbits can be observed directly. These orbits will have the appearance of ellipses traced out on the sky relative to the 'fixed' star background. The ellipses may be nearly circular or highly elongated depending upon the individual star masses and the inclination of the plane of the orbit of the pair to our line of sight. In practice, this data has been gathered for less than a hundred binary systems.

If the stars are too distant to be resolved by telescopes, the periodic Doppler shift of the lines in the spectrum reveals their binary status. When the plane of their orbits is nearly in our line of sight, we observe the stars eclipsing each other. In such an **eclipsing binary** the masses may be deduced to a reasonable accuracy; otherwise the masses cannot be obtained.

A third method of mass determination has been applied to some condensed stars. We shall learn that white dwarfs have a very high density and this results in the light emitted by the star suffering an observable **gravitational redshift**. The wavelength shift (usually written $\delta\lambda$) of a spectral line from its natural place (written λ_0 since λ denotes the wavelength) in a low density situation (for example, laboratory studies or the spectra of normal stars) to the wavelength at which it is observed in the spectrum of the white dwarf is directly related to the mass M and the radius R of the white dwarf:

$$\delta\lambda/\lambda_0 = GM/Rc^2.$$

Therefore, if the radius of the white dwarf can be obtained from its luminosity, then the mass M may

Table 3·3 The twenty brightest stars

star		apparent visible magnitude m_v	absolute visible magnitude M_v	spectral class	luminosity class	distance (pc)
Sirius	α CMa	−1.45	+1·41	A1	V	2·7
Canopus	α Car	−0·73	+0·16	F0	Ib	60
Rigel Kent	α Cen	−0·10	+4·3	G2	V	1·33
Arcturus	α Boo	−0·06	−0·2	K2 p	III	11
Vega	β Lyr	0·04	+0·5	AO	V	8·1
Capella	α Aur	0·08	−0·6	G8		14
Rigel	β Ori	0·11	−7·0	B8	Ia	250
Procyon	α CMi	0·35	+2·65	F5	IV	3·5
Achernar	α Eri	0·48	−2·2	B5	IV	39
Hadar	β Cen	0·60	−5·0	B1	II	120
Altair	α Aql	0·77	+2·3	A7	V	5·0
Betelgeuse	α Ori	0·80	−6·0	M2	I	200
Aldebaran	α Tau	0·85	−0·7	K5	III	21
Acrux	α Cru	0·9	−3·5	B2	IV	80
Spica	α Vir	0·96	−3·4	B1	V	80
Antares	α Sco	1·0	−4·7	M1	Ib	130
Pollux	β Gem	1·15	+0·95	K0	III	11
Fomalhaut	α PsA	1·16	+0·08	A3	V	7·0
Deneb	α Cyg	1·25	−7·3	A2	Ia	500
Mimosa	β Cru	1·26	−4·7	B0	III	150