ANGULAR DIAMETERS OF COOL STARS MEASURED BY THE METHOD OF LUNAR OCCULTATIONS

Nathaniel M. White

Lowell Observatory

Given the angular diameter and total energy flux of a star, its effective temperature can be determined. Until recently, there were few well-determined angular diameters of cool stars, and effective temperature calibrations rested on angular diameter measurements of several not necessarily "normal" stars. The number of measured angular diameters of stars cooler than about spectral type G is steadily being increased by using the method of photoelectric observations of lunar occultations.

Angular diameter measurements of 42 stars are compiled in the Table. These are the results of many authors; most have been published since 1970. Excluding several geometric occultations (i.e., no diffraction pattern), the mean angular diameter measured has been about 5 milliseconds of arc, with an average error of about 0.8 milliseconds of arc. (Methods of error estimates vary among authors.) This is an indication of the unique power of the lunar occultation technique.

Thirteen of the 42 stars have more than one independent observation, with μ Gem having eight observations. Since the observational data are recorded in a fraction of a second, are not repeatable, and therefore are unique for a given site and time, duplication of observations at various sites is extremely important and is obviously possible.

As the lack of known cool star angular diameters is being alleviated systematically through the lunar occultation technique, the lack of homogeneous photometry is becoming more important. Photometry reducible to absolute fluxes and covering a wide wavelength range for the stars listed in the Table will provide the

A. G. Davis Philip and D. S. Hayes (eds.), The HR Diagram, 447–450. All Rights Reserved.
Copyright © 1978 by the IAU.

https://doi.org/10.1017/S0074180900145966 Published online by Cambridge University Press

STELLAR ANGULAR DIAMETERS FROM LUNAR OCCULTATIONS

BS	Name	Spectral Type[1]	m_V[1]	Milliseconds of Arc[2] ϕUD	ϕLD	Central Wavelength[3]	Ref. Code[4]
224	63 δ Psc	K5 III	$4^{m}.44$	4.2 ± 1.		≃.5	7
601		gM2	6.11		2.6 ± 0.5	≃.5	2
867	45 Ari	M6⁻ III	5.94		9.5 ± 2.0	≃.75	1
				9.88 ± 0.2	10.27 ± 0.21	1.64	24
				11.16 ± 0.99	11.38 ± 1.01	3.45	24
	+24°571	K5	6.77	1.8			5
1977	Y Tau	C6,4	Var	8.39 ± 0.24	8.80 ± 0.25	1.64	24
				7.98 ± 0.23	8.38 ± 0.24	1.64	24
2013	BD+27°888	gG7	5.52	2.4 ± 1.2		≃.5	7
2047	χ^1 Ori	G0 V	4.41		1.6 ± 0.5	≃.70	12
2063	U Ori	M7.0-M9.0	Var	14.30 ± 0.54		1.64	24
				15.45 ± 0.33	15.45 ± 0.33	2.10	24
2286	μ Gem	M3 III	2.97	11.8 ± 2.4	13.2 ± 2.4	.456	10
				12.3 ± 1.4	13.5 ± 1.4	.820	10
				12.1 ± 1.8		V	27
				12.0 ± 0.7		V	27
				11.8 ± 0.9		y	27
				12.3 ± 1.8		V	27
				12.3 ± 0.34	13.70 ± 0.41	.45,.52,.58	23
				14.2 ± 1.3	15.81 ± 1.45	V	20
2473	ε Gem	G8 Ib	3.08	5.6 ± 0.6		≃.5	7
				1.8			5
2533	87 B Gem	gK5	5.62	2.8			5
2671	R Gem	S3,9e-S6,9e	6.5	3.7			5
2938	74 Gem	M0 III	5.07	2.78 ± 0.27		.75	28
3094	1 Cnc	gK3	5.81	2.1 ± 0.6		.6	7
	V Cnc	S2.9e	7.5-	2.6 ± 0.7	2.8 ± 0.8	.845	16
	+13°1994	M4 III	6.61	3.84 ± 0.55		1.64	24
				4.0 ± 0.5		.75	28
3541	X Cnc	C5,4	6.22	7.9 ± 0.8	9.3 ± 0.8	.69	4
3550	60 Cnc	gK5	5.56	3.3 ± 0.4		.75	28
3882	R Leo	gM8e	5.0-	67 ± 5		≃.70	19
3950	π Leo	M2 III	4.71	5.2 ± 0.5	5.9 ± 0.5	R	25
3980	31 Leo	K4 III	4.43	2.8 ± 0.6		≃.55	7
				3.1 ± 0.2		≃.5	13
4127	46 Leo	gM2	5.54	5.6 ± 1.1		.51	21
4432	87 Leo	K4 III	5.07	3.7 ± 0.4	4.1 ± 0.4	.547	9
				2.9 ± 0.5		y	28
4517	ν Vir	M1 III	4.02		5.65 ± 0.05		22
4902	ψ Vir	M3 III	4.91		6.1 ± 0.3	.63	26
					6.5 ± 0.3	.69	12
				4.92 ± 0.38	5.11 ± 0.39	1.64	24
5301		gM3	4.91		3.6 ± 0.5	≃.80	2
				4.65 ± 0.33	4.79 ± 0.34	1.64	24
				5.0 ± 1.		b	28
5824	42 Lib	K4 III	4.95	2.2 ± 0.3		V	15
6134	α Sco	M1 Ib	1.08	41. ± 1.			11
	IRC-20 321	M6		4.37 ± 0.25		2.2	24
	V774 Sgr	M5	12.-	5.65 ± 0.73		1.64	24

https://doi.org/10.1017/S0074180900145966 Published online by Cambridge University Press

STELLAR ANGULAR DIAMETERS FROM LUNAR OCCULTATIONS (continued)

BS	Name	Spectral Type[1]	m_V[1]	Milliseconds of Arc[2] ϕ_{UD}	ϕ_{LD}	Central Wavelength[3]	Ref. Code[4]
	IRC-20 445	M1		4.0 ± 1.0		2.40	24
6861	70 B Sgr	gM5	6.25	3.2 ± 0.8		V	15
6913	22 λ Sgr	K2 III	2.85	4.4 ± 0.3			18
7023		M4	6.49		8.5 ± 1.5	≈.80	3
7150	ζ² Sgr	K1 III	3.52		3.0 ± 1.0	≈.71	1
				3.7 ± 0.5	4.2 ± 0.5	R	25
	SAO 162049	Ma	6.7		2.8 ± 0.9	≈.8	2
7776	β Cap	gKo	3.07	3.05 ± 0.12	3.17 ± 0.17	1.64	24
7900	ν Cap	M2 III	5.10	4.1 ± 0.5	4.7 ± 0.5	.694	8
				8.6 ± 2.		.762	7
8318	47 Cap	gM3	6.20	2.8 ± 0.6		≈.5	15
8698	λ Aqr	M2 III	3.74	7.4 ± 0.4	8.2 ± 0.4	V	17
8834	ϕ Aqr	M2 III	4.22	4.9 ± 0.8		V	21
9004	19 Psc	C6,2	5.30	9. ± 1.		R	14
				8.0 ± 1.	8.9 ± 1.0	.71μ	6
					10.2 ± 2.5	.69μ	8

NOTES TO TABLE

[1]Spectral types and magnitudes are from the reference listed or the Bright Star Catalog.

[2]ϕ_{UD} and ϕ_{LD} indicate the fitted model used, either a uniform disk or limb-darkened disk approximation, respectively. Nearly all limb-darkened fits used the fully darkened assumption, i.e., $\beta = 1.0$.

[3]The approximate central wavelengths are in micron units, with the letters being the usual notation for standard photometric systems.

[4]The five angular diameters with reference code 28, White, N. M. (1978), have not been published previously.

---

best estimate of their total flux output. Since the effective temperature is a function of the fourth root of the total flux, the error in effective temperature determinations will be reduced to mostly that related to the angular diameter measurement, that is, about 5% in the effective temperature.

The purpose of this compilation is to draw attention to these stars (some of which do not even have good MK spectral types), in order to encourage their detailed observational and theoretical investigation.

REFERENCES TO TABLE

1. Africano, J. L., Cobb, C. L., Dunham, D. W., Evans, D. S., Fekel, F. C., and Vogt, S. S. (1975). Astron. J. **80**, 689.
2. Africano, J. L., Evans, D. S., Fekel, F. C., and Ferland, G. J. (1976). Astron. J. **81**, 650.
3. Africano, J. L., Evans, D. S., Fekel, F. C., and Montemayor, T. (1977). Astron. J. **82**, 631.
4. Bartholdi, P., Evans, D. S., Mitchell, R. I., Silverberg, E.C., Wells, D. C., and Wiant, J. R. (1972). Astron. J. **77**, 256.
5. Beavers, W. I., and Eitter, J. J. (1974). Bull. Amer. Astron. Soc. **6**, 216.
6. de Vegt, Chr. (1974). Astron. Astrophys. **34**, 457.
7. de Vegt, Chr. (1976). Astron. Astrophys. **47**, 457.
8. Dunham, D. W., Evans, D. S., Silverberg, E. C., and Wiant, J. R. (1975). Astron. J. **78**, 199.
9. Dunham, D. W., Evans, D. S., and Sandmann, W. H. (1974). Astron. J. **79**, 483.
10. Dunham, D.W., Evans, D.S., and Vogt, S.S. (1975). Astron. J. **80**, 45.
11. Evans, D. S. (1957). Astron. J. **62**, 83.
12. Evans, D. S., Fekel, F. C., and Silverberg, E. C. (1977). Astron. J. **82**, 828.
13. Glass, I. S., and Morrison, L. V. (1976). Monthly Notices Roy. Astron. Soc. **175**, 57.
14. Lasker, B. M., Bracker, S. B., and Kunkel, W. E. (1973). Publ. Astron. Soc. Pacific **85**, 109.
15. Harwood, J.M., Nather, R.E., Walker, A.R., Warner, B., and Wild, P.A.T. (1975). Monthly Notices Roy. Astron. Soc. **170**, 229.
16. McGraw, J. T., and Angel, J.R.P. (1974). Astron. J. **79**, 485.
17. Nather, R. E., McCants, M. M., and Evans, D. S. (1970). Astrophys. J. **160**, L181.
18. Nather, R. E. (1972). Ph.D. dissertation, Univ. of Cape Town.
19. Nather, R. E., and Wild, P.A.T. (1973). Astron. J. **78**, 628.
20. Nelson, M. R. (1975). Astrophys. J. **198**, 127.
21. Poss, H. L. (1971). in Highlights of Astronomy, Vol. **2**, C. de Jager, ed., D. Reidel, Dordrecht, p. 692.
22. Rakos, K. D. (1971). in Highlights of Astronomy, Vol. **2**, C. de Jager, ed., D. Reidel, Dordrecht, p. 675.
23. Ridgway, S. T., Wells, D. C., and Carbon, D. F. (1974). Astron. J. **79**, 1079.
24. Ridgway, S. T., Wells, D. C., and Joyce, R. R. (1977). Astron. J. **82**, 414.
25. Vilas, F., and Lasker, B. M. (1977). Publ. Astron. Soc. Pacific **89**, 95.
26. Walker, A.R. (1975). Monthly Notices Roy. Astron. Soc. **173**, 29P.
27. White, N. M. (1974). Astron. J. **79**, 1076.
28. White, N. M. (1978). In preparation.

https://doi.org/10.1017/S0074180900145966 Published online by Cambridge University Press