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ABSOLUTE ENERGY DISTRIBUTIONS FOR STARS OF SPECTRAL TYPES F, G AND K

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ABSOLUTE ENERGY DISTRIBUTIONS FOR STARS OF SPECTRAL TYPES F, G AND K

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Abstract

Absolute energy distributions over the range 3600 ⩽ λ ⩽ 4500 A. are given for 154 stars of spectral types F, G and K. The spectral energy distributions of these stars are compared to those of globular clusters and galaxies. Globular clusters are found to resemble metal-poor high-velocity stars. The spectral energy distributions of the nuclei of M31 and M32 are obviously composite. M32 appears to be either dwarf-enriched or moderately metal-poor.

The observations reported in this paper were obtained with a spectrum scanner which is located at the Cassegrain focus of the 74-inch telescope. The dispersing element of this instrument is a Bausch and Lomb replica reflection grating with 600 grooves per millimetre. The centre of its blaze is at λ3750 in the second order, which was the order used. A refrigerated 1P21 photomultiplier was employed as a light detector.

Tracings of a large number of stars covering the range 3600 ⩽ λ ⩽ 4500 A. were available from previous observing programmes (van den Bergh 1963, 1966, and van den Bergh and Sackmann 1965). All tracings were made at an effective resolution (spectral purity) of 20 A.

Observations of early-type standard stars (Oke 1960) were used to transform the observed deflections to absolute energy units. The mean wave-length-dependence of atmospheric extinction was taken from van den Bergh and Henry (1962).

It should be emphasized that the observations used for the present programme were originally made to measure narrow-band parameters. Such measurements do not require nights of the highest photometric quality. The accuracy of the results is therefore lower than that which could have been obtained in a programme devoted exclusively to studies of the spectral energy distributions of stars. The present study includes only those stars for which at least four tracings obtained during two or more nights were available. The average *internal* mean error of the combined data for each star is found to be 0.02 mag. at λ4000, 0.03 mag. at λ3800 and 0.04 mag. at λ3600. Within the accuracy of the data these errors are found to be independent of apparent magnitude and spectral type.

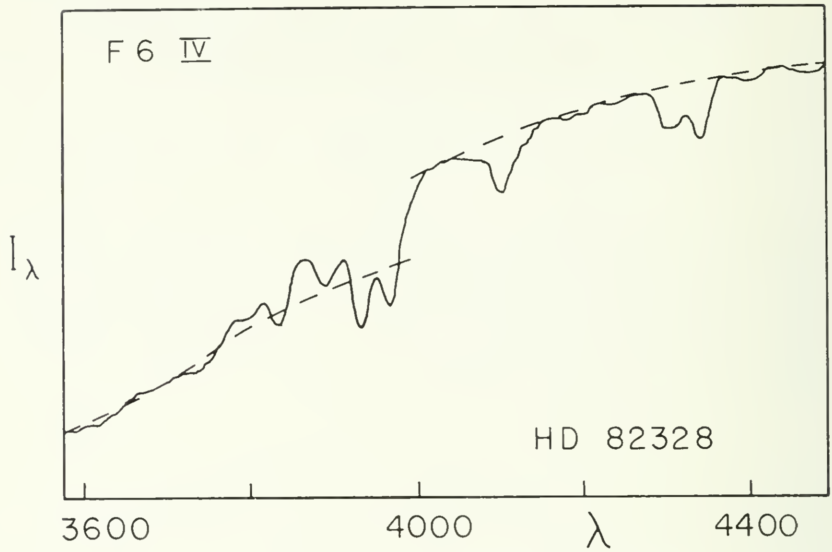

FIG. 1—Spectrum scan at 20 A. resolution of the F6 IV star θ UMa. The dashed line indicates the adopted schematic continuum.

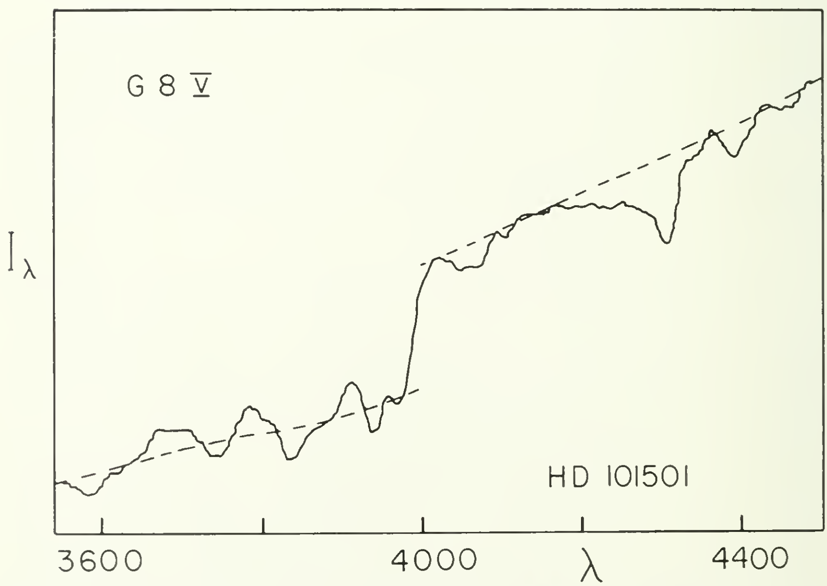

FIG. 2—Spectrum scan at 20 A. resolution of the G8 V star 61 UMa. The dashed line indicates the adopted schematic continuum.

Typical tracings of stars are shown in figures 1 and 2 where the dashed line represents the adopted schematic continuum. Except near the G-band and the Hγ and Hδ lines the adopted schematic continuum in the region $\lambda > 4000$ A. coincides with the observed pseudo-continuum. For $\lambda < 4000$ A. the adopted schematic continuum represents the strongly smoothed mean of the actually observed pseudo-continuum. The only reason for drawing the schematic continuum in this particular fashion is that it yields consistent and easily reproducible results.

For all of the programme stars the observed values of $m(1/\lambda)$, at 100 A. intervals along the schematic continuum, are given in Table I. In the table n is the number of tracings on which the tabulated values of $m(1/\lambda)$ are based. Stars whose H.D. numbers are marked with an asterisk have spectral types which were determined by Mr. Peter Hagen using 74-inch spectra having dispersions of 33, 40 or 66 A./mm. The spectral types for H.D.208110 and H.D.22211 are uncertain.* Figures 3 and 4 show sample plots of the schematic spectral energy distributions of stars of different spectral types and luminosity classes.

The data in Table I may be used to form monochromatic colour indices. For example a monochromatic colour index $C(41\text{–}45)$ can be defined by the equation

$$C(41\text{–}45) = m(1/\lambda)(4100) - m(1/\lambda)(4500).$$

Figure 5 shows a plot of the observations of the colour index $C(41\text{–}45)$ versus $C(38\text{–}45)$ for main sequence stars (dots) and subgiants (crosses). Binaries and metal-poor stars with ultraviolet excess $\delta(U\text{-}B) > 0.10$ have not been plotted. Figure 6 shows that such metal-poor stars (dots) lie above the monochromatic colour-colour curve for stars of normal metal abundance.

Using the wave-length dependence of interstellar reddening given by Whitford (1958) and the globular cluster reddening values given by van den Bergh (1967) it is possible to obtain the monochromatic intrinsic colour indices of globular clusters (van den Bergh and Henry

*H.D.208110. Peter Hagen classifies this star as G0 IV, III with the following comments: (1) the star rotates very slowly. (2) the standards available at D.D.O. in this region are not complete. (3) Sr II (λ4077) is very sharp and indicates a much higher luminosity than given by other criteria. (4) Ca II (λ4227) gives an earlier spectral class than do the H lines.

H.D.22211. The spectral type is uncertain because all the lines appear to be rotationally broadened to an extent which may be inconsistent with the classification of G0 III.

1962). In figure 6 the intrinsic colours so obtained are plotted as crosses. The figure shows that globular clusters fall in the same region of the monochromatic two-colour diagram as do high-velocity stars.

Monochromatic intrinsic colours of the nuclear regions of M31 and M32 were derived by assuming a reddening $E_{B-V} = 0.12$. The positions of M31 and M32 in figure 6 suggest that their spectral energy

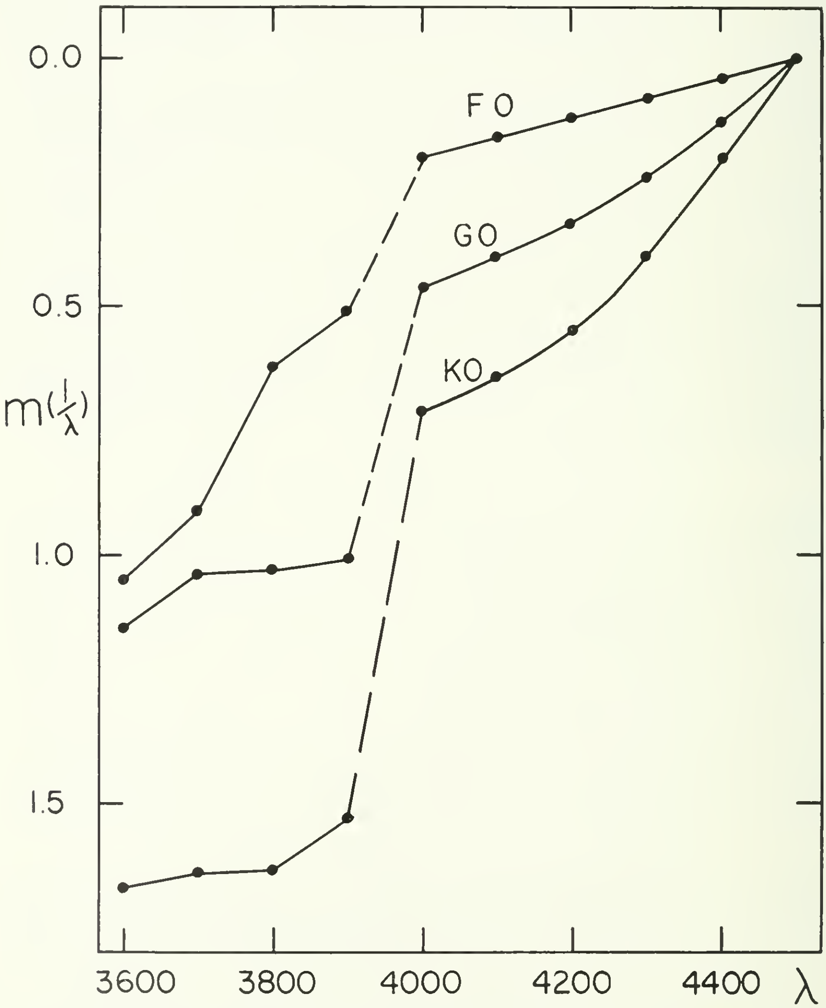

Fig. 3—Comparison of the absolute energy distributions of the following main sequence stars: H.D.58946 (F0), H.D.34411 (G0) and H.D.75732 (K0).

distributions are composite. Table II shows that the combination G0 V + K2 III (with the G star contributing one third of the light at λ4500) gives a reasonably good representation of the spectral energy distribution of the nucleus of M31 over the range 3600 < λ < 4500 A. It should be emphasized that this type of synthesis is not unique. Nevertheless the data suggest that stars near the main-sequence turn-off

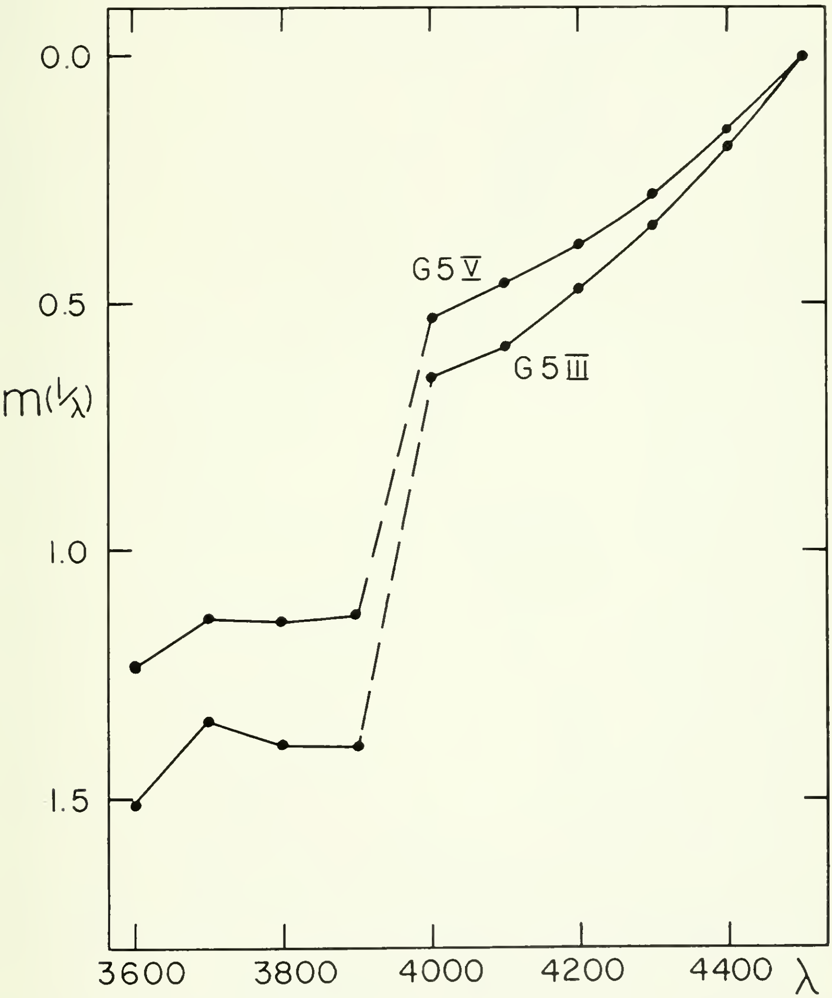

FIG. 4—Comparison of the absolute energy distributions of H.D.20630 (G5 V) and H.D.27022 (G5 III).

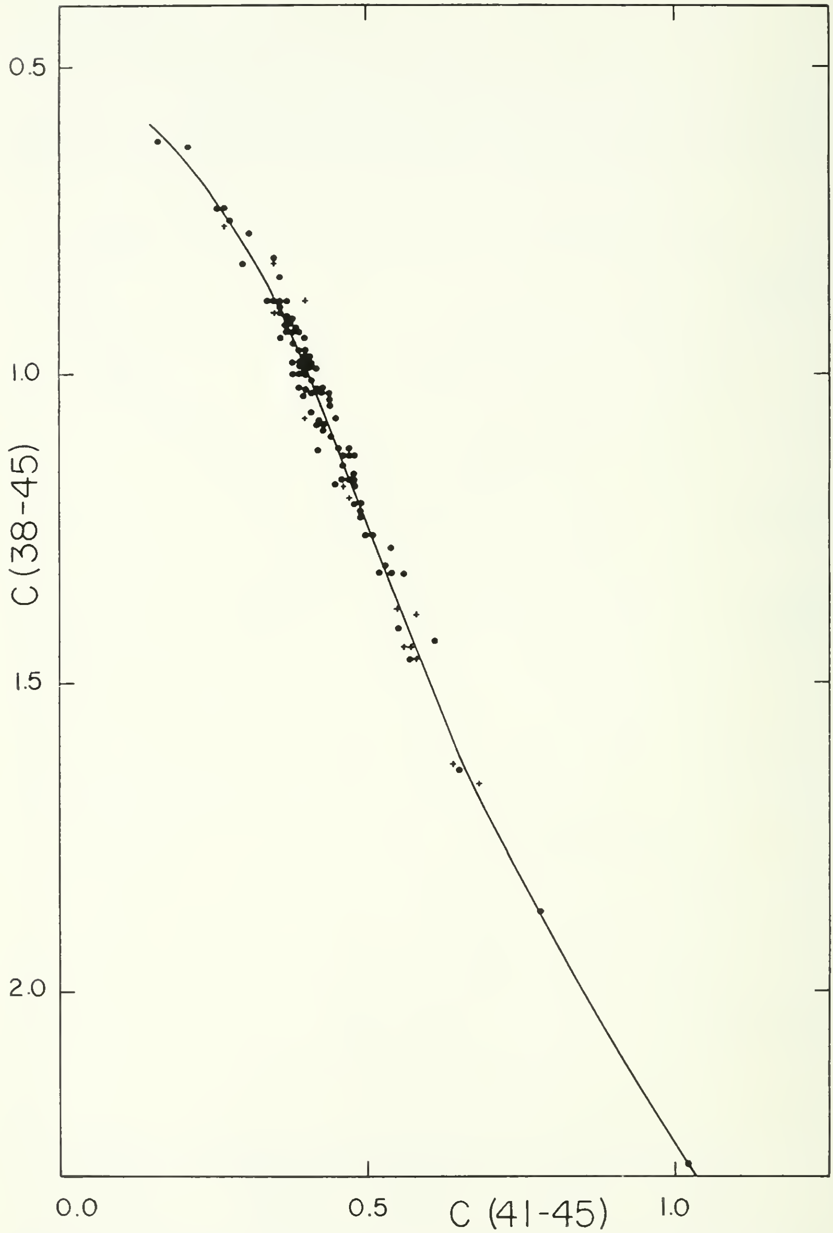

Fig. 5—Monochromatic colour-colour plot for main sequence stars (*dots*) and subgiants (*crosses*). Metal-poor stars with $\delta(U\text{-}B) > 0.10$ have not been plotted.

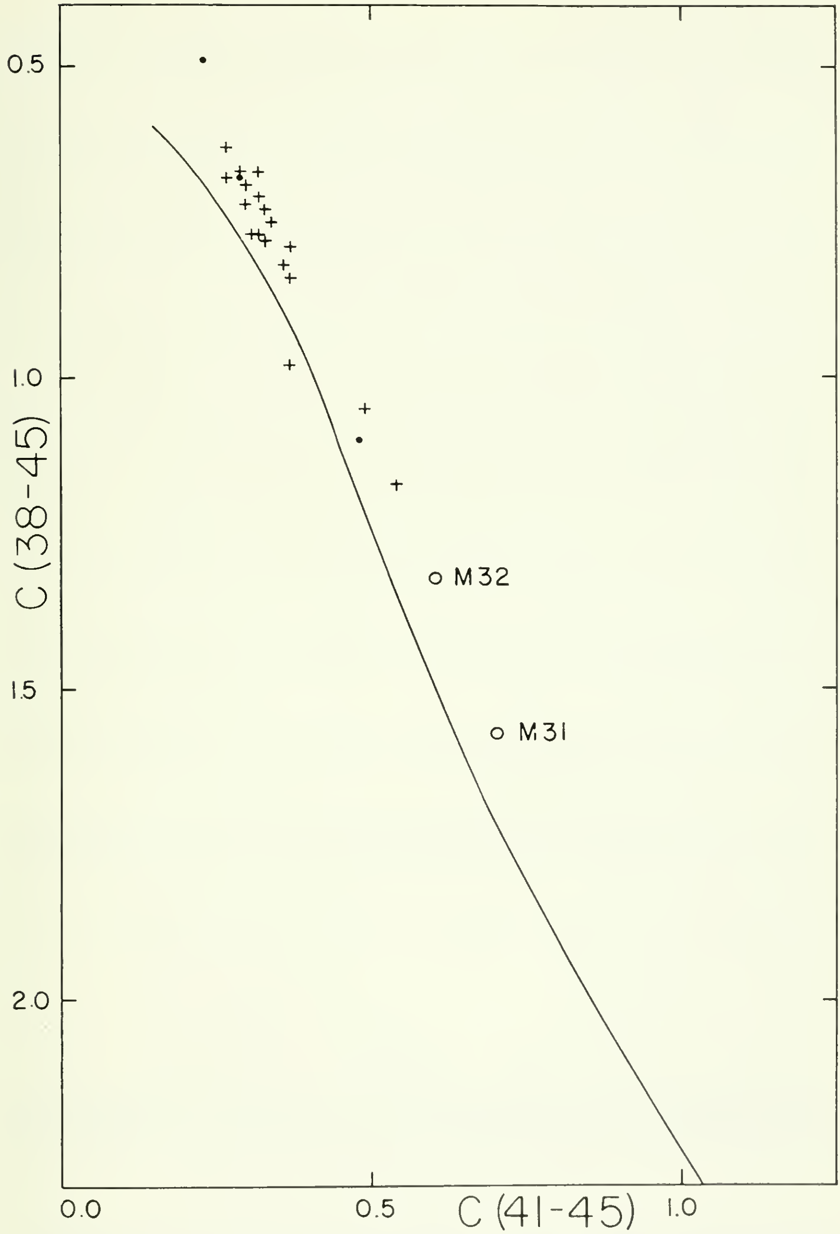

FIG. 6—The figure shows the positions of metal-poor high-velocity stars (*dots*), globular clusters (*crosses*) and of the nuclei of M31 and M32 relative to the intrinsic colour-colour relation of figure 5. The data for M31, M32 and the globular clusters have been corrected for interstellar reddening.

TABLE 1

H.D.	Sp.	n	4500	4400	4300	4200	4100	4000	3900	3800	3700	3600
26	K0 IIIp	4	0.00	0.26	0.49	0.66	0.80	0.89	1.54	1.57	1.61	1.62
166	K0 V	8	0.00	0.17	0.33	0.44	0.52	0.59	1.26	1.32	1.28	1.35
3651	K0 V	4	0.00	0.22	0.39	0.55	0.65	0.74	1.57	1.64	1.62	1.64
4614	G0 V	6	0.00	0.12	0.22	0.30	0.37	0.42	0.89	0.91	0.95	1.06
6582	G5 VI	10	0.00	0.14	0.27	0.36	0.44	0.52	1.06	1.04	1.02	1.10
8036AB	G8 III	8	0.00	0.12	0.22	0.31	0.36	0.42	0.96	1.14	1.27	1.44
8262	G3 V	4	0.00	0.13	0.25	0.34	0.41	0.48	1.00	1.01	1.01	1.10
9270	G8 III	7	0.00	0.19	0.36	0.54	0.66	0.72	1.58	1.62	1.61	1.66
9407	G6 V	4	0.00	0.16	0.30	0.41	0.48	0.56	1.18	1.21	1.21	1.29
9826	F8 IV, V	8	0.00	0.11	0.21	0.28	0.35	0.42	0.88	0.90	0.98	1.15
10307	G2 V	12	0.00	0.13	0.24	0.32	0.39	0.45	0.99	1.00	1.00	1.10
10697*	G5 V	4	0.00	0.16	0.30	0.42	0.51	0.58	1.22	1.26	1.26	1.39
11592	F5 V	7	0.00	0.08	0.15	0.21	0.27	0.32	0.68	0.73	0.86	0.99
12235*	G0 IV	5	0.00	0.14	0.27	0.37	0.46	0.51	1.06	1.12	1.17	1.31
13974	G0 V (SB)	11	0.00	0.12	0.22	0.31	0.38	0.44	0.90	0.92	0.96	1.04
16141	G5 IV	5	0.00	0.16	0.28	0.36	0.47	0.55	1.14	1.20	1.17	1.32
16397*	G1 V	5	0.00	0.11	0.20	0.27	0.35	0.41	0.86	0.86	0.86	1.00
16895	F7 V	5	0.00	0.10	0.18	0.24	0.30	0.35	0.77	0.82	0.89	1.05
17584	F2 III	4	0.00	0.06	0.10	0.14	0.20	0.23	0.59	0.70	1.05	1.29
18757	G4 V	6	0.00	0.14	0.26	0.34	0.42	0.49	1.09	1.12	1.11	1.21
18925	G8 III: + A3:	4	0.00	0.13	0.23	0.32	0.38	0.42	0.94	1.19	1.36	1.60
19373	G0 V	8	0.00	0.13	0.23	0.32	0.38	0.45	0.99	1.00	1.02	1.16
19445	sdF7	10	0.00	0.07	0.13	0.18	0.23	0.27	0.47	0.49	0.55	0.70
20630	G5 V	9	0.00	0.15	0.28	0.38	0.46	0.53	1.13	1.14	1.13	1.23
21770	F4 III	5	0.00	0.06	0.11	0.17	0.22	0.26	0.59	0.67	0.91	1.11
22211*	G0 III	4	0.00	0.12	0.22	0.32	0.38	0.48	0.93	0.98	1.08	1.28
22879*	G0 VI	4	0.00	0.11	0.20	0.26	0.32	0.36	0.76	0.75	0.78	0.90
23089/90	A + G2 III	6	0.00	0.14	0.25	0.35	0.44	0.50	0.85	0.99	1.22	1.46
25680	dG1	4	0.00	0.15	0.27	0.35	0.43	0.49	1.06	1.08	1.06	1.18
27022	G5 III	4	0.00	0.18	0.34	0.47	0.59	0.65	1.39	1.39	1.34	1.51

H.D.	Sp.	n	4500	4400	4300	4200	4100	4000	3900	3800	3700	3600
28068	G1 V	6	0.00	0.15	0.27	0.35	0.44	0.52	1.05	1.05	1.04	1.12
28099	dG2	6	0.00	0.16	0.29	0.38	0.48	0.55	1.12	1.13	1.13	1.21
28305	K0 III	4	0.00	0.23	0.44	0.63	0.77	0.85	1.81	1.93	1.92	1.92
28344	G2 V	6	0.00	0.13	0.25	0.33	0.43	0.50	1.02	1.02	1.04	1.15
30455	G2 V (SB)	6	0.00	0.13	0.24	0.32	0.40	0.46	0.97	0.98	1.01	1.08
30649	G1 V–VI	7	0.00	0.12	0.22	0.29	0.37	0.44	0.86	0.88	0.88	0.99
32923AB*	G1 IV	7	0.00	0.16	0.27	0.37	0.44	0.51	1.06	1.08	1.09	1.21
33021	dG2	4	0.00	0.13	0.24	0.32	0.40	0.48	0.98	1.00	1.02	1.13
34411	G0 V	10	0.00	0.13	0.24	0.33	0.40	0.46	1.01	1.03	1.04	1.15
38858	dG4	4	0.00	0.17	0.26	0.35	0.44	0.50	1.02	1.02	1.00	1.09
39587	G0 V	5	0.00	0.14	0.24	0.33	0.40	0.45	0.96	0.96	0.96	1.01
39881	dG0	4	0.00	0.15	0.26	0.35	0.44	0.50	1.07	1.10	1.11	1.19
42618	G4 V	5	0.00	0.17	0.25	0.36	0.45	0.51	1.05	1.07	1.06	1.10
42807	G6 V	4	0.00	0.17	0.28	0.38	0.47	0.55	1.10	1.13	1.13	1.19
48682	G0 V	5	0.00	0.14	0.23	0.31	0.38	0.44	0.92	0.95	0.99	1.10
50692	dG0	6	0.00	0.15	0.23	0.31	0.38	0.44	0.93	0.93	0.94	1.06
52711	dG2	4	0.00	0.16	0.24	0.32	0.40	0.43	0.94	0.94	0.96	1.06
55575	G0 V	4	0.00	0.11	0.21	0.29	0.35	0.42	0.88	0.88	0.89	1.03
58946	F0 V	8	0.00	0.04	0.08	0.12	0.16	0.20	0.51	0.62	0.91	1.05
60803	F8	5	0.00	0.16	0.24	0.32	0.40	0.45	0.96	0.98	1.01	1.12
62613	dG8	4	0.00	0.18	0.31	0.44	0.54	0.64	1.27	1.32	1.29	1.35
65583	G8 V	4	0.00	0.16	0.27	0.38	0.47	0.56	1.15	1.12	1.08	1.13
66242*	F7 V	4	0.00	0.15	0.25	0.35	0.43	0.50	1.03	1.02	1.08	1.24
70110	G0	4	0.00	0.17	0.25	0.34	0.43	0.50	1.00	1.02	1.04	1.18
72905	G0 V	8	0.00	0.13	0.24	0.33	0.40	0.48	0.99	1.00	1.02	1.14
74874AB	G0 III	4	0.00	0.15	0.25	0.34	0.42	0.47	1.03	1.15	1.26	1.42
75732*	K0 IV	8	0.00	0.20	0.40	0.55	0.64	0.71	1.53	1.63	1.64	1.67
76151	dG3	6	0.00	0.18	0.29	0.39	0.48	0.55	1.13	1.17	1.15	1.24
77236	K2 III	4	0.00	0.26	0.53	0.76	0.90	1.02	1.97	1.99	1.90	2.11
79096	K0 V	6	0.00	0.16	0.30	0.40	0.49	0.57	1.24	1.23	1.19	1.22

H.D.	Sp.	n	4500	4400	4300	4200	4100	4000	3900	3800	3700	3600
81192*	G8 IV	4	0.00	0.19	0.36	0.51	0.63	0.74	1.49	1.47	1.42	1.52
81809	G2 V (SB)	6	0.00	0.16	0.26	0.36	0.44	0.51	1.06	1.03	1.03	1.16
82328	F6 IV	4	0.00	0.08	0.15	0.21	0.27	0.33	0.70	0.76	0.92	1.09
82885	G8 IV–V	6	0.00	0.20	0.37	0.49	0.58	0.62	1.34	1.39	1.36	1.46
84737	G2 V	4	0.00	0.14	0.25	0.33	0.40	0.48	1.01	1.03	1.05	1.18
86728	G4 V	10	0.00	0.16	0.28	0.38	0.46	0.54	1.16	1.17	1.14	1.24
89025	F0 III	4	0.00	0.06	0.08	0.13	0.17	0.18	0.50	0.60	1.16	1.41
90508	G1 V	6	0.00	0.13	0.24	0.34	0.40	0.47	0.96	0.97	0.98	1.10
95128	G0 V	13	0.00	0.12	0.24	0.33	0.39	0.46	1.00	1.02	1.03	1.16
97334	G0 V	8	0.00	0.13	0.24	0.34	0.40	0.46	0.98	0.99	1.00	1.11
97561AB	G7 IV	4	0.00	0.18	0.33	0.46	0.55	0.61	1.21	1.26	1.28	1.35
99491*	G8 IV	6	0.00	0.18	0.37	0.51	0.61	0.67	1.34	1.43	1.42	1.56
101501	G8 V	12	0.00	0.16	0.30	0.40	0.48	0.56	1.20	1.21	1.19	1.26
102870	F8 V	5	0.00	0.12	0.22	0.29	0.36	0.42	0.92	0.94	1.00	1.16
103095	G8 VI	7	0.00	0.13	0.27	0.38	0.48	0.58	1.11	1.10	1.08	1.14
109358	G0 V	10	0.00	0.11	0.22	0.30	0.36	0.42	0.90	0.90	0.92	1.04
110897	G0 V	8	0.00	0.11	0.20	0.27	0.34	0.39	0.80	0.81	0.85	0.97
111395	G7 V	4	0.00	0.14	0.29	0.40	0.48	0.56	1.15	1.18	1.16	1.26
113226	G9 II–III	4	0.00	0.18	0.36	0.55	0.70	0.75	1.65	1.72	1.62	1.85
114174	G5 IV	4	0.00	0.14	0.28	0.38	0.46	0.52	1.06	1.08	1.08	1.17
114710	G0 V	7	0.00	0.12	0.22	0.29	0.36	0.40	0.89	0.89	0.93	1.04
115043	G1 V	8	0.00	0.13	0.24	0.31	0.39	0.46	0.96	0.96	0.98	1.09
115383	G0 V	4	0.00	0.12	0.22	0.30	0.37	0.41	0.90	0.92	0.97	1.08
117176	G5 V	10	0.00	0.16	0.29	0.39	0.47	0.55	1.17	1.17	1.16	1.27
121370	G0 IV (SB)	4	0.00	0.13	0.23	0.32	0.40	0.45	1.01	1.07	1.10	1.28
122548	K0	4	0.00	0.24	0.48	0.66	0.79	0.87	1.82	1.89	1.88	1.94
122742	G8 V	4	0.00	0.18	0.34	0.45	0.54	0.61	1.22	1.28	1.26	1.30
124553	dF8	4	0.00	0.12	0.24	0.33	0.42	0.48	0.97	0.99	1.01	1.14
125184	G0	5	0.00	0.18	0.32	0.41	0.50	0.53	1.16	1.20	1.20	1.29
126053	dG3	6	0.00	0.13	0.25	0.33	0.41	0.48	0.98	0.98	0.98	1.08

H.D.	Sp.	n	4500	4400	4300	4200	4100	4000	3900	3800	3700	3600
128167	F2 V	4	0.00	0.06	0.10	0.16	0.21	0.25	0.54	0.63	0.86	0.99
130948	dG2 (SB)	4	0.00	0.11	0.22	0.31	0.37	0.42	0.90	0.93	0.96	1.07
133640	dG1, dG2	4	0.00	0.14	0.25	0.34	0.41	0.46	0.96	0.98	1.00	1.12
135102	G7	4	0.00	0.16	0.31	0.42	0.50	0.58	1.21	1.26	1.23	1.29
137107	G2 V	6	0.00	0.12	0.22	0.29	0.36	0.40	0.87	0.88	0.92	1.04
140573	K2 III	6	0.00	0.27	0.53	0.76	0.96	1.04	2.17	2.34	2.27	2.43
141004	G0 V	6	0.00	0.13	0.23	0.30	0.37	0.40	0.92	0.92	0.94	1.05
142373	F9 IV, V	4	0.00	0.12	0.24	0.32	0.40	0.45	0.86	0.88	0.96	1.11
142860	F6 IV (SB)	4	0.00	0.10	0.20	0.27	0.35	0.39	0.77	0.82	0.95	1.10
143761*	G0 V	9	0.00	0.13	0.24	0.32	0.40	0.46	0.96	0.98	1.02	1.14
144579*	G8 V	4	0.00	0.15	0.29	0.39	0.48	0.56	1.17	1.16	1.15	1.18
145328	K0 III (SB)	5	0.00	0.21	0.45	0.64	0.76	0.88	1.78	1.88	1.83	1.95
145675*	K0 IV	4	0.00	0.21	0.43	0.57	0.68	0.74	1.52	1.66	1.70	1.77
146233	dG1	4	0.00	0.15	0.27	0.37	0.46	0.52	1.10	1.12	1.11	1.21
150680AB	G0 IV	5	0.00	0.14	0.26	0.34	0.41	0.46	1.01	1.03	1.06	1.20
150997	G8 III, IV	4	0.00	0.20	0.39	0.53	0.63	0.69	1.47	1.51	1.48	1.62
152391	G8 V	5	0.00	0.17	0.33	0.45	0.56	0.65	1.28	1.32	1.30	1.39
152792	G0 V	16	0.00	0.13	0.24	0.31	0.38	0.45	0.93	0.91	0.94	1.06
154345	G8 V	5	0.00	0.17	0.32	0.43	0.50	0.57	1.24	1.26	1.24	1.30
156283	K3 II	4	0.00	0.28	0.62	0.99	1.26	1.44	2.72	2.78	2.72	2.81
157089	G0 V	7	0.00	0.10	0.18	0.27	0.34	0.40	0.80	0.81	0.86	0.99
157214	G0 V	7	0.00	0.13	0.23	0.30	0.37	0.43	0.92	0.91	0.91	1.04
157347	G5	4	0.00	0.15	0.27	0.36	0.46	0.53	1.12	1.14	1.10	1.18
158633*	K0 V (SB)	4	0.00	0.16	0.32	0.42	0.53	0.62	1.28	1.31	1.27	1.29
159222	G5 V	4	0.00	0.14	0.26	0.35	0.41	0.47	1.04	1.06	1.06	1.16
160269	G1 V	8	0.00	0.13	0.24	0.32	0.40	0.45	0.96	0.98	1.00	1.10
160346*	K2 V	5	0.00	0.25	0.46	0.62	0.78	0.91	1.74	1.87	1.87	1.87
160693	G0 V	4	0.00	0.11	0.22	0.28	0.36	0.42	0.85	0.84	0.86	0.95
161797	G5 IV	6	0.00	0.18	0.33	0.46	0.55	0.60	1.32	1.37	1.35	1.46
163588	K2 III	6	0.00	0.28	0.54	0.77	0.95	1.07	2.16	2.30	2.24	2.38

H.D.	Sp.	n	4500	4400	4300	4200	4100	4000	3900	3800	3700	3600
164922	K0 V	5	0.00	0.18	0.34	0.46	0.57	0.65	1.39	1.46	1.43	1.49
165401*	G0 V	5	0.00	0.13	0.24	0.32	0.39	0.43	0.91	0.93	0.92	0.98
173667	F6 V	4	0.00	0.08	0.14	0.21	0.28	0.34	0.71	0.75	0.88	1.03
178428	dG4 (SB)	4	0.00	0.17	0.31	0.41	0.49	0.54	1.18	1.21	1.22	1.30
179957/8	G4 V	7	0.00	0.15	0.27	0.35	0.43	0.50	1.08	1.07	1.07	1.15
182488*	K0 IV	4	0.00	0.20	0.37	0.50	0.58	0.63	1.41	1.46	1.44	1.49
182572	G8 IV	4	0.00	0.18	0.34	0.48	0.56	0.59	1.36	1.44	1.34	1.47
182807	F6 V	7	0.00	0.09	0.19	0.25	0.31	0.36	0.76	0.77	0.86	0.99
184499	G0 V	6	0.00	0.10	0.20	0.27	0.35	0.41	0.82	0.81	0.87	0.99
185144	K0 V	4	0.00	0.18	0.35	0.46	0.55	0.63	1.37	1.41	1.34	1.37
186408	G2 V	9	0.00	0.14	0.26	0.34	0.42	0.50	1.06	1.08	1.09	1.20
186427	G5 V	7	0.00	0.14	0.26	0.35	0.42	0.48	1.06	1.08	1.06	1.15
187923	G2 V	13	0.00	0.14	0.26	0.34	0.42	0.47	1.02	1.02	1.02	1.14
188512	G8 IV	6	0.00	0.19	0.36	0.49	0.57	0.61	1.36	1.44	1.37	1.47
190067	dG7	5	0.00	0.15	0.29	0.40	0.49	0.58	1.20	1.22	1.17	1.23
190360	G6 IV	5	0.00	0.18	0.34	0.46	0.55	0.59	1.36	1.38	1.34	1.40
193664	G5 V	5	0.00	0.12	0.22	0.31	0.38	0.44	0.95	0.98	0.98	1.07
196755	G5 IV	6	0.00	0.16	0.29	0.38	0.47	0.53	1.14	1.13	1.14	1.27
197076	dG2	5	0.00	0.13	0.25	0.32	0.40	0.46	0.99	0.99	0.98	1.07
197989	K0 III (SB)	4	0.00	0.22	0.45	0.64	0.78	0.90	1.82	1.88	1.86	1.94
199191	K0 III	4	0.00	0.19	0.34	0.54	0.67	0.79	1.58	1.57	1.56	1.67
201091	K5 V	5	0.00	0.25	0.51	0.76	1.02	1.30	2.26	2.28	2.26	2.25
201891	F9 VI	4	0.00	0.09	0.17	0.23	0.29	0.34	0.65	0.68	0.76	0.86
208110	G2 III	9	0.00	0.15	0.28	0.40	0.50	0.59	1.16	1.11	1.16	1.38
208776*	F8 V	4	0.00	0.11	0.22	0.31	0.38	0.43	0.90	0.93	0.96	1.07
210027	F5 V (SB)	10	0.00	0.08	0.15	0.21	0.26	0.32	0.67	0.73	0.89	1.05
211476	G2 V	4	0.00	0.10	0.20	0.27	0.34	0.40	0.88	0.88	0.91	1.01
215549	K1 III, IV	4	0.00	0.20	0.38	0.55	0.66	0.75	1.56	1.59	1.54	1.62
215812AB	G5 V	6	0.00	0.14	0.25	0.34	0.43	0.50	1.06	1.09	1.07	1.15
217014	G5 V	11	0.00	0.15	0.28	0.38	0.45	0.51	1.14	1.18	1.16	1.27
217166AB	dG1	5	0.00	0.14	0.26	0.34	0.42	0.47	1.04	1.07	1.05	1.16
219615	G8 III	4	0.00	0.19	0.37	0.53	0.65	0.72	1.51	1.50	1.49	1.59
224930AB	G2 V	13	0.00	0.14	0.25	0.34	0.41	0.48	0.97	0.96	1.05	1.15
225239	G2 V	6	0.00	0.13	0.24	0.33	0.40	0.45	0.92	0.97	1.00	1.11

TABLE II

Comparison of the intrinsic spectral energy distribution of the nucleus of M31 with a composite of H.D.109358 = β CVn (G0 V) and H.D.140573 = α Ser (K2 III). In the model one third of the light at 4500 A. is contributed by dwarfs.

λ	G0 V + K2 III	$(M31)_0$	Dwarf light
	m	m	per cent
4500	0.00	0.00	33
4400	0.21	0.20	37
4300	0.42	0.41	40
4200	0.58	0.61	43
4100	0.72	0.74	46
4000	0.79	0.80	47
3900	1.57	1.55	62
3800	1.63	1.62	65
3700	1.62	1.63	63
3600	1.77	1.76	65

TABLE III

Comparison of the intrinsic spectral energy distribution of the nucleus of M32 with a composite of H.D.109358 = β CVn (G0 V) and H.D.140573 = α Ser (K2 III). In the model one half of the light at 4500 A. is contributed by dwarfs.

λ	G0 V + K2 III	$(M32)_0$	Dwarf light
	m	m	per cent
4500	0.00	0.00	50
4400	0.19	0.17	54
4300	0.36	0.35	57
4200	0.50	0.52	60
4100	0.62	0.64	63
4000	0.69	0.73	64
3900	1.36	1.32	76
3800	1.40	1.37	79
3700	1.40	1.39	78
3600	1.52	1.58	78

point might contribute significantly to the integrated brightness of the nuclear region of M31. Table III shows that a dwarf enriched model, in which G0 V stars and K2 III stars contribute equally at 4500 A., gives a satisfactory representation of the spectral energy distribution of M32 over the range 3600 < λ < 4500 A.

Inspection of individual tracings of M32 shows that the blue cyanogen bands in M32 are much weaker than they are in M31. This is in qualitative agreement with the data in Table II and III which show that giants contribute only 40 per cent of the light in the M32 model at λ4200, compared to 57 per cent in the M31 model. To account for the quantitative differences between the cyanogen band strengths in M31 and M32 it may be necessary to assume that some of the giants in the nucleus of M32 are metal-poor objects in which CN is weak.

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