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ON THE λ4430 INTERSTELLAR BAND: A VISUAL CLASSIFICATION

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RESUMEN

Se ha desarrollado un sistema de clasificación visual de la intensidad de la banda de absorción interstelar λ4430. Este se basa en la observación al microscopio de espectros tomados a dispersión de clasificación espectral. La intensidad de la banda fue dividida en 8 clases principales definidas por un grupo de estrellas seleccionadas como prototipos.

El sistema fue aplicado a 1,111 estrellas O y B del hemisferio austral, contenidas en el catálogo de Garrison, Hiltner y Schild (1977). El error típico en la clasificación se estimó en ±1 clase. El ancho equivalente de la banda se midió para 100 estrellas y se encontró una excelente correlación con las estimaciones visuales. Se da una calibración entre estos dos parámetros.

ABSTRACT

A system of visual classification of the strength of the interstellar band λ4430 has been developed, based on spectra taken at spectral classification dispersion. The intensity of the band was divided into 8 main classes, defined by a group of selected standard stars.

The system was applied to 1,111 southern OB stars contained in the catalog of spectral types by Garrison, Hiltner, and Schild (1977). The mean error in the classification was estimated to be ±1 class. Equivalent widths were measured for 100 stars; an excellent correlation with the visual estimations was obtained. A calibration between these two parameters is given.

Key words: **INTERSTELLAR MATTER — STARS, EARLY TYPE.**

I. INTRODUCTION

For over 40 years the presence of interstellar bands in the spectra of early type stars has stimulated many astronomers to search for the origin and nature of the absorption. In 1934 four interstellar bands in the visual spectral region were first identified, (Merrill 1934). With time more features were discovered along the spectrum and up to 1975, 39 features between λ4430 and λ6850 had been identified as "certainly or very probably of interstellar origin" (Herbig 1975).

Since their discovery, several theories for the origin of the bands and the nature and properties of the tracer have appeared. The two classical theories for their origin are; by transitions in free molecules and by some process on the solid interstellar grains. These ideas have been considered for a long time and were first presented by Beals and Blanchet (1937) and Merrill and Wilson (1938) respectively. More recently an origin by small (300 Å) grains alone was suggested by Martin and Angel (1974) and Herbig

(1975). Also described have been some types of molecular transitions which could reproduce the observed profiles of the features (Smith, Snow, and York 1977). Unfortunately even the most modern studies have not had definitive success in confirming these.

Most of the studies have been based on the results of statistical analyses using the intensity of such bands and their correlations with other related physical parameters such as interstellar reddening, column density, ultraviolet extinction, etc. As a measure of the intensity, the equivalent widths have been mostly used. It is desirable to have very accurate equivalent width measurements, but since one has to have a calibration of the plates in order to avoid problems such as differences in exposure, the number of spectra with which one can work is rather restricted. However, there exist many spectra at classification dispersion without calibration that can be useful. We suggest that for these spectra, a visual classification —which is in fact very efficient and, as will be shown in §II, as accurate as the measurements of equivalent widths when a calibration is not available— can be carried out profitably.

In this work such visual inspection has been carried out for the strong band λ4430 which is the widest, shallowest and bluest of the known features. Because of its very shallowness and wideness the band is overlapped, and can be confused, with some stellar lines, OII λ4415-17 being the most typical example. This line can affect considerably the determinations of the equivalent widths, however the eye is a good tool that is able, in most of the cases, to differentiate between the band and the line profile. Furthermore it will be shown in a forthcoming paper (Arellano Ferro 1980) that the presence of OII λ4415-17 has not affected the classification or the results obtained by using it. The method used for the classification is described in §II and the results are presented in Table 2.

II. THE CLASSIFICATION

1,111 southern OB stars from the catalog of spectral types by Garrison *et al.* (1977) were classified. For this purpose Garrison's collection of spectra was used. These spectra were taken during the years from 1966 to 1973 at the observatories Cerro Tololo and Las Campanas in Chile.

The classification is based on a set of standards defined by looking through the complete file of spectra. It is not very simple at the beginning even to detect the band, but after practice one is able to distinguish differences in intensity and width. We have been able to differentiate 8 main classes of intensity and we identified them with numbers from 0 to 7, where the class 0 has to be interpreted as no band detectable at all and the class 1 as "well, I think it is there", i. e., it is at the limit of the visual detection. However, a few cases show the band a bit stronger than one of the main classes but not as much as the next main one. Those stars were classified with half classes (e. g., 0.5, 1.5, etc.).

The stars used as standards are listed in Table 1. The most frequently used are marked with an asterisk and shown in Plate 7*a*.

TABLE 1

STANDARD STARS

HBG	CPD	HD	CLASS
130	−48 1465	...	0*
1610	−34 7719	167 647	0
1192	−46 8158	150 500	0
528	−60 2571	...	1*
340	−50 2848	85 983	1
45	−27 2151	60 284	2*
157	−43 2396	69 648	3*
313	−56 2319	83 060	3
299	−48 2401	...	4*
1298	−46 8391	154 339	4
50	−21 2383	...	5*
898	−59 5634	...	5
72	−32 1734	...	6*
1071	−51 8967	144 555	6
958	−58 5910	136 471	7*
49	−21 2364	...	7

The λ4430 band is framed, in most cases, by the helium lines λ4387 and λ4471. Between these two lines and the band there is a good space of continuum, which can be used to see the contrast with the density at the center of the band.

The classifications are presented in Table 2. The columns are self-explanatory. For details see the notes to Table 2.

Most people are sceptical about visual estimations when they are compared with more quantitative classifications. A visual classification runs into as many troubles as any other classification, for instance, the determination of equivalent widths, which surely is the most frequently used method of quantification of the strength of spectral features, or central depths with a microdensitometer. In both cases the localization of the continuum level is a big problem.

In the classification by eye, one of the main problems to deal with is the difference in densities of the spectrograms. For spectrograms which are overexposed the band will appear shallower than if they were well exposed, and if they are underexposed, the band may appear either deeper, if it is not very underexposed, or may not even show up if it is too underexposed. A good example of how the exposition does affect the intensity of the band is shown in Plate 7*b* for the star CPD −56°6206 (HBG 883). However, during the classification a good idea of how a well-exposed spectrogram appears was formed; then, every spectrum unlike that average one was marked, (see remarks column in Table 2).

Two other main problems arise during the classification: one is the guiding; when it is not very good, the horizontal bands of different densities crossing the spectrum produce confusion. In general, in these cases, one tends to overestimate the band. The other problem is the line of ionized oxygen, λ4415-17. This latter is on the blue wing of the band and because of the superposition, it gives problems for a good estimation of the contrast between the band and the continuum. These characteristics are also marked in Table 2.

The existence of other, weaker stellar lines in the region of the band has always introduced a large uncertainty in the estimations of the strength of the band. Furthermore, it has been demonstrated that those lines can produce a band-like appearance in the spectrum, as is the case of the stars Rho Leonis (Blades and Somerville 1977) and BD 69474, HD 269660, HD 268718 and HD 269546 (Blades and Madore 1978). However, in most of the stars used in this work, the band, when it exists, is very obvious. When several lines were detected the band was not classified, but was marked in Table 2 with a question mark. This problem is an important one to bear in mind when the calibration of the band strength and the equivalent width is carried out. This problem will be discussed in section III.

For 203 stars with two or more spectrograms available, the spectra were classified independently. In some cases the classification was exactly the same but in others it differed. Because of the randomness of this sample of stars, the multiple spectrograms give us an idea of how consistent the classification is. From the statistics of this sample we found that; for a star picked at random from the sample, there is a 37% probability that its actual class is the one with which it was classified, 78% is in the range ±1 class and 95% is in the range ±2 classes. From this, we therefore estimate that the mean error in the classification is a bit less than 1 class.

For these 203 stars, the spectra were classified again independently of the first classification. It was found that in most of the cases the classification was equal to the first one and that the differences were due mainly to differences in density, exposition, or to poor guiding. The poor spectra were rejected. When differences in class still persisted, then the remaining spectra were averaged. These cases are indicated in the remarks column of Table 2 (see notes to Table 2).

Naturally, one is always tempted to compare the classification by eye with some other method of measurement. For some stars the spectra were traced with a microdensitometer and then the tracings were compared with the tracings of the standards. A classification following this method can also be carried out, but the accuracy is not higher than the eye method. Nevertheless one can use both methods complementarily. In our case, for those where the class was in doubt, the tracing method was used to reinforce the visual one.

Of course, several other methods of classification might have been used but for general purposes the visual classification is a good enough method that works well.

III. CALIBRATION WITH EQUIVALENT WIDTHS

We have calibrated the classification in terms of equivalent widths. In order to do that, 100 spectra with similar densities, but without the OII λ4415-17 line and without problems of guiding or exposure,

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TABLE 2

λ4430 BAND CLASSIFICATION

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1	-22 1594	51630	0.03	0.06	0.0	5
2	-21 1662	52437			0.5	AV (2)
3	-23 1827	54309			0.0	5
4	-23 1858	54669	0.03	0.06	0.0	5
5	-30 1551	55173	0.05	0.08	0.0	
6	-27 1791		0.05	-0.01	0.0	
7	-30 1579	55958	0.06	0.13	0.0	
8	-23 1978	56094	0.07	-0.02	0.0	5
9	-24 2125		0.22	0.16	?	3
10	-20 2167		0.29	0.21	5.0	
11	-20 2170		0.40		3.0	
12	-26 1971		0.18	0.14	0.0	
13	-24 2248	57192	0.05	0.16	0.0	5
14	-25 2190	57193	0.08	0.01	0.0	5
15	-24 2252		0.30	0.27	2.0	
16	-21 2019	57236	0.51	0.39	1.5	AV (3)
17	-21 2034	57370	0.35	0.21	4.0	24
18	-23 2084	57393			1.0	5
19	-20 2245		0.51	0.35	5.0	13
20	-20 2264	57613	0.37	0.21	4.0	
21	-19 2072		0.29	0.18	5.0	
22	-19 2082				0.0	
23	-20 2303		0.36	0.27	0.5	AV (2)
24	-20 2305				1.5	AV (2)
25	-20 2314		0.33	0.18	3.0	1
26	-25 2282	58011			0.0	5
27	-25 2290		0.09	0.09	?	24
28	-36 1261	58260	0.11	0.09	1.0	AV (2)
29	-23 2161	58256	0.64	0.48	5.0	
30	-20 2343	58321	0.44	0.36	2.0	
31	-28 1984		0.04	0.08	0.0	5
32	-20 2357	58416	0.30	0.19	2.0	
33N	-20 2365N	58509N			3.0	
33S	-20 2365S	58509S			3.0	
34	-20 2366		0.35	0.24	?	3
35	-20 2370	58510	0.33	0.22	0.0	1
36	-20 2375		0.29	0.12	1.0	3
37	-26 2106	58673	0.04	-0.06	0.0	
38	-20 2437		0.30	0.28	2.0	
39	-31 1588	59550	0.04	0.11	0.0	
40	-21 2238	59498			0.0	5
41	-33 1536	59864	0.14	0.11	2.0	
43	-28 2150	60196	0.26	0.13	1.5	AV (2)
44	-27 2143				2.0	
45	-27 2151	60284	0.45	0.31	2.0	
46	-28 2161	60369	0.33	0.25	1.6	AV (3)
47	-27 2163	60479	0.63	0.47	4.0	
48	-19 2352	60553	0.06	0.07	1.0	
49	-21 2364		0.71	0.45	7.0	
50	-21 2383		0.52	0.39	5.0	
51	-22 2386				2.0	
52	-25 2577	61071	0.15	0.12	0.0	5
53	-19 2396	61068	0.07	0.05	1.0	2
54	-31 1701				0.0	4
56	-32 1627	61355			0.5	AV (2)
57	-23 2513					
58	-31 1746	61709	0.39	-0.43	0.0	
59	-32 1661		0.44	0.35	3.5	
60	-32 1668	61827	0.69	0.54	4.0	AV (4)
61	-31 1757	61851	0.37	0.25	2.0	AV (3)
62	-31 1781		0.42	0.34	4.0	
63	-32 1682	62150	0.60	0.51	3.0	
66	-32 1694		0.53	0.23	3.0	
69	-21 2679	62654			0.0	34
70	-40 1682	62753			0.5	AV (2)
72	-32 1734		1.21	0.98	6.0	
73	-26 2486	62780			1.0	
74	-31 1856	62844	0.85	0.62	5.0	3
76	-20 2923	62866	0.37	0.24	2.0	1
77	-37 1555	62991	0.08	0.09	0.5	AV (2)
78	-26 2525	63005			0.0	
79	-36 1608	63150			2.0	
80	-26 2557		0.28	0.15	3.0	
82	-26 2560		0.34	0.20	2.0	
83	-27 2420	63290	0.68	0.49	5.0	13
84	-41 1685	63425	0.09	0.05	2.0	
85	-26 2575	63359			1.5	AV (2)
86	-30 2021	63423			1.0	1
87	-24 2915		0.20	0.13	2.0	13
88	-33 1798	63804			5.0	
89	-40 1793	63868	0.05	0.11	0.5	AV (2)
90	-48 1302	64014			2.0	
91	-25 2962		0.14	0.44	1.0	
92	-25 2974		0.36	0.25	2.0	
94	-25 2994		0.25	0.29	2.0	AV (2)
96	-24 2991	64219	0.15	0.04	?	3
98	-21 2878	64298			1.0	
99	-26 2698	64315			4.0	
100	-26 2716				?	3
101	-25 3039	64568			3.0	
102	-24 3039	64639			1.0	
103	-35 1704	64802	0.04	0.09	0.0	
105	-23 3133	64993	0.27	0.16	2.0	1
106	-28 2561				?	
	-28 2563				3.0	
107	-28 2569		0.45	0.33	4.0	4
108	-29 2183				5.0	
110	-31 2025		0.51	0.38	5.0	1
114	-27 2710		0.29	0.16	3.0	3
116	-30 2209		0.39	0.30	2.0	
117	-30 2208	66539	0.19	0.14	1.0	
119	-32 1935	66582	0.10	0.20	0.0	5
120	-47 1796	66765	0.07	0.10	0.0	
122	-26 2966	66695	0.28	0.20	?	3
123	-27 2757	66788	0.22	0.19	0.0	2
124	-31 2110				1.0	4
127	-46 2105	67341	0.02	0.06	0.0	
130	-48 1465		0.01	0.02	0.0	
132	-28 2830	67887	0.06		?	
133	-46 2185	68092	0.04	0.06	0.0	

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
134	-37 1927		0.51	0.36	2.5	AV (2)
135	-27 2907	68026	0.22	0.18	1.0	1
138	-36 2035	68450	0.28	0.23	1.5	
139	-31 2176	68552	0.33	0.17	1.0	
140	-37 1982	68572	0.28	0.15	1.5	1, AV (2)
141	-32 2037		0.55	0.39	5.0	
142	-38 2036		0.77	0.60	4.0	
143	-36 2069	68761	0.20	0.11	1.0	
144	-34 2135		0.70	0.50	3.5	
145	-46 2281	69144	0.05	0.18	0.0	
146	-31 2207	69080	0.07	0.15	1.0	
147	-36 2117	69106			0.0	
148	-46 2283	69168	0.04	0.08	0.0	1
149	-45 2285	69302	0.04	0.08	0.0	
150	-46 2306	69404			0.0	4
151	-35 2105		0.74	0.54	3.5	
153	-36 2158	69425			1.5	AV (2)
155	-48 1577				0.0	
156	-35 2117				0.0	1
157	-43 2396	69648	0.60	0.44	3.0	
158	-35 2136		0.44	-0.60	0.0	
159	-42 2316	69882	0.52	0.43	2.0	1
160	-43 2439	70122	0.76	0.61	4.0	1
163	-35 2212		0.58	0.41	?	3
165	-43 2485	70583	0.99	0.83	4.5	AV (2)
168	-42 2455	71302	0.04	0.05	0.0	
169	-43 2550	71304			2.5	AV (2)
170	-44 2597				3.0	
172	-41 2521	71528	0.29	0.22	1.0	1
173	-43 2586	71609	0.28	0.19	2.0	
174	-36 2512	71649	0.43	0.24	3.0	
176	-27 3222	71771	0.06	-0.04	0.0	5
177	-49 1653				0.0	
178	-28 3193	71928	0.59	1.00	0.0	5
179	-42 2551	72014			0.0	
181	-43 2636	72067	0.08	0.11	1.0	
183	-44 2685	72350	0.14		3.0	
184	-38 2399	72436	0.04	0.09	0.0	
185	-47 2348	72485	0.07	0.13	1.0	
186	-43 2677		0.65	0.52	3.0	
187	-45 2611	72554	0.55	0.41	4.0	
188	-43 2684	72648	0.34	0.28	1.0	
189	-37 2552	72787	0.05	0.14	0.0	
192	-46 2707	73326	0.24	0.11	1.0	
193	-43 2781	73420	0.44	0.34	2.0	
194	-44 2824	73568	0.57	0.40	4.0	1
195	-45 2742	73658	0.30	0.21	2.5	1, AV (2)
196	-37 2655	73653	0.30	0.21	1.5	AV (2)
197	-39 2696	73698	0.41	0.31	1.0	1
198	-39 2725	73882	0.72	0.62	2.0	
199	-45 2778	73919	0.47	0.32	2.0	4
200	-53 1796	74071	0.01	-0.02	0.0	
201	-52 1579	74146	0.04	0.08	0.0	
203	-44 2911	74194			1.5	AV (2)
205	-48 1862	74273	0.03	-0.01	2.0	1
206	-47 2565	74401			2.0	
208	-47 2578	74455	0.09	-0.02	1.0	
209	-47 2592	74531	0.08	0.02	0.0	
210	-52 1605	74535	-0.11		0.0	
212	-52 1607	74560	0.02	0.05	0.0	
213	-47 2605	74580	0.47	0.01	1.0	
214	-45 2907	74677	0.44	0.39	2.0	1
215	-49 1793	74753	0.10	0.07	0.0	
216	-46 2892	74711	0.34	0.25	2.0	
217	-40 2824	74805	0.63	0.44	2.0	
218	-40 2848	74979	0.24	0.19	1.0	1
221	-39 2858	75125	-0.05		0.0	5
222	-45 3028	75149	0.42	0.34	3.0	
223	-43 2972	75211			1.0	
225	-36 2966	75222	0.63	0.49	2.0	
226	-38 2697	75272	0.04	0.04	0.0	
227	-45 3056	75309	0.25	0.19	1.0	1
228	-42 2963	75387	0.04	0.08	1.0	
229	-47 2750	75534	0.59	0.44	2.5	1, AV (2)
230	-46 3054		0.35	0.24	2.0	
231	-47 2765	75658			2.0	
232	-41 3027	75655	0.21	0.11	2.0	
233	-41 3032	75724	0.20	0.11	1.0	
235	-32 2435				3.0	
236	-41 3040	75759	0.21	0.18	1.0	
237	-45 3131		0.66	0.50	3.0	1
240	-43 3044	75860	0.93	0.71	6.0	1
241	-41 3067	75871	0.23	0.10	1.0	
242	-45 3174		0.65	0.49	4.0	1
243	-47 2830	75991	0.40	0.32	2.0	
244	-43 3078	76031	0.78	0.62	5.0	12
245	-48 2002		0.35	0.28	2.0	
246	-45 3218		1.10	0.94	5.0	
247	-42 3092	76341	0.60	0.50	1.0	
248	-46 3232	76535	0.71	0.50	2.0	
249	-47 2913	76556			1.3	AV (2)
250	-44 3226	76566	0.02	0.08	1.0	
251	-40 2985	76554	0.37	0.25	1.0	
253	-42 3145	76838	0.22	0.09	0.0	
255	-48 2087	76852	0.57	0.38	3.5	
256	-50 1936	76968	0.40	0.29	2.0	
257	-58 1306	77032			1.0	
258	-47 2963				5.0	AV (2)
261	-48 2119	77217	0.88	0.66	3.0	
263	-42 3235	77320			0.0	
264	-48 2140	77421	0.71	0.50	4.0	
265	-48 2142	77434			0.0	
266	-41 3232	77475	0.01	0.01	0.0	
267	-40 3072	77581			3.0	1
268	-46 3340	77718	0.96	0.74	3.0	12
269	-46 3371	78005	0.06	0.15	0.0	
273	-44 3436	78616	0.22	0.15	1.0	1
274	-52 1968				1.0	1
275	-42 3406	78927	0.64	0.51	3.0	12
276	-43 3397	78958	0.91	0.76	3.0	1

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
278	-44 3495	79186	0.33	0.21	1.5	
279	-57 1908		0.18	0.10	1.5	AV (2)
280	-46 3474	79275	0.02	0.03	0.0	
283	-55 2028	79778			3.0	
287	-44 3605	80057	0.27		1.0	
288	-49 2323	80077			6.0	
289	-62 1209	80325	0.12	0.07	2.0	
290	-52 2185	80383	0.28	0.22	2.0	
291	-51 2101	80558	0.62	0.43	4.0	
292	-45 3655		0.01	-0.06	?	
299	-48 2401		1.39	1.18	4.0	
300	-52 2281	81370	0.37	0.31	3.0	AV (2)
302	-52 2303		0.59	0.36	5.0	
304	-58 1513	81654	0.24	0.17	2.0	
305	-52 2362		0.58	0.34	4.0	
306	-53 2433	82003	0.0	-0.03	0.0	
308	-51 2299		0.89	0.65	4.0	
312	-46 3733	82830			2.0	2
313	-56 2319	83060			3.0	
314	-53 2571	83043			1.0	2
315	-49 2600	83281	0.55		2.0	
318	-59 1428	83475	0.22	0.13	3.0	
319	-53 2656	83597			1.0	
322	-48 2616	84136	0.70	0.54	3.3	AV (2)
326	-53 2806	84523			1.5	AV (2)
327	-44 4165	84816	0.06	0.15	0.0	
328	-53 2865	84861	0.52	0.45	2.0	
329	-52 2793	84877	0.71	0.54	3.0	13
331	-51 2616		1.39	0.96	2.0	
334	-51 2659		0.40	0.29	1.5	1, AV (2)
335	-47 3653	85356	0.19	0.14	0.0	1
336	-60 1510	85567			1.0	
338	-52 2883	85894	0.09		0.0	
339	-53 2964	85740	0.55	0.40	5.0	
340	-50 2848	85983	0.06	0.14	1.0	
341	-56 2635	86117	0.53	0.38	3.5	AV (2)
342	-58 1697	86162	0.20	0.12	2.5	AV (2)
343	-59 1528	86214	0.26	0.16	2.0	
345	-62 1360	86272			1.5	
346	-52 2962		0.09		0.0	
347	-50 2889	86352	0.03	0.03	0.5	AV (2)
348	-52 2980	86466	0.06	0.13	0.0	5
349	-55 2704	86490	0.59	0.32	5.0	
351	-59 1559	86689			1.0	2
356	-54 3033	87166	0.51	0.32	3.0	
359	-52 3087	87152	0.07	0.10	1.0	
361	-60 1602	87406	0.18	0.17	2.0	15
362	-53 3218	87380	0.21	0.23	2.0	
363	-57 2580	87384	0.60	0.39	5.0	
364	-57 2596	87494	0.65	0.47	4.0	
365	-61 1441	87543			1.0	
368	-58 1886		0.74	0.57	3.5	
370	-62 1438	88115	0.19	0.13	2.0	1
371	-57 2696		0.45	0.29	3.5	
376	-60 1708	88412	0.18	0.17	1.0	
379	-60 1765	88844	0.14	0.10	0.0	1
386	-50 3241	89137	0.27	0.19	1.0	1
387	-51 3138	89174	0.36	0.26	0.0	1
391	-59 2049		0.65	0.51	5.0	
392	-51 3211	89767	0.38	0.29	2.0	1
394	-59 2079	90075	0.38	0.27	2.0	1
395	-59 2080	90087	0.33	0.23	0.0	
397	-53 3709	90135	0.36	0.23	2.0	1
398	-57 3105	90187			0.0	
399	-48 3261	90202	0.43	0.32	2.0	1
400	-53 3730			0.21	0.11	1.5	
402	-58 2163	90313	0.54	0.37	4.7	1, AV (2)
408	-59 2126	90600			0.0	3
409	-56 3322	90615	0.47	0.37	3.0	1
411	-57 3237	90707	0.55	0.34	3.0	
412	-57 3256	90772			?	
413	-57 3265		0.44	0.36	3.0	2
419	-56 3448	91188			0.0	
420	-62 1622		0.28	0.25	4.0	3
421	-57 3387	91421	0.32	0.25	2.0	1
422	-63 1465	91452	0.48	0.35	2.0	
423	-60 1968	91597			1.0	
424	-57 3423	91572			0.0	
425	-57 3431	91619			1.0	5
426	-59 2214	91651	0.31	0.23	0.0	
426B	-59 2214B	91651B			?	
429	-57 3463	91824	0.26	0.21	0.0	
432	-57 3468	91850	0.39	0.32	2.0	1
434	-61 1734	92027	0.29	0.24	0.0	5
435	-57 3540	92007	0.41	0.29	1.0	1
437	-57 3545	92060	0.56	0.40	5.0	1
438	-58 2372	92061	0.34	0.24	0.0	
439	-57 3553		0.34	0.22	2.0	12
440	-57 3566	92144	0.63	0.45	5.0	1
445	-59 2378	92451	0.22	0.13	2.0	
447	-56 3622	92504	0.27	0.21	0.0	5
449	-60 2126	92554	0.42	0.31	1.0	
451	-60 2125	92555	0.27	0.20	0.0	
452	-62 1706		0.47	0.27	2.0	
453	-60 2150	92704	0.23	0.09	1.0	
454	-57 3671	92714			3.0	
456	-56 3676	92850	0.32	0.23	1.0	
457	-56 3696	92936	0.20	0.12	1.0	1
459	-61 1842	93208	0.23	0.14	2.0	1
460	-57 3756		0.67	0.46	5.0	12
461	-60 2265	93445	0.27	0.18	2.0	1
463	-54 4029	93561			1.0	
466	-55 3847	93631	0.38	0.20	3.0	
468	-59 2712	93683			1.0	
469	-63 1672	93738	-0.03	-0.14	0.0	3
472	-59 2732	93843			0.0	
473	-60 2298	93827	0.25	0.21	2.0	1
474	-59 2735	93858	0.44	0.27	3.5	1
475	-58 2747	93873	0.66	0.46	3.5	1
476	-58 2750	93890	0.96	0.73	5.0	1

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
477	-57 3856	94024	0.45	0.29	2.0	
478	-55 3902		0.35	0.23	3.0	
480	-59 2791	94230	0.57	0.36	3.5	1
482	-57 3895	94304	0.55	0.37	1.0	
483	-58 2801				7.0	
484	-59 2802	94345	0.35	0.25	3.5	
485	-58 2809	94370			0.0	
487	-60 2359	94493	0.20	0.11	1.0	1
488	-61 1951	94559	0.26	0.21	1.0	15
492	-63 1748		0.74	0.62	3.0	1
493	-59 2855	94878			0.0	
494	-56 4016	94909	0.83	0.65	2.0	
495	-60 2395	94936	0.44	0.34	4.0	
496	-61 1975	94963			0.0	
497	-59 2883	95095	0.53	0.41	2.5	AV(2)
499	-59 2899		0.43	0.31	3.0	
502	-58 2916	95357	0.33	0.20	2.0	1
504	-58 2922	95461	0.65	0.46	3.0	1
505	-59 2929		0.64	0.46	3.0	
506	-61 2022	95589	0.58	0.42	4.0	
508	-59 2961		0.40	0.32	4.5	AV(4)
509	-58 2963	95862	0.68	0.49	6.0	
511	-59 2972	95880	0.42	0.31	3.5	AV(2)
512	-59 2984		0.40	0.30	3.0	AV(2)
513	-60 2505	96264	0.23	0.17	0.0	
514	-59 3024	96286	0.39	0.24	3.0	1
515	-60 2511	96355	0.41	0.26	3.0	13
516	-61 2064	96357			2.0	3
517	-59 3059	96669	0.43	0.33	3.0	1
518	-59 3057	96670			2.0	
519	-59 3064	96715			2.0	
520	-55 4156	96864			2.5	AV(2)
522	-60 2554	96883	0.51	0.25	2.0	
523	-60 2555	96899	0.35	0.25	1.0	1
524	-56 4238	96917			0.0	
525	-59 3083	96945	0.47	0.37	4.5	
526	-60 2559	96946			2.0	
528	-60 2571		0.23	0.11	1.0	
529	-63 1852	97136	0.26	0.15	1.0	
531	-59 3114	97222	0.47	0.33	3.0	
532	-60 2606	97319	0.54	0.43	0.0	5
533	-60 2613		0.99	0.81	1.5	AV(2)
534	-60 2615	97352	0.39	0.24	3.0	
536	-60 2638	97484	0.64	0.47	1.0	5
537	-64 1641	97522	0.48	0.35	2.0	
538	-59 3193	97557	0.24	0.17	2.0	
539	-59 3204		0.44	0.29	2.0	1
543	-60 2698	97707	0.39	0.21	1.0	15
544	-65 1646	97851	0.49	0.34	3.0	
545	-58 3351	97848	0.32	0.23	1.5	1, AV(2)
547	-58 3366	97913	0.33	0.18	3.0	2
548	-58 3372	97966	0.36	0.26	2.0	
550	-62 1946	98097	0.34	0.27	1.5	AV(2)
553	-57 4536	98310			3.0	
555	-62 1964	98410			5.0	
558	-58 3477	98614	0.37	0.27	3.0	
561	-59 3376	98733	0.41	0.13	3.0	12
563	-60 2867	98927			1.0	
564	-58 3534	98955	0.25	0.19	2.0	
565	-58 3566	99146			1.0	
566	-60 2893	99160	0.53	0.39	1.0	35
567	-69 1537	99205	0.27	0.20	4.0	
568	-62 1992	99193	0.45	0.38	5.0	
570	-62 2003	99316	0.33	0.25	1.0	
571	-60 2920	99354	0.36	0.21	1.0	15
573	-60 2923	99391	0.24	0.18	2.0	
574	-59 3454	99416	0.28	0.24	2.0	
575	-58 3620	99545	0.29	0.20	0.0	
577	-65 1669	99857	0.34	0.23	2.0	1
579	-64 1665	99856	0.55	0.40	2.0	
580	-61 2350	99897	0.49	0.35	2.0	
581	-55 4399	99890	0.24	0.16	2.0	
583	-57 4745	99939	0.29	0.21	2.0	1
585	-62 2039	99953	0.49	0.34	2.0	1
586	-63 1902	99992	0.38	0.23	1.0	
587	-63 1904	100099	0.42	0.30	2.0	2
589	-62 2075	100199			2.0	
590	-65 1675	100213	0.37	0.27	3.0	
591	-59 3556	100242	0.40	0.18	2.5	1, AV(2)
592	-62 2080	100243	0.37	0.27	4.0	
593	-58 3693	100262	0.76	1.00	?	
594	-59 3562	100276	0.27	0.16	2.0	12
596	-67 1758	100324			2.0	
597	-63 1911	100323	0.32	0.22	3.0	12
598	-61 2391	100355	0.23	0.18	2.0	
600	-62 2094	100444	0.49	0.38	3.0	
601	-58 3706		0.43	0.30	3.0	3
603	-63 1919		0.32	0.23	2.0	2
606	-62 2142	101008	0.28	0.21	1.0	
609	-62 2163	101190			0.0	
611	-62 2164	101191	0.35	0.27	1.0	
613	-62 2168	101205	0.36	0.27	1.0	2
614	-62 2186	101298	0.40	0.28	0.0	
615	-62 2191	101332	0.33	0.23	2.0	
616	-62 2190	101333	0.41	0.29	3.0	
618	-62 2205	101413	0.39	0.32	?	
619	-62 2206	101436	0.39	0.28	1.0	
620N	-61 2508N	101545N			1.7	AV(3)
620S	-61 2508S	101545S			2.0	
622	-61 2541	101794			2.0	
623	-59 3727				1.0	
625	-61 2550	101838	0.27	0.17	2.0	1
626	-59 3734	101850	0.27	0.23	0.0	
627	-60 3278		0.33	0.20	5.0	
629	-62 2264	102153	0.20	0.04	3.0	
630	-61 2611	102368	0.29	0.20	?	15
631	-60 3333	102415	0.45	0.33	1.0	
632	-61 2622	102475	0.24	0.20	2.0	1
634	-59 3809	102552	0.32	0.22	2.0	1
639	-61 2677	102878	0.27		0.0	15

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
640	-61 2691	102997	0.40	0.23	2.0	5
645	-57 5086				2.0	
647	-59 3959	103762	0.24	0.16	3.0	
649	-62 2455	103779	0.22	0.44	2.0	1
651	-62 2512	104285	0.25	0.16	2.0	
652	-61 2906	104553	0.31	0.19	2.0	
653	-57 5199	104565	0.61	0.43	4.0	
654	-61 2914	104631	0.32	0.24	1.0	1
655	-63 2115	104683	0.20	0.14	2.0	1
656	-62 2549	104705	0.24	0.17	2.0	1
657	-62 2564	104876	0.63	0.46	4.0	1
659	-64 1791	105071	0.21	0.12	1.0	4
660	-57 5272		0.62	0.45	2.0	
661	-61 2987	105627	0.38	0.26	1.0	
662	-63 2164		0.29	0.18	3.0	
663	-63 2162	105650	0.27	0.19	0.0	1
664	-63 2166	105675			3.0	
665	-63 2172	105753			1.0	
666	-63 2178	105892	0.40	0.30	2.0	1
667	-62 2626				3.0	
668	-62 2633	106261	0.38	0.26	2.5	AV(2)
669	-61 3036	106325	0.48	0.36	4.5	
670	-63 2203	106343	0.29	0.21	2.0	1
671	-61 3039	106391	0.91	0.76	6.0	
673	-60 3863	106590	0.47	0.34	3.0	1
674	-60 3864		0.91	0.72	6.0	
675	-64 1835	106616	0.23	0.20	3.0	1
676	-59 4147		0.74	0.58	4.0	
677	-62 2659	106708	0.40	0.30	2.0	
678	-63 2219	106730			0.0	
680	-57 5375	106871	0.46	0.32	3.0	
686	-64 1877	107565	0.40	0.27	2.0	
688	-62 2707		0.32	0.19	2.0	
689	-64 1879	107593	0.26	0.22	?	12
690	-59 4193		0.53	0.37	3.0	
692	-64 1883	107667	0.25	0.22	2.0	1
693	-61 3121		0.47	0.36	1.0	2
694	-64 1898	108002	0.30	0.19	?	12
695	-61 3166	108170	0.60	0.43	5.0	
697	-61 3198	108434	0.44	0.37	2.0	
698	-61 3212				0.0	
699	-60 4047	108639	0.38	0.29	1.0	15
700	-72 1275	109399	0.25	0.17	1.0	12
701	-60 4170	109505	0.49	0.31	2.0	1
703	-66 1861	109867	0.24	0.13	2.0	12
704	-70 1502	109885	0.37	0.22	0.0	1
706	-61 3327	109978	0.72	0.52	3.0	
708	-59 4396	110360	0.49	0.34	1.5	
710	-64 1997		0.39	0.25	2.0	1
711	-59 4423	110863			3.0	
713	-60 4285	110984	0.77	0.61	5.0	1
718	-59 4460	111193	0.44	0.33	3.0	1
720	-71 1389	111290	0.22	0.16	2.0	1
721	-60 4309	111377	0.39	0.26	3.0	
722	-68 1777	111558	0.11	0.01	1.0	
725	-60 4341	111886	0.32	0.26	4.0	
726	-59 4538	111916	0.52	0.37	4.0	1
728	-60 4350	112027	0.85	0.72	5.0	
729	-60 4351	112026	0.30	0.22	1.0	1
730	-59 4579	112168	0.21	0.09	0.0	
731	-59 4580	112181	0.35	0.25	4.5	1
732	-58 4593	112202	0.36	0.28	3.0	
733	-63 2454	112272	1.01	0.76	4.0	1,AV(3)
734	-59 4600	112364	0.39	0.27	3.0	1
737	-57 5810	112484	0.30	0.19	2.0	1
738	-60 4372	112497	0.64	0.52	2.0	1
739	-61 3401	112661	0.90	0.61	3.5	3
740	-59 4629	112690	0.45	0.32	3.0	
742	-63 2474	112751	0.64	0.50	4.5	1,AV(2)
744	-59 4634	112784	0.36	0.28	3.0	
745	-69 1743		0.30	0.24	3.5	1
746	-59 4640	112842	0.31	0.34	2.0	1
747	-71 1416	112843	0.32	0.24	2.0	1
749	-59 4651	112999	0.21	0.04	2.0	2
751	-59 4654	113012	0.34	0.23	2.0	1
752	-63 2485	113016	0.46	0.36	3.0	
755	-56 5541	113109	0.28	0.20	2.0	
756	-70 1553	113120			1.0	
758	-60 4396	113163	0.53	0.41	2.0	1
762	-63 2512		0.78	0.54	3.3	1,AV(2)
763	-63 2513		0.92	0.66	2.5	1,AV(2)
764	-59 4711	113421	0.49	0.34	4.0	
765	-61 3439	113422	1.00	0.75	4.0	1
766	-62 2993	113432	0.96	0.75	6.0	1
767	-63 2519	113511	0.76	0.56	4.0	
768	-63 2527	113606	0.74	0.57	4.0	
769	-61 3445	113605			3.0	
776	-61 3462		0.82	0.65	2.5	1,AV(2)
778	-60 4466	114011	0.95	0.80	5.0	1
779	-59 4769	114026	0.37	0.23	4.0	
782	-62 3028	114122	0.79	0.59	4.0	12
783	-64 2212	114169	0.23	0.12	0.0	1
785	-60 4485	114213	1.12	0.95	3.0	1
786	-70 1567	114200			1.0	2
787	-59 4801	114341			2.0	
788	-59 4804	114340	0.73	0.50	4.0	1
789	-58 4723	114394	0.40	0.26	2.0	
790	-60 4512	114530	0.62	0.47	3.0	1
793	-60 4528		0.48	0.31	2.0	1
794	-61 3512		0.61	0.44	3.0	
795	-57 5952	114733	0.53	0.38	2.0	
796	-62 3079	114737	0.50	0.36	3.0	
798	-62 3090	114800			3.5	
799	-62 3096	114886	0.43	0.32	3.0	
800	-60 4551				5.0	
801	-63 2662	115034	0.37	0.23	3.5	
803	-61 3539	115042	0.95	0.74	5.0	1
804	-60 4558				3.0	
805	-61 3544	115071	0.52	0.32	2.0	
807	-61 3546	115114			?	3

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
808	-61 3566	115316	0.50	0.33	3.0	
809	-63 2684	115363	0.81	0.56	7.0	1
810	-61 3575	115455	0.53	0.39	3.0	3
812	-61 3608	115704			6.0	
812A	-61 3600A		0.69	0.48	0.0	
812B	-61 3603B				0.0	
812C	-61 3615C				0.0	
814	-55 5504	115842	0.53	0.35	3.0	1
815	-59 4926	116003	0.25	0.16	2.0	125
816	-59 4951	116282	0.72	0.52	3.0	
817	-60 4651	116438	0.44	0.33	2.0	1
818	-58 4858	116491	0.36	0.24	4.0	
819	-62 3270	116781			1.0	
820	-62 3271	116796	0.36	0.25	1.0	
821	-63 2778	117024	0.26	0.23	1.0	12
822	-61 3736				2.0	1
823	-60 4708				?	3
824	-64 2428	117111			3.0	
826	-60 4718		0.55	0.44	3.0	
827	-63 2789	117326	0.36	0.24	1.0	3
828	-61 3760	117357			2.0	1
830	-62 3326	117460	0.26	0.23	1.0	
831	-60 4744	117490			1.0	
832	-60 4759	117687	0.36	0.26	2.0	
833	-61 3793	117704	0.46	0.35	1.0	
834	-64 2468	117707	0.75	0.56	4.0	13
836	-62 3374	117856	0.51	0.40	2.0	
839	-61 3825	118016	0.35	0.29	1.0	1
840	-63 2856	118198	0.46	0.33	1.0	
845	-60 4836	118571	0.26	0.17	2.0	
849	-63 2942	119547	0.28	0.22	1.0	
850	-61 3987	119646	0.35	0.30	2.0	1
851	-60 4951	119815	0.29	0.24	2.0	
852	-62 3600	119911	0.30	0.19	3.0	
854	-61 4046	120211	0.35	0.23	2.0	
855	-57 6339	120521			3.0	
857	-62 3703	120678			0.0	
858	-65 2503	120680	0.32	0.24	2.0	
860	-60 5056	120739	0.47		4.0	
861	-62 3725		0.36	0.31	4.0	
864	-58 5282	121228	0.43	0.32	2.0	15
865	-59 5310	121556			2.0	
868	-55 5841	122324	0.61	0.44	2.3	1, AV (2)
869	-61 4286	122313	0.61	0.45	4.5	AV (2)
870	-61 4292		0.43	0.32	4.0	1
871	-58 5340	122450			3.0	4
872	-61 4317	122669			3.0	AV (2)
873	-61 4318	122691			3.0	
874	-59 5395	122879	0.37	0.26	1.0	
875	-63 3134	123008			5.0	
876	-59 5404	123056	0.47	0.35	3.5	
879	-58 5383	123335	0.20		0.5	1, AV (2)
880	-62 4007		0.40	0.21	4.0	
882	-65 2655	124197	0.16	0.20	2.0	2
883	-56 6206	124367			2.0	
887	-65 2681	125159			3.0	
889	-60 5300	125241	0.79	0.57	4.5	AV (2)
890	-57 6616	125545	0.34	0.28	2.0	1
891	-58 5515	125792	0.75	0.57	5.0	1
893	-59 5593		0.75	0.50	5.0	
895	-63 3268	126693			5.0	
897	-63 3303	127489			2.5	
898	-59 5634		1.06	0.80	5.0	
901	-60 5437	127756			3.0	
903	-60 5849	129926	0.61	0.45	4.0	
906	-57 6712	128089	0.68	0.47	3.0	
908	-64 2961	128522	0.43	0.31	4.0	1
912	-62 4263	129225	0.58	0.35	3.0	
915	-55 6150	129557	0.18	0.09	1.0	1
918	-55 6191	130298			3.0	
919	-58 5725	130350	0.83	0.61	5.0	
923	-55 6296	132481	0.16	0.09	0.0	5
927	-56 6567	132984	0.22	0.10	0.0	5
928	-51 7536	133518	0.14	0.14	0.0	5
929	-61 4838	133738			1.0	
930	-65 2993	133823	0.28	0.21	1.0	
934	-65 3001	134401			2.0	
938	-62 4423	134733	0.60	0.42	2.0	
941	-57 6957	134844	0.48	0.31	5.0	
943	-58 5866	134959	1.15	0.89	5.0	
944	-57 6960	134958			4.0	
945	-54 6410	135038	0.09		0.0	5
947	-52 8049	135113	0.39	0.43	1.0	
948	-61 4882		0.49		1.0	2
950	-61 4896				4.0	
951	-54 6445	135885	0.32	0.28	1.0	
952	-60 5744		0.33	0.31	3.0	
953	-59 5917	135917	0.17	0.05	0.0	
954	-55 6509	136003	0.44	0.33	3.0	1
957	-58 5897	136239	1.09	0.86	5.0	1
958	-58 5910	136471	1.01	0.82	7.0	
959	-49 8031	136556			4.0	
960	-63 3580		0.47	0.30	3.0	
967	-60 5814	137405	0.33	0.33	1.0	1
968	-44 7405	137518			2.0	
969	-59 6020	137439	0.43	0.42	2.0	
971	-59 6033	137543	0.35	0.34	1.0	
976	-60 5868		0.42	0.34	3.0	1
978	-59 6095	138112	0.40	0.36	4.0	
984	-60 5926	138679	0.22	0.19	1.0	
986	-58 6089	138729	0.72	0.50	4.5	
992	-45 7545		0.26	0.15	0.0	4
993	-49 8451	139790			4.0	3
1000	-58 6277	140336			3.0	
1010	-54 6687	140926			3.0	
1011	-59 6345	140946			4.0	
1017	-61 5327		0.30	0.22	3.5	
1019	-59 6394	141522	0.45	0.37	3.0	
1022	-61 5361		0.33	0.29	2.0	
1023	-54 6759	141926			3.5	AV (2)

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1025	-54 6788	142152	0.66	0.44	3.0	
1030	-54 6802	142237			0.0	
1034	-56 7084	142452	0.07		0.0	
1035	-53 6845	142468	0.81	0.59	5.0	1
1037	-54 6849	142565	0.68	0.50	5.0	
1038	-53 6868	142634	0.96	0.73	4.0	
1039	-40 7155	142754	0.44	0.29	2.0	
1040	-54 6878	142775	0.95	0.74	6.0	
1041	-58 6543	142758	0.39	0.30	3.0	1
1047	-54 6938	143218	0.61	0.38	1.0	
1050	-60 6348	143448			3.0	
	-60 6349				1.0	
1051	-48 8139	143545			3.0	
1055	-56 7228	143605	0.36	0.31	3.0	
1058	-47 7528	143700			5.0	
1059	-51 8896	143738	0.34	0.33	3.0	
1060	-49 8910		0.69	0.56	5.0	
1067	-54 7060	144320			3.0	
1068	-47 7546	144439	1.03	0.86	7.0	
1069	-54 7093	144479	0.20		1.0	
1071	-51 8967	144555			5.0	
1073	-55 7124	144575	0.29	0.31	2.0	
1077	-49 8961	144695	0.90	0.66	6.0	
1078	-55 7162	144858	0.16		0.0	5
1080	-55 7159	144816	0.32	0.34	1.0	
1086	-48 8198	144969	1.12	0.88	6.0	1
1088	-55 7175	144951	0.21	0.16	1.0	
1089	-51 9021	145107			?	4
1090	-53 7350	145304	0.33	0.18	4.0	
1093	-51 9082	145492	0.77	0.58	6.5	AV(2)
1099	-52 9393	145664	0.51	0.28	4.0	
1100	-52 9416	145794	0.48	0.31	4.0	
1101	-52 9422	145846			3.0	24
1102	-25 5777	146001	0.13	-0.05	0.0	
1105	-50 9141	146058	0.70	0.54	5.0	1
1109	-53 7650	146224	0.13		0.0	
1110	-49 9136	146444			3.0	
1111	-56 7552	146427	0.33	0.25	3.0	
1112	-54 7452	146463			0.0	
1113	-57 7854	146428	0.20	0.19	2.0	4
1115	-52 9604	146805	0.24	0.22	0.0	
1118	-52 9643	146955	0.36	0.29	?	
1119	-52 9668	147049	0.54	0.43	?	1
1120	-52 9685	147090	0.29	0.28	2.0	4
1123	-52 9731	147274			0.0	
1124	-51 9449	147318	0.66	0.51	3.0	4
1125	-55 7498	147302	0.22	0.15	3.0	
1126	-52 9741	147331	0.60	0.46	4.0	2
1127	-51 9456	147359	0.34	0.28	3.0	
1128	-54 7624	147347	0.19		1.0	
1129	-54 7632	147362	0.18	0.19	3.0	
1130	-59 6723				1.0	
1131	-34 6506	147683	0.37	0.34	1.0	
1132	-51 9506	147617	0.58	0.43	?	
1133	-55 7540	147690	0.26	0.21	1.0	
1134	-45 7912	147756			3.0	
1135	-51 9526		0.49	0.37	2.0	12
1137	-47 7683	147894	0.17	0.23	1.0	3
1138	-52 9838	147880	0.19		0.0	4
1139	-53 7991	147942	0.26	0.22	0.0	
1140	-50 9410	147987	0.15	0.14	0.0	
1141	-53 7997				3.0	
1142	-57 8026	148063	0.24	0.11	2.0	1
1143	-53 8012	148106	0.24	0.17	0.0	
1145	-44 7909	148260	0.60	0.46	6.0	1
1146	-44 7910	148259	0.37	0.32	3.5	2
1148	-45 7969	148379	0.75	0.56	5.0	1
1151	-56 7729	148422	0.29	0.18	0.0	1
1152	-38 6416	148537	0.74		2.0	
1153	-37 6675	148546	0.58	0.43	4.0	2
1154	-55 7569	148473	0.22		1.0	
1155	-46 8038	148567			3.0	3
1156	-54 7736	148549	0.29	0.16	3.0	
1157	-52 9965	148720	0.41	0.30	4.0	1
1159	-41 7504	148887	0.55	0.51	6.0	
1160	-50 9496	148877			0.0	
1161	-52 9998	148878	0.57	0.44	?	2
1162	-47 7765	148937			4.0	3
1164	-48 8575	148989	0.84	0.60	7.0	1
1166	-46 8067	149076	0.49	0.35	4.0	3
1167	-41 7510	149125	0.66	0.43	6.0	
1168	-49 9429		0.62	0.21	4.0	
1169	-53 8064	149100	0.19	0.16	0.0	
1171	-33 4064	149255	0.25	0.28	0.0	4
1172	-34 6555	149273	0.28	0.16	2.0	
1173	-45 8027	149257	0.23	0.08	1.0	
1174	-45 8028	149277	0.28	0.23	3.0	3
1175	-41 7520	149276	0.60	0.46	6.0	
1176	-41 7521	149313			6.0	
1178	-46 8096	149452	0.66		4.0	
1179	-43 7637	149779	0.48	0.29	2.0	13
1180	-52 10092	149729	0.22	0.10	3.0	
1182	-53 8122	149922	0.22	0.19	2.0	
1183	-39 7009	150059	0.44	0.37	0.0	
1184	-36 7017	150069	0.36	0.30	?	3
1185	-48 8689	150041	0.39	0.28	1.0	1
1186	-47 7821	150083	0.16		0.0	3
1187	-35 6763	150151	0.33		0.0	
1188	-48 8703	150136			0.0	5
1189	-46 8138	150288			3.0	
1190	-37 6726	150475	0.58	0.42	4.0	
1191	-46 8151	150422			3.0	
1192	-46 8158	150500	0.03		0.0	
1193	-47 7855		0.63	0.58	4.0	
1194	-45 8095	150533	0.92	0.72	?	
1195	-47 7858		0.59	0.37	4.0	4
1196	-45 8100	150574	0.55	0.39	3.0	
1197	-47 7862		0.59	0.44	5.0	
1198	-41 7570		0.67	0.49	3.0	
1199	-51 9908	150839	0.40	0.31	4.0	

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1200	-37 6728	150927	0.59	0.43	1.0	34
1201	-46 8223	150958			5.0	
1202	-41 7600	151003	0.47	0.36	3.0	
1203	-45 8127	151018	0.90	0.69	6.0	
1204	-51 9933	151083			1.0	13
1205	-41 7617	151139	0.55	0.40	5.0	
1206	-40 7505	151212	0.41	0.26	2.5	AV (2)
1207	-47 7911	151213	0.51	0.38	4.0	1
1208	-46 8242	151300			0.0	4
1209	-30 4475	151395	0.10	0.08	1.0	3
1210	-39 7114	151397	0.47	0.31	4.0	1
1211	-46 8252	151475	0.41	0.34	3.0	
1212	-41 7649	151515			3.5	
1213	-41 7651	151564	0.41	0.27	3.0	
1218	-47 7934	151835	0.98	0.75	3.0	1
1220	-38 6560	152002	0.44	0.36	1.5	
1221	-41 7681	152042	0.41	0.27	2.0	
1222	-52 1030	1519900	0.40	0.27	0.0	4
1224	-43 7731	152077	0.53	0.41	4.0	1
1225	-31 4503	152180	0.27		0.0	3
1226	-31 4504	152179	0.48	0.34	4.0	
1227	-41 7694	152147	0.68	0.50	6.0	3
1228	-41 7699	152182	0.34	0.20	3.0	13
1229	-41 7704	152197	0.44	0.30	1.0	
1230	-41 7708	152217	0.47	0.39	2.0	
1231	-40 7569	152245	0.39	0.30	3.0	1
1232	-28 5445	152286	0.22	0.08	1.0	
1233	-40 7570	152246	0.49	0.35	?	
1234	-40 7573	152268	0.41	0.29	3.0	1
1235	-40 7576	152292	0.38	0.24	1.0	
1236	-41 7754	152333	0.53	0.41	3.0	
1238	-40 7592		0.32	0.21	2.0	
1239	-48 8913	152372	0.44	0.29	2.0	
1240	-44 8104	152386			4.0	2
1241	-40 7596	152405	0.41	0.30	3.0	
1242	-41 7763	152424	0.66	0.49	4.0	
1243	-38 6577	152456	0.09		0.0	
1244	-21 6238	152516	0.30	0.25	0.0	
1245	-47 7958		0.91	0.76	4.0	
1247	-40 7615	152560	0.39	0.21	3.0	3
1248	-40 7617	152559	0.39	0.25	0.0	24
1249	-46 8299	152541	0.15		0.0	
1250	-40 7621	152591	0.42	0.28	?	12
1251	-44 8112		0.65	0.46	?	3
1252	-40 7624	152590	0.47	0.34	2.0	24
1254	-40 7633	152622	0.49	0.36	4.0	1
1255	-40 7639	152667	0.50	0.35	0.0	1
1256	-42 7569	152686	0.54	0.36	3.0	4
1257	-40 7645		0.42	0.35	4.0	2
1258	-40 7650	152723	0.46	0.34	1.0	
1259	-55 7751	152640	0.15	0.11	0.0	2
1260	-43 7749	152756	0.93	0.76	?	
1261	-45 8215	152743	0.40	0.33	1.0	
1262	-19 6061	152909	0.21	0.19	0.0	
1263	-45 8227	152853	0.35	0.27	3.0	2
1264	-37 6811	152901	0.36	0.31	1.0	2
1266	-19 6065		0.32	0.26	2.0	
1267	-45 8234	152979	0.44	0.32	4.0	
1268	-29 4541	153084	0.18	0.11	1.0	
1269	-46 8324	153106	0.22	0.13	2.0	
1270	-46 8327	153140	0.63	0.49	5.0	3
1272	-43 7768	153178	0.92	0.69	3.5	1
1273	-43 7769	153199	0.45	0.38	3.0	
1274	-31 4534	153294	0.29	0.21	0.0	3
1275	-49 9714	153222			2.0	
1277	-42 7590	153295			1.0	2
1279	-40 7694	153677	0.36	0.39	1.0	
1280	-32 4327	153839	0.23		1.0	
1281	-31 4549	153855	0.18	0.15	2.0	12
1282	-47 8014	153827	0.29	0.28	3.0	
1283	-24 5799	153977	0.27	0.41	1.0	3
1284	-51 10144	153879			3.0	
1286	-46 8376	154041	0.82	0.61	6.0	1
1287	-45 8296	154042	0.58	0.44	3.5	
1288	-27 5572	154150	0.39	0.25	4.0	1
1289	-52 10438	154111	0.21	0.17	2.0	
1290	-48 8995	154154			4.0	
1291	-36 7131	154218			1.0	
1292	-35 6846	154217	0.71	0.50	3.0	12
1293	-21 6299	154293	0.27		0.0	
1294	-36 7134	154243			2.0	
1296	-42 7631	154313	1.07	0.86	4.0	
1297	-35 6849	154368	0.79	0.59	1.0	
1298	-46 8391	154339	0.55	0.33	4.0	
1300	-35 6852	154385	0.61	0.49	2.5	1, AV (2)
1301N	-35 6856N	154407N			2.0	
1301S	-35 6856S	154407S			2.0	
1302	-35 6860	154450			0.0	
1303	-48 9010	154388	0.43	0.35	2.0	5
1305	-34 6725	154535	0.31	0.22	2.0	1
1307	-33 4205		0.30	0.20	2.0	
1308	-34 6733	154643	0.57	0.45	1.0	
1309	-37 6979	154834	0.40	0.30	2.0	
1310	-46 8416	154811	0.67	0.49	3.5	
1311N	-46 8423N	154873N			3.0	
1311S	-46 8423S	154873S			3.0	
1312	-38 6703	154911			2.0	
1313	-46 8428	155020	0.33	0.32	3.0	
1314	-41 7883	155051	0.74	0.53	4.0	
1315	-55 7931	154970	0.13	0.14	1.0	
1316	-41 7889	155134	0.64	0.46	4.0	3
1317	-32 4385	155217	0.25	0.16	1.0	
1320	-34 6760	155320	0.36	0.22	2.0	
1322	-56 8449	155280	0.56	0.40	5.0	
1323	-33 4251	155403	0.20	0.20	0.0	
1324	-33 4252	155402	0.22	0.16	1.0	1
1325	-37 7023	155416	0.40	0.34	3.0	
1328	-44 8301	155436			6.0	
1329	-51 10232	155418	0.24	0.27	1.0	5
1330	-33 4263	155506	0.19	0.13	2.0	1

1979RMxAA...4..351A

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1331	-55 7965	155409	0.16	0.21	1.5	
1332	-54 8115	155438	0.17	0.13	1.0	
1333	-45 8386	155509	0.64	0.48	4.0	2
1334	-44 8313	155605	0.55	0.35	5.0	
1336	-33 4278	155754	0.23	0.18	0.0	
1337	-50 9930	155670	0.33	0.28	0.0	5
1338	-38 6750	155775	0.27	0.19	2.0	
1339	-33 4282	155806			0.0	
1341	-45 8413	155756	0.80	0.64	4.0	
1342	-40 7764		0.92	0.70	4.0	
1344	-32 4428	155851			1.0	
1345	-33 4296	155889	0.29	0.24	1.0	
1346	-42 7704	155873	0.94	0.79	2.0	
1348	-42 7710	155913			1.0	
1349	-32 4436	156004	0.26	0.13	0.0	
1350	-44 8333	155985	0.46	0.32	5.0	
1351	-35 6910	156041	0.87	0.67	4.0	1
1353	-35 6915	156134	0.90	0.71	4.0	
1354	-54 8439	156085	0.47	0.39	3.0	
1355	-44 8343	156103	0.82	0.63	6.0	
1356	-35 6916	156154	0.84	0.38	3.0	
1357	-27 5605	156212	0.80	0.57	3.5	AV (2)
1358	-41 7933	156172			1.5	AV (2)
1359	-35 6919	156201	0.91	0.68	2.7	1, AV (3)
1360	-38 6774		1.07	0.87	6.0	
1361	-34 6799	156256	0.30	0.26	0.0	5
1363	-33 4336	156269	0.27	0.16	3.0	
1364	-28 5602	156351	0.66	0.52	3.5	
1365	-42 7720	156292	0.57	0.47	4.0	
1366	-32 4461	156325	0.31	0.20	1.0	
1367	-32 4462	156321	0.27	0.16	2.0	
1368	-42 7719	156271	0.56	0.40	2.5	AV (2)
1369	-39 7328	156409			3.8	AV (3)
1370	-30 4658	156465	0.31	0.19	2.0	1
1371	-37 7083	156468	0.41	0.16	3.0	
1374	-45 8472	156575	0.49	0.40	1.0	15
1376		156779	0.41	0.40	1.0	
1377	-37 7104	156688	0.33	0.29	1.0	
1378	-45 8479	156662	0.43	0.32	3.0	1
1379	-38 6782	156702			3.0	
1383	-39 7346	156834	0.42	0.31	3.0	
1386	-37 7121	157038	0.90	0.70	5.0	
1387	-38 6800	157098	0.34	0.30	2.0	AV (2)
1389	-42 7745	157099			0.0	
1390	-38 6803	157127	0.44	0.29	2.0	
1395	-37 7163		1.08	0.91	7.0	
1396	-41 7983	157519	0.20	0.19	1.0	
1397	-42 7761	157572	0.57	0.51	0.0	
1399	-41 7991	157646	0.37	0.25	2.0	
1400	-34 6823	157693	0.64		2.0	
1402	-40 7831	157783	0.36	0.32	2.0	
1404	-41 7999	157846	0.30	0.34	1.0	
1407	-40 7843	157973	0.78	0.63	5.0	1
1408	-33 4411	158073	0.45	0.37	2.0	
1409	-32 4551	158155	0.66	0.44	2.0	
1410	-31 4739	158186	0.32	0.26	1.0	
1411	-45 8630	158144	0.01		1.0	
1412	-33 4421	158320	0.38	0.31	1.0	1
1413	-42 7799	158323	0.20	0.20	1.0	
1414	-31 4773	158563	0.22		0.0	
1415	-30 4777	158618	0.48	0.38	3.0	1
1416	-32 4573	158644	0.50	0.35	2.0	
1417	-31 4787	158705	0.96	0.79	6.0	15
1420	-29 4767	158902	0.46	0.74	4.0	
1421	-45 8680	158864			1.0	
1422	-46 8728	158906	0.08	0.04	1.0	
1425	-30 4798	159090	0.42	0.27	2.0	
1426	-38 6911	159073	0.52	0.39	4.0	
1427	-41 8062	159110	0.21	0.21	1.0	
1428	-32 4603		0.34	0.24	0.0	
1431	-32 4606				1.0	
1432	-32 4616	159176	0.16	-0.44	1.0	
1433	-37 7287	159278	0.50	0.66	3.0	
1434	-44 8634	159402	0.19	0.17	0.7	AV (3)
1435	-45 8715	159489			2.0	
1436	-35 6937	159573	0.53	0.48	2.0	
1437	-35 7064	159684			3.0	
1440	-46 8786	159792	0.40	0.32	?	3
1442	-35 7078		0.83	0.58	4.0	
1443	-33 4511	160065	1.20	1.00	6.0	2
1445	-33 4513	160095	0.27	0.25	1.0	2
1446	-29 4826	160109	0.23	0.25	1.0	
1447	-28 5752	160319			3.0	
1448	-37 7377	160337	0.68	0.50	4.0	1
1449	-23 6631	160430	0.58	0.46	3.0	1
1450	-35 7128	160575	0.61	0.49	4.0	
1453	-38 7000	160812	0.40	0.40	2.5	AV (2)
1454	-35 7167	160872	0.46	0.39	?	3
1455	-41 8189	160876	0.15		1.0	
1456	-22 6421		0.70	0.48	3.0	
1457	-44 8726	160878	0.20	0.20	1.0	5
1458	-34 7014	160974	0.63	0.54	2.0	1
1460	-27 5738	161103			0.0	2
1461	-40 8057	161141	0.24	0.26	0.0	
1463	-36 7566	161249	0.15	0.23	0.0	
1464	-40 8077	161378	0.10	0.08	0.0	
1465	-40 8084		-0.49	0.0	0.0	
1467	-42 7963		0.26	0.22	2.0	1
1468	-38 7043	161653	0.24	0.20	1.5	1, AV (2)
1470	-33 4618	161774			2.0	
1471	-32 4896	161789	0.75	0.63	2.0	24
1472	-38 7053	161807			1.0	
1473	-31 4996	161839	0.60	0.43	4.0	2
1474	-31 4999	161853	0.56	0.47	1.5	AV (2)
1475	-41 8282	161841	-0.08		0.0	5
1477	-38 7079	162047	0.32	0.29	2.0	
1478	-32 4913	162168	0.84	0.67	4.0	
1480	-38 7101	162289	0.26	0.23	0.0	4
1481	-37 7572	162352			1.5	AV (2)
1482	-38 7111	162356	0.26	0.11	1.0	

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1483	-40 8181	162376	0.18	0.22	1.0	
1484	-38 7116	162394	0.27	0.27	1.0	
1485	-38 7121	162418	0.24	0.17	1.5	
1486	-39 7683	162440	0.06	-0.29	0.0	
1487	-42 8040	162568			1.0	
1488	-36 7738	162633			1.0	2
1491	-29 4977	162856	0.32	0.30	2.0	
1492	-29 4982		0.52	0.46	4.0	
1494	-33 4691	162910	0.39	0.34	2.0	2
1496	-38 7174	163004	0.15	0.18	1.0	
1497	-30 5033	163065	0.56	0.42	3.0	1
1498	-32 4970	163181			4.5	AV(2)
1499	-41 8402	163254	0.14	0.20	1.0	5
1500	-30 5057	163338	0.55	0.41	2.0	
1503	-32 4987	163430	0.19	0.21	0.0	5
1504	-30 5071	163454			1.0	
1505	-30 5080	163555	0.01		0.0	5
1506	-42 8122	163522	0.19	0.14	0.0	1
1507	-28 6083	163685	0.11	0.17	1.0	
1508	-31 5166	163667	0.69	0.51	4.0	1
1510	-22 6501	163800			2.0	
1511	-41 8451	163745	-0.01		1.0	
1512	-36 7854	163758			1.0	2
1513	-22 6507	163892	0.47	0.35	2.5	AV(2)
1514	-33 4751	163868			1.0	
1515	-33 4748	163899	0.41	0.30	3.0	1
1516	-35 7619	163924	0.23	0.12	2.0	
1517	-29 5107	163984	0.27	0.11	3.0	
1518	-28 6127	164019	0.50	0.38	2.0	
1519	-29 5117	164032	0.31	0.23	1.0	
1520	-24 6092	164146	0.28	0.20	1.0	
1523	-36 7924	164245	0.09		0.0	5
1524	-22 6543	164359	0.31	0.26	3.0	1
1525	-35 7658	164320	0.09		0.0	5
1526	-23 6745	164384	0.22	0.13	2.0	
1527	-22 6547	164402	0.24	0.16	1.0	15
1528	-36 7936				?	4
1529N	-27 5985N	164404N			2.0	
1529S	-27 5985S	164404S			2.0	
1530	-19 6393	164438	0.64	0.48	3.5	AV(2)
1531	-40 8357	164340	0.14	0.11	1.0	1
1532	-23 6758	164492	0.34	0.31	1.0	
1533	-33 4795	164455	0.15	0.22	1.0	
1534	-29 5179	164516	0.21	0.31	0.0	5
1536	-29 5187	164606	0.16	0.21	1.0	
1537	-22 6577	164637	0.25	0.21	1.0	15
1538	-22 6587	164704	0.22	0.10	2.0	
1539	-27 6046	164769	0.17	0.11	1.0	
1541	-24 6146	164816	0.30	0.24	1.0	
1542	-22 6613	164833	0.31	0.24	2.0	1
1543	-31 5266	164798	0.33	0.29	2.0	5
1544	-24 6157	164865	1.11	1.27	3.0	1
1545	-24 6178	164933	0.39	0.27	2.0	
1546	-24 6194	165016	0.26	0.21	1.0	1
1547	-24 6201	165052			1.0	2
1548N	-36 7987N	165063N			0.0	
1548S	-36 7987S	165063S			0.0	
1549	-23 6816	165132	0.38	0.30	2.0	
1550	-26 6230	165225	0.25	0.26	2.0	
1551	-29 5254	165207	0.13	0.11	0.0	2
1552	-24 6208	165246	0.40	0.32	1.0	
1556	-38 7379		0.05	0.15	0.0	
1557	-34 7600	165582	0.24	0.19	3.0	
1558	-25 6344	165655	0.59	0.40	2.0	
1559	-42 8317	165617	0.03		0.0	
1560	-21 6639	165784	0.86		3.0	1
1562	-22 6732	165812	0.25	0.20	2.0	
1563	-36 8027	165793	0.20	0.14	1.0	1
1565	-24 6247	165921	0.46	0.35	3.0	
1569	-34 7625	165955	0.20	0.11	1.0	
1571	-40 8489	166198	-0.06		0.0	
1574	-32 5192	166345	0.05	-0.11	1.0	
1576	-19 6563	166569	0.64	0.50	5.0	1
1577	-41 8618	166427	-0.07		0.0	
1579	-39 7997	166453	0.05		0.0	
1580			0.39	0.34	?	
1581	-19 6567	166628	0.73	0.58	5.0	
1582	-28 6387	166612			0.0	
1586	-22 6830	166852	0.23	0.57	2.0	
1588	-36 8079	166832	0.07		0.0	
1591	-33 4963	167003	0.10	0.07	1.0	
1594	-43 8519	167095	0.04		0.0	
1595	-20 6919	167263	0.33	0.25	3.0	
1596	-41 8635	167235	0.03		0.0	
1599	-40 8515	167297	0.38		1.0	
1601	-30 5414	167402	0.24	0.16	1.0	12
1606	-19 6741	167659			2.0	
1607	-31 5475	167599	0.50		1.0	
1610	-34 7719	167647	0.09	0.13	0.0	
1612	-33 5012	167686	-0.01		0.0	5
1614	-19 6755	167815	0.44	0.32	2.0	
1615	-29 5477	167775	0.09		0.0	
1617	-42 8359	167756	0.08	0.06	1.0	1
1618	-34 7731	167846	0.02		0.0	
1621	-37 8074	168469	0.05		0.0	
1623	-30 5478	168785	0.28	0.12	1.0	
1624	-27 6389	168941	0.34	0.27	2.0	
1626	-30 5493	169100	0.22		0.0	
1628	-34 7817		0.08		1.0	
1629	-31 5547	169425	0.17		0.0	
1630	-36 8244	169679	0.05		0.0	5
1631	-19 6835	169805			2.0	
1632	-32 5385	169872	0.14		1.0	
1633	-25 6532	170235			1.0	
1635	-30 5538	170638			1.0	
1636	-19 6917	170835			3.5	
1637	-24 6440	170978	0.23	0.24	1.0	
1639	-22 7084	171348			2.0	4
1640		171432	0.41	0.27	4.0	
1641	-28 6618	171757			4.0	3

1979RMxAA...4..351A

TABLE 2 (CONTINUED)

HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS	HBG	CPD	HD	E(B–V)	E(U–B)	C	REMARKS
1642	-20 7112	172122	0.32	0.52	3.0	1	1652	-30 5678	173502	0.13	0.11	1.0	1
1643	-22 7117	172158			?	3	1653	-31 5719	173770	0.09		0.0	
1645	-22 7122	172256			3.5		1654	-19 7102	174073	0.33	0.29	3.0	
1647	-32 5501	172535	0.15	0.28	0.0	2	1655	-30 5729	174632	0.04	0.03	0.0	
1650	-22 7151	172854	0.43	0.44	1.5		1659	-19 7198	175253	0.07		0.0	
							1660	-19 7221	175754			2.0	

NOTES TO TABLE 2

The columns contain the following information:

[1] HBG Number (running number in the Heidelberg objective-prism survey, Klare and Szeidl, 1966).

[2] CPD Number, (Cape Photographic Durchmusterung)

[3] HD Number.

[4] and [5] Colour excess E(B–V) and E(U–B). These were calculated using the UBV photometry by Klare and Neckel (1977), the spectral classification by Garrison, Hiltner and Schild (1977) and the intrinsic colors by Johnson (1963).

[6] The Classification, C, for the λ4430 band. A question mark means that the band was not classified due to existence of many stellar lines or to bad conditions of the spectrum (see text).

[7] Remarks:

1 OII λ4415-17 line present in the spectrum
2 poor guiding
3 very poor guiding
4 underexposed
5 overexposed
AV( ) the class given is the average of several spectra. The number of spectra used is between the parentheses.

were chosen. Those spectra were scanned, normalized and traced with the DDO PDS microdensitometer. For the normalization, two continuum points were defined, λ4400 and λ4460. Once the spectra were normalized, the equivalent widths were measured with a planimeter.

The tight relationship between the class (C) and the equivalent widths is shown in Figure 1. The two lines represent the two correlation lines;

$$C = 1.76\ W\ (A) - 1.35, \quad (1)$$

$$W\ (A) = 0.40\ C + 1.22. \quad (2)$$

These lines determine the two extremes of a family of lines whose slope is different, depending on how much the class or the equivalent width contribute to the dispersion due to intrinsic error in the determination of each of them. We considered that 50% due to each of them is a good compromise, and in this case the average line of equation (3) represents well the calibration between the class and the equivalent width.

$$W\ (A) = 0.47\ C + 1.03. \quad (3)$$

The reason why this line does not pass through the origin might be the possible presence of stellar lines across the band (Blades and Somerville 1977; Blades and Madore 1979), which contribute to the equivalent width measurement and may cause a misclassification. Obviously the existence and strength of the stellar lines depends on the spectral type of the star. Because this sample of stars is well mixed in spectral types O and B, as well as all luminosity classes, part of the dispersion in Figure 1 could be due to this effect.

Because of the very good correlation between the class and the equivalent width, we are confident that the visual classes will work as well as the equivalent widths and the former is a much more efficient method.

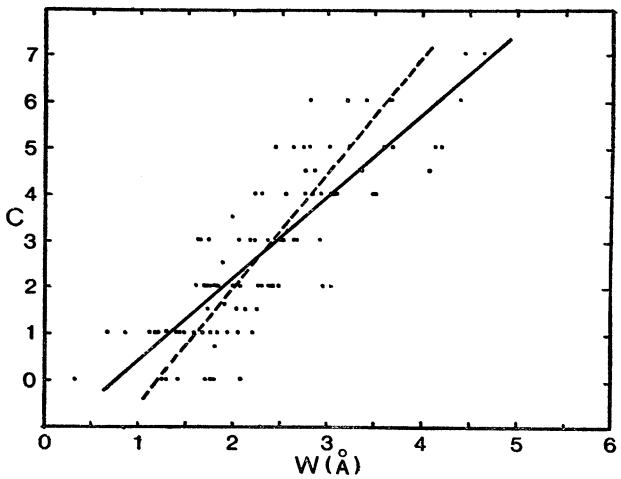

Fig. 1. Calibration between Class(C) and Equivalent Width (W). The small scatter illustrates the equivalence of both methods of strength estimation for the λ4430 band.

A statistical study for these stars based on the classification is in preparation.

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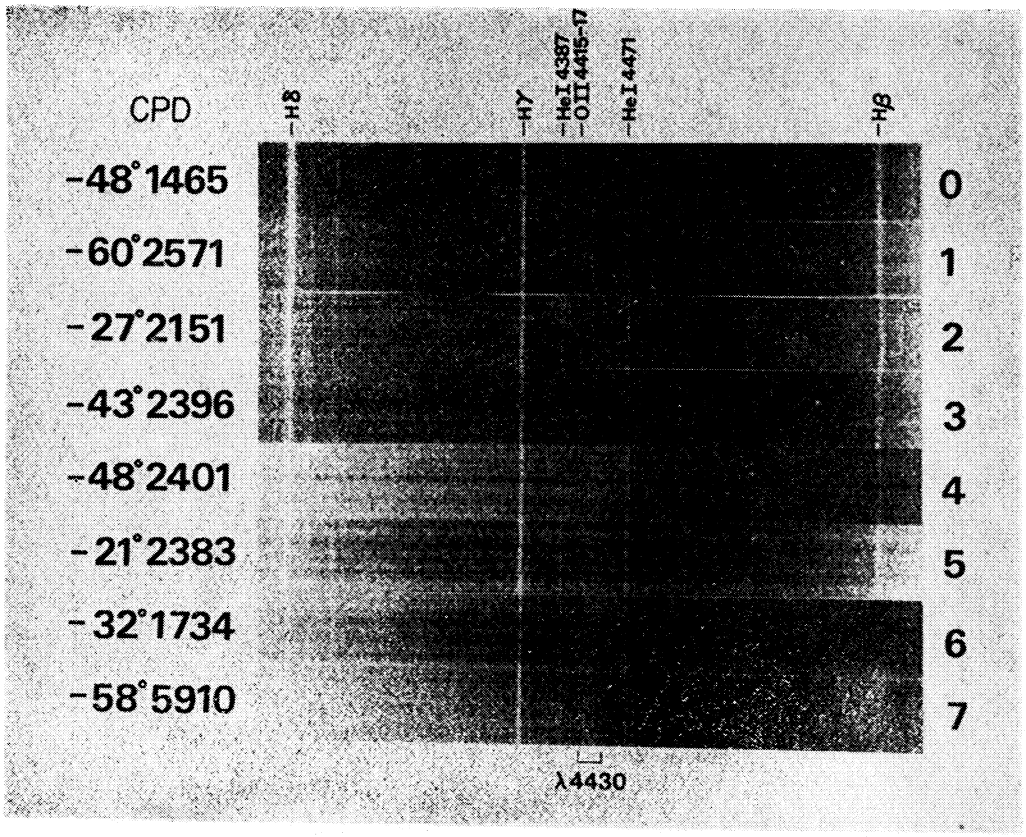

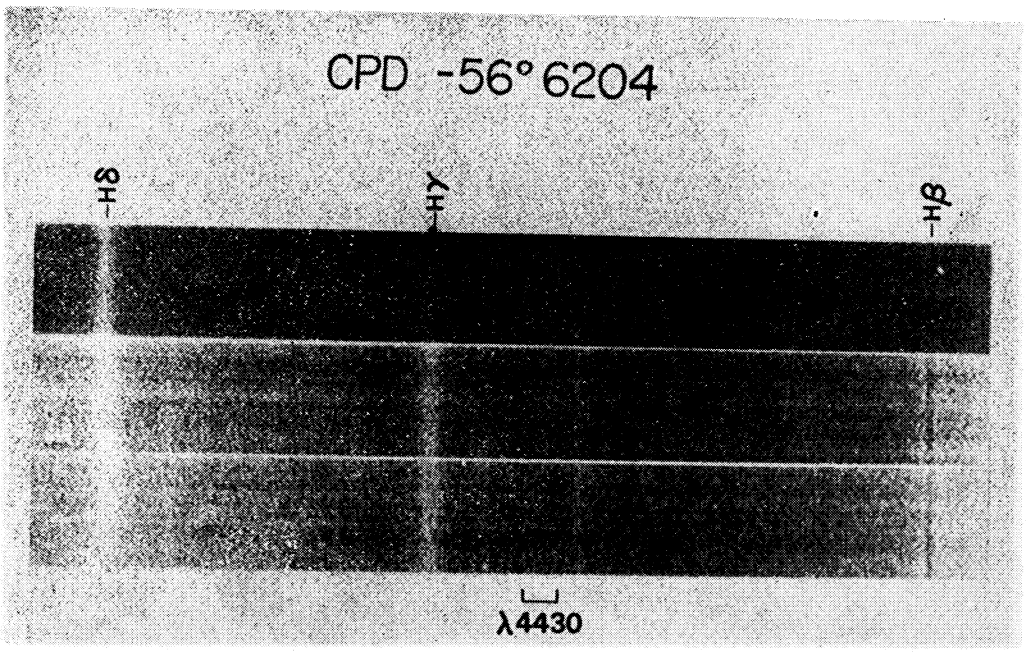

Plate 7*a*. The most frequently used standard stars.
Plate 7*b*. An example of the effect of the exposure time on the intensity of the λ4430 band, for CPD–56°6204.