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ON THE VARIABILITY OF A6 TO F9 SUPERGIANTS

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Adelman & Albayrak (1997), who examined the Hipparcos photometry (ESA 1997) of the A0 to A5 supergiants in the 5th edition of the Bright Star Catalog (Hoffleit & Warren 1991), agreed with Maeder (1980) that their amplitudes increase with luminosity. Recently Adelman, Yüce, & Engin (2000) using the same methodology studied O and B supergiants. In the process they identified some stars which deserve further study including some especially quiescent stars.

Table 1: The mean amplitudes

Spectral Classes	Number	Mean Amplitude [mag]
A0–A5Ia	13	0.069 ± 0.030
A0–A5Iab	5	0.058 ± 0.018
A0–A5Ib	8	0.035 ± 0.011
A0–A5II	17	0.036 ± 0.048
A6–A9Ia,Iab	4	0.050 ± 0.012
A6–A9Ib	3	0.017 ± 0.006
A6–A9II	9	0.029 ± 0.009
F0–F9Ia	10	0.060 ± 0.072
F0–F9Iab	7	0.033 ± 0.010
F0–F9Ib	25	0.036 ± 0.037
F0–F9II	46	0.025 ± 0.017
Cepheids	44	0.059 ± 0.028

Here we extend these studies and examine the cooler supergiants of spectral type A6 through F9 of luminosity classes Ia, Ib, and II and also for completeness A0–A5 luminosity class II stars. Celestia 2000 (ESA 1998) sometimes lists different spectral types for these stars, especially for those that are Cepheids. For example, HD 148321, which we would have included in this study, was classified by Houck & Smith-Moore (1988) as an A1m star. We also separated the known Cepheids from other F stars as they are both spectral type and photometric variables. We are particularly interested in the relatively non-variable stars, especially those in the Cepheid instability strip, as they are more easily

studied spectroscopically than their variable spectral type cohorts. We tried not to include stars which are known members of interactive binary systems. Although the bandpass of Hipparcos photometry is somewhat wider, the results in Table 1 are generally consistent with the averages of Maeder who used peak to peak V amplitudes. We also include values based on Adelman & Albayrak (1997). Maeder's results (in magnitudes) are 0.052 for A0–A9Ia stars, 0.039 for A0–A9Ib stars, 0.021 for B and AII stars, 0.051 for F0–F9Ia stars, 0.047 for F0–F9Iab stars, and 0.028 for F0–F9II stars. The A6–A9Ib and F0–F9Iab and II stars are less variable than Maeder found. In part this may be a matter of statistics or bandpass. But one of these stars ι Car is among the photometrically least variable stars found by Hipparcos.

Table 2 (available electronically from the IBVS Web-site as 4947-t2.txt) contains the Name (if any), HD number, Spectral type, HIP number, number of accepted transits, mean magnitude, standard errors, and amplitude for each star which contributed to the averages in Table 1. Table 3 (available electronically from the IBVS Web-site as 4947-t3.txt), which is similar to Table 2, lists one δ Sct star: ρ Pup, one RV Tauri (RVb) star: U Mon (see, e.g. Pollard et al. 1997), and 44 Cepheids. Here we also provide the variable star designation.

Several stars had amplitudes of $0\overset{\mathrm{m}}{.}01$ and $0\overset{\mathrm{m}}{.}02$. Of particular note are those with standard errors of $0\overset{\mathrm{m}}{.}0005$ or less, HR 2345 (A0II), HR 3426 (A6II), HR 3452 (A5II), HR 3426 (A6II), ι Car (A8Ib), α Lep (F0Ib), HR 1242 (F0II), 22 And (F2II), HR 4114 (F2II), ν Her (F2II), π Sgr (F2II), 35 Cyg (F5Ib), 41 Cyg (F5II), HR 8718 (F5II), HR 7945 (F5II–III), δ Vol (F6II), υ^2 Cen (F6II), 45 Dra (F7Ib), γ^1 Nor (F9Ia), and HR 3643 (F9II). With many of these belonging to luminosity class II, what was seen in the B supergiants by Adelman, Yüce & Engin (2000) also occurs in the A and F supergiants.

Polaris (α UMi) is the least variable of the known Cepheids. Feast & Catchpole (1997) identified it as a first overtone pulsator. There are only two other small amplitude ($\leq 0\overset{\mathrm{m}}{.}10$) Cepheids in Table 2, HR 690 and HR 4110, which have standard errors greater than Polaris. The former is noted as a Cepheid and the latter as a SR variable by Celestia 2000. They and the other F supergiants which are not listed as Cepheids with amplitudes and standard errors greater than Polaris and most of their cohorts, V885 Cen (F0Iaep), HR 4912 (F3Ia), 89 Her (F2Ib), HD 161796 (F3Ib), α Car (F0II), and HR 981 (F2II-III), should be investigated in more detail. The last six stars are listed as unsolved variables by Celestia 2000 except for HR 981, whose variability is noted as spurious due to duplicity (this is also noted for HR 292), and 89 Her which is noted as a SR variable with a period of 68 days, but whose light curve suggests multiperiodicity.

Having several kinds of stars occupying similar positions in the HR diagram indicates that their structures and evolutionary histories are different. What differentiates the normal Cepheids, the first overtone pulsating Cepheids, and these other F supergiants with slight photometric variability? Further is the variability of any of these stars related to that of the hotter supergiants such as Deneb?

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