COMPARISON OF CELESCOPE MAGNITUDES WITH MODEL ATMOSPHERE FLUXES FOR A, F AND G SUPERGIANTS

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This report concerns preliminary results from a comparison between theory and observation in the ultraviolet for fairly cool stars of high luminosity. During a two week visit to the Smithsonian Astrophysical Observatory, I searched the composite observation file of Project Celescope for all stars of luminosity classes I and II between spectral classes A and G. Fourteen such stars were found, all brighter than V = 6.0; most were observed with the U_2 filter (λ_{eff} ~2400 Å for an F0 star) and a few with U_1 (2600 Å) and/or U_3 (~1750 Å).

Figure 1 shows a color-color diagram for those stars measured with the U_2 Celescope filter: U_2 - V is plotted against B-V. For comparison, we show theoretical colors calculated by Dr. Eric Peytremann from the SAO conference grid of model atmospheres. Computed B-V has been transformed to the observational system above 7000° by the relation* given by Matthews and Sandage (1963) and below 7000° by the relation* I published (1970). The computed U_2 - V index has been shifted down by 3.6 mag; this figure is simply the conversion of visual magnitudes to a scale of -2.5 times the log of the

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* Unnormalized colors must be used in these relations, so that the normalized computed

$$B-V = -2.5 \log \frac{\int F_\lambda S_B(\lambda)\, d\lambda}{\int F_\lambda S_V(\lambda)\, d\lambda} \cdot \frac{\int S_V(\lambda)\, d\lambda}{\int S_B(\lambda)\, d\lambda}$$

first must be shifted by about -0.18 (this is a compromise between Peytremann's value of -0.16 and my value of -0.21).

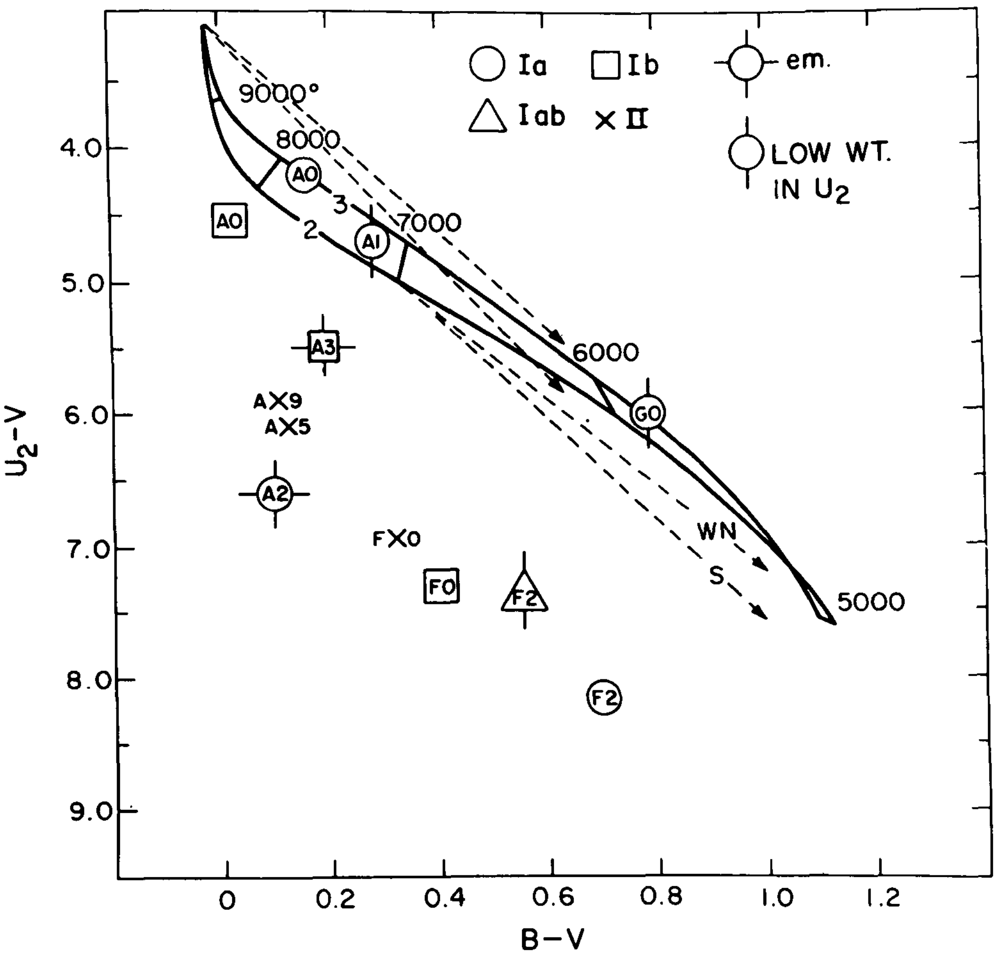

Figure 1.

flux in watts/m^2/m, so we assume here that the calibration of the ultraviolet magnitudes on this scale is essentially correct. The curves are for two surface gravities, log g = 2 and 3, and the dashed lines show the reddening trajectories according to Stecher's observations (1965) and Wickramasinghe and Nandy's model (1968) (parameter x = 0.23) of the ultraviolet interstellar extinction. Since reddening and temperature changes behave in similar ways, separation of these two parameters requires knowledge of the spectral class.

We see that most stars are deficient in ultraviolet flux, relative to the models, by 1.5 to 2 mag. The simplest explanation is that not enough line blocking has been included in the model atmospheres. The quantity 1 minus the blocking coefficient needs to be decreased by a factor of about 5, however; at 8000° we need to change the 8% assumed blocking coefficient to about 80%, and at 6000° to change the 58% blocking to about 90%. The high microturbulence, ~10 km/sec, deduced for supergiant stars will help to account for such heavy line absorption. On the other hand, the low-resolution ultraviolet spectrum from Gemini XI of Canopus (F0 Ib or II), as analyzed by Kondo, Henize, and Kotila (1970) did not indicate such excessive absorption. The line absorption around 2500 Å appears to be around 50%, similar to Underhill's result (elsewhere in these procedings) for the A6 star δ Doradus. The apparent continuum which Kondo et al . drew for the spectrum did agree reasonably with my model-atmosphere fluxes. If the absolute calibration of the Celescope magnitudes is revised upward, I would be happier than I am with 90% or more line absorption.

Analysis of those stars with U_1 and/or U_3 observations also indicates deficient fluxes, generally about 2 to 3 mag. There is no evidence for strong chromospheric emission except for two G0 stars that may be several magnitudes brighter in U_3 than the models predict, although the identifications for these stars are not certain. Of course G0 is where the Wilson-Bappu effect begins, and more definite and more detailed observations are eagerly awaited. Further analysis of these Celescope data will include the calculation of ultraviolet fluxes from model atmospheres computed by myself and by Eric Peytremann; these differ somewhat from the Smithsonian models.

I am indebted to the Smithsonian Astrophysical Observatory and its staff for making available the data for this study.

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