Star Temperature and Size

Temperature from the Line Spectrum: The Spectral Class

If λ_{peak} isn't known, thanks to the work of Cecilia Payne-Gaposchkin (1900-1979), the spectral class can be used to estimate the temperature. This is done by interpolation between the minimum and maximum temperatures of each spectral class:

Temperature from Spectral Type $$T = T_{max} - \left\{ (\text{subclass}) \times \left(\frac{T_{max} - T_{min}}{10} \right) \right\}$$

Here the subclass is the number given with the spectral type (*e.g.* the 2 in Sol's G2), T_{max} is the highest temperature in the spectral class and T_{min} is the lowest.

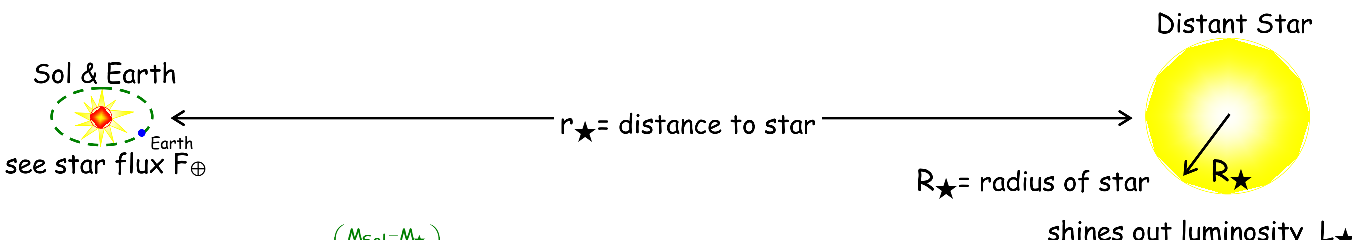
Size of an Opaque, Spherical Star: The Stefan-Boltzmann Law:

The Stefan-Boltzmann law relates the luminosity of a star to its temperature and its emitting surface area ($4\pi R^2$)

Radius from Luminosity and Temperature $$R_\star = \sqrt{\frac{L_\star}{4\pi\sigma T^4}}$$

where $R_\star$ is the *radius of the star* in m, $\sigma = 5.67 \times 10^{-8}$ W/M^{2}K^4, $R_\odot = 6.96 \times 10^8$ m, and $r_\oplus = 1.496 \times 10^{11}$ m.

Star	Field Guide to the Stars and Planets Table A2				Calculated					
					FG A3	Luminosity		Size		
	V	M_V	$r_\star$ ly	Spec. Type	T K	$L_{\star,SOL}$ In L_{Sol}	$L_\star$ In Watts	$R_\star$ Billions of m	$R_\star/R_\odot$ (number)	$R_\star / r_\oplus$ %
Polaris (α UMi)	2.0	-4.1	431	F5 I						
Vega (α Lyr)	0.03	0.6	25	A0 V						
Deneb (α Cyg)	1.25	-7.5	1467	A2 I						
Altair (α Aql)	0.77	2.1	17	A7 IV						
Betelgeuse (α Ori)	0.5	-5.0	522	M2 I						
Alnitak (ς Ori)	2.05	-5.5	817	O9.5 I						



$$L_\star = 10^{\left(\frac{M_{Sol} - M_\star}{2.5}\right)} L_{Sol} \quad \textit{AND} \quad L_{Sol} = 3.83 \times 10^{26} \text{ Watts}$$

Which star impresses you the most? Why? ← Don't skip this!