ASTR 1040 Recitation: Stars & Stuff

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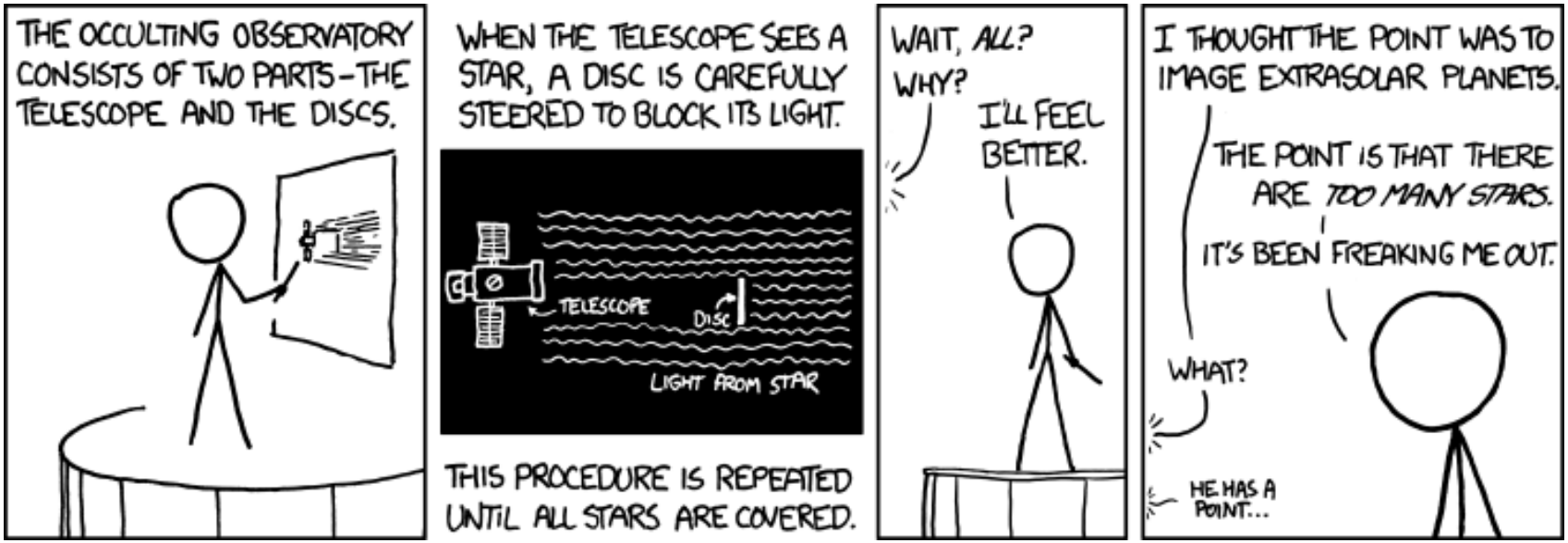
March 5 & 6, 2019

Announcements

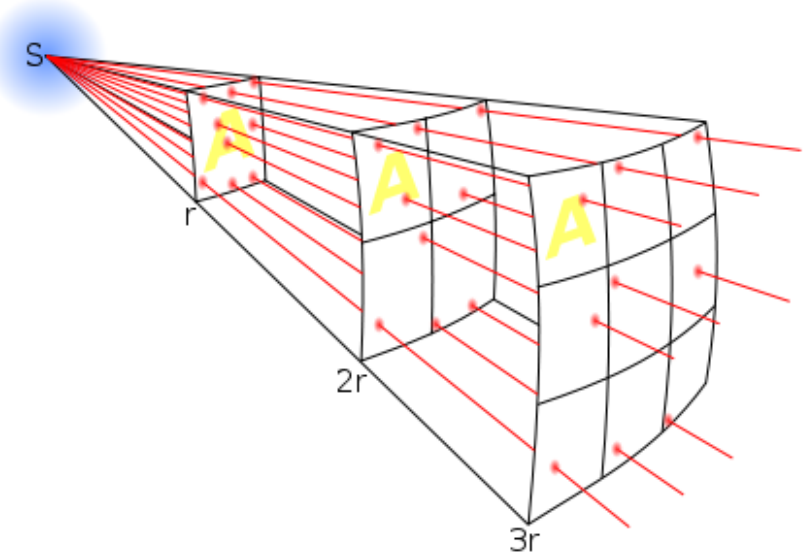
- Next Observing: Mon, Mar 11 (8pm or 9pm at SBO)
- Next week in Fiske: Tues, Mar 12 & Wed, Mar 13
- Review session: Wed, Mar 13, 6-8pm in Duane G126

Stars are Everywhere



Apparent Brightness, a.k.a., Flux

- Isotropic point source
- Each ray is radially outward
- Each ray has a unique direction
- Brightness per unit area, W/m^2



$$F = \frac{L}{4\pi r^2}$$

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- Normalize: how bright would it appear at 10 pc?
- $m_2 - m_1 = 2.5 \log_{10} \left(\frac{F_1}{F_2} \right) = 2.5 \log_{10} \left[\frac{L}{4\pi (10\,\mathrm{pc})^2} \frac{4\pi d^2}{L} \right]$
- $m - M = 5 \log_{10} \left(\frac{d}{10\,\mathrm{pc}} \right)$ Distance modulus
- Measures intrinsic brightness of the object

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- $m = M + 5 \log_{10} \left(\frac{d}{10\,\mathrm{pc}} \right)$
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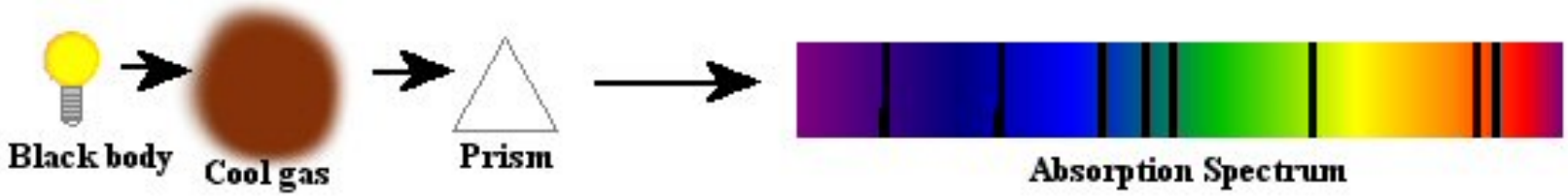
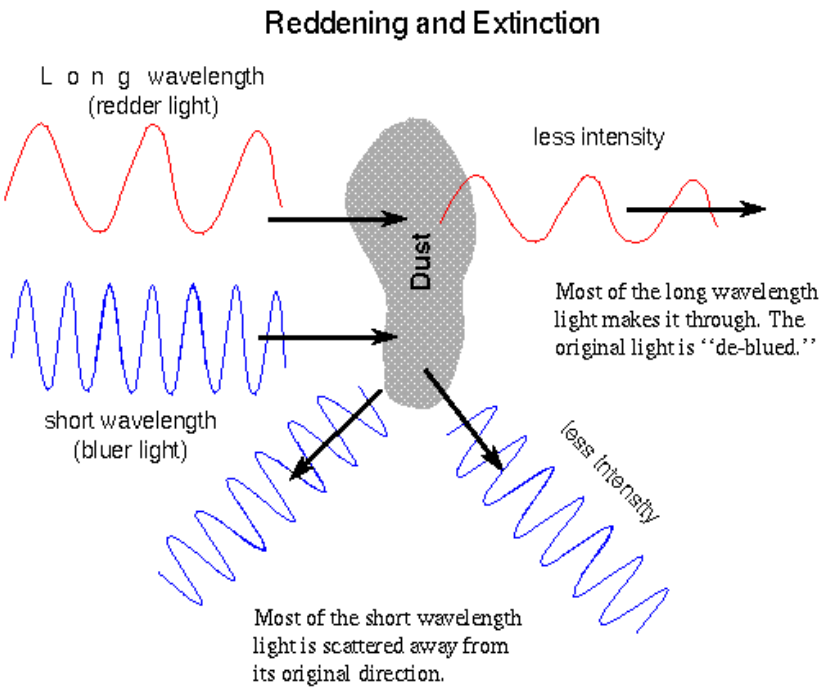
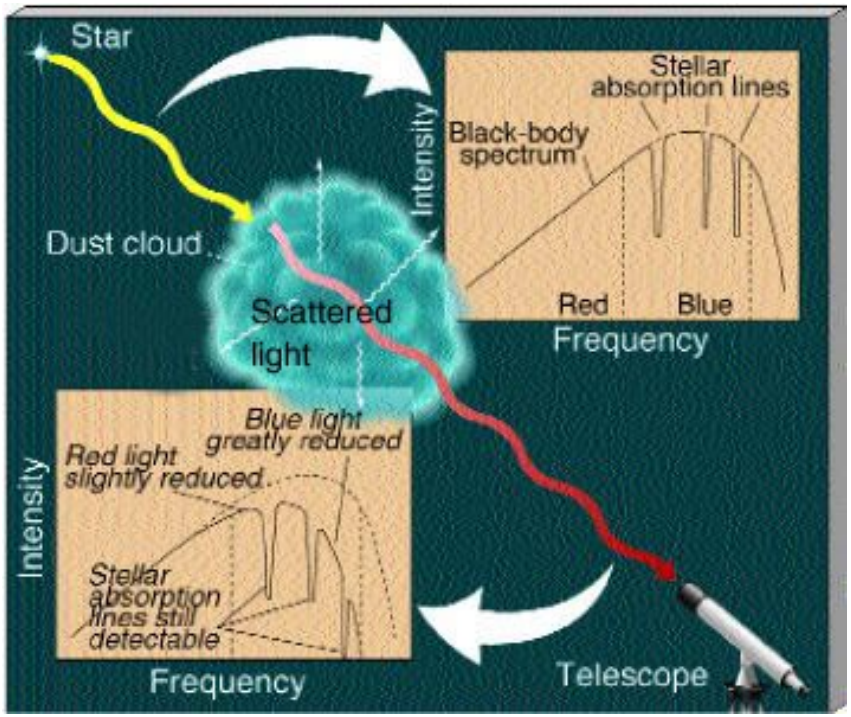


Interstellar Extinction





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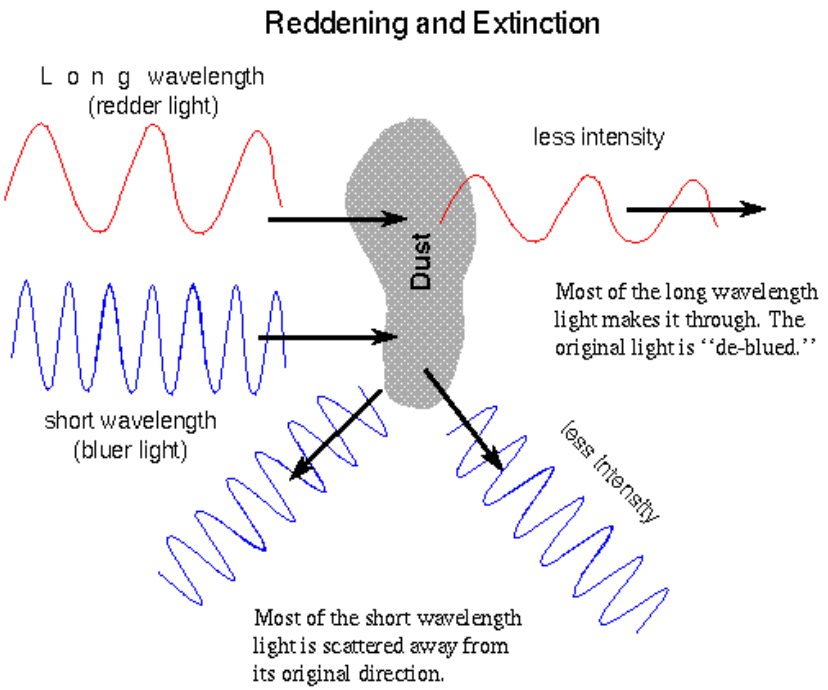

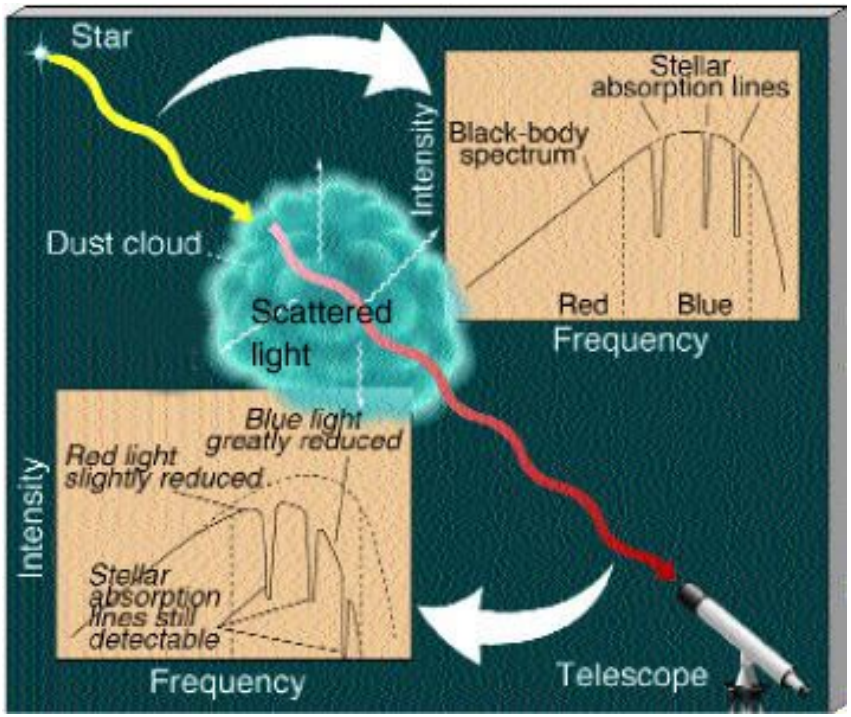

$$m = M + 5\log_{10}\left(\frac{d}{10\,\mathrm{pc}}\right) + A \qquad A > 0$$

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- 1901: Annie Jump Cannon rearranges the sequence placing O and B before A, also adding decimal subdivisions and consolidating
- Final order: O, B, A, F, G, K, M
- O stars are hotter/brighter, M stars are cooler/dimmer. This becomes a measure of effective temperature

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- Oven Bake And Fire Grill Kepler Meat
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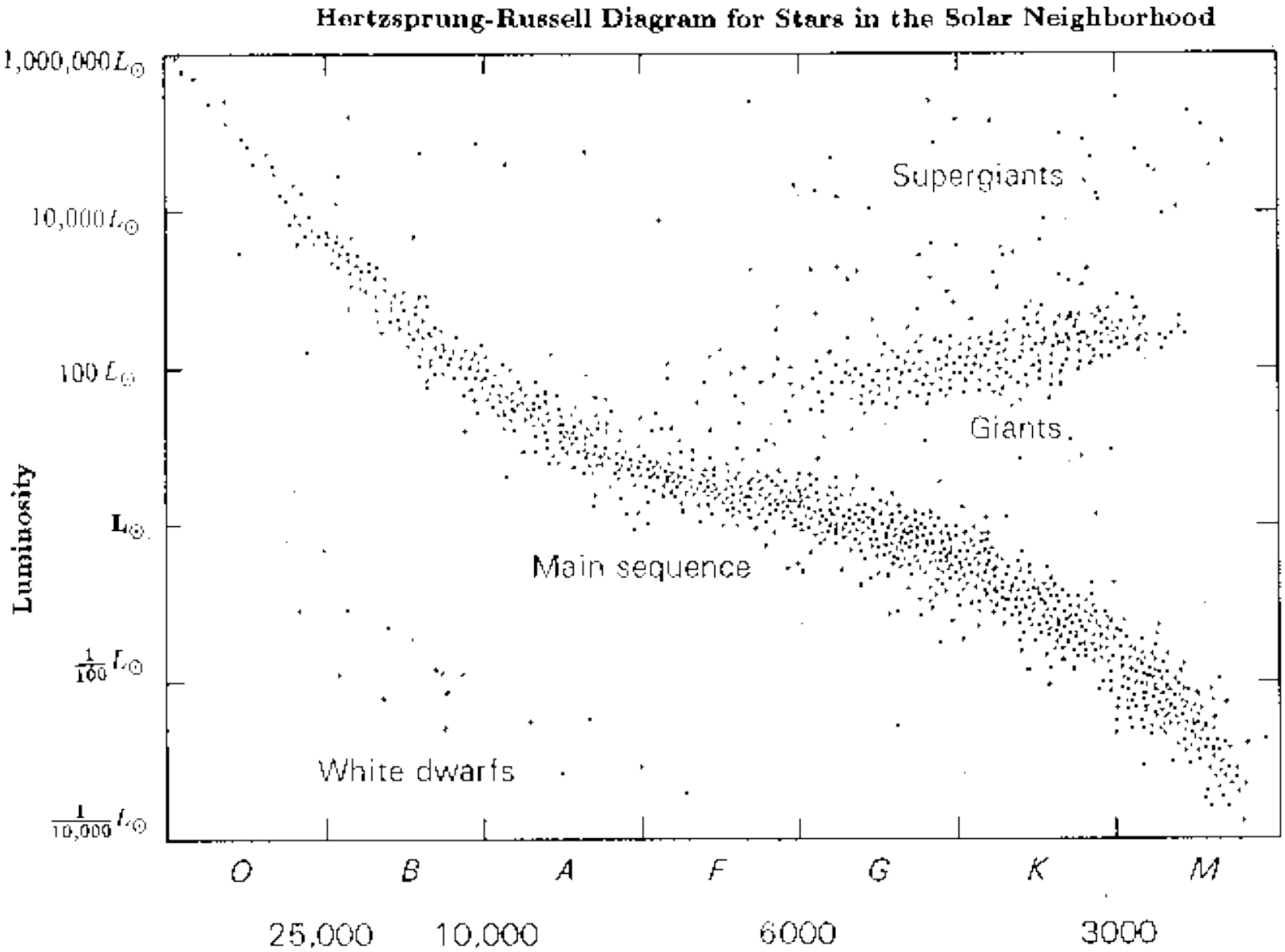
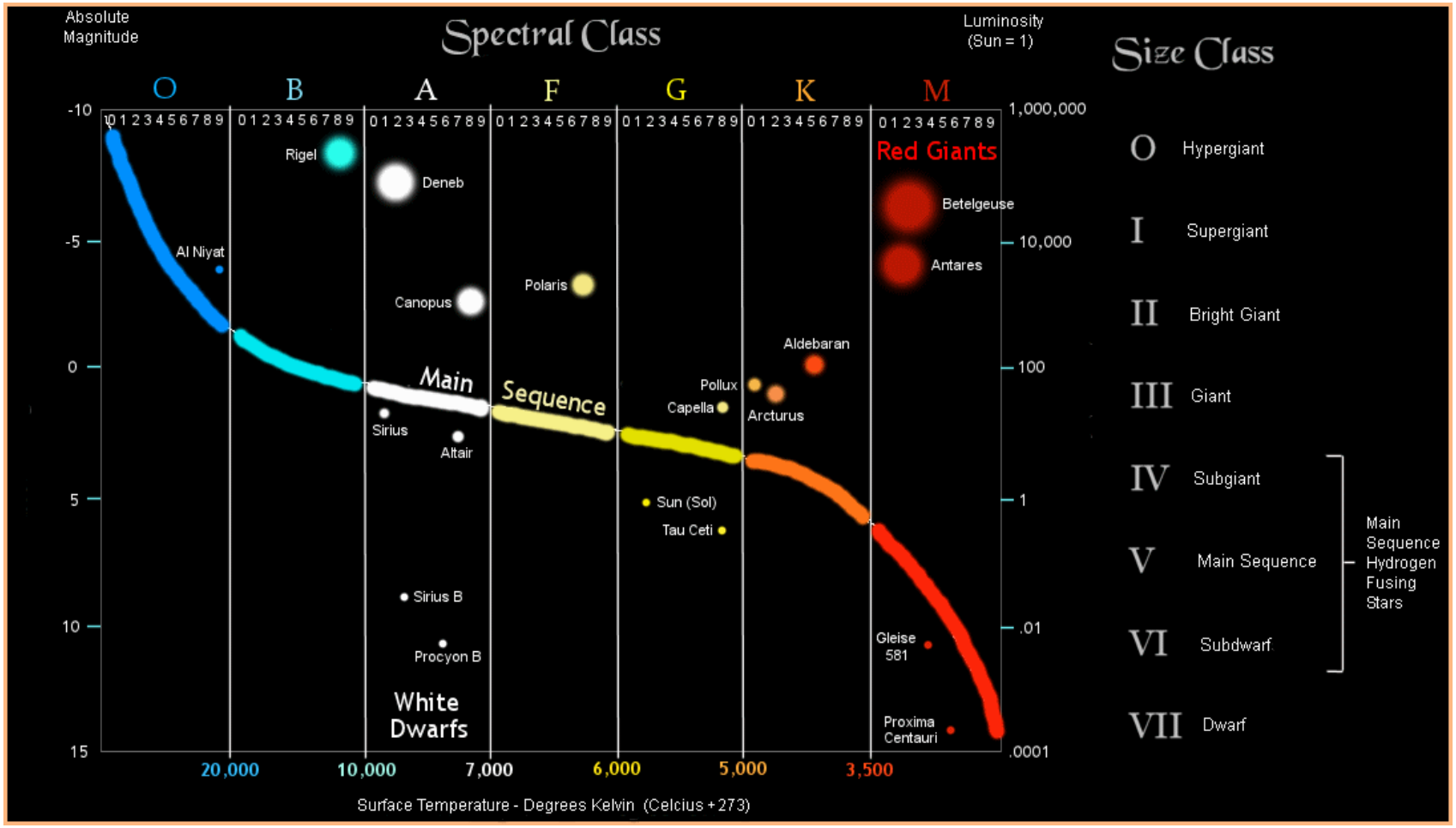
- $L = 4\pi R^2 \sigma T^4 \qquad \Rightarrow \qquad R = \frac{1}{T^2}\sqrt{\frac{L}{4\pi\sigma}}$

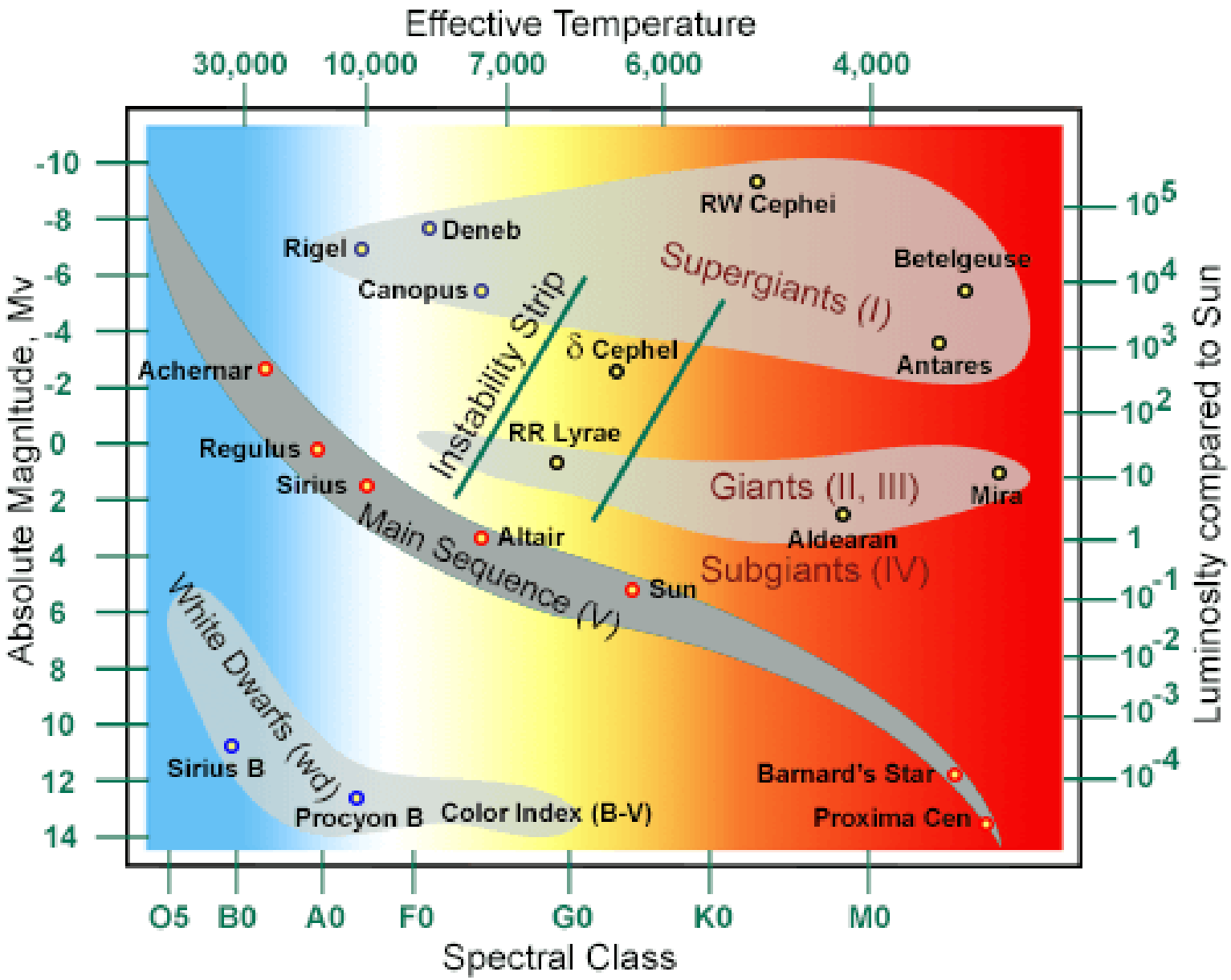
HR Diagram: Stars Appear in Particular Spots



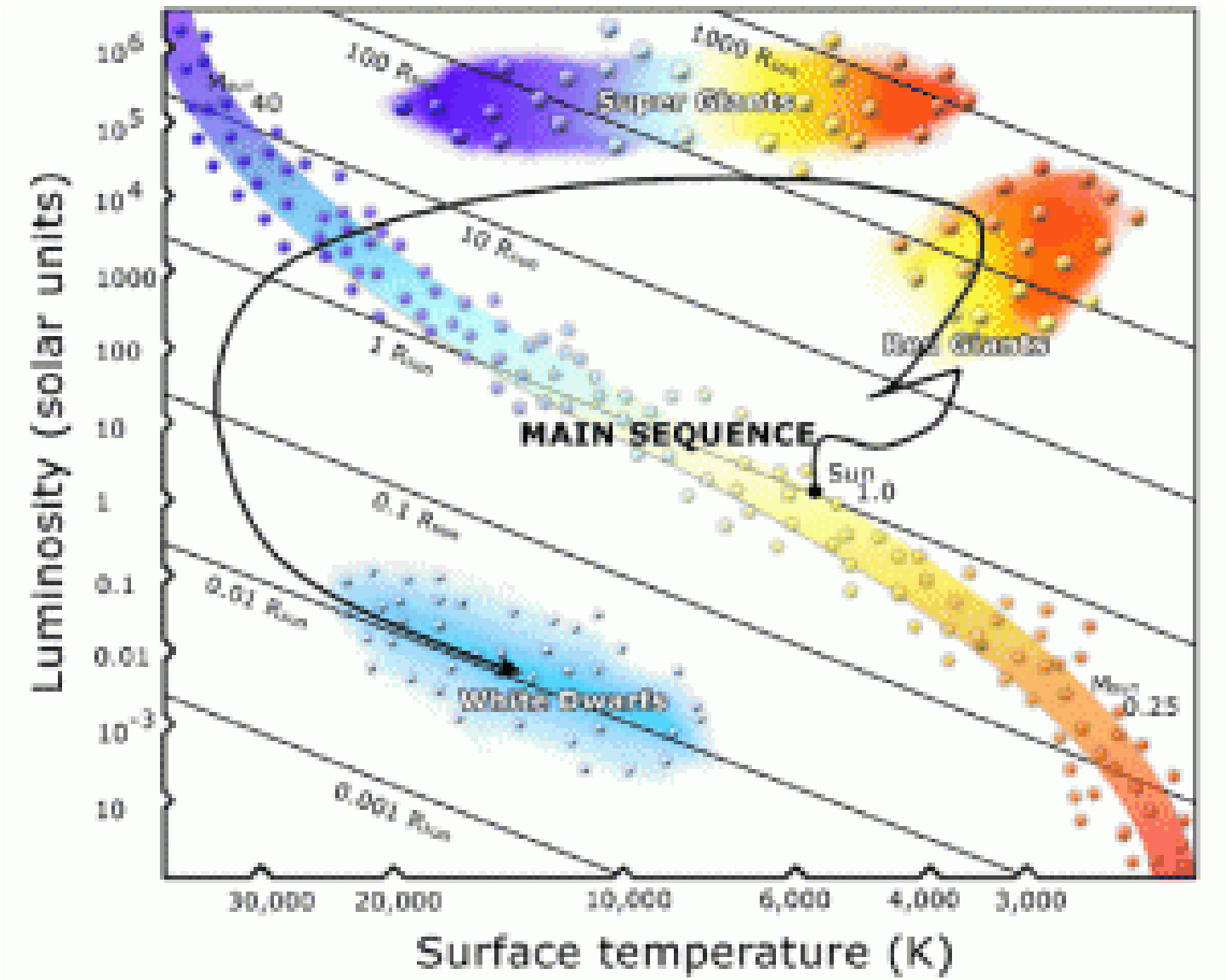
HR Diagram: Size Classes



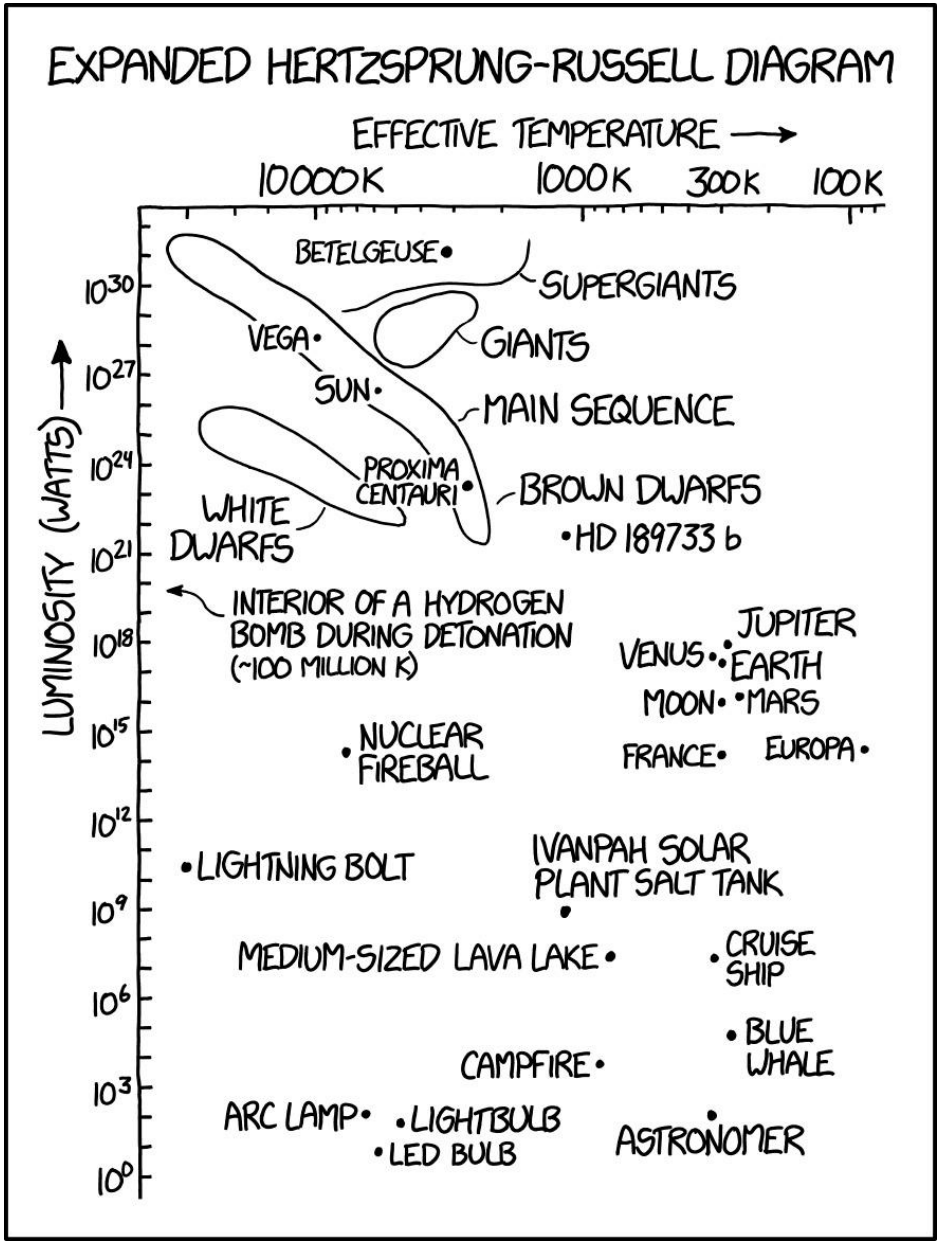
HR Diagram: Different Groups Have Finite Size



HR Diagram: Lines of Constant R



xkcd's HR Diagram



Practice Problem: Radius of White Dwarf

Suppose there is a white dwarf that has the same spectral type as the Sun, but has an absolute magnitude that is 10 mag fainter than the Sun.

$R_\odot/R_\oplus = 109.3$

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1. $L_{\rm WD}/L_\odot = 10^{-4}$: $m_2 - m_1 = 2.5 \log_{10}(F_1/F_2) \Rightarrow$ $M_2 - M_1 = 2.5 \log_{10}(L_1/L_2)$
2. $R_{\rm WD}/R_\odot = 10^{-2}$: $L \propto R^2 T^4$, same spectral type means T is the same
3. $R_{\rm WD}/R_\oplus = 1.093$