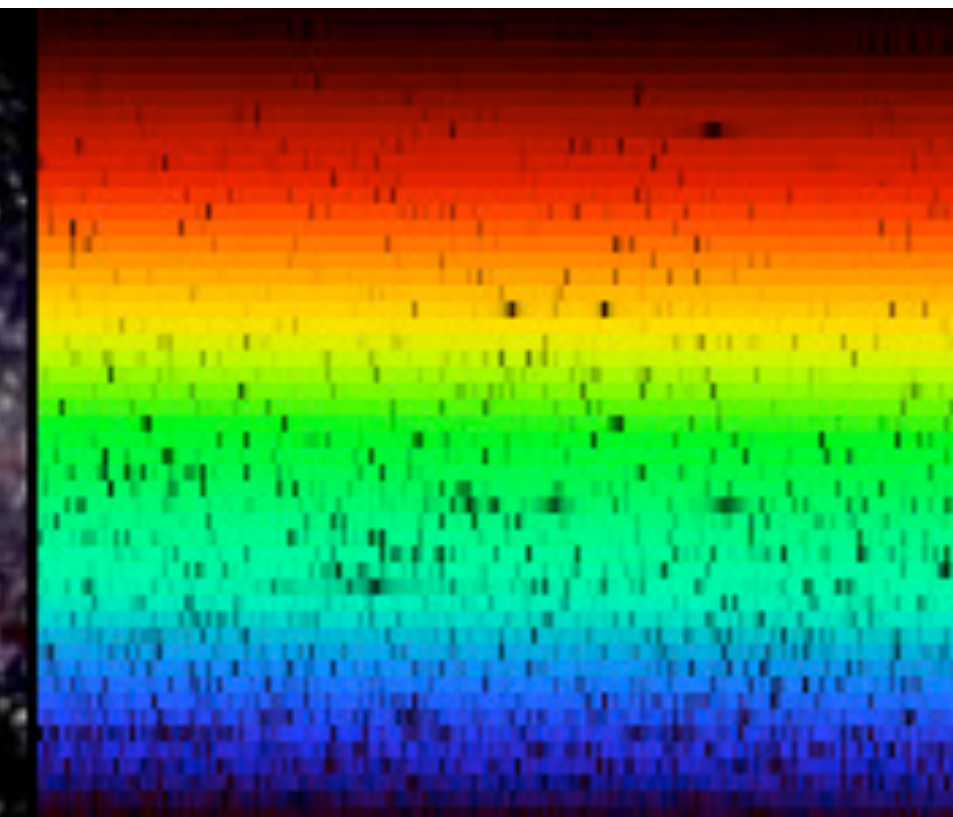




ASTR/PHYS 3070: Foundations Astronomy



Week 10 Tuesday

Today's Agenda

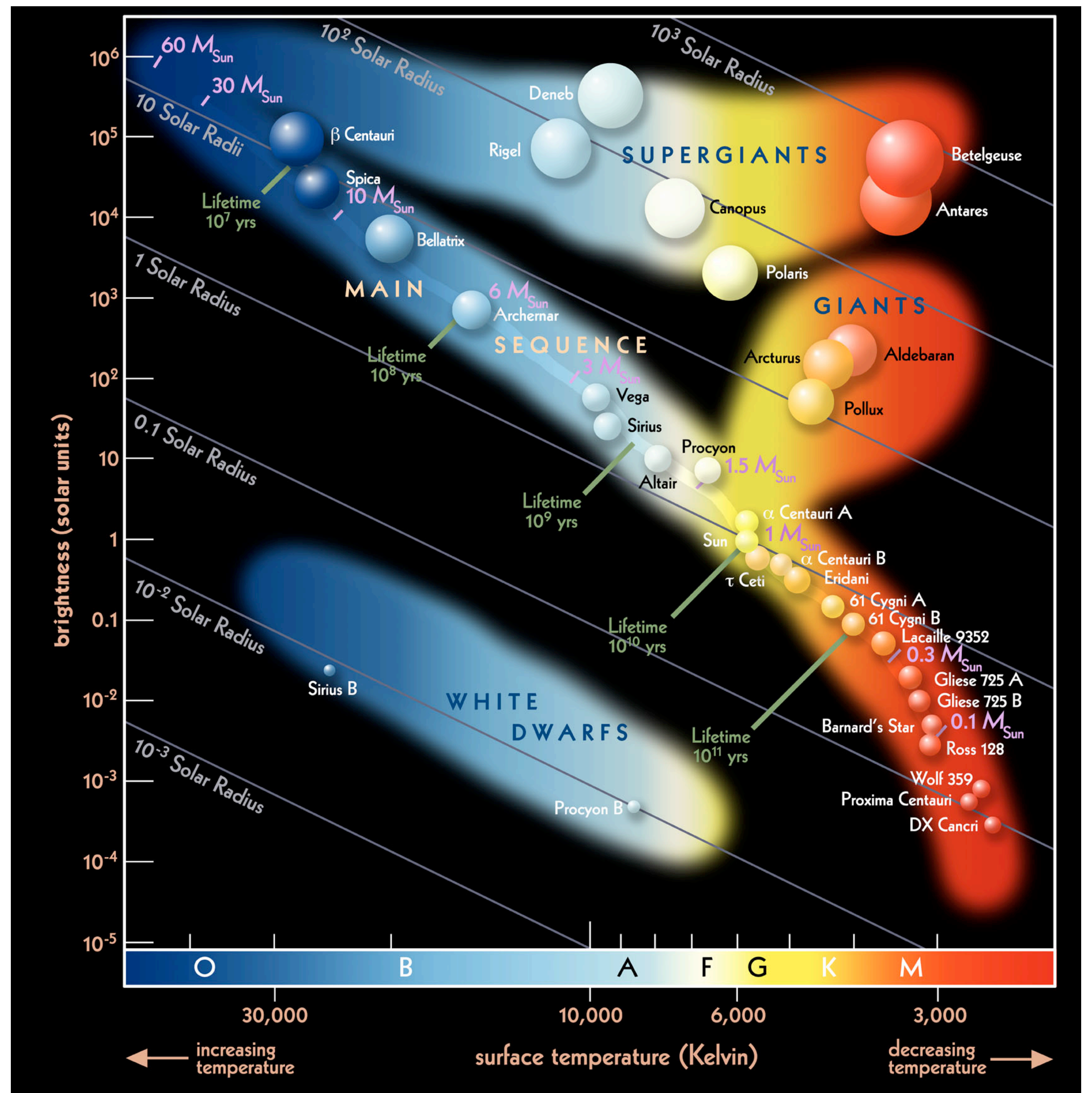
- Stellar types
- Spectral & Luminosity Classes
- HR / CM Diagrams
- Physics of stellar atmospheres

Announcements / Reminders

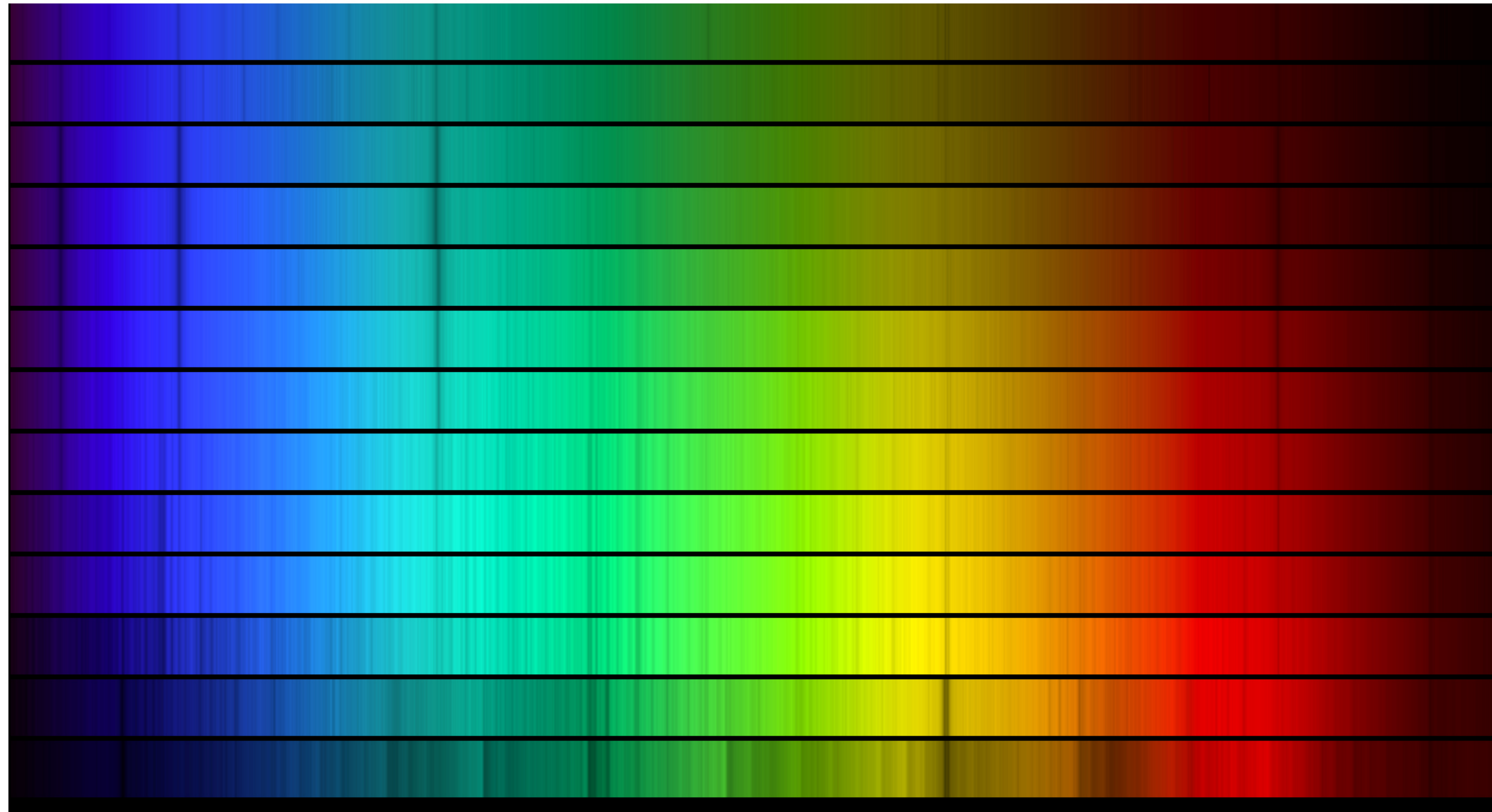
- HW 7 due Friday 1min before midnight
- Read Chapters 14 & 15.3
- HEAP talk at 4pm on Thursday
 - Theoretical dark matter candidate particle
- Colloquium at 2pm on Friday
 - Condensed matter theory, material properties in Earth's mantle maybe?

Luminosity vs Temperature

$$T_{\text{eff}} = \left(\frac{L}{4\pi R^2 \sigma_{\text{SB}}} \right)^{1/4}$$



But early on, no distances and no temperatures



Just spectral lines! And no quantum mechanics!!!

Harvard College Observatory

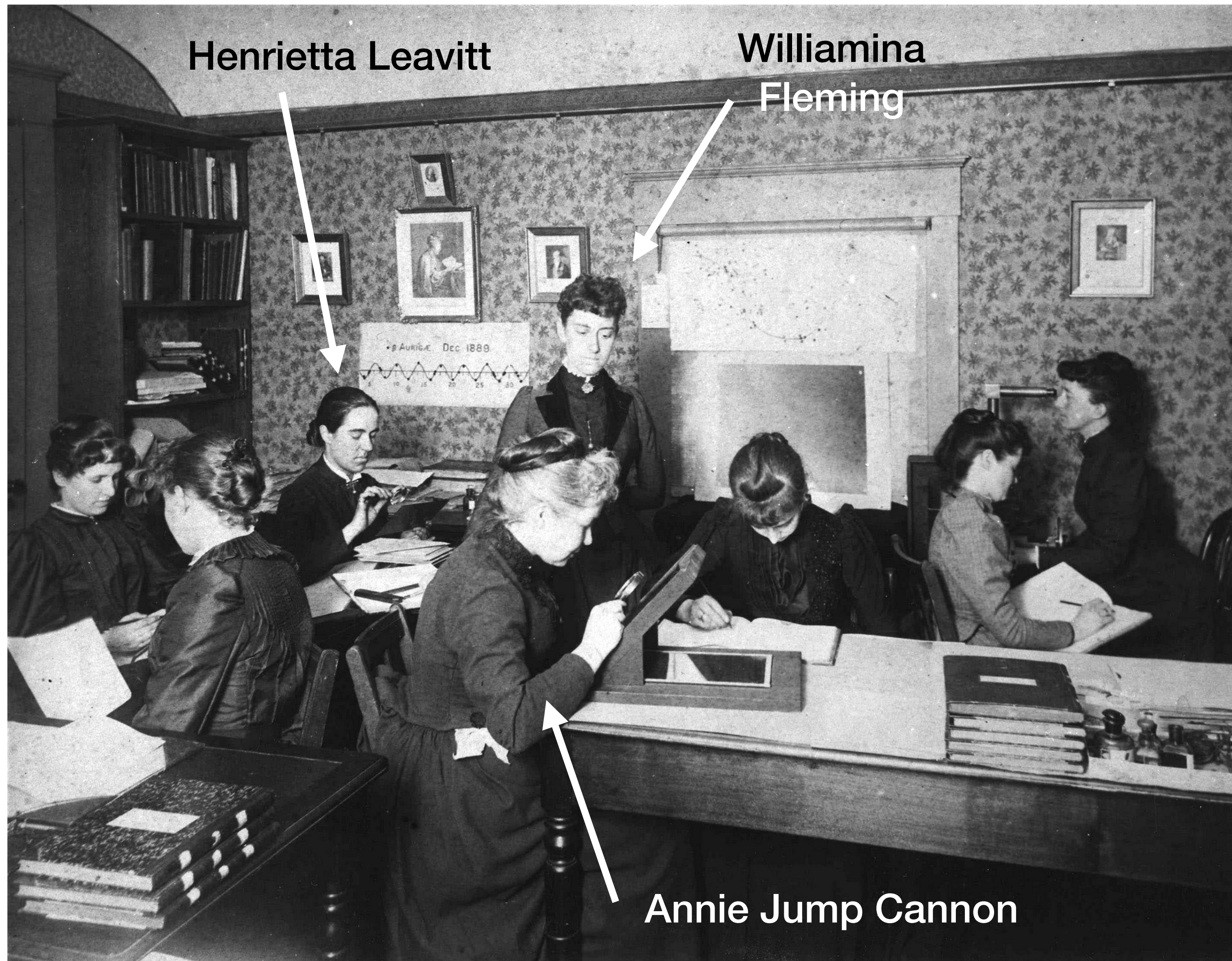
~1890

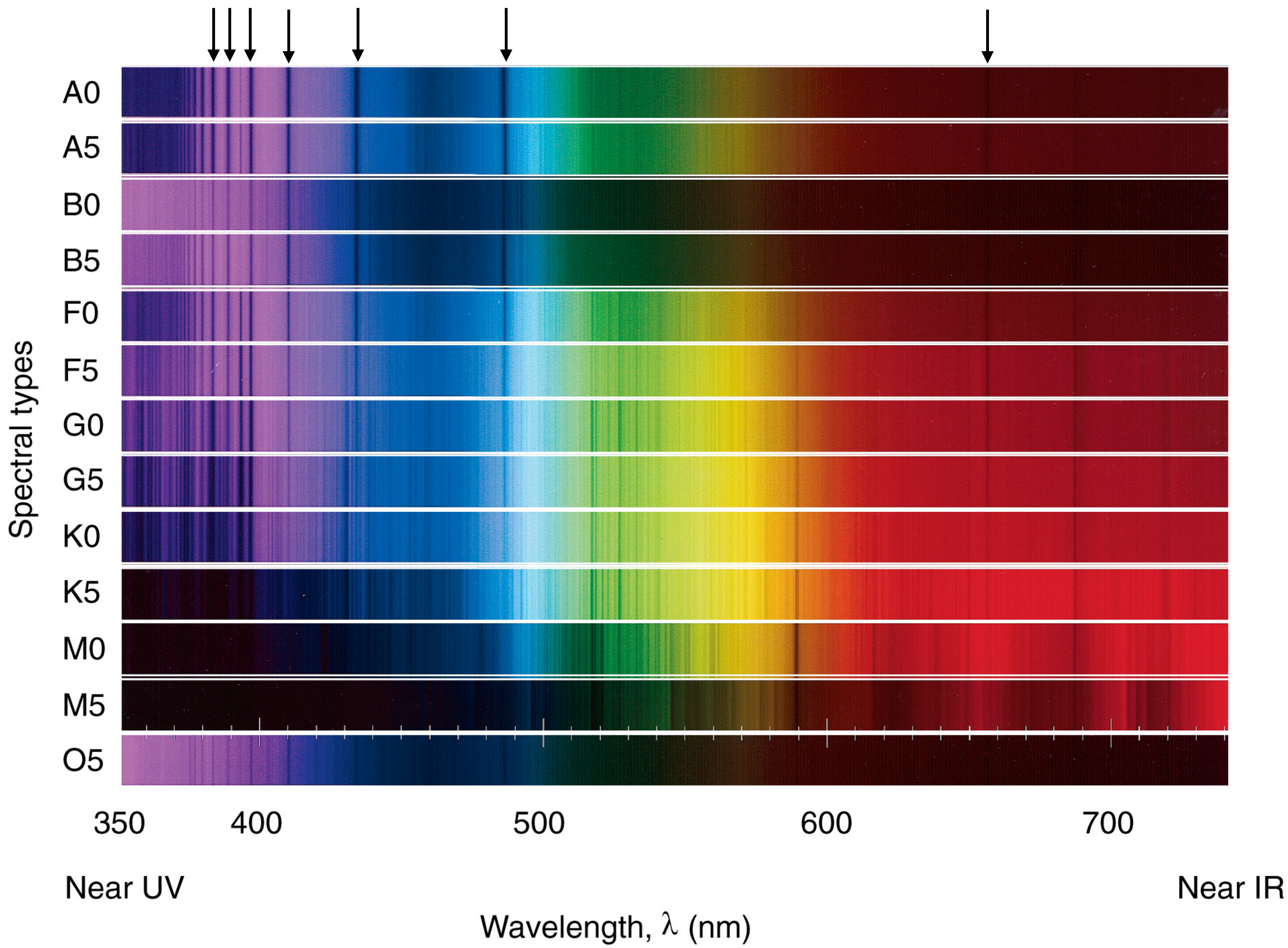
👎 “Pickering’s Harem” 👎

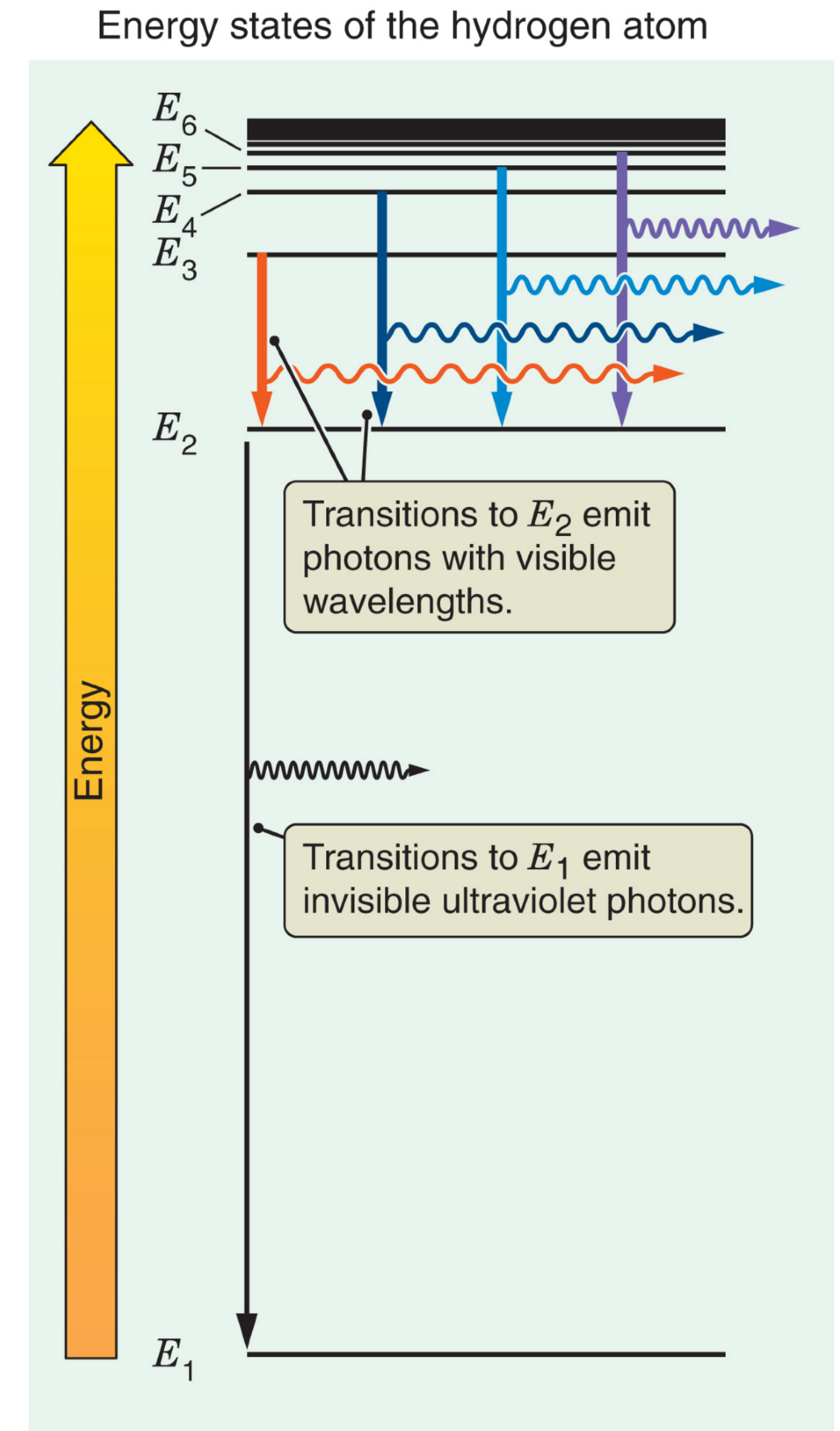
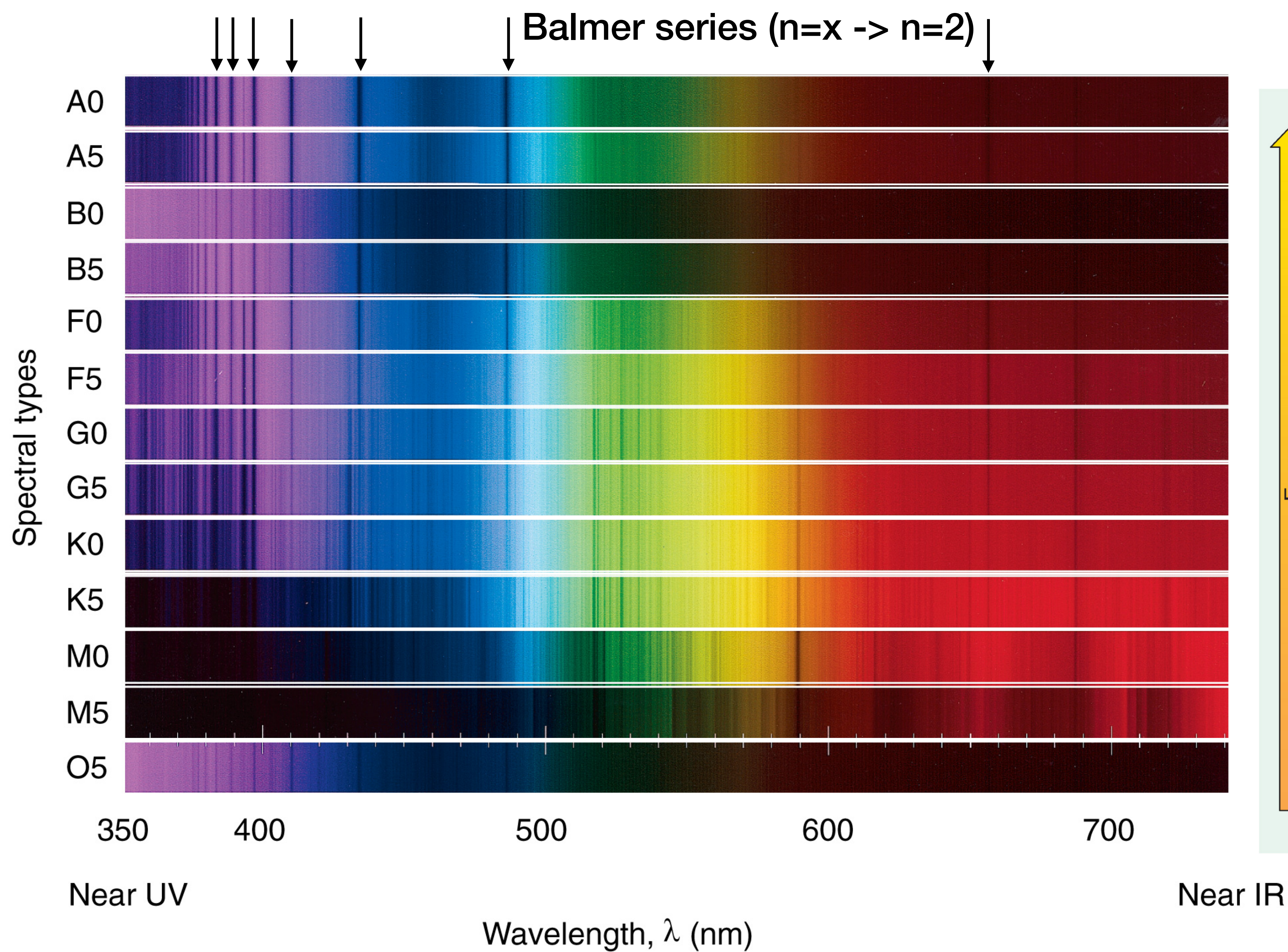
Prof Pickering did not really consider astronomy science, but the widow of Henry Draper (of the HD star catalog) donated a bunch of money.

His housekeeper, Williamina Fleming, was more competent (and cheaper) than his male assistant, so she ran the show

These female “computers” founded modern astronomy



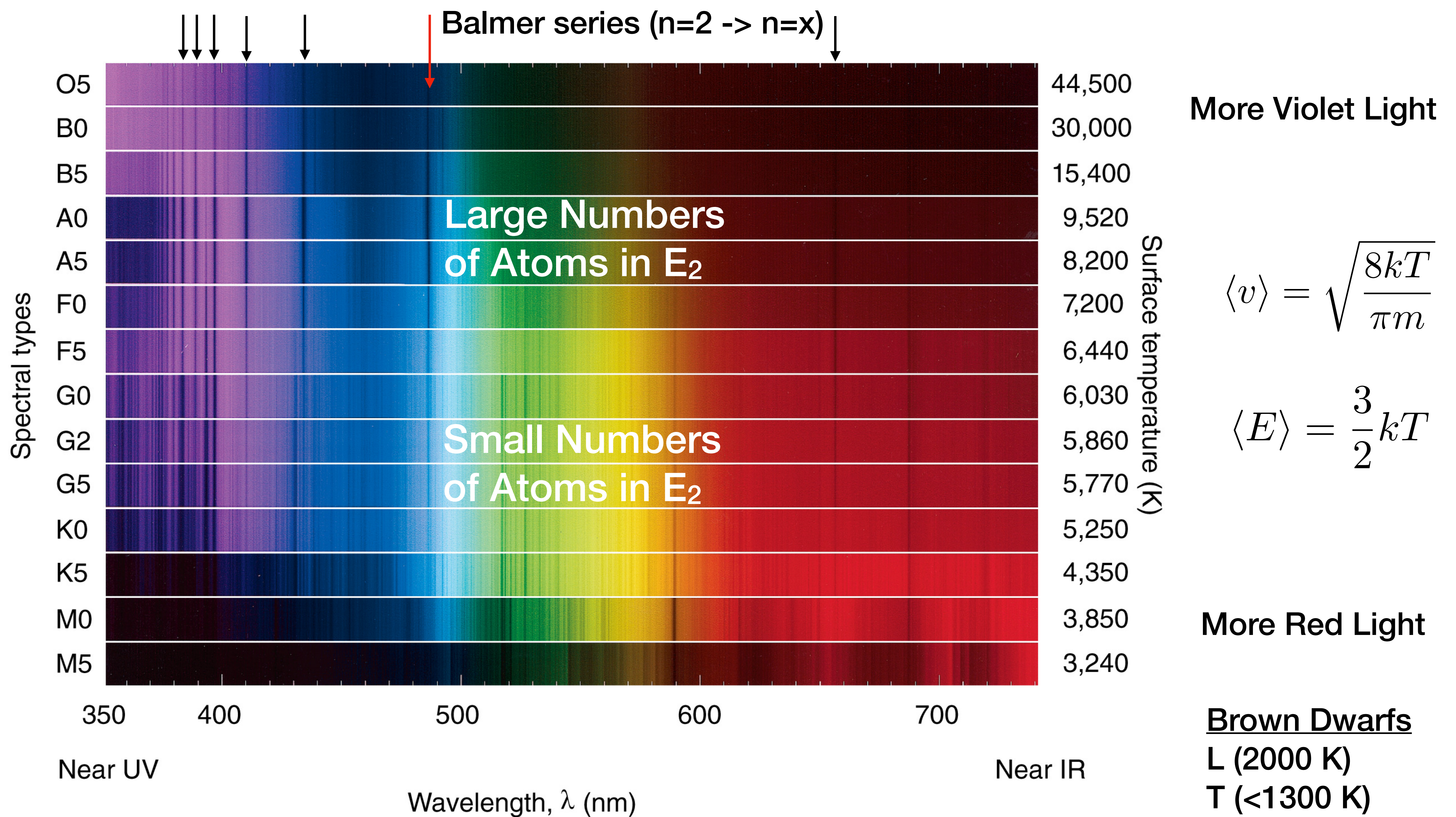




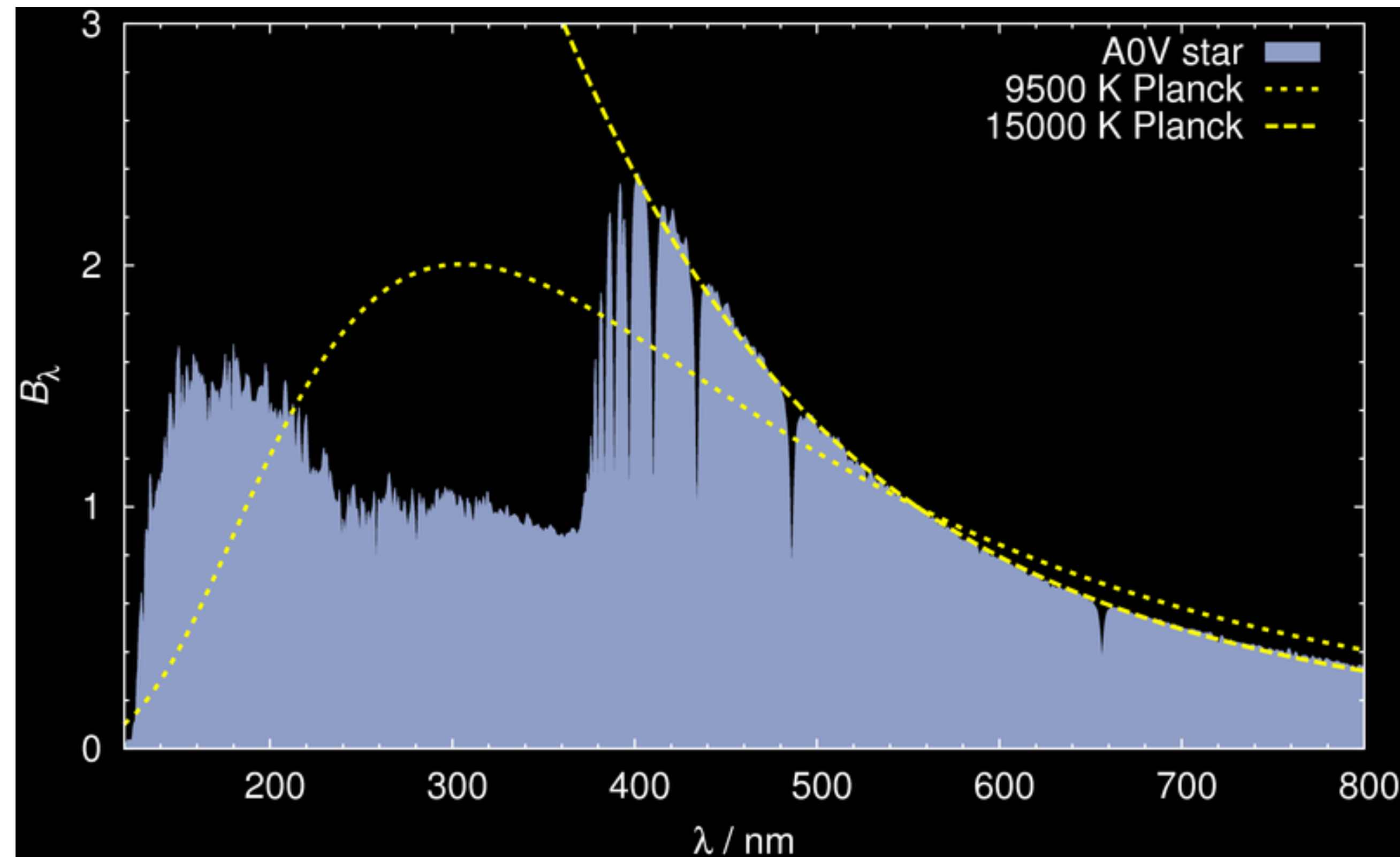
Annie Jump Cannon Classifies the Stars



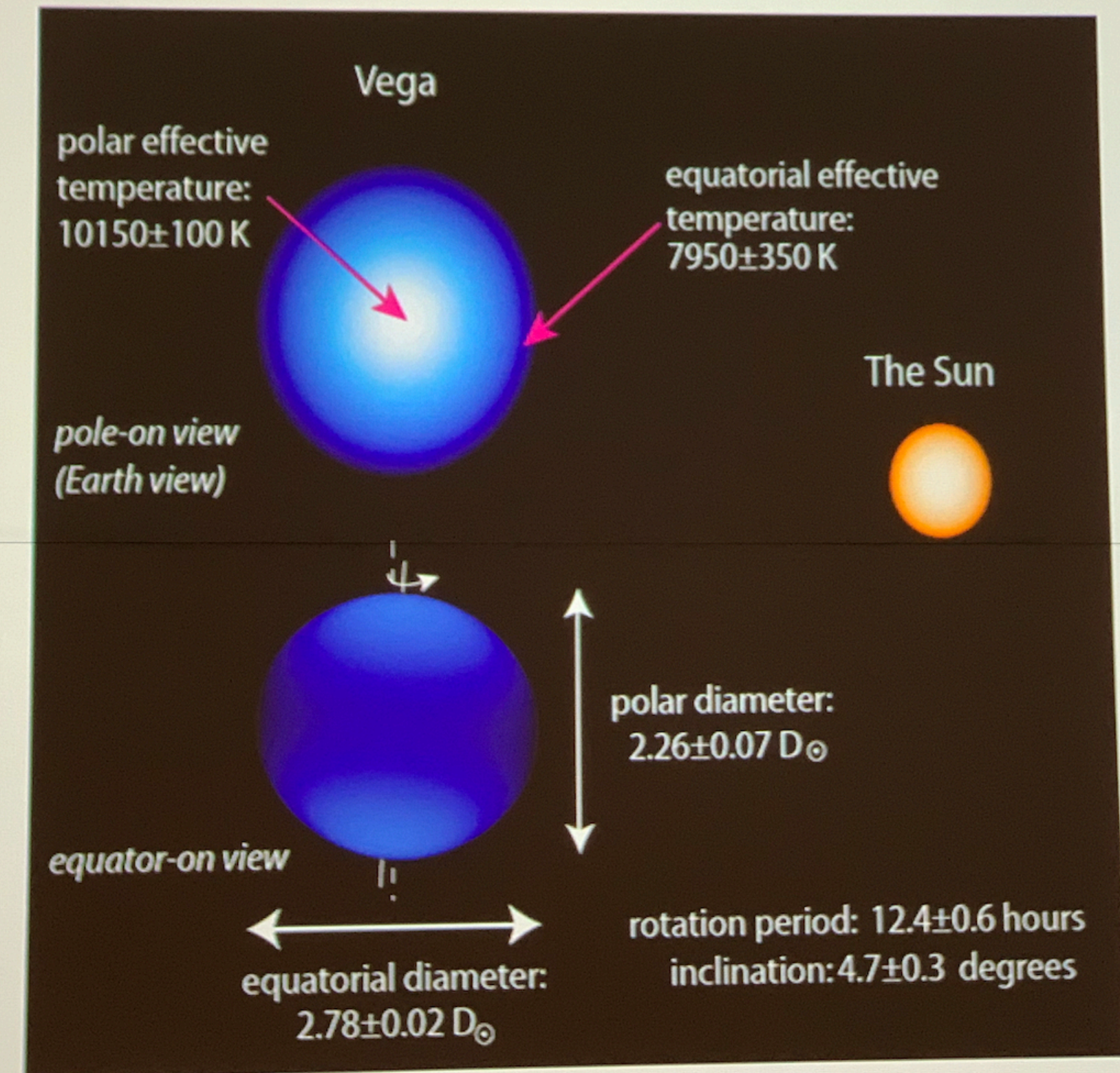
- part of the effort to catalog every star in the sky down to 9th magnitude
- defined the classification scheme for stellar spectra
- manually classified over 350,000 stars
- realized stellar types correlated with temperature (but not in the original order)



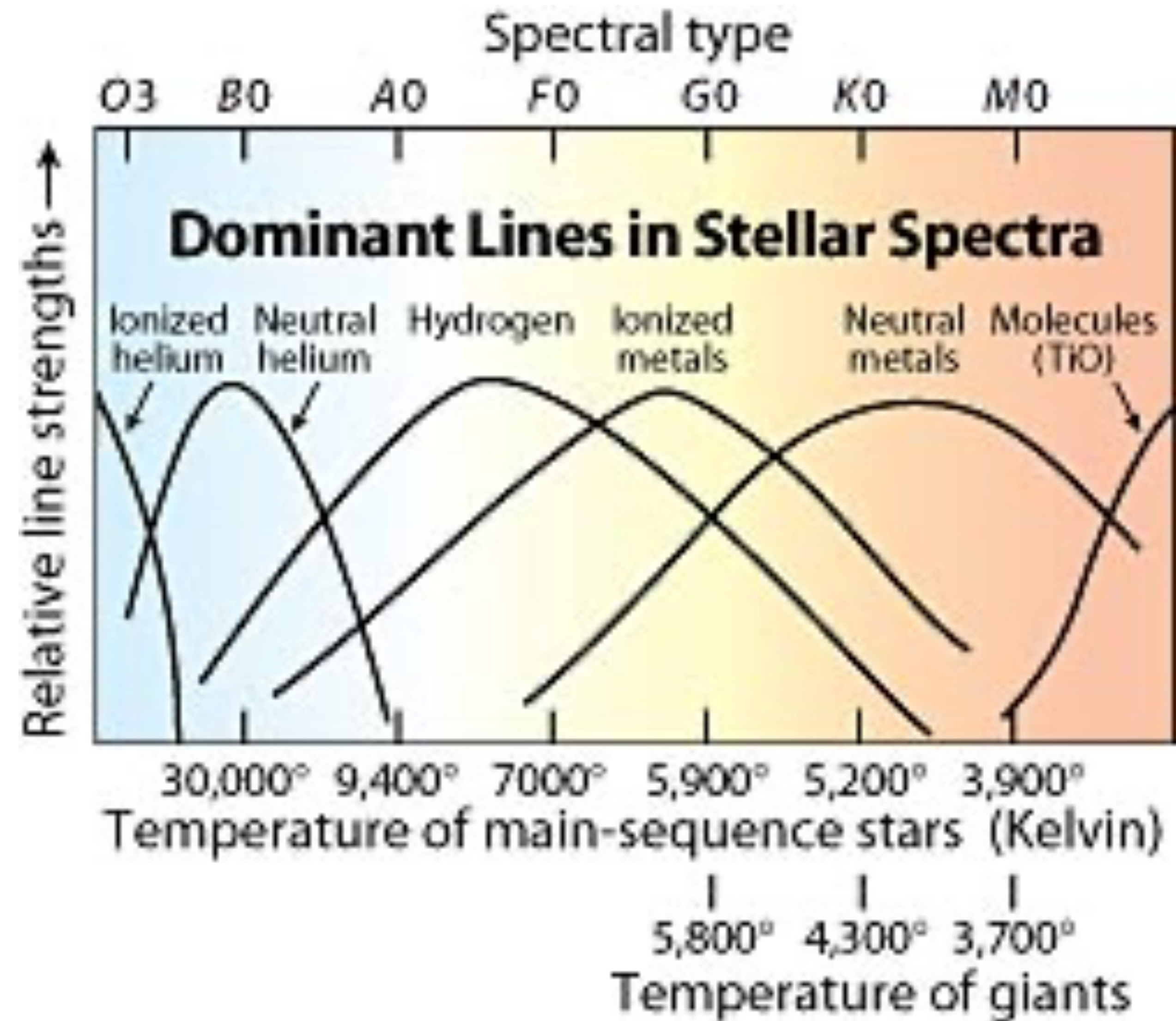
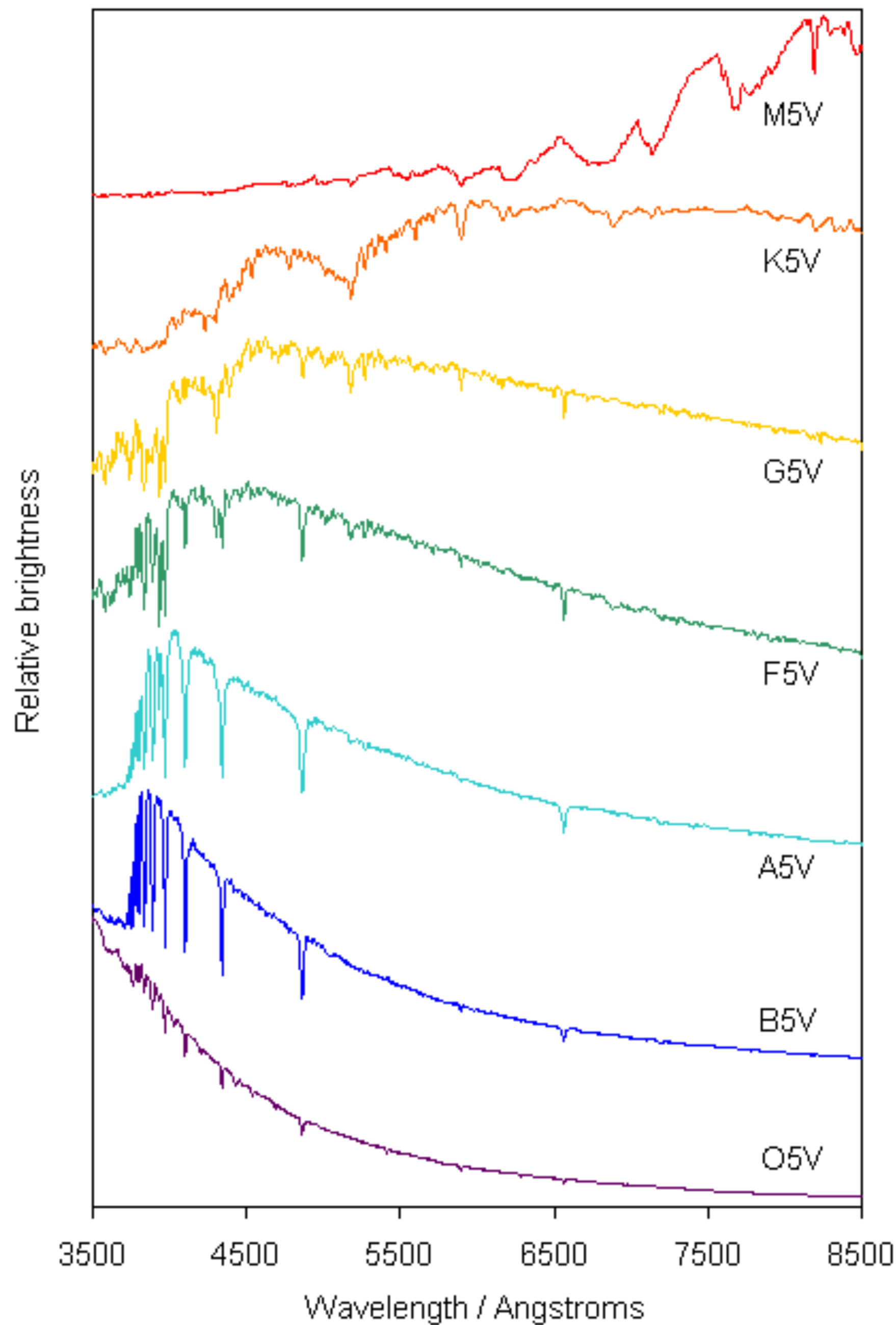
Vega is a blackbody & a total normal A star...



Many hot stars are rapid rotators and have hotter poles and cooler equators: the von Zeipel effect --> gravity darkening



Line Strengths depend on Type



Spectral Classification

Temperature Sequence (color)

OBAFGKM

“Oh, Be A Fine Girl/Guy, Kiss Me!”

“Only Boys Accepting Feminism Get Kissed Meaningfully”

“Only Boring Astronomers Find Gratification Knowing Mnemonics!”

<http://www.star.ucl.ac.uk/~pac/obafgkmrns.html>

Luminosity Classes

Luminosity Type corresponds to Star's Size

$$L \propto R^2 T^4$$

???

I

Supergiant

II

Bright giant

III

Giant

IV

Sub giant

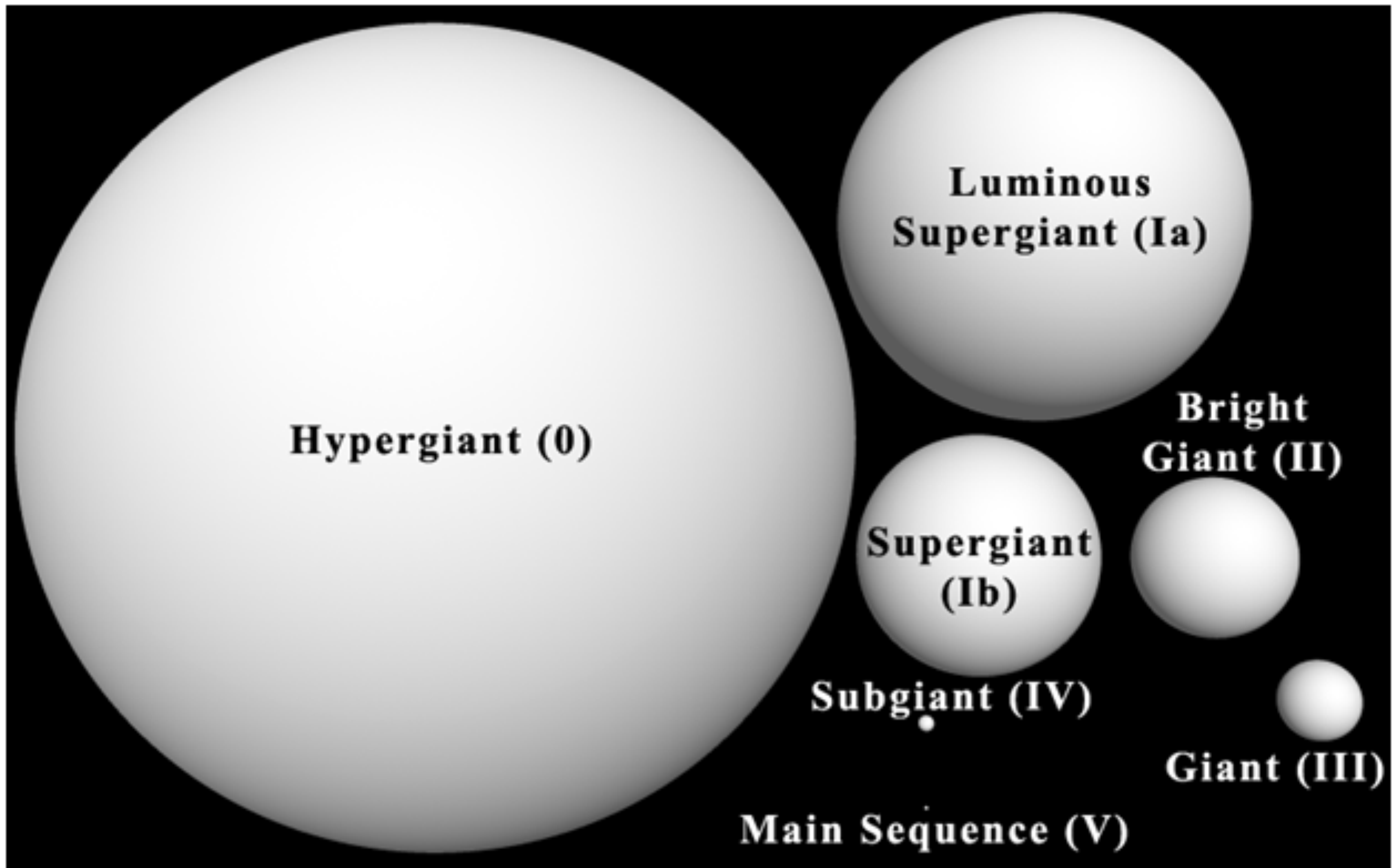
V

Dwarf (main sequence)

VI

Subdwarf

Our Sun is class G2 V

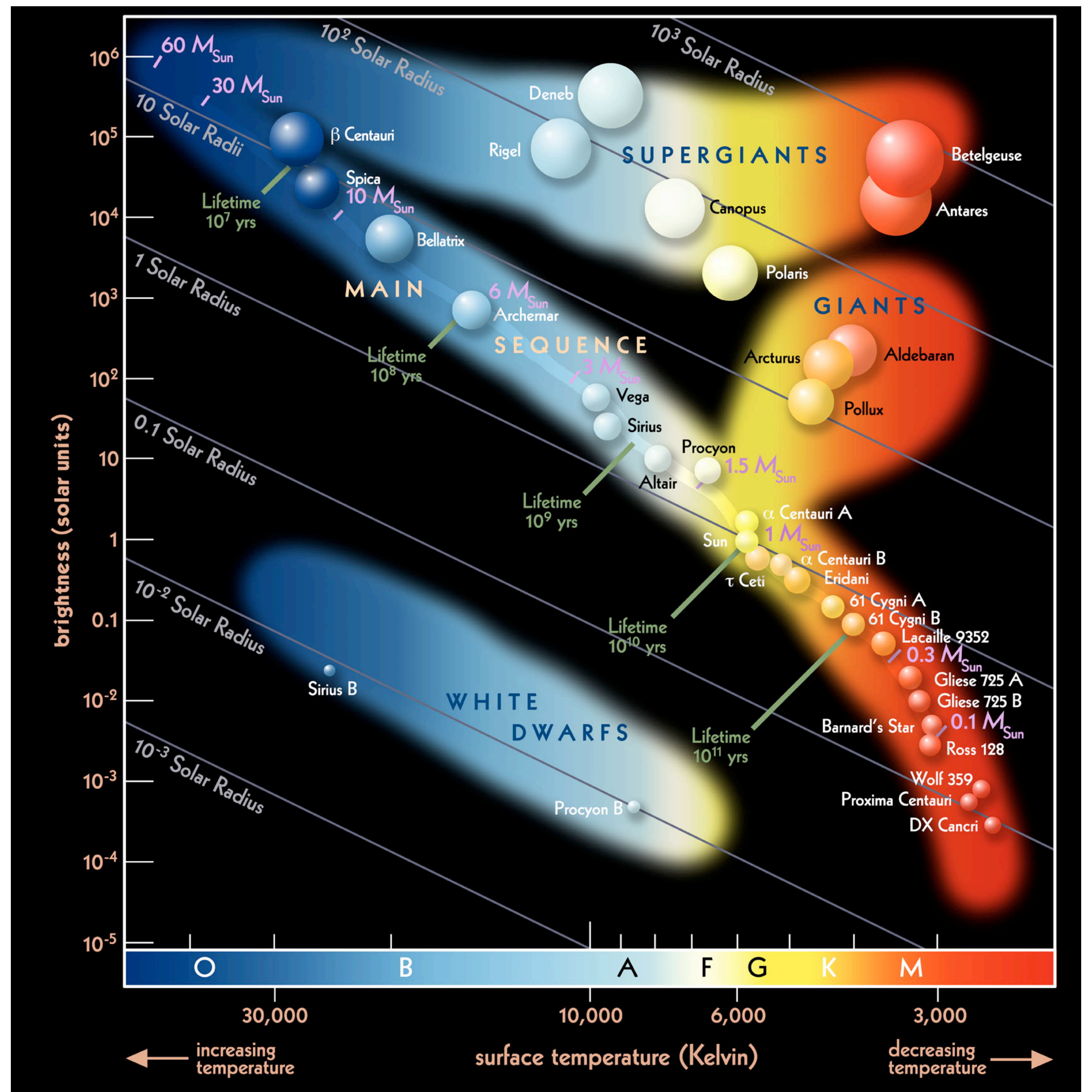


Hertzsprung-Russell Diagram (or color-magnitude diagram: CMD)

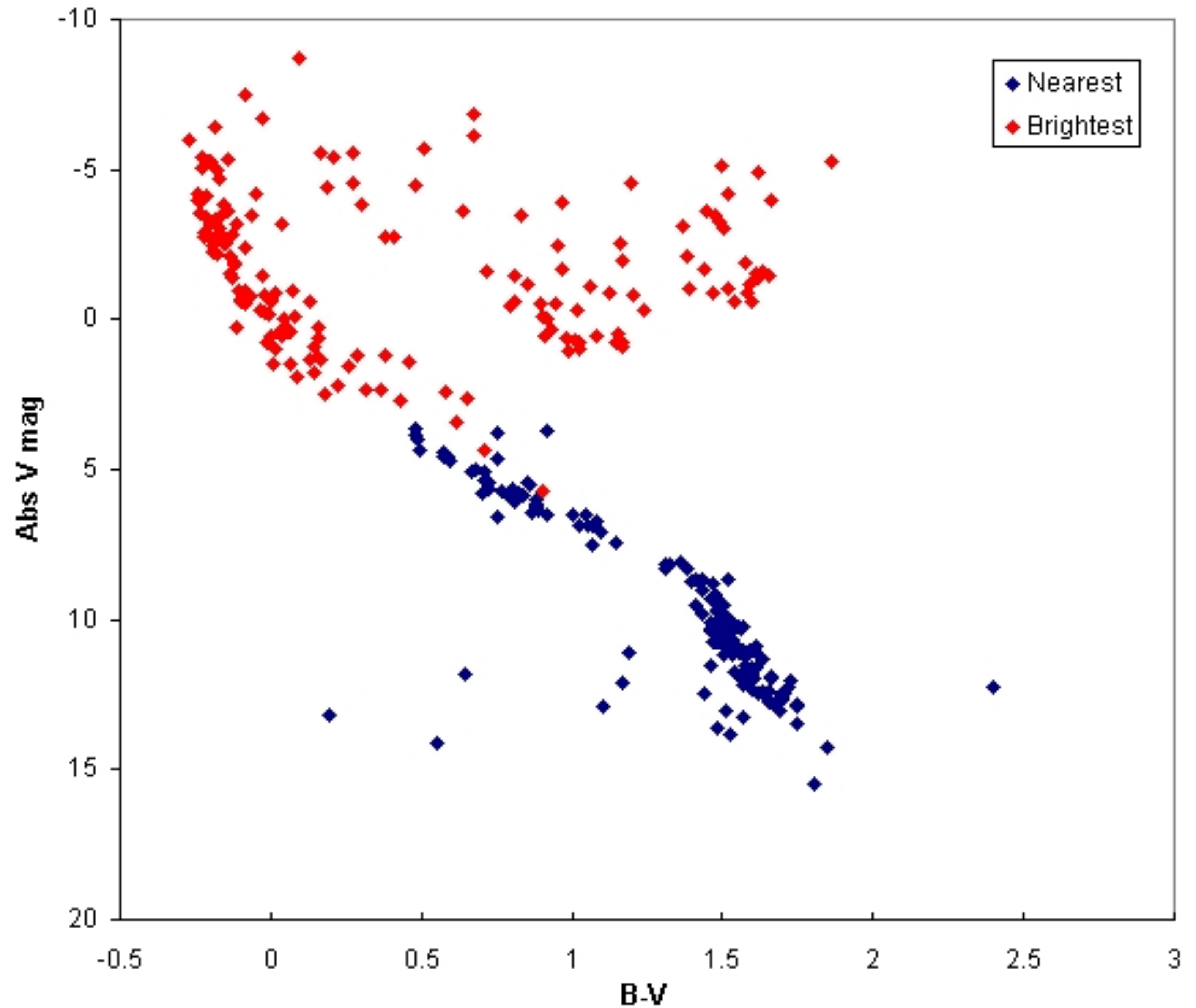
$$T_{\text{eff}} = \left(\frac{L}{4\pi R^2 \sigma_{\text{SB}}} \right)^{1/4}$$

$$L \propto R^2 T^4$$

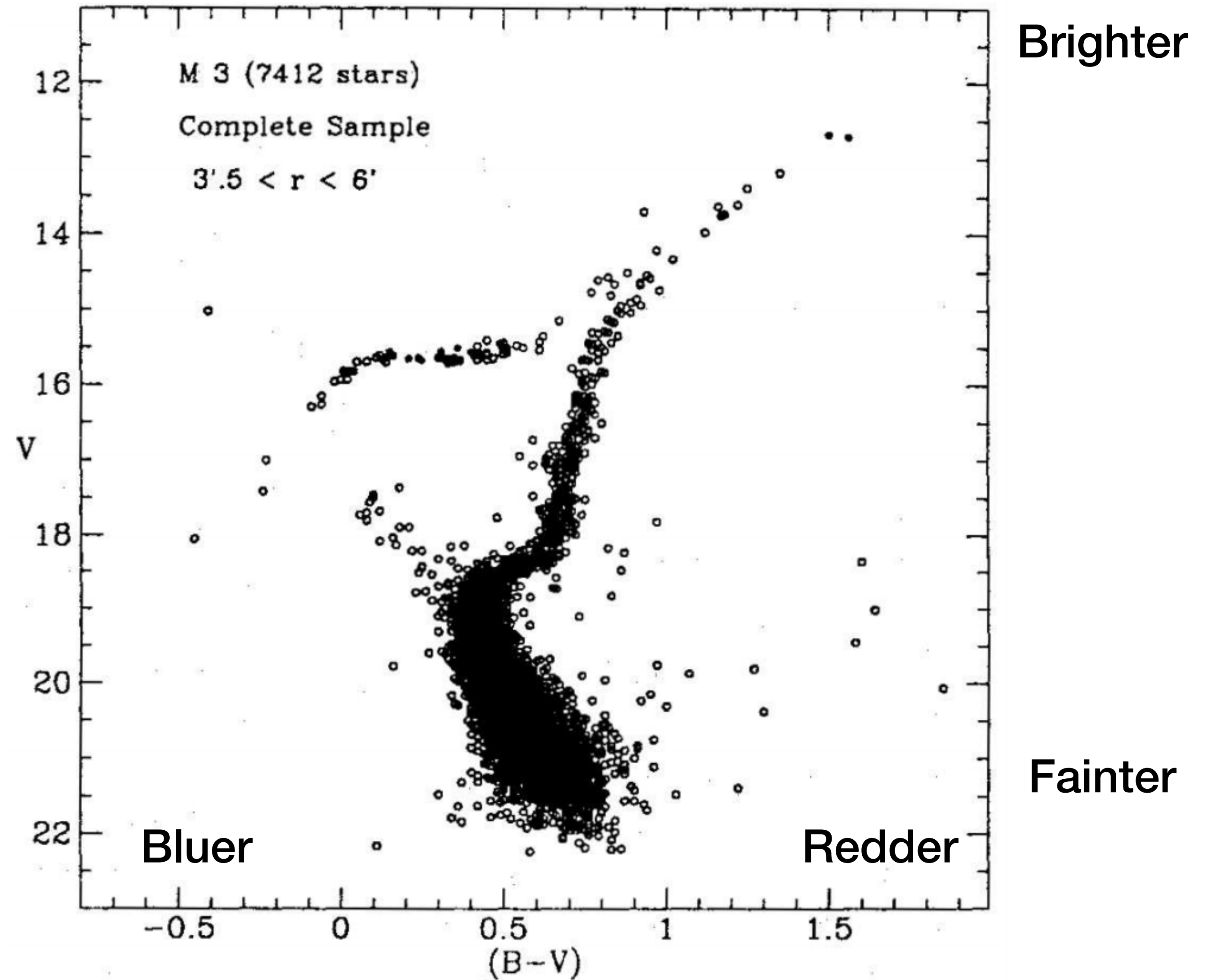
$$\log L \propto 2 \log R - 4 \log T^{-1}$$



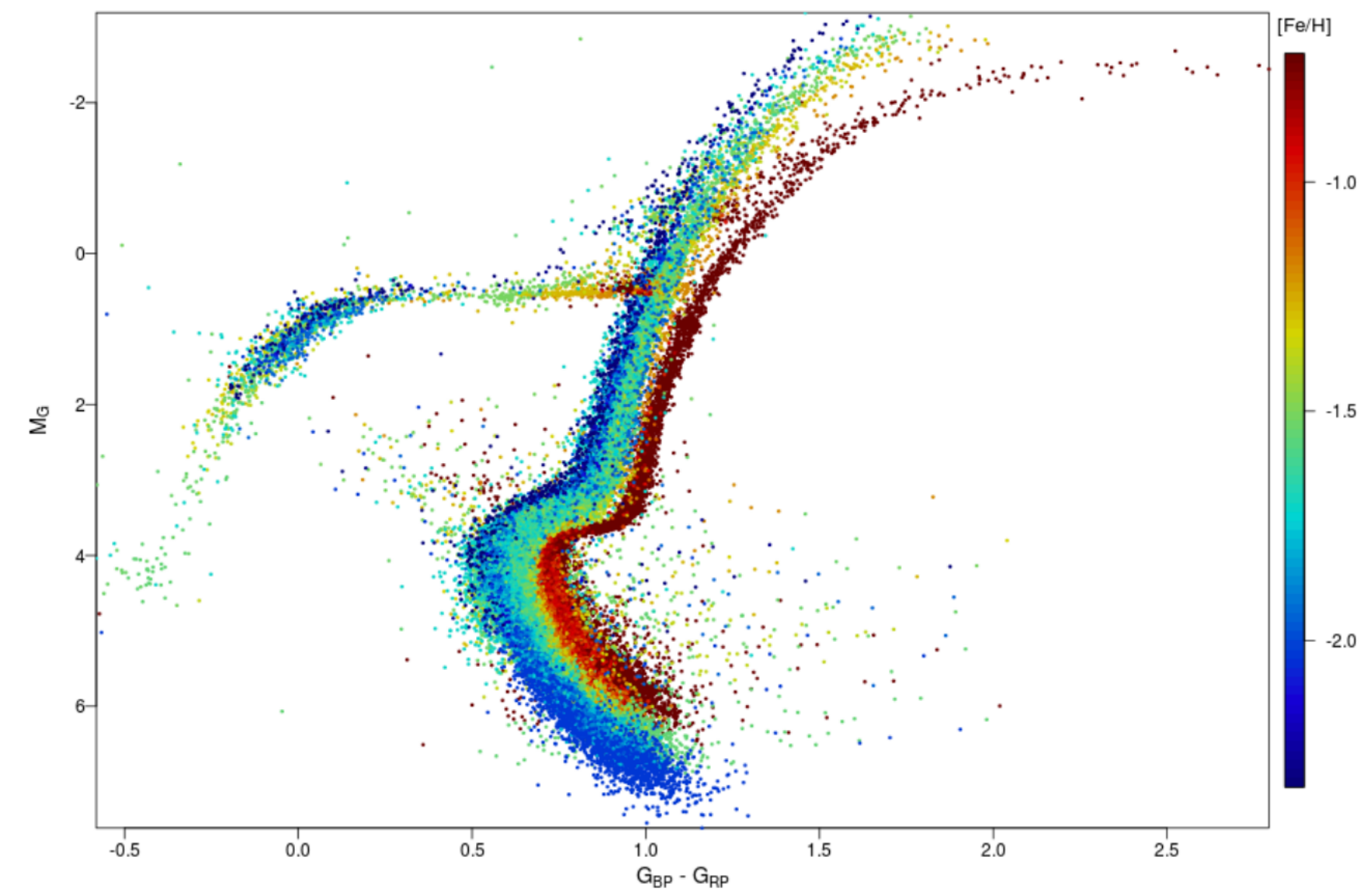
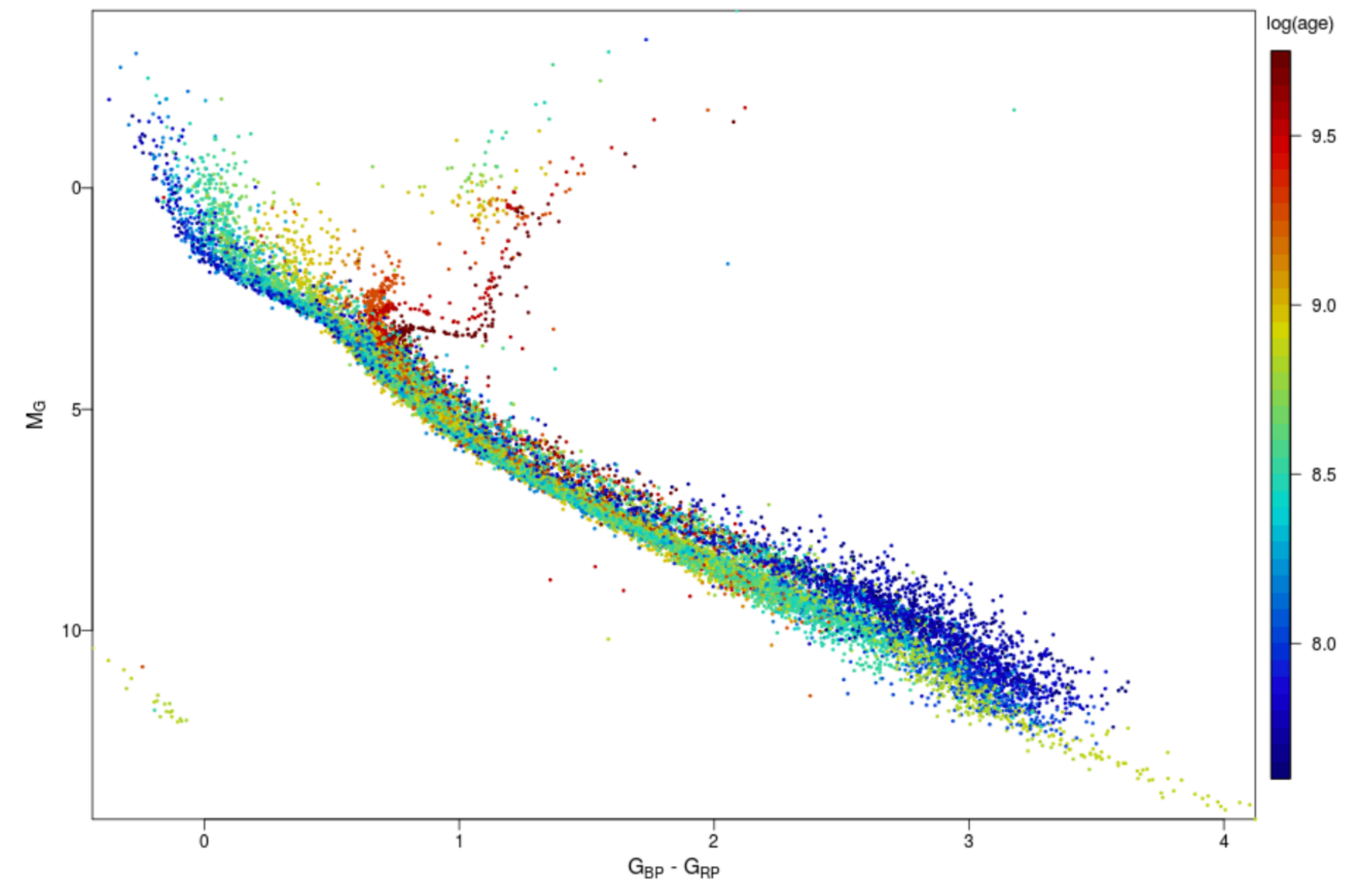
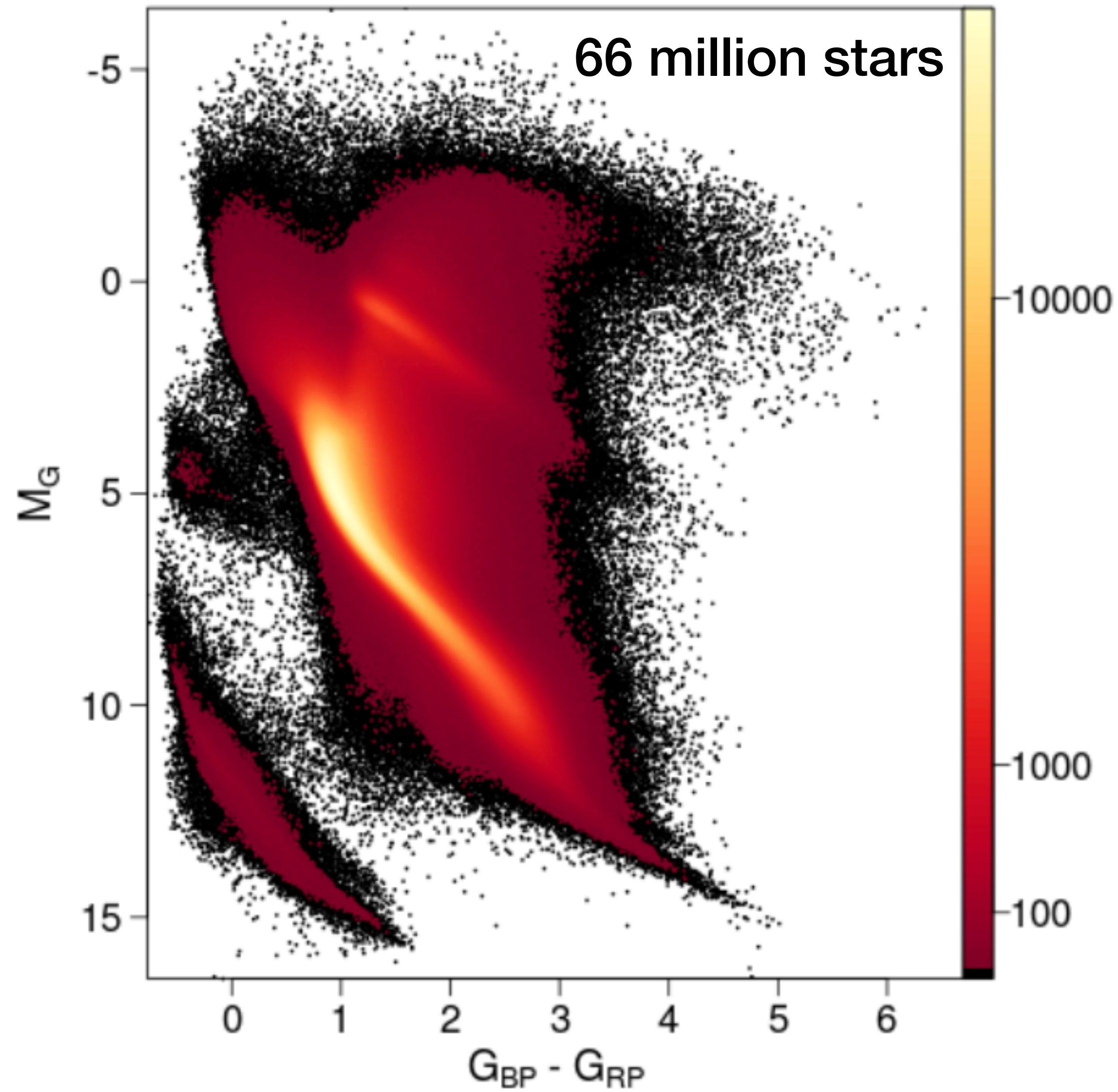
Color (B-V) - Magnitude (V) Diagram (CMD) version



Globular Cluster Color-Magnitude Diagram



Gaia CMDs



Hydrostatic Equilibrium

