Introductory Astronomy

Week 4: Stars

Clip 10: Stellar Stats

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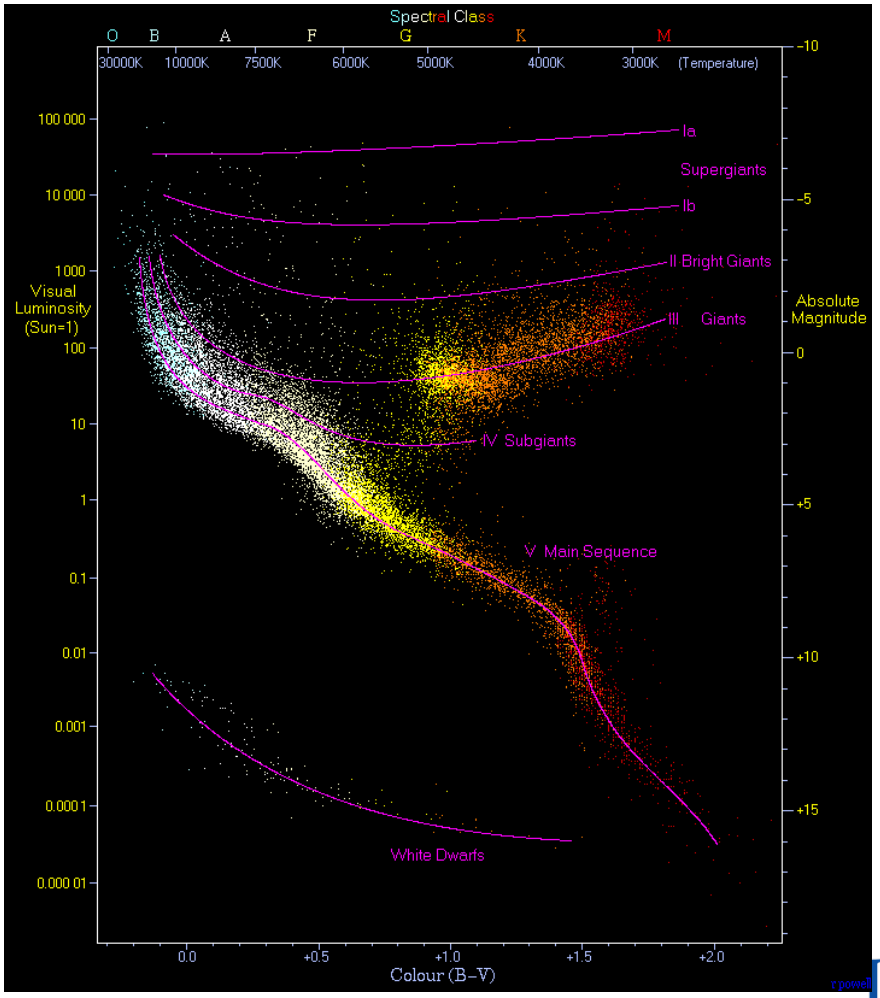
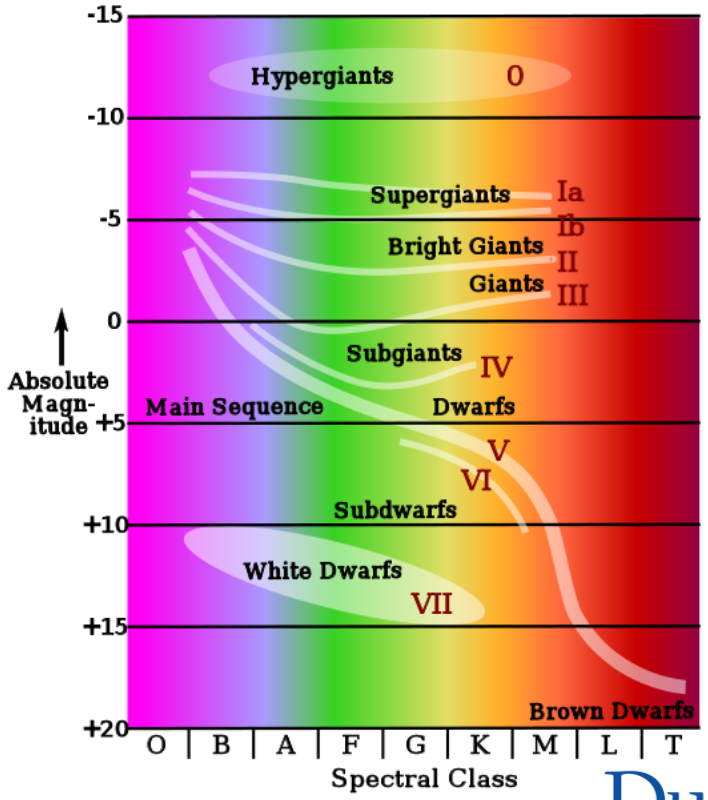
Stellar Statistics

- We can now use all this to study properties of stars as a population
- Luminosity varies hugely
- Radius varies less
- Patterns appear when you arrange it right: Herzsprung-Russell 1910



Luminosity Classes

- How to tell an orange giant from a much smaller orange MS star?
- Morgan, Keenan, Kellerman 1943: Spectral lines for small stars show effects of higher pressure, density
- Sun's spectral class is G2V



Spectroscopic "Parallax"

- From spectrum can obtain spectral class
- Extract luminosity from H-R diagram
- Use brightness to find distance
- No parallax

$$\frac{D}{1\,\mathrm{AU}} = \sqrt{\frac{L}{L_\odot}\frac{b_\odot}{b}}$$

An Example: Alphecca

- Dim white star. Flux $b_{\alpha CB} = 2.63 \times 10^{-12} b_{\odot}$
- Spectrum classifies it as A0V $T_{\alpha CB} = 9700K$
- Luminosity from HR $L_{\alpha CB} = 74 L_{\odot}$
- Radius:

$$R_{\alpha CB} = \left(\frac{L_{\alpha CB}}{L_{\odot}}\right)^{1/2} \left(\frac{T_{\alpha CB}}{T_{\odot}}\right)^{-2} R_{\odot} = \sqrt{74} \times \left(\frac{9700}{5780}\right)^{-2} = 3R_{\odot}$$

Alphecca

- Distance:

$$D_{\alpha CB} = \sqrt{\frac{L_{\alpha CB}}{L_\odot}\frac{b_\odot}{b_{\alpha CB}}}\,\mathrm{AU} = \sqrt{74/2.63\times 10^{-12}}$$
$$= 5.30\times 10^6\,\mathrm{AU} = 25.7\,\mathrm{pc}$$

- Hipparchos:

$$p_{\alpha CB} = .04365''$$
$$D_{\alpha CB} = 22.9\,\mathrm{pc}$$

- 10% error typical

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Credits

- HR Diagram: R. Powell http://www.atlasoftheuniverse.com/hr.html
- Astronomy Animations: University of Nebraska-Lincoln Astronomy Education Group http://astro.unl.edu/
- Luminosity Classes: Wikimedia/Rursus http://commons.wikimedia.org/w/index.php?title=File:HR-diag-w-text.svg&page=1
- Alphecca Data: ESA/Hipparcos http://www.rssd.esa.int/index.php?project=HIPPARCOS&page=Research_tools HIP 76267

  SIMBAD Database, CDS, Strasbourg, France
  http://simbad.u-strasbg.fr/simbad/sim-fid

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