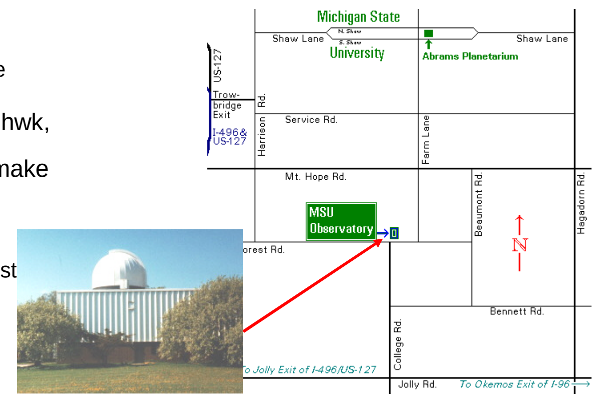
Hot-plate model of stars–March 14

- Test 2 will be "unhidden" on loncapa.msu.edu before end of day.
- Public viewing sessions at MSU campus observatory.
  - Fri & Sat, 9-11pm, if it is not cloudy.
    - Mar 18 & 19
    - Apr 15 & 16
    - May 13 & 14
  - 24-inch telescope in dome
  - small telescopes outside
- Same questions: 100% on hwk, 25% on test. How should homework be changed to make it more useful?
  - Study guide.
  - Write explanation for hwk.
  - If wording in unclear on test question, ask during test.

- Hot-plate model of a star
- Hertzsprung-Russell Diagram
- Dwarfs, giants, & white dwarfs



Observed properties of stars

- Mass
  - Measured in kg or $M_\odot$
  - 0.08-30 $M_\odot$
- Surface temperature
  - 5800K for sun
  - 3000 K for cool star
- Luminosity is amount of energy the star produces in a second
  - Watts=Joules/s or $L_\odot$
  - 40,000$L_\odot$ for Betelgeuse
- Flux or apparent brightness is amount of energy received from the star by a detector in a second.
  - Depends on distance
- Composition: abundances of elements.

Orion constellation
http://lithops.as.arizona.edu/~jill/EPO/Posters/Orion/protoplanets.html

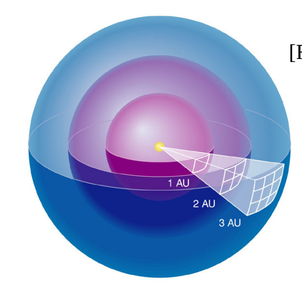
Finding luminosity from flux

- We measure *flux* incident on detector on Earth
  - Energy received/unit time /unit area
- We want to know *luminosity*
  - Energy produced by star/unit time
- Q1. Suppose Betelgeuse is moved closer. S1: Its flux increases. S2: Its luminosity increases. Statements S1 & S2 are
  a. TT
  b. TF
  c. FT
  d. FF

Finding luminosity from flux

[11.1]

- We measure *flux* incident on detector on Earth
  - Energy/unit time /unit area
- We want to know *luminosity*
  - Energy/unit time
- We need to also know the distance D
  - For nearby stars, use method of parallax. (Read about parallax in 11.1)

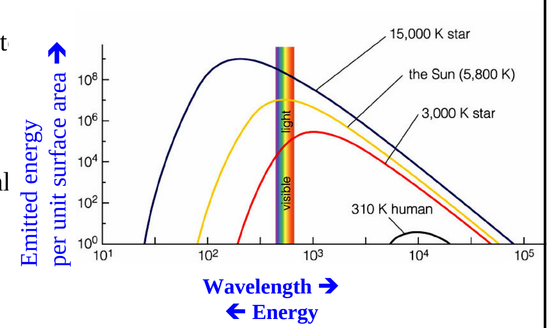


[Fig. 11.1]

$$F = L/(4\pi D^2)$$
$$L = 4\pi D^2 F$$

Hot-plate Model of a Star

- A hot plate emits light as a blackbody. The key paramet are
  - Temperature
  - Area
- A star is a really hot and real big hot plate.
- Ingredients
  - Radius: R. Area=4π R^2
  - Temperature: T
  - Distance: D
- Discover the model for flux.



- Q2: Should T, D, & R be in the numerator or denominator?
  a. NNN
  b. NND
  c. NDN
  d. DNN

Hot-plate Model of a Star

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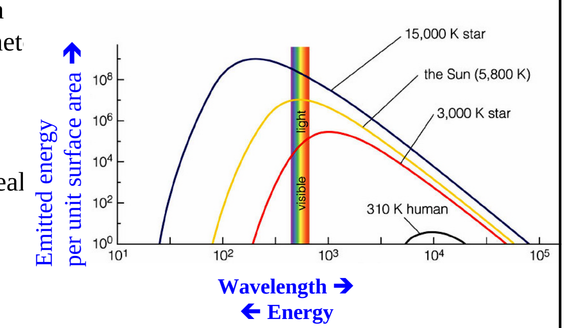
- Ingredients
  - Radius: R. Area=4π R^2
  - Temperature: T
  - Distance: D
- Hot plate model for flux

$$F = R^2 T^4 / D^2$$

Flux = $\text{Radius}^2\ \text{Temp}^4 / \text{Dist}^2$



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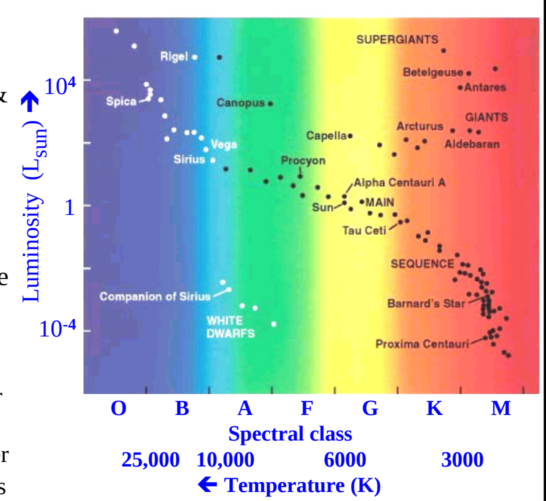
Hertzsprung-Russell (H-R) Diagram [p. 292]

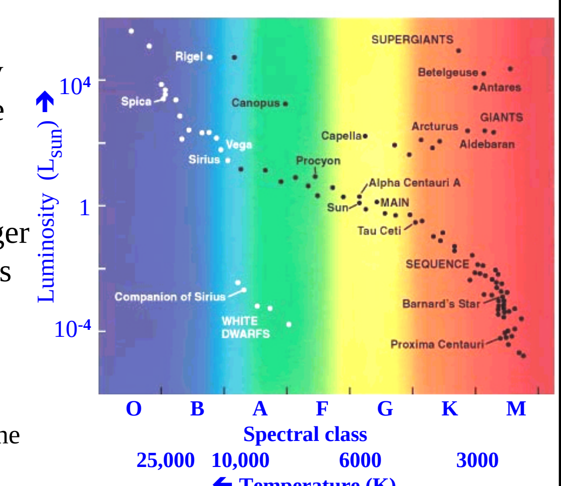
- H-R plotted luminosity vs. surface temperature (1905) & discovered a surprise.
  - Spectral class is a proxy for temperature
  - OBAFGKM. O is hottest
- Q3 Sirius A & Sirius B (companion of Sirius A) have about the same temperature. How can Sirius B be 10,000 times fainter?
  a. Sirius B is 100 times farther away.
  b. Sirius B is 100 times smaller
  c. Sirius A took away the mass
  d. Sirius A took away the light



[see Fig. 11.10]

Hertzsprung-Russell (H-R) Diagram [p. 292]

- H-R plotted luminosity vs. surface temperature (1905) & discovered a surprise.
- Sirius A is slightly larger than the sun. Sirius B is 100 times smaller. The same size as the Earth!
- Stars come in 3 sizes.
  - Main sequence: about the size of sun
  - White dwarf: size of Earth
  - Giants



[see Fig. 11.10]