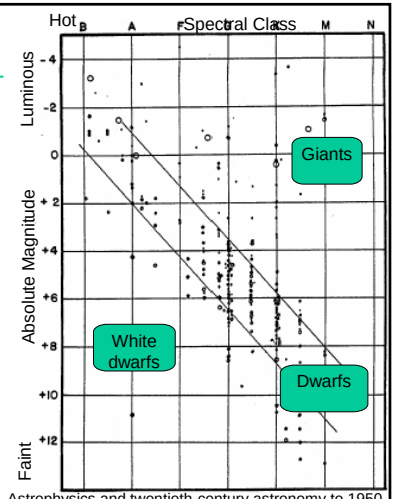
Model of Stars—29 Sep

- Hertzsprung-Russell diagram
- Spectral Class
  - Oh be a fine girl kiss me.
  - Hottest stars on left
- Absolute magnitude measures brightness with all stars placed at same distance
  - Brightest stars on top
- Model
  - Temperature
  - Size (therefore names dwarfs & giants)



Astrophysics and twentieth-century astronomy to 1950, O Gingerich, ed., Cambridge, 1984

The Hot-plate Model of a Star

- The surface of a star is made of tiles of hot plates.
- How does the energy from the hot-plate get to my hand?
  - Key observation: I can hold my hand much closer to the hot plate when it faces to the side, rather than up.

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  - Key observation: I can hold my hand much closer to the hot plate when it faces to the side, rather than up.
- Energy moves from the hot plate to my hand by
  - movement of hot air
  - by radiation (mostly infrared light)

1. How does energy move from the sun to the earth?
   A. By radiation only
   B. By movement of hot air only
   C. Both A & B

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- Energy leaves stars primarily by radiation.
  - For the sun, the radiation is mostly ultraviolet light, visible light and infrared light.
- We concentrate on the radiation produced by the hot plate.

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   A. Make the plates hotter.
   B. Make the plates bigger.
   C. None of the above answers.

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- The luminosity of a star (the energy produced every second) depends on temperature and size.

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1. What can I do to make the same hot-plate at the same setting burn my hand and not burn my hand? (Without modifying the sun, what can I do to make the sun brighter or fainter?)

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- The luminosity of a star (the energy produced every second) depends on temperature and size.
- The flux of a star (the energy received at the earth every second) depends on temperature, size, and distance to the star.

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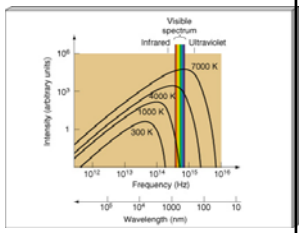
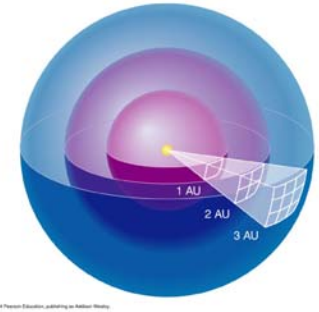
Model of a Star: Thermal Radiation

- Thermal radiation, also called black-body radiation
  - Emitted by everything
  - Brighter for hotter objects
  - Wavelength changes with temperature
    - λpeak ×T=2.9mm K (Wien's Law)
    - For the sun, T=5700K and λpeak =2.9mm/5700K=.0005mm=500nm
    - For a person, T=273+37=310K. λpeak =2.9mm/310K=.01mm (infrared)
- Radiation emitted by black objects does not depend on the material.
  - A "black" object absorbs all radiation
- A star or hot plate emits radiation. Energy emitted per second depends on Area×T^4.



Luminosity & Flux of Stars

- Luminosity = amount of energy per second (Watt) produced by the star
  - $L=R^2T^4$
- Flux = energy per second received by a detector on earth (Watt/m^2)
  - $F=L/D^2$
- At greater distances from star, light is spread over larger area. Flux is lower.



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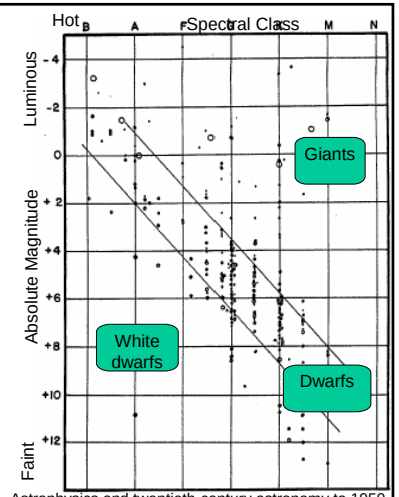
1. Supernova 1987a in the Magellanic Cloud became much, much brighter in one day. What quantity or quantities have changed?
   A. Flux and luminosity
   B. Flux only
   C. Luminosity only
   D. Neither flux nor luminosity

Supernova 1987a in the Magellanic Cloud

Summarizing question

- Hertzsprung-Russell diagram
- Spectral Class is related to temperature
  - OBeAFineGirlKissMe.
  - Hottest stars on left
- How can a star at the same temperature and the same distance as the sun be much brighter?



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