Monday, November 8
The Properties of Stars

The Properties of Stars
Key Concepts

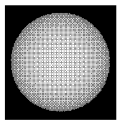
1) The color of a star depends on temperature: cooler stars are redder, hotter stars are bluer.

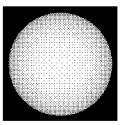
2) The stellar spectral classes (OBAFGKM) form a temperature sequence.

3) Hertzsprung-Russell diagrams plot luminosity vs. color, showing a main sequence of stars.

Stars are dense balls of gas that glow with a color that depends on their surface temperature.

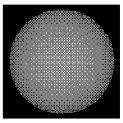
Hot stars appear **BLUE**
(T≈50,000 Kelvin)



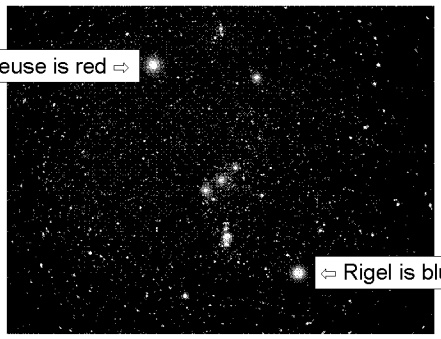


Medium-hot stars appear **YELLOW**
(T≈6000 K)

Cooler stars appear **RED**
(T≈3000 K)



Colors of stars are hard to see with the naked eye; binoculars help, & big telescopes help more.



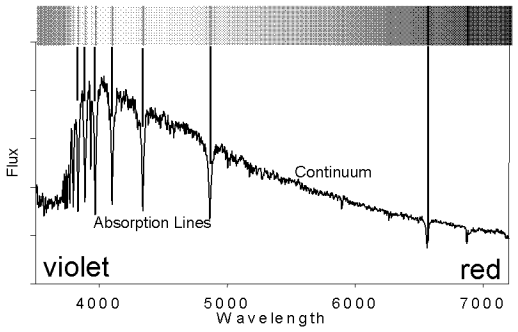
The luminosity (L) of a star depends on its surface temperature and surface area.

Luminosity can be measured in watts, or in units of the Sun's (present-day) luminosity:

1 "solar luminosity" = 1 L_{sun} = 3.8 × 10^{26} watts

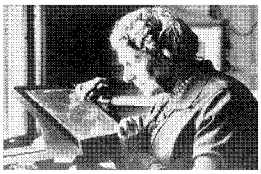
Hotter stars produce more watts per square meter. Larger stars have more square meters of surface area.

The spectrum of a star consists of absorption lines superimposed on a continuum spectrum.



In 1901, Annie Jump Cannon noticed that a star's spectrum depends on its temperature.

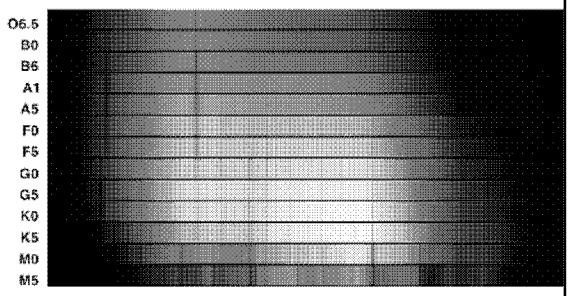
She re-ordered an earlier A-B-C spectral classification scheme, throwing away redundant classes.



She ended with the classes:

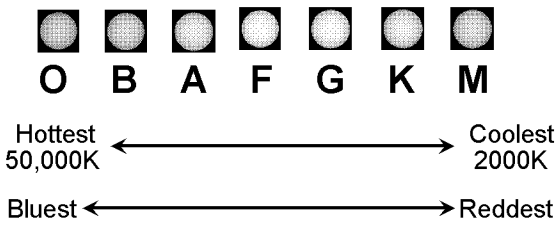
O B A F G K M

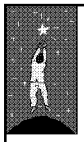
The stellar spectral sequence:



O stars are hottest, M stars are coolest.

The Stellar Spectral Sequence is a temperature sequence, from the hottest (O) to the coolest (M).





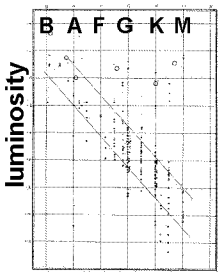
Huge range of stellar luminosities:
10^{-4} to 10^{6} L_{sun}

Moderate range of stellar temperatures:
2000 to 50,000 Kelvin

Large range of stellar radii:
0.01 to 1000 R_{sun}

Fairly large range of stellar masses:
0.08 to 50 M_{sun}

A Hertzsprung-Russell (H-R) diagram plots the luminosity of stars versus their **color** (or equivalently, their **spectral class**).

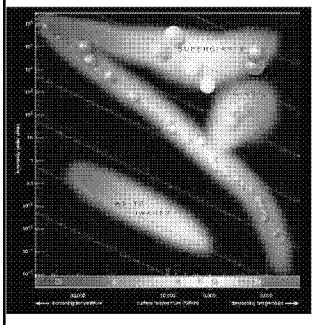


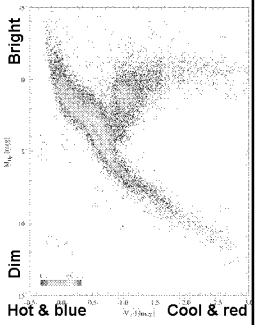
Eljnar Hertzsprung

Henry Norris Russell

Russell's original diagram (1914)

The H-R diagram yields interesting information about the physics of stars.

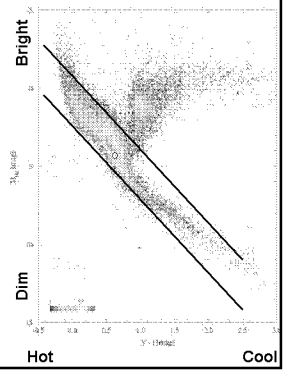




The **main sequence** is a diagonal band on the H-R diagram, containing 85% of nearby stars.

Range of properties:
L = 0.01 to 10^6 L_{sun}
T = 2000 to 50,000 K
R = 0.1 to 10 R_{sun}

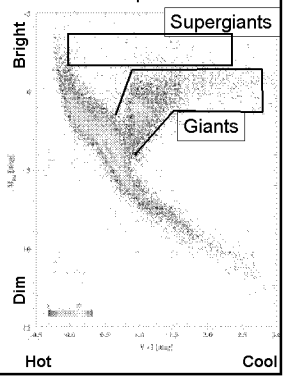
The Sun is a main sequence star.



Giants & **supergiants** are stars more luminous than main sequence stars of the same temperature.

Giants:
R=10 -100 R_{sun}
L=10^3 - 10^5 L_{sun}

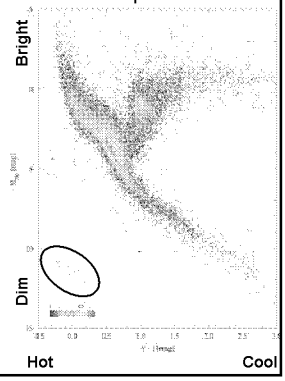
Supergiants:
R > 1000 R_{sun}
L=10^5 - 10^6 L_{sun}



White dwarfs are less luminous than main sequence stars of the same temperature.

To be so dim, despite being white-hot, they must be tiny.

A typical white dwarf is only as big as the Earth.



Sun: **G, main sequence**

Betelgeuse: **M,** supergiant

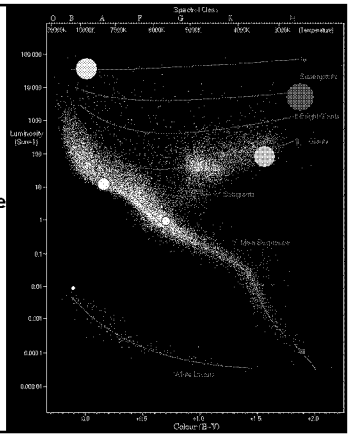
Rigel: **B, supergiant**

Sirius: **A, main sequence**

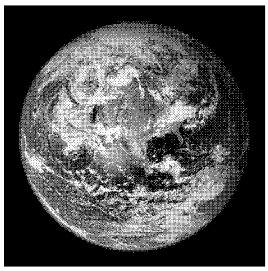
Aldebaran: **K, giant**

Proxima Centauri: **M, main sequence**

Sirius B: **white dwarf**

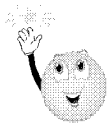


Sirius B
(white dwarf)



Tomorrow's Lecture:

Meet the Neighbors



This Week's Reading:

Chapter 11