Astro 301/ Spring 2005

(46690)

Introduction to Astronomy

Instructor: Professor Shardha Jogee

TAs: Nick Sterling & Nairn Baliber

MWF 12-1 Welch 3.502

Lecture 23,24,25 ; MWF Mar 28,30, Apr 1

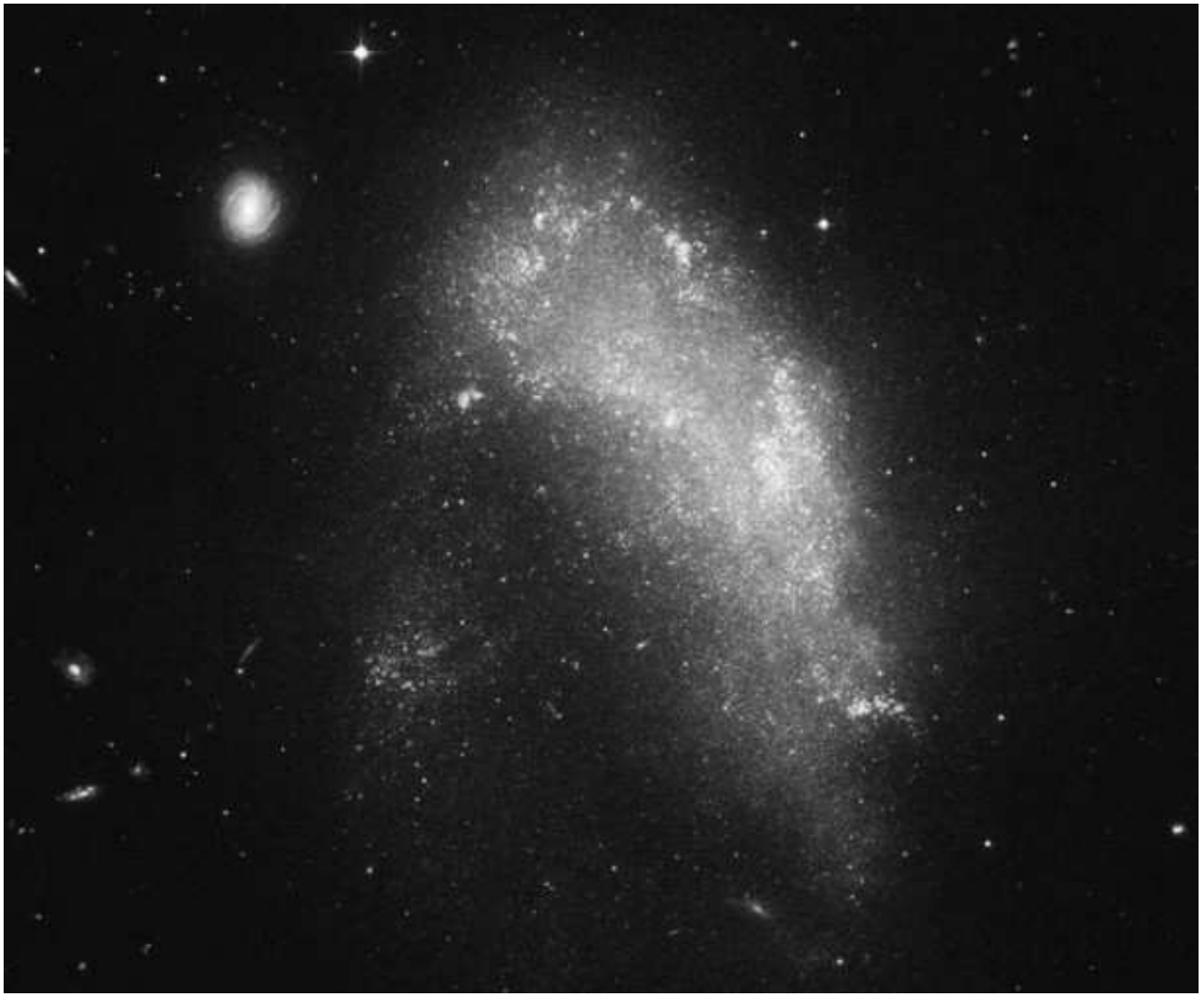
Lecture 23: Announcements

1) 15 min quiz today at start of class

2) Pick up homework 4. Due Monday Apr 4.
   Tip for homework: Read through and ask for help/clarification before the weekend.

3) Quiz/Reading assignment for Wed Apr 6:
   Ch 17, Properties of Stars (Cosmic Perspectives, 3rd Ed)
   Main ideas in “Summary of Key Concepts” at end of chapter.

Lecture 23: Astronomy Picture of the Day



NGC 1427A, an Irregular galaxy…. 20,000 lyr long, like the Large Magellanic Cloud

à It is moving at 600 km/s through Fornax cluster of galaxies.

à The gas between the galaxies exerts pressure on NGc 1427 as it moves,

Properties and Evolution of Stars

Topics to be covered in class this week

- Why do stars look different in the sky?

- Properties of stars: Luminosity, Flux, Temperature, Radius, Color

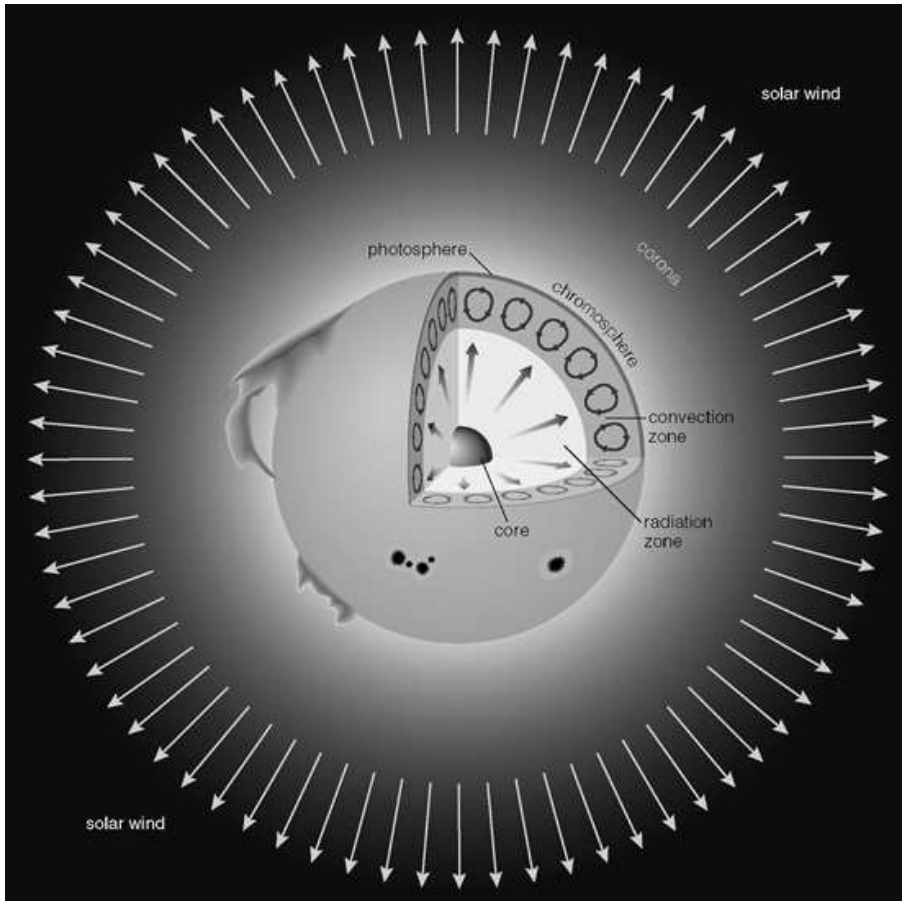
- The Hertzsprung Russell (H-R) diagram….a surprise for astronomers!
  How does a star's luminosity depend on its radius and temperature?
  Different stars on H-R diagram : Main sequence, Giants, Supergiants, White Dwarfs

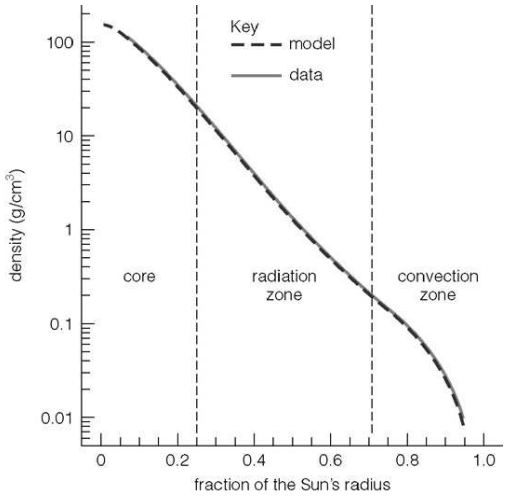
- Mass : the most fundamental property of a star
  How mass determines the lifetime, evolution, destiny, and (L,R,T) of a star!

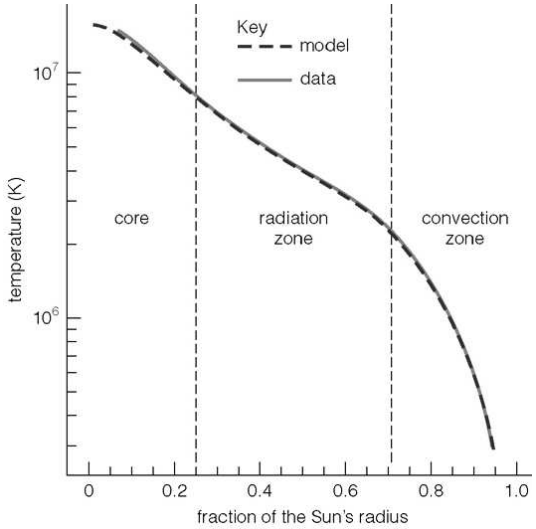
- Evolutionary track of a star on the H-R diagram
  Age-dating the Universe with an H-R diagram !

- How do we measure distance, luminosity, temperature, mass, radius of stars?

Temperature and Radius of a Star

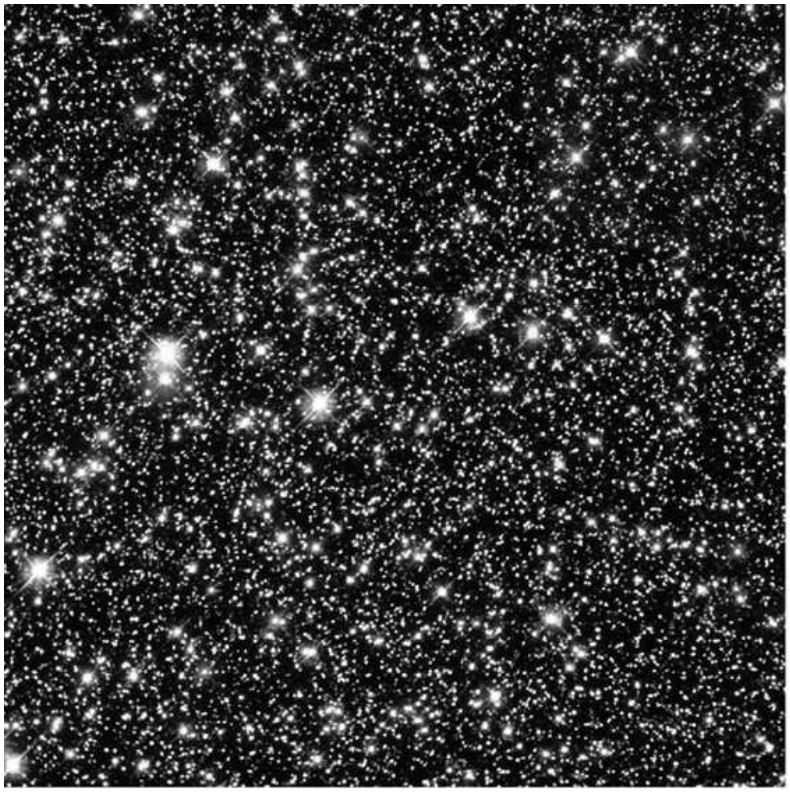




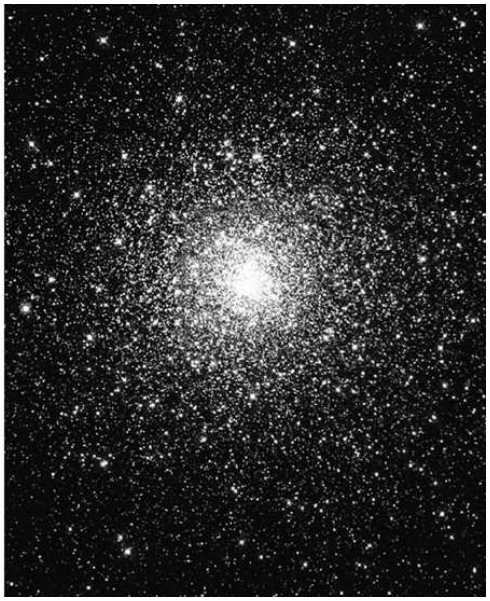


Temperature and radius of a star refer to these quantities as measured at the phtotosphere layer.

Temperature and Color of Stars:



Center of M Way (HST)



M80 globular cluster (HST)

Pleiades

- à Hot stars are blue, cool stars are red (Wien's law). The temperature of the star is set by its other properties such as age. mass
- à Careful: Sometimes dust can cause an intrinsically hot blue star to look red

Temperature and Color of Stars

- Stars produce different combination and strengths of emission and absorption lines from H He Ca, CO2. Were classfiied into spectral types OBAFGKM

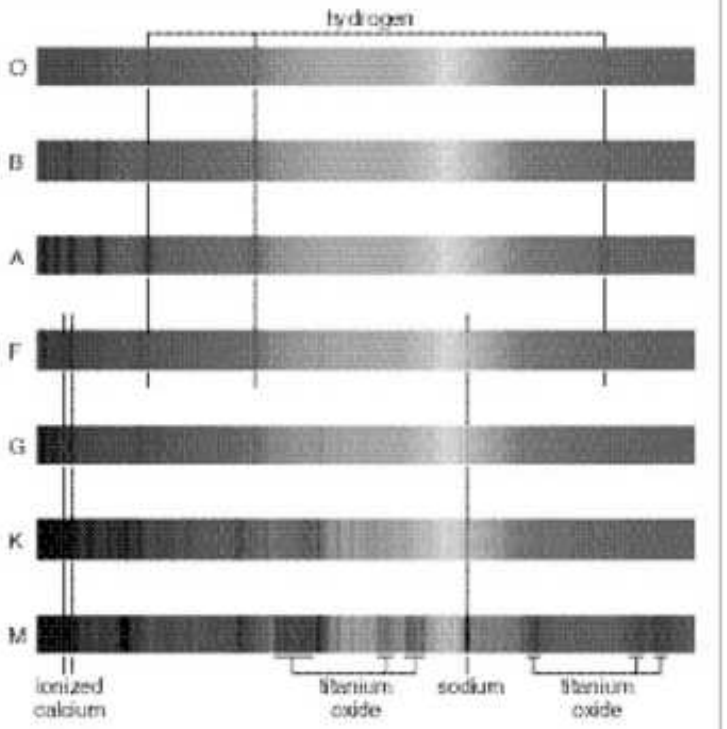
- Mnemonic Oh be a fine girl/guy kiss me
  Only business acts for good. Karl Marx
  Only bungling astronomers forget generally known mnemonics

The computers

Temperature and Color of Stars

Table 16.1 The Spectral Sequence

Spectral Type	Example(s)	Temperature Range	Key Absorption Line Features	Brightest Wavelength (color)	Typical Spectrum
O	Stars of Orion's Belt	>30,000 K	Lines of ionized helium, weak hydrogen lines	<97 nm (ultraviolet)*	
B	Rigel	30,000 K–10,000 K	Lines of neutral helium, moderate hydrogen lines	97–290 nm (ultraviolet)*	
A	Sirius	10,000 K–7,500 K	Very strong hydrogen lines	290–390 nm (violet)*	
F	Polaris	7,500 K–6,000 K	Moderate hydrogen lines, moderate lines of ionized calcium	390–480 nm (blue)*	
G	Sun, Alpha Centauri A	6,000 K–5,000 K	Weak hydrogen lines, strong lines of ionized calcium	480–580 nm (yellow)	
K	Arcturus	5,000 K–3,500 K	Lines of neutral and singly ionized metals, some molecules	580–830 nm (red)	
M	Betelgeuse, Proxima Centauri	<3,500 K	Molecular lines strong	>830 nm (infrared)	



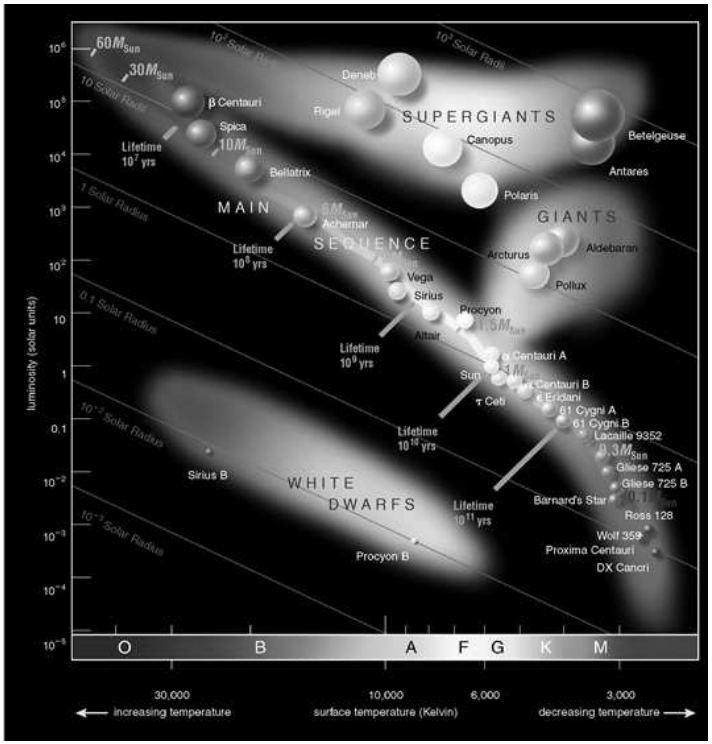
The spectral sequence of OBAFGKM stars was

à initially thought to be a sequence of stars of different chemical composition

à but shown to be a sequence of stars with decreasing temperature T (Cecilia Payne 1925)

The lower T produces different combination and strengths of lines from H He Ca, CO2 and higher λ-peak ('redder colors' cf. Wien's law)

Hertzsprung-Russell (H-R) diagram



Ejnar Hertzsprung

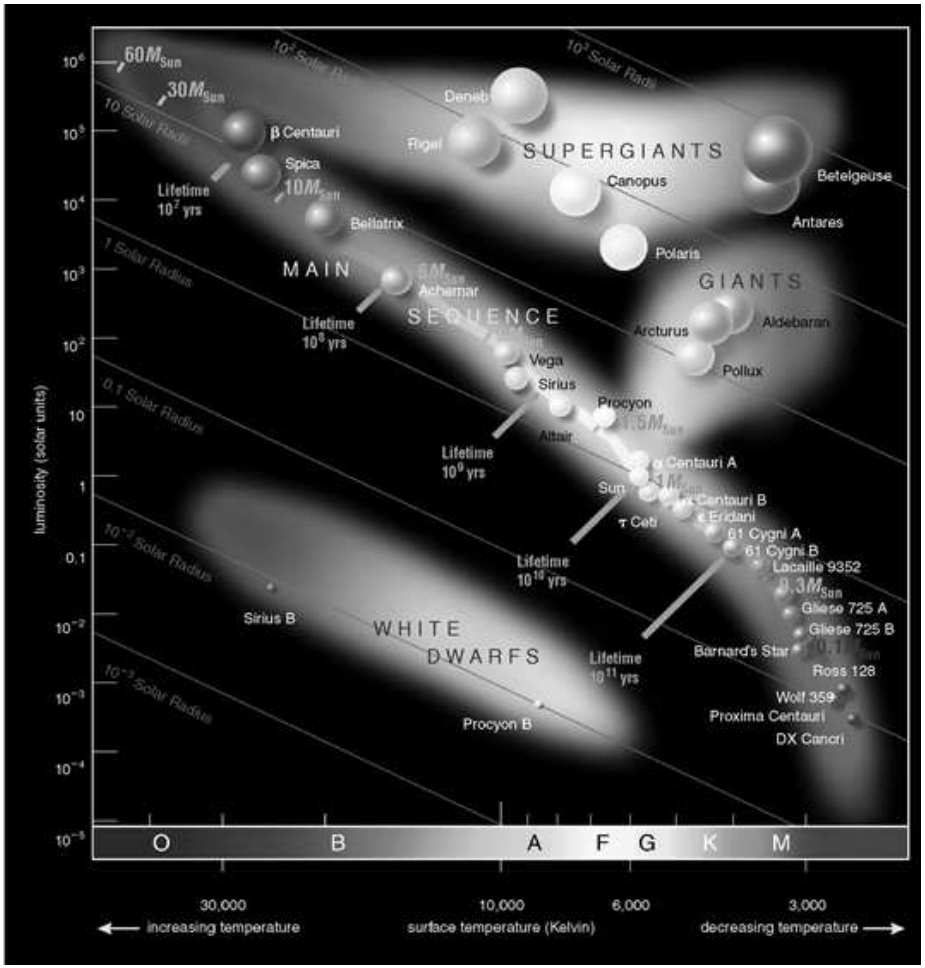
-1937 Bruce medalist
- Danish astronomer

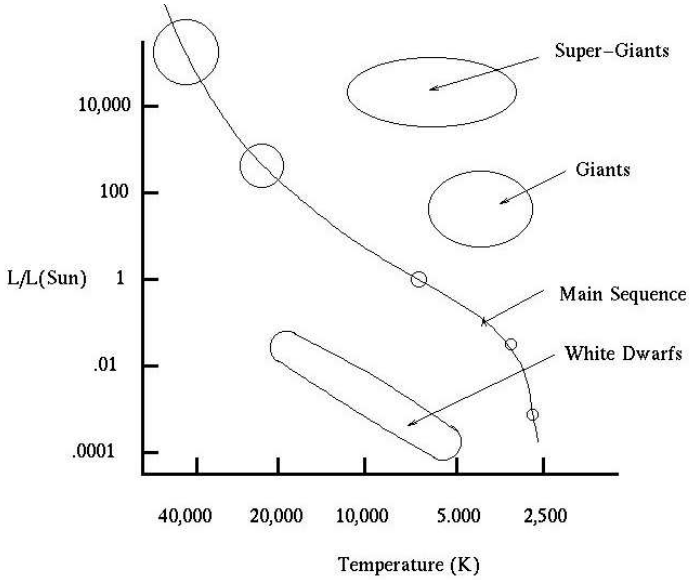
The first H-R diagram was plotted by Hertzsprung in 1911, and (independently) by Russell in 1913

Henry Norris Russell

-1925 Bruce medalist
- Princeton student, professor, observatory director.
- Dean of American astronomers

Hertzsprung-Russell (H-R) diagram





1) The whole (L,T) space is not entirely filled or populated randomly. Instead stars lie in well-defined, distinct regions of (L, T) space implying L and T are intimately tied to each other
2) Can show L is proportional to $R^2 T^4$
3) Different stars (main sequence, giants, supergiants, and white dwarfs) define distinct regions