September 1, 2009

Book - 1 copy on 2 hour reserve in Physics/Math/Astronomy Library - RLM.

Handouts from first class

ABCD answer sheets for One Minute Exams

Moon? Jupiter?

2 minute break after 50 minutes: 1:20

Astronomy in the News? Web, TV

Satellite orbiting Moon lost contact

Shuttle launched, docked with International Space Station

Pic of the Day - shadows on Saturn



- Schedule start with Chapter 5
- Leave room for Chapters 13 and 14 and extra stuff

# Reading: Chapters 1 thru 4 for background plus Chapter 5 - White Dwarfs

Chapters 1 & 2 - AST 301

- ➢ Particles, forces, neutrinos
- Charge repulsion
- > Pressure -
  - Thermal
  - Quantum
- Nuclear Reactions

- Chapters 3 & 4
- Binary Star Evolution
- Accretion Disks

# Will refer to as needed

One minute exams ABCD sheets

Peer interaction

The Universe is a strange place!

It began in a Big Bang, the creation of space and time as we know them,

It has been expanding for 14 billion years,

It is full of dark matter, unlike protons, neutrons, electrons, our stuff, that nevertheless gravitates.

It currently seems to be accelerating in the grip of some antigravitating "dark energy."

On the microscopic scale, which can determine the cosmological scale, nature follows the laws of quantum theory, probability not certainty, quantum jumps, wave-like properties of particles.

Study the stars - see where that leads...

### Background Check

What is a main sequence star?

What is a red giant star?

Write a few sentences, talk with your neighbors.

### Concept Check

What's on the cover of the book?

#### White Dwarfs (Chapter5) Red Giant Main Sequence Main Sequence Hain Sequence Main Sequence

Most common stellar "corpse." Come from low mass stars → plentiful.





Examples of planetary nebulae surrounding new-born white dwarfs





Sky Watch Extra Credit:

Try to find the constellation Lyra, location of the Ring Nebula, Messier 57.

Other planetary nebulae.



Also Moon, Jupiter, Big Dipper for orientation, NSEW, learning to use a star chart,

### White Dwarfs

Essentially every white dwarf formed since beginning of Galaxy is still here 10-100 billion of them (~ 100 billion stars total)

Most are dim, undiscovered, see only those nearby, none naked eye

Sirius, brightest star in the sky, has a white dwarf companion. Can't see the white dwarf with the naked eye, too small, dim, but Sirius is easy if you look for it at the right time.

Find Sirius for the extra credit project.

What do we know about white dwarfs?

Mass ~ Sun Most are single,  $0.6 M_{\odot}$  (solar masses) Some in binary systems, higher mass



### HUGE GRAVITY!



Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

Gravity on surface acts *as if* all mass beneath were concentrated at a point in the center -- Newton/Calculus

Huge gravity compresses a white dwarf -requires special pressure to support it (Chapter 2)

Normal pressure -- thermal pressure
Motion of hot particles -- Pressure depends on Temperature
Quantum Pressure -- Quantum Theory
Uncertainty Principle -- Can't specify position of any particle exactly
Exclusion Principle -- No two identical particles (electrons, protons, neutrons) can occupy same place with same energy

### Figure 1.4





same momentum total exclusion

different momentum





gas dominated by quantum pressure