4/21/06

Exam 4, Friday, April 28

Chapter 9 Sections 6 - 8, Chapter 10, Chapter 11 (Revised, posted Chapters 11, 12).

Extra Credit due Friday, May 5, TYPED HARD COPY PLEASE

News:

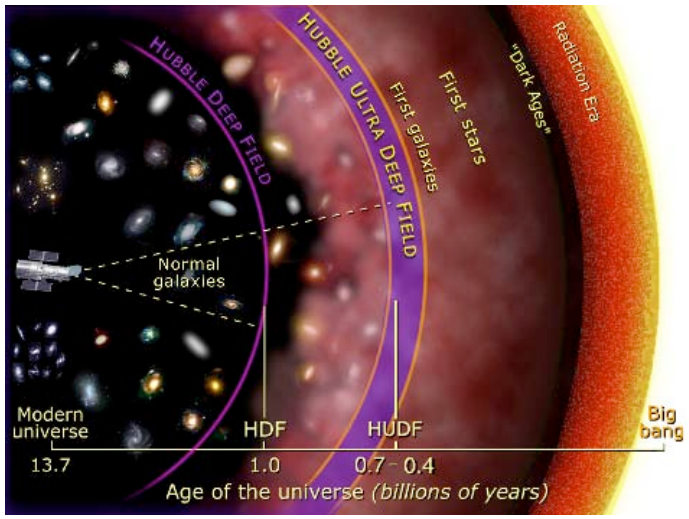
Pic of the day; NGC 253, dusty spiral galaxy with black holes

Gamma-ray bursts are intensely bright lights

Can be seen at great distance

Probe cosmology, the early Universe

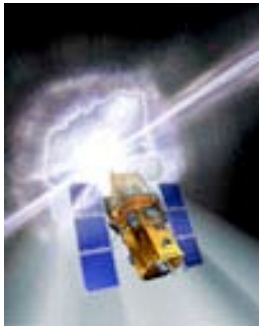
Dark Ages, after the Universe cooled off a million years after the Big Bang, before stars and Galaxies first formed half a billion years later



Gamma-ray bursts could be the first objects seen at the end of the Dark Ages as the first stars are born and die, over 13 billion years ago.

What's Next?

The Swift satellite launched Wednesday, November 17, 2004



Swift discovering a gamma-ray burst every few days!

Detailed follow up taxes all the world's great observatories.

With on-going improvements, the rapid-response, queue-scheduled HET should be well-situated to compete.

Swift can do optical observations, but needs a minute to swivel - too long!

We have joined the U. of Michigan RObotic Transient Source Experiment (ROTSE) collaboration.

Four ROTSE telescopes around the world. Texas, Australia, Namibia andTurkey.

18 inch mirrors, 1.85 degree squared field of view.

ROTSE can point and shoot within 6 secs of electronic satellite notification,take automatic snapshots every 1, 5, 20, 60 secs.

ROTSE will:
Discover the optical transient ***during*** the burst;
Follow the light in unprecedented detail;
Relay the discovery and coordinates to the HET for spectroscopic follow up.

One Minute Exam

It is important to understand that gamma-ray bursts emit their energy in tightly collimated beams because otherwise

A) Estimates of the distance will be wrong

B) Estimates of the mass of the black hole formed will be wrong

C) Estimates of the energy emitted will be wrong

D) Estimates of the type of supernova in which they explode will be wrong.

Latest: GRB 060418

Discovered Monday evening

Peak brightness: about 11th magnitude, one of brightest on record, from about 10 billion light years away

Observed by ROTSE

Spectrum obtained with Hobby-Eberly Telescope: explore the conditions as the intense light impacts the gas around the massive star that exploded

Are they black holes? Why do they jet? Which massive stars do this, and why?

Short, hard bursts

Evidence has gathered that there were two kinds of gamma-ray bursts, most lasted for about 30 seconds, but some lasted only a few tenths of a second (hence short) and had higher energy (hence hard) gamma-rays.

Major advance in summer of 2005. Found first “afterglow” of a few short, hard bursts. They are in distant galaxies, but not as distant as the “regular” bursts, not as bright, and they can occur in old galaxies no longer forming stars.

Most popular idea (but with problems): binary neutron stars spiralling together by radiating gravitational radiation and then merging.

http://www.nasa.gov/mpg/135241main_neutronstar4lunch-magic.mov_NASA%20WebV_Oct3.mpg

Chapter 11 Our Expanding Universe

Expanding Universe - we observe all distant galaxies (so far away we cannot sense their individual gravity) moving away from us with speed proportional to distance: as if we were in the center of an explosion.

Our Universe is not a bomb in pre-existing empty 3-D space!

Lesson from Einstein - ***space itself can expand carrying the*** (almost motionless***) galaxies***

All distant galaxies move away from all other distant galaxies.
No galaxy, certainly not us, is in the center.

The result: speed proportional to distance

All 3D space expands - carrying essentially motionless matter (galaxies)

No 3D center, no 3D edge, no 3D outside

As 3D astronomers, we don't have to ask what the Universe is expanding into, but if anything it is a 4 (or more) D hyperspace, just as a 2D balloon expands into 3D hyperspace.

Infinite flat rubber sheet could expand without expanding into any hyperspace (2D embedding diagram example).

Our Expanding Universe

Expanding ***surface*** of a balloon as an example

2D embedding diagram of 3D expanding Universe

No 2D center, no 2D edge, no 2D outside

There is a 3D center, a 3D edge, a 3D outside, in 3D hyperspace