11/10/06

Exam 3, Chapters, 8, 9, 10, This Friday, November 17

Review sheet posted

Review session RLM 4.102 Thursday 5 PM or see me or Sean.

Reading: material on supermassive, intermediate mass black holes in posted revised Chapter 10.

News? More frequent asteroid impacts?

Pic of the day -fogbow

Sky Watch Extra Credit

Link on class web site:

Set-your-own-time star chart, handy for checking when various constellations are “up.”

Have to be explicit in description that you didn’t just “see” the constellation on this web site, but actually went out at night and saw it for real.

Reading:

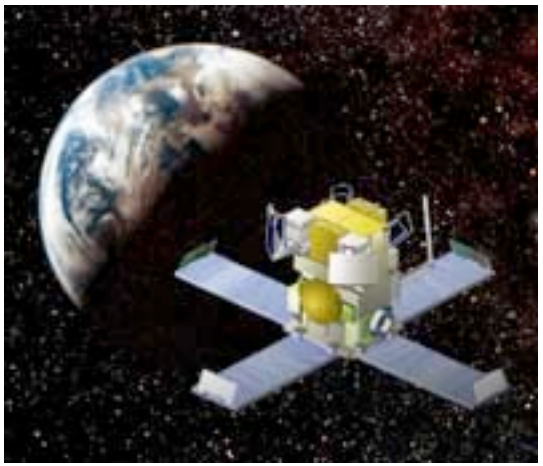
Next topic: Cosmic Gamma-Ray Bursts, part of old Chapter 11 in book, new separate Chapter 11 posted.

Then Supernovae and Cosmology, part of old Chapter 11 in book, new separate Chapter 12 posted.

Cosmic Gamma-ray Bursts

Old Chapter 11, New posted Chapter 11

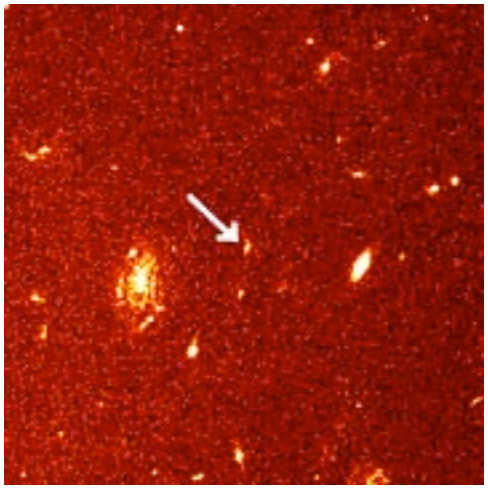
Gamma-Ray Bursts



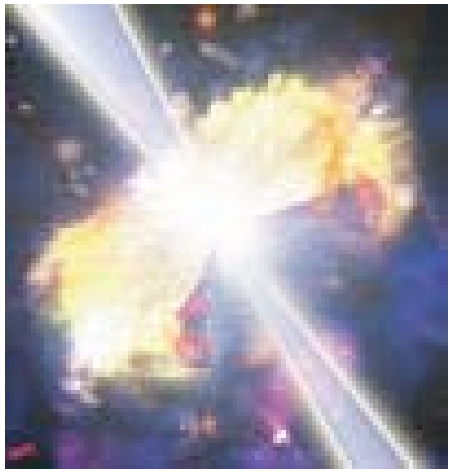
High Energy Transient Explorer

Cosmic explosions, flashes of gamma-rays lasting about 30 seconds, detected by satellites.

Seen across the Universe.



Energy is expelled in narrow jets.
Energy comparable to that of supernovae, but all in gamma-rays, with later ***afterglow*** in X-ray, radio and optical radiation.
Birth of a black hole?

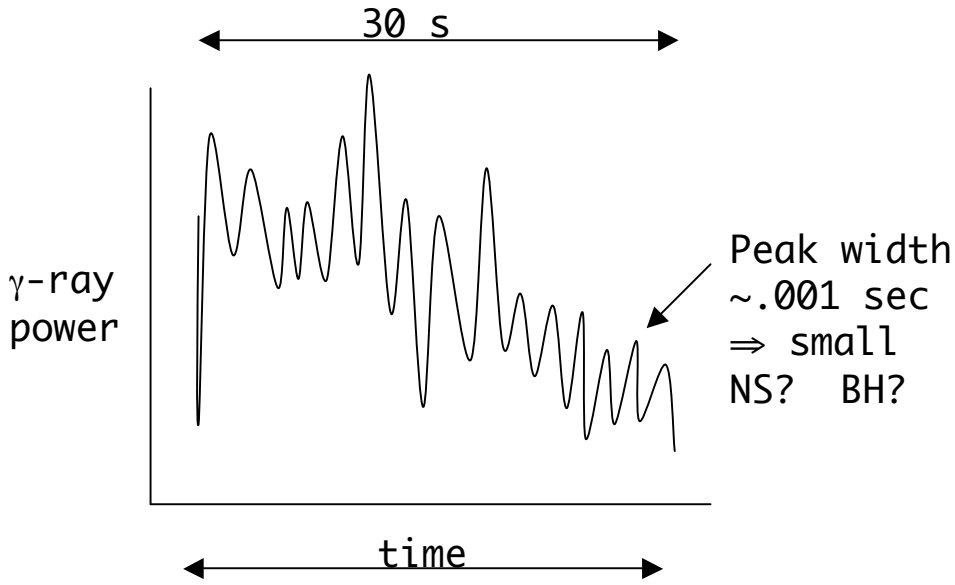


Gamma-Ray Bursts unite ***stars*** and ***cosmology***

Mystery since late 60's - satellites to monitor space nuclear test ban treaty, avoid confusion between astronomical effects, and bombs

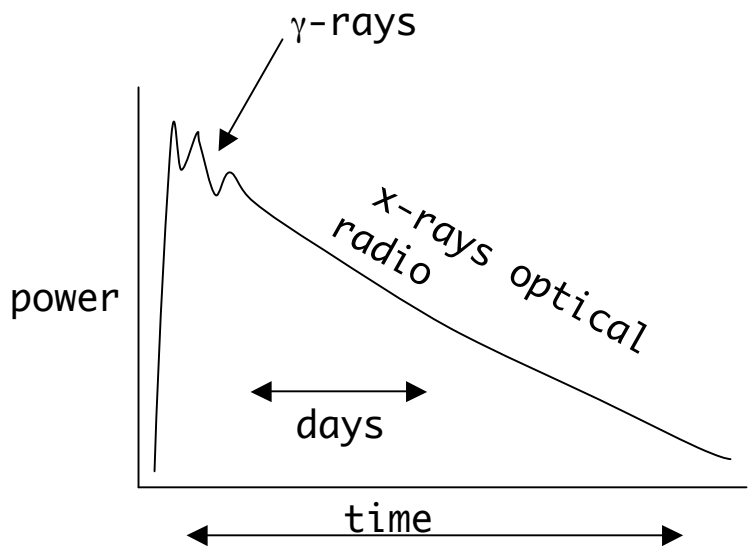
Flare of γ -rays lasts ~ 30 sec

Never Repeat - for 30 years, no optical counterpart,
C*an't focus gamma-rays*.
Did not know which of millions of stars to look at.



Did not know the distance: guesses ranged from within the Solar system to cosmologically distant

Revolution in 1997: 1st detection of "after glow" - optical, radio, X-ray, fading light



Position localized - could bring full armament of modern astronomy to bear on the fading radiation.

⇒Found bursts were in distant galaxies - all at huge, cosmological distances, billions of light years away.

⇒ Very bright to shine that far

January 23, 1999 optical flash associated with the gamma-ray burst itself (need to discover, swivel telescope, look in 30 seconds!)

9th magnitude - human limit 6th magnitude, could almost see with naked eye, could have seen with good binoculars, but half way across the Universe! ***Brightest optical event ever recorded.***

If gamma-ray bursts shine equally in all directions, the energy released in gamma rays would be 3000 × SN or 30 × core collapse neutrinos.

Comparable to total annihilation into pure energy of entire star!

BUT

Light bulb versus laser pointer or flash light

Bursts do not radiate in all directions!

They are strongly focused into jets!

Bursts are focused into only 1/100 to 1/1000 of total sky

Typical gamma-ray burst energy ~ 1/3 supernova kinetic energy

But send matter at 99.997% of the speed of light

Supernova energy into a mass equivalent to Jupiter, not the mass of the Sun, as for supernovae

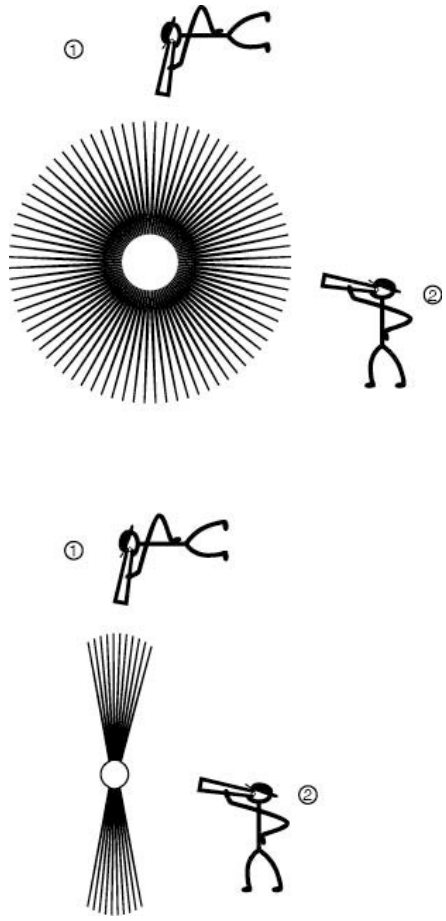


Figure 11.4

They explode ~100 times more often than observed (could observe about 2 per day if looked in all directions, all the time) because most have the jet aimed away from us.

Find all gamma-ray bursts in regions of massive young stars

Something to do with death of massive stars

Explode once every 10^4-10^5 years in a given galaxy versus about once per 10^2 years for ordinary supernovae, so relatively rare.

Most popular guess is that gamma-ray bursts represent the birth of a black hole in the collapse of a massive star (might be a highly magnetized neutron star or *magnetar* - Chapter 8)

Circumstantial evidence for several bursts associated with supernovae.