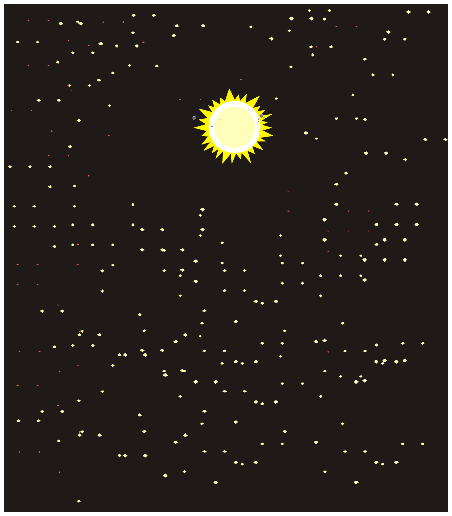
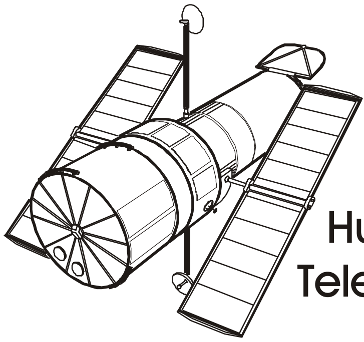
SECONDARY ARTICLE: GAMMA RAY BURSTS



Gamma rays are high-energy, short wavelength radiation. About once a day, the sky lights up with a short spectacular flash, or burst, of gamma rays. The source of the burst then disappears altogether. No one can predict when the next burst will occur or from what direction in the sky it will come. At present, scientists aren't even sure what causes these flashes or how far away they are. They do know that there is an enormous amount of energy in the bursts.

The two most discussed theories about the kinds of objects responsible for gamma-ray bursts are:

- Neutron stars in a big halo that surrounds the outside of our Galaxy.
- Some very, very powerful object that is not necessarily in our Galaxy in great abundance, but which can be found in all galaxies in the Universe.



For a long time, astronomers thought that the sources of GRBs were in our Milky Way Galaxy, which would help explain the enormous amount of energy detected. Scientists, therefore, expected the distribution of GRB locations to be concentrated along the galactic plane. The galactic plane is where most of the stars are located in our Galaxy, and it was believed that a GRB had to be related to some stage of the life of a star.

However, this is not what scientists see. Bursts occur randomly all over the sky. This makes it very hard for scientists to determine what is causing the GRBs and where to look for the next burst.

One way to discover the kind of object that is responsible for a GRB is to find what is called a 'counterpart' to the burst. The 'counterpart' is an object that is connected to the GRB-emitting object, for example an object in a binary system. It is called a 'counterpart' because it is an object that can be used to study the GRB-emitting object in an indirect way. If scientists can see the counterpart in another part of the electromagnetic spectrum, this would allow them to bring a whole range of science tools to bear on what is causing the GRB, such as spectra, photometry, distance estimates, and comparisons with other objects.

A gamma ray burst on January 23, 1999, had the power of nearly ten million billion suns, and the light grew so bright that anyone gazing at the night sky could have seen it using only a pair of binoculars. The chances were slim, however, that someone would be looking at that exact point in the sky at 4:47 a.m. EST. But thanks to the use of two satellites, a unique ground-based telescope, and the Internet, scientists around the world were able to pinpoint the location of the burst and to monitor it from start to finish. Scientists, using gamma-ray telescopes, detect only a few hundred gamma-ray bursts a year.

Today, two optical counterparts of recent gamma-ray bursts are being closely observed by astronomers. The preliminary results of these observations seem to show that the bursts originate billions of light-years from Earth.

Analysis of a February 2002 burst reveals that the burst object is associated with a faint, fuzzy patch of light dwarfed by the brighter emission of the GRB source. This faint emission is thought by many scientists to be distant galaxy, within which some cataclysmic event led to the GRB. The Hubble telescope allowed astronomers to determine that the source of the burst is not at the center of the galaxy, but is offset, most likely in the disk population of normal stars.

This finding seems to rule out the possibility that gamma ray bursts are powered by massive black holes at the center of galaxies and, instead, suggests that the products of typical stellar evolution, such as colliding neutron stars, are the most likely producers. Our Milky Way could produce a bursting object every few million years, an explosion that, for a few seconds, could out-shine the entire galaxy.

*For more information on GRBs, go to **www.batse.msfc.nasa.gov**.*