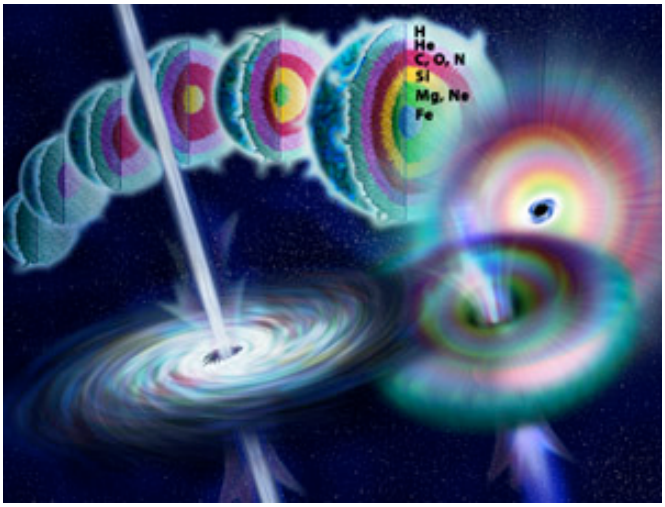
Light from a cosmic “dark age”

Oct. 28, 2009
Courtesy Nature
and World Science staff

Astronomers are reporting the discovery of the most distant object ever discovered, from a time when the first stars were forming.

Two research groups described a gamma-ray burst from a star that died when the universe was 640 million years old, or less than 5 percent of its present age, in this week’s issue of the science journal *Nature*.



A schematic of how a gamma-ray burst originates. Stars shine by burning hydrogen, in a process called nuclear fusion. Hydrogen burning produces helium "ash." As the star runs out of hydrogen (and nears the end of its life), it begins burning helium. The ashes of helium burning, such as carbon and oxygen, also get burned. The end result of this fusion is iron. Iron cannot be used for nuclear fuel. Without fuel, the star no longer has the energy to support its weight. The core collapses. If the star is massive enough, the core will collapse into a black hole. The black hole quickly forms jets; and shock waves reverberating through the star ultimately blow apart the outer shells. Gamma-ray bursts are the beacons of star death and black hole birth. (Credit: Nicolle Rager Fuller/ NSF)

“This observation allows us to begin exploring the last blank space on our map of the Universe,” said Nial Tanvir of the University of Leicester, who led one of the teams.

Dubbed GRB 090423, the record-breaker is an example of the brightest and most violent explosions known. The blast is thought to accompany the catastrophic death of a huge star, and is triggered by the center of the star collapsing to form a black hole.

Although the burst itself occurred about 630 million years after the Big Bang believed to have given birth to our universe, it is so far away that the light from the explosion only arrived at the Earth last April.

“It is tremendously exciting to be looking back in time to an era when the first stars were just switching on,” said team member Andrew Levan of the University of Warwick, U.K.

Much of the light from the burst was in the form of very high energy gamma-ray radiation, which triggered the detectors on a NASA satellite called Swift.

Following an automatic announcement from Swift several of the world's largest telescopes turned to the region of the sky within the next minutes and hours and located the afterglow of the burst. Analysis revealed that the afterglow was seen only in infrared light and not in the normal optical. This was the clue that the burst came from very great distance, astronomers said.

Beyond the mere breaking of a record, the age of the newly detected object opens a window into a cosmological era that has not previously been accessible to observation. The cosmic "Dark Ages" are thought to have ended about 800-900 million years after the Big Bang. That's when light from stars and galaxies electrically charged, or "re-ionized," gas pervading the Universe. This process also made the gas, and thus the universe itself, more transparent, leading it to have the characteristics we see today.

As more gamma-ray bursts are detected from these early times, it should be possible to trace the progress of this re-ionization, astronomers say.

Gamma-ray bursts are the Universe's most luminous explosions. Most occur when massive stars run out of nuclear fuel. As their cores collapse into a black hole or neutron star, gas jets—driven by processes not fully understood—punch through the star and blast into space. There, they strike gas previously shed by the star and heat it, which generates short-lived afterglows.

The "redshift" of GRB 090423, a gauge of its distance, is estimated at 8.2. Redshift indicates how much the light from the object has been "stretched" because of the expansion of the universe, which is most apparent at great distances. The previous record holder for a distant gamma-ray burst had a redshift of 6.7, which placed it 180 million light-years closer than the newfound one. A light-year is the distance light travels in a year.