Blast lights up invisible galaxy from “dark ages”

Aug. 6, 2013
Courtesy of the Harvard-Smithsonian
Center for Astrophysics
and World Science staff

More than 12 billion years ago a star exploded, ripping itself apart and blasting its remains outward in twin jets at nearly the speed of light. At its death it glowed so brightly that it outshone its entire galaxy by a million times. This brilliant flash traveled across space for 12.7 billion years to a planet that hadn’t even existed at the time of the explosion—our Earth.

By analyzing this light, astronomers learned about a galaxy that was otherwise too small, faint and far away for even the Hubble Space Telescope to see.

This artist's illustration depicts a gamma-ray burst illuminati clouds of interstellar gas in its host galaxy. By analyzing a recent gamma-ray burst, astronomers were able to learn about the chemistry of a galaxy 12.7 billion light-years from Earth. They found it contains only one-tenth of the heavy elements (metals) found in our solar system. (Credit: Gemini Observatory, art-work by Lynette Cook)

“This star lived at a very interesting time, the so-called dark ages just a billion years after the Big Bang,” said Ryan Chornock of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., lead author of a report on the findings. The Big Bang is an explosive event believed to have created the universe itself.

“In a sense, we’re forensic scientists investigating the death of a star and the life of a galaxy in the earliest phases of cosmic time,” he added.

The star announced its death with a flash of gamma rays, an event known as a gamma-ray burst. This one was classified as a “long” burst since lasted for more than four minutes. NASA’s Swift spacecraft detected it on June 6. Chornock and his team quickly organized follow-up observations

by the MMT Telescope in Arizona and the Gemini North telescope in Hawaii.

“We were able to get right on target in a matter of hours,” Chornock said. “That speed was crucial in detecting and studying the afterglow.”

A gamma-ray burst afterglow occurs when jets from the burst slam into surrounding gas, sweeping that material up like a snowplow, heating it, and causing it to glow, astronomers say. As the afterglow’s light travels through the dead star’s host galaxy, it passes through clouds of gas. Chemical elements within those clouds absorb light at certain wavelengths, or colors, leaving “fingerprints.” By splitting the light into a rainbow spectrum, astronomers can study those fingerprints and learn what gases the distant galaxy contained.

All chemical elements heavier than hydrogen, helium, and lithium are created by stars, according to astronomers. As a result those heavy elements, which astronomers collectively call “metals,” took time to accumulate. Life could not have existed in the early universe because the elements of life, including carbon and oxygen, did not exist.

Chornock and his colleagues found that their galaxy contained only about one-tenth of the “metals” in our solar system. Theory suggests that although rocky planets might have been able to form, life probably could not thrive yet. “The universe was still getting ready for life. It didn’t have life yet, but was building the required elements,” said Chornock.

At a distance of 12.7 billion light-years, the burst, dubbed GRB 130606A, is one of the most distant gamma-ray bursts ever found. A light-year is the distance light travels in a year. “In the future we will be able to find and exploit even more distant [gamma-ray bursts] with the planned Giant Magellan Telescope,” said Edo Berger of the center, a co-author on the publication.

The team’s results are to be published in the Sept. 1 issue of *The Astrophysical Journal* and are available online