

# Discovery confirms explosive prediction made by astrophysicists in 1999

September 12 2005

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NASA's Swift satellite and ground-based telescopes have discovered the most distant exploding star on record, confirming a 1999 prediction made by University of Chicago astrophysicist Don Lamb and Daniel Reichart, who was then a graduate student at Chicago.

Now a faculty member at the University of North Carolina, Chapel Hill, Reichart led the team that discovered the afterglow of the explosion, called a gamma-ray burst (GRB), which culminated in the confirmation of his and Lamb's earlier prediction.

"This is far and away the most distant explosion ever observed in the universe," said Lamb, the Louis Block Professor in Astronomy & Astrophysics at the University of Chicago. "Dan had to have some good fortune to discover the first one, but it wasn't an accident," Lamb said.

Lamb also lauded Neil Gehrels, who heads the Swift science team. "I'm so thrilled that Swift has made this possible," Lamb said. "It's wonderful to have the premier scientific objective of the mission come to fruition less than a year after launch."

Gamma-ray bursts are the birth cries of black holes, signaling the deaths of massive stars. They are the most powerful explosions in the universe, lasting anywhere from fractions of a second to many minutes. They occur almost daily, come from any direction in the sky, and are followed by afterglows that are visible for a few days at X-ray and optical wavelengths.

In astronomical terms, the Sept. 4 GRB has a redshift of 6.29. Redshift is a measure of the amount that light from a distant object is shifted toward the red end of the light spectrum by the expansion of the universe. The higher the redshift, the greater the distance and the younger the universe was when the light was emitted.

A redshift of 6.29 translates to a distance of approximately 12.6 billion light years from Earth. Lamb and Reichart had predicted that Swift would be able to detect GRBs at such great distances at a scientific meeting in 1999, and in a paper published in the June 10, 2000 issue of the *Astrophysical Journal*.

Back then, most astrophysicists thought that the most distant GRBs would be found at a redshift of 2 or 3. Beyond that distance, there would be no GRBs, scientists assumed, because few massive stars would have formed by then.

But Lamb and Reichart's calculations, based on emerging cosmological evidence, showed that the bursts should occur as far away as a redshift of 20, (13.3 billion light years distant). The most distant known object today is a galaxy at a redshift of 6.5 (12.7 billion light years away).

Reichart received his Ph.D. in astronomy and astrophysics from the University of Chicago in 2000, and became determined to find high-redshift GRBs. Using coordinates of the GRB relayed to ground stations by the Swift satellite on Sept. 4, Reichart's team at North Carolina discovered the afterglow of the burst with the Southern Observatory for Astrophysical Research (SOAR) telescope in Chile.

Over the next several nights, his team conducted further follow-up observations with SOAR and the Gemini South Telescope, also in Chile. Also making key follow-up observations was a team led by Nobuyuki Kawai of the Tokyo Institute of Technology, using the Subaru

Observatory in Hawaii.

"This burst smashes the old distance record by 500 million light years," Reichart said. "We are finally starting to see the remnants of some of the oldest objects in the universe."

Lamb anticipates that Swift will detect many more GRBs at even greater distances. "Gamma-ray bursts are uniquely powerful and probably the only way for a very long time to observe the moment of first light, that redshift when the very first stars formed," he said.

In fact, high-redshift GRBs open a whole host of potential studies. Scientists now will be able to begin filling in new details about the star-formation history of the universe and the creation of the heavy elements that were necessary for the emergence of life on Earth. "Now the fun begins," Lamb said.

Source: University of Chicago

Citation: Discovery confirms explosive prediction made by astrophysicists in 1999 (2005, September 12) retrieved 17 April 2024 from <https://phys.org/news/2005-09-discovery-explosive-astrophysicists.html>

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