Star death may explain universe's biggest bangs

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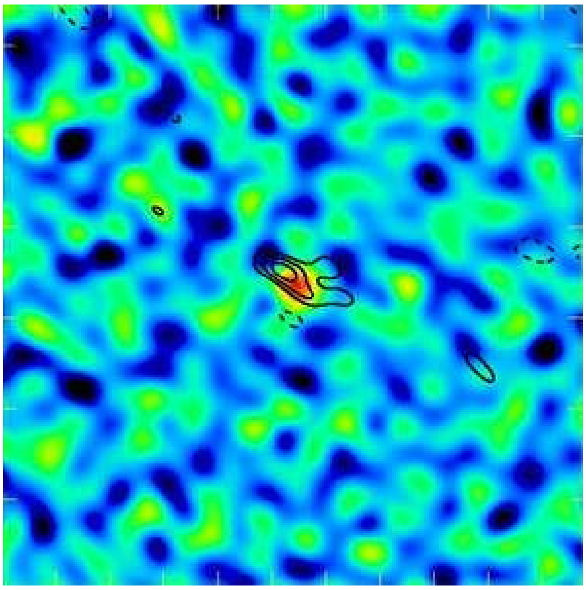

JIVE

Radio telescope data of the oddball supernova SN 2007gr, which behaves somewhat like a gamma-ray burst, without the gamma-rays. The image was taken with the European Very Long Baseline Interferometry Network, with data from the Green Bank Telescope overlaid in the contour lines.

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updated 1:19 p.m. PT, Wed., Jan. 27, 2010

Scientists have observed a peculiar type of star death in deep space that may help explain the most powerful explosions in the universe.

The blast, called a supernova, didn't behave as most such explosions do. In some ways it seemed similar to a sub-class of supernova called **gamma-ray bursts**, which are the most energetic outbursts known, and can accelerate material to extreme speeds.

But instead of a vast amount of high-energy gamma ray light pouring from the star, which would be expected for gamma-ray bursts, the scientists saw the supernova's explosion in lower-energy radio waves.

"We think that radio observations will soon be a more powerful tool for finding this kind of supernova in the nearby universe than gamma-ray satellites," said Alicia Soderberg, of the **Harvard-Smithsonian Center for Astrophysics** in Cambridge, Mass.

Soderberg led the team that observed the blast, using the National Science Foundation's Very Large Array (VLA) **radio telescope** in New Mexico.

"Our observations... provide new clues for the understanding of how supernovae explode, and how some of them may be related to the even more energetic gamma-ray bursts," said co-researcher Zsolt Paragi of the Joint Institute for VLBI (Very Long Baseline Interferometry) in Europe (JIVE), based in the Netherlands.

The new observations showed material expelled from the **supernova explosion**, dubbed SN2009bb, at speeds approaching that of light. This characterized the blast, first seen last March, as the type thought to produce one kind of gamma-ray burst.

Supernovas occur when the nuclear fusion reactions at the cores of very massive stars no longer can provide the energy needed to hold the core up against the weight of the rest of the star, and so the core collapses into a superdense neutron star or **black hole**. Meanwhile, the rest of the star's material is blown out into space in a massive explosion.

Only about one of out of a hundred of this type of supernova produce gamma-ray bursts, though, which are characterized by having an extremely powerful engine that can accelerate some of the ejected material up to nearly the **speed of light**.

Until now, no such "engine-driven" supernova had been found any way other than by detecting gamma rays emitted by it.

"Discovering such a **supernova** by observing its radio emission, rather than through gamma rays, is a breakthrough. With the new capabilities of the Expanded VLA coming soon, we believe we'll find more in the future through radio observations than with gamma-ray satellites," Soderberg said.

The scientists aren't sure why they didn't see gamma-rays coming from this pseudo gamma-ray burst, but suggested that it might just have been a problem of orientation: The gamma-rays in such explosions generally fly out in distinct jet streams, and maybe in this case the jet streams weren't pointed at Earth.

"Another possibility is that the gamma rays were 'smothered' as they tried to escape the star," Soderberg said. "This is perhaps the more exciting possibility since it implies that we can find and identify engine-driven supernovae that lack detectable gamma rays and thus go unseen by gamma-ray satellites."

The researchers reported their findings in the Jan. 28 issue of the journal Nature.

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