Swift Observes An Unusual Bang In The Far Universe

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Almost 40 years have passed since top secret nuclear weapon warning satellites accidentally discovered bursts of high energy gamma rays coming from space. Although many thousands of gamma ray bursts (GRBs) have since been detected, the origin and nature of these bursts is still not well understood.

One example of an unusual gamma ray burst occurred on 1 August 2005, when instruments on board the NASA-UK-Italy Swift spacecraft detected a bizarre GRB, which displayed unprecedented behaviour. Results based on the Swift data were presented yesterday at the RAS National Astronomy Meeting in Leicester by Massimiliano De Pasquale from Mullard Space Laboratory-UCL.

Gamma ray bursts take the form of a brilliant burst of radiation, followed by a slowly fading afterglow. This shallow decay in the X-ray and optical light curve usually lasts for several days after the high energy explosion.

Swift data have shown that, whatever the 'central engine' that powers the GRB may be, it does not switch off after a few seconds, but often produces fast flares of radiation and injects energy into the outflow for hours.

Scientists believe that most GRBs are thought to be the result of a black hole swallowing a large star. This process might take long enough to explain both the prompt emission of X-rays and gamma rays, the late flares and energy injection.

The remaining matter is launched outwards at a huge velocity, but the interstellar medium around the burst acts like a “brake” to this outflow, being heated in the process and producing the afterglow emission.

In the case of the August 2005 gamma ray burst, known as GRB050801 after its date of detection, there was a bright afterglow with a steady emission both in X-ray and optical wavelengths, without any initial, brilliant flare. This behaviour lasted for only 250 seconds after the end of the prompt emission, before the afterglow began the typical decline in brightness. This behaviour has never been observed before.

The flat emission both in X-ray and optical wavelengths gives some hints about the ‘central engine’ of this GRB.

“This feature might be explained if we assume that, rather than a black hole, the core of the star has shrunk its mass and its magnetic field into an object known as a magnetar,” said Massimiliano De Pasquale.

A magnetar is a form of neutron star, the remains of a collapsed star that was originally about 10 times more massive than the Sun. This extremely dense object typically has a radius of only 10 km but the same mass of the Sun.

Magnetars are thousands of times more magnetic than ordinary neutron stars, with a magnetic field 1,000 million million times stronger than the Earth’s. Only a few of these exotic objects are known.

“Such an object initially rotates very quickly, typically hundreds of times every second, but it slows down by irradiating its energy at the magnetic poles, like a lighthouse,” said De Pasquale. “This would keep the afterglow emission steady for a time scale similar to that observed for

GRB 050801.

The joint analysis of data from the XRT and UVOT instruments on Swift has also allowed the team to determine the distance of GRB050801, which was previously unknown, by measuring the amount of light absorbed during its intergalactic travel en route to the Earth.

It turns out that the burst took place 9 billion light-years away, which means that the gamma rays, X-rays and light from the gamma ray burst were created and began their journey across the universe 4,500 million years before the Earth was born.

“The explosion produced the same amount of energy as the Sun produces during its entire lifetime of 10 billion years,” said Massimiliano De Pasquale.

Source: Royal Astronomical Society

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