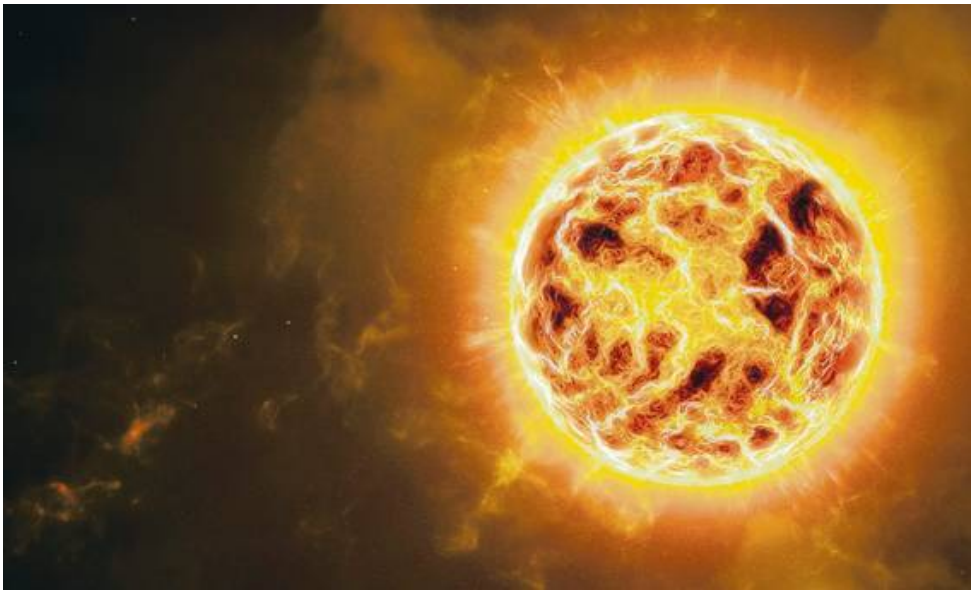
Queen's University Belfast scientists solve riddle of brightest exploding stars in the universe



A graphic impression of a star becoming a supernova

BY LINDA STEWART – 17 October 2013

Rare exploding stars billions of times brighter than our sun have overturned existing theories on how stars die, according to astronomers at Queen's University Belfast.

The scientists have used some of earth's most powerful telescopes to probe the mysterious origins of the brightest stars in the universe – so-called super-luminous supernovae that are much brighter than normal exploding stars.

Until now, astronomers believed that the brightest supernovae were caused by super -massive stars blowing up.

The latest research from QUB suggests that the origins of these unusually bright stars can be explained by an explosion within the star's core which gives rise to a smaller but extremely dense neutron star which has a gigantic magnetic field that spins hundreds of times a second.

These stars are so bright that they can be used as 'torches' to investigate the very distant reaches of the universe, shining a light on what happened shortly after its birth.

The research, published in Nature Magazine today, was carried out by an international team led by Queen's Astrophysics Research Centre using some of the world's most powerful telescopes.

Much of the data was collected using Pan-STARRS – the Panoramic Survey Telescope and Rapid Response System, based on Mount Haleakala in Hawaii.

The astronomers observed two of the universe's most luminous exploding stars for more than a year.

Matt Nicholl, a research student at the Astrophysics Research Centre at Queen's School of Mathematics and Physics and lead author of the study, said: "Super- novae are several billions of times brighter than the sun, and in fact are so bright that amateur astronomers regularly search for new ones in nearby galaxies.

"It has been known for decades that the heat and light from these supernovae come from powerful blast-waves and radioactive material.

"But recently some very unusual supernovae have been found, which are too bright to be explained in this

way.

He explained: "They are hundreds of times brighter than those found over the last 50 years and the origin of their extreme properties is quite mysterious.

"Some theoretical physicists predicted these types of explosions came from the biggest stars in the universe destroying themselves in a manner quite like a giant thermonuclear bomb, but our data doesn't match up with this theory.

"In a supernova explosion, the star's outer layers are violently ejected, while its core collapses to form a super-dense neutron star.

"We think that, in a small number of cases, the neutron star has a very strong magnetic field, and spins incredibly quickly – about 300 times a second.

"As it slows down, it could transmit the spin energy into the supernova, via magnetism, making it much brighter than normal."

The study is one of the projects funded by a prestigious €2.3million grant from the European Research Council.

The money was awarded to Professor Stephen Smartt, director of Queen's Astrophysics Research Centre, in 2012 to lead an international study to hunt for the universe's earliest supernovae.

Prof Smartt said: "These are really special supernovae. Because they are so bright, we can use them as torches in the very distant universe.

"Light travels through space at a fixed speed, as we look further away, we see snapshots of the increasingly distant past.

"Our goal is to find these supernovae in the early universe, detecting some of the first stars ever to form and watch them produce the first chemical elements created in the universe."

The full article is available on Nature magazine's website.

FACTFILE

Supernovae are the brilliant, explosive deaths of stars. For a short time, these explosions can outshine an entire galaxy containing billions of stars. A recently discovered rare class of supernovae, termed "super-luminous supernovae", are the most luminous and most energetic of these explosions. They are 10 to 100 times brighter and more powerful than "normal" supernovae. During their explosion, they emit more light than our sun will emit over its entire 10 billion year lifetime and even more energy.