Breakthrough in puzzle of giant explosions in space

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Astronomers at the University of Hertfordshire have helped to solve one of the longest standing puzzles in astrophysics— the nature of the enormous explosions known as short-duration gamma ray bursts (GRBs).

In a paper to be published in *Nature* tomorrow (15th December), they will reveal that around 15% of short-duration bursts originate from galaxies within 300 million light years of the Milky Way – more than 10 times closer than previously thought.

Dr Nial Tanvir who is leading the Hertfordshire team commented: "GRBs are difficult to observe because they last such a short time, and the signature flash of gamma rays can only be observed by specially-designed satellites."

He claims that this was one of the reasons that the nature of GRBs remained completely enigmatic until 1997, when it was found that at least one variety— the so-called `long-duration' bursts, which last for more than two seconds — arise in very remote galaxies, billions of light years distant, and therefore must be the most violent explosions known.

However, the second variety of GRBs — the short-duration bursts (those lasting less than two seconds) — remained mysterious until earlier this year when a few short bursts were pin-pointed sufficiently well to track down their host galaxies. From looking at the kinds of galaxies the bursts were found in, and the way their light faded away, astronomers have concluded that these events were most likely the result of the merging of

two super-dense objects, called neutron stars.

“Neutron stars are amongst the most bizarre objects known to science and are incredibly dense,” said Dr Robert Priddey, another member of the team. “A tea-spoon full of neutron star material would weigh tens of billions of tons. Their intense gravitational fields provide huge reservoirs of energy which we believe can power GRBs when two neutron stars merge together to form a black hole.”

The Hertfordshire team’s new result adds a further, unexpected twist to the tale: a significant proportion of short bursts seem to originate from galaxies much more local to us than those previously observed. These nearby short bursts, could, like their more distant brethren, result from the catastrophic collision of neutron stars, though if so then their outbursts must be much weaker. Alternatively they could be a fundamentally different kind of explosion. A prime candidate could be an exotic object called a magnetar — a lone neutron star with a magnetic field a hundred thousand billion times that of the Earth - tearing itself apart due to enormous magnetic stresses.

“An example of such an explosion was seen a year ago coming from a magnetar in our own Galaxy, the Milky Way, so it seems reasonable to expect they should occur occasionally in other galaxies too,” said Bob Chapman, a graduate student working on the project as part of his PhD research: “If so, they would look very much like short-duration GRBs.”

“Although we still don’t know for sure what produces the short-duration gamma-ray bursts, this is a crucial breakthrough because in astronomy knowing where something occurs is often the decisive step towards understanding it,” said Dr Andrew Levan, another Hertfordshire astronomer involved in the discovery.

Source: University of Hertfordshire