Powerful Bursting Radio Source Discovery Points to New Class of Astronomical Objects

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Astronomers at Sweet Briar College and the Naval Research Laboratory have detected a powerful new bursting radio source whose unique properties suggest the discovery of a new class of astronomical objects. The researchers have monitored the center of the Milky Way Galaxy for several years and reveal their findings in the March 3, 2005 edition of the journal, "Nature."

Image: An image of the new source located below a large expanding ring of debris from a supernova remnant. The plot below is a radio light curve

of the five detected bursts occurring every 77 minutes.

Principal investigator, Dr. Scott Hyman, professor of physics at Sweet Briar College, said the discovery came after analyzing some additional observations from 2002 provided by researchers at Northwestern University. "We hit the jackpot!" Hyman said referring to the observations. "An image of the Galactic center, made by collecting radio waves of about 1-meter in wavelength, revealed multiple bursts from the source during a seven-hour period from Sept. 30 to Oct. 1, 2002 - five bursts in fact, and repeating at remarkably constant intervals."

Hyman, four Sweet Briar students, and his NRL collaborators, Drs. Namir Kassim and Joseph Lazio, happened upon transient emission from two radio sources while studying the Galactic center in 1998. This prompted the team to propose an ongoing monitoring program using the National Science Foundation's Very Large Array (VLA) radio telescope in New Mexico. The National Radio Astronomy Observatory, which operates the VLA, approved the program. The data collected, laid the groundwork for the detection of the new radio source.

"Amazingly, even though the sky is known to be full of transient objects emitting at X- and gamma-ray wavelengths," NRL astronomer Dr. Joseph Lazio pointed out, "very little has been done to look for radio bursts, which are often easier for astronomical objects to produce."

The team has monitored the Galactic center for new transient sources and for variability in approximately 250 known sources, but the five bursts from the new radio source, named GCRT J1745-3009, were by far the most powerful seen. The five bursts were of equal brightness, with each lasting about 10 minutes, and occurring every 77 minutes.

The source of the bursts is transient Hyman noted. "It has not been detected since 2002 nor is it present on earlier images."

Although the exact nature of the object remains a mystery, the team members currently believe that GCRT J1745-3009 is either the first member of a new class of objects or an unknown mode of activity of a known source class.

One important clue to understanding the origin of the radio bursts is that the emission appears to be "coherent," Hyman said. "There are very few classes of coherent emitters in the universe. Natural astronomical masers - the analog of laser emission at microwave wavelengths - are one class of coherent sources, but these emit in specific wavelengths. In contrast, the new transient's bursts were detected over a relatively large bandwidth."

In addition to these intriguing properties, NRL astronomer Dr. Paul Ray and colleague, Dr. Craig Markwardt of NASA's Goddard Space Flight Center, have searched the source for X-ray emission but have not found any convincing evidence. "The non-detection of X-ray emission is intriguing," Ray said. "Many sources that emit transient X-ray flares, such as black hole binary star systems, also have associated radio emission. If upon further observations, X-ray emission is definitively detected or ruled out, this will be a significant help in understanding the nature of this remarkable source."

"Needless to say, the discovery of these transients has been very exciting for our students," Hyman added. Participating in this research program has inspired at least two of Hyman's students - Jennifer Neureuther and Mariana Lazarova - to pursue graduate studies in astronomy.

This project was supported at Sweet Briar College by funding from Research Corporation and the Jeffress Foundation. Basic research in radio astronomy at NRL is supported by the Office of Naval Research.

Further Research: Hyman and his NRL colleagues plan to continue

monitoring the Galactic center and search for the source again with the VLA and other X-ray and radio telescopes. They are also developing (with Dr. Kent Wood of NRL) a model that attempts to account for the radio bursts as a new type of outburst from a class of sources known as "magnetars."

NRL is also contributing to an effort to build the world's largest and most sensitive low-frequency telescope, called the Long Wavelength Array (LWA), which may revolutionize future searches for other radio transient sources. Current plans call for the LWA, which is being developed by the University of New Mexico-led Southwest Consortium, to be sited in New Mexico, not far from the VLA.

"One of the key advantages of observing at long radio wavelengths," explained NRL astronomer, Dr. Namir Kassim, "is that the field-of-view is so large that a single observation can efficiently detect transient phenomena over a large region."

"When completed, the LWA may uncover hundreds of previously unknown radio transients, some of which may be examples of Jupiter-like planets orbiting other stars," Kassim added. Jupiter is the most famous example of a nearby radio transient.

Source: Naval Research Laboratory