Research sheds new light on neutron stars (w/ Video)

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(PhysOrg.com) -- Research by Michigan State University scientists has shed new light on the properties of neutron stars, galactic oddities that are formed when a large star runs out of fuel and collapses.

Writing in the journal Physical Review Letters, researchers at MSU's National Superconducting Cyclotron Laboratory detail a new model they developed for highly magnetized neutron stars known as magnetars.

Using this new model, which analyzed X-ray bursts from the magnetars, the researchers determined that low-frequency X-ray oscillations, released when magnetars undergo powerful seismic eruptions known as "starquakes," are linked to activity in the surface layer of a neutron star.

Video Credit: NSCL/K. Sharghi

"Previous models associate low-frequency X-ray oscillations with the core of a neutron star," said Andrew Steiner, postdoctoral research associate at the NSCL and a co-author of the study. "We believe they result from motions in the crust."

Starquakes are triggered by the rapid decay of a magnetar's massive magnetic field. This decay causes the dense, solid crust of a neutron star to rupture and release violent bursts of X-rays and gamma rays.

Although it is unclear how X-rays are generated from starquakes, the frequency of the pulsating energy waves act as stellar fingerprints that

pinpoint the layer of the star set in motion by the burst.

“This helps us to form new theories about the properties of neutron stars, including the nuclear physics of the crust,” said Steiner.
“We haven’t shown that the previous theory was incorrect,” said Anna Watts, assistant professor at the Anton Pannekoek Institute at the University of Amsterdam and a co-author of the study. “What we have done however is to shake up assumptions about the crust, which we thought was well understood.”

Scientists have modeled the X-ray oscillations resulting from starquakes since mid-1990. However, assignment of low frequency X-rays - that oscillate at 20 Hz and lower - to the core resulted in problematic constraints on the models’ predictive capability.

“The seismic modeling that had been done using old crust models had implied a worryingly low mass for the neutron star,” said Watts. “Our new models permit higher masses, more in line with theoretical expectations.”

Reassignment of the 20 Hz frequency to the crust in the new model seems to resolve this issue. However, additional factors related to neutron star properties exist that must feed into the new model to reduce any uncertainty, says Watts.

Provided by Michigan State University (news : web)