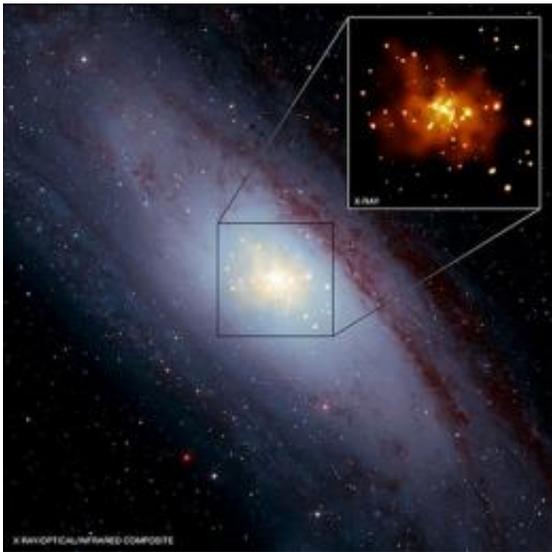


Chandra Reveals Origin of Key Cosmic Explosions

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Composite image of M31, also known as the Andromeda galaxy. Image credit: X-ray: NASA/CXC/MPA/ M.Gilfanov & A.Bogdan; Infrared: NASA/JPL-Caltech/SSC; Optical: DSS

(PhysOrg.com) -- New findings from NASA's Chandra X-ray Observatory have provided a major advance in understanding a type of supernova critical for studying the dark energy that astronomers think pervades the universe. The results show mergers of two dense stellar remnants are the likely cause of many of the supernovae that have been used to measure the accelerated expansion of the universe.

These supernovae, called Type 1a, serve as cosmic mile markers to measure expansion of the universe because they can be seen at large distances, and they follow a reliable pattern of brightness. However, until now, scientists have been unsure what actually causes the explosions.

"These are such critical objects in understanding the universe," said Marat Gilfanov of the Max Planck Institute for Astrophysics in Germany and lead author of the study that appears in the Feb. 18 edition of the [journal *Nature*](#). "It was a major embarrassment that we did not know how they worked. Now we are beginning to understand what lights the fuse of these explosions."

Most scientists agree a Type 1a supernova occurs when a white dwarf star -- a collapsed remnant of an elderly star -- exceeds its weight limit, becomes unstable and explodes. Scientists have identified two main possibilities for pushing the white dwarf over the edge: two [white dwarfs](#) merging or accretion, a process in which the white dwarf pulls material from a sun-like companion star until it exceeds its weight limit.

"Our results suggest the supernovae in the galaxies we studied almost all come from two white dwarfs merging," said co-author Akos Bogdan, also of Max Planck. "This is probably not what many astronomers would expect."

The difference between these two scenarios may have implications for how these supernovae can be used as "standard candles" -- objects of a known brightness -- to track vast cosmic distances. Because white dwarfs can come in a range of masses, the merger of two could result in explosions that vary somewhat in brightness.

Because these two scenarios would generate different amounts of X-ray emission, Gilfanov and Bogdan used Chandra to observe five nearby elliptical galaxies and the central region of the Andromeda galaxy. A

Type 1a supernova caused by accreting material produces significant X-ray emission prior to the explosion. A supernova from a merger of two white dwarfs, on the other hand, would create significantly less X-ray emission than the accretion scenario.

The scientists found the observed X-ray emission was a factor of 30 to 50 times smaller than expected from the accretion scenario, effectively ruling it out. This implies that white dwarf mergers dominate in these galaxies.

An open question remains whether these white dwarf mergers are the primary catalyst for Type 1a supernovae in spiral galaxies. Further studies are required to know if supernovae in spiral galaxies are caused by mergers or a mixture of the two processes. Another intriguing consequence of this result is that a pair of white dwarfs is relatively hard to spot, even with the best telescopes.

"To many astrophysicists, the merger scenario seemed to be less likely because too few double-white-dwarf systems appeared to exist," said Gilfanov. "Now this path to supernovae will have to be investigated in more detail."

In addition to the X-rays observed with Chandra, other data critical for this result came from NASA's Spitzer Space Telescope and the ground-based, infrared Two Micron All Sky Survey. The infrared brightness of the galaxies allowed the team to estimate how many [supernovae](#) should occur.

Provided by JPL/NASA

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