First X-ray detection of a colliding-wind binary beyond Milky Way

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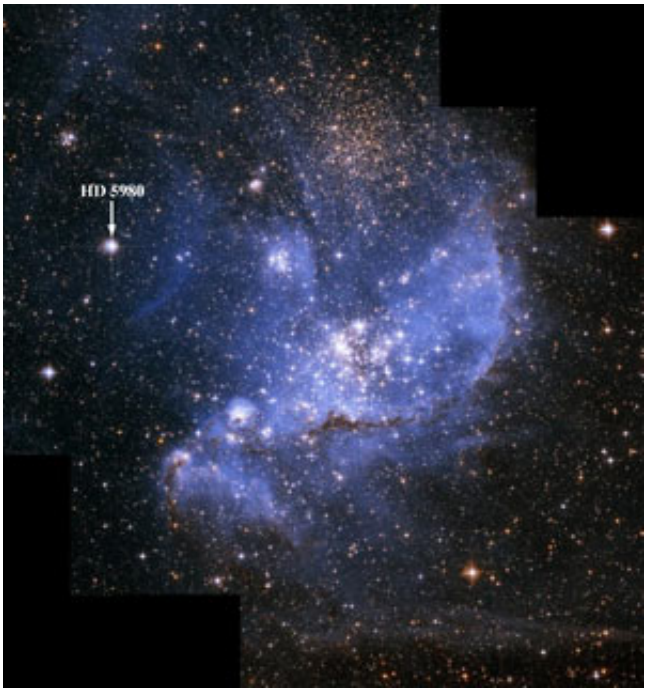

The Hubble Space Telescope captured this image of the Small Magellanic Cloud, a satellite of our Milky Way Galaxy. The arrow indicates the position of HD 5980, which is located near the edge of the star cluster NGC 346. Click image to enlarge. Credit: NASA/ ESA/Antonella Nota (STScI/ESA).

Imagine two stars with winds so intense that they eject an Earth's worth of material roughly once every month. Next, imagine those two winds colliding head-on. Such titanic collisions produce multimillion-degree gas, which radiates brilliantly in X-rays. Astronomers have conclusively

identified the X-rays from about two-dozen of these systems in our Milky Way. But they have never seen one outside our galaxy — until now.

Thanks to the European Space Agency's XMM-Newton X-ray observatory, with help from NASA's Chandra X-ray Observatory, an international team led by Dr. Yaël Nazé of the Université de Liège in Belgium has found such a system in the Small Magellanic Cloud, a dwarf galaxy located about 170,000 light-years from Earth.

The binary star system, known as HD 5980, contains two stars "weighing" about 50 and 30 times the mass of our Sun. Each star radiates more than a million times as much light as the Sun. The sheer photon pressure of this incredible outpouring of light blows off gas from each star in a "wind" that is 5 times faster than the solar wind. Each star's rate of mass loss is about 10 billion times greater than the solar wind.

HD 5980's two stars are separated by only about 56 million miles (90 million kilometers), roughly half Earth's average distance from the Sun. With such close proximity, the winds smash into each other with tremendous force, heating the gas and generating enormous numbers of X-rays. The system emits about 10 times more energy in X-rays alone than the Sun radiates over the entire spectrum.

Using data from Chandra, the same team first reported HD 5980's highly energetic X-ray emission in 2002. But its origin was uncertain. Data taken from 2000 to 2005 with XMM-Newton shows that it is indeed produced by a wind collision. The stars orbit each other every 20 days in a plane that is edge-on to Earth's line of sight, so the stars periodically eclipse each other. The wind collision is thus seen from different angles and through different amounts of material. XMM-Newton saw the X-ray emission rise and fall in a repeating, predictable pattern.

"Similar X-ray variability from massive binaries inside the Milky Way has been detected, but this is the first indisputable evidence for the phenomenon outside our galaxy," says Nazé. "This discovery highlights the great capabilities of modern X-ray observatories."

XMM-Newton has the largest mirrors of any X-ray observatory ever flown, which enabled astronomers to monitor this distant system. HD 5980 itself is embedded inside hot interstellar material that creates a diffuse X-ray glow that makes the object difficult to study. Chandra data enabled the scientists to pinpoint HD 5980 and resolve the system from the diffuse emission.

HD 5980 is one of the Small Magellanic Cloud's brightest stars. Situated on the periphery of the star cluster NGC 346, the two stars are nearing the end of their lives and will eventually explode as supernovae.

"Colliding winds provide an important handle on how massive stars shed material," says team member Dr. Michael F. Corcoran, a scientist with the Universities Space Research Association at NASA's Goddard Space Flight Center in Greenbelt, Md. "Being able to study them in external galaxies means we can study the effects of different compositions and environments on how these massive stars evolve. From the XMM-Newton data, we can study the delicate balance between the two winds, and determine the changing strength of the winds."

The team's paper has been accepted for publication in *The Astrophysical Journal Letters*.

Source: by Bob Naeye, Goddard Space Flight Center

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