

Chandra Observatory reveals new star generation

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Black holes are often regarded as galactic bullies. With an infamous appetite for stars and mayhem, they're nothing but menacing destroyers. Or are they? For the first time, scientists using NASA's Chandra X-ray Observatory have tested and proven how a black hole at the center of the Milky Way is protecting and nurturing a flock of young stars.

Image: Chandra's image of the Galactic Center (left) has provided evidence for a new and unexpected way for stars to form. A combination of infrared and X-ray observations indicates that a surplus of massive stars has formed from a large disk of gas around Sagittarius A*, the Milky Way's central black hole (illustration on right). Credit: X-ray: NASA/CXC/MIT/F.K.Baganoff et al.; Illustration: NASA/CXC/M. Weiss

"Many scientists are going to be very surprised by these results," said



Chandra scientist Rashid Sunyaev.

Called Sagittarius A* ("A-star"), the black hole hosts a ring of stars sitting one light-year from its center, a relatively slim distance in a galactic sense. Until now, why the stars are orbiting so dangerously close to the hole's lethal center was an ongoing debate among astronomers.

Stars are thought to emerge out of clouds of cold, dark gas floating in space. The idea is that at some point, a cloud begins to collapse under its own pull of gravity. As the cloud shrinks, the competition for space inside causes atoms to grow hot enough to start fusing together. The continuing process releases light and heat, and provides enough explosive pressure to halt the cloud's collapse and stabilize its formation into a star.

Black holes, with all of their brooding turmoil, hardly seem a safe place for nurturing stars. "Massive black holes are usually known for violence and destruction," said project lead scientist Sergei Nayakshin. In fact, black holes arise from the death of stars, and have a vicious reputation for light-warping gravity or devouring anything that comes near them. In such an environment, the gas clouds that form stars should be ripped apart by the black hole's tidal forces, which stretch, flatten and accelerate matter at great strength. Given the object's treacherous demeanor, it's a real surprise Sagittarius A* has a maternal side.

"In one of the most inhospitable places in our galaxy, stars have prevailed," said Nayakshin. "It appears that star formation is much more tenacious than we previously believed."

Navakshin and Sunyaev tested a pair of explanations for the black hole's ability to offer safe harbor. In one possibility, known as "the disk model," the gravity of the dense disk of gas that swirls around Sagittarius A* is strong enough to offset the black hole's distorting tidal forces.



With the two forces in balance, gas clouds can naturally settle in and form stars. The second, "migration" option suggests the stars formed in a cluster far somewhere in space and were drawn into the black hole. The migration scenario predicts about one million low-mass stars in Sagittarius A*. The disk model, on the other hand, suggests the number of stars to be well below one million.

To sort out which explanation is likeliest, the two scientists counted the stars around the black hole. They estimated the number of stars in Sagittarius A* by comparing the amount of X-ray light seen around the black hole to the amount emitted from the Orion Nebula, known to have a few thousand stars. The two researchers determined the black hole holds about 10,000 low-mass stars. The relatively low number of stars ruled out the one-million-star migration model and offered solid evidence to support the protective disk concept.

"We can now say that the stars around Sagittarius A* were not deposited there by some passing star cluster. Rather, they were born there," said Sunyaev.

What's more, growing up in the tough neighborhood of a black hole appears to change the stars themselves. Despite their difficult surroundings, stars born in the disks around black holes tend to grow larger or more "massive" than free-floating stars.

Despite the malicious reputation of black holes, NASA's Chandra X-ray Observatory has shown there's a bright side to these dark wonders. Not only is Sagittarius A* proving a stable, nurturing environment for stars to grow up safe and sound, but it's also a place where they develop to be big and strong as well.

Source: Chandra X-ray Observatory (by Charlie Plain)



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