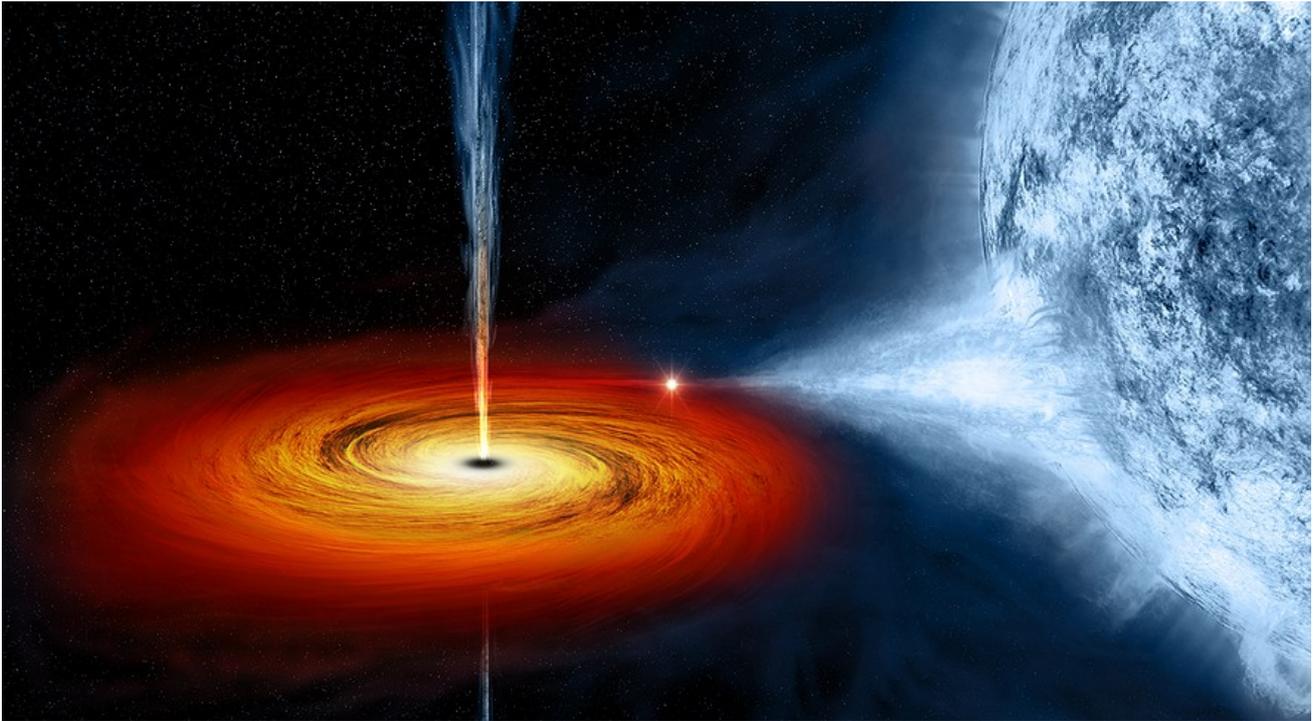


Scientists solving a mystery about black holes

By Los Angeles Times, adapted by Newsela staff on 11.18.13

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An artist's drawing of a different black hole named Cygnus X-1. It formed when a large star caved in. This black hole pulls matter from the blue star beside it. NASA/CXC/M.Weiss

LOS ANGELES — Black holes are regions of space with a gravitational pull so powerful that everything around them gets sucked into them, including light. Astronomers have known for years that hyper-dense black holes also shoot matter into the universe. These high-speed streams are known as relativistic jets. However, nobody knew exactly what type of material the jets were spewing.

Now, that black hole mystery may have been solved.

A team of scientists says it found traces of nickel and iron in the powerful jets shooting out of a black hole called 4U 1630-47. This small black hole is just a few times the mass of our sun.

Their discovery may help solve a scientific puzzle that has been around for years.

What's The Matter In Them?

“It was one of the unsolved questions about relativistic jets produced in the vicinity of black holes,” said astronomer Avi Loeb. “What is their composition?”

Everyone was in agreement that the jets would contain electrons, which have a negative charge. But the jets did not have a negative charge overall. That suggested there was something else in there with a positive charge that canceled it out.

Some models of the jets suggested they were shooting lightweight electrons and positrons away from the black hole and into the universe. Positrons are positively charged and are the opposite of electrons. Unlike electrons, they are not found in normal matter. Instead, they are a part of so-called antimatter. They can also exist on their own, as can electrons.

But other scientists were not convinced: They thought the jets were made of much heavier normal matter.

“Until now, it wasn’t clear whether the positive charge came from positrons, the antimatter ‘opposite’ of electrons, or positively charged atoms” of normal matter, said study coauthor James Miller-Jones. Because the researchers found nickel and iron in the jets, “we now know that ordinary matter must be providing the positive charge.”

Seeking Signatures

It takes a lot more energy to move normal matter than it would to move lightweight electrons and positrons. For this reason, the authors suggest that the high-speed jets are carrying more energy away from the black hole than was previously known.

The study also sheds light on another question: Exactly where do the jets emerge from? It has been unclear whether the jets are caused by the spin of the rotating black hole, or if they come from the disk of matter that surrounds the black hole.

“Our results suggest it’s more likely the disk is responsible for channeling the matter into the jets,” Miller-Jones said. “We are planning further observations to try and confirm this.”

To come to these conclusions, the researchers looked at radio waves and X-rays that were emitted by black hole 4U 1630-47. Different things have different characteristic radio wave and X-ray patterns associated with them. These are known as their signatures. These signatures fall within the complete range or spectrum of possible wave and ray patterns.

The first time the researchers looked, the radio wave spectrum suggested the jets were not on. The X-ray spectrum did not show anything unusual.

“The jets are not always on,” Miller-Jones said. “It depends a little bit on how fast the black hole is feeding.” Black holes can expand — or “feed” — by sucking in matter around them.

Second Time's The Charm

But the second time the team looked, the radio waves seemed to indicate the jets were on. At the same time, the X-ray spectrum picked up the characteristic signatures of iron and nickel. That signal, however, was off just a bit.

The scientists believe the signatures were slightly skewed because of a Doppler-like effect in space.

“Just like a sound wave gets higher as it moves toward you and lower as it moves away from you, we saw the same effect,” Miller-Jones said. “The energy was shifted a little bit to higher energies when it was moving toward us, and lower when it was moving away from us.”

One especially cool result of this effect is that it allowed the researchers to determine how fast the material in the jets was moving. Their finding? A whopping 123,000 miles per second, or about 66 percent of the speed of light.

Quiz

- 1 Which sentence from the section "Second Time's The Charm" does NOT explain why the X-ray signals were slightly off?
- (A) The scientists believe the signatures were slightly skewed because of a Doppler-like effect in space.
 - (B) "Just like a sound wave gets higher as it moves toward you and lower as it moves away from you, we saw the same effect," Miller-Jones said.
 - (C) "The energy was shifted a little bit to higher energies when it was moving toward us, and lower when it was moving away from us."
 - (D) One especially cool result of this effect is that it allowed the researchers to determine how fast the material in the jets was moving.
- 2 What conclusion can be drawn from the following paragraph?
- "The jets are not always on," Miller-Jones said. "It depends a little bit on how fast the black hole is feeding." Black holes can expand — or "feed" — by sucking in matter around them.*
- (A) All black holes behave in the same way.
 - (B) Some black holes have more jets than others.
 - (C) Black holes are constantly changing their characteristics.
 - (D) It is impossible to study a black hole for a long period of time.
- 3 Which paragraph from the section "Seeking Signatures" BEST supports the central idea of that section?
- 4 Which detail LEAST supports the central idea of the article?
- (A) Black holes are regions of space with a gravitational pull so powerful that everything around them gets sucked into them, including light.
 - (B) A team of scientists says it found traces of nickel and iron in the powerful jets shooting out of a black hole called 4U 1630-47.
 - (C) "It was one of the unsolved questions about relativistic jets produced in the vicinity of black holes," said astronomer Avi Loeb.
 - (D) That suggested there was something else in there with a positive charge that canceled it out.