

## Black holes spew out cosmic rays

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Astronomers think they've found where the most high-energy rays in the universe come from, mysterious particles that shoot out of an equally mysterious source: the very biggest black holes. Black holes in the centres of galaxies are known mostly for sucking everything in - even light, which is why no one can see them.

But in the process, they also spew something out: cosmic rays, which likely are bits of torn-apart atoms that shoot across the universe at close to the speed of light.

These are 100 million times more energetic than anything produced by the most powerful particle smashers on Earth, and are even more energetic than the rays from an exploding star.

Bursts of these rays periodically slam into Earth's upper atmosphere, and this collision scatters bits of debris smaller than atoms down to Earth's surface.

Now, astronomers from nearly 90 universities and observatories around the globe have traced the sources of these rays. They say "supermassive" black holes at the centres of galaxies, each holding the mass of several billion stars, are firing out particles and electromagnetic radiation from gamma and X-rays to ultraviolet, visible and infrared light, and radio waves.

The discovery comes from the Auger Collaboration, the international drive to find the origin of these cosmic rays. (Pierre Auger was a French physicist who, in 1938, discovered showers of debris particles from cosmic rays).



*An artist's portrayal of the IC 10 X-1 system shows a black hole at the upper left and its companion star is on the right. Ultra-high energy cosmic rays -- particles that pack the punch of a rifle shot -- make their way to Earth from massive black holes in nearby galaxies, scientists said on Thursday, in a finding that may solve a mystery that has puzzled physicists for decades.*

"They are extremely rare," said astronomer Antoine Letessier-Selvon, spokesman for the international project. On average, each square metre of Earth would be hit by such a ray once per century.

That means detectors have little chance of catching one. Instead they focus on the debris. It's like a rock hitting a window: if you don't notice the rock, you'll notice all the broken glass.

"We see a few particles a year but we don't see them directly. We see their trace in the atmosphere, a cascade of particles that they produce," he said.

"One particle of high energy at the top of the atmosphere creates one billion particles on the ground, each with one billion times less energy."

The streaking ray also produces a trail of light in the air, caused by excited nitrogen atoms. It can be visible if it happens at night.

"We aren't yet sure of what they (rays) are," Letessier-Selvon said. "They could be protons or maybe nuclei (of atoms) like iron."

The findings are published today in the journal Science.

The Auger group set out 1,600 water tanks in rural Argentina with instruments that detect particles from these showers. It recorded 77 cosmic rays with ultra-high-energies, indicating high-energy cosmic rays.

And out of the 27 most energetic rays, 20 come from the direction of the centres of galaxies where the biggest black holes are known to exist. The possibility this could happen by random does exist, but the chances are less than one in 100, the group says.

The highest-energy cosmic ray ever detected was measured in 1991 by the University of Utah's observatory. It had an energy of 300 quintillion (300 billion billion) electron volts. The university says one such particle, smaller than an atom, would feel like a fast-pitched baseball if it could penetrate the atmosphere and hit a person.