How to Get Out of a Black Hole

Scientists now say it's possible as long as you're not in a hurry

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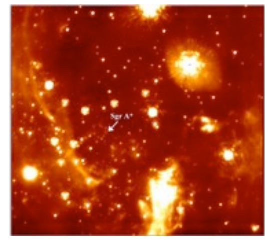

The supermassive black hole Sgr A* located at the center of the Milky Way has about 2.6 million times the mass of our Sun.

The gravitational pull of the largest black holes is equal to that of more than 3 million of our Suns—not even nearly massless light can escape it. According to Einstein's theory of general relativity, the force is so great, whatever falls into a black hole is crushed beyond its very essence into a state that "crosses over" the boundary between something and nothing, never to be seen again.

What's troubled scientists is the ultimate end of matter, or "information"—there isn't a good word for the stuff—runs counter to another well-established law of physics that describes the sub-atomic world in which quantum principles say information can't be destroyed. Both relativity and quantum mechanics work well on their respective large and small scales, but finding a way to reconcile them has been the hobgoblin of modern physics.

The debate plays out dramatically in the gullet of a black hole—what's left of a star after it explodes and caves in on itself in the wake of an indescribably powerful gravity field—which is where physicist Abhay Ashtekar and his colleagues at Pennsylvania State University took it on. They say they have figured out a way information can survive a black hole.

Ashtekar and the others used a type of "physics-math" called quantum geometry, which provides for a repulsive force that counteracts gravity and blurs the boundary between something and nothing. Physicists call that boundary a singularity. Renowned physicist Stephen Hawking suggested years ago that a singularity is the last remnant of a dead black hole, and that it continues holding tightly to the infinitely compressed "information" so it can't escape. Hawking himself renounced the idea in 2004.

"When the Cheshire cat disappeared, his grin remained," Ashtekar said of Hawking's theory of singularities.

According to Ashtekar, quantum geometry suggests that space-time—the sum of the three spatial dimensions plus time—is not a continuum as physicists once believed. Instead, it is made of individual building blocks. At certain resolutions, space-time may appear to be continuous the way a piece of fabric does, even though from other vantage points, we see it is made up of individual threads.

"Singularities are merely artifacts of our insistence that space-time should be described as a continuum," Ashtekar said.

Their calculations thin out space-time to make room for information to "reappear in the distant future on the other side of what was first thought to be the end of space-time," said Madhavan Varadarajan, a professor at the Raman Research Institute in India and one of Vashtekar's collaborators.

The team used a 2-dimensional model of black holes to investigate the quantum nature of real black holes, which exist in four dimensions. That's because 2-dimensional systems are simpler to study mathematically. But because of the close similarities between 2-dimensional black holes and spherical 4-dimensional black holes, the team believes the approach is a general mechanism that can be applied in four dimensions. The group now is pursuing methods for directly studying 4-dimensional black holes.

The finding not only gives the cat his smile back, but perhaps a few more lives. If Chessie has the misfortune of falling into a black hole, whatever remains could gather the wherewithal to crawl back out—but only when the black hole itself dies, which takes a really long time.

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—By Leslie Fink/*NSF*

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