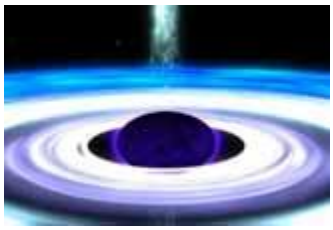

The True Shape of Black Holes

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Scientists and journalists throw the term black hole around as if has great meaning. Then people like Jim Wilkins come along and try to make everything as complicated as it really is.

Wilkins, a reader in Southampton, UK, wrote to ask: "If I had the opportunity to look at a black hole, would it look like a hole all the way around or just a hole above and below a funnel?"

The answer reminds me of favorite question that, as a kid, I'd pose to anyone who would listen: How much dirt is in a hole in the ground measuring 1 foot by 2 feet by 3 feet?

We'll get to that later. Back to the question at hand:

A black hole "is not a hole in the usual sense," says Amy Barger of the University of Hawaii Institute for Astronomy.

"But 'hole' describes one of its most important aspects," Barger continues. "Namely, things that go into a black hole cannot come back out. A black hole is like a one-way valve. When dirt is pitched into a hole in the ground, it stays there. Similarly, anything that enters a black hole stays there."

This incredible trapping effect extends to light, which is why we can't see a black hole.

But light passing *near* a black hole can escape capture and just be bent. That's one way scientists study and characterize the thing they can't see: They examine light coming from bright stars or galaxies behind a black hole, note how much it bends, and make inferences.

Even better, black holes are not as stealthy as one might imagine.

A riot of activity surrounds many of them, in fact, providing further clues to what's actually there. When a black hole consumes matter, it does so rather carelessly. As matter spirals inward and is accelerated to significant fractions of light-speed, it is superheated. A bunch of radiation is created, from radio waves to X-rays, and cast off into space for astronomers to examine.

By these indirect observational means, Barger and other black hole experts learn something about what's going on at the fringes of a black hole, the beginning of the invisible realm, a region they call an event horizon. It is there where things slip into oblivion.

The scientists also glean ideas about what a black hole should look like.

"If we could 'see' black holes, they would be of two different types," Barger says. "One type would have the symmetry of a sphere. The other type would have the symmetry of a top. The latter type of black hole possesses the axial-symmetric shape because it has spin."

Yes, black holes spin. That is no big surprise to astronomers, because stars spin, and stars are the progenitors of one class of black holes, the lightweight versions known as stellar black holes that are ubiquitous through our Milky Way galaxy.

Most descriptions of black holes -- and the illustrations that sometimes accompany them -- depict the objects as spheres and do not mention the alternative look.

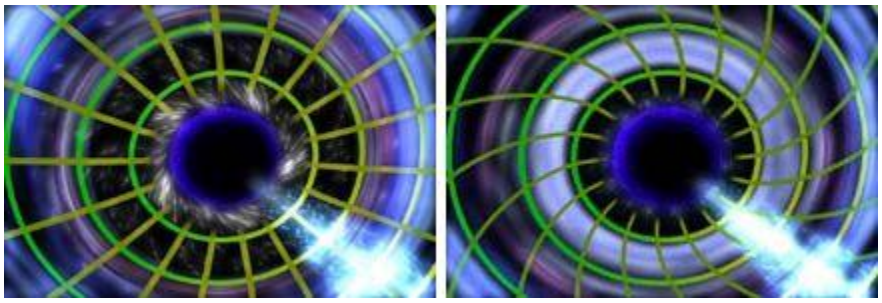
However, we must remain cautious about stating anything as hard fact. Black holes are theoretical. We can't see them, so it's hard to prove beyond all doubt that they exist. No mainstream scientists doubt their existence, but these same scientists remain extremely puzzled about the formation, evolution, and physics of Nature's greatest gravitational beasts.

One theory -- and this is not so farfetched by black hole standards -- suggests there are five dimensions of space-time involved with a nonspherical, rotating, donut-shaped "black ring." Other research, using computer simulations, shows that at the very least, the fabric of space-time is distorted around a spinning black hole.

Black holes, black tops, black rings. Obviously, there are hefty differences between a hole in space and a hole in your backyard.

Perhaps the simplest distinction is this: A black hole can pack the mass of several suns into a region of space comparable to the size of a city. But a 1 foot by 2 foot by 3 hole in the ground -- checking to see if you're paying attention here -- has nothing in it.

Messing with space and time



This artist's concept illustrates the difference between a spinning black hole (right) and one that is not spinning (left). In both computer images, looking down from above, the central dark circle represents the black hole's point of no return, called the event horizon.

The surrounding blue and white rings are hot gas whirling around and toward the black hole, much like water near a bathtub drain. The green grid depicts space-time coordinates, distorted by the spinning black hole at right.

IMAGE: NASA/HONEYWELL MAX-Q DIGITAL GROUP/DANA BERRY