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Breaking Open a Black Hole: The World's Most Dangerous Experiment

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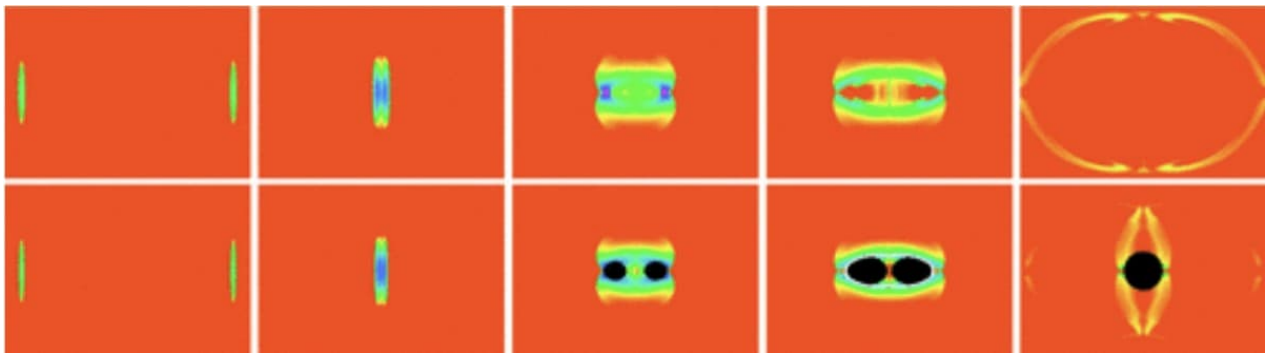
Theme: Science and Medicine
Global Research, November 08, 2019
OilPrice.com 3 November 2019

2012 was a big year for black holes. Or, rather, for our understanding of them. First, Scientific American published a moderately terrifying paper titled "Black Holes are Everywhere" and then a team of researchers at Princeton University numerically solved the Einstein-hydrodynamic equations in order to determine that black holes are, in fact, way easier to create than previously thought.

Their findings showed that the formation of a black hole requires considerably less energy than previous calculations suggested. Meanwhile, perhaps at least partly because of these revelations, concern over the world-destroying possibility–no matter how unlikely–of a man-made particle collider opening up an Earth-swallowing black hole has remained omnipresent in the larger conversation around atomic research.

The "Ultrarelativistic Black Hole Formation" study from Princeton University, published in 2013, developed new computer models which they utilized to show that the formation of a black hole would actually require less than half the energy — 2.4 times less, to be precise — than previous research had determined. The study reports that the researchers found that "the threshold for black hole formation is lower (by a factor of a few) than simple hoop conjecture estimates, and, moreover, near this threshold two distinct apparent horizons first form postcollision and then merge."



Credit: W. E. East and F. Pretorius, Phys. Rev. Lett. (2013)

As a report at Phys.org explains,

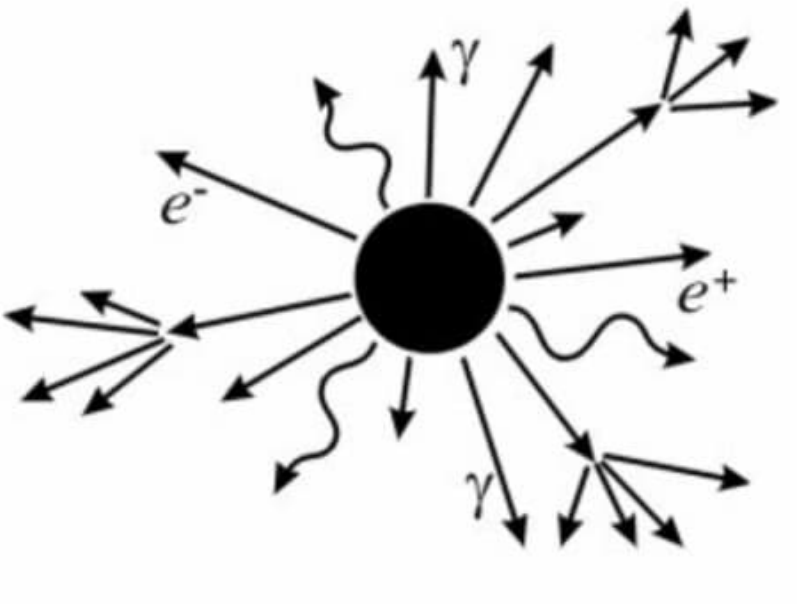
> "Researchers know that it is theoretically possible to create black holes because of Einstein's Theory of Relativity—particularly the part describing the relationship between energy and mass—increasing the speed of a particle causes its mass to increase as well."

This is what drove the Princeton researchers to form a computer model based on Einstein's original hydrodynamic equations. The model "provides a virtual window for viewing what happens when two particles collide—they focus their energies on each other and together create a combined mass that pushes gravity to its limit and as a result spawns a very tiny black hole. That result was expected—what was surprising was that the team found that their model showed that such a collision and result would require 2.4 times less energy than has been previously calculated to produce such a tiny black hole."

And our galaxy is positively chock-full of them. It's not just the famous supermassive black hole at the center of the Milky Way, but scores of smaller black holes as well. Scientific American's "Black Holes are Everywhere" tells readers that "most of the holes in our galaxy are perhaps 4 or 5 solar masses, and they're teeny, with horizons of only about 12 km in radius. But there have to be tens of thousands of them, the inevitable remnants of the short lives of huge stars."

This news fed into fears that "Mad Scientists Performing Universe-Breaking Experiments" were flying a bit too close to the sun (so to speak) by conducting experiments at the European Organization for Nuclear Research's (CERN) Large Hadron Collider (LHC) with the potential to open up microscopic black holes with potentially disastrous consequences. These concerns surfaced before the LHC — an underground accelerator which forms a ring with a diameter of 5 miles near Geneva, Switzerland — was ever switched on. A 2008 report from NASA succinctly titled "The Day the World Didn't End" tells readers that bringing the accelerator online "did not trigger the creation of a microscopic black hole. And that black hole did not start rapidly sucking in surrounding matter faster and faster until it devoured the Earth, as sensationalist news reports had suggested it might."

The fear around these larger-than-life experiments was so potent and widespread that CERN has an entire page on their website dedicated to the Frequently Asked Question "Will CERN generate a black hole?" and even the Princeton scientists addressed it in their academic report, noting that even with the new calculations finding that black holes require much less energy to open up than previously thought, opening up a black hole big enough to collapse the earth would still require billions of times more energy than the LHC is capable of generating. What's more, even if and when a black hole did open up in the collider, it would disappear just as quickly thanks to an effect called Hawking radiation.



Source: https://science.nasa.gov/

While fears of the Armageddon-causing potential of these microscopic black holes may have been overblown, however, the fact that the particle can open up these tiny black holes was then and remains now an absolute truth. Even CERN's FAQ page concedes that "The LHC will not generate black holes in the cosmological sense. However, some theories suggest that the formation of tiny 'quantum' black holes may be possible." Of course, the page goes on to reassure concerned readers that "the observation of such an event would be thrilling in terms of our understanding of the Universe; and would be perfectly safe."

Nevertheless, there are still some scientists who think we are right to be worried about these experiments that are probing the boundaries of physics. Just last year the well-respected (not to mention knighted) British scientist Sir Martin Rees published a warning to take fears around the LHC seriously in his book "On the Future." As paraphrased by NBC's science news site MACH, "the particles crashing about inside an accelerator could unleash bits of 'strange matter' that shrink Earth into a ball 300 feet across. In another [scenario], the experiments could create a microscopic black hole that would inexorably gnaw away at our planet from the inside. In the most extreme scenario Rees describes, a physics mishap could cause space itself to decay into a new form that wipes out everything from here to the farthest star." Rees himself recognizes that these scenarios are extremely unlikely, but in the author's own words, "given the stakes, they should not be ignored."

And now that the Event Horizon Telescope has successfully captured the first-ever image of a black hole, scientists are dreaming up ever more radical future experiments. Let's just hope that as scientists continue to push against the limitations of human knowledge and ability the headlines continue to read "The Day the World Didn't End." Or that we continue to have headlines at all.

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