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NO NAKED BLACK HOLES

By **Daive Castelveccchi**

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Even high-speed mergers keep an event horizon

No matter how hard you try to push their boundaries, black holes always seem to preserve their modesty. Indiscreet astrophysicists have simulated the most violent collisions of black holes yet, and found that the resulting black hole still has an event horizon — the surface through which even light cannot escape and that hides black holes' interiors.

An international team of researchers created a computer simulation of what they call the most violent collision imaginable: Two black holes of equal masses smashing into each other head-on, moving at close to the speed of light.

Previous studies have suggested that when black holes collide they merge into one larger black hole, radiating huge amounts of energy in the form of gravitational waves — ripples in the very shape of space — that travel at the speed of light. This study's results were no exception. But the extreme velocities of the team's simulated black holes led to waves of unprecedented energy. Up to 14 percent of the black holes' masses, instead of just a few percentage points, was converted into gravitational waves, the team reports in an upcoming *Physical Review Letters*.

The simulations also showed that the resulting black hole conformed to a long-standing conjecture, often attributed to Roger Penrose of the University of Oxford in England and called the cosmic censorship hypothesis.

Physicists believe that at the center of every black hole lies a singularity, a region where space curls up so much that the known laws of physics cease to apply, including general relativity, Albert Einstein's theory of gravity. But a black hole's event horizon prevents the singularity from interacting with the outside world.

Mathematically, "naked" singularities, or those without event horizons, can exist, but physicists wouldn't know what to make of them. All known mechanisms for the formation of singularities also create an event horizon, and Penrose conjectured that there must be some physical principle — a "cosmic censor" — that forbids singularity nakedness, explains coauthor Emanuele Berti of NASA's Jet Propulsion Laboratory in Pasadena, Calif. "We hope it's true," he says of the cosmic censorship hypothesis, "because it basically hides the failures of general relativity behind the event horizon."

The scenario that Berti and colleagues simulated was admittedly unrealistic because real black holes would not travel at close to the speed of light. But even in such extreme conditions, the event horizon draping wasn't lost.

Greg Cook of Wake Forest University in Winston-Salem, N.C., says that the results are interesting, but that many questions remain. What happens, for example, when the ultrafast colliding black holes have different masses, or are rapidly spinning?

Coauthor Ulrich Sperhake, now at Caltech, says that his and other teams will keep trying to produce naked singularities, but that he doubts that they really exist. "If you ask me, 'What am I going to put my next two salaries on?' That Penrose was right."