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Scientist Thinks He's Proven Hawking's Theory That Black Holes Glow

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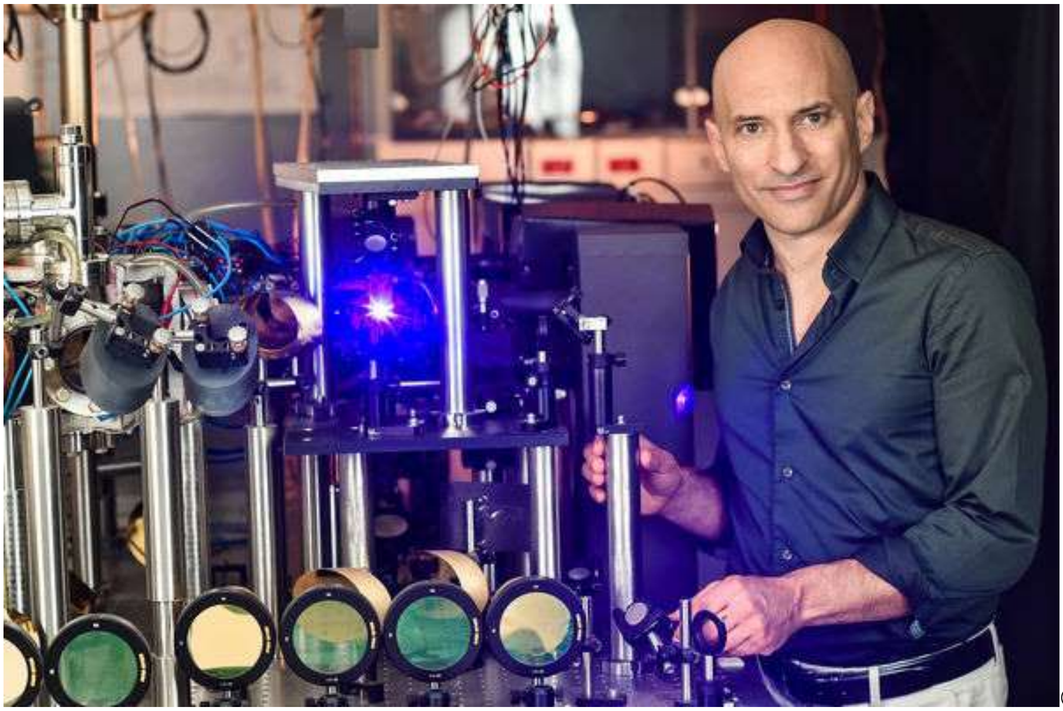
© Provided by Popular Science Black Hole Devouring Star

You might think of black holes as evil interstellar whirlpools, massive balls of who-knows-what so dense that their gravity prevents even light from escaping. But in 1974, Stephen Hawking made waves (this is a physics joke) in the science world by theorizing that maybe black holes weren't so dark; maybe they let out a faint glow of particles that barely escape the pull. A scientist thinks he's recreated that glow.

Jeff Steinhauer from the Technion-Israel Institute of Technology in Haifa, Israel created an analogue to a black hole in his lab, using the laws of sound, rather than light. His black hole let out a telltale signature providing compelling evidence for Hawking's namesake theory, Hawking radiation. This research implies that black holes might not be the bottomless voids we thought they were. It also has broader implications in the field of physics as a whole, where a major goal is creating one theory that links the vast distances required by gravity theories and the tiny lengths studied in particle physics.

"I think this work stands on its own as verification of Hawking's calculations," Steinhauer told *Popular Science.*

Instead of a light-sucking behemoth, Steinhauer's black hole is a line of cold rubidium atoms in a lab, as a form of matter called a Bose-Einstein condensate. Using lasers, he created a kind of waterfall: there's a lot of atoms on one side moving slowly, but then pouring over the edge faster than the speed of sound to the other side. This means that phonons, individual units of sound, can't escape past the boundary up the energy waterfall. This is like a black hole, except with space black holes, its light particles can't escape gravity's light-speed pull. Steinhauer published his results today in the journal *Nature Physics.*


© Provided by Popular Science Steinhauer with his black hole machine

Quantum mechanics is strange, and on the smallest scales, particles will appear alongside their antiparticles and disappear. In real black holes, Stephen Hawking predicted that these particles might randomly appear on either side of the furthest extent of the black hole's pull, so one particle gets sucked into the black hole and the other just manages to escape. Steinhauer observed this same effect on either side of his atomic waterfall; a stream of particles that fell into the black hole, and a matching stream that came out on the other side. Steinhauer was able to show that these two particles were entangled, meaning the properties are dependent on each other no matter how far away they were separated, which is a requirement of so-called Hawking radiation

It's important to emphasize that Steinhauer isn't using real black holes, Grant Tremblay, astrophysicist and NASA Einstein Fellow at Yale University told *Popular Science* in an email. You can't immediately translate the results to say that the black holes we see in space have the same behavior. However, physicists like Brain Greene frequently discuss uniting gravity with electromagnetism and the forces inside atoms with theories like the string theory and quantum gravity to make a theory of everything. Observing the interactions of particles with gravity in the case of the black hole would add further support that these theories can actually be united, noted Steinhauer. Seeing Hawking radiation in Steinhauer's black holes show that his sound analogues are useful tools in making models of the real thing.

"This result is an incredibly elegant example of how a Bose-Einstein condensate can act as a black hole analogue in a laboratory environment," said Tremblay, "enabling experiments that could never be done on a real black hole."