Stephen Hawking says he's solved a black hole mystery, but physicists await the proof

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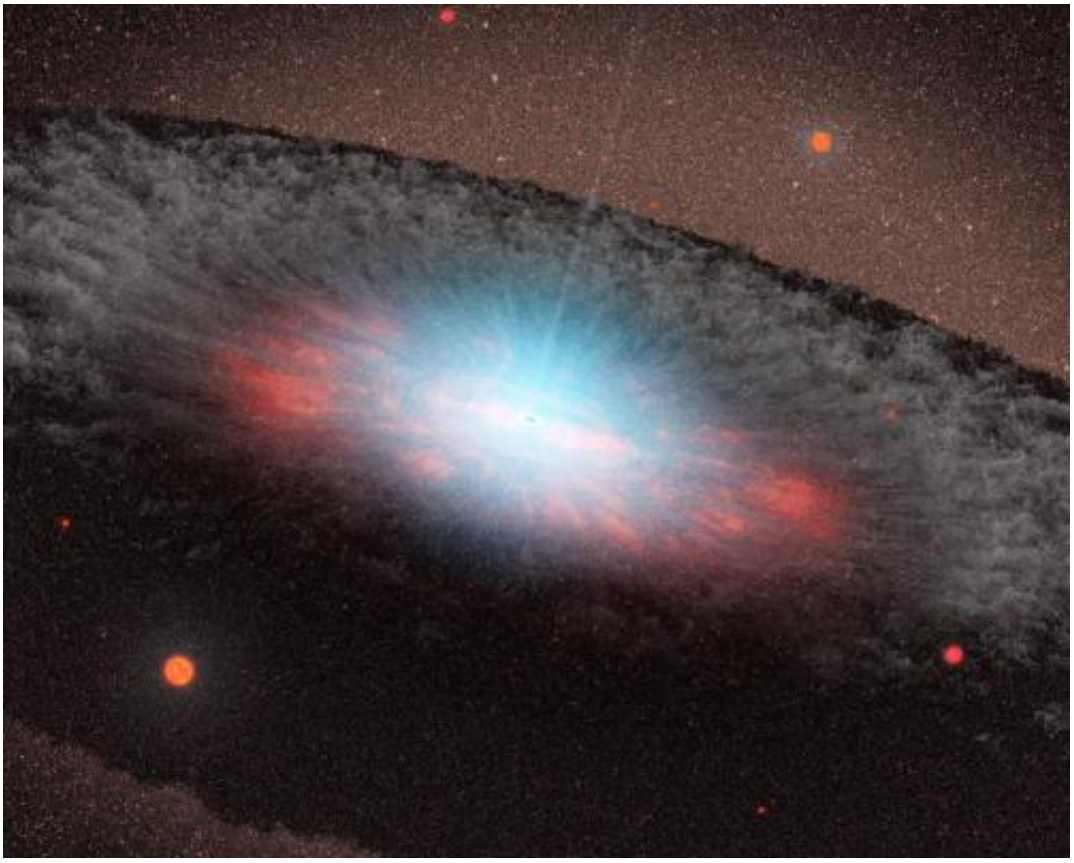

This artist's concept depicts a supermassive black hole at the center of a galaxy. The blue color here represents radiation pouring out from material very close to the black hole. The grayish structure surrounding the black hole, called a torus, is made up of gas and dust. Credit: NASA/JPL-Caltech

Physicist Stephen Hawking made a splash this week when he announced

that he had solved a vexing conundrum that had puzzled generations of leading physicists - including the 73-year-old scientific superstar himself - for the better part of a half-century.

During an eight-minute speech at a scientific meeting in Sweden, Hawking said that he had landed upon a solution for the so-called information paradox, a problem posed by black holes that rattles the very foundations of physics.

Headline writers got very excited, but initial reactions from scientists who study theoretical physics was more measured. Many said they were thrilled by the prospect that the mystery might be solved, but that they were waiting to see the proof, expected in a forthcoming scientific paper.

"It's hard to tell what the substance is there, scientifically, to be honest," said California Institute of Technology physicist John Preskill, who once prevailed in a famous wager with Hawking on the matter of black holes and information loss. "We should control our expectations until we know more."

The basic problem posed by the information loss paradox is that the laws of physics require that the total amount of information describing the state of the universe is always fixed and can't be destroyed, said Caltech physicist Sean Carroll.

Black holes, which allow nothing - not even light - to escape their gravitational grasp, confuse matters. If information that enters a black hole can't get out, and black holes don't last forever (as Hawking discovered in the 1970s), what happens to the information, which must be conserved? Over time and after a lot of debate, scientists including Hawking came to agree that the information must have to escape the black hole somehow. But they've struggled to explain how.

"I don't think anyone has a very promising mechanism for how the information can get out," Carroll added. "So it would be exciting if Hawking is on the right track with this."

At the Hawking Radiation conference at the KTH Royal Institute of Technology in Stockholm on Monday, Hawking offered a somewhat but not entirely new explanation for what might happen to the information about objects swallowed up by black holes, physicists said: It is encoded on the event horizon, the strange boundary between space outside a black hole and the abyss within.

The information is trapped there as a hologram - a garbled, two-dimensional representation - and is theoretically, if not practically, retrievable.

"The information about ingoing particles is returned, but in a chaotic and useless form," Hawking told his audience Monday. "This resolves the information paradox."

Preskill said that some aspects of this explanation had already been worked out by other scientists - in particular, the notion that the information remains on the event horizon. What's new to the equation, he said, is the additional emphasis on a concept known as supertranslation. Preskill said he would need to see further analysis to understand exactly how supertranslation fits into the explanation.

University of California, Santa Barbara, physicist Joseph Polchinski, who has thought about the problem a great deal in the past, said that he, too would need to see Hawking's calculations to understand if the solution made sense.

"I don't think what Hawking and his collaborators are proposing is radical enough to solve the problem," he said. "But I haven't seen the

publication, so I'm just speculating."

Hawking did not release a scientific paper detailing his arguments, though one is expected soon, co-written by physicists Malcolm Perry of the University of Cambridge and Andrew Strominger of Harvard, who Hawking credited with giving him the idea for the solution. Polchinski called Strominger a "very creative and influential" scientist with elegant ideas.

Contacted via telephone Tuesday evening, Strominger said he felt confident that the information loss paradox was not irreconcilable. But he didn't think everything was settled just yet.

He had heard Hawking say there would be a paper by the end of September. It had been the first he'd learned of it, he laughed, though he said the group did have a draft.

Whatever the team publishes, Strominger added, it's unlikely to be the final word.

"There's still much more work to be done to show that when something falls into a black hole that it leaves a record of exactly what it was. That is the part we still need to work out," he said. "Stephen is very optimistic that it's all going to work perfectly. But physics is a hard mistress. You have to get all the calculations to work perfectly and everything has to line up.

"Stephen is a smart guy," Strominger continued. "Maybe he's seeing all the way to the end. I'm certainly not."