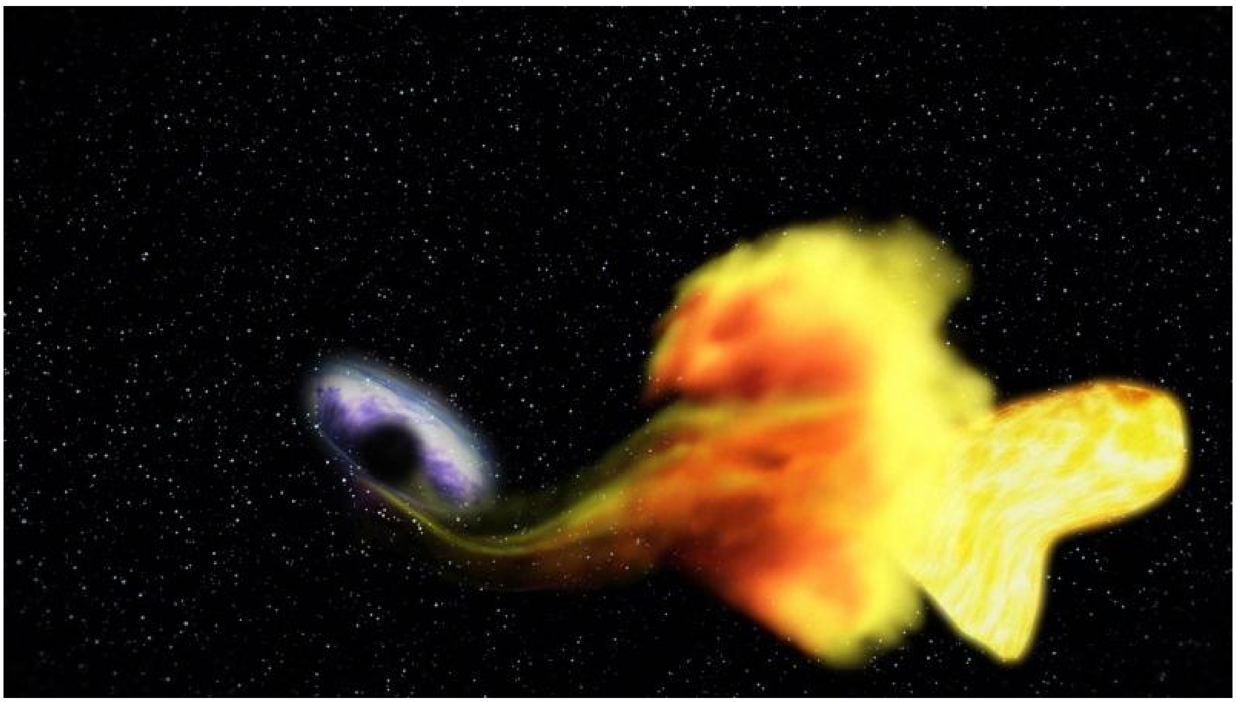
# Physicists split on ideas expressed in Hawking's latest black hole paper

January 28 2016, by Bob Yirka



A black hole devouring a star. Credit: NASA

(Phys.org)—It has been nearly a month since, Stephen Hawking, Malcolm Perry and Andrew Strominger uploaded a paper to the *arXiv* preprint server that described a possible solution to the black-hole conundrum—they showed a way that information that had been pulled into a black hole could be retained via soft particles. Now that others in the field have had time to react to the paper, there appears to be a split

—some agree with the findings in the paper while others suggest that there is still a vital piece of the puzzle to be explained.

The black hole conundrum came to exist due to work done by John Wheeler in the 60's and then Steven Hawking and colleagues—first in the early 70's and then later in 1976—it centers around the idea of what happens to the information contained in particles that are pulled into a black hole, once the black hole shrinks away to nothing. It was Hawking that first postulated that contrary to prior belief, black holes do emit something—now called Hawking radiation. But, as he and colleagues noted in the later paper, such radiation would have properties that are completely random, and that would suggest that once the black hole was gone, some of the information carried by the radiation would be lost—gone forever. This of course runs contrary to the laws of physics which state that energy is conserved—thus there came to exist a conundrum.

Moving forward 40 years, Hawking and colleagues believe they have solved the conundrum—the earlier work did not take into account the possibility of empty space carrying information, they suggest. More specifically, they propose that soft particles are at work. These particles they note, can exist in a zero energy state, and because of that particles falling into a black hole would leave information behind with them. Most in the field have been with them to this point, it is the next that causes concern. Hawking and his colleagues go on to suggest that a mechanism exists that is involved in allowing the information to be transferred—called black hole (soft )hair, a term they came up with to describe calculations that showed encoding data in quantum descriptions of the event horizon—information would be stored in them, and thus not lost.

Some in the field have expressed their frustration with the soft hair idea, in part because Hawking and his team have yet to explain how the information exchange to the Hawking radiation would actually occur. This suggests that more work will have to be done before the idea will be accepted by the majority of scientists in the field.

**More information:** Soft Hair on Black Holes, arXiv:1601.00921 [hep-th] arxiv.org/abs/1601.00921

**Abstract**

It has recently been shown that BMS supertranslation symmetries imply an infinite number of conservation laws for all gravitational theories in asymptotically Minkowskian spacetimes. These laws require black holes to carry a large amount of soft (i.e. zero-energy) supertranslation hair. The presence of a Maxwell field similarly implies soft electric hair. This paper gives an explicit description of soft hair in terms of soft gravitons or photons on the black hole horizon, and shows that complete information about their quantum state is stored on a holographic plate at the future boundary of the horizon. Charge conservation is used to give an infinite number of exact relations between the evaporation products of black holes which have different soft hair but are otherwise identical. It is further argued that soft hair which is spatially localized to much less than a Planck length cannot be excited in a physically realizable process, giving an effective number of soft degrees of freedom proportional to the horizon area in Planck units.



Citation: Physicists split on ideas expressed in Hawking's latest black hole paper (2016, January 28) retrieved 22 July 2024 from
https://phys.org/news/2016-01-physicists-ideas-hawking-latest-black.html