Escaping gravity's clutches: The black hole breakout

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New research by scientists at the University of York gives a fresh perspective on the physics of black holes.

Black holes are objects in space that are so massive and compact they were described by Einstein as "bending" space. Conventional thinking asserts that black holes swallow everything that gets too close and that nothing can escape, but the study by Professor Samuel Braunstein and Dr Manas Patra suggests that information could escape from black holes after all.

The implications could be revolutionary, suggesting that gravity may not be a fundamental force of Nature.

Professor Braunstein says: "Our results didn't need the details of a black hole's curved space geometry. That lends support to recent proposals that space, time and even gravity itself may be emergent properties within a deeper theory. Our work subtly changes those proposals, by identifying quantum information theory as the likely candidate for the source of an emergent theory of gravity."

But quantum mechanics is the theory of light and atoms, and many physicists are skeptical that it could be used to explain the slow evaporation of black holes without incorporating the effects of gravity.

The research, which appears in the latest issue of Physical Review Letters, uses the basic tenets of quantum mechanics to give a new description of information leaking from a black hole.

Professor Braunstein says: "Our results actually extend the predictions made by well-established techniques that rely on a detailed knowledge of space time and black hole geometry."

Dr Patra adds: "We cannot claim to have proven that escape from a black hole is truly possible, but that is the most straight-forward interpretation of our results. Indeed, our results suggest that quantum information theory will play a key role in a future theory combining quantum mechanics and gravity."

More information: Black Hole Evaporation Rates without Spacetime, *Phys. Rev. Lett.* 107, 071302 (2011)
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Abstract
Verlinde recently suggested that gravity, inertia, and even spacetime may be emergent properties of an underlying thermodynamic theory. This vision was motivated in part by Jacobson's 1995 surprise result that the Einstein equations of gravity follow from the thermodynamic properties of event horizons. Taking a first tentative step in such a program, we derive the evaporation rate (or radiation spectrum) from black hole event horizons in a spacetime-free manner. Our result relies on a Hilbert space description of black hole evaporation, symmetries therein which follow from the inherent high dimensionality of black holes, global conservation of the no-hair quantities, and the existence of Penrose processes. Our analysis is not wedded to standard general relativity and so should apply to extended gravity theories where we find that the black hole area must be replaced by some other property in any generalized area theorem.

Provided by University of York

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