

# Answers to black hole evolution beyond the horizon?

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One of the most important predictions of Einstein's theory of General Relativity is the existence of black holes. The dynamics of these systems are not yet fully understood, but researchers from Queen Mary, University of London have now provided a rigorous way of determining the evolutionary stage of a black hole by analysing the region outside where matter cannot escape, the event horizon.

Dr Thomas Bäckdahl and Dr Juan A. Valiente Kroon at Queen Mary's School of Mathematical Sciences have developed a method based on properties of the Kerr solution, a time-independent solution to the equations of General Relativity.

The Kerr solution is one of the few exact solutions to the equations of General Relativity, and describes a rotating, stationary (time-independent) black hole. It is also proposed that it describes the final evolutionary stage of any dynamical (time-dependent) black hole.

General Relativity provides a unified description of gravity as a geometric property of space and time. The theory predicts the existence of [black holes](#) as regions in which the space and time are distorted so that nothing can escape them.

Dr Valiente Kroon, an EPSRC Advanced Research Fellow, said: "By looking at the region outside the black hole we have shown how to ascertain how much a dynamical black hole differs from the Kerr solution. There are very strong indications that the end state of the evolution of a black hole is described by this solution." The findings are reported in the journal *Proceedings of the Royal Society A*.

The ideas developed in the article may be of relevance in developing numerical simulations of black holes, an area of research that has experienced a great development in recent years. Due to the complexity of the equations of [General Relativity](#), these simulations are the only way of systematically exploring the theory in realistic scenarios.

**More information:** The paper "The 'non-Kerrness' of domains of outer communication of black holes and exteriors of stars", Thomas Bäckdahl and Juan A. Valiente Kroon will appear in *Proceedings of the Royal Society A* on 19 January. [arxiv.org/abs/1010.2421](http://arxiv.org/abs/1010.2421)

Provided by Queen Mary, University of London

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