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Black Holes in the Extreme

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Black holes are one of the most interesting theoretical predictions of general relativity. They arise as solutions to Einstein's equations which govern the classical gravitational field, generally described by a small number of parameters - mass, charge, and spin. A particular subset has recently attracted a great deal of attention: extremal black holes. For fixed mass, they are characterized by having the maximum spin and charge. There is good astrophysical evidence that they exist in our Universe. Further, they have zero temperature and do not suffer from the quantum mechanical instability of Hawking radiation. In short, they occupy a privileged position in a number of contexts.

In this talk I will discuss the key properties of extremal black holes and some of the techniques used to understand them. In particular I will describe the notion of the near-horizon geometry of an extremal black hole. This gives us a precise representation of the black hole close to its event horizon, allowing us to study Einstein's equations in a simplified setting. Near horizon geometries provide us with the ability to analyze extremal black holes in a way not possible for general, non-extremal black holes. I will discuss a symmetry enhancement result for these geometries and progress made on their classification.

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