Summary

Penrose's discovery of the singularity theorem showed that black holes are a robust consequence of the theory of general relativity, forming naturally in very overdense regions.

During the more than half a century that has passed since this conceptual breakthrough, technological advances have enabled probing closer and closer to the black hole event horizon. The observations by LIGO, rewarded the Nobel Prize in 2017, and the exquisite observations by Genzel and Ghez sharing this year's prize, as well as the remarkable picture of the centre of M87 taken by the Event Horizon Telescope, are all compatible with the existence of supermassive black holes.

The extent to which the structure of a black hole surrounded by an event horizon actually match the predictions of general relativity is still an open question. Nature may still have surprises in store.

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