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Physical black holes in semiclassical gravity

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Assuming only the existence of an apparent horizon and its regularity, we derive universal properties of the near-horizon geometry of spherically symmetric black holes. General relativity admits only two distinct classes of physical black holes, and both appear at different stages of the black hole formation. Using a self-consistent semiclassical approach, we find that the resulting near-horizon geometry differs considerably from the one that is obtained using classical notions of a horizon. If semiclassical gravity is valid, then accretion after horizon formation inevitably leads to a firewall that violates quantum energy inequalities. Consequently, physical black holes can only evaporate once a horizon has formed. Comparison of the required energy and time scales with the known semiclassical results suggests that the observed astrophysical black holes are horizonless ultra-compact objects, and the presence of a horizon is associated with currently unknown physics. This has interesting implications for the information loss paradox.

Note: the results presented in this talk are summarized in Phys. Rev. D **103**, 064082 (2021).

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