



# Asymptotic Safety and Black Holes (Springer Theses)

*Kevin Falls*

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One of the open challenges in fundamental physics is to combine Einstein's theory of general relativity with the principles of quantum mechanics. In this thesis, the question is raised whether metric quantum gravity could be fundamental in the spirit of Steven Weinberg's seminal asymptotic safety conjecture, and if so, what are the consequences for the physics of small, possibly Planck-size black holes? To address the first question, new techniques are provided which allow, for the first time, a self-consistent study of high-order polynomial actions including up to 34 powers in the Ricci scalar. These novel insights are then exploited to explain quantum gravity effects in black holes, including their horizon and causal structure, conformal scaling, evaporation, and the thermodynamics of quantum space-time. Results indicate upper limits on black hole temperature, and the existence of small black holes based on asymptotic safety for gravity and thermodynamical arguments.

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