

## The Nonlinear Tails of Black Hole Ringdown

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Black hole perturbation theory is a cornerstone of gravitational wave science, providing a powerful framework to test General Relativity in the strong-field regime and to characterize the final remnant of a binary merger. The final “ringdown” phase, where the newly formed black hole settles into its stationary state, is a particularly clean probe of its fundamental properties. In this talk, I will begin by reviewing the essential structure of the Green’s function in black hole perturbation theory, which governs the response of the black hole to any disturbance. I will then present our main result on the late-time behavior of gravitational waves, demonstrating the existence of non-linearly generated power-law tails that dominate after the initial ringdown signal has decayed. We show that this late-time tail is a generic and robust feature for spinning black holes, carrying important information about the nonlinear nature of spacetime dynamics. If time permits, I will also briefly discuss the connection between these nonlinear phenomena and the behavior of tidal Love numbers during the inspiral phase.

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