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Title: *Challenges in Black Hole Spectroscopy and New Perspectives from Bound States*

Abstract: Black hole spectroscopy, applied to the ringdown phase of compact binary mergers, is one of the most promising tools to test the nature of black holes. It allows us to quantify whether black holes and their perturbative dynamics are well described by general relativity and, thus, serve as a magnifier to explore fundamental physics. In this talk, I will review the basics of black hole spectroscopy, discuss recent progress, and then highlight open problems. Finally, I will explore the intriguing idea of relating quasi-normal modes with the bound states of an inverted potential to provide complementary insights into the fascinating nature of these systems.