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Black Hole Ringdown in Astrophysical Environment

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When a black hole (BH) rings due to some external perturbation, it emits gravitational waves described by quasi-normal modes (QNMs) –a series of exponentially damped harmonic oscillations. If the Kerr(-Newman) metric fully describes the BH, QNMs carry a unique signature of the BH parameters encoded in the modes' complex frequencies. Consequently, any deviation in the QNMs spectrum from the Kerr-Newman prediction would provide compelling evidence challenging general relativity and offer valuable insight into the true nature of BHs. However, astrophysical BHs are rarely isolated. Even a mild astrophysical environment, such as an accretion disc, modifies the spacetime geometry, thereby affecting the QNMs spectrum. In this talk, I present our efforts to investigate these effects and discuss spectral features that could help disentangle them from potential deviations associated with theories beyond general relativity.

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