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Tidal Deformation and Dissipation of Rotating Black Holes
HORNG SHENG CHIA, Institute for Advanced Study (IAS) — Black holes are never isolated in realistic astrophysical environments; instead, they are often perturbed by complicated external tidal fields. How does a black hole respond to these tidal perturbations? In this talk, I will discuss both the conservative and dissipative responses of the Kerr black hole to a weak and adiabatic gravitational field. The former describes how the black hole would change its shape due to these tidal interactions, and is quantified by the so-called "Love numbers". On the other hand, the latter describes how energy and angular momentum are exchanged between the black hole and its tidal environment due to the absorptive nature of the event horizon. I will show that the Love numbers of the Kerr black hole vanish identically — in other words, you cannot stretch a black hole. I will also describe how the Kerr black hole's dissipative response implies that energy and angular momentum can either be lost to or extracted from the black hole, with the latter process commonly known as the black hole superradiance. Finally, I will discuss how these tidal responses leave distinct imprints on the gravitational waves emitted by binary black holes.

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