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A Spheroidal Harmonic Picture for GWs from Astrophysical Sources I: Bi-Orthogonality LIONEL LONDON, Massachusetts Institute of Technology MIT — The study of isolated perturbed Kerr black holes plays an important role in gravitational wave (GW) signal modeling for coalescing binary black holes. In this, the natural multipolar structure of Kerr black holes has informed both signal models (Numerical Relativity and approximants) and related tests of General Relativity. In this talk we present new results on the multipolar structure of GWs from Kerr black holes; in particular, we demonstrate for the first time that the natural spherical harmonics for Kerr, the spheroidal harmonics, display bi-orthogonality and so obey a spectral theorem. We thereby present a method for the general calculation of spheroidal harmonic GW multipole moments. This marks a departure from the spherical multipole moments that are currently ubiquitous, despite being most appropriate for only non-spinning spacetimes. Noting that all astrophysical systems with angular momentum are asymptotically similar to the Kerr metric, we discuss possible applications for the spheroidal harmonic decomposition of gravitational waves from general astrophysical sources.

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