

Quasi-normal mode expansions of black hole perturbations: a hyperboloidal Keldysh's approach

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We study asymptotic quasi-normal mode expansions of linear fields propagating on a black hole background, in order to achieve this we exploit the compactified hyperboloidal approach in order to cast quasi-normal modes as eigenfunctions of a non-selfadjoint problem and we adopt a Keldysh scheme for the spectral construction of resonant expansions. The role of the scalar product structure in the Keldysh construction is clarified, although it is key to provide a notion of scale, it is proven to be non-necessary to construct a unique quasi-normal mode time-series at null infinity. We present (numerical) comparison with the time-domain signal for test-bed initial data, we demonstrate the efficiency and accuracy of the Keldysh spectral approach. Polynomial tails following the Price law are recovered and the importance of the contribution of highly-damped modes to the early time behaviour is illustrated and presented as an introduction to the question of the convergence of the asymptotic series.

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