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Late-time asymptotics for the wave equation on spherically symmetric, stationary spacetimes

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ABSTRACT

We derive precise late-time asymptotics for solutions to the wave equation on spherically symmetric, stationary and asymptotically flat spacetimes including as special cases the Schwarzschild and Reissner–Nordström families of black holes. We also obtain late-time asymptotics for the time derivatives of all orders and for the radiation field along null infinity. We show that the leading-order term in the asymptotic expansion is related to the existence of the conserved Newman–Penrose quantities on null infinity. As a corollary we obtain a characterization of all solutions which satisfy Price's polynomial law τ^{-3} as a *lower* bound. Our analysis relies on physical space techniques and uses the vector field approach for almost-sharp decay estimates introduced in our companion paper. In the black hole case, our estimates hold in the domain of outer communications up to and including the event horizon. Our work is motivated by the

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stability problem for black hole exteriors and strong cosmic censorship for black hole interiors.

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