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Late-time signal from binary black hole coalescences

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Recently, studies on numerical evolutions of eccentric binary inspirals found a several orders of magnitude enhancement of the post-ringdown tail amplitude. This characteristic might render the tail a phenomenon of observational interest, opening the way to experimental verification of this general relativistic prediction in the near future. I will present an analytical perturbative model that accurately predicts the numerically observed tail evolution.

Considering a source term describing an infalling test-particle in generic non-circular orbits, driven by post-Newtonian radiation reaction, I derive an integral expression over the system's entire history, showing how the post-ringdown tail is inherited from the non-circular inspiral in a non-local fashion. Beyond its excellent agreement with numerical evolutions, the model explains the tail amplification with the progenitors' binary eccentricity. Specifically, I will show that the tail is enhanced by motion at large distances from the black hole, with small tangential velocity.

I will prove the tail to be a superposition of many power-laws, with each term's excitation coefficient depending on the specific inspiral history. A single power law is recovered only in the limit of asymptotically late times, consistent with Price's results and the classical soft-graviton theorem. I will conclude by discussing future directions, including the non-linear extension to comparable masses, exploiting the fact that for highly eccentric binaries, our model predicts the tail amplitude to be determined mainly by the motion near the last apastron.

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