

The black hole always chirps twice

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The product of a black hole merger is a highly distorted black hole that relaxes to a Kerr black hole by emitting gravitational waves. This phenomenon provides a unique laboratory to observe the dynamics of black hole horizons in a highly deformed and dynamic state, far from their equilibrium, and study gravity in its most extreme regime. In this talk we report, for the first time, how a particular geometric feature of this highly distorted horizon is correlated with a concrete feature in the observed gravitational waves. In particular, we find that multiple secondary chirps can be found in the post-merger emission of standard binary black holes. These chirps, whose strength and frequency peak depend on the location of the observer around the final black hole, correlate to the passage of the fading, strongly radiating “cusp” of the final horizon through the line of sight. This constitutes the first link between a concrete geometrical aspect of the final black hole event horizon and a concrete feature of a gravitational wave signal.