

Astrophysical lessons from merging binary black holes: gap and highly spinning subpopulation

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Uncovering the origins of binary black holes through gravitational-wave detections provides a powerful probe of the evolution, interactions, and environments of massive stars. Stellar theory predicts a forbidden range of black-hole masses between 50-130 M_{sun} due to pair-instability supernovae. In this talk, I will present our latest observational evidence of the pair-instability gap in the distribution of black hole masses. While the gap is not present in the distribution of primary masses, it appears unambiguously in the distribution of secondary masses. The location of the gap lines up well with a previously identified transition in the binary black-hole spin distribution; binaries with primary components in the gap tend to spin more rapidly than those below the gap. We interpret these findings as evidence for a subpopulation of hierarchical mergers. I will also highlight the concurrent signatures of hierarchical mergers. If time permits, I will introduce the results of the astrophysical distributions of merging compact objects in the latest GWTC-5 LVK paper.

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