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The origin of low effective spins, high black hole masses, and O1/O2 rates in LIGO/Virgo binary black hole mergers

All of the ten LIGO/Virgo BH-BH merger O1/O2 detections have near zero effective spins. One explanation makes BH spin magnitudes small.

We test this hypothesis with the classical isolated binary evolution scenario. We test three models of angular momentum transport in massive stars: mildly efficient transport by meridional currents (as employed in the Geneva code), efficient transport by Tayler-Spruit magnetic dynamo (as implemented in the MESA code), and very-efficient transport (as propsed by Fuller et al.) to calculate natal BH spins. We allow for binary evolution to increase the BH spins through accretion and account for the potential spin-up of stars through tidal interactions. Additionally, we update calculations of stellar-origin BH masses,
include revisions to the history of star formation and chemical evolution across cosmic time.

We find that we can match simultaneously the observed BH-BH merger rate density, BH masses, and effective spins. Models with efficient angular momentum transport are favored. The updatd stellar-mass weighted gas-phase metallicity evoltuion now used in our models appears to be a key in better reproducing the LIGO/Virgo merger rate estimate. Mass losses during the pair-instabilty pulsation supernova phase are likely overestimated if the merger GW170729 hosts a BH more massive than 50 Msun.

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