Contribution ID: **40** Type: **not specified**

The black hole mass function and merger rate across cosmic time

Friday, September 8, 2023 10:30 AM (1 hour)

With nearly one hundred gravitational-wave events observed by LIGO and Virgo, the mass function of binary black holes starts revealing a number of features. While the most common primary black hole mass is about 8-10 Msun, the data show an excess at ~35 Msun and a long tail extending out to 90 Msun. Such features must encode the formation history of binary black holes, but their analysis has brought us more questions than answers. In my talk, I discuss several possible scenarios for the emergence of these features, based on novel semi-analytic models of binary evolution and star cluster dynamics. Furthermore, I will show that the merger rate density of binary black holes contains crucial information to explain the formation of such extreme systems as a function of redshift. In particular, metal-poor and metal-free stars are the key progenitors of binary black hole mergers in the early Universe, which will be the target of next-generation ground-based detectors.

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