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Modeling the multi-messenger signatures of massive black hole evolution[1] LAURA BLECHA, University of Florida, LUKE KELLEY, Northwestern University, MOHAMMAD SAYEB, JULY THOMAS, University of Florida, MEGAN NEWSOME, University of California - Santa Barbara, GREGORY SNYDER, Space Telescope Science Institute, SHOBITA SATYAPAL, George Mason University, SARA ELLISON, University of Victoria — Massive black hole (BH) binaries are one of the most promising gravitational wave (GW) sources for pulsar timing arrays (PTAs) and the Laser Interferometer Space Antenna (LISA). However, much is still not known about the BH population; in particular, the rates of BH binary inspiral and merger are highly uncertain. We describe our recent work to address these pressing issues in advance of LISA, using hydrodynamics simulations to characterize the EM and GW signatures of BH binary inspiral, spin evolution, and GW recoil. Nuclear obscuration during galaxy mergers likely plays a significant role in the elusive nature of BH pairs; we demonstrate that a high fraction of infrared-selected merging galaxies should contain BH pairs resolvable with JWST or with future X-ray imaging. Detections of such systems in the coming years will provide important constraints on GW source modeling in advance of low-frequency GW detections with PTAs and LISA. Finally, we discuss the prospects for identifying candidate recoiling BHs; such objects would provide another EM signature of BH mergers and constrain LISA event rate predictions.

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