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Parameter estimation and sky localization of massive binary black holes with LISA

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LISA is a future space-based gravitational wave detector that will complement the LIGO/Virgo observations at much lower frequencies, enabling the detection (among other targets) of coalescences of massive black hole binaries (MBHB). Most MBHB signals are expected to be short and merger-dominated. The development of data analysis tools for LISA is still in its exploratory phase, and it is crucial to understand the capabilities of LISA and the trade-offs in its instrumental design. While previous studies often used simplified signals and instrument response and a Fisher matrix approach, we developed a set of tools that allows fast likelihood computations for Fourier-domain waveform models, enabling Bayesian analyses exploring the full parameter space. We present examples of simulated parameter recovery for massive black hole binaries. We highlight degeneracies in parameter space, finding that both frequency-dependent effects in the instrument response and higher harmonics in the signal play a crucial role in breaking these degeneracies and refining the sky localization of the source. We also discuss whether LISA is able to detect and localize these systems before the merger occurs, enabling advance warnings for EM observatories.

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