Sky Localization of Massive Black Hole Binaries with LISA: Applying Coronagraphic Time-delay Interferometry to Low-latency Searches

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The Laser Interferometer Space Antenna (LISA) will be a space-borne gravitational wave (GW) detector to be launched in the next decade. Central to LISA data analysis is time-delay interferometry (TDI), a numerical procedure which drastically reduces otherwise overwhelming laser frequency noise. LISA data analysis is usually performed on subsets of TDI variables which form a basis, e.g. Michelson variables (X, Y, Z) or quasiorthogonal variables (A, E, T). We investigate a less standard TDI variable, denoted κ, which depends on time and two parameters (β, λ). For any GW source located at sky position $(\beta_\star, \lambda_\star)$, κ has the singular property of canceling GW signal when (β, λ) tend to $(\beta_\star, \lambda_\star)$, very much like a coronagraph. Thanks to this property, coronagraphic TDI has the potential to be an efficient model-agnostic method for sky localization of GW sources with LISA. Those characteristics make it relevant for low-latency searches of sources with a high multi-messenger potential, such as Massive Black Hole Binaries (MBHBs). Building upon previous theoretical work [1, 2, 3], and a first assessment of the sky localization capabilities of κ in the current LISA configuration [4], we investigate a sky localization algorithm based on coronagraphic TDI. In particular, we evaluate the performance of the method when confronted with a physically motivated population of MBHBs with multi-messenger potential [5, 6]. We discuss the results in the context of the accuracy required by facilities susceptible of detecting electromagnetic counterparts emitted by such sources [7].

References

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