Listening to Gravity With LISA from Incomplete Measurements: a Bayesian Data Augmentation Method

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LISA will listen to the low-frequency gravitational universe, between 0.1 mHz and 1 Hz, and is expected to detect tens of thousands of sources from cosmic dawn to the present. Performing the global fit of all resolvable sources is a real challenge, but we expect this process to be further complicated by interruptions in the measurement. Data gaps arise from the very sensitive nature of the detector, either because of planned events such as antenna repointing or laser relocking, or unplanned events such as loud instrumental glitches that need to be masked. Thus a thorough assessment of the impact of data gaps on the scientific performance is required, as well as adapted strategies to handle them in the data processing. To this aim, we study the effects of data gaps on the recovery of compact galactic binary parameters using different gap scenarios. We show that for low frequency sources and dense gap patterns, the use of standard window functions in the time domain may not be sufficient to prevent noise frequency leakage, which degrades the precision of astrophysical parameter estimates. To mitigate this effect we develop a Bayesian data augmentation method that allows us to deal with gaps in a statistically consistent way, by considering the missing data as auxiliary parameters of the probability distribution. By sampling for missing data together with astrophysical parameters, we obtain accurate posterior distributions which are comparable to the case with complete data.