

# Resolving individual signals in the presence of stochastic background in future pulsar timing arrays

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Recent pulsar timing array (PTA) observations have reported evidence for a gravitational wave background (GWB). If this signal is primarily produced by supermassive black hole binaries (SMBHBs), future PTA observations with the Square Kilometre Array (SKA) are expected to detect multiple continuous gravitational waves (CGWs) from bright individual sources in addition to a stochastic GWB. In this study, we revisit the Fe-statistic, a detection method for single source signals in PTA datasets, and introduce an improved model that treats unresolved gravitational waves as a stochastic GWB. We apply this method to mock datasets containing both CGWs and a GWB and evaluate its performance in recovering CGW parameters. We find that the improved Fe-statistic significantly enhances the estimation of the CGW sky location and amplitude, particularly when the GWB dominates over white noise. We further demonstrate that, when combined with MultiNest, the Fe-statistic enables an efficient Bayesian search for CGWs and the GWB simultaneously. This work serves as an initial step toward developing an efficient and robust algorithm for future PTA observations.

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