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Geometric template bank for low-mass compact binaries with moderately eccentric orbits

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Compact binaries on eccentric orbits are another class of sources for gravitational wave (GW) detectors that can provide a wealth of information on binaries'formation pathways and astrophysical environments. However, historically, eccentricity in template waveforms is often ignored in modelled search analyses for compact binaries, which assumes templates for non-precessing quasi-circular binaries. We show that quasi-circular template banks are highly ineffectual in detecting binary neutron stars and neutron star-black hole systems that enter Advanced LIGO at the projected O4 sensitivity with eccentricities in the range $e \in [0—0.15]$. With populations of marginally eccentric binaries with aligned/anti-aligned component spins in binary neutron stars (BNS) and neutron star-black hole (NSBH) parameter space, we demonstrate that quasi-circular template banks incur 27% and 20% loss in detection rates of GW signals from BNS and NSBH systems, respectively. Motivated by the inefficiencies of current searches of compact binaries, we developed a geometric template bank that included masses, spins, and eccentricity in the parameter space for searches of compact binaries on moderately eccentric orbits. This TaylorF2Ecc waveform model-based geometric template bank improves eccentric signal recovery significantly, as less than 6

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