

# 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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