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Direct Determination of Supermassive Black Hole Properties with Gravitational-Wave Radiation from Surrounding Stellar-Mass Black Hole Binaries HANG YU, YANBEI CHEN, Caltech — A significant number of stellar-mass black-hole (BH) binaries may merge in galactic nuclei or in the surrounding gas disks. With purposed space-borne gravitational-wave observatories, we may use such a binary as a signal carrier to probe modulations induced by a central supermassive BH (SMBH), which further allows us to place constraints on the SMBHs properties. We show in particular the de Sitter precession of the inner stellar-mass binarys orbital angular momentum (AM) around the AM of the outer orbit will be detectable if the precession period is comparable to the duration of observation, typically a few years. Once detected, the precession can be combined with the Doppler shift arising from the outer orbital motion to determine the mass of the SMBH and the outer orbital separation individually and each with percent-level accuracy. If we further assume a joint detection by space-borne and ground-based detectors, the detectability threshold could be extended to a precession period of $\sim 100\,\mathrm{yr}$.

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