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SgrA* spin and mass estimates through the detection of an extremely large mass-ratio inspiral

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Estimating the spin of SgrA* is one of the current challenges we face in understanding the center of our Galaxy. In the present work, we show that detecting the gravitational waves (GWs) emitted by a brown dwarf inspiraling around SgrA* will allow us to measure the mass and the spin of SgrA* with unprecedented accuracy. Such systems are known as extremely large mass-ratio inspirals (XMRIs) and are expected to be abundant and loud sources in our galactic center. We consider XMRIs with a fixed orbital inclination and different spins of SgrA* (s) between 0.1 and 0.9. For both cases, we obtain the number of circular and eccentric XMRIs expected to be detected by space-borne GW detectors like LISA and TianQin. We find that if the orbit is eccentric, then we expect to always have several XMRIs in band while for almost circular XMRIs, we only expect to have one source in band if SgrA* is highly spinning. We later perform a Fisher matrix analysis to show that by detecting a single XMRI the mass of SgrA* can be determined with an accuracy of the order 10^{−2}M⊙, while the spin can be measured with an accuracy between 10^{−7} and 10^{−4} depending on the orbital parameters of the XMRI.

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