Detecting bodies orbiting the Galactic Center black hole Sgr A* with LISA

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We present the first fully relativistic study of gravitational radiation from bodies in circular equatorial orbits around the massive black hole at the Galactic Center, Sgr A* [1]. The computations are based on the theory of perturbations of the Kerr spacetime and take into account the Roche limit induced by tidal forces in the Kerr metric. We have evaluated the signal-to-noise ratio in LISA data, as well as the time spent in LISA band, for white dwarfs, neutrons stars, stellar black holes, primordial black holes of mass larger than $10^{-4} M_\odot$, main-sequence stars of mass lower than $\sim 2.5\, M_\odot$ and brown dwarfs. It is found that an object in any of these categories is detectable in one year of LISA observations with a signal-to-noise ratio above 10 during at least 10^5 years in the slow inspiral towards either the innermost stable circular orbit (compact objects) or the Roche limit (main-sequence stars and brown dwarfs). The longest times in-band (SNR $\geq$ 10), of the order of 10^6 years, are achieved for brown dwarfs as well as for primordial black holes of mass $\sim 10^{-3} M_\odot$ down to $10^{-5} M_\odot$, depending on the spin of Sgr A*. They are just followed by white dwarfs and low mass main-sequence stars. This makes Sgr A* a valuable target for LISA.

[1] E. Gourgoulhon, A. Le Tiec, F. Vincent, & N. Warburton, arXiv:1903.02049