Abstract.

Among the astrophysical systems targeted by \textit{LISA}, stars on relativistic orbits around massive black holes (MBHs) are particularly promising sources. Unfortunately, the prediction for the number and characteristics of such sources suffers from many uncertainties. Stellar dynamical Monte Carlo simulations of the evolution of galactic nucleus models allow more realistic estimates of these quantities. The computations presented here strongly suggest that the closest such extreme mass-ratio binary to be detected by \textit{LISA} could be a low-mass MS star (MSS) orbiting the MBH at the center of our Milky Way. Only compact stars contribute to the expected detections from other galaxies because MSSs are disrupted by tidal forces too early.

Captures of stars by a massive black hole: Investigations in numerical stellar dynamics.

M. Freitag

I INTRODUCTION

An object of stellar mass orbiting a MBH with a mass below $10^7 \, M_\odot$ would become an ideal source of gravitational waves (GW) for \textit{LISA} in the last few years before plunge through the horizon, if compact enough to withstand the tidal forces. Such systems will be detectable to distances as large as a few hundreds Mpc. From the gravitational signal emitted by the stars as they spiral in, precise information about the mass and spin of MBHs can be obtained.

While considerable progress has been achieved in computing the orbit of a small body around and its GW signal, our understanding of the other aspects of the problem are still far from satisfactory. At one end, astronomers will have to detect and measure the parameters of such sources by using signal-processing algorithms still to be devised. On the other end of the process, Nature has to create sources by sending stars onto relativistic orbits, through processes and with rates still debated. The usual conservative approach – also applied here – is to assume that galactic nuclei are spherical and to rely on 2-body relaxation to bring stars onto “capture orbits”, for which, by definition, GW emission is the main agent of evolution.

II SIMULATIONS

To simulate the relaxational stellar dynamics of spherical galactic nuclei, we rely on our Monte Carlo (MC) code which, besides captures, includes all the important physics: cluster self-gravity, 2-body relaxation, stellar collisions, tidal disruptions and stellar evolution. The specific advantage of the MC approach is that it treats the various aspects of the stellar dynamics (collisions, mass-segregation...) in a self-consistent way. Furthermore, the simulations do not only provide us with capture rates but with the distribution of stellar