Poster Session #E
Astrophysics and Gravitational Waves

E12

Improved Gravitational Radiation Timescales

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Peters' formula is an analytical estimate of the time-scale of gravitational wave (GW)-induced coalescence of a binary system. It is used in countless applications, where the convenience of a simple formula outweighs the need for precision. However, many of the most promising sources of the Laser Interferometer Space Antenna (LISA), such as supermassive black hole binaries and extreme mass-ratio inspirals (EMRIs), are expected to enter the LISA band with highly eccentric ($e \sim 0.9$) and highly relativistic orbits. These are exactly the two limits in which Peters' estimate performs the worst. With this poster, we present a simple analytical formula to quantify how the inspiral time-scale is affected by the 1.5 post-Newtonian (PN) hereditary fluxes and spin-orbit couplings. We discuss several cases that demand a more accurate GW time-scale and show how this can have a major influence on quantities that are relevant for LISA event-rate estimates, such as the EMRI critical semi-major axis or the Kozai-Lidov quenching radius. We further discuss two types of environmental perturbations that can play a role in the inspiral phase: the gravitational interaction with a third massive body and the energy loss due to dynamical friction and torques from a surrounding gas phase ubiquitous in galactic nuclei. With the aid of PN corrections to the time-scale in vacuum, we find simple analytical expressions for the regions of phase space in which environmental perturbations are of comparable strength to the effects of any particular PN order, being able to qualitatively reproduce the results of much more sophisticated analyses.