Leor Barack
University of Southampton

Gravitational self-force: orbital mechanics beyond the geodesic approximation

Authors: Leor Barack

The fundamentally simple question of motion in a gravitationally-bound two-body system is a longstanding open problem of General Relativity. When the mass ratio is large the problem lends itself to a perturbative treatment, whereby corrections to the geodesic motion of the smaller object (due to radiation reaction, internal structure, etc.) are accounted for order by order in a small-mass-ratio expansion, using the language of an effective "gravitational self-force". The prospect for observing gravitational waves from compact objects inspiralling into massive black holes in the foreseeable future has in the past 15 years motivated a program to obtain a rigorous formulation of the self-force and compute it for astrophysically interesting systems. I will begin this talk by reviewing the general theory of the gravitational self-force in curved spacetime, and proceed to describe how this theory is being implemented today in actual calculations of the self force for inspiral orbits. I will discuss recent calculations of some conservative post-geodesic effects of the self-force (including the finite-mass correction to the precession rate of the periastron), and highlight the way in which these calculations allow us to make a fruitful contact with post-Newtonian theory and with Numerical Relativity, and also inform the development of a universal Effective One Body model of the two-body dynamics.