

PerAPS

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DIPARTIMENTO
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ORE 15:30 – AULA A



Probing Fundamental Physics through Asymmetric Binary Mergers

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Black hole binaries with large mass asymmetries, such as Extreme Mass Ratio Inspirals, represent a new class of gravitational wave sources for next-generation detectors—largely undetectable by current interferometers. In the most extreme cases, these asymmetric binaries can remain within the detector band for hundreds of thousands of orbits before the final plunge. Moreover, while currently observed sources exhibit relatively simple behavior—quasi-circular orbits, mild eccentricities, and mostly aligned spins—highly asymmetric binaries are expected to follow much more complex trajectories, featuring significant eccentricity, off-equatorial motion, and orbital resonances. The combination of an exceptionally large number of orbital cycles and rich relativistic dynamics makes asymmetric binaries a unique laboratory for testing fundamental physics.

In this talk, I will review some of the exciting possibilities offered by asymmetric binaries, focusing on their potential to provide novel insights into the environments in which binaries evolve and the existence of new fundamental fields in the Universe coupled to gravity. I will examine the methodologies used to model such systems within non-vacuum spacetimes and beyond General Relativity, highlighting recent progress in waveform modeling. Finally, I will discuss the constraints that next-generation observations are expected to place on these models.