

# Dark Matter and Stars: Multi-Messenger Probes of Dark Matter and Modified Gravity

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## Dirty black hole binaries as probe of dark matter halos

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Coalescing compact binaries provide natural laboratories in which black holes act simultaneously as targets of gravitational wave observations, and moving probes of their medium, where matter fields and particles live in a genuine strong gravity regime.

Within the family-tree of coalescing systems, asymmetric binaries provide a unique phenomenology, which makes them golden sources for next generations of interferometers to investigate the properties of non-vacuum spacetimes.

In this talk I will review some of the possibilities offered by such sources to provide novel insights on the environment in which binaries evolve. I will focus on astrophysical scenarios in which binary black holes orbit embedded by a dark matter halo, showing how the latter affects the propagation and generation of gravitational waves, leaving a detectable imprint on the emitted signals. I will discuss how future observations can exploit such footprints to infer the properties of the dark matter content, possibly allowing to distinguish between different models proposed so far to describe its distribution around massive objects.

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