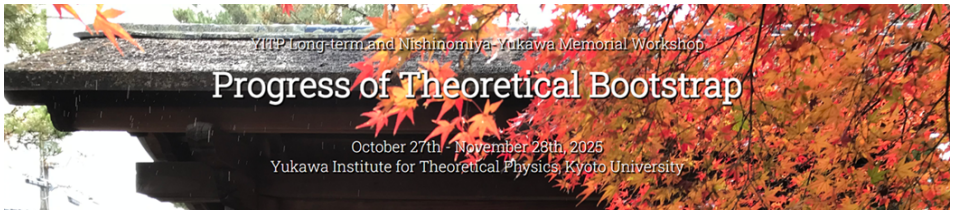

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Andrea Cristofoli "The Common On-Shell Language of Black Hole Mergers and Radiation"

Wednesday, November 26, 2025 11:00 AM (1 hour)

Abstract: The two-body problem in general relativity can be described —in the post-Minkowskian expansion —purely in terms of on-shell amplitudes and their classical limit, without ever invoking a Lagrangian or equations of motion. However, beyond this perturbative regime, it is not known whether more complex aspects of binary dynamics —such as the merger phase or the influence of event horizons —can be captured on-shell. In this talk, I will argue that both the merger and the presence of an event horizon can indeed be described on-shell within a common framework based on mass-changing three-point amplitudes. The merger can be viewed as a fusion process once such amplitudes are introduced. Conversely, the presence of an event horizon can be described either as a decay process (Hawking radiation) or as a fusion process (classical wave absorption), following the same logic. This leads to a unified on-shell viewpoint in which black-hole mergers, gravitational-wave absorption, and Hawking radiation —seemingly distinct nonperturbative phenomena —reveal a surprising simplicity and common structure when formulated through on-shell methods. As an application, I will show how to derive conservation laws and compute memory waveforms associated with black-hole mergers, as well as how to describe the effects of Hawking radiation on the two-body problem using only gauge-invariant data and on-shell mass-changing amplitudes.