

Giovedì
12 marzo
Aula B, ore 16:00



To infinity and beyond: the hyperboloidal framework for wave equations

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Wave propagation and radiation are common phenomena across many areas of physics, from classical field theory to modern gravitational-wave astronomy. In this talk, I will introduce the mathematical and physical ideas behind the so-called hyperboloidal framework, a concept developed upon Penrose's seminal work on the "Conformal Treatment of Infinity". By exploiting spacetime's causal structures, this framework allows us to treat distant radiation and strong-field regions within a single unified picture, providing a natural way to study waves as they propagate all the way to the infinity far wave zone. The first part of the talk presents an overview of the conceptual foundations of hyperboloidal methods, emphasizing their geometric intuition and their advantages for analyzing wave behaviour at the wave zone. In the second part, I will illustrate how these ideas have become powerful infrastructure in black-hole perturbation theory and gravitational-wave physics, enabling new insights into phenomena such as black-hole ringdown and radiation from binaries systems. Beyond their role in general relativity, the underlying concepts offer a broader perspective on wave-like systems and may find applications across different areas of physics.

