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From Black Hole Scattering to Calabi-Yau Manifolds

Thursday 4 September 2025 11:00 (1 hour)

I will present recent four-loop results on black hole scattering observables. These unprecedented results shed new light on the classic gravitational two-body problem, achieve new levels of precision required in gravitational wave physics, and, strikingly, involve Calabi–Yau periods in their analytic description. Although classical and free of quantum effects, these results are deeply informed by techniques originally developed in quantum chromodynamics and particle physics, encapsulated in the worldline quantum field theory (WQFT) formalism. In my talk, I will introduce the basics of WQFT and its Feynman diagrammatic expansion of the classical black hole scattering system, highlighting both the physical aspects and the mathematical structures. Examples of the former include dissipative, self-force, and spin effects; of the latter, loop integrals, differential equations, and special functions. Finally, as a perspective on applications in gravitational wave physics, I will compare the perturbative four-loop results and their resummation with numerical relativity.

Presenter: JAKOBSEN, Gustav Uhre