Amplitudes

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Modern amplitude methods have made a huge impact on our understanding of quantum field theory and our ability to make precise predictions for physical observables. Their remarkable mathematical structure has led to new results in an enormous range of subjects from collider experiments to gravitational wave emissions.

The research activity of the Amplitudes project deals with the computation of scattering amplitudes which are of interest in Collider Physics and in Gravitational-Wave Physics. In particular, in the LNF node we have dealt with:

- developing a scheme for the computation of cross sections at next-to-next-to-leading order (NNLO) accuracy in the strong coupling constant α_s and beyond in a process-independent way [1, 2], exploiting the universality of the infrared divergences;
- exploring common patterns in the computation of scattering amplitudes in gauge theories, analysing them in the Regge limit [3, 4];
- computing the emission of gravitational waves from a binary system of massive compact objects through the use of scattering amplitudes and effective field theories [5, 6, 7, 8, 9];
- participating in the feasibility study of a Future Circular Collider [10, 11, 12].

News from the LNF node

- Since October 2024, we have had a junior postdoc fellow, Dr. Francesco Alessio, with research project "Scattering amplitudes and modelling of gravitational wave emissions".
- Since October 2025, we have had a senior postdoc fellow, Dr. Ming-Ming Long, with research project "Developing a scheme for high-precision computations of cross sections at hadron colliders".
- In October 2025, V. Del Duca started supervising the thesis of a MSc student of University of Roma "La Sapienza", Lorenzo Pietrini, with research project "The high-energy kernels of gravitational scattering".
- In October 2024, V. Del Duca started supervising the PhD project of Emanuele Rosi of University of Roma "La Sapienza" with research project "Modelling waveforms of binary systems of massive compact objects with gravitational wave emission".
- In October 2025, V. Del Duca started supervising the PhD project of Victor Sanz Sanchis of University of Roma Tor Vergata with research project "The high-energy limit of gravitational scattering".

- On 1-4 October 2024 and on 22-24 January 2025, V. Del Duca organised at LNF two workshops: "High Luminosity LHC and Hadron Colliders" and "FCC-ee and Lepton Colliders", both in the context of the INFN initiatives for the European Strategy for Particle Physics (ESPP) Update - 2025-2026.

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