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Vacuum amplitudes in the loop-tree duality for theoretical predictions at colliders

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This talk presents recent advances in the cancellation of ultraviolet (UV) and infrared (IR) singularities within perturbative quantum field theory (QFT), focusing on automating theoretical tools for more precise predictions at high-energy colliders. Loop-Tree Duality (LTD) is introduced as an efficient technique to achieve the local cancellation of singularities directly at the integrand level, eliminating the need for dimensional regularization. This approach naturally unifies loop and tree-level contributions, simplifying integrals and optimizing the calculation of amplitudes.

Additionally, the talk explores the causal properties of scattering amplitudes within the LTD representation and how these can be leveraged to enhance precision in higher-order QFT processes. Furthermore, advancements in quantum computing are discussed, specifically its use in efficiently calculating scattering amplitudes within the LTD framework. Quantum algorithms are employed to optimize Feynman integrals, facilitate the analysis of higher-order processes, and leverage quantum entanglement to solve problems in quantum field theory more efficiently. This opens new possibilities for simulating higher-order phenomena at high-energy colliders.

Abstract

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