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## Four-loop scattering amplitudes journey into the forest

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A crucial challenge in perturbative Quantum Field Theory is the description of quantum fluctuations at high-energy scattering processes by the calculation of multi-loop scattering amplitudes. Aiming for improving the efficiency of these computations, we delve into a new technique based on the Loop-Tree Duality (LTD). We analyse the multiloop topologies that appear for the first time at four loops and manage to assemble them in general expression, the  $N^4\text{MLT}$  universal topology. Based on the fact that the LTD enables to open any scattering amplitude in terms of convolutions of known subtopologies, we obtained the dual representation of the universal  $N^4\text{MLT}$  topology and determined the internal causal structure of the entire amplitude. Remarkably, we verified the causal conjecture for the  $N^4\text{MLT}$  family and present explicit causal representations of selected configurations, allowing a more efficient numerical implementation due to the absence of non-causal singularities.

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### Collaboration / Activity

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