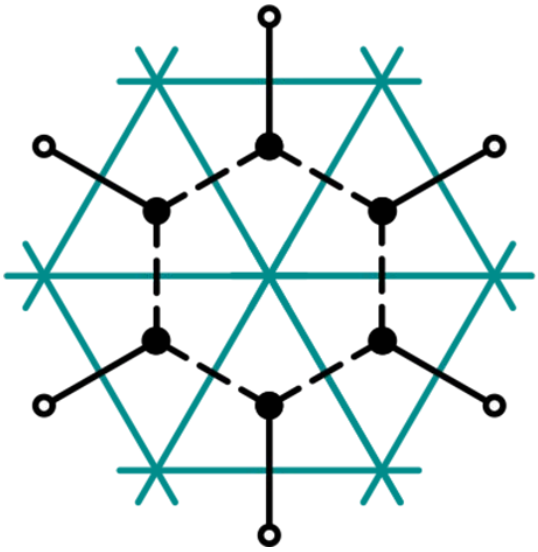
Hidden Symmetries in Massive Quantum Field Theory



Theoretical models with a large amount of symmetry are ubiquitous in physics and often key to developing efficient methods for complex problems. If the number of symmetries surpasses a critical threshold, a system is called integrable with a prime example being the Kepler problem of planetary motion. While integrability typically comes with a rich spectrum of mathematical methods, it is often hard to identify the underlying symmetries. For the first time quantum integrability was now discovered in the context of massive quantum field theories in four spacetime dimensions. Florian Loebbert and Julian Miczajka (both Humboldt University) together with Dennis Müller (NBI Copenhagen) and Hagen Münkler (ETH Zürich) have shown that large classes of mostly unsolved massive Feynman integrals feature an infinite dimensional Yangian symmetry - a hallmark of integrability. This mathematical structure is highly constraining and it allows to completely fix these building blocks of quantum field theory as has been demonstrated for first examples. The observed Yangian symmetry goes hand in hand with an extension of the important structure of conformal symmetry to situations including massive particles. Remarkably, this discovery suggests that similar symmetry features may also be hidden in massive versions of the celebrated holographic duality between gauge theories and gravity. These findings were recently published in Physical Review Letters 125 (2020) 9, 091602.

Massive Conformal Symmetry and Integrability for Feynman Integrals
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