Loops, Trees and the Search for New Physics

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Abstract: Feynman diagrams are a cornerstone of our ability to extract physics from quantum field theories. It can, however, be surprisingly difficult to evaluate even seemingly simple diagrams. Modern methods for dealing with this problem using basic concepts of unitarity in quantum mechanics will be outlined. Applications of the new ideas to a variety of problems ranging from physics at the Large Hadron Collider at CERN to basic issues in quantum gravity will be given.

Besides their importance for carrying out explicit calculations that would have been otherwise impossible, using even the most powerful computers, the methods also clarify a connection between gravity and the strong subnuclear force, showing that in a precise sense gravitons can be thought of as two copies of gluons.