C O L L O Q U I U M

From the Parke-Taylor Amplitude to Deeper Origins for Space-time and Quantum Mechanics

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30 years ago, Fermilab theorists Stephen Parke and Tomasz Taylor made one of the most important discoveries in theoretical physics of the past three decades--the Parke-Taylor gluon scattering amplitude--replacing hundreds of pages of complicated Feynman diagram calculations with an astonishingly simple expression. Triggered by this electrifying result, the intervening years have seen revolutionary advances in our understanding of scattering amplitudes, associated with a radical new way of thinking about fundamental physics, ``quantum field theory without the quantum fields''. These developments have had a major impact on experiments, allowing the reliable calculation of many of the most important Standard Model backgrounds at Hadron colliders. They have also been profoundly influential in theoretical physics, pointing the way to an understanding of space-time and quantum mechanics as emerging hand-in-hand from more primitive principles. In this talk I will begin by reviewing these ideas, before proceeding to describe a new formulation of maximally supersymmetric gauge theory scattering amplitudes, arising from deep mathematical structures in "positive geometry", making no reference to Hilbert space or space-time. In this example we can concretely see how the usual rules of space-time and quantum mechanics arise, joined at the hip, from fundamentally geometric and combinatorial origins.