

Scattering Forms from Geometries at Infinity (Song He, ITP Chinese Academy of Science)

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Abstract: Scattering amplitudes play a prominent role not only in high energy particle physics, but also for quantum gravity in asymptotically flat spacetime. The search for a “theory at infinity” of the S-Matrix has revealed surprising geometric structures underlying amplitudes ranging from the string worldsheet to the amplituhedron, but these are all geometries in auxiliary spaces as opposed to the space at infinity where amplitudes actually live. By thinking of amplitudes as differential forms, we propose a novel geometric picture directly in kinematic space for a wide range of massless theories in general dimensions.

As a primary example, we show that tree amplitudes of bi-adjoint scalars are given by the “volume” of an associahedron living naturally in kinematic space, and scattering equations act as a diffeomorphism from the open-string moduli space (also an associahedron) to it. We find general “scattering forms” dual to color-dressed amplitudes e.g. for gluons and pions, which is possible due to a remarkable fact – “Color is Kinematics”. All these forms are well-defined in projectivized space, a property which provide a geometric origin for color-kinematics duality.

Summary