

On-shell bootstrap of a general spontaneously broken gauge theory

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It is well known that the most general renormalizable quantum field theory one can write down for a finite spectrum of spin-0, 1/2, and 1 particles is a gauge theory, with possible spontaneously broken symmetries. The existence of Lie group structures in such a theory is dictated by perturbative unitarity of the on-shell scattering amplitudes. Armed with new tools developed for scattering amplitudes, we demonstrate very explicitly how broken symmetries emerge from the constraints of tree unitarity. We review the on-shell spinor helicity formalism, using which we enumerate all possible 3-pt and 4-pt tree amplitudes of massive spin-0, 1/2 and 1 particles satisfying unitarity constraints. We show in these amplitudes how massive vectors and scalars need to be in the same representation of some Lie group, and how the longitudinal components of these massive vectors are equivalent to scalars in the high energy limit. We will also comment on an extended color-kinematics duality that can be hiding in such a general theory.

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