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Special Relativity from Soft Gravitons

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We study all translationally and rotationally invariant local theories involving massless spin 2 and spin 1 particles that mediate long range forces, allowing for general energy relations and violation of boost invariance. Although gauge invariance is not a priori required to describe non Lorentz invariant theories, we first establish that locality requires 'soft gauge invariance'. Then by taking the soft graviton limit in scattering amplitudes, we prove that in addition to the usual requirement of universal graviton couplings, the special relativistic energy-momentum relation is also required and must be exact. We contrast this to the case of theories with only spin ≤ 1 particles, where, although we can still derive charge conservation from locality, special relativity can be easily violated. We provide indications that the entire structure of relativity can be built up from spin 2 in this fashion.

Presentation type

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