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Lorentz Invariance from Locality of Massless Spin 2

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It is known that local, Lorentz invariant, unitary theories involving particles with spin 1 demand that the matter sector they couple to are organized by internal physical symmetries and the associated charge conservation, while spin 3/2 demands supersymmetry. However, the introduction of a spin 2 graviton does not obviously demand new symmetries of the matter sector (although it does demand a universal coupling). In recent work we relaxed the assumption of Lorentz boost symmetry, while maintaining a basic notion of locality that there is no instantaneous signaling at a distance. In order to avoid potential problems with longitudinal modes of the graviton, we chose to project them out, leaving only two degrees of freedom. This nevertheless leaves a large classes of theories that a priori may violate Lorentz boost invariance. By requiring the tree-level

exchange action be local, consistency demands that the Lorentz boost symmetry must be satisfied by the graviton and the matter sector, which in turn recovers general relativity uniquely at this

order of analysis. In this sense, the Lorentz boost symmetry can be seen to be an underlying physical symmetry that is demanded of the graviton and matter sectors, analogous to internal symmetries of theories involving spin 1, a fact which is usually taken for granted.

Summary

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