Homework 2

Massless spin-3 particles

Consider a massless particle with helicity ±3.

1. Construct the field operator and discuss its behavior under Lorentz transformations.

2. What is the gauge invariance we need in order to construct a Lorentz invariant theory?

3. What is the “field-strength” operator in this case—the analogue of $F^{\mu\nu}$, which is gauge-invariant and therefore Lorentz-covariant?

4. By $S$-matrix arguments, we have seen that in the low-energy limit, massless spin-1 particles (“photons”) can only couple to conserved charges, and massless spin-2 particles (“gravitons”) can only couple to the four-momentum. If we go through the same argument for our massless spin-3 particles, what do we get?