

## Week 6 (due Nov. 11)

Reading: Schwartz 27.1-27.7.

1. The 4-gluon color-ordered scattering amplitude  $A(1-, 2-, 3+, 4+)$  is usually written as in Eq. (27.85) in Schwartz. Show (without appealing to parity symmetry) that it can also be written as follows:

$$A(1-, 2-, 3+, 4+) = \frac{[34]^4}{[12][23][34][41]}.$$

2. Graviton scattering amplitudes can also be computed using the helicity formalism. Recall that gravitons also have two polarization states, with helicities  $+2$  and  $-2$ . The corresponding polarization tensors are simply squares of polarization vectors of photons with helicities  $+1$  and  $-1$ , respectively. One difference compared to the case of gluons is that the interaction constant is dimensionful: it is  $1/M_{Pl}$ , where  $M_{Pl}$  is the Planck mass. Use dimensional analysis to show that the 3-graviton interaction vertex is quadratic in momenta. Then use little group scaling to determine all 3-graviton on-shell scattering amplitudes.

3. Use the BCFW recursion to deduce the 4-graviton scattering amplitude  $A(1-, 2-, 3+, 4+)$ .