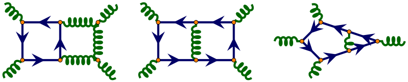
Color-Kinematics Duality for Fundamental Matter at Two-Loops

work with H. Johansson & G. Mogull [1706.09381]

Gregor Kälin

Uppsala University

12.06.2018



Motivation

Double Copy

$$(\text{gauge theory})^2 \sim \text{gravity}$$

Goal: Pure (super)gravity amplitudes

Problem: Matter states on gravity side

$$\mathcal{V}_{\mathcal{N}} \otimes \mathcal{V}'_{\mathcal{M}} \equiv \mathcal{H}_{\mathcal{N}+\mathcal{M}} \oplus X_{\mathcal{N}+\mathcal{M}} \oplus \overline{X}_{\mathcal{N}+\mathcal{M}}$$

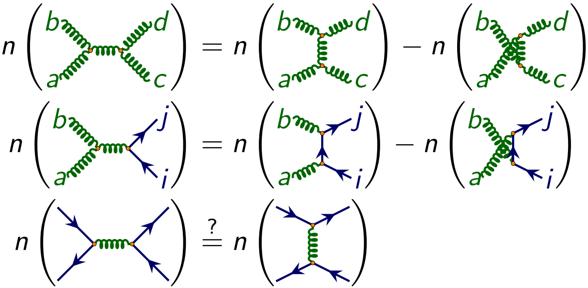
Solution: Matter states in the Gauge theory

$$\Phi_{\mathcal{N}} \otimes \overline{\Phi}'_{\mathcal{M}} \equiv X_{\mathcal{N}+\mathcal{M}},$$
$$\overline{\Phi}_{\mathcal{N}} \otimes \Phi'_{\mathcal{M}} \equiv \overline{X}_{\mathcal{N}+\mathcal{M}}$$

Color-kinematics duality

[BCJ '08, JO '14]

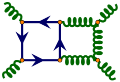
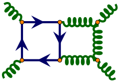
$$\mathcal{A}_m^{(L)} = i^{L-1} g^{m+2L-2} \sum_{\text{cubic graphs } \Gamma_i} \int \frac{\mathrm{d}^{LD}\ell}{(2\pi)^{LD}} \frac{1}{S_i} \frac{n_i c_i}{D_i}$$



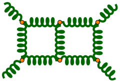
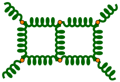
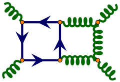
$\mathcal{N} = 2$ SQCD: Input data

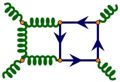
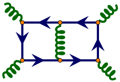
Input data = constraints on the numerators

- Hyper and antihyper (half-)multiplet have the same particle content:

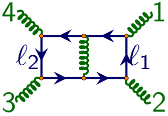
 $=$ 

- Supersymmetric decomposition:

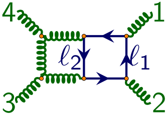
$n^{\mathcal{N}=4}$ () $= n^{\mathcal{N}=2}$ () $+ 2n^{\mathcal{N}=2}$ ()

$+ 2n^{\mathcal{N}=2}$ () $+ 2n^{\mathcal{N}=2}$ ()

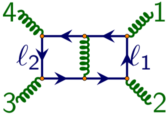
$\mathcal{N} = 2$ SQCD: Results MHV

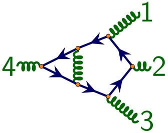


$$= -\mu_{12}(\kappa_{12} + \kappa_{34}) + \mathrm{tr}_+(p_1, \bar{\ell}_1, p_2, p_3, \bar{\ell}_2, p_4)\tilde{\kappa}_{13} + \mathrm{tr}_+(p_1, \bar{\ell}_1, p_2, p_4, \bar{\ell}_2, p_3)\tilde{\kappa}_{14} + \mathrm{tr}_-(p_1, \bar{\ell}_1, p_2, p_3, \bar{\ell}_2, p_4)\tilde{\kappa}_{24} + \mathrm{tr}_-(p_1, \bar{\ell}_1, p_2, p_4, \bar{\ell}_2, p_3)\tilde{\kappa}_{23}$$



$=$





$= 0$

All other numerators are determined by above identities!