UV Properites of N=8 SUGRA at Five Loops and Beyond

Alex Edison

with

Zvi Bern, John Joseph Carrasco, Wei Ming Chen, Henrik Johansson, Julio Parra-Martinez, Radu Roiban, and Mao Zeng

hep-th/1804.09311, ongoing

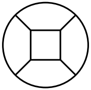
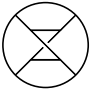
Amplitudes School 2018 Gong Show

UCLA The Mani L. Bhaumik Institute for Theoretical Physics

The Five-Loop Results

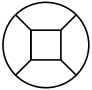
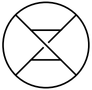
$$\mathcal{M}_4^{(5)}\Big|_{\text{leading}}^{D=22/5} = 0\,. \tag{1}$$

$$\mathcal{M}_4^{(5)}\Big|_{\text{leading}}^{D=24/5} = -\frac{16\times 629}{25}\left(\frac{\kappa}{2}\right)^{12}(s^2+t^2+u^2)^2 stu\mathcal{M}_4^{\text{tree}}$$

$\times \Bigg(\frac{1}{48}$  $+ \frac{1}{16}$  $\Bigg)$ (2)

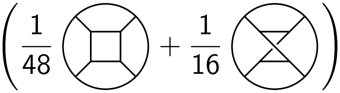
Emerging Patterns

Very simple result, but it took 1000s of hours to get to. Is there a better way?

$\Bigg(\frac{1}{48}$  $+ \frac{1}{16}$  $\Bigg)$

Emerging Patterns

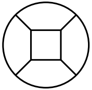
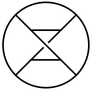
Very simple result, but it took 1000s of hours to get to. Is there a better way?



- Consistency with lower loops
- Integration system
- Special BCJ on sYM

Emerging Patterns

Very simple result, but it took 1000s of hours to get to. Is there a better way?

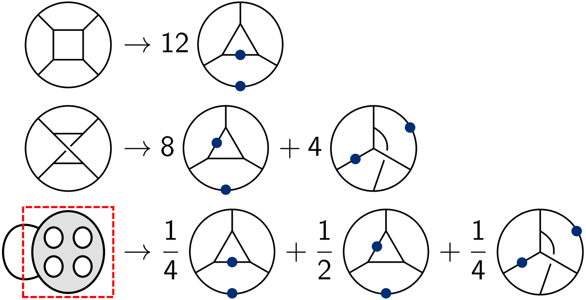
$\Bigg(\frac{1}{48}$  $+ \frac{1}{16}$  $\Bigg)$

- Consistency with lower loops
- Integration system
- Special BCJ on sYM

Working on applying all of these to 6 loops!

Consistency with Lower Loops

Removing legs appropriately always lands on correct lower loop



(3)

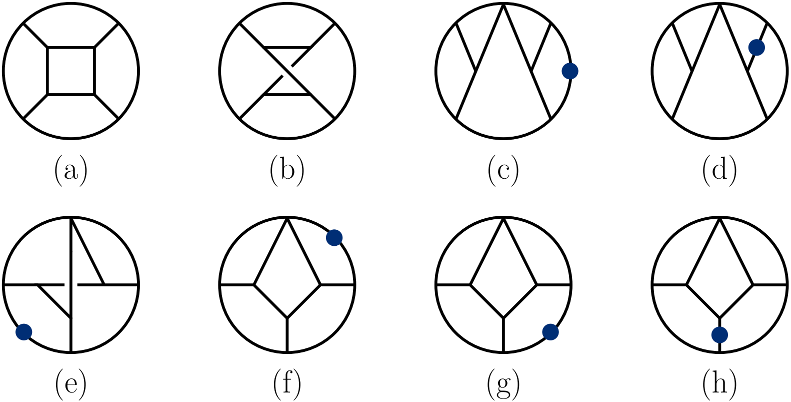
(4)

(5)

Pattern continues all the way down to one loop. Consistency with one loop requires *no triangles*. Can use to constrain ansatz at 6 loops.

Integration Patterns

$\mathcal{N} = 8$ SUGRA IBP master integrals for five loops:



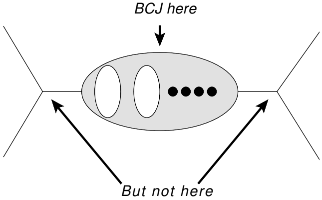
Integration systems for *both* SUGRA and sYM can be written in terms of masters with limited numerators.

Special BCJ on sYM

- Early indication of being able to determine sYM divergence using a subset of BCJ

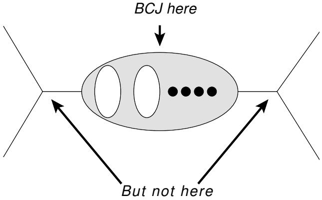
Special BCJ on sYM

- Early indication of being able to determine sYM divergence using a subset of BCJ
- "Two-Point BCJ": relations between specific diagrams



Special BCJ on sYM

- Early indication of being able to determine sYM divergence using a subset of BCJ
- "Two-Point BCJ": relations between specific diagrams



- Works up to 5 loops. Looks like it might square to gravity "divergence".

Warming up in 6 Loop sYM, then on to SUGRA!

Questions?