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

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with

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hep-th/1804.09311, ongoing

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The Five-Loop Results

\[ \mathcal{M}_4^{(5)} \bigg|_{D=22/5}^{\text{leading}} = 0. \quad (1) \]

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

\[ \times \left( \frac{1}{48} \begin{array}{c} \text{Diagram 1} \\ \end{array} + \frac{1}{16} \begin{array}{c} \text{Diagram 2} \\ \end{array} \right) \quad (2) \]
Emerging Patterns

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

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

\[ \rightarrow 12 \]

\[ \rightarrow 8 + 4 \]

\[ \rightarrow \frac{1}{4} + \frac{1}{2} + \frac{1}{4} \]

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.
• Early indication of being able to determine sYM divergence using a subset of BCJ
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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”.

BCJ here

But not here

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

Questions?