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Aspects of Four Point One Loop Superstring Amplitudes in Celestial Holography

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Celestial holography is a candidate for flat space holography. Scattering amplitudes of massless particles in the bulk four dimensional Minkowski spacetime can be mapped to correlators in a putative two dimensional conformal field theory living on the celestial sphere via Mellin transform.

In 1806.05688 string tree level amplitudes have been cast into their celestial form. In it, the authors displayed some intriguing features of celestial string amplitudes including that the α'-dependance is limited to an overall factor as opposed to being present at different powers as an expansion parameter like in regular string scattering amplitudes. Additionally, they argued that in a special limit the string world-sheet can be interpreted as the celestial sphere itself. This observation gives credence to the idea that there might be a string theoretic top-down construction for flat space holography.

Motivated by this, an obvious next step is to try to generalize this analysis to one-loop order. The first step towards this goal was taken in 2307.03551. I will present results of ongoing work using two different approaches that extend this analysis. I will show that the α'-dependance is a persistent feature of celestial (loop) amplitudes and reproduce the known $\alpha'^{\beta-3}$ prefactor in both approaches. Using one approach, I will give a formula for the celestial open one-loop superstring amplitude expressed in terms of powers of the conformal cross ratio. Using the other approach, I will show that the Nielsen Polylogarithm structure found in 1806.05688 at tree level, persists at loop level. An explicit formula of the planar amplitude in the forward limit below the threshold energy of massive string excitations will be presented.

Summary

Primary author: BOCKISCH, Daniel (LMU Munich)

Presenter: BOCKISCH, Daniel (LMU Munich)

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