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Nonperturbative Negative Geometries: From the Amplituhedron to AdS

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We consider scattering amplitudes in $N=4$ super Yang-Mills theory. Apart from any physics motivation about the exponentiation of infrared divergences, purely from the positive geometry of the loop Amplituhedron, we find that the logarithm of the amplitude appears as a natural object to look at. Thinking about ‘negative geometries’ gives a useful decomposition of the latter, different from usual Feynman diagrams. We define a new observable that can be defined directly in terms of negative geometries, and integrated directly in four dimensions. Purely from the perspective of the geometry, there is a clear separation in the complexity of different contributions. We compute analytically a particular class of terms to all loop orders, and extract their contribution to the cusp anomalous dimension. We find that our analytic result reproduces several qualitative features of the full answer.

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