

# Positive Geometry, Canonical Forms and Scattering Amplitudes

Chi Zhang<sup>1</sup>

<sup>1</sup>CAS Key Laboratory of Theoretical Physics, Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing 100190, China

## Abstract

Inspired by the idea of viewing amplitudes in  $\mathcal{N} = 4$  SYM as differential forms on momentum twistor space, we introduce differential forms on the space of spinor variables. In  $\mathcal{N} = 4$  SYM, such forms can be thought of as “bosonizing” superamplitudes in non-chiral superspace. Remarkably all tree-level amplitudes in  $\mathcal{N} = 4$  SYM combine to  $d \log$  forms in spinor variables, which are given by pushforward of canonical forms of Grassmannian cells. The tree forms can also be obtained using BCFW or inverse-soft construction, and we present all-multiplicity expression for MHV cases to illustrate their simplicity. We initiate the study of its geometry by connecting it to the moduli space of Witten’s twistor-string theory. For comparison, we give another example that amplitudes can be viewed as geometric objects, that is, tree amplitudes in the bi-adjoint  $\phi^3$  theory can be viewed as canonical forms of associahedra in kinematic space.