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The NCTU string theory group is currently interested in several research topics in string and field theories:

### A. High energy string scatterings

1. We study high energy string scatterings and derive relations among amplitudes of different string states in both fixed angle and Regge regimes. We use the combinatorial theory to link the relationship between string scattering amplitudes of these two high energy regimes.
2. We apply BCFW method and KLT relation to study field theory and string theory scattering amplitudes. BPST vertex operator is also used to probe Regge string theory.

### B. AdS/QCD&CMT duality

1. AdS/CFT duality provides a suitable frame to study various strongly coupled systems in field theory. One of the most interesting strongly coupled systems in high energy physics is low energy QCD. We apply the AdS/CFT duality to study the thermodynamics properties at finite temperature and finite density in low energy QCD.
2. We apply the AdS/CFT duality to study strongly coupled condensed matter systems, like Lifshitz-fixed point, (non) Fermi liquid, and high temperature superconductor.

### C. Gauge theory scattering amplitudes

The studies of Yang-Mills field theory amplitude continue to bring new understandings even after decades of development. Recent year witnesses the discovery of dual super conformal symmetry, color-kinematic duality, Grassmannian integral formulation, as well as the twistor space geometric interpretation, which were unforeseen from the standard lagrangian formulation. We study the analytic structure of gluon amplitude and amplitude relations using on-shell technique along with other string inspired methods.

### D. Yang-Mills Instanton Sheaves

The complete SU(2) Yang-Mills instanton solutions were constructed in 1978. By using an one to one correspondence between anti-self-dual SU(2)-connections on  $S^4$  and certain holomorphic vector bundles of rank two on  $CP^3$ , ADHM converted the highly nontrivial system of nonlinear partial differential equations of anti-SDYM into a much more simpler system of quadratic algebraic equations in quaternions. Recently We extended the ADHM results to the non-compact SL(2,C) Yang-Mills instantons and discovered that, in addition to the holomorphic vector bundle solutions, there are many instanton solutions with associated sheaf structure on  $CP^3$ .