STRING THEORY FROM A WORLDSHEET PERSPECTIVE
TRAINING WEEK

Lecturer: **Oliver Schlotterer**
Title: ***Superstring Amplitudes in RNS and Pure Spinor Formalism***

SYLLABUS

- Tree-level amplitude prescriptions in the RNS- and pure-spinor formalism
- Simplifying the n-point tree amplitude in the pure-spinor formalism
- Double-copy and field-theory structures in string tree amplitudes
- Moduli-space integrals at genus zero and multiple zeta values
- The structure of one-loop amplitudes from the RNS and pure-spinor formalism
- Field-theory limits at one loop and ambitwistor strings
- Genus-one integrals, elliptic multiple zeta values and modular graph forms
- Two- and three loop amplitudes and their low-energy limits

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TRAINING WEEK

Lecturer: **Ted Erler**
Title: ***Quantum Properties of String Field Theory***

CONTENT

We give an elementary introduction to closed string field theory. We start by defining off-shell amplitudes and a convenient prescription for defining the measure on moduli space of decorated Riemann surfaces using the Schiffer variation. We then try to build off-shell amplitudes through a Feynman graph expansion, first gluing cubic vertices through plumbing fixture and iteratively introducing new vertices to fill gaps in the integration over the moduli space.
The recursive procedure leads to an action whose vertices realize a special algebraic structure, called a (quantum) L_∞ algebra. At the end we discuss issues specific to the superstring, including the formulation of a free action for Ramond fields, the measure for integration on the decorated moduli space including picture changing operators, and the associated concept of ``vertical integration" needed to avoid spurious poles in the integration measure.

References:

Zwiebach: ``Closed String Field Theory: Quantum Action and the BV Master Equation"
http://inspirehep.net/record/335613
This mega-paper is the primary source for closed string field theory. Only discusses the closed bosonic string, but in this setting already 90% of the nontrivial ideas are at play. The superstring just requires a little extra dressing.

de Lacroix et al: ``Closed Superstring Field Theory and its Applications"
http://inspirehep.net/record/1518427
This review goes into additional issues for the superstring, and summarizes many of the physical applications of the formalism in recent years, especially due to the work of A. Sen.

Erler et al: ``One Loop Tadpole in Heterotic String Field Theory"
http://inspirehep.net/record/1589860
This is not an especially important paper or review article, but is one of few places where the calculation of an off-shell amplitude in closed string field theory is explained pedagogically and in full detail. In this it may be helpful to people trying to learn the subject.