

# Introduction to String Theory, PHY 7097

## SYLLABUS

### I. Review: Properties of tree approximation

1. Paradigms:  $\phi^3$  and Yang-Mills
  - (a) Singularity structure
  - (b) Crossing Symmetry and Unitarity
  - (c) Unstable particles
2. Composite particles and resonances
  - (d) Bound states
  - (e) Quasi-bound states (resonances)
  - (f) Implications of Unitarity for resonances: the ghost problem
3. The  $1/N$  expansion, quark confinement, and a new tree approximation

### II. The Veneziano Model and its n-point generalization

1. Motivation from strong interactions: Narrow resonances and Linear Regge trajectories
2. Veneziano's 4-point function and its physical properties.
3. n-point functions: Koba-Nielsen variables and the electrostatic analogue.
4. Factorisation and operator formalism
5. Ward-like identities and the Virasoro Algebra
6. No-ghost theorem

### III. Dual models with fermions

1. Lovelace-Shapiro model
2. Neveu-Schwarz-Ramond operator formalism
3. Super Virasoro algebra and Ward-like identities
4. Fermions
5. No-ghost theorem

### IV. Interpretation of Dual Models as String Scattering amplitudes

1. Action principle, reparametrization and conformal invariance.
2. Lightcone quantization
3. Covariant quantization
4. Path Integral formalism

5. Closed Strings

V. Dualities and D-branes

VI. AdS/CFT Correspondence and Field/String Duality