

INTRODUCTION TO STRING THEORY SYLLABUS

The course aims at giving an updated introduction to string theory, including D-brane techniques, non-perturbative dualities, and black-hole entropy calculations.

The course will cover the items detailed below. Lecture notes shall be made available during the course. Besides lecture notes, relevant references are listed below, after each item, and denoted as follows: Author(s) (acronym) = Section, subsection (if applicable).

- Why Strings?
P=1.1; GSW=1.1,1.2; K=1,2
- The Classical Particle and the Bosonic String
P=1.2; GSW=1.3,2.1; K=3
- Light-Cone Quantization and the String Spectrum
P=1.3,1.4; GSW=2.3; K=4.2,4.3
- World-Sheet 2D Supersymmetry
GSW=4.1,4.3
- Space-Time Supersymmetry in the RNS Formulation
GSW=4.3
- The Heterotic Superstring (Free-Fermion Formulation)
GSW=6.3
- Toroidal Compactifications of the Bosonic String
P=8.2; GSW=6.4
- Toroidal Compactifications of the Superstring
GSW=6.4; K=12.1
- The Heterotic Superstring (Bosonic Formulation)
GSW=6.4; P=11.6
- T-Duality of the Bosonic String
P=8.3; K=7.3
- T-Duality of the Superstring
P=13.1

- String Interactions
P=3.1-3.6
- Strings in Curved Spacetime and Compactifications
P=3.7; GSW=3.4
- String S-Matrix and Moduli of Riemann Surfaces
P=5.1,5.2,5.3
- Tree-Level Amplitudes
P=6.1-6.4
- Chan-Paton Factors and Admissible Gauge Groups
P=6.5; GSW=6.1
- Closed String Amplitudes and Tadpoles
P=6.6
- One-Loop Amplitudes; Tadpole Cancellation Conditions
P=7.3,7.4,10.7,10.8; GSW=8.2,10.4
- Modular Invariance of the Heterotic String and Narain Compactifications
P=11.6, GSW=9.4
- Low-Energy Effective Theory of the Superstring
P=12.1
- Anomalies and Anomaly Cancellation
P=12.2; GSW=13.3-13.5
- Calabi-Yau compactifications
GSW=15.1-15.5,15.7.1; P=17.1-17.3
- T-Duality of Open Strings and D-Branes
P=8.6-8.8,13.2
- D-Brane Dynamics
P=13.3-13.5 (see also P')
- D-Brane Bound States and the NS5 Brane
P=13.6 (see also P')
- Non-Perturbative Dualities of Strings
P=14.1,14.3-14.6

- Black Hole Quantum Mechanics
P=14.8

GSW=M.B. Green, J.H. Schwarz and E. Witten, *Superstring Theory* Vols. 1,2. Cambridge, UK: Univ. Pr. (1987).

P=J. Polchinski, *String Theory* Vols. 1,2. Cambridge, UK: Univ. Pr. (1998).

K=E. Kiritsis, *Introduction to Superstring Theory*. hep-th/9709062.

Additional material can be found in:

P'=J. Polchinski, *TASI Lectures on D Branes*. hep-th/9611050 (see also hep-th/9602052).

Z= B. Zwiebach, *A First Course in String Theory*. Cambridge, UK: Univ. Pr. (2004).