

## 2016 HRI WORKSHOP ON STRING THEORY

### Preparatory Material

#### Preparatory material for lectures of Prof. Berkovits

- <http://arxiv.org/abs/hep-th/0209059>
- <http://arxiv.org/abs/hep-th/0509120>
- <http://arxiv.org/abs/1311.4156>
- <http://arxiv.org/abs/1503.03080>

#### Content and Background for lectures of Prof. Green

##### Content:

- Duality relationships between string theory and 11-dimensional supergravity - special emphasis on the connection between 11-dimensional supergravity on a two-torus and type IIA and IIB superstrings.
- String perturbation theory at low genus and the low energy expansion of the four-graviton amplitude. The one-loop amplitude, properties of modular functions, Eisenstein series and connections with zeta values.
- Supersymmetry and non-perturbative features of graviton scattering amplitudes. Exact features of low order terms in the low energy expansion.
- Dimensional reduction and higher-rank duality groups. Langlands Eisenstein series.

##### Background:

The lectures will assume some familiarity with basic ideas in quantum field theory and string theory. It would be helpful to be familiar with Zwiebach's book. The lectures will assume that students are able to understand material at about the level of chapters 7-11 in Green, Schwarz and Witten although it will not be assumed that they have covered this material. In addition, some familiarity with the duality relationships between various string theories and 11-dimensional supergravity would be useful.

#### References and Preparatory material for lectures of Dr. Mafra

- arXiv:1106.2645
- arXiv:1404.4986
- arXiv:1410.0668
- arXiv:1510.08846

## Content and References for lectures of Prof. Narain

### Content:

- Mathematical preliminaries: line bundles on higher genus surfaces, Riemann-Roch theorem, theta divisor, theta identities etc. Bosonization on higher genus surfaces
- $F_g$  (based on hep-th/9307158)
- Heterotic-Type II duality and Schwinger formula (based on hep-th/9507115)
- Physical string realization of Walcher's real topological string (tentative)

### Reading material:

- Friedan, Martinec, Shenker (Nucl.Phys. B271 (1986) 93)
- Verlinde and Verlinde (Nucl.Phys. B288 (1987) 357),
- Antoniadis, Gava, Narain, Taylor, hep-th/9307158
- Antoniadis, Gava, Narain, Taylor, hep-th/9507115