

Propaedeutical Course in String Theory

Giulio Bonelli*

*International School of Advanced Studies (SISSA) and INFN, Sezione di Trieste
via Beirut 2-4, 34014 Trieste, Italy
E-mail: bonelli@sissa.it*

A short course on few basics in String Theory has been given. In the following the subjects are itemized.

*School on Particle Physics, Gravity and Cosmology
21 August - 2 September 2006
Dubrovnik, Croatia*

*Speaker.

The course was intended to give a short overview on basic topics in string theory for phenomenology oriented PhD students. Therefore, its aim was to introduce, avoiding technicalities, to general concepts, superstring compactification and low energy spectra, D-branes and holography.

The course went along the following items:

- Introduction: Motivations & point particles vs strings.
- Classical strings : equations of motion & boundary conditions, solutions in flat spacetime, global symmetries, gauge symmetry, Polyakov action, fermionic strings & supersymmetry, heterotic string.
- Quantum strings : BRST quantization, critical vs non-critical strings, the central charge of free CFTs in $D=2$, Spectrum of open and closed bosonic string, tachyon instability.
- Low energy effective theories: Ricci flatness from conformal invariance in the general σ -model, open and closed bosonic strings, summary of massless spectra for superstrings.
- D-branes: Dirichlet boundary conditions for open strings, low energy and dimensional reduction, black p-brane metric.
- String interaction: Riemann surfaces and their moduli space, the torus case and one loop.
- T-duality: free bosons on the circle.
- Compactification: Planckian and Kaluza-Klein modes, massless spectra of type II A & B on tori, Calabi-Yau manifolds and type II A & B on CY_3 .
- Maldacena conjecture: D3-branes near horizon, the decoupling limit, $\mathcal{N} = 4$ super Yang-Mills and its global symmetries, the conjecture.
- Conclusions on scattered topics.

At the beginning of the course a set of string theory classics has been listed [1].

References

- [1] O. Aharony, S. S. Gubser, J. M. Maldacena, H. Ooguri and Y. Oz, Phys. Rept. **323** (2000) 183 [arXiv:hep-th/9905111].
- L. Brink and M. Henneaux, "PRINCIPLES OF STRING THEORY," NEW YORK, USA: PLENUM (1988) 297p.
- M. B. Green, J. H. Schwarz and E. Witten, "SUPERSTRING THEORY. VOL.s 1 and 2" Cambridge, UK: Univ. Pr. (1987) 469 + 596 P. (Cambridge Monographs On Mathematical Physics).
- J. Polchinski, "String theory. Vol.s 1 and 2" Cambridge, UK: Univ. Pr. (1998) 402 + 531 p.
- A. M. Polyakov, "GAUGE FIELDS AND STRINGS," CHUR, SWITZERLAND: HARWOOD (1987) 301 P. (CONTEMPORARY CONCEPTS IN PHYSICS, 3).
- B. Zwiebach, "A first course in string theory," Cambridge, UK: Univ. Pr. (2004) 558 p.