

PiTP, Summer 2002
Katz lectures

Lecture 1.

- Overview of these lectures.
- Differential geometry
 - Metrics, connections, and holonomies.
 - Classification of special holonomies. Calabi-Yau and G_2 manifolds.
- Gauge fields and their holonomies (the Bohm-Aharonov effect). Generalization to p -form gauge fields.
- Low energy type II superstring
- Supersymmetry
 - Review of supersymmetry in dimension 4.
 - A few words about supersymmetry in dimension 10.

Lecture 2.

- The relation between holonomy, compactification, and supersymmetry.
- Low energy effective theories from compactification
- Vacuum expectation values as moduli
- Crash course on complex and algebraic manifolds
- Calabi-Yau manifolds (closed string version)
 - Complex moduli
 - Examples

Lecture 3.

- Kähler moduli of Calabi-Yau manifolds
- Special Lagrangian cycles (A-branes)
 - Low energy effective theory
 - Moduli
 - Examples
- Holomorphic bundles (B-branes)
 - Low energy effective theory
 - Moduli
 - Examples

Lecture 4.

- Dualities
 - Mirror symmetry
 - T -duality (SYZ construction)
- Remarks on M theory
- G_2 manifolds
 - Low energy effective theory
 - Moduli
 - Supersymmetric cycles
 - Examples

References.

1. B. Greene, String theory on Calabi-Yau manifolds, hep-th/9702155
2. S. Gubser, TASI lectures: Special holonomy in string theory and M theory, hep-th/0201114.
3. S. Kachru, S. Katz, A. Lawrence, and J. McGreevy, Open string instantons and superpotentials, hep-th/9912151
4. N. Hitchin, Lectures on Special Lagrangian Submanifolds, math.DG/9907034
5. C. Nash and S. Sen, Topology and Geometry for Physicists, Academic Press, London 1983.
6. D.A. Cox and S. Katz, Mirror Symmetry and Algebraic Geometry, AMS, Providence RI 1999.
7. Green, Schwarz and Witten, Superstring theory, vols I,II, Cambridge University Press, Cambridge 1987.
8. J. Polchinski, String Theory, vols I,II, Cambridge University Press, Cambridge 1998.