1. Compactifications, moduli and SUSY [1, 2]

   - Dimensional reduction of supergravity, Kaluza-Klein compactification
   - Toy model of moduli stabilization and flux compactifications
   - Dirac monopoles, magnetic branes and quantization of flux
   - 4D SUSY and geometry of internal manifold

2. Introduction to differential geometry [3, 4, 5, 6]

   - Coordinates on manifolds, tangent and cotangent spaces,
   - Differential forms, deRham operator, wedge product,
   - Metric, Hodge operation, integration of forms
   - Closed and exact forms, deRham complexes, cohomology groups.

3. Special geometry and geometry of CY manifolds. [7, 8, 9, 10, 11, 12].

   - Complex structures, complex coordinates,
   - Differential forms, Dolbeaut cohomologies
   - Hermitean structures, Kähler manifolds, Fubini-Study metric,
   - Calabi-Yau manifolds, quintics and quartics

4. Moduli spaces of CY manifolds [13, 14, 15]

   - Deformations of the metric and measure
   - Hodge star on Kähler manifold, metric on the space of Kähler structure moduli, holomorphic prepotential
   - Metric on the space of complex structure moduli, cohomology cycles

5. Effective action of Type II theories in $D = 4$ [16, 17].

   - Field content and the Lagrangian of the 10D $\mathcal{N} = 2$ Type IIA supegravity
   - CY compactifications of the theory to $D = 4$, cycles, moduli of the fields
   - Lagrangian of $\mathcal{N} = 2$ sugra in $D = 4$,
   - Killing vectors on Kähler manifolds superpotential

6. String orientifolding and $\mathcal{N} = 1$ supergravity [18, 19] and [16, 20, 18, 17, 21, 22, 2]

   - Massless string spectrum, orientifolding,
   - Effective action of Type IIA supergravity on CY_3 orientifold without fluxes
   - Towards flux compactifications and moduli stabilization

In this lecture course compactifications of string theory on Calabi-Yau manifolds and orientifolds with and without fluxes will be considered. After an introduction to the general theory of special manifolds, specific supergravity models on CY_3 orientifold will be examined.

We will show how geometric properties of the internal CY space and topological properties of gauge field configurations on it determine physical quantities such as masses of scalar fields and their interactions. The main goal is to make contact to the lectures on stringy inflationary models by constructing supergravity actions in 4 dimensions from string theory.

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