

PHY668A: Introduction to Conformal Field Theory

Summary: Conformal field theory (CFT) is one of the most powerful tools in modern theoretical physics. CFTs are scale invariant quantum field theories (QFTs). All QFTs can be understood as renormalization group flows away from fixed points governed by CFTs. CFTs are also vitally important in statistical mechanics (the study of critical phenomena), studies of quantum gravity through the holographic principle and string theory, as well as cosmology. This course aims to give an introduction to this very widely applicable and extremely important subject.

Course content:

S.No	Topics	Details	Lecture Hours (Offline)
1	Introduction	Renormalisation group flows in QFTs and advent of CFTs	2
2	Global Conformal Invariance	CFTs in general dimensions. Representation theory, correlation functions.	8
3	Conformal Invariance in 2 dimensions	Infinite enhancement of symmetry in $d=2$. Virasoro algebra and its many consequences.	6
4	Operator formalism	Use of complex analysis for 2d CFTs. Operator Product Expansions. Energy- momentum tensor and Virasoro algebra.	8
5	Minimal Models	Simplest models of 2d CFT.	6
6	Modular Invariance	2d CFT on the torus. Partition functions. Cardy formula for entropy.	8
7.	Towards holography	Asymptotic analysis in AdS3 and AdS3/CFT2.	6

Prerequisites: Quantum Mechanics I and II, Statistical Mechanics, Quantum Field Theory.

Reference books/notes:

1. Philip Di Francesco, Pierre Mathieu, David Senechal: “Conformal Field Theory”.
2. Sergie Ketov: “Conformal Field Theory”.
3. R. Blumenhagen, E Plauschinn: “Introduction to Conformal Field Theory”.
4. Paul Ginsparg: “Applied Conformal Field Theory” (hep-th/9108028).