PHY652A: Introduction to Conformal Field Theory

2023-24, Semester - I

Conformal field theories (CFT)s are building blocks for quantum field theories that describe nature. It explains universal behaviours that arise during phase transitions. Study of CFTs is also relevant for quantum gravity. This course aims to give an introduction to CFTs while at the same time touching upon the modern developments.

Lecture outline: 39×50 minutes $= 26 \times (t = 1.25$ Hours$)$

Topics	**Details**	t
Ingredients	Group, Representations, Operator Product Expansion	2
Operators & Correlators	Primaries, Stress tensor, Commutators, Ward identities, Conformal blocks	3
Examples	Minimal model, Coulomb-gas formalism	2
Higher genus	CFT on torus, Characters, Modular bootstrap for asymptotics	4
Boundary CFT	Ishibashi states, Boundary entropy, Finite cylinder and annulus	2
Liouville CFT	Action, Solutions, Correlators, Boundary states, S-matrix	3
Applications	Entanglement, Thermalization, String scattering amplitudes	3
CFTs in $D \geq 3$	Projective null cone, Spinning fields, Conformal bootstrap	3
Modern developments	Analytic bootstrap, Dispersion relations	2
Deformations	Conformal perturbation theory, c-theorem, Numerical techniques	2

Pre-requisites: PHY681A: Quantum field theory - 1.

Evaluations : Assignments [60%]. Endsemester examination will involve submission of a term paper [10%] and a viva [30%].

References :

1. *Conformal Field Theory* , Francesco, Mathieu , Senechal; **2.***Lectures on Conformal Field Theory*, Qualls; **3.***Lectures on Liouville Theory and Matrix Models*, Zamolodchikov brothers; **4.***EPFL Lectures on Conformal Field Theory in D >= 3 Dimensions*, Rychkov; **5.***Selected Topics in Analytic Conformal Bootstrap: A Guided Journey*, Bissi, Sinha, Zhou.