Frequency
Every year

Remarque
Next time: Fall

Summary
This course is an introduction to the non-perturbative bootstrap approach to Conformal Field Theory and to the Gauge/Gravity duality, emphasizing the fruitful interplay between these two ideas.

Content
1. Scaling and Renormalization - quick review of phase transitions, critical exponents, block spin transformations, scaling variables and operators, renormalization group flows.
2. Conformal field theory - Conformal transformations, conformal algebra, local operators (primaries and descendants), correlation functions, stress tensor, Weyl invariance, conformal Ward identities, Radial quantization (state-operator map), unitarity bounds, operator product expansion, conformal blocks (Casimir equation), conformal bootstrap, conformal anomaly, embedding space formalism, large N factorization.
3. Anti-de Sitter spacetime - Geometry, particle dynamics, free fields in AdS, interacting fields in AdS.
4. The AdS/CFT correspondence - quantum gravity as CFT, semi-classical limit and the large N expansion, the role of String Theory, black holes and thermodynamics, universal long range forces, entanglement entropy.

Keywords
gauge/gravity duality
conformal bootstrap

Learning Prerequisites

Required courses
Quantum Field Theory, General Relativity

Recommended courses
Advanced Quantum Field Theory
Gauge Theories and the Standard Model

Learning Outcomes
By the end of the course, the student must be able to:
• Formulate the bootstrap conditions on the CFT data.
• Use the gauge/gravity duality to describe QFT phenomena.
• Apply CFT methods to explain properties of continuous phase transitions.

Transversal skills
• Plan and carry out activities in a way which makes optimal use of available time and other resources.
• Continue to work through difficulties or initial failure to find optimal solutions.
• Make an oral presentation.
• Demonstrate the capacity for critical thinking
• Write a scientific or technical report.

Teaching methods
Black board lectures and problem solving sessions.

Expected student activities
Attendance of lectures and problem solving sessions. Critical study of the material.

Assessment methods
Oral exam.
Small project including presentation and short written report.

Resources
Bibliography