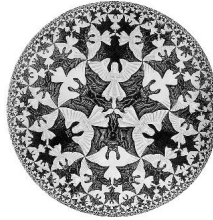


# CONFORMAL FIELD THEORY

Winter term 2016-2017, USOS code: 1102-4`CFT  
Friday, 15:30-17:00 – Lecture room 2.03 (Faculty of Physics)  
Lecturer: Piotr Sułkowski (IFT FUW)



Conformal quantum field theory is a very active area of research in modern theoretical physics. Its applications range from statistical and condensed matter physics, where it provides a description of critical phenomena, to high energy physics and string theory. It is a source of inspiration for, and has deep links with modern mathematics – several Fields medals have been awarded for results directly related to conformal field theory. Conformal field theories are particularly interesting in two dimensions, where their symmetry group is infinite. Such a large symmetry makes it possible to classify, and even solve various such theories. Conformal field theories in two dimensions can be also regarded as relatively simple models of interacting, yet exactly solvable quantum field theories, and their analysis provides a great opportunity to learn tools and intuitions necessary to understand more general quantum field theories.

In this lecture the following topics will be discussed:

- the conformal group, conformal invariance in classical field theory
- conformal invariance in two-dimensional quantum field theory
- radial quantization and operator formalism
- Virasoro algebra, Verma modules
- conformal blocks, crossing symmetry, conformal bootstrap
- minimal models: Yang-Lee singularity, Ising model, Potts model, etc.
- Belavin-Polyakov-Zamolodchikov equation, fusion rules
- Coulomb-gas formalism, vertex operators
- modular invariance
- modern applications: statistical physics, string theory

The lecture should be accessible for second and third year students, as well as MSc students; it should be of interest to PhD students and everyone interested in various applications of conformal field theory. The knowledge of mathematical analysis and classical mechanics is required; the acquaintance with (at least) basics of quantum mechanics and classical field theory will be of advantage.

## **Conformal Field Theory – topics and questions**

1. Conformal transformations and conformal group
2. Conformal transformations and conformal group in 2 dimensions
3. Energy-momentum tensor in conformal field theory
4. Definition and properties of primary fields
5. Radial quantization
6. Central charge
7. Virasoro algebra
8. Hilbert space in 2d CFT
9. Conformal blocks and bootstrap program
10. Free boson theory
11. Vertex operators
12. Kac determinant, constraints on unitarity
13. Singular vectors
14. Minimal models
15. Ising model and CFT