INSTITUTO DE FÍSICA - USP

Disciplina do Curso de Pós-Graduação

1° Semestre de 2017

NOME DA DISCIPLINA:

INTRODUCTION TO CONFORMAL FIELD THEORIES

Obrigatória? SIM ( ) NÃO (X)

PROFESSOR RESPONSÁVEL: Prof. Diego Trancanelli

CARGA HORÁRIA: SEMANAL

Aulas Formais.....	04
Aulas práticas, seminários e/ou outras atividades programadas	00
Horas de estudo	02

ATIVIDADES DISCENTES: Início: March 2017 Término: April 2017

NÚMERO DE CRÉDITOS: 06

DURAÇÃO: 8-10 weeks

PRÉ-REQUISITOS:
Quantum Mechanics I.
Familiarity with quantum field theory will be helpful, although an effort will be made to review necessary material.

PROGRAMA:
1. QFTs, renormalization group flow, and CFTs
2. Conformal symmetry
3. Primaries and descendants, correlators
4. Radial quantization and the state/operator correspondence
5. The operator product expansion (OPE) and conformal blocks
6. CFTs in various dimensions
7. The conformal bootstrap program

BIBLIOGRAFIA:

1. Di Francesco, Mathieu, Senechal, “Conformal Field Theory” Springer
2. Rychkov, “EPFL Lectures on CFT in D>=3”
3. Simmons-Duffin “TASI Lectures on the Conformal Bootstrap”

CRITÉRIO DE AVALIAÇÃO DO APROVEITAMENTO:
Homework lists and final presentation

NÚMERO MÁXIMO DE ALUNOS: -x-

OBJETIVOS DO CURSO:
This course will provide students with an introduction to conformal symmetry and conformal field theories. After an extensive discussion of the physical foundations of conformal symmetry and the basics of conformal field theories, emphasis will be given to the study of theories in D=3,4,6 dimensions and the techniques used to solve them.

JUSTIFICATIVA:
Theories which display an invariance under scale transformations or under the larger group of conformal transformations are called *conformal field theories (CFTs)*. These theories play a central role in various areas of theoretical physics, ranging from high energy physics and string theory to condensed matter systems. Some of the reasons they are so important are:

1. The endpoints of the renormalization group flow of quantum field theories (QFTs) are typically CFTs. In particular, the long distance/low energy (IR) behavior of QFTs is described by a CFT. Different QFTs may flow to the same IR CFT fixed point, as is the case, for example, of the 3d Ising model, of water at the critical point, and of the phi^4-theory in 3 dimensions, which all become equivalent in the IR. This is called *critical universality*. Studying CFTs allows us to classify the possible IR fixed points at which the most different UV realizations of a system might flow.

2. CFTs play a central role in holography and in the dualities between gauge theories and gravity/string theory. Typically, the gauge theory side of the duality is represented by a CFT, as is the case of the archetypal example of the correspondence between N=4 super Yang-Mills in 4 dimensions (which is a CFT) and type IIB string theory on AdS5 x S5.

3. Thanks to the constraining power of the conformal symmetry, much can be computed in CFTs (spectra, correlation functions, and so on). In particular, this is at the center of a recent revival of an old program, the *conformal bootstrap*. One important aspect of this program is that it can be applied very generally, even to theories without a Lagrangian description, for which techniques based on weak coupling expansions and Feynman diagramatics are not available.