Physics 253c: Quantum Field Theory III (Conformal Field Theory)
Harvard University, Fall 2023

Instructor: Xi Yin

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Course Description: An introduction to conformal field theories. Conformal bootstrap via the conformal block expansion and the use of semidefinite optimization. The Ising model in 2 and 3 dimensions. Maximally supersymmetric Yang-Mills theory in four dimensions.

Prerequisites: familiarity with perturbative quantum field theory, Green functions and the S-matrix, basic knowledge of the renormalization group and the epsilon expansion, quantization of non-Abelian gauge theories and asymptotic freedom.

Slack Workspace: cftfall2023.slack.com

All written communication in this course will be conducted through the slack workspace (contact Xi Yin for invitation.)

Lectures: Tuesdays and Thursdays 1:30-2:45pm at Jefferson 453

The lectures will be live streamed over Zoom at the link

https://harvard.zoom.us/j/95351338955?pwd=ZS91OEFSZGtQZnFtSENzVnVBNU5LQT09

The recording will be posted after each lecture.

Sections: weekly section time and location TBD

Course Requirements and Grading:

Homework: There will be (roughly) biweekly problem sets. You are encouraged to discuss the problem sets but you should write your solutions individually. The problem sets will account for 70% of the grade.

Final Project: You will choose one problem from a list, write up your own solution as a term paper, and give a 45 minute presentation on it. Both understanding the

problem and solving it will likely involve reading beyond the lecture material. You may also find the answer in the literature, but your solution should be self-contained. The list of possible problems and references will be posted during the second half of the semester. The presentations will be held in the reading period, and the term paper is due by the end of the exam period. The term paper and presentation will account for 30% of the grade.

There will be no final exam.

Textbooks: There is no official textbook for this course. Hand written lecture notes will be posted as the course proceeds.

Some useful references include: Slava Rychkov, "EPFL Lectures on Conformal Field Theory in D≥3 Dimensions," https://arxiv.org/abs/1601.05000; David Simmons-Duffin, "TASI Lectures on the Conformal Bootstrap", https://arxiv.org/abs/1602.07982; Paul Ginsparg, "Applied Conformal Field Theory", https://arxiv.org/abs/hep-th/9108028; Niklas Beisert et al., "Review of AdS/CFT Integrability", https://arxiv.org/abs/1012.3982.