Gauge/Gravity Duality (E16)

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Gauge/Gravity duality (also known as AdS/CFT) is an amazing duality that relates theories of quantum gravity (with a negative cosmological constant) to certain quantum field theories living in a smaller dimensional spacetime. This is the most precise known realization of the holographic principle, the idea that all information in the universe is encoded somehow at the boundary of the universe. These lectures will describe in detail the "dictionary" used to relate observables on the bulk side to observables on the boundary side.

Topics covered: Anti-de Sitter spacetime; conformal field theory; wave equations in AdS, and their relationship to CFT operators and sources; the duality between black holes and thermal states; holographic entanglement entropy. If time permits: recent developments concerning bulk reconstruction, and the black hole information puzzle.

Pre-requisites

Required: General Relativity, Black Holes, Advanced Quantum Field Theory

Helpful: Some basic aspects of quantum information theory and conformal symmetry will play an important role in this course, but the relevant aspects will be reviewed in a self-contained manner.

Not Required: String Theory, Supersymmetry. Although most of the specific known examples of AdS/CFT come from superstring theories, these aspects will not be emphasized in these lectures. (There will probably be one lecture on Juan Maldacena's original derivation of black hole entropy in string theory, but it will not be on the exam.)

Literature

More information about the course, including a list of relevant review articles, is available here:

http://www.damtp.cam.ac.uk/user/aw846/AdSCFT.html

(If you read through the lecture notes from the previous unexaminable version of this course from 2018-2019, please note that Topic 5: Large N Gauge Theories and Examples of AdS/CFT will be mostly excluded.)

Additional support

Three examples sheets will be provided and three associated examples classes will be given.