

Gauge-Gravity Duality (E16)

Professor A. Wall

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.

Prerequisites

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 be one or two lectures on Maldacena’s original derivation of black hole entropy in string theory, but this topic will not be examinable.)

Literature

Lecture notes for the course will be provided in pdf format. Additional information about the course, including a list of relevant review articles, is available here:

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

Additional support

Two examples sheets will be provided, and two associated examples classes will be given. There will be a one-hour revision class in the Easter Term, subsequent to the lectures.