

PHYS 859A FALL 2023

Instructor: Raman Sundrum, Tu + Thu 11am-12.30pm

AdS/CFT and BSM

This is an advanced graduate course in theoretical particle physics. It is intended for students that have completed a year of quantum field theory (at the level of PHYS 624, 851), or roughly at the level of understanding the basics of Gauge Theory, the Higgs mechanism, Loops and Renormalization. A familiarity with the Standard Model at the level of PHYS 751 will be helpful, as will familiarity with General Relativity.

In these lectures, I will begin by reviewing ideas within non-perturbative gauge theory, non-renormalizable effective field theories (EFT), conformal field theory (CFT), and a variety of non-perturbative approximations ($1/N$, strong-coupling, chiral perturbation theory). I will then introduce the AdS/CFT duality and the “holographic” emergence of a higher-dimensional General Relativity EFT. The duality will be applied to the Composite Higgs paradigm, thereby connecting it with Randall-Sundrum higher-dimensional models. The duality between hot (or highly entangled states of) CFTs and QFTs and higher-dimensional black holes/branes will be described, relating it to theoretical issues such as the black hole information puzzle as well as phenomenological issues such as cosmological phase transitions and gravitational wave backgrounds. If time permits I would like to use AdS/CFT to describe the consistent description of traversable wormholes between distant points in space, as well as motivating the (less understood) dS/CFT correspondence and its connection to observable cosmological correlators.

The requirements for getting course credit will be discussed at the first meeting of class.

I will be making up my own lectures, so there is no text book as such, but I may suggest other reading material as the course progresses.