

Black Holes and Quantum Information
PHYS 7661 Fall 2021

Professor:

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Office: PSB 434

Office hours: Tuesday, 2:15pm until ?

Website:

www.hartmanhep.net/topics2021

Lectures:

Tues/Thurs 1-2:15pm in Clark 247

Course Description

This course is an introduction to current research topics in quantum gravity, with a focus on holographic duality and the black hole information paradox. We will cover:

- Some advanced topics in quantum field theory (finite temperature; conformal invariance; Euclidean path integrals).
- Black hole thermodynamics (the 3 laws; Hawking radiation; path integrals in quantum gravity; generalized entropy; black holes in the AdS/CFT correspondence).
- Black holes and quantum information (quantum entropy and entanglement; holographic entanglement entropy; Hawking's information paradox; replica methods and wormholes; scrambling and quantum chaos).

Prereqs. 1 semester of general relativity and 1 semester of quantum field theory (or equivalent). Specifically, you should be familiar with the material in the first 6 chapters of Carroll's GR book and the first half of any introductory QFT book (field operators, propagators, and Feynman diagrams).

Grades. This course is graded Satisfactory/Unsatisfactory. To get a "satisfactory" you must either complete most of the homework, or do a final presentation. There are no exams.

Mathematica. You are strongly encouraged to use Mathematica for the homework. For GR calculations, I recommend the GREATER2 package (which you can download from my website) or something similar.

Books. We will not follow a textbook, but some recommended reading can be found in the attached bibliography.