

Syllabus
General Relativity II
Physics 6554 / Astro 6510 --- Spring 2025

Professor:

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Office: PSB 434

Office hours: after lecture on Tuesdays

Grader:

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Lectures: T-Th 2:55-4:10pm in Malott 406

Website: canvas.cornell.edu

This is a 2nd-semester graduate course in general relativity. We will cover:

- Advanced topics in black hole physics such as charge, rotation, perturbations, merger and ringdown, superradiance, singularity theorems, and properties of the horizon.
- Black hole thermodynamics
- de Sitter and anti-de Sitter spacetimes
- The mathematics of hypersurfaces and geodesic congruences
- Energy and the Hamiltonian in GR

We are not closely following any textbook, but much of this material is discussed in the textbook of Poisson and in Wald chapters 8-12.

Prereqs: One semester of general relativity or equivalent, at the level of Carroll chapters 1-8 (minus chapter 6, which we will cover this semester).

Textbooks

Primary: *A Relativist's Toolkit: The Mathematics of Black Hole Mechanics*, by Eric Poisson

Secondary: *General Relativity* by Robert Wald

Policies

- Problem sets every 1-2 weeks will be posted on the Canvas course website. Some problems will be assigned from Poisson, so you will need access to that text. There will be a final project, but no exams.
- Use Mathematica as much as possible -- you've already completed a semester of GR, and never again is it necessary to calculate a curvature by hand! Various free GR packages are available online. You can find one my website (GREATER2); another popular one is called GRTensorII.
- You are welcome to use ChatGPT or similar, but if it provides significant help on homework, then you must turn in the transcript of your discussion with it (and obviously you need to understand things yourself).
- For students who need a grade: it will be based on homework (60%) and final presentation (40%). One late homework, up to 7 days late, is allowed with no questions asked and no permission needed; otherwise, late homeworks receive half credit. Please do not use your free homework too early--- you might need it later. All late work must be submitted by the first day of the final exam period.

Auditing

Note to anyone planning to audit: If you will attend some reasonable fraction of the lectures, then I encourage you to take the course pass/fail instead. The requirements to pass are to (i) attend a reasonable fraction of lectures, and (ii) give a final presentation on a topic of your choice *OR* complete a reasonable fraction of the homework problems. The presentation is great practice for your future career and everyone should do it.