

Syllabus
General Relativity II
Physics 6554 / Astro 6510 --- Spring 2023

Professor:

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Office: PSB 434
Office hours: after lecture on Tuesdays

Grader:

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Lectures: T-Th 2:45-4pm in Rockefeller 103

Website: canvas.cornell.edu

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

- Black hole thermodynamics
- Other advanced topics in black hole physics such as rotation, perturbations, merger and ringdown, superradiance, singularity theorems, and properties of the horizon.
- 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 final projects, 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 on my website (GREATER2); another popular one is called GRTensorII.
- 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.

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.