PHYS 7810
Hydrodynamics
Spring 2026

OVERVIEW

Lectures: T/Th 3:30-4:45 PM; Duane G1B25

Instructor: Andrew Lucas (andrew.j.lucas@colorado.edu); Duane D137.
Office hours: F 3-4 PM

Canvas: https://canvas.colorado.edu/courses/128883

Books and References: N/A.

Recommended prerequisites: The standard undergraduate sequence in physics, PHYS 5210, and PHYS 5250, or similar.

COURSE THEMES

- **stochastic processes** underlie **dissipative effective theories** built with **MSR Lagrangians**
- **diffusion** of a conserved charge is the simplest hydrodynamic theory
- the **Navier-Stokes equations** follow from charge/mass, momentum and energy conservation
- **kinetic theory** can be used to derive hydrodynamics in weakly-interacting gases
- **superfluid hydrodynamics** includes the dynamics of Goldstone bosons
- **magnetohydrodynamics** follows from higher-form symmetry

COURSE POLICIES

- All documents are found by clicking appropriate links on the homepage of Canvas.
- Lectures are held in-person. There will be no recording of in-person lectures. Lecture notes will be posted shortly after each lecture, if not beforehand,
- When I am traveling, I will try to hold class synchronously via Zoom; if this is not possible I will post a pre-recorded lecture via the Zoom tab on Canvas.
- You are allowed to collaborate with and consult humans and AI on take-home assignments. It is considered cheating, as opposed to collaboration, when you turn in something that you did not write in your own words, and/or that you could not explain independently, without acknowledging the steps that you are borrowing from elsewhere.
- Standard university policies regarding appropriate conduct on campus also apply to this class, and can be found in writing on the course website.

GRADES

- **100% homework:** Homework can be found on the course website, and on Canvas. Homework is **due at or before 11:59 PM on the due date**. Solutions will be posted on Canvas on the third day after the due date. You must upload every homework assignment electronically into Canvas. I anticipate 6 homework assignments in this class.

  Late/drop policies: Every student starts with 2 extensions, which can be tracked in the ungraded "Extensions Left" assignment in Canvas. Extensions can be used as follows:

  - To receive a no penalty 48 hour extension on the due date for a homework assignment.
  - To drop a homework which was not turned in, *or* a homework which was turned in late but is (at the end of the class) below your average homework score.
  - To drop a low score. (Remaining extensions will be used this way at the end of the class.)

  Assuming no apocalypse, I will not give more extensions or push back deadlines. I apply these rules automatically, in the order above, so you do not need to ask for permission to use these extensions.

Grade cutoffs will be chosen to avoid students being just below a cutoff. The cutoff for A-range grades will be $\leq 80\%$. I expect everyone will get an A-range grade in this advanced class.

Each homework will be graded out of 100 points. The numbers besides each (sub)problem denote the number of points it is worth. If a (sub)problem is worth $5k$ points, you'll receive 0, k, $2k$, $3k$, $4k$ or $5k$ points according to a holistic grading scheme. Points are deducted for conceptual/"big picture" issues, not minor algebra/calculational mistakes (as long as they did not lead to an absurd answer that you should have noticed was wrong!). If you quote something without sufficient explanation or justification, even if it is correct, this may lead to points being deducted. The number of points earnable on an assignment may exceed 100 points, in which case you can earn "extra credit" by completing the entire assignment.

Consequences for cheating will, at minimum, include receiving a 0 on the assignment(s) in question and a university-required referral to the Honor Code board. Further consequences may occur, at the discretion of the course instructor and graders.