

Explore the world of warm dense matter

The High Energy Density Science (HEDS) Center at Lawrence Livermore National Laboratory, the University of South Florida, and the University of California, San Diego, are offering a one-of-a-kind course titled

Warm Dense Matter: Concepts and Fundamentals

Warm dense matter (WDM) science lies at the intersection of condensed matter physics, dense liquids, and plasma physics. It is characterized by pressures above 1 megabar and temperatures of several thousand Kelvin—conditions under which standard theories often break down. This challenging regime of HEDS arises in planetary interiors, white dwarf atmospheres, meteorite impacts, and inertial confinement fusion experiments.

Course objectives:

World-class leaders in the field will deliver a total of 20 lectures covering basic physics, hydrodynamics and shock physics, equilibrium and transport properties, simulation and experimental capabilities, diagnostics, and applications of WDM. In the course, you will learn:

- **Cutting-edge experimental science:** The experimental breakthroughs made possible by high-power lasers, x-ray free electron lasers, and pulsed power facilities.
- **Advanced theory:** Overview of state-of-the-art computational tools including density functional theory, path integral Monte Carlo, and molecular dynamics.
- **Real-world applications:** WDM for astrophysics, planetary science, fusion energy, and more.

More information, including the course syllabus, can be found at:

<https://heds-center.llnl.gov/education>

For general questions, contact Federica Coppari (coppari1@llnl.gov).

Course Details:

- **Duration:** 10 weeks (9/25/25 to 12/4/25).
- **Pre-course bootcamp:** Mandatory 5-week session (8/25/25–9/23/25) for credit-seeking students on semester-system; optional and encouraged for other attendees.
- **Audience:** Advanced undergraduates and beginning graduate students (may receive credits), and professionals and the general public (not for credit).
- **Format:** Live online lectures with homework and exams for credit-seeking students.
- **Pre-requisites:** Calculus-based physics is recommended.
- **Registration:** Email your name and institution to Jessica Karlton (karlton1@llnl.gov). Credit-seeking students on the semester system should also contact Ivan Oleynik (oleynik@usf.edu), and those on the quarter system should contact Farhat Beg (fbeg@ucsd.edu). **Registration deadline is 8/18/25.**

