Warm Dense Matter: Concepts and Fundamentals

Dates: September 25–December 4, 2025 (10 weeks, 20 lectures)
Times: Tuesdays/Thursdays (9:30 a.m.–10:45 a.m. Pacific, 12:30 p.m.–1:45 p.m. Eastern

Topic	Lecturer(s)	No. of lectures	Date
Introduction and overview: What is Warm Dense Matter (WDM) and why we should study it	Frank Graziani	1	9/25
States of matter (gas, liquid, solid, plasma)	Frank Graziani	1	9/30
Background introductory physics: Quantum mechanics & statistical mechanics	Aurora Pribram-Jones Burkhard Militzer	2	10/02 10/07
Equilibrium properties of WDM: Equation of States (EOS), phase transitions	Rip Collins	2	10/09 10/14
Extreme matter, hydrodynamics, shocks, other techniques to experimentally generate WDM	Jon Eggert	2	10/15* 10/16
Kinetics, transport, and optical properties of WDM	Tobias Dornheim	2	10/21 10/23
Simulations of WDM: Quantum mechanical density functional theory (DFT) and classical molecular dynamics (MD)	Sebastien Hamel Ivan Oleynik	2	10/28 10/30
Examples of experimental studies of WDM 1. Overview 2. Dynamic compression (nanoseconds–microseconds) 3. Static compression (seconds–hours)	Federica Coppari Marcus Knudson Zsolt Jenei	3	11/04 11/06 11/13 (skip 11/11)
New experimental capabilities: synchrotron, XFEL and high-power lasers	Jon Eggert	1	11/18
Properties and diagnostics of strongly coupled plasmas	Michael Murillo Tilo Doeppner	2	11/20 11/25 (skip 11/27)
Applications: WDM in astrophysics and planetary science	Dan Shim	1	12/2
Applications: WDM and inertial confinement fusion	Omar Hurricane	1	12/4
			Final exam

*Special Wednesday lecture to make up for the holidays (11/11 Veterans Day and 11/27 Thanksgiving).

Prepared by LLNL under Contract DE-AC52-07NA27344. LLNL-WEB-2005792