Syllabus: Stellar Physics (AST 5214)

Department of Physics
Charles E. Schmidt College of Science

Spring, 2005. 3 credits

Instructor: Dr. Pedro Marronetti, CESCOS Rm 440.
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Classes: M-W-F, 9:00 to 9:50 AM. Classroom PS 109

Office hours: M-W-F, 2:30 to 3:30 PM. CESCOS Rm 440.

Course Description:

Fluid dynamics is one of the most pervasive subjects in astrophysics. Interstellar and intergalactic media, stellar envelopes, planetary nebulae, superfluid neutron star interiors, degenerate Fermi gases in white dwarfs, supernova core collapses, accretion disks, and even galaxies can be described, to some extent, as fluids. In this course, we will cover several advance topics in fluid dynamics with applications in astrophysics, including the interaction of matter and radiation. Starting from the derivation of the Navier-Stokes equation from statistical mechanics principles, we will address the study of some of the most interesting astrophysical scenarios, including the ones mentioned above.

This course requires background in **Classical and Quantum Mechanics**, as well as **Statistical Thermodynamics**, at the level usually covered in graduate courses of the Department of Physics.

The course will cover the following subjects:

- Overview of Statistical Mechanics
- Relation between Kinetic Theory and Fluid Mechanics
- Navier-Stokes and Euler Equations
- Flux Conservation Formalisms
- Equilibrium of Self-Gravitating Systems
- Inviscid Barotropic Fluids
- Accretion Disks
- Fluid Instabilities
- Viscous Flow and the onset of Turbulence
- Theory of Convection
- Waves and Shock Fronts

- Method of Characteristics
- Supersonic Flows
- Blast Waves and Supernova Remnants
- Gravitational Collapse and Stellar Formation
- Magnetohydrodynamics (MHD)

Text Books:

The Physics of Astrophysics Vol. II: Gas Dynamics
by Frank H. Shu