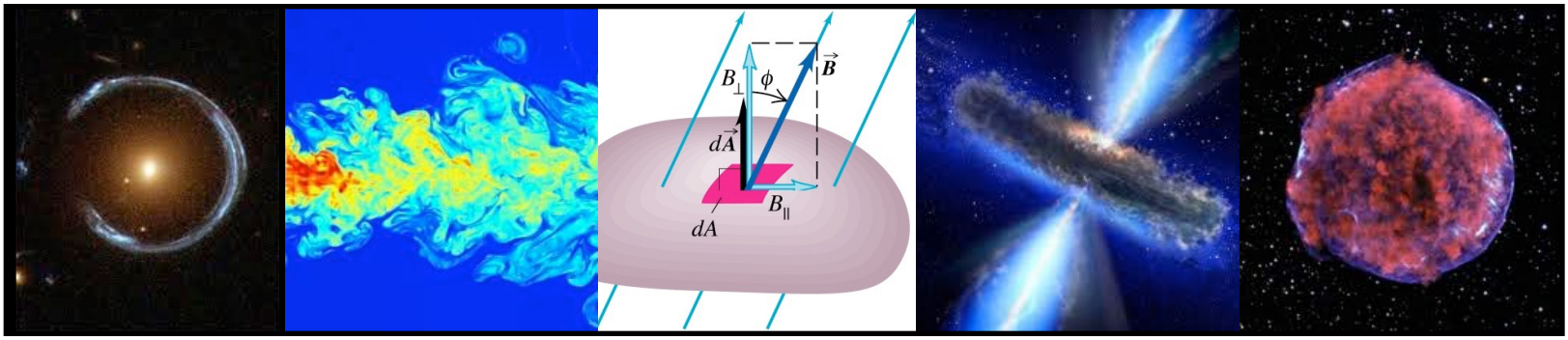
ASTRO 320; Fall Semester 2017
Physical Processes in Astronomy



Course Description

This course discusses physical processes relevant for astrophysics and consists of three parts. Part I covers fluid dynamics. We will derive the continuity, momentum & energy equations, discuss hydrostatic equilibrium, viscous flows, fluid instabilities, equations of state, shocks, turbulence and focus on various astrophysical applications such as stellar structure and accretion disks. Part II deals with collisionless fluids. We will derive the Jeans equations, contrast them to Euler equations of collisional fluids, and study some applications of collisionless dynamics, including dynamical friction and the impulse approximation. Finally, in Part III we address radiation. We discuss both thermal and non-thermal emission mechanisms, study the interaction of radiation and matter, delve into radiative transfer, and address statistical equilibrium.

Instructor: Prof. Frank van den Bosch (52 Hillhouse, Office: 320)
frank.vandenbosch@yale.edu

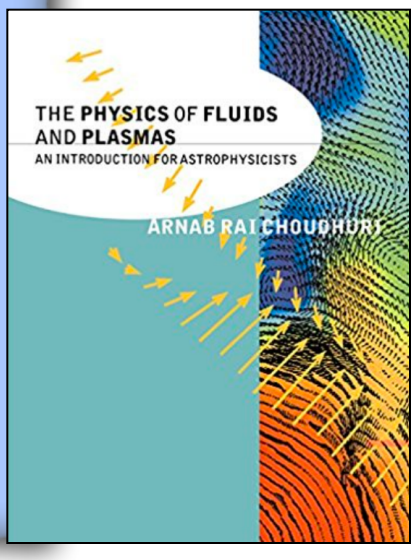
Course Website: https://campuspress.yale.edu/astro320/

Lecture Hours: Tue & Thu: 4.00 - 5.15pm; Location WTS A60

Recommended Textbooks: The Physics of Fluids and Plasmas: An Introduction for Astrophysicists

Grading: 35% Final Exam
30% Problem Sets
35% Term Paper & Presentation

Lecture Format: Blackboard presentations + weekly summary sheets



Preliminary Schedule

week	Date	Topic
1	Thu 08/31	Fluid Dynamics: introduction
2	Tue 09/05	Fluid Dynamics: continuity & momentum equations (Euler)
2	Thu 09/07	Fluid Dynamics: the stress tensor & viscosity (shear & bulk)
3	Tue 09/12	Fluid Dynamics: The Navier-Stokes equations
3	Thu 09/14	Fluid Dynamics: Microscopic Approach; From Liouville to Boltzmann to Navier Stokes
4	Tue 09/19	Fluid Dynamics: Vorticity & Kelvin's Circulation Theorem
4	Thu 09/21	Fluid Dynamics: Bernoulli Equation & Crocco's theorem
5	Tue 09/26	Fluid Dynamics: Turbulence
5	Thu 09/28	Fluid Dynamics: Equations of State (ideal gas, photon gas & degenerate EoS)
6	Tue 10/03	Fluid Dynamics: the Energy Equation
6	Thu 10/05	Fluid Dynamics: Gravity (Poisson equation & Virial Theorem)
7	Tue 10/10	Fluid Dynamics: Collisionless fluids, Dynamical Friction & Impulse Approximation
7	Thu 10/12	Fluid Dynamics: Sound waves
8	Tue 10/17	Fluid Dynamics: Shocks
8	Thu 10/19	NO CLASS: October Recess
9	Tue 10/24	Fluid Dynamics: Astrophysical Gases; Thermodynamic Equilibrium & Saha equation
9	Thu 10/26	Fluid Dynamics: Instabilities **[GUEST LECTURE]**
10	Tue 10/31	Fluid Dynamics: Hydrodstatic Equilibrium & Stellar Structure **[GUEST LECTURE]**
10	Thu 11/02	Radiation: The Interaction of Light with Matter I. Scattering
11	Tue 11/07	Radiation: The Interaction of Light with Matter II. Absorption
11	Thu 11/09	Radiation: The Interaction of Light with Matter III. Extinction
12	Tue 11/14	Radiation: radiative transfer
12	Thu 11/16	Radiation: continuum emission
13	Tue 11/21	NO CLASS: Thanksgiving Break
13	Thu 11/23	NO CLASS: Thanksgiving Break
14	Tue 11/28	Plasma Physics
14	Thu 11/30	Plasma Physics
15	Tue 12/05	IN CLASS PRESENTATIONS OF TERM PAPERS
15	Thu 12/07	IN CLASS PRESENTATIONS OF TERM PAPERS