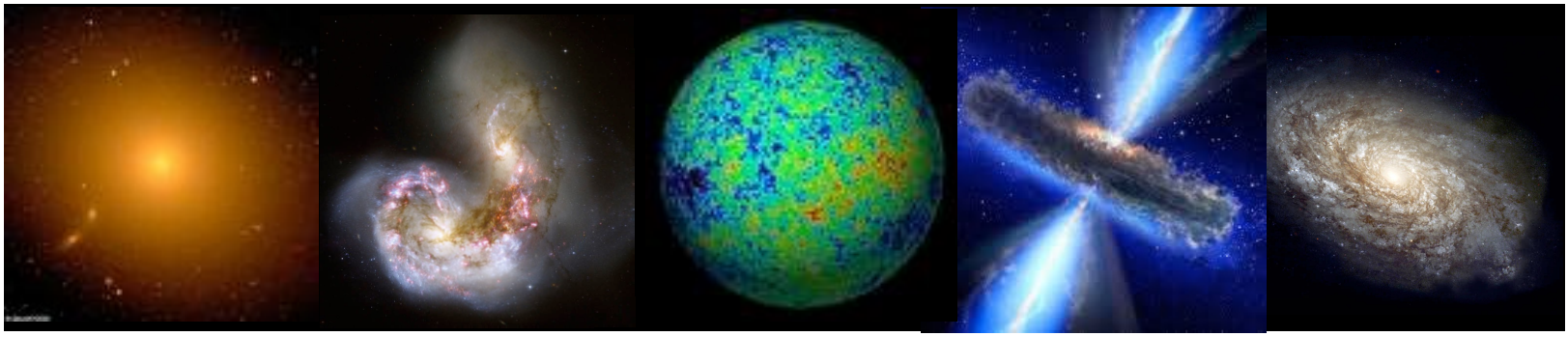
THEORY OF GALAXY FORMATION

ASTR 610; Fall Semester 2020



Course Description

This course prepares the student for state-of-the-art research in galaxy formation and evolution. The course focusses on the physical processes underlying the formation and evolution of galaxies in a LCDM cosmology. Topics include Newtonian perturbation theory, the spherical collapse model, formation and structure of dark matter haloes (including Press-Schechter theory), merger trees, the virial theorem, dynamical friction, cooling processes, theory of star formation, feedback processes, the structure and formation of disk galaxies and ellipticals, AGN, supermassive black holes and N-body simulations. The course also includes a detailed treatment of statistical tools used to describe the large scale distribution of galaxies and introduces the student to the concepts of galaxy bias and halo occupation modeling. During the final lectures we will discuss a number of outstanding issues in galaxy formation, and the students will present and discuss their term paper on a current topic in the field of galaxy formation & evolution.

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

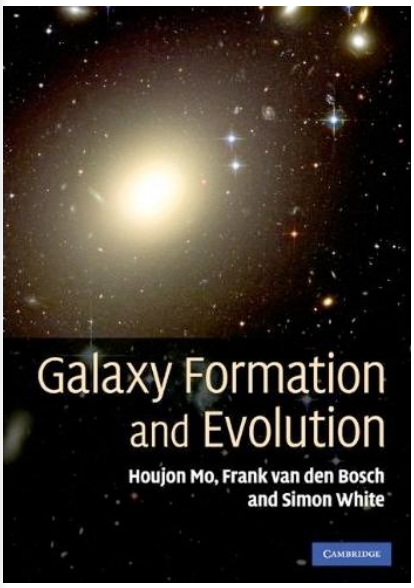
Course Website: http://campuspress.yale.edu/astro610/

Lecture Hours: Tuesday & Thursday 9.00 - 10.15am
online via zoom

Office Hours: online via zoom, only by appointment

Textbook: Galaxy Formation & Evolution
(Mo, van den Bosch & White)

Grading: 40% Final Exam
30% Term Paper & Presentation (topic picked in class)
30% Problem Sets



Preliminary Schedule

week	Date	Topic	Textbook
1	Tue 09/01	Introduction; A Broad Brush Overview of Galaxy Formation	chapter 1
1	Thu 09/03	Cosmology (Riemannian geometry, FRW metric, cosmological distances)	§3.1
2	Tue 09/08	Relativistic Cosmology (GR, Friedmann eqs)	§3.2
2	Thu 09/10	Newtonian Perturbation Theory: linearized fluid equations	§4.1
3	Tue 09/15	Newtonian Perturbation Theory: baryonic perturbations	§4.1
3	Thu 09/17	Newtonian Perturbation Theory: dark matter	§4.1
4	Tue 09/22	Transfer Function and the Cosmic Microwave Background	§4.3 - §6.7
4	Thu 09/24	Non-linear collapse and Relaxation	chapter 5
5	Tue 09/29	Press-Schechter Theory, Excursion Set Formalism and Halo Mass Function	§7.2
5	Thu 10/01	Press-Schechter Theory, Excursion Set Formalism and Halo Mass Function	§7.2
6	Tue 10/06	Merger Trees and Halo Bias	§7.3 - §7.4
6	Thu 10/08	Structure of Dark Matter Halos	§7.5
7	Tue 10/13	Large Scale Structure	§6.1 - §6.2 - §6.5
7	Thu 10/15	Halo Model and Halo Occupation Statistics	§7.6 - §15.6
8	Tue 10/20	Galaxy Interactions & Transformations	chapter 12
8	Thu 10/22	Cooling Processes & Photo-Ionization Heating	§8.1 - §8.3 - §8.4
9	Tue 10/27	Star Formation	§9.1 - §9.3 - §9.5
9	Thu 10/29	Supernova Feedback	§8.6 - §10.5
10	Tue 11/03	Structure and Formation of Disk Galaxies	chapter 11
10	Thu 11/05	Structure and Formation of Elliptical Galaxies	chapter 13
11	Tue 11/10	Numerical Simulations	App C
11	Thu 11/12	Active Galactic Nuclei	Chapter 14
12	Tue 11/17	The Inter-Galactic Medium	Chapter 16
12	Thu 11/19	Semi-Analytical Models of Galaxy Formation; putting it all together	
13	Tue 11/24	NO CLASS: Thanksgiving Break	
13	Thu 11/26	NO CLASS: Thanksgiving Break	
14	Tue 12/01	Student Presentations	
14	Thu 12/03	Student Presentations	