

ASTRO 170: Introduction to Cosmology

Fall Semester 2013



Course Description

Cosmology is the study of the origin, structure and evolution of the Universe itself: the totality of phenomena of space and time. It is the oldest science, and addresses the biggest questions:

- How old is the Universe? Did time have a beginning?
- What is the Universe made of? What are Dark Matter and Dark Energy?
- Is the Universe finite, and if so, what do we find at the edge?
- Are we alone in the Universe?

In this course we journey from the Ancient Greek world views of Ptolemy and Aristotle to the hot Big-Bang model of modern-day cosmology. Along the way we learn how stars shine, how black holes form, how galaxies take on their shapes, and how Copernicus, Galilei, Newton, Einstein, Hubble and others have transformed our geocentric views to one in which we inhabit just a small planet immersed in an infinite, expanding space-time that is 13.8 billion years old and consists of dark matter and dark energy, and in which galaxies are the product of quantum fluctuations.

Instructor: Prof. Frank van den Bosch (Office: JWG 255)

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Office Hours: Wed 3-5 pm (or by appointment)

Lecture Hours: Tuesdays & Thursdays: 4.00 - 5.15pm in WLH 208

Teaching Assistants: Sarah Benjamin sarah.benjamin@yale.edu

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Office Hours: Mon 2-4pm in JWG 207 (or by appointment)

Course Website: <http://www.astro.yale.edu/vdbosch/astro170.html>

Discussion Sections: TBD

Textbook: No textbook needed (for recommendations, see course website)

Grading: 38% Final Exam (Thursday Dec 12 at 7pm; [subject to change!!](#))

30% Mid-Term Exam (Tuesday Oct 22 during class)

30% Homework (five problem sets)

2% ASTR QR 00 Assessment tests

Preliminary Schedule

Week	Date	Topic	Homework
1	Thu 08/29	Introduction: Brief History of Cosmology & The Universe in a Nutshell	
2	Tue 09/03	Looking Back in Time, Scientific Notation & Powers of Ten; a sense of scale	
2	Thu 09/05	Historical Perspectives; From Thales to Ptolemy	Hand-out HW-1
3	Tue 09/10	The Scientific Revolution: Copernicus, Brahe, Galilei, Kepler & Newton	
3	Thu 09/12	Kepler's Laws of Motion & Newtonian Gravity	
4	Tue 09/17	Dynamics: Orbits & Conservation of Energy	
4	Thu 09/19	Elementary Particles & Fundamental Forces	Hand-in HW-1
5	Tue 09/24	Electromagnetic Radiation, Quantum Physics & Emission Mechanisms	Hand-out HW-2
5	Thu 09/26	Doppler Effect, Luminosity and Flux & the Hertzsprung-Russel diagram	
6	Tue 10/01	Life and Death of Stars: white dwarfs, neutron stars & black holes	
6	Thu 10/03	Stellar Populations & Globular Clusters	Hand-in HW-2
7	Tue 10/08	Galaxies and Dark Matter	Hand-out HW-3
7	Thu 10/10	Supermassive Black Holes and Active Galactic Nuclei	
8	Tue 10/15	Special Relativity and Geometry	
8	Thu 10/17	General Relativity: Einstein's theory of gravity	Hand-in HW-3
9	Tue 10/22	MIDTERM EXAM	
9	Thu 10/24	NO CLASS; OCTOBER RECESS	
10	Tue 10/29	Gravitational Lensing	Hand-out HW-4
10	Thu 03/31	Expanding Space & the Hubble Law	
11	Tue 11/05	Big Bang Cosmology	
11	Thu 11/07	Dark Energy; the biggest mystery of them all	Hand-in HW-4
12	Tue 11/12	The Cosmic Microwave Background; radiation from the Big Bang	Hand-out HW-5
12	Thu 11/14	The Early Universe	
13	Tue 11/19	Big Bang Nucleosynthesis; we're all made from stardust	
13	Thu 11/21	Inflation; how Alan Guth saved Big-Bang Cosmology	Hand-in HW-5
14	Tue 11/26	NO CLASS: NOVEMBER RECESS	
14	Thu 11/28	NO CLASS: NOVEMBER RECESS	
15	Tue 12/03	Structure Formation; from quantum fluctuation to Milky Way	
15	Thu 12/05	Questions & Answers Session [open discussion]	