A420: Galaxies and Cosmology

Instructor: Dr. Jennifer Chen
email: chen57@usc.edu
office: SSC 220
telephone: (213) 740-6248

Lecture: Tues, Thurs 3 – 4:50 pm in VKC105
Office hours: Thurs 5-6 pm or by appointment
Website: http://blackboard.usc.edu

Textbooks available in the bookstore:

1) Barbara Ryden *Introduction to Cosmology*, Addison Wesley, 2003, ISBN 0-8053-8912-1.
QB981 .R93 2003
2) Carroll and Ostlie *Modern Galactic Astrophysics and Cosmology* 2nd Ed., ISBN 0-8053-0347-2.

Other recommended books:

1) Edward Harrison *Cosmology – The Science of the Universe*, Cambridge Univ. Press, 2000,
ISBN 0-521-66148-X, QB981.H37 1999
2) Malcolm Longair *Galaxy Formation*
3) Andrew Liddle *An Introduction to Modern Cosmology*
4) Peter Schneider *Extragalactic Astronomy and Cosmology* Springer 2006

Readable graduate-level texts:

1) Sean M. Carroll *An Introduction to General Relativity - Spacetime and Geometry*
Lecture notes available at: http://xxx.lanl.gov/abs/gr-qc/9712019
2) Kolb and Turner *The Early Universe* (Helps to know some GR and particle physics)

Links:

Cosmology Primer: http://preposterousuniverse.com/writings/cosmologyprimer/
Cosmology Tutorial: http://www.astro.ucla.edu/~wright/cosmolog.htm
Cosmic Variance (blog): cosmicvariance.com
Sloan Digital Sky Survey: http://www.sdss.org/
Wilkinson Microwave Anisotropy Probe: http://lambda.gsfc.nasa.gov/product/map/current/
CMB: http://background.uchicago.edu/
Online paper archive: http://arxiv.org/

Overview:

Cosmology is the study of the origin, evolution, and fate of the universe. On the largest scales, the universe can be idealized as a perfect fluid, and Einstein's theory of gravitation dictates its dynamics. On the smallest scales, or in the earliest epochs, the universe presents a unique opportunity to probe fundamental physics beyond the capabilities of accelerators on Earth. In the first part of this class, we will introduce the theoretical foundations of cosmology, deduce its contents and geometry, quantitatively investigate its various epochs, and predict its fate. We will then switch gears to survey galactic formation and evolution. You are encouraged to interact and ask questions. Because the class size is small, you have an excellent opportunity to develop widely applicable presentation skills; the optional presentation is therefore highly recommended. You will also have the opportunity to investigate topics beyond the standard lore covered in this class by writing a review-style article.

Grading:

Option I: 20% homework, 20% review paper, 15% presentation, 10% class participation, 20% midterms (10% each), 15% final exam.

Option II: 20% homework, 20% review paper, 10% class participation, 30% midterms (15% each), 20% final exam.

Homework: There will be about 5 assignments during the course due at the beginning of the lesson on the due date. Sorry, but no late homework will be accepted.

Review Paper: Choose a research topic within the realm of cosmology and astrophysics, and review the essential background, progress in research, and perhaps history. The paper should be at least ten pages (double-spaced, normal margins, 11pt font) and written at a level your classmates can understand. You should use at least ten sources. You should have a topic by week 5 (I can assist if you like), a rough draft by week 10, and the final is due on the Thursday of week 15 at the beginning of class.

Presentation: This is an optional 15-20 minute presentation on a topic within the scope of cosmology and astrophysics, and it can be based on your paper. Again, I can assist you with a topic if needed, which you should have by week 5. Presentations are scheduled during the last two weeks as noted below. Keep in mind that should you choose not to do a presentation, your exam grades will weigh more heavily in the determination of your final grade.

Exams: Exams are closed book, but you can use both sides of an 8x11 crib sheet. They are scheduled on the Thursday of the weeks indicated below, and there are no make-up exams. Midterm 1 covers weeks 1-5, Midterm 2 covers 6 -10, and the final is semi-cumulative with a focus on weeks 11-16. The final exam is scheduled for Tuesday, May 12th, 2-4PM.

Week (beginning)	Topics (Some topics will spill into adjacent weeks)
1 (1/12)	Introduction, Motivation, Scope, Overview
2 (1/19)	Relativity and Gravity
3 (1/26)	Friedmann's Equations, Cosmological parameters, Time evolution
4 (2/2)	Contents of the Universe, Thermal history of the universe
5 (2/9)	Cosmic Background Radiation, Big Bang Nucleosynthesis
6 (2/16)	Big Bang Nucleosynthesis, Midterm 1 (on material up to, not including BBN)
7 (2/23)	Gravitational Lensing, Evidence for Dark Matter
8 (3/2)	Evidence for Dark Energy, Particles and Fields
9 (3/9)	Dark Matter and Dark Energy candidates
10 (3/16)	SPRING BREAK
11 (3/23)	Early Universe: Symmetry breaking, Defects, Baryogenesis, Midterm 2
12 (3/30)	Inflation, Eternal inflation, Multiverses, Anthropic principle, Beginning of time
13 (4/6)	Structure formation, Galaxy type and formation
14 (4/13)	Galaxy evolution, Active galactic nuclei
15 (4/20)	Current research, Presentations, Papers due
16 (4/27)	Presentations, Review