Astronomy 202b: Cosmology

Tue./Thu., 9:30-11:00AM, Spring 2012

Syllabus

Course Instructors
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Course Requirements

Problem sets (due every second week): 30% of grade

Numerical project: 20% Final Exam: 50%

Course Texts

Required:

⋆ Loeb, A. & Furlanetto, S. 2012, The First Galaxies
(Princeton: Princeton Univ. Press)

⋆ Mo, H., Van den Bosch, F. & White, S.D.M. 2010, Galaxy Formation and Evolution
(Cambridge: Cambridge Univ. Press)

⋆ Padmanabhan, T. 1993, Structure Formation in the Universe
(Cambridge: Cambridge Univ. Press)

Recommended:

⋆ Schneider, P. 2006, Extragalactic Astronomy and Cosmology
(Berlin: Springer)

⋆ Mukhanov, V. 2005, Physical Foundations of Cosmology
(Cambridge: Cambridge Univ. Press)

Course Outline

1. **Introduction 1/24, 1/26**
   (a) The Big Picture
   (b) Composition of the current universe
   (c) Scales in Astrophysics
   (d) Standard observables
2. **The Big Bang: Birth of our Universe 1/31, 2/2, 2/7**
   (a) The cosmological principle: isotropy and homogeneity
   (b) The Hubble expansion: the redshift-distance relation
   (c) Relics from the Big-Bang: the microwave background, synthesis of light elements
   (d) Geometry of the Universe: the expansion factor, lookback time
   (e) Cosmological parameters: the Hubble constant, the mean mass density
3. **Thermal History of the Universe 2/9, 2/14, 2/16**
   (a) Early times: Planck era, inflation, baryogenesis, electroweak and QCD phase transitions, neutrino decoupling
   (b) Nucleosynthesis
   (c) Ionization history of the universe
   (d) The Microwave background
4. **Structure Formation I: Linear Regime ... 2/21, 2/23, 2/28, 3/1, 3/6, 3/8, 3/20**
   (a) Friedmann equations, fluid equations
   (b) Linear theory, Jeans' instabilities
   (c) Cosmological density fields: stochastic fields, Gaussian fields, ergodic hypothesis, power spectra, correlation functions
   (d) Anisotropies in the Microwave background
   (e) Lyman-α forest
   (f) Reionization and 21cm cosmology
5. **Structure Formation II: Non-Linear Regime ... 3/22, 3/27, 3/29, 4/3, 4/5**
   (a) Spherical collapse, Press-Schechter, mass function
   (b) Dark Matter: evidence, detection, searches

(c) Dark Matter halos: mass distribution and virial properties

(d) Galaxy clusters: structure, evolution, cosmological probes

(e) Galaxy formation: classification, mergers, starburst, quiescent accretion, physical models

(f) Black holes: AGN, quasars, coevolution with galaxies

6. **Numerical Cosmology** **4/10**

(a) N-body methods

(b) Hydrodynamical methods and state-of-the-art results

Numerical projects **4/12, 4/17, 4/19**