

COSMOLOGY: AST 625

Instructor: Dr. Anatoly Klypin

Lecture times: Tuesdays & Thursdays, 01:00 – 02:15

Office hours: Tuesdays 15:00 – 15:30

Textbook: J. Peacock “Cosmological Physics”

Lecture Notes: every student will have a copy of my notes

Homework: every other week you will have 4-5 problems to solve at home.
Homework assignments are due a week after they are given to you.

Grades:

Homework 20%

Two Midterms 20%

Project 20%

Final Exam 20%

Project

For given parameters of a cosmological model ($\Omega_{\text{total}}, \Omega_{\text{dm}}, \Omega_{\nu}, \Omega_{\Lambda}, H_0, P(k), \sigma_8$) find:

- (1) Age of the Universe at different redshifts ($z = 0 - 5$)
- (3) Amplitude of fluctuations $\Delta M/M$ on galactic scales $M = 10^{10}, 10^{11}, 10^{12}$ at redshifts 0-10.
- (4) Power spectrum of fluctuations for galaxies in real space (assuming a linear bias). Compare results with observational data.
- (5) Fraction of mass of the Universe in galaxies at different redshifts.
- (6) Bulk velocity of a sphere of radius R .
- (7) Number density of halos with different mass at different redshifts.

Tentative Course Schedule

- 1) Introduction. Keystone observations. Matter, luminosity, age. Short history of time. Kinematic properties of the Friedmann universe.
- 2) Kinematic properties of the Friedman universe. Metric, geometry of open, flat, closed world.
- 3) Friedman equations: simple derivation. Corrections for GR effects. Expansion laws, age of the Universe in different model.
- 4) Different modes of perturbations. Waves longer than the distance to the horizon.
- 5) Equations of hydrodynamics in comoving coordinates. Small waves. Velocities.
- 6) Different solutions for small waves. Jeans instability.
- 7) Silk damping. Free streaming.
- 8) Transfer functions. Power spectrum.

MIDTERM EXAM

- 9) Statistical description of small fluctuations. Filters. Correlation function.
- 10) Measurements of the correlation function and power spectrum.
- 11) Introduction. Galaxies, clusters, filaments, and voids at different redshifts.
- 12) Spherical model. Homogeneous ellipsoid model.
- 14) Zeldovich approximation. Truncated Zeldovich approximation.
- 13) Mass functions: the Press-Schechter approximation.
- 15) Nonlinear evolution of fluctuations. Biases.

MIDTERM EXAM

- 16) Inflation I. Ideas. Different models of inflation.
 - 17) Inflation II. Slow-roll approximation. Reheating. Origin of fluctuations.
 - 18) Thermal history of the Universe. Entropy. "Freeze out". Neutrinos and WIMPS.
- BBN -I
- 19) BBN-II. Decoupling and recombination.
 - 20) Cosmic Microwave Background anisotropies: physical processes.
 - 21) Statistics of CMB anisotropies. Observations.
 - 22) Cosmological models: predictions and observations.

FINAL EXAM