COSMOLOGY: AST 625

Instructor: Dr. Anatoly Klypin

Lecture times: Tuesdays & Thursdays, 1:10 – 2:25

Office hours: Tuesdays 3:00 – 3:30

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 ($\Omega_{\rm total}$, $\Omega_{\rm dm}$, Ω_ν, Ω_Λ, H_0, $P(k)$, σ_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 Friedman 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. 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 dumping. 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