The CMB and Cosmology

Astro 448

MW: 1:30-3:00

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Office Hours: Monday 3-4 PM

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Description

This course will have a heavy emphasis on the theory of cosmic microwave background anisotropies.

Its goal is to provide the student with a sufficient knowledge of their calculation in the standard cosmological model that they will be able to make custom modifications to the calculations with the help of CMBfast.

I will be using Scott Dodelson's book as a reference source. Copies will be made available to registered students or can be downloaded from

http://background.uchicago.edu/~whu

under "Teaching". You will also find CMB resources at all levels on this website (under "CMB Physics").

Requirements

Requirements for this course are Astro 321 (or suitable graduate level introduction to cosmology). Specifically, working knowledge of rudimentary GR (metric and index pushing) and Friedman-Robertson-Walker cosmologies will be assumed (a brief refresher will be provided).

Students may either choose to complete

- Complete approximately 1 problem per lecture as homework plus a longer final problem set.

(programming skills to calculate and plot numerical solutions to equations will occasionally be required) or

- Research a related topic of current interest and present it in the form of a web page.

(see http://casa.colorado.edu/~ajsh/astr5720/project.html#titles for examples of what I mean).

Syllabus

There will be approximately one lecture per topic. Lectures will normally open with a qualitative discussion of each issue followed by blackboard/overhead treatment of technical aspects (derivations of central equations etc.). "Additional Topics" will be covered only if there is time at the end of the course.

Main Topics:

- Overview
- FRW Cosmology
- Thermal History
- Linear Perturbation Theory I: General Aspects
- Linear Perturbation Theory II: Scalar and Tensor Modes
- Initial Conditions and Inflation
- Acoustic Oscillations I: Kinematic Effects
- Acoustic Oscillations II: Dynamical Effects
- Boltzmann Equation I: Normal Modes
- Boltzmann Equation II: Scattering
- Boltzmann Equation III: Solutions
- Polarization
- Parameter Estimation
- Large Scale Structure

Additional Topics

- Secondary Redshift Effects
- Secondary Lensing Effects
- Secondary Scattering Effects
- Thermal SZ Effect
- Non-Gaussianity