COSMOLOGY

Astronomy 6599/Physics 6599

Fall 2024

Time/Place	8:40-9:55 am MW Rm 622 Space Sciences Building	
Teacher	David Chernoff Rm 602 Space Sciences Building	
Help	After class or by appointment 10-11 am W in 602 SSB	
Books	"Modern Cosmology" by Scott Dodelson & Fabian Schmidt (SD) "Cosmology" by Steven Weinberg (SW) "Cosmology" by Daniel Baumann (DB) "Introduction to Cosmology" by Barbara Ryden (BR)	
Problem Sets	Weekly or biweekly	60%
Assignment	Final problem set	40%

- Canvas: I will distribute information (handouts, problem sets,etc.) via the course page at canvas.cornell.edu
- Grader: There is no TA and it's unlikely that there will be a grader. This means that most of your homework will be lightly graded. The final assignment will be scrutinized more carefully. I encourage you to do all the homework problems in detail, keeping in mind that the final assignment will depend crucially upon them.
- Prerequisites: Assume a strong foundation in undergraduate physics (special relativity, thermodynamics, statistical mechanics and classical mechanics). The math background is multivariate calculus and differential equations. General relativity is not a prerequisite but will be reviewed/introduced as needed; it will of course be helpful to have had prior exposure. Likewise, observational astronomy will be reviewed/introduced as needed and previous exposure will be helpful.
- Grading; Letter grade or S/U or audit (register for the audit if you intend to attend the class). The problem sets will be handed out approximately every two weeks. You are expected to abide by the Cornell University Code of Academic Integrity. There will also be a final longer problem set (not quite a take home final!).
- Textbooks: Depending upon your background you might end up using a combination of books.

  The class text is Modern Cosmology by Dodelson and Schmidt (2021), a modern, complete and self contained treatment of the background cosmology and it's linearized perturbations, with all the derivations given in detail, using standard notations. Normally I try to refer to sections of this book for topics I cover. If you intend to go into cosmology you should become familiar with this book.

  Second on the list is Weinberg's Cosmology book (2008), excellent, comprehensive and detailed coverage all the topics in which we're interested and having the minimum mathematical formalism. The only drawback is that the choice of notation often differs from what is standard in the cosmological community.

  Third is Baumman's Cosmology book (2022). This is the most recent of the offerings and presents an especially clear and clutter-free exposition. I am only partially familiar with it but I imagine that it will be the text I use for future offerings of this class!

Fourth is Ryden's Introduction to Cosmology (2017). It does not go into the same level of detail as we will in the course, but it explains all the topics that it covers simply and lucidly. I have been told by previous teachers of this class: always read this book first, on any topic, to understand the basics of that topic. Then move on to one of the more advanced treatments above.

Lecture	Date	Tentative Topic	Subjects
1	M Aug 26	Intro	Organization, foundations, role of gravity History including Hubble law, redshift, CMB temps, anisotropies
2	W Aug 28	Key approximations	Homogeneity and Isotropy Broad outline for course Olbers GR
**	M Sep 2		
3	W Sep 4	FRW	spatial curvature, scale factor, conformal time, comoving coordinates, local inertial frame in cosmology, redshift, horizons
4	M Sep 9	Dynamics of FRW	orthonormal basis, perfect fluid, energy conservation, first law, constituents, equations of motion
5	W Sep 11	Friedman equations	Solutions and observables, Einstein deSitter, radiation, curvature, Einstein static, matter+curvature, matter+Λ
6	M Sep 16	Standard Model	age, distances, schematic log z vs log ρ, observable probes of the background, observable probes of the fluctuations
7	W Sep 18	Temperature, age, SNIa	angular diameter distance, luminosity distance, nucleosynthesis
8	M Sep 23	Galaxy clusters	gravitational lensing, virial theorem, X-rays
9	W Sep 25	Baryonic mass	SZ, Alcock-Pacyznski, BAOs
10	M Sep 30	Particle interactions	
11	W Oct 2	TBD...	