

Astronomy 422: Cosmology

Time: Tu & Th 11-12:15 am

Room: CSS 0201

Office Hours: Tu & Th 10-11 am, or by appt.

Phone/Email: (301) 405-6647, apeel@umd.edu

Textbook: [An Introduction to Modern Cosmology](#) by Andrew Liddle (ISBN: 978-0470848357)

Course Website: www.astro.umd.edu/~peel/ASTR422/, and also ELMS elms.umd.edu

Dates: 26 Jan – 11 May 2010

Lecturer: Dr. Alan Peel, CSS 1223

Graders: TBD (probably just me)

Mailbox: CSS 1204 (9 am - 4 pm)

Course Description

Cosmology is an exciting field of astrophysics and underwent an important transformation in the 1990s from a speculative science in which factors of two in predictions were routinely ignored to a precision science able to constrain the Universe's global parameters into the single digit percent ranges (and that's $2\text{-}\sigma$ no less). Through the early years of this millennium, a "concordance" model about various cosmological parameters emerged, which, while not entirely controversy free, looks likely to stand the tests of new data for the immediate future. Having said that, the numerical *values* of the concordance model leave some exciting challenges unanswered for future physicists and astronomers such as yourselves to solve.

This course is intended primarily for ambitious juniors and seniors in physics and/or astronomy. We will survey over many topics in modern physical cosmology, such as (in no particular order here):

- Why do we think the Universe had a Big Bang?
- What did the Big Bang expand out of? [Or, for you grammarians: "From what did the Big Bang expand?"]
- How do we measure the expansion rate?
- How does the expansion rate change (accelerate/decelerate) as a function of what the universe is "made of"?
- Why do we think dark matter exists? Do we have any candidates for what dark matter is?
- Why do we think dark energy exists? Any candidates?
- What global cosmological parameters can we measure? Are they degenerate?*
- Why is the universe mostly made of hydrogen and helium?
- Can we calculate how much helium is primordial vs. how much has been made by stars since the Big Bang?
- What is the ultimate fate of the Universe?
- [Or better: what are the possible ultimate fates of the Universe?]
- What is inflation (in a non-financial context!)? What evidence is there that inflation took place?

*Don't get excited. It's not that kind of degeneracy

For you to answer these questions requires a broad understanding of many different branches of physics: a bit of quantum mechanics, a healthy dose of general relativity, a functional grasp of thermodynamics, a passing acquaintance with nuclear physics, and, of course, an understanding of basic astronomy. We will attempt to outline basic controversies and the most current and upcoming data.

We will use a fair amount of mathematics in this course and a lot of physical reasoning. To that end, various tricks of the trade will be used on how to estimate quantities, how to check units and how to argue dependencies. Within the first two weeks, you will get a taste of the level of work expected, an outline of the various topics covered a sense of the in-class discussions and problem solving sessions and a homework assignment so that you can assay how prepared you are for this course. Your challenge

is not a small order: you will learn to master this diverse and extensive body of knowledge in order to create a large scale understanding of the past, present and future of the largest scales in the Universe.

Grading

In my larger survey (CORE) courses, I routinely use the [ELMS Blackboard](#) website for almost everything. However, due to the intimate size of this course, I expect to use it primarily for its "Discussion Board," "Announcements" and maybe the "Course Documents" pages. You will also be able to keep track of your overall grade there. But for the homework, tests and final exam, we will use 15th century technology (paper and pencils). The assignments will be available as pdfs on the [Homework Assignments & Tests](#) webpage.

Partial points on the homework, tests, and final will be generously given for any reasonable attempt at a solution, even if you end up on the wrong track or make the occasional algebra/calculus error. Only blank, or nearly blank answers will receive a "0". I grade on a point scale with different weights as shown in this table (note that you can divide any of these numbers by 10 and get a percentage):

ASSIGNMENT	Class Participation	Homework (5)	Tests (3)	Final Exam	Total
POINTS	100	400	300	200	1000

From the lecture schedule, you'll see that there are five homeworks at 80 points each (400 total) and three tests at 100 points each. Details about each element of the class are spelled out below in the relevant section.

Letter grades will be assigned based upon your cumulative score, but I do not curve lightly. It is my experience that the following percentage scale holds roughly true if I want a "B" to be the average grade. If I curve, it will always be in your favor. The point scale makes it possible for everyone in the class to do well. For example, if everyone scores above 80% in the course, you would all receive either a B or better letter grade. Unlikely as it may be, the entire class could potentially get A's. I *will* be using +/- modifiers for the final grade. Here is a **rough** guide as to how your final points relate to your final grade with the understanding that it can only be *more* generous than this, not less:

Letter Grade	A	B	C	D	F
Course Total	900+	800-899	680-799	550-679	<550

Attendance and Class Participation

As you can see, missing 100 points of the class participation can drop your grade a whole letter. So **DON'T SKIP THE LECTURES!** Let me know in person or by email as soon as possible if you are planning on missing lectures, e.g., due to a religious holiday. Letting me know *after* the holiday will not work.

In order for you to succeed in this course, I expect you to attend all the lectures. This is very important! Not only are the homework assignments, tests and final exam based upon the material lectured by me; understanding, comprehension and material beyond the textbook will be hashed out by all of us in class. You are not expected to always "know the answer" or "get it right" off the top of your head! But, if you remain aloof, never answer anything and refuse to be drawn into discussions, I will assume you aren't actually there and you will lose participation points. The very few people that have ever received truly bad grades from me not coincidentally also had terrible attendance.

This class has an official cap of twenty students. (Which doesn't explain why there are ~28 of you, but never mind). Within the first two weeks, I expect to know all your names and faces. I consider this to be a small class in which discussion, tangents and problem solving will be built in and even occasionally arise spontaneously. Your absence means either 1) *you* will not benefit from discussion that day or 2) *others* will not benefit from your personal insights and genius. Either way, missing class is not a good idea. If you do have to miss a lecture be sure to look at another student's notes and make sure that you understand what was covered or come to office hours.

Attendance as measured by these participatory discussion will count towards 10% of your grade in the class (see above table).

Tests and the Final Exam

If you have to miss a test, such as due to illness, please be sure to contact me by email or voice mail as soon as you know, but in any case **no later than the day of the test itself** to arrange a possible makeup (severe medical emergencies being the obvious exception).

There will be three forty-five minute in-class tests. These are closed book with no notes and no calculators allowed. Each test will consist of two or three multipart questions on topics covered in class or on the homework. These tests are generally incremental (i.e., non-cumulative) checkups on the material though elements of problem solving will pop up in all of them.

You can always review the [Lecture Schedule](#) (periodically check for updates!) to see what material will be covered on each test. If for whatever reason, the University is **officially** closed on the test date, the test date shifts to the next lecture date.

According to the Course Schedule, the final exam for this course has not been set yet; but based on Maryland's [Standard Final Exam Schedule](#), most likely it will be Thursday May 13th (the first day of finals and only two days after our last lecture!) at the undignified hour of 8 am. I will endeavour to bring donuts and coffee; you will bring a pencil, your brainpower, and your newfound comprehension of the largest scales in the Universe.

The final exam is cumulative, that is, it will cover *all* material discussed in this course. The final will include a mixture of short answer and problem solving questions. This exam is also closed book with no notes and no calculators allowed.

PLEASE NOTE that many of the questions on the tests and final exam will NOT be exactly the same as homework questions (not even with "the numbers changed") but will challenge you on how well you comprehended the material.

Missed Test Policy

If you are not able to take a test due to a VALID EXCUSE as outlined in the Academic Information section of the schedule of classes and you wish to take a full credit make-up test (which may be considerably harder than the original test and, for example, may consist only of essay questions), you must:

1. contact me by email or phone **before** you miss the regularly-scheduled test if physically possible **and**
2. **submit a valid written excuse for your absence within one week after the regularly-scheduled test (by US Postal mail if necessary!).**

Homework Assignments

Right out of the starting gate, you have a (no points value) homework due February 4th and worth nothing and everything. This first homework ("HW #0") includes:

1. Signing off that you've read and understood this syllabus;
2. A few fun questions to poke at your problem solving skills and familiarize you with the math expectations of this course;

NOTE: While not worth any points by itself, HW #0 is a gauge for you to decide whether to drop the class. I will make every effort to avoid a severe case of professoritis. This disease affects a great number of researchers, and manifests most clearly when they try to teach their own discipline (as I am doing here). Namely, due to multiyear (or even multidecade!) familiarity with topics in their field, researchers often fail to see why these things aren't "totally obvious," or even recall what it was like when they first encountered them.

HOWEVER, I will not dumb down the material below an advanced undergraduate level. Your responsibilities are to keep up with the material, interrupting me as often as needed to make things clear; to challenge me to rephrase things when they are not. If, after the first four lectures and HW #0 you feel completely overwhelmed, I urge you to talk to me about dropping the class. Add/Drop deadline for undergrads is Friday, February 5th which is why HW #0 is due the day before that.

Beyond that, there are a total of five (content-related) homeworks in this course. Roughly speaking, each HW covers about three chapters. HW #1 will be available on the [Homework Assignments](#) page (see header, too) shortly after the first class has met. If you have tremendous trouble with the first homework, consider it an ominous sign and consult with me as soon as possible! Future homeworks will also become available on the same page as the term progresses.

Although you are **HEAVILY** encouraged to discuss the homework problems with your classmates, the final writeup **must be in your own words**. Copying from a friend's homework, copying from a book without citing, or allowing a colleague to copy your homework is academic dishonesty and will not be tolerated in this class. If you consult a reference other than the course text, **including websites**, please acknowledge or cite it in your homework!

Each homework assignment is due at the beginning of class on the due date. Late homework (as in more than fifteen minutes after class has begun) will not be accepted. Due dates are listed both on the [Lecture Schedule](#) and on the [Homework Assignments](#) webpage.

Extra Credit?

There will be no extra credit. Simple, really, i'n'it?.

Course Expectations (and Suggestions!)

Attendance and Class Participation Grade: You are expected to try to attend all lectures, and your grade depends on participation. While many students bring laptops to take notes, it is extremely rude to surf on irrelevant websites during lecture as it can distract those around you. So, don't do it. **I will deduct participation points for those who cannot abide by this simple rule.**

If you don't understand the text, attending lecture will help you to gain important clues and caveats. If you do understand everything, you'll be able to share your unique perspective with others during discussion and problem-solving sessions. Either way, be there! (See [above](#) for more details.)

Preparation: I expect you to be prepared to work. You will understand the lecture more easily if you preview the reading assignment (listed in the Lecture Schedule and updated during the semester). A more careful second reading is recommended after lecture. It is also good to study your class notes sometime before the next lecture to make sure that everything is clear. I encourage you to ask questions in class, during office hours, or on the ELMS Discussion Board for our class.

Study Habits: PLEASE ask for help if you need it. If you rely on cramming the night before a test, you are not likely to do well. It is better (and easier) if you keep up with the material on a daily basis. Make it a point to read the chapters in pace with the lectures; this is one of the best study habits you can have. If you have questions, please see me. DO NOT WAIT until the day before an test!

Discussions! Sometimes the best way to understand something (or check that your understanding is correct!) is to try to explain it to someone else. I encourage collaboration (but not plagiarism!) and discussion inside and outside class and online at the ELMS Discussion Board.

Disability Accommodation

Students with a documented disability who require academic accommodations should contact me as soon as possible.

Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the definitions and consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.studenthonorcouncil.umd.edu/code.html>.

Copyright Issues and Your Notes

Selling or distributing copies or modified copies of instructors' course materials or assisting another person or entity in selling or distributing those materials will be considered a violation of the University Code of Student Conduct, Part 9(k). The overhead presentations shown in class will not be available on the web. Students may request a reviewing of them during office hours.

Course Evaluations

CourseEvalUM will be open for students to complete their evaluations later in the semester. Students can go directly to the [website](#) to complete their evaluations. You will be alerted when the evaluation sites are ready closer to that time via your official University e-mail account. Students who complete evaluations for all of their courses in the previous semester (excluding summer), can access the posted results via Testudo's CourseEvalUM Reporting link for any course on campus that has at least a 70% response rate. You can find more information, including periodic updates, at the [IRPA course evaluation website](#). **The expectation is that all students will complete these. This is YOUR chance to anonymously evaluate this class: please use this opportunity!**

Last Modified: January 2010 *subject to change*