ASTRONOMY C1404Y SPRING 2015

STARS, GALAXIES, & COSMOLOGY

Tu Th • 4:10 – 5:25 pm • Pupin 329

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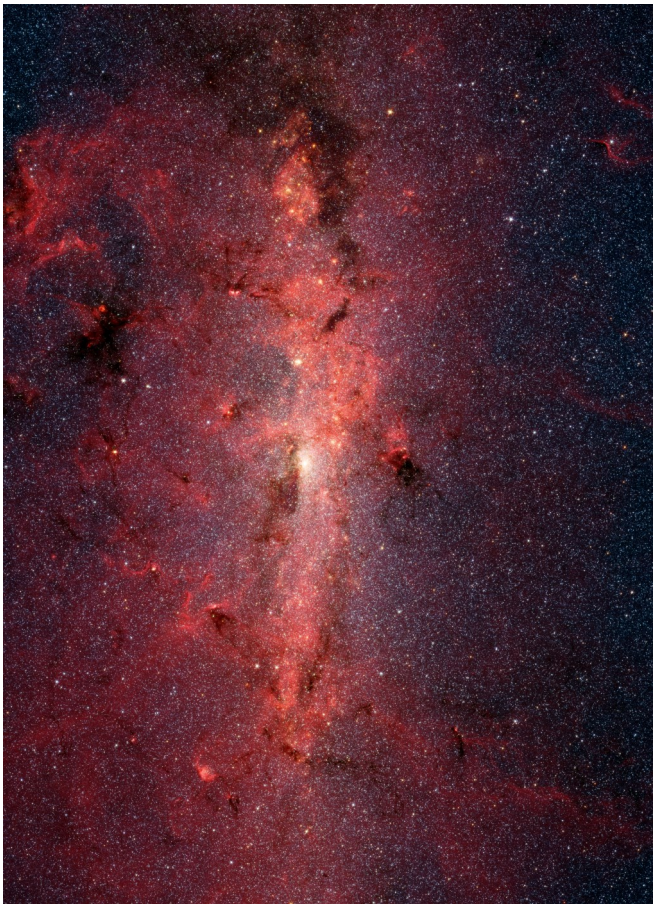
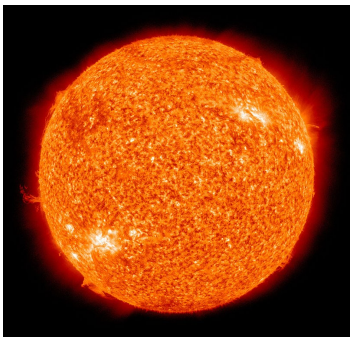
The "official" textbook for the course is *Stars, Galaxies, and Cosmology*, which is the slightly shorter version of *The Cosmic Perspective* by J. Bennett et al. (Addison-Wesley, 7th edition). Earlier editions of this book, which you might find on the street or on websites, are OK. And the full version (*The Cosmic Perspective*) — any edition after the 4th — is also OK. The chapter numbers are the same, and changes in the text are really minimal. You can also use a different introductory textbook, as long as it's not one of the highly-math-phobic variety (ask, if you have doubts; a good rule is: if the math looks minimal and very elementary, that would qualify as math-phobic). All of the texts previously used in Columbia–Barnard introductory astronomy classes (1000-level) are OK and very similar; they all address the same curriculum at a pretty similar level. ***The course is really defined by the lectures, not the text.*** The only drawback of using an alternate textbook is that you'll have to decide yourself on the chapter numbers corresponding to the topic du jour. Not so difficult... I swear!





Office hours:

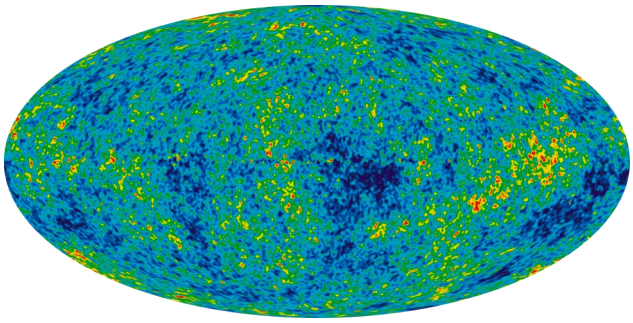
W 9:00 – 10:00 am, and other times by appointment. But you don't need an appointment; drop by any time, with good odds of finding me.

TAs:

Several, identities and coordinates to be specified later.

None of these books will be mistaken for great literature. Astronomy has, however, produced a few very excellent and readable books which you should consult (sometime in your life, not necessarily soon). A few relevant to this semester's topics are:

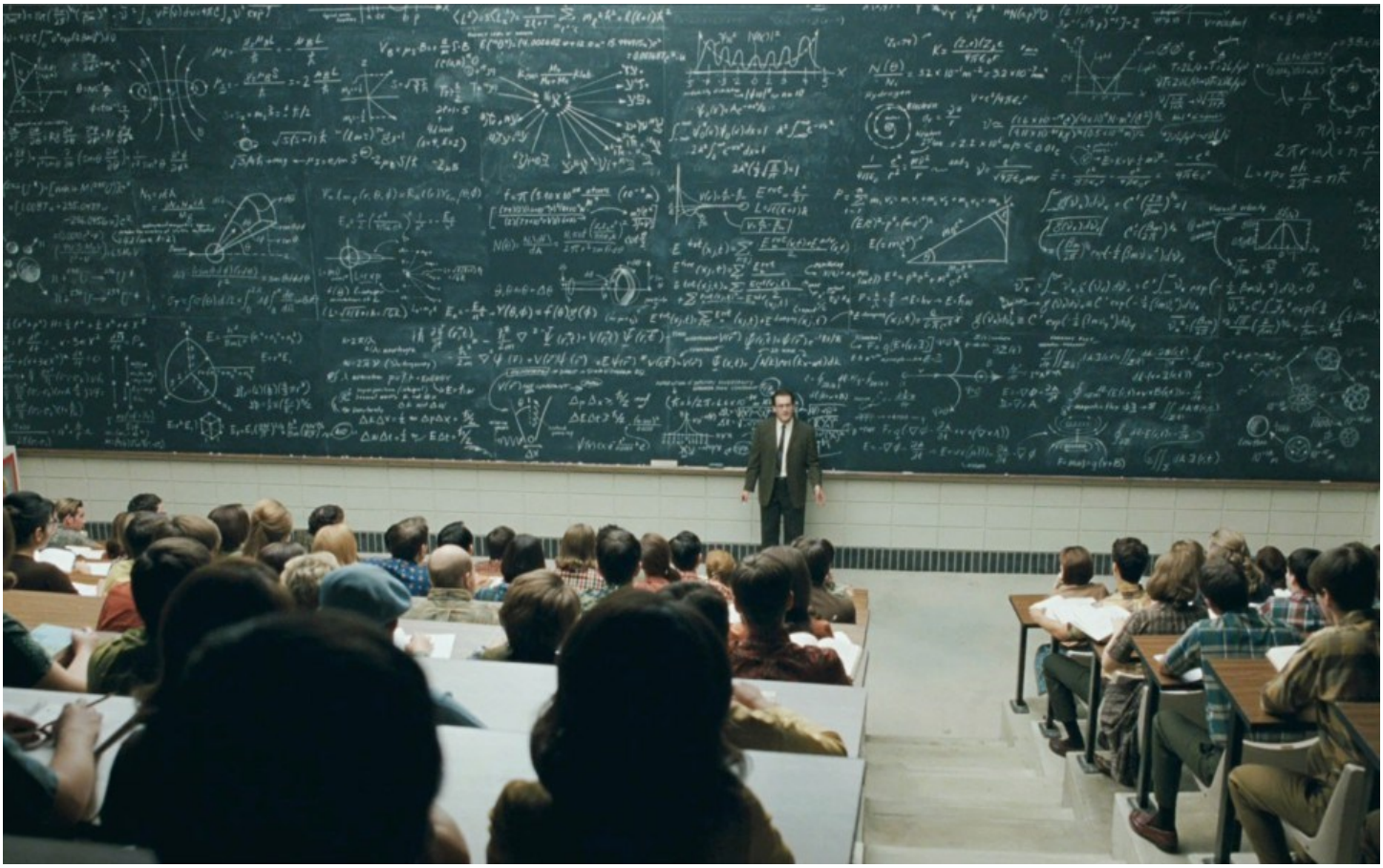
- *Coming of Age in the Milky Way*, by Timothy Ferris
- *Frozen Star*, by George Greenstein
- *The Shadows of Creation*, by Michael Riordan and David Schramm
- *The Extravagant Universe*, by Robert Kirshner



I will also be handing out lecture notes, a few supplementary readings, and a few powerpoints. There will be 4-5 problem sets, spaced at strategic intervals, a midterm exam, and a final. Grading will go something like this:

Midterm	Final	Problem Sets	Class Contribution
25%	40%	25%	10%

Astro 1404 counts towards the science requirement as a simple 3-point class. On the Barnard side of Broadway, it counts towards either the science or the quantitative reasoning requirement (but possibly not both simultaneously? I'm unsure about this). Most Barnard students will want to enroll separately in Astro 1904, a weekly 1-point lab which will *roughly* track the coverage of topics.



Lecture Schedule

Dates	Topics	Readings
January 20, 22, 27, 29	Surveying the universe from Earth: from the Stone Age to the Silicon Age. Numbers: do they rule the Universe? Motions of the night sky. This spinning Earth. The "scientific revolution"... and especially gravity.	Chapters 1, 2, 3, 4.
February 3, 5	The nature of light, mostly, and matter, somewhat. The physicists arrive for a lengthy visit. Wave and particle theories of light. Speed and energy in light. Thermal ("blackbody") radiation. An abundance of formulas.	Chapters 4, 5.
February 10	Telescopes, for every wavelength.	Chapter 6.
February 12, 17, 19	The nature of matter on the smallest scales: atoms, molecules, nuclei. Spectral lines and the Rutherford–Bohr "miniature solar-system" model of the atom. Roentgen's discovery of X-rays. Becquerel's discovery of natural radioactivity. The concept of *binding energy*. Turning lead into gold, and vice versa. Hydrogen burning in stars, the nearly inexhaustible source of stellar energy. Exeunt most of the physicists.	Chapters 5, 15, S4.
February 24	Down and dirty inside and outside the local star. The Sun's luminosity, 11-year spot cycle, and internal structure. Diffusion (collisions!), the mechanism by which all that energy finally leaks out into space, thirty thousand years later. The Sun's remaining mysteries: magnetism, the heating of the solar corona, and the "Little Ice Ages".	Chapter 14.
February 26	How far the stars? Use of triangulation, or "trigonometric parallax", to measure distances to stars. Absolute and apparent magnitudes; luminosities and fluxes. The inverse-square law of light. Learning masses and radii from binary stars.	Chapters 15, 16.
March 3	Birthing stars against the formidable barrier of angular momentum (spin). Nurturing stars on the "main sequence", where they burn H in their cores.	Chapter 16.
March 5, 12	Stellar senility: red giants. Stellar necrology: white dwarfs, neutron stars, black holes.	Chapters 17, 18.
March 10	Good candidate date for the midterm exam.	
March 24	Interstellar gas, dust, and 200 billion stars: the Milky Way galaxy.	Chapter 19.
March 26	External galaxies. Hubble's Law and the expanding universe. Distance-finding and the role of "standard candles".	Chapters 20, 21.
March 31, April 2	Quasars, and black holes in galactic nuclei. The discovery of dark matter. The need for "new physics".	Chapters 21, 22.
April 7, 9	The Special and General Theory of Relativity.	Chapters S2, S3.
April 14, 16, 21, 23, 28, 30	Cosmology: the origin, age, and structure of the universe. The discovery of dark energy. The hot big bang, today's most popular cosmology. The inflationary universe. Will the universe continue to expand forever, or collapse in a "big crunch"? Fascinating stuff, and all the big questions remain to be solved.	Chapter 23.
May 12	Good candidate date for the final exam. May 14 is also possible, so hold off on buying plane tickets.	