

ASTR/PHYS 109: Big Bang and Black Holes

Spring 2017

Course objectives: This course is designed to give an intuitive understanding of the Big Bang and Black Holes, without mathematics, and de-mystify it for non-scientists. The primary goal is for students to learn about the origin and evolution of the Cosmos and communicate their understanding using their own words to a lay audience.

Prerequisites: None

Instructor: Prof. David Toback
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Course website: <http://people.physics.tamu.edu/toback/109>

Textbook: Required: “Big Bang, Black Holes, No Math,” by Toback
You can get this book at the bookstore or order online. EBook format is also available online. See bigbang.physics.tamu.edu for more details.
Recommended books:
“A Briefer History of Time,” by Hawking and Mlodinow
“Theory of Everything,” by Hawking
“Stephen Hawkings’s Universe,” by Filkin
“The First Three Minutes,” by Weinberg
Other readings can be downloaded from the web
All books available on Reserve at the Library

Course Work and Grading: The bulk of the grade for this course is in the writing component. A premium will be placed on the ability to understand and convey the excitement about science, cosmology and the physical universe to the lay reader. There are two additional parts of the grade: 1) Online Pre-Lecture Reading Question (PLRQ) assignments in Calibrated Peer Review (CPR) format and eCampus format (PLRQ-prep); these will help with lecture prep, and to help you ask good scientific questions), as well as in-class quizzes (to make class time more productive), and 2) Additional online end-of-chapter (EOC) quizzes in eCampus (to consolidate learning after class). By percentage, the grade is based on:

- Short papers: 90%
- PLRQ assignments in CPR/In-class quizzes: 5%
- Online quizzes (EOC and PLRQ-prep) in eCampus: 5%

Note that you cannot pass the course without

- 1) Completing all the parts of all the papers in CPR (there are multiple attempts in some case)
- 2) Passing all of online quizzes (e.g. End-of-Chapter and PLRQ-prep quizzes)

You will be allowed as many attempts as needed, for these last two.

Frequently Asked Questions: Answer to frequently asked questions about grading and other parts of the class can be found at <http://people.physics.tamu.edu/toback/109/109FAQ.shtml>. It is expected that all students have read this document.

Students in the Honors Sections: The regular sections and honors section meet together during the regular class period. However, each honors student will have an additional Research Paper that will be part of their paper grade. More information about it can be found at <http://people.physics.tamu.edu/toback/109/Honors/>

Description of the Writing Portion of the Course: Each paper assignment will be submitted online and graded using the CPR system (you will also submit it to turnitin using eCampus). Many students find using CPR to be the most difficult and unpleasant portion of the course. The instructor believes evaluating papers, as a way of learning to critique your own work, and the work of others, is the most important part of the class and one of the best ways to improve your writing. We will spend time discussing each paper in class, and practice CPR techniques using the PRLQ materials before the first paper.

We are here to help you get excellent grades if you will put in the time and effort required. Before each paper is due, students will be encouraged to submit drafts to the TA for feedback with enough time for the TA to respond with comments (drafts will be submitted to eCampus, with feedback returned to the same place). This will help produce an excellent final draft paper. Getting help from the TA's during both the writing and the Calibration stages of CPR will be encouraged. In the case that you don't get the grade you want on the full paper score, you will be encouraged to resubmit your paper. However, doing so requires doing the full CPR process again (and submitting the new version to turnitin). In general, we will take the average of the two scores as long as the first draft shows a "good-faith" effort. Exceptions will be made in rare cases.

ADA Policy: The American's with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Disability Services in Cain Hall B118, call 845-1637, or e-mail disability@tamu.edu. Additional information is available at <http://disability.tamu.edu>.

Honor Code: The Aggie Honor Code states, "An Aggie does not lie, cheat, or steal or tolerate those who do." Further information regarding the Honor Council Rules and Procedures may be found on the web at <http://www.tamu.edu/aggiehonor> . The plagiarism statement for the course can be found at <http://people.physics.tamu.edu/toback/109/WritingAssignments/plagiarism.shtml>

50-Word Summary: This course is designed to give an intuitive understanding of the Big Bang and Black Holes, without mathematics, and de-mystify it for non-scientists.

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Dr. David Toback

Unit	Topics	Preliminary Reading Assignments (N.B.: BBBHNM is required, all other readings are recommended)
1	Introduction	
	- Course Introduction	BBBHNM: 1-4, BHOT: 1-3, SHU: 1-2, TOE: 1
	- The very big objects in the universe	(Same as above)
	- The very small objects in the universe	(Same as above)
	- Evidence, C10Scientific Models and questions we can answer with experiments	(Same as above)
	- Early Cosmology: From Aristotle to Newton	
2	The Physics we Need	
	- Light and Doppler Shifts	BBBHNM: 5, SHU: 3 (p55-69)
	- Gravity, General Relativity and Dark Matter	BBBHNM: 6, BHOT: 4-6
	- Atomic Physics and Quantum Mechanics	BBBHNM: 7, SHU: 6&7 (up-to page 153), BHOT: 9, 11 (117-122)
	- Nuclear Physics and Chemistry	BBBHNM: 8
	- Thermal Equilibrium and Temperature	BBBHNM: 9
3	The Evidence for the Big Bang	
	- The Exploding Universe	BBBHNM: 10, TOE: 2, TFTM: 1-3, BHOT: 7, SHU: 3(69-76), 4(77-86), 5(95-104)
	- Expanding Space-Time	BBBHNM: 11
	- Photons and Hydrogen in the Universe	BBBHNM: 12
5	Evolution of the Universe	
	- The Early Universe	BBBHNM: 13, TFTM: 4&5, SHU: 5 (104-114), 7 (154-158), BHOT: 8 (68-76)
	- After the first three minutes	BBBHNM: 14
4	Black Holes and Other "Big" Objects	
	- Galaxy Formation	BBBHNM: 15, SHU: 4 (87-93), TOE: 3, BHOT 8: (76-85)
	- Stars	BBBHNM: 16
	- Black hole formation and properties	BBBHNM: 17
6	Early Times and the Fate of the Universe	
	- Possible Fates of the Universe, Dark Matter and Dark Energy	BBBHNM: 18, SHU: 8 (159-164), BHOT 11 (122-137), Seeds Handout
	- Particle Physics, Dark Matter and the Very Early Universe	BBBHNM: 19
	- Inflation and the Earliest Moments in Time	BBBHNM: 20, BHOT 12

Primary Textbooks and Reading:

Big Bang, Black Holes, No Math (Toback): BBBHNM
 Briefer History of Time (Hawking): BHOT
 Stephen Hawking's Universe (Lufkin): SHU
 Theory of Everything (Hawking): TOE
 The First Three Minutes (Weinberg): TFTM
 Cosmology in the 21st Century (Seeds) - Download from Webpage