

ASTR/PHYS 109: Big Bang and Black Holes

Spring 2018

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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Email: toback@tamu.edu (office hours by appointment)
Course website: <http://people.physics.tamu.edu/toback/109>

Textbook and Reading:

Required and recommended reading schedule at
<http://people.physics.tamu.edu/toback/109/LecturesReading.pdf>

Required Textbook: “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) Pre-Lecture Reading Question (PLRQ) assignments designed to both help you be well prepared for lecture, as well as help you get good at asking scientific questions, and 2) 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 and In-class quizzes: 5%
- EOC quizzes in eCampus: 5%

Note that you cannot pass the course without passing all the EOC quizzes (you will be allowed as many attempts as needed for this). There are significant penalties for late assignments. While not doing all the EOC quizzes is the leading cause of failure in this course, you should never be afraid to ask for more attempts or an extension if you want/need one. Just follow the instructions for doing so.

Frequently Asked Questions: Answers 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 has three (3) parts and is administered using the Peerceptiv system on eCampus. For more information see <http://people.physics.tamu.edu/toback/109/WritingAssignments/Papers and Peerceptiv.pdf>. For those of you who have not used this system before, it means you will 1) submitting a paper, 2) evaluating the quality of the papers of your peers, and 3) giving feedback to those who evaluate your paper. Accordingly, your total grade for this portion will be based on the quality of the text, as well as the quality of your evaluations. We note that the primary reason people don't do well in this course is that they don't do all three portions of the paper assignment on time.

Many students find using Peerceptiv 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 there will be a practice Peerceptiv assignment before the first paper.

We want to help all students get excellent grades. For this reason, 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 TurnItIn on eCampus). Comments will be returned in the same location

In the case that you don't get the grade you want on your paper, you will be encouraged to resubmit your paper. Note that this can only help the text submission portion of your paper grade, and 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>

ASTR/PHYS 109: Big Bang and Black Holes

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

Tentative Schedule for ASTR/PHYS 109, Spring 2018

Week #	Date	Lecture #	Chapter in Class	Online Quizzes	Reading and PLRQ Assignments	Paper Assignments	TAMU Notes	Honors
(Tentative dates - In all cases, items are due before class)								
1	Monday, January 15, 2018						No class, MLK Day	
1	Wednesday, January 17, 2018	1	1		Unit 1 Reading and PLRQ Assigned in class		First day of class	
1	Friday, January 19, 2018	2	2	Warmups due	PLRQ Unit 1 due			
2	Monday, January 22, 2018	3	2				Last day add/drop Mon Jan 22nd	Stage 0 heads up (2nd week)
2	Wednesday, January 24, 2018	4	2					
2	Friday, January 26, 2018	5	3	EOC 2 due				
3	Monday, January 29, 2018	6	3					Stage 0 assigned (3rd Week)
3	Wednesday, January 31, 2018	7	4	EOC 3 due		Paper 0 Reviewer Training Mentioned		
3	Friday, February 2, 2018	8	4		Unit 2 Reading and PLRQ Assigned in class	Paper 0 Reviewer Training Assigned		
4	Monday, February 5, 2018	9	5	EOC 4 due	PLRQ Unit 2 due	Paper 0 Reviewer Training Reviews due		Confirm topic (4th week)
4	Wednesday, February 7, 2018	10	5			Paper 0 Reviewer Training Back-Evaluations due		
4	Friday, February 9, 2018	11	5					
5	Monday, February 12, 2018	12	6	EOC 5 due		Paper 1 Mentioned		First draft of Stage 0 (5th week)
5	Wednesday, February 14, 2018	13	6			Paper 1 Assigned		
5	Friday, February 16, 2018	14	7	EOC 6 due		Paper 1 Text due		
6	Monday, February 19, 2018	15	7			Paper 1 Reviews due		Follow up on Revisions (6th week)
6	Wednesday, February 21, 2018	16	7			Paper 1 Back-Evaluations due		
6	Friday, February 23, 2018	17	8	EOC 7 due		Paper 2 Mentioned		
7	Monday, February 26, 2018	18	8			Paper 2 Assigned		Follow up on Revisions (7th week)
7	Wednesday, February 28, 2018	19	9	EOC 8 due				
7	Friday, March 2, 2018	20	9		Unit 3 Reading and PLRQ Assigned in class			
8	Monday, March 5, 2018	21	10	EOC 9 due	PLRQ Unit 3 due	Paper 2 Text due	Mid-term grades	First draft of Stage 1 (8th week)
8	Wednesday, March 7, 2018	22	10			Paper 2 Reviews due		
8	Friday, March 9, 2018	23	11	EOC 10 due		Paper 2 Back-Evaluations due		
	Monday, March 12, 2018	--	--				Spring Break	
	Wednesday, March 14, 2018	--	--				Spring Break	
	Friday, March 16, 2018	--	--				Spring Break	
9	Monday, March 19, 2018	24	11					Follow up on Revisions (9th week)
9	Wednesday, March 21, 2018	25	12	EOC 11 due		Paper 3 Mentioned		
9	Friday, March 23, 2018	26	12		Unit 4 Reading and PLRQ Assigned in class	Paper 3 Assigned		
10	Monday, March 26, 2018	27	13	EOC 12 due	PLRQ Unit 4 due			Follow up on Revisions (10th week)
10	Wednesday, March 28, 2018	28	13			Paper 3 Text due		
10	Friday, March 30, 2018	--	--				Reading Day, no classes	
11	Monday, April 2, 2018	29	14	EOC 13 due		Paper 3 Reviews due		Follow up on Revisions (11th week)
11	Wednesday, April 4, 2018	30	14			Paper 3 Back-Evaluations due		
11	Friday, April 6, 2018	31	14		Unit 5 Reading and PLRQ Assigned in class			
12	Monday, April 9, 2018	32	15	EOC 14 due	PLRQ Unit 5 due			First draft of Stage 2 (12th week)
12	Wednesday, April 11, 2018	33	15					
12	Friday, April 13, 2018	34	16	EOC 15 due				
13	Monday, April 16, 2018	35	16		Unit 6 Reading and PLRQ Assigned in class			Follow up on Revisions (13th week)
13	Wednesday, April 18, 2018	36	17	EOC 16 due	PLRQ Unit 6 due	Paper 4 Mentioned		
13	Friday, April 20, 2018	37	17			Paper 4 Assigned		
14	Monday, April 23, 2018	38	18	EOC 17 due			Tues April 17th is q-drop date	Follow up on Revisions (14th week)
14	Wednesday, April 25, 2018	39	18			Paper 4 Text due		
14	Friday, April 27, 2018	40	19	EOC 18 due		Paper 4 Reviews due		
15	Monday, April 30, 2018	41	19			Paper 4 Back-Evaluations due		
15	Tuesday, May 1, 2018	42	20	EOC 19 due			Last day of class, redefined day (Friday)	Final Paper due (15th week/Last Day)
15	Wednesday, May 2, 2018						No class	
15	Friday, May 4, 2018			EOC 20 due			No class	
16	Monday, May 7, 2018						No class	
16	Tuesday, May 8, 2018						No final	
16	Wednesday, May 9, 2018						Degree candidate grades due	
17	Monday, May 14, 2018						Regular grades due	