

ASTR/PHYS 109: Big Bang and Black Holes

Spring 2019

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 and Reading:

Required and recommended textbook information can be found at <http://people.physics.tamu.edu/toback/109/textbooks.shtml>

The reading schedule can be found at <http://people.physics.tamu.edu/toback/109/LecturesReading.pdf>

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 evidence for our topics (science, cosmology and the physical universe) to the lay reader. There are two additional parts of the grade: 1) Pre-Lecture Reading Question (PLRQ) quizzes designed to both help you be well prepared for lecture, as well as help you get good at thinking about what constitutes a good 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 quizzes 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 on the course FAQ.

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.

Honors Sections (201): Students in the honors section attend the regular lecture, and have all the same requirements. However, there is an additional paper on a topic we will agree upon together. More information about it can be found at <http://people.physics.tamu.edu/toback/109/Honors/>

Description of the Writing Portion of the Course: The paper assignments are different in this course than in the typical course. Each assignment has three 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 be 1) submitting a paper, 2) reviewing your peer's papers and providing critiquing them, and 3) giving feedback to those who evaluate your paper. Your grade for this portion will be based on the quality of your text, as well as the quality of your evaluations. We note that the primary reason people do not get the grade they want in this course is that that they don't complete all three portions of the paper assignment by the assigned due dates.

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

For all assignments, after the assignment is complete, you will be allowed to submit a revised version of the text of your paper for a better grade. The assumption here is that you will use the feedback from the original Peerceptiv attempt. Note that this can only help the *text submission portion* of your assignment. 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.

Extra credit is available to students who do more than the three require reviews.

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>

Tentative Schedule for ASTR/PHYS 109, Spring 2019

Week #	Date	Lecture #	Chapter In Class	Online Quizzes	Reading and PLRQ Assignments	Paper 0 Reviewer Training	Paper 1 Evidence for Dark Matter	Paper 2 Evidence Stars are Made of Atoms	Paper 3 Evidence Universe Began with a Big Bang	Paper 4 Evidence for Black Holes	TAMU Notes	Honors
***** (Tentative dates - In all cases, items are due before class, last updated 1/13/2019) *****												
1	Monday, January 14, 2019	1	1		Unit 1 Reading and Quiz Assigned						First day of class	
1	Wednesday, January 16, 2019	2	2	Warmups I due	Unit 1 due							
1	Friday, January 18, 2019	3	2	Warmups II due							Last day add/drop Friday Jan 18th	
2	Monday, January 21, 2019	--									No class. MLK Day	
2	Wednesday, January 23, 2019	4	2									Stage 0 assigned (2nd Week)
2	Friday, January 25, 2019	5	3	EOC 2 due								
3	Monday, January 28, 2019	6	3									Stage 0 idea submitted (3rd Week)
3	Wednesday, January 30, 2019	7	4	EOC 3 due		Mentioned						
3	Friday, February 1, 2019	8	4		Unit 2 Reading, Quiz and Writing Assignment Assigned	Assigned						
4	Monday, February 4, 2019	9	5	EOC 4 due	Unit 2 due	Reviews Due						Stage 0 reading check (4th week)
4	Wednesday, February 6, 2019	10	5			Back-Evals Due						
4	Friday, February 8, 2019	11	5									
5	Monday, February 11, 2019	12	6	EOC 5 due			Mentioned					First draft of Stage 0 (5th week)
5	Wednesday, February 13, 2019	13	6				Assigned					
5	Friday, February 15, 2019	14	7	EOC 6 due								
6	Monday, February 18, 2019	15	7				Text Due					Stage 1 discussion (6th week)
6	Wednesday, February 20, 2019	16	7				Reviews Due					
6	Friday, February 22, 2019	17	8	EOC 7 due			Back-Evals Due	Mentioned				
7	Monday, February 25, 2019	18	8					Assigned				Stage 1 draft due (7th week)
7	Wednesday, February 27, 2019	19	9	EOC 8 due								
7	Friday, March 1, 2019	20	9		Unit 3 Reading and Quiz Assigned			Text Due				
8	Monday, March 4, 2019	21	10	EOC 9 due	Unit 3 due			Reviews Due			Mid-term grades	Stage 1 Final draft due (8th week)
8	Wednesday, March 6, 2019	22	10					Back-Evals Due				
8	Friday, March 8, 2019	23	11	EOC 10 due								
	Monday, March 11, 2019	--									Spring Break	
	Wednesday, March 13, 2019	--									Spring Break	
	Friday, March 15, 2019	--									Spring Break	
9	Monday, March 18, 2019	24	11									Stage 2 discussion (9th week)
9	Wednesday, March 20, 2019	25	12	EOC 11 due				Mentioned				
9	Friday, March 22, 2019	26	12		Unit 4 Reading and Quiz Assigned			Assigned				
10	Monday, March 25, 2019	27	13	EOC 12 due	Unit 4 due							Stage 2 draft due (10th week)
10	Wednesday, March 27, 2019	28	13					Text Due				
10	Friday, March 29, 2019	29	14	EOC 13 due				Reviews Due				
11	Monday, April 1, 2019	30	14					Back-Evals Due				Stage 2 Final Draft Due (11th week)
11	Wednesday, April 3, 2019	31	14		Unit 6 Reading and Quiz Assigned							
11	Friday, April 5, 2019	32	15	EOC 14 due	Unit 5 due							
12	Monday, April 8, 2019	33	15									Stage 3 discussion (12th week)
12	Wednesday, April 10, 2019	34	16	EOC 15 due								
12	Friday, April 12, 2019	35	16		Unit 6 Reading and Quiz Assigned						Tues April 15th is q-drop date	
13	Monday, April 15, 2019	36	17	EOC 16 due	Unit 6 due				Mentioned			Stage 3 draft due (13th week)
13	Wednesday, April 17, 2019	37	17						Assigned			
13	Friday, April 19, 2019	--									Reading Day, no classes	
14	Monday, April 22, 2019	38	18	EOC 17 due					Text Due			Stage 3 Final Draft due (14th week)
14	Wednesday, April 24, 2019	39	18						Reviews Due			
14	Friday, April 26, 2019	40	19	EOC 18 due					Back-Evals Due			
15	Monday, April 29, 2019	41	19								Last day of class	Stage 4 draft due (14th week)
15	Tuesday, April 30, 2019	42	20	EOC 19 due							Redefined Day	Stage 4/Final Paper due (Last Day)
15	Wednesday, May 1, 2019			EOC 20 due							Reading Day, no classes	
15	Friday, May 3, 2019										No class	
15	Monday, May 6, 2019										No class	
16	Tuesday, May 7, 2019										No final	
16	Wednesday, May 8, 2019										Degree candidate grades due	
	Monday, May 13, 2019										Final grades due	

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