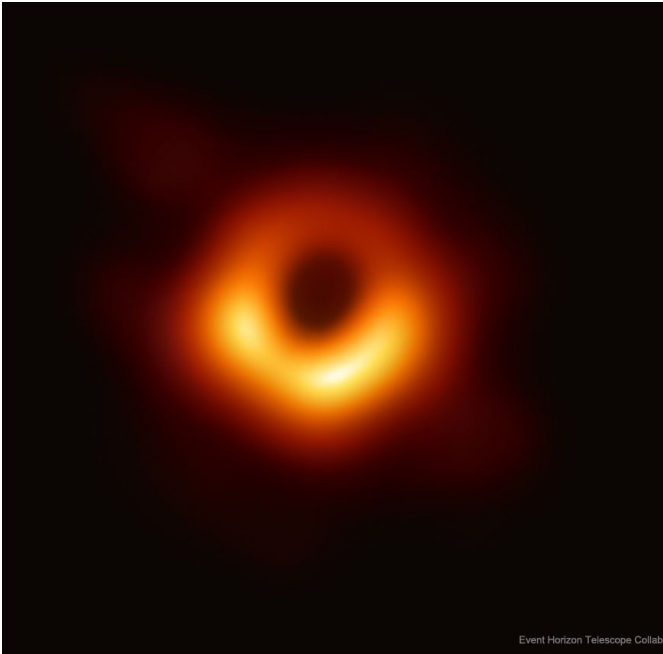


Eyes to the Universe: A Full Spectrum View of Our World First Year Seminar, Fall 2019



Explanation (from Astronomy Pic of the Day 2019 April 11) : What does a black hole look like? To find out, [radio telescopes](#) from [around the Earth](#) coordinated observations of [black holes](#) with the largest known [event horizons](#) on the sky. Alone, black holes are just [black](#), but these monster attractors are known to be surrounded by glowing gas. The first image was released yesterday and [resolved](#) the area around the [black hole](#) at the center of [galaxy M87](#) on a scale below that expected for its [event horizon](#). [Pictured](#), the dark central region is not the event horizon, but rather the [black hole's shadow](#) -- the central region of emitting gas darkened by the central black hole's gravity. The size and shape of the shadow is determined by bright gas [near the event horizon](#), by strong [gravitational lensing deflections](#), and by the black hole's spin. In resolving [this black hole's shadow](#), the [Event Horizon Telescope](#) (EHT) bolstered evidence that [Einstein's gravity](#) works even in [extreme regions](#), and gave clear evidence that [M87](#) has a central spinning black hole of about 6 billion solar masses. The [EHT](#) is not done -- future observations will be geared toward [even higher resolution](#), better tracking of variability, and exploring the immediate vicinity of the [black hole](#) in [the center](#) of our [Milky Way Galaxy](#).

Image Credit: [Event Horizon Telescope Collaboration](#)

Class time and location: Mon, Wed 12:30-1:50 pm @ Science Center 1343

Instructor:

Dipankar Maitra

Email: maitra_dipankar@wheatoncollege.edu (*best way to reach me*)

Office: Science Center 1330 (*come in whenever the doors are open*)

Phone: x5697 (*mostly untested technology for me, I stay away from it*)

Office Hours: Tue & Thu 2 - 4pm, or email to schedule an appointment.

Staff Mentor:

Jillian Amaral

Email: amaral_jillian@wheatoncollege.edu

Office: Wallace Library 113

Phone: x3767

Office Hours: Tue 2-4pm & by appointment.

Student Success Advisor:

Susan Friedman

Email: friedman_susan@wheatoncollege.edu

Office: Kollett Hall 209

Phone: x3848

CO- Preceptor(s) / Peer Mentor(s) :

Ian Kobelenz <kobelenz_ian@wheatoncollege.edu>,

Emma Hert <hert_emma@wheatoncollege.edu>,

Carol Teran <teran_carol@wheatoncollege.edu>

Course Goals: Our quest to understand the nature of things, from microscopic atoms to stars and galaxies, relies heavily on the light we receive from these objects. Even the discovery of exotic objects such as black holes and dark matter, which by themselves do not emit any light, relies on light produced by objects near them. In this seminar we will explore properties of light in general, not just visible light but the whole

spectrum ranging from radio waves to gamma-rays. In this hands-on, project-based course we will learn about how mirrors, lenses and cameras work, visit research laboratories, hear about cutting-edge developments from scientists, and use telescopes in our observatory to study the treasures of the night sky. Making use of Wheaton’s *Makerspace* facilities, we will design and build instruments and use them to explore nature.

- I encourage you to approach me with any kind of questions as soon as they arise, and to attend the office hours if you need assistance.
- Collaboration with classmates is also highly encouraged.
- If at any point in the lectures or lab you are confused or we are moving through the material too quickly, do not hesitate to ask a question. If you have any confusion, someone probably else does too, and far from judging you, we will respect you for thinking critically, speaking up, and taking ownership of your education.

Course Book: “*Black Hole: How an Idea Abandoned by Newtonians, Hated by Einstein, and Gambled on by Hawking Became Loved*”, by Marcia Bartusiak. Yale University Press. Additional handouts and/or online readings will be given during the class.

Website: An onCourse site has been established for the course; please check it regularly for information about the class/assignments/lab, etc.

Communication: I will be using email extensively to communicate with everyone. I will not be FaceBook-ing, tweeting, instagram-ing and such. **Please check your email frequently.**

Attendance Policy: Class attendance and participation is expected. Absences for school-sanctioned events will be excused. Please know that it is your responsibility to inform me in case of absence due to serious or prolonged illness.

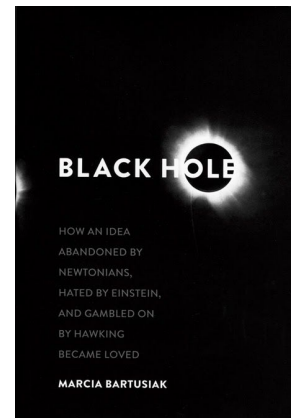
Grading scheme:

- Reading assignment summary, unanswered questions 30%
- Active class participation: 15%
- Labs: 32%
- Google Suite, FoR, EUI 3%
- Presentations:
 - Team presentation: 8%
 - Paper on presentation: 8%
 - Peer-evaluation of presentations: 4%

Exams: There will be no exams.

Reading assignment summary and unanswered questions: Reading assignments for the upcoming topic/text chapter will be posted on onCourse. Please go through the relevant parts of the text and submit a summary of at least 100 words, *AND* at least three things that were confusing/not clear to you.

Active Class Participation:



- includes taking part in problem solving, class discussions, etc. The learning process requires your dedication and involvement; it is not just the instructor lecturing to you. Your active participation in class is required, not just expected.

Labs: Labs, done in groups of 2-3 students, will incorporate hands-on activities. Lab reports need to be handed back at the end of each lab.

- *If you miss three labs and are unexcused, you will fail the course.*
- *A lab for which you do not turn in any work constitutes a missed lab.*

Team presentations: Early in the semester, students will be randomly assigned to work in teams of two. Teams will work together on projects in class and also give a team presentation near the end of the semester. The topics for the presentations will be decided by lottery during the middle of the semester.

Paper on team presentations: Will be based on the presentation given by you and your teammate. Both team members will collaborate and write a single paper (1500 words minimum, plus references, figures, graphs, plots, images, tables, etc.).

Peer-evaluation of presentations: Evaluate presentations of at least 4 other teams. Take short notes (e.g., good points, what you learned, what could be improved, etc.) on a form that we will hand out.

Grading Scale: You will not be graded on a curve. Your grades will be scaled according to the table on the right. This absolute scale is designed, in part, to encourage you to work together. Please help one another inside and outside of class!

Grade	+		-
A	>96	92-96	88-92
B	85-88	81-85	77-81
C	72-77	67-72	63-67
D	60-63	56-60	52-56
F	<52		

Late Work Policy: Except in case of lateness due to illness or school-sanctioned events, homework and labs must be turned in by the stated deadline to get full credit. Every week's worth of delay will cost 10% of the maximum score. E.g. if you turn in a lab/HW (that is originally worth, say, 10 points) 3 weeks late, then you can get only 7 points max for that HW.

Academic Integrity and Honor Code: I encourage you to work together on homework assignments, but straight copying of someone else's work is a violation. When in doubt, please acknowledge the work of the students that you studied with. Signing another person's name on an attendance sheet is an Honor Code violation.

Accommodations: Wheaton is committed to ensuring equitable access to programs and services and to prohibit discrimination in the recruitment, admission, and education of students with disabilities. Individuals with disabilities requiring accommodations or information on accessibility should contact Autumn Grant - Associate Director for Accessibility Services at the Filene Center for Academic Advising and Career Services. ~ accessibility@wheatoncollege.edu or (508) 286-8215

Class Schedule (Tentative)		
Date	Topics	Read chapt/sec
08/28 W	First class meeting: Introduction; 1st day questionnaire; bicycle	
09/02 M	Labor Day --- No classes	
09/03 Tu	It is therefore possible	ch 1
09/04 W	Career Services FYS Visit Lab: Creating images with pinholes	
09/09 M	Newton, Forgive Me	ch. 2
09/11 W	Foundations of Research - LIBR - WEC	
09/16 M	One Would Then Find Oneself ...	ch. 3
09/18 W	Lab: Makerspace	
09/23 M	There Should Be a Law of Nature ...	ch. 4
09/25 W	Ethical Use of Information - LIBR -WEC	
09/30 M	I'll Show Those ...	ch. 5
10/02 W	Lab: Creating images with lenses	
10/07 M	Only Its Gravitational Field Persists ...	ch. 6
10/09 W	Google Suite - LIBR -WEC	
10/14,15	October Break --- No classes	
10/16 W	Lab: Pinholes and Lenses	
10/21 M	I Could Not Have Picked a More Exciting Time ...	ch. 7
10/23 W	Lab: Telescopes	
10/28 M	It Was the Weirdest Spectrum ...	ch. 8
10/30 W	Lab: Break a telescope, make a telescope • Guest lecture by Prof. Kim McLeod (Wellesley) from 5pm.	
11/04 M	Why Don't You Call It a Black Hole? 4:30pm --- Dinner w/ Prez. Hanno	ch. 9
11/06 W	Science Research@Wheaton	
11/11 M	***** MERCURY TRANSIT ***** Medieval Torture Rack	ch. 10
11/13 W	Science Research@Wheaton	
11/18 M	Team Presentations, during class	
11/20 W	Team Presentations, during class	
11/25 M	Whereas Stephen Hawking ...	ch. 11
11/27 W	Thanksgiving Break --- No classes	
12/02 M	Black Holes Ain't So Black ...	ch. 12
12/04 W	Last FYS class.	
• One November Friday: Field trip to TBD. We'll leave Wheaton at 12:30 and be back ~6pm.		