

## Astronomy 130, Fall 2022: *The Universe*



**Explanation (from Astronomy Picture of the Day 2022 July 13):** [This is the deepest](#), sharpest infrared image of the cosmos so far. [The view](#) of the [early Universe](#) toward the southern constellation Volans was achieved in 12.5 hours of exposure with the NIRCam instrument on the [James Webb Space Telescope](#). Of course the stars with six visible spikes are well within our own Milky Way. [Their diffraction](#) pattern is characteristic of Webb's 18 hexagonal mirror segments operating together as a single 6.5 meter diameter primary mirror. The thousands of galaxies flooding the field of view are members of the distant galaxy cluster SMACS0723-73, some 4.6 billion light-years away. Luminous arcs that seem to infest the deep field are even more distant galaxies though. Their images are distorted and magnified by the dark matter dominated mass of the galaxy cluster, an effect known as [gravitational](#) lensing. [Analyzing light](#) from two separate arcs below the bright spiky star, Webb's NIRISS instrument indicates the arcs are both images of the same background galaxy. And that galaxy's light took about 9.5 billion years to reach the [James Webb Space Telescope](#).

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

**Class Meets:** [MW 2-3:20 pm (lectures)] AND [Tues or Thurs 7-9pm (labs)] in **Discovery Center 1343**

### Instructors:

Prof. [Dipankar Maitra](#)  
(MW Lectures and Tuesday lab)  
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**Office:** Discovery Center 1330

Prof. [Geoff Collins](#)  
(Thursday lab)  
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**Office:** Discovery Center 1331

**Drop-in Hours:** MW 11am --- 1:30pm in DC1330, and/or email DM to schedule a time.

**Course Goals:** Discover the nature of stars, black holes, nebulae, supernovae, galaxies, and other cosmic phenomena. We will learn what these objects are, how they formed, and what is ultimately in store for the universe. Explore the roles of light, energy, and gravity in astronomy. By the end of this course, you will have a greater appreciation for and understanding of the universe, and I look forward to working with you as we explore it together.

**Expectations:** If you would like to work hard and learn a great deal, then AST 130 is definitely for you. The material may not be easy, but few things of value are. As a rule of thumb, expect to spend 2-3 hours studying outside class for each hour of class time. This implies that you should allow 6-9 hours a week to study for this course. Taking AST 130 as a fifth course has proven to be a bad idea many times.

- We encourage you to approach us 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 a 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:** *The Cosmic Perspective: Stars, Galaxies & Cosmology*, Bennett et al., 6<sup>th</sup> or newer edition, and additional handouts or online readings. The bookstore should have copies of the text. The library should also have a copy on reserve. You can also search online for inexpensive copies (but make sure to get the correct version). Please keep in mind that the textbook will be a general guide only. We will cover certain aspects in more detail than the book. Exam/HW problems will be based on topics discussed in the class.

**Website:** A canvas site has been established for the course; please check it regularly for information about the class/assignments/lab, etc. Please go to <https://canvas.instructure.com/enroll/LNHWL8> to enroll in the class.

**Communication:** I will be using email extensively to communicate with everyone. We 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 us in case of absence due to serious or prolonged illness.

**Grading scheme:**

- Exams (two, 20% each) ..... 40%
- Labs ..... 25%
- Homeworks ..... 10%
- Class participation: ..... 5%
- Observing (Team) Project:
  - Team presentation: ..... 10%
  - Project report: ..... 7%
  - Peer-evaluation of presentations: ..... 3%

**Exams:** There will be 2 in-class exams (open book/notes) during the semester. Please check our calendar/schedule on our class website for the exam dates. There will be no make-up exams under ordinary circumstances, so please plan accordingly. The exams are not cumulative, but you will need to know/understand stuff from Exam 1 in order to do well in Exam 2.

**Homework:** Weekly HWs will include questions and problems covering class topics. HWs will typically be posted online as a google form on Wednesdays and will be due the following Wednesday.

**Labs:** Labs will incorporate hands-on activities to illustrate topics discussed in class. 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.

**Class Participation (Astronews/in-class quizzes/attentiveness and/or focus during class):**

- *Astronews:* Every class we will have someone present either a recent [Astronomy Picture of the Day](#), or a recent astronomy related news. The idea is to convey the excitement generated by the astronews in less than 2 minutes.

- Class participation includes 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.

**Observing Project:** Early in the semester, students will be randomly assigned to work in teams. Teams will work together, collaborating with DM/GC, on an observational project that will require:

- Submitting 1-page proposal on their observing target
- Working out a strategy to observe the target using iTelescope
- Observing the target
- Analyzing the data
- Giving a team presentation near the end of the semester
- Submitting a project report (team members will collaborate and write a report (of 1200 words minimum, plus references, figures, graphs, plots, images, tables etc.) summarizing their project.
- Peer-evaluation of presentations: Evaluate observing project presentations of other teams. Take short notes (e.g., good points, what you learned, what could be improved, etc.) on a form given to you.

**Extra-credit challenges:** We want you to get inspired and have new experiences, and to learn science and astronomy through trying new things. So, throughout the term, we will issue special challenges to the class. Some challenges may ask you to make a special observation, others may ask you to construct something, and so on. The rewards for completing these challenges will vary, but enticements may include things like 10-20% improvement on your worst exam, an automatic perfect score on homework or lab, etc. *Please note however that the extra-credit projects require some planning, original thinking, and oftentimes cooperation of nature (which we instructors cannot guarantee, especially if you come two days before the last day of classes! Plan ahead.).*

**Grading Scale:** You will not be graded on a curve. Your test 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	+		-
<b>A</b>	<b>&gt;96</b>	<b>92-96</b>	<b>88-92</b>
<b>B</b>	<b>85-88</b>	<b>81-85</b>	<b>77-81</b>
<b>C</b>	<b>72-77</b>	<b>67-72</b>	<b>63-67</b>
<b>D</b>	<b>60-63</b>	<b>56-60</b>	<b>52-56</b>
<b>F</b>	<b>&lt;52</b>		

**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 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](mailto:accessibility@wheatoncollege.edu) or (508) 286-8215

Date	Discussion Topic	Read chapter/ section
8/31	Class logistics; A quick survey; The Universe and its scale	1
9/5	<b>No class - Labor Day</b>	
9/7	Telescopes: The Eyes and Ears of an Astronomer; The nature of science	6; 3.4
9/12	The Copernican Revolution; Motion; Conservation laws	3.3; 4.1
9/14	Newton's laws of motion; Energy	4.2; 4.3
9/19	Gravity	4.4
9/21	Gravity and motion	4
9/26	Light, photons and the electromagnetic spectrum	5
9/28	Properties of matter; Interactions between light and matter	5
10/3	Light and matter	5
10/5	Light and Matter; Review of concepts	5
10/10	<b>No class - October Break</b>	
10/12	The Sun	14
10/17	The Sun	14
10/19	<b>Exam 1, in-class</b>	
10/24	Stellar populations and their properties	15
10/26	Stellar populations and their properties	15
10/31	The lives of stars: Star formation; The "Main Sequence"	16, 17
11/2	The lives of stars II: The "Main Sequence"	17
11/7	The lives of stars III: Remnants --- White dwarfs, Neutron Stars, Black Holes	18
11/9	The lives of stars III: Remnants --- White dwarfs, Neutron Stars, Black Holes	18
11/14	<b>Team Project Presentations, on 11/14, 11/15, 11/17</b>	
11/16	The Milky Way: Our backyard	19
11/21	The Milky Way: Our backyard	19
11/23	<b>No class - Thanksgiving Break</b>	
11/28	Galaxies everywhere; Cosmology	20
11/30	Dark matter, dark energy and the fate of the universe	23
12/5	The Big Bang	22
12/7	The Big Bang	22
<b>Finals Week</b>	<b>Exam 2 - self-scheduled, timed</b>	