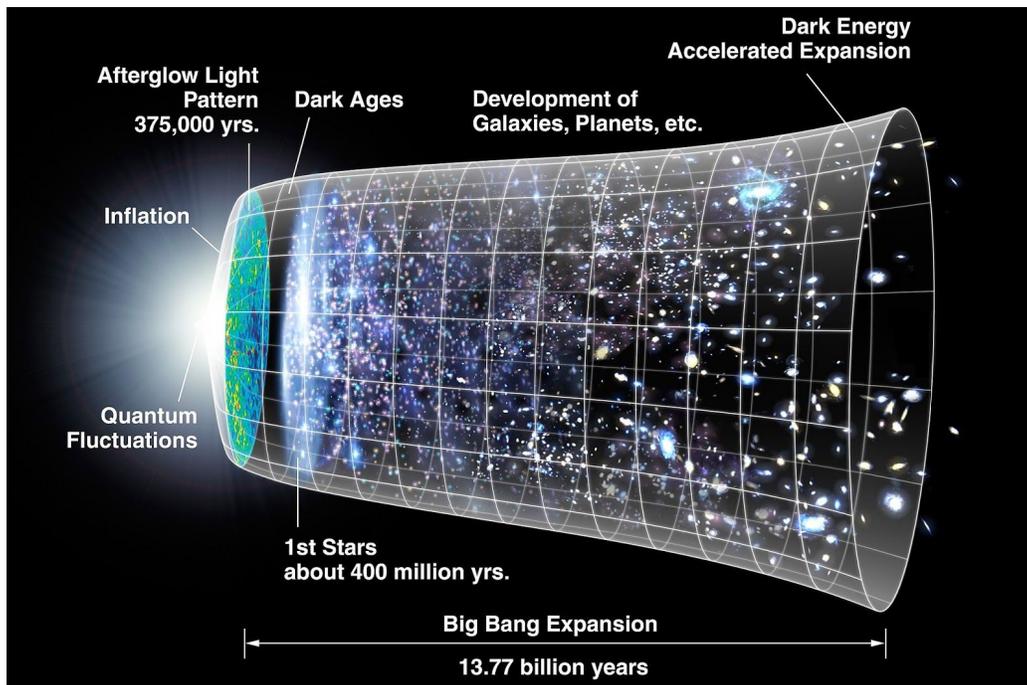


*Introduction to Astrophysics (AST-272)*  
*Advanced Astrophysics (AST-302)*

Fall 2019, MWF 10:30-11:20am, @ SC1343



(Image credit: NASA/WMAP Science Team)

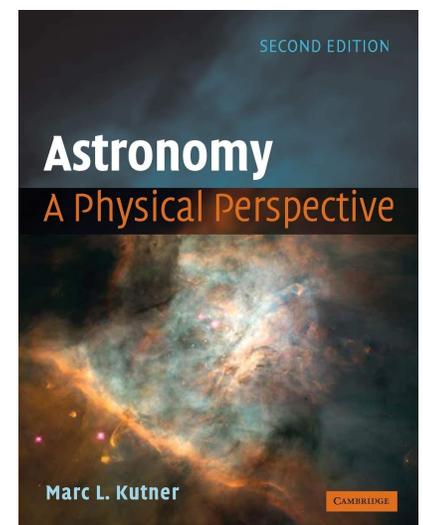
**Course Goals:** In this class we will attempt to understand the large scale structure of the Universe. We will study our current understanding of fundamental questions like: what constitutes galaxies; how galaxies differ from each other; what are active galactic nuclei and what physical processes power these cosmic lighthouses; how galaxies interact with each other and the large scale structures in the universe; what is the geometry, past, present, and future of the universe; what does the cosmic background radiation tell us about the early universe; our understanding of the universe right after the big bang; how fundamental forces may unite at the very beginning of time.

**Course Book:** *Astronomy: A Physical Perspective*, by Marc L. Kutner 2<sup>nd</sup> edition, and additional handouts or online readings. The bookstore should have copies of the text. Please keep in mind that the textbook will be a general guide only. We will cover certain aspects in more detail than the book.

**Website:** An onCourse site has been established for the course; DM will post course materials there.

**DM's Office Hours:** Tues, Thurs 2-4pm, or email @ SC 1330. And come in anytime my doors are open.

**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/ Grade items	Percentage of final grade
<ul style="list-style-type: none"> <li>● <b>Scholarly activities:</b> <ul style="list-style-type: none"> <li>○ Critical reading</li> <li>○ Question, debate, discuss</li> <li>○ Application/problem solving</li> </ul> </li> </ul>	 5 5 15
<ul style="list-style-type: none"> <li>● Leaving<sup>1</sup>/Climbing<sup>2</sup> the ivory tower</li> </ul>	5
<ul style="list-style-type: none"> <li>● Data or Computational or Observational Project</li> </ul>	10
<ul style="list-style-type: none"> <li>● Exams (three, 20%+20%+20%)</li> </ul>	60

**Scholarly activities:** Weekly reading assignments will be posted on onCourse. You will be expected to have read the material critically, making detailed notes (e.g., of what you understood and what you didn't) as you go through the material. We will have discussions (group and individual) during the first half of each class where we will discuss issues that were not clear. The second half of the class (or sooner, if discussions finish early) will be devoted to solving problems. Submit solved problems for grading before next class. Solutions typeset in LaTeX, e.g. using the [overleaf](#) website, will receive a bonus point.

**Leaving<sup>1</sup>/Climbing<sup>2</sup> the ivory tower:** The words of the eminent astrophysicist Meghnad Saha, who developed the theory of thermal ionisation of gases, and thereby explained the spectra of different stars, still ring true: "Scientists are often accused of living in the "Ivory Tower" and not troubling their mind with realities". Furthermore, in an age when empirical findings are often greeted with disbelief, the importance of public outreach is critical. A small but significant fraction of the course grade will therefore be awarded for your efforts towards doing public outreach in some form (this is the "leaving the ivory tower" part). If you have ideas, I encourage you to come and discuss them with me early in the semester. Otherwise you can go to four (4) of our [Public Night](#) events (given the location of our observatory, this is the "climbing the ivory tower" part), team up with our observing assistants, and explain the wonders of the night sky to the public. For every Public Night that you help out, submit a short (1-page) summary of who you interacted with and what you explained to them. While I encourage you to do more public outreach, I am afraid I have to cap the grade at 5%, given the scope of this class.

**Research Project on a topic of your choice:** In consultation with DM pick a topic that interests you most, no later than late September. It could be an Observational, Computational, or Data-related project. You will present your results to the class on the Poster Presentation day (see course calendar below for the date). Needless to say, you will need to make a poster.

**Exams:** There will be 3 exams over the course of the semester. See the course calendar below for the dates. There will be no make-up exams under ordinary circumstances, so please plan accordingly.

**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. These challenges will include solving challenging problems, sometimes analytically or sometimes numerically. You are also strongly encouraged to attend **Physics/Astronomy Seminars** held during the

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<sup>1</sup> Philosophically

<sup>2</sup> Literally

semester. Submitting a 1-page write-up of what you learned during the seminar, within a week of the seminar, will earn you 1% extra credit.

**AST272 (Introductory) vs. AST302 (Advanced):** We will not have any extra class(es) for AST302. But given the advanced (exalted!) background/wisdom of the AST302 students, they will usually

- (a) have an additional, slightly advanced, HW problem,
- (b) take a slightly different exam,
- (c) be expected to take a more leading role during group activities such as problem solving.

**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!

<b>Grade</b>	<b>+</b>		<b>-</b>
<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. Tests are closed-book, and you will be asked to sign the Wheaton College Honor Code statement.

**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

<b>Tentative Class Schedule</b>		
	<b>Topics</b>	<b>Read chapter/section</b>
8/28	Presentations; Class logistics	
8/30	The Milky Way --- Overview --- Differential galactic rotation --- problems	16.1, 16.2
9/3	Determination of rotation curve --- Gas distribution --- problems	16.3, 16.4
9/4	Second half of presentations	
9/6	Spiral structure --- Galactic center --- Sgr A* --- problems	16.5, 16.6
~2wk	Normal galaxies	17 (check later for detailed updates)
~2wk	Clusters of galaxies	18
~2wk	Active Galactic Nuclei	19
~2wk	Cosmology	20
~3wk	Big Bang	21
<b>Some special dates</b>		
09/02 M	<i>Labor day --- No classes!</i>	
09/03 Tu	<i>This is a Wheaton Monday! AST272/302 meets on 09/03 from 10:30.</i>	
10/07 M	<b>Mid-term I. Take home. Submit completed work by 9am Wednesday 10/09.</b>	
10/14 M	<i>October break --- No classes!</i>	
11/11 M	***** <b>MERCURY TRANSIT</b> ***** <b>Mid-term II. 2 hrs. No class. Take it anytime during the day. Submit completed work by 6pm.</b>	
11/27-29	<i>Thanksgiving --- No classes</i>	
12/06 F	<b>Poster Presentations</b>	
12/11 W	<b>Final Exam (cumulative) 2-5pm</b>	