

Astronomy 98

# Beginner's Guide to the Universe

Spring 2022



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<b>Office Hours:</b>	Orion: TBD Siddhant: TBD Hannah: TBD Christian: TBD
<b>Course Email:</b>	<a href="mailto:ucb.beginners.guide@gmail.com">ucb.beginners.guide@gmail.com</a>
<b>Instructor of Record:</b>	Jessica Lu
<b>Lecture Time and Location:</b>	Tuesday 6:00-7:30PM (PT) in Campbell 131
<b>Discussion Times/Locations (Choose ONE):</b>	5:00-6:00 PM (PT) Thursday in Campbell 121 , 6:00-7:00 PM (PT) Thursday in Campbell 121
<b>Course Number:</b>	Astronomy 98
<b>Units:</b>	2 units, P/NP
<b>Prerequisites:</b>	None

## Course Description

Physics, broadly the study of motion and interaction in nature, captivates as much as it bemuses. As a centuries old “hot topic,” physics today is filled with thriving research in quantum information, cosmology, planetary astrophysics, nonlinear dynamics, and countless others subfields. Yet the subject is often cloaked with inaccessible jargon, with the big picture ideas obscured behind seemingly insurmountable prerequisites and confounding pseudoscience. *In this class, we will qualitatively summarize the broad and vibrant landscape of physics as it is today.*

## Learning Objectives

At the close of the semester, the student will have the ability to critically assess physics as it appears in popular expositions. The student will recognize overarching themes within physics and will be able to make connections between contemporary research in physics and astronomy and important fundamental ideas in these fields. The student will be able to unify many unintuitive ideas and extreme phenomena in physics and astronomy with everyday occurrences.

## Enrollment

Students should enroll in the course through CalCentral. The relevant CCN will be published on the DeCal website. Students are required to enroll in one of two discussion sections, as well as the lecture.

There are no prerequisites for this course. Though the course will contain some mathematical asides for completeness, students will only be expected to understand the physics at a qualitative, conceptual level. In general, this course will emphasize broad concepts and large results with little regard for mathematical detail.

As such, this class should be accessible to all students of any year and major. Though there are no enrollment restrictions, physics majors (especially upper division students) are slightly discouraged from taking this course as it will generally reiterate concepts from the standard physics curriculum.

This course is affiliated with Democratic Education at Cal (DeCal, [decal.berkeley.edu](http://decal.berkeley.edu)).

## Grading

<b>Attendance</b>	35%
<b>Participation</b>	15%
<b>Homework</b>	20%
<b>Final Paper</b>	30%

*A cumulative grade of 70% or above and a final paper submission is required to pass the class.*

## Attendance & Participation

The class will meet twice a week in 131 Campbell for lecture (for the exposition of new topics) and discussion (for extra topics and dialogue). Note that there are two options offered for discussion each week – please attend ONE of the two offered every week. *Attendance for both the lecture and discussion section is mandatory.* The instructor should be notified by email of absences known in advance.

The participation grade will be assessed holistically based off of a student's willingness to comment and participate in discussions. Note that attendance of discussion sections is prerequisite to participation.

## Homework

Homework worksheets will be posted on BCourses at least one week in advance and will be due before the lecture section on the Monday following the topical lecture, unless otherwise specified. Late homework without an exemption will be accepted for a maximum of 50% credit up to a week late.

## Final Paper

At the end of the semester, students will submit a final paper  $\sim 1000$  words ( $\sim 4$  pages double-spaced) reviewing a topic of physics of the student's choice. The paper should reflect an educated assessment of the given topic. In order to pass the class, a student *must* submit a final paper. *A passing grade will not*

be awarded to any student who does not submit a final paper, regardless of their grade percentage in the class.

This assignment will be due via BCourses by the end of the day on **Monday, 2 May 2022** (during reading/review/recitation week).

### Academic Misconduct

Cheating, plagiarism, and other forms of academic dishonesty will not be tolerated. While students are encouraged to cooperate and discuss assignments outside of class, they should write assignments separately reflective of their own effort and understanding. First violations will result in a zero on the assignment, and any subsequent violations may result in administrative action in accordance with the [Berkeley Campus Code of Student Conduct](#).

### Schedule

Below is a schedule of class lectures along with a (tentative) curriculum. Discussion sections are the Thursdays of the same week.

week	lectures	topic
1	1/25	overview and introductions
2	2/1	classical dynamics
3	2/8	electromagnetism and optics
4	2/15	special relativity
5	3/1	general relativity
6	3/8	thermodynamics and statistical mechanics
7	3/15	astrophysics
8	3/29	cosmology
9	4/5	review
10	4/12	quantum mechanics
11	4/19	applications of quantum mechanics
12	4/26	particle physics
13	5/3	special topics

### Reading List

week	readings
1	◇ Susskind, L., & Hrabovsky, G. (2013). <i>The Theoretical Minimum: What You Need to Know to Start Doing Physics</i> . S. I.: Penguin Books. Lecture 1.
2	◇ Susskind, L., & Hrabovsky, G. (2013). <i>The Theoretical Minimum: What You Need to Know to Start Doing Physics</i> . S. I.: Penguin Books. Lecture 1. ◇ Bradley, L. (n.d.). <i>Chaos and Fractals</i> . Retrieved from <a href="http://www.stsci.edu/~lbradley/seminar/index.html">http://www.stsci.edu/~lbradley/seminar/index.html</a>
3	◇ Purcell, E. M., & Morrin, D. J. (n.d.). <i>Electricity and Magnetism</i> . ◇ Turnbull, G. (n.d.). <i>Maxwell's equations [Scanning Our Past]</i> G. Turnbull. Retrieved from <a href="http://www.researchgate.net/publication/260497847_Maxwells_equations_Scanning_Our_Past">http://www.researchgate.net/publication/260497847_Maxwells_equations_Scanning_Our_Past</a> ◇ Vohnsen, B., & . (1970, January 1). <i>A Short History of Optics</i> . Retrieved from <a href="http://adsabs.harvard.edu/abs/2004PhST..109...75V">http://adsabs.harvard.edu/abs/2004PhST..109...75V</a>
4	◇ Morin, D. J. (2007). <i>Introduction to classical mechanics: with problems and solutions</i> . Cambridge: Cambridge University Press. Sections 11.1-11.3

	<p>◇ Reid, J. S. (n.d.). <i>Einstein's 1905 Paper on Special Relativity - Spacetime Centre</i>. Retrieved from <a href="http://spacetimecentre.org/vpetkov/courses/hall.html">http://spacetimecentre.org/vpetkov/courses/hall.html</a></p>
5	<p>◇ Hartley, J. (n.d.). <i>Gravity: An Introduction to Einstein's General Relativity</i>. pp. 3-12</p> <p>◇ The Imagine Team, NASA (n.d.). <i>Cosmic Times: 1919</i>, pp. 3-13</p> <p>Retrieved from <a href="http://imagine.gsfc.nasa.gov/educators/programs/cosmictimes/online_edition/1919/gravity.html">http://imagine.gsfc.nasa.gov/educators/programs/cosmictimes/online_edition/1919/gravity.html</a></p> <p>◇ LIGO Collaboration (n.d.). <i>Direct Observation of Gravitational Waves: Educator's Guide</i>, pp. 3-13</p> <p>Retrieved from <a href="http://www.ligo.caltech.edu/system/media_files/binaries/303/original/ligo-educators-guide.pdf">http://www.ligo.caltech.edu/system/media_files/binaries/303/original/ligo-educators-guide.pdf</a></p>
6	<p>◇ Sattel, S. (n.d.). <i>The Three Laws of Thermodynamics</i>. Retrieved from <a href="http://www.autodesk.com/products/eagle/blog/three-laws-thermodynamics">http://www.autodesk.com/products/eagle/blog/three-laws-thermodynamics</a></p> <p>◇ McDonough, J. M. (2009). <i>Fluid Dynamics: Physics, Mathematics and Applications</i>, pp. 1-8, 37-40</p>
7	<p>◇ McBride, N. &amp; Gilmour, I. (2004). <i>An Introduction to the Solar System</i>, pp. 3-21</p> <p>◇ Kaler, J. (n.d.). <i>The Natures of the Stars</i>. Retrieved from <a href="http://stars.astro.illinois.edu/sow/star_intro.html">http://stars.astro.illinois.edu/sow/star_intro.html</a></p>
8	<p>◇ Tong, D. (2019). <i>Cosmology</i>, pp. 1-6</p> <p>Retrieved from <a href="http://www.damtp.cam.ac.uk/user/tong/cosmo/cosmo.pdf">http://www.damtp.cam.ac.uk/user/tong/cosmo/cosmo.pdf</a></p> <p>◇ Ryden, B. (2006). <i>Introduction to Cosmology</i>, Chapter 2</p> <p>◇ Liddle, A. (2003). <i>An Introduction to Modern Cosmology</i>, Chapters 4, 13</p> <p>◇ Hu, W. &amp; White, M. (2004). <i>The Cosmic Symphony</i>. Retrieved from <a href="http://w.astro.berkeley.edu/~mwwhite/sciam03_short.pdf">http://w.astro.berkeley.edu/~mwwhite/sciam03_short.pdf</a></p>
10	<p>◇ Norton, J. D. (2001). <i>Origins of Quantum Theory</i>. Retrieved from <a href="http://www.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/quantum_theory_origins/">http://www.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/quantum_theory_origins/</a></p> <p>◇ Feynman, R. P. (1963). <i>The Feynman Lectures on Physics, Volume III</i>, Chapters 1, 2</p>
11	<p>◇ Rieffel, E. &amp; Polak, W. (2011). <i>Quantum Computing: A Gentle Introduction</i>, pp. 1-21</p> <p>◇ Bonsor, K. &amp; Strickland, J. (2000). <i>How Quantum Computers Work</i></p> <p>Retrieved from <a href="http://computer.howstuffworks.com/quantum-computer.htm">http://computer.howstuffworks.com/quantum-computer.htm</a></p>
12	<p>◇ Griffiths, D. (1986). <i>Introduction to Elementary Particles</i>, pp. 1-18</p> <p>◇ Feynman, R. P. (1985). <i>QED: The Strange Theory of Light and Matter</i> (Richard P. Feynman), pp. 3-35</p>
13	<p>◇ Adams, D. (1979). <i>The Hitchhiker's Guide to the Galaxy</i></p>



credit: Zach Weinersmith, [Saturday Morning Breakfast Cereal](#)