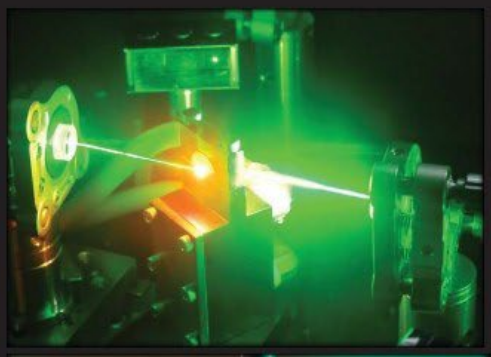
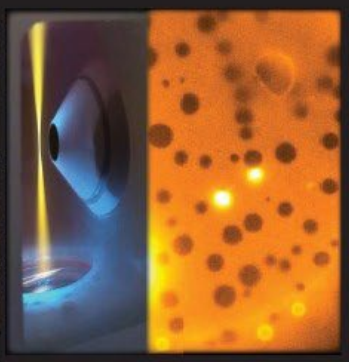
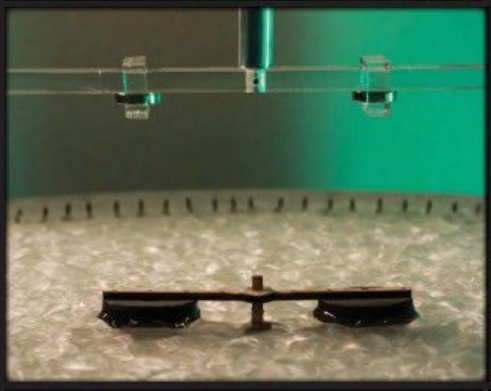
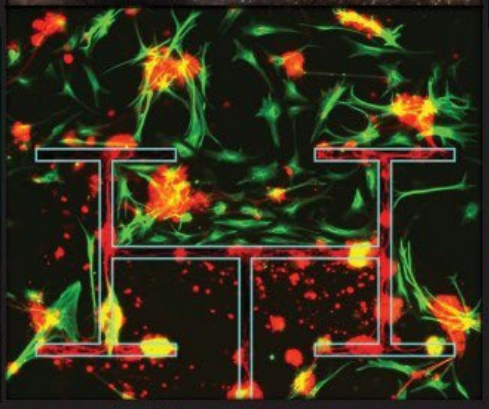
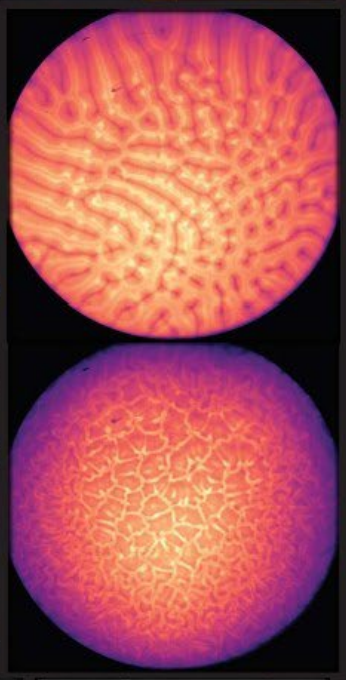
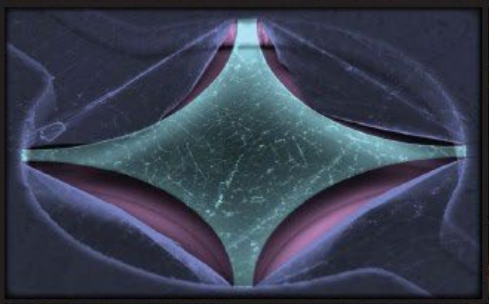
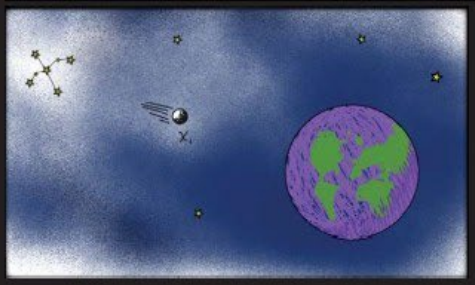
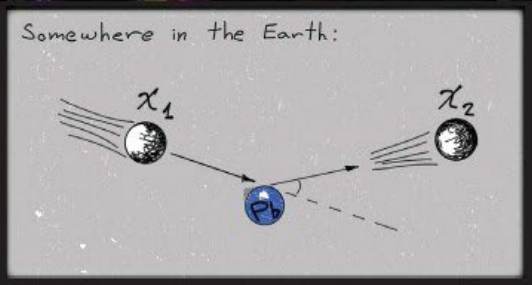
Physics Degree Program

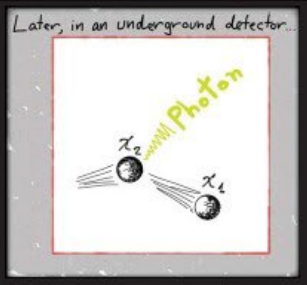
UNIVERSITY OF OREGON

PHYS Physics





Why a degree in Physics?

Earning a physics degree at the University of Oregon (UO) entails rigorous training in mathematics, multiple areas of physics, and supporting sciences -- such as chemistry, biology, and computer science -- with breadth across the humanities and social sciences. It is an exciting journey because physics is the study of methods and theories that have allowed humanity to construct the most reproducible, precise, and predictive models of our Universe, from the scales of subatomic particles and living cells up to the Cosmos itself. These models of the Universe are constantly in flux, as we take new measurements, discover new phenomena, and construct new theoretical frameworks that link it all together.

An integral component to planning and understanding the value of your degree is to consider what you are preparing for: an industry job, policy, non-profits and/or pre-law, medical physics, or the advanced training offered by graduate school and research careers beyond. Physics even provides unique preparation for careers outside of science, such as art, music, teaching, or government. While such choices can be daunting, remember that training in physics prepares you to analyze and engage with many different kinds of problems -- the power of the tools, concepts, and ways of viewing a problem offered by a physics degree is that they provide value to myriad career paths.

Your undergraduate coursework will offer many choices of what to study, when, and maybe even where. As such, rarely do any two students have the same exact academic trajectory. Likewise, faculty availability and the larger flow of course scheduling at an institution of UO's size mean that not all courses in our department are offered every term nor in the same term every year. It behooves you to consider our departmental recommendations on course ordering, to consult with undergraduate advising at least once a year, and to think strategically while planning your class schedule so that you can meet all requirements of the physics degree in four years.

The purpose of undergraduate physics advising is to empower you to decide which advanced undergraduate courses will best prepare you to pursue your interests. We encourage all physics majors to communicate early and often with the Director of Undergraduate Studies (Prof. Scott Fisher, rsf@uoregon.edu).

Structure of the Degree

All students have the same training and required courses in the first two years. To fill the core requirements and the advanced course work requirements you need to maintain a physics GPA of 2.0 or better, and you cannot take these courses *Pass / No Pass.*

Core Classes - Year 1

FALL	WINTER	SPRING
Foundations of Physics I (251)	Foundations of Physics I (252)	Foundations of Physics I (253)
Found. of Physics Lab (290)*	Found. of Physics Lab (290)*	Found. of Physics Lab (290)*
Calculus I (251Z)	Calculus II (252Z)	Calculus III(253Z)

Foundations of Physics I (PHYS 251, 252, 253): three-course intro physics sequence using calculus.
* Foundations of Physics Lab (PHYS 290): **two terms** of lab are required, we strongly recommend three.

Core Classes - Year 2

FALL	WINTER	SPRING
Foundations of Physics II (351)	Thermal Physics & Statistical Mechanics I (352)	Thermal Physics & Statistical Mechanics II (353)
Physics Experimentation Data Analysis Laboratory (391) †	Physics Experimentation Data Analysis Laboratory (391) †	
Intro to Differential Equations (256)	Several-Variable Calculus I (281)	Several-Variable Calculus II (282)

PHYS 352: Foundations of Thermal Physics & Statistical Mechanics I; PHYS 353: Foundations of Thermal Physics & Statistical Mechanics II

† Experiments & Data Analysis (391): **one term** is required, to be taken in Fall or Winter.
NOTE: Check with MATH course listings to verify which term the core classes will be offered.

While not required, we strongly recommend that students complement the math core requirements with additional math courses that cover elemental linear algebra (e.g. MATH 341 / 342) and/or partial differential equations I / II (e.g. MATH 421M / 422).

Interdisciplinary Science Classes
To complete the core requirements for a physics degree you must take at least two of the following classes (8 credits) for scientific breadth. The earlier you take these courses the more integrated their content will be as you proceed through your physics training, and thus you will likely benefit more from them -- try to complete them within your first two years.

General Chemistry I *or Advanced General* Chemistry I (CHEM 221Z / CHEM 224H)

General Chemistry II *or* Advanced General Chemistry II (CHEM 222Z / CHEM 225H)
Principles of Biology I: Cells (BI 221Z
Principles of Biology II: Organisms (BI 222Z)
Principles of Biology III: Ecology & Evolution (BI 223Z)
Computer Science I (CS 210)
Computer Science II (CS 211)
Computer Science III (CS 212)
Dynamic Planet Earth (ERTH 201)
Scientific Investigation in Physiology (HPHY 212)

Years 3 & 4

After your core course work is complete, you will complete 30 credits of advanced physics course work. Of those 30 credits, 6 **must** be research/lab credits and/or *Advanced Projects Lab*; and **up to** 12 credits of lab work may count toward the 30-credit requirement. You are welcome to take more than 12 lab credits, but they will not count toward the advanced course work requirement. We offer some courses that can fill either the lab credit requirement or the non-lab requirement -- for instance, Analog Electronics (PHYS 431) or Digital Electronics (PHYS 432). Pay attention to the prerequisites for advanced courses, for instance, you may struggle if you attempt to take *Topics in Quantum Physics* (PHYS 417) before taking Electricity & Magnetism *I / II* (PHYS 412 / 413), or if you take Intro to *Biological Physics* (PHYS 444) before taking Thermal Physics & *Statistical Mechanics II* (PHYS 353).

As you approach years 3 & 4, we **strongly** encourage every physics major to consult with the Director of Undergraduate Studies (Prof. Scott Fisher), Prof. Bryan Boggs, or another faculty member about which courses will best prepare you for your career trajectory, whether that be graduate school, industry, or teaching. Below we lay out a suggested list of courses you might take if you are, broadly speaking, interested in those directions.

*Recommended Upper Division Courses for **Graduate School***
PHYS 411 -- Mechanics (4 credits)
PHYS 412 / 413 -- Electricity & Magnetism I / II (8 credits)
PHYS 414 / 415 -- Quantum Physics (8 credits)
PHYS 417 – Topics in Quantum Physics (4 credits)
PHYS 422 -- Electromagnetism (4 credits)
Total Credits: 32 (non-lab)

Lab component (some combination of these need to add up to 6 credits)
PHYS 401 -- PI Sponsored Research
PHYS 431 / 432 – Analog Electronics / Digital Electronics
PHYS 433 Radio Frequency & Low Noise Measurements
PHYS 445 Computational Physics
PHYS 481 Design of Experiments

PHYS 495 Nanofabrication
PHYS 49X -- Advanced Projects Lab

We also recommend taking MATH courses: Elemental Linear Algebra (MATH 342), Partial Differential Equations & Fourier Analysis (MATH 421M), and/or Functions of a Complex Variable (MATH 411).

Recommended Upper Division Courses for ***Public / Private Sector***
PHYS 411 -- Mechanics (4 credits)
PHYS 412 / 413 -- Electricity & Magnetism I / II (8 credits)
PHYS 414 -- Quantum Physics (4 credits)
PHYS 424 -- Classical Optics (4 credits)
Total Credits: 24 (non-lab)

Lab component (at least 6 and we recommend 12 credits in total)
PHYS 401 – PI Sponsored Research (variable credits)
PHYS 424 Classical Optics
PHYS 431 / 432 – Analog Electronics / Digital Electronics (8 credits)
PHYS 433 Radio Frequency & Low Noise Measurements
PHYS 445 Computational Physics
PHYS 481 Design of Experiments
PHYS 495 Nanofabrication
PHYS 49X -- Advanced Projects Lab (variable credit)

Your intellectual and/or career interests may pull you toward other topics, and we recommend looking at the wide range of courses listed in the course catalog and schedule. These courses are routinely offered, and our department also offers unique and topic-specific advanced courses that change each year. For instance, some years we may offer a course in general relativity or advanced statistical and data science techniques. Consult the physics course schedule for terms when advanced courses will be offered. A full list of courses offered by the Physics Department with their pre- and/or co-reqs can be found in the UO course catalog:
http://uocatalog.uoregon.edu/arts_sciences/physics/#courseinventory

Getting Involved with Research
We are a research department -- that means that in addition to teaching, many of your instructors are also generating new and valuable knowledge that expands our collective understanding of the physical world. Many of our research faculty teach and have undergraduates in their lab. Working in a research group is often cited as one of the most valuable and meaningful experiences of an undergraduate degree in physics, and constitutes valuable training both for future academic pursuits and careers outside academia. These research experiences offer introductory training in research and often culminate in students acquiring advanced experimental and data analysis techniques that contribute to the research mission of our

department, and occasionally result in publication of new results. They also offer a golden opportunity to see if the pace, challenges, and exhilaration of research are for you.

We strongly encourage motivated students to contact and meet with research faculty. Arranging a productive meeting with research faculty is a multi-step process: (i) give thought to which areas of physics interest you, (ii) identify faculty who are actively researching in those areas, (iii) spend time reading their websites and even better reading a recent publication from their lab to form an idea of which research questions they pursue, and finally (iv) contact the professor via email using professional and specific language that demonstrates your interest in their area of research and ask a topically relevant question (however naive)!

If you do end up working in a research lab, you can receive research credit (PHYS 401) or it could be a compensated research experience if agreed upon by the corresponding faculty member.

Instead of working in a specific research group, many students choose to engage with our *Advanced Projects Lab* (PHYS 49X). This alternative provides many of the same opportunities for building experimental apparati, performing data analysis, and communicating your results. The *Advanced Projects Lab* offers STEM skills and knowledge building projects as well as more open-ended research projects. Speak with the director of the Advanced Projects Lab (Prof. Bryan Boggs, bsboggs@uoregon.edu) for more information.

You can find a list of our faculty, their emails, and a brief summary of their research interests at: physics.uoregon.edu under the 'People' tab.

Tutoring, Office Hours, Email and Time Management

If you ask any professor or thriving student what are some of the best actions you can take to ensure success under the challenging course load, you will repeatedly hear them say: go to tutorials, go to office hours, seek help with class content if you are feeling lost, talk with your professors earlier rather than later about your challenges and barriers to committing the necessary time. Success goes hand-in-hand with being proactive. Use and check your UO email -- it is the major way that instructors, the department, and the University will communicate with you. Develop the 'soft skills' of time management -- for instance, to get the most out of tutorials and office hours, it is imperative that you attempt homework problem sets and assignments beforehand, otherwise you will not be able to ask useful questions nor learn from the answers to the questions posed by other students. Likewise, your stress levels will decrease, and your grades and conceptual understanding will increase if you start problem sets early and work with other students. It should not be surprising that establishing good habits for studying, working with other students, and self-care will be immensely beneficial in your time at UO and well beyond.

Transfer Students

We welcome and support transfer students from community colleges and other 4-year institutions, and our department has a healthy and supportive cohort of transfer students at all levels. We also encourage transfer students to get involved with tutoring and extracurricular activities in the department (like *The*

Society of Physics Students), in part to facilitate the social integration that is known to support student success. Transfer students should communicate with the Director of Undergraduate Studies to determine which courses from their previous studies can be used to meet credit requirements in the first two years of study. We do not generally accept transfer credits for advanced course work (i.e. post year 2).

Minoring in Physics

Non-physics majors, especially those majoring in other sciences, like biology, chemistry, computer science, math, human physiology, or data science, may opt to get a physics minor. A physics minor builds a strong foundation in classical mechanics and thermodynamics, while offering introductory training in (e.g.) electricity and magnetism, classical mechanics, or quantum physics. This training can be a great fit if you want to use the mathematical and analytical tools of physics to explore other fields like arts, architecture, social sciences, or other natural sciences.

Our minor has 32 required credits. Students first take (12 credits):
Foundations of Physics I (PHYS 251, 252, 253): three-course intro physics sequence using calculus.

Students then take (16 credits):
Foundations of Physics II (PHYS 351, 352, 353): three-course sequence primarily focused on thermodynamics, computational physics, and statistical mechanics.
Advanced Physics Lab (PHYS 391)

Finally, students must take one additional advanced course (4 credits). PHYS 444, ASTR 321, and all 400-level courses count toward this requirement -- for instance, first term of quantum mechanics, first term of electricity and magnetism, classical mechanics, or computational physics.

Keep in mind that there are math pre/co-requisites that go along with PHYS 25X and PHYS 35X.

Summer Session

While the department does offer elective and general (non-major) physics courses over the summer, we do not offer core or advanced courses for physics majors over the summer. However, many of the core math courses required by the physics degree *are* offered during the summer. Many students choose to fill those requirements in the summer to get ahead, to free up their academic-year course load, to remedy gaps in their high-school math training, or for other time constraint reasons. Consult with the Director of Undergraduate Studies (Prof. Scott Fisher, rsf@uoregon.edu) and the Undergraduate Program Coordinator (Ms. Ingrid Karson-Hickman, ingridk@uoregon.edu for summer course information.

Bachelor of Science *vs.* Bachelor of Arts

Generally, a Bachelor of Science (BS) is recommended for natural science majors, and the statistical fact is that very few physics majors (at UO) seek a BA (even before reading this). The functional difference between the two degrees is that a BA requires substantial additional foreign language credits. We support students who wish to increase their humanities breadth and ask that you seek guidance from the Director of

Undergraduate Studies (Prof. Scott Fisher, rsf@uoregon.edu) and the Undergraduate Program Coordinator (Ms. Ingrid Karson-Hickman, ingridk@uoregon.edu) , if you want to pursue a BA in Physics.

Prepared by: Dr. Scott Fisher, Director of Undergraduate Studies), 10/24/2025