If you’re a student or prospective student interested in Physics and/or Astronomy at Amherst College, this guide is for you. Welcome! Here, you’ll find an overview of our department, details about our two majors, and some information about what comes after college. If you need more information, feel free to contact any of the faculty or staff in the department with questions.

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CONTACT INFORMATION

The Physics and Astronomy Department is located on the first and second floors of Merrill Science Center. The first floor holds faculty labs, the machine and electronics shops, and the student lounge. The second floor has classrooms, instructional labs, and faculty labs. Faculty and staff offices are spread throughout. The department office is Merrill Science 214.

Coming soon: We will be moving to a new science center in Fall 2018!

Department Chair for 2017-2018
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Merrill 228

Academic Department Coordinator
Alice Simmoneau
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413-542-2251
Merrill 214

Mailing addresses

<table>
<thead>
<tr>
<th>USPS</th>
<th>UPS</th>
<th>FedEx</th>
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<tr>
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<td>Amherst College</td>
<td>Amherst College</td>
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<tr>
<td>PO Box 5000</td>
<td>15 Mead Dr.</td>
<td>214 Merrill Science Center</td>
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<tr>
<td>Amherst, MA 01002</td>
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YOUR FIRST COURSE IN PHYSICS OR ASTRONOMY

There’s a physics or astronomy course for any student at Amherst. If you’re eager for an in-depth look at space, time, and motion, you could start with The Newtonian Synthesis (PHYS 123). Those seeking a survey course with little in the way of prerequisites could look at Exploring the Cosmos (ASTR 111), Alien Worlds (ASTR 112), or Energy (PHYS 109). Astronomers often deal with large data sets; those interested in data analysis and programming could join Practical Astronomy (ASTR 200). Students interested in physics en route to medical school will want to look into Introductory Physics I and II as well as Oscillations and Waves (PHYS 116, 117, 125). PHYS 116 and 117 are offered every semester.

Placement advice: Most students considering a major in Physics or Astronomy should start with The Newtonian Synthesis (PHYS 123), which is only offered in the fall. If you have already taken a calculus-based mechanics course and received a 5 on the AP Physics C Mechanics exam, you should place out of PHYS 123 and take Oscillations and Waves (PHYS 125). If you have taken a calculus-based mechanics course but do not have AP credit, you should take our placement exam. The placement exam covers Newton’s laws of motion, work and energy, momentum, rotation, gravitation, and oscillation. It is a 90-minute take-home test that can be picked up outside the department office during orientation. Tests must be returned by the Monday before the first day of class. The chair will contact students with results by email. If you have scores from IB Higher-Level or comparable exams, you should take the placement exam.

Math preparation: Physics and Astronomy make thorough use of the calculus. The Astronomy major requires MATH 111 and 121. The Physics major requires these and MATH 211. If you are placed in MATH 105/106 or 111, you should complete this before taking PHYS 123. If you are placed in MATH 121, you should take it at the same time as PHYS 123, since MATH 121 is a prerequisite for PHYS 124. If you are placed into MATH 211, you should take it in your first two years – earlier if you plan to take more math courses.

Students who do not plan to major in Physics or Astronomy can take either PHYS 116 (offered both semesters) or PHYS 123 (fall only). Both satisfy the requirements for medical school. (Both also satisfy the requirements for the majors.) If the student has a background sufficient to place out of PHYS 116/123, they should discuss with their advisor or the department chair whether Introductory Physics II: Electromagnetism and Optics (PHYS 117) or Oscillations and Waves (PHYS 125) would be appropriate.

1 In Fall 2017, we are not offering PHYS 125. You may want to take Methods of Theoretical Physics (PHYS 227), Modern Physics (PHYS 225), or an introductory astronomy course (ASTR 111 or 112).
DEPARTMENT EVENTS

WEEKLY COLLOQUIUM

Most weeks during the semester, we host a scholar for a one-day visit. The visit culminates with a public talk on a topic of contemporary physics or astronomy. Students are welcome to these talks, and seniors are required to attend at least nine over the course of a year. We gather before the talks for tea, coffee, and cookies. Near the end of each semester, honors thesis students give public lectures on their work. The typical schedule has refreshments at 4:15pm in Merrill 204 with the talk at 4:45pm in Merrill 3.

Our Astronomy program is part of the Five College Astronomy Department, which hosts its own colloquium series Thursdays at 3:45 pm at UMass in LGRT 1033.

ANNUAL EVENTS

<table>
<thead>
<tr>
<th>Time</th>
<th>Events</th>
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<tbody>
<tr>
<td>Early Fall</td>
<td>Welcome-back pizza party – Preview of the coming year</td>
</tr>
<tr>
<td></td>
<td>Summer student poster session – See what happened over</td>
</tr>
<tr>
<td></td>
<td>the summer</td>
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<tr>
<td>Mid-Fall</td>
<td>Parents reception</td>
</tr>
<tr>
<td>Late Fall</td>
<td>Thesis student talks</td>
</tr>
<tr>
<td></td>
<td>Winter party – science prizes and silly songs</td>
</tr>
<tr>
<td>Early Spring</td>
<td>Junior pizza party – Planning for senior year</td>
</tr>
<tr>
<td>Mid-Spring</td>
<td>Physics Phormal</td>
</tr>
<tr>
<td>Late Spring</td>
<td>Thesis student talks</td>
</tr>
<tr>
<td>Year-end</td>
<td>Department BBQ</td>
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<tr>
<td></td>
<td>Commencement reception</td>
</tr>
<tr>
<td></td>
<td>Reunion reception – Welcome back alumni!</td>
</tr>
</tbody>
</table>
STUDENT RESEARCH

Research involvement is an important part of many students’ education at Amherst. It emphasizes that science occurs primarily outside the classroom. It develops skills that complement those learned through coursework. It gives a taste of research for those considering grad school.

Students can get involved as early as their first year. All of our faculty have active projects, and most students directly participate in a faculty member’s work. How do you join in? Talk to the faculty about their work and ask if there’s a way you can take part. Just send an e-mail and ask for a lab tour.

Most students start when there’s a large amount of time available. That typically means over the summer, though sometimes the Interterm can be a trial time for starting a project.

In the summer after your first or second year, consider applying to the SURF program on campus. It will fund up to 10 weeks in a professor’s lab and provides additional programs about scientific communication and research methods. It is often possible to fund students outside the SURF program either through the Dean of the Faculty’s office or a faculty member’s external grant. Deadlines for on-campus research are typically in February and March.

A senior honors thesis is an opportunity to explore a topic in depth for a whole year. You’ll work closely with a faculty advisor and present your work publicly and in a written document. The summer before senior year is a great time to get started and build momentum that carries you into the semester. Funding for a stipend and housing is typically available for eight weeks and sometimes more.

Beyond Amherst, there are many summer research opportunities across the country and around the world. The National Science Foundation supports many Research Experience for Undergraduate (REU) sites. Many large labs like NIST and Fermilab host their own programs. In recent years, we have sent students to places like LIGO and CERN. The summer before your junior year is a great time to attend one of these. Application deadlines are typically in January.
THE ASTRONOMY MAJOR

The Astronomy major is designed to introduce students to the computational techniques, statistical tools, instrumentation, and physical principles that underlie modern Astronomy. Computational and statistical techniques are introduced in the first course in the major sequence, ASTR 200 (Practical Astronomy), and further honed in ASTR 228 (Introductory Astrophysics) and ASTR 352 (Advanced Astrophysics). ASTR 228 and 352 also draw on physical principles introduced in the three course required physics sequence (PHYS 123, 124 and 225).

A joint Five College Astronomy Department offers courses beyond those offered at Amherst. All required courses are taught at Amherst, but students are also encouraged to take elective courses at the four other institutions, Hampshire, Mount Holyoke and Smith Colleges and the University of Massachusetts (http://www.astro.umass.edu/about/fcad/). As a result of this five college partnership, students can enjoy the benefits of a first-rate liberal arts education while maintaining association with a research department of international stature. Students may pursue independent theoretical and observational work in association with any member of the Five College Astronomy Department, either during the academic year or the summer term. The facilities of all five institutions are available to departmental majors. Students may search for Astronomy courses through the Five College online catalog. The Website is https://www.fivecolleges.edu/academics/courses.

MAJOR REQUIREMENTS

Students who wish to major in Astronomy are required to complete the following coursework:

- Required courses in mathematics and physics
  - MATH 111: Introduction to the Calculus
  - MATH 121: Intermediate Calculus
  - PHYS 123 (or 116): The Newtonian Synthesis: Dynamics of Particles and Systems, Waves
  - PHYS 124 (or 117): The Maxwellian Synthesis: Dynamics of Charges and Fields, Optics
  - PHYS 225: Modern Physics

- Required astronomy courses
  - ASTR 200: Practical Astronomy
  - ASTR 228 (FC28): Introductory Astrophysics: Stars and the Interstellar Medium
  - ASTR 352 (FC52): Advanced Astrophysics: Galaxies and Cosmology

- Three elective courses that meet the following specifications
  - At least one elective course in Astronomy to satisfy a depth requirement in the major.
  - At least two additional electives, one of which must be at the 300-level or higher, e.g., a 300-level Astronomy course, one selected from the handbook’s list, or one approved by the department.

Students who have placed out of calculus or introductory physics are excused from taking those courses. Astronomy majors may place out of up to two courses without having to replace those courses. Students placing out of more than two courses must replace all but two of those courses with additional Astronomy courses numbered 200 or higher, approved Physics courses numbered 200 or higher, or other courses approved by the Department to complete the major.

The Comprehensive Evaluation for the Astronomy major will consist of an oral presentation of a published scientific paper (selected in consultation with Amherst faculty), and will take place in the second semester of a student’s senior year.

All students majoring in Astronomy must also attend at least nine public astronomy lectures during the senior year.
ELECTIVES

Astronomy is a data-driven, interdisciplinary science. Any of the following courses may be used to fulfill the elective requirements.

- Astronomy 220 (FC20): [Topical Courses, e.g., Black Holes, Astrobiology, etc.]
- Astronomy 223 (FC23): Planetary Science
- Astronomy 224 (FC24): Stellar Astronomy
- Astronomy 225 (FC25): Galaxies and Dark Matter
- Astronomy 226 (FC26): Cosmology
- Astronomy 301 (FC): Writing about Astronomy
- Astronomy 330: (FC30): [Topical Courses, e.g. Exoplanet Atmospheres, High Energy Astrophysics]
- Astronomy 335 (FC35): Astrophysics II: Stellar and Planetary Structure
- Astronomy 337 (FC37): Observational Techniques I
- Astronomy 339 (FC39): Astronomy in a Global Context
- Astronomy 341 (FC41): Observational Techniques II
- Astronomy 444 (FC44): Radiative Processes
- Astronomy 445 (FC45): Astrophysical Dynamics
- Physics 226: Signals and Noise Laboratory
- Physics 227: Methods of Theoretical Physics
- Physics 230: Statistical Mechanics and Thermodynamics
- Physics 343: Dynamics
- Physics 347: Electromagnetic Theory I
- Physics 348: Quantum Mechanics I
- Physics 490: [Special Topics]
- Chemistry 351: Quantum Chemistry and Spectroscopy
- Chemistry 361: Physical Chemistry
- Geology 331: Paleoclimatology
- Geology 341: Environmental and Solid Earth Geophysics
- Geology 431: Geochemistry
- Geology 450: Seminar in Biogeochimistry
- Mathematics 260: Differential Equations
- Mathematics 272: Linear Algebra with Applications
- Mathematics 284: Numerical Analysis
- Mathematics 320: Wavelet and Fourier Analysis
- Mathematics 335: Time Series Analysis and Applications
- Math/Stats 360: Probability
- Mathematics 365: Stochastic Processes
- Math/Stats 370: Theoretical Statistics
- Statistics 220: Bayesian Modeling and Inference
- Statistics 225: Nonparametric Statistics
- Statistics 230: Intermediate Statistics
- Statistics 240: Multivariate Data Analysis
- Statistics 495: Advanced Data Analysis
- Computer Science 201: Data Structures and Algorithms I
- Computer Science 247: Machine Learning
- Computer Science 301: Data Structures and Algorithms II

To gain approval for an alternate elective, students must file a petition for the Department to consider. To submit a petition, email the Chair of the Department with relevant information about the course to be considered, for example, a syllabus from a recent semester of the course or a link to the course description.
HONORS PROGRAM

Students who wish to receive departmental Honors should enroll in ASTR 498 and 499 in addition to completing the other requirements for the major. To enter the Honors program, a student must attain an average grade of at least B– in all required courses taken through the end of the junior year, or receive department approval. At the end of the first semester of the senior year the student’s progress on the Honors problem will determine the advisability of continuation in the Honors program.

The aim of Departmental Honors work in Astronomy is to provide the student an opportunity to pursue, under faculty direction, in-depth research into a project in experimental and/or theoretical astronomy/astrophysics. Current areas of research in the department include direct imaging of extrasolar planetary systems, circumstellar disk imaging and computational modeling, adaptive optics instrumentation, and next generation telescope mission design. Additional opportunities within the Five College Astronomy Department include planetary science, star formation, molecular clouds, galactic structure, galaxy evolution and cosmology. Subject to availability of resources and faculty interest, Honors projects arising out of students’ particular interests are encouraged.

Students must submit a written thesis on the Honors work a few weeks before the end of their final semester (in late April for spring graduation). Students give a preliminary presentation of their work during the first semester, and a final presentation at the end of the second semester. In addition, they have a conversation with department faculty about the thesis work. The departmental recommendation for the various levels of Honors will be based on the student’s record, Departmental Honors work, Comprehensive Examination, and Oral Examination on the thesis.
ASTRONOMY MAJOR CHECKLIST

Name: _________________________________________________________  Class year: _______________

You may pass out of up to two courses without replacement. Any additional courses placed out of must be replaced with an ASTR course at or above the 200-level, approved PHYS course at or above the 200-level, or other course approved by the department. If you have passed out of a course, that should be officially noted in your placement status or advisor comments.

**Introduction to mathematics and physics**

- MATH 111
- MATH 121
- PHYS 123 (or 116)
- PHYS 124 (or 117)
- PHYS 225

**Introduction to astronomy**

- ASTR 200
- ASTR 228 (FC28)
- ASTR 352 (FC52)

**Three advanced elective courses. At least one must be in ASTR and one at the 300-level. (See handbook for approved selections.)**

- ASTR
- 300-level

**Comprehensive requirement**

- Oral presentation

- Attend nine public astronomy lectures during senior year
PATHS THROUGH THE ASTRONOMY MAJOR

There are many ways to complete the 11 course requirements for the Astronomy major. Here are some possibilities. We encourage you to discuss your own path with your advisor or any other member of the department.

### Math placement 105/111

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>First</td>
<td>MATH 105/111</td>
<td>MATH 106/111</td>
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<tr>
<td></td>
<td>PHYS 123/116 / MATH 121</td>
<td>PHYS 124/117 / Practical Astro 200</td>
</tr>
<tr>
<td>Junior</td>
<td>Modern PHYS 225 / Astrophys I 258</td>
<td>Astrophys III 352 / Elective</td>
</tr>
<tr>
<td>Senior</td>
<td>Elective</td>
<td>Elective</td>
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- MATH 111 can be taken either semester

### Math placement 121 (no thesis)

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<th>Year</th>
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<tbody>
<tr>
<td>First</td>
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<tr>
<td></td>
<td>Modern PHYS 225 / Elective</td>
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<tr>
<td></td>
<td>Astrophys I 258 / Astrophys III 352</td>
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### Math placement 121 (with thesis)

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<th>Spring</th>
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<tbody>
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<td>Mechanics / PHYS 123/116 / MATH 121</td>
<td>Electromagnetism / PHYS 124/117 / Practical Astro 200</td>
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<tr>
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<td>Modern PHYS 225 / Astrophys I 258</td>
<td>Elective / Astrophys III 352</td>
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<tr>
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<td>Thesis</td>
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### Study abroad (fall)

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<th>Spring</th>
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<td>PHYS 123/116 / MATH 121</td>
<td>PHYS 124/117 / Practical Astro 200</td>
</tr>
<tr>
<td></td>
<td>Modern PHYS 225 / Astrophys I 258</td>
<td>Elective</td>
</tr>
<tr>
<td>Junior</td>
<td>Abroad</td>
<td>Astrophys III 352 / Elective</td>
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<tr>
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<td>Elective</td>
<td>Thesis</td>
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### Study abroad (spring)

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<td>PHYS 123/116 / MATH 121</td>
<td>PHYS 124/117 / Practical Astro 200</td>
</tr>
<tr>
<td></td>
<td>Modern PHYS 225 / Elective</td>
<td>Astrophys I 258 / Astrophys III 352</td>
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<tr>
<td></td>
<td>Abroad</td>
<td>Elective</td>
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<tr>
<td>Senior</td>
<td>Elective</td>
<td>Thesis</td>
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- Many students attend programs with courses suitable for electives
- Plan ahead to verify the scheduling of the electives you wish to take
## Late start

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<tr>
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<tr>
<td>Senior</td>
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</table>

### Sophomore
- MATH 111
- PHYS 116
- Elective
- Practical Astro 200
- MATH 121
- PHYS 117
- Astrophys III 352
- Elective

## Grad school track

<table>
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<th>Year</th>
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<tr>
<td>Senior</td>
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</tbody>
</table>

### Sophomore
- Mechanics PHYS 123
- MATH 121
- Modern PHYS 225
- Waves PHYS 125
- Electromagnetism PHYS 124
- Practical Astro 200
- Stat Mech PHYS 230
- Linear Algebra MATH 271
- Astrophys I 258
- MATH 211
- Astrophys III 352
- Quantum Mech PHYS 348

### Junior
- Diff Eq MATH 260
- Observ Astro 337
- Thesis
- Thesis

### Senior
- Thesis
- Thesis
THE PHYSICS MAJOR

Physics is the study of the natural world emphasizing an understanding of phenomena in terms of fundamental interactions and basic laws. As such, physics underlies all of the natural sciences and pervades contemporary approaches to the study of the universe (astronomy and astrophysics), living systems (biophysics and neuroscience), chemistry (chemical physics), and earth systems (geophysics and environmental science). In addition, the relationship of physics to mathematics is deep, complex and rich. To reflect the broad range of activities pursued by people with training in physics, the department has developed a curriculum that provides a solid background in the fundamentals of physics while allowing some flexibility, particularly at the upper level, for students’ interests in astronomy, biology, chemistry, computer science, geology, mathematics and neuroscience.

The core physics program provides a course of study for those who are interested in physics as a liberal arts major, with career plans in diverse fields such as engineering, law, medicine, business and education. The department also provides a number of upper-level electives to deepen the background of those students intending to pursue careers in physics and closely related technical fields.

MAJOR REQUIREMENTS

Students who wish to major in Physics are required to complete the following coursework:

• A comprehensive introduction to the calculus: MATH 111, 121, and 211
• An introduction to the core physics concepts of mechanics (PHYS 123 or 116), electromagnetism (PHYS 124 or 117), oscillations and waves (PHYS 125), relativity and quantum mechanics (PHYS 225), and statistical mechanics (PHYS 230 or CHEM 361).
• One advanced course in laboratory or observational techniques (PHYS 226 or ASTR 337)
• Three advanced elective courses on physics, the application of physics in other disciplines, or techniques used in physics. These courses must be approved by the chair of the department in consultation with the faculty of the department. At least one must be a 300-level PHYS course. At most one may be counted towards a second major.

All Physics majors must demonstrate satisfactory performance on an approved standardized test in general physics. All Physics majors must also attend at least nine public physics or astronomy lectures during the senior year.

Students who place out of a course are excused from that requirement.

ELECTIVES

The goal of the elective courses is to allow students to explore at an advanced level their own interests in physics. Elective courses should be beyond the introductory level. Below are some examples of electives pre-approved by the department. The list is not exhaustive, and we encourage students to seek approval for other courses. Also included is a list of courses that do not count as electives.

Examples of courses that satisfy the elective requirement

• Any PHYS or ASTR course at the 200- or 300-level not already required for the major
• Special topics courses PHYS 490 or ASTR 490
• Quantum Chemistry and Spectroscopy (CHEM 351)
• Environmental and Solid Earth Geophysics (GEOL 341)
• **Groups, Rings, and Fields** (MATH 350)
• **Stochastic Processes** (MATH 365)
• **Neurophysiology** (NEUR 351)
• **Molecular and Cellular Biophysics** (PHYS 400)
• **Theoretical Statistics** (STAT 370)

*Examples of courses that do not satisfy the elective requirement*

• Any PHYS or ASTR course at the 100-level
• Senior departmental honors courses
• Introductory coursework in other departments (for example COSC 111, STAT 135)
• **Statistical Mechanics and Thermodynamics** (PHYS 230) and **Physical Chemistry** (CHEM 361)
• Coursework at the 200-level in Mathematics, Statistics, or Computer Science (for example **Differential Equations** (MATH 260), **Linear Algebra** (MATH 271/272), **Data Structures and Algorithms** (COSC 201))

### HONORS PROGRAM

Students who wish to receive departmental Honors should enroll in PHYS 498 and 499D in addition to completing the other requirements for the major. To enter the Honors program, a student must attain an average grade of at least B– in all Physics courses taken through the end of the junior year or receive department approval. At the end of the first semester of the senior year the student’s progress on the Honors problem will determine the advisability of continuation in the Honors program.

The aim of Departmental Honors work in Physics is to provide the student an opportunity to pursue, under faculty direction, in-depth research into a project in experimental and/or theoretical physics. Current experimental areas of research in the department include atomic and molecular physics, precision measurements and fundamental symmetries, Bose-Einstein condensation, ultracold collisions, the quantum-classical frontier, nonlinear dynamics, optical trapping, ion trapping, cellular and molecular mechanics, and phase transitions. Theoretical work is in high energy and elementary particle physics, statistical mechanics, and mathematical physics. Faculty members also pursue studies in quantum computers, foundations of quantum mechanics, and classical gravitation theory. In addition to apparatus for projects closely related to the continuing experimental research activity of faculty members, facilities are available for experimental projects in many other areas. Subject to availability of equipment and faculty interest, Honors projects arising out of students’ particular interests are encouraged. Students must submit a written thesis on the Honors work a few weeks before the end of their final semester (in late April for spring graduation). Students give a preliminary presentation of their work during the first semester, and a final presentation at the end of the second semester. In addition, they have a conversation with department faculty about the thesis work.
PHYSICS MAJOR CHECKLIST

Name: _____________________________________________ Class year: __________

If you have passed out of a course, that should be officially noted in your placement status or advisor comments.

If you declared your major prior to Fall 2018 and had already completed PHYS 227, it may replace both MATH 211 and PHYS 125. Alternatively, the old PHYS 227 requirement may be waived by completing MATH 211 and two other MATH courses approved by the department chair (such as MATH 260 and 271).

Comprehensive introduction to the calculus

MATH 111 __________ MATH 121 __________ MATH 211 __________

Introduction to the core physics concepts

PHYS 123 or 116 __________ PHYS 124 or 117 __________ PHYS 125 __________

PHYS 225 __________ PHYS 230 or CHEM 361 __________

Advanced course in laboratory or observational techniques

PHYS 226 or ASTR 337 __________

Three advanced elective courses. At least one must be a 300-level PHYS course. At most one may be counted towards a second major. (See handbook for approved selections.)

300-level PHYS __________ Counted for second major? Yes / No

______________ Counted for second major? Yes / No

______________ Counted for second major? Yes / No

Comprehensive requirement

Standardized test in general physics __________

Attend nine public physics or astronomy lectures during senior year __________
PATHS THROUGH THE PHYSICS MAJOR

There are many ways to complete the 12 course requirements for the Physics major. Here are some possibilities. We encourage you to discuss your own path with your advisor or any other member of the department.

<table>
<thead>
<tr>
<th>Math placement 105</th>
<th>Math placement 111</th>
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<tbody>
<tr>
<td><strong>Year</strong></td>
<td><strong>Fall</strong></td>
</tr>
<tr>
<td><strong>First</strong></td>
<td>MATH 105</td>
</tr>
<tr>
<td><strong>Sophomore</strong></td>
<td>Mechanics 123, MATH 121</td>
</tr>
<tr>
<td><strong>Senior</strong></td>
<td>Elective, Elective</td>
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- MATH 111 students could also start physics in their first spring with the sequence 116-125-124.
- Occasionally, MATH 111 students may be approved to take PHYS 123 concurrently.

<table>
<thead>
<tr>
<th>Math placement 121 (no thesis)</th>
<th>Math placement 121 (with thesis)</th>
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<tr>
<td><strong>Year</strong></td>
<td><strong>Fall</strong></td>
</tr>
<tr>
<td><strong>First</strong></td>
<td>Mechanics 123, MATH 121</td>
</tr>
<tr>
<td><strong>Sophomore</strong></td>
<td>Waves 125</td>
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<tr>
<td><strong>Junior</strong></td>
<td>Modern 225, Elective</td>
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<tr>
<td><strong>Senior</strong></td>
<td>Elective</td>
</tr>
</tbody>
</table>

- Electives can be rearranged
- Stat. Mech./SNL can be flipped; Waves/Modern can be flipped

<table>
<thead>
<tr>
<th>3-year major with thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td><strong>First</strong></td>
</tr>
<tr>
<td><strong>Sophomore</strong></td>
</tr>
<tr>
<td><strong>Junior</strong></td>
</tr>
<tr>
<td><strong>Senior</strong></td>
</tr>
</tbody>
</table>

- Assumes placement out of MATH 111
### Pass out of PHYS 123

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Waves 125 MATH 121</td>
<td>Electromagnetism 124 MATH 211</td>
</tr>
<tr>
<td>Sophomore</td>
<td>Modern 225</td>
<td>Stat Mech 230 SNL 226</td>
</tr>
<tr>
<td>Junior</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Senior</td>
<td>Thesis</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

### Study abroad (fall) vs Study abroad (spring)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Mechanics 123 MATH 121</td>
<td>Electromagnetism 124 MATH 211</td>
<td>Mechanics 123 MATH 121</td>
<td>Electromagnetism 124 MATH 211</td>
</tr>
<tr>
<td>Junior</td>
<td>Abroad</td>
<td>Elective</td>
<td>Elective</td>
<td>Abroad</td>
</tr>
<tr>
<td>Senior</td>
<td>Elective</td>
<td>Thesis</td>
<td>Elective</td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Thesis</td>
<td>Thesis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Many students attend programs with courses suitable for electives
- Plan ahead to verify the scheduling of the electives you wish to take
AFTER GRADUATION

GENERAL TRENDS

Nationwide, around half of physics bachelor degree holders enter the workforce and half pursue graduate studies. Amherst grads are split comparably, though leaning more towards grad school. Those who enter the workforce pursue a wide range of careers, including engineering, computer or information systems, other STEM careers, and non-STEM careers like banking or finance. The American Institute of Physics (AIP) surveys recent graduates about the knowledge and skills they use in their jobs. Among the most used skills are solving technical problems, working on a team, and writing technically. You can see the full list as well as data on employment sectors, starting salaries, and job satisfaction at www.aip.org/statistics. The AIP provides many other data sets as well, including numbers of degrees granted nationwide, who is receiving them, and other trends in education and employment in physics and astronomy.

GRADUATE SCHOOL

Over half of our Physics and Astronomy majors go to graduate school. In the past few years, our students have entered programs at Harvard, Princeton, Stanford, Yale, the University of Colorado, and Rice University, among others. They are pursuing Ph.D.’s in diverse fields such as Physics, Applied Physics, Electrical Engineering, Oceanography, and Atmospheric Studies.

Graduate programs are not like undergraduate programs. While you will likely take some courses and may need to pass a challenging exam, the main emphasis is on research. A good way to get experience is to spend a summer conducting research either at Amherst or elsewhere. An honors thesis is even better. Success in grad school requires self-motivation and enough persistence to dedicate five or more years to working on one problem.

Our main advice for graduate school is to talk to your professors early and often. Of all your options after graduation, this is the one we know the most about. It’s also one of the harder ones to navigate on your own.

Students thinking about graduate school should choose their electives carefully and should take courses beyond those required for the major. Be sure to discuss your options with your advisor.

For Physics graduate school, we recommend that your electives be the advanced courses in mechanics (PHYS 343), electromagnetism (PHYS 347), and quantum mechanics (PHYS 348). Graduate programs in Astronomy and Astrophysics require a substantial background in physics and mathematics. Students intending to pursue Astronomy/Astrophysics graduate school should consider a Physics major instead of (or in addition to) an Astronomy major. For either graduate program, you should consider additional physics or astrophysics regular or special-topics courses; math courses in differential equations, linear algebra, or group theory; and courses in statistics, computer programming, or data analysis.

The application process is not short or easy, so use your time as an investment. Learn about the open questions in the field. Beyond identifying what the questions are, learn about how they’re being addressed as well as who is working on them and where the work is being done. Use guides like the internet, journal articles, discipline-specific magazines like Physics Today, gradschoolshopper.com, and your professors. Your grad school application will be due in late fall of your senior year. It is handled differently than your undergrad applications; it will be read by physics and astronomy faculty not a generic admissions office. Be sure to address your essays to this audience. You’ll need several recommendation letters. At least one should come from a professor who has worked closely with you in a research setting. For Physics and some other programs, you will need to take the Physics GRE. You
should take it September or October of your senior year or April junior year if you’re ready. Study thoroughly. We recommend you form a study group over the summer and work together. There are a few practice exams available, and you should treat them like gold; take them only after studying and under test-like conditions.

FELLOWSHIPS

Any student pursuing studies after graduation should apply for an Amherst College Fellowship. The College has endowed funds specifically for this purpose and regularly gives away over a million dollars a year to recent alumni. It does not have to be a Ph.D. program and the application is easy. See https://www.amherst.edu/mm/140397 for more information.

Amherst College students are regularly competitive in national fellowship programs. Finalists and winners typically have high GPAs and compelling backgrounds or proposals. For more information, contact the Fellowships Office or visit their website at https://www.amherst.edu/academiclife/support/fellowships. Recent Physics and Astronomy majors have been winners or finalists for the Goldwater, Marshall, Keasbey, and Fulbright scholarships.