Undergraduate Physics Majors Handbook

2015–2016

University of Wisconsin-Madison
Department of Physics
www.physics.wisc.edu

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CONTENTS

QUICK NOTES

- University of Wisconsin
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  Department Chair
  Professor Albrecht Karle

- Looking for a Physics group? Check out the UPS (University Physics Society) in room 2328 Chamberlin Hall, or on the web at www.ups.physics.wisc.edu

- If you can not find the information you are looking for or if you would like a printed copy of this manual please contact the department office.

WELCOME

Welcome to the UW-Madison Department of Physics! We have a long history of providing our students with a great educational experience. That experience will increase your understanding of the physical universe and provide you with the foundation for your future career. Expect hard work that pays big dividends.

If you have concerns about your studies in the department, you should discuss them with the faculty member in charge of the course you are interested in, or with the teaching assistant who has responsibility for the discussion or laboratory to which you are assigned.

Apart from purely academic matters, we are interested in your personal well-being. If there is anything you think we can help with, contact the department office, or Email info@physics.wisc.edu.

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Group Offices & Facilities

Department Office	2320 Chamberlin	262.4526	
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Astronomy	5534 Sterling	262.3071	
BioPhysics	741 MVL	262.4540	
High Energy/Theory/Pheno	4288 Chamberlin	262.2281	
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FACULTY LISTING—ALPHABETICALLY

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FACULTY LISTING—AREA OF INTEREST

Astrophysics & Cosmology

Experimental

Center for Magnetic Self Organization (CMSO): Boldyrev | Egedal | Forest | Sarff | Terry | Zweibel
CMB Polarization with POLARBEAR & LiteBIRD: Arnold
IceCube: Halzen | Hanson | Karle | Vandenbroucke | Westerhoff
Observational Cosmology: Timbie
X-ray Astrophysics: McCammon

Theoretical

Theoretical Cosmology: Chung | Shiu

Atomic, Molecular, & Optical Physics

Experimental

Atomic Collisions: Lin
Atom Trapping: Walker
Nonlinear Optics and Atomic Physics: Saffman
Quantum Optics and Ultrafast Physics: Yavuz

Theoretical

Atomic, Molecular, & Optical: Lin | Walker
Neutral Atoms: Saffman

Biophysics & Condensed Matter Physics

Experimental

Biophysics: Gilbert | Coppersmith
Magnetic Fields: McDermott | Rzchowski
Nanostructures: Eriksson | Gilbert | Himpsel | Rzchowski
Polymer Photophysics and Structure: Winokur
Synchroton Radiation: Gilbert | Himpsel | Onellion

Theoretical

Complex Systems: Coppersmith
Low-Dimensional Systems: Vavilov
Novel Superconductors: Lechenko | Vavilov
Silicon Quantum Dots: Coppersmith | Eriksson | Joynt | McDermott | Vavilov
Strongly-Correlated and Topologically Nontrivial Systems: Levchenko | Joynt
Transport in Nanostructures: Lechenko | Vavilov

High Energy

Experimental

ATLAS at CERN: Wu
CMS at CERN: Carlsmith | Dasu | Herndon | Smith
LBNE Project: Balantekin
LZ: Carlsmith | Dasu | Palladino
Neutrino Physics at Daya Bay: Balantekin

Theoretical

Particle Theory: Bai | Balantekin | Barger | Chung | Everett | Hashimoto | Shiu
Phenomenology: Bai | Barger | Everett | Halzen
String Theory: Hashimoto | Shiu

Neutrino and Astroparticle Physics

Experimental

ARA Project: Hanson | Karle
CHIPS: Karle | Pan
Daya Bay Project: Balantekin
Deep Core Project: Halzen | Karle | Vandenbroucke | Westerhoff
DM-Ice: Karle
HAWC Project: Westerhoff
IceCube: Halzen | Hanson | Karle | Vandenbroucke | Westerhoff

Theoretical

Dark Energy: Chung
Neutrino Astrophysics: Balantekin | Barger | Everett

Nuclear

Theoretical

Nuclear Theory (NucTh): Balantekin

Plasma Physics

Experimental

Center for Magnetic Self Organization (CMSO): Boldyrev | Egedal | Forest | Sarff | Terry | Zweibel
CMTFO: Forest | Terry
CPTC: Forest | Terry | Zweibel
Madison Dynamo Experiment (MDE): Forest
Madison Plasma Dynamo Experiment (MPDX): Forest | Zweibel
Madison Symmetric torus (MST): Forest | Sarff
Plasma-Couette Experiment (PCX): Boldyrev | Forest
Rotating Wall Machine (RWM): Forest | Sarff

Theoretical

MHD Turbulence: Boldyrev | Terry | Zweibel
Plasma Astrophysics: Boldyrev | Terry | Zweibel
RFP Theory: Boldyrev | Terry | Zweibel
Transport in Fusion Devices: Boldyrev | Terry | Zweibel

Quantum Computing

Experimental

Quantum Computing: Coppersmith | Eriksson | McDermott | Saffman | Walker

Theoretical

Quantum Computing: Coppersmith | Joynt

FACULTY & AREAS OF RESEARCH

Department of Physics Professors

Arnold, Kam S., Ph.D. University of California, Berkeley, 2010. Experimental cosmology, cosmic microwave background polarization, superconducting detectors, mm-wave detectors, neutrino physics.

Bai, Yang, Ph.D., Yale University, 2007. New physics beyond the Standard Model including the dark matter phenomenology, the Large Hadron Collider physics, the electroweak symmetry breaking models and the underlying dynamics of quark and lepton masses.

Balantekin, A. Baha, Ph.D., Yale, 1982. Theoretical physics at the interface of nuclear physics, particle physics, and astrophysics; mathematical physics; neutrino physics and astrophysics; fundamental symmetries; nuclear structure physics.

Barger, Vernon, Ph.D., Penn State, 1963. Theory and phenomenology of elementary particle physics; neutrino physics; electroweak gauge models; heavy quarks; supersymmetry; cosmology.

Boldyrev, S., Ph.D., Princeton, 1999. Plasma theory.

Carlsmith, Duncan L., Ph.D., Chicago, 1984. High-energy and fundamental particle physics at the Tevatron and LHC.

Chung, Daniel J.H., Ph.D., Chicago, 1998. Theoretical cosmology, high energy physics; quantum field theory in curved spacetime.

Coppersmith, Susan N., Ph.D., Cornell, 1983. Theoretical condensed matter physics, nonlinear dynamics, quantum computation and information, biomineralization.

Dasu, S., Ph.D., Rochester, 1988. Experimental high energy and elementary particle physics; electro-weak symmetry breaking and search for new physics phenomena using the CMS experiment at the Large Hadron Collider; tigger and computing systems for high energy physics.

Egedal, Jan, Ph.D., Oxford University, 1998. Experimental plasma physics.

Eriksson, Mark, Ph.D., Harvard, 1997. Condensed matter physics, nanoscience, semiconductor membranes, semiconductor nanostructures, quantum dots, quantum computing, thermoelectric materials.

Everett, Lisa, Ph.D., University of Pennsylvania, 1998. Theoretical elementary particle physics, superstring phenomenology and supersymmetry.

Forest, Cary B., Ph.D., Princeton, 1992. Experimental plasma physics, and liquid metal magnetohydrodynamics, with applications to astrophysics and magnetic confinement of fusion plasmas.

Gilbert, Pupa, Ph.D., First University of Rome "La Sapienza," 1987. Biophysics, specialized in biomineralization, nanobiology, synchrotron spectromicroscopy.

Halzen, Francis, Ph.D., Louvain, 1969. Theory and phenomenology of particle physics; particle astrophysics; neutrino astronomy.

Hanson, Kael, Ph.D., University of Michigan, 2000. IceCube..

Hashimoto, Akikazu, Ph.D., Princeton, 1997. String theory, black hole physics, quantum field theory, theoretical physics.

Herndon, M., Ph.D., Maryland, 1998. Fundamental particle physics involving high energy hadron collisions with the CDF experiment at the Tevatron and the CMS experiment at the LHC. Research topics include rare decay of B hadrons, diboson physics, Higgs physics, and searches for fundamental new particles. Detector and algorithm development involving muon triggers and tracking detectors.

Joynt, R. J., Ph.D., Maryland, 1982. Theory of superconductivity and heavy fermion systems; quantum Hall effect; magnetism, high-Tc ; quantum computing.

Karle, A., Ph.D., Munich, 1994. Experimental particle astrophysics; high energy neutrino astronomy, neutrino physics, cosmic rays.

Lawler, J. E., Ph.D., Wisconsin, 1978. Experimental atomic physics; laser spectroscopy; gas discharges, laboratory Astrophysics..

Levchenenko, Oleksandr, Ph.D. University of Minnesota, 2009. Condensed matter theory: field-theoretical treatment of many-body systems and transport phenomena.

Lin, C. C., Ph.D., Harvard, 1955. Atomic and molecular physics; atomic collisions.

McCammon, D., Ph.D., Wisconsin, 1971. Astrophysics; x-ray astronomy; interstellar and intergalactic medium, x-ray detectors.

McDermott, Robert, Ph.D., University of California, Berkeley, 2002. Experimental condensed matter physics, quantum computing.

Onellion, Marshall, Ph.D., Rice, 1984. Experimental solid state; synchroton radiation and ultra-fast optical techniques, nanomaterials.

Palladino, Kimberly J. Ph.D. The Ohio State University, 2009.

Pan, Yibin, Ph.D., University of Wisconsin-Madison, 1991. High energy experimental particle physics.

Rzchowski, Mark S., Ph.D., Stanford, 1988. Experimental condensed matter physics; magnetic heterostructures and nanostructures; low-temperature scanning tunneling spectroscopy; superconductivity in novel materials; thin film growth and fabrication.

Saffman, M., Ph.D. Colorado, 1994. Atomic physics; quantum computing with neutral atoms; quantum optics; entanglement; non-linear optics; solitons; pattern formation.

Sarff, John S., Ph.D., UW-Madison, 1988. Plasma physics; magnetic confinement; instabilities and turbulence.

Shiu, Gary, Ph.D., Cornell, 1998. String theory, Theoretical physics; elementary particle physics; cosmology.

Smith, Wesley H., Ph.D., California, Berkeley, 1981. High-energy and fundamental experimental particle physics;/ep/collisions at the LHC, CERN, Geneva, Switzerland.

Terry, P. W., Ph.D., Texas, 1981. Theory of turbulent plasmas and neutral fluids; plasma theory; anomalous transport and turbulence in fusion plasmas; plasma astrophysics.

Timbie, Peter T., Ph.D., Princeton 1985. Observational astrophysics and cosmology, measurements of the 2.7 K cosmic microwave background radiation; 21-cm hydrogen tomography; microwave detectors and cryogenics.

Vandenbroucke, Justin, Ph.D., University of California, Berkeley, 2009. Ice Cube project, gamma-ray astronomy and neutrino astronomy.

Vavilov, Maxim, Ph.D., Cornell University, 2001. Condensed matter theory: nanoscale and low dimensional systems.

Walker, T., Ph.D., Princeton, 1988. Laser trapping of atoms; collisions between ultra-cold atoms, neutral atom quantum computing, spin-exchange optical pumping, biomagnetometry.

Westerhoff, Stefan, Ph.D., University of Wuppertal, Germany, 1996. Experimental particle astrophysics, high energy neutrino astronomy, ultra high energy cosmic rays.

Winokur, Michael J., Ph.D., Michigan, 1985. Condensed matter physics; structure of novel materials; phase transitions.

Wu, Sau Lan, Ph.D., Harvard, 1970. High-energy and elementary particle physics; weak, electromagnetic, and strong interactions, Higgs Boson, CERN, Geneva, Switzerland.

Yavuz, Deniz, Ph.D., Stanford University, 2003. Experimental atomic, molecular, and optical physics.

Zweibel, Ellen, Ph.D., Princeton University, 1977. Theoretical astrophysics, plasma astrophysics; origin and evolution of astrophysical magnetic fields.

Affiliated Professors

Anderson, David, Ph.D., University of Wisconsin-Madison, 1984. Electrical & Computer Engineering.

Eom, Chang-Beom, Ph.D., Stanford University, 1991. Materials Science & Engineering.

Hegna, Chris, Ph.D. Ph.D., Columbia University, 1989. Engineering Physics. Theoretical plasma physics, fusion science, magnetic confinement of plasmas, and magnetohydrodynamics.

Heinz, Sebastain., Ph.D., University of Colorado, Boulder, 2000. Astronomy. High Energy Astrophysics, extragalactic astronomy, and theory & computation.

Knezevic, I., Ph.D. Arizona State University, 2004. Electrical & Computer Engineering. Simulation of electronic and optoelectronic semiconductor devices; nanowire thermoelectrics, heat transport on the nanoscale; Decoherence and relaxation in nanostructures; transient and high-frequency response; transport in curved 2D electron systems; and solid-state-based quantum information processing.

Lagally, M. G., Ph.D., Wisconsin, 1968. Materials Science & Engineering. Surface physics; structure and disorder; electronic materials; thin-film growth.

Lazarian, Alexandre, Ph.D., University of Cambridge (UK), 1995. Astronomy. MHD Theory: Reconnection, Dynamo Theory; Interstellar Dust: Alignment, Microwave Emission; Interstellar Turbulence: Statistical Studies; Circumstellar Regions and Comets: Polarization Molecular Clouds: Dynamics.

Sovinec, Carl, Ph.D., University of Wisconsin-Madison, 1995. Engineering Physics. Computational plasma physics--computational fluid dynamics--magnetohydrodynamics--numerical methods for partial differential equations.

Vetsigian, Kalin, Ph.D., University of Illinois at Urbana-Champaign. 2005. Bacteriology. Dynamics of microbial interactions in natural and synthetic microbial communities.

UNDERGRADUATE PHYSICS PROGRAM

Roughly speaking, Physics is to the inanimate world what philosophy is to the patterns of human thought. We observe, describe, categorize, synthesize, and abstract. At one time, in fact, Physics was natural philosophy. But in the modern era, the two have parted company. Science moved away from the guidance of philosophers and adopted its own approach to truth, asserting that measurement is the precise form of questioning and that precise questioning is the beginning of understanding.

Physics is the science of the properties of matter, radiation, and energy in all forms. As such, it is the most fundamental of the sciences. It provides the underlying framework for the other physical sciences and engineering and for understanding physical processes in biological and environmental sciences.

WHY CHOOSE TO BE A PHYSICS MAJOR?

Why Study Physics?

1. **Intellectual Satisfaction**. First, and foremost, Physics satisfies our deep desire to understand how the universe works. Physics is interesting.
2. **Intellectual Challenge**. By striving for fundamental understanding, the physicist accepts the challenge to move past a merely descriptive approach of our world and probes deeply into how and why it works.
3. **Physics Produces New Technology**. Today's esoteric Physics research will become tomorrow's technological advances.
4. **Technical Expertise**. Physicists exploit forefront technologies in their pursuits.
5. **Flexibility.** In a fast-paced and changing world, it is much more important to have a broad substantive education than to be trained in a specific skill. We teach people how to think, and how to apply and extend what they know to new types of problems.
6. **Physics is Analytical and Quantitative**. People who can reason analytically and quantitatively are essential for the success of almost any pursuit.

Options

A degree in Physics helps prepare you for employment in industry, research, government, and academia. A bachelor's degree from the undergraduate Physics program will provide an overall view of both classical and modern Physics along with problem-solving ability and the flexibility to continue learning. Your training can:

- Prepare you for employment in industrial or governmental laboratories.
- Prepare you for graduate studies for master's or doctoral degrees in experimental or theoretical Physics.
- Provide a broad background for further work in other sciences, such as materials sciences, aerospace, astronomy, computer science, geophysics, meteorology, radiology, medicine, biophysics, engineering, and environmental studies.
- Provide a science-oriented liberal education. This training can be useful in some areas of business administration, law, or other fields where a basic knowledge of science is useful.
- Provide part of the preparation you need to teach Physics. To teach Physics in high school, you will also take education courses to become certified. You will need a doctoral degree to become a college or university professor.

MAJORING IN PHYSICS

Helpful Hints

- For the most up-to-date information, consult the university web site at: http://pubs.wisc.edu/ug/ls_physics.htm
- If you can not find the information you are looking for or if you would like a printed copy of this manual, please contact the department office (see below).
- Undergraduate Physics advisors are listed on page 4. A list is also available in the department office (see below).
- Forms for declaring a Physics major or to receive a Certificate in Physics are available in the department office (see below).

Department Office

- Physics Department Office
  2320 Chamberlin Hall

  Email info@physics.wisc.edu
  Tel 608 262.7782

As soon as a student decides, and before the end of the sophomore year, prospective Physics majors should discuss their plans and curriculum with the appropriate Advisor. A list of advisors is available on page 4 or from the Physics Department website. Students should consult the L&S Undergraduate Catalog for the general requirements for BA and BS degrees.

TO DECLARE A PHYSICS MAJOR

You must declare your major by filing out a "major declaration form," signed by a Physics Department Undergraduate Advisor (see page 4). You should talk with one of the undergraduate advisors as soon as you know you might have an interest in the Physics major. Students can declare their Physics major at any time after completing their first Physics course on the Madison campus, and we encourage doing this as early as possible. You must have a 2.5 GPA in Physics and math courses taken at Madison at the time you declare. In all cases, the major must be declared before the semester in which you graduate. The form can be obtained at the department office in 2320 Chamberlin Hall. Note: You should bring a copy of your current course history when you talk with the undergraduate advisor.

Note: All L&S undergraduate students are required to declare a major or be admitted into a program before or upon the completion of 86 credits (including credits from transfer, AP, test, study abroad, or retroactive credits).

Engineering and Other Non-L&S Majors Seeking an "Additional Major" in Physics

An undergraduate in the College of Engineering or any college other than Letters and Science (L&S) needs to complete the Physics requirements for the Physics major; and the L&S residence and quality of work in the major requirements. None of the other requirements of the L&S need to be satisfied. Students majoring in any other program that is NOT in the L&S require formal approval from the other college to declare the additional major in Physics. This process may delay declaring the major in Physics.

REQUIREMENTS

The requirement is a total of 35 credits. The 35 credits must include these four groups:

1. Introductory Requirements

First Course: Physics 247 (recommended) or 207 or 201 or (EMA 201 and either EMA 202 or ME 240)

Second Course: Physics 248 (recommended) or 208 or 202

Third Course: Physics 249* (recommended) or 205 or 235 or 241 or 244

Note: A maximum of 5 credits from EMA 201, EMA 202, and ME 240 count toward the 35 required. It is recommended that students follow one of the sequences Physics 247–248, Physics 207–208, or Physics 201–202 for the first two courses, and Physics 249 or 241 is strongly recommended for the third course. But any combination can be used to satisfy the requirements, except that students may not transfer into the Physics 247–248–249 sequence from another introductory sequence.

*Students registering for Physics 249 are required to register concurrently for 307 lab (2 cr).

2. Core Requirements

Mechanics: Physics 311

Electromagnetic Fields: Physics 322 or (ECE 220, 320 and 420)

Thermal Physics: Physics 415 or (CHEM 561 and 562) or ME 361

Quantum Physics: Physics 448 and 449 (recommended) or Physics 531

Note: A maximum of 3 credits from CHEM 561 and 562 apply toward the 35 required. A maximum of 3 credits from ECE 220 and ECE 320 and ECE 420 apply toward the 35 required.

3. Laboratory Requirements

All Physics majors must take 6 credits of intermediate and/or advanced lab.

Full registered credit per course: Physics 307, 308, 407

Two credits applies for each of these courses: Physics 321, 623, 625, NE 427, 428

One credit applies for each of these courses: ECE 305, 313

Note: For non-physics courses, students will receive only the credit applied as lab toward the 35 credits requirement. Non-physics lab courses may be substituted for lab course credit, if approved by a Physics advisor and must cover substantially the same breadth and depth of experience as one of the Physics lab courses.

4. Advanced Physics Electives

The remaining credits to total 35 must be from advanced level Physics courses (see "Level:" designation in the course description), or Physics 301. The Physics Department suggests that your program include the seminar on Physics Today (Physics 301).

Transition Notes

Note 1
First Course Prior to Fall 2015

If you declared a Physics major at UW-Madison before September 2, 2015, you will graduate under the old core requirement of Physics 311 and 322. There are other minor differences. Please consult with an undergraduate Physics advisor (see page 4).

Note 2
Took Physics 307, 308, or 407 Prior to August 1, 2011

If you have taken Physics 307, 308, or 407 OR declared a Physics major before August 1, 2011, you will graduate under the even older requirements of 32 credits of Physics, including 2 credits of intermediate/advanced lab (or 3 credits if you have taken Physics 249).

For more information regarding either of these transition notes, please see an undergraduate Physics advisor (see page 4).

L& S Residence and Quality of Work in the Major Requirements

- 2.000 GPA in all major and major subject (Physics) courses
- 2.000 GPA in all upper level work in the major. All courses that would count toward core, laboratory, and advanced Physics electives are included.
- 15 credits of upper level work in the major must be taken in residence. All courses that would count toward core, laboratory, and advanced Physics electives will count toward this requirement.

L&S Graduation Requirements

The University of Wisconsin College of Letters and Science also has curriculum requirements for the Bachelor of Arts and Bachelor of Science degrees:

- Foreign Language
  BS - third-year level in high school, or equivalent.
  BA - fourth level in one language, OR third level in one language and second level in another language.
- Communication (A & B)
- Quantitative Reasoning (A & B)
- Breadth Requirements
  Minimum 12 credits Humanities
  Minimum 12 credits Social Science
  Minimum 12 credits Natural Science
  Minimum 3 credit Ethnic Studies
- Total Degree Credits: 120
- Liberal Arts and Science Credits: 108

SUGGESTED CURRICULUM

The appropriate program for a student's goals should be established with the help of the advisor. **For the introductory program,** Physics 247-248-249/307 is strongly recommended, but the listed substitutes are acceptable. Note, however, that Physics 247 is offered only in the fall semester. It is possible to enter the core program in either semester since 201, 202, 205, 207, 208, 235, 241, 311, and 322 are offered each semester.

Intermediate and Advanced Lab Courses

Students in Physics 249 must simultaneously enroll in Physics 307 lab (2 cr). Students taking the alternate introductory sequences are encouraged, but not required, to take 307. Physics 307 and 308 can be taken in reverse order (308, 307) if that fits better into your schedule. Physics 407 provides a lab experience closer to that of actual research, with more student initiative and less overall structure. This option should be seriously considered by those intending to go on to graduate school in Physics or who desire a broad and thorough background in laboratory work. Physics 407 can be taken for two or four credits, but consent of instructor is required to take it without first having either 307 or 308.

Physics 321 provides experience in electronics and is a useful, but not required, preparation for the other laboratory courses. 321 is a four credit course, including two credits of intermediate laboratory that can be used toward fulfilling your intermediate and advanced laboratory requirement. Physics 623 provides similar experience but at a significantly higher level. It is also a four credit course, including two credits that count toward the lab requirement. Finally, Physics 625 is an advanced, four credit course in applied optics that includes two credits of advanced laboratory work. It is an applied optics course and covers quite different material from Physics 325 (which has no lab).

Mathematics

There are specific math courses listed as prerequisites for our Physics courses. Depending on your interest in math (some Physics majors also major in Math as well), the courses you select may be different. A typical math sequence is: Math 221, 222, 234, 319, (or Math 320 instead of 319/340), 321, 340, 322. Please consult with an advisor when choosing your Mathematics courses, particularly before deciding on one of the honors sequences in Math.

- **Math 221/222**: Standard Introductory calculus sequence. Math 221 is a prerequisite to Physics 247, 207, and 201.
- **Math 234:** Calculus of Several Variables, typically taken to complete the sequence Math 221/222/234. This course can be taken simultaneously with Math 319.
- **Math 319:** Techniques in Ordinary Differential Equations. You are strongly advised to take this or Math 320 before or with Physics 311 (Mechanics). According to the Timetable, Math 319 is a prerequisite for Math 322.

- **Math 340:** Elementary Matrix and Linear Algebra. This course is a bridge between concrete and abstract math. The next step for students interested in more abstract math is Math 521/522 (Advanced Calculus). Many Physics students find Math 240 to be particularly useful and we strongly suggest taking it or Math 320. Math 320 overlaps with Math 319 and Math 340 and can be taken as a one-semester alternative to those if you are short on time. It's kind of a "sampler plate." Many Physics students feel strongly that taking Math 319 and 340 is well worth the time. The honors section of Math 320 covers **all** material from 319 and 320, but is a challenging course.
- **Math 321:** Applied Mathematical Analysis. Techniques for solving problems in the physical sciences, engineering, and applied mathematics, using advanced calculus and analytic function theory. Can be taken before or after Math 322. It is recommended that Math 321 be taken before taking Physics 322.
- **Math 322:** Applied Mathematical Analysis. Techniques for solving partial differential equations, with an emphasis on practical problems in the physical sciences. Also covers special functions, Fourier Transformations, etc. Math 321 and 322 are recommended for those planning to continue on to graduate school in Physics.

Chemistry

A college course in chemistry is advised for all Physics students. Courses in physical and organic chemistry are useful for Physics students. Organic chemistry is particularly valuable for those interested in biophysics or other life sciences.

Computing

Students are advised to learn the methods of scientific programming. The most useful courses would be in Python or C and C++.

Degree Audit Reporting System (DARS)

The Degree Audit Reporting System (DARS) is part of UW-Madison's commitment to academic advising for undergraduate students. A DARS report is particularly helpful when combined with the personal wisdom and insight of skilled advisors. DARS reports should always be reviewed with transcripts. This report becomes increasingly important as a student first decides on a particular college, then determines a particular major or combination of majors, and finally approaches graduation. DARS shows which requirements have already been completed and which remain unsatisfied. The report can offer suggestions about appropriate courses that may be taken to meet specific requirements. DARS is not intended to replace students' contact with academic advisors. Students should print their DARS report through My-UW. DARS may be helpful in showing how completed or in-progress courses may be used in different degree programs.

RECOMMENDED PROGRAM

Starting Physics in the Fall semester of First Year

	First Semester		Second Semester	
Year	**Course No. & Title**	**Cr**	**Course No. & Title**	**Cr**
1st*	Math 222—Calculus & Analytic Geometry	5	Physics 248—A Modern Intro to Physics	5
	Physics 247*—A Modern Intro to Physics	5	Math 234—Calculus of Several Variables	3
2nd	Physics 249—General Physics	4	Physics 311—Mechanics	3
	and Physics 307—Intermediate Lab	2	Physics 308—Intermediate Lab	2
	Math 319—Tech in Ordinary Differential Eqns	3	Physics 301**—Physics Today	1
			Math 321—Applied Mathematical Analysis	3
3rd	Physics 322—Electromagnetic Fields	3	Physics 325—Wave Motion and Optics	3
	Physics 321—Electric Circuits & Electronics	4	Physics 407—Advanced Laboratory 2 or 4	
	Math 322—Applied Mathematical Analysis	3	Math 340—Elem. Matrix & Linear Algebra	3
4th	Physics 415—Thermal Physics	3	Physics 449—Quantum Physics	3
	Physics 448—Quantum Physics	3	Electives	

Accelerated program: Students entering with Math 222 credit can move Math 234, 319, 321 and Physics 311–322 sequences up by one semester, and Physics 448–449 to the third year. (Physics 407 lab can be delayed to the fourth year.)

Starting Physics in the Second Semester of First Year

	First Semester		Second Semester	
Year	**Course No. & Title**	**Cr**	**Course No. & Title**	**Cr**
1st*	Math 221—Calc. & Analytic Geometry	5	Physics 207—General Physics	5
			Math 222—Calc. & Analytic Geometry	5
2nd	Physics 208—General Physics	5	Physics 241—Modern Physics	3
	Math 234—Calculus of Sev'l Variable	3	Physics 301**—Physics Today	1
	Physics 321—Electric Ck'ts & Electronics	4	Math 319—Tech in Ordinary Diff'l Eqns	3
	(this year or next)		or 320—Linear Mathematics	3
3rd	Physics 311—Mechanics	3	Physics 322—Electromagnetic Fields	3
	Physics 321—Elec. Circuits & Electronics	4	Physics 308—Intermediate Lab,	2
	Physics 307—Intermediate Lab	1	or 407—Advanced Laboratory	1–2
	Electromagnetic Fields & Optics	1	Math 322—Applied Mathmtcl Anlys	3
	Math 321—Applied Mathmtcl. Anlys	3	Math 340—Elem. Matrix & Linear Algebra	3
			(If you did not take Math 320)	
4th	Physics 415—Thermal Physics	3	Physics 449—Quantum Physics	3
	Physics 448—Quantum Physics	3	Physics 407—Advanced Lab	2 or 4
	Electives			

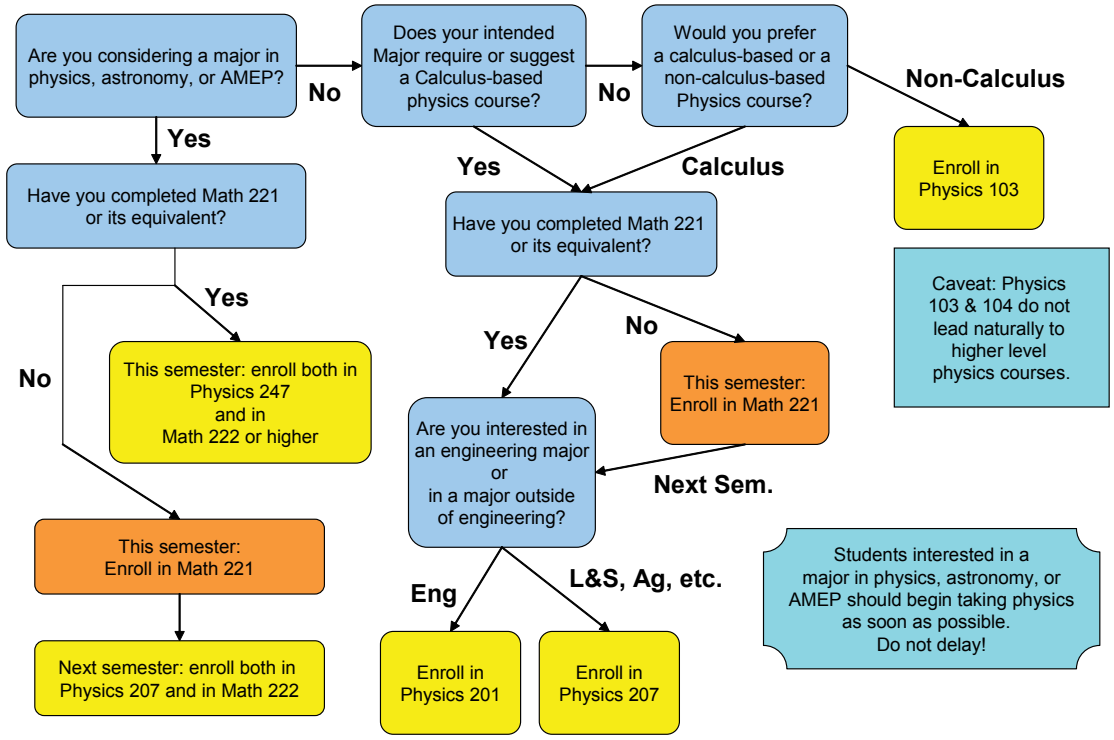
The underlined courses are the "Physics Core Program." The senior year could include electives, such as 522, Advanced Classical Physics (offered Spring semester); 525, Plasma Physics; 535, Particle Physics (offered Fall semester); 623, Electronics (offered Fall semester); or 625, Applied Optics (offered Spring semester).

* Some students take Physics 115 in their first semester to see if they really want to go into Physics.

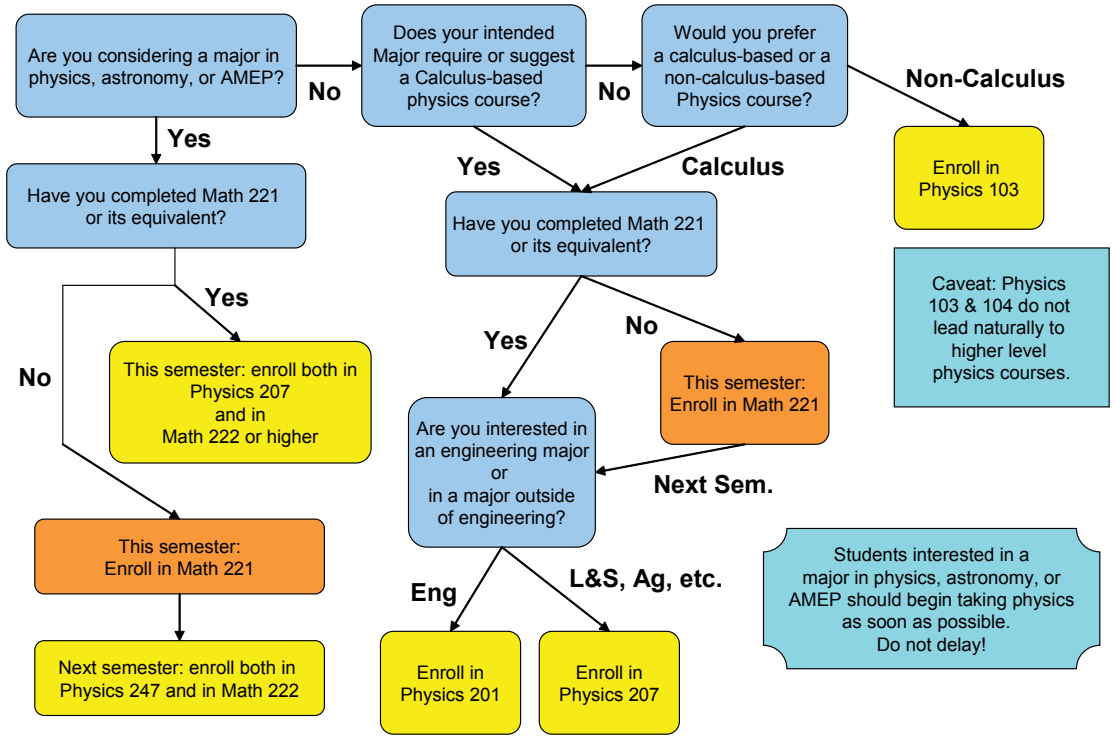
** Physics 301, Physics Today, is an introduction to modern fields of Physics research and, with permission, can be taken more than once (though counted only once toward the 30 credits requirement in Physics.) It may also be attended as a colloquium series with no registration, credit, or requirements.

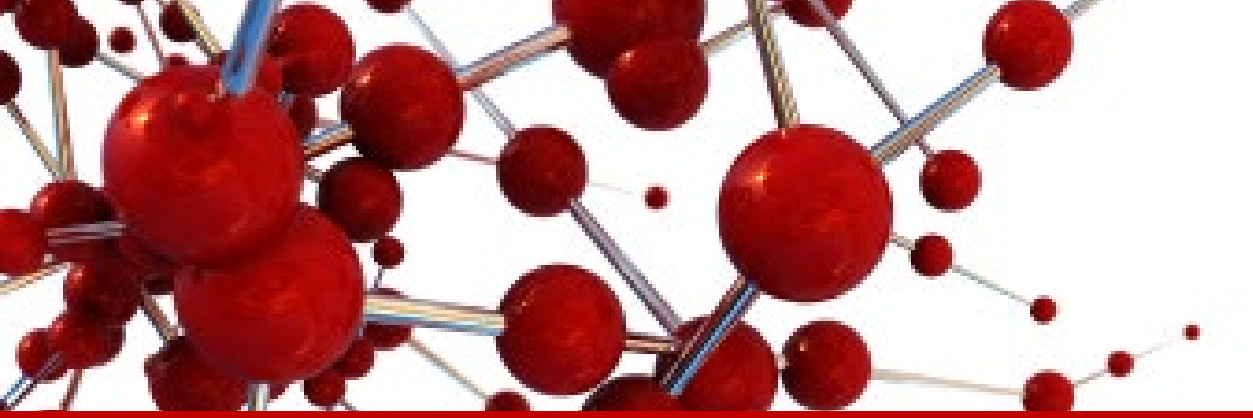
INTRODUCTORY PHYSICS COURSE SELECTION FLOW CHARTS

Choosing an Introductory Physics Course in the Fall Semester



Choosing an Introductory Physics Course in the Spring Semester





GRADE CHANGES & INCOMPLETES

POLICY ON CHANGE OF GRADE

Extra work to improve a final grade is not allowed. Faculty legislation states that final grades can be changed only because of clerical error. To dispute the accuracy of the grade, first contact the professor/instructor of the course. A student who disputes the accuracy of a final course grade and who does not find satisfaction by informal approaches to the instructor may appeal to the department chair.

1. The appeal must be made within the first four weeks of the semester following the grading.
2. The appeal must be submitted in writing to the Department Chair (Professor Albrecht Karle <karle@icecube.wisc.edu>) and the Instructional Program Coordinator (Professor Mark Rzchowski <rzchowski@physics.wisc.edu>).
3. The Department Chair, or a delegate of the Chair, will request a written summary of the instructor's case. The student may also be asked to submit a further written response.
4. The Department Chair will make a final disposition of the appeal at the Department level by:
    a. rejecting the appeal,
    b. recommending that the instructor change the grade, or
    c. prescribing a further examination or submission of work which the Department Chair finds is required to remove any ambiguities in the previous evaluation of academic performance. This may result in a meeting with the Department Chair, the instructor, and the student.

Note: The decision to change a grade is ultimately up to the instructor, and the Department Chair cannot make a change to the grade. The decision of the Department will be communicated to the student in writing.

POLICY ON INCOMPLETES

An Incomplete may be reported for a student who has carried a subject with a passing grade until near the end of the semester and because of a substantiated cause has been unable to complete the course. An incomplete must be completed by the end of the fourth week of classes of the student's next semester of residence at the University (exclusive of summer sessions) or it will lapse into a Failure.

DEGREE OPTIONS

The Department of Physics offers students several different options for majoring or minoring in Physics. There are both a BA and BS degree for Physics Majors (see page 7). Students can earn a BA or BS with Honors (see page 14) or take certain Physics courses for honors credit (see page 14). There is also a Certificate in Physics available (see page 13). Students can earn a BA or BS in Astronomy-Physics through the Department of Astronomy (see page 15) The AMEP program is a specialized four-year program in interdisciplinary physical sciences of applied math, engineering, and Physics (see page 16). Finally the School of Education offers a Physics major for secondary education (see page 18).

CERTIFICATE IN PHYSICS (CERT 783)

The department offers an undergraduate certificate in Physics. An understanding of the physical universe informs many disciplines. The study of Physics is essential to understanding nature and to advancing technology in the coming century. A certificate in Physics increases the opportunities for students to become better informed on technological issues at the local, state, national, and international levels.

The certificate (18 credits) is designed to serve undergraduates majoring in biology, chemistry, mathematics, engineering, education and other fields who wish to extend their study of Physics beyond what may be required or recommended for their major without completing the full L&S Physics major requirements (35 credits including 6 intermediate/advanced lab credits).

The Certificate Requirements

To earn a certificate in Physics, a student must complete at least 18 credits in Physics courses at the "intermediate" level or higher. Graduate-level courses are permitted. No more than 3 credits of independent study and no special topics courses may be used to satisfy this requirement. Transfer or AP credit for 200-level introductory Physics is acceptable for meeting the requirements of the certificate. EMA 201 and EMA 202 or EMA 201 and ME 240 may be substituted for Physics 201 and together count for 5 credits. Otherwise, only courses within the department (or cross-listed with Physics) are acceptable. Only one course from each of the three semesters of introductory Physics can be counted.

1. All undergraduates and special students are eligible (physics majors are not eligible).
2. The certificate will be awarded upon completion of requirements.
3. At least nine of the credits must be in residence.
4. Only graded courses may be used toward the certificate.
5. A minimum grade of C is required for each course used toward the certificate.

TO DECLARE A PHYSICS CERTIFICATE

To declare a certificate in Physics you must fill out a major/certificate declaration form. An Undergraduate Physics Advisor must sign the form. Students can declare the Physics certificate at any time after completing one Physics course on the Madison campus. You must have a 2.5 GPA in Physics and math courses taken at Madison at the time you declare. In all cases, the certificate must be declared before the semester in which you graduate. Once you complete the requirements for the certificate you must request that the certificate be posted to your transcript. Both the form to declare the certificate and the completion of the certificate can be obtained at the department office in 2320 Chamberlin Hall.

Note: You should bring a copy of your current course record when you talk with the undergraduate advisor.

HONORS IN THE MAJOR—PHYSICS

Students wishing to earn BA or BS with Honors in Physics must speak with an undergraduate advisor in Physics. You must also complete the Honors in the Major declaration form available in the Honors Program office (Washburn Observatory). Please note that the Honors in the Major declaration form is NOT the same as the major declaration form used to declare a major in Physics. Major declaration forms can be obtained from the Physics department office.

Students may declare Honors in this Major in consultation with their Major Advisor. To earn Honors in the Major, students must take the same introductory, core, and lab courses as the standard major plus meet these additional requirements:

1. 3.300 University GPA
2. 3.300 GPA in all major and major subject (Physics) courses
3. Senior Honors Thesis: Physics 681 and 682 for 6 credits
4. 12 honors credits in courses used to satisfy the requirements, with at least 9 at the advanced level

DISTINCTION IN THE MAJOR

Distinction in the Major requires no declaration, and is awarded at the time of graduation. Students may not receive Distinction and Honors in the same major.

To receive Distinction in the Major, students must have met the following requirements:

1. 3.300 University GPA
2. 3.300 GPA in all major and major subject (Physics) courses
3. 6 additional credits in advanced-level Physics beyond the minimum required for the major.

HONORS IN PHYSICS COURSES

Many Physics courses can be taken for general honors program credit, as indicated in the timetable. You must speak with the faculty member teaching the course. You can then add honors through the on-line student center.

Helpful Hints

- For the most up-to-date information, consult the university web site at: http://pubs.wisc.edu/ug/ls_astron.htm

- Department of Astronomy
  2532 Sterling Hall
  475 North Charter Street
  Madison, WI 53706

  Sharon Pittman
  Tel: 608.890.3775
  Fax: 608.263.6386
  Email: pittman@astro.wisc.edu
  Web: www.astro.wisc.edu

- Faculty Advisor
  Assistant Professor
  Rich Townsend
  Email: townsend@astro.wisc.edu

THE ASTRONOMY–PHYSICS MAJOR

Astronomy, the oldest of the sciences, for the last several decades has been one of the most exciting fields of modern scientific research. New discoveries concerning the solar system, stars, galaxies, and the origin of the universe continue to be made by both ground and space telescopes. To understand and pursue modern astronomy, one must have a solid background in Physics and mathematics as well as in astronomy.

The astronomy-physics major, administered by the Dept. of Astronomy, provides undergraduates the opportunity to appreciate our current understanding of the astronomical universe, while developing the necessary Physics and math background. Students who intend to continue astronomy in a graduate program are strongly encouraged to do a Senior Thesis (Astro 681/682 (honors) or Astro 691/692). The experiences of research and of writing a major paper develop both technical and writing skills.

Course Requirements For The Major

The major requires a minimum of 34 credits in the field of specialization, with at least 6 of these credits in astronomy and at least 28 credits in Physics. Before declaring the major, students must complete the first two of the three intro sequence Physics classes: Physics 247, 248, and 249 (recommended sequence), or 207, 208, and 241, or Physics 201, 202, 205. We encourage students to declare their major as early as possible, and no later than the semester before graduation. In addition, the specific course requirements for the major are (these also count toward the 15 credits of upper-level courses as required by the College of Letters & Science):

Astronomy Courses

At least two of the following (but note that 310 is a prerequisite for 330, 335, and 500):

310 Stellar Astrophysics, 3 cr
320 The Interstellar Medium, 3 cr
330 Galaxies and Cosmology, 3 cr
335 Cosmology, 3 cr
340 Solar System Astronomy, 3 cr
500 Techniques of Modern Observational Astrophysics, 3 cr

Astronomy 103 and 104 are not required for majors.

Physics Courses

247–248–249 A Modern Introduction to Physics
(or 201–202–205; or 207–208–241) 14 cr
311 Mechanics, 3 cr
322 Electromagnetic Fields, 3 cr
415 Thermal Physics, 3 cr
448 Atomic and Quantum Physics, 3 cr
449 Atomic and Quantum Physics, 3 cr
531 Introduction to Quantum Mechanics (3)
may be substituted for the 448–449 sequence.

A 300-level or higher laboratory course must be taken; Astronomy 510 (Radio Astronomy Lab) or Physics 308 (Intermediate Laboratory– Electromagnetic Fields and Optics) or 321 (Electric Circuits and Electronics) are recommended to satisfy this requirement.

APPLIED MATHEMATICS, ENGINEERING & PHYSICS

What is AMEP?

Applied Mathematics, Engineering, and Physics (AMEP) is an interdisciplinary bachelor of science degree program focusing on math, physics, and an area of Engineering. Despite its demanding curricula, AMEP is designed to be completed in four years.

Why AMEP?

AMEP provides solid, interdisciplinary foundations for students interested in academic and industrial careers in engineering and the sciences. Program graduates consistently land coveted spots in well-ranked graduate programs and on the tech and science job markets.

AMEP is for the student who is very interested in mathematics, physics and engineering but does not want to specialize too early into any one of those directions. AMEP tries to achieve an optimum balance of breadth and depth.

AMEP offers a unique combination of mathematical physics and engineering education that not only provides excellent preparation for graduate school in applied science or engineering, but is also of great value to industry. AMEP students interact with Mathematicians, Physicists and Engineers throughout their education and this leaves them well equipped to contribute to interdisciplinary teams and to adapt to complex and changing situations and technologies.

Please visit the Opportunities page to learn more about scholarships, research, and internship opportunities for AMEP students.

How is the AMEP program different?

The AMEP program is challenging and demanding. It is a program recommended only for those students who have strong ability and great interest in mathematics and physical science. An incoming AMEP student must have had sufficient preparation from high school to begin with calculus, chemistry and physics in his or her freshman year.

The AMEP program has specific graduation requirements which are different from those for a typical BS or BA degree as described in the L&S-Bulletin or the Guidelines-Brochure. AMEP requires a minimum of 21 engineering credits forming a coherent concentration of courses into an engineering field. See Courses and Requirements for a description of the AMEP core curriculum and graduation requirements, course tips and suggestions, and links to course descriptions.

QUICK NOTES

AMEP Program
Department of Mathematics
203 Van Vleck Hall, 480 Lincoln Drive
Madison WI 53706-1388
Tel: 608.263.2546
Web: www.math.wisc.edu/amep/

Program Director: Professor Waleffe (Mathematics, Engineering Physics)

Committee-in-Charge: Professors Forest (Physics), Graham (Chemical Engineering), and Waleffe (Mathematics, Engineering Physics)

Advising
Each student will have three faculty advisors: A degree advisor, who is a Professor in the Department of Mathematics; a Physics advisor, who is a Professor in the Department of Physics; and an engineering advisor, who is a Professor in the department in which the student focuses.

The Physics AMEP Advisor
Prof. Cary Forest.
Tel: 263.0486
Email: cbforest@wisc.edu

Credits
AMEP requires a total of a least 125 credits in the College of Letters and Sciences and/or the College of Engineering. These include the following minimum specific requirements:

Field/Dept	Credits
Math	31
Physics	28-29
Engineering	21
Chemistry	5-9
Laboratory	3
Computing	3
General Education	22-30

The remaining credits to reach the minimum 125 are free electives typically selected with the help of an AMEP faculty advisor.

This four-year degree program in the interdisciplinary physical sciences offers a strong theoretical foundation in related areas of engineering sciences, mathematics, and physics for professional work in the field of industrial research and technology. It also provides a foundation for graduate degree work in applied mathematics, engineering sciences, and physics.

The AMEP program is an excellent choice for the student with broad interests in mathematics, physics and engineering. AMEP emphasizes an integrated mathematics and physics curriculum and strives to achieve an optimum balance of breadth and depth in the physical sciences within the confines of a 4-year degree.

Requirements for the Degree

- A total of at least 125 credits
- A minimum GPA of 2.000

The basic requirements for the degree include:

- General Education (22-30 cr)
- Mathematics (31 cr)
- Physics (28-29 cr)
- Engineering (21 cr)

General Education Requirement (22-30 credits)

The AMEP program requires the completion of the General Education requirements that all students entering UW-Madison as freshmen or undergraduate transfer students must satisfy for the University.

The General Education requirements include:

- Communication
- Quantitative Reasoning
- Breadth (Natural Science, Humanities/Literature/Arts, Social Sciences)
- Ethnic Studies

Foundation Courses (26-27 credits)

Note: Students should be eligible to take calculus and physics during their first semester on campus.

1. **Introductory Math (13 cr)**
   A student must have a grade point average of at least 2.75 in the following Calculus courses: Math 221 (5 cr), 222 (4 cr), and 234 (4 cr)

2. **Introductory Physics (13-14 cr)**
   A student must have a grade point average of at least 2.75 in the following Physics courses: (Recommended) Physics 247 (5 cr), 248 (5 cr), and 249 (4 cr) OR Physics 207 (5 cr), 208 (5 cr), and 241 (3 cr)

Core Requirements (71-75 credits)

1. **Chemistry (5-9 cr)**
   Complete at least one semester of general Chemistry (Chem 109 or Chem 103/104).

2. **Math (18 cr)**
   Complete the following Intermediate Math courses: Math 320*, 321, 322 (* Taking both Math 319 and Math 340 can be substituted for Math 320.)

   Complete additional credits of Mathematics from the following courses: Math 415, 431, 513, 514, 632

3. **Physics (15 cr)**
   Complete the following Intermediate Physics courses: Physics 311, 322

   Complete additional credits of Physics from the following courses: Physics 321, 325, 415, 448, 449.

4. **Engineering (21 cr)**
   Complete at least 21 credits in Engineering science, forming a progressive and cohesive sequence, in consultation with your AMEP engineering advisor.

5. **Laboratory (3 cr)**
   Complete 3 credits of approved Laboratory experience. These credits can be met by one of the courses taken to meet the Physics or Engineering requirement that are also designated as a lab.

6. **Computational (3 cr)**
   Complete 3 credits of approved Computational experience. These credits can be met by one of the courses taken to meet the Physics or Engineering requirement that are also computational in content.

Residence and Quality of Work Requirement

Earn a 2.000 GPA on 30 credits of Core Requirements in residence required in the program.

RESEARCH EXPERIENCE

Web Site

- **For More Information**
  www.physics.wisc.edu/resources/employment/student-jobs

WHY?

The Physics department considers direct experience with ongoing research to be one of the most important parts of a Physics major's education.

From your perspective, there are two major reasons for this:

1. It is a good way to find out what working in Physics is actually like, and whether it's something you really want to do or not. It's an entirely different experience than classes.
2. If you end up applying to graduate school (and many of our majors end up doing this even though they weren't considering it when they started out), the current expectation of admissions committees is that you will have real research experience and a letter of recommendation to go with it. Letters from professors you've just taken a course or two with are much less useful.

WHAT'S INVOLVED?

Most research groups in the department are run by a single professor and may involve a postdoc or two, several graduate students, and in many cases some undergraduates. Some are larger and have several professors collaborating on a single project. Most of the groups have websites that tell a little about what they are doing. You can locate these through http://www.physics.wisc.edu/research/groups, and a list of faculty by research area can be found on page 5 in this handbook. Working with one of these groups involves a serious time commitment: they will generally expect a minimum of 10-15 hours a week on the average. Less that this results in little benefit for either you or the research group. But the scheduling is usually flexible — you can work less around midterms and finals and make up for it at other times, and in many cases you can do some of your work evenings or weekends when that fits your schedule better. Most research groups pay normal hourly rates for the time you put in. Some are on tight budgets and you may improve your chances of getting in if you let it be known you're willing to volunteer.

WHEN?

Sooner is usually better. The more time you spend with a research group, the more you'll know about how they do things, and the more responsible and interesting jobs you'll be able to take on. If you are taking Physics 248, you should be thinking about getting involved in research. For most research jobs, there is not a course work requirement; you're going to learn what you need to know on the job. Most groups are not interested in taking on seniors because they won't be around long enough to get useful.

HOW?

Getting into a research group depends entirely on your initiative. Look on the websites referred to above and see what looks interesting to you. Talk to the professors in your classes and to other majors in the Physics club. Do your homework: read up a little on what someone is doing before you go to talk with them. Ask them if they would tell you more about it, and let them know you're interested in getting involved. Above all, be persistent! The UW Honors program has good opportunities for sophomore summer research support, and the Hilldale program has a competition for Juniors and Seniors that includes a nice stipend. The National Science Foundation funds Research Experience for Undergraduate (REU) programs at many universities around the country. These are really intended for students from small schools that cannot offer their own research opportunities. For you, it is usually better to work with an on-campus group over the summer, so you can continue during the academic year. But if you see one offering something you are really interested in, these programs do sometimes take UW students.

There are occasional opportunities to do research in another country. We strongly support the benefits of broadening your education with a semester or year abroad in one of the many excellent programs offered by the university. Doing this and still finishing your Physics degree in four years is possible, but requires careful planning, so be sure to talk with an advisor early on.

THE PHYSICS CLUB (UPS)

Helpful Hints:

- **University Physical Society**
  2328 Chamberlin Hall

  Web: ups.physics.wisc.edu
  E-mail: ups-officers@googlegroups.com

- **To Join...**
  Drop by Room 2328 Chamberlin Hall and pick up a membership form. Turn in your completed form with your $5 annual dues to any club officer, and you're done.

- **2015–2016 Officers:**
  President: Francis Klein
  VP: Phillip Buelow
  Treasurer: Tom Feigenson
  Social Events Coordinator: Cory Hawley
  Professional Development: Nate Hilliard
  Outreach: Ben Reeve

The University Physical Society (UPS)—also known as the Physics Club—is a student organization for people interested in Physics and related fields.

What does the Physics Club do?

The Physics Club organizes events such as seminars, tours, trips, and socials for its members. Physics Club volunteers also offer free drop-in tutoring to students in introductory Physics and astronomy classes. In addition, we maintain subscriptions to science related magazines such as Scientific American, Astronomy, and Physics Today, which are kept in the club's room (2328 Chamberlin Hall) for students to read at their leisure. Every Friday afternoon, we meet with the Physics colloquium speaker for half an hour, so we can learn about the process of becoming a scientist.

The club also sponsors a variety of other events. For example, in the past, we took a trip down to Fermilab and sponsored a racquetball tournament. Who knows what we'll come up with this year? If you have any good ideas feel free to suggest something.

Why should you join the Physics Club?

By joining the Physics Club you'll be meeting many Physics majors, who are, in general, really cool people to hang out with. If you are even thinking about declaring a Physics major, this is the place to come for helpful advice about taking classes and getting a job in the Physics department. But even if you don't care about Physics, you're still quite welcome here. We like to meet all sorts of people. We are all truly laid back individuals and nobody should feel intimidated about approaching us.

If you join up, you can get access to the Physics Major's Room, 2328 Chamberlin Hall, which is a great place to study or goof off any time. The club room has computers on the net, a laser printer, and wireless access for your own laptop. Joining also adds you to the club e-mail list, so you can be notified about club sponsored events.

We also sell cheap soda.

Perks of being a Physics Club Member

When you join the Physics club, you get access to an excellent room, 2328 Chamberlin Hall. This room contains a refrigerator, reference shelves of textbooks, couch, tables, and chairs, a phone, blackboards, and a microwave. We have a several computers in the room. You can get your own key to the room and come visit at your leisure and stay as long as you like. Plus, you get the added bonus of knowing people that are in your classes (Yay! Study partners!).

Some of the Things We Do

There are organized and planned events such as:

Field trips to research facilities both inside and outside of UW... for instance, Fermilab, Argonne National Lab, the Madison Plasma Torus, and the UW Nuclear Accelerator. Trips are generally free, except for any food you choose to eat along the way.

Every week at selected times, there are tutors if you have some class related questions. UPS members are the tutors, so if you would like to get involved please e-mail the officers. You can find the current schedule for tutoring here.

And there are very random and basically non-educational things that we do from time to time to get to know each other better such as:

Ice cream socials, pizza parties, ice skating parties, movie night, card playing, pool, bowling, and just about anything else that we decide would be fun.

PEER MENTORING

Helpful Hints:

For more information

Physics Learning Center
2337/2338 Chamberlin

Susan Nossal
nossal@physics.wisc.edu
Tel: 262-9107

The Physics Learning Center: Striving to help all students succeed in Physics

- Do you enjoy Physics?
- Are you patient?
- Do you like to teach?
- Would you like to help other undergraduate students?

The Physics Learning Center (PLC) matches upper-level undergraduate students as tutor/mentors in small study groups with students studying introductory Physics (algebra-based Physics 103–104 and calculus-based Physics 207–208). Physics Peer Mentor Tutors meet twice a week with the same small group of students to overview key concepts, choose and supervise practice problems, answer questions, and serve as a mentor. We strive to create a supportive learning environment to help students gain skills, increase confidence, and meet potential study partners.

Peer Mentor Tutors receive extensive training in teaching Physics and in general pedagogy. Tutors meet with a PLC staff member each week to discuss strategies for teaching course content, including how to use teaching materials that stress conceptual understanding. In addition, tutors from all courses meet as a group for a weekly teaching seminar to discuss issues such as group dynamics, techniques for actively involving students in learning, helping students to prepare for exams, raising awareness of diversity in student experiences, resources on campus, etc.

Our Peer Mentor Tutors report that they greatly enjoy working with their students and in the process strengthen their own foundation in Physics and presentation skills. They also tell us that teaching Physics helps to review for the Graduate Record Exam and to prepare for post-graduate teaching in middle/high school or as a University teaching assistant.

Most of our tutors are upper-class students majoring in Physics, astrophysics, secondary science education, and engineering. We also welcome students from other fields if they have a strong Physics background. Students receive either independent study credit or a stipend for participation in the Physics Peer Mentor Tutor program. To apply, please submit a resume, your transcript (unofficial copy is fine), and a short statement about why you would like to be a Physics Peer Mentor Tutor (½–1 page).

UNDERGRADUATE STUDENT AWARDS

For More information

For more information go to www.physics.wisc.edu/awards

or contact the department of Physics:

E-mail: info@physics.wisc.edu
Tel: 262-4526

Application Process

The deadline for student applications for all awards will be March 1. All application materials will need to be submitted via the on-line system by 4:00 pm on or before March 1. No late applications will be accepted.

www.physics.wisc.edu/awards

To Apply

Please submit a statement of interest and how this award would help your education. If it is an award that is for financial need (Crabtree and Firminhac) you need to emphasize what the need is. If the award you are applying for also has a merit requirement, the department will run your transcript.

The Fay Ajzenberg-Selove Award is presented to undergraduate women majoring in Physics, Astronomy, or Physics/Astronomy for the purpose of encouraging women to continue their careers in science. Dr. Ajzenberg-Selove, who received her Ph.D. in Physics in 1952, is currently a Professor Emerita the University of Pennsylvania.

The Dr. Maritza Irene Stapanian Crabtree Award in Physics was established by William Crabtree to honor his wife, Dr. Maritza Crabtree, who graduated with a Physics degree in 1971. This annual award benefits undergraduate students in Physics based equally on merit and need.

The Bernice Durand Undergraduate Research Scholarship was established by Vice Provost/Physics Professor Bernice Durand to promote meaningful undergraduate research opportunities and to support and encourage women and ethnic minorities as undergraduate majors in the Departments of Physics and Astronomy.

The Henry and Eleanor Firminhac Physics Undergraduate Scholarship is given to undergraduates in Physics with financial need as the primary consideration. Funding provided by Ralph Firminhac in honor of his parents.

The L. R. Ingersoll Prize is given for distinguished achievement in introductory Physics. This prize is underwritten by a fund established by the family and friends of the late Professor Ingersoll, a distinguished physicist and teacher at the University who served as Department Chair for many years.

The Liebenberg Family Research Scholarship is for Physics, AMEP, or Astronomy/Physics majors. This scholarship opportunity was initiated by the Liebenberg family for the purpose of promoting undergraduate summer research opportunities.

The Albert Augustus Radtke Scholarship Award is given to outstanding junior or senior students majoring in Physics or Applied Mathematics Engineering and Physics. This award was made possible by a bequest of the late Mrs. Elizabeth S. Radtke in honor of her husband, a 1900 degree recipient from UW-Madison.

COLLOQUIA & SEMINARS

The Physics Department hosts a large number of colloquia and seminars each year. Check out the web for Colloquium & Seminar Notices (www.physics.wisc.edu/twap/).

Undergrads are sometimes shy about attending events they see advertised in the departmental weekly calendar. Don't be—the seminars and colloquia are open events that you are welcome to attend. The percentage of a talk that you will understand varies widely from one seminar to another, and from one speaker to another. If you can understand the title and it sounds interesting, then there is a fair chance you will be able to keep up for a while. (Keep in mind that many people there will not generally follow the whole talk.)

The Physics Colloquium on Friday afternoon is intended to be a broad-based presentation that physicists in all subfields will enjoy. When it adheres to that ideal, it is often accessible to undergrads.

The Astronomy Colloquium on Tuesday afternoon is often understandable. There is also the Astronomy Journal Club, usually given by grad students in astronomy and astrophysics at noon on Thursdays—sometimes straightforward. The Astrophysics Seminar on Thursday afternoons begins with a social period, proceeds to a talk which is addressed to a group with widely varying interests, and encourages questioning the speaker to death, often running overtime in the process. It's meant to be a place where those with astrophysical interests at all levels of experience can find a supportive interaction.

Most of the other topical seminars are usually very detailed talks for specialists in the fields, but if you watch the announcements you'll occasionally find one in which a speaker from outside the field is giving a more general talk. These can be quite interesting. Actually, the Chaos and Complex Systems Seminar at noon on Tuesday often has interesting and understandable sounding titles. The other topical seminars are: Plasma Physics, Medical Physics, High Energy Physics, Theoretical Physics, Atomic Physics, Nuclear Physics, and Solid State Physics.

QUICK NOTES

Seminar & Colloquium Notices

- www.physics.wisc.edu/twap/

Physics Colloquia

- 3:30 PM on Fridays
  2241 Chamberlin Hall

Undergrad Colloquium

- Spring Semester Only
  www.hep.wisc.edu/wsmith/p301syl.html
  1:20 PM on Tuesdays
  2223 Chamberlin

Related Colloquia & Seminars
http://www.physics.wisc.edu/twap/

- Astronomy Colloquium
- Chaos & Complex Systems
- High Energy Physics
- NPAC (Nuclear/Particle/Astro/Cosmo) Forums
- Plasma Physics (Physics/ECE/NE 922) Seminar
- R. G. Herb Materials Physics Seminar
- String Theory Seminar
- Theory/Phenomenology Seminar
- UW College of Engineering

Academic Year Seminars & Colloquia

- **Seminar & Colloquium Notices**
  Check out the website for the current seminar and colloquium schedule
  www.physics.wisc.edu/twap/
- **Spring Semester**
  The Undergrad Colloquium, 1:20 PM, Tuesdays, 2223 Chamberlin Hall
  In principle this is something similar to the Intro Seminar above, but it differs in several ways. It is pitched at undergrads directly. It consists of individual faculty talking about recent developments in their fields, as well as what is happening here, or being done by them. It is not a group effort as the intro seminar is, and it is not an advertisement to attract grad students to the group. It tends to try to be more educational.

Other Physics Related Events

- **PUMP**—Fall
- **Majors Meeting with Career Advisors/Resume Builders**—Fall
- **Undergraduate Graduation Reception for Graduating Majors**—Spring

Special Lectures and Colloquia

- **Holiday (Spoof) Colloquium**—Friday in December
- **Physics Club Events**
  Ice Cream—September
  Trips and Tours
  Pizza Meetings
  Check with the club for the most recent info on coming events.
- **Wonders of Physics**—February
- **Physics Fair**—February

GRADUATE SCHOOL

Helpful Hints

- **For More Information**
  Renee Lefkow
  Physics Graduate Coordinator

  2320H Chamberlin Hall
  Tel: 608.262.9678
  E-mail: physgrad@physics.wisc.edu
  Web: www.physics.wisc.edu

WHERE DO I START?

Application information for institutions other than UW-Madison should be requested directly from the school(s) to which you wish to apply. Many colleges and universities now have web sites available to provide you with all kinds of information, and most, if not all, allow you to apply electronically. Browse around to get your questions answered and to find a graduate school that meets your needs. You can learn about all the details, resources, and registration information for the GRE at their web site (www.gre.org). A copy of the GRE Information and Registration Bulletin can be downloaded from there as well. (Watch for advertisements of our annual practice GRE in the fall.) We generally recommend that our undergraduate majors consider attending graduate school elsewhere, but those who would like to apply should apply online at http://www.gradsch.wisc.edu/eapp/eapp.pl, and ask questions of the Physics Department Graduate Coordinator in Room 2320H Chamberlin Hall.

Renee Lefkow
Physics Graduate Coordinator

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