**PHYSICS, B.A.**

**WELCOME TO THE UW-MADISON DEPARTMENT OF PHYSICS**

We have a long history of providing our students with a great educational experience. Our physics department awarded its first Ph.D. in 1899. Since then, our students have earned degrees in virtually every area of physics, and our faculty have played key roles in a myriad of important research efforts.

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.

**CHOOSING TO BE A PHYSICS MAJOR**

**WHY STUDY PHYSICS?**

- **Intellectual Satisfaction.** First, and foremost, physics satisfies our deep desire to understand how the universe works. Physics is interesting.
- **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.
- **Physics Produces New Technology.** Today’s esoteric physics research will become tomorrow’s technological advances.
- **Technical Expertise.** Physicists exploit forefront technologies in their pursuits.
- **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.
- **Physics is Analytical and Quantitative.** People who can reason analytically and quantitatively are essential for the success of almost any pursuit.

**YOUR FUTURE IS SO BRIGHT...**

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 education 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.

**PHYSICS MENTOR PROGRAM**

Any student contemplating becoming a physics major is encouraged to obtain a faculty mentor. A mentor is a faculty member with whom students can discuss physics, courses, careers, graduate schools, aspirations, etc. Mentors are not primarily academic advisors. Information is available at the department office.

**OTHER PROGRAMS**

**AMEP**


**Astronomy-Physics**

Students interested in an astronomy–physics major should contact the astronomy department ([http://guide.wisc.edu/undergraduate/letters-science/astronomy](http://guide.wisc.edu/undergraduate/letters-science/astronomy)).

**Education-Physics**

A student working toward the Bachelor of Science–Education degree may major or minor in physics. Interested students should contact the School of Education ([http://guide.wisc.edu/undergraduate/education](http://guide.wisc.edu/undergraduate/education)). Upon request, the physics department will assign an advisor.

**Medical-Physics**

A suggested curriculum for students interested in graduate study in medical physics is available in the medical physics ([https://www.medphysics.wisc.edu](https://www.medphysics.wisc.edu)) department office.

**HOW TO GET IN**

**TO DECLARE A PHYSICS MAJOR**

Students must declare the physics major by filing out a major declaration form, signed by a physics undergraduate advisor. They should talk with one of the undergraduate advisors as soon as they know they 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 UW–Madison campus, and we encourage them to do this as early as possible. They must have a 2.5 GPA in physics and math courses taken at UW–Madison at the time they declare. In all cases, the major must be declared before the semester of graduation. The form can be obtained at the department office in 2320 Chamberlin Hall. Note: Students should bring a copy of their current course history when they talk with the undergraduate advisor.

**ENGINEERING AND OTHER NON-L&S MAJORS SEEKING AN ADDITIONAL MAJOR IN PHYSICS**

An undergraduate in any college other than Letters & 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 L&S need to be satisfied. Students majoring in any other program that is not in 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.
## UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

### Requirements Detail

**General Education**
- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

## COLLEGE OF LETTERS & SCIENCE BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF ARTS (B.A.)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)

### BACHELOR OF ARTS DEGREE REQUIREMENTS

#### Requirements Detail

**Mathematics**
- Fulfilled with completion of University General Education requirements Quantitative Reasoning a (QR A) and Quantitative Reasoning b (QR B) coursework. Please note that some majors may require students to complete additional math coursework beyond the B.A. mathematics requirement.

**Foreign Language**
- Complete the fourth unit of a foreign language; OR
- Complete the third unit of a foreign language and the second unit of an additional foreign language

Note: A unit is one year of high school work or one semester/term of college work.

## REQUIREMENTS FOR THE MAJOR

The physics major requires **35 credits** from the following:

### Code | Title
--- | ---
PHYSICS 247 | A Modern Introduction to Physics (recommended) ¹
PHYSICS 207 | General Physics
PHYSICS 201 | General Physics
EM A 201 & EM A 202 | Statics and Dynamics ²
EM A 201 & M E 240 | Statics and Dynamics ²

Select one of the following First Introductory Courses: 5

**Introductory Physics**

Select one of the following Second Introductory Courses: 5

**Select one of the following Third Introductory Courses:** 3-4

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<thead>
<tr>
<th>Code</th>
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<tr>
<td>PHYSICS 248</td>
<td>A Modern Introduction to Physics (recommended)</td>
</tr>
<tr>
<td>PHYSICS 208</td>
<td>General Physics</td>
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<tr>
<td>PHYSICS 202</td>
<td>General Physics</td>
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<tr>
<th>Code</th>
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<tr>
<td>PHYSICS 249</td>
<td>A Modern Introduction to Physics (recommended)</td>
</tr>
<tr>
<td>PHYSICS 205</td>
<td>Modern Physics for Engineers</td>
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<tr>
<td>PHYSICS 241</td>
<td>Introduction to Modern Physics</td>
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<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>PHYSICS 244</td>
<td>Modern Physics (Primarily for ECE Majors)</td>
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Core Physics  
- PHYSICS 311 Mechanics  
- Select one of the following options:  
  Option 1:  
  - PHYSICS 322 Electromagnetic Fields  
  Option 2:  
  - ECE 220 Electrodynamics I  
  - ECE 320 Electrodynamics II  
  - ECE 420 Electromagnetic Wave Transmission  
- Select one of the following:  
  - PHYSICS 415 Thermal Physics  
  - CHEM 561 & CHEM 562 Physical Chemistry and Physical Chemistry  
  - M 361 Thermodynamics  
- Select one of the following:  
  - PHYSICS 448 Atomic and Quantum Physics and Atomic and Quantum Physics (recommended)  
  - PHYSICS 531 Introduction to Quantum Mechanics  
- Laboratory  
- Select 6 credits from the following:  
  - PHYSICS 307 Intermediate Laboratory-Mechanics and Modern Physics  
  - PHYSICS 308 Intermediate Laboratory-Electromagnetic Fields and Optics  
  - PHYSICS 407 Advanced Laboratory  
  - Two credits apply for each of these courses:  
  - PHYSICS 321 Electric Circuits and Electronics  
  - PHYSICS 623 Electronic Aids to Measurement  
  - PHYSICS 625 Applied Optics  
  - N 427 Nuclear Instrumentation Laboratory  
  - N 428 Nuclear Reactor Laboratory  
  - One credit applies for each of these courses:  
  - ECE 305 Semiconductor Properties Laboratory  
  - ECE 313 Optoelectronics Lab  
- Select additional electives to reach 35-credit minimum for the major:  
  - Advanced Physics Electives  
  - PHYSICS 301 Physics Today  
  - PHYSICS 325 Wave Motion and Optics  
  - PHYSICS 406 Special Topics in Physics  
  - PHYSICS/ENVIR ST 472 Scientific Background to Global Environmental Problems  
  - PHYSICS/B M E/H ONCOL/MED PHYS/PHMCO-M/RADIOL 619 Radiological Physics and Dosimetry  
  - PHYSICS 507 Graduate Laboratory  
  - PHYSICS/ECE 525 Introduction to Plasmas  
  - PHYSICS/ECE 527 Plasma Confinement and Heating  

1. It is recommended that students follow one of the sequences PHYSICS 247–PHYSICS 248, PHYSICS 207–PHYSICS 208, or PHYSICS 201–PHYSICS 202 for the first two courses, and PHYSICS 249 or PHYSICS 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–PHYSICS 248–PHYSICS 249 sequence from another introductory sequence.  
2. A maximum of 5 credits from EMA 201, EMA 202 and M 240 count toward the 35 required.  
3. A maximum of 3 credits from ECE 220 and ECE 320 and ECE 420 apply toward the 35 required.  
4. A maximum of 3 credits from CHEM 561 and CHEM 562 apply toward the 35 required.  
5. For nonphysics courses, students will receive only the credit applied as lab toward the 35 credits requirement.  
6. It is recommended that the student’s program include the seminar PHYSICS 301 Physics Today.

RESIDENCE AND QUALITY OF WORK IN THE MAJOR  
- 2.000 GPA in all PHYSICS and major courses  
- 2.000 on at least 15 credits in upper-level work taken in residence: courses in Core, Laboratory, and Advanced Physics Electives  
- 15 credits in PHYSICS, taken on campus

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:  
- 3.300 university GPA  
- 3.300 GPA in all major and major subject (physics) courses  
- 6 additional credits in advanced-level physics beyond the minimum required for the major.

THESIS OF DISTINCTION  
An exceptional original thesis will be designated as a Thesis of Distinction upon recommendation by the department.

MATHEMATICS  
MATH 221–MATH 222–MATH 234 or equivalents are necessary since they are prerequisites for other courses.
CHEMISTRY
A college course in chemistry is advised for all physics students.

COMPUTING
Students should become familiar with scientific programming using a language such as C or FORTRAN. The computer sciences department offers introductory courses (such as 302). The Division of Information Technology (DoIT) also offers short courses to introduce programming.

HONORS IN THE MAJOR
Students may declare Honors in this Major in Physics in consultation with their major advisor.

HONORS IN THE PHYSICS MAJOR REQUIREMENTS
To earn a B.A. or B.S. with Honors in the Major in Physics students must satisfy both the requirements for the major (above) and the following additional requirements:

• Earn a 3.300 university GPA
• Earn a 3.300 GPA in all PHYSICS courses, and all courses accepted in the major
• Complete 12 credits for Honors in courses counting in the major, to include:
  • 9 credits at the advanced level
  • A two-semester Senior Honors Thesis in PHYSICS 681 Senior Honors Thesis and PHYSICS 682 Senior Honors Thesis for a total of 6 credits

UNIVERSITY DEGREE REQUIREMENTS

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<tr>
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<th>Detail</th>
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<tr>
<td>Total Degree</td>
<td>To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.</td>
</tr>
<tr>
<td>Residency</td>
<td>Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. &quot;In residence&quot; means on the UW–Madison campus with an undergraduate degree classification. &quot;In residence&quot; credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.</td>
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<tr>
<td>Quality of Work</td>
<td>Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.</td>
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LEARNING OUTCOMES
The physics curriculum is intended to provide a broad and thorough understanding of the fundamental properties and interactions underlying physical phenomena (including mechanical behaviors, electrical and magnetic sources and interactions, light and optics, heat, relativity of space time, quantum mechanics, atomic and nuclear structure, solid state matter, etc). Many students who major in physics as undergraduates enter graduate schools for work leading to the M.S. or Ph.D. degrees. Others seek employment in a wide range of fields in government, business, and industry. Since current research, both pure and applied, involves interdisciplinary efforts, the broad training of physics with its stress on fundamentals proves to be a valuable experience.

ADVISING AND CAREERS

PHYSICS UNDERGRADUATE ADVISORS
Professor Dan McCammon
6207 Chamberlin Hall
608-262-5916

Professor Stefan Westerhoff
4209 Chamberlin Hall
608-262-3989

Professor Michael Winokur
5106 Chamberlin Hall
608-262-5425

AMEP Advisor
Professor Cary Forest
3277 Chamberlin Hall
608.263.0486

CAREER RESOURCES
The UW Department of Physics encourages our majors to begin working on their career exploration and preparation soon after arriving on campus. We partner with the L&S Career Services office to help you leverage the academic skills learned in your major and liberal arts degree, explore and try out different career paths, participate in internships, prepare for the job search and/or graduate school applications, and network with professionals in the field (alumni and employers).

Letters & Science graduates are in high demand by employers and graduate programs. It is important to us that our students are career ready at the time of graduation, and we are committed to your success.

Career Resources:
• Why the liberal arts? (http://ls.wisc.edu/about/why-liberal-ar ts)
• Set up a Career Advising Appointment (http://careers.ls.wisc.edu/Undergraduate-Advising.htm)
• L&S Career Services (http://careers.ls.wisc.edu/students.htm): We launch our students higher, sooner
• INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)
• Learn how we’re transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/about/lsci?p=careerinitiative.html)

Additional Resources:
• Link to physics department advising page (https://www.physics.wisc.edu/undergrads/resources/advising)
• Link to physics department student jobs and research opportunities (https://www.physics.wisc.edu/resources/employment/student-jobs)
PEOPLE

FACULTY

Yang Bai (https://www.physics.wisc.edu/people/yangbai), Associate Professor

Baha Balantekin (https://www.physics.wisc.edu/people/bahabalantekin), Professor

Vernon Barger (https://www.physics.wisc.edu/people/vernon-dbarger), Professor

Stas Boldyrev (https://www.physics.wisc.edu/people/stanislavboldyrev), Professor

Victor Brar (https://www.physics.wisc.edu/people/victorbrar), Assistant Professor

Duncan Carlsmith (https://www.physics.wisc.edu/people/duncancarlsmith), Professor

Daniel Chung (https://www.physics.wisc.edu/people/daniel-jchung), Professor

Susan Coppersmith (https://www.physics.wisc.edu/people/susan-coppersmith), Professor

Sridhara Dasu (https://www.physics.wisc.edu/people/sridharadasu), Professor

Jan Egedal (https://www.physics.wisc.edu/people/janegedal), Associate Professor

Mark Eriksson (https://www.physics.wisc.edu/people/markeriksson), Professor

Lisa Everett (https://www.physics.wisc.edu/people/lisa-leverett), Professor

Cary Forest (https://www.physics.wisc.edu/people/cary-bforest), Professor

Pupa Gilbert (https://www.physics.wisc.edu/people/pupagilbert), Professor

Francis Halzen (https://www.physics.wisc.edu/people/francis-ihalzen), Professor

Kael Hanson (https://www.physics.wisc.edu/people/kael-dhanson), Professor

Aki Hashimoto (https://www.physics.wisc.edu/people/akihashimoto), Professor

Matthew Herndon (https://www.physics.wisc.edu/people/matthew-herndon), Professor

Lev Ioffe, Professor

Robert Joynt (https://www.physics.wisc.edu/people/robert-joynt), Professor

Albrecht Karle (https://www.physics.wisc.edu/people/albrechtkarle), Department Chairperson and Professor

James Lawler (https://www.physics.wisc.edu/people/james-elawler), Professor

Alex Levchenko (https://www.physics.wisc.edu/people/alexlevchenko), Assistant Professor

Chun Lin (https://www.physics.wisc.edu/people/chun-clin), Professor

Dan McCammon (https://www.physics.wisc.edu/people/dannmccammon), Professor and Undergraduate Advisor

Robert McDermott (https://www.physics.wisc.edu/people/robert-fmdermott), Professor

Marshall Onellion (https://www.physics.wisc.edu/people/marshall-onellion), Professor

Kimberly Palladino (https://www.physics.wisc.edu/people/kimberly-jpalladino), Assistant Professor

Yibin Pan (https://www.physics.wisc.edu/people/yibinpan), Associate Professor

Mark Rzchowski (https://www.physics.wisc.edu/people/markrzchowski), Associate Chair and Professor

Mark Saffman (https://www.physics.wisc.edu/people/mark-saffman), Professor

John Sarff (https://www.physics.wisc.edu/people/john-ssarff), Professor

Gary Shiu (https://www.physics.wisc.edu/people/garyshiu), Professor

Wesley Smith (https://www.physics.wisc.edu/people/wesley-hsmith), Professor

Paul Terry (https://www.physics.wisc.edu/people/paul-wterry), Professor

Peter Timbie (https://www.physics.wisc.edu/people/peter-ttimbie), Professor

Justin Vandenbroucke (https://www.physics.wisc.edu/people/justinvandenbroucke), Assistant Professor

Maxim Vavilov (https://www.physics.wisc.edu/people/maxim-gvavilov), Professor

Thad Walker (https://www.physics.wisc.edu/people/thad-gwalker), Professor

Stefan Westerhoff (https://www.physics.wisc.edu/people/stefanwesterhoff), Professor and Undergraduate Advisor

Michael Winokur (https://www.physics.wisc.edu/people/michael-jwinokur), Professor and Undergraduate Advisor

Sau Lan Wu (https://www.physics.wisc.edu/people/sau-lanwu), Professor

Deniz Yavuz (https://www.physics.wisc.edu/people/deniz-yavuz), Professor

Ellen Zweibel (https://www.physics.wisc.edu/people/ellen-gzweibel), Professor
Physics Learning Center: Striving to help all students succeed in Physics

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–PHYSICS 104 and calculus-based PHYSICS 207–PHYSICS 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, and so on.

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 postgraduate teaching in middle/high school or as a university teaching assistant. Most 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 (1/2–1 page).

Physics Learning Center
2337/2338 Chamberlin Hall
Contact: Susan Nossal
2328 Chamberlin Hall
nossal@physics.wisc.edu
608-262-9107

Astronomy
Physics, B.A.

Student Awards

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 (applied mathematics, engineering, and physics) 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 AMEP. 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.

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**For more information.** Go to [www.physics.wisc.edu/awards](http://www.physics.wisc.edu/awards) or contact info@physics.wisc.edu.

**Application Process.** The deadline for student application materials is March 15th. No late applications will be accepted.

**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.