MEDICAL PHYSICS, PH.D.

One of the basic science departments of the UW–Madison School of Medicine and Public Health, the Department of Medical Physics offers comprehensive training in diagnostic and therapeutic medical physics and in health physics. Achievement of the Ph.D. degree in this department reflects strong scholarship and research skills in one of the top medical physics programs in North America. Graduates are prepared for teaching and/or research positions in universities, national laboratories, or in the medical and nuclear technology industries. Graduates are also prepared for admission into medical physics residency programs to become board eligible for clinical medical physics positions.

Medical physicists may participate professionally in the treatment of patients, in advanced medical imaging and diagnostic procedures, or in related areas of research and teaching. Health physicists may operate radiation protection programs at nuclear industrial facilities, hospitals, or laboratories, or may perform research on methods of measuring ionizing radiations (i.e., dosimetry).

A unique quality of the medical physics program is the broad range of expertise and research interests of the faculty. Students receive training in diagnostic x-ray physics, x-ray computerized tomography (CT), magnetic resonance imaging (MRI) and spectroscopy, nuclear medicine and positron emission tomography (PET) imaging, biomagnetism, medical ultrasound, elastography, radiation dosimetry, radiation treatment planning, and radiobiology.

The department also houses the Medical Radiation Research Center and the Accredited Dosimetry Calibration Laboratory, one of four in the U.S. accredited by the American Association of Physicists in Medicine. In addition, the department provides clinical support services to the radiology and human oncology departments. It also operates a PET radiotracer production facility (with two cyclotrons available), a medical image analysis laboratory, and a small bore MRI scanner and photoacoustic ultrasound system in the Small Animal Imaging Facility. Each of these facilities provides unique training and support opportunities for graduate students. Access to state-of-the-art x-ray angiography, CT, MRI, and PET/CT and PET/MR systems is readily available.

The Ph.D. degree is primarily a research degree that extends the student’s depth of knowledge in one of the specialty areas. Faculty positions at universities, research positions, and an increasing number of clinical physics positions require the Ph.D. degree. Medical physics faculty maintain close collaborative ties with faculty in other departments, including human oncology, radiology, cardiology, medicine, psychiatry, pharmacology, and biomedical engineering, broadening the scope of research opportunities open to medical physics students and providing access to sophisticated clinical facilities.

ADMISSIONS

About 100–125 applicants per year apply to the medical physics program. Each fall, the program admits 15–20 students. This results in an average enrollment of approximately 100 students each semester. Less than one-fifth of the students pursue the M.S. degree as a terminal degree, and the remainder continue on to the Ph.D.

A bachelor’s degree in physics is considered the best preparation for graduate study in medical physics, but majors such as nuclear engineering, biomedical engineering, electrical engineering, or chemistry may also be acceptable. The student’s math background should include calculus, differential equations, linear algebra, and Fourier analysis, such as might be learned in modern optics or undergraduate quantum theory. Some facility in computer programming and electronic instrumentation is desirable. One year of chemistry, a year of biology, and an introductory course in physiology are also advantageous.

Beginning graduate students should start their studies in the fall semester, as the course sequence is based on that assumption. Students applying for admission should submit an online application and all supporting documentation by December 1 (for domestic applications; international applications are due November 15), to ensure consideration for admission and financial support to begin the following fall.

Admission to the graduate program is competitive. Applications are judged on the basis of a student’s previous academic record, Graduate Record Exam (GRE) scores, research experience, letters of recommendation, and personal statement of reasons for interest in graduate study in medical physics.

The application process is in two parts:

1. Complete the online application to the Graduate School and pay application fee.
2. Provide electronic copies of resume (include awards, fellowships, and scholarships received, publications, volunteer activities, and research experience); the “applicant data sheet”; personal statement of reasons for interest in graduate study in medical physics; and mail two official sets of paper transcripts to the department. Note: Recommendation letters are submitted electronically through the online application. To report Graduate Record Exam (GRE) scores, use Institution Code 1846 for the University of Wisconsin–Madison.

GRADUATE SCHOOL ADMISSIONS

Graduate admissions is a two-step process between academic degree programs and the Graduate School. Applicants must meet requirements of both the program(s) and the Graduate School. Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/admissions).

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding) is available from the Graduate School. Be sure to check with your program for individual policies and processes related to funding.

PROGRAM RESOURCES

The department typically supports 85–95 percent of students enrolled in the medical physics graduate program through department or university fellowships, research or teaching assistantships, or NIH NRSA training grant appointments. All awards include a comprehensive health insurance program and remission of tuition. The student is responsible for segregated fees.
REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

<table>
<thead>
<tr>
<th>Mode of Instruction Definitions</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to Face</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Evening/Weekend</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Online</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hybrid</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Accelerated</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Mode of Instruction Definitions

- **Evening/Weekend**: These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.
- **Online**: These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.
- **Hybrid**: These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.
- **Accelerated**: These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

CURRICULAR REQUIREMENTS

<table>
<thead>
<tr>
<th>Minimum Credit Requirement</th>
<th>54 credits</th>
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<tbody>
<tr>
<td>Minimum Residence Credit Requirement</td>
<td>42 credits</td>
</tr>
<tr>
<td>Minimum Graduate Coursework Requirement</td>
<td>Seventy-five percent of degree coursework (40 credits out of 54 total credits) must be in graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university's Course Guide (<a href="http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle">http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle</a>).</td>
</tr>
<tr>
<td>Overall Graduate GPA Requirement</td>
<td>3.00 GPA required.</td>
</tr>
</tbody>
</table>

Other Grade Requirements

- The Graduate School requires an average grade of B or better in all coursework (300 or above, not including research credits) taken as a graduate student unless conditions for probationary status require higher grades. Grades of Incomplete are considered to be unsatisfactory if they are not removed during the next enrolled semester.

Assessments and Examinations

- Candidates are expected to take the Oral Ph.D. Qualifying Examination by the end of the second year of study, and to take the Ph.D. Preliminary Examination by the end of the third year of study. Permission of the Graduate Committee is required if the Ph.D. Preliminary Examination must be taken after the end of the third year. Defense of a dissertation is required within five years of successful completion of the Ph.D. Preliminary Examination.

Language Requirements

- No language requirements.

REQUIRED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MED PHYS/ B M E/H ONCOL/ PHYSICS 501</td>
<td>Radiological Physics and Dosimetry</td>
<td>3</td>
</tr>
<tr>
<td>MED PHYS/ PHYSICS 563</td>
<td>Radionuclides in Medicine and Biology</td>
<td>2-3</td>
</tr>
<tr>
<td>MED PHYS/ B M E 566</td>
<td>Physics of Radiotherapy</td>
<td>4</td>
</tr>
<tr>
<td>MED PHYS/ B M E 567</td>
<td>The Physics of Diagnostic Radiology</td>
<td>4</td>
</tr>
<tr>
<td>MED PHYS/N E 569</td>
<td>Health Physics and Biological Effects</td>
<td>3-4</td>
</tr>
<tr>
<td>MED PHYS/ B M E 573</td>
<td>Medical Image Science: Mathematical and Conceptual Foundations</td>
<td>3</td>
</tr>
<tr>
<td>MED PHYS/ B M E 578</td>
<td>Non-Ionizing Diagnostic Imaging</td>
<td>3</td>
</tr>
<tr>
<td>MED PHYS 701</td>
<td>Ethics and the responsible conduct of research and practice of Medical Physics</td>
<td>1</td>
</tr>
<tr>
<td>MED PHYS 900</td>
<td>Journal Club and Seminar</td>
<td>4</td>
</tr>
</tbody>
</table>

Required Courses for Health Physics Emphasis

- Course in anatomy/physiology chosen in consultation with advisor.

Health Physics Track

In addition to the above requirements, students completing the Health Physics emphasis must take the following courses:

<table>
<thead>
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<th>Code</th>
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<th>Credits</th>
</tr>
</thead>
</table>
Medical Physics, Ph.D.

N E 427 Nuclear Instrumentation Laboratory 2
N E 571 Economic and Environmental Aspects of Nuclear Energy 3

One (1) credit of an independent reading course on Health Physics Rules and Regulations.

Electives

6 elective credits are required, and Anatomy for 3 credits or Physiology for 5 credits (or alternative) is required as one of the electives.

An exemption from the Core Curriculum requirement requires the approval of the chair of the graduate committee. If the entirety of the Core Curriculum is not taken, the student will not satisfy the CAMPEP Core Curriculum requirement.

These tracks are internal to the program and represent different pathways a student can follow to earn this degree. Track names do not appear in the Graduate School admissions application, and they will not appear on the transcript.

Policies

Graduate School Policies

The Graduate School’s Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

Major-Specific Policies

Graduate Program Handbook

The Graduate Program Handbook (https://www.medphysics.wisc.edu/graduate/documents/handbook.pdf) is the repository for all of the program’s policies and requirements.

Prior Coursework

Graduate Work from Other Institutions

With program approval, students are allowed to count no more than 12 credits of medical physics graduate coursework from other institutions. coursework earned five years or more prior to admission to the doctoral degree program is not allowed to satisfy requirements.

UW–Madison Undergraduate

With program approval, 7 credits in medical physics courses from a UW–Madison undergraduate degree above the undergraduate graduation requirements are allowed to count toward the degree.

UW–Madison University Special

With program approval, students are allowed to count no more than 15 credits of coursework numbered 500 or above taken as a UW–Madison Special student. coursework earned five years or more prior to admission to the doctoral degree program is not allowed to satisfy requirements.

Probation

For a graduate student in the Medical Physics Department who is a research assistant, fellow or trainee, to be making satisfactory progress, he/she must:

1. Obtain at least a 3.0 GPA in the most recent semester. Grades in all research courses and courses with grades of P, F, S or U are excluded from the average. A student who fails to make satisfactory progress will be dropped from the department. In exceptional cases, the chairperson may grant permission to continue for a specified probationary period.

2. Maintain a minimum cumulative GPA of 3.0 for all courses taken while in the Medical Physics program and for all Department of Medical Physics courses. All research courses and all courses with grades of P, F, S or U are excluded from the average.

3. Have taken the qualifier examination by the end of the 2nd semester of study. If a basic (low level) pass is not obtained on the first attempt, the second (and last) attempt to pass the qualifier examination must be made no later than the 4th semester.

Any student, who fails to meet the requirements of 1-3 above, will be placed on probation. Failure in the first semester of probation to obtain a 3.0 average for the semester and a cumulative GPA of at least 3.0 will result in termination unless the student’s advisor requests and the department and the Graduate School approves, continued enrollment. The particular courses which count toward the GPA in any probation semester must be approved in writing by the student’s advisor and the Medical Physics Graduate Committee Chairman in order for the work to count toward returning the student to good standing.

Advisor / Committee

Candidates must acquire a major professor/advisor by the beginning of the second semester of study.

Credits Per Term Allowed

15 credits

Time Constraints

The oral Ph.D. qualifying examination should be taken by the end of the second year, and the Ph.D. preliminary examination should be taken by the end of the third year of study. Permission of the graduate committee is required if the Ph.D. preliminary examination must be taken after the end of the third year. Defense of a dissertation is required within five years of successful completion of the Ph.D. preliminary examination.

Other

Most students are funded with research assistantships through the research programs of their advisors. A limited number of traineeships are available to advanced students in the UW Radiological Sciences Training Program for career training in cancer research. Other fellowships are also available to qualified students (e.g., AAPM, Cardiovascular and Neurological Sciences Training Programs, Advanced Opportunity Fellowship Program).
PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (https://grad.wisc.edu/pd) to build skills, thrive academically, and launch your career.

LEARNING OUTCOMES

1. Articulates research problems, potentials, and limits with respect to theory, knowledge, or practice within the field of medical physics.

2. Formulates ideas, concepts, designs, and/or techniques beyond the current boundaries of knowledge within the field of medical physics.

3. Creates research, scholarship, or performance that makes a substantive scientific contribution.

4. Demonstrates breadth within their learning experiences.

5. Advances contributions of the field of medical physics to society.

6. Communicates complex ideas in a clear and understandable manner in both oral and written formats.

7. Fosters ethical and professional conduct.

PEOPLE

Faculty: Professors Jackson (chair), Alexander, Bayouth, Block, Campagnola, Chen, Christian, DeJesus, DeWerd, Fain, Grist, Hall, Henderson, Jeraj, Korosec, Meyerand, Peppler, Reeder, Thomadsen, Varghese, Wakai; Associate Professors Birn, Brace, Bednarz, Cai, Emborg, Ranallo, Vetter, Weichert, Wieben; Assistant Professors Culberson, Engle, Li, Nagle, Prabhakaran, Szczytkowicz, Smilowitz, Speidel; Emeritus Professors DeLuca, Holden, Mackie, Mistretta, Nickles, Paliwal, Zagzebski

ACCREDITATION

Accreditation

Commission on Accreditation of Medical Physics Education Programs (http://www.campep.org)