



Introduction to Medical Physics

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Outline

- What is medical physics?
- Subfields of medical physics
 - Radiation Therapy
 - Diagnostic Imaging
 - Nuclear Medicine
 - Health Physics
 - Magnetic Resonance Imaging
- How do you become a medical physicist?
- Things you should know
- Where to go from here
- Q & A

What is medical physics?

- According to the AAPM:
“Medical Physics is an applied branch of physics concerned with the application of the concepts and methods of physics to the diagnosis and treatment of human disease.”



<https://www.medicalradiationinfo.org>

What does a medical physicist do?

- It depends on your subfield/focus!

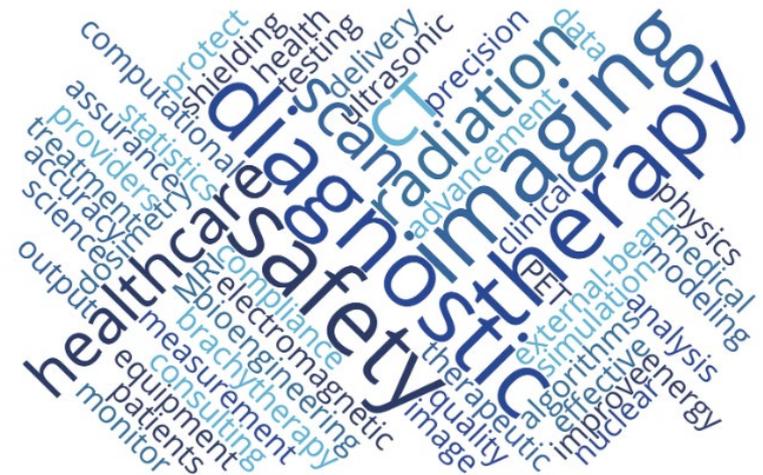
- **Radiation Therapy** 

- **Diagnostic Imaging** 

- **Nuclear Medicine** 

- **Health Physics** 

- **Magnetic Resonance Imaging** 

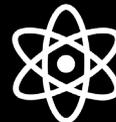


Radiation Therapy

- Therapy Equipment
 - CT Simulator
 - LINAC
 - Proton Therapy
 - Afterloader

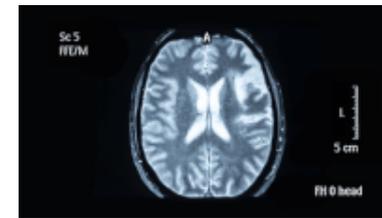
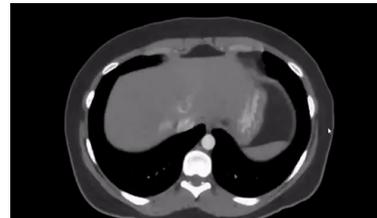
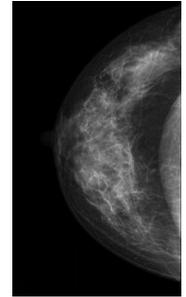


- **Physicist's role:** Frequently test equipment, develop treatment protocols, work to make treatments/clinic more effective and efficient, help plan and quality assure radiation therapy treatments, and much much more!

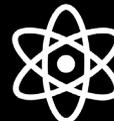


Diagnostic Imaging

- Imaging modalities:
 - Radiography (i.e. X-ray)
 - Fluoroscopy (i.e. video X-ray)
 - Mammography (i.e. breast X-ray)
 - CT (computed tomography)
 - MRI (magnetic resonance imaging)
 - Ultrasound
 - Nuclear Medicine

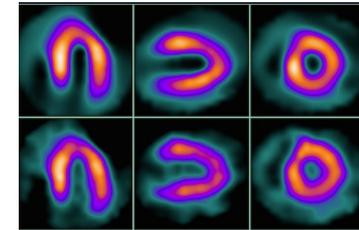
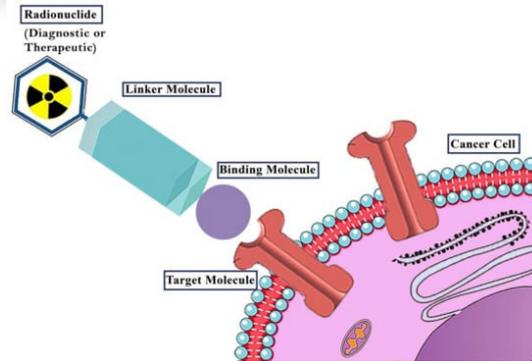


- **Physicist's role:** Test equipment annually, perform radiation dose estimates, work to improve image quality/lower radiation dose, and so much more!



Nuclear Medicine

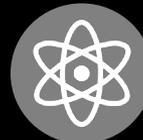
- Diagnostic:
 - Planar
 - SPECT
 - PET
- Therapeutic:
 - I-131 for thyroid cancer
 - Lu-177 for prostate cancer
- Physicist's role: Test imaging equipment, perform pre- and post-treatment dosimetry, conduct quantitative data analysis, and more!



CT Scan
Organs and bones

PET Scan
Cell activity

PET/CT Scan*
Exact location of high cell activity



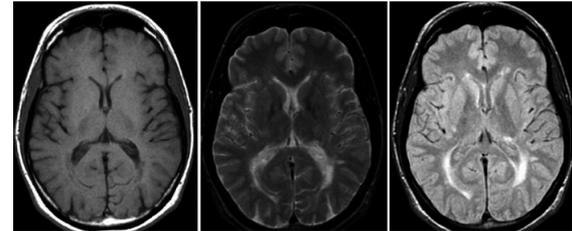
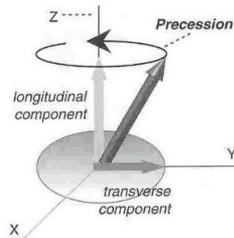
Health Physics

- **Physicist's role:** "protect people and their environment from potential radiation hazards while making it possible to enjoy the beneficial uses of radiation"
- Can work in a variety of disciplines
 - Research, industry, education, environmental protection, and enforcement of government regulations



Magnetic Resonance Imaging

- Physicist is in charge of
 - Ensuring that MRI equipment produces adequate image quality
 - Optimizing and developing MRI sequences
 - Understanding the principles of MRI safety and implementing safety protocols for patients and staff



How do you become a medical physicist?



Attend a CAMPEP-
accredited
Graduate Program
(MS, PhD, or both)

ABR Part 1 Exam
(General, Written)



Participate in a
Residency
(Therapy or
Imaging)

ABR Part 2 Exam
(Focus-Specific,
Written)



Work for an
Institution or
Firm
(Hospital or
Consulting)

ABR Part 3 Exam
(Focus-Specific, Oral)

*CAMPEP: Commission on Accreditation of Medical Physics Education Programs
ABR: American Board of Radiology*

Graduate program

Purpose: Didactic training in broad range of medical physics topics

- >70 CAMPEP-accredited **MS, PhD** programs
 - Coursework determined by CAMPEP, similar between institutions
 - 2-6 years to complete
 - Tuition and financial assistance are program-dependent
- Academic hospital
- Clinical experience!

CAMPEP



Graduate program



School of Medicine
Medical Physics Program

Applying for grad school:

- OHSU Medical Physics Graduate Program prerequisites:
 - B.S. in physics, engineering, radiation health physics, or other physical science
 - Students must have at least the equivalent of a physics minor to be offered admission
 - Physics Minor Equivalent = 2 Basic Physics courses (and labs) + 3 upper level (300/400) Physics courses
 - 3.0 cumulative GPA for all undergraduate coursework
 - General GRE must be taken (no score requirement)
- Applications open September – January

For Admission stats: <https://www.ohsu.edu/school-of-medicine/medical-physics-graduate-program/program-effectiveness>



ALL First Year Medical Physics Students

Year / Term	Required -or- Optional	Designation	Number	Major Core Course Title	Credits
Fall Term: September 26 - December 16, 2022					
Y1 Fall	Required:	MGRD	650	Practice and Ethics of Science	1
		MP	521	Radiological Anatomy & Physiology	3
		MP	531	Radiophysics	3
		IPE	501	Interprofessional Education (auto-enroll)	0.25
		BSTA	525	Introduction to Biostatistics	4
		MP	507	Matriculation Seminar (required)	1
Winter Term: January 9 - March 24, 2023					
Y1 Winter	Required:	MP	561	Therapy Physics I	3
		MP	541	Diagnostic Physics I	3
		MP	535	Rad Shielding and External Dosimetry	3
		IPE	501	Interprofessional Education (auto-enroll)	0.25
Spring Term: April 3 - June 23, 2023					
Y1 Spring	Required:	MP	562	Therapy Physics II	3
		MP	542	Diagnostic Physics II	3
		MP	570	Radiation Biology	3
		IPE	501	Interprofessional Education (auto-enroll)	0.5
		MP	507	Diagnostic Physics Journal Club (observe)	0
		MP	507	Therapy Physics Journal Club (observe)	0
Summer Term: June 26 - September 15, 2023					
Y1 Summer	Required:	MP	536	Advanced Radiation Detection (Summer A)	3
		MP	545	Diagnostic Physics Practicum (Summer B)	3
		MP	565	Therapy Physics Practicum (Summer B)	3

Year Two Medical Physics Students Radiation Therapy Physics Track

Year / Term	Required -or- Optional	Designation	Number	Major Core Course Title	Credits
Fall Term: September 26 - December 16, 2022					
Y2 Fall	Required:	MP	563	Therapy Physics Lab I	2
		MP	543	Advanced Diagnostic Imaging (MRI)	3
		MP	544	Nuclear Medicine Imaging	3
		MP	503	Thesis	1
<i>This Term: Finalize advisor and MS thesis committee (submit forms)</i>					
Winter Term: January 9 - March 24, 2023					
Y2 Winter	Required:	MP	564	Therapy Physics Lab II	2
		MP	503	Thesis	4
<i>This Term: Complete all MS research data gathering - start thesis</i>					
Spring Term: April 3 - June 23, 2023					
Y2 Spring	Required:	MP	503	Thesis	4
		MP	507	Diagnostic Physics Journal Club	1
		MP	507	Therapy Physics Journal Club	1
<i>This Term: Thesis co form in May</i>					

Year Two Medical Physics Students Diagnostic Imaging Physics Track

Year / Term	Required -or- Optional	Designation	Number	Major Core Course Title	Credits
Fall Term: September 26 - December 16, 2022					
Y2 Fall	Required:	MP	546	Diagnostic Imaging Physics Lab I	2
		MP	543	Advanced Diagnostic Imaging (MRI)	3
		MP	544	Nuclear Medicine Imaging	3
		MP	503	Thesis	1
<i>This Term: Finalize advisor and MS thesis committee (submit forms)</i>					
Winter Term: January 9 - March 24, 2023					
Y2 Winter	Required:	MP	547	Diagnostic Imaging Physics Lab II	2
		MP	503	Thesis	4
<i>This Term: Complete all MS research data gathering - start thesis</i>					
Spring Term: April 3 - June 23, 2023					
Y2 Spring	Required:	MP	503	Thesis	4
		MP	507	Diagnostic Physics Journal Club	1
		MP	507	Therapy Physics Journal Club	1
<i>This Term: Thesis complete (early term), final MS defense & submit Oral Exam form in May</i>					

Fall - Year 1	Winter - Year 1	Spring - Year 1
<p>MP 521—Rad Anatomy DeWeese, 3 credits T/Th, 2-3:30PM, (T/RLSB, Th/UHS 10C26)</p> <p>MGRD 650—Practice & Ethics of Science OHSU Staff, 1 credit T, 4-6PM, Vollum</p> <p>MP 531—Radiophysics Pugachev, 3 credits T/Th 9-10:30AM, RLSB</p> <p>MP 507—Seminar Griglock, 1 credit T, 11-12PM, RLSB</p> <p>BSTA 525—Statistics OHSU Staff, 4 credits Online</p> <p>IPE 501 Faculty, 1 credit Synch/Asynch</p>	<p>MP 535—Rad Shielding & Ext. Dosi. Bailey, 3 credits T/Th, 11:30-1PM, RLSB 15006</p> <p>MP 541—Diagnostic Imaging I DeWeese, 3 credits T/Th, 2-3:30PM, RLSB 55052/UHS 10C26</p> <p>MP 561—Therapy Physics I Pugachev, 3 credits T/Th, 9-10:30AM, RLSB 1A013</p>	<p>MP 570—Rad Bio for Medical Physicists Mench, 3 credits T/Th, 2-3:30PM, UHS 10C26</p> <p>MP 542—Diagnostic Imaging II Griglock, 3 credits T/Th, 12-1:30PM, RLSB 15019</p> <p>MP 562—Therapy Physics II Pugachev, 3 credits T/Th, 8:30-10, RLSB 1A013</p>
Summer - Year 2		
<p>MP 536—Advanced Radiation Detection Mench, 3 credits, Summer A T/Th, 12:30-3:30PM, RLSB</p>	<p>MP 545—Diagnostic Imaging Practicum Bailey, 3 credits, Summer B M/T/Th/F 8AM-12PM, W 1-5PM, Radiology</p>	<p>MP 565—Therapy Physics Practicum Junell, 3 credits, Summer B M/T/Th/F 1-5PM, W 8AM-12PM, Rad Med</p>
Fall - Year 2	Winter - Year 2	Spring - Year 2
<p>MP 546—Imaging Physics Lab I Bailey/Residents, 2 credits T 2-3PM RLSB/ W 2-5PM UHS</p> <p>MP 563—Therapy Physics Lab I Wilson, 2 credits W 4-6PM, KPV</p> <p>MP 543—MRI Wyatt, 3 credits T/Th, 9:30-11AM, MAC 2136</p> <p>MP 544—NM & PET Winters, 3 credits T/Th, 11:30-1PM, MAC</p>	<p>MP 547—Imaging Physics Lab II Mench/Residents, 2 credits T 11-12 MAC 2136, Th 2-5 UHS</p> <p>MP 564—Therapy Physics Lab II Wilson, 2 credits W 4-6PM, KPV</p> <p>MP 503—Thesis Hours 4 credits ≥9 total required</p>	<p>MP 503—Thesis Hours 4 credits ≥9 total required</p> <p>MP 507—Seminar Imaging DeWeese, 1 credit T, 10:15-11:15, RLSB 15008</p> <p>MP 507—Seminar Therapy Bayouth 1 credit Th, 4-5PM, RadMed</p>
<p>Diagnostic Track Specific Course</p>	<p>Diagnostic Required for both tracks</p>	<p>Therapy Required for both tracks</p>
		<p>Therapy Track Specific Course</p>

Residency

Purpose: Clinical training in focus of interest

- >150 CAMPEP-accredited residency programs
 - 116 **Therapy**, 40 **Imaging**
 - \$50-\$70k resident salary
 - 2-4 years, majority are 2
- Hospital or consulting firm

CAMPEP



Employment

- Median salary (2021): **\$210k** for certified MPs
 - **\$150k** for non-certified MPs
 - Education level-, years experience-, subspecialty-, and sector-dependent
- Sectors:
 - Clinical
 - Academic
 - Regulatory
 - Industrial

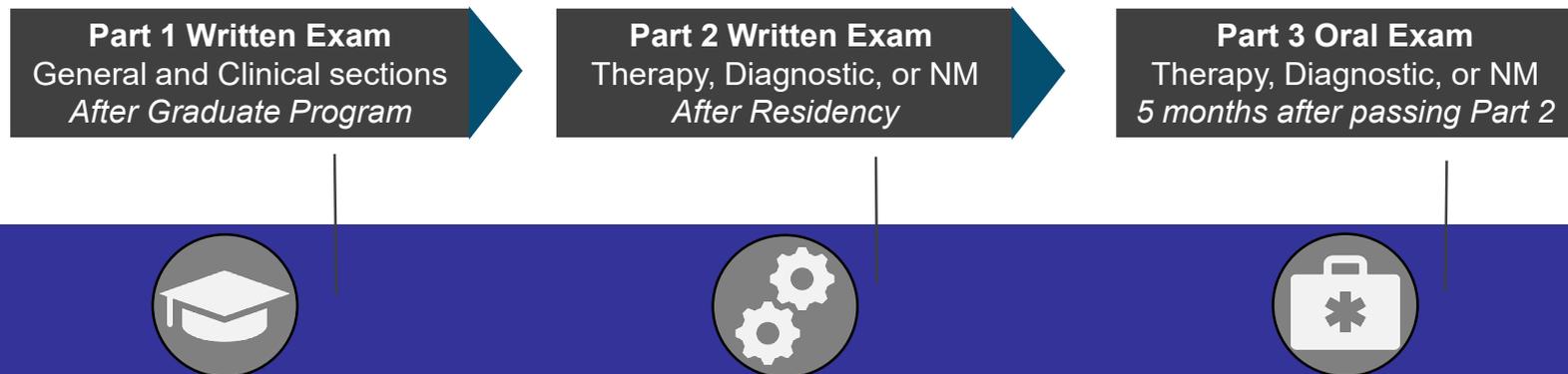
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Board certification



- **The American Board of Radiology (ABR)**
 - Most board-certified medical physicists are "DABR-ed", or Diplomates of the ABR
 - To become DABR-ed, you must take three exams throughout your training
 - Any part of the exam can be retaken, and you are not required to pass on the first try



Board certification

- Other certifying boards:
 - The American Board of Medical Physics (ABMP)
 - The Canadian College of Physicists in Medicine (CCPM)
 - The American Board of Science in Nuclear Medicine (ABSNM)
 - The American Board of Health Physics (ABHP)



Other things you should know

- Once you start, you do not HAVE to become a medical physicist
- **Research** is optional and varies widely
- There are **teaching** opportunities
- **Communication** skills are VERY important
 - Be able to explain physics concepts to people with different levels of understanding

Opportunities for Undergraduates



AMERICAN ASSOCIATION
of PHYSICISTS IN MEDICINE

**INTERESTED IN APPLYING YOUR PHYSICS OR
ENGINEERING KNOWLEDGE IN MEDICINE?
WANT TO MAKE A CLINICAL IMPACT THIS SUMMER?**

**THEN THE SUMMER UNDERGRADUATE
FELLOWSHIP PROGRAM IS FOR YOU!**

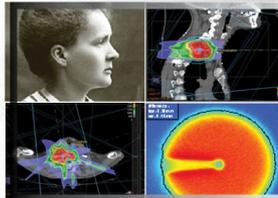
We provide opportunities for excellent undergraduates to gain experience in medical physics at leading clinical and research institutions. A large menu of mentor-defined projects is available and Fellows select their mentor according to their mutual interests.

\$6,000 stipends will be awarded to selected students on a competitive basis. The stipend is based upon an expectation of 40-hours per week for 10 weeks during the summer (May through September).



Application Deadline:
February 2, 2023

For more details, visit:
<https://gaf.aapm.org/index.php#SUF>



Sponsored by the AAPM Educational Council through the AAPM Education and Research Fund
PROGRAM CONTACT: Karen MacFarland, karen@aapm.org or 571-298-1282



DIVERSITY RECRUITMENT through
EDUCATION AND MENTORING

DREAM

THE DREAM PROGRAM is a 10-week summer program designed to increase the number of women and racially underrepresented groups in medical physics by offering research opportunities, outreach and strategic mentorship geared towards recruiting a more robust and diverse group of skilled undergraduate students in the field of medical physics. DREAM students will be placed into summer research and mentorship groups that are consistent with their research and career interests. DREAM fellows

are selected on a competitive basis. Selected fellows will be awarded a \$6,000 stipend with the expectation of a 40-hour per week effort for 10 weeks.

ELIGIBILITY

- Undergraduate sophomores, juniors, and seniors majoring in physics, engineering, or other science
- US Citizens, Canadian Citizens, or Permanent Citizens of the US

HOW TO APPLY

- Go to <https://gaf.aapm.org/index.php#DREAM>
- Send official transcripts to karen@aapm.org
- Two letters of recommendation to karen@aapm.org
- Be sure to address diversity and/or the impact this fellowship would have on you in your self-statement.

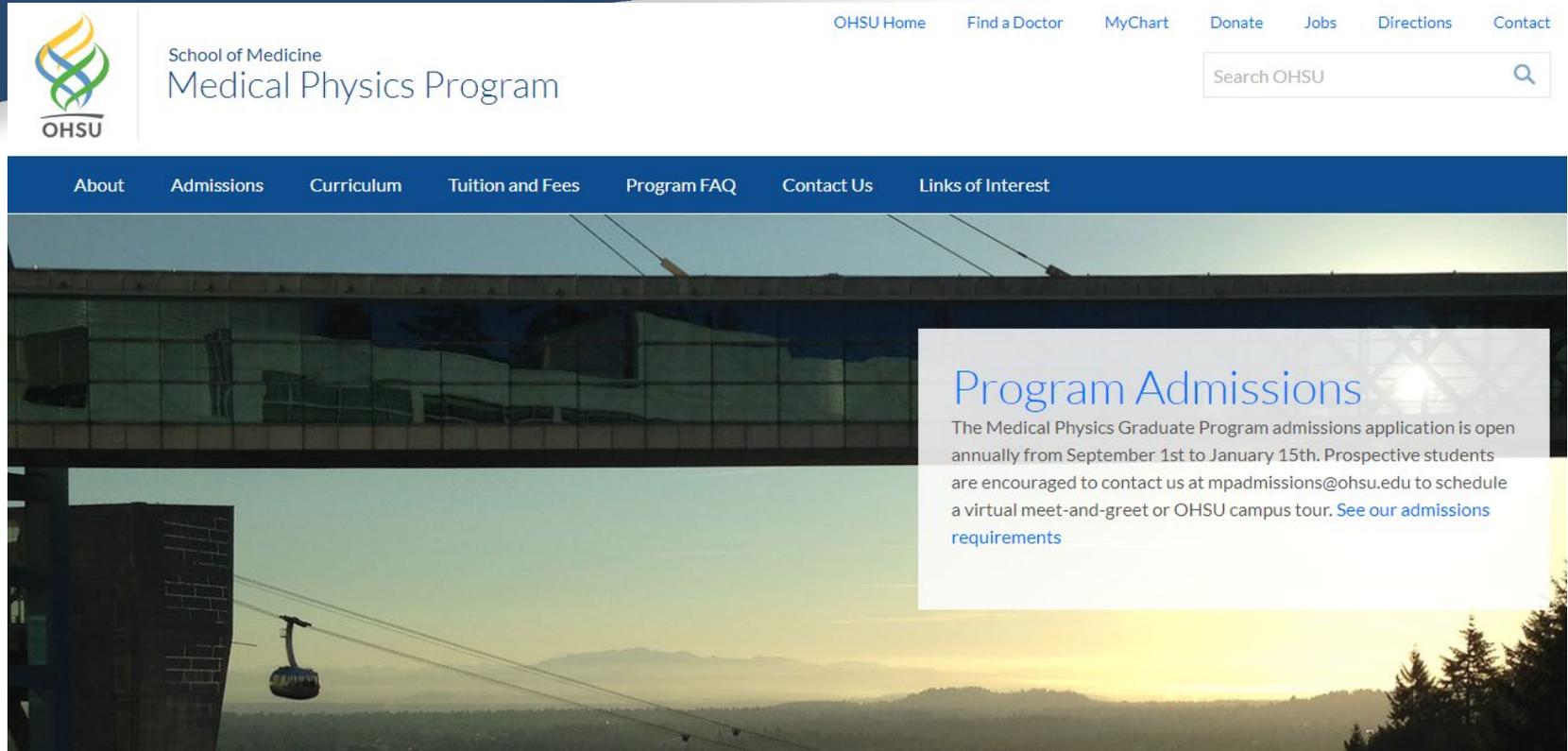
APPLICATION DEADLINE:
February 2, 2023



FOR MORE DETAILS, VISIT: <https://gaf.aapm.org/index.php#DREAM>

PROGRAM CONTACT: Karen MacFarland, karen@aapm.org or 571-298-1282
Sponsored by the AAPM Professional Council through the AAPM Education and Research Fund.
Additional funding provided by the Southeast Chapter of AAPM.

Opportunities for Undergraduates



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Program Admissions

The Medical Physics Graduate Program admissions application is open annually from September 1st to January 15th. Prospective students are encouraged to contact us at mpadmissions@ohsu.edu to schedule a virtual meet-and-greet or OHSU campus tour. [See our admissions requirements](#)

[Visit Us!](#)

References:

- [The OHSU Medical Physics Graduate Program](#)
- [American Association of Physicists in Medicine](#)
- [Commission on Accreditation of Medical Physics Education Programs, Inc.](#)
- [Medical Physics Matching Program](#)
- [The Society of Directors of Academic Medical Physics Programs](#)