Medical Physics

The new Master of Science in Medical Physics (MSMP) (https://radonc.wustl.edu/education/master-of-science-in-medical-physics/) offered through the Department of Radiation Oncology at the School of Medicine and the Post-PhD Graduate Certificate in Medical Physics (https://radonc.wustl.edu/education/post-phd-graduate-certificate-in-medical-physics/) are available for graduate and postgraduate physics students who are interested in exploring pathways to prepare for residency programs as well as for careers in the field of medical physics.

Program Contacts

MSMP and Post-PhD Certificate Program Director
Michael Altman, PhD

MSMP Associate Program Director
Tiezhi Zhang, PhD

MSMP Program Coordinator
Justina Dodson, MS

Degrees & Offerings

• Master of Science in Medical Physics (http://bulletin.wustl.edu/medicine/degrees-offerings/msmp/)
• Post-PhD Graduate Certificate in Medical Physics (http://bulletin.wustl.edu/medicine/degrees-offerings/med-phys-grad-cert/)

Research

Master of Science in Medical Physics

The MSMP program offers two different pathways to allow students to choose either a thesis option or a clinical option. Students who choose the thesis pathway will be required to complete 6 credits of thesis research, with the option for additional research opportunities over the summer semester as part of the 30-unit requirement. Students who choose the clinical pathway will be required to complete a 1-credit-unit clinical rotation and a 3-credit-unit clinical project, with the option for additional clinical rotations over the summer.

Post-PhD Graduate Certificate in Medical Physics

The medical physics division in the Department of Radiation Oncology currently provides research and training opportunities to a large number of PhD researchers in different areas of science and engineering as applied to radiation oncology. The Department of Radiation Oncology established the Post-PhD Graduate Certificate in Medical Physics program in 2017, with the intent of providing a pathway for postdoctoral fellows to enter into clinical physics residencies.

Our post-PhD certificate program focuses on providing students with the medical physics background necessary for future success in medical physics while also offering students the opportunity to perform cutting-edge research in patient-focused areas.

Faculty

Program Director

Michael Altman PhD
Assistant Professor of Radiation Oncology
BA, Physics, University of Chicago, 2002
PhD, Medical Physics, University of Chicago, 2010
Medical Physics Residency, Henry Ford Health System, 2012

Associate Program Director

Tiezhi Zhang, MS, PhD (https://radonc.wustl.edu/people/tiezhi-zhang-phd/)
Assistant Professor of Radiation Oncology (primary appointment)
BS, Jilin Medical University, 1994
MS, Drexel University, 1999
PhD, University of Wisconsin–Madison, 2004

Instructors

Buck Edward Rogers, MA, PhD (https://radonc.wustl.edu/people/buck-rogers-phd/)
Professor of Radiation Oncology (primary appointment)
Adjunct Professor of Chemistry (courtesy affiliation)
Professor of Radiology
BS, Loyola University Chicago, 1989
MA, Washington University in St. Louis, 1991
PhD, Washington University in St. Louis, 1995

David Strait, PhD (https://anthropology.wustl.edu/people/david-strait/)
Instructor of Principles of Human Anatomy and Development
PhD, State University of New York at Stony Brook

Joseph O’Sullivan, PhD (https://engineering.wustl.edu/Profiles/Pages/Joseph-OSullivan.aspx)
Instructor of Biological Imaging Technology
BS, University of Notre Dame, 1982
MS, University of Notre Dame, 1984
PhD, University of Notre Dame, 1986

Yao Hao, PhD
Instructor in Radiation Oncology (primary appointment)
BS (Physics), Shanxi University, 2004
MA (Logic), Shanxi University, 2007
PhD (Medical Physics), University of Massachusetts, 2016
**Courses**


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**M91 MedPhys 501 Clinical Imaging Fundamentals**

This course will cover the physical principles underlying various imaging modalities used in medicine, including radiography, computed tomography, ultrasound, positron emission tomography and magnetic resonance imaging. Topics to be covered include (1) aspects of X-ray generation for imaging, including X-ray tube construction and imaging geometries; and (2) image-acquisition devices, such as storage phosphor plates, image intensifiers, and various digital imagers. Clinical applications of X-ray imaging, including mammography and angiography, will be reviewed. Advanced imaging systems to be covered include diagnostic computed tomography (CT) scanners and cone-beam CT scanners. Basics of MRI imaging systems will be reviewed, including (1) the physics underlying both commonly used and specialized pulse sequences; and (2) the design and construction of typical scanners. The physics and clinical applications of both ultrasound and PET imaging will also be discussed. Topics to be considered throughout the course include image-quality metrics used to evaluate the performance of any imaging system and how the performance of imaging platforms can be degraded or improved in terms of these metrics. In addition to the didactic component, there will also be hands-on laboratory sessions on ultrasound, cone-beam CT, MRI imaging, radiography, and computed tomography performance testing for various clinical systems. Prerequisites: modern physics and calculus; permission of the program director.

Credit 2 units.

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**M91 MedPhys 502 Radiological Physics and Dosimetry**

This course is designed to construct a theoretical foundation for ionizing radiation dose calculations and measurements in a medical context and to prepare graduate students for proper scientific applications in the field of X-ray imaging and radiation therapy. This course will cover the fundamental concepts of radiation physics, how ionizing radiation interacts with matter, and how the energy that is deposited in the matter can be measured in theory and practice. Prerequisites: calculus and modern physics; permission of the program director. Instructor: Tiezhi Zhang, PhD. Fall.

Credit 3 units.

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**M91 MedPhys 503 Independent Study**

The graduate student will pursue independent laboratory or industrial research during the academic year. Many WUSM faculty have research opportunities for students. Students should reach an agreement with a faculty member who is willing to serve as their supervisor for the objective and scope of the project. The faculty supervisor must be either employed full-time in the Department of Radiation Oncology or affiliated with its Medical Physics Division. The grade for the independent study will be pass/fail. The student may continue to develop their research during a second term and expand the research into either a clinical project or thesis research. Instructor Rao Khan, PhD. Fall and spring.

Credit 1 unit.

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**M91 MedPhys 503C Clinical Project**

Students will complete a clinically focused, hands-on project under the supervision of a faculty mentor. The student will develop a project statement that includes the purpose, overview of proposed methods, expected duration, and required effort to complete the project. The statement must be approved by the mentor and program director prior to the student initiating work on the project. An oral presentation and/or a written report describing the completed project work is required. Prerequisites: Radiological Physics and Dosimetry, Radiation Oncology Physics, Radiobiology, and Independent Study courses, or permission of the program director.

Credit 3 units.

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**M91 MedPhys 503T Thesis Research**

Students will complete a research project under the supervision of a faculty mentor. Thesis students will develop a thesis proposal, conduct mentored research, and disseminate this research in the form of an oral defense and written thesis. Thesis proposals must be approved by the faculty mentor and program director prior to initiating the thesis research. Prerequisites: Radiological Physics and Dosimetry, Radiation Oncology Physics, Independent Study courses, and permission of the program director.

Credit 3 units.

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**M91 MedPhys 504 Ethics, Professionalism and Current Topics**

This course prepares students to critically evaluate ethical, regulatory and professional issues and for leadership in clinical practice and research. The principal goal of this course is to prepare students to recognize ethics and compliance resources in clinical research and the situational factors that give rise to them, to identify ethics and compliance resources, and to foster ethical problem-solving skills. In addition, the course introduces professionalism, core elements, common traits of the medical physics profession, confidentiality, conflict of interest, interpersonal interactions, negotiations and leadership skills. Characteristics of successful leadership are also identified. Interaction with patients, colleagues, vendors, and clinic staff will also be emphasized. Prerequisite: Permission of the program director.

Credit 1 unit.

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**M91 MedPhys 505 Radiobiology**

This course is designed to establish a foundation for ionizing radiation interaction with biological tissues. It will cover the fundamental concepts of cell biology, how ionizing radiation interacts with cells, radiation damage and carcinogenesis, and radiation therapy fractionation and related concepts. The effects of ionizing radiation on living cells and organisms -- including the physical, chemical, and physiological basis of radiation cytotoxicity, mutagenicity, and carcinogenesis -- are also covered. Prerequisites: One year each of biology, physics and organic chemistry; permission of the program director.

Credit 2 units.

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**M91 MedPhys 506 Radiation Oncology Physics**

This course is designed to build on the concept of radiation dosimetry techniques and bring them into the clinical realm. The students will learn clinical applications of radiation dose measurements as used in radiation therapy for the treatment of cancer. Ionizing-radiation-producing devices such as external beam, brachytherapy, protons and charged particles, imaging...
modalities, simulation, radiation delivery, treatment verification imaging, quality assurance, motion management, and image-guided techniques will be the major focus. Prerequisites: Radiological Physics and Dosimetry; permission of the program director. Credit 3 units.

M91 MedPhys 521 Radiation Protection and Safety
This class is designed to introduce concepts of radiation protection and safety as well as the biological consequences of human radiation exposure. Protection and safety of the radiation worker and patient as well as detection equipment and shielding analysis will be the main focus. The course will broadly cover regulations and radiological protection in various clinical environments. Prerequisites: one year each of biology, physics and organic chemistry; permission of the program director. Instructor: Rao Khan, PhD. Fall. Credit 2 units.

M91 MedPhys 522 Clinical Rotations
The student will rotate through various areas within the Radiation Therapy Clinic and develop an understanding of the applications of physics in the use of radiation for the treatment of cancers. This will include simulation, quality assurance of various imaging and radiation sources, dose calculation, intensity modulation treatments, radiosurgery, stereotactic body radiotherapy, brachytherapy, radiopharmaceutical therapy, and more. Prerequisites: Radiological Physics and Dosimetry, Radiation Oncology Physics; permission of the program director. Credit 1 unit.

M91 MedPhys 523 Advanced Clinical Medical Physics Laboratory
This course is designed to introduce concepts of radiation protection and safety as well as biological consequences of human radiation exposure. Protection and safety of the radiation worker and patient, as well as detection equipment and shielding analysis, will be main focus. The course will broadly cover regulations and radiological protection in various clinical environments. Prerequisites: One year each of biology, physics and organic chemistry; permission of the program director. Credit 2 units.