Department of Radiation Oncology
Medical Physics Graduate Student Handbook

2024-2025

Table of Contents

Introduction 4
Medical Physics Graduate Programs 7
Programs Governance 8
Faculty and Staff 10
Academic Requirements and Benchmarks 13
MSMP Program 13
Independent Study 14
Master's Thesis 14
Clinical Project 16
Comprehensive Exam 16
PhD Program 17
Research Rotations 18
Qualifying Exam 18
Thesis Proposal 19
Dissertation and Thesis Defense 19
Mentored Teaching Experience 20
Post-PhD Graduate Certificate in Medical Physics 22
Grading Policies 24
Academic Dismissal 25
Course Descriptions 26
Student Feedback 31
Advisement and Mentorship 32
Clinical Etiquette and Professional Conduct 36
Radiation Safety 37
Academic Calendar 39
Student Spaces, Facilities, and Clinical Equipment 40
Registration 44
Withdrawal or Leave of Absence 45
Integrity and Conduct 46
Academic Integrity 46

Abusive Conduct / Student Mistreatment 46
Graduation Requirements and Applying for Graduation 48
Student Health Services and Insurance 50
Student Financial Services 51
Library and Computing Facilities 52
Accommodations for Students with Disabilities 53
Student Housing Resources 54

Introduction

Welcome to our graduate and post-graduate programs in Medical Physics! The programs are governed by the Division of Medical Physics, Department of Radiation Oncology at Washington University School of Medicine in St. Louis, although provide a comprehensive education in all of the major disciplines of medical physics: Medical Imaging, Radiation Therapy, Nuclear Medicine and Radiation Safety. Our programs include the Master of Science in Medical Physics (MSMP), PhD in Medical Physics and Post-PhD Graduate Certificate in Medical Physics.

The CAMPEP-accredited Post-PhD Graduate Certificate in Medical Physics was established in 2017, followed by the CAMPEP-accredited MSMP in 2019 and the PhD in Medical Physics in 2021.

The mission of the graduate and post-graduate programs in Medical at Washington University School of Medicine is to meet the growing need of proficient, practicing medical physicists that excel in providing high quality patient services, education, and research. The programs aim to meet and exceed the CAMPEP requirements for program quality by equipping students with sufficient didactic and practical background knowledge in Medical Physics to facilitate their entry into a CAMPEP accredited residency program and into clinical or academic careers in Medical Physics beyond that. The Division of Medical Physics within the Department of Radiation Oncology has a long, rich history of training physicists to become successful and valuable contributors to the field of medical physics, from clinical and academic to industry applications. What helps make our team so successful in training future medical physicists is incorporating our six core values into everything we do, including education. These core values are (1) Patient Care, (2) Integrity, (3) Teamwork, (4) Community, (5) Advancement, and (6) Us (Fig. 1).

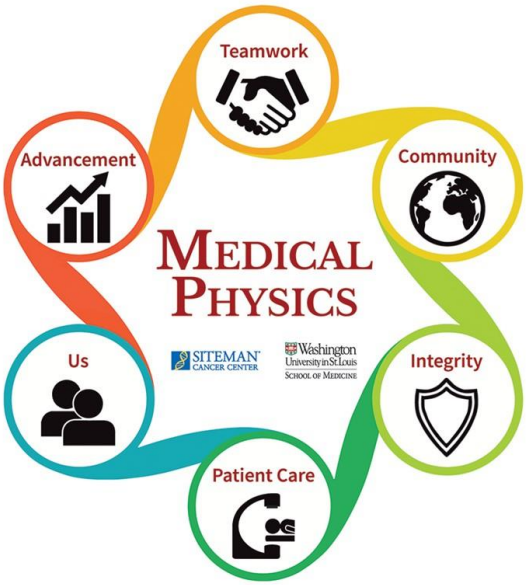

Fig 1: Core Values of the Division of Medical Physics

The first core value, Patient Care, is focused on the concept that we are dedicated to the delivery of highly consistent, excellent, effective, and safe radiation therapy, diagnostic imaging, and nuclear medicine to all patients with the utmost consideration. This core value essentially encompasses all of the fundamental principles of clinical medical physics. In our educational programs, including our PhD, MSMP, and Certificate program, we emphasize the importance of understanding the fundamental principles behind medical physics, including physics, mathematics, and biology and how these all tie into patient and public safety. In the graduate and post-graduate programs, this is largely accomplished through didactic coursework, but is also translated over to clinical rotations where students can see the whole picture of how it all ties together.

The second core value, Integrity, means that we are dedicated to cherishing and rewarding honesty, responsibility, stewardship, and the highest integrity in all of our acts and interactions. This core value is essential for building trust in our community, in our patient, and within our team. Ethical conduct and professionalism is taught by example through clinical and research rotations and through didactic coursework to our trainees.

The third core value, Teamwork, embodies the idea that we are dedicated to the inclusion of diverse backgrounds and ideas while empowering and holding one another accountable to achieve the collective success of our team as we all play and important role in accomplishing common goals. The field of medical physics, particularly in the clinical setting, is highly collaborative, working with many people across diverse disciplines. Having strong interpersonal and communication skills is essential to succeeding and providing the best patient care and innovative research in this field. This is something that we strongly emphasize in our training programs, and we will continue to teach in our MSMP, PhD, and Certificate programs. Clinical and research rotations and projects will allow students the opportunity to work with others in the department, including but not limited to other physicists, physicians, residents, dosimetrists, and radiation therapists. Through these experiences, students will have the opportunity to build these skills that create a strong team-player.

The fourth core value, Community, means that we are dedicated to the community by sharing knowledge and best practices, educating the future generation of scientists and healthcare workers, and practicing outreach to enable the full potential of medical physics around the world. This core value embodies everything that we believe in terms of education and training. Our department has several training, educational, and outreach programs, including all of our graduate and post-graduate programs as well as the first CAMPEP-accredited Medical Physics Residency program, and a summer undergraduate research fellowship. We have also trained graduate students from other programs within the University, including Biomedical Engineering, Physics, and others. We also strongly believe that by educating and training others, we are challenged to continue our own education and endeavor for career-long learning. By example, we hope to instill this drive into our own trainees.

The fifth core value, Advancement, focuses on our dedication to the pursuit of innovation and continuous improvement in medical physics by encouraging curiosity,

creativity, and appropriate risk-taking. Basically, this core value describes all things research and innovation within our department and division. This research and innovation occurs not just at the basic science, bench-top level, but also at the clinical development and improvement level. We have strong ties to industry partners and are constantly seeking for new collaborations and projects to continually improve patient care. Our trainees and students are often involved in these projects, and we plan to continue that precedent with our graduate and post-graduate programs. Through research (independent study) rotations and clinical or thesis projects in the MSMP program as well as PhD research rotations and thesis research in the PhD program, students will have the opportunity to learn how research and innovation work, from the beginning of a question or idea to formulating tests and critically evaluating the data to find answers and develop solutions.

The sixth and final core value, Us, means that we are dedicated to providing a supportive and respectful work environment that enables us to balance our personal values and professional goals to be happier, healthier, and ultimately more productive and creative medical physicists. While the preceding core values focus on our goals together as a team, it is important to remember that a team is made up of individuals with individual goals and individual values. We must recognize and respect that in order for the team to function with strong camaraderie. This is built into our educational and trainee programs, where we recognize that not everyone who enters our programs may want to pursue a career in academia or a career in a clinical environment. Our goal is to make sure that every student that enters our program comes out with the intellectual and interpersonal tools to accomplish their own goals and to contribute to the field of medical physics.

These six values are the core of everything we do in our medical physics division, from clinical and academic work to education. They are also at the heart of our mission for our MSMP, PhD in Medical Physics, and Post-PhD Graduate Certificate in Medical Physics programs, and aspects of them mirror those of the CAMPEP objectives for educational programs. We aim that by holding true to these values, and by practicing them and leading by example, we can inspire future generations of medical physicists.

Medical Physics Graduate Programs

The Division of Medical Physics offers three different graduate programs: Master of Science in Medical Physics (MSMP), PhD in Medical Physics and Post PhD Graduate Certificate in Medical Physics.

The MSMP program, initially accredited in 2021 provides for students to learn fundamental concepts and techniques in the field of medical physics. Students in the program are exposed to a wide array of diagnostic medical imaging, radiation therapy, nuclear medicine, and radiation safety approaches and techniques. Opportunities are also provided for students to perform cutting-edge research with renowned investigators. These experiences equip students with the knowledge, skills and experiences necessary to further their careers in medical physics. For more information - https://radonc.wustl.edu/education/master-of-science-in-medical-physics/

The PhD program, which is pending initial accreditation provides for students to learn fundamental concepts and techniques, and perform academic research in the field of medical physics. The program is geared towards undergraduates with a strong background in physics and mathematics, graduate students with a physics and mathematics background from fields outside of medical physics, as well as continuing learners with a CAMPEP-accredited Master's level degree in medical physics. Students in the program are exposed to a wide array of diagnostic medical imaging, radiation therapy, nuclear medicine, and radiation safety approaches and techniques, and perform cutting-edge research with renowned investigators. These experiences equip students with the knowledge, skills and experiences necessary to further their careers in clinical and/or academic medical physics. For more information - https://radonc.wustl.edu/education/doctor-of-philosophy-phd-in-medical-physics/

Through the Post-PhD Gradaute Certificate program, initially accredited in 2017 students become familiar with the major texts and literature in the area of medical physics and are exposed to a wide array of treatment techniques and quality control procedures. These experiences equip students with the necessary means to further their education. Graduates of the program have an understanding of the role of patient safety in clinical physics; have necessary physical and scientific background for a career in medical physics; use research and inquiry to acquire knowledge; and the ability to critically evaluate research and scholarship, pose new questions and solve problems in medical physics. The program also helps develop professional and interpersonal skills necessary for success in a collaborative, multidisciplinary environment. For more information - https://radonc.wustl.edu/education/post-phd-graduate-certificate-in-medical-physics/

Programs Governance

The MSMP, PhD, and Certificate programs are administered primarily through the Medical Physics Division within the Department of Radiation Oncology in the Washington University School of Medicine. The School of Medicine is in turn one of the component schools of Washington University in St. Louis. The administrative structure of the departments overseeing and contributing to the program are shown in **Figure 2.** As shown in Figure 2, the programs share a number of classes, instructors, and leadership personnel. Faculty from other departments and schools in the University participate as instructors, course masters, and committee members in the medical physics graduate and post-graduate programs. These participating schools and department include the Mallinckrodt Institute of Radiology, the McKelvey School of Engineering (which contains the Department of Biomedical Engineering (BME), among others), and the School of Arts & Sciences (which houses the physics, chemistry, and biology departments, among others).

The Washington University School of Medicine has 2471 full time faculty members spread across 20 different departments. School of Medicine faculty had $686.4 million in research support from grants and contracts at the end of 2019, $485.7 million of which was direct support from the National Institutes of Health (NIH). 13 different degree programs are offered through the School of Medicine offering MD, Ph.D. and MS degree programs, among others. The Department of Radiation Oncology is one of the component departments of the School of Medicine. The faculty in Radiation Oncology is itself divided into three divisions: the clinical division, the medical physics division, and the cancer biology division. The Medical Physics division, under the leadership of interim Director Geoffrey Hugo, Ph.D., has over 35 physics faculty and staff, a number of whom have supported research projects across diverse areas such as adaptive radiation therapy, image-guided radiation therapy, heavy charged particle therapy, knowledge-based treatment planning, among many others. Medical Physics education programs in Radiation Oncology are led by the Director of Education, Medical Physics Division, Michael B. Altman, Ph.D, ensuring that students in all medical physics graduate and post-graduate programs have the resources and infrastructure to support them throughout their education provided by the Department of Radiation Oncology, the School of Medicine, and Washington University in St. Louis. In Radiation Oncology, that support includes a dedicated Program Coordinator who works directly with the Master of Science and Post PhD Graduate Certificate programs. The Program Coordinator works with different departments, schools, and offices across the university to provide a diverse range of support for students including interfacing with the Office of the University Registrar and the Office of Financial Aid, among others. The Program Coordinator also acts as an independent ombudsperson for students in the program, however, as Washington University in St. Louis students, all students are provided free, confidential, impartial, informal, and independent advocate resources through the Office of the Ombuds (https://staffombuds.wustl.edu/).

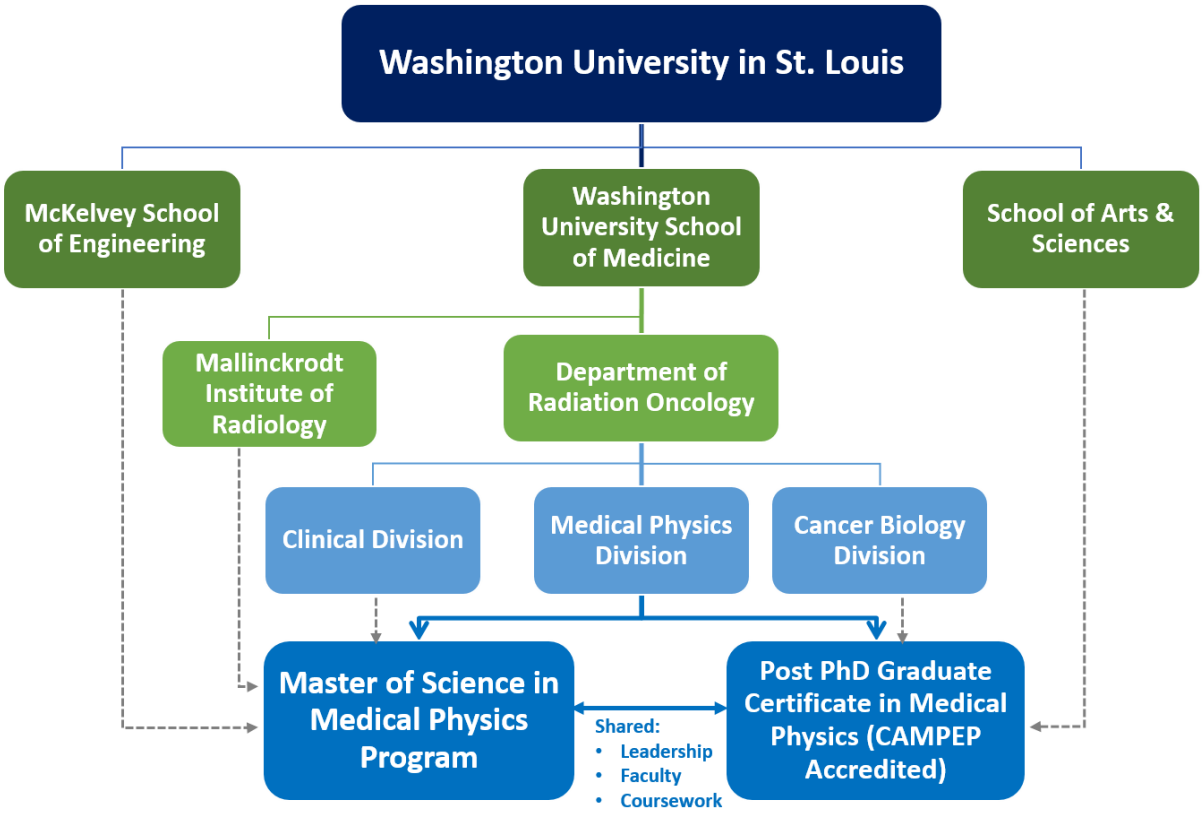

Fig 2: Administrative structure of graduate and post-graduate Medical Physics programs at Washington University in St. Louis. Solid lines indicate direct oversight. Dashed lines indicate contribution to programs as instructors, course masters, mentors, and/or committee members.

The graduate and post-graduate programs in medical physics are overseen by a Steering Committee. The purpose of the steering committee is to provide oversight of the program including its leadership, educational program, and student body. The Steering Committee meets at least twice annually to perform these duties, although the Steering Committee chair can schedule special meetings to manage with issues requiring urgent attention. The Steering Committee is chaired by the Program Director for the Master of Science in Medical Physics program and has up to five additional sitting members: the Chair of Radiation Oncology, the Director of the Division of Medical Physics, the Education Director of the Medical Physics Division, the Associate Program Director, and the Program Coordinator. Additionally there are 3-5 at-large positions on the Steering Committee which are filled by other faculty members who are directly involved in the medical physics educational programs.

Faculty and Staff

Graduate Program Leadership

Michael Altman, PhD Program Director	
Tiezhi Zhang, PhD Associate Program Director	
Julie Follman, MBA Education Coordinator	

Department of Radiation Oncology Leadership

Dennis Hallahan, MD FASTRO Chair, Department of Radiation Oncology	
Geoffrey Hugo, PhD, FAAPM Vice Chair of Medical Physics	

Department of Radiology Leadership

Pamela K. Woodard, MD Chair, Department of Radiology	
Yuan-Chuan Tai, PhD Senior Vice Chair and Division Director Radiology Research Facilities	

For a full listing of all faculty in the Radiation Oncology Department, including bios, publications, and research specialties, please visit: Our Faculty | Department of Radiation Oncology | Washington University in St. Louis (wustl.edu)

PhD Faculty - https://radonc.wustl.edu/education/doctor-of-philosophy-phd-in-medical-physics/program-faculty/

MSMP Faculty - https://radonc.wustl.edu/education/master-of-science-in-medical-physics/program-faculty/

Certificate Faculty - https://radonc.wustl.edu/education/post-phd-graduate-certificate-in-medical-physics/program-faculty/

Academic Requirements and Benchmarks

MSMP Program

The Master of Science in Medical Physics program is a 30 credit hour program designed for students who are intending to proceed into a medical physics career, either into a clinical career through a CAMPEP-accredited Medical Physics Residency program or directly into opportunities in industry, government work, or academia. The program is designed to provide students with sufficient background to pursue a career in any of the major focus areas of medical physics, including radiation therapy, radiology, or nuclear medicine.

The general program format is shown in Figure 3. Students take 24 credit hours of core medical physics coursework and then proceed into one of two program arms: 1) a Thesis arm where the students do a two semester, 6 credit hour thesis project, and 2) a Clinical Project arm where the students do a one semester, 3 credit hour clinical project and then take 3 credit hours of elective coursework to finish their degrees. In the Thesis arm, students are expected to give a thesis defense at the conclusion the second semester of their project work. Thesis research is evaluated through successful completion of thesis defense examination by a thesis examining committee. All students in the program will undergo a final comprehensive examination, and a passing designation is required in order to graduate from the MS program.

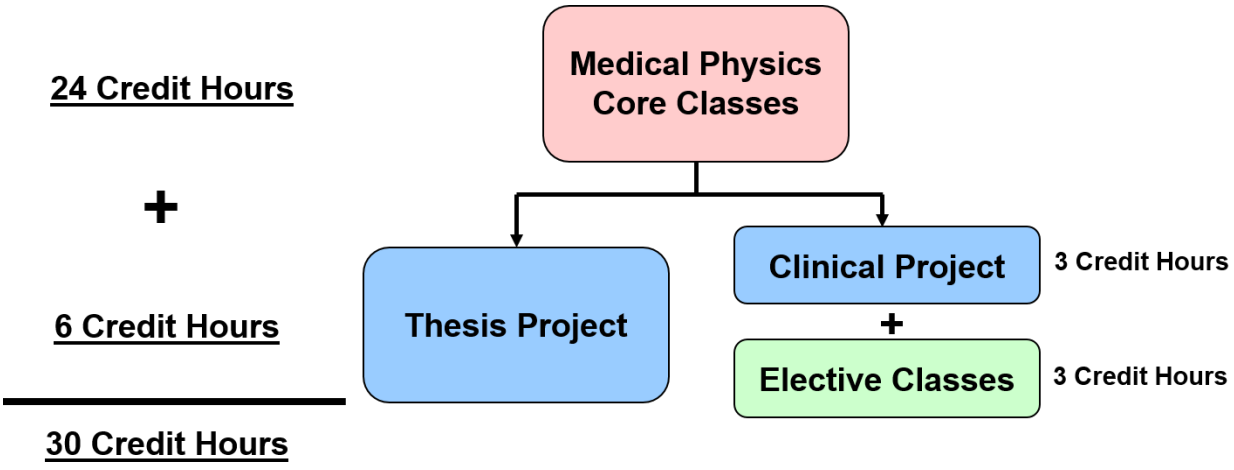

Fig 3: Didactic structure of the Master of Science in Medical Physics Program

Sample Schedule – https://radonc.wustl.edu/education/master-of-science-in-medical-physics/program-format-course-catalog/

Independent Study

The independent study course provides graduate students with an opportunity to gain insight into an aspect of the field of medical physics. The goal of the course is to provide introductory experience on a focused project with one or more faculty mentor(s). Graduate students will be matched with a project/mentor based on a number of factors, including student interest in the area of study and availability.

Projects may have one or two mentors. At least one mentor must be a faculty member at Washington University in Radiation Oncology with an appointment in the Physics Division and/or other affiliation with Medical Physics at the University. Exceptions and/or judgments on appropriate mentorship can be made at the discretion of the Course Director.

Students are required to provide 60-80 hours of total work on Independent Study projects, which, over the course of the semester averages 4-5 hours per week. Additional effort is at the discretion of the student.

Students who are enrolled in MP503 and taking less than 9 credit hours in a given semester may provide additional effort on above the their Independent Study minimum thresholds at a level which satisfies the credit hours required to be full time. Students will confer with the program director and thesis advisor regarding this intent and the additional expected effort. Approval is granted by the program director. Approved students are enrolled in M91-883 Master's Continuing Student Status to attain full time status.

Additional Requirements:

- Students are required to meet face-to-face (live or virtually) with at least one mentor 30 minutes each week, or one hour every two weeks. Mentors may request more interaction time with graduate students as needed. Meeting time with mentors is not considered part of the effort time as described above.

- Students will be required to submit a typed, written synopsis of the project by the Friday of the next to last week of the semester. The write-up should be 700-1000 words, typed double spaced, using a standard 12 point font. The report should have 4-5 sections: Background, Summary of Project, Conclusions, Impact of Study (either clinically or on Medical Physics as a whole), and Future Directions. Figures, Tables, and References can be included in the report, and do not count towards the overall word count.

Master's Thesis

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. The goal of this project is to gain an in-depth understanding about an area of development or research in the medical physics field, as well as to gain an understanding about how to structure, perform, and present academic work. Projects may have one to three mentors. At least one mentor must be a program faculty member. Exceptions and/or judgments on appropriate mentorship can be made at the discretion of the Course Director.

Students are required to provide at least of 170 hours of total work per semester on Master's thesis research projects, which, over the course of the semester averages 12 hours per week. Additional effort is at the discretion of the student.

Students who are enrolled in MP503T or were enrolled in MP503T in a previous semester and taking less than 9 credit hours in a given semester may provide additional effort on above the their Master's Thesis minimum thresholds at a level which satisfies the credit hours required to be full time. Students will confer with the program director and thesis advisor regarding this intent and the additional expected effort. Approval is granted by the program director. Approved students are enrolled in M91-883 Master's Continuing Student Status to attain full time status.

Additional Requirements:

- Mentor Meetings: Students are required to meet face-to-face (live or virtually) with at least one mentor regularly, with a recommendation of at least 30 minutes each week, or one hour every two weeks. Mentors may request more interaction time with graduate students as needed. Meeting time with mentors is not considered part of the effort time as described above.

- Conclusion of Fall Semester:

    - Students are required to submit a typed, brief summary of detailing the background, aims, status, and future direction of the project. This should be typed and 1-2 pages maximum. Suggested format is similar to an NIH aims page. The summary is due by the beginning of finals week, unless the Thesis Mentor grants an extension.

- Conclusion of Spring Semester:

    - Students are required to submit a written Master's thesis. The thesis should be of the length, content, and scope of a publication-quality manuscript. The Thesis Mentor is the arbiter as to if the manuscript is of "publication quality" level and length. The manuscript can but does not have to be submitted or under consideration for publication at the time it is due. The due date for the Master's Thesis is 4/26/2024. It should be submitted to the Thesis Mentor as well as the Program Coordinator Julie Follman (jfollman@wustl.edu).

- Students will be required to give a 20-25 minute oral presentation regarding the content of their Master's Thesis to program faculty, students, and other invitees at the conclusion of their Thesis. The oral presentation will be during finals week

Clinical Project

Students will complete a clinically focused project under the supervision of a faculty clinical supervisor. Clinical project students will learn about clinical measurements, analyses, and or developmental elements and about composing a focused descriptive clinical report. Projects may have one or two supervisors. At least one supervisor must be a program faculty member. Exceptions and/or judgments on appropriate mentorship can be made at the discretion of the Course Director.

Students are required to provide at least of 170 hours of total work for one semester on the clinical project, which, over the course of the semester averages 12 hours per week. Additional effort is at the discretion of the student.

Additional Requirements:

- Mentor Meetings: Students are required to meet face-to-face (live or virtually) with at least one supervisor regularly, with a recommendation of at least 30 minutes each week, or one hour every two weeks. Supervisors may request more interaction time with graduate students as needed. Meeting time with mentors is not considered part of the effort time as described above.

- Conclusion of Semester:

    - Students are required to submit a typed, complete clinical report detailing actions/measurements taken and associated results. Suggested format is at the discretion of the Clinical Project Supervisor. The report is due by the beginning of finals week, unless the Supervisor grants an extension.

Comprehensive Exam

Successfully passing an oral comprehensive examination is required for graduation. A comprehensive examination will take place during the spring semester in the second year. The comprehensive exam is an in-person oral exam and will have four stations, each of about 25 minutes in length (with 5 minutes to transition between stations). The four stations are Radiation Physics and Dosimetry, Medical Imaging, Radiation Protection and Safety, and Radiation Therapy Physics. The content of the exam stations will generally correlate to what was presented in the classes in the program. Within each station you will have 4-5 question/discussion topics. Each

question/discussion topic will start with a PowerPoint slide that students can then respond to. Each station will have two program faculty examiners. Students are scored on each station and the examiners meet after all exams and merge the scores. For the total exam, students can PASS, CONDITION (pass at least one or more sections), or FAIL. The exam is not "one-and-done"; even if an individual conditions or fails opportunities for retakes or other pathways to pass are offered.

PhD Program

The Doctor of Philosophy in Medical Physics program is a minimum 70 credit hour program. As shown in Figure 4, the program has two available branches for students. One branch is for recent college graduates in physics or another related physical science field or individuals with a graduate degree outside of medical physics. This pathway requires at least 34 credit hours of didactic coursework, comprised of 22 credit hours of medical physics core classes and at least 12 credit hours of elective coursework, as well as a minimum of 36 credit hours of thesis research. Students who possess an MS in medical physics from a CAMPEP accredited program, including our internal MSMP program, can get credit for up to all credit hours of 22 medical physics core courses. The 12 credit hours of didactic elective coursework and minimum 36 credit hours of thesis research are still required in this branch.

In addition to the credit hour requirements described above, to complete the degree, students must satisfactorily complete at least one research rotation, pass the qualifying examination, pass the thesis proposal, have at least one accepted and one submitted first author manuscript, and complete a research dissertation.

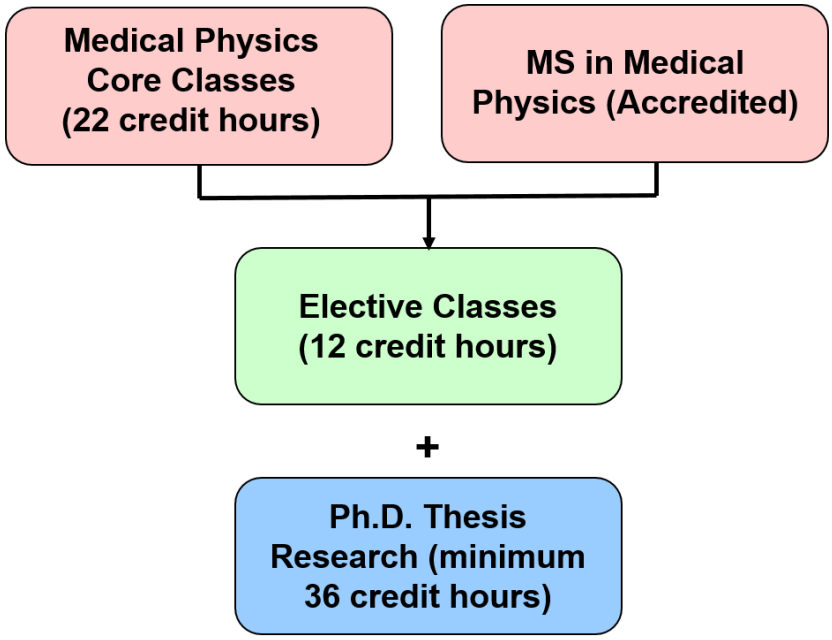

Fig. 4: Schematic of Ph.D. program pathways

Sample Schedule – https://radonc.wustl.edu/education/doctor-of-philosophy-phd-in-medical-physics/program-format-course-catalog/

Research Rotations

The Phd Research Rotation course is designed to provide students with an experience working with one or more potential thesis mentors on a focused research opportunity. Projects may have one to three mentors. Mentors are assigned to students by the program director or their designate based on student interest and mentor availability in supporting a PhD student. At least one mentor must be a faculty member at Washington University in Radiation Oncology with an appointment in the Physics Division and/or other affiliation with the Medical Physics program at the University. Exceptions and/or judgments on appropriate mentorship can be made at the discretion of the Program Director.

Students may continue to rotate with the same mentor in both the fall and spring semesters with the permission of the program director. At the conclusion of the spring semester, students may elect to join with one of the labs/mentors they have rotated with for their PhD thesis based on mutual interest/consent of the student and mentor, however, students are permitted to do a third rotation during the summer of their first year at their discretion.

Additional Requirements:

- Mentor Meetings: Students are required to meet face-to-face (live or virtually) with at least one mentor regularly, with a recommendation of at least 30 minutes each week, or one hour every two weeks. Mentors may request more interaction time with graduate students as needed

- Written Report: Students are required to submit a typed, brief summary of detailing the background, aims, status, and future direction of the project. The report should be 1500-2000 words (figures allowed) and be broken into the following headings: Background, Impact of Study, Summary of Project, Conclusions, and Future Directions. The summary is due by the beginning of finals week, unless the Thesis Mentor grants an extension. For the 2023-2024 school year those dates are 12/14/2023, 5/2/2024, and 8/15/2024 for the Fall, Winter, and Summer semesters, respectively

Qualifying Exam

The PhD Qualifying Exam is an in-person oral exam and will have four stations, each of about 25 minutes in length (with 5 minutes to transition between stations). The four stations are Radiation Physics and Dosimetry, Medical Imaging, Radiation Protection and Safety, and Radiation Therapy Physics. The content of the exam stations will generally correlate to what was presented in the classes in the program. Within each station you will have 2-3 question/discussion topics. Each question/discussion topic will start with a PowerPoint slide

that students can then respond to. Each station will have two program faculty examiners. Students are scored on each station and the examiners meet after all exams and merge the scores. For the total exam, students can PASS, CONDITION (pass at least one or more sections), or FAIL. The exam is not “one-and-done”; even if an individual conditions or fails opportunities for retakes or other pathways to pass are offered.

Thesis Proposal

A written and oral thesis proposal must be completed ideally within two years completion of the qualifying exam, although some flexibility is allowed. However, the thesis proposal should be completed at least one year before the thesis defense. The thesis proposal should take the format of a short, 5-12 page NIH grant and outline the general hypothesis and aims of the thesis, as well as the prospective timeline for completion. The written thesis proposal must be reviewed by the thesis committee and the oral proposal will be presented to the thesis committee and have a question and answer portion.

Dissertation and Thesis Defense

After the thesis proposal is approved, dissertation research occupies the bulk of the student's effort. Upon completion of the dissertation, students will defend the dissertation. At the time of the defense, the student will have composed at least two manuscripts of publishable quality, as judged by the thesis committee. Students will work with the Thesis Advisor to assess when work has sufficiently progressed to perform the thesis defense.

The student will present their research work in the form of a written dissertation to the thesis committee at least 3 weeks before the defense exam date. The dissertation should be reviewed and evaluated by the thesis committee before the defense. The thesis defense should be an oral presentation of approximately 45 minutes in length followed by a question and answer period. After the student passes the defense, presentation to and acceptance by the registrar's office of the final dissertation completes the degree requirements.

<u>Thesis Defense Rules and Conduct:</u>

The thesis defense should not take place if the members of the thesis committee are not present (physically or remotely) or available within 15 minutes of the designated time. If an emergent situation occurs and one or more of the members of the defense is unable to attend, it is at the discretion of the thesis committee chair whether to proceed.

The oral defense will be open to the public only for the duration of the candidate’s presentation and for the initial question and answer period.

After the public defense, the audience will be dismissed and a second closed question and answer period with only the candidate and the thesis committee will commence.

After the closed question and answer period, the committee will dismiss the candidate and a closed period of discussion and deliberation to review the candidate and the thesis defense will commence.

At the conclusion of the closed discussion session, the thesis committee will come to a consensus on whether the candidate has passed or failed the thesis defense. After the closed discussion the committee or committee chair will inform the candidate whether or not they have passed the thesis defense.

If the candidate fails the examination, the thesis committee chair prepares a report of the examination and a suggested remediation process and submits it to the Program Director. If approved by the director, the candidate is allowed to have the opportunity to remedy the issues and undergo the defense once more. Failure to pass the defense a second time is grounds for program dismissal.

Mentored Teaching Experience

Medical Physics is a field which includes teaching at a number of levels, regardless of the career pathway. Being able to clearly explain and educate others about medical physics topics is an important skill due to the mutli-disciplinary nature of the field, and the position of medical physicists at the nexus of communication between a number of different individuals with differing backgrounds and levels of understanding regarding medical physics topics and concepts. Medical physicists in both clinical and academic settings may be involved with educating students, trainees, and other personnel both in classroom-type, one-on-one trainings, and other settings. Even those in industry or regulatory experience must be able to educate others on the use of products and equipment, and/or how to achieve required benchmarks or guidelines. Individuals attaining a PhD are likely to participate in one or more of those pathways throughout their professional life. The mentored educational experience, either in the form of a Mentored Teaching Experience (MTE) or Mentored Professional Experience (MPE), is thus an important element for helping aspiring medical physicists gain comfort with educating individuals in many of the ways in which they may need to in their careers. It can also help individuals identify interest in teaching and training elements which can help guide them on the selection of their chosen pathways.

Two preparatory engagement activities are required:

1. Center for Teaching and Learning (CTL) Teaching Orientation – this is required for all students. Students entering the program <u>without</u> a CAMPEP accredited MS degree will take the orientation at the beginning of their second year in the program. Those entering the program <u>with</u> a CAMPEP-accredited MS degree will take it upon matriculating into the program.
2. A teaching / pedagogical orientation provided by the course master or other teaching mentor before commencement of the MTE. This orientation may include, but is not limited to:
    a. A review of expectations and/or benchmarks for the student's MTE

b. Discussion of how to address student/trainee queries and/or issues
c. Discussion of student/trainee evaluation philosophy and approaches

Mentored Teaching Experience (MTE) consists of instruction and/or mentored independent teaching activities.

PhD students (both full and part-time) will spend an average of 10 MER units (same as 10 weekly hours) as an Assistant in Instruction (AI) (maximum is 30).

For all PhD Students: 10 MER units are required in the form of acting as Assistant in Instruction.

Full time PhD Students: The 10 MER units are achieved by acting as an AI in one of the required core medical physics classroom or laboratory courses listed below. Duties may include (depending on the specific course/course master):

a. Attendance of class/laboratory sessions
b. Preparation of and/or grading of homework
c. Preparation of and/or grading of exams
d. Leading weekly discussion sessions
e. Setup and/or aid with performing laboratory or practica sessions
f. Other course specific elements as discussed with the course master

Part-time PhD students: The 10 MER units can be achieved by either acting as an AI as described for full time PhD students or, may pursue an alternate AI pathway. The alternate AI pathway is allowed if the part-time PhD student is a full time Washington University in St. Louis employee and their professional duties include teaching and/or training of residents or training and/or providing continuing education to Washington University in St. Louis or BJC faculty or staff. In these instances, students may propose a 10 MER equivalent (~150 hours total) project spread over one or two academic semesters. These projects must be medical physics education focused and may be classroom-style, small/group individual training style, or other proposed structure. Students who wish to pursue the alternative pathway should identify a faculty mentor, and craft a minimum 500 word proposal submitted no less than 6 weeks before the commencement of the MTE. The proposal must describe the educational need and focus of the AI project, the student's role(s) as AI in the project, and the role of the selected mentor. The proposal should then be approved by both the identified MTE mentor and Program Director before the alternative AI project can commence.

Courses:

Dept Course Number & Title	MER Units
MP501 Clinical Imaging Fundamentals	10
MP502 Radiological Physics and Dosimetry	10
MP506 Radiation Therapy Physics	10
MP521 Radiation Protection and Safety	10

MP523 Advanced Clinical Medical Physics Lab	10

Teaching Intensive Pathway (TIP): The Teaching Intensive Pathway (TIP) is an optional pathway for those students whose career interests lie in academia or another field that would benefit from extended teaching experiences. This immersive experience allows students to further explore the breadth and depth of teaching best practices and pedagogy related to their respective field. Students who are interested in participating in this elective experience must formally request to participate, which is subject to departmental approval. Due to this experience being an elective, unpaid experience, students who participate in the TIP will not receive compensation. Please note that students may not be compelled to engage in the TIP.

Students who successfully complete their AI requirements and have interest in pursuing additional teaching opportunities can complete TIP in any of the courses listed above. However, there must be space for an AI in the course in a given semester, as preference is given to those individuals who have not completed their required MTE. In addition, students may be allowed to participate as an AI in classroom-based resident training courses. In all instances, students must obtain permission from their Thesis Advisor and the Program Director to undertake additional AI opportunities. A maximum of 20 MER units total is allowed.

Post-PhD Graduate Certificate in Medical Physics

The Post PhD Graduate Certificate in Medical Physics program (CAMPEP-accredited) at Washington University in St. Louis provides students with an opportunity to become familiar with the major texts and literature in the area of medical physics as well as be exposed to a wide array of treatment techniques and quality control procedures. These experiences equip students with the necessary means to further their education and career development including qualification for the ABR Part I Exam in medical physics and CAMPEP-accredited residencies in medical physics.

Graduates of the program will:

- have necessary physical and scientific background for a career in clinical medical physics
- have an understanding of the role of patient safety in clinical physics
- gain the ability to critically evaluate research and scholarship in medical physics
- pose new questions and solve problems in medical physics
- help develop professional and interpersonal skills necessary for success in a collaborative, multidisciplinary environment

The program is comprised of 18-credit hours spread over 7 courses that may be completed over the course of one or two years: Coursework includes:

- MP 500: Structure and Function of the Human Body for Medical Physics (3 credits)
- MP 501: Clinical Imaging Fundamentals (3 credits)
- MP 502: Radiological Physics and Dosimetry (3 credits)
- MP 505: Radiobiology (2 credits)
- MP 506: Radiation Oncology Physics (3 credits)
- MP 521: Radiation Protection and Safety (2 credits)
- ESE 589: Biological Imaging Technology (3 credits)

Sample Schedule - https://radonc.wustl.edu/education/post-phd-graduate-certificate-in-medical-physics/program-format-course-catalog/

Grading Policies

All courses in the medical physics graduate programs are scored on an A-F scale. No pass/fail courses exist in the program at this time. Grades will be assigned using the following scale:

93–100	A
90	A-
87	B+
83	B
80	B-
77	C+
73	C
70	C-
67	D+
63	D
60	D-
<60	F

Students failing to maintain an overall “B” (GPA of 3.0) in courses may be advised to repeat some of the courses. Failure to achieve the minimum required grade in a course for the second time may result in termination from the program. Final decisions will be made by the program committee. Students may appeal grades by filing a Grade Appeal Form (available through the office of the registrar) within 30 days of completing the course. Grade appeal forms will be reviewed by the Assessment Committee.

Academic Dismissal

Regardless of the program, all students must maintain a cumulative GPA of at least a 3.0 (an overall “B” average) in order to remain in good academic standing. Courses are offered only during the semester in which they are listed and must be taken in a set order as indicated by the program director.

Failure to pass a course may require the student to retake the course and may delay his/her graduation date. Students who are required to retake courses who pay tuition (i.e. those in the MSMP or Certificate programs) must pay tuition for any course retakes. Failure to achieve the minimum required grade in a course for the second time may result in termination from the program.

Students who do not achieve the required academic levels or the necessary benchmarks and program requirements in their respective programs may be placed on probation. Probation will require the Assessment Committee, with input from a student’s Faculty Advisor and Thesis Advisor, to craft a plan and timeline for the student to remediate any issues. Failure to meet the conditions, timeline, and/or benchmarks of the probationary plan may result in termination from the program. The program committee will make final decisions as to matters of dismissal. Appeals for decisions of academic dismissal may be made to the Office of the Senior Associate Dean for Eduction for the School of Medicine.

Course Descriptions

Medical Physics Core Courses:

ESE 589: Biological Imaging Technology (3 credits - required for MS, PhD and Certificate)

This class will develop a fundamental understanding of the physics and mathematical methods that underlie biological imaging and critically examine case studies of seminal biological imaging technology literature. The physics sections will examine how electromagnetic and acoustic waves interact with tissues and cells, how waves can be used to image the biological structure and function, image formation methods and diffraction limited imaging. The math sections will examine image formation and analysis using basis functions (e.g. Fourier transforms), synthesis of measurement data, reduction of multi-dimensional imaging datasets, and statistical image analysis. Original literature on electron, confocal and two photon microscopy, ultrasound, nuclear imaging, computed tomography, functional and structural magnetic resonance imaging and other emerging imaging technology will be critiqued.

MP 500: Structure and Function of the Human Body for Medical Physics (3 credits – required for MS, PhD and Certificate)

This comprehensive course is designed to describe the structure and function of the human body through an integrated survey of anatomy, physiology, and histopathology. This information will provide a framework for understanding clinical aspects of medical physics. During this course, students will be introduced to the structure of the human body, including its regions, viscera (organs), tissues, and spatial orientation, will attain a profound understanding of human physiology from cellular to systemic levels, with the ability to articulate and comprehend the core principles of physiological concepts within major human systems, and will be introduced to human histology, including the principal tissue types (epithelia, connective tissue, blood vessels, muscle, neural tissue) and their organization into organs. The course content will be delivered through a combination of in-person lectures and, for a majority of the physiology content, self-paced, asynchronous, interactive modules available through Canvas. Team-based active learning sessions will provide an opportunity for students to consolidate and apply the knowledge gained from both lectures and learning modules.

MP 501: Clinical Imaging Fundamentals (2 credits – required for MS and PhD)

This course will discuss the main imaging modalities used in the clinic. This includes x-ray, magnetic resonance, ultrasound, and nuclear imaging. Applications with an emphasis on diagnostic imaging and image-guided radiotherapy will be covered. The focus of this course is on the underlying physical principles, technical implementations, image reconstruction algorithms, and quality assurance. In addition to the didactic component, there will be hands-on laboratory sessions on CT, cone-beam CT, planar x-ray imaging, mammography, MRI, ultrasound, and nuclear medicine.

MP 502: Radiological Physics and Dosimetry (3 credits – required for MS, PhD and Certificate)
This class is designed to construct a theoretical foundation for ionizing radiation dose calculations and measurements in a medical context and 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. Specifically, a student completing this course will be able to do the following:

1. Understand and apply key concepts specific to energy deposition for both ionizing photon interactions and transport in matter and for energetic charged particle interactions and transport in matter. Radiation sources include radioactivity, x-ray tubes, and linear accelerators.
2. Understand the theoretical details of ion-chamber based dosimetry and of cavity-theories based clinical dose measurement protocols.
3. Perform and present real-world style research projects as a group, and present these projects in a typical professional scientific format and style.
4. Achieve an appreciation of the history and potential future developments in ionizing radiation detection and dosimetry

MP 503: Independent Study (1 credit – required for MS)
The independent study course is designed to provide graduate students with an opportunity to gain insight into an aspect of the field of medical physics. The goal of the course is to provide introductory experience on a focused project with one or more faculty mentor(s). Graduate students will be matched with a project/mentor based on a number of factors, including student interest in the area of study and availability.

MP 503c: Clinical Project (3 credits – required MS)
Students will complete a clinically-focused, hands-on project under the supervision of a faculty mentor. Students will learn background as to the impetus of this project, will develop a plan or procedure for completing the project, and will take a major role in performing and completing the developed tasks. The goal of this is to simulate and gain an understanding of the workflow needed to achieve advancements in the clinic and/or patient care, as well as for students to gain a deeper understanding about a clinically focused topic. An oral presentation and written report describing the completed project work is required.

MP 503p: PhD Thesis Research (3 credits – required for PhD)
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. The goal of this project is to gain an in-depth understanding about an area of development or research in the medical physics field, as well as to gain an understanding about how to structure, perform, and present academic work. Students may also learn about academic publication composition and submission. An oral presentation and written report describing the completed project work is required.

MP 503r: PhD Research Rotation (3 credits – required for PhD)
The PhD Research Rotation course is designed to provide students with an experience working with one or more potential thesis mentors on a focused research opportunity. Students will gain insight into an aspect of the field of medical physics and a program of academic research, as well as cultivating a relationship with a potential thesis mentor. PhD students will be matched with a project/mentor based on a number of factors, including student interest in the area of study and availability.

MP 503t: MS Thesis Research (3 credits – required for MS)
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. The goal of this project is to gain an in-depth understanding about an area of development or research in the medical physics field, as well as to gain an understanding about how to structure, perform, and present academic work. Students may also learn about academic publication composition and submission. An oral presentation and written report describing the completed project work is required.

MP 504: Ethics, Professionalism and Current Topics (1 credit – required for MS and PhD)
This course prepares students to critically evaluate ethical, regulatory and professional issues, and 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. Additionally, 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.

MP 505: Radiobiology (2 credits – required for MS, PhD and Certificate)
This class 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, radiation therapy fractionation and related concepts. The effects of ionizing radiations on living cells and organisms, including physical, chemical, and physiological basis of radiation cytotoxicity, mutagenicity, and carcinogenesis are also covered.

MP 506: Radiation Oncology Physics (3 credits – required for MS, PhD and Certificate)
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.

MP 521: Radiation Protection and Safety (2 credits – required for MS, PhD and Certificate)
This class is designed to further the concepts of radiation interactions and dosimetry to radiation protection and safety and biological consequences of radiation exposure in humans. Protection and safety of the radiation worker and patient, as well as detection equipment and shielding analysis will be main focus. This course will briefly cover regulations, and radiological protection in various clinical environments.

MP 522: Clinical Rotations (2 credits – required for MS, PhD)
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.

MP 523: Advanced Clinical Medical Physics Laboratory (2 credits – required for Certificate)
The objective of this course is to reinforce and enhance the understanding concepts developed in didactic medical physics courses through practica, laboratory work, and/or special lectures. Students will gain a deeper understanding of the physics and methods involved in clinical imaging and/or radiation therapy treatment processes. The various practica will cover an array of topic areas including absolute dosimetry, relative dose measurements, patient QA, imaging QA, radiation beam modeling, treatment planning, proton therapy, brachytherapy, stereotactic radiotherapy, and adaptive radiation therapy.

Medical Physics Electives (usually 3 credits – required for MS and PhD)
The graduate programs in medical physics participate in the “free trade” agreement of the university. As such, students are allowed to take coursework as electives from any of the other schools and programs of the university which participate in the agreement, which include most of the relevant programs of interest to medical physics students. Recommended electives should be at the graduate level (500 numbering or above) and generally come from departments listed as Medical Physics (MP), Physics (Physics), Biomedical Engineering (BME), Electrical and Systems Engineering (ESE), Computer Science and Engineering (CSE), or Mathematics (Math). The student’s Faculty Advisor (MSMP) or Thesis Advisor (PhD), as well as the Program Director will provide guidance and approval for elective selection. Up to two 400 level courses may be allowed at the discretion of the relevant advisor and Program Director. Students in the Certificate program are not allowed to take elective courses.

Example electives include (note this list is not comprehensive):

- BME 544 Biomedical Instrumentation
- BME 570 Mathematics of Imaging Science
- Phys 435 Nuclear and Radiochemistry Lab
- BME 594 Ultrasound Imaging

- ESE 5933 Theoretical Imaging Science
- ESE 5934 Practicum in Imaging Science
- CSE 417t Introduction to Machine Learning
- CSE 427s Cloud Computing and Bid Data Applications
- CSE 514A Data Mining
- CSE 559A Computer Vision

Student Feedback

Students can provide feedback regarding the program, lecturers, and mentors at the end of each semester in several different ways. Feedback is very important to us as it helps us determine how to further improve our graduate programs in medical physics.

For each course in the program, including both those offered within and outside of the Department of Radiation Oncology, students are provided anonymous feedback forms to evaluate the course and the instructors. Toward the end of each semester, students will be prompted via email to complete an evaluation for each course they are finishing. They will be asked to provide timely feedback through a university wide evaluation system (https://wustl.bluera.com/wustl/) that is managed by the University Registrar's Office. For more information - https://registrar.wustl.edu/washu-course-evaluations/. The feedback is, compiled, anonymized, and passed on to the program director and/or course masters.

The Faculty Advisor for each student will hold a meeting with the students at the end of each semester. One element of this meeting is to get feedback on quality of education, the program, and their perspective. This feedback is relayed to the Program Director (if the Program Director is not the Faculty Advisor).

In addition, at the conclusion of the program, a final evaluation/exit interview is performed with each graduating student to assess the overall effectiveness of the program and seek any recommendations for improvement. Any relevant issues or concerns that are identified through feedback are compiled and summarized by the program director.

Furthermore, the Steering Committee contains a student member who is a current student in good standing. The student member is appointed by volunteer from the current program student body. The student member acts to facilitate student communication with the Steering Committee, providing students with a method to raise issues or concerns with the Steering Committee, as well as provide a student perspective on any discussion items. The individual selected as student member is asked to serve a term of one year, but may be reappointed at the discretion of the student body.

Advisement and Mentorship

MSMP

Master's Thesis Advisor:

MSMP students who select the Master's Thesis arm of the program will have a primary Master's Thesis Advisor for their dissertation who will be a program faculty member. Due to the multidisciplinary nature of the research it may be possible that a co-advisor may selected from Radiation Oncology, Radiology, or another department or school. Students are encouraged to meet regularly with their Thesis Advisor, generally given as an average of once per a week to discuss research progress and results. Thesis Advisors document the students' progress during their regular meetings and this progress should be shared and discussed and with the Assessment Committee. Course grades and evaluations provided by each faculty mentor are all considered as part of the students' performance. If issues arise between the Thesis Advisor and the student, the student may discuss with the separate Faculty Advisor, program or department leadership, or file a grievance.

Clinical Project Supervisor:

MSMP students who select the Clinical Project arm of the program will have a primary Clinical Project Supervisor who will be a program faculty member. Students are encouraged to meet regularly with their Project Supervisor, generally given as an average of once per a week to discuss progress and results. Clinical Project Supervisors document the students' progress during their regular meetings and this progress should be shared and discussed and with the Assessment Committee. Course grades and evaluations provided by each faculty mentor are all considered as part of the students' performance. If issues arise between the Clinical Project Supervisor and the student, the student may discuss with the separate Faculty Advisor, program or department leadership, or file a grievance.

Faculty Advisor:

Upon matriculation into the program, a Faculty Advisor will be assigned to each student from the program faculty. The Faculty Advisor for MSMP students is typically the Program Director or Associate Director. The Faculty Advisor may provide mentoring for students independent of the Thesis Advisor. The Faculty Advisor may review thee student's progress and provide overall guidance to the student in terms of career development in the field of medical physics. The student should meet with the Faculty Advisor at least once every six months, although alternative timelines may be allowed based on extenuating circumstances. The Faculty Advisor should be a different individual from the Thesis Advisor; if the Faculty Advisor becomes the student's Thesis Advisor, the Faculty Advisor will be transitioned to another program faculty member. If issues arise between the Faculty Advisor and the student, the student may discuss with their thesis advisor, program or department leadership, or file a grievance.

Independent Study Mentor:

Independent Study Mentors provide similar advising and mentoring services to students during the Independent Study courses in the first year. An Independent Study Mentor can transition to the Master's Thesis Advisor or Clinical Project Supervisor if the student selects to work with them. As with other primary mentors, if issues arise between the student and the Independent Study Mentor, the student may discuss with the separate Faculty Advisor, program or department leadership, or file a grievance.

PHD

Thesis Advisor:

The student's primary Thesis Advisor (also called Primary Investigator or PI) for the dissertation will be a program faculty member. Due to the multidisciplinary nature of the research it may be possible that a co-advisor may selected from Radiation Oncology, Radiology, or another department or school. The qualifications of thesis advisors will align with the policies and procedures of the School of Medicine and Washington University. Students in good standing after the first year will be allowed join a research group led by their Thesis Advisor. Students are encouraged to meet regularly with their Thesis Advisor, generally given as an average of once per a week to discuss research progress and results. Thesis Advisors document the students' progress during their regular meetings and this progress should be shared and discussed and with the Assessment Committee. If issues arise between the Thesis Advisor and the student, the student may discuss with the separate Faculty Advisor (see below), program or department leadership, or file a grievance.

Thesis Committee:

The Thesis Committee must be comprised of at least 5 members and is chaired by the Thesis Advisor or an appropriate alternative designee. The qualifications of thesis committee members will align with the policies and procedures of the School of Medicine and Washington University as well as CAMPEP.

he dissertation committee consists of at least five members, comprising of:

1. Three of the five members (or a similar proportion of a larger committee) must be full-time Washington University faculty members or, for programs offered by WashU-affiliated partners, full-time members of a WashU-affiliated partner institution who are authorized to supervise PhD students and who have appropriate expertise in the proposed field of study (i.e. who are program faculty). One of these three members must be the PhD student's primary thesis advisor, and one may be a member of the emeritus faculty.

2. All other committee members must be active in research/scholarship and have appropriate expertise in the proposed field of study, whether at Washington University, at another university, in government, or in industry.

3. At least one of the five members must bring expertise outside the student's field of study to the committee, as judged by the School of Medicine Graduate Program Council.

Once a committee is formed, students must fill out a Dissertation Defense Committee Form from the Washington University in St. Louis School of Medicine. The form must be submitted to the School of Medicine Graduate Program Council (GPC) where the committee is reviewed and approved by council members.

To achieve this, it is recommended that the committee shall be formed no later than three months before the student's thesis proposal. If issues arise between any Thesis Committee member and the student, the student may discuss with the separate Faculty Advisor, program or department leadership, or file a grievance.

Faculty Advisor:

In addition to the Thesis Advisor, a Faculty Advisor will be assigned to each student from the program faculty. The Faculty Advisor may provide mentoring for students independent of the Thesis Advisor. Typically the Faculty Advisor for the first year of the program will be the Program Director or Associate Director. Once the student has a primary thesis advisor, the Faculty Advisor is transitioned to another appropriate individual. The Faculty Advisor may additionally provide overall guidance to the student in terms of career development in the field of medical physics. The student should meet with the Faculty Advisor at least once every six months, although alternative timelines may be allowed based on extenuating circumstances. The Faculty Advisor may work with the Thesis Advisor and the Program Director, to create a custom plan for each student throughout the program. The Faculty Advisor should be a different individual from the Thesis Advisor; if the Faculty Advisor becomes the student's Thesis Advisor, the Faculty Advisor will be transitioned to another program faculty member. Faculty Advisors can serve on a student's Thesis Committee, but are not required to. If issues arise between the Faculty Advisor and the student, the student may discuss with their thesis advisor, program or department leadership, or file a grievance.

Rotation Mentor:

Rotation Mentors provide similar advising and mentoring services to students during the Research Rotations courses in the first year. A Rotation Mentor can transition to the Thesis Advisor if the student joins their group. As with Thesis Advisors, if issues arise between the student and the Rotation Mentor, the student may discuss with the separate Faculty Advisor, program or department leadership, or file a grievance.

CERTIFICATE PROGRAM

Faculty Advisor:

All students in the Post-PhD Graduate Certificate program are assigned a Faculty Advisor The Faculty Advisor will typically be the Program Director or Associate Director. The Faculty Advisor provides mentorship, support, and overall guidance to the student in terms of career development in the field of clinical medical physics. The

student should meet with the mentor at least once every six months, although alternative timelines may be allowed based on extenuating circumstances. If issues arise between the Faculty Advisor and the student, the student may discuss with their thesis advisor, program or department leadership, or file a grievance.

Clinical Etiquette and Professional Conduct

The clinical environment for the Department of Radiation Oncology is a different environment than students may be used to. The dress code for the clinic is business casual, in addition to any safety gear and dosimeter/monitors students may need to wear depending on what they are working with that day. Business casual has a fairly broad definition, but some specifics include no jeans, shorts, or t-shirts. Ties and jackets may be worn but are not required. Dress code in laboratory only spaces and students offices can be more casual and can include jeans and other elements mentioned above, although should still be appropriate and respectful for a work environment. Thesis or Faculty advisors may have specific rules or recommendations for their lab spaces which should be followed.

Students may also have access to patient health information (PHI). This information is strictly confidential and should never be shared with anyone outside the university. Students are required to follow the guidelines in the Washington University and BJC confidentiality agreements when dealing with any confidential information. Prior to beginning the program, students will be required to complete online HIPAA training.

When addressing faculty/staff, students are asked to refer to them by their appropriate professional titles, i.e. Dr., professor, etc. unless they are given explicit permission to call them by their first names. When scheduling meetings, students should remember to work within the faculty's typical work schedule whenever possible.

Under the mentorship of faculty, students are expected to behave in a professional and ethical manner throughout their programs. Didactically, they are introduced to these topics through the ethics course, and practically, are always given guidance as needed in the clinic. Our many faculty and staff physics members also serve as excellent examples of professional and ethical behavior, which the students have ample opportunities to observe.

For more information about related policies at Washington University:

Student conduct code - https://wustl.edu/about/compliance-policies/academic-policies/university-student-judicial-code/

Professionalism and conduct policies - https://bulletin.wustl.edu/medicine/policies/wusm-professionalism-conduct/

Radiation Safety

All new students will complete the following tasks before beginning work with radiation or radioactive materials:

- Fill out a radiation monitoring request form
- Study and register for a radiation safety exam
- Receive a dosimeter badge and/or ring as needed

All students and staff who work with radiation are required to wear radiation monitors. Following are guidelines and information that should be noted before beginning work with radiation or radioactive materials:

1. Dosimeter badges are exchanged quarterly.
2. Students and staff must wear badges while operating or working near radiation producing machinery or radioactive isotopes.
3. Ideally, wear badges at chest level (position of dot on monitor). If using a lead apron, wear monitor on the outside of the apron at the collar.
4. Employees handling radioactive materials will wear a ring monitor.
5. Wear ring badges under gloves, with the monitor towards the source.
6. If you lose your monitor, alert Julie Follman at follman@wustl.edu or Gregory Kamal at gkamal@wustl.edu ASAP.
7. If your monitor is irradiated off-body, try to be specific about location and duration.
8. When not working, keep your monitor in a designated location. Do not take the monitor home or to another institution! (Use the monitor boards in the Employee Lounge or across from Perez Conference Room.)
9. Rings will be provided to those handling isotopes.
10. Maintain the monitors in a dry, ambient location.
11. Only wear the monitors assigned to you by a facility at that facility. If working elsewhere, that facility must monitor you. Ensure records are being cross-transferred.
12. Your radiation monitor does not protect you from radiation.
13. It is not a warning device (i.e. it will not alarm, beep or change color)
14. Dosimetry documents the radiation dose an individual receives when working with radiation sources.
15. It is ILLEGAL to intentionally expose an individual's dosimeter.

If you become pregnant, you are invited to alert Gregory Kamal, in writing, in confidence, using the declaration form. This is not mandatory. However, the institution is not required to make accommodations unless notified in writing. You will be provided an additional monthly monitor, worn at the level of the uterus.

Notify one of the following in case of an emergency or to report a problem:

Gregory Kamal
Chief Compliance Officer
(314) 503-81871: cell
E-mail: gkamal@radonc.wustl.edu

Radiation Safety Office
(314) 362-3476: general office
(314) 826-3440: 24 hour emergency pager
E-mail: radsafety@wustl.edu

Academic Calendar

The medical physics graduate programs follow the same calendar as the McKelvey School of Engineering. The most current academic calendar can be found here: Academic Calendars | Office of the University Registrar | Washington University in St. Louis (wustl.edu) Fall term typically starts the last week of August and ends a few days before Christmas. Spring term typically starts mid-January and ends in early May.

Other important dates for the summer, fall and spring semesters can be found here: Semester Academic Dates and Deadlines | Office of the University Registrar | Washington University in St. Louis (wustl.edu)

Student Spaces, Facilities, and Clinical Equipment

Student Space
The MSMP and first year PhD graduate students have shared office space in the 4511 Forest Park Parkway Building on the second floor. Each student has an assigned cubicle for studying and meeting on the medical campus. Each student is also assigned a Washington University School of Medicine issued laptop and accessories such camera and headphones. Those further along in the PhD program and those in the Post PhD Certificate program typically have office space and equipment as provided by their assigned PI or mentor.

The 4511 Forest Park Parkway building also has classroom space for some of the required courses for the programs. Other classes meet in other locations such as the Radiation Oncology Academic Suites in the lower level of the Center for Advanced Medicine (about two blocks away). One course is offered remotely as the coursemaster is physically located in Springfield, MO (one of our satellite locations).

Facilities – Mallinckrodt Institute of Radiology
The Mallinckrodt Institute of Radiology is one of the largest and most scientifically sophisticated radiology centers worldwide. It consists of over 400,000 square feet of space, over 170,000 of which is dedicated to research space, housed in its own 13-story building and includes satellite facilities in the CAM, among other locations. Around 800,000 diagnostic examinations, 15,000 nuclear medicine examinations, and 53,000 interventional radiology procedures are performed annually.

Facilities – Department of Radiation Oncology
The Division of Medical Physics occupies approximately 4,000 square feet of space at the Siteman Cancer Center (clinical and research operations) and Clinical Sciences Research Building (research operations), and 3,000 square feet at the Forest Park building (research operations). Staff offices, secretarial area, dosimetry and research laboratories are located on the fourth floor of the Clinical Sciences Research Building, the lower level of the Siteman Cancer Center building, and on the second and third floor of the Forest Park building. Clinical physics and dosimetry work areas are maintained in the treatment areas. The Physics Division also hosts and maintains two 3D printers which may be used by residents as needed.

The Radiation Oncology Department has approximately 24,000 square feet of space devoted to patient-related services and 40,000 sq.ft. space for basic science and translational research. In addition, there is an Elekta Gamma Knife facility and a two vault proton facility on the premises. Integral components of the department are programs in Cancer Biology, Physics, Bioinformatics, and Computer-based patient information and data retrieval systems.

The Forest Park Medical Building, located one block from the Siteman Cancer Center building, provides approximately 2,450 square feet of space for IT personnel and houses departmental servers. The Radiation Oncology Department has its own

dedicated development team, Oncology Computing Facilities (OCF), consisting of developers with extensive experience optimizing clinical workflow and custom application development. In place for over a decade, the OCF development team has close relationships with their BJC IT counterparts and IT resources in other departments of Washington University.

In addition to the main campus at Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of medicine, our department provides clinical services to six satellite locations across the metropolitan St. Louis region. Of the six sites, residents have access to and train at the four satellite sites closest to the main campus: Siteman Cancer Center – South County, Siteman Cancer Center at Barnes-Jewish West County Hospital, Siteman Cancer Center at Northwest HealthCare, and Barnes Jewish St. Peters Hospital. Each site is equipped to provide world-class comprehensive cancer care to patients in the greater St. Louis. Radiation oncology facilities at these sites include at least one CT simulator and one C-arm linear accelerator along with a full suite of patient waiting areas, exam rooms, and treatment areas.

Equipment – Mallinckrodt Institute of Radiology

- CT: 18 scanners (all Siemens), including 1 Siemens Alpha (photon-counting); a second Siemens Alpha is at Missouri Baptist Hospital and two more will be installed with new Radiology tower in a couple years' time

- MRI: 21 clinical scanners (all Siemens), wide variety of research scanners as well, including a new 7T scanner recently installed.

- PET/CT: 2 clinical scanners, 2 research scanners – all Siemens; new Siemens Quadra whole body scanner to be installed within roughly a year's time.

- SPECT/CT: 5 scanners, both GE and Siemens, with one CZT scanner in clinical use; new GE Starguide CZT scanner to be installed within a year's time.

- IR procedure rooms: 16 (all Siemens); most have video recording system that archives all procedures.

- Cath Labs: 10

- Mammography: 13

- Rad/RF rooms (x-ray): 44

- Various other x-ray systems (c-arms, portable x-ray, DXA, dental, etc): 125

Equipment – Department of Radiation Oncology

- Varian ARIA R & V system
    - All facilities are integrated into one system
    - Aria = patient management component of Rad Onc workflow
    - Eclipse = Treatment Planning
- All linacs are Varian (except ViewRay)
    - 20 system wide (6 at main site)
    - Primarily Trilogies and Truebeams, plus Edge
    - Tx8 is a Varian EDGE w/ smaller collimator field size for fractionated RT for CNS, lung, and cardiac SBRT
    - Two Halcyon linacs – one with Ethos workflow for CT adaptive treatments
- Mevion Proton Center - Two pencil beam units
- GammaKnife with Icon - Option for frame-based & frameless tx
- ViewRay 0.35-T MR-IGRT (linac-based)* - Not currently in clinical use
- HDR units (2 Varian Bravos at main site)
    - Vaginal cylinders, tandem and ovoid, interstitial implants, Rotte Y applicator for inoperable endometrial, prostate HDR, esophagus, sarcoma
- Radiopharmaceuticals (NaI, Lutathera, Pluvicto, Xofigo, MIBG, IOMAB, others)
- LDR Brachytherapy treatments (Prostate, eye plaques)
- Philips 1.5-T MRI sim (Ingenia)
- Philips and Siemens CT sims (2 at BJH, 1 at each satellite)
    - Almost all are Siemens systems

Registration

The education coordinator will register all students for the required medical physics courses prior to the beginning of each semester. If students are taking courses offered outside the Division of Medical Physics, they will need to register themselves.

If a student must deviate from the recommended course sequence such as in the case of repeating a failed course or taking a departmental approved elective, the student must contact the education coordinator with permission from the program director prior to the enrollment deadline.

Withdrawal or Leave of Absence

Please make an appointment with the program director if you wish to withdraw from the program. Withdrawal from the program may affect eligibility of re-entry in the future.

Should students require a leave of absence for academic or personal reasons from their respective program, they must submit a statement in writing to the program director for approval. Such statements should include anticipated start and return dates as well as a brief description of the reason. Leaves of absence are granted for no more than one year, but in rare occasions may be renewed by the program. Students requiring a personal leave of absence for medical reasons must also submit a letter from their attending physician.

Integrity and Conduct

Academic Integrity

All students are expected to adhere to the Washington University policies on academic, research, and professional integrity and conduct. The Academic and Professional Policy for graduate students can be found here:

https://bulletin.wustl.edu/pdf/Academic%20and%20Professional%20Integrity%20Policy%20for%20PhD%20Students_2022.pdf

Note that although the policy notes for PhD students, we apply this policy to all graduate and post-graduate students in the medical physics programs.

Allegations of breach of the Research Integrity Policy are the primary responsibility of the Research Integrity Committee of the School of Medicine. Complaints regarding students or instructors in the student's respective program will be directed promptly to that committee. For further information, visit the Research Integrity Policy posted on the Washington University website.

Individuals who are accused of violating the Academic, Profesional, or Research Integrity policies are subject to review by the Assessment Committee of the Medical Physics programs. The assessment committee may then make recommendations to the Program Director and Steering Committee about any potential resolution, including dismissal from the program. A final decision is then made by the Program Director or designee who informs the aggrieved party in writing. Copies of this decision will be kept on file. Should the aggrieved party consider the decision unacceptable, they may appeal to the Office of the Senior Associate Dean for Eduction for the School of Medicine.

Abusive Conduct / Student Mistreatment

Students, faculty, and other Washington University personnel are additionally expected to not exhibit any inappropriate or abusive conduct. The definitions of this behavior as well as the policies as it relates to such conduct are found on https://hr.wustl.edu/items/abusive-conduct-policy/. Student mistreatment including the definitions and policies for reporting and monitoring can be found at https://bulletin.wustl.edu/medicine/policies/student-mistreatment/.

The process for managing with any potential breaches of integrity begins when an individual files a complaint to the program director or their designate regarding a grievance or perceived issues. This complaint includes pertinent information which supports the grievance. If the program director is directly involved in the complaint or grievance, the aggrieved party may file the complaint with the Assistant Director or any other faculty member of the Steering Committee. The Program Director (or the individual who the complaint was filed through) will then convene a Grievance Committee of no less than three members. These members are program faculty or

other reasonable designees who are not involved in the incident. The members of the Grievance Committee then appoint a chair who will initiate the process.

The Grievance Committee will perform an investigation into the matter and make a recommendation as to a solution within a reasonable time of the complaint, which is submitted to the Program Director (or designee if the Program Director is involved in the complaint). A final decision is then made by the Program Director or designee who informs the aggrieved party in writing. Copies of this decision will be kept on file. Should the aggrieved party consider the decision unacceptable, they may appeal to the Office of the Senior Associate Dean for Eduction for the School of Medicine.

Graduation Requirements and Applying for Graduation

MS Requirements

☐ Student satisfies requirements for program entry, including an undergraduate degree in physics and/or a related field and the equivalent of a minor in physics.

☐ Student has completed at least 30 credit hours of Medical Physics coursework including 24 credit hours of core medical physics coursework with B average and:

- ☐ A 3 credit hour clinical project and 3 credit hours of elective coursework or
- ☐ A 6 credit hour thesis project

☐ Student has attended/participated in Journal Clubs and conferences to a satisfactory level

☐ Student has passed a Comprehensive Exam at the end of Year 2

Student has completed all of the graduation requirements and can be awarded a Master of Science in Medical Physics from Washington University in St. Louis

☐ Yes ☐ No Program Director Signature: _____ Date: _____

PhD Requirements

☐ Student satisfies requirements for program entry, including an undergraduate degree in physics and/or a related field and the equivalent of a minor in physics.

☐ Student has completed at least 34 credit hours of coursework including 22 credit hours of core medical physics coursework with B average or has an MS from an accredited Medical Physics program and has completed 12 credit hours of elective coursework and any required core classes (if any)

☐ Student has attended/participated in Journal Clubs and conferences to a satisfactory level

☐ Student has passed a Comprehensive Qualifying Exam at the end of Year 2

☐ Student has successfully passed their Thesis Defense within 18 months after passing the Qualifying Exam

☐ Student has completed at least 36 credit hours of research training (including up to 6 hours of Research Rotations)

☐ Student has had a successful mentored teaching experience

☐ Student has completed a written defense and successfully passed their oral defense

☐ Student has submitted the written defense to the appropriate university offices

Student has completed all of the graduation requirements and can be awarded a Doctor of Philosophy in Medical Physics from Washington University in St. Louis

☐ Yes ☐ No Program Director Signature: _____ Date: _____

Certificate Requirements

☐ Student satisfies requirements for program entry, including a PhD degree in physics, engineering and/or a related field with at least three courses (nine credit hours) of advanced 300-400 level physics courses

☐ Student earned a GPA of at least a 3.0 and completed the required 18 credit required course hours in one to two years

Student has completed all of the graduation requirements and can be awarded a Post Doctorate Certificate in Medical Physics from Washington University in St. Louis

☐ Yes ☐ No Program Director Signature: _____ Date: _____

Intent to Graduate

All graduates must complete an Intent to Graduate form for the registrar's office prior to commencement. They will be prompted to do this via email through the Workday database.

Student Health Services and Insurance

The Student Health Service is a mandatory self-funded program of services for all full-time students enrolled in the medical or allied professional schools of Washington University School of Medicine (WUSM). These students are automatically charged for the health fees and enrolled in the Student Health Service. There is no waiver for this fee-based service. Students must complete the student health packet online in Workday by July 15th prior to the start of their first fall semester. Any eligible dependents of full time students may also participate in the service.

For more information, please contact student and occupational health services:

Website: https://wusmhealth.wustl.edu/students/
Phone: (314) 362-3523
Email: studenthealthservice@wusm.wustl.edu

For those students in need for lactation rooms -
https://facilities.med.wustl.edu/services/lactation-room/

Student Financial Services

For information regarding what financial aid options may be available to you, please contact the office of student financial planning:

Website: https://finaid.med.wustl.edu/
Phone: (314) 362-6845
Email: medfinancialaid@wustl.edu

Library and Computing Facilities

Libraries and online education resources

The Becker Medical Library, located at School of Medicine, will be the primary source for the graduate students, however all university libraries will be available for use. Since most contents are available online in the form of journals and books – the graduate students will have access to electronic resources as a registered student in Radiation Oncology. To help facilitate the didactic education in the graduate program, both students and faculty have access to the online WUSTL Zoom software and Canvas system which can help facilitate coursework in-person, remotely, or in a mixed “hybrid” system as the situation requires.

Computing facilities

Students will have access to facilities in the Department of Radiation Oncology, in student areas at their desks as well as access to various other facilities throughout the campus. The students will have access to desktop computers, classrooms, poster printing, and administrative office suites. The student may also use computers in the Becker Medical Library. Additionally, the students will have access to computers in the labs in which they will perform their research. A research cluster in the Center for High Performance Computing is available for student research use through the student’s faculty advisor.

Accommodations for Students with Disabilities

Students who need accommodations for disabilities should refer to disability resources on the Danforth campus.

Website: https://students.wustl.edu/disability-resources/
Email: disabilityresources@wustl.edu
Phone: (314) 935- 5970

Student Housing Resources

As a student at the medical school, there are many options for housing. Several of our students live within walking distance from the medical campus in the Central West End, which has an abundance of apartments and condominiums.

Another popular area to live is around the main university campus in the inner-lying suburbs of St. Louis such as University City and Clayton. Students can utilize the free park and ride offered by Metrolink and take the subway to the Central West End Station – short distance. Metro passes are provided to students at no cost. Students can also opt to drive to and park on campus if they are interested in purchasing a parking pass.

Some useful links to explore housing options:

Central West End Apartments:
https://www.apartments.com/central-west-end-saint-louis-mo/?gad_source=1&gclid=CjwKCAjw_LOwBhBFEiwAmSEQAe60JmZtkHX1NZbGxVy9_gn-sgnFnbVt7FtDTxifHlXS0QI9__-8WRoC6wcQAvD_BwE&gclsrc=aw.ds

Washington University Referral Services:
https://ars.wustl.edu/

Quadrangle Wash U Off-Campus Living:
https://quadrangle.wustl.edu/