

Medical Physics Program Open House 2019

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School of Medicine
and Public Health
UNIVERSITY OF WISCONSIN-MADISON



Madison and UW-Madison

- Madison is the state capitol and home to UW-Madison
 - The result is a small, manageable city with plenty of excitement. (7th "Best Small City in the US", National Geographics, 2018)
 - Many excellent city and nearby state parks, numerous bike trails, great hiking (and snowshoeing and cross-country skiing)
- Great academics and research
 - #6 in total research expenditures (US universities, 2018)
 - #6 in patents granted among US universities (2016)
 - #2 in doctorate degrees granted among US universities (2016-17)
 - One of the top 25 universities in the world (Center for World University Rankings, 2017)
- Great college town atmosphere
 - #3 best college town (Best College Reviews, 2018)
- Great university athletics
 - Routinely ranked as one of the best college sports towns in the nation by ESPN, Sports Illustrated, and USA Today



Madison's State Street at night



Camp Randall during a Badger game



Department Overview

- One of 10 Basic Science departments in UW School of Medicine and Public Health
- 95 faculty, including emeritus, joint, affiliate, adjunct, volunteer, and honorary fellow appointments*
- Faculty at SMPH*:
 - 24 tenured/tenure track (many with joint appointments)
 - 5 clinical health science (CHS) track
 - 1 clinical teaching track
 - 10 Emeritus professors (including past Provost and two previous dept chairs)
 - 2 Joint department appointments (in Radiology)
 - 30 Affiliates (in Radiology, DHO, Engineering, Medicine, Psychiatry)

*As of 1/1/2018



Department / Program Admin

- Chair and Program Director: Ed Jackson, PhD WIMR 1016
- Assistant to the Chair: TBD WIMR 1018
- Graduate Committee Chair: Tomy Varghese WIMR 1159
- Educational Programs Coordinator: Carol Aspinwall WIMR 1008
- Department Admin Staff:

• Amy Martens, MBA	WIMR 1006	Department Administrator
• Lyddia Ruch-Doll	WIMR 1005	Office Operations
• TBD	WIMR 1002	HR
• Kymber Lomax	WIMR 1011	Finance
• Yacouba Traore	WIMR 1115	IT System Administrator
• Charles Reinke	WIMR 1004	IT Support & Web / Database Support
• Mary Paskey	WIMR 1012	Grants Manager
• Clint Colby	WIMR 1004	Finance
- Lab Rotations & Training Grant PI: Tim Hall, PhD WIMR 1153



Department / Program Admin

- Vice Chair for Faculty: Tim Hall, PhD WIMR 1153
- Vice Chair for Research: Oliver Wieben, PhD WIMR 1127
- Graduate Student Representatives
 - Blake Benyard WIMR-1 B1138-B
 - Cole Cook 1122-F1 WIMR
 - Ian Marsh CSC L5/162-C
 - Autumn Walter WIMR-1 B1138-E

Excellent sources of information and primary reasons for the success of every Open House (and social events, town hall information events, newsletters, and more)



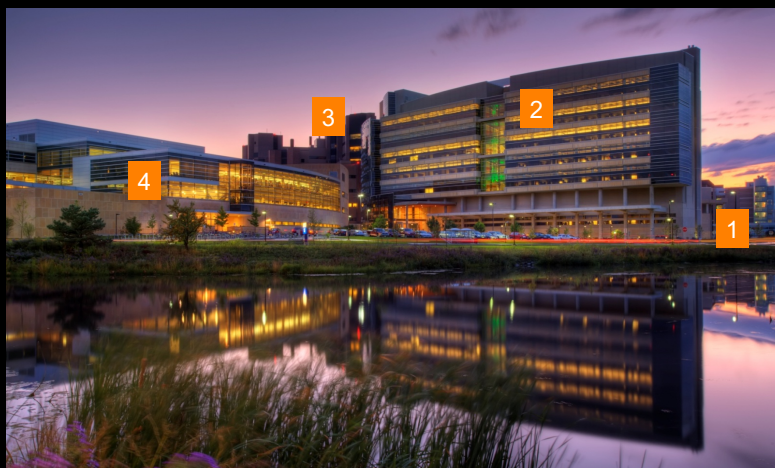
UW-Madison Medical Physics



Locations of Key Resources



1. Wisconsin Institutes of Medical Research (WIMR 1)
2. UW Carbone Comprehensive Cancer Center
3. UW Hospitals & Clinics
4. UW School of Medicine and Public Health (SMPH)



UW School of Medicine and Public Health

17 Clinical Departments

- Anesthesiology
- Dermatology
- Family Medicine
- Human Oncology
- Medicine
- Neurological Surgery
- Neurology
- Obstetrics & Gynecology
- Ophthalmology & Visual Sciences
- Orthopedics & Rehabilitation
- Pathology & Laboratory Medicine
- Pediatrics
- Psychiatry
- Radiology
- Surgery
- Urology
- Emergency Medicine

10 Basic Science Departments

- Biomolecular Chemistry
- Biostatistics & Medical Informatics
- Cell & Regenerative Biology
- Medical Genetics
- Medical History & Bioethics
- Medical Microbiology & Immunology
- Medical Physics
- Neuroscience
- Oncology
- Population Health Sciences



Med Phys Relationships w/Other Entities

10 Basic Science Departments

- Biomolecular Chemistry
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- Medical History & Bioethics
- Medical Microbiology & Immunology
- Medical Physics
- Neurosciences
- Oncology
- Population Health Sciences

- Waisman Center
 - Lab for Brain Imaging & Behavior
- Carbone Comprehensive Cancer Center
- Morgridge Institute for Research
- Wisconsin National Primate Research Center
- LOCI (Laboratory for Optical and Computational Instrumentation)
- Health Emotions Research Institute



Med Phys Relationships w/Other Entities

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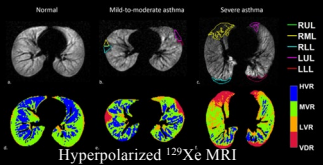
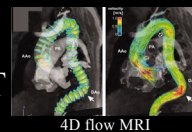
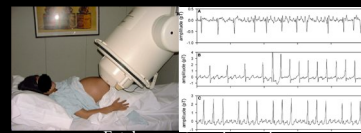
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- Biostatistics & Medical Informatics
- Cell & Regenerative Biology
- Medical Genetics
- Medical History & Bioethics
- Medical Microbiology & Immunology
- Medical Physics
- Neurosciences
- Oncology
- Population Health Sciences

- Physics
- Engineering
 - Nuclear Engineering & Engineering Physics
 - Biomedical Engineering
 - Electrical & Computer Engineering
- School of Veterinary Medicine
- Industry (Partial Listing)
 - Accuray (Tomotherapy)
 - Philips (Treatment Planning)
 - Standard Imaging
 - RMI/Gammex/Sun Nuclear
 - Marvel MedTech
 - inseRT MRI
 - GE Healthcare (including Lunar BMD systems)
 - Siemens Healthcare
 - Varian
 - Hologic (Breast Imaging)



Major Research Areas

- Biomagnetism
- Diagnostic x-ray imaging, including CT
- Image-guided therapy and assessment
- Magnetic resonance imaging and spectroscopy
- Medical radiation research and metrology
- Molecular imaging and nanotechnology
- Radiation therapy physics
- Radionuclide production and PET
- Ultrasound physics
- Multiscale/optical imaging



WIMR Research Facilities

WIMR Tower 1: Floor B

- ★ PET/CT (GE Discovery MI scanner)
- ★ MicroCT scanner
- ★ Micro PET/CT scanner
- ★ 4.7T small-bore MRI scanner
- ★ HyperSense C-13/N-15 hyperpolarizer
- ★ Radiochemistry lab
- ★ Cyclotron (PETTrace, 2nd RDS cyclotron @ MSC)
- ★ Medical Radiation Research Center / ADCL
- ★ PET/CT (GE 710 scanner)
- ★ GMP radiopharmaceutical facility
- ★ Machine shop
- ★ Radiation Detector Lab
- ★ Radiation Therapy Physics Lab
- ★ 3.0T MR/PET (GE Signa PET/MR)
- ★ High-freq US / photoacoustic system
- ★ Xenogen IVIS spectrum optical system

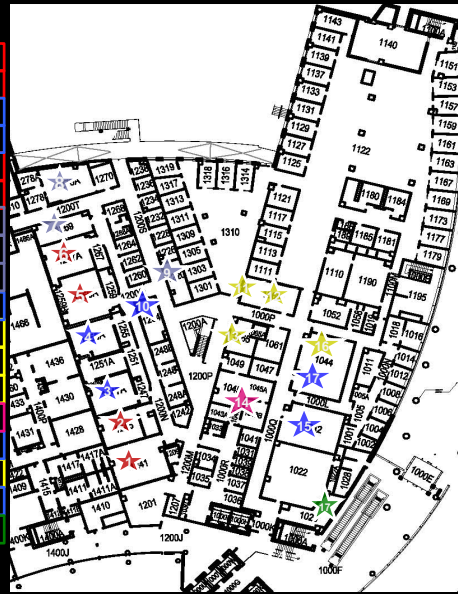
Accuray Radixact Next-Gen Tomo System
Varian 21EX Linac



WIMR Research Facilities

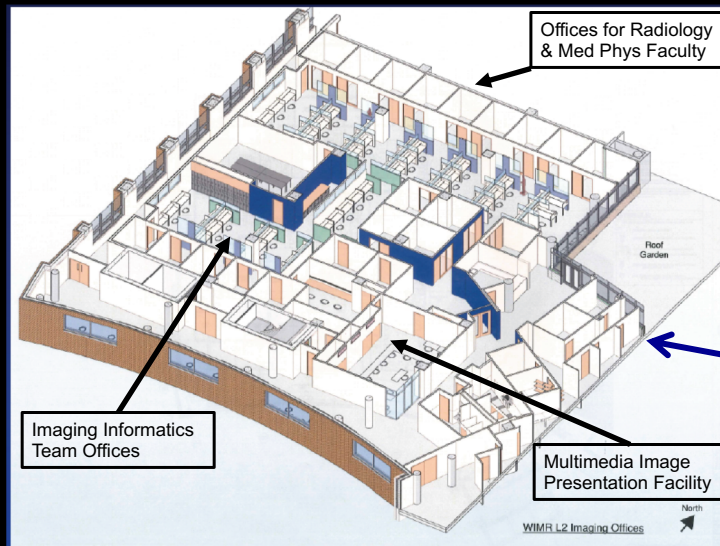
WIMR Tower 1: Floor 1

- ★ 64 slice, dual energy CT scanner
- ★ Four flat-panel CT scanner, breast tomosynthesis
- ★ 3.0T MRI scanner (GE Signa Premier)
- ★ 3.0T MRI scanner (GE MR750)
- ★ Angiography unit
- ★ SBDX angiography unit
- ★ RF/Thermal/Microwave ablation lab
- ★ Animal surgery suite
- ★ Image data processing and informatics
- ★ He-3 polarizer, Xe-129 polarizer
- ★ Medical elastography lab
- ★ 64-channel ultrasound machine
- ★ 192-channel ultrasound machines
- ★ 72-channel SQUID biomagnetism unit
- ★ Electronics/radiofrequency lab
- ★ Acoustics lab
- ★ MRI lab
- ★ Treatment planning system lab



WIMR Research Facilities

Radiology / Med Phys Expansion (10,000 sq ft)



Level 2 of WIMR Tower 2

Opened June 2014



Clinical Research Facilities

- UW Hospitals and Clinics
 - State-of-the-art X-ray, CT, MRI, Nuclear Medicine, and ultrasound facilities
 - State-of-the-art radiation therapy facilities, including ViewRay MR-guided radiation therapy system
- American Family Children's Hospital
- William S. Middleton Memorial Veterans Hospital
- UnityPoint Health – Meriter Hospital (now UW Health affiliate)
- UW Health American Center Hospital
- Other UW Health facilities across Madison
- Health Emotions Research Institute (HERI)



Research Facilities

Waisman Center – Dedicated to the advancement of knowledge about human development, developmental disabilities, and neurodegenerative diseases.

Waisman Laboratory for Brain Imaging and Behavior

- 3T MR Scanner (fully equipped for fMRI studies)
- MR Scanner Simulator
- Siemens ECAT HR+ PET Scanner
- Siemens Focus 220 microPET Scanner
- Tandem Accelerator (7 MeV protons) and Radiochemistry Lab
- 256-Channel EEG/ERP System

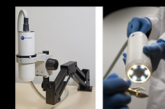
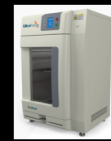
Additional Waisman Center Cores:

- Admin
- Clinical Translational
- Cellular & Molecular Neuroscience
- Rodent Models



Research Facilities – Small Animal

- Inveon micro-PET/CT
- Faxitron UltraFocus Digital X-ray
- Perkin-Elmer IVIS Spectrum
- Vevo LAZR High Frequency Ultrasound / Photoacoustic
- Varian 4.7T MR and HyperSense Polarizer
- Fluoptics Fluobeam 800 Intraoperative NIR
- Gamma Counter and Hematologic Analyzer
- Image Analysis Workstations
- Small Animal Irradiator



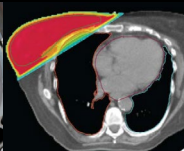
UW Med Phys Graduate Program

- Typical Program Enrollment: ~90
- Typical Entering Class Size: 16 – 22
- Faculty also supervise students from outside of the Medical Physics Program (BME, ECE, NEEP, physics, neuroscience, *etc.*), bringing total number of students working in medical physics to >100.
- Post-Docs: ~15
- Scientists: ~15



UW Med Phys Program Graduates

- Over 300 Ph.D. degrees granted since the department's inception.
- ~150 terminal M.S. degrees (very uncommon at this time)
- Broad didactic offerings with significant focus on research training
- Graduate students often involved in patents, tech transfer, and startups



United States Patent [19] [11] **4,204,226**
Mistretta et al. [45] **May 20, 1980**

[54] **REAL-TIME DIGITAL X-RAY TIME INTERVAL DIFFERENCE IMAGING** Scanning Video Densitometry-Cardiovascular Imaging and Image Processing, SPIE Publication edited by Harrison et al., 1975, pp. 183-194.
[72] Inventors: Charles A. Mistretta, Robert A. Kruger, Theodore L. Hawk, all of Madison, Wis.
[73] Assignee: Wisconsin Alumni Research Foundation, Madison, Wis.

United States Patent [19] [11] Patent Number: **5,528,650**
Swerdlhoff et al. [45] Date of Patent: **Jun. 18, 1996**

[54] **METHOD AND APPARATUS FOR RADIATION THERAPY** 5,394,452 2/1995 Swerdlhoff et al. 378/05
OTHER PUBLICATIONS
[76] Inventors: Stuart Swerdlhoff, 2309 Upham St., Madison, Wis. 53704; Thomas R. Mackie, 2310 Ravenwood Rd., Madison, Wis. 53711; Timothy Holmes, 12 Coronado Ct. #2, Madison, Wis. 53702
Calculation and Application of Point Spread Functions For Treatment Planning With High Energy Photon Beams, Altmose et al., Acta Oncol. 26:49-56, 1987.
Methods of Image Reconstruction From Projections Applied to Conformal Radiotherapy, Bortfeld et al., Phys. Med. Biol. 35(10), 1423-1439, 1990.



UW Medical Physics Program

- The UW Program is the largest medical physics graduate program in North America.
- The UW Program was one of the first medical physics graduate programs accredited by CAMPEP (1988) and has been continuously accredited since that time.
- There are no published “rankings” of medical physics graduate programs. Rankings are by reputation.
- Differences between the programs relate primarily to:
 - Resources (faculty/staff, space, equipment, access to equipment)
 - Didactic and laboratory course breadth and depth
 - Degree and timing of subspecialization of education and training
 - Research breadth and quality
 - Clinical experience opportunities



Core Curriculum

- The UW Medical Physics Program has defined a core curriculum (29 credits)* that satisfies the graduate education requirements specified by CAMPEP standards**. However, the program has an “opt out” option for students who wish to complete degree requirements without taking the full slate of core courses.
- For such programs, CAMPEP accreditation requires identification of students who complete the core curriculum.
- Beginning with students who matriculated in fall 2014, those students who complete the core curriculum can receive a certificate (letter) attesting to such completion.

*Note that the core curriculum is undergoing a transformation to update and expand content. It is anticipated that the total number of credits, however, will remain similar.

**Standards for Accreditation of Graduate Educational Program in Medical Physics, www.campep.org



UW Medical Physics Program

Breadth and depth of curriculum

- General Medical Physics & Radiation Therapy
 - Radiological Physics and Dosimetry (501)*
 - Physics of Radiotherapy (566)*
 - Health Physics & Biological Effects (569)*
 - Monte Carlo Radiation Transport (506)
 - Introduction to Energy-Tissue Interactions (535)
 - Patient Safety and Error Reduction in Healthcare (559)
 - Advanced External Beam Radiotherapy (571)
 - Advanced Radiation Treatment Planning (572)
 - Advanced Brachytherapy Physics (570)
 - Radiation Physics Metrology (679)

*Core Courses



UW Medical Physics Program

Breadth and depth of curriculum

- Imaging Science & Nuclear Medicine
 - Radioisotopes in Medicine and Biology (563)*
 - Medical Image Science: Mathematical and Conceptual Foundations (573)*
 - Physics of Diagnostic Radiology (567)*
 - Magnetic Resonance Imaging (568)*
 - Diagnostic Ultrasound Imaging (575)*
 - Imaging in Medicine: Applications (574)
 - Principles of X-ray Computed Tomography (777)
 - Advances in Medical Magnetic Resonance (710)
 - Advanced Ultrasound Physics (775)
 - Digital X-Ray Imaging (707)
 - Multi-Modality Molecular Imaging in Living Subjects (719)
 - Microscopy of Life (619)

*Core Courses



UW Medical Physics Program

Breadth and depth of curriculum

- Rad Labs
 - Diagnostic Radiological Physics (662)
 - Nuclear Medicine Physics (663)
 - Health Physics (664)
 - CT, MRI, and DSA Physics (665)
 - Medical Ultrasound Physics (666)

*Core Courses



UW Medical Physics Program

Breadth and depth of curriculum

- Associated Courses (selected from wide range of options)
 - Radiobiology (410)
 - Ethics & Responsible Conduct of Research & Practice of Medical Physics (701)*
 - Special topics courses (471) in, for example,
 - Digital Medical Image Management
 - Targeted Radionuclide Therapy
 - Methods for Neuroimaging Research
 - Human Anatomy and various other courses in physiology, neuroscience, *etc.**
 - Courses in biostatistics, medical informatics, *etc.*

*Core Courses



UW Medical Physics Program

Residence Credit for Prior Courses

- The Student Handbook* and Graduate School webpages specify the maximum number of residence credit reductions allowed for the [MS degree](#) and [PhD degree](#) programs.
- Residence credit will be granted at the discretion of the Medical Physics Graduate Committee. No considerations for waiver of course requirements will be allowed for students who receive residence credit reduction.
- PhD Program:
 - Minimum credits: 54
 - Maximum allowed residence credit reduction: 12
- MS Program:
 - Minimum credits: 32
 - Maximum allowed residence credit reduction: 3

*www.medphysics.wisc.edu/graduate/



UW Medical Physics Program

Waivers for a Prior MS Degree in Medical Physics

- Up to a 12-credit reduction in minimum of 54 credit hours required for PhD degree (residence hour reduction).
- If residence credit reductions are granted, no other waivers are allowed.
- Oral Qualifier: If waivers are granted, the standard Oral Exam Panel (8 members from Medical Physics Program) will serve as the examiners and the student is responsible for content from the waived courses.
- A prior MS in medical physics *cannot* be used as a means of satisfying the 9-credit minor requirement. (A prior MS in other areas of science can potentially satisfy the minor requirement.)

See Graduate Student Handbook at www.medphysics.wisc.edu/graduate/



UW Medical Physics Program

- Didactic courses addressing core Medical Physics topics
- Laboratory components
 - As part of several core courses
 - Standalone “Rad Labs” (may be taken after dissertator status is reached, if desired)
- Oral PhD Qualifying Exam (end of Yr 2)
- Wide range of elective courses (subspecialty and outside of Med Phys)
- Prelim Exam (defense of research prospectus, public+exam, by end of Yr 3)
- Research in broad range of areas Dissertator Status
- Clinical exposure options (working with clinical medical physicists)
 - Radiation therapy “teams”
 - Diagnostic imaging physics team
- Dissertation defense and exam plus required separate public seminar
- Typical times: 2 years for (non-thesis) MS plus 4-5 years for PhD



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Financial Support

Research Assistantship (RA)

- Most first year students
- Funding from individual professor research grants / contracts
- Provides stipend, tuition remission, health insurance
 - Stipend levels effective fall 2019: \$28,000 (pre-dissertator); \$31,000 (dissertator)
- Availability of open positions varies
- Requirements vary (some professors allow flexible schedules)
- Strong, informed interest in the work of the lab is a plus!



Financial Support

- Training Grants
 - Outside departments
 - Must be nominated by faculty member and department
 - Department NCI T32 – Research focus must be related to cancer
 - Dr. Tim Hall is PI
 - Must be at or past prelim exam stage (dissertator status)
 - Competitively awarded through application with specific faculty member
 - 8 pre-doc slots and 3 post-doc slots
- Department Service Labs
 - Accredited Dosimetry Calibration Lab: Dr. Wes Culberson, Director
 - Others
- Self Funding



Career Paths

- UW-Madison medical physics program graduates have gone on to a very wide range of subsequent additional training programs and careers.
- Additional training / education programs:
 - Postdoctoral fellowships
 - Medical physics residency programs (therapy and imaging)
 - “On the job training” junior medical physics positions
- Careers
 - Academia
 - Industry
 - Entrepreneurs
 - Clinical medical physics positions in academic health centers, hospitals, consulting groups



Board Certification

Certifying Boards Relevant to Medical Physics:

- American Board of Radiology (ABR)
 - Therapeutic Medical Physics
 - Diagnostic Medical Physics
 - Nuclear Medical Physics
- American Board of Medical Physics (ABMP)
 - Magnetic Resonance Imaging Physics
 - Health Physics
- American Board of Science in Nuclear Medicine (ABSNM)
 - Nuclear Medicine Physics and Instrumentation
 - Radiopharmaceutical Science
 - Radiation Protection
 - Molecular Imaging



ABR Board Certification

- **Part 1: Written Exam**
 - “You must be enrolled in and in good standing with, or have graduated from, a CAMPEP-accredited program (graduate program, doctorate in medical physics [DMP] program, certificate program, or medical physics residency).”
- **Part 2: Written Exam**
 - “You must have passed the Medical Physics Part 1 exam (general and clinical)”, and
 - “You must have completed a CAMPEP-accredited residency by August 31 of the year in which the Part 2 exam is to be taken.”
- **Part 3: Oral Exam**
 - “Candidates who have passed all of the Part 1 computer-based exam and their chosen medical physics specialty Part 2 computer-based exam(s) are eligible to take the Part 3 (oral) exam.”

<http://www.theabr.org>

