M.S. in MEDICAL PHYSICS and HEALTH PHYSICS PROGRAM

CAMPEP Accredited through 2011

- Overview and Program Goals
- Sample Curriculum
- Student Stipends
- FAQs
- Request for Additional Program Information

Ph.D. in PHYSICS (MEDICAL PHYSICS SPECIALIZATION)

- Overview and Program Goals
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MEDICAL PHYSICS FACULTY, RESEARCH, and PHYSICAL RESOURCES

- Faculty
- Research / Research Concentrations
- Physical Resources

OVERVIEW AND PROGRAM GOALS
MEDICAL PHYSICS AND HEALTH PHYSICS PROGRAM

OVERVIEW – M.S. PROGRAM

To meet increasing demand of hospitals, clinics, and industry for trained medical physicists and health physicists, LSU's Department of Physics and Astronomy offers a Master of Science degree in Medical Physics and Health Physics. The M.S. degree program is oriented toward professional training, and students graduating from the Program are well prepared for entry-level professional positions and for future board certification exams.

Students spend one year in the classroom learning the fundamentals of medical and health physics, radiation biology, and human anatomy. Next, students in the medical physics concentration learn to apply the knowledge gained in the classroom. For two semesters these students take additional courses in radiation oncology physics and receive clinical training and experience by working side-by-side with medical physicists, medical dosimetrists, and radiation oncologists at Mary Bird Perkins Cancer Center. Students in the health physics concentration take additional courses in applied nuclear science to better prepare them for careers at hospitals, industrial companies, and national laboratories that use radiation sources.

Students in both the medical physics and health physics concentrations are required to complete a thesis based on hypothesis-driven research. Full-time thesis research is begun the Summer semester of the second year and should be completed by the end of the Spring semester of the third year. The results of the thesis are expected to be submitted for publication in a peer-reviewed scientific journal.

OBJECTIVES: MEDICAL PHYSICS

The Medical Physics component of the Program is designed for individuals who seek the M.S. degree and wish to be educated in clinical medical physics. The Program's objective is to provide clinical and research training in Medical Physics, which give the student opportunity to prepare for:

- Career as a professional medical physicist in a clinical environment,
- Career as a professional medical physicist in a clinical-support industry,
- Career as a professional medical physicist in a clinical-support research laboratory, or
- Further research training in a Ph.D. medical physics program.

Upon graduation medical physics graduates are prepared to receive advanced clinical training through working under the direction of a board-certified medical physicist or entering a medical physics residency program.

OBJECTIVES: HEALTH PHYSICS

The Health Physics component of the Program is designed for individuals who seek the M.S. degree and wish to be educated in medical health physics. The Program's objective is to provide clinical, industrial, and research training in Health Physics, which give the student opportunity to prepare for:

- Career as a professional medical health physicist in a hospital environment,
- Career as a researcher in a health physics research laboratory, and
- Further research training in a Ph.D. health physics or medical physics program.

QUALIFICATIONS FOR ADMISSION

Students considering the medical physics and health physics field should have a B.S. in physics or a related scientific or engineering discipline with a strong background in physics.

Prerequisites for entry into the program include completion of the following courses:

- Biology: one semester of general biology; one semester of human anatomy
- Chemistry: two semesters of general chemistry
- Physics: a core of calculus-based physics courses, which includes at least two semesters of general physics, and additional courses covering classical mechanics, electromagnetism, electronics, and modern physics
- Mathematics: Three semesters of calculus; one semester of differential equations
- Computer Science: Proficiency in a programming language such as C, C++, or FORTRAN; knowledge of basic numerical analysis methods

Most students applying for the program are deficient in the human anatomy prerequisite, which is removed by taking the "KIN 2500- Anatomy" course during the summer semester of the first year. Some students are deficient in knowing a high level computer language (e.g. C or FORTRAN) and basic numerical methods. This deficiency can be removed by an advanced topics course or PHYS 2411- Computational Science I.

OVERVIEW – Ph.D. PROGRAM

To meet the ongoing demand of university hospitals, clinics, and industry for medical physicists trained in research and clinical medical physics, LSU's Department of Physics and Astronomy offers a Ph.D. degree in Physics with specialization in medical physics. The Ph.D. degree program provides students a fundamental knowledge of physics and medical physics, advanced research training in a particular subfield of medical physics, and optionally, introductory clinical training. Students are required to fulfill the department's requisites for the Ph.D. degree, which are summarized in the department's "A Brief Guide to Graduate Studies in Physics and Astronomy." http://www.phys.lsu.edu/graduate/guide.html

Students will spend their first year in the classroom completing the graduate physics core courses. The second year and a portion of the third year are spent completing comprehensive curricula in the fundamentals of medical physics, radiation biology, and radiation oncology. Subsequently, students are required to complete a dissertation based on hypothesis-driven research. Full-time dissertation research should begin no later than the Summer semester of the third year and is expected to require approximately 3 years of study. The results of the dissertation are expected to result in multiple publications in peer-reviewed scientific journals. The program length will be approximately 6 years. However, for students entering with a M.S. in Physics, transferred courses should be able to meet all or part of the physics core requirement, shortening the expected program length to 5 years.

Students in the medical physics specialty have the opportunity to apply their medical physics knowledge to the clinic by taking practical courses in which they work side-by-side with medical physicists, medical dosimetrists, and radiation oncologists at Mary Bird Perkins Cancer Center. Clinical training is optional, as students pursuing a clinical career might select to complete more comprehensive clinical training through a medical physics residency program. Commencing 2014, in order to take the American Board of Radiology Part 1 examination in Radiologic Physics, candidates must be enrolled in or have completed a CAMPEP accredited residency program. (ABR October 13, 2007 Policy Statement) http://www.theabr.org/Policy_Pri_CAMPEP.htm

OBJECTIVES: MEDICAL PHYSICS

The Ph.D. Program is designed for individuals who wish to be educated in medical physics with emphasis in research. The Program's objective is to provide a general knowledge of medical physics, research training in a particular subfield of medical physics, and optionally, clinical training in medical physics. The Ph.D. degree will give the student opportunity to prepare for:

- Entry level research position, i.e., a junior faculty or postdoctoral fellow position in an academic medical physics department,
- Entry level professional medical physicist position, as either a medical physics resident or a junior medical physicist under the supervision of a board-certified medical physicist in a clinical environment, or
- Career as a medical physicist researcher in a clinical-support industry.

TYPICAL CURRICULA – M.S. in MEDICAL PHYSICS and HEALTH PHYSICS

- Medical Physics Specialization
- Health Physics Specialization

TYPICAL ACADEMIC PLAN FOR M.S. in MEDICAL PHYSICS

Year 1, Fall Semester

(3)	MEDP-4331	Radiation Protection and Exposure Evaluation
(1)	MEDP-4332	Radiation Detection Laboratory
(2)	MEDP-4351	Radiation Detection and Instrumentation
(3)	MEDP-7537	Radiation Interactions and Transport
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

Year 1, Spring Semester

(3)	MEDP-4111	Introduction to Medical Imaging
(3)	MEDP-7121	Radiobiology
(2)	MEDP-7530	Radiation Shielding
(3)	MEDP-7331	Radiation Therapy Physics
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

Year 1, Summer Semester

(3)	KIN-2500	Anatomy
(0-3)	MEDP-7991	Advanced Projects in Medical Physics and Health Physics, or
(0-3)	MEDP-7992	Advanced Topics in Medical Physics and Health Physics

Year 2, Fall Semester

(3)	MEDP-7111	Advanced Medical Imaging Physics
(3)	MEDP-7260	Clinical Radiation Therapy Physics Rotation
(3)	MEDP-7270	Advanced Radiation Therapy Physics
(1)	MEDP-7991	Advanced Projects in Medical Physics and Health Physics
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

TARGET DATE FOR FORMATION OF SUPERVISORY COMMITTEE

Year 2, Spring Semester

(3)	MEDP-7210	Clinical Principles of Radiation Therapy
(2)	MEDP-7280	Advanced Clinical Radiation Therapy Physics Rotation
(4)	MEDP-8000	Thesis Research

Year 2, Summer Semester

(6)	MEDP-8000	Thesis Research

Year 3, Fall Semester

(9)	MEDP-8000	Thesis Research

Year 3, Spring Semester

(9)	MEDP-8000	Thesis Research

TYPICAL ACADEMIC PLAN FOR M.S. in HEALTH PHYSICS

Year 1, Fall Semester

(3) MEDP-4331 Radiation Protection and Exposure Evaluation
(1) MEDP-4332 Radiation Detection Laboratory
(2) MEDP-4351 Radiation Detection and Instrumentation
(3) MEDP-7537 Radiation Interactions and Transport
(1) MEDP-7995 Medical Physics and Health Physics Seminar

Year 1, Spring Semester

(3) MEDP-4111 Introduction to Medical Imaging
(3) MEDP-7121 Radiobiology
(2) MEDP-7530 Radiation Shielding
(3) Elective course from approved set (see below)
(1) MEDP-7995 Medical Physics and Health Physics Seminar

Year 1, Summer Semester

(3) KIN-2500 Anatomy
(0-3) MEDP-7991 Advanced Projects in Medical Physics and Health Physics, or
(0-3) MEDP-7992 Advanced Topics in Medical Physics and Health Physics

Year 2, Fall Semester

(3) MEDP-7331 Radiation Therapy Physics (recommended elective)
(2-3) MEDP-7991 Advanced Projects in Medical Physics and Health Physics or
(2-3) MEDP-7992 Advanced Topics in Medical Physics and Health Physics
(1) MEDP-7995 Medical Physics and Health Physics Seminar

TARGET DATE FOR FORMATION OF SUPERVISORY COMMITTEE

Year 2, Spring Semester

(6) Elective courses from approved set (see below)
(1-6) MEDP-8000 Thesis Research

Year 2, Summer Semester

(6) MEDP-8000 Thesis Research

Elective Courses may be selected from the following, as example:

(3) MEDP-7111 Advanced Medical Imaging Physics
(3) MEDP-7210 Clinical Principles of Radiation Therapy
(3) MEDP-7331 Radiation Therapy Physics
(3) MEDP-7538 Monte Carlo Simulation of Radiation Transport
(1-3) MEDP-7991 Advanced Projects in Medical Physics and Health Physics
(1-3) MEDP-7992 Advanced Topics in Medical Physics and Health Physics
(1-6) MEDP-7999 Report Investigation

TYPICAL CURRICULA – Ph.D. in PHYSICS, MEDICAL PHYSICS SPECIALIZATION

- Entering with B.S. in Physics
- Entering with M.S. in Physics

EXAMPLE OF ACADEMIC PLAN
For Ph.D. in PHYSICS, MEDICAL PHYSICS SPECIALIZATION
(Entering with B.S. in Physics)

Year 1, Fall Semester

(3)	PHYS-7221	Classical Mechanics
(3)	PHYS-7241	Quantum Mechanics
(3)	MEDP-4331	Radiation Protection and Exposure Evaluation
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

TAKE WRITTEN QUALIFYING EXAM

Year 1, Spring Semester

(3)	PHYS-7231	Classical Electrodynamics
(3)	PHYS-7242	Quantum Mechanics
(3)	PHYS-7398	Graduate Laboratory
(1)	PHYS-7857	Graduate Seminar

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

Year 1, Summer Semester

(3)	KIN-2500	Anatomy
(0-3)	MEDP-7991	Advanced Projects in Medical Physics and Health Physics
(0-3)	MEDP-7992	Advanced Topics in Medical Physics and Health Physics

Year 2, Fall Semester

(3)	PHYS-7225	Statistical Mechanics
(1)	MEDP-4332	Radiation Detection Laboratory
(2)	MEDP-4351	Radiation Detection and Instrumentation
(3)	MEDP-7537	Radiation Interactions and Transport
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

Year 2, Spring Semester

(3)	MEDP-4111	Introduction to Medical Imaging
(3)	MEDP-7121	Radiobiology
(2)	MEDP-7530	Radiation Shielding
(3)	MEDP-7331	Radiation Therapy Physics
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

Year 2, Summer Semester

(0-6) MEDP-7991 Advanced Projects in Medical Physics and Health Physics
(0-6) MEDP-7992 Advanced Topics in Medical Physics and Health Physics

Year 3, Fall Semester

(3) MEDP-7111 Advanced Medical Imaging Physics
(3) MEDP-7270 Advanced Radiation Therapy Physics
(3) MEDP-7991 Advanced Projects in Medical Physics and Health Physics

Year 3, Spring Semester

(3) MEDP-7210 Clinical Principles of Radiation Therapy
(6) PHYS-9000 Dissertation Research

TAKE ORAL GENERAL EXAM

Year 3, Summer Semester

(6) PHYS-9000 Dissertation Research

Year 4, Fall Semester

(9) PHYS-9000 Dissertation Research

Year 4, Spring Semester

(9) PHYS-9000 Dissertation Research

Year 4, Summer Semester

(6) PHYS-9000 Dissertation Research

Year 5, Fall Semester

(9) PHYS-9000 Dissertation Research

Year 5, Spring Semester

(9) PHYS-9000 Dissertation Research

Year 5, Summer Semester

(6) PHYS-9000 Dissertation Research

Year 6, Fall Semester

(3) MEDP-7260 Clinical Radiation Therapy Physics Rotation (Optional)
(6-9) PHYS-9000 Dissertation Research

Year 6, Spring Semester

(2) MEDP-7280 Advanced Clinical Radiation Therapy Physics Rotation (Optional)
(7-9) PHYS-9000 Dissertation Research

FINAL EXAMINATION/ORAL DISSERTATION DEFENSE

EXAMPLE OF ACADEMIC PLAN*
For Ph.D. in PHYSICS, MEDICAL PHYSICS SPECIALIZATION
(Entering with M.S. in Physics)

*This example assumes that all Physics core requirements are met. If not, this plan must be modified to complete those requirements.

Year 1, Fall Semester

(3)	MEDP-4331	Radiation Protection and Exposure Evaluation
(1)	MEDP-4332	Radiation Detection Laboratory
(2)	MEDP-4351	Radiation Detection and Instrumentation
(3)	MEDP-7537	Radiation Interactions and Transport
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

TAKE WRITTEN QUALIFYING EXAM

Year 1, Spring Semester

(3)	MEDP-4111	Introduction to Medical Imaging
(3)	MEDP-7121	Radiobiology
(2)	MEDP-7530	Radiation Shielding
(3)	MEDP-7331	Radiation Therapy Physics
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

Year 1, Summer Semester

(3)	KIN-2500	Anatomy
(0-3)	MEDP-7991	Advanced Projects in Medical Physics and Health Physics
(0-3)	MEDP-7992	Advanced Topics in Medical Physics and Health Physics

Year 2, Fall Semester

(3)	MEDP-7111	Advanced Medical Imaging Physics
(3)	MEDP-7270	Advanced Radiation Therapy Physics
(3)	MEDP-7991	Advanced Projects in Medical Physics and Health Physics
(1)	MEDP-7995	Medical Physics and Health Physics Seminar

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

Year 2, Spring Semester

(3)	MEDP-7210	Clinical Principles of Radiation Therapy
(6)	PHYS-9000	Dissertation Research

REPEAT WRITTEN QUALIFYING EXAM (IF NECESSARY)

TAKE ORAL GENERAL EXAM

Year 2, Summer Semester
(6) PHYS-9000 Dissertation Research

Year 3, Fall Semester
(9) PHYS-9000 Dissertation Research

Year 3, Spring Semester
(9) PHYS-9000 Dissertation Research

Year 3, Summer Semester
(6) PHYS-9000 Dissertation Research

Year 4, Fall Semester
(9) PHYS-9000 Dissertation Research

Year 4, Spring Semester
(9) PHYS-9000 Dissertation Research

Year 4, Summer Semester
(6) PHYS-9000 Dissertation Research

Year 5, Fall Semester
(3) MEDP-7260 Clinical Radiation Therapy Physics Rotation (Optional)
(6-9) PHYS-9000 Dissertation Research

Year 5, Spring Semester
(2) MEDP-7280 Advanced Clinical Radiation Therapy Physics Rotation (Optional)
(7-9) PHYS-9000 Dissertation Research

FINAL EXAMINATION/ORAL DISSERTATION DEFENSE

FACULTY
MEDICAL PHYSICS AND HEALTH PHYSICS PROGRAM

FACULTY	ACADEMIC TITLE	CERTIFICATIONS:	SPECIALTY
LSU DEPARTMENT OF PHYSICS AND ASTRONOMY (http://www.phys.lsu.edu/)			
Hogstrom, Kenneth	Professor and Director	1:	Radiation Oncology Physics
Matthews II, Kenneth	Associate Professor	3:	Nuclear Medicine Physics, Medical Imaging
Sajo, Erno	Associate Professor		Radiation Physics, Health Physics
Shikhaliev, Polad	Assistant Professor		X-ray Imaging Physics, Medical Imaging
Wang, Wei-Hsung	Associate Professor	7,8:	Health Physics, Radiation Safety
Varnes, Marie	Instructor (part-time)		Radiation Biology
MARY BIRD PERKINS CANCER CENTER (http://marybird.org/)			
Fontenot, Jonas	Adjunct Assistant Professor	1:	Medical Physicist (Radiation Oncology)
Gibbons, John	Adjunct Associate Professor	1,2,4:	Chief of Clinical Physics (Radiation Oncology)
Hogstrom, Kenneth	Professor	1:	Chief of Physics (Radiation Oncology)
Parker, Brent	Adjunct Assistant Professor	1:	Medical Physicist (Radiation Oncology)
Price, Michael	Adjunct Assistant Professor	1:	Medical Physicist (Radiation Oncology)
SOUTHEAST LOUISIANA RADIATION ONCOLOGY GROUP			
Fields, Robert	Affiliate Graduate Faculty	5:	Radiation Oncologist
Henkelmann, Gregory	Affiliate Graduate Faculty	5:	Radiation Oncologist
Johnson, Sheldon	Adjunct Assistant Professor	5:	Radiation Oncologist
King, Maurice	Affiliate Graduate Faculty	5:	Radiation Oncologist and Medical Director
Levine, Renee	Affiliate Graduate Faculty	5:	Radiation Oncologist
Lo, Kenneth	Affiliate Graduate Faculty	5:	Radiation Oncologist
Wood, Charles	Affiliate Graduate Faculty	5:	Radiation Oncologist
OUR LADY OF THE LAKE REGIONAL MEDICAL CENTER (http://www.ololrmc.com/)			
Bujenovic, Stephen	Affiliate Graduate Faculty	6:	Director, PET Imaging Center

BOARD CERTIFICATIONS

1-Certified by American Board of Radiology in Therapeutic Radiologic Physics
2-Certified by American Board of Radiology in Diagnostic Radiologic Physics
3-Certified by American Board of Radiology in Medical Nuclear Physics
4-Certified by American Board of Medical Physics in Radiation Oncology Physics
5-Certified by American Board of Radiology in Radiation Oncology
6-Certified by American Board of Nuclear Medicine
7-Certified by American Board of Health Physics
8-Certified by Board of Laser Safety

PROGRAM RESEARCH
MEDICAL PHYSICS & HEALTH PHYSICS PROGRAM

The medical physics and health physics groups research the applications of radiation technology to the health-care, national defense, and nuclear energy industries. The Medical Physics and Health Physics Program presently offers the M.S. degree, which requires that the student complete a research thesis. The Program offers Specialization in Medical Physics within the Ph.D. degree in Physics, which requires the student complete dissertation research in Medical Physics or Health Physics research.

Research Faculty

- Jonas Fontenot, Ph.D.- Adjunct Assistant Professor
- John P. Gibbons, Ph.D.- Adjunct Associate Professor
- Kenneth R. Hogstrom, Ph.D.- Professor and Director
- Kenneth L. Matthews II, Ph.D.- Associate Professor
- Brent Parker, Ph.D.- Adjunct Assistant Professor
- Michael Price, Ph.D. - Adjunct Assistant Professor
- Erno Sajo, Ph.D.- Associate Professor
- Polad Shikhaliev, Ph.D.- Assistant Professor

Areas of Research Concentrations

Medical Physics Research

- Intensity-modulated Radiotherapy
- Image-guided Radiotherapy
- X-edge Capture Therapy
- Prostate Brachytherapy Dosimetry
- Radioisotope Imaging Systems
- Intravascular Radioisotope Imaging
- X-ray Imaging Detectors

Health Physics Research

- Radiation Damage in DNA
- Aerosol Transport
- Radiation Detectors for Medical Physics, Health Physics and Security Applications

Research Facilities

- Mary Bird Perkins Cancer Center
- CAMD Synchrotron Radiation Facility
- Animal Irradiation Facilities
- Nuclear Science Building
- Radiation Detector Development Lab
- Computing Facilities
- Shared Departmental Resources

Areas of Research Concentrations

Medical Physics Research

Intensity-modulated Radiotherapy: Medical physicists at Mary Bird Perkins Cancer Center are studying the fundamentals and clinical potential of using intensity modulated x-ray therapy (IMXT) in lieu of or in conjunction with modulated electron therapy (MET). This research is being done by Dr. Hogstrom as part of a research agreement with TomoTherapy, Inc. Parallel to this work, applications of an electron multi-leaf collimator (eMLC) to MET are being studied and compared to utilization of compensating wax bolus to achieve energy modulation. This research is being done by Dr. Hogstrom as part of a research agreement with Varian Medical Systems, Inc.

Image-guided Radiotherapy: Drs. Hogstrom, Gibbons, and Parker at Mary Bird Perkins Cancer Center are conducting research in image-guided radiation therapy physics, gated radiotherapy, and adaptive radiotherapy. One research program concentrates on usage of orthogonal x-ray imaging using the BrainLab Novalis for radiosurgery and radiotherapy of brain and extra-cranial cancers, e.g. spine, liver, and prostate. Another program focuses on usage of megavoltage CT scanning using the TomoTherapy HiART for radiotherapy of prostate, head and neck, and many other anatomical sites. These programs are currently supported by research agreements with BrainLAB, Inc. and TomoTherapy, Inc., respectively.

X-ray Capture Therapy: X-ray capture therapy is a potentially new radiotherapy paradigm (chemo-irradiation) that uses monochromatic x-rays to deliver targeted radiation dose to high-Z labeled (e.g. iodine) pharmaceuticals that are preferentially taken up by cancer cells, e.g. IUdR taken up by DNA. Our research program, led by Drs. Hogstrom, Sajo, and Varnes, uses the CAMD synchrotron's monochromatic x-ray beam line to study dosimetry techniques, treatment planning dose algorithms, microdosimetry, cell biology, and small animal irradiations. Our long term goal is to conduct clinical trials using a prototype laser-particle accelerator to produce monochromatic x-rays such as one developed by MXI Systems, Inc. (www.mxisystems.com).

Prostate Brachytherapy Dosimetry: Faculty members have recently received a US Patent on a proposed new method for the direct dosimetry of permanent interstitial prostate implants (seeds). Traditional prostate dosimetry entails the tedious and error-prone task of identifying and locating the implanted radioactive seeds on anatomical images following treatment. The new method allows direct determination of the dose distribution without the intermediate step of explicitly finding the seeds. Thus, both the accuracy and required time in mapping the dose should be improved. Dr. Sajo and Dr. Matthews are presently researching this proposed method.

Radioisotope Imaging Systems: Dr. Matthews is pursuing research in radioisotope imaging. Radioisotope imaging uses radioactive materials injected into a patient or subject to evaluate physiological function. Positron emission tomography (PET) and single-photon imaging are common methods for radioisotope imaging. Current projects include:

- development of hand-held CZT detector systems for intraoperative imaging
- development and performance characterization of a compact CZT-based gamma camera

- development of a modified gamma camera design to facilitate coincidence imaging of PET radiotracers
- observer performance study to evaluate acquisition protocols for commercial clinical PET/CT systems
- methods for performance assessment and quality assurance of PET/CT imaging systems

Intravascular Radioisotope Imaging: Drs. Shikhaliev and Matthews are developing methods for intravascular imaging of radiopharmaceuticals (e.g., ^{18}F-fluorodeoxyglucose). This approach utilizes storage phosphor detectors mounted on the end of a catheter to detect radiotracer uptake in vulnerable plaques in coronary arteries. [*Phys Med Biol* 51: 963-979 (2006)]

X-ray Imaging Detectors: A current project is the development of photon counting detectors for x-ray imaging and computed tomography (CT). The use of CZT detectors, tilted relative to the x-ray beam, facilitates both photon counting and energy weighting. Energy weighting allows a reduction of scattered radiation and good dose efficiency for imaging. [*Phys Med Biol* 51: 4267-4287 (2006)]

Health Physics Research

Radiation Damage in DNA: Dr. Sajo conducts fundamental research in radiation biology in cooperation with faculty members in the Department of Physics and Astronomy and the Department of Biological Sciences to quantify genetic effects of high versus low linear energy transfer (LET) radiation by examining interaction physics at the DNA molecular level. This work may help researchers to understand more clearly the damage mechanism of radiative energy deposition in human tissue, and thus the relationship between radiation exposure and disease formation. A major grant proposal has been submitted to NASA to investigate the mutation spectrum caused by galactic radiation of extremely high energy and high mass particles. This research will facilitate the assessment of the risks of prolonged manned missions in outer space.

Aerosol Transport: The US Department of Energy (DOE) is funding an experimental and numerical modeling study aimed at understanding how aerosolized particles disperse in enclosed environments. This work, directed by Dr. Sajo, may be used to predict the behavior of radioactive or other hazardous materials in indoor environments following accidental releases, and can also be applied to analyzing terrorism threats from bacterial and germ warfare agents. In addition, the work provides a better understanding of how aerosols travel in human airways. A major application of this research would be improving ways to deliver aerosol medications.

Radiation Detectors for Medical Physics, Health Physics and Security Applications: Faculty and graduate students are developing novel instruments and methods for radiation detection applications in radiation protection, dosimetry, and nuclear security.

PHYSICAL RESOURCES

GENERAL

- Student offices with individual desks and personal computer
- Student lab coats and radiation badges
- Medical Physics Program administrative support office

LIBRARIES

- Department of Physics and Astronomy library
- Medical physics library in Program Office and at Cancer Center
- LSU University library

CLINICAL FACILITIES at MARY BIRD PERKINS CANCER CENTER

- Treatment Delivery Systems
  - 5 Varian Clinac radiotherapy accelerators with Millenium MLC (4, 6, 10, 15, 18 MV x-ray and 6, 9, 12, 16, and 20 MeV electron beams)
  - BrainLab Novalis stereotactic radiotherapy system
  - TomoTherapy HI-ART II system
- Patient Data Systems
  - GE Lightspeed RT CT Simulator (4D Advantage Windows)
  - GE Discovery ST PET-CT
- IMPAC record and verify system
- Treatment Planning Systems
  - Philips ADAC Pinnacle^3 systems (13)
    - 9 - Baton Rouge
    - 2 – Hammond
    - 2 – Covington
  - Philips ADAC Pinnacle^3 systems (Research Server)
  - TomoTherapy planning station (Clinical)
  - TomoTherapy planning station (Research)
  - BrainLab stereotactic system (iPlan)
  - K&S Diamond MU Software
  - MU Check Software
- Brachytherapy Systems
  - Varian VariSource HDR system
    - MammoSite (breast)
  - Varian VariSeed LDR planning system (prostate seeds)
  - Sr-90 ophthalmic applicator
  - I-125 eye plaques for ocular melanoma
- Dosimetry Lab
  - 3D beam scanning system (Welhoffer/Scanditronix)
  - 2D beam scanning systems (Scanditronix, TomoDose, CRS)
  - Cylindrical water and plastic phantoms
  - TLD in-vivo dosimetry system
  - Radiographic Film scanning system (Vidar scanner, RIT, and TomoScan software)

  - Radiochromic Film scanning system (Epson scanner, Image Acquisition, and Film QA software)
  - Tissue equivalent phantoms (rectangular, cylindrical, and 4D)
  - Sun Nuclear (1D (Profiler) and 2D (MapCheck) diode arrays)
- Patient Support Labs/QA Systems
  - Treatment planning room
  - Block and mold room

RESEARCH FACILITIES

Mary Bird Perkins Cancer Center: Most of the equipment used for patient care during the day (listed above for clinical training), is available for research at nights and on weekends.

CAMD Synchrotron Radiation Facility: The 1.3 GeV electron storage ring (200 mA) has multiple beam lines of varying light energy. Two beam lines, produced by a superconducting wiggler magnet, allow medical radiological research using x-ray beams up to 40 keV. http://camd.lsu.edu/

Radiation Detector Development Lab: The Radiation Detector Development (RDD) Laboratory currently provides 480 sq. ft. of research space and is located in the renovated Nicholson Hall (which houses the Department of Physics and Astronomy); the lab occupies an additional 300 sq. ft. of lab space in the Nuclear Science building, which is rated for full use of radioactive materials. The RDD Lab has equipment and materials for design, fabrication, testing, and analysis of prototype detector systems. This includes: oscilloscopes; PC-based multi-channel analyzer; UNIX workstation for simulations, data processing and analysis; electronics prototyping equipment; dose calibrator; sealed long-lived radiation sources and collimation/shielding materials; general-purpose collection of nuclear instrumentation modular electronics; general-purpose collection of scintillation crystals and photomultiplier tubes (PMT); and imaging phantoms. Some project-specific items that are available include a light-tight ("black") box, a selection of wavelength-shifting optical fibers (both individual fibers and assembled ribbons), three 5"x5"x1" NaI(Tl) scintillation crystals, a multi-channel PMT, green-enhanced-response PMTs, custom-built detector assembly fixtures, and multi-channel DAQ cards.

Micro-CT Imaging System: Skyscan 1074 instrument with 37 μm resolution, 3 cm field of view and variable beam energy. Image reconstruction software has multiple capabilities and can run on a distributed computing environment.

Design and Construction Shops: The Department of Physics and Astronomy provides fully-staffed machine and electronics shops. These shops provide in-house fabrication facilities. In addition, a "student" machine shop is also available for faculty and student use. Other resources include a drafting shop operated by the College of Basic Sciences.

Animal Irradiation Facilities: The School of Veterinary Medicine supports radiological facilities for animals. Diagnostic facilities include x-ray fluoroscopy and CT scanning, and access to a PET/CT. MRI capability is anticipated in the near future. A small animal therapy facility includes a Varian Clinac 600C with a 52-leaf MLC and the Pinnacle treatment planning system.

Computing Facilities:

- Various multi-teraflop systems, including Tezpur (15 Tflop, 360 node) and Pelican (3 Tflop, 32 node), operated by the Center for Computation and Technology
- Linux cluster for student use, operated by Department of Physics and Astronomy.
- The Medical Physics and Health Physics Program has several high-performance multi-processor Unix workstations for research and instructional purposes with the following software:
  - Philips ADAC Pinnacle^3 research treatment planning system
  - TomoTherapy research treatment planning system
  - EGSnrc MCNP (various versions), and GEANT Monte Carlo codes
  - A collection of deterministic neutron, photon and charge particle transport codes, including cross section processing routines
  - Fortran, C, C++ compilers with high-performance multi-threading extension
  - In-house software for advanced aerosol transport computations, external beam photon transport calculations, and brachytherapy seed identification and dosimetry.

Nuclear Science Building:

The Nuclear Science Building serves primarily as a laboratory research and teaching facility. In addition, it gives housing to the LSU campus Radiation Safety Office. The building houses:

- Six research laboratories equipped with fume hoods, sinks, counters, storage space. All are all acid-proof and are rated for radiochemistry, radiobiology, nano-sized aerosol, and generic radiation research. The aerosol laboratory houses a 1.8x1.5x0.6 m^3 environmental chamber equipped with a real-time laser multi-channel aerosol spectrometer and nano-particle nebulizer. This lab supports experimental and computational study of how aerosols transport in confined spaces.
- Multiple irradiation facilities (high-intensity radio-isotopic source irradiators having a maximum dose rate of 5000 R/min include): self-contained Co-60 irradiator, pool-type Co-60 irradiator, and Eberline Cs-137 calibrator/irradiator. Neutron facilities include: a subcritical assembly for neutron physics experiments and Cf-252 sources (total isotope mass of about 60 micro-grams) stored in two separate neutron irradiators (scalar thermal neutron flux of about 5E6 n/cm^2/s).
- Multiple radiation detection systems: HPGe detectors, NaI(Tl) detectors, a Si(Li) detector, liquid scintillation detector, etc. Counting laboratories maintain a cross-calibration schedule with the State of Louisiana Radiation Laboratory under the Louisiana Department of Environmental Quality, using NIST traceable standards.

STUDENT STIPENDS

M.S. Program

It is the goal of the program faculty to provide student funding through graduate assistantships throughout the course of graduate study. M.S. students are currently ineligible for stipend enhancements above the base level. Graduate student assistantships for Program students are typically:

Medical Physics Concentration

- Teaching Assistantships- Year 1
- Medical Assistantships- Year 2 (Fall and Spring Semesters)
    - These assistantships are provided during the 2 semesters that students are receiving clinical training at Mary Bird Perkins Cancer Center.
- Research Assistantships- Year 2 (Summer Semester) and Year 3 (until Program requirements completed)
    - Student typically funded by his or her faculty supervisor for the M.S. thesis research.

Health Physics Concentration

- Teaching Assistantships- Year 1
- Research Assistantships- Years 2,3 (until Program requirements completed)
    - Student typically funded by his or her faculty supervisor for the M.S. thesis research.

Ph.D. Program

Under Revision

FREQUENTLY ASKED QUESTIONS

Question: Do I need to be a physics major in college to go into medical physics?
Answer: Graduate students in medical physics come from a variety of backgrounds – physics and engineering are common. However, all students must have a solid background in physics, including a year of calculus-based general physics, and upper-level courses in mechanics, E&M, modern physics and experimental lab. Often, some engineering courses are sufficiently equivalent.

Question: What are the GRE and GPA requirements for entry into the Program?
Answer: The LSU Graduate School requires a minimum score of 1100 on the GRE and a minimum GPA of 3.0. Please note that for the past 3 years, entering medical physics students had an average GRE of about 1250 and average GPA of about 3.5. No subject test is required for the M.S. program.

Question: Can I earn a PhD in medical physics at LSU?
Answer: Yes, although the LSU Physics Department does not currently offer a dedicated Ph.D. in medical physics program. Students working on a Ph.D. in Physics are eligible to specialize in medical physics. Upon completion of the core curricula in Physics and the written general exam, students may specialize in a medical physics dissertation topic.

Question: After completing the MS program, will I be capable of entering a medical physics PhD program?
Answer: Yes. The academic instruction in the first year of the M.S. program is comparable to that of other medical physics graduate programs. In recent years, some of our M.S. graduates have gone on to other Ph.D. programs.

Question: How many students do you accept each year? When are applications due? Do you offer graduate assistantships or other for M.S. of financial support?
Answer: We accept 4-6 students per year, with all students beginning in the Fall semester. We begin reviewing applications in late January and competitive applicants are invited to interview in February and early March. Offer letters are extended in priority of applicant rating, usually by March 15. Most acceptance offers include financial support in the form of a graduate assistantship or fellowship.

Question: Do you accept international students?
Answer: All students are welcome to apply; however, international students currently in the U.S. receive consideration for admission if their undergraduate degree is from a four-year college within the U.S.

Question: What are the institution and department codes for GRE reporting?
Answer: Institution: 6373 (Louisiana State University - Baton Rouge)
Department: 0808 (Physics)

Question: Do students in your program generally specialize in learning one specific area of medical physics (medical imaging, radiation therapy, radiation safety), or is the program geared more toward a general knowledge of all medical physics areas?
Answer: Courses cover all areas of medical physics; however, the advanced courses and clinical rotations are focused on radiation therapy. For the final year, students focus on their area of research, typically in radiation therapy physics or medical imaging physics.

Question: On average, how long does it take to complete the master's program?
Answer: Three years.

Question: Do you accept students who are deficient in one or two classes (for example, physics, math or chemistry) and allow them to take those classes while pursuing the master's degree?
Answer: Deficiencies are handled on a case-by-case basis, and are usually made-up during the summer prior to your first semester or during your first two semesters as a graduate student.

Question: What is the CAMPEP accreditation status of the LSU medical physics program?
Answer: The LSU M.S. in Medical Physics and Health Physics Program recently received full accreditation by CAMPEP through December 2011.
http://www.campep.org/campeplstgrad.asp

Question: Can I come to visit LSU and the medical physics program?
Answer: Certainly. Contact the LSU Medical Physics Program office at 225-578-2163 or medphys@phys.lsu.edu to discuss a visit at any time during the year. In the Spring of each year, we invite our highest-rated applicants to visit LSU (at our expense) for an interview with the Program faculty.

Question: Where have your graduates found employment?
Answer: Graduates from the LSU medical physics and health physics program have found employment in public and private hospitals, private cancer clinics, university hospitals, and government regulatory divisions. Some students have even struck out on their own, performing medical physics contract and consulting work.

Question: What duties and time commitment are required for a graduate assistant?
Answer: Students are expected to work 20 hours per week for their assistantships. Teaching assistants may teach undergraduate physics labs, do grading and proctoring for the physics service courses, or work in the department's tutoring center. Research assistants work in the research lab of their major professor.

Question: Whom should I contact if I have more questions?
Answer: To speak with Program faculty or to get answers to questions about the program and the admissions process, contact the LSU Medical Physics Program office at 225-578-2163 or medphys@phys.lsu.edu.

REQUEST FOR ADDITIONAL PROGRAM INFORMATION

Additional information may be obtained by contacting:

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