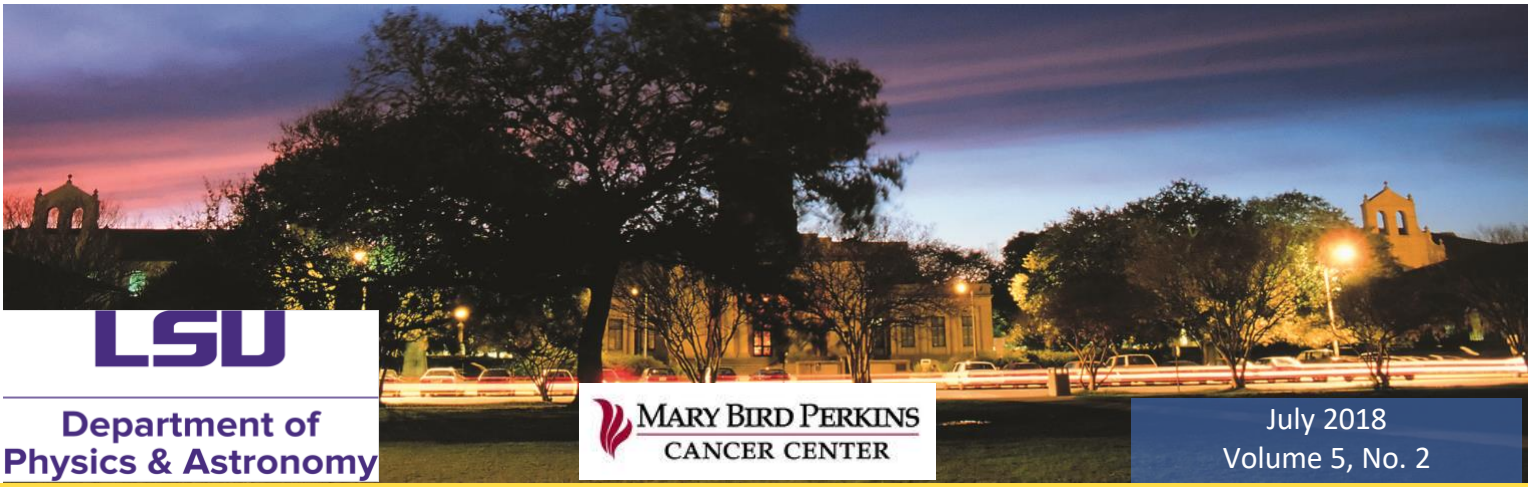
LSU Medical & Health Physics Newsletter, July 2018



LSU
Department of Physics & Astronomy
Mary Bird Perkins Cancer Center
July 2018
Volume 5, No. 2

Director's Message

Dear Alumni, Students, Colleagues, and Friends:

We are delighted to report that 2018 has been another banner year for the Medical Physics and Health Physics Program. The education and research programs have been productive this year. This issue covers half of the calendar year of 2018, from January-July.

Students are the life blood of our program, which is plain to see in the pages of this newsletter. They perform original research, write scholarly works, and they engage with the local community. Several of our students are even performing portions of their research at leading institutions in Germany and France. We are proud of the accomplishments of our current and former students.

If students are the life blood, then our faculty are the heart of the program. Their dedication to excellence in classroom teaching and research enables our students to graduate with outstanding qualifications and future prospects. By virtually any measure, our current and former students are doing very well, indeed. The newsletter highlights many of their achievements and successes in 2018.

On behalf of the entire faculty, we thank you for all you do for the program and we look forward to staying in touch with you throughout the rest of 2018.

Sincerely,

Wayne Newhauser, PhD

Table of Contents

2. Trainee Milestones

2.1 Graduations

On Wednesday, May 9th, Joe Steiner defended his dissertation titled "Endorectal Digital Prostate Tomosynthesis".

On Tuesday, May 29th, John Chapman defended his dissertation titled "Development of a Fast Monte Carlo Proton Dose Algorithm with a Material-Dependent Nuclear Halo Model"

On Thursday, June 21st, Elizabeth Hilliard defended her thesis titled "Verification and Evaluation of a Passive Intensity Modulation Device for Bolus Conformal Therapy"

2.2 Match Results

- Elizabeth Hilliard, MS – Therapy – Medical University of South Carolina
- John Chapman, PhD – Therapy – Washington University (St Louis) School of Medicine
- Addie Barron, MS – Therapy – Mary Bird Perkins Cancer Center
- Joe Steiner, PhD – Imaging – Henry Ford Health System

3. Featured Stories

3.1 Health Physics Society President-Elect Visits LSU

In February, Health Physics Society (HPS) President-elect Dr. Nolan Hertel, CHP, visited Louisiana to share his research on radiation protection as well as the state of health physics and the HPS. Prior to his meeting with the Deep South Chapter, Hertel chatted with some students and faculty of the Louisiana State University (LSU) medical and health physics program.

The health physics degree program developed from LSU's nuclear science program and was merged into an integrated medical and health physics program in the Department of Physics and Astronomy. LSU offers both undergraduate and graduate level courses in health physics. In 2011, the health physics portion of the program began a rejuvenation process funded in part by grants from the U.S. Nuclear Regulatory Commission and other sponsors. At present, there are six graduate students in health physics. LSU is a member of the Oak Ridge Associated Universities (ORAU) network and was recently designated a member of the Nuclear Energy University Program (NEUP) by the U.S. Department of Energy.

The program primarily includes three faculty members: Dr. Wayne Newhauser (program director), Dr. Wei-Hsung Wang, and Dr. Kenneth Matthews, with another faculty member (residing in the Department of Environmental Sciences) scheduled to arrive in September 2018. A second health physics faculty search began in March 2018. Several faculty members from other academic units also participate in radiation safety-related education and research. A program goal is to provide high-quality didactic education and practical training to prepare graduates for successful careers as professional health physicists.

http://hps.org/newsandevents/academic_health_physics_programs.html

3.2 LSU Physics Students Receive NRC Scholarship in Health Physics

By Mimi Lavalle (via Press Release)

LSU's Department of Physics & Astronomy has announced Rebecca DiTusa and Khang Pham as recipients of the NRC scholarship program in health physics. A grant from the U.S. Nuclear Regulatory Commission (NRC) was established at LSU in 2017 supporting undergraduate students to explore careers in the radiation sciences through the field of health physics.

The health physics field focuses on protecting people and the environment from radiation hazards. This typically includes making measurements and calculations, providing radiation safety training, and developing new radiation instruments and software programs. Health physicists find careers in hospitals, cancer clinics, research laboratories, universities, and nuclear facilities.

Baton Rouge native, Rebecca DiTusa is a junior who appreciates the opportunity the NRC scholarship provides to discover the aspects of the health physics field. "Along with physics, I have found interest in nuclear science and have decided to minor in it," said DiTusa. "With the knowledge that I will gain in my undergraduate career, I hope to go to graduate school. By combining nuclear science and physics I will be able to apply my knowledge in either a research setting or a medical one. Receiving this scholarship has made me even more dedicated to continue on with getting a health/medical physics career as I feel I have been accepted into this community."

Khang Pham, a native of Vietnam and a McNair Research Scholar, is a graduating senior, and

is looking forward to furthering his research with the NRC award. “I have been given the opportunity to continue my nuclear physics research at LSU during the upcoming summer,” said Pham. “With the NRC grant, I can fully commit myself to my research. Furthermore, the research that I conduct in the upcoming summer will give me a much-needed head start into my graduate career.”

LSU’s medical physics and health physics program offers scholarships of $5000 each to fund undergraduate students in STEM fields who are interested in exploring careers in the radiate on sciences. To be eligible to apply, students must be a full-time student enrolled at LSU A&M or Southern University in Baton Rouge and maintain a 3.0 grade point average.

LSU Professors Wayne Newhauser and Wei-Hsung Wang received a federal grant to fund the scholarship program. According to Newhauser, “LSU is truly fortunate to have received more than $1M in funding from the NRC to support our education and research programs in health physics. We will award additional undergraduate scholarships in the next year or so and encourage interested students to apply. We also received grants from the NRC to support graduate students and to hire two new faculty members. The demand for radiation professional is strong and will continue to grow for the foreseeable future. Nationally, there are many great career opportunities for young people in the radiation sciences, including specialties in health care, the environment, national security, and nuclear power. Locally, LSU has strong programs in radiation science and Louisiana needs radiation professionals.”

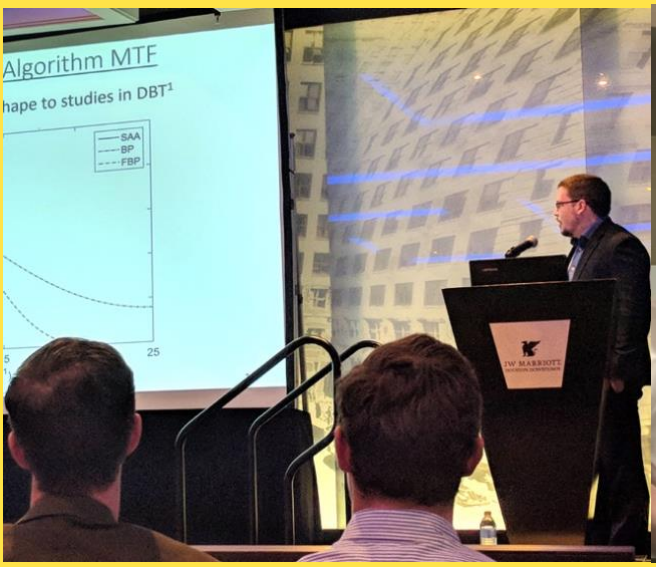
3.3 PhD Student Lydia Wilson Collaborates with LMU on Dissertation Research

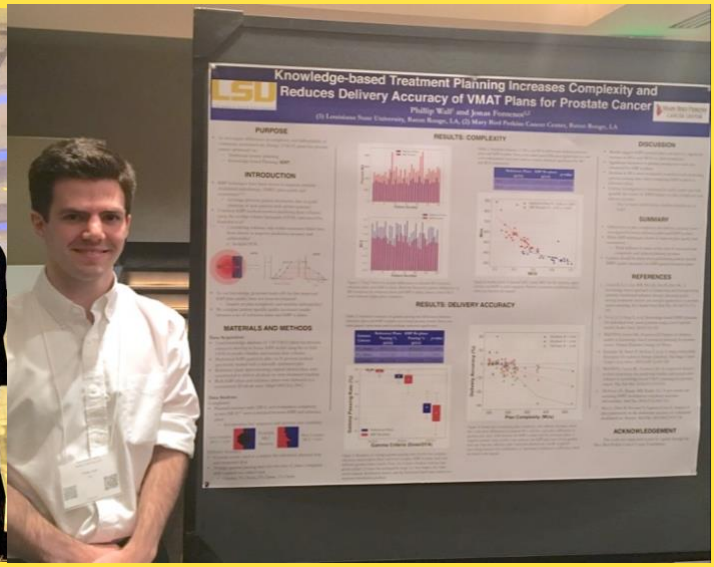
From September 2017 through February 2018, Ph.D. student Lydia Wilson was in Munich, Germany on a DAAD grant (translates to German Academic Exchange Service). While there, she continued her dissertation research in collaboration with the Chair of Medical Physics at the Ludwig Maximilian University, Dr. Katia Parodi. She spent her time there working to implement the analytical models being developed by the Newhauser research group for stray radiation does from photon and proton therapy into a research treatment planning system.

3.4 LSU Medical Physics Program is now on Facebook

We are excited to share with you the latest news from the LSU/MBPCC Medical Physics and Health Physics Education Program. Please visit https://www.facebook.com/LSUMPandHP/ and read all about it. We are hoping that in addition to sharing news from the program, you will find this a useful tool to stay in touch with your extended LSU family of peers, colleagues, and friends.

3.5 LSU Students Attend SWAAPM





The 2018 meeting of the Southwest Chapter of the American Association of Physicists in Medicine (SWAAPM) was held April 26-28 in Houston, Texas. Krystal Kirby presented a poster.

Phillip Wall organized and moderated a student activity for the meeting, “AAPM Resources and Volunteering Opportunities for Students/Trainees: Panel Discussion”, presented a poster, and was a finalist for the MedPhys Slam competition. Joe Steiner gave an oral presentation of his abstract “Endorectal Digital Prostate Tomosynthesis: A Novel High-Resolution Imaging Method for the Prostate Region” in the Young Investigator Symposium and volunteered as Southwest Chapter Liaison to the Student and Trainee Subcommittee for organizing the MedPhys Slam competition.

3.6 PhD Student Michelle Lis Attends Her 1st OMA Topical Workshop, "Facility Design Optimization for Treatment"

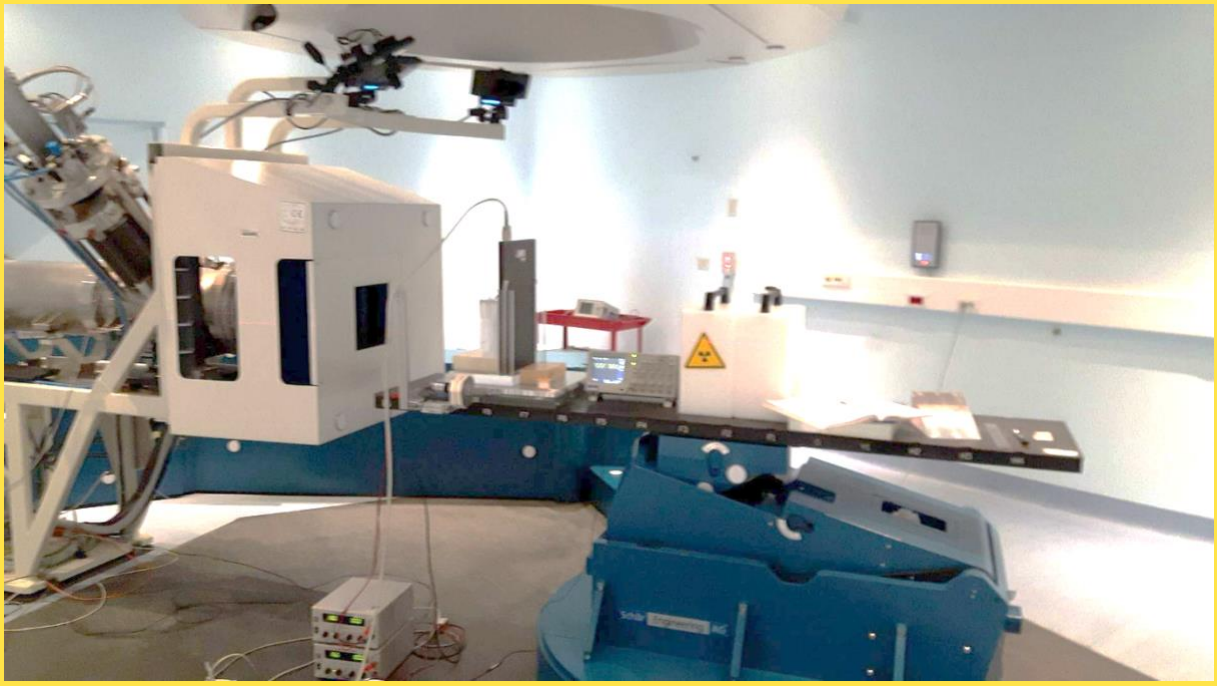
From March 12th – 13th, PhD student Michelle Lis attended the 1st topical workshop for her fellowship at the Paul Scherrer Institute (PSI) in Switzerland. PSI is a world-renowned, multi-disciplinary research institute, actively studying solid-state physics, elementary particle physics, and health science applications. During the workshop, Michelle had the opportunity to learn about the processes of designing treatment rooms. The focus was on discussing how different beam characteristics impact on dose delivery and how this is linked in return to the efficiency of cancer treatment. As well as gantry and room design options in consideration of the patient needs and minimization of preparation times before treatment.

During the workshop, Michelle also had the opportunity to present the theory and research in her work on 4D robust optimization treatment planning and dose delivery.

3.7 PhD Student Michelle Lis Performs Experiments at MIT and CNAO

As part of her research in designing a 4D dose delivery system, Michelle has visited both the Marburger Ionenstrahltherapie-Zentrum (MIT) in Marburg, Germany, and Centro Nazionale d Adroterapia Oncologica (CNAO), in Pavia, Italy, to measure the beam parameters of these clinical lines. The experiments will enlighten Michelle to the limitations of current particle therapy machines.

On the evening of January 18th, Michelle delivered several static and moving treatment plans of basic geometries to a 1000 ion chamber array detector. The experiments were performed on a regularly moving sliding table and the motion information was fed into the dose delivery system. The ion delivery sequence, target motion, and treatment delivered were recorded. From February 16th to 18th, the same experiments were performed at CNAO.



With this data, Michelle will be able to simulate the beams at both MIT and CNAO, and to compare the dose delivery quality to that of GSI and HIT.

3. 8 LSU Students Volunteer at LSU Outreach LASM Engineering Day

Andrew McGuffey, Andrew Hastings, and his fiancée Erin White represented the LSU chapter of the American Nuclear Society at the annual LASM Engineering Day outreach event held by the Louisiana Arts & Science Museum. There, they held an interactive booth where kids were introduced to all sorts of interesting things relevant to physics, such as laser diffraction, magnetic fields, and nanomaterials.

3.9 LSU Medical Physics Student Elizabeth Hilliard Receives 1st Place at LSU Three Minute Thesis Competition

Congratulations to third-year MS student Elizabeth Hilliard, who received 1st place in the 2017-2018 LSU Three Minute Thesis Competition in February. The competitors were selected from a University-wide preliminary competition of over 40 students. After winning at LSU, Elizabeth was awarded the opportunity to compete in the regional Three Minute Thesis competition in Fayetteville, AR.

The Three Minute Thesis is an international academic competition, developed at the University of Queensland, that invites Master's and Ph.D. students to present their thesis research and explain its importance in an engaging narrative delivered in non-technical language.

3.10 Dr. Kip Matthews Receives Socolofsky Award

Associate Professor Kenneth “Kip” Matthews, Department of Physics & Astronomy, is the recipient of the 2018 Dr. Marion D. “Soc” Socolofsky Award for Teaching Excellence. Matthew was presented with the award during a surprise visit to his classroom by College of Science Dean Cynthia Peterson and Wayne Newhauser, Dr. Charles M. Smith Chair of Medical Physics.

Matthews joined the department in 2001 as the first imaging physicist at LSU and developed a new sequence of courses (MEDP-4111 Introduction to Medical Imaging Physics and MEDP-7111 Advanced Medical Imaging Physics). He currently teaches MEDP-4351 (classroom) and MEDP-4352 (laboratory) courses on Radiation Instrumentation. The MEDP-4111 and MEDP-4351/4352 courses are extremely popular with undergraduate students that are looking to attend graduate school in medical physics.

“I am particularly impressed by his commitment and passion for providing the best possible instruction and guidance to our students,” said John DiTusa, department chair, LSU Physics & Astronomy. “Dr. Matthews stands out for his exceptional devotion to teaching and mentoring. He has consistently put the interests of his students first. Those of us who work closely with Kip know that he is motivated by the desire to provide students with the high-quality education he knows they deserve.”

Matthews has served as major professor to 14 graduate students and been on the committee for 43 others. He is very actively engaged with these students throughout their research, even when he is not the major professor. Students seek him out for his caring and supportive demeanor, and he freely gives time and advice and that goes far beyond.

One of his former students, who is currently attending medical school, wrote, “He brought me into his lab as a freshman and stuck with me through my senior Honors College thesis. I really enjoyed the hands-on experience and knowing that he would make time to help me with the project. From start to finish, Dr. Matthews impressed me with his patience and ability to translate his knowledge to my level of understanding.”

Dr. Matthews has performed a tremendous service for the department and the broader community as director and principal investigator of the LSU physics and astronomy National Science Foundation (NSF) funded Research Experience for Undergraduates (REU) program since its inception in 2010. This program hosts more than a dozen undergraduate students for a 10-week program every summer.

A former REU student from the University of Alabama writes, “I was awarded a Fulbright Research/Study Grant to spend 10 months at the Max Planck Institute in Greifswald, Germany. My time at LSU was really the impetus for me getting serious about physics and opened a lot of doors for me.”

The Socolofsky Award for Teaching Excellence honors the legacy of the late Marion “Soc” Socolofsky, who was a fierce advocate for students at LSU and one of the College of Science’s most influential leaders and educators. Throughout Socolofsky’s 36 years at LSU, he served as head of microbiology for 20 year, taught more than 12,000 students, advised more than 250 master’s and PhD students and was a member of the Dean’s Circle.

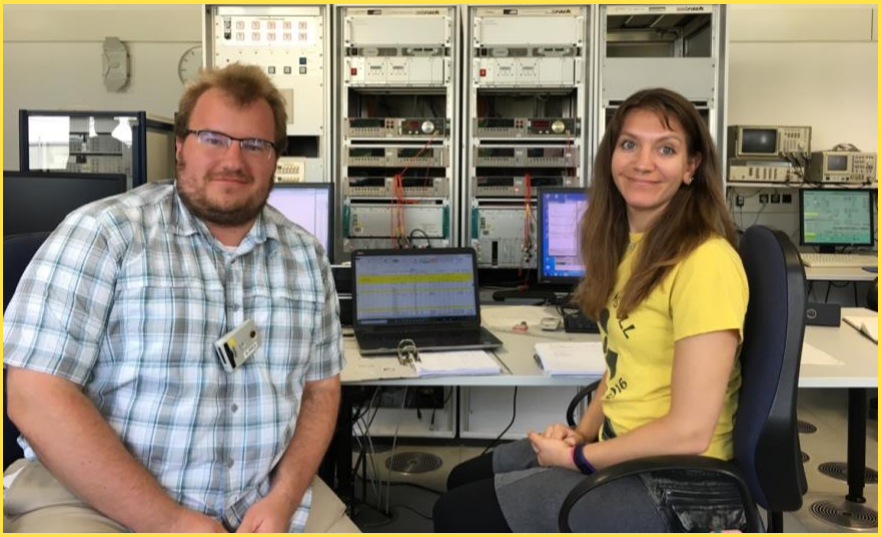
The Socolofsky Award recognizes faculty members who embody pedagogic qualities that Dr. Socolofsky was known for including strong student mentoring and passion for the student experience.

3.11 Newhauser Research Group Collaborating with PTB

The Newhauser group is fostering a strong collaboration with the Physikalisch-Technische Bundesandstalt (PTB) in Braunschweig, Germany. The PTB is Germany's national standards laboratory and provides a great opportunity for the group to perform high quality measurements of therapeutic and stray radiation in air, water, and anthropomorphic phantoms with a wide range of detectors. These measurements are critical for the

continued development and refinement of our physics-based analytical models for total absorbed dose from photon therapy.

PhD candidate Lydia Wilson first traveled to the PTB in February for a week-long research trip. While there, she gave a seminar presentation introducing the local PTB research groups to the research goals and needs of the Newhauser Research group and how the collaboration at the PTB meets those needs. Additionally, Lydia surveyed the equipment available and gained experience with the measurement capabilities and procedures at the PTB.



Using this information, the Newhauser group developed an extensive measurement campaign plan. In May-June 2018, Dr. Newhauser returned to the PTB with two of his graduate students, Lydia Wilson and Chris Schneider, for a 6-week research trip. During this trip, the group was able to obtain high-quality measurements of photon and photo-neutron radiation resulting from photon radiotherapy at a range of nominal beam energies, field sizes, and using a variety of detectors and phantoms.

3.12 Health Physics Student Tony Davila Performs Research at Oak Ridge

Health physics master's student Tony Davila will be participating in an exciting research experience at Oak Ridge Institute for Science and Education (ORISE) starting in July. Earlier this year, Dr. Newhauser approached him with the opportunity to do health physics research at the institution. Specifically, Tony will be doing research at Oak Ridge's REAC/TS (Radiation Emergency Assistance Center/Training Site). There, he will be working with Jason Davis, CHP, PhD., on two projects.

The first project deals with estimating dose to the lungs from americium-241 using a FIDLER probe. In the event that someone becomes internally contaminated, being able to quickly and accurately gauge the severity of the contamination with a commonly used and readily available field detector is important.

The second project is determining the depth of radioactive contamination from a wound. Aside from inhalation and ingestion, contaminated wounds can be an internal radiation hazard. During a radiological incident the dose from this pathway. Both projects will provide Tony with invaluable insight on responding to a radiological emergency, and he is looking forward to starting on them soon.

4. Grants

- Rui Zhang awarded NIH K22 Grant on breast cancer, $600,000
- Wayne Newhauser awarded NRC Faculty Development Grant, $450,000
- Wayne Newhauser awarded NRC Fellowship Grant
- Wayne Newhauser awarded NRC Scholarship Grant
- Wayne Newhauser awarded LSU Board of Regents Graduate Student Matching Grant, $160,000
- Kip Matthews, Jacqueline Stephens (PBRC) awarded Louisiana Biomedical Collaborative Research Program (LBCRP) Grant, $52,676

5. Honors and Awards

- Lydia Wilson, Coates Travel Award, for travel to IBPRO (April, Detroit, MI)
- Lydia Wilson, GSA Travel Award, for travel to IBPRO (April, Detroit, MI)
- Lydia Wilson, GSA Travel Award, for travel to AAPM (July, Nashville, TN)
- Krystal Kirby, Coates Travel Award, for travel to SWAAPM (April, Houston, TX)
- Joe Steiner, GSA Travel Award, for travel to SWAAPM (April, Houston, TX)
- Christopher Schneider, Chateaubriand Travel Fellowship (7200 Euro)
- Michelle Lis, National and International Fellowships Enrichment Awards Program
- Erika Kollitz, LMU Fellowship
- Meagan Moore wins 1st place for her presentation at LSU Discover Day “3D-Printing Whole Body Personalized Phantoms for Radiotherapy Measurements”
- Elizabeth Hilliard wins 1st place at LSU Three Minute Thesis competition
- Dr. Kip Matthews receives 2018 Dr. Marion D. “Soc” Socolofsky Award for Teaching Excellence

6. Medical and Health Physics Program in the News

6.1 How Physicists Advance Cancer Care, Featuring Dr. Jonas Fontenot

With Dr. Kay Solar and Betsy Barnes

Dr. Jonas Fontenot, head of medical physics at Mary Bird Perkins—Our Lady of the Lake Cancer Center, joins Dr. Kay Solar to discuss the role of medical physics in cancer care. He explains the innovation, such as the breath hold technique, that the medical physics department has developed and implemented at the Cancer Center to improve the quality of care given to patients. Dr. Fontenot also gives insight into the partnerships with the medical physics program and the School of Veterinary Medicine at LSU and how they work together with Mary Bird Perkins—Our Lady of the Lake Cancer Center to accelerate innovation.

https://marybird.org/press/#mb-minute

7. Selected Publications

Journal Articles:

- Taddei PJ, Khater N, Youssef B, Howell RM, Jalbout W, Zhang R, Geara FB, Giebeler A, Mahajan A, Mirkovic D, Newhauser WD. Low- and middle-income countries can reduce risks of subsequent neoplasms by referring pediatric craniospinal cases to centralized proton treatment centers. Biomed. Phys. Eng. Express. 4 025029 (2018). http://iopscience.iop.org/article/10.1088/2057-1976/aaa1ce/meta
- J. Chetty and J. D. Fontenot, "Adaptive radiation therapy: Off-line, On-line, or In-line?," Int J Radiat Oncol Phys 98(3):689-91 (2017). https://doi.org/10.1016/j.ijrobp.2017.07.017
- K. Smith, P. Balter, J. Duhon, G. White, D. Vassy, R. Miller, C. Serago, and L. Fairobent, "AAPM Medical Physics Practice Guideline 8.a.: Linear accelerator performance tests," J App Clin Med Phys 18(4): 23-39 (2017). DOI: 10.1002/acm2.12080
- Phillip DH Wall, Robert L Carver, and Jonas D Fontenot. Impact of Database quality in knowledge-based treatment planning for prostate cancer. *Practical Radiation Oncology*, 2018. https://doi.org/10.1016/j.prro.2018.03.004
- Phillip DH Wall, Robert L Carver, and Jonas D Fontenot. An improved distance-to-dose correlation for predicting bladder and rectum dose-volumes in knowledge-based

VMAT planning for prostate cancer. *Physics in Medicine and Biology*, 63(1):015035, 2018. DOI: 10.1088/1361-6560/aa9a30

- Newhauser, W.D., Schneider, C., Wilson, L., Shrestha, S., Donahue, W. "A Review of Analytical Models of Stray Radiation Exposures from Photon- and Proton-Beam Radiotherapies" Radiat. Prot. Dosimetry, 2017 Nov. 21:1-7. DOI: 10.1093/rpd/ncx245
- Williams, J.P., Newhauser, W.D. "Normal tissue damage: Its importance, history, and challenges for the future." Br. J. Radiol. 2018 Apr 9:20180048. Doi: 10.1259/bjr.20180048
- Jingzhu Xu, Joyoni Dey, Kyungmin Ham, Narayan Bhusal, Leslie G. Butler, "Two-dimensional single grating phase contrast system", Proc. SPIE 10573, Medical Imaging 2018: doi: 10.1117/12.2292829; https://doi.org/10.1117/12.2292829
- Yoon, J. , Xie, Y. and Zhang, R. (2018), Evaluation of surface and shallow depth dose reductions using a Superflab bolus during conventional and advanced external beam radiotherapy. J Appl Clin Med Phys, 19: 137-143. doi:10.1002/acm2.12269
- Yoon, J. , Xie, Y. , Heins, D. and Zhang, R. (2018), Modeling of the metallic port in breast tissue expanders for photon radiotherapy. J Appl Clin Med Phys, 19: 205-214. doi:10.1002/acm2.12320
- Zhang, R. , Heins, D. , Sanders, M. , Guo, B. and Hogstrom, K. (2018), Evaluation of a mixed beam therapy for postmastectomy breast cancer patients: Bolus electron conformal therapy combined with intensity modulated photon radiotherapy and volumetric modulated photon arc therapy. Med. Phys., 45: 2912-2924. doi:10.1002/mp.12958
- Carmichael, O.T., Pillai, S., Shankapal, P. et al. A Combination of Essential Fatty Acids, Panax Ginseng Extract, and Green Tea Catechins Modifies Brain fMRI Signals in Healthy Older Adults. J Nutr Health Aging (2018) 22: 837. https://doi.org/10.1007/s12603-018-1028-2
- Owen Carmichael, Adam J. Schwarz, Christopher H. Chatham, David Scott, Jessica A. Turner, Jaymin Upadhyay, Alexandre Coimbra, James A. Goodman, Richard Baumgartner, Brett A. English, John W. Apolzan, Preetham Shankapal, Keely R. Hawkins. The role of fMRI in drug development, Drug Discovery Today, Volume 23, Issue 2, 2018, Pages 333-348, ISSN 1359-6446, https://doi.org/10.1016/j.drudis.2017.11.012
- Sick, J., Fontenot, J. (2018) "The Air Out There: Treatment Planning When Target Volumes Extend Beyond the Skin" *Int. J. Radiat. Oncol. Biol. Phys.* 101(5):1025-1026. https://doi.org/10.1016/j.ijrobp.2018.03.019

- McLaughlin, D. J., Hogstrom, K. R., Neck, D. W. and Gibbons, J. P. (2018), Comparison of measured electron energy spectra for six matched, radiotherapy accelerators. J Appl Clin Med Phys, 19: 183-192. doi:10.1002/acm2.12317
- Pitcher, G. M., Hogstrom, K. R. and Carver, R. L. (2018), Evaluation of prototype of improved electron collimation system for Elekta linear accelerators. J Appl Clin Med Phys, 19: 75-86. doi:10.1002/acm2.12342
- N. Bhusal, J. Dey, J. Xu, K. Kalluri, A. Konik, J. M. Mukherjee, P. H. Pretorius," Performance Analysis of a High-Sensitivity Multi-Pinhole Cardiac", submitted Medical Physics, accepted pending minor revisions

Abstracts:

- Phillip DH Wall and Jonas D Fontenot. Knowledge-based planning increases complexity and reduces delivery accuracy of VMAT plans for prostate cancer. AAPM Southwest Chapter Annual Meeting, 2018.
- Phillip DH Wall and Jonas D Fontenot. Knowledge-based planning increases complexity and reduces delivery accuracy of VMAT plans for prostate cancer. AAPM Annual Meeting, 2018.
- Phillip DH Wall Abbie Wood. Construction and validation of tissue-matching phantoms for optimizing image quality in MR-guided cervical cancer brachytherapy. AAPM Annual Meeting, 2018.

8. Seminars and Presentations

- Steiner J, Matthews K, Jia G. "Endorectal Digital Prostate Tomosynthesis: A Novel High-Resolution Imaging Method for the Prostate Region." SWAAPM Young Investigators Symposium, Houston, TX, April 2018. Oral Presentation.
- Wall, P. and Fontenot, J. "Knowledge-Based Treatment Planning Increases Complexity and Reduces Delivery Accuracy of VMAT Plans for Prostate Cancer." Oral Presentation, AAPM Annual Meeting; Nashville, TN, Aug. 1, 2018.
- Wall, P and Wood, A. "Construction and Validation of Tissue-Matching Phantoms for Optimizing Image Quality in MR-Guided Cervical Cancer Brachytherapy." SNAP Oral Presentation, AAPM Annual Meeting; Nashville, TN, Jul. 29, 2018.
- Wall P and Fontenot J. "Improved Knowledge-Based Radiation Therapy Treatment Planning." MedPhys Slam, AAPM Southwest Chapter Annual Meeting; Houston, TX, Apr 27, 2018.