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LSU Medical/Health Physics Newsletter

LSU Department of Physics & Astronomy

MARY BIRD PERKINS CANCER CENTER™

Message from the Program Director

Dear Alumni, Students, Colleagues, and Friends:

I hope that this newsletter finds you in good health and fine spirits. I'm pleased to tell you that the Medical Physics and Health Physics Program continues to thrive! In particular, our faculty and students are a source of great pride, as evidenced by the inspiring stories in this issue. Since our last newsletter, much has changed; thankfully these changes have been exclusively positive. We returned to in person teaching and learning, quite a few students graduated and moved on to the next step in their careers, and we welcomed many outstanding new students to the program. All are doing remarkably well in their studies, research projects, and career progression.

Other changes include the growth of endowed funds for the benefit of the students and faculty of our program. Several Superior Graduate Student Scholarships have been awarded, and the number of scholarships available has been growing as our endowments have accrued expendable funds. Drs. Krystal Kirby and Chris Schneider joined Mary Bird Perkins Cancer Center and were appointed as adjunct junior faculty here at LSU. Both completed residency training and board certifications. Ms. Paige Whittington joined the program as Program Manager in 2022 and she has become an invaluable member of our team.

In our program, thankfully, some things have stayed the same. For example, for more than five years running, we have had a full compliment of tenure or tenure-track faculty. Two faculty members were awarded tenure in recent years (Drs. Dey and Zhang). The scope and number of accomplishments from our team remains impressive. Research, grants, and publications continue to be plentiful and are increasing year by year. LSU budgets have continued to be stable, and we have continued to enjoy unwavering support from the Department of Physics and Astronomy, the College of Science, the University, and the Louisiana Board of Regents. In addition, we owe a debt of gratitude to all our donors, including the Bella Bowman Foundation, which continues to support our research on side effects from radiotherapy for children.

This year, our students, faculty, and staff worked together to overcome the challenges we faced. The teamwork and sense of community is inspiring. We hope you enjoy reading about many of the recent achievements and successes of our students and faculty.

Sincerely,
Wayne Newhauser, PhD
Professor and Director, Medical Physics & Health Physics
Dr. Charles M. Smith Chair of Medical Physics

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Medical & Health Physics Alumni Newsletter is published by the LSU Medical & Health Physics Graduate Program

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Feedback from alumni is always welcomed by the Program. Please send your suggestions or comments to:
pamedphys@lsu.edu

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Students presenting their research at Mary Bird Perkins Cancer Center (from left to right: Grant Debevec, Mason Heath, Richard Lesieur,Lam Lay, Morgan Aire, Reagan Dugan, and Carson Matthews.)

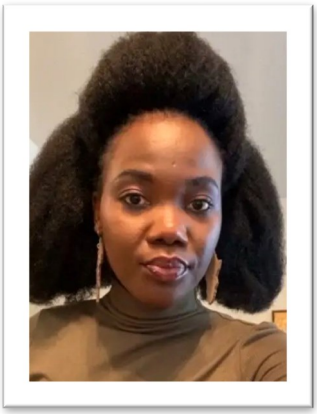
Meet the class of 2022

Matthews, Carson
BS/2021
Weber State University, UT
MS tract (MP) 2022 - present

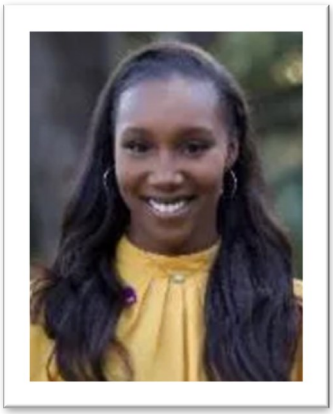
Barber, Corinne
MS/2022
University of South Carolina, SC
PhD tract (MP) 2022 - present

Heath, Mason
MS/2022
Oregon Health & Science University, OR
PhD tract (MP) 2022 - present

Aire, Morgan
BS/2021
University of Colorado Boulder, CO
MS tract (MP) 2022- present



Bundi, Purity
BS/2022
Carthage College, WI
MS tract (MP) 2022 - present



Manning, Shanice
BS/2020
Louisiana State University, LA
MS tract (MP) 2022 - present

From left to right: 2022 new students Shanice Manning, Morgan Aire, Thomas Zhang, Carson Matthews, Mason Heath, Corinne Barber, and Purity Bundi.

Zhang, Tiantong
MS/2022
Hofstra University, NY
PhD tract (MP) 2022 - present

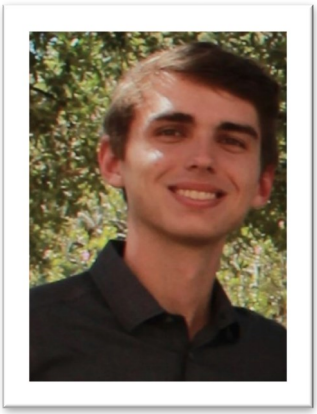
Meet the class of 2023

Rohani, Aliasghar
MS/2018
Tehran Univ. of Medical Science, Iran
PhD tract (MP) 2023 - present

Reaux, Hailey
BS/2020
Louisiana State University , LA
MS tract (MP) 2023 - present

Masters, Joseph
MS/2023
Vanderbilt University , TN
PhD tract (MP) 2023 - present

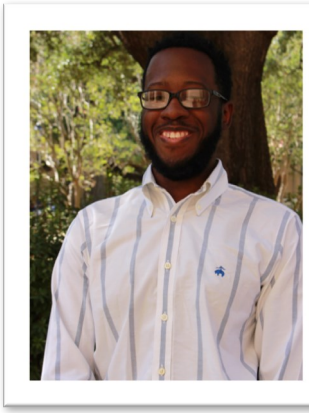
Dickson, Lily
MS/2023
University of Richmond, VA
PhD tract (MP) 2023 - present



Dobranski, Nathan
BS/2023
Michigan State University, MI
MS tract (MP) 2023 - present

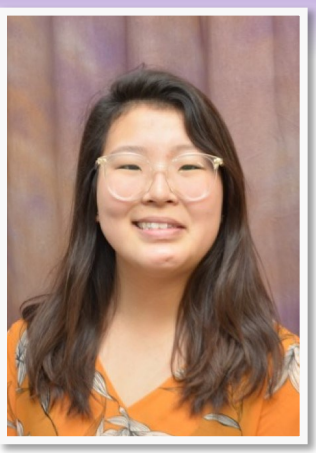
Magneson, Olivia
BS/2023
Lebanon Valley College, PA MS
tract (MP) 2023 - present

From left to right: 2023 new students Nathan Dobranski, Joseph Masters, Aliasghar Rohani, Lily Dickson, Sadiki Daniel, Olivia Magneson, and Hailey Reaux.



Daniel, Sadiki
MS/2023
LeMoyne College, NY
PhD tract (MP) 2023 - present

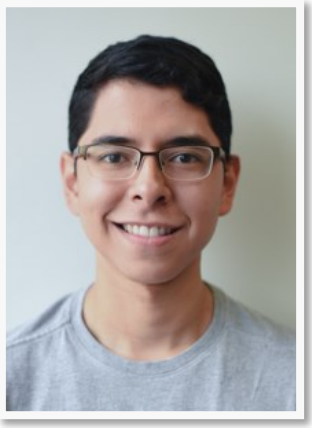
2022 Program Graduates



Elizabeth Park, MS

Advisor: Joyoni Dey, Ph.D

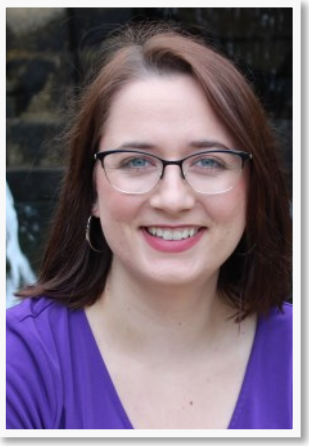
Dissertation: Hybrid Modulated-Phase-Grating for Phase contrast X-Ray for a Varying Fringe Period Clinical Interferometry System.



Ivan Hidrovo Giler, MS

Advisor: Joyoni Dey, Ph.D.

Dissertation: Neutron Interferometry Using a Single Modulated Phase Grating.

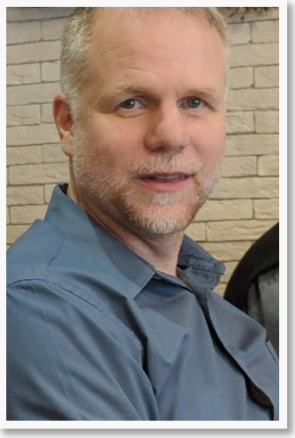


Megan Chesal, MS

Continuing on to Ph.D.

Advisor: Jeffery Chancellor, Ph.D.

Dissertation: A Physiological Scalable Analog That Can Simulate the Non-Homogenous Space Radiation Enviroment In a Laboratory Setting.

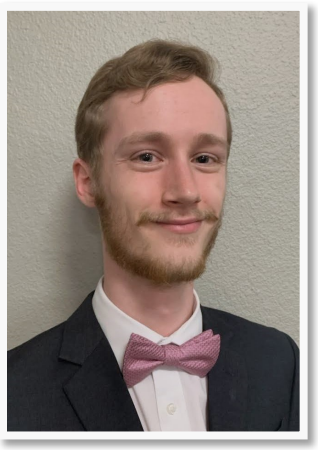


Michael McMahon, MS

Advisor: Jeffery Chancellor, Ph.D.

Dissertation: Accident Simulation Study for Nuclear Power Plant Impacting Louisiana.

2022 Program Graduates



Michael Taylor, MS

Advisor: Jonas Fontenot , Ph.D.

Dissertation: In-Phantom Film Measurements of Two Treatment Planning Systems for Single-Fraction Spine SBRT.

Charles Zimmerman, MS

Advisor: Kip Matthews, Ph.D.

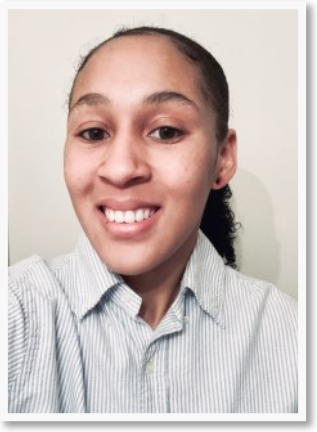
Dissertation: Dosimetric Simulation of a Talbot-Lau-X-Ray Interferometry System for Medical Diagnostic

2023 Program Graduates

Andrew McGuffey, Ph.D.

Advisor : Garrett Pitcher, Ph.D.

Dissertation: Intensity Modulated Bolus Electron Conformal Therapy (IM-BECT): Methods of Quality Assurance of PRIME Intensity Modulators and Evaluation of Planned IM-BECT Dose Distributions.



Sydney Carr, MS

Advisor: Joyoni Dey, Ph.D.

Dissertation: Experimental and Imaging Data Analysis for Modulated Phase Gratings in X-Rays.

Jackie Chien, Ph.D.

Advisor: Rui Zhang, Ph.D.

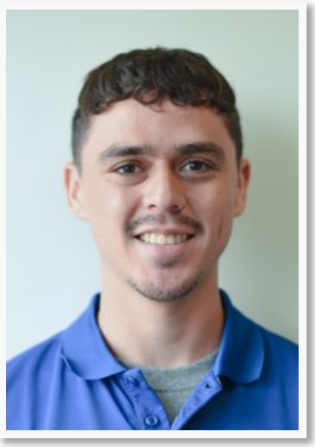
Dissertation: Reconstruction of Volumetric Modulated Arc Therapy-Computed Tomography.

James Crist, MS

Advisor: Garrett Pitcher, Ph.D.

Dissertation: Development and Testing of MapCheck3-based Patient Specific QA Method for PRIME Intensity Modulators Used With Bolus Electron Conformal Therapy.

2023 Program Graduates



Jared Taylor, Ph.D.

Advisor: Jeffery Chancellor, Ph.D.

Dissertation: An Artificial Intelligence Framework to Design Radiation Shielding for Spacecraft and Satellites Using Machine Learning and Topology Optimization.

Kai Cheng Chuang, Ph.D.

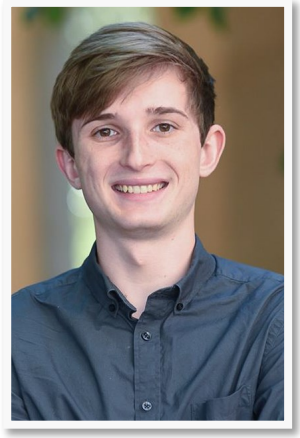
Advisor: Owen Carmichael, Ph.D.

Dissertation: Effective Connectivity of Functional MRI via Deep Learning Methods.

Lacey Medlock, MS
Continuing on to Ph.D.

Advisor: Joyoni Dey/Owen Carmichael, Ph.D.

Dissertation: Patient Specific Normalized Glandular Dose Range Estimate for Mammography.



Bryce Smith, MS

Advisor: Joyoni Dey, Ph.D.

Dissertation: Maximum-Likelihood Estimation of Glandular Fraction for Mammography.

2023 Program Graduates

Payton Stone, Ph.D.

Advisor: David Solis, Ph.D.

Dissertation: Does Calculation and Prediction Methods for Gamma Knife Stereotactic Radiosurgery.

Trainee Milestones - Certifications

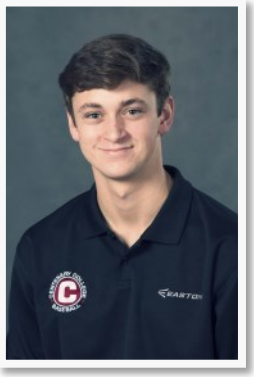
Congratulations to all students who have made progress in achieving certification. The following current students have chosen to disclose their status.

Blair, Rachel

BA // student

Passed Part I of the ABR Exam

January 12, 2023



Debevec, Grant

BS // student

Passed Part I of the ABR Exam

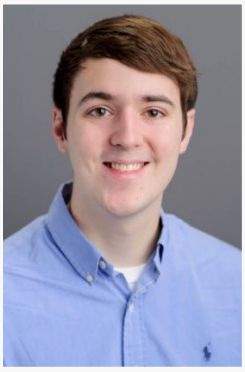
January 12, 2023

Lesieur, Richard

BS // student

Passed Part I of the ABR Exam

January 12, 2023



Meyer, Hunter

BS // student

Passed Part I of the ABR Exam

January 12, 2023

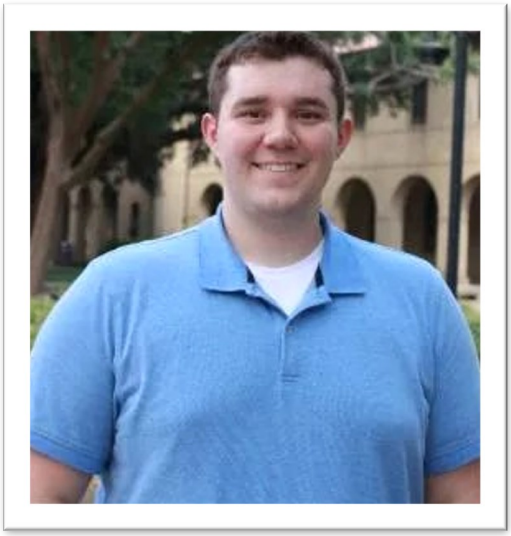
Medlock, Lacey

MA // student

Passed Part I of the ABR Exam

January 13, 2023

A Message from Student-Faculty Liaison



Mason Heath, //PhD Student, Student's Liaison

The previous academic year has been one full of opportunity and community among LSU Medical Physics graduate students. We were fortunate to be in close proximity to this year's AAPM meeting which resulted in significant representation by our LSU Tigers! This includes the SWAAPM SLAM competi-tion winner Nousha Afshari who com-peted on the national level, Hunter Meyer who gave a presentation on his research on X-ray interferometry, as well as several poster presentations from other students and Mary Bird Perkins Cancer Center (MBPCC) residents. This is in addition to several presentations at various other conferences.

As always, we found several ways to take a break from studying and re-lax. This includes everything from bread parties to supporting LSU athletics in route to 2 national titles! We've also continued old traditions by kicking off the start of the 2023 football season with another successful tailgate, with more to come! We've been able to build our great com-munity through mutual support which has helped navigate the inherent stress of being a graduate student.

We were also lucky to host our speaker Dr. Steve Jiang, at MBPCC's first annual H.N. Saurage IV, Distinguished Lecture Series. He gave an enlight-ening talk on his groups work on implementing A.I. in radiation oncolo-gy. This was a special event where students were able to discuss their research with their peers through poster presentations, as well as pick the brain of our speaker in a private discussion. We are looking forward to the second installation of this event which will be held later this year.

The previous academic year has been productive and fruitful for the Medical Physics students. We have an excellent group of graduate stu-dents who never cease to capture every opportunity. Over the previous year we've been able to build a strong community built on support and achievement. I know this will only continue with time and I look forward to what the remainder of the 2023-2024 academic year will bring in our great scholastic environment.

STUDENT UPDATE

Honors and Awards

- Assistant Professor Jeffery Chancellor received $1.8 million in funding from NASA's Hu-man Research Program to investigate biological, physiological, and behavioral adap-tations to spaceflight.
- Ph.D. student Chia-Lung "Jackie" Chien Awarded Hogstrom Superior Graduate Student Scholarship. (2021 - 2022)
- Ph.D. students Andrew McGuffey and Max Cole Awarded Hogstrom Superior Graduate Student Scholarship (2022 - 2023)
- Ph.D. student Richard Lesieur Awarded Hogstrom Superior graduate Student Scholarship (2023-2024).
- MS student Sydney Carr featured in an article about her research experience concern-ing Novel X-ray Interferometry Imaging of Plant Root Systems.
- BS student Miscia Fortna received DAAD's RISE Scholarship to continue his training at the Justus-Liebig-Universität-Gieβen.
- Ph.D. student Chloe DiTusa awarded the Outstanding LSU Physics & Astronomy TA/Grader award for the Undergraduate Quantum Physics course.
- Alumnus Dr. Kai-Cheng Chuang receives the Coates Travel Research Award from LSU.
- PhD student Maxwell Cole received Best Poster Award at the WAMTA conference.
- Dr. Kenneth "Kip" Matthews II elected to his second two-year term as Treasurer of the Southwest Chapter for 2023 and 2024.
- Ph.D. student Nousha Afshari won the MedPhys 3-Minute Slam Competition at the 2023 meeting of the Southwest Regional Chapter of AAPM.
- Ph.D. student Maxwell Cole Received the Roussel Family Graduate Student Award in Communication from LSU.

Honors and Awards

- MS student Morgan Aire placed 3rd in H.N Saurage IV Distinguished Lecture Series Event Poster Session with a poster titled "Magnetic Resonance Fingerprinting for Adap-tive radiotherapy".
- Dr. Yong-Ha Kim awarded multiple awards, including: 2023 LSU Service - Learning Faculty Scholar, Excellent Paper Award 2022 & 2023 - Korean Society of Radiology Fall conference, Best Paper Award 2022 - Korean Society of Radiology Fall Conference, and the Bronze Award 2022 - Korean Society of Radiology Spring Conference.
- Alumna Dr. Krystal Kirby awarded multiple awards, including: 1st place at AAPM Art of Scientists Art Show 2023, and 3rd place in Early Career Investigator Symposium, Spring Clinical AAPM 2022.
- Dr. Sotiri Stathakis received the Favre Award at MBPCC for a clinical exploratory study on the use of wearable devices in radiation therapy.
- Dr. Patrick Diehl granted $300,000 by the National Science Foundation for his project t: POSE: Phase I: Constellation: A Pathway to Establish the STE.
- Dr. Yong-Ha Kim granted $199,998 for the LSU Nuclear Multidisciplinary Scholarship Program from the Nuclear Regulatory Commission, PI.
- Alumnus Joe Steiner Featured on page 6 of the Buffalo State University Muriel A. Howard Honors Program Newsletter.
- Graduate students Nousha Afshari and Shanice Manning, as well as undergraduate student Gregory Field appointed as Graduate and Undergraduate Fellows for LaSpace.

Honors and Awards

Maxwell Cole Wins WAMTA 2023 Best Poster Award

Stellar Group awards Maxwell Cole "Best Poster Award" winner for his poster: Computational feasibility of simulating radiation induced changes to vasculature and blood flow rates in the entire human body.

Computational feasibility of simulating radiation induced changes in vasculature and blood flow rates in the entire human body

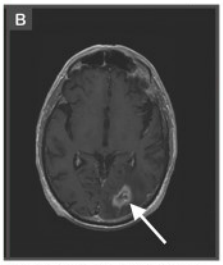
Maxwell Cole | mcole36@lsu.edu

College of Science
Department of Physics & Astronomy

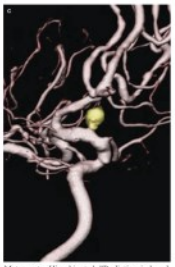
STE||AR GROUP

Motivation

Radiation therapy is used widely for the treatment of cancers. However, healthy tissues are often exposed to radiation during treatment, damaging the vasculature and leading to secondary health problems. As the long-term survivability of cancer increases, it is important to understand the systemic effects of the treatments. Radiation-induced blood vessel injury can lead to, for example, white-matter necrosis, atherosclerotic heart disease, or cerebral aneurysms[1]. Computational simulations can be used to analyze the effects of radiation in the vascular system.



Munier, Sean, et al. "Radiation necrosis in intracranial lesions." *Cureus* 12.4 (2020).



Matsumoto, Hiroaki, et al. "Radiation-induced cerebral aneurysm treated with endovascular coil embolization: A case report." *Interventional Neuroradiology* 20.4 (2014): 448-453.

Introduction

The human body has over 60,000 miles of blood vessels[2]. When analyzing the systemic effects of radiation on the vasculature of the entire body, it is necessary to consider each vessel, the dose it receives, and the blood flow through it. In vivo and epidemiological studies often neglect to analyze blood flow in the pathogenesis of radiation-induced vasculopathy. Recently, several groups have performed computational blood flow simulations. However, these simulations do not include radiation injury, and are often limited in scale[3]. Therefore, the goal of this study is to model the radiation damage and analyze the changes to blood flow in a vascular network the size of the entire human body, approximately 34 billion vessels.

Methods

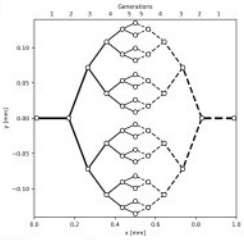
Vascular Geometry

We use a fractal algorithm to create 2 or 3-dimensional vascular networks that are scalable by number of generations (N_G):

$$N_v = 2^{N_G+1} - 2$$

N_v is number of vessels

Vessels are represented by rigid cylinders connected at junctions to form a closed loop. With each succeeding generation, each parent vessel creates two daughters in which the angle of bifurcation, length, and radius are scaled down to anatomical data. The network generates symmetrically comprising of arterial and venous halves, with the smallest levels representing the capillary beds.



Fluid Dynamics

The fluid dynamics follow from assumptions of steady-state, laminar, and fully developed flow. The volumetric flow rate (Q) in each vessel is calculated using a specialized case of the Navier-Stokes equation, known as the Poiseuille equation:

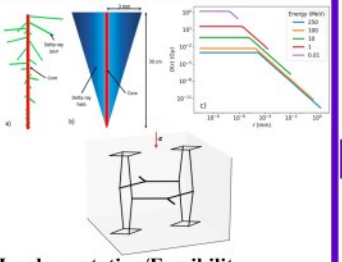
$$Q = \frac{\pi r^4}{8\eta L}(P_{in} - P_{out})$$

L is length, r is radius, η is viscosity, and P_{in} and P_{out} are the pressures at the vessel inlet and outlet, respectively

Because blood is incompressible, the net flow at each junction must be zero. The network can then be cast as system of linear equations, with appropriate anatomical boundary conditions. The system is solved by iterative Krylov methods.

Radiation Transport

We simulate a beam of protons propagating in the $-z$ direction with stochastically sampled starting energy, position and direction. Dose deposition is modeled using an amorphous track-structure model, in which the dose is deposited radially symmetrically from protons and secondary ionized electrons, or δ-rays, with an energy dependent radius. We use a position dependent space-partitioning data structure to determine if a track radius intersects a vessel boundary, then score the dose accordingly. The biological response of vessels is modeled to fit experimental data.



Implementation/Feasibility

We implemented the algorithms in the C++ language. We utilize distributed memory parallelization on HPC clusters. Persistent storage is handled with the Hierarchical Data Format library. To assess the speed of the algorithm, we created networks ranging from 3 to 30 generations. We assessed the strong scaling by calculating the Speedup Factor (S):

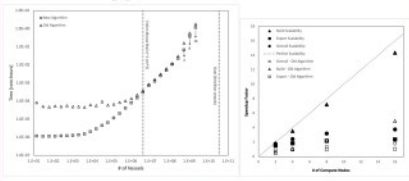
$$S = \frac{T_q}{q \cdot T_n}$$

T_q is execution time for reference number of compute nodes, q, and T_n is execution time for the same task on n compute nodes

The task was to create a 27-generation network. We will be integrating High Performance ParalleX (HPX) C++ library developed by the STE||AR Group.

Preliminary Results

Previous results from our laboratory have shown the computational feasibility of calculating blood flow in 17 billion vessels[4]. We have also shown the feasibility of demonstrating vascular injury from radiation in a network of 9 billion vessels from 2 million protons[5]. We have streamlined the previous algorithm by removing costly processes, thus decreasing execution time and improving scalability, as shown below for vessel network generation and export data. Execution time was improved by an average of 17.12 times, while speedup increased by an average of 58.3%. Further preliminary results are being generated at the CCT's Rostam cluster.



Challenges

1. **Size:** One instance of the vessel class is 80 bytes, meaning the construction of the entire human body requires nearly three terabytes of memory. This can be accomplished on 256 compute nodes with at least 64 GB of memory each.
2. **Anatomy:** To achieve greater anatomical accuracy, we must first include more biophysical mechanisms of blood flow. This includes pulsatile flow, vessel wall elasticity, and fluid momentum at junctions. We must also consider the stochastic geometry of vascular networks and the arrangement of organs in the body. We plan to implement these changes in future works.

References

1. Yang, Eric H., et al. "Radiation-induced vascular disease—a state-of-the-art review." *Frontiers in Cardiovascular Medicine* 8 (2021): 652761.
2. Bautch, Victoria L., and Kathleen M. Caron. "Blood and lymphatic vessel formation." *Cold Spring Harbor perspectives in biology* 7.3 (2015): a008268.
3. Salman, Huseyin Enes, and Huseyin Cagatay Yalcin. "Computational modeling of blood flow hemodynamics for biomechanical investigation of cardiac development and disease." *Journal of Cardiovascular Development and Disease*8.2 (2021): 14.
4. Donahue, William P., et al. "Computational feasibility of calculating the steady-state blood flow rate through the vasculature of the entire human body." *Biomedical Physics & Engineering Express* 6.5 (2020): 055026.
5. Donahue, William P., et al. "Computational feasibility of simulating changes in blood flow through whole-organ vascular networks from radiation injury." *Biomedical Physics & Engineering Express* 6.5 (2020): 055027.

Honors and Awards

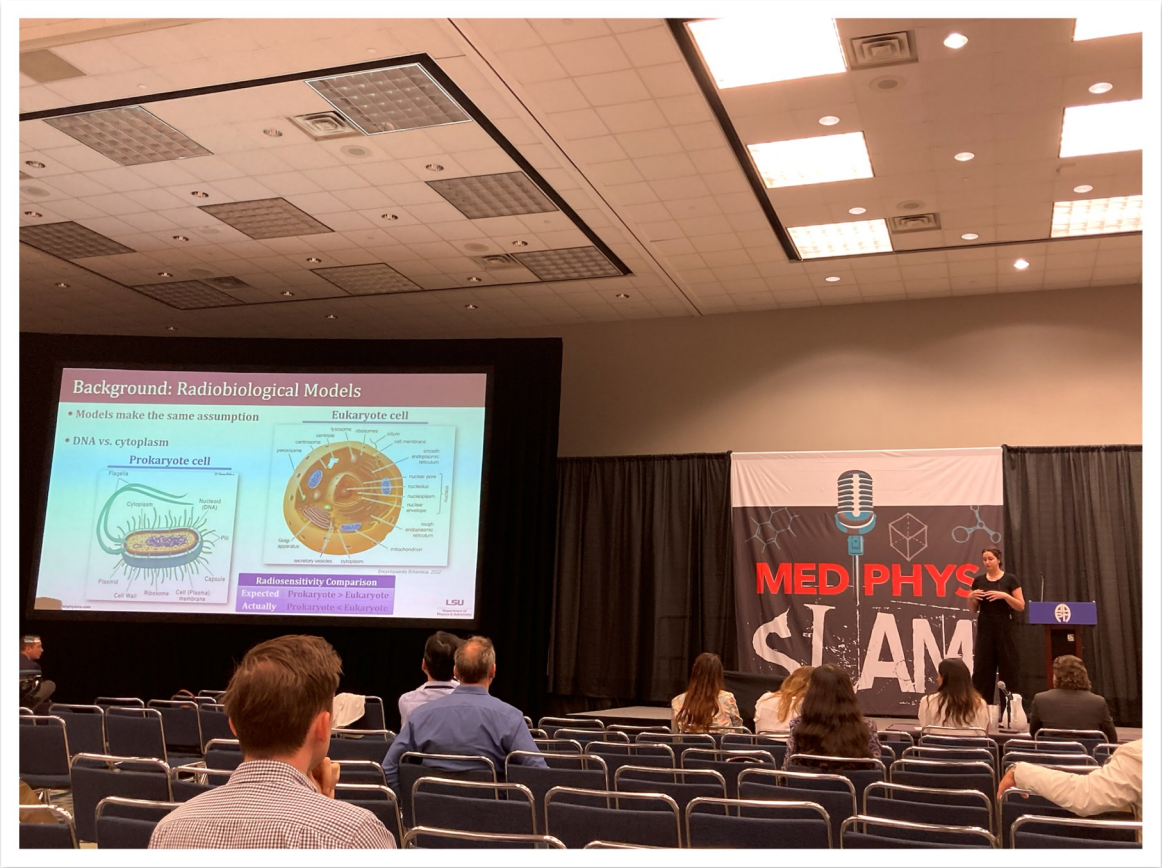
Graduate Students Receive Awards

Chloe DiTusa receives Outstanding Physics and Astronomy TA/Grader Award for her work as a grader for undergraduate Quantum Physics.

Kai-Cheng Chuang receives the Coates Travel Research Award.

Honors and Awards

Nousha Afshari Wins Southwest Regional AAPM Med Phys SLAM Competition



"This year was my first time attending the annual AAPM meeting, and participating in the Slam competition was really fun. Essentially, the challenge of the event is to condense a thesis project into a 3-5 minute presentation and it's not an easy feat! And while learning about the other participants' research projects was interesting, my favorite part of the experience was hearing the creativity in their explanations. Some presenters had incredibly ingenious analogies that took complex, physics-heavy concepts and simpli-fied it enough so participants of every skill and education level could easily understand."

-Nousha Afshari, Ph.D candidate.

Honors and Awards

Kip Matthews Elected Treasurer of the Southwest Regional Chapter of AAPM

Kip Matthews was re-elected as Treasurer for 2023-2024 of the Southwest Regional Chapter of the American Association of Physicists in Medicine. The Southwest Chapter serves medical physicists in Louisiana, Arkansas, Oklahoma, and Texas; it is one of the largest chapters within the AAPM. As Treasurer, Dr. Matthews manages the Chapter's finances and plays a substantial role in planning the Southwest Chapter's annual meetings.

"I'm pleased to have been reelected by our Chapter members for another term," said Dr. Matthews.

"Giving back to our profession through service is very important to me. I encourage our alumni to run for offices in their regional chapters and to volunteer for roles in AAPM." In addition to the Southwest Chapter and AAPM, Dr. Matthews also served as a Senior Associate Editor for the Medical Physics journal, and a member of the Graduate Education Program Review Committee for the Commission on Accreditation of Medical Physics Academic Programs, and as a funding proposal reviewer for the U.S. Nuclear Regulatory Commission.

SWAAPM

Honors and Awards

Richard Lesieur Awarded:

HOGSTROM SUPERIOR GRADUATE AWARD

Click here to view the announcement!

Honors and Awards

Miscia Fortna Receives DAAD's RISE Scholarship

"RISE Germany offers summer research internships in Germany for undergraduate students from North America, Great Britain and Ireland. In their internships, students are carefully matched with doctoral students and researchers (only from universities of applied sciences, UAS) – whom they assist and who serve as their mentors. Interns receive a monthly stipend to cover every day costs. About 300 scholarships are available each year."

" RISE stands for Research Internships in Science and Engineering. RISE Germany offers undergraduate students from North American, British and Irish universities the opportunity to complete a summer research internship at top German universities and research institutions. RISE Germany is funded by the German Federal Foreign Office."
- RISE Germany

"RISE Germany internships were first offered in 2005 to applicants from the United States and Canada, with the program extended to the United Kingdom in 2009 and Ireland in 2018. Our objective remains to promote student exchange to Germany in the fields of natural science, engineering and life sciences, and to motivate undergraduate students to learn more about Germany's research landscape and study opportunities."

"All interns receive a scholarship to help cover living expenses, international travel stipend and health insurance. The partner universities and research institutions provide housing assistance. DAAD also invites all fellows to a RISE meeting at the beginning of July where they have an opportunity to learn from each other's experiences."

Credit to RISE Germany for their quotes and information.

Grants

2022

▪ Dr. Jeffrey Chancellor

Atlantis Industries, INC. Grant: Small Business Innovation Research (SBIR) Phase 2 Award Automated Space Weather Anomaly Detection & Countermeasure Response. 2022, US $1,500,000

Atlantis Industries, INC.Grant: Small Business Innovation Research (SBIR) Phase 2 Award AI-Enabled Radiation Modeling and Design of Advanced Space Electronics in xGEO. 2022, US $750,000

Grant: Texas Advanced Computing Center (TACC) Allocation AI Framework to Design Radiation Shielding for Spacecraft Using Machine Topology Optimization. 2022-2024, Stampede2 cluster 53, 856, 000 CPUh

Grant: NASA 2021: Lunar Explorer Instrument for Space Biology Applications Impacts of radiation and space travel stress stimuli expected during long-duration exploration space missions on photosynthesis, crop growth and yield. 12/2022-12/2023, US $8,000

▪ Dr. Patrick Diehl

Grant #2229751 (Rod Tohid)

Name of Funding Organization: National Science Foundation
Amount Awarded: $300,000 Period of Grant Award: Sept 15 2022 - Oct 31 2023 Title of Project: POSE: Phase I: Constellation: A Pathway to Establish the STE||AR Open-Source Organization

Grants

Dr. Carmichael

C. Muller
R01AG078533-01 NIH/NIA
Education and Cognitive Functioning in Later Life: The Nation's High School Class of 1972

J. Luchsinger
U19AG078558 NIH (NIA)
Alzheimer's Disease and Alzheimer's Disease Related Dementias in Pre-diabetes and Type 2 Diabetes: The Diabetes Prevention Program Outcomes Study AD/ADRD Project

L. Bazzano, OT Carmichael , and EM Urbina
R01AG077497 NIH (NIA)
$2,891,965
I3C DECADE: Disparities and Equity in Childhood Cardiovascular Exposures and Alzheimer's Dementia

S. Yasar
R01AG074258 NIH (NIA)
$526,730
Effects of the Renin Angiotensin System on MRI Volumetric Measures and Cognitive Function in the Alzheimer's Disease Process: the LookAHEAD study

T. Kelly, L. Bazzano, and O. Carmichael
R01AG077000
Early Life Cardiovascular Disease Risk Factors, Epigenetic Age Acceleration, and Alzheimer's Disease Related Brain Health

Grants

- **Dr. Patrick Diehl**

Grant #2229751 (Rod Tohid)
Name of Funding Organization: National Science Foundation
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- **Dr. Yong-Ha Kim**

LSU Nuclear Multidisciplinary Scholarship Program, Nuclear Regulatory Commission. 2022– Present.

- **Dr. Kip Matthews**

STTR Phase 1 with Refined Imaging LLC: Implementation and Validation of a Lung X-ray Interferometry Imaging System, with Applications to COPS, COVID-19, and Other Lung Diseases. National Institutes of Health, 1R41HL158414-01A1. 9/2022 - 8/2024. $322,966

LSU Health Science Center - Radiological Physics for Residents. LSU Health Sciences Center, New Orleans. 11/2022 - 5/2023. $2,730 Contract.

Grants

- **Dr. Wang**

LSU Nuclear Multidisciplinary Scholarship Program. US Nuclear Regulatory Commission Award #31310022M0010

2023

- **Dr. Jeffrey Chancellor**

Audax Exploration & Geospace Integrated Strategies, LLC Grant: Small Business Innovation Research (SBIR) Phase 1 Award (NOAA) AI Based Long Range Space Weather Prediction System. 10/2023-4/2025, US $90,000

Grant: LaSPACE Graduate Research Fellowship Translating Space Radiation Genotoxicity from Rodent to a Non-Human Primate Model Using CRISPR/CAS9 and Radiobiology Computational Models. 8/2023 – 07/2024, US $20,000

Grant: LaSPACE Graduate Research Fellowship Improvement of the Radiobiological Models by In-vivo Validation to Numerical Methods. 8/2023 – 07/2024, US $20,000

Grant: LaSPACE Undergraduate Research Assistantship (LURA) Development of Scientific Instrumentation Payloads to Measure the Space Radiation Environment in Cis-Lunar, Lunar Surface, and Lunar Orbit. 8/2023 – 07/2024, US
$6,000

- **Dr. Yong-Ha Kim**

Modelling Inhaled Radionuclide Deposition in the Human Lung, LSU Provost's Fund for Innovation in Research. Awarded but returned to teach in Summer 2023.

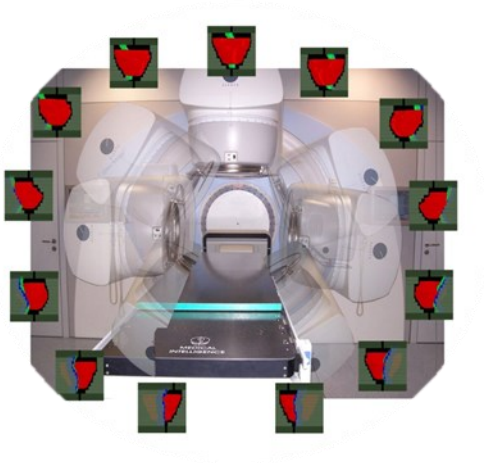
Featured Stories

LSU Professor Aims to Improve Radiation Therapy to Save Lives

Joseph T. Bullard, LSU Manship School of Mass Communication

More than half of cancer patients will receive radiation therapy. To improve radiation treatment outcomes for patients, the American Cancer Society has awarded LSU Associate Professor of Physics Rui Zhang a $786,000 grant for his research at LSU and Mary Bird Perkins Cancer Center.

Zhang aims to improve upon a commonly used radiation therapy technique known as Volumetric Modulated Arc Therapy, or VMAT, during which a beam of radiation shaped to the tumor is delivered continuously as the treatment machine rotates. Traditionally, images of the patient's anatomy are acquired before the VMAT treatment to determine the location of the tumor and its surrounding area. However, should the tumor move, or the surrounding area not be aligned the same way during imaging, the beam can miss the target, causing the treatment to be less effective, and possibly damage normal tissue, which can lead to secondary cancers.



"We are proud to support the work of Dr. Zhang and others who are working every day to enhance cancer care and move medical physics forward," said Jonas Fontenot, Ph.D., president and chief executive officer, Mary Bird Perkins Cancer Center. "His work through the LSU-Mary Bird Perkins collaboration is part of the Cancer Center's commit-ment to bring leading-edge research and innovative treatment options to the Gulf South."

Zhang seeks to make VMAT more efficient and reduce the room for error by introducing VMAT-Computed Tomography, or VMAT-CT, an imaging tool that utilizes therapeutic VMAT beams to provide a three-dimensional or four-dimensional mapping of the patient anatomy during treatment. The images would enable doctors to view the patient's anatomy and assess dose information to adjust the treatment plan if the tumor moves, something blocks the beam's path or any other issue that could cause the radiation beam to hit healthy cells instead.

Zhang said this concept was first proposed over 10 years ago by researchers in Europe, but technological limitations long stifled any serious advancements. After years of developing algorithms to improve image quality, Zhang's team may be the first to develop the only VMAT-CT that is clinically applicable in the world.

"It occurred to me the huge amount of daily portal images during VMAT were not collected or utilized," said Zhang. "These data do not require additional hardware, beam time or imaging dose, and could have been used for treatment monitoring and dose tracking. After reading the original VMAT-CT paper published in 2010, I believed this concept should be revisited, despite the obvious challenges. For most scientists, it is more interesting to pursue a significant and difficult question than a well-studied easy question."

"Successful completion of this project will generate a convenient, low-cost, harmless, effective imaging tool, and overcome a critical barrier to the urgently needed intrafraction image guidance for VMAT. It will afford a powerful way to safely deliver and escalate radiation dose, reduce possible toxicities and improve treatment outcomes. Millions of patients in the United States may benefit from this research, especially since radiation therapy is critical for cancer care and VMAT and other rotational radiation therapy is commonly prescribed," Zhang said.

Featured Stories

Undergraduate Student Gregory Fields Assists Intuitive Machines In Preparing For 2024 Launch

During the trip to the Intuitive Machines headquarters in Houston, TX, Gregory performed a variety of responsibilities in order to get the Tiger Eye Minipix detector integrated into the Intuitive Machines flight hardware. Because the last detector they received was damaged, the first objective of the trip was to always ensure proper handling of the detector. This included, but was not limited to: proper ESD procedures, working on the device without damaging the sensor, maintaining the device's health, and tracking it through the variety of tests it was to be put through.

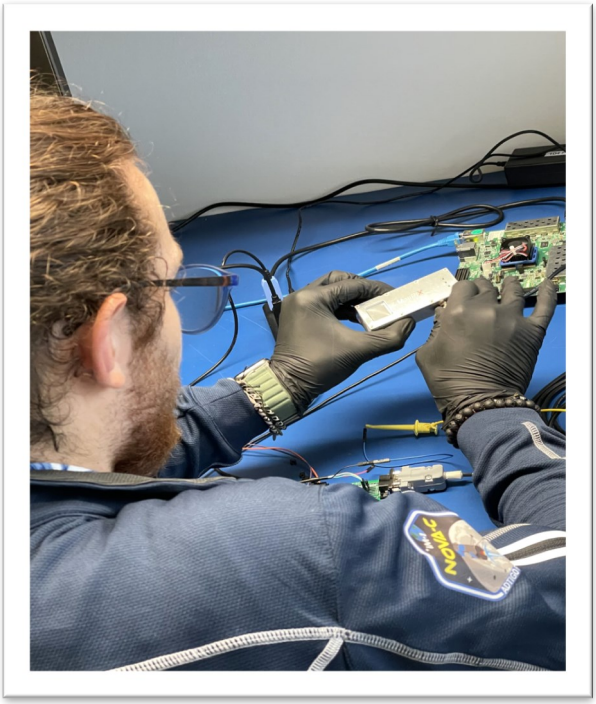
Gregory next introduced the UART interface libraries from Advacam. This included the Minipix UART interface, which is the main underlying control library for the detector: Dummy, the Minipix emulator.

Featured Stories

Undergraduate Student Gregory Fields Assists Intuitive Machines In Preparing For 2024 Launch

Dr. Jeffery Chancellor then presented how to run the emulator and example interfaces through a FTDI loopback over the USB ports on their flat sat mockup. This setup was later used to test all of their software before introducing it to the actual device.

Once the software was verified on the emulator, it was then tested with the Minipix detector. A uranium marble was used as a radiation source to confirm the detector was functioning as intended. Measurements were then taken using example software, which showed decay particle tracks. Finally, the detector was then tested with the flight software as an Interface. Data was decoded, and the functionality of the software was confirmed with particle tracks from decoding the received data.



Design Credit: Katie Hostetler

Featured Stories

LSU Physics Students Receive Louisiana Space Grant Research Awards

Colleen Fava, Assistant Director Louisiana Space Grant & NASA EPSCoR Programs 225-578-8680

colleenf@lsu.edu

LSU Department of Physics & Astronomy graduate student Megan Chesal and undergraduate Haley Pellegrin have been granted Louisiana Space Grant student research awards.

Under the direction of Assistant Professor Jeffery Chancellor, both students will receive a monetary stipend for research work conducted in Chancellor's lab. In addition to hands-on technical experience, these students will be offered other professional development opportunities, like presenting their work at professional meetings while also working towards their LSU degree.

Building transdisciplinary teams that perform research and provide educational opportunities is the key to developing the 21st century workforce desired by both NASA and the State of Louisiana.

An LSU 2018 BS physics alumna, Megan Chesal is currently a third-year medical physics graduate student. Her research with with Dr. Chancellor involves a physiological scalable analog that can simulate the non-homogenous space radiation environment in a laboratory setting.

Featured Stories

LSU Physics Students Receive Louisiana Space Grant Research Awards

The 2020-2021 LaSPACE Graduate Student Research Assistance (GSRA) award will augment Chesal's student stipend, help to defray dissertation related research expenses, and promote student research presentations at national meetings.

"This research is highly relevant to the NASA Human Exploration and Operations Mission Directorate (HEOMD)," said Chancellor. "Megan has been working in my research laboratory and she intends to pursue a career in aeronautics."

Receiving a 2020-2021 LaSPACE Undergraduate Research Assistantship (LURA) award, Haley Pellegrin is a senior undergraduate working in Dr. Chancellor's SpaRTAN Physics laboratory, conducting research on the development of an AI based deep generative design framework and topology optimization for spacecraft radiation shielding.

"This lab's work is highly relevant to NASA HEOMD," said Chancellor. "The overall goals of the lab will help develop Haley's technical, scientific, and professional development skills. Although Haley is relatively new to space science applications of medical physics, this project could impact her career path."

"The fundamental premise underlying Louisiana Space Grant Consortium (LaSPACE) programming is involvement in research at all levels (undergraduate, graduate, and faculty) that aligns with NASA research" priorities and mission goals, and then leveraging that infrastructure to increase NASA-relevant science literacy around the state."

Medical Physics Graduate Student Sydney Carr Shares her Research Experience

Houston native Sydney Carr is an LSU graduate student participating in "Novel X-ray Interferometry Imaging of Plant Root Systems" research and focuses on testing a portable (and removable) low-dose MPG interferometry system. She completed her undergraduate degree in physics at Houston Baptist University. While there, she also played 4 years of Division-1 Women's Basketball for the Huskies.

Can you describe your experience at LSU Physics & Astronomy in one word?

Memorable.

What sparked your initial interest in physics?

When I was younger, I was always interested in science as well as sports, specifically basketball. I was also fascinated with how the basketball could make such crazy trajectories during games and practices. In eighth grade and throughout high school, I became infatuated with the science that answered all my questions — physics. I then decided to major in physics at Houston Baptist University, as well as accepting a full-ride athletic scholarship. Eventually, this led me to where I am today as one of LSU's graduate students.

What do you like/love about LSU Physics & Astronomy?

I love how diverse and family oriented our department is. Even though the Medical and Health Physics Program is a little family of its own within the whole department, I love how warm and welcoming the environment is in LSU Physics & Astronomy.

Why did you choose LSU for graduate school?

Specifically, LSU's Medical and Health Physics program is CAMPEP (Commission on Accredited Medical and Physics Education Programs) accredited, which is highly sought out in my field. It essentially means that LSU meets at least the minimum requirements and standards for an educational program to provide a consistent quality education of medical physicists. LSU also waived tuition and stipends for their master's students, which is huge since most programs don't offer this benefit. Plus, I am Creole and most of my family is originally from Louisiana, so living in Baton Rouge is like being at home when it comes to the food, culture, and crawfish!

What interesting experiences or things have you learned during your time at LSU?

One of the most interesting experiences I had was the opportunity to travel across the country to Richland, Washington, to the Pacific Northwest National Laboratory to conduct research experiments on x-ray computed tomography machine at their EMSL (Environmental Molecular Sciences Laboratory) facility, which is a Department of Energy Office of Science user facility on PNNL's campus. It was so cool to experience the protocol, screening, and overall work at a government lab. I also got to experience doing work at Pennington Biomedical Research Center and at the Center for Advanced Micro structures and Devices (CAMD) here in Baton Rouge. I have learned such a variety of hands-on experimental skills as well as learning the many concepts, physics and theories behind the systems I worked on. I feel if I didn't attend LSU for graduate school, I wouldn't have gotten to add these experiences and new, wide variety of skills upon completion of my master's degree.

Feature by Savannah St. Romain, LSU Manship School of Mass Communication.

Featured Stories

How has your experience been as a research assistant?

Very rewarding. I feel as if being a research assistant has filled in specific holes within my didactic learning as well as within the building of my professional skills. Before I was a research assistant, my time was always managed around designated class times. Now, I have become more vigilant concerning my time management by carefully sorting my work week into designated times for my research, miscellaneous work, various meetings with my advisor, Dr. Joyoni Dey, as well as allowing myself "me-time" during the week. I also have to make time for my involvement as a councilman for NSBP (National Society of Black Physicists), a society that strives to promote the professional well-being of African-American physicists within the scientific community and within the society at large.

Some advice I have for prospective research assistants at LSU would be to first choose an advisor not just based on pure research topic interests but who you will work very well with together regarding personality type - how they supervise and run their research lab as examples. I chose Dr. Dey based off not only interests but because we work well together, and she is very understanding regarding mental health days and breaks. Lastly, become the best expert possible at time management so that the transition into research work is easier.

(lLeft to Right) Graduate Student Sydney Carr & Dr. Joyoni Dey

Are there any professors in particular that have acted as mentors during your academic journey?

My advisor Dr. Joyoni Dey and our program director, Dr. Wayne Newhauser. Both were, and still are, people who constantly believed in me since the day I stepped foot into the program. They are always open to any technical questions I may have, as well as life questions, creating a safe space for any and everyone. Specifically, Dr. Dey took me on as a research assistant and constantly encouraged me on my abilities, as well as helping me along the way whenever I needed.

What was it like getting to investigate advanced X-ray interferometry concepts on a commercial CT system with Dr. Dey?

Super cool honestly. It was my first time working on a commercial CT (computed tomography) system where a series of x-ray images are taken at various angles around a sample and combined using computer processing to create cross-sectional slices of the sample. And I had the best advisor to help guide and teach me. I feel like it added to the strength of good dexterity with my hands (a skill I need while doing clinical work) because I was required to move the MPGs in certain coordinate directions sometimes within 0.01mm using a joystick.

Featured Stories

What made you interested in testing a portable (and removable) low-dose Modulate Phase Grating interferometry system (MPG) where incident of the x-ray beam is controlled?

In my graduate imaging physics course, I learned about the important role the small spatial resolution is for mammography and the role it plays to detect any malignant microcalcifications within the breast that can often be indistinguishable from normal breast tissue. Once I entered my Advanced Imaging Physics course at Mary-Bird Perkins Cancer Center under Dr. Dey, I was exposed to the intriguing world of digital image processing and one of its many applications, low-dose MPG interferometry. I became interested in the way that not only can you recover x-ray absorption images but phase-contrast images that provide even more information of the sample being imaged, all within one single x-ray scan. I became interested in testing a portable (and removable) system because this being accomplished could open doors for clinical applications. Specifically, within my field, my passion for testing a system like this originated from the instilled importance of an adequate diagnosis for cancer patients in order to better our treatment planning and delivery accuracy.

How is your research beneficial?

Within my desired concentration of radiation physics, mammograms require a very small spatial resolution, or the ability to distinguish two separate structures from each other, to adequately detect microcalcifications, also known as calcium salt deposits (that are considered robust markers for breast cancer), within the breast that can often be indistinguishable from normal breast tissue. A portable (and removable) low-dose MPG interferometry system for diagnosis produces images recovered from x-ray absorption as well as from phase-stepping, a part of phase-contrast imaging which is just using the information concerning how an x-ray beam shifts, or changes phase, when it passes through a sample. By using a phase stepping technique of the MPG, we acquire phase-contrast images based on x-ray phase shift and scatter (dark-field) all within the same scan without increasing the dose to the patient. Therefore, this x-ray interferometry system has the potential to yield higher detection sensitivity and specificity than conventional mammography or breast computed tomogra-phy (BCT), a system that uses the same techniques as a traditional CT machine like I explained before, but now just to recreate a 3-D image of the breast tissue. Eventually, this low-dose MPG interferometry system could be implemented into a multi-contrast BCT system in the clinic after continued testing and addressing of any critical issues.

Can you describe the reality of being in physics compared to the stereotypes of physicists?

Physicists are usually depicted as a white man with wild hair in a lab coat, tirelessly trying to solve a long, drawn-out equation on a chalk board. Physicists come in all shapes and sizes, within an incredible number of different fields and aren't just limited to solving theoretical problems but experimental ones too. Physicists can be female also.

What do you think it means to be part of an organization like the National Society of Black Physicists?

I think being a part of NSBP is extremely important. Per a 2020 Forbes statistic, African Americans only account for ~3% representation in the field of physics. This is extremely low due to a multitude of reasons that can be fixed and extinguished by promoting the professional well-being of students and physicists within the international scientific community and within society at large. To be able to be apart of that movement alone is invigorating.

What is your role in the organization?

I am an active member of the NSBP Student Council. I am also the chair of the LGBTQIA+ Committee and a member of the Women in Physics Committee. Being a part of NSBP's student council as well as the committees has been extremely rewarding. I enjoy the connections I get to make by meeting other young black physicists as well as ones that have ripened into a long career. I got the experience of setting up and working a professional conference, proposing ideas to elicit change for our small community we have in the field of physics, and representing people who go through similar experiences as me during our careers and in life.

Featured Stories

What kept you motivated while pursuing your degree?

My family. One of the many reasons that I pursued a medical physics master's degree was because my family has unfortunately been riddled with deaths due to cancer. Every time I get down or feel defeated over something, I think about how I can provide the same love and adequate care for someone else's family member during their lowest points in their lives or even in their last days. Essentially, me completing my degree is not only life changing for myself, but potentially for thousands of other lives I encounter during my career.

Do you have words of advice for upcoming or current students?

Don't ever give up. A career within the fields of Physics and Astronomy can be quite challenging at times but never impossible. If you are a student within the department, there is a reason you are here, so don't lose sight of that. You BELONG here. Continue to surround yourself with others of the same goal as you and support each other throughout your beautiful journeys through this field.

Hobbies?

Coming from playing Division-1 Women's Basketball, my main hobby is exercising. I love weightlifting and going for a good jog in the mornings. If I'm not doing that, I enjoy reading a good Stephen King novel, fishing, or going on a foodie run somewhere with my girlfriend.

Any graduation plans?

I plan on taking on a 2-year, Medical Physics Residency Program that emphasizes clinical work within oncology and radiotherapy.

Dream career path or profession?

My dream career path after graduate school would be to start in a medical physics residency program back in my home state of Texas. I wish hopefully to then accept a full medical physicist position within an oncology department, pursuing certain specializations in Gamma Knife and SRS modalities.

Featured Stories

Bella Bowman Foundation Teams Up with LSU on Pediatric Cancer Research

Mimi LaValle

On New Year's Day 2011, seven-year-old Bella Bowman, from Baton Rouge, was diagnosed with an ependymoma brain tumor, which resulted from a rare side effect from proton radiation treatment she received.

Bella passed away on December 23, 2011 from the brain stem necrosis. This prompted Bella's parents, Trey and Kim Bowman, to establish the Bella Bowman Foundation to support other families dealing with the struggles of having a child diagnosed with brain cancer.

One of the foundation's pillars of philanthropy is to further pediatric cancer research, so the Bella Bowman Foundation eventually teamed up with researchers at Louisiana State University to improve outcomes for children with cancer.

Bella Bowman - photo credit: Trey Bowman

Today, on Bella's birthday, the Bella Bowman Foundation presents a $75,000 pledge to the LSU-Mary Bird Perkins Cancer Center Dr. Charles M. Smith Medical and Health Physics Program to support a portion of the next phase of a research study to understand rare but potentially fatal side effects following cancer therapy, including radiation necrosis—the death of healthy tissues. This comes following the recent announcement of a $7.8 million estate gift from the late Dr. Charles M. Smith of Sulphur, La., to advance cancer treatment through a longstanding partnership with LSU and Mary Bird Perkins Cancer Center that began in 1980.

"Our continued support towards radiation necrosis research is a passionate topic for the Bella Bowman Foundation," said Trey Bowman. "Part of our donation will have an impact on LSU student researchers with funding needed to support their research and further their careers and passion to spearhead the fight against pediatric cancer."

Led by Professor Wayne Newhauser, LSU's Dr. Charles M. Smith Chair in Medical Physics and director of the LSU-Mary Bird Perkins Cancer Center Dr. Charles M. Smith Medical and Health Physics Program, the LSU research team seeks to better understand the biophysical processes that can lead to a rare but potentially fatal side effect of radiation therapy.

"Radiation necrosis is a difficult problem to study in patients for many reasons," said Newhauser. "Suffice it to say, we need better research models so that we can accelerate the pace of key research questions. To that end, the project will focus on computation simulations of radiation injury of the brain.

Featured Stories

For Newhauser, finding methods that limit collateral health damage to patients post-medical treatments has been a driving force in his scientific career.

"We're always trying to be aggressive in terms of treating the cancer but being conservative and gentle on the patient, so they don't have a lot of serious consequences from the treatment, said Newhauser. "Everybody loves talking about the war on cancer, but few are keen to talk about the collateral damage from friendly fire, so most of my career has been devoted to trying to reduce the harmful effects in healthy tissues."

Lydia J. Wilson, 2019 LSU PhD alumna, was a part of Newhauser's research group and is advancing her career in the Department of Radiation Oncology at St. Jude's Children's Research Hospital in Memphis, TN.

"I chose to pursue my PhD at LSU specifically to work with Wayne Newhauser because of our shared drive to improve the lives of children diagnosed with cancer," said Wilson." While that goal has been clear to me since high school, meeting the Bowmans and learning about Bella's story has specifically driven every step I have taken since. Their story provided me with a concrete problem that I, as a physicist, have the tools to solve. Bella drove me to not only pursue a career in research, but postdoctoral training and a permanent position as a faculty member at St. Jude Children's Research Hospital. I see her in every patient whose treatment I work to improve, and the Bowmans in every parent I pass in the halls.

"Watching the progression of Lydia's career enlightens me that Bella's story has had a real impact on these LSU students conducting research," said Bowman. "We are excited to support fundamental research that could lead to a breakthrough. Research laboratories working on this topic are few and far between, so we are doubly excited that this research is taking place right here in our home community."

"The longer-term ultimate goal is to provide cancer care specialists with tools to support clinical decision making, a complex task in personalized radiotherapy treatments for children," said Newhauser. "We are grateful for the vision and support from the Bella Bowman Foundation. Bella's story is an inspiration for us to work together to solve this rare but serious side effect."

The partnership between the Bella Bowman Foundation and the LSU Medical Physics program began in 2013 with a seed grant of $22,000, followed by a $75,000 gift in 2014 in support of research to understand the factors that contribute to radiation injuries to the brain from proton radiotherapy and develop diagnostic and therapeutic approaches to reduce the severity of radiation necrosis, and ultimately eliminate occurrences of the rare side effect. Today's pledge will provide an additional three-year, $75,000 of funding to the LSU-Mary Bird Perkins Cancer Center Dr. Charles M. Smith Medical and Health Physics Program.

Featured Stories

The Bella Bowman Foundation, founded in 2012, aims to create and support research initiatives for pediatric brain cancer, fund educational opportunities and offer non-medical comfort care to children diagnosed with cancer and the families who care for them. The Bella Bowman Foundation has a unique ability to address emerging challenges that a family faces following a child's diagnosis of cancer. Please visit www.bellabowman.org for more information.

LSU-Mary Bird Perkins Cancer Center Dr. Charles M. Smith Medical and Health Physics Program is a nationally recognized leading program in medical physics education, and the only such program in the state of Louisiana. Mary Bird Perkins is a leading provider of cancer care in southern Louisiana.

Featured Stories

NASA Supports LSU Physicist's Work to Advance Human Space Exploration

LSU Assistant Professor Jeffery Chancellor's research looks to help answer questions about astronaut health and performance during future long-duration missions beyond low-Earth orbit.

Mimi LaValle, External Relations Manager

A low Earth orbit (LEO) is, as the name suggests, an orbit that is relatively close to Earth's surface. It is normally at an altitude of less than 1000 km but could be as low as 160 km above Earth – which is low compared to other orbits, but still very far above Earth's surface. The orbit of the International Space Station, as well as the majority of satellites have been in low-Earth orbit.

With $1.8 million in new funding from NASA's Human Research Program, Chancellor now joins a group of scientists who are investigating biological, physiological, and behavioral adaptations to spaceflight. The 21 selected projects will contribute to NASA's long-term plans, which include crewed missions to the Moon and Mars.

Chancellor's proposal "Integration of in-silico and in-vivo models for determining preclinical indicators and/or integrated biomarkers of radiation-induced vascular dysfunction," is focused on ways to help protect astronaut's cardiovascular health.

"We look to develop and validate a novel ground-based model to more accurately predict short and long-term degenerative tissue effects of the space radiation environment and its health risks to astronauts, with an initial focus on the cardiovascular system," Chancellor said. "For this purpose, we first propose the use of a novel radiation moderator block that we believe generates an organ radiation dose distribution that more closely replicates that encountered by humans in deep space vehicles."

Chancellor's Space Radiation Transport & Applied Nuclear (SPARTAN) physics laboratory will conduct most of the research at LSU.

"We will also be exposing our models to a simulated cosmic ray spectrum at the NASA Space Radiation Laboratory located at Brookhaven National Lab in Brookhaven, NY," Chancellor said.

NASA's Human Research Program works to address the practical problems of space-flight that impact astronaut health, and its research may provide knowledge and technologies that could improve human health and performance during space exploration and aid the development of potential countermeasures for problems experienced during space travel. The organization's goal is to help astronauts complete their challenging missions successfully and preserve their long-term health.

NASA has selected 21 proposals from a total of 19 institutions in 12 states, and the projects will receive about $19.3 million over a one-to-five-year period. Science and technology experts from academia, government, and industry reviewed a total of 109 proposals received in response to NASA's 2019 Human Exploration Research Opportunities Appendices C and D.

The complete list of selected proposals, principal investigators, and organizations can be found at:

https://www.nasa.gov/feature/nasa-selects-21-research-proposals-to-advance-human-space-exploration

Medical & Health Physics Program in the News

Atlantis Industries aims to accelerate off-world technology breakthroughs

BATON ROUGE – The space between Earth and the moon is estimated to offer a $10 trillion industry opportunity. LSU Department of Physics & Astronomy Assistant Professor Jeffery Chancellor has launched a new start-up company, Atlantis Industries, to join the 21st century space race. Chancellor is a scientist and expert consultant on radiation effects for manned spaceflight and the aerospace industry. Prior to coming to LSU, he briefed NASA astronaut crews on radiation health risks associated with their missions as a senior research engineer at NASA's Johnson Space Center. At LSU, he and his team of students are advancing space radiation detection and protection for human space travel and space vehicle hardware systems. They have developed three new technologies at LSU that will now be available for commercial and governmental use through Atlantis Industries.

"At Atlantis Industries, we aim to accelerate off-world technology breakthroughs that drive the cislunar and space economy."

Jeffery Chancellor, *LSU Department of Physics & Astronomy assistant professor and Atlantis Industries founder*

The company leverages artificial intelligence, or AI, and machine learning in its signature solution, PHALANX AI, which helps design, build and deliver safe satellites and space infrastructure. PHALANX AI performs submicron-scale radiation particle modeling and analysis to inform and validate optimal protection schemes for using state-of-the art microelectronics and electrical, electronic and electromechanical components in space.

REFORGE is a model-driven high energy radiation test support to validate advanced material shielding to mitigate radiation hazards on sensitive electronics, components or humans in space.

TIGER EYE is a small, lightweight, low power radiation sensor developed and tested at LSU. The radiation device is scheduled to be part of an upcoming lunar mission to collect new information about radiation on the moon.

With support from the LSU Office of Innovation & Ecosystem Development and the Louisiana Small Business Development Center, or LSBDC, at LSU, Atlantis Industries recently won a federal $750,000 Small Business Innovation Research Phase II award from Space Command, which will grow the company from two to seven people.

"The LSBDC at LSU works with technology companies across the state, supporting small business owners and entrepreneurs such as Dr. Chancellor. We provide the business acumen, strategy and the essential tools to help start-up companies with innovative technology, like Atlantis Industries, succeed and become industry changers," said Adam McCloskey, director of the LSBDC at LSU.

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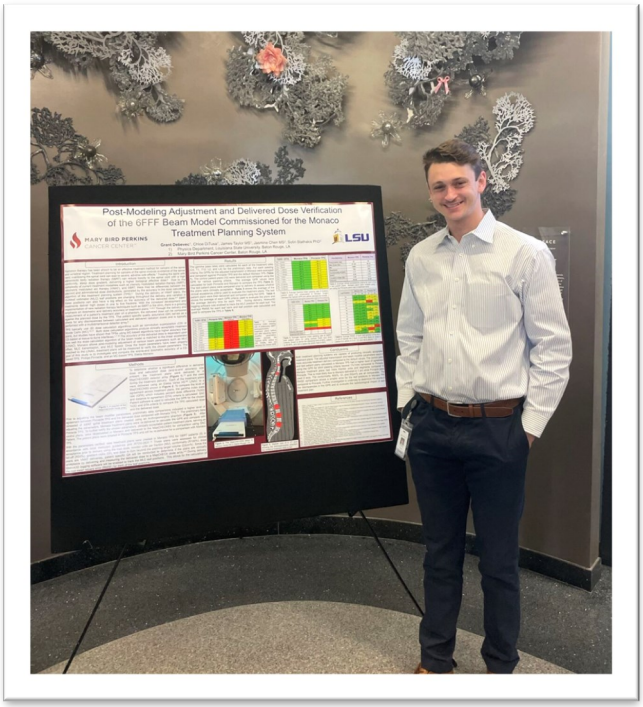
Mary Bird Perkins Hosts a Night of Innovation to Highlight Advances in Cancer Care

Mimi LaValle, External Relationships Manager

Mary Bird Perkins hosted A Night of Innovation to highlight its significant advancements in cancer care. During the event, attendees learned more about the Cancer Center's progress bringing cutting-edge technologies to our patients, including Adaptive Radiation Therapy, new MR-imaging and the transformative use of Artificial Intelligence. The Elekta Unity MR-LINAC, the cornerstone of Adaptive Radiation Therapy, was viewed by community members for the first time. This breakthrough technology was made possible by the Art Favre family, community donors, and an investment by Mary Bird Perkins. We are the sole program in Louisiana and one of the few in the country offering this level of precision medicine technology for some of the most difficult to reach cancers.

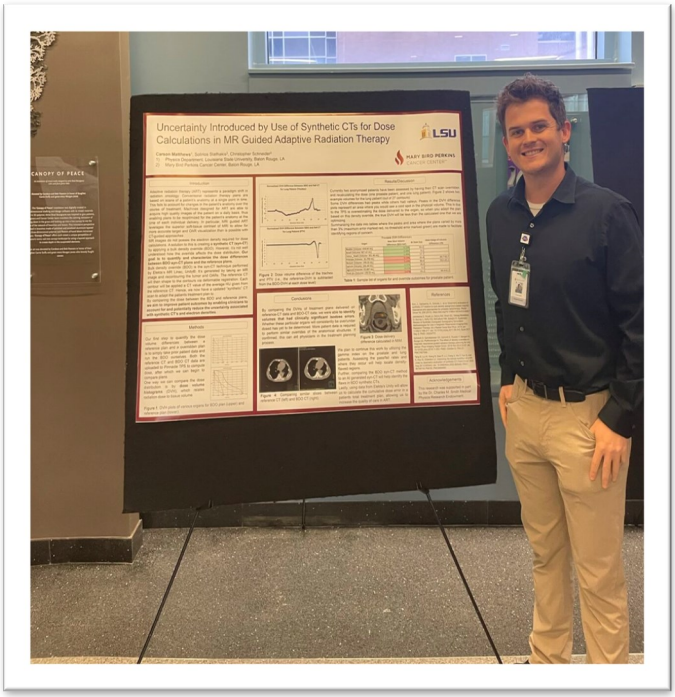
Medical & Health Physics Program in the News

LSU Students Present Their Research at Mary Bird Perkins Cancer Center

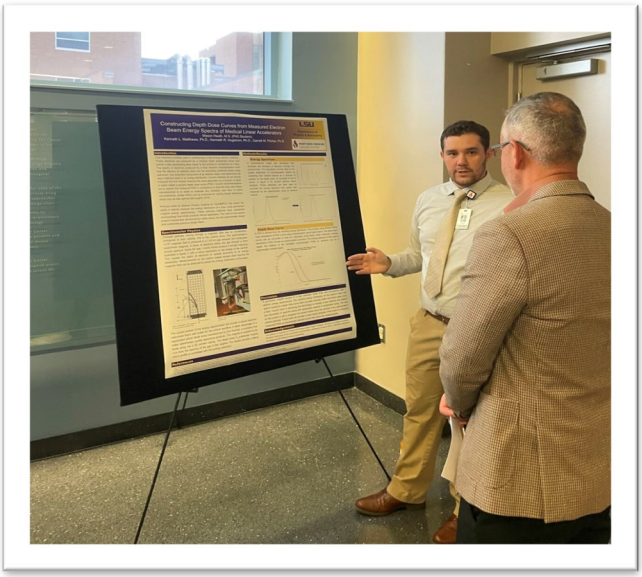


Grant Debevec

Carson Matthews

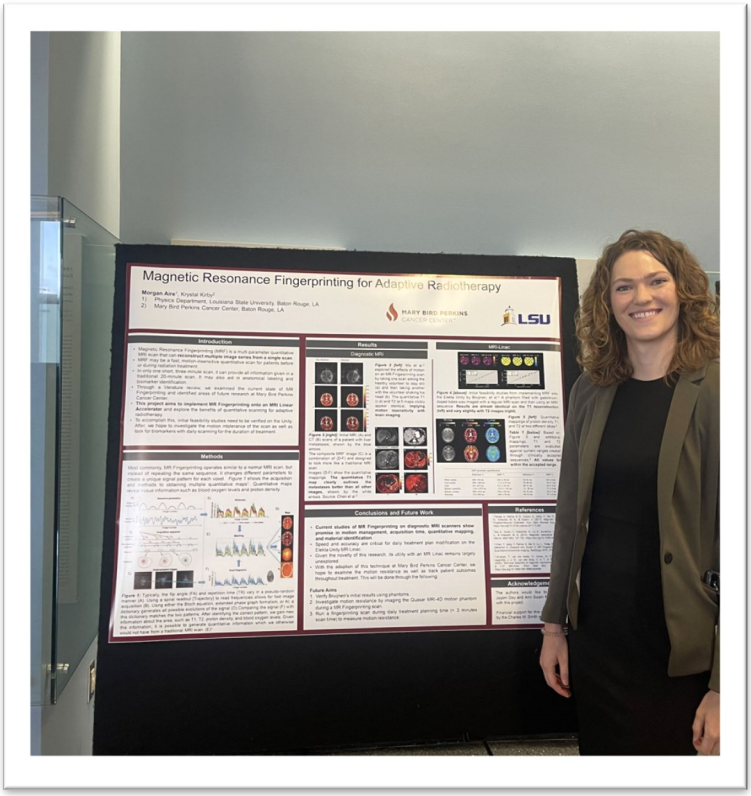


Mason Heath



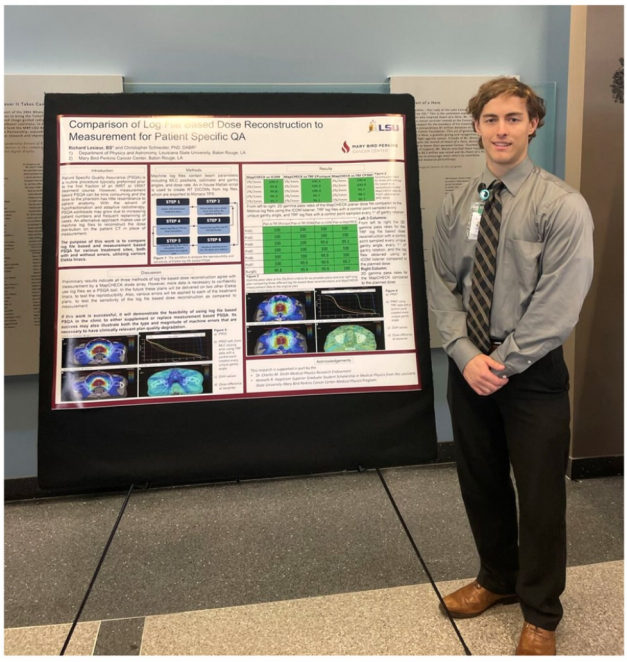
Medical & Health Physics Program in the News

LSU Students Present Their Research at Mary Bird Perkins Cancer Center



Morgan Aire

Richard Lesieur



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- Fox, T., Chansangavej, S., Kirby, K., Cho, D., Rodriguez, R., Gare, G., Collins, G., Galeotti, J., Krishnan, A., deBoisblanc, B., "Effects of Lung Ultrasound Technique and Pleural Line Depth on In Vitro and In Vivo Measurements of Pleural Line Thickness." Ultrasound Med Biol. 2023;S0301-5629(23) 00311-3. doi:10.1016/j.ultrasmedbio.2023.09.010

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- Newhauser W.D., Williams, J. P., Noska, M.A., Bluth, E.I., Townsend, L.W., Tol-machev, S.Y., & Dewji, S.A. (2023). In support of ICRP's call to action to strengthen expertise in radiological protection worldwide. Radiation and Environmental Biophysics, 62(3), 287-288.

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- Katelyn Marie Heath1, John Dooley1, Ethan Steele, MD, MS1, Matthew Whitmill, MD1, Xuguang Scott Chen1, Sotirios Stathakis, PhD2, Bhishamjit S Chera, MD3, Shiva K. Das, PhD4 and Panayiotis Mavroidis, PhD1, Use of a Center-to-Surface Distance Metric to Identify Cases That May Need Replanning Due to Significant Anatomical Changes during Head & Neck Radiotherapy2023(Medical Physics).

- P Mavroidis, SA Brundage, RM Morse, BA Radcliffe, A Malakapalli, J Williamson, Sotirios Stathakis, DL Casey, LB. Marks, E Jones, K Pearlstein, GP Gupta, and SK. Das. NTCP Modelling of Dosimetric and Follow-up Data for Skin Reactions after Breast Radiation Therapy 2023 (Medical Physics)

- A Tzikas, E Lavdas, D Kehagias, S Stathakis, and P Mavroidis. Toolkit for Derivation and Validation of Dose-Response Relations Using Individual Patient Dosimetric and Outcome Data. 2023(Medical Physics)

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- Meyer, H., Dey, J. (2023, July 23 – 27). A Mathematical Model of Talbot-Lau, Dual Phase Grating, and Modulated Phase Grating Interferometers [Oral Presentation]. 2023 AAPM Annual Meeting, Houston, TX, United States. https://aapm.confex.com/aapm/2023am/meetingapp.cgi/Paper/5593

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- G Debevec, MJ Taylor, C Poduska, J Chen, JD. Fontenot, P Mavroidis, and S Stathakis. Single Fraction Spine SBRT Pre-Treatment and Post-Treatment Dose Verification Comparison between Phillips Pinnacle and Elektra Monaco Using Mobius3D ,2023 (Medical Physics)

- G Debevec, MJ Taylor, C Poduska, J Chen, JD. Fontenot, P Mavroidis, and S Stathakis. Single Fraction Spine SBRT Delivered Dose Comparison between Phillips Pinnacle and Elektra Monaco Using a MapCHECK3 Diode Array. 2023 (Medical Physics)

- A Husain, J Chen, V Shivers, P Mavroidis, and S Stathakis. Head and Neck Radiation Therapy Plan Metrics Can be Used to Predict Weight Loss, 2023 (Medical Physics)

- S A. Brundage, RM Morse, BA Radcliffe, A Malakapalli, J Williamson, S Stathakis, DL Casey, LB. Marks, E Jones, K Pearlstein, GP Gupta, SK. Das, and P Mavroidis, PhD1, Correlations between Dosimetric Indices and Follow-up Data for Skin Reactions after Breast Radiation Therapy. 2023 (Medical Physics)

- Gwizdala KL, Bazzano LA, Newton, Jr. RL, Carmichael OT. Race and sex differences in the association between lifespan glycemic status and midlife cognitive function: The Bogalusa Heart Study. Frontiers in Public Health, section Aging and Public Health. In press. 2023

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- Carmichael O. The Role of fMRI in Drug Development: An Update. Adv Neurobiol. 2023;30:299-333. PMID: 36928856.

- Vartanian O, Lam TK, Mandel DR, Ann Saint S, Navarrete G, Carmichael OT, Murray K, Pillai SR, Shankapal P, Caldwell J, Berryman CE, Karl JP, Harris M, Rood JC, Pasiakos SM, Rice E, Duncan M, Lieberman HR. Effect of exogenous testosterone in the context of energy deficit on risky choice: Behavioural and neural evidence from males. Biol Psychol. 2023;176:108468. PMID: 36481265

Seminars and Presentations

- Chancellor, Jeffery, LSU Health Science Center, Shreveport, LA, Colloquia, Dept. of Pharmacology, Toxicology and Neuroscience, "NSFW: A Look Behind the Curtain at Computational Space Radiobiology Mitigating the Dirty Secrets of Space Radiation Research" May. 2022

- Chancellor, Jeffery, University of Pennsylvania, Philadelphia, PA, Colloquia, Medical Physics Seminar "Everything You Wanted to Know About Space Radiation But Were Afraid to Ask" April. 2022

- Chancellor, Jeffery, UTMB School of Medicine, University of Texas Medical Branch Aerospace Medicine Short Course, Galveston, TX. Jul. 2022, "NSFW: A Look Behind the Curtain at the Dirty Secrets of Space Radiation Risk"

- Kim, Y.-H; Yiacoumi, S.; Tsouris, C. 2022. "Influence of Radioactive Decay on Atmospheric Transport of Radioactive Particles." 2022 International MACCS User Group (IMUG)/MACCS Workshop, Washington, DC.

- Kirby, Krystal, June 7, 2022. "Journal paper review: Air gap technique is preferred for axiolateral hip imaging." AAPM imaging residency multi-institutional journal club.

- Kirby, Krystal, June 1, 2022. "Digital radiography – post-processing." Mayo Clinic Radiology Residency noon talk.

- Kirby, Krystal, May 17, 2022. "Projects in Digital Radiography at Mayo Clinic." Medical Physics Division meeting presentation.

- Kirby, Krystal, April 21, 2022. "Shielding digital radiography rooms and geometric distortion in MRI." Invited talk for the American College of Radiography

Seminars and Presentations

- Meyer, H., Dey, J. (2023, July 23 – 27). A Mathematical Model of Talbot-Lau, Dual Phase Grating, and Modulated Phase Grating Interferometers〔Oral Presentation〕. 65th Annual Meeting & Exhibition of the AAPM, Houston, TX, 2023

- Won, Y.; Kim, Y.-H; 2022. "Ion Selectivity of Oxidized Carbon Electrodes in Capacitive Deionization." 2022 Southwest Regional Meeting of the ACS, Baton Rouge, LA.

- Won, Y.; Kim, Y.-H; 2022. "Effects of Carbon Oxidation on Capacitive Deionization." 2022 Southwest Regional Meeting of the ACS, Baton Rouge, LA.
- Kim, Y.-H; 2022. "Charging of Radioactive Cesium Particles in Human Respiratory Systems." 2022 Fall Conference of the Korean Society of Radiology, South Korea.

- Won, Y.; Kim, Y.-H; 2022. "Removal of Cesium and Strontium Using Capaci-tive Deionization." 2022 Fall Conference of the Korean Society of Radiolo-gy, South Korea.

- Bender, M.; Kim, Y.-H; 2022. "The Effects of Climate Change on Radon Exposure in Permafrost Areas." 2022 Fall Conference of the Korean Society of Radiology, South Korea.

- Kim, Y.-H; Yiacoumi, S.; Tsouris, C. 2022. "Development of Radioactive Aerosol Microphysical Model." 2022 Spring Conference of Korean Society of Ra-diology, South Korea.

Seminars and Presentations

- Chancellor, Jeffery, Southeastern Louisiana University, Hammond, LA, Colloquia, Dept. of Physics "Ground-Based Space Radiation Analogs for Accurate Assessment of Human Health Outcomes" March. 2022
- Chancellor, Jeffery, NASA Human Research Program, 2022 Investigators Workshop "Accurate Prediction of Dose Topology for Assessing Human Health Outcomes Following exposures to the Space Radiation Environment" Feb. 2022
- Chancellor, Jeffery, Louisiana State University, College of Science, Dean's Reception, "Research in the SpaRTAN Physics Laboratory" Jan. 2022
- Chancellor, Jeffery, UTMB School of Medicine, University of Texas Medical Branch Aerospace Medicine Short Course, Galveston, TX. Jul. 2022, "NSFW: A Look Behind the Curtain at the Dirty Secrets of Space Radiation Risk"

2023

- Chancellor, Jeffery, UTMB School of Medicine, University of Texas Medical Branch Aerospace Medicine Short Course, Galveston, TX. Jul. 2023, "NSFW: A Look Behind the Curtain at the Dirty Secrets of Space Radiation Risk"
- Chancellor, Jeffery, Johns Hopkins University, Baltimore, MD, Space Life Sciences Symposium, "Space Radiation: Still a Problem?" May. 2023
- Chancellor, Jeffery, Louisiana Nuclear Society, Baton Rouge, La, Continuing Professional Development Seminar, "Shooting For the Stars- A Look Behind the Curtain on How the SpaRTAN Physics Lab is Solving the Dirty Secrets of Space Radiation" Apr. 2023

Seminars and Presentations

- Chancellor, Jeffery, University of Texas Medical Branch, Galveston, Grand Rounds, Aerospace Medicine, "Navigating the Space Radiation Health Risks in the Commercial Spaceflight Era" March. 2023

- Kirby, Krystal, June 26, 2023. "MRI in the Radiation Oncology Environment." Siemens Healthineers MR in RT webinar.

- Kirby, Krystal, October 28, 2023. "Residency Q&A." Invited panel for Duke Alumni monthly journal club.

- Kirby, Krystal, 2023 AAPM Annual Meeting, Houston, TX, United States. https://aapm.confex.com/aapm/2023am/meetingapp.cgi/Paper/5593

- Pitcher, G.M, Florida AAPM Fall Meeting - Electron Intensity Modulation and its Potential for FLASH Therapy – September 2023

- P. Diehl. Simulating Stellar Merger using HPX/Kokkos on A64FX on Super computer Fugaku. The 24th IEEE International Workshop on Parallel and Distributed Scientific and Engineering Computing (PDSEC 2023),15.05-19.05 2023, St. Petersburg, USA.

- P. Diehl. Recent developments in HPX and Octo-Tiger. Physics & Astronomy Colloquium, 23.1 2023, Baton Rouge, USA.