

The American Association *of* Physicists in Medicine



focus on
our future

2017

ANNUAL REPORT





AAPM

Education & Research Fund Annual Report 2017

The AAPM Education & Research (E&R) Fund is a collection of funds that support the development of our vital medical physics profession by funding strategic education and research programs such as seed grants for early-career researchers, matching support for clinical residency programs, and fellowships for PhD students. Over 100 such grants, residencies, and fellowships have been awarded since the inception of the Fund over 20 years ago. Also, the Fund is used to attract undergraduates to medical physics and to promote diversity by supporting Summer Undergraduate Fellowships and the Diversity Recruitment Through Education and Mentoring (DREAM) Program.

In 2017, the AAPM Education & Research Fund supported more than \$400,000 in programs, whose budgets were funded by gifts from AAPM members and our sister societies and by AAPM revenues. As always, AAPM is extremely grateful for these generous gifts.

The following awards were funded through the E&R Fund in 2017:

- **Research Seed Grants**

Science Council, through its Research Committee, was funded \$75,000 to support three research seed grants for new researchers in the field.

- **Imaging Physics Residency Program Grants**

In 2013, AAPM and the Radiological Society of North America (RSNA) partnered to support eight imaging physics residency programs, either diagnostic or nuclear medicine, with the goal of their becoming Commission on Accreditation of Medical Physics Educational Programs (CAMPEP) accredited prior to resident graduations. The AAPM and RSNA each contributed \$560,000, which funded eight \$140,000 program grants; each institution received \$35,000 per year for four years, which the institution matched. With the expenditure of \$105,000 in 2017, this program was completed.

- **Nuclear Medicine Physics Residency Program Grants**

In 2016, AAPM and the Education and Research Foundation (ERF) for Nuclear Medicine and Molecular Imaging-Society of Nuclear Medicine and Molecular Imaging (SNMMI) partnered to support two imaging physics in nuclear medicine residency programs with the intent that the awardee institutions will continue to fully support the programs and that they become CAMPEP accredited prior to graduation

of the first resident. AAPM and ERF-SNMMI each contributed \$70,000, which funded two \$70,000 program grants, and each institution received \$35,000 per year for two years, which the institutions matched. With the expenditure of \$70,000 in 2017, this program was completed.

- **Graduate Fellowships in Medical Physics**

Earnings from the AAPM Education & Research Fund funded \$36,000 to support the first of two years for the fellow selected for the 2017-2019 RSNA/AAPM Graduate Fellowship in Medical Physics and the second of two years for the fellow selected for the 2016-2018 AAPM Graduate Fellowship in Medical Physics.

- **Summer Undergraduate and DREAM Fellowships**

Education Council, through its Education & Training of Medical Physicists Committee (ETC), was funded \$35,000 to support seven undergraduate fellowships in the Summer Undergraduate Fellowship Program (SUFF) and another \$40,000 to support eight undergraduate fellowships in the Diversity Recruitment Through Education and Mentoring (DREAM) Program.

- **Presentation and Publication Awards**

Multiple named, endowed E&R Funds supported awards given for the best abstracts and presentations at our Annual Meeting, for the best papers published in AAPM's journal *Medical Physics*, and for distinguished lectureships at AAPM Meetings. These include (1) the Jack Fowler and Jack Krohmer Junior Investigator Awards, (2) the John R. Cameron Young Investigator Awards, (3) the Farrington Daniels Award, (4) the Moses and Sylvia Greenfield Award, (5) the Anne and Donald Herbert Distinguished Lectureship in Modern Statistical Modeling, (6) the Carson/Zagzebski Distinguished Lecture on Medical Ultrasound, and (7) the Award for Innovation in Medical Physics and Education.

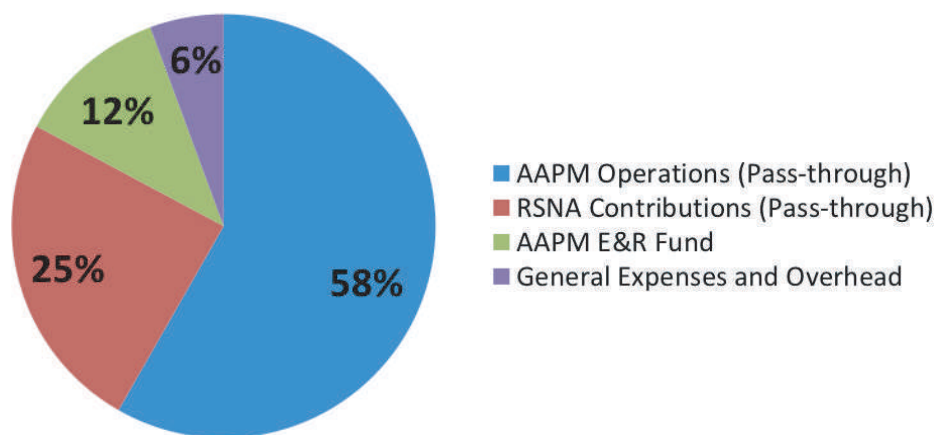
- **Cultivation Awards**

Awards aimed at cultivating junior medical physics researchers and providing medical physics education included (1) five early-stage researcher awards from the AAPM Science Council Associates Mentorship Program, (2) five AAPM Expanding Horizons Travel Grants, (3) five AAPM Best Awards, and (4) six AAPM Summer School Scholarships.

The benevolence of our members and sister societies is greatly appreciated, without which these programs and awards would not be possible. AAPM reports in the following pages details of these programs, 2017 award recipients, and testimonials, which demonstrate the enormous value the recipients place on the value of this support. As you read the report, visualize how

these programs impact our medical physics profession by attracting bright, young people into our profession, encouraging development of quality graduate and resident medical physics education programs, rewarding outstanding achievement, and helping develop outstanding research scientists, all resulting from contributions to our AAPM Education & Research Fund.

2017 AAPM E&R Fund Expenses Budget
Funding Sources for Awards
Total = \$427,872



Distribution of sources that funded 2017 E&R programs. Overhead costs are charged to the E&R Fund.

2017 REVIEW

Grants & Fellowships

The Research Seed Funding Grant

Three \$25,000 grants were awarded to provide funds to develop exciting investigator-initiated concepts, which will hopefully lead to successful longer term project funding from the NIH or equivalent funding sources. Funding for the 12-month grant period began July 2017. Research results are submitted for presentation at future AAPM meetings.

(See AAPM website for more details, including eligibility requirements)

Sponsored by the AAPM Science Council through the AAPM Education & Research Fund



Jiming Zhang, PhD

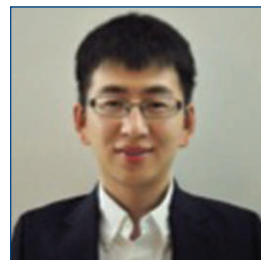
CHI St. Luke's Health–Baylor
St. Luke's Medical Center
Houston

"Intra-Treatment Monitoring of Magnetic Resonance Imaging Guided High Intensity Focused Ultrasound Surgery (MR-HIFU) using Acoustic Radiation Force Imaging to Improve Outcomes"

For patients undergoing high-intensity focused ultrasound (HIFU) surgery, a common problem is that there can be a substantial mismatch between tissue volume ablated (based on thermal dose delivered) during the treatment to the eventual necrosis volume that is observed after treatment. My prior research work identified a potential source of this mismatch arises from the perfusion response of the tissue to heating, and underscored the need for developing non-contrast MRI based biomarkers to monitor the progress of HIFU ablation during surgery.

The seed grant from AAPM helped me to propose and test how three different MR imaging based biomarkers – changes in tissue stiffness, tissue transverse relaxation rate, and tissue diffusivity due to thermal ablation – can help evaluate tissue response to thermal ablation during HIFU surgery without using contrast. Furthermore, these MRI based biomarkers can be measured by using existing MR guided HIFU device without the need for additional hardware and software. The funding has helped me complete the implementation of these methods and test these methods in phantoms and in ex vivo tissue (completion of the phase 1 of the proposal), and these results have been submitted to the 2018 Annual

Meeting. We are in the process of getting approval for animal studies for in vivo evaluation. I am excited about pursuing this work that can provide an objective, non-invasive marker for evaluating patient specific response to thermal ablation during HIFU surgery, and may have broader applications for all thermal ablative procedures. I am hopeful that the preliminary data obtained using this seed funding proposal would form the basis of a larger NIH application which would help to establish me as an independent researcher in this exciting field.



Hao Zhang, PhD

Johns Hopkins University
Biomedical Engineering

"Ultra-Low-Dose Lung Nodule CT Surveillance Using Prior-Image-Based Reconstruction"

With the AAPM Seed Funding Grant I am able to investigate an exciting idea to prospectively predict prior image regularization strength for prior-image-based reconstruction (PIBR) methods. This addresses the major challenge of PIBR and helps people to understand and control PIBR performance. The extensive experimental results from this project provide strong evidence of the efficacy of our proposed framework, which also paves the way for clinical translation of PIBR in CT-based lung nodule surveillance to substantially reduce the radiation exposure to patients. I sincerely appreciate the grant to support this exciting project and will share our studies in the 2018 AAPM Annual Meeting.



Don Vernekohl, PhD

University of Stanford
Radiation Oncology

"Enhanced X-ray Fluorescence Instrumentation for Fast High-Resolution Imaging"

The AAPM Seed Funding Grant provided resources to conduct initial experiments with a polycapillary X-ray for XFCT imaging. The field of XFCT imaging experienced high interest in recent years as a concept of XFCT predicts manifold application in molecular imaging, cancer treatment, and radiation oncology. While several experiments have validated the theoretical performance of the modality in bench-top experiments, the field is currently preparing the first preclinical in-vivo measurements. The use of polycapillary X-ray optics has the potential of being the key solution to speed up acquisition times required for preclinical in-vivo imaging. The resources of the grant were used to acquire a polycapillary optic and a state-of-the-art silicon drift detector. The results of the experiments were used to prepare a K99 application, which is an NIH Career Transition Award.



AAPM/RSNA Imaging Physics Residency Grants

In 2013, AAPM and the Radiological Society of North America (RSNA) partnered to support eight imaging physics residency programs, either diagnostic or nuclear medicine, that previously had neither been supported by AAPM nor submitted an application to CAMPEP for accreditation. The intent was that the awardee institutions will continue to fully support the imaging physics residencies and that they become CAMPEP accredited prior to resident graduations. AAPM and RSNA each contributed \$560,000, which funded eight \$140,000 program grants; each institution received \$35,000 per year for four years. Each institution was expected to provide matching support, resulting in two years of full support for two residents.

Sponsored by the AAPM Board of Directors and RSNA through the AAPM Education & Research Fund

The AAPM/RSNA Imaging Physics Residency Grants have accomplished their purpose with all eight programs becoming CAMPEP accredited in Imaging Physics (table below). See AAPM Education & Research Fund Annual Reports 2015 and 2016 for individual resident reports and testimonials.

Year of Award	Institution	Program Director	Year of Initial Accreditation
2013	University of Alabama at Birmingham	Sharon L White, PhD	2016
2013	Memorial Sloan Kettering Cancer Center	Lawrence N Rothenberg, PhD	2016
2013	University of Wisconsin	Frank N Ranallo, PhD	2017
2014	Emory University	Jonathan A Nye, PhD	2014
2014	University of Chicago	Zheng Feng Lu, PhD	2014
2014	Duke University Medical Center	Ehsan Samei, PhD	2016
2014	University of Oklahoma Health Science Center	Jagadeesh R Sonnad, PhD	2016
2014	Indiana University School of Medicine	Yun Liang, PhD	2017

AAPM and ERF-SNMMI Residency Grants

AAPM and the Education and Research Foundation (ERF) for Nuclear Medicine and Molecular Imaging-Society of Nuclear Medicine and Molecular Imaging (SNMMI) partnered to support two imaging physics in nuclear medicine residency programs that have submitted an application to CAMPEP for accreditation or will submit one in a timely fashion. The intent was that the awardee institutions will continue to fully support the imaging physics in nuclear medicine residencies and that they become CAMPEP accredited prior to graduation of the first resident. AAPM and ERF-SNMMI each contributed \$70,000, which funded two \$70,000 program grants, and each institution received \$35,000 per year for two years, which the institutions matched. With the expenditure of \$70,000 in 2017, this program was completed.

Sponsored by the AAPM Board of Directors and ERF-SNMMI through the AAPM Education & Research Fund

These grant awards commenced in 2016 and information on the two residents was reported in the AAPM Education & Research Fund Annual Report 2016. The AAPM/ERF-SNMMI Residency Grants in Imaging Physics (Nuclear Medicine) are accomplishing their purpose with one of the programs having achieved CAMPEP accreditation in Nuclear Medicine Physics (table below).

Year of Award	Institution	Program Director	Year of Initial Accreditation
2016	Stony Brook University Medical Center	Terry M Button, PhD	2009*
2016	Henry Ford Health System	Beth A Harkess, PhD	2009

* CAMPEP accredited in Nuclear Medicine Physics Option.



Graduate Fellowships

The RSNA/AAPM Graduate Fellowship and AAPM Graduate Fellowship are awarded in alternating years. Each fellowship is awarded for the first two years of graduate study leading to a doctoral degree in Medical Physics (PhD or DMP). Both BSc and MS holders are eligible to apply. A stipend of \$13,000 per year, plus tuition support not exceeding \$5,000 per year, is assigned to the recipient.

*(See AAPM website for more details, including eligibility requirements)
Sponsored by the AAPM Education & Research Fund*

RSNA/AAPM Graduate Fellowship (2017-2019)



Qiyuan Hu
University of Chicago

Receiving the RSNA/AAPM Graduate Fellowship is a tremendous honor and I am truly grateful for the support it provides as I start my medical physics career. This year, I started my graduate study at The University of Chicago Medical Physics program and the fellowship has provided me with part of my stipend and tuition support. So far, I have been doing research rotations in different labs to learn about a variety of research topics and acquire diverse skillsets. This experience has been invaluable and has helped me gradually formulate a clear research interest and career direction. The support provided by the fellowship will go a long way in helping me advance in my medical physics career, and I look forward to more exciting experiences throughout this journey.

AAPM Graduate Fellowship (2016-2018)

Rebecca L Culcasi
Wayne State University

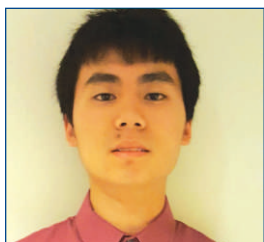
(see AAPM Education & Research Fund Annual Report 2016 for personal statement)

Summer Undergraduate Fellowship Program

The Summer Undergraduate Fellowship Program is a 10-week (40 hours per week) summer program designed to provide opportunities for undergraduate university students to gain experience in medical physics by performing research in a medical physics laboratory or assisting with clinical service at a clinical facility. The mentor and fellow determine the exact 10-week schedule (May-September). In this program, AAPM matches exceptional students with exceptional medical physicists, many who are faculty at leading research centers. Students participating in the program are placed into summer positions that are consistent with their interest. Selected for the program on a competitive basis, summer fellows receive a \$5,000 stipend from AAPM.

(See AAPM website for more details, including eligibility requirements)

Sponsored by the AAPM Education Council through the AAPM Education & Research Fund



Raymond Fang

Mentor:

Rao FH Khan, PhD

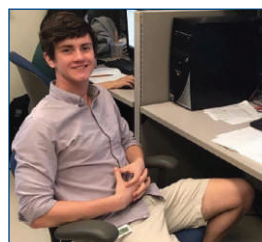
Washington University School
of Medicine

Department of Radiation
Oncology

The dosimetric impact of physical density variations on the commercial Eclipse™ electron Monte Carlo (eMC) algorithm and the import of tessellated CAD models into GEANT4 were investigated. The Eclipse™ eMC algorithm is used to calculate radiation dose from electron beam transport through patients. This Macro Monte Carlo algorithm transports particles through a patient CT volume based on pre-calculated probability density functions. Material assignment within the patient CT volume is dependent on a Hounsfield Unit (HU) to physical density conversion table. However, measured HU depends on factors such as CT machine, reconstruction algorithm and tube voltage. Thus, natural variations in the HU to physical density conversion table exist. Systematic literature review of HU measurements of the CIRS 062 phantom and Gammex Tissue Characterization Phantom was done to capture clinically relevant physical density variations and generate HU to physical density conversion calibrations. Radiation dose from electron beams was calculated using the reference curve in the Treatment Planning System (TPS) and HU to physical density calibrations found in literature. Statistically significant differences in dose distribution and 90% isodose volume were found when different HU to physical density calibrations were used by the TPS. However, 3D gamma index evaluation indicated that these differences in dose distributions

were not clinically significant in the Planning Target Volume at the 3% and 3mm level.

GEANT4 is a C++ based software that is capable of simulating the passage of electron and photon beams through matter using Monte Carlo schemes. The geometries of the components of the LINAC are complicated and often require CAD designs to represent the geometry accurately. The import of tessellated CAD designs into GEANT4 using the CADMesh library was evaluated. It was found that CAD geometries could be imported into GEANT4 and that the resulting Monte Carlo simulations generated realistic dose distributions. Dosimetrically relevant parameters of the resulting dose distributions were calculated and specific phenomena such as interleaf leakage could be evaluated.



Byron Grant

Mentor:

Maryellen L Giger, PhD

The University of Chicago

Department of Radiology/
Medical Physics

A deep convolutional neural network machine learning approach was investigated as a method of determining image quality in Thoracic CT images. A radiologist rating was given to 72 thoracic CT image cases, which each contained roughly 300 image slices. Using a support vector machine, features extracted from the deep neural network were compared with the case rating, and an area under the receiver operating curve was used to assess efficacy. This approach was compared with previous methods for quantifying CT image quality.



Reed Michael Kolany

Mentor:
Alistair K Templeton, PhD
Rush University Medical Center
Department of Radiation
Oncology

This past summer, as one of the 2017 AAPM Summer Undergraduate Fellows, was the most rewarding research experience I have had thus far in my academic career. I was fortunate enough to spend 10 weeks working alongside my mentor, Dr. Alistair Templeton, and the rest of the Department of Radiation Oncology at Rush University Medical Center in Chicago, IL. The project I worked on investigated the prophylactic nature of the incidental irradiation from stereotactic radiosurgery in the development of brain metastases. I learned how to read radiology reports for MRIs and navigate the treatment planning system Eclipse. The purpose of the project was to determine if the incidental irradiation from SRS did in fact have prophylactic effects, and if that was true, to determine a baseline dose which discourages the incidence of new metastases. I was able to present my results to the entire physics team in the department, I have started a paper intended to be submitted for publication, and I drafted an abstract to be submitted for the poster session at AAPM 2018. As a whole, the fellowship program confirmed my desire to pursue a career in medical physics and provided me with experience and professional connections needed when applying to graduate schools.



Timothy Patrick McMullen

Mentor:
Krishna Wijesooriya, PhD
University of Virginia Health
Systems
Radiation Oncology
Department

This summer, I worked on a clinical data analysis project with Prof. Krishna Wijesooriya. We specifically looked at treatment-related lymphopenia as it relates to radiation dose to blood-rich tissue in lung SBRT treatments. Following data analysis, I wrote a manuscript based on the results we observed. This manuscript was edited by Prof. Wijesooriya, Dr. James Lerner of the University of Virginia Department of Radiation Oncology, and Dr. Clayton Alonso, one of Dr. Lerner's residents. We are currently finalizing the manuscript for submission to a journal. Below is a slightly edited version of the abstract I wrote for our project:

Treatment related lymphopenia (TRL) is a side-effect of radiation therapy. Moderate to severe TRL decreases immunological function, causing suppression of immunoresponse to solid tumors as well as increased susceptibility to infection. Severity of TRL has been shown to correlate with inferior outcomes for patients with solid tumors of various tissues. Incidence of TRL among solid tumor patients has provided an impetus for the identification of lymphocyte-depleting factors. We have conducted statistical analysis of clinical data collected at the University of Virginia Medical Center for 94 solid lung tumor patients treated at our facility via Stereotactic Body Radiation Therapy (SBRT) between 2008 and 2016. For each patient, the maximum dose and the integral dose to vital anatomical structures were extracted from treatment plans created using Phillips Pinnacle³ software. This dose information was analyzed in conjunction with retrospective complete blood count (CBC) panels in an effort to identify significant correlations between tissue-specific doses and post-treatment acute lymphocyte depletion (ALD). We have identified significant positive correlations between ALD and dose to the great vessels as well as between ALD and dose to healthy lung tissue. Additional findings include that ALD is more strongly correlated with tissue-specific integral dose than with tissue-specific maximum dose in the tissues studied. Increased irradiation of healthy lung tissue and great vessel tissue is correlated with increased ALD. As such, an increased emphasis should be placed on avoiding significant irradiation of these tissues. Our results also indicate that tissue-specific integral dose is a superior predictor of ALD when compared with tissue-specific maximum dose.

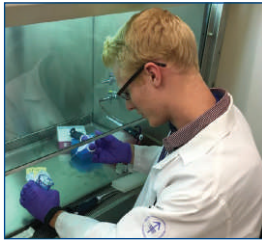
The AAPM SUF gave me an opportunity to work under a highly-supportive research advisor as well as to practice my science writing skills and gain a further understanding of how research is conducted in a clinical environment. The AAPM SUF has also facilitated my efforts to become a first-time published author in a peer-reviewed journal, and I hope all goes well with the manuscript I wrote this summer. Ultimately, this program provided me with a fantastic opportunity to develop as a scientist, and I intend to build on these experiences as I enter my senior year of college and begin to determine the next steps in my career.



Joseph G Scotto

Mentor:
Jan PO Schuemann, PhD
Massachusetts General Hospital
Department of Radiation
Oncology/Physics Division

To evaluate the impact of the DNA density on the induction of radiation damage, a chromatin rosette of specific densities was simulated in TOPAS-nBio. In addition, another DNA representations, plectonemic supercoiled DNA, was modeled utilizing harmonic knot parameterizations.



Daniel Seiter

Mentor:
Assen S Kirov, PhD
Memorial Sloan-Kettering
Cancer Center
Department of Medical Physics

This summer at Memorial Sloan Cancer Center in NYC has been incredible. Dr. Kirov is a kind, helpful, thoughtful advisor. He always respected my ideas and contributions. He not only made sure I felt welcome in his own department (Nuclear Medicine), but was also happy to introduce me to professionals in every specialty of medical physics and the research community at large. The professional connections I have made and the research experience I have gained will help me enormously in my career.

My summer project involved autoradiography of biopsies taken from radioactive gel. As the gel decayed, data points were taken once or twice per half-life. The response of the autoradiography methods, once plotted against the corresponding specific activity of the gel, creates a calibration curve. In clinical image guided biopsies of tumors, this calibration curve will be used to determine the specific activity of patient tissue based on the autoradiography response to the specimen.

On the side, I worked to install openGATE on a 60-processor computer. I was completely new to Linux, but with the guidance of my advisor managed to develop a working proficiency. With patience, we successfully compiled and installed GEANT4,

ROOT, and GATE's other complicated dependencies. GATE will be used to run advanced Monte Carlo simulations based on the geometry and physics of our autoradiography experiments, hopefully providing support for our observations and conclusions.



Mark Elliott Tracy

Mentor:
Clemens Grassberger, PhD
Massachusetts General
Hospital
Department of Radiation
Oncology/Physics Division

I worked in the Physics Division at Massachusetts General Hospital with Clemens Grassberger, PhD. It was a wonderful educational experience, but more importantly, the work excited me because it has the potential to improve outcomes for cancer patients. The goal of the project was to use machine learning models to predict outcomes for patients with medulloblastoma.

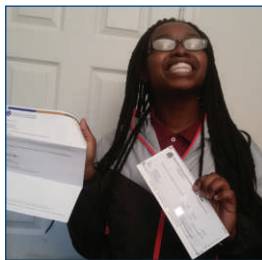
Current clinical practice is to classify patients as either standard or high risk according to a handful of criteria, including metastasis, patient age, tumor histology, and residual tumor size after surgery. I was able to show using data for 120 patients from two clinical studies that this clinical risk stratification was not a statistically significant predictor of patient outcomes. After mining data for informative features, I demonstrated that machine learning models are much more useful tools for identifying at-risk patients than clinical risk stratification. This work showed, in particular, that hematological toxicities recorded during treatment are significantly related to patient outcomes. These phenomena—the inadequacy of clinical risk stratifications and the apparent importance of blood toxicities—are not unique to medulloblastoma; we repeated the analysis with a dataset of liver cancer cases and found similar results. I plan to continue working on this project after the conclusion of the 10-week AAPM program. Ongoing work includes paring down the set of features used to classify medulloblastoma patients without sacrificing model accuracy. As I begin my senior year in the fall, I will be exploring options to pursue a career in medical physics, due in part to my experience in this program.

Diversity Recruitment Through Education and Mentoring Program (DREAM)

The Diversity Recruitment Through Education and Mentoring Program (DREAM) is a 10-week (40-hours per week) summer program designed to increase the number of underrepresented groups in medical physics by creating new opportunities, outreach, and mentoring geared towards diversity recruitment of undergraduate students in the field of medical physics. Students participating in the program are placed into summer positions that are consistent with their interest. Selected for the program on a competitive basis, DREAM fellows receive a \$5,000 stipend from AAPM.

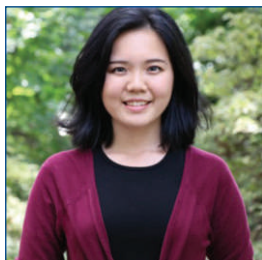
(See AAPM web site for more details, including eligibility requirements)

Sponsored by the AAPM Education Council through the AAPM Education & Research Fund



Jasmine J Byard

Mentor:
George Sgouros, PhD
Johns Hopkins Medical
Institute
Department of Radiology/
Division of Nuclear Medicine

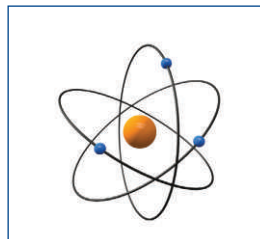


Jeongin Choi

Mentor:
Andrew D A Maidment, PhD
University of Pennsylvania
Department of Radiology/
Physics Section

Over the summer, I investigated a new calibration method for the next generation tomosynthesis (NGT) system. The NGT system introduces additional geometric movements to conventional digital breast tomosynthesis acquisition geometries to provide isotropic super resolution. This benefit of the NGT system is only achievable with precise geometric calibration. Following the work by a previous (2016) AAPM SURF William Ferris, a new calibration method using virtual line segments of the same phantom was investigated. Additionally, two algorithms to compensate for lower than desired precision in manufacturing the phantom were tested. Using this calibration method, magnification digital breast tomosynthesis was also performed. Tomographic image reconstructions successfully demonstrated isotropic SR and magnified SR.

I had an amazing experience here at Penn with Dr. Maidment and I would like to thank AAPM for providing this opportunity. Also, I recently submitted an abstract for SPIE conference in February.



Ann K Kogler

Mentor:
Mark Bennett Williams, PhD
University of Virginia
Department of Radiology
and Medical Imaging

This summer, as part of Dr. Mark Williams' radiology and medical imaging lab, I helped to develop an intraoperative imaging system that maps the distribution within the patient of radioisotope-labeled tracers for the detection of potentially cancerous lymph nodes. The system reconstructs a 3-D image of the sources of the measured radiation to assist surgeons in locating and removing the nodes. The system uses a light, handheld gamma camera whose position and orientation in space are tracked by a pair of infrared cameras, providing real-time visualization of the radioactive tracers. As part of this project, I have been able to assist in the debugging of some technical issues we have encountered, especially those involving a compensation mechanism installed in the system that is designed to ensure constant gamma camera gain in conditions of fluctuating temperature, such as those in the operating room. In preparation for the human trial, I assembled, refined, and completed the system's user manual. This process involved using radioactive point sources and phantoms to test the calibration protocols for the equipment, to test the sensitivity and resolution of the camera, as well as to detail the scanning procedures used to acquire the 3-D images. This research experience has given me hands-on exposure to medical physics research and the opportunity to experience the collaboration of research with clinical medical practice by working with surgeons and participating in a human trial.



Ruvini Navaratna

Mentor:
Daniel A Low, PhD
UCLA
Department of Radiation
Oncology

With the AAPM Fellowship, I was able to spend 10 weeks at UCLA doing research in medical physics under the guidance of Dr. Daniel Low. I studied internal-external correlation in fast helical thoracic CT scans. In commercial 4D-CT, scan images are acquired at the same time as a signal from an external breathing surrogate. It is important that the breathing surrogate signal has a strong correlation with the internal tissue motion. To test this, I calculated the correlation between the motion of multiple anatomical points and a non-invasive abdominal bellows signal for fourteen patients who underwent repeated fast helical CT. Ultimately, we wanted to see whether the surrogate's ability to accurately predict breathing motion is dependent on surrogate location and/or patient. I am very grateful to AAPM for providing me with this award to give me this extremely valuable experience.

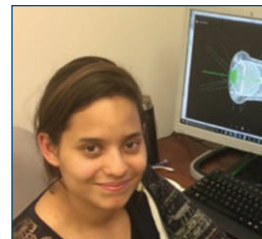


Melton Douglas Parham, Jr.

Mentor:
Steven Palefsky, PhD
Elekta, Inc.
Operational Physics

I evaluated the quality of iViewDose, a gross detector error software, by inducing several errors under controlled conditions. These errors included: patient setup, change in energy, beam symmetry, and change in anatomy.

In addition, I learned about medical physics and being a medical physicist. This included several reading assignments, attending lectures taught by Elekta physicists, networking with other medical physicists across the country, and learning the daily QA of medical physicists and the process of daily clinic life.



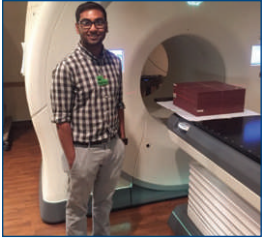
Stacy L Mendez

Mentor:
Wu Liu, PhD
Yale University School of
Medicine
Therapeutic Radiology

I am a rising senior at Fairfield University. This year my internship was at the Yale University Medical Center. I was mentored by Dr. Lui Wu, who is an assistant professor in the Department of Therapeutic Radiology, Yale University, New Haven, CT. I was given an EYE structure/model project to be created in C++ using Geant4 as the 3D image or simulator.

Constructing the EYE was very challenging and one of the hardest tasks I have ever done in computing. The completion of the structure of the eye without the parts took me three weeks followed by an additional three weeks to add the cornea, lens, macula, optic nerves, retina, choroid, and the sclera. I handed a successful completed EYE model to Dr. Wu eight weeks later. The best feeling was seeing that Dr. Wu was really pleased with my eye model and is using it for future research projects. In addition, I am elated that this project will be published and my name will be included.

This internship has helped unveil the best in me. Turning fear into strength and knowing what I am capable of has made me a stronger and more confident person, one who is able to take on many challenges. I must say, I impressed myself.



Azmul H Siddique

Mentor:
Jennifer B Smilowitz, PhD
University of Wisconsin
Department of Human
Oncology and Medical
Physics

With any radiotherapy techniques, patient setup plays a significant part for an accurate delivery of the treatment plan. Patients are positioned on the couch depending on the technique and machine used, but in most radiation therapy, daily or weekly image scans are taken to position the patient according to plan. In helical tomotherapy, MVCT images of patients are acquired, compared, and registered with the treatment planning CT image prior to delivering the treatment fraction. This registration process allows the radiation therapists to position the patient in the translational (x, y, z) and rotational (pitch, yaw, roll) axes. However, the couch for tomotherapy cannot account for pitch and yaw setup error due to rotational inability in those directions. Thus, to increase the treatment delivery accuracy with tomotherapy, it is important to quantify the magnitude of pitch and yaw setup error and assess the dosimetric effect as a result.

The AAPM DREAM Summer 2017 project speculated the magnitude of pitch and yaw setup error by gathering anonymized patient data set and re-registering daily MVCT images for every fraction to obtain the error. Then using a stand-alone dose calculator developed at Accuray, the dosimetric effect for several degrees of pitch and yaw setup errors were calculated. Furthermore, to compare and verify the results from the stand-alone dose calculator, measurements on a solid water phantom were carried out by first irradiating the phantom with the same patient plan followed by adding small degrees of error. Lastly, the provided solution by Accuray to account for yaw setup errors was also tested by irradiating the water phantom including the error but with a corrected delivery plan that accounts for the inaccuracy.



Amanda Swanson

Mentor:
Harald Paganetti, PhD
Massachusetts General
Hospital
Department of Radiation
Oncology/Physics Div.

During my fellowship, I worked with Drs. Paganetti and Trofimov to evaluate the dose distortion caused by eyelid retractors in proton therapy treatments of uveal melanoma. I used Monte Carlo simulations in TOPAS to model various treatment parameters, including a model treatment based on a patient's alignment images and treatment plan. I simulated the dose delivered to an eye with a lid retractor partially in the treatment field to determine whether the distortion could be significant enough to warrant consideration in treatment planning. At the close of my internship, I presented my results and began writing a report on my findings.

While working on the project, I observed much of the process for uveal melanoma treatments, as well as daily QA procedures and various treatments at the Burr Proton Center at MGH. I learned a great deal about how Medical Physics research is planned, conducted, and presented by attending departmental seminars and I significantly improved my programming capabilities.

This fellowship provided me with an excellent opportunity to familiarize myself with Medical Physics, gain valuable skills to further my career and make lasting connections with fellow physicists. The researchers at MGH were remarkably welcoming, and I am very grateful to have worked with them!

2017 REVIEW

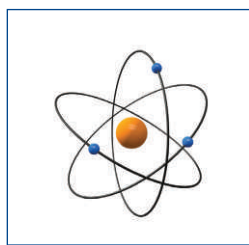
Presentation & Publication Awards

Each of the following, a competitive, prestigious award or lecture, which is connected to the AAPM Annual Meeting, is supported by a named, endowed E&R Fund:



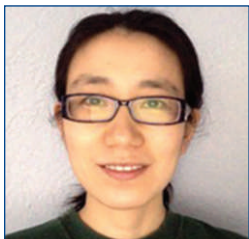
Farrington Daniels Award

This award is for the best paper on Radiation Dosimetry published in *Medical Physics* in 2016. Presented in 2017, it went to (left to right) **Jeffrey F Williamson**, **Dong Han** and **Jeffrey V Siebers** for their paper "A linear, separable two-parameter model for dual energy CT imaging of proton stopping power computation," *Medical Physics* 43(1), 600-612 (2016).



Moses and Sylvia Greenfield Award

This award is for the best paper other than Radiation Dosimetry published in *Medical Physics* in 2016. Presented in 2017, it went to **Ludwig Ritschl**, **Jan Kuntz**, **Christof Fleischmann** and **Marc Kachelriess** for their paper "The rotate-plus-shift C-arm trajectory. Part I. Complete data with less than 180° rotation," *Medical Physics*, 43(5), 2295-2302 (2016).



Jack Fowler Junior Investigator Award

This award was established in honor of Jack Fowler, PhD, Emeritus Professor of Human Oncology and Medical Physics, University of Wisconsin. The award was presented to **Yunhe Xie, PhD**, University of Pennsylvania, for the top scoring abstract submitted by Junior Investigators, who entered the competition, entitled "First Clinical Prompt Gamma Imaging for in Vivo Range Verification in Pencil Beam Scanning Proton Therapy."



Jack Krohmer Junior Investigator Award

This award was established in honor of Jack Krohmer, PhD, a pioneer in the medical physics community. The award was presented to **Timur Alexeev, PhD**, University of Colorado School of Medicine, for the best abstract submitted to the Scientific Program of the AAPM Annual Meeting, judged according to criteria of significance, innovation, and the potential for major scientific impact in an area of cutting edge interest in medical physics, entitled "Development and Evaluation of a Two Dimensional Antiscatter Grid for CBCT."



Award for Innovation in Medical Physics Education

This award is given for the best presentation at an Education Council session concerning innovative programs in medical physics education of physicists, physicians, ancillary personnel, and the public. Presentations can be concerned with scientific research, novel teaching strategies (team teaching or adult learning efforts), or novel educational materials (lectures, websites, or other innovations). This year's award went to **Debbie Gilley, MPA**, International Atomic Energy Agency, for her presentation "Improving Safety and Qualifying Radiotherapy Using Web-Based Learning." This award was made possible by a generous request from the estate of Dr. Harold Marcus.

Anne and Donald Herbert Distinguished Lectureship in Modern Statistical Modeling

On Tuesday, August 1 at the AAPM Annual Meeting, invited lecturer, **Daniel Krewski, PhD, MHA**, Natural Sciences and Engineering Research Council of Canada Chair in Risk Science, Professor and Director, McLaughlin Centre for Population Health Risk Assessment, University of Ottawa, delivered his lecture “Modeling Exposure-response Relationships for Ionizing and Non-ionizing Radiation.”

Carson/Zagzebski Distinguished Lecture On Medical Ultrasound

On Wednesday, August 2 at the AAPM Annual Meeting, invited lecturer, **Lihong Wang, PhD**, Bren Professor of Medical Engineering and Electrical Engineering, from the California Institute of Technology, delivered his lecture “Photoacoustic Tomography: Multi scale Imaging from Organelles to Patients by Ultrasonically Beating Optical Diffusion.”

John R. Cameron Young Investigator Awards

The Young Investigator's Symposium is a competition in honor of University of Wisconsin Professor Emeritus John R. Cameron, PhD. The 10 highest scored abstracts submitted for the Symposium are selected for presentation, from which the top three presentations receive awards. 2017 winners were:



1st place: Ashley Rubinstein

The University of Texas MD Anderson Cancer Center

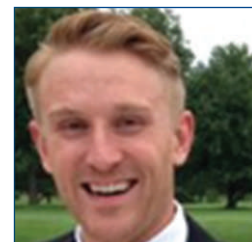
“A Pre-Clinical Study of Radiation-Induced Lung Toxicity When Treating in a Strong Magnetic Field”



2nd place: Suzanne Lydiard

University of Sydney; Auckland District Health Board

“First Cardiac Radiosurgery MLC Tracking Results”



3rd place: Jordan Slagowski

University of Wisconsin-Madison

“Inverse-Geometry CT with a Rotating C-Arm: Implementation On the Scanning Beam Digital X-Ray System”

2017 REVIEW

Cultivation Awards

AAPM Science Council Associates Mentorship Program

The program has been established to recognize and cultivate outstanding researchers at an early stage in their careers with the goal of promoting a long-term commitment to science within AAPM. The program uses the process of “shadowing” to integrate the Associates into the scientific activities of the organization. Science Council Associates participate in the program for one year and are funded up to \$4,000 per Associate (to cover travel costs including flight, hotel and meeting registration) to attend two consecutive AAPM Annual Meetings, including the pre-meeting activities associated with each Committee.

(See AAPM website for more details, including eligibility requirements)

Sponsored by the AAPM Science Council through the AAPM Education & Research Fund

- **Christina L Brunnquell, PhD**
Mentor: Kristy K Brock, PhD
The University of Texas MD Anderson Cancer Center
- **Elizabeth Huynh, PhD**
Mentor: Jean M Moran, PhD
University of Michigan Medical Center
- **Xuanfeng Ding, PhD**
Mentor: Robert Jeraj, PhD
University of Wisconsin
- **Rongxia Zhang, PhD**
Mentor: Timothy C Zhu, PhD
University of Pennsylvania
- **Austin M Faight, PhD**
Mentor: Lei Dong, PhD
University of Pennsylvania

AAPM Expanding Horizons Travel Grant

The Expanding Horizons Round 2 awards up to ten travel grants per year, each up to \$1,000, for the purpose of providing additional support for student and trainee travel to conferences that are not specifically geared toward medical physics. The travel grant is designed to provide an opportunity to broaden the scope of scientific meetings attended in order to introduce students and trainees to new topics which may be of relevance to medical physics research and which may subsequently be incorporated into future research in order to progress the field in new directions.

(See AAPM website for more details, including eligibility requirements)

Sponsored by the AAPM Science Council through the AAPM Education & Research Fund

- **Fahed Alsanea**
The University of Texas MD Anderson Cancer Center
- **Evan Harvey**
University of Wisconsin
- **Carlos Cardenas, MS**
The University of Texas MD Anderson Cancer Center
- **Reza Taleei, PhD**
UT Southwestern Medical Center
- **William Donahue**
Louisiana State University

Team BEST / AAPM Award



Team BEST provides funding for five fellowships in the amount of \$1,000 each, to be used for travel, food and lodging expenses to attend the Annual Meeting. AAPM provides complimentary Annual Meeting registration for each recipient, including social functions. Team BEST also provides a plaque for each of the five fellowship recipients.

Sponsored by Team BEST through the AAPM Education & Research Fund

- **Timur Alexeev, PhD**

University of Colorado, School of Medicine
Radiation Oncology

- **Sang Ho Lee, PhD**

Memorial Sloan Kettering Cancer Center
Medical Physics

- **Juan Montoya**

University of Wisconsin
Medical Physics

- **James Spencer, MS**

Duke University Medical Center
Radiation Oncology

- **Chunhao Wang, PhD**

Duke University Medical Center
Radiation Oncology

Summer School Tuition Scholarships

Summer School Tuition Scholarships were in the form of a full waiver of tuition fees for the entire AAPM 2017 Summer School. This award is available to applicants who are in the first five years of their careers in medical physics.

(See AAPM website for more details, including eligibility requirements)

Sponsored by the AAPM Administrative Council through the AAPM Education & Research Fund

- **Ning Cao, PhD**

University of Washington

- **Michael Carlson, DMP**

Arthur G James Cancer Hospital

- **Qiyong Fan, PhD**

University of Nebraska Medical Center

- **Tony Law, MS**

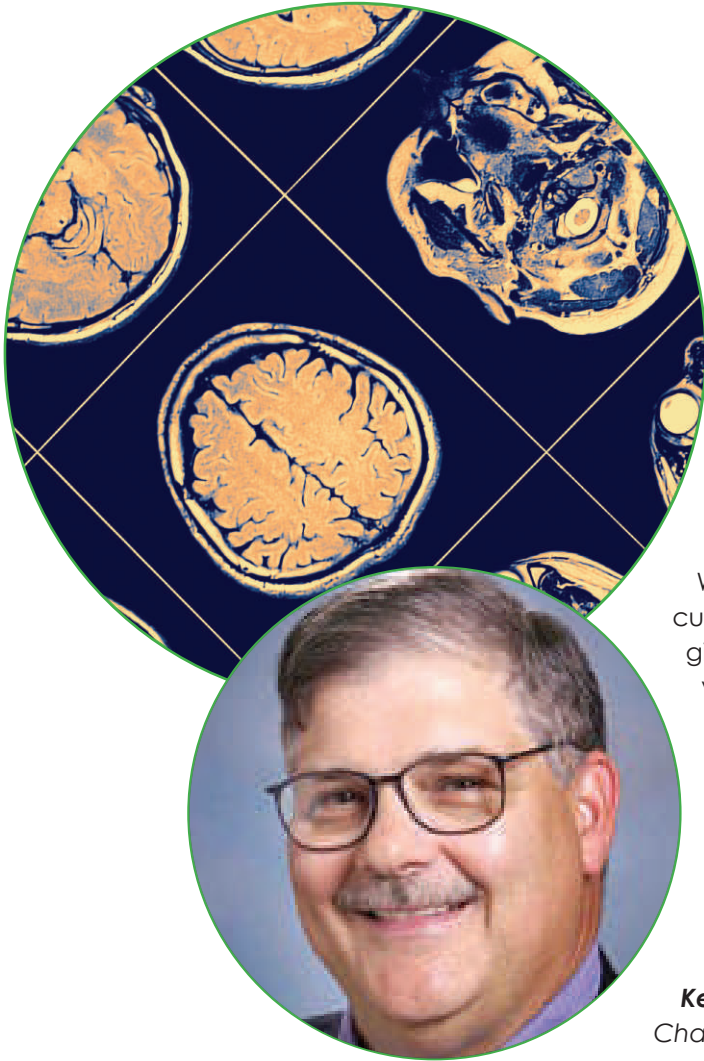
Cancer Treatment Centers of America

- **Irina Vergalasova, PhD**

Rutgers Robert Wood Johnson Medical School

- **Kai Yang, PhD**

Massachusetts General Hospital



The AAPM Development Committee hopes that this report conveys the worthwhile activities supported by the AAPM E&R Fund and the value of your contributions, encouraging additional member support for the AAPM Education & Research Fund. Although the success of these programs depends on the diversity of current funding, the AAPM aims to increase its dependence on earnings from the E&R Fund through future growth. Below, see information on the E&R Fund balances at the end of 2017, revenues for 2017, and member contributions in 2017.

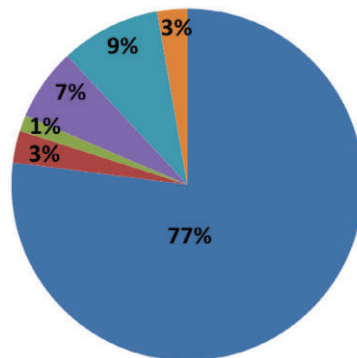
We ask each AAPM member to participate and to consider the current incentive, availability of 1:1 matching funds from AAPM for gifts no less than \$500 per year to our Five-Year Pledge Program, which was initiated in January 2016 by the AAPM Board of Directors.

(visit: www.aapm.org/education/edfundintro.asp)

Our members truly appreciate and thank you for your support. On the following pages is a listing of the many who have given their support to the Fund.

Kenneth R Hogstrom, PhD
Chair, AAPM Development Committee

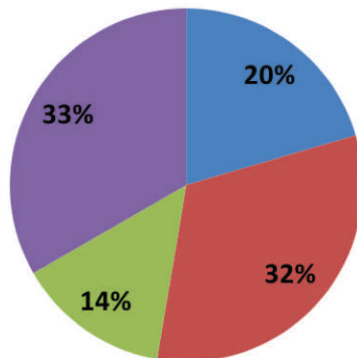
2017 AAPM E&R Fund Account Balances
Total = \$2,146,971



- General Fund, Unendowed
- General Fund, Endowed Corpus
- General Fund, Endowed Activity
- Named Funds (17), Unendowed
- Named Funds (5), Endowed Corpus
- Named Funds (5), Endowed Activity

Distribution of AAPM E&R Fund account balances between endowed and non-endowed accounts at end of 2017. Numbers in parentheses indicate the number of accounts in each Fund type.

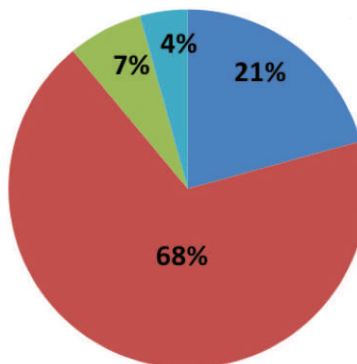
2017 AAPM E&R Fund Revenues
Total = \$748,370



- Member Contributions
- Investment Income/Unrealized Gains
- Other Professional Societies
- AAPM Budget (Pass-through)

Sources of E&R Fund revenues used to fund 2017 awards and to grow the Fund.

2017 AAPM E&R Member Contributions
Total = \$153,093



- General, Unendowed, Single (192)
- General, Unendowed, 5-year (42)
- Named Funds, Unendowed (51)
- Named Funds, Endowed (0)
- General, Endowed (56)

Distribution of member contributions to different types of accounts of the AAPM E&R Fund in 2017. Numbers in parentheses represents the number of gifts. The General, Unendowed, 5-year amount reflects the total of first-time pledges in 2017.



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