The American Association *of* Physicists in Medicine

AAPM EDUCATION & RESEARCH FUND

2014 **ANNUAL REPORT**

focus on our **future**

AAPM

Education & Research Fund Annual Report 2014

The AAPM Education & Research Fund supports the development of our great profession via the provision of seed money for research, fellowships for Ph.D. students, and support for clinical residencies and our Future Graduate Program (added in 2014), which provides additional funding for Summer Undergraduate Fellowships and the Minority Undergraduate Summer Experience (MUSE) program (renamed the Diversity Recruitment through Education and Mentoring (DREAM) program in 2014). Also in 2013 we started two new initiatives: a Five-Year Pledge Program and Endowed Distinguished Lectureships by which members can contribute a lump sum sufficient to support an annual lectureship from the earnings accrued. Without contributions from our generous members we would never have been able to provide the now over 100 grants, fellowships and residencies since the inception of the Fund over 20 years ago. As always, the AAPM is extremely grateful for the generous gifts from our members.

Even though the Education & Research Fund realized a 7% increase in contributions in 2014, the increase was entirely due to Distinguished Lectureship contributions. Without these we would have experienced a 15% drop in donations, so we continue to be well underfunded if we are to provide all the support necessary to maintain our programs at a desirable level. We desperately need more contributions from members. In 2014, only 170 members out of a total of over 8,000 contributed $100 or above. The profession is fortunate in that our average income exceeds $175,000. Asking for a $100 contribution to support the education and research endeavors of their professional society seems a meager amount to give to ensure the future of Medical Physics for the next generation.

We realize that many of you spread your philanthropy over numerous charities but support for the future of your own profession seems a worthy cause and one for which a meager donation of about 0.05% of your annual income is a reasonable contribution.

There are many AAPM members who give substantially more than the $100 request we make each year. For example, last year we received 60 individual contributions in the range of $200 to $25,000. This generosity is greatly appreciated and in the following paragraphs you will read testimonials from the graduate students, residents, fellows and undergraduates whom these contributions supported.

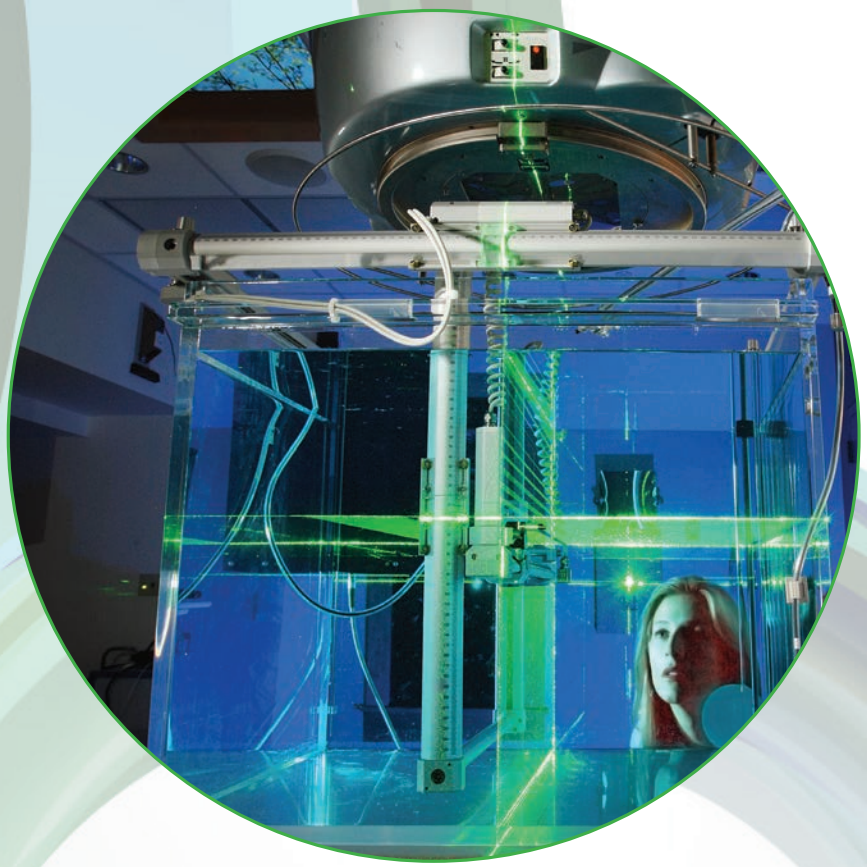
The Education & Research Fund also tracks funding for awards coming from within AAPM Councils and Committees, as well as support from outside organizations. The following awards were funded in 2014 through sources within and without the AAPM itself:

- The Education & Training of Medical Physicists Committee (ETC) of the Education Council funded $40,000 in Summer Undergraduate Fellowships and $32,000 DREAM Summer Fellowships.
- The Awards & Honors Committee of the Administrative Council awarded $5,000 in scholarships for the Summer School and travel grants in the amount of $1,000.
- Science Council, under the sponsorship of the Research Committee, awarded two $25,000 research seed grants to new researchers in the field.

The Education & Research Fund independently funds two annual awards of $18,000 each. These grants are the AAPM Fellowship in Medical Physics and the AAPM/RSNA Fellowship in Imaging Medical Physics. This latter award recognizes the contributions made by RSNA in assisting to establish the AAPM Education & Research Fund in its infancy.

The AAPM and RSNA partnered to support a total of eight new Commission on Accreditation of Medical Physics Educational Programs (CAMPEP)-accredited imaging physics residences over six years. The AAPM will provide $560,000 and the RSNA will provide $560,000. Each institution will receive $35,000 per year for four years in matching support for two residents. Three awards were approved in 2013 and the remaining five awards were granted in 2014.

The AAPM is proud to include the following testimonials from the recipients of our 2014 awards programs. These demonstrate the enormous value the recipients place on the value of this support. Please read through the reports from the recipients to learn how the monies from the Education & Research Fund are aiding in the development of their careers.



2014 REVIEW

Grants & Fellowships

The Research Seed Funding Grant

Jongmin Cho, PhD, DABR

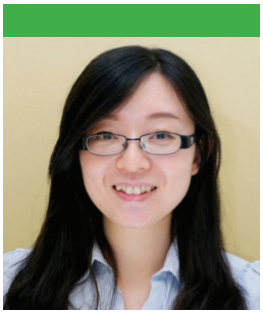
"Design of practical proton-activated implantable markers for proton range verification using PET"

Our 2014 AAPM research Seed Funding Grant was used to develop a patient injectable hydrogel fiducial marker. This biocompatible/biodegradable marker was made by suspending Zn powder in 18O-enriched water followed by cross-linking with hydrogel polymer. 18O in the hydrogel become positron emitters when proton activated -18O(p,n)18F, and Zn and water in the hydrogel provides CT and US/MRI visibilities, respectively. Therefore, the developed hydrogel marker serves as a universal CT/PET/US/MRI marker with a key function of proton therapy/range verification.

> *"Thanks to the AAPM award, we have made important progress in making proton therapy/ range verification and GNP- radiation therapy more practical and adaptable by many radiation therapy centers without additional investments on complicated instrumentation."*

We have additionally developed "PET-detectable bimetallic (Zn@Au) nanoparticles for radiotherapy and molecular imaging applications." Zn@Au (Zn core and Au shell) nanoparticles were synthesized and proton activated using a medical cyclotron, thereby the Zn cores became positron emitters. Au shells provide radiosensitization similar to that of gold nanoparticles (GNP). The developed nanoparticles can serve as PET-mediated GNP-radiation therapy as well as molecular imaging.

"Thanks to the AAPM award, we have made important progress in making proton therapy/range verification and GNP- radiation therapy more practical and adaptable by many radiation therapy centers without additional investments on complicated instrumentation."



Grace Jianan Gang

"Task-Driven, Patient-Specific Imaging for CT and Cone-Beam CT"

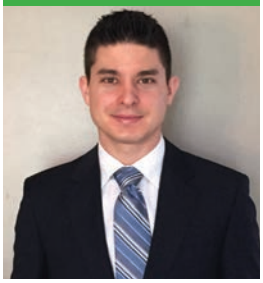
With the 2014 AAPM Research Seed Funding Grant, we initiated investigation into a task-driven imaging framework that prospectively designs task- and patient-specific acquisition and reconstruction techniques to maximize imaging performance and reduce radiation dose for interventional procedures. Specifically, the framework takes advantage of the pre-operative CT and/or previous intra-operative cone-beam CT scans to provide quantitative information regarding the imaging task and the patient-specific anatomy. Detectability index, a common metric for image quality assessment, was used directly as the objective function in a multivariate optimizer to yield the combination of acquisition and reconstruction parameters best suited for subsequent imaging procedures. The framework has demonstrated significant improvement in image quality compared to conventional approaches. This work opened up numerous future research opportunities that leverage advanced acquisition and reconstruction capabilities of modern robotic C-arm systems. We are excited to extend our investigation in multi-task optimization, non-circular orbit design, as well as optimal acquisition for statistical reconstruction algorithms.

> *"This work opened up numerous future research opportunities that leverage advanced acquisition and reconstruction capabilities of modern robotic C-arm systems."*

AAPM/RSNA Imaging Physics Residency Grants

Indiana University

Our two-year residency program in diagnostic imaging medical physics was initiated in July 2014 and it is partially funded with the Imaging Physics Residency Grant from AAPM/RSNA. The program is designed to provide clinical imaging physics training in areas of clinical quality assurance, clinical research and teaching. Marcus Lamaster, M.S., was selected as our first resident in July of 2014. He has been making good progresse during the past nine months. He stays well on track in the curriculum and has finished the first round of rotations in the following categories: general radiography, ultrasound, MRI, CT, and Mammography. He participated in a clinical research project and has recently submitted a scientific abstract for RSNA 2015.



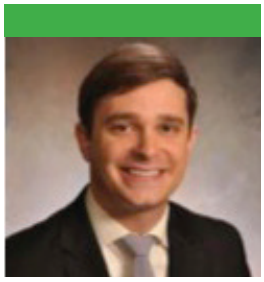
Marcus Lamaster, M.S.
Indiana University School of Medicine, Deparatment of Radiology and Imaging Sciences

The University of Chicago

Our program enrolled the first resident, Xia Jiang, Ph.D., on July 1, 2013. The program was CAMPEP approved in December, 2014 and has been granted initial accreditation through December 31, 2017.

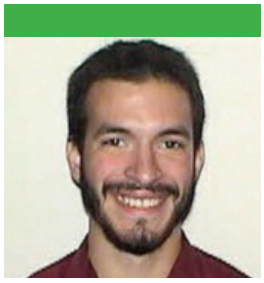
Xia Jiang, Ph.D.
Senior Resident,
The University of Chicago Medical Center, Department of Radiology

Xia is expected to graduate on June 30, 2015. He is on schedule to complete all the training elements as indicated in our self-study. He presented QI project work on patient radiation dose and staff radiation safety at the AAPM Annual Meeting in 2014 and the AAPM Spring Clinical Meeting in 2015. He also gave an educational talk on PET/CT protocol optimization at he 2015 annual spring meeting of the Central Chapter Society of Nuclear Medicine and Molecular Imaging.



Kevin Little, Ph.D.
Junior Resident,
The University of Chicago Medical Center, Department of Radiology

Kevin started on July 1, 2014 and is expected to graduate on June 30, 2016. He is on schedule to complete all the training elements as indicated in our self-study. He has submitted abstracts to 2015 AAPM Annual Meeting and RSNA Annual Meeting. The AAPM/RSNA award covers 50% of the stipend that supports his training.



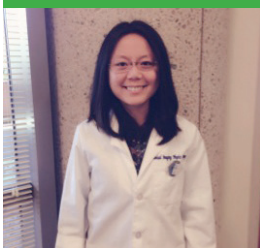
Adrian Sanchez, Ph.D.
Incoming Resident,
The University of Chicago Medical Center, Department of Radiology

Our program participated in MedPhysics Match this year for one opening. Adrian A Sanchez, Ph.D., has been matched to the program. Adrian will start on July 1, 2015 and is expected to graduate on June 30, 2017.

University of Oklahoma
We currently have two residents in the program – Chuck Hill, 2nd year and Matthew DeLorenzo, 1st year. We have invited candidates for a site visit and we will make our selection in early May. Our start date for the new resident will be July 1, 2015.

Duke University
The objective of the Imaging Physics Residency program at Duke University Medical Center is to produce an independent practitioner in the physics of diagnostic imaging who is a lifelong learner and who can work unsupervised at a safe and highly professional standard.

The program maintains a level of training, through periodic self-evaluation by both residents and mentors/staff, adequate to enable resident physicists to reach a level of competence sufficient to perform all aspects of routine diagnostic imaging tasks and to contribute to safe and accurate imaging procedures. In addition, the training prepares the resident to perform other aspects of an imaging physicist's responsibilities including teaching, research, radiation safety, and administration.



Yakun Zhang, M.S.
Duke University, Imaging Physics Residency Program

Our resident has this far completed rotations in radiography, MRI, CT, and fluoroscopy. Rotations planned or in progress include nuclear medicine, IT, ultrasound, radiation protection, and mammography. In addition Yakun has made meaningful and significant contributions to our clinical processes in MR RF coil testing, organ dosimetry, CT system characterization, and dose monitoring.

Emory University
Emory's Imaging Residency program is provisionally accredited through December 2015. We expect a site visit for full 5-year accreditation to occur in fall of 2015. We are negotiating a second affiliation agreement with Alliance Medical Physics LLC for training of our 2015–2017 cycle resident. Lastly, we have submitted a funding proposal to SNMMI for expansion of our program to include a 3rd year of dedicated nuclear medicine training. We anticipate that NJ will successfully complete her first year of training in June 2015.

Ngoneh Jallow, Ph.D.
Emory University

AAPM Fellowship for the Training of Doctoral Candidates in the Field of Medical Physics

Erin Adamson

The Graduate Fellowship has contributed strongly towards my continued graduate studies in the field of Medical Physics at the University of Wisconsin-Madison. Since receiving the Fellowship, I have had the opportunity to research methods of non-invasively probing and quantifying cancer metabolism in-vivo through the use of hyperpolarized ^{13}C MRI.

Diversity Recruitment through Education and Mentoring Program "DREAM"

Arun Chockalingam

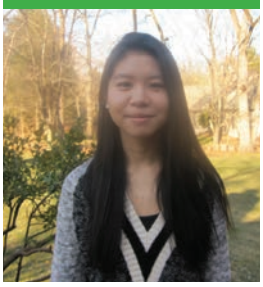
I was mentored during his fellowship by Dr. MingDe Lin of Philips Research North America. I worked in the Division of Interventional Radiology within the hospital's Department of Radiology. There I collaborated with medical students, post-doctoral fellows and my mentor to optimize tumor response assessment for hepatocellular carcinoma. At the end of my internship, I was able to produce a peer-reviewed manuscript for submission and two abstracts that I hope to present at the Society of Interventional Radiology (SIR) Conference in early 2015.

Morgan Killefer

I was mentored during my fellowship by Dr. Katja Langen, University of Maryland.

While participating in the program, I worked on the commissioning of the program Mobius3D. When I was not working on Mobius3D, I worked with the medical physics team on quality assurance of the machines, assisted in the steps of patient care from the beginning to conclusion of treatment, and observed brachytherapy treatments.

Alice Huang

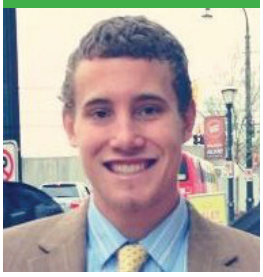


In the summer of 2014, I was accepted as AAPM DREAM intern at Memorial Sloan-Kettering Cancer Center, NYC in the Medical Physics department. My internship mentor, Dr. Neelam Tyagi, was working towards a paper on the amount and change in magnetic resonance image (MRI) pixel distortion in head and neck cancer patients. Previous studies have indicated significant MRI pixel distortion occurs because of changes in individual patient magnetic susceptibility. This may further indicate physiological changes in cancer patients in response to chemotherapy.

Given the data set, I independently created and implemented four sets of analyses for nine head and neck cancer patients with Excel and MATLAB. The analyses successfully identified time-points of unusual distortion, which were additionally identified as systematic error. Once those weeks of systematic error were eliminated, the amount of pixel distortion stayed the same week-to-week. The analysis also revealed there to be an unusually large amount of pixel distortion in the oral cavity as opposed to other regions, likely due to air. These results disproved the initial hypothesis: the physiological changes brought on by chemotherapy do not appear as pixel distortions in MR images. If unusual pixel distortion occurs, it is due to systematic error — which appears to be machine related, not patient related.

While I had a highly enjoyable and productive experience, this internship showed me that my preference is for fundamental physics research.

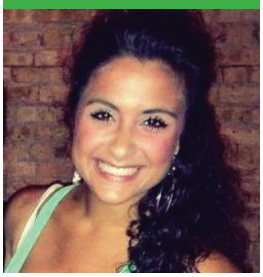
Summer Undergraduate Fellowship



Brian Anderson

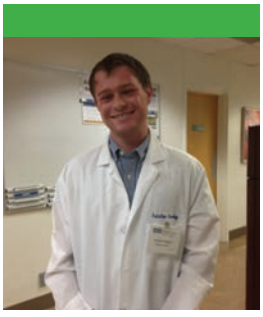
This summer program was a hands on experience with the commissioning of a new Elekta linear accelerator to the St. Joseph Hospital radiation oncology facility. This linear accelerator includes a 160 MLC head, onboard imaging capabilities and generates 6, 10 and 15 MV photon beams, as well at 6, 9, 12, 15, and 18 MeV electron beams. Firstly, I was guided through protocols for necessary shielding of the new machine before use with NCRP 151. A radiation safety survey was performed in all necessary places around the accelerator. Next I was present for the acceptance testing of the machine, ensuring that the manufacturer's specifications were being met, from the coincidence of isocenter at differing gantry angles and coincidence of light fields with the radiation field from the portal's eye view. The machine output calibration was performed, essentially verifying that the machine is generating the desired output across all beam capabilities. Monitor Units were established to correspond with 1 MU equal to 1 cGy at 10 cm depth in water across all photon energies. This depth was chosen in keeping up with Task Group TG 71's suggestions, as well as minimizing dosimetric differences between similarly calibrated machines in the facility.

After proper output was calibrated, data was collected which would be necessary for a treatment planning system. This data included checking percent depth dose curves and beam symmetry at varying depths with cross plane, in plane, and diagonal scans in a water phantom in beams with and without wedges. This data is then used to create a model that the treatment planning system can use to estimate dose delivered in body tissues. This will be checked with the use of previously created dosimetry tables as well as spot checks with a water phantom as necessary. Finally, Quality Assurance daily, weekly, monthly, and annual checks were established pulling from TG 142, Elekta's recommendations for QA, and 'A quality assurance program for on-board imager' – 2006 AAPM. From these three documents a concise plan was created which was believed to have all the necessary components to determine if any large variation from the established base occurs that might affect clinical treatment. Thanks to this program I was able to experience many things I will likely do in my future career as a physicist in medicine and make me a better physicist.



Lianna Di Maso

The summer of 2014 was one of the best experiences of my life as I was awarded the amazing opportunity to spend my summer in Baltimore, Maryland working at Johns Hopkins Hospital as an AAPM Undergraduate Fellow. This fellowship afforded me the invaluable experience of learning hands-on the ins and outs of a career as a Clinical Medical Physicist in the Department of Radiation Oncology. I also conducted my own research under the supervision of my Clinical Medical Physicist Mentor/Advisor, Dr. Teboh Roland Forbang. My project was titled "Dosimetric Consequences of Uncorrected Rotational Setup Errors for Pancreatic Cancer Patients." I have since presented my research at multiple AAPM conferences and will present my poster at the Annual Conference in July 2015. I am extremely excited to continue my education starting this summer at The University of Wisconsin-Madison School of Medicine and Public Health as a research assistant/ Medical Physics Ph.D. student. I am extremely grateful to AAPM for giving me this fellowship opportunity and for the help and guidance of my mentor/advisor and the Department of Radiation Oncology at Johns Hopkins Hospital. This experience was crucial in building a strong foundation for my future in medical physics.



Franklin Feingold

I worked on a research project in the summer of 2014 in the Radiation Oncology Department at the University of California Los Angeles under the guidance of Dr. Daniel Low. I worked on motion management of lung cancer

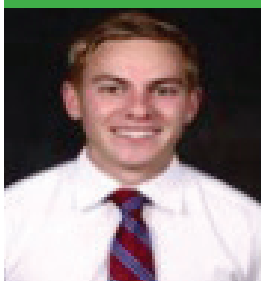
patients using the model developed by Dr. Low's lab. My responsibilities were to debug and help synchronize the model code. During my time there, Dr. Low's lab was in the middle of a clinical trial, testing his new model. This was a very enriching experience and I plan to continue in Medical Physics.

Amy Frederick

The AAPM Summer Undergraduate Fellowship Program (SUFP) was a wonderful, well-rounded experience that provided me with valuable insight into the clinical and research duties of a medical physicist. At the University of Texas MD Anderson Cancer Center, my mentor, Dr. Julianne Pollard, provided me with opportunities to observe treatment planning, simulation, treatment delivery, and quality assurance for thoracic cancer patients. Through my clinical observations, I now understand how crucial collaboration between physicians, physicists, and therapists is in determining the best and safest treatment plan for a patient. I also learned about new and innovative treatment techniques and platforms by attending clinical research meetings and weekly lectures on medical physics topics given by graduate students.

In addition to gaining clinical experience in the field, I was able to assist Dr. Laurence Court and one of his current graduate students with a radiomics research project. This project aimed to determine the effect of variations in measuring methods and imaging parameters on texture features measured from CT images of non-small cell lung cancer tumors. In order for texture features to be reliably measured at different institutions and become clinically useful, their dependence on measurement conditions and imaging parameters must be well understood. My involvement in this research project was instrumental in teaching me how to think critically about scientific questions and bring a project to a point where it can be submitted for publication.

Ultimately, my participation in the AAPM SUFP allowed for me to gain valuable experience in the field of medical physics, which is challenging to obtain as an undergraduate student. This program has given me a strong understanding of what the field has to offer as a future career and furthered my confidence in pursuing graduate studies in clinical medical physics.



Mark Leibensperger

First off, I would start by saying the the AAPM summer undergraduate fellowship was great for me and anyone even remotely interested in medical physics. I had known some general things about the field, but my summer at MD Anderson really opened my eyes to how broad the field is and the many career paths it can lead to. While in Houston, I worked on a project to characterize the time dependence of optically stimulated luminescence detectors. The overall goal of the project is to use these detectors to measure linear energy transfer in proton therapy beams to optimize proton treatment planning. Along with my contribution to research, I was able to shadow several medical physicists and oncologists, exposing me to the various clinical procedures such as treatment planning, QA, patient chart rounds, and more. I do plan to continue in the field of medical physics and will be pursuing my Ph.D. at the University of Wisconsin this coming fall.

Jocelyn Hoye

In my time at UCSF this summer, I worked on a research topic exploring quality assurance of stereotactic alignment and patient positioning accuracy for robotized Gamma Knife Radiosurgery. Additionally, I collected and briefly analyzed data exploring ways to improve Gamma Knife Radiosurgery treatment plans. I also was able to observe several of the many types of radiation therapy available at UCSF, including Gamma Knife Radiosurgery, Intensity Modulated Radiation Therapy, CyberKnife Image Guided Therapy, Brachytherapy, and Proton Ocular Radiation Therapy.

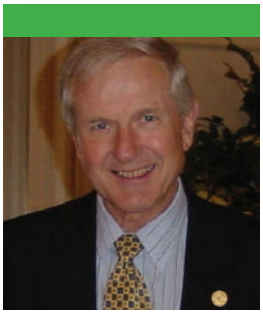
Kayla Mendel

During my 2014 Summer Experience, I did research at Massachusetts General Hospital with Dr. Alexei Trofimov. I studied alignment x-ray images of patients treated for ocular melanoma with proton therapy. I quantified the fidelity of alignment and variation effects on dosage.

Ashma Shiwakoti

The Undergraduate Fellowship Program granted by AAPM was a wonderful experience. I got to learn a lot of new stuff during the 10-week program. We worked on total body fat segmentation using a whole body-MRI scanner. A female subject was selected and her whole body-MRI images for two different years (2009 & 2011) were used for fat segmentation. MRI images were imported into the software Avizo® Standard 7.1 ed., which was used to visualize and segment the 3D images. To segment the different regions of the body, anatomically relevant areas were assigned to specific materials. Segmentation was performed automatically using thresholds, and then the materials were manually revised by selecting individual voxels to be added or subtracted from the material. The segmented regions were then merged together by using overlapping slices as a reference to form a whole body representation. The fat volume in each region from each year was measured and compared to analyze the regional fat fluctuation.

It was an incredible experience for me to work on this project and learn about Magnetic Resonance Imaging. I got a chance to learn the safety rules about MRI and also see how a whole body-MRI is done. The most amazing experience for me was a shadowing for a day in the Mary Bird Perkin Cancer center where I got to meet with the actual medial physicist and learn a lot of stuff from them. I got to see a lot of MRI, CT, and PET scanners used for the treatment and also got to see a little bit about how the treatment plan is done. The research opportunity provided by the AAPM gave me a chance to learn a lot of things about Medical Physics and its application in various fields. Thank you AAPM for such a wonderful opportunity.



The AAPM Development Committee hopes that these testimonials to the value of your contributions will encourage greater support for the AAPM Education & Research Fund and the worthwhile activities the Fund supports.

As Chairman of the Committee I urge each and every AAPM member to contribute a minimum of $100 annually to support our educational and research activities. We must strive to obtain the level of contributions that will help to accomplish our mission of much-needed educational and research opportunities for our young professionals.

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

Colin G. Orton, Ph.D.
Professor Emeritus

(A complete list of contributors at the various contribution levels follows.)

CONTRIBUTORS

to the Education & Research Fund (as of June 11, 2015)

The AAPM would like to thank the following individuals who have made contributions to the Education and Research fund since it's inception in 1990:

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$20,000 and Above

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