focus on our future

2012 Annual Report of the AAPM Education & Research Fund

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. 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 20 years ago. As always, the AAPM is extremely grateful for the generous gifts from our members.

Even though the Education & Research Fund realized an increase in contributions in 2012, 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 2012, 124 members out of a total of 8,212 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 contribution of about 0.05% of your annual income is a worthy endeavor.

There are many AAPM members who give substantially more than the $100 request we make each year. For example, last year we received 50 individual contributions in the range of $200 to $3,000. This generosity is greatly appreciated and in the following paragraphs you will read testimonials from the graduate students, residents and fellows whom these contributions supported.

In addition to support for the general fund, the AAPM received almost $5,000 in contributions to the Endowment Fund. These contributions remain permanently in the investment portfolio with only the earnings on the funds used to support educational and research activities.

The 'named' funds, contributed in the name of deceased members, also received donations in 2012. These included the Cameron Memorial, Glasser Memorial, John Hale Memorial, Doug Jones Memorial, Krohmer Memorial, Laughlin Memorial, Loevinger Memorial and the Ted Webster Memorial. In total, these funds received $1,685.

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 2012 through sources within and without the AAPM itself:

- The Education & Training of Medical Physicists Committee (ETC) of the Education Council funded $20,000 in Summer Undergraduate Fellowships and $8,000 in Minority Undergraduate Summer Experience grants. Additionally, one additional Summer Undergraduate Fellowship grant was made possible by a contribution from the AAPM Southern California Chapter.

- The Education and Training of Medical Physicists Committee also funded one matching grant of $33,5000 for a Clinical Residency in Imaging Medical Physics.

- The Awards & Honors Committee of the Administrative Council awarded $4,500 in scholarships for the Summer School and travel grants in the amount of $2,750.

- 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 helping us establish the AAPM Education & Research Fund in its infancy.

The AAPM is proud to include the following testimonials from the recipients of our 2012 awards programs. These demonstrate the enormous value the recipients place on 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.

Joshua Grimes
Mayo Clinic Rochester

2012 AAPM Grant in Support of Clinical Residency in Imaging

The recipient of the 2012 AAPM Grant in Support of Clinical Residency in Imaging is **Joshua Grimes, Ph.D.** **Dr. Grimes** has a PhD in Medical Physics from the University of British Columbia in Vancouver. His graduate thesis research focused on patient-specific internal dose calculation techniques for clinical use in targeted radionuclide therapy. **Dr. Grimes** is a resident in the Mayo Clinic Rochester Residency Program in Imaging Physics, which was accredited by CAMPEP in 2010. The Mayo Clinic Rochester residency is a three-year training program focusing on imaging for diagnosis and image-guided interventional procedures which provides training in all aspects of a medical imaging practice, including imaging equipment specification, purchase, acceptance testing, ongoing quality assurance, measurement and estimation of radiation dose, evaluation and correction of artifacts and other specific imaging problems, evaluation and implementation of new imaging techniques. Rotations in radiography, fluoroscopy, angiography, cardiac interventional, mammography, CT, MRI, ultrasound, nuclear medicine, PET, bone densitometry and imaging informatics are included.

Imaging physics residencies serve an important function by training physicists to work in a clinical environment. Grants of this type support the establishment of residency programs to ensure the availability of medical physicists with clinical training to support quality, safety and innovation in medical imaging.

Magdalena Bazalova
Stanford University
2012 AAPM Research Seed Funding Grant
"Towards radiation therapy with very high-energy electron beams"

Our 2012 AAPM Research Seed Funding Grant was used to investigate the feasibility of rapid radiotherapy with very high-energy electron (VHEE) beams through Monte Carlo simulations and treatment planning studies.

First, we have compared three Monte Carlo codes for dose calculations with VHEE beams and validated them with dose measurements in homogeneous and heterogeneous phantoms taken at SLAC National Accelerator Laboratory. We found good dose agreement between the three Monte Carlo codes and between Monte Carlo simulations and measurements.

Second, we have investigated the optimal treatment beam parameters of VHEE radiation therapy with a number of patient cases. Treatment planning optimization of VHEE radiotherapy using a customized version of RayStation (RaySearch, Stockholm, Sweden) revealed that VHEE plans are superior to plans delivered with state-of-the art photon beam therapy.

Thanks to the AAPM award, we have made important progress on our project investigating the feasibility of radiotherapy with VHEE beams. Our research to date suggests that rapid treatments with VHEE beams are indeed feasible.

David Fried
2012 AAPM Graduate Fellowship

Since receiving the 2012 AAPM Graduate Fellowship, I have been conducting research under the mentorship of Dr. Laurence Court at MD Anderson Cancer Center examining the prognostic ability of tumor texture features calculated from routine imaging. Tumor texture

has been shown to be prognostic in lung, breast, and esophageal cancers in terms of predicting patient outcomes. However, prognostic ability has been predominantly demonstrated in studies with small sample sizes and varying methods of texture calculation.

To date, I have examined tumor texture features from both primary and nodal disease in head and neck cancer patients in an attempt to determine if texture features could also be prognostic for malignancies of the head and neck. These analyses were burdened by lack of sufficient sample size and features that were initially significant but did not remain significant after correcting for multiple hypothesis testing. Portions of this work have led to an abstract that has been submitted to the 2013 AAPM Annual Meeting. Currently, I am examining a large cohort of previously treated lung cancer patients in an attempt to gather further data regarding the prognostic ability of texture features in this patient population.

The ultimate goal of this research is to not only determine features that are prognostic but ultimately to generate accurate prediction models of outcome based on tumor texture. This research could aid the field of medical physics tremendously in that more effective treatment methods may be implemented for patients who are less responsive to standard therapies.

Jaebum (Albert) Chung
2012 Summer Undergraduate Fellowship

The 2012 Summer Undergraduate Fellowship from AAPM helped me gauge my interest in physics in medicine. I gained valuable experience in the field of X-ray imaging by computer modeling X-ray images of a water slab containing lesions with two contrast agents. It is an approximation of a patient after ingesting or dosed with contrast agents. The goal is to have the most clear X-ray images with the two contrast agents by using a dual-energy CT scanner. The project has been on-going even after the summer

of 2012. Right now, I am working on how to properly distribute the radiation dose between two energies to obtain the maximum contrast.

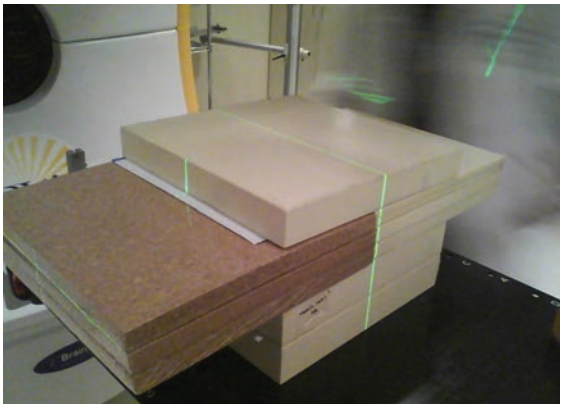
From this experience, I discovered my interest in physics involving photons. I will be pursuing a Ph.D. degree in Applied Physics at Caltech and will be concentrating on fields related to quantum optics and optoelectronics.

Thank you for the wonderful opportunity. I wouldn't have been where I am now without your help.

Paul Leo
2012 AAPM Summer Undergraduate Fellow

Last summer (the summer of 2012,) I worked in the Radiation Oncology Department of Loyola University Medical Center in Maywood, Illinois. I conducted research in radiation therapy treatment planning with **Dr. Anil Sethi**. Our project explored the effectiveness of Monte Carlo treatment planning in certain treatment geometries.

In radiation treatment planning, two common dose-delivery algorithms are the Monte Carlo algorithm and the Pencil Beam algorithm. The algorithms are used to determine what setup is needed to deliver a certain amount of dose to a patient while keeping the patient's vital organs safe. However, the two algorithms are very different in nature. Pencil Beam is a very fast algorithm that is not too accurate in certain situations (it can cause too much dose to be delivered to the patient.) Monte Carlo is an extremely precise algorithm, but it is much slower than Pencil Beam. Monte



Carlo algorithm cannot be used in all radiation therapy treatment planning (because it is so slow and hospitals would not be able to function correctly with such slow treatment planning times,) so it is the job of medical physicists to determine when Monte Carlo algorithms are most appropriate. In other words, because Monte Carlo can't be used all the time (it is too slow,) our project was to figure out when it needs to be used the most (i.e. the situations under which Pencil Beam performs most poorly.)

Over the course of the summer we constructed a number of phantoms and irradiated them with different geometries, comparing the measured dose to the dose predicted by Pencil Beam and by Monte Carlo. From these experiments we determined that the Monte Carlo algorithm is necessary in situations where there is a drop in density, such as at the lung-tissue interface. We explored these results in a number of phantom geometries, several of which have never been explored before in the academic setting.

We are currently working on writing a paper associated with our findings. If published, our findings will hopefully be insightful to medical physicists working in the field of radiation therapy treatment planning (especially those who work in an environment that involves Monte Carlo.)

On a personal level, this award allowed me to conduct research to a more in-depth extent than I had ever done research before. It was my first 9-5, 5-days-a-week research experience, and it gave me a thorough view of how scientists function in the world of research. The research itself, relating to radiation oncology, is very relevant to my future plans (to become an oncologist.)

Lauren Rigsby
Middle Tennessee State University
2012 AAPM Summer Undergraduate Fellow

"A comparison between pencil beam and AAA calculation algorithms for SBRT treatment planning"

Questions have arisen over the difference in the dose calculated using iPlan's pencil beam kernel algorithm and Eclipse's AAA point kernel algorithm. Eclipse's dose calculations are reliable in both homogeneous and inhomogeneous media, but iPlan's algorithm does not account for the difference in photon and electron fluence in air equivalent media. This could prove a problem when using iPlan to plan radiation treatment in the lungs. Twelve existing static beam stereotactic body radiotherapy (SBRT) lung plans were transferred from Eclipse and optimized in iPlan. Dose data was taken for these twelve plans in iPlan with the heterogeneity correction turned both on and off. When the heterogeneity correction is turned on, the lungs are modeled as air, but when the correction is turned off, the lungs are modeled as water.

The plans were then transferred back to Eclipse with matching monitor units (MU), gantry angles, table angles, jaw size, and multi-leaf collimator (MLC) margins. Dose data was compared between the corresponding plans in iPlan and Eclipse. It was found that the non-corrected plans in iPlan agreed with Eclipse within 10%. However, the heterogeneously corrected plans in iPlan differed from Eclipse by more than 25% in some cases because the pencil beam kernel algorithm does not account for dose build-up regions and scattering correctly. This is important information for anyone working in iPlan, since the heterogeneity correction can skew the results greatly. The dose discrepancy is within the clinically accepted allowance of 10% if the heterogeneity correction is not turned on; that is, if the lung tissue is treated as water equivalent instead of air equivalent.

The opportunity to work on this project at Vanderbilt helped me choose medical physics as my career path. I will be attending Vanderbilt's Medical Physics Program starting in the fall of 2013.

Hannah Ponek
2012 AAPM Summer Undergraduate Fellow

During the 2012 summer, I was given the opportunity to participate in the 10 week AAPM Summer Undergraduate Fellowship Program at Johns Hopkins University Hospital. It was an incredible experience that has furthered my desire to continue my education in the medical physics field. The summer program consisted of experiencing both clinical radiation therapy with **Dr. Mahadevappa Mahesh** and diagnostic imaging and nuclear medicine with **Dr. Eric Frey**. In my clinical experience, I assisted in calibrating clinical imaging equipment, attended radiation lectures, worked on patient radiation dose analysis, and wrote a literature review of a medical imaging textbook. During my computational experience, I attended several theoretical imaging lectures, ran several scripts of imaging simulations on a UNIX cluster, and presented results to other faculty members. This summer experience has been inspirational fuel for my last year in undergraduate school and was the basis for doing a senior honors project on nuclear medicine research.

Under the honors project guidelines, I was given the opportunity to have an advisor from another institution; this allowed me to continue working with **Dr. Frey** on a nuclear medicine research project he had assigned to me during the summer. My honors project focuses on assessing the reliability of quantitative imaging of the radioactive isotope Samarium-153 for palliation of bone metastases. Without the AAPM summer program, I would not have been presented the opportunity to work on a project like this as an undergraduate student. I find the research process to be extremely fulfilling and exciting, and I plan to make it an integral part of my future career.

This summer experience has not only introduced me to the world of medical physics, but it has also prepared me for my future steps in the medical physics field. I am very thankful to have been given the opportunity to work with **Dr. Mahesh**, **Dr. Frey**, and several of the graduate students in their department. After completing my undergraduate education this spring, I plan to further my education

at the graduate level in pursuit of a PhD in Medical Physics, and more specifically in clinical radiation therapy. My past summer experience at Johns Hopkins has increased my interest in the clinical aspect of medical physics. My ideal goal would be using the new forms of imaging technology and imaging simulation methods to contribute to the cancer research community and eventually become an educational advisor.

Omar Orbe-Toledo
2012 AAPM Minority Undergraduate Summer Experience (MUSE) Program

I, **Omar Orbe-Toledo** was a recipient of the 2012 MUSE award of the American Association for Physicists in Medicine (AAPM). I chose the H. Lee Moffitt Cancer Center and Research Institute (MCC) as the host Institution because of the attractive internship proposal offered by **Dr. Eduardo G. Moros**, who designed a very intense summer program to gain clinical experience in the radiation therapy physics.

Below I have listed some of the activities in which I was involved during the program:

- Observed Daily QAs and image collection at the CT simulation room.
- Participated in treatment planning applied to different body parts, such as lung, pancreas, kidney, head and neck. I spent a significant amount of time with dosimetrists and physicists planning on Pinnacle, Brainlab, Tomotherapy, and Brachytherapy treatment planning systems. I learned how to perform dosimetry calculations by hand. By the end of my fellowship, I had the opportunity to interact with Pinnacle (treatment planning) and Mirada (deformable image registration and fusion).
- Spent time at different treatment rooms observing how the treatments are delivered to patients. In treatment

rooms like Trilogy, Novalis, Truebeam, Tomotherapy, and Clinac, I became familiar with immobilization devices and techniques, accessories used in the machines, and procedures that required the supervision of a physicist such as respiratory gating and TBI. I was also able to witness several HDR brachytherapy treatments for prostate, cervix and sarcoma cancers.

- Biweekly participation in QAs held in different treatment rooms such as: Novalis (where I learned the Winston Lutz test), Tomotherapy (where I became familiar with radiographic films and MVCT) and Trilogy. Pertinent to QAs performed in the Trilogy room, I would like to thank Dr. Dylan Hunt for providing me with an intense training on how to perform IMRT QAs utilizing the Delta 4 phantom.

- Assisted the physicist for monthly QAs check at Trilogy and Clinac.

- Followed the Physics Plan Review Procedure, where the physicist ensures that the physician's approved plan is correctly implemented.

- Contributed in a project to create a virtual gantry check (to predict potential collisions) that could be added to the treatment planning software, in order to save time and expenses in the clinic. I was involved on the project by doing different sets of measurements in the treatment machine to double check the theoretical equations. This project is still ongoing.

- Attended lectures from the Online Learning Center in the AAPM website.

- Studied the book "The Physics of Radiation Therapy" by Khan as suggested by **Dr. Moros**. This reading offered me a strong theoretical base on the diverse physics concepts applied to the Radiation Therapy field. I was able to quickly relate my reading to actual clinical situations.

During this ten-week program I acquired a great amount of technical knowledge in the medical physics field. I feel greatly motivated to continue my education in this direction, and I look forward to put all the necessary effort to contribute to the development and implementation of innovative cancer treatments as a medical physicist.

I would like to express my gratitude to the AAPM and to the MCC for the MUSE, which has contributed greatly to my education and to my desire to pursue medical physics as my career.

Desmond Fernandez, B.S.
2012 AAPM Minority Undergraduate Summer Experience (MUSE) Program
"'Uniform' Planning Target Volume of Intensity-Modulated Proton Therapy of Pediatric Brain Tumors"

I, **Desmond Fernandez**, was awarded the American Association of Physicist in Medicine Summer Undergraduate MUSE Fellowship for the summer of 2012. After being awarded the fellowship, I chose to conduct research at the Mayo Clinic in Rochester, Minnesota. Due to the development of a new scanning beam proton treatment center at the Mayo Clinic, my project was in the area of proton radiation therapy.

I investigated intensity-modulated proton therapy (IMPT) to determine the optimal uniform planning target volume (PTV) margin for pediatric brain tumor proton treatment via a scanning beam system. IMPT single field optimization and multi-field optimization 3-field treatment plans were generated for centrally localized brain tumors of three pediatric patients. Additionally, a 6-field photon intensity-modulated radiation therapy (IMRT) plan was incorporated for comparison. Uniform PTV margins ranging from 0-5 and 10 mm were contoured from the clinical target volume (CTV) margin. With dose targeted at each desired PTV, each treatment plan was manipulated for setup uncertainties in the right-left (x), anterior-posterior (y) and superior-inferior

(z) directions. Furthermore, I modeled range uncertainties, and combinations of random and systematic shifts that may occur during treatment. Each PTV margin was analyzed according to plan optimization type, target coverage, critical structure sparing, and statistical difference.

This research will benefit the medical physics profession by helping provide an advanced proton treatment center that will benefit patients. Also, this research has benefited me by the acceptance into Louisiana State University's CAMPEP Accredited Graduate Medical Physics Program and has assured me that a career in medical physics is what I want to pursue.

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, PhD
Professor Emeritus

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

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