



**focus
on our
future**

2011 Annual Report
of the
AAPM Education &
Research Fund

The AAPM Education & Research Fund was founded in 1989 to support clinical residencies and Ph.D. student fellowships, and has since been expanded to include research seed grants. Since its inception, we have been able to support a total of 84 residencies, 17 fellowships and 12 research grants. This is great. Unfortunately, the rate at which new donations have been coming into the Fund over the past few years has not been sufficient to sustain this level of support, even though the need for such funding has increased, especially for residencies. Over the past two years, for example, less than \$50,000 has been donated by the general membership. Fortunately, in 2011 we received a \$20,000 bequest from deceased member, Harold Markus which helped to alleviate our shortfall for that year. We are very grateful for this support and, of course, for the support received from the other 82 members who made a donation to the Fund. But only 82 members out of over 7,000 donated \$100. Clearly, far greater membership participation is essential if we are going to be able to provide the support needed to keep our profession furnished with exceptional new talent.

We continue to strive for an increased level of donation from our members, with the ultimate goal of \$100 per member annually. The profession is fortunate in that 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 Physicists for the next generation.

We realize that many of you spread your philanthropy over numerous charities, however, support for the future of your own livelihood seems a worthy cause and one for which a meager contribution of 0.057% of your annual income is worth the effort.

There are many AAPM members who give substantially more than the \$100 request we make each year. For example, in addition to the \$20,000 bequest, the fund received 22 individual contributions in the range of \$200 to \$3,000 in 2011. This extraordinary 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, 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 2011. These included the Cameron Memorial, Glasser Memorial, John Hale Memorial Fund, Doug Jones Memorial, Krohmer Memorial, Laughlin Memorial, Loevinger Memorial and the Ted Webster Memorial Fund. In total, these funds received \$5,362.

Beginning in 2010, the Development Committee recommended that funding for awards coming from within AAPM Councils and Committees, as well as support from outside organizations, be tracked through the Education & Research Fund. Thus, in 2011, the following awards were funded 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. The ETC also awarded a matching grant of \$33,500, sponsored by RSNA, which contributed \$67,000 in 2011 for a combined total of just over \$100,000 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 include the AAPM Fellowship in Medical Physics and the AAPM/RSNA Fellowship in Imaging Medical Physics. This award recognizes the contributions made by RSNA in assisting to establish the AAPM Education & Research Fund in its infancy.

AAPM is proud to include the following testimonials from the recipients of our 2011 awards programs. We hope these present a brief synopsis of 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 their careers.



Dr. Alphonso Magri

Medical Physicist

Upstate Medical Physics, New York

2011 RSNA Residency in Imaging Medical Physics

Dr. Magri, recipient of the **2011 RSNA/AAPM Residency Grant**, has been a part of the Upstate Medical Physics CAMPEP Accredited Residency Program since it began in 2009. Thus far he has completed rotations in radiography, fluoroscopy, computed radiography, ultrasound, patient and fetal dose calculations, mammography, computed tomography, shielding design, radiation protection surveys, and magnetic resonance imaging. In August of 2011 he passed the ABR part II exam for Diagnostic Medical Physics and qualified to take the ABR part III exam in May of 2012.



During his 3rd and final year at Upstate Medical Physics, **Alphonso** has been active with CT protocol review, independent MQSA surveys, investigating interventional DAP and Air Kerma displayed accuracy, and participating in CT and MR ACR accreditation surveys. Through this unique consultant based residency program **Alphonso**, will be well prepared for meeting the demands of a medical physicist consultant and actively participating in the medical physics community.



Victoria Yu

Senior, Rutgers University

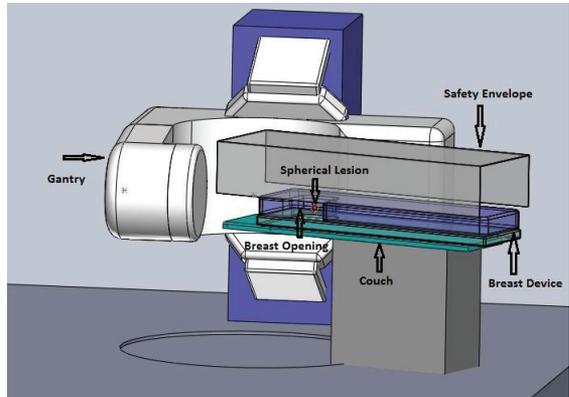
Summer Undergraduate Fellowship, Stanford University

Through the **2011 AAPM Summer Undergraduate Fellowship Program**, **Victoria** was assigned to conduct medical physics research for ten weeks at the **Department of Radiation Oncology, Stanford University** under the supervision of **Dr. Dimitre Hristov**. The purpose of the project was to explore possible breast cancer treatment trajectories on Varian TrueBeam STx treatment linear accelerators for a novel Accelerated Partial Breast Irradiation (APBI) technique that significantly increases dose conformality while

sparing significantly large amounts of normal tissue compared to the conventional five field IMRT treatment technique. This APBI technique utilizes coordinated motion of the gantry, multi-leaf collimator (MLC) and patient couch rotation and translation, in conjunction with a prone patient setup to produce multiple coronal arcs around the ipsilateral breast.

Extreme complexity comes into operating this proposed novel technique due to the geometrical arrangements of all the components of the linear accelerator and the possibility of collisions.

She independently built a model of the linear accelerator in SolidWorks with a built-in beam eye view camera, shown in the figure below. This model enabled her to determine gantry and couch trajectories so as to avoid collisions and yet keep the target



within the beam apertures. Patient specific trajectories were implemented in the treatment planning system Eclipse. The calculated treatment plan was delivered on a phantom and the dose distribution achieved a 2.4% deviation from that of the treatment plan. This work was presented at the annual meetings of AAPM and the American Society for Radiation Oncology (ASTRO) in 2011. She is currently working on manuscripts corresponding to these presentations as a part of her senior thesis.

She states: “This award truly made me realize how big of an impact my work could make on the success of breast cancer patients once it is successfully implemented, and it brought me to the decision of pursuing a graduate degree in Medical Physics. It was because of this fellowship that I have become inspired to make a contribution in making new discoveries and innovations in the field of Medical Physics.”



Mara Rosenberg

Brandeis University, BS Physics 2012

Summer Undergraduate Fellowship, Oregon Health & Science University



As an **AAPM Summer Undergraduate Fellow**, **Mara** reports that she had the opportunity to work under **Dr. James Tanyi** at **Oregon Health and Science University**, studying the effect of beam arrangement on dose to the contralateral lung for stereotactic body radiation therapy (SBRT). SBRT is a noninvasive technique used to deliver potent doses of radiation to sites including the lung, liver, and spine. While SBRT has demonstrated higher local control rates ($> 85\%$) when compared with conventional fractionated treatment schemes, SBRT can potentially result in clinically significant lung toxic effects, such as collapse of airways, atelectasis, fibrosis and symptomatic pneumonitis. Limiting the amount of normal tissue that is exposed to an amount of radiation that approaches the prescribed dose is crucial to minimizing collateral damage to the surrounding normal tissue or organs. This study analyzed static gantry Intensity Modulated Radiation Therapy (IMRT) delivery methods in order to evaluate the significance of entrance dose to the contralateral lung. These conclusions will aid radiation oncologists in dose delivery planning.

“My **AAPM fellowship** allowed me to work closely with radiation oncologists and medical physicists and explore my desired career path. I further gained experience in the drafting of a scientific manuscript and, through collaboration with a biostatistician, learned methods for data analysis. I am honored to have received such an opportunity.”



Dr. Yahya Alivov

University of California, Irvine

2011 Research Seed Funding Initiative Grant “Development of Nanotube Field Emission X-ray Source”



Dr. Alivov reports: “My **AAPM 2011 Research Seed Funding Initiative Grant** was on development of TiO₂ nanotube field emission X-ray source. With this grant support, I was planning to achieve the following: 1) simulate the design of a TiO₂ nanotube-based X-ray tube to determine optimal parameters, 2) construct X-ray tube with the found optimized parameters, and 3) to test the performance of the constructed X-ray tube. To date, I have done all simulations using commercial software SIMION 3D to determine the optimum electrical and geometrical parameters of the electron optics that provide the minimum electron-beam focal spot size. The simulations were done for a wide range of parameters, including cathode size, anode size, lens aperture, anode-lens distance, and anode voltage. I have constructed a new X-ray tube using hardware purchased with the provided **AAPM 2011 Research Seed Grant**. Currently, I am in the process of testing X-ray tube’s performance. I plan to finish this testing by the end of this grant – June 30, 2012. X-ray tubes based on field emission electron sources have significantly improved spatial and temporal resolution, and therefore, X-ray sources based on TiO₂ nanotubes have a great potential of being a widely-used medical imaging device in the near future. I am very grateful for AAPM’s research support and highly appreciate the opportunity to work on feasibility studies of such X-ray sources.”



Zephyr McCormick

University of Washington Medical Center

AAPM Summer Undergraduate Fellow 2011

Zephyr reports: “Due to the generosity of the AAPM, I was able to spend the summer of 2011 in Seattle, WA working with **Dr. Lori Young** and her colleagues at the **University of Washington Medical Center (UWMC) Radiation Oncology Department**.

During my summer there, I was exposed not only to the daily routine of a Therapeutic Medical Physicist but also of a Dosimetrist, Radiation Therapy Technician, Radiation Oncology Physician, and Diagnostic Medical Physicist. The UWMC houses one of only a few Clinical Neutron Therapy Systems in the United States. Optically Stimulated Luminescent (OSL) dosimetry is widely used to measure exposure to ionizing radiation. The main focus of my summer fellowship was to help Dr. Young characterize the effect that neutron radiation has on OSL crystals in an attempt to determine the feasibility of using OSLs for neutron dosimetry. The combination of research and clinical experience culminated in a summer fellowship that was highly rewarding. It is my opinion that my summer at the UWMC has greatly prepared me for a future in Medical Physics by providing a rare opportunity to briefly integrate myself into a field that would otherwise be inaccessible at this stage in my education."



Dr. Hao H. Zhang
University of Maryland, School of Medicine
2011 AAPM Research Seed Funding Grant

Dr. Zhang was the recipient of the **AAPM Research Seed Funding Grant** entitled "Functional Imaging Based Radiotherapy." He reports that radiotherapy, including intensity modulated radiation therapy (IMRT) and volumetric modulated arc therapy (VMAT), has the ability to provide highly conformal radiation dose to irregularly shaped tumors while reducing the dose and consequently the toxicity to organs-at-risk (OARs). However, the ability relies heavily and often exclusively on medical imaging to determine the extent of disease and the spatial relation between target region and surrounding healthy organs. In current clinical practice, CT is the gold standard for anatomical definition of treatment targets and OARs. The limitation of developing treatment plans solely based on CT is the assumption of spatially uniform organ function. The functions of OARs, such as lung, liver and brain,



are not uniformly distributed throughout the whole volume. There is potential risk of distributing high dose to the area corresponding to high organ functions when organ function heterogeneity is not considered during the planning process. This can result in higher normal tissue toxicity or fatal radiation-induced complications. Functional imaging, such as functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and single photon emission computed tomography (SPECT), has the ability to provide physiological information. Advanced techniques have been developed for generating functional images from these modalities, such as tumor metabolism, ventilation/perfusion scans.

Dr. Zhang provided the following report on his work.

“With the support of the **AAPM Research Seed Funding Initiative** and the **Department of Radiation Oncology at University of Maryland School of Medicine**, and mentored by **Dr. Warren D’Souza**, my focus has been to develop a treatment planning framework that directly incorporates both anatomical CT images and physiological functional images. My approach currently applies to preserving lung ventilation and perfusion functions based on 4DCT and MRI images for locally advanced lung cancer patients, but can be easily adapted to other disease sites. Because of the low survival rate for lung cancer patients (average 5-year survival across all stages is only 14%), clinical trial data suggest increasing the prescription dose to improve the local control and overall survival. Since a large population of the lung cancer patients are heavy drinkers/smokers, the pulmonary function of the lung is weakened before treatment. Some patients are also suffering from chronic conditions such as COPD or emphysema. Increases in prescription dose will lead to increasing the risk of radiation-induced complications, such as pneumonitis and fibrosis, or other severe respiratory impairment. This can lead to substantial negative consequences on both clinical outcomes (symptom burden, therapy interruptions or dose reductions, life-threatening complications, and quality of life) and resource utilization (treatment of complications, hospitalization and emergency room visits, and staff time). So avoiding radiation-induced complications is critical when applying radiotherapy.

“My preliminary results demonstrated the feasibility to develop

high resolution voxel-based optimization approach to improve preservation of organ function. To avoid dose calculation inaccuracy when developing physiological radiotherapy approach, a Monte Carlo Kernel Superposition (MCKS) dose calculation method was utilized for aperture dose calculations as well as the final dose calculations. Exact optimization approaches, including Linear and Quadratic Programming, were applied to formulate and solve the functional dose optimization problem. In contrast to heuristic or gradient-based methods, these approaches guaranteed optimal solutions. Within the framework, instead of utilizing the function information in the same fashion across patients, we took one step further to not only incorporate heterogeneous pulmonary function during treatment planning but also generate personalized utility function for each patient. This tailor-made utility function based on each patient's pulmonary function distribution is the first step for personalized organ-function-based radiotherapy. Retrospectively evaluated with five locally advanced lung cancer patients, our method achieved significant reduction of fV20, fV30 and mean lung dose (p-value < 0.01). "

Two abstracts based on this research were presented at the 2011 AAPM Annual Meeting and 2011 INFORMS annual meeting. His most recent work has been submitted to the 2012 AAPM Annual Meeting.

1. **Zhang, HH, Mistry, N., D'Souza, W. Beyond Utilizing Functional Imaging for Contours and Visualization, Towards Physiological Radiotherapy to Improve Patient Outcome, 2011 Joint AAPM/COMP Meeting, Vancouver, July 31 – August 4, 2011.**
2. **Zhang, HH, Mistry, N., Meyer, RR, D'Souza, WD. Organ Function Based Radiation Treatment Planning, INFORMS Annual Meeting, Charlotte, North Carolina, November 13-16, 2011.**
3. **Zhang, HH, Diwanji, T., Mistry, N., Lu, W., D'Souza, W. Personalized Utility Function for Radiotherapy Based on Pulmonary Ventilation of Locally Advanced Lung Cancer Patients, submitted to 2012 AAPM annual meeting.**

As a result of this **Research Seed Funding Grant**, **Dr. Zhang** will receive a three-year (\$300,000) Varian Research Grant, as co-PI together with Dr. D'Souza, titled *“Combined Functional and Anatomic Imaging based Radiotherapy Treatment Planning.”*



Anisley Valenciaga
Summer Undergraduate Fellow, UCLA

As a junior student in college and a Biomedical Engineering student, **Anisley** became very interested in the field of medical physics. She participated in a research program at her undergraduate university, but decided that she needed more training and exposure to the field. She learned of the **AAPM Minority Undergraduate Summer Experience Fellowship** through her sister, who was one of the recipients in a previous year. She applied and was awarded support for a Summer experience.

Anisley reports: “I went to **UCLA** during the Summer of 2011 to participate in a research experience working in the **Radiation Oncology Department**. My project mentors were **Dr. Michael McNitt-Gray** and **Dr. Keisuke Iwamoto**. During this research experience, I performed experiments to compare the effect that 5-fluorouracil and IFN- β have on cell viability at different concentrations and irradiation doses. With this purpose, two cell lines (U87 and MCF7) were incubated with 5-fluorouracil (5FU) and interferon-beta (IFN- β), and irradiated in different combinations. It was found that higher concentrations of 5FU by itself reduce the cell viability in a steady decline. However, when treating the cells with IFN- β after 5FU exposure, the 5FU does not kill as many cells in high concentrations of IFN- β as in low concentrations. This finding opened the door for future projects to study the specific mechanisms of why this happened. Overall, the greatest decrease in cell viability was obtained with high concentrations of both 5FU and IFN- β together with radiation.

“This experience gave me the opportunity to learn different techniques, but more importantly, it allowed me to explore in more depth the field of medical physics. I was able to interact with students and faculty that work in the field, expanding my network

opportunities. After participating in this program, I became more interested in medical physics, and I feel strongly about pursuing a career in this field.

“The **AAPM MUSE Fellowship** benefited me and the medical physics profession. It helped me decide for a specific career choice. It also showed me that being a minority student is not an obstacle in pursuing a goal because minority students are also given opportunities at the academic and scientific level. Awarding me this scholarship benefits the medical physics profession in the future as well. By recruiting a dedicated and passionate student like me to this field, the number of professionals working in future advances and discoveries grows, guaranteeing the future of the medical physics profession.”



Scott H. Robertson

Duke University

AAPM/RSNA Fellowship in Imaging Medical Physics



Mr. Robertson's research aims to develop improved quantitative metrics of pulmonary function using functional imaging of hyperpolarized Xenon-129, and then translate their application into the evaluation of pulmonary disease management strategies. In hyperpolarized gas imaging, it is imperative to extract maximal image content from the large, but non-renewable longitudinal magnetization of each hyperpolarized gas dose. Therefore his contributions to this research will largely be in the optimization of image quality by utilizing under sampled image reconstruction techniques. In addition to starting his image quality optimization research, he has automated key portions of the clinical workflow. This optimization will enable the MR technologist to run hyperpolarized gas scans which previously had to be run by MR physicists. This type of automation of workflow will expedite the adoption of this research into clinical studies.

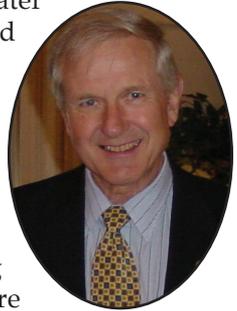
Mr. Robertson says: “The **RSNA/AAPM Graduate Fellowship** has helped to fund both my academic studies and research in the

Doctoral Medical Physics program at Duke University. The funding provided additional flexibility in my research, which allowed me to excel in my academic curriculum, while also making progress towards my research in Hyperpolarized gas MRI. This investment will not only benefit my studies and research, but will hopefully also improve patient outcomes. “



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. Current levels are insufficient to carry out our mission of much-needed educational and research opportunities for our young professionals. Our current contribution levels are a poor testament to our profession. If even half of the membership would contribute at the \$100 level, this would mean \$350,000 to support medical physics education and research.



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.

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