North American Chinese Medical Physicists Association

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NACMPA NEWSLETTER

Inside this issue:

President's Corner

NACMPA co-organized the 15th Asia-Oceania Congress of Medical Physics (AOCMP) annual meeting (jointly held by Chinese Society of Medical Physics (CSMP)) in the historical city of Xi'an, China, November 6-8, 2015, as well as the 1st Hefei International Forum for Radiological Medical Physics, in Hefei, China, June 13-14, 2015.

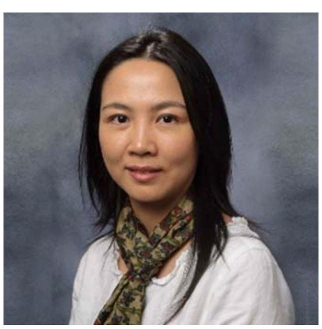
Many prominent NACMPA members have served as scientific committee members, keynote speakers and invited speakers, for the aforementioned conferences and several other medical physics meetings held in China, they include **Drs. Jun Deng, Lei Dong, Jianyue Jin, Zuofeng Li, Allen Li, Xiaoming Lu, Charlie Ma, Jie Shi, Brian Wang, Raymond Wu, Ying Xiao, Ping Xia, Lei Xing, Jack Yang, Fang-Fang Yin, and Ning J. Yue.** Their lectures cover a broad scope of medical physics research and practice, such as big data in RT, proton therapy, image registration, quality assurance, stereotactic body radiotherapy, etc.

Jackie Wu, Ph.D , FAAPM
President 2015-2016

Besides the on-going meetings, we also have broadened our scopes to participate in many trainings and seminars in China and Asia-Pacific regions, with our members' efforts to devote their knowledge, time and expertise to help improve the medical physics profession with our international colleagues. We hope to continue this great tradition in coming years and to make the NACMPA a great society. Welcome to our annual meeting!

Chair of the Board's Report

The 22nd Annual NACMPA Meeting at Washington, DC on August 3rd, 2016



Maria F. Chan, Ph.D. FAAPM
CHAIR OF THE NACMPA BOARD

Under the leadership of NACMPA president **Jackie Wu**, our annual NACMPA meeting was successfully held in Washington, DC on August 3, 2016. The NACMPA was formally founded in the United States in 1995 followed by the social dinner gathering of all Chinese physicists at the 1994 annual meeting of AAPM at Anaheim, CA. I attended the memorable first gathering in Anaheim when I was a PhD student. I was sitting right next to **Dr. Sou-Tung Chiu-Tsao,** who taught in the AAPM Summer School of Brachytherapy and initiated the Chinese gathering on Wednesday evening. I still remember the friendly and energetic atmosphere in the dinner meeting.

After 21 years of continuous growth, NACMPA became a truly international organization with more than 500 members, including 40 from outside the North America. With the increasing international recognition, NACMPA hosted the first international conference for Chinese physicists around the world in Lijing, China, 2011. Also, the organization launched the first officially endorsed scientific journal, International Journal of Medical Physics, Clinical Engineering and Radiation Oncology (**IJMPCERO**) in the Spring of 2012. There were about 200 physicists, vendors, and their families

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Dr. Cedric Yu received the Hall of Fame award.

Dr. Hualin Zhang received the Service award, in recognition of his outstanding service as secretary from 2013 to 2015.

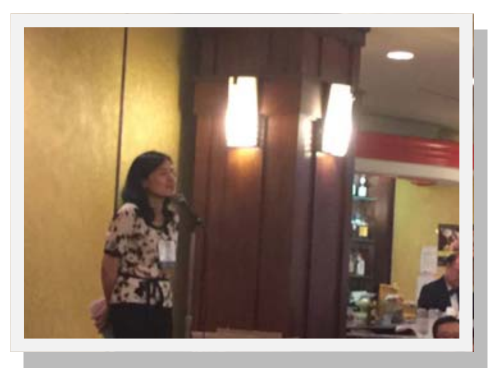
2016 NACMPA Annual Meeting - Washington, DC , August 3, 2016.

attended this year's annual meeting in a local Chinese restaurant. During the meeting, **Dr. Cedric Yu** received the Hall of Fame award for his long time contributions. At the meeting, **Dr. Zhigang (Josh) Xu** from Stony Brook University Hospital of New York and **Dr. Ming Chao** from The Mount Sinai Medical Center of New York were elected as the next President-elect and Treasurer, respectively.

The NACMPA Hall of Fame award is an annual award to acknowledge the individual who made an outstanding contribution to the field of medical physics through research or clinical work, or the individual who was outstanding in service in NACMPA. The former Hall of Fame recipients include **Drs. Clifton Ling, Andrew Wu, Raymond Wu,** and **Charlie Ma**.

For the past several years, the NACMPA has issued awards to manuscripts published inJMPCERO journal deemed by both the Board of Editors and NACMPA officers to be worthy of the designation "Best Papers." This year's NACMPA Award for Excellence for the best paper published during 2015-2016 in IJMPCERO was "Biological dose estimation model for proton beam therapy", Vol. 4(2):149-161,2015. The authors are **Drs. Vladimir Anferov and Indra J. Das.** Along with award certificates given to the authors at the annual meeting was a check of $500 paid by NACMPA to the first author. The journal is indexed in several world class databases and its papers are cited in many prestige journals. Since the IJMPCERO is not yet indexed in the PubMed, the accepted manuscript could be deposited in the PubMed Central (PMC) for NIH access .

Drs. Vladimir Anferov and Indra J. Das received NACMPA Award for Excellence for the best paper published during 2015-2016.



Rays of Hope: The Past, The Present and the Future of Radiotherapy

C. Clifton Ling, Ph.D., FAAPM
NACMPA Hall of Fame
Recipient 2008

Cancer has long struck fear in the minds of patients and their families. Through much of human history, the scourge of cancer most often led to death. But thanks to many factors, a large number of cancer patients today can expect to recover from this increasingly treatable illness. The National Cancer Institute of the United States estimates that the relative five-year survival rate for people with cancer has increased to 60 percent. This achievement is due, at least in part, to significant advances over the last 50 years in the technology for treating cancer with radiation.

While radiation therapy technology has progressed considerably in the last half-century, the basic goal of such treatment is unchanged: To target and kill cancer cells while exposing the surrounding healthy tissue to as little radiation as possible. Virtually all of the advances in radiation therapy have worked to achieve a more successful clinical outcome by increasing the intensity, precision, and accuracy of a radiation beam.

Early Forms of Radiotherapy

Radiation therapy was first introduced as a palliative treatment for cancer in the early 1900s. Devices, using primitive X-ray tubes, generated low energy radiation that was not sufficient to provide a cure or to even to penetrate the body very deeply. The best hope for a patient was for the radiation to shrink the size of the tumor and provide some measure of pain relief.

Around 1913, radium was being mined in America and General Electric used it to create a "Radium Bomb" used at short source to surface distance to treat superficial cancers of the breast, head, and neck lymph nodes. For brachytherapy, the radium or radon gas was put into small tubes and inserted directly into cancers or into body cavities containing cancer. But naturally-occurring radium was scarce and costly. Researchers later discovered how to use cyclotrons and nuclear reactors to produce synthetic "radium" and other radioactive elements for cancer treatment. After World War II, the cobalt machine, which used the reactor-produced isotope cobalt 60 (^{60}Co) to generate X-ray energies of about 1.2 million volts (MV), arrived on the scene.

The Modern Medical Linear Accelerator

Modern radiation therapy traces its origins to the invention of the "klystron" tube by brothers Russell and Sigurd Varian in 1937. First used in radar systems, the kystron could accelerate electrons through a vacuum tunnel to nearly the speed of light.

In the early 1950s, Dr. Henry Kaplan, head of Stanford University's Department of Radiology, proposed that a linear accelerator, or "linac," be specifically designed to generate high energy X-rays to bombard a cancerous tumor. The Varian brothers and several colleagues, who had formed a company called Varian Associates, developed a machine based on the klystron tube. It accelerated electrons and crashed them into a metal (usually tungsten) target to generate photons, or X rays, with very high energies. The first Varian medical linac produced an X-ray beam of 6 MV.

The new medical linac subsequently underwent a variety of transformations. In the late 1960s, Varian introduced an innovative "standing wave guide" that reduced the size, cost, and complexity of these machines and made them economically competitive with cobalt machines.

In the early 1970s, another important innovation, the "gridded electron gun," allowed precise dose regulation and very rapid beam stabilization, capabilities that were essential to the later development of today's most advanced forms of treatment, such as intensity-modulated radiation therapy and RapidArc™ volumetric radiation therapy. By this time, medical linear accelerators could produce X-ray beams of up to 18 MV, and by the early 1980s, a patented energy switch was added, making it possible to operate the accelerator at either of two widely separated energy levels. Varian's "C" series Clinac® linear accelerators, introduced in 1989, put beam generation and movements fully under computer control. These evolved into more advanced machines such as the Trilogy® machines, as well as the Novalis Tx™ for radiosurgery, capable of radiation dose rate of up to 1,000 monitor units (MU) per minute.

Beam Shaping Technology

During the evolution of the linear accelerator, another line of development focused on strategies for improving accuracy. Early linacs generated X-ray beams that were rectangular or square in shape and were directed at the tumor from two to four different angles. Naturally, tumors themselves are not square or rectangular, and so, these beams invariably encompassed some of the surrounding healthy tissues, resulting in unwanted side effects. This made it necessary for doctors to minimize the damage by using less-than-optimal therapeutic doses. Improvements were attained in the 1970s, when custom-molded, lead-alloy blocks and wedges were placed in the path of the beam to shape them so that they more closely matched the two dimensional profile of a targeted tumor. This spared some healthy tissue but the process was highly labor-intensive and time-consuming. The blocks were very heavy, had to be individually manufactured for each and every patient, and then, during treatment, loaded in and out of the machine by the radiation therapists.

In the 1990s, Varian achieved a significant advance with the development of its Millennium™ multileaf collimator (MLC), a special beam-shaping device. Today, Varian's highest resolution MLC has 120 computer-controlled slats or "leaves" that can be individually adjusted to shape the aperture through which the radiation beam passes. By changing the beam shape over time while delivering radiation, clinicians achieve very fine control over how, and where, the radiation is administered, and precisely conform the beams to the shape of the targeted tumor. The enhanced precision enabled radiation oncologists to boost the dosage of the X-ray beam to more effective treatment levels, improving outcomes and limiting side effects.

The IMRT Revolution

Parallel developments in software controls and the use of diagnostic imaging led to another leap forward: intensity-modulated radiation therapy, or IMRT. IMRT is based on the inverse treatment method approach in which the computer is asked to design the optimal approach for achieving the desired dose distribution using intensity-modulated radiation beams and a given number of beam angles. The adjustable leaves of the MLC are used to control not only the shape of the beam, but also the exposure duration for small segments of the tumor, effectively "modulating" the dose within the treatment area. Using this approach, higher doses can be concentrated in some parts of the tumor while lower doses can be used in other areas where nearby sensitive tissues need protection.

Since the early 2000s, further advances have made IMRT treatments even more accurate and faster to deliver. Image-guidance technology has improved tumor targeting by enabling clinicians to pinpoint the exact location of the tumor just prior to each daily treatment, effectively dealing with interfraction changes in tumor position and set-up uncertainties. And innovations like Varian's RapidArc™ radiotherapy technology reduce the time it takes to deliver a precisely-shaped treatment beam to just under two minutes, with just a single rotation of the linac around the patient. Other important advances are making it possible to measure and compensate for tumor motion due to respiration.

Stereotactic Strategies in Radiation Oncology

With technology enhancing the precision and the accuracy of treatments, radiation oncologists have become increasingly interested in using extremely accurate stereotactic approaches to deliver higher doses more precisely over a smaller number of treatment sessions. Conventional fractionation schedules, designed many years ago when treatments were less precise so that normal tissues would have the best chance of recovering, are being revisited, as stereotactic body radiosurgery (SBRT) is investigated as a potentially viable approach for treating small lesions of the lung, liver, and other areas of the body. In fact, within the last decade, SBRT has been established as an acceptable method for several types of cancers, e.g. prostate and lung. Some have suggested the acronym SABR (stereotaxic ablative radiotherapy) for treatments delivering only 3-5 fractions of 8-20 Gy per fraction. Responding to the need for geometrical precision and higher dose-rate of SBRT or SABR, Varian has introduced new treatment machines, specifically the TrueBeam™ and the Edge™. Both machines are capable delivering highly accurate radiation beams at dose rates of up to 2400 MU/min. While the TrueBeam™ is a comprehensive general purpose machine fully capable of SABR, the Edge™ is adapted and fully equipped specifically for SABR treatments. These enhanced capabilities have facilitated the increased use of SBRT/SABR techniques with effective treatment results and reduced medical costs.

Proton Radiotherapy

The unique dose deposition pattern of proton, with low entrance dose and much high dose at its path-end, the so-called "Bragg peak", offers potential clinical advantage of proton therapy (PT) over conventional photon therapy. There is growing interest in and enthusiasm for using proton therapy in cancer management, as evinced by the 40% increase in the number of proton therapy centers within the last three years, according to the Particle Therapy Co-Operative Group. However, the accumulating clinical data has not yet provided unequivocal demonstration of the increased effectiveness of proton therapy. While there may be many reasons for this lack of evidence to date, one speculation is that the real potential advantages of PT have yet to be realized clinically. Up to now, most of the proton patients have been treated with passively-scattered beam with the inherent disadvantage of increased dose to normal tissues. In addition, there are many treatment limitations and uncertainties that attend PT as practiced today, and these have yet to be adequately addressed.

Importantly, within the last 2-3 years, the most advanced form of proton therapy, using the pencil beam scanning (PBS) technology, has become available. With PBS-PT, 3D intensity modulated PT (IMPT) can be delivered, which avails dose deposition modulation in the direction of the proton beam. The term 3D IMPT is used to emphasize that dose modulation can be performed in 3 dimensions, whereas fluence modulation can only be achieved in 2D for IMRT. Concomitantly, as the number of centers using IMPT increases, research and development efforts are beginning to surge, and these will likely mitigate the many treatment limitations/uncertainties of PT as performed today. It is likely that improvement in the technological and physical aspects of PBS-PT will further enhance the potential benefits of IMPT, lead to better clinical outcome, and establish proton therapy as a standard treatment method for many types of solid tumors.

Looking Toward the Future

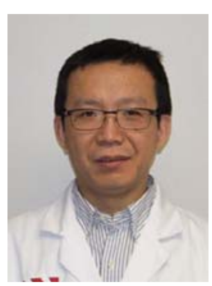
While predicting the future is difficult at best, there are trends poised to bear fruit and further enhance clinicians' ability to extend life for cancer patients and offer them a higher post-treatment quality of life.

With additional technological and physical advances, IMPT will be empowered and yield improved clinical outcome data relative to IMRT, particularly in the reduction of treatment morbidity. Proton therapy will be democratized and become widely available to cancer patients needing radiation treatment.

While challenges in assimilating "big data" still remain, eventually methodologies will be developed to personalize cancer management, and optimize the combination of radiation, surgery, and targeted molecular therapy. The use of molecular therapy will be facilitated by improved genomic testing and biomarker discovery.

Other unforeseen discoveries may also emerge, as exemplified by the recent clinical success of immunologic check-point inhibitors in a subset of patients, some of which (e.g. anti PD-1 and PD-L1) are effective in producing long term survival. That local radiation treatment can act as a cancer vaccine and enhance immunologic responses has stimulated tremendous interest in combining radiation and immunologic treatments.

With further advances in the many fronts outlined above, we hope to turn what was once a sure killer into a manageable disease for many more patients diagnosed with cancer.



Xiaofeng Zhu, Ph.D.,
NACMPA Webmaster

NACMPA would like to thank our member **Dr. Xiaofeng Zhu** for his daily work to keep the website updated and for his great effort in designing the best website possible. His contribution for coordinating memberships for various events, such as the NACMPA annual meeting in DC, 2016, is greatly appreciated.

NACMPA Travel Grants and Fellowships Application

X. Allen Li, PhD, FAAPM
NACMPA President-Elect

NACMPA travel awards

The NACMPA has established two travel awards per year, each with up to $2000, to support NACMPA members to travel to China or other relevant regions, to be determined on a case-by-case basis, for academic activities. These activities include attending scientific conferences in medical physics or radiation oncology, or visiting a medical physics related institution. The travel award program is designed to enhance scientific exchange between NACMPA members and the medical physicists in the host countries or institutions.

Eligibility Criteria:

Must be a member of NACMPA in good standing at the time of application.

Must give at least one research or educational presentation at the conference or the institution

Must be willing to write an one-page report describing the attended scientific activities one month after the completion of the travel. This report will be included in the NACMPA Newsletter.

Application materials to be submitted:

1. Statement describing the goals and motivation to attend the selected activities including the title (s) of the anticipated presentation (s).
2. Curriculum Vitae.
3. Budget indicating expected expenses.

All applications will be reviewed by the NACMPA board based on the following criteria:

- Appropriateness of selected activities
- Significance and overall impact
- Qualifications of applicant

Application Deadline: December 31, 2016, with travel to be completed by the end of 2017.

All application documents are due by the application deadline and should be sent to NACMPA Secretary at:

jing.cai@duke.edu

蕭安成教授
President, Chinese Society of Medical Physics, Taipei

醫學物理學在台灣發展的現狀-蕭安成

President, Chinese Society of Medical Physics, Taipei

台灣總計有77家醫療單位提供放射治療服務，設備則有135部 Linac、36部HDR Brachytherapy、19部Tomotherapy、6部Cyberknife、8部Gamma knife及1部質子治療系統。若以台灣人口計算，每百萬人的MV遠隔治療機數約為7.25部，與先進國家相仿。台灣約有205位臨床醫學物理師，其MV machines/MP約為0.82，則明顯高於先進國家。在台灣，醫學物理的組織是中華民國醫學物理學會Chinese Society of Medical Physics, Taipei；CSMPT），成立於1996年，目前會員數約為250人。學會例行性於每年8月舉辦為期兩天的年會，第一天的議程著重在教育訓練，第二天則設定不同主題邀請國內外學者分享研究新知，同時定有年輕學者、口頭與壁報發表競賽。此外，在台灣北、中、南及東部分別於每月舉辦月會，提供經驗分享交流的機會。

台灣醫學物理人力主要來自各放射相關研究所。學會定有甄審考試辦法，報考學歷為碩士以上，臨床訓練期放射科系碩士3年，博士2年，非放射科系碩士為4年。甄審考試每年一次區分筆試與口試。該項考試因為審核嚴格，在台灣放射治療界廣受肯定。對於通過甄審考試的物理師，定有在職進修學分辦法，必須在5年內修得足夠學分始得續保資格。

放射治療設備與技術在台灣是發展良好的。但是在醫學物理專業人力的部分則呈現顯著不足的情形，而具有博士學位的人數也遠低於先進國家。藉台灣正積極推展質子與重粒子放射治療的時機，期望在未來能促使醫療單位擴大進用醫學物理師，同時開拓在職博士進修管道，深化醫學物理專業的發展，為提升醫療水平做出貢獻。

Outlines of the Development of Medical Physics in China

Cancer Institute (Hospital), Chinese Academy of Medical Sciences

胡逸民 (**Yimin Hu**) 教授
Chinese Society of Medical Physics

Overview

Medical physicists (MPs) in China mainly work in radiation medicine, are mostly involved in Radiotherapy, Diagnostic imaging, Nuclear medicine, and Radiation protection. Radiation medicine needs expensive equipment, and highly depends on economy. The duties of MPs are including clinical service, R&D, and education and training.

Number of MPs

Thanks to the fast economic growth since 1978, radiation medicine develops quickly in China, and so is the number of MPs. The total number of MPs is estimated to around 3000, about 2650 in radiotherapy among them about 2500 work in hospitals, 100 in companies and institutes, 50 in universities.

Where are MPs educated?

About 150 MPs are recruited by hospitals every year, Only about 25 are graduated with medical physics degrees; All others are graduated with degree of other science/ engineer majors; A few universities and colleges have a medical physics program, such as Tsinghua University, Wuhan University, Peking University, Peking Union medical school, and Taishan Medical College.

How are MPs trained?

So far there is no MP residency program yet. Most junior MPs are trained by their senior colleagues; Some junior MPs may be sent out to prestigious hospitals for training of a few months to one year; MPs all have chance to join short term training courses/meetings.

MP Certification

There is a certification examination organized by Ministry of Public Health and Chinese Medicine Association. Junior MPs are required to pass this examination and get a certification after working for two years

Professional Body and Journal

Chinese Society of Medical Physics (CSMP) was founded in1981 (http://csmp.org.cn/), and jointed IOMP since 1986. Its official journal, Chinese Journal of Medical Physics, was founded in 1984 (http://www.cjomp.com). It is a monthly publication.

Problems in development process

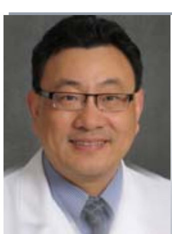
It is difficult for MPs to get promoted because there is no MP professional title series. Some MPs choose to leave hospitals to companies. More MP graduate programs are needed. Residency programs need setting up from scratch.

Prospects on MP in China

It is certain that the number of MPs will continue to grow quickly at least in next ten years. MPs must work together to overcome the problems hindering our development. Hopefully, MPs will be well recognized by other professions, patients, and government in five to ten years

Acknowledgement

Many thanks to Dr. Jianhua Geng from Cancer Institute (Hospital), Chinese Academy of Medical Sciences, and Dr. Ruijie Yang from 3rd Hospital, Medical School, Peking University for relevant information.



EDITOR'S NOTE

NACMPA NEWSLETTER is published by the North American Chinese Medical Physicists Association on a semiannually schedule. We welcome all readers to send us any suggestions or comments on any of the articles or new features to make this a more effective and engaging publication and to enhance the overall readership experience. Next issue: June 2017. Contact us @ http://www.nacmpa.org/

Editor: Zhigang (Josh) Xu, PhD

The 2nd Hefei International Forum for Radiological Medical Physics-2016

Brian Wang, PhD
NACMPA Board Members

The 2nd Hefei International Forum for Radiological Medical Physics (HIFRMP) was held at the University of Science and Technology of China (USTC) in Hefei , October 16-19, 2016. The annual event was organized and chaired by **Dr. X. George Xu** who is also the leading faculty member of a newly established medical physics program at USTC. Anhui Nuclear Society (ANS) and North American Chinese Medical Physicists Association (NACMPA) were co-sponsors of the annual event. Commercial sponsored include Varian, IBA and Mevion, etc. The theme of forum was on proton and heavy ion therapy with the following sessions: 1)Clinical efficacy of proton and ion therapy; 2)Necessity and feasibility of Chinese proton and heavy ion radiotherapy devices; 3)Current challenges and opportunities in clinical medical physics; and 4)Medical physics education in China.

NACMPA president, **Dr. Jackie Wu**, and the member-at-large, **Dr. Brian Wang**, were among the invited guest speakers that also include **Drs. Jeff Yue, Fang-Fang Yin, Peng Wang, Hsiao-Ming Lu, Zuofeng Li, Tim Zhu, Ronald Zhu, Charlie Ma, Lei Dong**. Prior to the conference, Dr. Jeff Yue, an alumnus of USTC's physics department who is returning to the campus for the first time after 29 years, delivered a passionate talk to a large crowd of USTC students on "Seeking the bridge between physics and medicine - from USTC to medical physics in North America". In the afternoon prior to the 2-day conference, a boot camp was held with 5.5 hours intense training courses and it was delivered by eight physicians and physicists from the North America. The topics were focused on proton radiotherapy and it was overwhelmingly well-received by more than 150 attendees.

The 1st day of the Forum composed two sessions each covering the topics of photon/proton/carbon ion treatment efficacy comparison, the necessity and feasibility of manufacturing equipment in China, challenges and opportunities of clinical medical physics issues on proton/heavy ion. During the two-hour lunch break, a young investigator symposium (YIS) oral presentation competition was held with ten finalists of the junior physicists and students. On the 2nd day of the Forum, presentations covered the state-of-art medical physics issues and training for the next generation of Chinese medical physicists. The top two YIS competitors also presented their research in a normal 15-minute time slot. The first place was won by Ms. **Lu Yang** from USTC and her research was "calculation of dose distribution in MRI guided proton radiotherapy with TOPAS Monte Carlo simulation".

More than 200 national and international experts attended the forum including radiation oncologists, accelerator engineers, medical physicists, faculty members, students and medical equipment manufacturers, officials from the city of Hefei which signed a contract with Varian earlier this year to construct a proton cancer center. The year of 2016 will be remembered as an important milestone in the history of proton therapy in China as the government also approved two R&D projects, each at 200 million RMB, to fabricate Chinese proton therapy systems in Shanghai and Wuhan. Taiwan is building the 2nd hospital on the island and Hong Kong is also in the middle of an actively planning process. Since its inaugural conference last year, the Hefei International Forum in Radiological Medical Physics has been appraised by attendees as one of the best of such kind in China in terms of the quality of speakers and the style in which scientific exchanges took place. Video recording of the event is available at http://hifrmp2016.csp.escience.cn. To join the invited speaker list for the next year, please contact **Prof George Xu** at xgxu@ustc.edu.cn.

North American Chinese Medical Physicists Association

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President-Elect: X. Allen Li, PhD (Jan 2017-Dec 2018)
Secretary: Jing Cai, PhD (Jan 2016-Dec 2017)
Treasurer: Pengpeng Zhang, PhD (Jan 2015-Dec 2016)

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Almon Shiu, PhD Jan 2011-Dec 2012
Maria Chan, PhD Jan 2013-Dec 2014

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Chairman:Maria Chan, PhD
Almon Shiu, PhD
Jackie Wu, PhD
X. Allen Li, PhD
Brian Wang, PhD

Nomination/Election Committee

Chairman: Maria Chan, PhD- Most recent Past President
Almon Shiu, PhD - Past President

http://www.nacmpa.org/