MEDICAL PHYSICS GAZETTE

NEWSLETTER OF ASSOCIATION OF MEDICAL PHYSICISTS OF INDIA (AMPI)

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Editorial Office:
Medical Physics Unit
IRCH, AIIMS
New Delhi – 110029
(M) 9810197511
(O) 011-26594448
Email: drpratikkumar@gmail.com

Editorial

MEDICAL PHYSICS GAZETTE: A COMMUNICATION CHANNEL AMONG AMPI MEMBERS

Association of Medical Physicists of India (AMPI) has completed 40 years of its existence. It is easy to note the changes which have occurred in Medical Physics profession in India since then. The most noticeable change is the spread of Medical Physicists across the length and breadth of the country due to boom in corporate and private hospitals offering cancer treatment. The crowd of youngsters in AMPI conference is easily discernible now-a-days which boasts of attendance of the good part of 1 k. It is natural that the present pool of Medical Physicists has members of all age-group from varied geographical locality having services in government sector, private sector, corporate hospitals and even freelance services having range of goals in their lives. Active communications among such diverse group is one of the most important threads that may help to make Medical Physics community a strong and well nit society. Keeping this in mind AMPI took initiative to start its first ever newsletter as an official yet informal channel of communication among all of us.

Therefore, it is inbuilt assumption that Medical Physics Gazette must display and express the views and aspiration of the general mass. I extend invitation to Medical Physicists to contribute their thought, suggestion, article etc. to Medical Physics Gazette to make it our true representative.

2017 is the 150th birth anniversary of legendary Marie Curie who was born in 1867 at Warsaw in Poland (then part of Russia). She has many firsts to her credit: first woman in Europe to earn doctorate, first woman to win a Nobel prize, the first person and so far only woman to win two Nobles and first woman who became professor at the University of Paris.

The first use of radioactivity to treat cancer was undertaken under her leadership. Madam Curie struggled against the existing parochial system to establish herself firmly in the contemporary science. The situation for women has improved since but a lot yet to be achieved. Women still face unfair treatment, discrimination and unfavourable stereotype social traditions. Under this backdrop Medical Physics Gazette organised a writing contest to highlight the issue related with women in the field of Medical Physics. The result of the contest is the part of this issue.

Chairmen and Secretaries of all chapters of AMPI are requested to send information of Chapters' Activities in the column meant for it. AMPI members may send information regarding their academic as well as social recognition under column Three Cheers, information regarding movement and joining new assignment, any scientific and relevant news from any source with reference, article related with medical physics, information about vacancies and availability of manpower both and views on contemporary issues under letter to the editors.

Let's make Medical Physics Gazette a means to disseminate information, motivating performance, prompting unity and improving morale of Medical Physicists of India.

Kindly send manuscript by email by **31st August 2017.**

Pratik Kumar

MESSAGE FROM THE DESK OF THE PRESIDENT, AMPI

"Live as if you were to die tomorrow. Learn as if you were to live forever'
Mahatma Gandhi

Great line by *Mahatma Gandhi,* the *Father of Nation*, which says learning, is a continuous process and there is always a room for learning in one's life. With such an objective in roots, Association of Medical physicist of India (AMPI) has started a "***Medical Physics Gazette***" a newsletter as mouthpiece of AMPI from this year to give one more wing to AMPI learning flight. This Medical Physics Gazette will definitely provide a great platform for all medical physicists and AMPI members to discuss or present their research, experiences, ideas and thoughts with others.

AMPI has started its journey with *Medical Physics Bulletin* in 1976 it was a quarterly publication. Great success of *Medical physics Bulletin* has converted it into a prestigious Journal known as *Journal of Medical Physics* in 1993, which is an official journal of AMPI. This time AMPI has started a newsletter namely ***"Medical Physics Gazette***" with a hope to promote, develop and increase academic strength of Medical Physics and Medical Physics community in India. I appreciate all the hardwork and sincere efforts of the AMPI academic team and the Editorial Board behind this wonderful initiative.

As a president of AMPI, I want to congratulate all the AMPI members and Medical physicist community for the first issue of AMPI Medical Physics Gazette with the emphasis on women physicists' participation as this is 150 th Birth anniversary of Mary Curie and appropriately chosen IDMP2017 theme is **Medical Physics: Providing a Holistic Approach to Women Patients and Women Staff Safety in Radiation Medicine** and wish all the success to it. I believe, it will achieve its objectives of promoting, developing strong academic environment between Medical physics community. I appeal all the Medical Physicists especially young Medical Physicists to take this opportunity and participate actively to enhance their concepts and academic orientation.

At last, I wish all the success to Medical Physics Gazette.

Prof. Arun Chougule
President
Association of Medical Physicists of India

MESSAGE FROM THE DESK OF THE SECRETARY, AMPI

Dear Esteemed Members of AMPI,
Warm Greetings!
It is a great honor and privilege to write this message and to interact with you all members of AMPI through this first issue of AMPI Newsletter namely "Medical Physics Gazette" in the capacity as a Secretary of AMPI.
Let me begin with congratulating all members of the AMPI and special thanks to the Editor-in-Chief Prof. Pratik Kumar for bringing this new inaugural issue of AMPI's newsletter and it's an immense pleasure to start the newsletter during our tenure.

As of today, AMPI has completed more than 40 years of its establishment. The development of Medical Physics profession in this country is progressing well for the benefit of members of this association. AMPI successful journey is reflected from its around 3000 membership growth, which not only spread across the country, but also globally. It is a great pride that AMPI has contributed to the world community of Medical Physics by giving its members as former President of International Organization for Medical Physics (IOMP) Dr. Madhuvanath in 90's and currently Dr. M.M. Rehani as Vice-President of IOMP. In this auspicious occasion, I take this opportunity to extend my gratitude for our distinguished and respected founding members, former officer bearers, executive and general members for significant contribution and achievements for the success of this association, which is evident by conducting scientific annual conventions and periodic journal publications and professional accreditation competency exams for our members to maintain the professional standard in order to provide quality service to mankind and directly to our nation.

It is my humble appeal to all esteemed members to introspect ourselves that in what way we, as an individual, can contribute to this world reputed scientific organization to further improve the status of Medical Physics profession and to make AMPI as a powerhouse of medical radiation scientists/physicists in the field of medicine which is, in turn, a call for contribution to our country.

With this message, I invite your creative criticism, suggestions, feedback and contribution for overall improvement of our association by exchanging your views and ideas through this official channel of communication of AMPI in the form of Newsletter.

Thanking you all for your kind support
With Best Regards

Dr. V. Subramani
Secretary, AMPI

PHYSICS ASPECTS OF ACUROS ALGORITHM

K.K.D. Ramesh, Chief Physicist & RSO, Manipal Super Speciality Hospital,Vijayawada.

Introduction

In Radio therapy treatment planning, Monte Carlo simulations (MCS) are golden standard of its accuracy, but calculation time is more. As we know that with number of events uncertainty comes down.

$$\downarrow \text{Uncertainty } \alpha \ 1/\sqrt{\ } \text{(no of Events } \uparrow)$$

i.e. by providing sufficient number of particle histories to Monte Carlo simulations (MCS), we will get accuracy but calculation time is more, as it is simulating more number of particles (no. of events). So always there exists a trade of between accuracy & speed. But in day to day clinical practice we require both accuracy & speed.

Alternate to MCS, Varian Medical systems, Pal Alto, California, USA introduced Acuros-XB® (AXB) algorithm to its Eclipse ™ treatment planning system with two strategic needs. Such as Speed & Accuracy, and the accuracy is comparable to MCS.

AXB uses a sophisticated technique to solve Linear Boltzmann transport equation (LBTE) [4]. As Boltzmann transport equation governs the behaviour of radiation transport particle. By using numerical methods AXB explicitly solves the linearised form of Boltzmann transport equation and directly accounts the effects of hetrogenties, in material like lung, bone, air and other non biological models. AXB simulates infinite no. particles so there will be no statistical noise but systematic errors are introduced because during dose calculation,

AXB uses discretization of variables in angle, space and energy. Even though it is simulating more no. of particles , calculation time is less because during dose calculation it uses discretization. If the size of the discretization is more calculation time is less, but compromising accuracy. So there is a limit of discretization of variable for optimal balance between accuracy & speed.

Dose Calculation in AXB done in two phases, in first phase: radiation beam fluence from LINAC head is done from sub- source model[1] i.e. (a)primary photons fluence from target which are not interacting with scattering foil , (b) secondary photons from scattering foil and collimator, (c)electron contamination near to the patient surface, (d)scattered photons from wedge.

In second phase: AXB calculates 3D dose in patient deterministically using 4 components: (1) Primary photon source model: AXB models the Beam source and a ray tracing is performed to calculate uncollided particle distribution for every CT voxel inside the patient contouring. (2) Scattered photon fluence & (3) Scattered electron fluence. AXB uses LBTE to provide solution for scattered particle distribution for each CT-Voxel inside the patient contouring. Once energy dependent fluence is obtained then dose value is calculated by the fluence based dose response function of that specific grid in step (4).

Computational Grid: As shown in fig (1) [a] AXB uses spatially variable computational grid and local element size is adopted & provides rigorous solution at each point in computational grid.

Cut off energy: AXB assumes if the energy of the particle is less than cut off energy, all the energy is deposited within the computational domain, if energy is more than cut off energy, particle is carry forward to next computational domain. Cut off energy for electron is 500Kev and for Photons is 1 Kev.

Voxel size: Range of the voxel in AXB is up to 3mm

Material assignment: AXB explicitly models the physical interaction of radiation in the material, it don't use generalised kernels like model based convolution algorithms. It requires chemical composition[1, 2] of each material in its computational grid to perform dose calculation. If mass densities are known for CT voxel from CT calibration curve as shown in fig (2) [2], AXB automatically assigns material for CT voxel from the table stored in Varian database[1]. In database it is having densities for biological material up to 3 gm/cc which is equivalent to bone and 16 non biological material densities up to 8gm/cc. If the densities are more from the density database, requires user assignment of material otherwise leads to error in dose calculation.

Dose reporting: Default dose reporting is Dose to medium in a medium ($D_{M,M}$ material based response function)

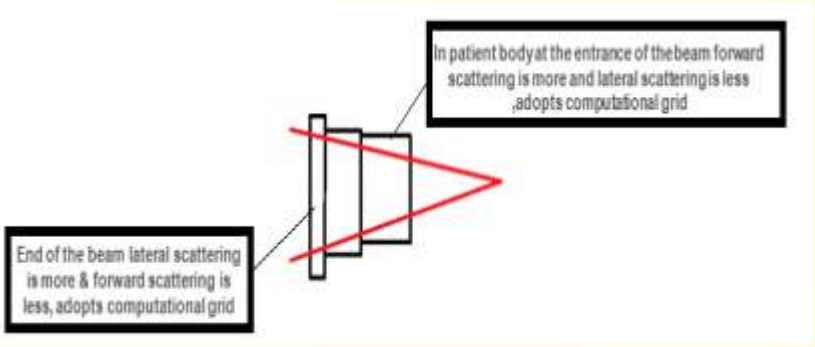

Figure 1[a]: Adoption of local element size depends on space angle & energy

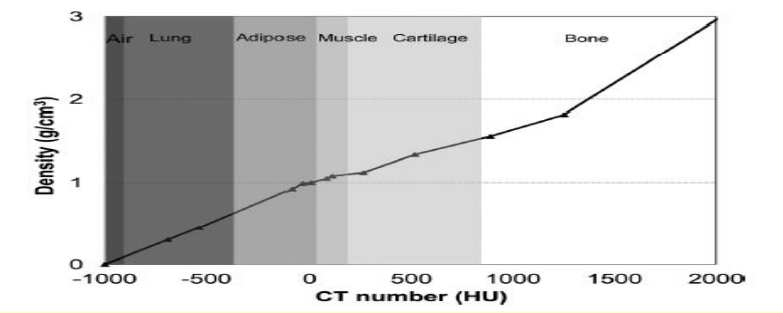

Figure 2[2]: Graph of CT number and material assignment

once material is known from CT number, then it calculates energy dependent response function based on properties of material corresponding to that voxel. Reporting of Dose to water in a medium $(D_{W,M})_{\&}$ Dose to water in a water $(D_{W,W})$ is also possible in AXB.

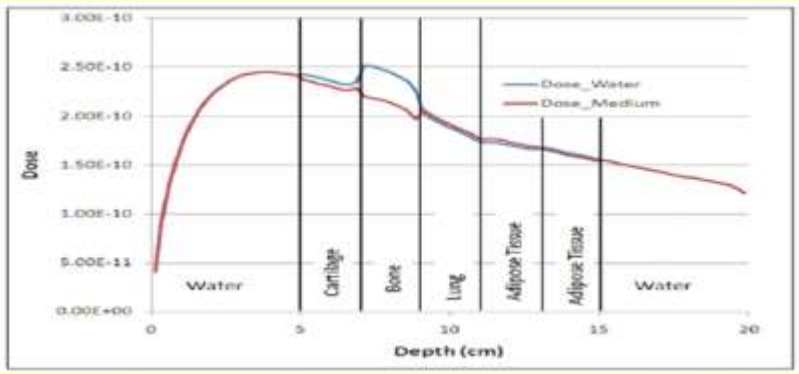

Figure 3[1]: PDD profile for 18 MV Photon beams at field sizes 5X5 cm^2 in a multilayered phantom lung slab [1]

From the graphs[1] in Fig (3) with the two reporting modes, in multi–layered phantom, electron transport is same but electron deposition energy is different especially at the interface of the material, this difference highlights the material significance of using actual composition.

AXB having unique option called "Planned Dose Calculation"; in plan dose calculation mode calculation time has very week dependence of number of fields. For example in five field IMRT, first it calculates primary fluence for each five individual beams, then scattered photon and electron fluence is performed only once for all beams in the plan. Once energy dependent fluence is obtained then dose calculation is done at 4th step. In five field 3DCRT, for each beam AXB calculates primary photon fluence and during the optimization by adjusting beam weights scattered photon & electron fluence calculation is done for each individual beam, so for 3DCRT AXB calculation time is more rather than the IMRT & Rapid ARC.

AXB is suitable for IMRT & Rapid Arc and is not suitable for 3DCRT. With increase of number of fields, relatively calculation time is less in AXB®. Some of the authors done validation of AXB with MCS, found AXB is good agreement with MCS[1,2]. Modelling of secondary electron transport done well, they are able to calculate dose deposition, in addition to all biological tissues, also in the presence of high-Z implanted materials. AXB has proven to perform better than other existing commercial dose calculation algorithms[2]. AXB balances both accuracy and computation speed.

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a. For the ease of readers understanding figure 1 drawn using MS-Paint.

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THREE CHEERS !!!

Dr S. Senthilkumar, Asst. Professor of Radiology Physics Cum RSO, Department of Radiotherapy, Govt. Rajaji Hospital & Madurai Medical College, Madurai, Tamil Nadu have won the First prize in the Best Paper Competition for his innovative work entitled **"Clinical experience with the indigenously fabricated Non Metallic artifact free CT fiducial marker"** at the 7th Cancer Conference International 2017 during 2nd - 5th February 2017 at HICC, Hyderabad . He has been awarded with Certificate and Rs. 50,000/- cash prize. Congrats !!!

RESULTS OF WRITING CONTEST

Pratik Kumar, Professor, Medical Physics Unit, IRCH, AIIMS, New Delhi

Medical Physics Gazette (MPG) organized a writing contest on the topic "**Women and Medical Physics: My take on Indian Scenario".** Though women were encouraged to participate in the contest the entry was open for all Medical / Radiological Physicists. We got 11 entries which were judged by 7 referees. It was heartening to note that 9 out of 11 participants (82%) were women and we may presume that female Medical Physicists utilized the opportunity to express themselves. The jury was comprised of senior women Medical Physicists and even sponsor of the prizes is a woman entrepreneur. Ensuring all these was a learning experience which indicated the skewed presence of fairer sex in all sphere of accomplishments. It is very clear that efforts must be made to ameliorate the situation.

The Super Six contestants according to merit are:

Ms. Richa Sharma, Delhi State Cancer Institute, Delhi (Average Percentile 94.07)

Ms. Ranjna Agarwal, Lions Cancer Detection Centre Trust, Surat (Av. Percentile 92.02)

Ms. Rajni Verma, SMS Medical College, Jaipur (Average Percentile 89.94)

Mr. Ashish Binjola, AIIMS, New Delhi (Average Percentile 89.86)

Ms. Nidhi Marjara, Max Healthcare Hospital, Delhi (Average Percentile 89.48)

Ms. Harpreet Kaur, Artemis Hospital, Gurgaon (Average Percentile 86.77)

Ms. Richa Sharma bags FIRST prize of Rs. 2000/-, **Ms. Ranjna Agarwal** gets SECOND prize of Rs. 1500/- and **Ms. Rajni Verma** stands THIRD to get Rs. 1000/- sponsored by M/S Meditornix Corporation.

We are thankful to following judges who took pains to evaluate the entries: **Dr Kamlesh Passi**, Ludhiana; **Ms. Deboleena Mukherjee**, Mumbai; **Ms. S. Mahalakshmi**, Mumbai; **Dr. N. Amudhavalli**, Chidambaram; **Ms. Anupama C.M.**, New Delhi; **Ms. K. Soubhagya**, Gulbarga and **Ms. L. Nithya**, New Delhi.

FIRST PRIZE WINNER ENTRY

WOMEN AND MEDICAL PHYSICS: MY TAKE ON INDIAN SCENARIO

Richa Sharma, Medical Physicist & RSO, Delhi State Cancer Institute, Delhi

In my view no profession can be complete without women. It's not about the numbers but it's about their contribution to each one of the profession. The relation of women and Medical Physics is as old as the discovery of Radium, which has set a milestone in the field of medicine and that has later been developed as a separate branch of radiotherapy known as brachytherapy. Maria Sklodowska, better known as Madam Curie was born in Poland on 7th November, 1867 and was the first woman who had received Nobel Prize both in Physics and Chemistry. Hence, she is the source of inspiration for all. In fact, she is the one who is inspiring our lives since primary school, where we were taught her biography. Whenever a girl/boy joins medical physics community, they wish to do better and contribute to medical physics.

But to do well in medical physics, a female medical physicist has to overcome many barriers,

It is vital to keep in mind that there is no "safe" dose of radiation to anyone of either gender at any age. Both cancer incidence and death are 50% higher for women. Radiation harm includes not only cancer and leukemia, but reduced immunity and also reduced fertility, increases in other diseases including heart disease, birth defects including heart defects. When damage is catastrophic to a developing embryo spontaneous abortion or miscarriage of a pregnancy may result. So first of all, a female medical physicist has to make her understand that working in Medical Physics involves risk and she is ready to go for it.

Secondly, in our country people are not much aware about radiation and its useful applications, rather they are scared of radiation. A female medical physicist need to make her family understand that it is safe to be in such a profession that deals with radiation.

Moreover, since Medical Physics in India is a rarely known subject even to scientific community. Thus, it is just assumed to be a professional course after which one gets a routine job in hospital, that's it! In India, research in Medical Physics is following the speed of turtle, although technology is getting advanced at rocket speed. A study by UK psychologists has shown that, "women really are better than men at multitasking". Hence, balancing between a routine job and family life is not a big issue like in any other profession. But if she thinks to expand her working area to research she has to get worried about the fact that she cannot afford to stay for long in evening in a laboratory or hospital for her research work. The reason is not only the degraded quality of family life but rather is the insecurity that she experiences while coming back to home during late night. Not only that but also she has to face a society, comprising of neighbours and relatives who are almost always ready to pass comments like "she gets back to home very late.", "what are her office timings?" And she has to answer them as well.

Furthermore, she needs to show her competency again and again at her workplace due to some of the colleagues who believe that women are not as good as men in Medical Physics. Such people should not forget the mother of radiation Marie Curie. Even in radiology the first x-ray image taken by W.C. Roentgen was that of her wife Anna Bertha Ludwig's hand who used to inspire him for his work.

Besides this in case she has a great job in one city and is doing well if she gets married to someone in another city where no vacancies are available at that time, she is left with no other option than just sitting at home and waiting for the vacancy. This may add a noticeable time gap in her curriculum vitae which is an unavoidable circumstance.

Also in metropolitan cities, like Delhi, Mumbai etc. most of the private hospitals are not willing to hire a female medical physicist due to the women safety issue in these cities, which is another hurdle that is to be faced. Moreover, she can not avail maternity leave, if she works in a government hospital on contract basis. The only option that is left for her is to resign from her post. Since there is saturation in market for Medical Physics jobs, hence at the time of resignation she is never sure whether she will be able to get back to same centre in future or not.

While writing on such a topic "Women and Medical Physics: My Take on Indian Scenario", as a young medical physicist, a few questions that came to my mind were, how many of the female medical physicist in India have been an EC member and how many of them have been the President of AMPI? How many of them have received young scientist award or Dr. Ramaiah Naidu award? How much they have contributed to research and paper publishing? Finally, I came out with a list of female medical physicists who are although small in number but their contribution to Medical Physics field was not at all small. There exist female medical physicists who have done a lot of work in Medical Physics and have represented our country at international level as well. In spite of all the obstacles such great female medical physicists are the constant source of inspiration for us to achieve more and to do better. I have been lucky enough to work with a few of them. In my short career of less than 4 years what I have observed is, only a very few of the female medical physicists participate in most of the conferences, their participation should increase. The continuously increasing number of female medical physicists in the country is a ray of hope and I believe that the contribution of women in Medical Physics will also rise with time like other professions.

BREAKING NEWS

College of Medical Physics of India (CMPI), an autonomous academic wing of AMPI is organizing 1st CMPI Refresher Course at Mumbai during June 23-24, 2017 aiming to stimulate the potential aspirants for CMPI Certification Examination due on 5th August 2017. The course fee Rs. 1000/- includes hostel accommodation, lunch and dinner. For details contact **Dr Jamema Swamidas** (svjamema@gmail.com). "This time, there are record-breaking 35 applicants for CMPI Exam 2017" said **Dr KJ Mariadas**, Secretary, CMPI in an informal chat. The Chief Examiner **Dr SD Sharma** informed that revised scheme of examination has probably attracted the youngsters. Registrar **Dr S Dayanand** quipped that written examination is to be held at multiple centers but the oral examination is on 3rd Nov. 2017 at Jaipur, the venue of AMPICON-2017. **Dr T Ganesh**, Vice-chairman stressed that such competency certification by an independent body indicated the academic and practical ability of the professionals and such practices were standard in many developed countries. The Chairman **Mr VK Sathiya Narayanan** with Board Members **Dr Pamidighantam Suresh** and **Mr Raghavendra Holla** have extended their good wishes to all the candidates who are taking up CMPI certification examination meant for qualified Medical Physicists with 2 years hospital experience.

EMPLOYMENT NEWS

Two vacancies of Senior Residents are available at Deptt. of Radiological Physics, MDM Hospital, Jodhpur, Rajasthan with salary Rs. 57000/- approx. for the candidates with M.Sc. Physics plus DipRP or M.Sc. Medical Physics. Kindly contact **Prof. Devesh Gupta,** HOD (gup_dev65@yahoo.co.in).

THREE CHEERS !!!

Mr. Devi Prasad Pandey, Asstt. Professor, Deptt. of Radiotherapy, S.S. Medical College, Rewa, Madhya Pradesh was awarded **AMPI Meritorious Medical Physicist Award for the year 2016** during 37th Annual Conference at Hyderabad in recognition of commendable service rendered with limited resources in a rural area. Congrats !!!

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Bergen Healthcare Pvt. Ltd.

#305-306, Magnum House I, Karampura Commercial Complex, New Delhi 110015 (India)

Ph:+91 11 2592 0283~6 Fax: +91 11 2592 0289

E mail: info@bergengroupindia.com; r.chaudhry@bergengroupindia.com; Website: www.bergengroupindia.com;

Branch offices: [SCO 272, 2nd Floor, Sector 32-D, **Chandigarh 160030,** Phone: 0172 2609901, 2608719, Telefax: 0172 5009930],

[# 3668, First Floor, 8th cross,13th D Main, HAL 2nd Stage, Indiranagar, **Bangaluru- 560008,** Karnataka Tel : +91 80 42152861, Fax : +91 80 25211862]

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