

INTERNATIONAL COLLEGE ON MEDICAL PHYSICS AT ICTP – 30 YEARS SUPPORT FOR THE COLLEAGUES IN LOW AND MIDDLE INCOME COUNTRIES

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Abstract—The ICTP College on Medical Physics celebrated its 30th Anniversary during 2018. Over this period the College has educated c.1200 participants from over 100 developing countries. Many of the College past students have become professional leaders in their countries - in particular from Asia, Africa, Latin America and Eastern Europe. The success of the College on Medical Physics has triggered other medical physics activities at ICTP. The paper presents brief statistics and results of the College, showing its international impact.

In 2018 the College on Medical Physics at ICTP (the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy) celebrated its 30th Anniversary. The first College on Medical Physics at ICTP was conducted in 1988. The purpose for establishing a College was to support colleagues from Low and Middle Income (LMI) countries (aka developing countries). It was originated by Dr Anna Benini (at that time IAEA expert) and was supported over the years by Prof. Luciano Bertocchi (at that time ICTP Deputy Director). Both continue to be at the heart of the College and other medical physics activities in the ICTP. The college was strongly supported by all ICTP Directors: from Prof. Abdus Salam, to Prof. Virasoro, Prof. Srinivasan and now Prof. Quevedo.

Since the start in 1988 the ICTP Medical Physics Colleges were held during 1990, 1992, 1994, 1996, 1999, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018. Over the years the College Directors included: A Benini, L Bertocchi, J Cameron, F De Guerrini, S Mascarenhas, R Cesareo, P Sprawls, J Chela-Flores, S Tabakov, G D Frey, F Milano, M DeDenaro. The faculty of lecturers included eminent specialists from many countries.

In 2001 the Coordinating Directors (P Sprawls and S Tabakov) modified the teaching programme to develop the participants as more effective educators in their institutions. This “Train-the-Trainer” approach had three components, as described later. This was of special value to colleagues from LMI countries— gradually building their knowledge necessary for the clinical application of digital medical imaging. The materials presented to each student after 2002 were enriched with purpose built e-learning materials. This

facilitated the global dissemination of the knowledge from the College, as many of the College students used these materials for their teaching activities and organising courses in their countries. The new programme structure also allowed the College to be condensed in 3 weeks (from 2008) and to introduce to each College a different emphasis. This structure allowed introduction of laboratories with computer simulations, and further practical labs at the Trieste Hospital. These principles continue to be the backbone of the College and is highly appreciated by all students.

The materials from the ICTP College on Medical Physics were used for similar activities in India, in South-East Asia and in Latin America and Caribbean Region. All Colleges after 2002 also include a Workshop, where students present the main professional and educational activities in their countries. This exchange of experience facilitated the creation of professional networks, which they continue to support.

From 1988 to 2018 the College has had approximately 1200 students from over 100 countries, these were students with ICTP support plus self-funded attendees and ICTP associates and students. 31% of all students are women. The percentage of women grew from 15% at the beginning to 42% in recent years. In the period 2002-2018 the College students were c.700 from 89 LMI countries (Fig.1)

Many of the students from the ICTP College on Medical Physics became respected medical physicists and leaders in their countries who established Academic Departments and Societies; became Professors, Heads of Departments and Officers of their Societies; took active roles in the further professional development and healthcare provision in their countries; took part in various international projects, including the Multilingual Medical Physics Dictionary. Our data after 2002 shows that 35 men and 16 women, College students from 25 countries, have become professional leads in their countries and regions. Many other College students have later organised University programmes and short courses in their countries. Over the years the International College on Medical Physics at ICTP has become a real

ICTP Colleges on Medical Physics (2002-2018) – student's countries of origin:

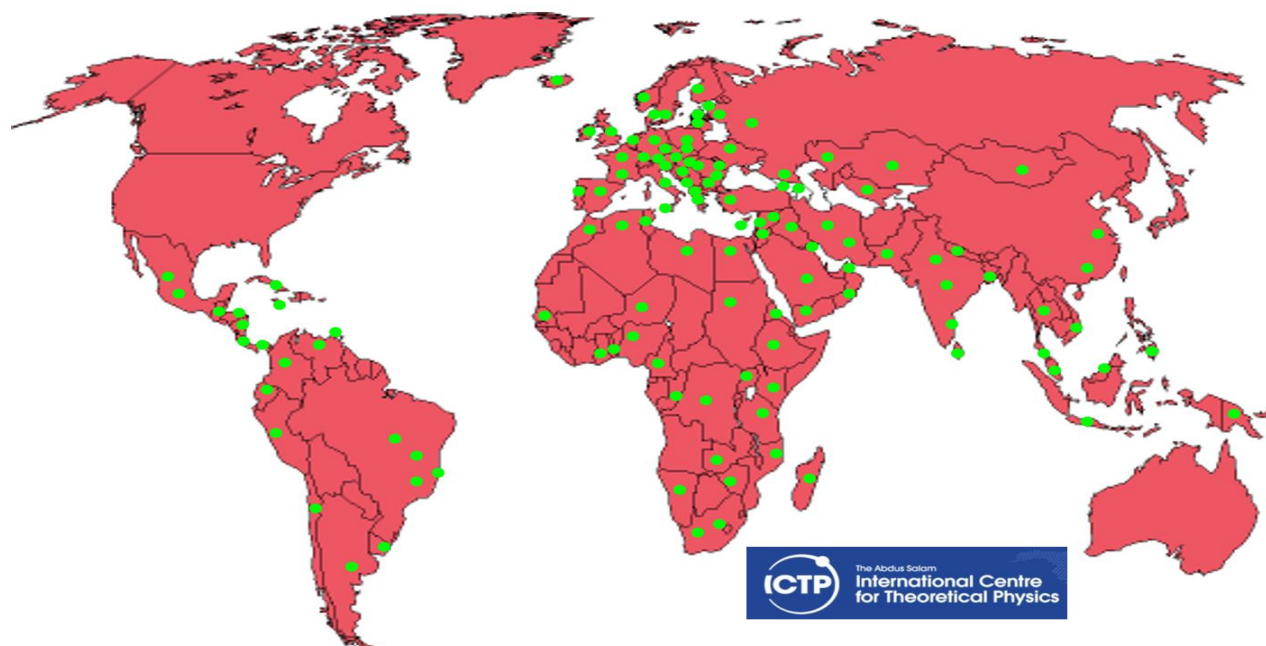


Fig.1 ICTP Colleges on Medical Physics (2002-2018) – students from: Albania, Algeria, Armenia, Argentina, Bangladesh, Belarus, Bosna, Brazil, Brunei, Bulgaria, Burkina Faso, Cameroon, P.R. China, Chili, Croatia, Columbia, Congo, Costa Rica, Cote D'Ivoire, Cuba, Czech Rep., Ecuador, El Salvador, Estonia, Ethiopia, Egypt, Eritrea, Georgia, Ghana, Guatemala, Honduras, Hungary, India, Indonesia, Iran, Iraq, Jordan, Kenya, Kuwait, Latvia, Lebanon, Lesotho, Lithuania, Libya, North Macedonia, Madagascar, Malaysia, Malawi, Moldova, Mongolia, Mexico, Morocco, Montenegro, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Peru, Philippines, Papua New Guinea, Panama, Pakistan, Poland, Romania, Russia, Serbia, Senegal, Slovenia, Slovakia, Sudan, Syria, Sri Lanka, South Africa, Tanzania, Trinidad and Tobago, Thailand, Turkey, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela, Vietnam, West bank, Yemen, Zambia, Zimbabwe (some College participants have come from High Income countries, where they have studied).

beacon of medical physics for colleagues from LMI countries. Its international impact has been particularly strong in the countries of Asia, Africa, Latin America and Eastern Europe.

A major College objective is to develop the students as educators who can create within their countries effective programmes in medical physics (imaging and radiation safety). This is achieved through the combination of three specific activities:

- (i) providing guidance on modern imaging methods and related radiation safety;
- (ii) providing instruction on the process of learning and teaching and the development of appropriate educational programmes for their institutions;
- (iii) providing students with extensive high-quality teaching materials/resources to be used in their courses.

The educational activities in the College have been innovative from the very beginning. Because of the College in 1995 the ICTP was included in the project EMERALD, that developed one of the first e-learning materials in the world. As a result in 1996 the College introduced in its curriculum e-learning, thus becoming the first educational activity in medical physics to embrace this new type of learning. Later all its students received full sets of lecture

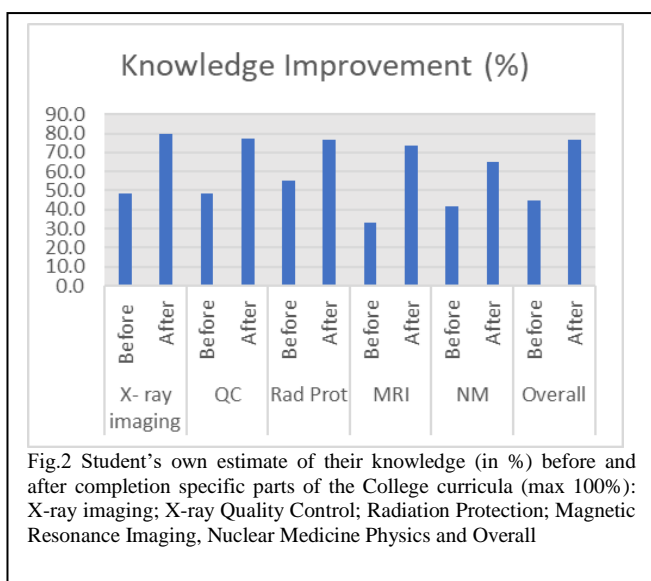
notes and Power Point presentations, plus copies of the above e-learning materials, which they could use in their countries. The Feedback collected from all College students shows that this was highly appreciated and most College participants have made plans during their stay at ICTP how to apply these materials in their practice.

The first major educational websites in medical physics www.emerald2.eu and www.sprawls.org were introduced in the College and the feedback was used for their updates. This early connection of the ICTP College with e-learning led to involvement of the applicants in other e-learning activities in their countries. The latest feedback questionnaires show that 66% of the students already apply e-learning in their teaching activities through the materials given to them at the College, and 27% plan to take part in further e-learning activities.

The needs of the ICTP College students for translation of some teaching materials into their own languages triggered in 2002 the development of the Multilingual Dictionary of Medical Physics Terms through the projects EMIT and EMITEL. A number of College participants took part in this activity, which is now freely available to all through its web site www.emitel2.eu (interlinked with the e-Encyclopaedia of Medical Physics).

Applications to the College (currently 300+ applications for 40–50 places) show its popularity amongst young medical physicists from LMI countries.

One particular strength of the College is the emphasis on Quality Control (QC) of X-ray Equipment – one of the most widely used medical technologies. The EMERALD protocols were of significant importance for this activity. These are still some of the most widely used parts of the whole EMERALD package in many LMI countries. Some of these protocols were used in the College as Computer Labs and from 2010-12 these were additionally strengthened by practicals in the Trieste Hospital. The QC practicals in Nuclear Medicine and practicals in Radiation Protection were also added to the College curriculum. This reflected in significant increase of students’ knowledge in these fields – see the survey results in Fig. 2.



These results are further supported by the overall 94% positive feedback from the College (mean 4.7, st.dev 0.2), where the students had to grade anonymously from 5 (excellent) to 1 (unsatisfactory) the following questions:

- 1.Are you satisfied with the organisation of the College?
- 2.Do you like the ICTP teaching facilities?
- 3.Do you find the topics useful for your future activities?
- 4.Do you exchange valuable information with your colleagues in the College?
- 5.Are the lectures accessible?
- 6.Did you find-the Computer labs useful?
- 7.Do you like the Teaching materials received?

The students who indicated that they have attended other medical physics courses before ICTP varies over the years from 25 to 44%. They all highly valued the College information, its detail and presentation, as well as the practical knowledge they have received at ICTP.

Another strength of the ICTP College is the inclusion of instructions on the process of learning and teaching. Special Workshops were introduced where College participants present and discuss the professional and education activities in their countries. These Workshops were associated with class discussions and exchange of expertise on the subject. This resulted in the introduction of many improvements in medical physics teaching, as well as establishment of new educational courses and forming stable links between lecturers from different countries. Some of these led to later formation of educational projects supported by the IAEA and other institutions. In 2016 the most innovative ideas and achievements were supported through the newly established Emerald Award.

The information from these Workshops was published in the book *Medical Physics and Engineering Education and Training – part I*, ISBN 92-95003-44-6, ICTP, Trieste, Italy 2011, (edited by S Tabakov, P Sprawls, A Krisanachinda, C Lewis). The book includes information about the educational activities in 27 countries (plus 9 Institutions and projects). A new book on the subject (part II) is in preparation at the moment. These publications present the vector of professional development not only in LMI countries, but also in the developed countries.

A most important impact of the College is that after their graduation more than 80% of the College students have clear ideas how to spread the knowledge from the College in their countries and how to boost the development of medical physics there. Indicatively, during the past 10 years the number of students who know other ICTP College participants in their countries has risen from 62% to 80%. While we could not establish the exact number of Professors, course Directors and Society Officers from LMI countries, who have studied at the ICTP College, our students report that many of their teachers or senior colleagues have participated at the ICTP College. At the other end of this scale are some College students from LMI countries, who inform that they are the first people in their countries to have some education in medical physics.

The College on Medical Physics 2018 introduced online teaching. This added significant value to the program by having live presentations and discussions by international experts from other countries directly with the students in the ICTP classroom. Also there was expansion of the practicals in Trieste Hospital, plus visits to the Udine Hospital, and introduced medical equipment management topics. This way the students could also learn how to organise medical physics departments and activities associated with maintenance of the equipment in their countries. The College lecturers and leads deliver for free their teaching and provide free access to all their educational and e-learning materials. This secures more resources for supporting the travel of some students to the College. We

have to underline that the ICTP College do not charge participants with attendance fees and provides free accommodation for most students from LMI countries.

Over the years ICTP appreciates the College on Medical Physics as one of its very successful activities in the field of applied physics. In 2005 ICTP was Co-Organiser of the UNESCO World Conference on Physics and Sustainable Development (November 2005, Durban, South Africa). At this high-level international event the case of “Physics and Health” was presented by P Sprawls, D Van Der Merwe, S Tabakov and A Niroomand-Rad. Following this the Conference selected this area of applied physics to be one of the four main UNESCO Millennium Development Goals with special importance for the years ahead.

The success of the College on Medical Physics led to opening and supporting of other medical physics activities in ICTP – notably various IAEA Courses. In 2015 ICTP started a regular activity - School of Medical Physics for Radiation Therapy (in alternating years with the College). This School is headed by R Padovani, with the support from EFOMP, IOMP, AAPM, IAEA and ICTP. This School just had its 3rd delivery.

In 2004 the College Directors (S Tabakov, P Sprawls and L Bertocchi) discussed with the ICTP Director the idea of forming a regular post-graduate educational course in ICTP. This continued to be discussed and updated until in 2014, when ICTP formed an alliance with the University of Trieste, resulting in the first international MSc programme in Medical Physics, headed by R Padovani and R Longo. This MSc on Advanced Studies in Medical Physics, with IAEA support, has already produced several alumni and has the strong support of the Italian Association of Medical Physics. In 2016 IOMP (the International Organization for Medical Physics) provided International Accreditation for this MSc programme. At the end of this issue of the MPI Journal are the abstracts of the Master Dissertations of the students from the MSc graduation in December 2018.

The MSc students and College participants have a number of joint activities. Some young colleagues from both groups take part in research activities organised by ICTP – the Programme of Research and Training in Italian Laboratories (TRIL) and become ICTP Associate Members

The ICTP College was also the reason for the ICTP to host some other Medical Physics Conferences – Regional, EFOMP and International, including the first International Conference for Medical Physics Training (1998), the first International Conference for e-Learning in Medical Physics (2003) and the International Conference “Medical Physics Encyclopaedia” (2008).

The College students, and indirectly - their students, have become a very important part of the healthcare delivery in LMI countries. On the occasion of the 30th Anniversary of the ICTP College on Medical Physics a special Gratitude Folder was presented to the ICTP Directorate, which includes photos from all Colleges and other medical physics activities in ICTP, Trieste (Fig. 3). The Folder also includes appreciation and gratitude emails from College students from 42 countries (in the period 2010-2018), available from: <http://indico.ictp.it/event/8296/material/3/>

The education and training activities of the ICTP College on Medical Physics will be pivotal in the dealing with the current challenge confronting the profession – the global shortage of medical physics specialists, especially in many LMI countries and, related to this, the need of almost tripling the medical physicists globally by 2035. The ICTP College on Medical Physics students (and their students) have made the physics applied to medicine an inseparable part of the lives of millions of patients globally.

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Fig.3 ICTP College on Medical Physics 2018 presenting to ICTP Deputy Director Prof. S Scandolo a Gratitude Folder from students and College Faculty: R>L: R Padovani, P Bregant, M DeDenaro, F Milano, S Tabakov, S Scandolo, A Benini, L Bertocchi, S Radosic (missing Faculty on photo: P Sprawls, A Seibert, J Oshinski, M Stoeva, S Tipnis, Prof. F Quevedo)