IRPS BULLETIN

Newsletter of the International Radiation Physics Society

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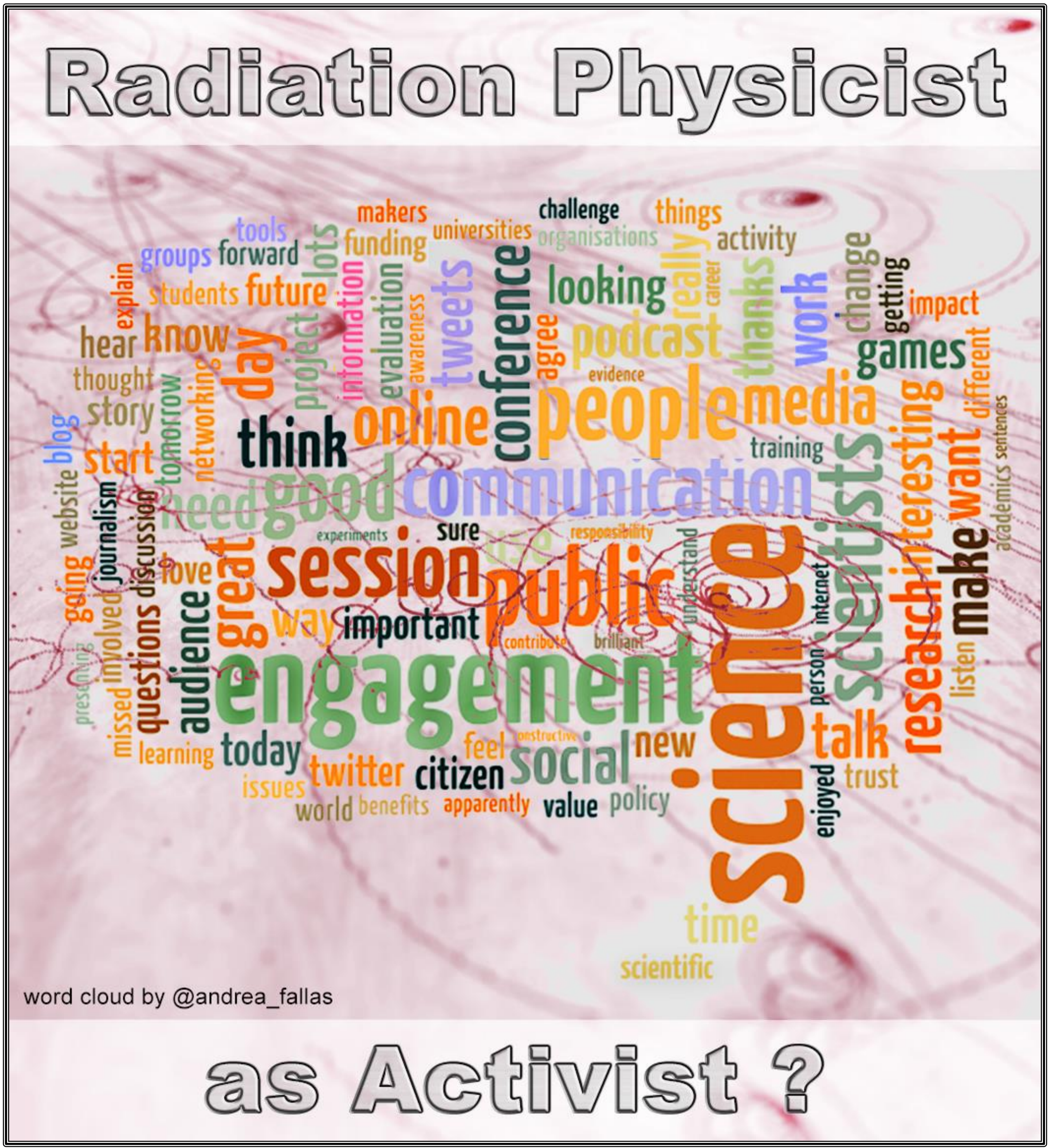

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(Transfer to new Canberra University site now complete !)

And we have a developing "sister website " : http://radiationphysics.org/

Contents of this Journal

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From the Editors

We continue to hear that public understanding of science is in crisis, requiring a public that is somehow more engaged with science and technology by vocational scientists themselves.

Welcome to this special "theme" issue of the Bulletin of the International Radiation Physics Society. The cover art and articles within explore the question : should radiation physicists be activists in the public arena?

This month's President's Column laments the uninformed state of the general public, and the drag this has on eliciting the fruits of tomorrow's science from today's visionaries.

A scientifically-literate public is necessary also for a society's robust and continued funding of the hard sciences. Alas, we researchers are said to generally do a poor job "selling our wares" in the public arena. We would rather be doing the work we were trained to do.

But not so fast : are not writing proposals, giving talks at meetings, giving VIP tours of our labs, and writing publicity highlights for our institutions a form of promotion of the science we do? We already possess many of the skills needed to perform public outreach, toward the end of an informed populace, increased public funding, and finally to outcomes that meaningfully improve the lives of others.

What then is a Radiation Physicist to do ? ! Options are easily imagined, to mention but a few:

- volunteer as a docent at a participatory science museum
- offer physics demonstrations in your child's classroom
- speak at social clubs about your research and the joy and challenges of that pursuit
- produce a laser light show at a neighborhood party (see photo below)
- write a science blog that welcomes non-scientists and demonstrates in the first person how the scientific method works
- visit legislative offices to communicate how local research institutions benefit the local community
- give public tours of your lab and hold theme-based, open-house events
- contact your local newspaper with general-interest stories arising naturally from your research
- encourage funding agencies to require a fraction of the grants be spent on communicating the results and their significance to the tax payers who paid the bill
- contribute to one of the various symposia or journals dedicated to public communication of science and technology
- influence local school-board science textbook selection
- write letters-to-the-editor when "voodoo science" needs countering, such as homeopathy and the wearing of magnets to alleviate disease
- encourage physics societies to give awards for communicating the beauty and unifying power of their research to diverse audiences
- introduce science and its evolving findings through the vehicle of general-interest narratives of the history and biography of science and scientists
- support quality science TV programming (think Cosmos, not Ancient Aliens)

Also in this issue, member Sameen Ahmed Khan reports on the celebration in 2014 of the official United Nations International Year of Crystallography, and 2015 as the International Year of Light and Light-based Technologies. Keeping with the theme of this issue, he points out that these international observances offer excellent opportunities to present the case of radiation physics and radiation facilities to the public and policy makers, including government officials.

IRPS Vice President Christopher Chantler also highlights the Australian connections to the International Year of Crystallography, and on topic, the occasional scientist-politician divide that opens up between dollars and "sense."

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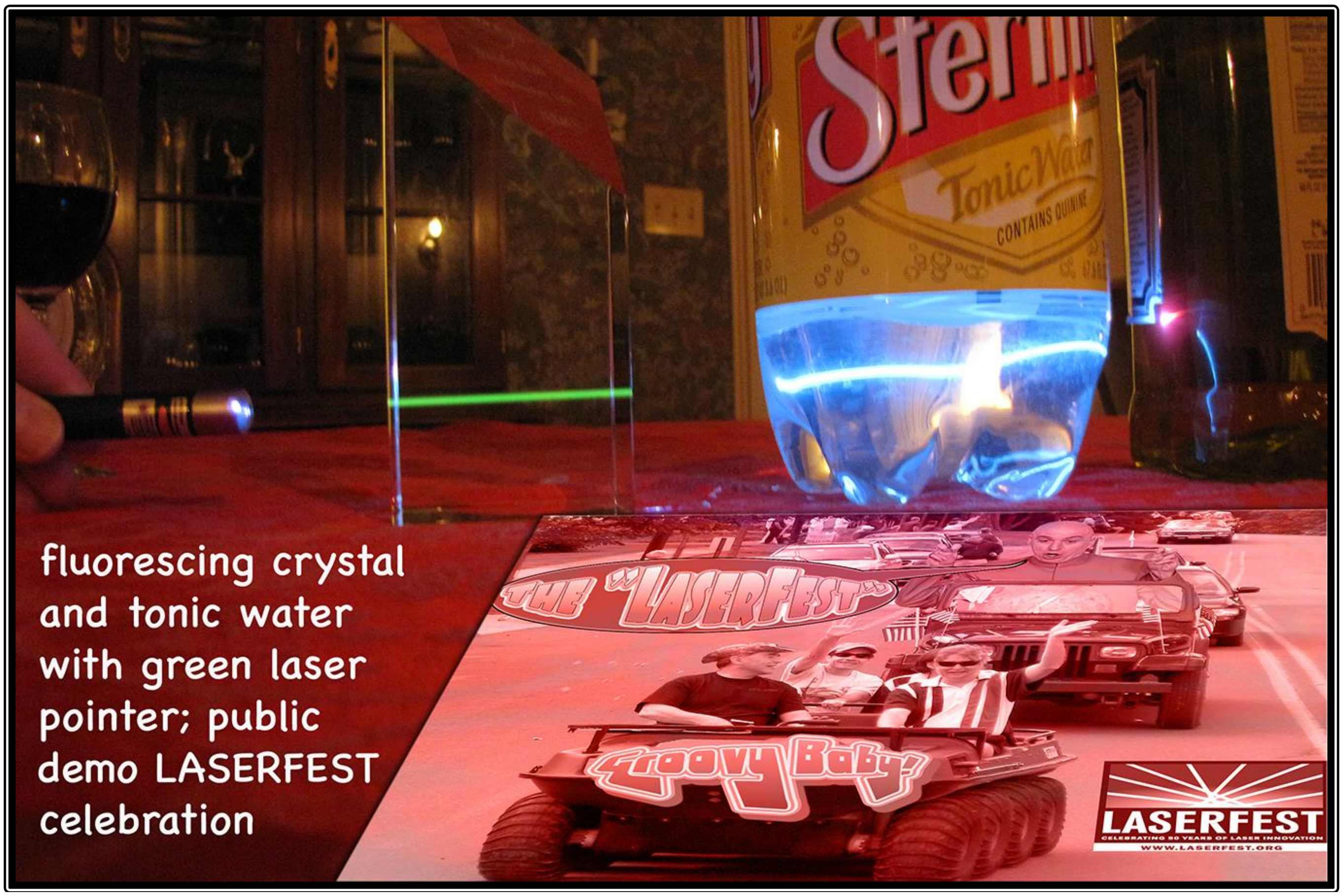
And in Part 3 of our review of radiation physics groups in central and Eastern Europe, four faculty members from the Physics Department of the University of Novi Sad, Serbia, provide IRPS readers with a thoroughgoing overview of their research, with a clear and strong focus on serving the public good.

Finally, as we do each year, we review the highlights of discoveries related to radiation physics over the course of the previous year (2013).

Do feel free to send us your "highlights" for inclusion in the Bulletin, and your ideas for engaging the public and increasing science literacy for the greater good of all.

Larry Hudson and Ron Tosh



[Featured in IRPS Bulletin, Vol. 24, No. 2]

President's Column

Dear Colleagues

Articles in the mass media about progress in science are rarely targeted at the general public, but they do sometimes appear. I recently read a popular article in the internet version of a serious newspaper that mainly carries news about the economy and about management. The article was about the future of large accelerators. The first part of the article summarised the basic parameters of the LHC, including information that it has replaced LEP in its tunnel, 27 km in circumference. There was a nice figure showing the trajectories of particles after collision, together with a mention of the annual amount of data gathered for processing. I will not discuss here how many of the readers of this newspaper understand what a Higgs boson is, or quark-gluon plasma, but let us assume that most of the readers come from the more educated level of society, and have at least heard these words at some time. And, in my opinion, the text was well prepared and informative.

The second part of the article described future needs (and dreams for the future). It discussed the path towards higher energies of particles and collisions. TLEP (a study of the future e^-- e^+ collider at CERN, with proposed centre-of-mass energy of 90 to 400 GeV and a tunnel length of 80 to 100 km) was mentioned as a possible first step, and a return to the idea and the design of SSC as another variant. Finally, the vision was offered of a proton accelerator with a tunnel 270 km in circumference and with energy of 50 TeV, with the possibility of an upgrade to 300 TeV.

Why am I talking about a single article in the non-scientific but serious media? Articles in web journals and newspapers are usually supplemented by a discussion, in which sometimes competent readers, and sometimes less competent readers, express their opinions. Internet discussions of this kind often are written by people who are at least a bit interested in scientific matters. They therefore to some extent reflect the position of top science (and, of course, expensive science) in the eyes of the public.

The general feeling evoked by this discussion is somewhat depressing, as fewer than a half of the comments took a positive view. Let me reproduce some examples of the more antagonistic statements:

> "It is a pity I can't prevent a single crown (unit of Czech currency) from my taxes going on these toys. I am really not interested in quarks or in other worthlessness things that are absolutely unnecessary for life and for the development of mankind."

> "I'm not sure if I should laugh or cry. It is all very nice, but is it really necessary to throw money away on this? I can imagine some more rational uses for it."

> "Another black hole (for our money)! When an accelerator is built, they always say within a short time that it is not adequate, and a bigger one is needed. And again, and again ... And we get nothing."

> "I think it is like when you shoot a cannon into a forest and you are trying to figure out what exactly the forest looks like from the chips.   And if you fail, you make an even bigger cannon."

> "The article is quite interesting, but this knowledge about the universe will not be of much use when they mess things up and accidentally create a black hole."

The article was in Czech, and the readers, too, were mostly or exclusively Czechs. Nevertheless, I do not believe that the result of a public opinion survey of this kind would be much different in any other country.

So, what is the message for us? Public opinion is probably not in favour of big scientific projects, which are expensive and provide measurable benefits only for the distant future.   The public often does not even understand that a number of

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achievements of civilization that now make life easier were preceded by many years of scientific research, during which there was no evidence that they would have any practical impact.

It is important to move our knowledge forward (and unfortunately, because of the ways in which our work is assessed, to publish our results in journals with the highest possible impact factor), but it is equally important to explain to our grandmothers, relatives, friends and neighbours that what we do is not an end in itself, and has a profound impact on our future.

Jules Verne-type visionaries would have a harder job in our postmodern money-dominated world than they did in the 19th century. If their visions are to be realized, modern visionaries must communicate much more effectively with the public.

I am almost moved to finish this text with a pathetic exclamation of the type :

May God please help us in this !

Ladislav Musilek

CONFERENCE IN MAY - REGISTRATION DUE 15 MAY !!

27 - 30 May, 2014

(RAD2014)

The Second International Conference on Radiation and Dosimetry in Various Fields of Research

Hosted by the Faculty of Electronic Engineering
University of Niš, Serbia

Registration Deadline May 15, 2014

For full information : http://www.rad2014.elfak.rs/

Vice President's Report, Australasia

International Year of Crystallography

This year [2014] marks the official United Nations International Year of Crystallography, launched at UNESCO Headquarters in Paris in January. This is loosely based on the centennial of the discovery of Bragg Diffraction by the Braggs and von Laue, and hence XRD, PD and all consequent technology of X-rays and consequently synchrotrons. It is a great heritage.

Australia has been celebrating the centenary of Bragg's Law (1912), von Laue's Nobel Prize (1914) and the 1915 Nobel Prize in Physics to William Henry and William Lawrence Bragg; including a special 'Bragg Symposium' in Adelaide on 6th December 2012, special-issue Australia Post stamps and other activities. Part of the reason for celebration are the dramatic advances which X-rays, XRD, PD and other X-ray and synchrotron technology have made and continue to make in our technological world; partly it is the new science uncovered, revealed, and put to work; and partly it is that the Braggs are Australian.

Yes, the odd Brit might comment, Bragg the father was from the mother country and, as a post-doc., exported to Australia to become Chair and Head of the School of Physics in the infant University of Adelaide, from which he was able to return to Manchester (before the discovery). But the key discovery, we understand well, was that of the Australian and Australian-born son, and it was his interpretation of Laue's data that led to the revolution in science, and one of the most perfect examples of the uptake of a scientific idea by the world-wide community, to the point of taking X-rays of feet to determine one's shoe size within a decade of the discovery. We comment also that the School (St. Peter's College) which William Lawrence attended in Adelaide has the uncommon privilege of being one of the Schools with the highest number of Nobel Laureates (three) trained thereat in the world, with the first three places taken by schools in New York. Additionally, William Lawrence was the youngest ever Nobel Laureate – at the age of 25 !

The number of Nobel prizes depending upon this single achievement (and consequent meticulous development by both Braggs and many others) is an astounding record, in Physics, Chemistry and Medicine. Australia has remained strong in Crystallography and allied techniques and has continued to have a strong representation at the international level. Sandy Matthiesen, Edward Maslen, Sydney Hall, and many others are links of continuity and development across the country.

The first major infrastructure investment of Australia was the Australian National Beamline Facility at Tsukuba, a joint collaboration between Australia and Japan, just over some 25 years ago. Seminal contributors to this effort included Stephen Wilkins, Dudley Creagh, Zwi Barnea, John White, Andrew Stevenson, Richard Garrett and others on the Australian side, and Jimpei Harada, Professors Ito, Ando, Kawata, Oyanagi and others on the Japanese side, which led to the most productive of the Tsukuba beamlines and of the Australian synchrotron activities up to and into the new period of the Australian Synchrotron.

BigDiff (the Powder Diffractometer at ANBF) and the beamline were decommissioned last year, in part because of funding pressure on external synchrotron access and a need to fund the Australian Synchrotron. Last year (Feb 2013) we held a Celebration Closing Ceremony with many of these distinguished pioneers to acknowledge and thank the joint efforts and communication (see report in IRPS Bulletin Vol 27 No 1 March 2013).

Part of the future lies in full and proper funding of new facilities, new technology and new beamlines at the Australian Synchrotron and elsewhere. However, with current budget concerns the [Australian] state and federal governments see research and education as being relatively easy targets compared to e.g. industry, medicine and health (it is always unwise when such

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labels are presented in competition rather than being seen as jointly necessary future directions).

The current status is that CSIRO and our other national scientific organisations ANSTO and DSTO, are under some fiscal pressure to prove that their outcomes can be measured in dollars rather than sense. A recent claim in the national newspaper The Age attempts to suggest that synchrotrons should [also] return direct industrial dollars, again rather than sense – especially confused given that the world has perhaps proven that this mindset is not based in reality. So we clearly have a job in retraining minds that have not learnt or perhaps read the word 'science' but instead are stuck with 'short-term reward' or other myopic terms.

Back onto the positive side, my new laboratories had a great opening ceremony late last year (November 2013) with distinguished speakers and representatives from industry and government. In the local sense, the Vice-President of our academic Board opened the laboratories, and the President-elect of the International Union of Physics made kind and generous comments on what the laboratories of X-ray Optics and Synchrotron Science may achieve.

As Chair of the International Union of Crystallography Commission on X-ray Absorption Fine Structure (XAFS) it has been my pleasure to coordinate part of the celebratory IUCr Congress in Montreal, to be held August 2014, and the collegiality involved across the globe and across Commissions has been truly heart warming. We have a record number of microsymposia, a record number of which (6) were proposed by the XAFS Commission, and a sequel of the very successful series of Workshops held on the first day of the Congress (5 August): the IUCr 2014 XAFS Tutorial for crystallographers and beginners. This is free, so feel welcome to come! It is also my privilege to announce that a new Volume of the International Tables for Crystallography has been proposed, with Editors Chantler, Bunker and Boscherini, which will develop over the next couple of years, we hope.

A message here is that the subject matter and fields continue to grow and develop, continue to create new fields and opportunities, and continue to foster young and old minds - to bring the young to levels of cutting-edge world leadership and to prevent the old ones from achieving early senility! I claim myself to have one foot in each camp !

Chris Chantler

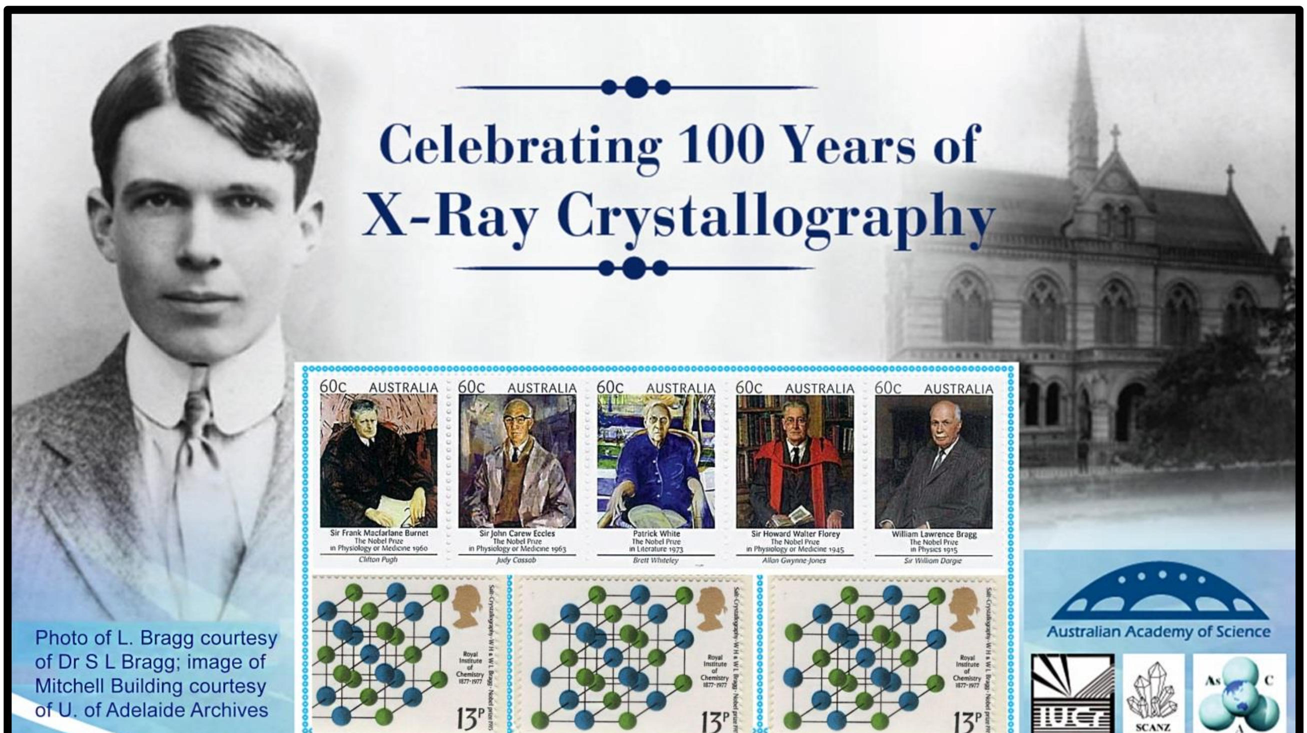

Photo of L. Bragg courtesy of Dr S L Bragg; image of Mitchell Building courtesy of U. of Adelaide Archives

X-Rays to Synchrotrons and the International Year of Light

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Introduction:

The world of radiation related sciences is at an interesting and active epoch marked with anniversaries and celebrations. Crystallography is synonymous with X-Rays and the year 2014 is being celebrated as the *International Year of Crystallography*. Light needs no introduction and the year 2015 has been declared as the *International Year of Light and Light-based Technologies.* Both events are a time to recognize the role of the radiation sciences in our lives.

INTERNATIONAL YEAR OF LIGHT 2015

It is a century since it was discovered that crystals could diffract x-rays, a finding that helped revolutionize our ability to visualize matter at the atomic scale. It was found that x-rays can be used to determine accurately the positions of atoms within a crystal and thus unravel its three-dimensional structure. This discovery has contributed hugely to the modern development of all the natural sciences, because atomic structure governs chemical and biological properties of matter, and the crystal structure determines most of its physical properties.

The insights gained from the structure of matter have impacted chemistry, solid state physics, biology and medicine. This has resulted in synthesis of novel materials, new drugs and our understanding of the structure of proteins and DNA. The United Nations has declared 2014 as the International Year of Crystallography (IYCr 2014) at its Sixty-Sixth Assembly on 3rd July 2012. This to commemorate the centennial of x-ray diffraction and related discoveries [1]. The scope of the crystallographic studies has been extended by using electron, neutron and other particle beams in place of x-rays. The underlying mechanisms differ but the resulting diffraction patterns are analyzed by similar procedures based on coherent diffraction imaging techniques.

The community of radiation sciences is blessed with an additional and consecutive year of celebrations! On Friday, 20 December, 2013, the United Nations adopted a resolution calling for 2015 to be recognized as the *International Year of Light and Light-based Technologies* (IYL 2015). In making the proclamation, during the 71st Plenary Meeting of the UN General Assembly's 68th Session, the UN recognizes the importance of raising global awareness of how light-based technologies promote sustainable development and

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provide solutions to global challenges in energy, education, agriculture and health. IYL will bring together the worlds of science, engineering and the arts. A resolution welcoming and endorsing IYL 2015 was first adopted by the UNESCO Executive Board at its 190th session in October 2012. The IYL 2015 resolution was then submitted to the UN Second Committee in November 2013. The resolution was adopted without vote, with co-sponsorship from 35 countries as part of a more general agenda item on science and technology for development.

The text of the resolution, which was adopted as part of a more general agenda item on science and technology for development, stated: "*Applications of light science and technology are vital for existing and future advances in medicine, energy, information and communications, fiber-optics, astronomy, architecture, archaeology, entertainment and culture*" [2-4]. It is the product of a consensus developed over a three-year effort sustained by numerous organizations that eventually led to the proclamation. The cross-disciplinary educational and outreach project of IYL draws its strength from over a hundred partners distributed in eighty-five countries, accompanied by the UNESCO International Basic Sciences Program. The figures are sure to grow and will involve scientific societies and unions, educational and research institutions, technology platforms, nonprofit organizations and private sector partners to promote and celebrate the significance of light and its applications during 2015.

The pivotal role of light in our very existence needs no elaboration. First and foremost it provides us vision. The plant kingdom needs it for photosynthesis. Light is necessary for the existence of life itself. The synthesis of the essential vitamin-D in human skin is not possible without sunlight. Light-based technologies have impacted all spheres of our lives. Light-based technologies have revolutionized medicine and opened up international communication via the Internet, and will continue to underpin the future development of human society. The everyday gadgets in our lives such as DVDs, barcode scanners, smart phones, and flat screen televisions are all based on *photonics*, the science of light-based technologies. When harnessed, the light-based technologies can promote sustainable development and provide solutions to global challenges in energy, education, agriculture, health and well-being.

Light is one of the main messengers in our understanding of the world around us, from the subatomic to the universe at large. The history of the study of light spans millennia, and has involved virtually all the major figures of science. The year 2015 commemorates many important milestones in the history of the light sciences dating back to 50, 100, 150, 200 and 1000 years, starting with the early work on optics by the medieval Arab scholar Abu Ali Al-Hasan Ibn Al-Haytham in 1015; he is more commonly known by his Latinized name Alhazen [5-7]. In 1815, Fresnel published his first work introducing the theory of light as a wave. In 1865 Maxwell formalized the electromagnetic theory of light. In 1905 Einstein explained the photoelectric effect using the quanta of light. In 1915 Einstein embedded light in cosmology through the very structure of space and time in cosmology. The cosmic microwave background was discovered by Penzias and Wilson in 1965. In the same year Charles Kao achieved the transmission of light in fibres for optical communication [3].

Light science is one of the most accessible themes to promote in cross-disciplinary education. IYL 2015 is endorsed by the International Council of Science and a number of other international scientific unions. IYL 2015 will be administered by an International Steering Committee in collaboration with the UNESCO International Basic Sciences Program at UNESCO headquarters in Paris and a Global Secretariat at ICTP: the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, which is a UNESCO Category 1 Institute. The international committee will run a number of cornerstone projects while encouraging national committees to inspire celebrations at a more local level [8].

Particle Accelerators, Radiation Sciences and the Light Sciences:

The interdisciplinary fields of radiation sciences and light sciences are intimately linked through the common thread of electromagnetism. The mechanisms of detection and handling, of course differ when one is using visible sources, lasers, x-rays or synchrotron radiation. The underlying mechanisms of production of the aforementioned sources of radiation differ dramatically.

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Oil lamps of antiquity have been replaced by the electrically heated filaments in evacuated bulbs. Lasers provide us highly coherent light. X-Rays are produced by the collision of energetic electrons with tungsten or other surfaces. Different sources serve different purposes. X-Rays are one of the most widely used tools to understand the structure of matter. Many pathbreaking discoveries in physics, chemistry and medicine have been made using x-rays. At least twenty-three persons have been awarded with Nobel Prizes with the distribution, Physics: 8; Medicine: 5 and Chemistry: 10. The count can be up to twenty-nine depending upon the criteria used [9-10].

Particle accelerators provide us a family of sources including synchrotrons and Free Electron Lasers (FELs) among others. The accelerator-based sources have very specialized properties (higher intensity, coherence, etc) and a very wide range (in principle) covering the complete electromagnetic spectrum. These special features come with a price tag! They are costly and require a high-level of technological expertise to build.

There are about seventy-five synchrotron radiation sources in various stages of operation, construction or planning in twenty-five countries: Armenia, Australia, Brazil, Canada, China, Denmark, France, Germany, India, Iran, Italy, Japan, Jordan, Korea, Russia, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, The Netherlands, Ukraine, United Kingdom, and USA. Iran is the most recent country to join this elite group. The Iranian Light Source Facility (ILSF) is a 3 GeV facility, presently in the design phase and to be located at Qazvin, 150km northwest of the capital Tehran [11]. From this list it is evident that the world of synchrotron sources has its own share of haves and have-nots ! The continent of Africa is yet to construct a single synchrotron [12-14]. There are more than 20,000 synchrotron users per year and strong growth is predicted [15]. There are some synchrotrons operated jointly, notable among these are the European Synchrotron Radiation Facility (ESRF, [16]) and the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME, [17]). The proposal for regional synchrotron radiation facilities (RSRF) is not new [18-21].

The International Year of Light will provide a forum for scientists, engineers and all others inspired by light to interact with each other. IYL 2015 will consist of activities on national, regional and international levels. IYL is an excellent platform for conducting the outreach programmes. IYL is a tremendous opportunity to ensure that policymakers are made aware of the problem-solving potential of light technology. In view of the strong relationship between the light sciences and the radiation sciences, IYL will be an excellent platform to conduct radiation-related outreach programmes. Cornerstone projects such a *Radiation Physics Day* or *Radiation Physics Week* can be organized. Those connected with accelerator facilities can explore the projects such as *Synchrotron Day* or *Synchrotron Week*, when synchrotron radiation facilities around the world will open their doors to public visitors. This will enable highlighting the role of novel radiation sources in human endeavours, ranging from structure of matter at the molecular level to diverse applications in medicine and industry. There are over ten thousand electron linacs world-wide dedicated to cancer therapy. In addition, there are other types of medical accelerators covering therapies such as hadron therapy and ion therapy [9, 22].

The demand of accelerator-based radiation sources has necessitated international collaborations. The future machines in this direction will require hefty funding in billions of US dollars. Many nations will find it difficult to meet the financial requirement individually. Moreover, the technology to individually build and run such large facilities will be beyond the reach of many nations. For such facilities to become a reality, the outreach programmes described above provide possible assistance. The IYL 2015 provides one such opportunity.

Concluding Remarks:

In the beginning of this article, we noted that 2014 is being celebrated as the International Year of Crystallography, and 2015 has been declared as the International Year of Light and Light-based Technologies. We have further noted that these two consecutive years of celebrations have a lot to do with radiation physics. It is a strange but fruitful coincidence that several institutional jubilees related to radiation sciences fall during these two years. These include the sixty years of CERN: European Organization for Nuclear Research [23]; ESRF: European Synchrotron

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Radiation Facility completes twenty years of User Operation [24]; sixty years of UNSCEAR the United Nations Scientific Committee on the Effects of Atomic Radiation [25]; and fifty years of ICTP: Abdus Salam International Centre for Theoretical Physics [8]. A detailed account of the radiation-related activities at ICTP can be found in [8, 26].

Their younger jubilees were covered in this newsletter a decade back [26-27]. These institutional jubilees will be marked with several programmes that bring scientists, engineers, policy makers and government officials together. These will be another excellent opportunity to present the case of radiation physics and radiation facilities; IRPS is in an excellent position to do so.

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26. Sameen Ahmed Khan, **2004 - the Year of Jubilees; Fifty Years of CERN; Forty Years of ICTP; Ten Years of ESRF User Operation**, *IRPS Bulletin*, **19** (1), 4-8 (June 2005). (**IRPS:** International Radiation Physics Society); *ICFA Beam Dynamics Newsletter*, **37**, 12-18 (August 2005). (**ICFA**: International Committee for Future Accelerators).

27. Sameen Ahmed Khan, **Fifty Years of UNSCEAR the UN Scientific Committee on the Effects of Atomic Radiation**, *IRPS Bulletin*, **20** (3), 15-16 (December 2006). (**IRPS:** International Radiation Physics Society); *Bulletin of the IAPT*, **24** (2), pp. 49 & 52 (February 2007). (**IAPT**: Indian Association of Physics Teachers); *AAPPS Bulletin*, **17** (1), 32-33 (February 2007). (**AAPPS**: Association of Asia Pacific Physical Societies).

The Member "spotlight" from Central/Europe (Part 3)

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In the first and second parts of this series devoted to radiation physics groups in Central and Eastern Europe, we presented several groups from Croatia (IRPS Bulletin, vol. 26, No.s 2/3, 4). Now we turn to Serbia, or more exactly to its northern Province of Vojvodina and its capital Novi Sad.

At the Department of Physics

http://www.pmf.uns.ac.rs/en/about_us/departments/physics

of the Faculty of Science

http://www.pmf.uns.ac.rs/en

of the University of Novi Sad, there is a large Laboratory of Nuclear Physics. The staff is involved in teaching, research and applications of radiation physics. The strong contingent of "women power" from this Laboratory – four female physicists (Nataša Todorović, Jovana Nikolov, Sofija Forkapić and Kristina Bikit) – joined the IRPS in 2013. Since this is the first time that a Serbian radiation physics group is highlighted for the IRPS membership, the four ladies prepared the following comprehensive description of the University of Novi Sad and the activities of their group.

At this point I would like to congratulate two of them, J. Nikolov and S. Forkapić, who recently successfully finalized their Ph.D. Theses. Moreover, Jovana Nikolov received the award for the best young scientist in Vojvodina. Congratulations!

Figure 1. Jovana Nikolov (left) receives the Award for the best young scientist in Vojvodina.
Photo taken from http:// www.021.rs/Novi-Sad/Vesti/Jovana-Nikolov-najbolji-mladi-naucnik-u-Vojvodini.html

Radiation Physics in Novi Sad, Serbia

Nataša Todorović, Jovana Nikolov, Sofija Forkapić and Kristina Bikit

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The city of Novi Sad is the political, administrative, economic, cultural, science and tourist centre of the Province of Vojvodina, and the second largest city in Serbia. The city represents a unique combination of modern and traditional values with a special emphasis on successfully bringing together European and Balkan countries.

The University of Novi Sad, founded in 1960, is a comprehensive, internationally oriented educational and research centre, with 49,000 students, 3,300 professors and assistants, and 1,200 non-teaching staff working in an area of 260,000 m^2.

The University of Novi Sad promotes all aspects of academic and scientific cooperation with neighbouring universities through bilateral and multilateral agreements, conferences, exchanges, summer schools, joint projects, etc. The University also reflects the multiethnic society of Vojvodina, providing lectures in national minority languages at four faculties.

The motto of the University of Novi Sad Faculty of Sciences (UNSPMF) is: "We study nature while respecting it". In business, science and education, we respect and preserve our environment.

The Faculty of Sciences consists of five departments: Department of Biology and Ecology, Department of Physics, Department of Geography, Tourism and Hotel Management, Department of Chemistry, Biochemistry and Environmental Protection, and Department of Mathematics and Informatics. The overall number of people employed at the Faculty of Sciences in November 2012 was 565, of which 383 were members of the teaching staff (126 full professors, 39 associate professors, 77 assistant professors). National and international projects in the fields of fundamental research, technological development, and integral and interdisciplinary research are carried out within all departments.

The **Department of Physics** consists of the following chairs: Experimental Condensed Matter Physics, Physical Electronics, Nuclear Physics, Theoretical Physics, and General Physics and Teaching Methodology in Physics. The Department provides the bachelor, master and PhD study programs.

Bachelor studies are the beginning of academic education and the student can choose between two subject groups at this level – Physics Education and Physics. The group "Physics" consists of four modules: Research in Physics, Medical Physics, Physics – Meteorology and Physics – Astronomy with Astrophysics.

Master studies provide further academic education, i.e., Master studies in Physics Education, and Master studies in Physics with elective modules: Research – Physics of Materials, Research – Nuclear Physics, Research – Plasma Physics, Research – Theoretical Condensed Matter Physics, Medical Physics, Physics – Meteorology and Physics – Astronomy with Astrophysics.

PhD studies provide further education in nuclear physics, physics of materials, plasma physics and theoretical condensed matter physics as well as teaching methods in science subjects, including physics.

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For the International Radiation Physics Society, probably the most interesting are activities of the **Nuclear Physics Laboratory** of the Department of Physics. The activities can be summarized as:

1. Investigation of rare nuclear events, double beta decay, cosmic ray physics, muon induced nuclear reactions;
2. Public services in radiation protection (gamma spectrometry, field alpha, beta, gamma, neutron dosimetry, non-ionizing radiation, radon);
3. Expertise in low-level gamma spectroscopy (common high sensitivity direct, coincidence, anticoincidence methods for fundamental and applied research).

The members of the Nuclear Physics Laboratory involved in both teaching and research are:

- Ištvan Bikit, full professor, the Academician
- Miroslav Vesković, full professor
- Miodrag Krmar, full professor
- Nataša Todorović, associate professor
- Dušan Mrđa, associate professor
- Tijana Prodanović, associate professor
- Jovana Nikolov, assistant professor
- Sofija Forkapić, assistant with Ph.D.
- Jan Hansman, Ph.D. student
- Kristina Bikit, Ph.D. student

The available laboratory equipment *(Figure 1)* includes: two hyper-pure HPGe germanium spectrometers of nominal efficiencies of 36 % shielded by 12 cm thick lead with a Canberra four input multiport data acquisition system; low-background extended range GMX detector (Ortec) of an efficiency of 50 % situated in a lead + copper + tin passive shielding; big-volume HPGe spectrometer with a nominal efficiency of 100% in ultra-low background shielding and configuration (Canberra); the big low-background iron chamber of a useful volume of 1 m^3, with 25 cm thick walls, made out of pre-WWII iron (free of ^{60}Co); the chamber accommodates another HPGe detector actively shielded with a large (9" × 9") NaI(Tl) annulus acting also as a Compton suppressor; ultra low-level alpha-beta liquid scintillation spectrometer – QUANTULUS; alpha-particle spectrometer dedicated to the measurement of low levels of radon and other alpha-particle emitting isotopes in different gaseous and liquid media; canisters with charcoal for passive adsorption of radon from the air, the gamma-ray spectroscopy of which, providing proper calibration, yields the concentration of radon in the air; a number of high-quality ionization chambers for low-level dosimetry of environmental samples; a neutron survey meter (He-3 detector), and health physics instruments.

For many years, the Nuclear Physics Laboratory at UNSPMF has operated a program of surveillance of radioactivity in the environment. The monitoring program consists of monitoring both natural and artificial radionuclides in the environment and monitoring environmental alpha, beta and gamma-radiation levels. To support the monitoring program and other studies of environmental radioactivity in Novi Sad, the Laboratory operates methods of sample preparation with a range of measurement systems for the detection and determination of low-levels of natural and artificial radionuclides in environmental samples.

One important environmental monitoring program of the Laboratory is the analysis of radioactivity in various foodstuffs, such as dairy products, grains, fruit and vegetable products, meat and meat products and other miscellaneous items (cookies, tea, herb, cacao, mineral water and sugar). The types of radionuclides that are typically assessed include ^{134}Cs and ^{137}Cs, which arise from nuclear fallout, and naturally-occurring radionuclides such as ^{40}K, ^{226}Ra and other radionuclides in the uranium and thorium decay chains. The main goal of foodstuff's radioactivity measurements and investigation is the estimation of the ingestion doses of the population.

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Figure 1. A panoramic view to the measurement systems in the Nuclear Physics Laboratory of the Department of Physics at the Faculty of Sciences of the University of Novi Sad.

Indoor radon activity concentration in air has been measured across the whole of the Province of Vojvodina. Special attention has been paid to rural regions of 45 municipalities and type of dwellings characteristic for the Vojvodina region. The main aim of the study was to exploit the critical group for radon exposure. Thus the mean values obtained for the whole region should be most probably considered as upper limits yo the evaluation of the radon doses.

Because of the potential public health hazard, surveys of radon in water sources are also necessary. The presence of numerous underground hot springs and sources of natural gas in the Vojvodina region, as well as some crude oil reservoirs, point to the possibility of elevated radon levels in water. Radon content in drinking water from the Vojvodina region is investigated in the Nuclear Physics Laboratory.

The accident at the Fukushima Dai-ichi nuclear power plant, caused by the devastating earthquake and subsequent tsunami that struck the northeastern coast of Japan in March 2011, has raised concerns about the fate of radioactive particles released into the environment. Radioactive particles with different composition, size, shape and structure have been identified worldwide in different biotic and abiotic media. The presence of particulate ^{131}I in traces in the aerosol samples was recorded for the first time in Serbia on 24 March, 2011, by the Nuclear Physics Laboratory, by observing the 364.5 keV line in the gamma spectrum.

Determination of tritium in water samples is important, since it can be the indicator of an artificial contribution. A rapid tritium activity determination method by the LSC Quantulus 1220 is performed in the Nuclear Physics Laboratory, according to the ASTM D4107-08 standard method.

Considerable amounts of natural radionuclides can be found in river sediment as the result of industrial activities. Surface run-off waters wash down a part of deposited radionuclides and finally store it in the river bed. Processes of accumulation sometimes can elevate concentrations of the ^{238}U family members at the river bottom more than one order of magnitude. If the influence of uranium or thorium released by human activities has the same order of magnitude (or lower) than the existing amount of natural uranium in the sediment or soil, it is rather difficult to estimate the relative contribution of the non-natural component. Direct correlation between the activity concentrations of natural radioisotopes in soil and sediment can be a good index of some changes induced by human activities. The goal of the Novi Sad Nuclear Physics Group is to establish a range of specific activities of natural radionuclides in sediment in

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parts of the Danube and Tisa Rivers and irrigation channels through Serbia. If a correlation between some of the natural radionuclides can be established, it is important to check the range of obtained values of activity ratios.

For more than 15 years, the Group for Nuclear Physics from the University of Novi Sad has been a part of the ISOLDE collaboration at CERN, working on the experimental setup NICOLE on low temperature nuclear orientations. The Group for Nuclear Physics two years ago joined the POLAREX collaboration at the University of Orsay, France. The main research topics within these two collaborations are measuring nuclear magnetic moments on oriented nuclei with the NMR method.

The Nuclear Physics Group, Department of Physics, University of Novi Sad Faculty of Sciences, has two accredited laboratories (Accreditation Board of Serbia, according to the international standard for the competence of testing and calibration laboratories ISO/IEC 17025:2006, accreditation numbers 01-167 and 02-001).

The scope of accreditation for the Laboratory for source radioactivity and dose measurements includes: 1) Gamma spectrometric radionuclide activity concentration measurements in: air, water, soil, human and animal food, industrial and building materials and general market items; and 2) dose measurements from the sources used in medicine and industry. For the Laboratory for gamma spectrometer and source activity, the scope of accreditation is calibration of high resolution gamma spectrometers and calibration of gamma emitting radionuclides (point and voluminous sources).

The following list of scientific publications, as well as the participation in national and international projects of the Novi Sad research group, provides a good indication of the breadth and depth of its experience within this field.

* * * * * * * * * * * *

M. Krmar, D. Radnović, J. Hansman. Correlation of unsupported ^{210}Pb activity in soil and moss. Journal of Environmental Radioactivity 129 (2014) 23-26.

N. Todorović, I. Bikit, M. Krmar, D. Mrđa, J. Hansman, J. Nikolov, S. Forkapić, M. Vesković, K. Bikit, I. Jakonić. Natural radioactivity in raw materials used in building industry in Serbia. Int. J. Environ. Sci. Technol (2014), DOI 10.1007/s13762-013-0470-2

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T. Ohtsubo, N. J. Stone, J. R. Stone, I. S. Towner, C. R. Bingham, C. Gaulard, U. Köster, S. Muto, J. Nikolov, K. Nishimura, G. S. Simpson, G. Soti, M. Vesković, W. B. Walters, F. Wauters. Magnetic Dipole Moment of the Doubly-Closed-Shell Plus One Proton Nucleus ^{49}Sc, Phys. Rev. Lett. 109, 032504 (2012).

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N. Todorović, J. Nikolov, S. Forkapić, I. Bikit, D. Mrdja, M. Krmar, M. Vesković. Public exposure to radon in drinking water in Serbia. Applied Radiation and Isotopes 70 (2012) 543-549.

J. Nikolov, N. Todorović, T. Petrović Pantić, S. Forkapić, D. Mrdja, I. Bikit, M. Krmar, M. Vesković. Exposure to radon in the radon spa Niška Banja, Serbia. Radiation Measurements 47 (2012) 443-450

I. Bikit, D. Mrdja, N. Todorović, J. Nikolov, M. Krmar, M. Vesković, J. Slivka, J. Hansman, S. Forkapić, N. Jovančević. Airborne radioiodine in northern Serbia from Fukushima. Journal of Environmental Radioactivity 114 (2012) 89-93.

N. Todorović, S. Forkapić, I. Bikit, D. Mrdja, M. Vesković, S. Todorović. Monitoring for exposures to TENORM sources in Vojvodina region. Radiation Protection Dosimetry 144 (2011) 655-658.

As we observed last year, *APS News* looks back at the headlines around the world to see which physics news stories grabbed the most attention. These are excerpted below, and are followed by excerpted physics highlights from APS journals selected by the APS web site editors. Please be invited to contribute Radiation Physics items that you think deserve attention; indeed, discovery is so rapid these days, some of the following reports may already need updating!

--Bulletin editors

Physics Newsmakers of 2013

excerpted from (http://www.aps.org/publications/apsnews/201402/newsmakers.cfm)

Exoplanets

2013 was another banner year for the search for another Earth. In February astronomers announced the discovery of Kepler-37b: With a diameter just slightly larger than Earth's moon, it's the smallest exoplanet discovered yet. Two months later, astronomers discovered the twin worlds of Kepler-62e and Kepler-62f, planets about the size of Earth, covered in liquid water oceans, and orbiting safely within their sun's habitable zone. Then in June another surprise: Astronomers using Earth-based telescopes discovered that the three planets orbiting the star Gliese 667C were all within its habitable zone (largest number of such planets in the one solar system discovered so far). However, sad news came at the beginning of June. The prolific Kepler Telescope, which revolutionized the planet-hunting field, suffered a terminal malfunction, effectively ending its mission after only four years. In the November issue of the *Proceedings of the National Academy of Sciences*, scientists estimated that one in five sun-like stars in the galaxy have planets in their habitable zones, meaning statistically that there could be an inhabited planet within 12 light-years of Earth.

Planck Telescope

The European Space Agency released the final results from the Planck Space Telescope in March. The spacecraft took the most detailed picture yet of the cosmic microwave background, and there were still some surprises left. It turns out that the universe is a little bit older (13.82 billion years old as opposed to 13.7 billion) and made up of more dark matter than astronomers had previously thought. In October, the agency announced that after its successful mission, the observatory would shut down for good.

Higgs Boson

The Higgs boson continued to make headlines a year after its discovery. In March, CERN made an announcement that with more than twice as much data as in July 2012, the research team was even more convinced that the particle discovered was the Higgs boson. In October, Peter Higgs and François Englert jointly won the Nobel Prize for their fundamental contributions to the underlying theory.

Dark Matter

Apparently conflicting results dominated the ongoing search for dark matter this year. First in April, the Cryogenic Dark Matter Search reported that after analyzing data from their five-year run, they identified three signals that looked like dark-matter candidates. Though the team was unwilling to say the results amounted to a discovery, it seemed tantalizing evidence of a relatively light dark-matter particle. However, in October, scientists at the Large Underground Xenon experiment in South Dakota released the null results of their first run. It should have been able to spot the signals seen by CDMS, but the fact that it didn't has left physicists scratching their heads.

Particles from Space

Earth is constantly pelted by a menagerie of particles, and this year scientists identified some of their interstellar sources. In April, the team running the Antarctic neutrino detector, IceCube, announced that they saw two neutrinos of such high energy, more than a petaelectronvolt, that it's almost impossible for them to have originated in the Milky Way Galaxy. In August, researchers

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using data from IceCube's surface detectors, IceTop, confirmed that, as scientists had long suspected, supernovae are among the main sources of the high-energy protons known as cosmic rays.

Ununpentium

A new element joined the periodic table in August. An international team of researchers created a few short-lived atoms of ununpentium (its temporary name) with atomic number 115 at the GSI Helmholtz Center for Heavy Ion Research in Germany by bombarding a film of americium with calcium ions. The element was first reported in 2003 by a group in Russia, however the International Union of Pure and Applied Chemistry said they wouldn't recognize the discovery until an outside group confirmed it. That confirmation came this year, and now researchers get to argue about what to call it.

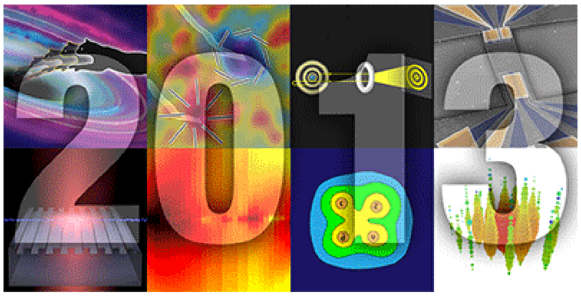
Voyager 1

For the first time, a human-built object left the bounds of the solar system. In September 2013, NASA released its official statement that the Voyager 1 space probe had entered interstellar space. Launched in 1977, the spacecraft visited Jupiter and Saturn before setting its course for the stars. It actually passed through the heliopause, the outermost edge of the solar wind, in August of 2012, but after several previous false positives, scientists needed more data to be sure.

NIF

In October, a rumor started floating around that the National Ignition Facility had achieved ignition, in which more energy is released from a fusion reaction than was put in. Alas, it was not to be. After a mistaken *BBC News* article touched off a flurry of escalating headlines on the internet, reason prevailed and it turned out that the facility was still a long way from its goal. The timing couldn't have been worse. The article was published in the middle of the government shutdown, when there was no one at the lab to set the record straight.

–list compiled by Michael Lucibella



Highlights of 2013

(excerpted from http://physics.aps.org/articles/v6/139)

Four–Quark Matter

Quarks come in twos and threes—or so nearly every experiment has told us. This summer, the BESIII Collaboration in China and the Belle Collaboration in Japan reported they had sorted through the debris of high-energy electron-positron collisions and had seen a mysterious particle that appeared to contain four quarks. Though other explanations for the nature of the particle, dubbed *Zc*(3900), are possible, the "tetraquark" interpretation may be gaining traction: BESIII has since seen a series of other particles that appear to contain four quarks.

Light Stopped for One Minute

Light travels at 1 billion km/hour in vacuum, but physicists know how to engineer materials that can bring it to a complete halt—an effect that could be used in quantum computing to store information carried by photons. A team at the Technical University of Darmstadt, Germany, managed to stop a beam of light for a record-breaking full minute. The method exploits a phenomenon called electromagnetically induced transparency, in which a control laser can make an opaque medium temporarily transparent and thus able to store

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light. While one minute is approximately the theoretical limit accrystal the team used, much longer storage times may be in sight: The researchers are now tuning their experiments to work with europium-doped crystals, which theoretically allow storage times of several hours.

Telescope Detects Twist in Ancient Cosmic Light

The cosmic microwave background (CMB)—the "afterglow" of the big bang—is our best source of information on the infant Universe. While researchers race to interpret the all-sky CMB map released in March 2013 by the Planck satellite, one of the year's highlights in cosmology came from a terrestrial observation: A collaboration running the South Pole Telescope made the first detection of a subtle distortion in the CMB radiation known as B-mode polarization. The observed twisting occurs because the CMB light rays experience gravitational lensing as they encounter lumps of matter *en route* through the Universe to us. The achievement could lead to a map of the distribution of matter in the Universe, including the elusive dark matter.

Lasers of Sound

Sound waves and light have much in common, and many concepts from optics, from invisibility cloaks to lasers, have influenced acoustics. In March 2013, a research team at NTT Basic Research Laboratories, Japan, demonstrated the first entirely acoustic analog of a laser. The researchers used a "nanodrum" to excite acoustic vibrations (phonons), which they then amplified through stimulated emission to deliver spectrally pure sound waves with a frequency of around 1.7 megahertz. When the team reported their work in March, they weren't yet able to extract waves from the device. But recently, the group has demonstrated phonon waveguides that, in analogy to optical fibers, could be coupled to the phonon laser to transfer and use the generated acoustic waves. Phonon lasers might one day deliver directional and coherent sound beams, which could be used for imaging or communication applications.

Microscope Spies on Hydrogen

Open any first-year quantum mechanics book and you'll probably find a sketch of hydrogen's spherical, dumbbell, and clover-shaped electron orbitals. But until this year, researchers couldn't claim to have actually observed these electron clouds experimentally. To take a peek, researchers at the FOM Institute for Atomic and Molecular Physics, Netherlands, and collaborators designed a "quantum microscope" that ionized hydrogen atoms with light and then used an electrostatic lens to create an interference pattern of the escaping electrons. The researchers used the interference image to reconstruct the original electron orbitals.

Facilities in a Box

This year, scientists found new ways to offer some of the capabilities of large and expensive facilities in setups that could be housed in individual labs. With equipment that should ultimately fit onto a tabletop, researchers at Los Alamos National Laboratory, New Mexico, produced a beam of neutrons intense and focused enough to image defects in materials. Possible applications of the mini neutron source, which uses the interaction between a powerful laser and a solid target to generate the neutrons, include testing neutron sensors and analyzing the effects of radiation damage on materials. In a similar effort, two teams, one led by researchers at Stanford University, California, and the other a collaboration between researchers at the Max Planck Institute of Quantum Optics and Friedrich Alexander University Erlangen-Nuremberg, both in Germany, presented an important step toward making cheaper and more compact x-ray sources. The two teams showed they could accelerate electrons with nanoscale optical gratings that are much smaller than the radio-frequency technology used at particle accelerators. In future work, the teams want to show the devices can generate higher fields and a greater flux of electrons.

Majorana Fermions Annihilate in Nanowires

Physicists have long been searching for signs of Majorana fermions, which are neutral fermions that are their own antiparticles. Evidence for a fundamental particle that is also a Majorana fermion is inconclusive (see 19 September 2013 Synopsis), but condensed matter physicists have shown early evidence that collective states (quasiparticles) in certain superconducting devices can have an analogous behavior. This year, researchers at the University of Illinois at Urbana-Champaign generated two of the

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quasiparticles at either end of a nanowire connected to superconducting leads and then used a magnetic field to cause the states to annihilate, as expected when a particle meets its antiparticle. Finding examples of Majorana states in solids could be a route to making quantum computers that are more resistant to noise.

A Year of Quantum Victories—But No Quantum Computer Yet

Do we have quantum computers, and are they better than conventional ones? The Canadian company D-Wave Systems reported that they had successfully tackled a hard-to-solve problem on their putative quantum computer. But many scientists would argue there is no evidence that the device, made of ~100 superconducting elements, can be called a quantum computer or that it outperforms classical computers. While quantum computing may still be some years in the future, in 2013 researchers reported a number of victories against obstacles to quantum information and communication protocols. In quantum cryptography, code makers regained the upper hand against code breakers, when two independent research teams demonstrated a new encryption method that may provide the ultimate security against hackers. Two other reports showed how entanglement, the essential ingredient that gives quantum technologies an advantage over classical methods, can be protected from noise and dissipation. A team at the Massachusetts Institute of Technology, Cambridge, showed that in a secure quantum communication channel, the benefits of entanglement can be harnessed even after its breakup induced by noise. And researchers at the Free University of Berlin, Germany, the Niels Bohr Institute, Denmark, and the Technical University of Munich, Germany, suggested that, thanks to a technique called quantum illumination, dissipative processes can be put to use to engineer more robust quantum states.

What's Inside a Black hole?

In 2012, a group of physicists at the University of California, Santa Barbara, proposed that an observer falling into a black hole would be destroyed by a firewall at the event horizon. If such a firewall existed, they argued, it would solve certain inconsistencies in black hole theory, but the idea sparked a heated debate among theoretical physicists: firewalls violate Einstein's well-established equivalence principle, which says that an observer can't distinguish between inertial motion and free fall and therefore shouldn't be able to tell if he has passed the event horizon. This year, two of the original firewall proponents, have rekindled the debate. The authors developed a theoretical model to describe the interior of the black hole, suggesting an in-falling observer would encounter a sea of quanta of arbitrarily high energy, i.e., a "wall of fire."

–list compiled by Matteo Rini and Jessica Thomas

Calendar

2014

27 - 30 May, 2014 (RAD2014)

The Second International Conference on Radiation and Dosimetry in Various Fields of Research

REGISTRATIONS DUE 15 MAY, 2014 DETAILS ON PAGE 6

15 - 20 June, 2014

EUROPEAN C0NFERENCE ON X-RAY SPECTROMETRY

Bologna, Italy

Contact : jorge.fernandez@unibo.it ***Web Site :*** http://exrs2014.ing.unibo.it

Further information on page 19 of the December 2013 Bulletin

6 - 11 July, 2014

IRRMA-9

9th Industrial Radiation and Radioisotope Measurement Applications

Valencia, Spain

Contact : irrma-9@upv.es ***Web Site :*** http://irrma-9.webs.upv.es

Further information on page 20 of the December 2013 Bulletin

1 – 5 September 2014

ICHLNRRA 2014

8th International Conference on High Levels of Natural Radiation and Radon Areas

Prague, Czech Republic

Web Site : http://www.ichlnrra2014prague.cz

Updated full information on following page 24

13 – 17 September, 2014

AFRIRPA 04

4th Regional African Congress of International Radiation Protection Association

Rabat, Morocco

Web Site : http://www.afrirpa04.com

First announcement and full information in September Bulletin, pages 19 - 20

ICHLNRRA 2014

8th International Conference on High Levels of Natural Radiation and Radon Areas

1 – 5 September, 2014

ICHLNRRA 2014

We are pleased to announce that the Preliminary Programme has been added to the meeting website www.ichlnrra2014prague.cz/

Kindly note that the
deadline for Abstract submission is May 15,
the early registration fee is valid till June 30.

Registration and abstract submission are now available

Please, forward this information to all colleagues, who might be interested.
Should you require any additional information or assistance, do not hesitate to contact us.

We look forward to welcoming you in Prague !

Sincerely,

Lenka Thinova	**Mehdi Sohrabi**	**Tomas Cechak**
Chairman of the Organizing Committee	Chairman	Chairman

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INTERNATIONAL RADIATION PHYSICS SOCIETY

The primary objective of the International Radiation Physics Society (IRPS) is to promote the global exchange and integration of scientific information pertaining to the interdisciplinary subject of radiation physics, including the promotion of (i) theoretical and **experimental research in radiation physics,** (ii) investigation of physical aspects of interactions of radiations with living systems, (iii) education in radiation physics, and (iv) utilization of radiations for peaceful purposes.

The Constitution of the IRPS defines Radiation Physics as "the branch of science which deals with the physical aspects of interactions of radiations (both electromagnetic and particulate) with matter." It thus differs in emphasis both from atomic and nuclear physics and from radiation biology and medicine, instead focusing on the radiations.

The International Radiation Physics Society (IRPS) was founded in 1985 in Ferrara, Italy at the 3rd International Symposium on Radiation Physics (ISRP-3, 1985), following Symposia in Calcutta, India (ISRP-1, 1974) and in Penang, Malaysia (ISRP-2, 1982). Further Symposia have been held in Sao Paulo, Brazil (ISRP-4, 1988), Dubrovnik, Croatia (ISRP-5, 1991) Rabat, Morocco (1SRP-6, 1994), Jaipur, India (ISRP-7 1997), Prague, Czech Republic (ISRP-8, 2000), Cape Town, South Africa (ISRP-9, 2003), Coimbra, Portugal(ISRP-10, 2006), Australia (ISRP-11, 2009) and ISRP-12 in Rio de Janiero, Brazil in 2012. The IRPS also sponsors regional Radiation Physics Symposia.

The **IRPS Bulletin** is published quarterly and sent to all IRPS members.

The IRPS Secretariat is : Prof. Jorge E Fernandez (IRPS Secretary),
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The IRPS welcomes your participation in this "global radiation physics family."

INTERNATIONAL RADIATION PHYSICS SOCIETY

Membership Registration Form

1. Name : ____________________
(First) (Initial) (Last)

2. Date and Place of Birth : ____________________

3. Business Address : ____________________

____
(Post Code) (Country)

Telephone:__________ Email: __________ Fax: __________

4. Current Title or Academic Rank (Please also indicate if Miss, Mrs., or Ms.): __________

5. Field(s) of interest in Radiation Physics (Please attach a list of your publications, if any, in the field:

____

____

6. Please list any national or international organization(s) involved in one or more branches of Radiation Physics, of which you are a member, also your status (e.g., student member, member, fellow, emeritus):

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7. The IRPS has no entrance fee requirement, only triennial (3-year) membership dues. In view of the IRPS unusually low-cost dues, the one-year dues option has been eliminated (by Council action October 1996), commencing January 1, 1997. Also, dues periods will henceforth be by calendar years, to allow annual dues notices. For new members joining prior to July 1 in a given year, their memberships will be considered to be effective January 1 of that year, otherwise January 1 of the following year. For current members, their dues anniversary dates have been similarly shifted to January 1.

Membership dues (stated in US dollars - circle equivalent-amount sent):

Full Voting Member: 3 years	**Student Member: 3 years**
Developed country $75.00	Developed country $25.00
Developing country $30.00	Developing country $10.00

Acceptable modes of IRPS membership dues payment, to start or to continue IRPS membership, are listed below. Please check payment-mode used, enter amount (in currency-type used), and follow instructions in item 8 below. (For currency conversion, please consult newspaper financial pages, at the time of payment). All cheques should be made payable to :

International Radiation Physics Society.

(For payments via credit card - http://www.irps.net/registration.html)

[ ] *(in U.S. dollars, drawn on a U.S. bank)*: Send to Dr W.L. Dunn, Dept. Mechanical and Nuclear Engineering, Kansas State University, 3002 Rathbone Hall, Manhattan, KS, 66506-5205. U.S.A.
Amount paid (in U.S. dollars) ____________________

[ ] *(in U.K. pounds):* Send to Prof. Malcolm J. Cooper, Physics Dept., University of Warwick, Coventry, CV4 7AL, U.K.. Bank transfer details:
Account number: 30330701. Bank and Branch code: Barclays, code 20-23-55.
Eurochecks in U.K. pounds, sent to Prof. Cooper, also acceptable.
Amount paid (in U.K. pounds) ____________________

8. Send this Membership Registration Form ***AND*** a copy of your bank transfer receipt (or copy of your cheque) to the Membership Co-ordinator:

Dr Elaine Ryan
Department of Radiation Sciences
University of Sydney
75 East Street, (P.O. Box 170)
Lidcombe, N.S.W. 1825, Australia
email: elaine.ryan@sydney.edu.au

9. ____ ____________________

Signature *Date*