

IRPS BULLETIN

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Exoplanet Travel Bureau



Some 40 light-years from Earth, a planet called TRAPPIST-1e offers a heart-stopping view: brilliant objects in a red sky looking like larger and smaller versions of our own moon. But these are no moons. They are other Earth-sized planets in a spectacular planetary system outside our own. These seven rocky worlds huddle around their small, dim, red star, like a family around a campfire. Any of them could harbor liquid water, but the planet shown here, fourth from the TRAPPIST-1 star, is in the habitable zone, the area around the star when liquid water is most likely to be detected. This system was revealed by the TRAnsiting Planets and Planetesimals Small Telescope (TRAPPIST) and NASA's Spitzer Space Telescope. The planets also are excellent targets for NASA's James Webb Space Telescope. Take a planet-hopping excursion through the TRAPPIST-1 system.



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Contents of this Journal

From the Editors :	Page 3
From the President :	Page 4
Report from Vice President, M.A.M. Goma, Africa and the Middle East	Page 5
Reflections after 11th Symposium of the Croatian Radiation Protection Association Marina Poje Sovilj and Ines Krajcar Bronić	Page 8
The Importance of Research and Research Collaborations – David Bradley	Page 13
Trappist-1 The Harmony of the Worlds – Grace Wolf-Chase	Page 16
ISRP-14 First Announcement - Marcelo Rubio	Page 18
Membership Contacts :	Page 12
Membership Payment Information :	Page 17
Membership Registration Form :	Last two pages

From the Editors

In 2016, planets were discovered around the star Trappist-1, just 39 lightyears away from us (Earth's closest extra-solar star, Alpha Centauri, is 4.4 lightyears distant). This year a total of 7 planets have been confirmed to orbit Trappist-1, including the first Earth-sized planets to have their atmospheres studied. More detailed information continues to accumulate. While transit data can provide estimates of planet radii, gravitational interactions among the planets produce transit-time variations, which in turn permits the mass of the planets to also be inferred. Taken together, it has been concluded that at least the first six planets of Trappist-1 are rocky and all seven are in the habitable zone where water can be liquid. Interestingly, the planets receive similar amounts of radiation from their star as does Earth from the Sun; Trappist-1 has a much smaller mass than the Sun, but this "loss" of stellar fluence is largely offset by much smaller orbital radii. All this has stirred imaginings of exotic holidays (as in the accompanying cover art from NASA), the search for alien life, and has excited astronomers and astrophysicists such as guest-columnist Grace Wolf-Chase who offers additional insights and references on Trappist-1 for our readers this issue

In this issue we also welcome a report from IRPS member Marina Poje Sovilj, and IRPS Vice President for Central and Eastern Europe Ines Krajcar Bronić, on the Eleventh Symposium of the Croatian Radiation Protection Association. This report includes reflections on ethics and culture in radiation protection.

We are privileged to have gained access to a copy of the after dinner speech given by executive councillor David Bradley at a November 2017 meeting in Malaysia.

This chosen topic of the importance of research and collaborations resonates with the spirit and actions of IRPS and its members. Indeed, this calls to mind the statement of life philosophy of an IRPS founding member, John Hubbell, as penned for *Who's Who in the World* 2006:

"In this later stage of my life, I view my global science connections more and more as an opportunistic tool toward realizing, incrementally at least, Teilhard de Chardin's envisioned "noosphere" (humanity as a caring communication "thinking skin" of the earth), declaring the pragmatic and compelling authenticity of the option of a friendly cosmos as not only a place in which to live, but also to bravely wear as a suit of clothes, in contrast to the hostile and judgmental cosmos envisioned, dwelt in, and worn by many." — John Hubbell

Dr. Hubbell is also mentioned in Mohamad Goma's Vice President's report, along with other activities of interest from Egypt and news from the International Radiation Protection Association.

Note especially the first announcement of The International Symposium on Radiation Physics 14 (ISR-14), to be hosted in Córdoba, Argentina, from October 7 to 11, 2018. This is the original conference from which IRPS was formed and, of course, continues to enjoy the full sponsorship of IRPS. See your invitation from the ISR-14 chair, Marcelo Rubio.

Finally, we had expected to present an election slate and biographies for the 2018 election of new IRPS leadership. This will await a special issue in early 2018.

With best wishes for the new year,

Larry Hudson and Ron Tosh, Editors

FROM THE PRESIDENT

Dear All

I write this after the successful IRRMA-X meeting, and a special workshop in Moscow, and indeed looking forward to the exciting program for ISRP-14 in Cordoba, Argentina October 7-11. Do keep this in your diaries and submit abstracts etc. Remember, we don't get to Argentina often but they and nearby countries like Brazil often compete for the best steak and beef. (If you are vegetarian then I still think the coffee and hot chocolate might be worth it.)

As a second and similar comment, note in advance that we are very much looking forward to ICDA-3 in Lisbon, May 2019. The last one run by David Bradley was a great success and we expect Lisbon will be even more so. Those of us who are a little aged will remember with great affection Isabel Lopes coordinating an earlier ISRP meeting in Coimbra, Portugal, and we are sure that Pedro Vaz and Isabel will make this coming meeting truly memorable for all. Equally, some of us will remember that vintage port ages very well and we should find opportunities for that in Lisbon. This is just a flavour of our international friendship and the collaborative members of our Society.

I make a little note about Proceedings. The ICDA-2 proceedings came out a few months ago. If you were there, then you should have received a copy; if not do please look up the issue in RPC. I think that there are many excellent and noteworthy papers in the Special Issue. IRRMA-X has the proceeding submissions closed and most are under review as we speak. As reviewers or editors, do please expedite these to make an exciting and timely Special Issue.

As a reminder, the Society spans atomic, molecular, nuclear with x-ray, gamma-rays, neutrons, electrons, and VUV photons, and condensed matter, radiation detection and dosimetry and links to many applications including dark matter physics, non-proliferation, threat detection and many more. This diversity and topicality is a continuing strength and flexibility of our Society.

As we begin to prepare for elections before Cordoba, I am optimistic about many things - our potential as an international society, for good and the progress of science and development of facilities; our potential to bring one another together as friends, and for constructive and productive collaborations between countries and cultures; our capacity to make cutting-edge advances in radiation physics across all areas; and our potential with goodwill to support countries in difficulties whether third-world or not as the distinctions begin to blur. Especially following IRRMA-X and ICDA-2, I am optimistic at our ability to bring in and support young scientists and for them to give outstanding presentations, posters and talks, on excellent physics and science of relevance and interest to us all, and we hope that we may continue to be a society that nurtures such talent. We have an advantage that our members are theoretical and experimental; fundamental and applied; young and older.

Chris

Chris Chantler

Report from Vice President, Africa and the Middle East M.A.M. Gomaa

1- Visit to Wadi Sannur Cave

On 21 November 2017, a group of nuclear and radiation physicists travelled from Cairo 120 km south to the Beni Suef Governorate, and then on to the Sannur Valley Cave Protectorate. The cave is located in the eastern part of the governorate and was discovered in the 1980s after blasting in a quarry created an entrance. From Cairo, the journey is one hour's drive on a smooth road, then another hour on rough road. We were received by the protectorate supervisor who led us to the zone characterized by alabaster formations. A 90 meter curved path brought us to three flights of stairs leading down to the cave base. Excellent collections of alabaster stalactites and stalagmites were observed. The return to Cairo completed the nine-hour trip. Below are several photos from the day.



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- 2- A one-day seminar took place on 15 November 2017 at the Egyptian Atomic Energy Authority. This seminar was held by the Egyptian Radiation Physics Group to memorialize 25 years of the Radiation Physics conference series. The first international seminar of the series was held jointly with members of IRPS Council on 21 November 1992. Several lectures were given by Egyptian nuclear and radiation physicists with particular emphasis in physics and archeology, where several detection techniques were discussed such as thermoluminescence, nuclear track detection, electron probe microanalysis (EPM) and others.
- 3- ICRP and ICNIRP issued a joint statement on 14 Nov 2017, at the "Meeting on the International Systems of Radiation Protection: Bringing together Protection against Ionising and Non-Ionising Radiation." The statement was published on the main IRPA web site and is reproduced on the following page 7.
- 4- On this the 10th anniversary of the passing of John Hubbell, I forward a faded photo from the 6th ISRP that was held at the King Mohamed V University, Rabat, Morocco in 1994. The symposium was hosted by Professor Mohamed Barrada who was the second IRPS Vice President for Africa and Middle East and was working at the Nuclear Physics Laboratory of the university. An IRPS found member, Hubbell is indicated in the first row of the photograph.



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International Radiation Protection Association

2017 November 14

Meeting on the International Systems of Radiation Protection: Bringing together Protection against Ionising and Non-Ionising Radiation

Meeting on the International Systems of Radiation Protection: Bringing together Protection against Ionising and Non-Ionising Radiation

The two international organisations responsible for developing the systems of radiation protection worldwide are the International Commission on Radiological Protection (ICRP), and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Both aim to protect people and the environment from potentially harmful effects of exposure to radiation, while recognising the benefits that may be associated with some of these exposures.

Building on past interactions, ICRP and ICNIRP held a joint meeting in Munich, Germany, organised by the World Health Organization (WHO), hosted by the German Federal Office for Radiation Protection (BfS), and in cooperation with the International Labour Organization (ILO) and the International Radiation Protection Association (IRPA). The objectives of this meeting were to: increase mutual understanding of the approaches to protection; reach a common understanding of the state of the systems of protection; and explore possibilities for continued collaboration.

Over three days, November 8-10, 2017, the organisations exchanged information and views on the scientific basis, ethical basis, and basic principles of protection.

There are many commonalities between the systems of protection used for ionising and non-ionising radiation. There are also differences, most stemming from different biological effects. Ionising radiation can cause stochastic and deterministic effects, while most effects due to exposure from non-ionising radiation appear to be deterministic. However, stochastic effects have been demonstrated due to exposure to ultraviolet radiation, which bridges the ionising and non-ionising parts of the electromagnetic spectrum. For ionising radiation there is a greater emphasis on optimisation of protection even at low levels of exposure, whereas for non-ionising radiation there is a greater emphasis on keeping exposures below thresholds for observed effects.

ICRP and ICNIRP share significant common ground, and have reached an agreement in principle to strengthen communication and collaboration between them and with other organisations with similar interests.

www.irpa.net

Ethics and Culture in Radiation Protection - Reflections after ELEVENTH SYMPOSIUM OF THE CROATIAN RADIATION PROTECTION ASSOCIATION

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The Eleventh Symposium of the Croatian Radiation Protection Association (CRPA, [1]) with international participation was held in Osijek, Croatia, April 5 - 7, 2017. Osijek (Figure 1, Figure 2) was the host town of the Symposium for the first time. The Symposium was organized by CRPA and co-organized by the Department of Physics of the University of Osijek, Institute for Medical Research and Occupational Health, Ruđer Bošković Institute and State Office for Radiological and Nuclear Safety. Presidents of the Organizing and Scientific Committees were Marina Poje Sovilj and Vanja Radolić, respectively, from the Department of Physics of the University of Osijek.

The Symposium was attended by ninety participants: seventy of them came from Croatian scientific research and government institutions, universities, health and economy sector, and twenty participants from abroad - there were representatives from Denmark, Hungary, Montenegro, Romania, Serbia and Slovenia.

The scientific part of the meeting was divided into the following subjects: General topics in radiation science and radiation protection, Ethics and culture in radiation protection, Radiation protection in medicine, Biological

effects of radiation, Radiation dosimetry, Instrumentation and measurement techniques, Radio ecology, Exposure of the general population to radiation, Radon, and Non-ionizing radiation. A total of 61 papers were accepted for presentations, 26 of them in the form of posters and 35 as fifteen-minute oral presentations. The Proceedings [2] was printed in a traditional yellow color (Figure 3) and is also available as pdf on internet page <http://www.hdzz.hr>. Abstracts of all papers in English are sent to the International Nuclear Information System (INIS), by the International Atomic Energy Agency (IAEA), which already contains abstracts from the previous CRPA symposia [3].

The presentations have drawn the attention to some important issues in radiation protection such as: inadequate translation of the European Commission's laws, directives and recommendations concerning various aspects of ionizing radiation protection from English into the Croatian language; harmonization of conditions for radiation protection experts (RPE) and medical physics experts (MPE); problem of finding a radioactive waste disposal site in the Republic of Croatia; implementation of the EU directive on the protection against

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ionizing radiation; radon exposure both to the general population and to the professionally exposed groups.

The main topic and the motto of the 11th CRPA Symposium was "Ethics and Culture in Radiation Protection." During the last two decades, the International Radiation Protection Association (IRPA) has been devoting attention to these topics on various regional and international congresses, special workshops and an Internet page <http://www.irpa.net> [4]. Another international association, the International Commission on Radiological protection (ICRP), also intensively prepares a publication on the ethical foundations of the system of radiological protection [5]. Two introductory lectures presented ethical values underpinning the radiation protection systems including the historical development of ethical principles [6], and current status of radiation protection culture in medicine [7]. The concept of culture relates to the ideas, beliefs and customs that are shared and accepted by people in a society. Therefore, radiation protection culture can be understood as a combination of habits and knowledge of radiation protection in all its aspects for workers, patients, population and the environment, and in all exposure situations, combining scientific and social dimensions. The next presentation [8] discussed the important question of using ionizing radiation in pediatrics, and finally an interesting survey of medical students' opinions about the importance of radiation protection education was presented [9].

The IRPA Code of Ethics was adopted in 2004 [3]. It contains principles that should be regarded as guidelines to the members of IRPA and its associated societies in maintaining a professional level of ethical conduct related to radiation protection.

CRPA accepted the IRPA Code of Ethics in 2009 in its original English version. The translation to Croatian was prepared this year and accepted by the CRPA General Assembly. Both language versions are available on the Internet [1] and in the Proceedings [2].

All symposium participants were invited to give up to three votes for the best or most interesting poster presentation. The first prize went to poster "Radioisotopes in ground soil *terra rossa* samples from the island of Mljet" by the first author Marijana Nodilo (Figure 4). Second prize was awarded to the poster "¹³⁷Cs and ⁹⁰Sr in milk in Osijek region" by the first author Iva Franulović. The third prize was shared between posters "The impact of sun radiation on the parameters of comet assay" by the first author Marko Gerić and "Comparison of two different methods for determination of biogenic fraction in liquid fuels" by the first author Jovana Nikolov.

Important contributions to the Symposium were given by the sponsors: University Josip Juraj Strossmayer of Osijek, Osijek-Baranja County, Jadransko osiguranje d.d. (a subsidiary of Osijek), Ruđer Medikol Ciklotron Ltd., Varian Medical Systems, BISS Ltd., Saponia and Atlantic Group. The patrons of this Symposium were four ministries of the Republic of Croatia: the Ministry of Science and Education, the Ministry of Health, the Ministry of Environmental Protection and Energy and the Ministry of the Economy, Entrepreneurship and Crafts.

The following companies took part in the technical exhibition: LKB Vertriebs Ges.m.b.H. represented by Dusan Djurdjević (Vienna), Canberra Packard Central Europe GmbH represented by Csaba Buda, Varian Medical Systems represented by Boris Šimić

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and Ivan Pongrac, and the company HEBE d.o.o. with its representative Zoran Tomašković.

For all the participants two trips were organized. Guided tour of the city of Osijek was a tribute of the tourist board of the city of Osijek. At the end of the Symposium an

organized trip to Kopački Rit Nature Park and visit to the monument of the Batina Battle in Batina, a famous work of Croatian sculptor Antun Augustinčić, took place (Figure 5). The gathering continued in Zmajevac village in Baranja with a fish dinner in the traditional ambience.



Figure 1. The main square in the city of Osijek (*above*) and the Osijek Hotel where the symposium was held. (*photo by: Mario Romulić and Dražen Stojčić*)



Figure 2. Opening of the 11th CRPA Symposium and a lecture in the hall "Javor" in the Osijek Hotel.

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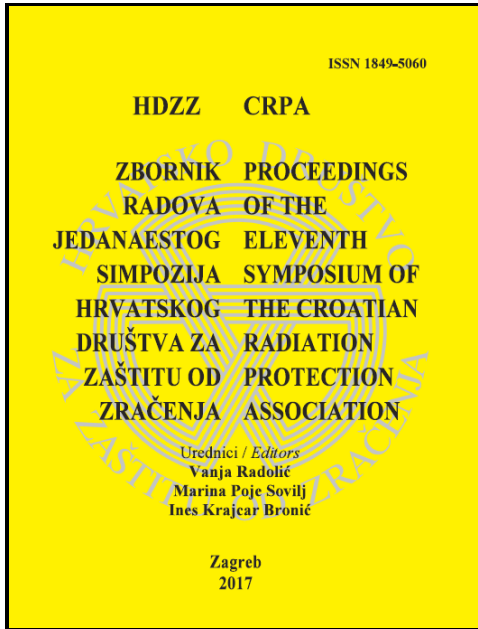


Figure 3. Cover page of the printed symposium proceeding in a traditional yellow color.



Figure 4. The winner of the first prize for the best poster - Marijana Nodilo (Ruđer Bošković Institute, Zagreb)



Figure 5. Part of the 11th CRPA Symposium participants at the Monument Battle of Batina in Batina during the excursion.

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8. Đurđica Milković and Maria Ranogajec Komor: Ethics of ionizing radiation protection in pediatric radiology of the upper respiratory tract, *ibid.* pp. 27-32.
9. Sanja Dolanski Babić: What do students at the Medical Faculty in Zagreb can learn about radiation protection in their physics education, *ibid.* pp. 33-38.

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The Importance of Research and Research Collaborations

**After-Dinner Speech given by David Bradley
at a meeting 'South East Asia – UK Springboard: Cities of the Future',
2 – 4 November 2017, Sunway Hotel and Spa, Sunway City, Malaysia**

Ladies and Gentlemen, I hope you will agree, if even only in part, that research is largely driven by primary factors that include the desire to live in health, with quality of life, within a safe, secure, equitable and harmonious environment, with an innate need for self-fulfilment, in short a desire to improve the human condition. Looking around you, hopefully you will recognise in practically everything that you see, do or otherwise sense, that there has been the benefit of research. Much of it has been driven by the needs of Society, the more socially beneficial needs being a result of Societal funding, largely Governmental, with some move towards fulfilling international norms regarding budget apportionment (we will come back to this struggle to obtain funding later on). Some of these Societal undertakings are huge (the need to provide for energy for instance) but without question applications research and development have also benefitted from fundamental/basic research, not least the desire to classify, categorise and question, including Mendeleev's construction of the Table of Chemical Elements, with an initial gap, now filled by helium first detected as an unknown yellow spectral line in sunlight during a solar eclipse in 1868. Norman Lockyer was the first to propose that the line was due to a new element and with its connection to a solar basis he adapted the Greek word for the sun (Helios) in its naming.

The table has been a truly amazing store of previously poorly understood science, and in as far as energy conversion is concerned, we have certainly come to appreciate the role of the two extremes in that table (H, He and C at the one end and U and transuranics at the other) (and going back to C, the recent desire to exploit the 2D material graphene in energy and other applications). Indeed in as far as exploitation is concerned, the wealth of nations have often derived from the control of elements, even back to the stone age; here we can reflect on how silica (sand) has become the basis of optical communications and therefore is of such great import for us - also let me draw a distinction between the light guide of for instance the sea sponge (in particular the Venus Flower Basket) and that of doped silica. In the former it is developed at deep water temperatures and in the modified chemical vapour deposition (MCVD) system used for the latter at well in excess of 1000 deg C - we have so much to learn from nature, not least in regard to bioluminescence. We then go on to the iron age, through to the carbon, uranium and hydrogen ages (all no-less important albeit with their prominence now and again sometimes usurped as a result of currency of interest). The elements supporting vitality are also well of vital interest, an embarrassingly stupid comment if ever there was one and for which I apologise. The continuous quest to control language is

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another universally shared problem but then if we work as a team, then this too can be a shared burden as we seek to publish our great results. But do let us go on to also consider for instance the role of Fe in the human body, a substance which without its presence within us of only some 6 g we would not exist.

More extreme still would be the case of the aptly called essential elements as co-enzymatic factors, present at sub gram quantities within the body (eg Zn and Cu) and without which at homeostatic levels we would be very ill indeed. We could go on to cite other examples of where science development has aided in work towards improving the quality of life, but I will refrain, present intention being different (as indicated by the title of this talk), and to borrow from the phrase of Louis Pasteur (famed in so many aspects of what is now termed microbiology and particularly in regard to the germ theory of disease) that 'Fortune favours the prepared mind' (itself borrowed from the golden age of Greek philosophy, with 'Fortune favours the brave' as the idea). Given the desire and enthusiasm to learn, the multidisciplinary group can have the benefit of many prepared minds and mitigation of silo thinking. Clearly recognition of patterns is important but it is the faults (omissions, additions and their rationalisation) that may not be readily apparent to most in what are often referred to as serendipitous discoveries. Another particular case to that of Lockyer and his recognition of a previously unknown element would be that of Roentgen and his discovery of x-rays, of which more will be discussed later. The point I am coming to is that it is the ability to recognise the germ of something that may well be of potential great import and collaborative research can offer such strength here.

In the present world of science, it is rare for any one person to stand alone (the 'gentleman' scientist, as perhaps Lockyer started out as, has become something of a rarity, but here we should make mention of the journal Nature, with Lockyer as its founder and first Editor, recognising that if we are to progress, those of different disciplines need to speak to each other, also of the Royal College of Science - the seed of Imperial College - where Lockyer taught) [I know you will all be able to cite other cases of the lone scientists, *e.g.* Peter Higgs, Srinivasa Ramanujan *etc.* but these are truly exceptions]. Knowledge now is represented by such a vast body of information that the polymath (the know-it all, to be a little unkind) must surely be even rarer (Ernst Mach was said to be one such person). Being within a multidisciplinary team we can be so much better prepared to recognise linkages, to share knowledge, to come to understand the discipline vocabulary of others, the seemingly abstract nature of which can doubtless be challenging, to make challenges to the vast Encyclopaedia of Ignorance, aptly described by Newton in his reflective:

I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

Working within a team, particularly so the multidisciplinary team, provides such great opportunities, a matter of great development for those early in their career, not least the postdoctoral scientist and overcoming the issue of inbreeding that all of us suffer from, to a greater or lesser extent. I offer here just one personal

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vignette; myself as a postdoc at the University of Pittsburgh, where as a junior experimentalist I found myself joining an atomic physics theory group; totally unsettling but so very rewarding.

Let me return to funding, resources and disbursement. We can all recognise the pressures brought about by finite resources confronted in university life by the additional need to publish (Peter Higgs experience, producing at the highest level of scientific thought but otherwise publishing very little in terms of quantity, is less likely to be tenable now, as he himself has recorded) and/or for patents. We could be trite here and I will be; now the only constant in university life is change and we must either adapt or wither. The opportunities brought about by shared facilities, shared experiences and inter-governmental funding (*e.g.* the Newton Fund) cannot be overlooked. This is no less true when one comes to seeking funding from business entities (by which one means venture capital groups, angels, or in the worst case the three F's, Friends, Fools and Family). For the serious money, here one needs to place things in rather terse but explicit terms, that of the Unique Value Proposition (basically 'What have you got?' and then 'So what?'), accompanied by the 30 second elevator pitch, and from that the three-minute pitch and so on. We need to work together towards sharing experience, working towards developing ideas and not least in how best to get those ideas across.

In closing, let me return to one development in Malaya, highly unexpected one might say. The event, was the demonstration of production of an x-ray image, occurring on 3 February 1897 in Taiping, Perak (just 14 months after Roentgen had made known his

serendipitous discovery of what he had intended to temporarily term the X-ray and that by others was termed as skiagraphy, the casting of shadows - 'peering through windows, darkly...' - to borrow from 1 Corinthians 13:12. There was yet to be an electric supply in Taiping, indeed the very first electric generator to come to Malaya was only in 1884, introduced by a mining company, presumably exploiting the earth for its tin deposits, much as the ground below us here at Sunway City has in the past been similarly exploited. The x-ray was of a flat fish, recognising as Roentgen had in the famous image of skeletal hand with wedding band on it, the hand of his wife (who was to say 'I saw in that my own death'), that the x-ray tubes of the time had highly limited capability to penetrate substantial matter. For this, use was made of an induction coil (a Wimshurst machine, itself only created by the end of 1883). The name of the person who demonstrated the machine? Mr. Wray, of course.

Malaysia has a great deal to offer, now much industrialised, ranging from the beneficiation of rare earth bearing ores upon which our mobile phones depend (Malaysia is host to one of the largest such factories outside of China), to perhaps the greatest natural resource of all, namely its people and their very clear desire to live in health, with quality of life, within a safe, secure, equitable and harmonious environment, with an innate need for self-fulfilment and the added feature of increasing internationalisation, all in pursuit of improvement of the human condition. The growth of tertiary education provision in Malaysia has been nothing short of amazing, the present Sunway University - Lancaster University initiative being one great indication of such efforts.

D. A. Bradley 2/11/17

TRAPPIST-1 : THE HARMONY OF THE WORLDS

By Grace Wolf-Chase, Ph.D.

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Recently the discovery of seven Earth-sized worlds orbiting the "nearby" star known as TRAPPIST-1 was reported. Because of the significance of this discovery to the search for life beyond Earth, I encourage those who are interested to keep up with the latest information on the website created by the science team.(1)

All seven worlds of TRAPPIST-1 transit (pass in front of) their star during their orbits, presenting an unprecedented opportunity to study the climates of these planets as starlight passes through their atmospheres. Patterns in the way starlight is absorbed can reveal the chemical composition and structure of the planets' atmospheres. The worlds of TRAPPIST-1 are currently our best bet for discovering evidence of biology beyond our Solar System, and theorists are already working out habitability models based on assumptions that will be better constrained after more detailed studies with the Hubble Space Telescope and the future James Webb Space Telescope.(2)

Another amazing aspect of the TRAPPIST-1 system is the proximity of the orbits of the seven worlds to each other. The planets are locked in an "orbital resonance," which means the lengths of time it takes them to orbit their star (each planet's "year") are related by integer ratios. In the time it takes the outermost planet to complete two orbits, the next planet inward has completed three orbits, then four, six, nine, 15, and 24 for the innermost planet.

Resonant orbits can be a source of chaos. They provide a gravitational "boost" that is similar to the way periodically pushing a child on a swing causes the swing to go higher and higher. The problem is that the pushes add up and initial computer simulations of the TRAPPIST-1 system indicated the planets should crash into each other in less than a million years, although their star is billions of years old. Resonant orbits can, however, also be a source of stability, depending upon other important factors. The results of research published this month by astrophysicist Daniel Tamayo suggest that if these planets formed slowly, the system could have been fine-tuned to orbits that could persist stably for billions of years.(3)

The research on the planets' orbits led to an interesting collaboration between Tamayo and Matt Russo, an astrophysicist with a degree in jazz guitar who moonlights as a guitarist in an indie pop band.(4) Musical harmonies arise from resonances in the frequencies of particular pitches. Russo, noted, "I immediately recognized that [the orbital resonance] would make beautiful music because it's the same pattern of period ratios that makes chords." Supercomputer simulations illustrate that this remarkable harmony keeps this

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system stable. I encourage you to listen to The Song of a Solar System: TRAPPIST-1 on YouTube (5), and while you're at it, check out the short stories, graphic novels, and poems that have been already inspired by this astonishing planetary system! (6)

A recent article in The Astrophysical Journal (7) derives an age of the star (TRAPPIST-1) on the order of 7.6 Gyr. This is particularly important because it implies the planetary orbits have remained stable over a very long period of time [with implications related to the habitability of its planets].

1. See www.trappist.one
2. Wolf, E. T. 2017, Assessing the Habitability of the TRAPPIST-1 System Using a 3D Climate Model, ApJL, 839 (6pp)
3. Tamayo. D. et al. 2017, Convergent Migration Renders TRAPPIST-1 Long-lived, ApJL, 840 (6pp)
4. https://www.washingtonpost.com/news/speaking-of-science/wp/2017/05/11/watch-the-delicate-song-and-dance-that-keep-trappist-1-planets-from-blowing-up/?utm_term=.9cab5e46a036
5. <https://www.youtube.com/watch?v=7i8Urhd6eI>
6. <http://www.trappist.one/#stories>
7. On the Age of the TRAPPIST-1 System, Adam J. Burgasser and Eric E. Mamajek, The Astrophysical Journal 845,(2017) p.110 (10 pp).
<http://iopscience.iop.org/article/10.3847/1538-4357/aa7fea>

New Memberships, Membership Renewals

Membership form for new members, and details for payments by cheque for new and renewing members are on the last 2 pages of this Bulletin and information for payment by credit card is below

If you are unsure when your renewal is due, contact

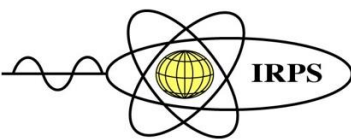
Elaine Ryan : *email:* elaine.ryan@sydney.edu.au

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To use this method of payment go to the <http://www.canberra.edu.au/irps>. Home Page on our website, click on Membership, scroll down to the selection of buttons and click on the one that suits your membership. If you have any queries or problems contact :

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Ministerio de
**CIENCIA
Y TECNOLOGÍA**

<https://isrp14.cba.gov.ar>

ISRP-14 - First Announcement

The **International Symposium on Radiation Physics 14 (ISRP-14)**, will take place in the city of Córdoba, Argentina, on **October 7-11, 2018**.

The Organizing Committee is pleased to invite you to participate in the event whose main characteristics are highlighted in the following paragraphs.

The International Radiation Symposia are one of the regular activities of the <http://www.canberra.edu.au/irps>, founded in Ferrara (Italy) in 1985. The main objective of the International Radiation Physics Society is to promote global exchange and integration of scientific information related to interdisciplinary issues of radiation physics, including the promotion of theoretical and experimental research in radiation physics. Research into the physical aspects of the interaction of radiation with inert or living material systems, education in radiation physics and the use of radiation for peaceful purposes.

The Symposium of Córdoba is organized according to the formal guidelines of the IRPS, whose format is not different from the conventional one of this type of congresses. The ISRP-14 is sponsored by the IRPS, and has the official declaration of interest and support of the Minister of Science and Technology of the Government of the Province of Córdoba, Argentina; the National Minister of Science and Technology of Argentina and the National University of Córdoba, official site of the event.

We invite you to visit the <https://isrp14.cba.gov.ar>
and write to the email indicated below all your concerns.

Looking forward to meeting you in October, 2018, in Córdoba !

On behalf of the Organizing Committee :

Marcelo Rubio

ISRP-14 chair Unidad Estudios Físicos

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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 (ISRP-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), Rio de Janeiro, Brazil (ISRP-12, 2012) and Beijing, P.R.China (ISRP-13, 2015) 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):

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.
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[] (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