

ARCHIVE EDITION OF IRPS BULLETIN

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From
the
Editor

Dudley
Creagh

Our apologies. We have been trying a new way of sending out the IRPS Bulletin but unfortunately we have had problems sending out this edition. Each edition is, however, available on our web site

<http://beth.canberra.edu.au/IRPS/welcome.html>.

I start by welcoming our new President Bikash Sinha to the pages of the IRPS Bulletin. His first President's Column is on page 2.

Our Past President John Hubbell has contributed much by way of material for the Bulletin, and continues in this issue with a summary of the recent ISRP7 Meeting in Jaipur. John's contribution to our society is immeasurable: he was there at the inaugural meeting in Calcutta, and was instrumental in the formation of the IRPS as a scientific society. To him we say, "Well done!!". And we give him a standing ovation for his achievements. We know that he will continue to provide interesting, informative and provocative copy for the Bulletin.

Also included in this Bulletin is a brief summary of CRYSTALXX, the meeting of the Society of Crystallographers in Australia, which this year was held in Christchurch, New Zealand. I hope that the two conference reports will be the first of many subscribed by readers to inform members of activities which are happening in all the four corners of the world.

As well, I would like to devote issues of the Bulletin to the discussion of topics such as:

- are high voltage powerlines a radiation hazard?
- do we exaggerate or underestimate the effect of environmental radiation?
- astrophysics and astronomy;
- particle physics.....

and so on.

I welcome copy on all of these issues, preferably using

electronic media such as email or floppy disc.

Your contributions to this your journal are very welcome.

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It is with some degree of humility that I take charge as the President of the International Radiation Physics Society from my very distinguished predecessor, Professor John Hubbell. Indeed, it is rather daunting to keep up with the very high standard established by John, including the regular Presidential column of our newsletter.

IRPS, very broadly speaking has two areas of activities, one, the nitty gritty of radiation physics, the science of it, as it were, starting from the ionising radiation, Compton scattering, light source and the related research activities, even application in the front edge of contemporary "material technology", to Cosmic rays and indeed radiation pervading the entire universe with so few baryons! The list goes on.

On the other end of the scale lies, the evolving world of cancer diagnostics and therapy, nuclear waste management by transmutation, preservation and sterilisation of necessary medical accessories, preservation of consumable food items, and so on.

What bothers me deeply is the general fear psychosis that still exists quite extensively about radiation and the imaginary harm it can cause. Of course, radiation overdose has to be avoided at any cost, there is no debate whatsoever about this issue. The other edge of this scenario is the realisation of the simple almost obvious fact that radiation at a certain critical level is absolutely necessary to sustain any kind of life form.

Between these two extreme points there lies the lurking fear, if not anxiety about waste management, evoking many issues, scientific, political, even genetic and the related sociology.

In my opinion, it is of paramount importance for our society to focus on these issues, highlighting the possible hazards of radiation at the same time argue persuasively the enormous benefit mankind can derive from using radiation as a tool for rather accurate diagnostics and indeed a whole host of areas, making sick people a little more hopeful.

Indeed, I do feel, in the next three years as your President it is my responsibility to educate and make common men and women aware of these critical issues across the world. The misunderstanding and misconceptions in this business are unfortunate and non productive.

We say nuclear power is the cheapest, safest and most environment friendly but the ghost of Chernobyl still haunts us. The great scission between the nuclear haves and have nots has opened up an age old wound, which looks particularly ugly.

In fact, I, like quite a few of my distinguished colleagues, never seem to be amazed about the abysmal progress in the scientific side of waste management; a technique, almost as old as the maddening events of the second world war is still the main thrust in this area. Billions of dollars are spent on a method which is clearly out of date scientifically. We all know that transmutation using high current, typically (say) of 1 GeV proton can be a possible and entirely viable, new and relatively efficient method, apart from the bonus of using neutron spallation for both research and application in material science. But the so called energy amplifier still remains a mere whisper; we certainly have to push this area world wide.

On the other side of the spectrum, the rapidly growing area of radiation for therapy and diagnostics, is reflected rather dramatically from the fact that out of some ten thousand particle accelerators in the world, at the most only one hundred of them are used for research, the rest is used entirely for therapy and diagnostic purposes.

That brings me to two areas where we need to consolidate in our society. First, the BULLETIN, the "mute spokesperson" of our thought processes has to gear up for this purpose. Dudley, is doing a heroic and fantastic job, we have to help the cause to the best of our abilities and bring out the BULLETIN as one of the most precious journal, any member will be proud of, and desperately interested to get the next issue. This in turn will help to increase our membership drive. Indeed, I feel with some confidence that with the sense of "all hope" that our BULLETIN, can easily be the precursor for a regular journal on radiation physics.

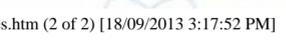
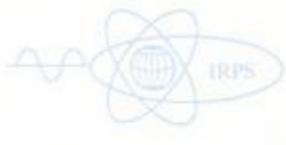
I had the great honour of delivering an evening lecture during this impressive conference, where one tried to have a broad sweep of "Hundred years since Becquerel and Roentgen, an India perspective". I am afraid I have decided to write up the lecture but release only in form of small excerpts, so to speak, for our BULLETIN. After all one does start from 400 B.C. and then go up to the end of the twentieth century. Two thousand five hundred years cannot be done in one go! Do forgive me please for such a scheme of thinking.

Finally I take this opportunity to thank all the members of our society for electing me the President, I shall try to serve the society to the best of my ability, and most important not to let you down, after all, the confidence you have extended to me, I consider, precious and a source of great motivation and honour.

Last but not the least, I cannot end this column without a special tribute to John Hubbell, and Gene Hubbell, with whom my association may be somewhat brief compared to other office bearers of our society; Hubbells have been always charming, warm and consistent, be it at Chengdu, Prague or wherever. A special, very special tribute to Anu Ghosh, who most unfortunately cannot be present at Jaipur.

Jaipur, of course holds a special place in my heart, Jaipur, the pink city, to me at least, evokes a deep sense of history, of time long gone by, a sense of immeasurable nostalgia, of kings and queens, of battles, of chivalry, of romance, of beauty, of camels and deserts, of elephants and princes.

Jaipur is an enigma, a symbol of an exotic witness of battles lost and won, of the eternal changes of fortunes of the victories and the vanquished yet preserving a fluent tradition of charm, candour and endless style, so terribly rare in our fragmented world of greed, despair and loneliness!



Dudley Creagh
Executive Councillor (Australia)

CRYSTAL XX CONFERENCE

New Zealand, 2-5 April, 1997

CRYSTALXX, the twentieth meeting of the Society of Crystallographers in Australia, was held in Queenstown, New Zealand, from 2 to 5 April 1997.

Although New Zealand and Australia vote as separate entities in the Congress of the International Union of Crystallography (which represents more than 100,000 scientists in 80 countries, and is one of the oldest members of the International Conference of Scientific Unions) many New Zealand scientists belong to the SCA, and a decision was made to hold the regular SCA meeting "off-shore".

About 100 SCA members attended the conference. The meeting was unusual in a number of respects, the most important of which was the presence of the President (Professor Ted Baker, Massey University, New Zealand) and the Immediate Past President, (Professor Philip Coppens, SUNY, USA) of the IUCr at the meeting.

In the opening session, the first of two sessions on macromolecules, Gerard Kleywegt (Uppsala, Sweden) discussed how information about the structure of proteins can be deduced from low-resolution data. Other important contributions to this session were made by Clyde Smith (Massey, NZ) who discussed research he has been undertaking in conjunction with Ivan Rayment (Wisconsin, USA) on the study of the mechanisms of muscle contraction at the molecular level, and the work of the group led by Mitch Guss (Sydney, Australia) into the crystal structure of a bacterial copper-containing amine oxidase.

Australasian scientists are highly mobile users of the major national facilities of other countries so it is not surprising that sessions on neutron studies and synchrotron radiation studies formed a significant part of the program. The development of a new single-crystal neutron diffractometer at the Australian Nuclear Science and Technology Organization was described by Ross Piltz (ANSTO, Sydney, Australia). This represents to an extent a commitment by government to local neutron scattering programmes. Most neutron scattering work is done overseas, however, and Elliot Gilbert (Australian National University, Canberra) described research into the stability of n-hydrocarbon films conducted at the neutron spallation source (ISIS) at the Rutherford Appleton Laboratory (UK).

Dudley Creagh spoke on the new opportunities which are emerging for Australian scientists in research using synchrotron radiation both at the Photon Factory (Japan) and the Advanced Photon (USA). Opportunities in protein crystallography, x ray powder diffraction, x ray reflectometry, grazing incidence diffraction, X ray Absorption Spectroscopy, and Small Angle X ray Scattering, were described, and elaborated on by other speakers. Novel techniques in x ray imaging were discussed by Mel Fehlman (ETH-Zentrum, Switzerland). Brendan Kennedy (Sydney, Australia) discussed both neutron and x ray diffraction studies of powder specimens of inorganic materials.

Electron microscopy studies into disordered solid are currently an important field, because of the importance of many of the materials in catalytic processes. Rav Withers (Australian National University, Canberra) described his systematic investigations of a variety of compositionally and displacively disordered flexible solids.

One of Australia's best known crystallographers, Professor Ted Maslen, died of a heart attack whilst running earlier this year. A commemorative session was held in his honour. In this session a number of speakers elaborated on his very significant contribution to Australian crystallography, and in particular his contribution to the understanding of electron density distributions in materials. Victor Strelsov, one of his close collaborators spoke of their studies using synchrotron radiation of the electron density distribution in a wide range of perovskite structures.

Philip Coppens (SUNY, USA) described experiments which he is pursuing into excited states of molecules in crystals, using synchrotron radiation sources.

Walter Steurer (ETH-Zentrum, Switzerland) discussed the current state of our understanding of quasi-crystals and their structure.

In the session on techniques for the teaching of crystallography speakers described their attempts to teach crystallography in a curriculum which is already over-crowded to students lacking basic mathematical skills: not an easy task. Max Taylor (Flinders, South Australia) described a new method he has devised using spread-sheets.

During the conference a number of meetings of committees occurred. The National Committee for Crystallography met to discuss, amongst other matters, the future of neutron scattering in Australia, and to hear progress reports on out involvement with the Advanced Photon Source. The Australasian members of the Asian Crystallographic Association met with the AsCA's President, Professor Jim Simpson, and the Japanese Representative, Professor Hiroo Hashizume, to discuss the progress of planning for the next AsCA Meeting which is to be held in Selangor, Malaysia in October 1998.



The IRPS Advisory Board

John Hubbell
Chairman, IRPS Advisory Board

The U.S. Army General Douglas MacArthur, famed for his exploits in World War II in the Pacific Theatre, is most quoted from his two pronouncements: (1) "I shall return." and (2) "Old soldiers never die, they just fade away." Both of these quotations have some bearing on a proposal, discussed at recent IRPS Executive Council Meetings, to establish an IRPS Advisory Board consisting of all the Council Members who have served but have now stepped down from office. The members of this newly-created Board would receive all the Council mailings, and would be invited to all Executive Council Meetings (usually held twice a year) as non-voting observers.

These mailings and invitations are already being provided informally by our IRPS Secretariat (Dick Pratt) as a courtesy to the eligible members who would comprise the Board. However, it now seems appropriate to recognize and acknowledge this past service to the IRPS in the form of a formal listing which can be publicized at the Symposia and in this newsletter, and to take advantage of the years of experience and IRPS history represented by the members of such an IRPS Advisory Board, both at the Council Meetings and by correspondence.

As was discussed at the IRPS Council Meeting at Warwick in 1995, an Elections Nominating Committee may, if it so chooses, draw one or more candidates (with consent) from among the Advisory Board members, to incorporate in an election slate. If such a candidate is duly elected and returns to the Council, his or her name would not be removed from subsequent IRPS Advisory Board listings.

Members of the IRPS Advisory Board, along with Members of the current Council, are requested to each write at least one article or report per year for our newsletter **IRPS Bulletin**, submitted to our Editor Dudley Creagh at his address as listed on the cover of this issue.

From my records, conveniently summarized in my President's Column "Origins and Chronology of the International Radiation Physics Society" in the IRPS Bulletin 10(2) (June/July 1996), this Board, following the Council changes for 1997-2000 as of the recent election announced at ISRP-7 in Jaipur February 24-28, 1997, should consist of:

IRPS Advisory Board 1997-2000:

As the Immediate Past-President of the IRPS, I will assume the Chairmanship of the Advisory Board for the term 1997-2000.

Dan J. Beninson (Argentina), IRPS President 1991-1994.

Denes Berenyi (Hungary), Hosted Council Meeting, Debrecen 1992. Executive Councillor 1985-1991, Vice President for East Europe and USSR 1991-1997.

Mohamed Berrada (Morocco), Hosted Council Meeting, Rabat 1990; Principal Organizer, ISRP-6, Rabat 1994. Vice President for Africa and Middle East 1988-1997.

Ernesto Casnati (Italy), Hosted IRPS/ISRP-3 Organizing Meeting, Ferrara 1984; Principal Organizer, ISRP-3, Ferrara 1985. Pro-tem Committee to form the Society 1984-1985, Executive Councillor 1985-1988.

Walter B. Gilboy (UK) has not yet held an elective Council Office, but he has been invited to Council Meetings over the past several years in view of his long time interest and enthusiasm in IRPS affairs, particularly for his ideas and creativity on building the membership of the Society. Hence his listing here in the Advisory Board seems appropriate for present Council communications purposes.

Mohamed A. Gomaa (Egypt), Hosted Council Meeting, Cairo 1992. Pro-tem Committee to form the Society 1982-1985, Vice President for Africa and Middle East 1985-1988.

D.V. Gopinath (India), Executive Councillor 1988-1991

John H. Hubbell (USA), Hosted Council Meetings, Gaithersburg 1988, 1996. Secretary, Pro-tem Committee to form the Society 1982-1985, Executive Councillor 1985-1991, Vice President for North America 1991-1994, IRPS President 1994-1997.

P.K. Iyengar (India), Hosted Council Meeting, Bombay 1990. Pro-tem Committee to form the Society 1982-1985, IRPS President 1985-1991.

Glenn F. Knoll (USA), Vice President for the Americas 1985-1988, Vice President for North America 1988-1991.

Zhengming Luo (PRC China), Hosted Council Meeting, Chengdu 1993. Vice President for North East Asia 1994-1997.

David J. Nagel (USA), Vice President for North America 1994-1997.

Ivan C. Nascimento (Brazil), Hosted Council Meeting, Sao Paulo 1986; Principal Organizer, ISRP-4, Sao Paulo 1988. Vice President for South America 1988-1994.

Anselmo Paschoa (Brazil), Vice President for South America 1994-1997.

Ian B. Whittingham (Australia), Pro-tem Committee to form the Society 1982-1985, Executive Councillor 1985-1991.

Missing from the above listing, but not forgotten, are two Council Members we have lost through death, who contributed much to the formation and nurture of the IRPS, and to whom we are much indebted:

Didier B. Isabelle (France), Hosted Council Meeting, Orleans 1987. Pro-tem Committee to form the Society 1982-1985, Treasurer, IRPS 1985-1991, died February 1, 1995.

Daphne F. Jackson (UK), Pro-tem Committee to form the Society 1982-1985, Vice President for Western Europe 1985-1988, died 1991.

In addition to the above noted service and affiliations of the former Council Members, there were many important and strenuous tasks performed, such as Chairing Technical Programme Committees and Local Organizing Committees, also in the Editing of ISRP Symposium Proceedings. Since these are generally joint efforts, it is difficult to single out and appropriately credit all the responsible individuals in the above format, but you know who you are, and on behalf of the IRPS you have my deep thanks and admiration.

SOME NOTES ON THE 1997-2000 IRPS COUNCIL

Although the results of the 1997-2000 Council Election will be posted elsewhere in this issue, it seems useful to me for archival and other purposes to here list comparable information on the incoming and continuing individual Council Members, in the same format as used above for the Advisory Board. In both lists, above and below, there are likely some mistakes and omissions, I will appreciate being brought to my attention.

The 1997-2000 IRPS Council Members (alphabetically):

David A. Bradley (UK, Malaysia), Editor, Editorial Board, **IRPS-News/IRPS Bulletin** 1986- . Executive Councillor 1991-2000.

Malcolm J. Cooper (UK), Hosted Council Meetings, Warwick 1989, 1995. Vice President for Western Europe 1988-2000.

Dudley C. Creagh (Australia), Editor, **IRPS Bulletin** 1995- . Executive Councillor 1991-2000.

Yongxiang (Victor) Feng (PRC China), Vice President for Northeast Asia 1997-2000.

Leif I. Gerward (Denmark), Designed and distributed IRPS promotional poster 1995. Executive Councillor 1994-2000.

Ananda M. Ghose (India), Principal Organizer for ISRP-1, Calcutta 1974 and for ISRP-2, Penang 1982. Editor, **IRPS-News** 1988-1994. Chairman, Pro-tem Committee to form the Society 1982-1985, Vice President for Asia and Pacific 1985-1991, Executive Councillor 1991-2000.

Kimberlee Kearfott (USA), Vice President for North America 1997-2000.

Rex J. Keddy (South Africa), Vice President for Africa and Middle East 1997-2000.

Ante Ljubicic (Croatia), Hosted Council Meeting, Zagreb 1986. Pro-tem Committee to form the Society 1982-1985, Vice President for East Europe and USSR 1985-1991, IRPS Treasurer 1991-2000.

Raúl Mainardi (Argentina), Vice President for South and Central America 1997-2000.

Michel M. Monnin (France), Executive Councillor 1994-2000.

Ladislav Musílek (Czech Republic), Hosted Council Meeting, Prague 1996; Principal Organizer for ISRP-8, Prague 2000. Vice President for East Europe and FSU 1997-2000.

Takashi Nakamura (Japan), Pro-tem Committee to form the Society 1982-1985, Executive Councillor 1985-2000.

Richard A. Pratt (USA), Editor-in-Chief, **IRPS-News/IRPS Bulletin** 1986- . IRPS Secretary 1985-2000.

Suprakash C. Roy (India), Associate Editor, **IRPS-News/IRPS Bulletin** 1986- . IRPS Membership Coordinator 1990- . Executive Councillor 1994-2000.

Franco Rustichelli (Italy), Hosted Council Meeting, Ancona 1994. Executive Councillor 1988-2000.

Prasanta Sen (India), Vice President for Southeast Asia and the Pacific 1997-2000.

Bikash Sinha (India), Hosted [with B.K. Sharma (Jaipur) and P. Sen] Council Meeting, Jaipur 1995. Principal Organizer, ISRP-7, Jaipur 1997. Vice President for Southeast Asia and Pacific 1994-1997, IRPS President 1997-2000.

I think the above composition of the 1997-2000 Council, under the able leadership of our President Bikash Sinha and combined with the interest and support of the now-formalized IRPS Advisory Board, will insure the continuing establishment of our International Radiation Physics Society in our unique and useful cross-disciplinary role in the family of Scientific Societies.

[Report on the 7th International Symposium on Radiation Physics \(ISRP-7\)](#)

Workshop and Conference held in Debrecen, Hungary, 1996

Denes Berenyi
Hungarian Academy of Sciences

A PET workshop with "A Critical Assessment of Recent Trends" title in Debrecen, October 1-4, 1996, was organised by NATO, Hungarian Academy of Sciences and the Hungarian PET Center.

Well-known foreign and Hungarian scientists delivered lectures in five sessions. These sessions were as follows :

- How to establish and run a PET Center
- Physics, radiochemistry, data acquisition, image processing
- PET in oncology
- PET in the exploration of the central nervous system
- PET in brain research.

On October 15, 1996, there was another conference with the title of "Human, Environmental, Radiation" at the Debrecen Regional Center of the Hungarian Academy of Sciences.

The central topic of the conference was the ionizing radiation. Well-known Hungarian scientists gave introductory lectures about their research results.

The three issues of the conference were as follows :

- Physics and energetics
- Biology and medical relation
- Law and economic aspects.



Report on the 7th International Symposium on Radiation Physics (ISRP-7)

Jaipur, India February 24 - 28, 1997

John Hubbell
Immediate Past President

In 1997 this Symposium series returned to the country of its birthplace, India. Of the 123 participants, 73 were from India, with the remaining 50 participants drawn from 22 other countries from all parts of the globe, to compose the Seventh International Symposium on Radiation Physics (ISRP-7) in Jaipur, India February 24-28, 1997. 23 oral plenary invited papers were presented by researchers from 13 different countries, in addition to three special lectures, and 113 contributed papers were presented by poster, representing 23 different countries. The presentations as usual offered a broad spectrum of stimulating and mind-stretching topics from the diverse scientific, technological, medical and other fields having in common the interdisciplinary crossroads of radiation physics. The proceedings (invited papers, plus summaries of the contributed papers) will be published in the Elsevier/Pergamon journal **Radiation**

Physics and Chemistry.

This Symposium was a sequel to previous Symposia held in Calcutta (ISRP-1, 1974), Penang (ISRP-2, 1982), Ferrara (ISRP-3, 1985), São Paulo (ISRP-4, 1988), Dubrovnik (ISRP-5, 1991) and Rabat (ISRP-6, 1994), with the next triennial Symposium (ISRP-8) planned to be held in Prague June 4-8, 2000. This Symposium was organized by the International Radiation Physics Society (IRPS) in collaboration with the University of Rajasthan, Jaipur and the Saha Institute of Nuclear Physics, Calcutta. Support for this Symposium was received from the University of Rajasthan, the Board of Research in Nuclear Science (Department of Atomic Energy, India), the Government of India, UNESCO, and the U.S. Naval Research Laboratory.

The **ISRP-7 Organizing Committee** consisted of Bikash Sinha (Chairman), R.N. Singh and A.M. Ghose (Co-Chairmen), B.K. Sharma (Convenor), D. Basu, D.V. Gopinath, Krishnan Lal, G. Muthukrishnan, K.S.V. Nambi, Santanu Pal, A.R. Reddy, S.C. Roy, P.K. Sarkar, Prasanta Sen, and K.K. Sud. **The ISRP-7 International Programme Committee** consisted of David A. Bradley (Chairman), Malaysia, Franco Rustichelli (Co-Chairman), Italy, M. Belli, Italy, D. Bhawalkar, India, B. Crasemann, USA, M.J. Cooper, UK, A.M. Ghose, India, W. Gilboy, UK, K.O. Groenewald, Germany, J.H. Hubbell, USA, R.J. Keddy, S. Africa, S. Mattson, Sweden, G. Muthukrishnan, India, A.M. El-Naggar, Egypt, T. Nakamura, Japan, R.H. Pratt, USA, S.C. Roy, India, P.K. Sarkar, India, B. K. Sharma, India, B. Sinha, India, P. Sen, India, J. Teixeira, France and D. Weaver, UK.

The above working committees were assisted in a variety of ways, including general promotion of the Symposium, by the **ISRP-7 International Advisory Board** consisting of B. Brockhouse (Canada), E. Casnati (Italy), P. Desai (India), M. Gasparatto (Italy), M. Goma (Egypt), P.K. Iyengar (India), P. P. Kane (India), J. Liu (USA), R. Mainardi (Argentina), C.K. Majumdar (India), L. Musilek (Czech Republic), I.C. Nascimento (Brazil), A.M. Prasad (India), J. Rotblat (UK), V.S. Ramamurthy (India), C.Shull (USA), B. Sinha (India), M. Stefanon (Italy), J. Turner (USA), A. Tsybin (Russia), H. Ullmaier (Germany), I.B. Whittingham (Australia) and N. Zovko (Croatia).

The Symposium was opened with welcoming remarks by the Organizing Committee Chairman (also President-Elect, International Radiation Physics Society) Bikash Sinha, followed by addresses by the IRPS Founding President P.K. Iyengar and by the IRPS Current President John H. Hubbell. An Inaugural Address was then presented by M.G.K. Menon, and this opening session was closed with a Vote of Thanks by the ISRP-7 Convenor B.K. Sharma (University of Rajasthan, Jaipur) who with his colleagues and students deserve in turn a Vote of Thanks from all ISRP-7 participants for all their efforts on the local level (airport and other transportation, accommodations, etc.) to assure the success of the Symposium.

At the opening session, regret was expressed that a key figure in the founding of the IRPS, and the Principal Organizer of both ISRP-1 (Calcutta 1974) and ISRP-2 (Penang 1982), Prof. Ananda Mohan (Anu) Ghose, was unable to attend ISRP-7 due to some surgery which prevented his travel from Calcutta to Jaipur. His full recovery is expected, we are happy to report, but only after some months of convalescence. This is the first ISRP missed by Prof. Anu Ghose, leaving John Hubbell the only surviving veteran of all the Symposia ISRP-1 through ISRP-7.

The ISRP-7 technical sessions (invited oral presentations) were chaired by (1A) B.K. Sharma (India), (1B) R.H. Pratt (USA), (2A) O. Reifenschweiler (Netherlands), (2B) Prasanta Sen (India), (3A) M.C. Cantone (Italy), (3B) D.J. Nagel (USA), (4A) D.T.L. Jones (South Africa), (4B) R. Keddy (South Africa), (5A) S.C. Roy (India), (5B) G.V. Iyengar (USA), (6A) Bikash Sinha (India) and (6B) F. Rustichelli (Italy). An Evening Talk by Bikash Sinha "A Hundred Years of X-Rays and Radioactivity: an Indian Perspective" was introduced by M.J. Cooper.

The oral presentations, by session, were as follows: (1A): "Some Solid State Environment Effects on Radioactivity" by O. Reifenschweiler (Netherlands) and "High Resolution Studies of Deep Core Level Threshold Auger Processes" by W. Dlubec (Germany); (1B): "Nuclear Excitations in Atomic Processes" by A. Ljubicic (Croatia) and "Synchrotron-Based Compton Scattering Studies" by S. Manninen (Finland); (2A):

"On the Construction and Application of a Tunable Gamma-Ray Source" by J. Jolie (Switzerland) and "Bremsstrahlung: Status and Prospects" by R.H. Pratt (India); (2B): "Detectors in High Energy Physics Experiments" by Y.P. Vijoyi (India) and "Polycapillary X-Ray and Neutron Optics (Kumakov Optics)" by Yu.M. Tshipenyuk (Russia); (3A): "X-Ray Scattering Studies of Surfaces and Interfaces" by M.K. Sanyal (India) and "Global Scenario of RIB (Radioactive Ion Beam) Facilities and Indian Efforts" by A. Chakrabarti (India); (3B): "Experimental Test of the Possible Violation of Pauli Exclusion Principle by Photoactivation of Carbon Content in Pure Boron" by Yu.M. Tshipenyuk (Russia) and "Developments in Monitoring Radon and Its Daughter Products in the Environment" by B. Sansoni (Germany).

The oral presentations continued with: (4A): "Developments in Accelerator-Based Boron Cancer Therapy" by S. Green (UK), presented by R. Keddy (South Africa) and "Management and Disposal of Waste from Sites Contaminated by Radioactivity" by C.J. Roberts (USA); (4B): "Re-evaluation of the Chemical Composition of Reference Man" by G.V. Iyengar (USA) and "The South African National Accelerator Centre: Particle Therapy and Isotope Production Programmes" by D.T.L. Jones (South Africa); (5A): "Industrial Application of High Energy Micro-Beams" by H. Bakhrum (USA) and "Recent Advances of Neutron Scattering in Material Science and Technology" by C.H. de Novion (France); (5B): "Accelerators in Nuclear Energy Applications" by R.K. Bhandari (India); (6A): "Status of Cold Fusion" by D.J. Nagel (USA) and "Solar Photons, Phonons and Neutrinos" by S. Chitre (India); (6B): "Perspective and Advantages of Portable X-Ray Spectrometers in Archeometry and Conservation" by G.E. Gigante (Italy) and "The Pierre Auger Cosmic ray Observatory" by C.O. Escobar (Brazil).

The contributed papers for ISRP-7 focused on a menu of topical areas of radiation physics in the tradition of previous Symposia in this triennial series:

- I. Fundamental Processes in Radiation Physics
- II. Radiation Sources and Detectors
- III. Application of Radiations in Fundamental Research
- IV. Radiation in Biophysics, Medicine and Environment
- V. Radiation in Technology
- VI. Radiation in Archeometry, Earth and Space Science and Cosmology

The following account describes the contributed (poster) papers actually presented at ISRP-7:

Under Topic I Fundamental Processes in Radiation Physics, the 36 contributed papers covered a wide range of subtopics including: The effect of Coster-Kronig transitions on L x-ray intensities, gamma-ray absorption in solutions, double photon Compton scattering, K-shell Compton scattering, slow-particle slowing down and stopping power, polarized photon transport, bremsstrahlung dose from a low-energy accelerator, photoluminescent excitation and emission spectra, thermally stimulated emission process, beyond dipole effects in atomic processes, statistical pulse height distribution width reduction, x-ray emissions from electrons and positrons on metallic targets, electron transport coefficients in gases, three-dimensional neutron transport equation, photoeffect cross sections near absorption edges, measurement of gamma-ray forward scattering, elastic gamma-ray scattering, measurement of K-electron capture in ¹⁶⁹Tm, effective atomic numbers in glasses and rocks, kinetic parameters of thermoluminescent dosimeters, observation of K hypersatellites by photon bombardment, spectator vacancies in Pt from S-ion impact, photon elastic scattering tabulations, DWBA calculations of pair production at intermediate energies, anomalous scattering factors, rare earth photoeffect cross sections, photon incoherent scattering measurements, decay times of lyoluminescent alkali halides, photon multiple scattering in thick samples, alignment of photon induced L3 vacancies, photon interactions in multielement materials, photon elastic scattering from excited states of atoms and ions, analytical expression for the L3 subshell fluorescence yield, and anisotropic x-ray emission from gold bombarded with carbon ions.

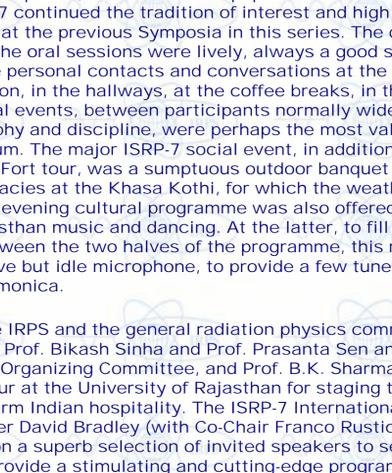
Under Topic II Radiation Sources and Detectors, the 19 contributed papers included: Thermoluminescence and optical characteristics of Eu-doped BaSO₄, x-ray polarization efficiencies of flat and cylindrical surfaces, efficiency of the channel electron multiplier for low energy Ag ions, performance of microstructures in liquid cooled, cobalt and vanadium self powered neutron detectors, freon-filled Si(Li) and Si-PIN Peltier cooled detectors, angular correlation measurement using XP2020Q fast tubes coupled with BaF₂ scintillators, dielectric properties of electrochemical etching response of a nuclear track detector, etchants for rapid and broad energy range alpha track backing on polycarbonate electrochemical etching, effect of source geometry in the backscatter peak in gamma spectra, neutron spectroscopy with superheated liquid drop (bubble) detector, nucleating efficiency of superheated droplets by neutrons, measurements of degraded neutron spectra in matrix composites using CR-39 films, a variable energy microtron for R & D work, CsI(Tl)-PIN detector as an element of a charged particle multiplicity filter array, decomposition of a particle energy spectrum by a channel electron multiplier device, a simple cosmic ray telescope for muon detection, hot particle spectrum determination by track image analysis, neutron energy spectrum of an Am-Be source by gamma gated neutron time of flight, and a novel method of using BaF₂ scintillators to increase counting efficiency in angular correlation experiments.

Under Topic III Application of Radiations in Fundamental Research, the 16 contributed papers included: Aluminium and alkali-related hydroxyl defects in quartz crystal and their radiation effects, damage induced by 45 and 80 MeV boron ions in crystalline silicon, Compton scattering studies on niobium and vanadium carbides, neutron diffraction measurement of residual stresses in a thermoelastically coupled alloy system, chemical composition effects on thermal stability of nuclear tracks in volcanic glass shards, anisotropy of the momentum density in Nb₅₀Mo₅₀ alloy, Compton profile study of BeO, importance of quasiequilibrium in thermally stimulated luminescence and conductivity, a critical review of theoretical treatments of thermally stimulated luminescence and conductivity and their applicability to experimental results, thermoluminescence and paramagnetic centers created by radiation in quartz, optical absorption bands and thermoluminescent peaks in heavily irradiated fluorite, radiation effects on optical properties of pure and doped BaF₂ crystals, radiation effects associated with reverse micellar systems in apolar solvent, MeV ion beam mixing of Au in Fe₇₈B₁₃Si₉ alloy, material identification using gamma-ray scattering, and an x-ray reflectivity study of thin organic films.

Under Topic IV Radiation in Biophysics, Medicine and Environment, the 19 contributed papers included: Experimental and Monte Carlo investigations of electron scattering foil systems for a clinical betatron, low energy ³He induced reaction for proton radiotherapy, the stable isotope approach to elemental biokinetics, effects of radiation-sterilization on medical implants, trabecular bone mineral density measurements using energy dispersive x-ray diffraction (EDXRD), climatic and diurnal variation of radon in Malaysia, decontamination leaching of Ra-226 contaminated gravel as monitored by liquid scintillation counting and thermoluminescent dosimetry, evaluation of neutron dose to patients undergoing high energy x-ray and electron radiotherapy using bubble detector, treatment of mycosis fungoides with total skin irradiation with a 5 MeV electron beam, a statistical method of handling data with determination limit in radioanalytical research, measurement of radon levels in dwellings of Una District, Himachal Pradesh using LR-115 plastic track detectors, PET dosimetry in proton bombardment, modelling production of positron emitting isotopes by proton therapy beams using the LAHET code system, a study of environmental radioactivity in and around Shimoga, Karnataka, India, environmental radioactivity at the horizon of uranium bearing quartz pebble conglomerates near Chickmagalur, India, K-characteristic photon absorption in medical diagnostic x-ray imaging receptors: calculation of contrast and resolution effects, radon emanation rates from soils under varying physical conditions, Cs-137 activity in the environs of Kaiga, India, and measurement of secondary to primary ratio of 60 keV photons in water phantoms.

Under Topic V Radiation in Technology, the 10 contributed papers included: Effect of energetic charged particles on laser ablated thin film of poly(phenylene sulfide), a Compton scanner for non-destructive examination, thin film thickness determination by x-ray fluorescence analysis, structural study of poly(1,3-propylene) adipates with cyanoazobenzene side-groups by x-ray diffraction, study of low energy plasma ion implanted hydrogen in GaAs, rapid quality control for coal seams by gamma ray transmission technique, evaluation of neutron shielding enhancement effects due to a structural material, improvement of a ⁹⁰Sr radioisotope battery, material analysis based on fluorescence induced by gamma rays, and the micro ion-beam facility at the Institute of Physics, Bhubaneswar, India.

Under Topic VI Radiation in Archeometry, Earth and Space Science and Cosmology, the 10 contributed papers included: Studies of natural radioactivity in fertilizers, radon emission from hydrothermal springs at Tantloi, radon geochemical anomaly at Bakreswar thermal springs, x-ray fluorescence analysis (XRFA) in monitoring the impact of coal burning, thermoluminescence reader for dating of brick structures, elemental analysis of archeological objects by x-ray emission spectroscopy, thermoluminescence studies on quartz grains from eolian sediments in Brazil, 3-D simulation of 5-MeV alpha particles inside Si diodes utilizing a modified delta-ray model, and EDXRF analysis of soil samples from alongside two major highways of Kenya.



The changing of the guard.
President John Hubbell passes the ceremonial bell to his successor Bikash Sinha

Epilogue

In this reporter's opinion, both the invited papers and the contributed papers at ISRP-7 continued the tradition of interest and high density of information set at the previous Symposia in this series. The question periods during the oral sessions were lively, always a good sign. In addition, the face-to-face personal contacts and conversations at the Sunday evening reception, in the hallways, at the coffee breaks, in the poster hall and at the social events, between participants normally widely separated by both geography and discipline, were perhaps the most valuable products of the Symposium. The major ISRP-7 social event, in addition to the Jaipur city and Amber Fort tour, was a sumptuous outdoor banquet buffet of Rajasthan delicacies at the Khasa Kothi, for which the weather happily cooperated. An evening cultural programme was also offered, with traditional Rajasthan music and dancing. At the latter, to fill some of the lengthy gap between the two halves of the programme, this reporter could not resist the live but idle microphone, to provide a few tunes on his ever-handy little harmonica.

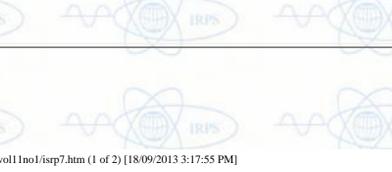
On behalf of the IRPS and the general radiation physics community, this reporter thanks Prof. Bikash Sinha and Prof. Prasanta Sen and their Calcutta-based Organizing Committee, and Prof. B.K. Sharma and his hard workers in Jaipur at the University of Rajasthan for staging the Symposium and for their warm Indian hospitality. The ISRP-7 International Programme Committee under David Bradley (with Co-Chair Franco Rustichelli) is to be congratulated on a superb selection of invited speakers to set the focus of ISRP-7 and to provide a stimulating and cutting-edge programme in the interdisciplinary field of radiation physics.

IRPS General Meeting

The Triennial International Radiation Physics Society General Meeting was held February 28, 1997 during ISRP-7 in Jaipur, chaired by IRPS Secretary Richard Pratt, with remarks by the retiring IRPS President John Hubbell and by the incoming President Bikash Sinha. The results of the mail-ballot triennial election of IRPS Officers, held just prior to ISRP-7, were announced. Based on the valid ballots received in time to be counted by the 1994-1997 IRPS Elections Committee Chairman Leif Gerward (with assistance from Arne Miller), the IRPS Officers for 1997-2000 will be:

- President:** B. Sinha (India)
- Secretary:** R.H. Pratt (U.S.A.)
- Treasurer:** A. Ljubicic (Croatia)
- Vice Presidents:**
 - Western Europe:** M.J. Cooper
 - E. Europe and FSU:** L. Musilek (Czech Rep.)
 - N. America:** K. Kearfott (USA)
 - Central America:** R.T. Mainardi (Argentina)
 - Africa and Middle East:** R.J. Keddy (South Africa)
 - S.E. Asia and Pacific:** P. Sen (India)
 - N.E. Asia:** Feng Yongxiang (China)
- Executive Councillors:**
 - D.A. Bradley (Malaysia)**
 - D.C. Creagh (Australia)**
 - A.M. Ghose (India)**
 - T. Nakamura (Japan)**
- Continuing terms as Councillor:**
 - L. Gerward (Denmark)**
 - M. Monnin (France)**
 - S.C. Roy (India)**
 - F. Rustichelli (Italy)**

Announced at the IRPS General Meeting was the acceptance by the Council of the invitation by Ladislav Musilek to organize and host the 8th International Symposium on Radiation Physics (ISRP-8) in Prague, Czech Republic. As was mentioned earlier in this report, the dates for ISRP-8 in Prague have been set by action of the Council, in consultation with Prof. Musilek, for June 4-8, 2000. This reporter hopes you will mark these dates on your calendars, and that most of you (and some new people) will again converge in Prague, from the mists of the far corners of the planet, for another week-long awakening of our "Brigadoon" in the Spring of 2000 (the Year of the Dragon) in this unique cross-disciplinary Symposium series on Radiation Physics.



Three stalwarts of the IRPS take a quiet drink at the ISRP-7 social event
Richard Pratt, John Hubbell and Ante Ljubicic



BOOK REVIEW

by

Lief Gerward

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Becquerel's Legacy : A Century of Radioactivity

Proceedings of a Conference,
London, February 20 and March 1, 1996.
Proceedings Editor : M.C. O'Riordan, Radiation Protection
Dosimetry,

Vol. 68, Nos 1/2, 1996. pp. viii + 154. Published by Nuclear
Technology Publishing, USD 56.00, ISBN 1-870965-47-7

A conference to mark the centenary of the discovery of radioactivity was organised by the National Radiological Protection Board and the British Association for the Advancement of Science at the Royal Society for Arts, in London on 29 February and 1 March 1996. The conference dealt with the discovery and exploitation of radioactivity and the parallel developments in radiation protection. Speakers included representatives of international and national agencies, academics, environmentalists and other institutions and professions, mainly from the UK but also from France, Belgium and Sweden. The Proceedings of this historical conference has been published as a Special Issue of Radiation Protection Dosimetry.

In a talk to the Academy of Sciences in Paris on 20 January 1896, the renowned mathematical physicist Henri Poincaré suggested that possibly all strongly fluorescent matter emitted X-rays, irrespective of the reason for the fluorescence. Poincaré himself did not find it very probable, but – as he put it – it should be rather easy to verify. Following his suggestion, Henri Becquerel initiated a series of experiments with sunlight induced phosphorescence in uranium salts. Although the original hypothesis proved false, it did lead to the discovery of radioactivity – a new property of matter.

In his historical account, A. Allisy of the Bureau International des Poids et Mesures recalls, with a wealth of biographical details, the history of the Becquerel family and in particular the pioneering period of radiation research around the fin de siècle. Myths are abundant, pretending to describe what actually happened when Becquerel recognised the unexpected phenomenon of radioactivity, but it is all there in his own words. One can follow his search for the truth, literally in the dark, in six notes delivered to the Academy of Sciences between 24 February and 18 May 1896.

In another historical account Bo Lindell, emeritus member of the International Commission on Radiation Protection (ICRP), delivers a personal view on the development of the art of radiation protection. The work so far has culminated in the ICRP Publication 60 in 1991, where the occupational dose limit is reduced to 20mSv per year, averaged over 5-year periods, and the public exposure is limited to 1 mSv per year. Another important ICRP Publication 65 in 1993 deals with protection against Radon-222 at home and at work.

radiation accidents resulting in severe consequences. Many accidents involve serious violations of the most elementary safety rules, often in a combination with lack of regulations and insufficient training. Hopefully, the lessons from these incidents will be learned.

Natural sources of radiation is dealt with in several papers. The radiation dose from basic background is a useful reference for limiting public exposure to artificial sources. It is interesting to note, as pointed out in the contributions by R H Clarke and S Brown, that the radioactive gas radon indoors accounts for approximately half of the 2.6 mSv average annual dose of the UK population. Surprisingly, householders tend to ignore the risks from radon. At the same time radioactivity in the environment from artificial sources generates much public concern, though the resulting doses are significantly less.

Functional brain imaging is an advanced application, which has improved considerably in recent years through progress in computing and experimental techniques. RT S J Frackowiak gives an interesting overview, focusing on positron emission tomography (PET) for the detection of trace quantities of ionising radiation. Further contributions in the important fields of nuclear medicine and biology are given by J H McKillop, R Doll and R Cox.

Nuclear industry is another heavy employment of radioactivity, and a number of industrial applications are reviewed by B L Eyre. A major application is the use of tracers, for example to measure materials transport and mixing in process plants, wear of components and leak detection. Attenuation measurements are widely used for quality control, for example in monitoring material thickness and density, in level detection and in radiography. Radioisotopes, X-ray generators and ion and electron accelerators are used as sources of radiation. It is remarked that there no longer are any small neutron reactors in the UK suitable for isotope production and neutron scattering work, and that the population of such reactors is getting quite old, particularly in Europe. On a more positive note, it is concluded that the use of radiation in medicine, agriculture and industry is one of the major benefits that stem from the development of atomic energy.

Nuclear fuel processes are discussed by D J Coulston and A V Kite. The initial unrealised promises of abundant electricity is contrasted with the current pressures on nuclear power involving economic viability and public and political acceptability. However, it can also be argued that the dependence on fossil fuels is not a viable position in the long term.

The safe disposal of radioactive waste presents one of the most difficult and controversial environmental problems faced by industrial countries. A consensus of opinion is far from having been reached as is evident from two contributions on the problems of deep disposal of radioactive waste. The Nuclear Industry Radioactive Waste Executive, now UK Nixie Ltd, was established in 1982 to develop disposal facilities for low and intermediate level radioactive waste. M Folger gives an account of the Nixie concept for deep disposal of between 200,000 and 275,000 m³ of intermediate level radioactive waste at a potential repository site near Sellafield. The next step of investigation includes the excavation of a 650-900 m deep Rock Characterisation Facility. The disposal principles practice are further related to similar programmes in Sweden, France and the US.

A somewhat different stance is taken by R Western, who represents the Friends of the Earth Energy, Nuclear and Climate Campaign. It is emphasised that the safety of a nuclear waste depository is largely dependent on the behaviour of the ground water, and the current concept is criticised for neglecting our poor understanding of water flow through fractures and pores in the surrounding rock. The quantification of the level of risk presented by radioactive waste disposal is made difficult by the complexity of the chemical and hydrogeological systems. There is certainly a great challenge here to develop expertise and technology in radiation waste management.

Legal and regulative aspects on radiation protection in nuclear and other installations are discussed for the UK by M K Williams et al and for the European Union by J Sinnaeve et al. A highly provocative paper by P Bowden is entitled "Legal affairs: the ultimate arbiter of radiation effects – the scientist or the lawyer?" In this final session of the Becquerel Conference radiation risks and health effects are viewed from a perspective slightly different from that of the preceding contributions.

The contrast between the legal and the scientific disciplines may appear unfamiliar to the scientist, the key feature of litigation being a game of winners and losers. The judge hearing a case will have to determine the causation issues solely on the evidence put before him. There is little room for the consensus, which scientists cherish as the proper approach. Scientific views as to causation of a particular health effect are often provisional and tentative. The court does not have that luxury. It has to reach a final decision on the evidence available. The law has developed a standard of proof which sometimes is characterised as being more than 50% probability. By way of contrast, scientists generally require a 95% confidence level. Anyway, in cases involving allegations of serious and wide-spread radiation health effects, the law performs a vital social function.

The quotations selected above represent the subjective choice of the present reviewer. However, it

should be clear that this well-rounded multi-author volume addresses a number of currently important aspects of radioactivity and radiation protection. The choice of authors has resulted in a refreshingly different point of view in many of the contributions. The text provides a good introduction to the phenomenon of radioactivity, the many uses of radioactive materials and approaches to radiation protection. Its emphasis on current problems and the many references to the primary literature suggest that the book will be much appreciated by radiation scientists and practitioners and indeed by anybody with a genuine interest in the subject.

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[Superphénix Survives](#)[Japan pays for CERN's anti-atom](#)**Brookhaven Bother***Source: Physics World, p.10, Vol 10, No. 4, April, 1997>*

The director of Brookhaven National Laboratory, Nick Samios, is to retire at the end of this month. The announcement follows the discovery of a major tritium leak in ground water near the laboratory's reactor-based neutron source. Brookhaven says the events are unrelated.

The reactor will remain closed until the leak is dealt with, which could be up to a year. Hundreds of neutron users will now have to find beam-time at other

neutron facilities Tests indicate that 7-14 gallons of water are leaking each day from a tank that stores spent fuel It is thought that the leak could have been growing for the last six years.

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Superphénix Survives*Alexander Hellemans (Paris)**Physics World, p.6, Vol 10, No. 4, April, 1997>*

France's Superphénix fast-breeder reactor was saved from possibly permanent closure last month by the prime minister, Alain Juppe. He overruled an earlier decision made by the Council of State that prevented the reactor from restarting after its current maintenance shutdown. Although France's plans for using fastbreeder reactors to generate electricity have long been abandoned, plans exist to use the reactor for research.

When it was built during the 1980s, Superphénix was viewed as the flagship of French nuclear technology, and exerted as much fascination as a perpetual motion machine. It uses plutonium as a fuel and t the same time it breeds a surplus of plutonium by transforming the abundant, but otherwise useless, uranium-238. Because :he process requires fast neutrons, liquid sodium is used to cool the reactor instead of water.

Using liquid sodium is a technical challenge - it spontaneously ignites in contact with air, producing large amounts of explosive hydrogen. It must also be heated continuously to stop it from solidifying when the reactor is shut down. And the reactor's positive void effect is viewed as an even greater danger. If for some reason the sodium in the reactor core disappears, the reaction rate increases instead of slowing down as in a conventional watercooled reactor. Because of these different technical problems, the multibillion dollar 1200 MW reactor has only totalled one year of full operation since it came online in 1985, making it the most expensive power plant ever built.

But there are now plans to use the reactor to study the incineration of plutonium and the other heavy isotopes that are produced as nuclear waste in conventional reactors, says Pascal Anzieu, who is responsible for the research programme.

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Japan pays for CERN's anti-atom*Alison Goddard**News Editor**Physics World, p.5, Vol 10, No. 4, April, 1997>***Japan pays for CERN's anti-atom***Alison Goddard**News Editor**Physics World, p.5, Vol 10, No.4, April 1997*

A new antihydrogen facility will be created in Europe by transforming an existing machine at CERN, the European laboratory for particle physics. CERN had shut down antihydrogen research at the end of last year for financial reasons. But now money from Japan means the lab can now afford to convert its antiproton

collector into an antiproton decelerator (AD). Experiments will start in spring 1999. The conversion will cost SwF 7 m (about £3 m) and running costs are expected to be SwF 1 m per year. Germany, Denmark, Italy, Poland and the US will also contribute. Japan is providing an extra SwF 10 m for experiments.

The AD will be used to test two cornerstones of physics - the conservation of charge-parity-time (CPT) symmetry and the principle of the equivalence of gravitational and inertial mass (Physics World July 1993 pp44-48). "It will be a new tool to study the symmetry between matter and antimatter to very high precision" says Rolf Landua of CERN.

To date, antihydrogen has been produced in two labs at CERN near Geneva and at Fermilab near Chicago in the US. In order to be useful, however, the antihydrogen must be produced at rest, rather than at close to the speed of light as happens in current experiments.

Electron cooling mechanisms will be added to the existing machine, and the vacuum and stochastic cooling systems upgraded, to produce low-energy antiprotons. Once combined with a positron, individual antihydrogen atoms will then be trapped in a magnetic bottle for laser spectroscopy experiments. "If we compare the spectrum of hydrogen and antihydrogen with modern laser techniques, we can test the CPT theorem with extremely high precision" says John Eades of CERN



Hands on - the trap for antiprotons or protons

The CPT theorem states that if, mathematically, a particle is replaced by its antiparticle, its position in space reflected, and the direction of time reversed, then the underlying equations governing the mass and interactions of the particle are unchanged. According to the theorem, a particle that has undergone a CPT transformation is indistinguishable from its original state. The theorem has survived all experimental tests to date. "If the CPT theorem were wrong, even by a tiny amount, then there would be trouble" says Eades. "This kind of asymmetry would have very real consequences. If we did find it, it would change our world model enormously.

The antiproton decelerator will also test the equivalence principle, which states that the gravitational attraction of matter and antimatter should be the same. "If the gravitation properties of matter and

antimatter were different, it could explain why we do not see antimatter in the universe," says Eades. If the principle were violated, it would also show up as a seasonal discrepancy between the antihydrogen and hydrogen spectra due to tiny variations in gravity experienced by the Earth as it orbits the Sun. So any discrepancy due to gravity would vary seasonally.

About 150 physicists will work on the antiproton decelerator. Two collaborations - ATHENA and ATRAP have already been formed to study antihydrogen at the facility, and a third experiment plus a range of smaller, general projects are planned. ATHENA and ATRAP are both laser spectroscopy experiments, but will use different techniques. "Competition always improves the speed and integrity of experiments," says Gerry Gabrielse of Harvard University in the US, and the principal investigator of ATRAP.

The AD is set to run from 1998 to about 2006, allowing physicists to carry out experiments while the large hadron collider (LHC) is being built at CERN. When the AD closes, it is possible that its components will be shipped to the KEK particle physics laboratory in Japan for other experiments.

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