I R P S BULLETIN

Newsletter of the International Radiation Physics Society

Vol 9 No 3 **SEPTEMBER/OCTOBER 1995**

From the Editor :

One of the real problems which we face as scientists interested in discovering the nature, properties and interactions of radiation of all kinds, is that society in general has such a *negative* feeling towards radiation.
A paranoia exists towards the term, especially when it is coupled with the word "nuclear".

Thus it may be that we live in a "nuclear-free city". We undergo medical procedures such as "magnetic imaging" and "isotope tracer techniques" because the general public has a fear of the words "nuclear" and "radioactive".

Now the world press is focussing on the "deleterious effects of electromagnetic waves" because of some data which might seem to link electromagnetic radiation with problems of human physiology. We, as scientists, must be aware that problems might occur. But as scientists we must weigh ***all*** the evidence before we make ***any*** judgements. Not so journalists. Or politicians.

The acceptance of a risk factor for a particular radiation by Environmental Protection Agencies is based on scientific and epidemiological data, and actuarial calculations. As well, such acceptance is weighted because of mistakes which have been made in the past, to prevent the mistakes from occurring in the future. These weighted judgements take time to develop, and require the concurrence of governments to implement.

The general public knows little of this, unthinkingly accepting every day risks far greater than those from nuclear radiation. How many do you see still seeking the "ultimate tan", even after warnings about the well-known relation between melanoma and ultraviolet radiation?

World hostility to the underground nuclear tests at Mururoa Atoll has been created by "environmental groups" and the press. Risks are incurred, but the best evidence is that these are infinitesimal. Objections might be based on scientific considerations They might, however be based equally on ***political realities, viz:***

1. an unnecessary escalation in nuclear weapon development and proliferation;
2. the distraction of attention away from much more pressing environmental problems;
3. the production of public opinion antagonistic to radiation physicists.

This latter I see as a real threat to our scientific interests Already in Australia we face the premature shut-down of our only nuclear reactor, a 10 MW research reactor. Other countries may experience similar problems because of the development of strong and ill-informed public opinion generated by adverse publicity.

Dudley Creagh

PRESIDENT'S COLUMN

John Hubbell

On Objective and Subjective Realities : some thoughts and conjectures

<u>*I. Objective Reality:*</u>

The "glue" that binds our Society (the IRPS) together as a "global family" is our pursuit of a particular subset of <u>objective reality</u>, this particular subset being the interactions of various kinds of radiation with atoms and with bulk materials. Interestingly enough, for questions we ask of this reality, there can be different, equally-valid answers to such questions as: "Is it a wave, or is it a particle?" We have made our peace with this and other indeterminancies, and do not feel obliged to fight to the death over which answer is "right."

In cosmology, it is still fashionable to think in terms of a single "Big Bang" and a time "t_0", before which "nothing was," and a finite boundary (or closure, by warping space-time, or whatever) beyond which "nothing is." The future is thought to be somewhat bleak, even beyond the near-term (astronomically speaking) demise of our Sun (and any trace of the presence and endeavors of the exquisitely precious biosphere [and noosphere] of the planet earth), with all matter and even photons disappearing into ever-hungrier voracious black holes. The end result of this process, at some doomsday time "t_0", has been described as the "Big Crunch" in which our beloved Cosmos (unlike Rice Krispies breakfast cereal) neither "snaps, crackles nor pops," but just lies quietly there in the bowl.

My personal preference (perhaps jumping ahead to the <u>subjective reality</u> to be discussed below) is for a Cosmos which "always was," replacing "t_0" (Single Big Bang) with "–□" and "t_0" with "+□" consistent with a "...Crunch-Bang-Crunch-Bang-Crunch..." oscillatory and more-durable Cosmos, with something like 80 billion years between bang and crunch, at least for our current cycle. Also, in my mind's eye, I see not a closed, finite cosmos, but rather I see, beyond our "red shift horizon," a sea of other crunch-bang cosmoses (some perhaps composed of anti-matter, the inverse of our ordinary matter) stretching infinitely (a process, not a number), in all directions.

Speaking of anti-matter, for the past nearly forty years I have found it satisfying to further conjecture that between anti- and ordinary matter there is gravitational repulsion, which I express in complex (or "imaginary," probably more applicable in the non-mathematical sense) notation:

For the force between two charged massive particles 1 and 2 separated by a distance r_{12} we can take the real part (Re) of the product of two complex quantities f_1 and f_2:

$$Force\ (+\ is\ repulsive) = \frac{Re\ (f_1 \infty f_2)}{r_{12}^2}$$

where

$$f_i(matter) = +\left(\frac{\pm q_i}{\sqrt{K}} + i\sqrt{gm_i}\right)$$

and

$$f_i(anti\text{-}matter) = -\left(\frac{\pm q_i}{\sqrt{K}} + i\sqrt{gm_i}\right)$$

where K is the dielectric constant, g is the gravitational constant, q_i is the electrostatic charge of the ith particle ($+q_i$ for proton or positron, $-q_i$ for electron or anti-proton), and m_i is the mass of the ith particle.

Performing the multiplication indicated in the first equation, for the sign of the force between any two particles 1 and 2, we obtain electrostatic repulsion (+) between like-charge particles ($+q_1,+q_2$), ($-q_1,-q_2$) particles in any case, and electrostatic attraction (–) between unlike-charge particles ($+q_1,-q_2$), ($q_1,+q_2$). Between two ordinary-matter particles, gravitation is attractive (–), and between two anti-matter particles, gravitation is still attractive (–). However, between an anti-matter particle and an ordinary particle, gravitation becomes repulsive (+), providing the separation mechanism we need, to avoid the suicidal mixing of these symmetric universes. A reversal (+) to (–) of the repulsive core potential, between an ordinary - and an anti-particle might even be helpful in explaining the annihilation process.

In 1957 Eugene Wigner (Nobel 1963, died January 1, 1995) wrote me about the above conjectures: "... it is my belief that your suggestion would be contrary to the standard theory of gravitation and to the equivalence of gravitational and inertial mass. Nevertheless, it is quite possible."

In any case, in <u>objective reality</u>, we can live peaceably with a multiplicity of possibilities, just as in mathematics the solution of a quadratic equation will have a "±" in it, which does not disturb us in the least. Although the above picture and scenario of the Cosmos appeals to me aesthetically as a personal preference, I do not feel <u>obliged</u> to select it "for sure" over the currently fashionable "t_0" (single Big Bang) model, nor even over the traditional Genesis model in which a teleological (purposeful) Deity, at a more-modest start-up time t_0 4000 b.c. instead of t_0 17 billion b.c., pronounced all-that-is into existence with His "Let there be light!"

In <u>objective reality</u> we do not <u>have</u> to decide "Is it a wave or is it a particle?" Indeterminacies are O.K..

<u>*II. Subjective Reality:*</u>

"Two men looked out from prison bars.
One saw mud, the other, stars."

I think this couplet (source unknown) nicely expresses <u>subjective reality</u> and the two major options we have on how we can perceive the "real world" and live and function accordingly. Never mind that (<u>objectively</u>) we self-propelled and "conscious" earthlings are an improbable microscopic fluff of froth on a flyspeck planet circling a ho-hum (we hope) star in the suburban fringe of a run-of-the-mill galaxy lost in the incredible reaches of space-time as conjectured above. Each of us lives in an individual subjective Cosmos determined by a combination of inheritance (religion, nationality and parental-transferred values as well as genetic) and of direct hands-on encounters with our physical world (including fellow humans), as we experiment with "what works" to navigate us from birth to death in a minimum-trauma voyage.

It seems to me something of a paradox that our subjective realities, that is, our perceptions of objective reality, while different for each of us, each one tends to be rather rigid, and less tolerant of indeterminancies and ambiguities, than in objective reality communities such as the International Radiation Physics Society as we believe ourselves to be. "It is a wave, you numbskull!" "No! It is a particle, you idiot!" Bang! "You heretic, you do not believe exactly as I do!" "You infidel, you do not believe exactly as I do!" Bang! A little more indeterminacy, and willingness to "agree to disagree" would make the human enterprise on this planet considerably less dreadful, I do believe.

There seem to me basically three kinds of eyes (and hearts) through which we each perceive our unique subjective reality Cosmos, wearing it like a suit of clothes, and behaving accordingly. I think that all three kinds of eyes are well-represented in all of the world's major religions and non-religions, since within each sect I am sure there are enormous variations in personal beliefs despite the impression of homogeneity within a sect from recitations of creeds and other articles of faith as required for acceptance as a member of a given congregation. In my opinion, the three kinds of eyes, following the above couplet, are:

1) Mud I (Dead): Through these eyes of the avowed atheist, peering out from his prison bars, the subjective reality Cosmos is seen to governed totally by a "mud" of physics and chemistry, with no sense of a teleological (purposeful) Deity. Although this Cosmos may be a valid option, it is unsatisfying to the bulk of the human population who aspire to be something more than just "the animal at the top of the food chain" whose primary function from birth to death would logically be to amass to himself the goods and comforts of this world. This amassing function is not fundamentally different from the crystal growing in a solution, amassing atoms unto itself, and I refer to this subjective reality Cosmos as the Dead Universe.

2) Mud II (Alive but Hostile): Through these eyes, the subjective reality Cosmos is indeed governed by a teleological Deity, but a hostile, capricious and judgmental Deity , who in past eras demanded blood sacrifices and other penances, as interpreted by an entrenched priesthood, to influence the flourishing of crops and other human ventures subject to the vagaries of weather and other otherwise uncontrollable entities. This prisoner lives in a fundamentally hostile Cosmos.

3) Stars (Alive, Loving and Caring): Through these eyes, with gaze lifted above the mud, the subjective reality Cosmos perceived by this prisoner is a loving, caring, forgiving place, sprinkled with wonders and surprises. Among these wonders and surprises is usually a sense of a teleological Deity, transcending and yet supported by physics and chemistry, and a "Grace like a warm nourishing rain

from heaven." In the face of pain, privation and even death, this prisoner exudes a buoyant and victorious spirit, confounding his mud-watching cell-mate.

I have known many people whose subjective realities are primarily the "mud" on this planet, and life is a "downer" for themselves and for those around them. Fortunately, the world is also well populated, particularly in the International Radiation Physics Society, with "star gazers" for whom life is an "upper" not only for themselves but also for all those whose lives they touch, near and far, in the global human family.

Chandrasekhar dies

Subrahmanyan Chandrasekhar, one of the world's leading astrophysicists, has died aged 84 in Chicago. Born in Lahore in 1910, he was awarded the Nobel prize in 1983 for showing that stars with a mass greater than 1.4 times that of the sun will collapse past the stage of a white dwarf and into a black hole. He recently completed *Principia for the Common Reader*, a translation of Newton's masterpiece into modern language, published by Clarendon Press. A full obituary will be published in *Physics World* next month.

(Physics World, September 1995, p7)

A W A R D S

John Hubble

Beninson to receive 1996 Sievert Award

Daniel J Beninson, IRPS PResident 1991–1994, will receive the 1996 Roslf M. Sievert Award at the 1996 International Cosngress on Radiation Protection (IRPA-9) in Vienna, April 14-19, 1996. His selection, announced in the November 1995 Health Physics Journal, was made at an Executive Council Meeting of the International Radiation Protection Association (IRPA) held in Johannesburg, February 1995. Nominations for the Sievert Award are made by the IRPA Associate Societies, such as the Health Physics Society. Daniel Beninson was selected on the basis of his outstanding contributions to radiological protection. He is most closely associated with the International Commission on Radiological Protection (ICRP), first as a Member of ICRP Committee 4, then successively as a Commission Member, then Vice Chairman, and finally ICRP Chairman, presently serving as Chairman of Committee 4. Daniel Beninson's major career has been with the Argentine Comision Nacional de Energia Atomica, culminating in his Chaimanship of the Regulatory Authority. He has been both Secretary and Chairman of United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and he was an IRPA Executive Council Member from 1966 to 1970.

Rotblat receives 1995 Nobel Peace Prize

Joseph Rotblat, whom those of you who attended ISRP-2 in Penang in 1982 will remember as actively participating in the discussions laying the groundwork for the founding of the IRPWS (at ISRP-3 in Ferrara in 1985), has, along with his brainchild the Pugwash Conferences on Science and World Affairs, been selected for the 1995 Nobel Peace Prize. Earlier, in 1993, Joseph Rotblat, for his Pugwash work, had also shared with Hans Bethe the Einstein Peace Prize, awarded by the Albert Einstein Foundation, which has the mission of drawing attention to individuals who have contributed importantly to nuclear disarmament. Joseph Rotblat was at first a participant in the Manhattan Project to develop atomic weapons, then in 1944 when he learned that Germany had abandoned its program, left the Project to go into medical physics, then dedicated the remainder of his life to "putting the genie back in the bottle". With Bertrand Russell and some help from Albert Einstein, and financial backing from American industrialist Cyrus Eaton, the first of many conferences, with this objective, was held in 1955 in Eaton's retreat in the village of Pugwash, Nova Scotia, hence the name given to this conference series.

The IRPS congratulates Daniel Beninson and Joseph Rotblat on these two well-deserved major recognitions, and thanks both of them for their significant contributions to the life and nurture of the IRPS "global radiation physics family".

Geoffrey Harding Awarded 1995 Röntgen Medal

At ISRP-4 in Sao Paulo in 1988, some of you will remember Geoff Harding's invited lecture "Scattered X-ray Beam Nondestructive Testing" in which he described his work at the Philips Laboratory in Hamburg with Josef Kosanetzky developing a tomographic Compton backscatter scanner (ComScan) system. This system, for which Geoff received a patent in 1977, has important applications in the nondestructive testing of plastic and light alloy components in the aircraft industry.

1995 is not only the 100th anniversary of Röntgen's discovery of x-rays, but it is also the 150th anniversary of Röntgen's birth – March 27, 1845 in Remscheid, Germany. The city of Remscheid is the home of the German Röntgen Museum (well worth a visit, according to Geoff), and the Friends of the Museum have awarded yearly since 1951 the Röntgen Medal to those individuals who "have contributed in the broadest sense to progress in the understanding and application of the Röntgen Rays". The previous recipients include many distinguished scientists, four of them Nobel Prize winners : Max von Laue (1953), W.L. Bragg (1955), A.H. Compton (1957) and Godfrey Hounsfield (1980).

Three Medals were presented this year, since 1995 is such a significant year in x-ray history, the decision having been made to forego any award in 1994. Professor Alfred Baer (Belgian radiologist) and Professor Mitsyaki Abe (Japanese oncologist) received the other two Medals. Geoff's own Medal was awarded for production of tomographic images. This refers to the ComScan (Compton scatter scanner) system mentioned above, which is marketed by Philips Industrial X-Rays. The Medal was jointly awarded to Josef Kosanetzky, also at Philips, for his work in the commercial development of ComScan.

The IRPS congratulates Geoff (and Josef) on this well-deserved recognition and honour.

REPORTS FROM VICE PRESIDENTS AND COUNCILLORS

From Councillor A M Ghose (India)

Fundamental Science and Technology

Recently an informal day-long seminar was organised by the Variable Energy Cyclotron Centre (VECC), the topic of which will interest all radiation physicists who are concerned with the development of pure radiation physics along with its application to industry, engineering, medicine, etc. The seminar "On the Interface between Fundamental Science and Advanced Technology" was introduced by Dr Bikash Sinha, Director, VECC. Several noted radiation physicists took part in the deliberations of the seminar, the first President of IRPS, former Chairman of the Atomic Energy Commission of India and currently its member, delivered the first talk which was entitled 'Why the gap between the promise of fundamental research and the resulting high technology?'
Dr Iyengar's talk was laced with various illustrations based on his four-decade long experience as a practicing radiation physicist. Professor Hans Guttrod who was visiting VECC talked about 'From SPS to Large Hadron Collider'. Dr V S Ramworthy, currently the Secretary of the Department of Science of Technology of the Garob of India, discussed various fundamental and applied aspects of 'Not yet fifty – new frontiers of nuclear fission'. Dr G Muthukrisnan's talk on 'Radiation Medicine – the new frontier' was based on his experience in the field at VECC, especially at the Regional Radiation Medicine Centre which he heads.

The participants recommeded that a formalised full-blown seminar be organised in the near future covering many facets of the relationship between fundamental research and advanced technology.

NEWS ITEMS

The National Network of Radiation Physics (Egypt)

M A Gomaa
Chairman, 2nd Radiation Physics Conference
Head of Atomic Reactors Division
Atomic Energy Authority
Cairo, Egypt

and

Prof Amin El-Bahay AEA
Prof Gaber M Hassib AEA
Prof Anas M El-Naggar AEA

The planning for co-operation between scientists from the Atomic Energy Authority and from Egyptian Universities and Research Centres, led to the formation of the Egyptian National Network of Radiation Physics (NNRP) early in 1993, after the end of the First Radiation Physics Conference.

The Proceedings of the First Radiation Physics Conference held at Qena (near Luxor) was published in J.Rad.Phys. and Chem. in 1994. Other NNRP activities were published in the Egyptian Atomic Energy Seminar Series:

- The First Seminar of Radiation Physics (*Current trends in Radiation Physics*) was published as ARE-AEA Seminar Series - 1 (1993).
- The Second Seminar of Radiation Physics (*The role of governmental and nongovernmental organization in teaching and development of Radiation Physics*) was published as ARE-AEA Seminar Series - 2 (1994).
- The Third Seminar of Radiation Physics (*Radiation Physics in Medicine*) will be published as ARE-AEA Seminar Series - 3 (1995).

The proceedings of contributed papers of the Second Radiation Physics Conference which was held at El-Menoufia University, Shebin El-Kom City (80 km north of Cairo) shall be published in J.Rad.Phys.Chem. The invited papers of the Second Radiation Physics Conference will be published by the Information Press Centre of the Atomic Energy Authority of Egypt in 1995.

Two new functions will be carried out in Egypt during 1995 and 1996:

- The Fourth Seminar of Radiation Physics (*Radiation Protection Legislation in Egypt, the need to update*) 11-12 November 1995. It will be held at the National Centre for Radiation Research and Technology, Nasr City, Cairo.
- The Third Radiation Physics Conference will be held at El-Menia University (13-17 November, 1996). El-Menia City is 400 km south of Cairo and 500 km north of Luxor. This Conference is organised by the Atomic Energy Authority and El-Menia University. The Atomic Agency and the Nuclear Research Centre of Libya will sponsor the conference.

Members of NNRP (of Egypt) support Training programs held in Egypt. These programs include:

Training programs at the Middle East Regional Centre for Radioisotopes, on radiation protection, radiation dosimetry and related topics.

Training programs at the Atomic Energy Authority on the peaceful uses of ionizing radiation and radiation protection and radiation culture programs.

Training programs of the Arab Atomic Energy Agency on the peaceful uses of nuclear energy, radiation protection and various relevant subjects

Within the function of the Radiation Physics Seminars held in Cairo, pioneers of radiation and nuclear physics such as Professor M El-Nadi, Professor M Mokhtar and the late Professor F El-Bedawi were awarded the NNRP AEA medal for their efforts in the advancements of radiation physics. Professor Ghose and the late Professor Isabelle were awarded the Assuit University emblem shield as members of the IRPS.ll

The National Network of Radiation Physics is co-sponsored by the IRPA, IRPS and the Egyptian Society for Nuclear Sciences and Applications (ESNSA).

Smoothness pays off for sub-mm astronomers

Jeff Hecht,
Boston, M4, USA
(From Physics World, July, 1995, p9)

These are exciting times for astronomers working at submillimetre wavelengths. In April the Submillimeter Telescope Observatory (SMTO) on Mount Graham in Arizona began scientific observations with its new $8m, 10 m Heinrich Hertz telescope. Its dish is made of a carbon-fibre reinforced plastic that is 20 times less sensitive to thermal change than ie metal used in similar telescopes completed in ie 1980s. And last month the Smithsonian Astrophysical Observatory broke ground on the summit of Mauna Kea in Hawaii to install an array of six 6 m submillimetre telescopes - also made of carbon fibre composites - that will begin operation in late 1997 or 1998

The submillimeter region, often called astronomy's last frontier, lies between about 350 and 1500 μm - a region where many molecules have strong emission lines. These wavelengths penetrate gas clouds in which young stars are forming, and can be used to map molecular gas clouds in galaxies. Astronomers hope that submillimeter observations will give them valuable data on star and planet formation. However, absorption by ie atmosphere in particular by water vapour - makes observations difficult except from dry locations at high altitudes.

Submillimeter astronomy has also been hampered by a lack of outside interest in the necessary technology. Until the military recently began developing submillimeter equipment such as radars, neither civilian nor military engineers had spent much effort on devices that worked at these wavelengths. (The communications industry abandoned millimetre waveguides in favour of fibre optics in the early 1970s.) Thus submillimetre astronomers have not benefitted from technology developed outside their field, unlike their colleagues in optical and radio astronomy.

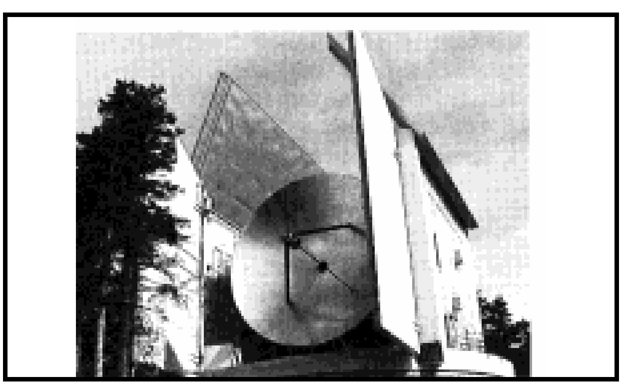
Some astronomers consider the Antarctic plateau an ideal place for observations, and a small submillimeter telescope has been installed there. But others prefer more accessible and less hostile mountain tops. Although Hawaii is surrounded by ocean, at 4200 m Mauna Kea is high enough for reasonable observation at night. Mount Graham is just under 3200 m, but the desert area is so dry that submillimeter observations can be made both day and night, except during July and August 1st, the wet months in Arizona.

The Heinrich Hertz telescope in Arizona is similar in size to two submillimetre telescopes already operating on Mauna Kea - the 10 m Caltech Submillimeter

Telescope and the 15 m James Clerk Maxwell Telescope. However, the 60 panels in the new Hertz dish can be adjusted to give a more accurate surface, says Robert Martin, director of the SMTO. Surface accuracy has been measured at 15 μm, about one-twentieth of the shortest wavelengths in the submillimeter region. Martin says that this makes the Hertz telescope much more efficient at shorter wavelengths than the older instruments, which work best at around 1300 pm.

In mid-June, Martin was "in the final stages of commissioning" the Hertz Telescope, with about half of the available time devoted to scientific observations. The wet months of July and August will be devoted to work on instrumentation and the further enhancement of the mirror accuracy. Applications for observing time from September onwards are already being processed by the SMTO's joint owners, the Max Planck Institute for Radio Astronomy in Bonn and the University of Arizona in Tucson.

The Smithsonian Submillimeter Array will be the first multi-element array in the submillimeter region. Its six antennae will be moved among 21 concrete observing pads, allowing effective apertures as large as 460 m, far larger than any other submillimeter telescope. The beams from the individual apertures will be combined and processed in a control building that will be built near the Maxwell telescope on Mauna Kea. The entire array will cost about $40m.



Astronomy's last frontier – the Heinrich Hertz submillimetre telescope in Arizona

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Japan takes a ten-year look at femtosecond technology

Frederick Shaw Myers
Tokyo, Japan
(From Physics World, July, 1995, p13)

The Japanese Ministry of International Trade and Industry (MITI) has announced a new 1 0-year programme on Femtosecond Technology to begin next April. The programme will be directed by MITI's Electrotechnical Laboratory in Tsukuba and will bring together companies, other government labs and universities. The main themes of the programme will be femtosecond laser technology, materials, optoelectronics and ultrafast information transmission and measurements. Foreign researchers and companies will be welcome to join the project.

Parts of the femtosecond technology programme will naturally follow on from the Optoelectronics Technology Research Corporation (OTRC), a similar ten-year programme that will finish next March 1996. MITI and the Ministry of Post and Telecommunications has have spent Y7bn (about £52m) on the OTRC since it started in 1986, with another Y3bn coming from 13 private companies *(Physics World* 1991 September p 10) . The OTRC explored the fundamental materials technology needed for optoelectronic integrated circuits and semiconductor nanostructures, such as quantum wires and boxes.

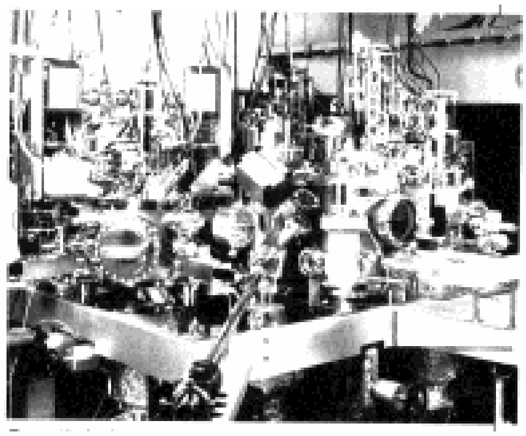
The majority of OTRC research was carried out at MITI's Optoelectronics Technology Research Laboratory (OTL). Izou Hayashi, the former managing director of the OTL who is now retiring as OTRC scientific adviser, had hoped to secure an extension to the project. This was not possible because of "the recession and the present need of companies for more immediate usable results that are less involved with basic science", he says. However, the femtosecond technology programme is showing keen interest in the OTL experiment hall and equipment.

According to Yoshifumi Katayama, managing director of the OTL, "many of the results of our research here are quite applicable to the femtosecond technology programme. Further, it would be extraordinarily expensive to disassemble and move the equipment elsewhere. Some of this equipment was developed here over a period of six or so years, and has been tuned up to a very high degree of performance." In particular, says Hayashi, much of the OTL/OTRC research into basic technologies needed for the very small optoelectronic devices will also be needed in the femtosecond programme.

Hayashi points out that the programme was "much more fundamental than those usually carried out by industry" and that it always studied the processing in terms of the fundamental physical processes at work. Although such processes are crucial to many future technologies, the need for quick results means that many companies are unable to do such basic research.

Hayashi and Katayama say that the processing techniques developed at the OTL will find uses in devices well before quantum-confined technology hit the market. "The quantum box is a sort of north star. By making an effort in that direction we naturally perfect the techniques that will be needed before then." An important challenge will be optoelectronic integration - the manufacture of electronic and optical components, such as transistors and laser diode, on the same chip.

However, Hayashi is quick to point out that the OTRC was only responsible for less than 1% spent of the total amount spent on optoelectronics by Japan. More than half this total was spent by industry. The Ministry of Education (Monbusho) also supports optoelectronics in Japanese universities but, critics point out, this is spread out very thinly among many researchers, which means that few of them do outstanding work.



Growth industry – a nanoscale fabrication facility at the OTL inTsukuba

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NEWS FROM ROUND AND ABOUT

Bare Uranium Produced in EBIT

David Knapp
Lawrence Livermore National Laboratory

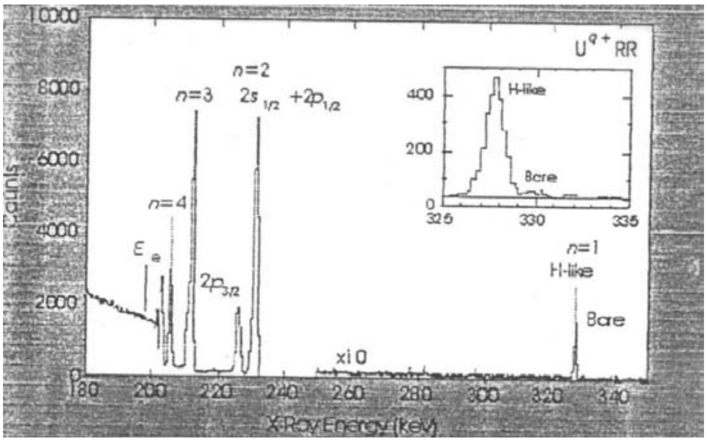
Recently bare uranium ions (U[92+]) were produced in Super-EBIT. This is the first time these ions have been produced without the use of a high-energy particle accelerator.

The bare uranium ions produced by Super-EBIT are essentially at rest, not moving at relativistic velocities like those produced in accelerators. This feature makes them useful for a number of previously impossible studies, such as the interaction of low-energy highly-charged ions with surfaces and precision studies of binding energies . The low energy of these ions also makes them available for experiments in the RETRAP, wnich requires cold, highly-charged ions.

The ions were produced in Super-EBIT with an electron beam energy of about 198 keV, well above the binding energy of the most tightly bound electron (that of hydrogenic uranium) of about 131 keV. We detected the ions by means of their emitted radiative recombination . From the intensity of the recombination, we infer that there were about 8 bare uranium ions in the trap at any time.

The radiative recombination was also to infer the ionization cross section for heliumlike and hydrogenic uranium, as described in a paper on the subject (Phys. Rev. Lett. 72, 4082 (1994)).

Below is a spectrum of the radiative recombination showing the features from heliumlike, hydrogenic, and bare uranium ions.



France thinks big

Philip Hill
(*From Physics World, Sept. 1995, p12*)

The French research minister, Elisabeth Dufourcq, has called for a return to big technology projects in Eureka, the programme that encourages collaboration between European companies developing advanced technologies for civilian applications. Big projects are needed, she says, to "open up high growth markets and better equip European companies for the competition of the 21 st century. " She was speaking at a meeting held to celebrate 10 years of Eureka. The initiative currently involves 24 countries.

Reductions in state funding for the scheme, and the increasing numbers of small- and medium sized companies involved in Eureka programmes, has led to "a net diminution in the size and the duration of projects, which has translated into a severe decline of large technological programmes," she told the meeting.

At the last meeting of European research ministers in Interlaken, Switzerland, Dufourcq won support for her ideas from Germany, Holland and the European Commission. However, she will find it difficult to convince small countries without the industrial infrastructure or large companies needed to profit from long-term projects.

Almost £10bn has been invested in some 1100 Eureka projects since the scheme started in 1985. A third of the total has been spent on large projects such as JESSI (an initiative to develop submicron silicon technology) and high definition digital television. Almost 150 new Eureka projects, worth a total of £190m, were given the green light in the first six months of this year. An independent renew of 300 Eureka projects has found that 60% were considered complete or partial successes, 24% were abandoned at an early stage and the rest were written off as total failures.

• Dufourcq is also trying to shake up the French Treasury. She claims that government finds for industrial research and development (known as FRT) are more than two years in arrears. The government owes a total of FFr 950m (about £121m) to companies, and the situation is causing new programmes to be blocked.

Magnetic X-ray scatterers swap crystals for powders

Malcolm Cooper
Department of Physics
University of Warwick
Coventry, UK

(From Physics World, Sept., 1995, pp25–26)

Magnetic X-ray scattering is either getting easier or the experimentalists are getting cleverer. Apparently you no longer need a third-generation synchrotron source, like the European Synchrotron Radiation Facility (ESRF) in Grenoble, so forget about *gratin dauphinoise avec vins de Sawie* and brace yourself for fish and chips and a nice cup of tea at the second generation Storage Ring Source (SRS) at Daresbury in the UK. Nor do you need a precious single crystal, so it is no longer essential for would-be experimentalists to cultivate a tame crystal grower. These revelations are a result of experiments by Steve Collins, David Laundy, Chiu Tang and Bob Cernik working at the SRS, who have reported the first observation of pure magnetic X-ray scattering firm a powder sample of antiferromagnetic uranium dioxide (S P Collins et al 1995, *J.Phys.Cond. Matt*. 7 L223).

Perhaps magnetic X-ray scattering is not so difficult. Almost everything that is now being hailed as new and revolutionary was first demonstrated in the 1970s and ,80s by that pioneering duo, Francois de Bergevin and Michel Brunel, who worked in Grenoble using a standard low-power X-ray tube and a single crystal of nickel oxide. They achieved count rates in the "several per minute" category and signal-to-noise ratios of less than one. Collins and coworkers, with the benefit of synchrotron radiation but only a powder sample from which the scattering is much weaker, recorded a few hundred counts per second and signal-to-noise ratios similar to those of their predecessors (figure 1).

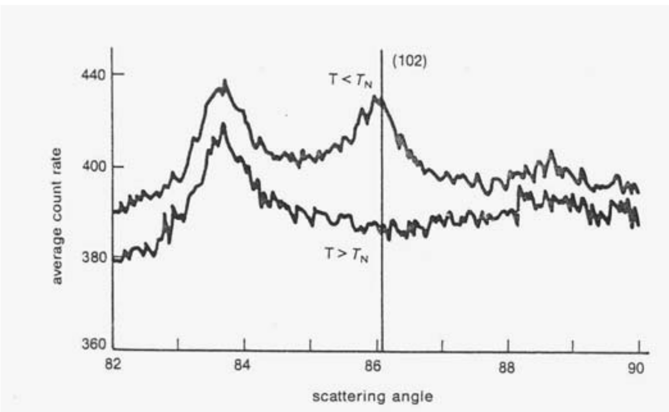


Fig. 1 First observation of magnetic scattering from a powder (UO_2). The vertical scales are offset for clarity and the peak at 83.5˚ is non-magnetic. The (102) magnetic peak at 86˚ disappears above the Néel temperature, T_N.

The more common neutron diffraction methods have long been used to explore magnetic ordering within crystals. When neutrons are directed onto a sample, the resultant nuclear scattering reveals the crystal structure. Also, the neutrons and electrons in the sample interact via their spins, and these diffraction effects provide information about the magnetization.

In X-ray experiments the electric and magnetic fields associated with the X-ray interact with the charge and the magnetic moment of the electrons, again allowing the chemical and magnetic structure to be revealed. In practice, however, it is difficult to distinguish the extremely weak magnetic signal caused by magnetic scattering from those that are the result of fluorescence and charge scattering processes.

Thus exploitation of the technique, rather than a demonstration *a la* de Bergevin and Brunel, had to wait for the higher flux rates and defined polarization provided by synchrotrons. A major catalyst for work in this field was the discovery of resonant exchange scattering, hat bit of serendipity whereby tuning the photon energy to an absorption edge of the ample produces an amazing enhancement of the scattered signal. This ranges from around 50 in holmium, in which it was first observed, to factors five or six orders of magnitude higher at the absorption edges of M-shell electrons (the "M-edges") of actinides such as uranium.

This magic effect makes all the practical difference between seeing something or seeing nothing at all. It arises because, in some materials, electrons are transferred from the spin down to the spin up energy band, which is a result of the local magnetic field. This uncovers a large density of empty states, which are then available to the electronic transitions that are made possible when the incoming X-rays satisfy the resonance condition. In uranium compounds, the signal due to this magnetic effect at some M-edges is as much as about 1% of that due to charge scattering processes, allowing it to be detected easily.

Prior to the work of Collins and coworkers, this effect had only been observed in single crystal antiferromagnets, in which the thermal diffuse background is lower than in a powder, and the magnetic signals are inherently stronger (typically by four orders of magnitude). Away from resonance, very few results have seen the light of day.

The data obtained by Collins and colleagues show a peak at an angle of 86°, which corresponds to the (102) reflection (figure 2). It is only about 10 cs^{-1} above background and, as with de Bergevin and Brunel's work on NiO, it is a case of finding molehills on top of mountains. The magnetic origin of the line is confirmed by the disappearance of the peak above the Néel temperature - the temperature at which UO_2 becomes paramagnetic. It also disappears at energies away from the M-shell absorption edge. Collins and co-workers have also demonstrated that the intensity of the magnetic peak is theoretically consistent with alternate layers of the U4+ ions having their magnetic moments aligned parallel and antiparallel with the w-axis (figure 2). Based on this model, the magnetic moment of U4+ is deduced to be 1.74 Bohr magnetons.

Also at Daresbury, Bill Nuttall from Keele University and colleagues have attempted to observe the even weaker magnetic scattering from holmium foil, for which the resonant enhancement effect is lower. However, they have concluded that these studies will only become feasible with the higher intensity of third-generation sources.

The work at the SRS indicates that experiments with powders should be routinely possible at third-generation sources, which are inherently brighter than the SR. Their insertion devices, such as wigglers and undulators, coupled with focusing optics can deliver much higher fluxes at chosen photon energies Collins and colleagues had to make do with unfocused radiation from a bending magnet.

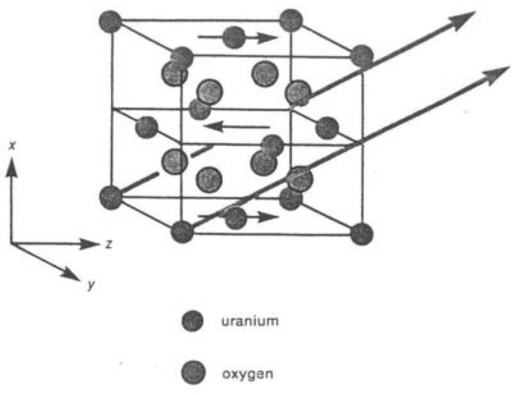


Fig. 2 The unit cell of UO_2. The arrows indicate the direction of magnetization and the red arrows show the direction normal to the (102) planes.

Third-generation sources can also produce beams with a higher degree of linear polarization, making it possible to discriminate against the elastically scattered background and to perform a polarization analysis of the magnetic scattering. With a focused beamline at the ESRF, for example, significant gains in flux, signal-to noise ratio and wavevector resolution will be possible - roughly three to five orders of magnitude according to Collins and coworkers, although the exact figure depends on the station parameters and the experimental priorities.

The magnetic structure community has been brought up on a staple diet of neutrons, but it is beginning to accept that varying this with doses of X-rays can be worthwhile. One practical advantage is that focused X-ray beams can produce results with samples that are smaller than those required for neutron work, and now it seems that powders, which are more readily available than single crystals, can be useful too. Moreover, the information that can be obtained from X-ray scattering is subtly different because the two contributions to the magnetic moment - one due to the electron's orbital motion and one due its spin - have different signatures. In addition, high wavevector resolution is more easily achievable.

There seems to be a real role for X-rays in the investigation of magnetic structure, especially when both X-ray and neutron communities can be found sharing the same site in Grenoble. Indeed, a beamline tailor-made for magnetic diffraction will be on line at the ESRF within the next few months. A dedicated ESRF bending magnet station, christened XMAS (for X-ray Magnetic Scattering) and funded by the UK, is also due to be operational from autumn 1997.

The ingenious experiment on UO_2 at the SRS, 38 years after Henshaw and Brockhouse studied the same material with neutrons, opens up considerable possibilities for X-ray studies of antiferromagnets. It proves that interpretable results can be obtained with readily available powders, rather than scarce single crystals, and with modest synchrotron sources. This result surely indicates that X-ray magnetic scattering from powders will provide highly accurate measurements at third-generation synchrotrons, providing a major boost to the study of magnetic ordering in crystals.

(from Physics World, July 1995, p12)

Japanese status symbol

Japan has been granted "observer" status at CERN, following its decision to provide Y5bn (about £37m) towards the construction of the laboratory's Large Hadron Collider *(Physics World June* p5). This makes Japan the first nonmember state from outside Europe to be made an observer. Japan will now be allowed to attend CERN council meetings and receive council documents, but it will not be able to play a role in constructing the LHC or take any part in policy-making. However, last month CERN council discussed the idea of a new "associate" status, which would allow Japan to be involved in policy-making. This proposal will be considered again by the council in December.

Canada TRIUMFs at last

The Canadian government has promised to contribute a total of C$167m (about £76m) to the TRIUMF panicle physics laboratory in Vancouver over the next five years. The money will allow Canada to make "contributions in kind,' to the construction of the Large Hadron Collider (LHC) at CERN and to improve the lab's own accelerators.

The investment, which includes C$17m of new money, was announced in the light of a renew that followed last year's decision not to build a $708m "kaon factory" at the lab *(Physics World 1994* April pl6) The renew had concluded that, without substantial increase in support, Canada would not be able to compete internationally in particle physics.

The extra money will also pay for a new Isotope Separator and Accelerator (ISAC-I) that will accelerate beams of exotic, short-lived radioactive atoms produced from the intense proton beam from TRIUMF's 500 MeV cyclotron ISAC-1 is expected to attract international interest from nuclear physicists studying the behaviour of unusual atomic nuclei, and from astrophysicists - who will be able to simulate the formation of elements in stars and in the early universe.

Canada hopes to pay its way at CERN by contributing technical and scientific expertise and equipment built by virtue of TRIUMF news which was described as "encouraging and interesting" by a CERN spokesman.

1995

October

30 Oct –1 Dec *School on Synchrotron Radiation in Science and Technology*, Trieste, Italy; (ICTP)

November

8–12 *Hong Kong College of Radiologists Röntgen Centenary Cosngress and 3rd Annual Scientific Meeting*, Hong Kong; Secretary, Organising Committee, Röntgen Centenary Congress, Hong Kong, Department of Diagnostic Radiology, Queen Mary Hospital, Hong Kong.
e-mail ccyau@ha.org.hk
WWW -
http://www.ha.org.hk'qmh/news/rontgen.html

20–24 *Int. Conf. on Ultrafast Processes in Spectroscopy*, Trieste, Italy; (ICTP)

December

8–9 *11th Annual Symposium of the Belgian Association of Hospital Physicists with special emphasis on Conformal Radiotherapy : Physics, Treatment Planning and Verification*, Ms G De Smet, Dept Radiotherapy and Nuclear Medicine, De Pintelaan 185, B-9000 Gent, Belgium. Fax +32 9 240 49 91;
Phone +32 9 240 30 74;
e-mail carlos.dewagter@rug.ac.be
WWW http://krtkg1.rug.ac.be

1996

January

7–10 *29th Midyear Topical Meeting of the Health Physics Society*, Wyndham Paradise Valley Hotel, Scottsdale, Arizona

18 *Radiation Protection Measurements: Are they defensible in court?* Commonwealth Institute, London, UK; Dr R Strong, Society for Radiation Protection, 148 Buckingham Palace Road, London SW1W 9TR, UK.
Fax +44 0171 824 8112
Phone +44 0171 823 4971

18–25 *International Schools and Conference on X-Ray Analytical Methods (AXAA)*, Sydney, Australia; N Stephenson, AXAA '96 Secretariat, GPO Box 128 Sydney, NSW 2001 Australia

1996 (Continued)

March

15–20 *Sixth Conference of Nuclear Sciences and Applications*, Cairo, Egypt; Prof Dr A I Helal, Atomic Energy Authority (ESNSAS) 101 Kasr El-Eini Street, Cairo, Egypt.
Fax/phone +20 2 3543451

April

14–19 *1996 International Congress on Radiation Protection (IRPA9)*, Congress Center Hofburg, VIenna, Austria; WWW –
http://www.tue.nl/sbd/irpa/9irpacon.htm #9th Int IRPA Con

May

7–10 *Sixth International Radiopharmaceutical Dosimetry Symposium*, Gatlinburg, Tennessee, USA; Audrey S Stelson, RIDIC.
Phone +1 423 576 3450

20–24 *International Symposium on Ionising Radiation : Protection of the Natural Environment*, Stockholm, Sweden; The Swedish Radiation Protection Institute, Carl-Magnus Larsson, S-171 16 Stockholm, Sweden. Fax +46 8 729 71 08

June

3 – 7 *Fourth International Conference on Radioactive Nuclear Beams*, Ohmiya, Japan; Mrs S Odai, RNB-4 Secretariat, Institute of Physical and Chemical Research (RIKEN), Linac Lab, 2-1 Hirosawa, Wako, Saitama 351-01, Japan
Fax +81 484 62 4689; Phone +81 484 62 111 ext. 4211; e-mail RNB4@rikvax.riken.go.jp;
WWW http://www.rarf.riken.go.jp

TBA *15th Annual Panasonic International Dosimetry Symposium*, Lake Geneva, Wisconsin, USA; David Katzman, Panasonic, USA. Phone +1 201 348 5339

July

21–25 *X International Conference on Small-Angle Scattering*, Campinas, Brazil; Prof. Aldo Craievich, LNLS, Cx Postal 6192, 13081-970 Campinas, SP, Brazil

../September

1996 (Continued)

September

9–11 *Second International Workshop on the Industrial, Medical and Military Applications of Radionuclides*, Salzburg, Austria. Workshop Secretariat, Institute of Physics and Biophysics, Hellbrunnerstr. 24, A-5020 Salzburg, Austria. Fax +43 662 8044 5704; Phone +43 662 8044 5700; e-mail physik@edvz.sbg.ac.at

18–20 *International Symposium on In Vivo Body Composition Studies*, Malmö, Sweden; Symposium Secretariat, Department of Radiation Physics, Malmö University Hospital, S-205 02 Malmö, Sweden. Fax +46 40 963185; Phone +46 40 331235

October

6–9 *3rd Topical Meeting on Industrial Radiation and Radioisotope Measurements and Applications (IRRMA'96)*, Raleigh, USA; W.F. Troxler, IRRMA'96 Conference General Chairman, Troxler Electronic Laboratories, PO Box 12057, Research Triangle Park, NC 27709, USA. Phone +1 919 549 8661

14–16 *International Symposium on Nuclear Energy and the Environment*, Beijing, China; Leng Ruiping, Wang Hengde, Chinese Society of Radiation Protection, PO Box 2102-14, Beijing 100822, China. Fax +86 10 8539375 Phone +86 10 8510370

21–25 *4th International Conference on High Levels of Natural Radiation*, Beijing, China; Prof. Tao Zufan, Secretary General of 4th ICHLNR, Laboratory of Industrial Hygiene, Ministry of Health, 2 Xinkang Street, Deshengmenwai, Beijing 100088, China. Fax : +86 10 2012501 Phone : +86 10 2021166 ext. 378

November

3–7 *International Conference on Radiation and Health in Israel*, Ben Gurion University of the Negev, GBeer Sheva, Israel; International COnference on Radiation and Health, Ortra Ltd., 2 Kaufman Street, Textile Center, POB 50432, Tel Aviv 61500, Israel. Fax +972 3 5174433; Phone +972 3 5177888 e-mail ortra@trendline.co.il

1997

February

TBA *7th International Syumposium on Radiation Physics (SIRP-7), Triennial Meeting of the International Radiation Physics Society (IRPS)* Jaipur, India; B. Sinha, Director, Variable Energy Cyclotron Centre, 1 A/F, Bidhan Nagar, Calcutta 700 064, India Fax +91 33 346781; Phone +91 33 370032

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 ionizing radiations (both electromagnetic and particulate) with matter". It thus differs in emphasis both from atomic and nuclear physics and from radiation biologyh and medicine, instead focussing 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 (SRP-4, 1988), Dubrovnik, Croatia (ISRP-5, 1991) and in Rabat, Morocco (ISRP-6, 1994). ISRP-7 (1997) will be in Jaipur, India. The IRPS also sponsors regional Radiation Physics Symposia.

A newsletter, **IRPS Bulletin**, is published quarterly and sent to all IRPS members.

The IRPS Secretariat is (Prof. R H Pratt, IRPS Sec), Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, PA 15260 USA. Telephone +1 412 624-9052, Fax +1 412 624-9163.

The IRPS welcomes your participation in this "global radiation physics family".

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   (First) (Initial) (Last)

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   ____

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   Telephone: __________ Telex: ___________ 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 organisation(s) involved in one or more branches of Radiation Physics of which you are a member, also your status (e.g., student member, member, fellow, emeritus):

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Developed country	$15	$40	Developed country	$6	$15
Developing country	$5	$12.50	Developing country	$2	$5

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Continued overleaf

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   Telex: 021-2646 Bi In *Fax:* +91-33-34-3886 or +91-33-350-6790 *e-mail:* scroy@boseinst.ernet.in

9. ______________________________ ______________

   (Signature) (Date)

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