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Main

FROM THE EDITOR

Dudley Creagh

Recently there was a meeting in Oxford of the Vice Chancellors of some forty universities from a diverse range of countries. They discussed a variety of issues which they perceived to be problems, not the least of which was the support by government for higher education funding.

This, I must say, is discussed extensively in Australia where governments of whatever political persuasions have been lambasted for their tardiness in providing funds to the higher education sector, and their parsimony in providing funding for university research. We have now under consideration a Green Paper which, if its underlying tenets are implemented, will see a major shakeup of universities, and the sidelining of a number of smaller universities in the research sector.

What does this have to do with the IRPS, I hear you ask? Simply this. In every country in the world there has been a very significant growth in the student population. And in only two countries, Singapore and Norway, has government funding matched the growth in the university population. The problem is endemic, and becoming worse.But one should look further and enquire as to what courses are being undertaken.

Later in this Bulletin you will find a news item on the introduction of Science fiction as a university science subject. Is this a valid use of scarce resources? How many subjects in the university calendar are worthwhile enterprises?We see that the numbers studying science, especially the hard sciences of physics, chemistry and mathematics, are declining. Fewer are entering courses involving engineeringand design. And the world is becoming more and more dependent on technology and its development.

I might be biased. But I believe the time has come to ration university places, and place emphasis on those disciplines which might lead to advances in knowledge: especially knowledge which will lead to a general increase in the quality of life of people worldwide.

What do you think?

PRESIDENT'S COLUMN

Bikash Sinha

Not available at this point in time

LETTERS TO THE EDITOR

Dear Ed :

I have accessed the IRPS Bulletin via the web and am sending this e-mail message to let you know that I prefer reading it in this manner, thereby saving the society the cost of mailing me a hard copy. However, I probably will forget to read the web-version unless I am reminded that a new one has just been posted. I DO NOT need to receive the bulletin by e-mail - all I need is a standard e-mail message from the society that a "new bulletin is now available on the web".

I must add, however, that many of us are VERY privileged indeed to be able to communicate via the web. At some point everyone within the IRPS will have full web access, but it will take some time for this to happen. Meanwhile, I think the society should try to send the bulletin along normal e-mail channels and not by mail (except in very special cases), so as to save money and keep the IRPS afloat. When I receive the bulletin a la e-mail, I will first attempt to look at it via the website.

I trust that this is what you want to hear from all of us. Good luck.

Ralph

Walter R Nelson, USA

All contributions gratefully received! Thank you for yours.

Ed.

Dear Ed :

I thought I would respond to your letter in the IRPS Bulletin, June 2, 1999.

Do not give up hope! There is a LOT of interest out there! Our silence only means that we are all too darned busy. The silent majority out there, if they think like me, love the IRPS Bulletin and the principles which the IRPS espouses.

The real reason for this letter is to argue against abandoning the paper version for those with e-mail addresses. I think this would be a mistake.

I skim through and read anything of interest in the newsletter as it now is, simply because it appears in my mailbox. E-mail gets treated in a different way. The electronic path from the e-mail inbox to the electronic wastebasket is a very short one. It has to stand out among the 100's of e-mails I get weekly, grabbing my attention in the subject line, or it is deleted. I suspect many of my colleagues have adopted this cut-throat attitude as a survival tactic in this day of electronic information overload. In fact, one of my colleagues (whom I will NOT identify) has set up his electronic mailer to automatically discard on average every second message!

So, please, keep sending me the paper version - even if it means an increase in my membership fees.

Kindly accept my congratulations on the fine IRPS bulletin. Keep up the excellent work and keep sending it to me - in paper!

With best wishes

Alex

Alex F Bielajew, USA

If we can rationalize distribution and have more feedback from members on content, we can substantially improve the standard of content and the quality of the distributed Bulletin.

Thanks, Ed.

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Superheated Drop Neutron Spectrometer

Mala Das, B K. Chatterjee, B. Roy and S C. Roy

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1. Introduction :

The 'Superheated Drop Detector' or SDD invented by Apfel in 1979 [1] is one of the most useful devices in neutron detection. The basic principle of operation of this detector is the same as a bubble chamber. Here the superheated drops are suspended in a dust free visco-elastic gel medium. Upon nucleation by energetic radiations the drops form bubbles and the drops nucleate independent of each other. So one nucleation does not consume the whole liquid and the repressurisation process that is needed in bubble chambers, is not required here. This is an advantage of SDD over the bubble chamber. Each drop stores mechanical energy that is released when triggered by radiation. The superheated liquid can be prepared by increasing the temperature of the liquid at a given pressure or alternatively it can be prepared by lowering the pressure of the liquid at a given temperature. This detector can be made on a polymer matrix where the bubbles formed after the nucleation of drops are tightly bound as was carried out by Ing and his group, called the 'Bubble Detector' (BD). Here the nucleation is observed by counting visually the number of bubbles trapped in the gel [2]. The test liquid remains in a glass tube under pressure created by another liquid and just before the experiment, the liquid is sensitized by unscrewing the cap of the tube and allows the liquid to become superheated. The superheated drops serve as an excellent detector for neutrons.

There are different detecting systems by which the nucleation in superheated drops can be measured. One way is to count acoustically the pulses produced by drop vaporization with the help of a piezo electric transducer and a drop counter [3]. Another way is to measure the volume of the vapor formed upon nucleation by a passive method. This system consists of a vertical graduated pipette [4] or horizontal glass tubes placed on a graduated platform [5,6] with an indicator (gel piston or coloured water column) indicating the volume of the vapor formed upon nucleation. Changing the diameter of the glass tube can vary the sensitivity of this type of detector. This system does not require any power source and can be used as an alarm dosimeter, in area monitoring etc. The third way is to count visually the bubbles trapped in hard polymer matrix [2]. The suitability of using superheated drops as a neutron dosimeter [7,8,9,10] has already been established. It is a very sensitive neutron dosimeter and can measure the neutron dose as low as 0.1μ Sv. The SDD and BD neutron dosimeters are now commercially available from Apfel Enterprises Inc, USA and from Bubble Technology Industries Ltd., Canada respectively.

2. Principle of neutron spectrometry :

Since its discovery, attempts have been made on the application of this detector in neutron spectrometry. There is a minimum energy required for nucleation at a given temperature below which no nucleation occurs. This minimum energy is called the threshold energy (W) for nucleation that can be obtained from reversible thermodynamics [11]. The threshold energy decreases as the degree of superheat of the liquid increases. The degree of superheat of a liquid is the difference between the vapor pressure of the liquid at a given temperature and the ambient pressure or the difference between the boiling point of the liquid and the ambient temperature. Therefore liquid with lower boiling point possesses a higher degree of superheat at a given temperature and as the ambient temperature increases the liquid becomes more and more superheated. This property of the superheated liquid is being utilized to develop the neutron spectrometry. There are different ways by which superheated drops can be used in neutron spectrometry. One of the ways is to use the different superheated liquids of different degree of superheat and the threshold neutron energies can be obtained by irradiating the detectors with different monochromatic neutron sources [12]. Another way is to use the same detector operating at a different temperature. The threshold energy depends on the operating temperature of the detector, hence by suitably varying the temperature of the detector, neutrons of different energies can be detected, as was achieved by d'Errico *et al.* [13]. Two superheated liquids operating at four different temperatures were used to obtain eight different threshold neutron energies. It is to be noted that in order to get good resolution of the spectrum, temperature variation at a close grid is necessary.

3. Present work :

There is a different approach by which the neutron energy spectrum can be obtained from the temperature dependence of threshold energy of a superheated liquid. After the interactions of the neutrons with the nuclei of the constituting atoms of a superheated liquid, ions of different energies are formed. The ion having the highest value of LET (dE/dx) in the liquid, will play the major role in nucleation. Another important point is that there is a specific length L, along the ion track, and the energy (E_c) deposited over that length will contribute a significant role in nucleation. Actually, a very small fraction of the deposited energy is normally used in nucleation i.e. W/E_c is very small and this ratio is called the thermodynamic efficiency of nucleation (η_T). After the deposition of energy by the ions, nucleation occurs with the formation of a critical size vapor bubble of radius r_c inside the liquid drop. It is suggested that $L = 2r_c$ [14,15] and E_c can be expressed as $E_c = 2\, r_c\, dE/dx$. Therefore,

$$W = \eta_T E_c \text{ or } W = 2\, \eta_T\, r_c\, dE/dx$$

$$\text{or}$$

$$W/r_c = k\, dE/dx, \text{ where } k = 2\eta_T$$

W and r_c are both functions of temperature and dE/dx is a function of the energy of the projectile ions in the superheated liquid, which can be converted to the energy of the incident neutrons. So this equation relates the threshold neutron energy for nucleation to the ambient temperature. This enables one to convert the temperature of the detector to the energy of the incident neutrons. Therefore using the above equation as a working equation, a neutron energy spectrum can be obtained by observing the detector response at different temperatures. This gives an important application of the superheated drop detector in neutron spectrometry. The nucleation rate in superheated drops is proportional to the total volume of the drops (V), incident neutron flux (ψ), neutron-nucleus interaction cross section (σ) and to the neutron detection efficiency (η) of the detector. Neutron detection efficiency η, is defined as the ratio of the observed nucleation to the incident neutrons. By observing the nucleation rate in superheated drops, η can be obtained from the known values of V, ψ and σ. If one measures η at different temperatures, the derivative of η against temperature resembles the neutron energy spectrum of the source. The temperature axis can be converted to the neutron energy following the method discussed here. For a given neutron energy spectrum, at low temperature only the high energy neutrons take part in nucleation. As temperature increases, threshold energy decreases and so in addition to the high energy neutrons, low energy neutrons are also detected. So for a polychromatic source, η should increase with temperature. When all the neutrons in the spectrum contribute in nucleation, η should be constant with temperature because no more neutrons are left to be detected. For a monochromatic source, there is only one sharp increase of η at a particular temperature corresponding to the energy and it should be constant for the other temperatures. This detector can be made sensitive to different ranges of neutron energies as the user's choice by varying the temperature of the liquid. This detector can detect neutrons with energies ranging from thermal to fast energy. We have tested the present principle of spectrometry with a 3 Ci Am-Be neutron source using superheated drop detector made of R12. The temperature was varied from -17^{o}C to about 60^{o}C with the help of an indigenously made temperature controller. There is a fair agreement between the neutron energy spectrum of Am-Be obtained from our experiment and the available spectrum of the source, the details of which will be published elsewhere [16].

The main advantage of this type of spectrometer is that it is easy to prepare, is low cost and does not require any power supply. Nowadays, superheated drops are widely used in the determination of neutron spectra in space, at high altitude studies, gamma detection, detection of radon, for cold dark matter search, charged particle detection etc. Besides these applications, the radiation induced nucleation in superheated drop detector is itself a very interesting field of research.

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CONFERENCE REPORTS

Combined Meeting on Hadron Therapy

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A hugely successful meeting covering a wide variety of technical, physical, biological and clinical topics within the field of hadron therapy, held in Cape Town, South Africa from 12-15 April 1999, was hosted by the Medical Radiation Group of the National Accelerator Centre (NAC). The meeting was held under the auspices of the Proton Therapy Co-Operative Group (it was the 30th meeting of this group – PTCOG XXX), the European Hadron Therapy Group (EHTG) and the European Clinical Heavy Particle Dosimetry Group (ECHED). In 1995 NAC hosted PTCOG XXIII, but it is the first time that the other two groups have met outside Europe. Dan Jones was organiser of the Combined Meeting and is an office bearer in both PTCOG and ECHED.

The 117 delegates who attended the meeting included the exceptionally high number of 72 foreign delegates from 13 countries, which is probably a record proportion for a meeting of this kind. There was a very full scientific and social programme which was spread over three and a half days. A total of 78 oral and 19 poster presentations were given. This necessitated parallel sessions being held on the first day.

The first day's programme consisted of an all-day charged particle Beam Scanning Workshop (under the auspices of PTCOG) while parallel sessions were held covering fast neutron and neutron capture therapy (ECHED) and radiobiology (PTCOG and EHTG). Beam scanning is a "hot" topic and is undoubtedly the technique which will be used in the future for both proton and heavy ion therapy beam delivery. The technique allows so-called intensity modulation and improved dose conformation to the target volume, thus sparing normal tissue and possibly allowing dose escalation. This technique will be used on the new proton therapy facility currently being developed at NAC. This Medical Radiation Group was largely responsible for establishing the Beam Scanning Workshop concept within PTCOG – the first such Workshop was held in 1998 and was co-chaired by Dan Jones. The second day began with the Radie Kotzé Commemorative Lecture. This lecture is given at an appropriate occasion every second year and concerns topics related to the NAC's medical research programme. The commemorative lecturer receives a gold medal, generously sponsored by the Joosub HS Ebrahim Foundation. The lecture this year was in the field of Radiobiology and was delivered by Dr John Gueulette of the Université Catholique de Louvain, Brussels, Belgium. Dr Gueulette is probably the pre-eminent Radiobiologist in hadron therapy and has undertaken studies at many of the operating hadron therapy facilities around the world. He has undertaken several pioneering research projects on both the NAC's neutron and proton therapy beams. The subject of his talk concerned the intercomparison of the biological effects of different clinical hadron beams.

This lecture was followed by a long session on eye treatments using proton beams (PTCOG). The treatment of eye lesions is an ideal application of proton therapy. Only low-energy beams (60-70 MeV) are necessary, although dedicated treatment facilities are required. The main conditions currently being treated are choroidal melanomas and age-related macular degeneration. The latter treatment is receiving a great deal of attention because of the large number of people who suffer from this condition and its poor visual prognosis. It is the leading cause of blindness in people over 50 years of age in Europe and North America and its prevalence increases with age rising to nearly 30% in those older than 75 years. The standard form of treatment is laser coagulation which results in an immediate loss of visual acuity but does arrest disease progression. The preliminary results with proton therapy are very promising as the disease appears to be arrested with no loss of visual acuity. However, it is too early for the definitive effects of proton therapy to be assessed.

The remainder of the meeting included contributions from all three professional associations. A special session on prostate treatments was held. Prostate cancer is one of the leading causes of death in males. Surgery, brachytherapy (radioactive implants) and external beam therapy were discussed during the session. Neutron therapy has been established as the treatment of choice for advanced prostate cancer, while proton therapy and brachytherapy are used for the treatment of early disease. Radiation is often given post-operatively. The remainder of the oral sessions concerned a variety of topics, including other clinical aspects, facilities and equipment, patient positioning, dosimetry, treatment planning and beam characterisation. The posters covered also a wide diversity of topics.

Included in the heavy programme was a tour of the NAC facilities which really impressed those who had not been there before. The tour was followed by a barbeque on site, which was thoroughly enjoyed by all. The meeting banquet was held at the 17th century Castle of Good Hope, and was superbly organised and catered by the South African National Defence Force. An authentic indigenous Cape flavour was provided by the Kaapse Klopse minstrels. All in all it was a most impressive and entertaining function. Delegates all pronounced the meeting a great success, both from the scientific and social point of new.

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WORLD NEWS

Around the Traps

(From The Physicist, Vol 36 , No 4, 1999, p129)

Quantum Well Lasers *(From ANU Reporter, June 16)*

Dr. Chennupati Jagadish and his colleagues at the ANU's Department of Electronic Materials Engineering, RSPhysSeE, have developed a "quantum well" laser with almost double the power of present lasers, concentrated largely in a single mode. It is based on crystal nanostructures so small that electrons are trapped, "like a ball bearing in an inkwell", and are restricted to only a few specific energy eigenvalues. The technology could produce up to a 100-fold increase in the capacity of existing optic fibre networks. Negotiations with a Taiwanese company are in progress to commercialize the technology.

Hubble (almost) constant

Professor Jeremy Mould, director of MSSSO, is co-leader of a large Key Project team of 27 astronomers who announced a new value of the Hubble constant at the beginning of June. They used the Hubble Space Telescope to observe some 800 Cepheid variable stars, whose brightness can be reliably translated into a distance measurement, thus acting as "cosmic yardsticks". They arrived at a figure of 70 ± 7 km per second per megaparsec. Their result is lower than previous estimates from this group, and almost within reach of the corresponding figure of 59 claimed by a rival camp headed by Dr Allan Sandage from California.

Life at the End of the Universe

Dr Charley Lineweaver of the University of New South Wales has made headlines with a new calculation of the age of the Universe. Based on new estimates of the Hubble constant, the rate at which the universe is expanding, and the amount of matter in the universe, he is able to calculate the cosmological constant, and arrive at an age of 13.4 ± 1.6 billion years for the universe. This is about a billion years younger than recent estimates, and only just older than the oldest known stars.

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Sci-fi to be studied in UK degree

Paul Guinnessy

(From Physics World, News - Higher Education, Vol 12 No 8, 1999, p9)

The University of Glamorgan in Wales is to start a degree course in science and science fiction. Mark Brake, the physicist who is director of the course, hopes that the new degree will encourage more people to follow careers related to science and technology. Between 50 and 100 students will start the course in September.

"Science fiction is unique in its close relationship with science," says Brake, "and society needs more people with the ability to inspire young people and get them interested in science and technology. Most people in the UK receive their science education through science fiction so it makes sense to study the link between science fiction and science fact."

The three-year degree course will be split into 30 modules, more than half of which will be based on astronomy and space science. There will be seven modules on science fiction, with the remaining modules covering the media, society and culture. According to Brake, the students will study science topics first and then look at the science-fiction works associated with them. They will also study the role of science and science fiction in recent historical events such as the space race and the Cold War.

"It's an interesting idea," says Jim Emerson, an astronomer from Queen Mary and Westfield College. "Any way of increasing the public understanding of scientific truth should be looked at."

The students will be expected to read popular books by physicists, and books such as The Making of the Atomic Bomb by Richard Rhodes. H G Wells, George Orwell and Philip K Dick will be on the reading list too. The students will also be expected to study computer games, merchandizing and films such as Blade Runner and The Terminator.

Glamorgan already runs a course on life in the universe, which includes material on the search for extraterrestrial life, and a course on popular science and culture, which looks at various aspects of Einstein's theories of relativity, including their cultural impact.

"It is important that we retain high academic standards that develop new and innovative ways of teaching science-related courses," says Brake. He hopes that graduates will go on to careers in publishing, education and social research.

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Chandra mission probes X-ray secrets

Peter Gwynne, Cambridge, MA

(From Physics World, News - Astrophysics, Vol 12, No 8, 1999, p11)

The latest mission of the space shuttle Columbia, which finally went into orbit as Physics World went to press last month, contained more than its share of pioneering moments. It was the first shuttle flight commanded by a woman. It was the first NASA mission run by an independent control centre. And it contained the largest and heaviest payload ever. For physicists, the interest focuses on that payload.

The $1.5bn Chandra X-ray Observatory will open a new window on the universe. Between 10 and 100 times more powerful than any of the dozen X-ray telescopes that have orbited to date, it will scan the universe with extraordinary resolution. "It has the sensitivity to look for distant and faint objects at a factor of 20 - 50 times better than anything else that has been done before," says Martin Weisskopf of NASA's Marshall Space Flight Center, the project scientist for the observatory. "We can make Superman jealous with our X-ray vision," jokes Kenneth Ledbetter, head of payload development at NASA.

Cosmic window – scientists will use Chandra's spectrometer gratings to study X-ray chemistry

Chandra takes its place as the third of NASA's series of "great observatories for astrophysics". It is designed to complement the Hubble Space Telescope and the Compton Gamma Ray Observatory, which are already in orbit, as well as the planned Space Infrared Telescope Facility and a series of ground-based radio observatories. "We need a multiwavelength view to understand what makes the universe tick," explains Weisskopf.

The Chandra observatory has four main scientific targets. It will study X-rays from the vicinity of black holes. It will seek evidence for the nature of the dark matter that may account for a significant proportion of the so-called "missing mass" of the universe. It will examine the afterglows of gamma-ray bursters, which are brief flashes of very energetic radiation. And it will aim to study infant quasars via long exposures that will detect very distant, faint objects that emit X-rays. To fulfil that mission, Chandra will fly in an eccentric orbit between altitudes of 10 000 km and 140 000 km.

The observatory has a long history - too long in the view of several scientists. Weisskopf first became associated with it in 1977, when it was known as the Advanced X-ray Astrophysics Facility. NASA changed its lame to Chandra, which means moon or luminous object in Sanskrit, in honour of the late Subrahmanyan Chandrasekhar. He won the 1983 Nobel Prize for Physics for his theoretical studies of the structure and evolution of stars.

However, the change of name did little to speed up the observatory's progress. The US Congress held back funding because it suspected that the observatory's mirrors would be too difficult to make. Last year its software proved faulty, and early this year possible problems emerged in its circuit boards. In April NASA postponed the flight to check the observatory's booster rocket.

One unique feature of Chandra is that it has its own control centre, run independently of NASA by the Smithsonian Astrophysical Observatory at Harvard University. "We serve as an interface for various space operations," says Marv Leblanc, director of the $50m centre.

Several contractors have technical investments in Chandra. The American firm Raytheon Optical Systems built the mirrors, using glass from Schott Glaswereke of Germany. The observatory's CCD imaging spectrometer was designed by Pennsylvania State University, which also developed one of the observatory's diffraction gratings. The other came from a European collaboration between the Dutch space research organization and the Max Planck Institute for Extraterrestrial Physics in Garching, Germany. Researchers at Leicester University in the UK also provided detectors for the spacecraft's high-resolution cameras.

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Physicists prove Van Gogh painting is not a forgery

Emma Sanders, Geneva

(From Physics World, News - Applied Science, Vol 12, No 8, 1999, p9)

Genuine – Van Gogh's Garden at Auvers

French physicists have helped to resolve a long-running mystery in the art world. They have shown that the painting Garden at Auvers" is indeed a work by Vincent Van Gogh. Claims that the painting was a forgery sent its value plummeting after the current owners had bought it for FFr 55m (about £5.6m) in 1985, and there were no bidders when it was put up for auction 11 years later.

Scientists at the research laboratory of the Museum of France in Paris compared the painting with nine of the 70 works accredited to Van Gogh during his time at Auvers. However, they were not allowed to remove samples from the painting, and could not use the lab's synchrotron X-ray source since radiation can sometimes heat organic matter. "Van Gogh used organic matter such as geranium for colouring," explains Elizabeth Martin, a scientist at the lab.

Instead, the team used a technique called microfluorescence, in which a beam of X-rays less than 1 mm wide was used to reveal the spectrum of most of the elements in the pigments. Unlike X-ray diffraction methods, microfluorescence does not destroy the surface of the painting The researchers also used radiography to show that the canvas matched the kind Van Gogh used during his period at Auvers. And they found that the way in which the paint was applied was also consistent with Van Gogh's style. Forgers often build up more layers of paint as they need several attempts to reproduce the style of the original.

Finally, the painting was examined by microscope. "This analysis gave very interesting clues," says Martin. As with the other nine studied, the canvas showed markings where Van Gogh had stacked up his paintings on his bed before the oil was completely dry. "We found nothing that was incompatible with the painting being a Van Gogh," says Martin. "Now it's for the art historians, who are the specialists of Van Gogh, to make their conclusions."

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Neutrino science enters a new era

Peter Rodgers** and **Emma Sanders

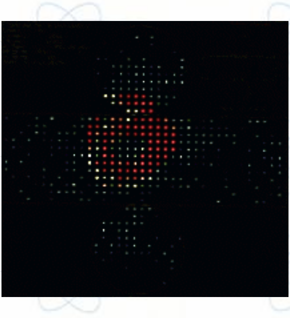
(From Physics World, News, Vol 12, No 8, 199, p7)

This summer is an exciting time for physicists working on neutrino experiments around the world. Installation work on Antares, an underwater neutrino telescope, is about to start off the French coast near Marseilles. In the US, construction of the MINOS neutrino oscillation experiment began in the Soudan underground mine in Minnesota last month. And at the end of June the K2K experiment in Japan detected its first neutrino. K2K is the world's first long-baseline neutrino oscillation experiment.

In the Standard Model of particle physics there are three flavours of neutrino electron, muon and tau neutrinos All three flavours have no charge or mass, and only interact weakly with matter. This makes them very difficult to detect. Neutrinos are routinely produced in high-energy particle collisions and high-energy astrophysical events such as supernova explosions.

Last year the SuperKamiokande experiment in Japan announced that it had strong evidence to show that atmospheric muon neutrinos – which are created when cosmic rays collide with nuclei in the atmosphere – can "oscillate" into tau neutrinos as they pass through the Earth (see Physics World , July 1998 pp 17-18). Such oscillations are allowed in various extensions of the Standard Model if the neutrino has a non-zero mass. However, accelerator-based experiments are needed to pin down the mass and other properties of the neutrinos. In the K2K experiment a beam of muon neutrinos is produced at the KEK particle physics lab in Tsukuba, which is on the east coast of Japan near Tokyo, and then detected at SuperKamiokande, which is some 250 km away in central Japan.

The advantage of accelerator-based experiments such as K2K is that the initial flux of neutrinos can be measured at the accelerator and then again much further away. This is not possible in experiments with atmospheric neutrinos. If the flux of muon neutrinos detected at SuperKamiokande is lower than that measured at KEK, that will be evidence for neutrino oscillations. Results from K2K are expected in about two years.



On target – the first event in a long-baseline neutrino oscillation experiment as seen in K2K

The SuperKamiokande experiment consists of 50,000 tons of water surrounded by hundreds of photon detectors and located 1000 m below ground in a lead and zinc mine. A tiny fraction of electron and muon neutrinos give off faint flashes of light known as Cerenkov radiation when they interact with electrons in the water molecules. SuperKamiokande cannot detect tau neutrinos.

The MINOS experiment in the US is also a long-baseline oscillation experiment. Muon neutrinos will be produced at Fermilab, near Chicago, and directed at the MINOS detector, which is 710 km away. The 5000-ton steel detector, which will be installed half a mile below ground in a former iron mine, is due to come on-line in 2003. There are also plans to send neutrino beams from CERN in Geneva to the Gran Sasso underground lab some 730 km away in Italy.

Unlike K2K and MINOS, the Antares detector is primarily an astrophysics experiment. The completed "telescope" will consist of a three-dimensional grid of 600 photomultiplier tubes.

The first tubes will be installed on the sea-bed this month. Like SuperKamiokande, the neutrinos will be detected via Cerenkov radiation. Luckily for the Antares team it is easy to distinguish the Cerenkov radiation from the light produced by the luminous plankton that inhabit the depths of the Mediterranean. Antares will be sensitive to neutrinos from astrophysical sources that have not been observed with neutrino telescopes before, such as supernova remnants, pulsars and active galactic nuclei. It will also be equipped with software that will allow observations of neutrino oscillations.

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The public enters the nuclear debate

Edwin Cartlidge

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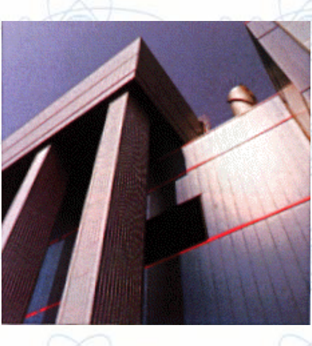
The media does not always give the public a balanced view of science. This was highlighted recently in the UK when newspaper stories of "Frankenstein foods" led to an outbreak of public anxiety over genetically modified food. To involve the public more closely with potentially sensitive scientific issues, several countries around the world have organized public debates in the shape of "consensus conferences". Pioneered in Denmark, and used in Canada, the US, the UK, New Zealand, Australia, Korea and Japan, these conferences give informed members of the public the chance to quiz experts and come up with their own conclusions on complex issues.

One such issue is radioactive waste. The nuclear industry has long had an uneasy relationship with the public, and has had a problem when trying to convince local communities that it is safe to store long-lived radioactive waste in their backyards. Two years ago local protests scuppered the plans of Nirex, an industry-owned body, to transfer radioactive waste from temporary surface storage to a deep repository at Sellafield in Cumbria.

In March this year a report from the science and technology committee of the House of Lords put deep storage back on the agenda. The committee concluded that "phased geological disposal" was the best way to deal with radioactive waste. But it recognized that such plans would have to be accepted by the general population. It added that in the past the industry had tried to force its plans on the public. Instead, says the report, "a national policy (on nuclear waste) must be established with which the public is broadly content".

The public has now had its say. Over four days in May a panel made up of 15 members of the public prepared its own report on radioactive waste after questioning representatives from the nuclear industry, government and environmental groups at a consensus conference in London. The panel was selected to represent a cross section of the public: the number of men and women were evenly balanced, as were educational backgrounds and regions of the country. The panel did plenty of background reading beforehand and was free to choose the questions and the experts. The meeting was set up by the UK Centre for Economic and Environmental Development, an independent charity, and was funded by the government and Nirex.



Public access – waste encapsulation at Sellafield

So what did the panel conclude? It felt that waste should be removed from the surface and stored underground, but, in contrast to the Lords committee, believed this should only be an interim solution. It felt that the waste should be easily retrievable hoping that science would come up with ways to make the waste non-hazardous. It also concluded that the UK's existing international reprocessing contracts should be honoured but that no new contracts should be taken up.

The panel believed that if the waste problem can be adequately dealt with, then the UK should continue, and perhaps expand, its use of nuclear energy. One of the panel members, Anna Hiett, said her preconceptions had been changed. "I had heard horror stories of two-headed chickens running around Sellafield, but having taken part in the consensus conference I now feel much more comfortable with the whole thing," she said. The panel also noted a "welcome shift in culture" from the nuclear industry, and said industry representatives inspired a new feeling of openness in dealing with difficult issues.

The panel's views have drawn praise from both sides of the nuclear debate. British Nuclear Fuels (BNFL) welcomed the report, accepting that there has previously been a lack of trust between the public and the industry. Patrick Green, Friends of the Earth's senior nuclear campaigner, disagreed that waste needs to be stored underground, but said that the panel had a "refreshing, common-sense view".

This is a feature of consensus conferences according to Steve Fuller, a sociologist at Durham University. "No consensus conference has ever come up with screwy proposals, although they are possibly a little conservative in their conclusions", he says.

John Durant, professor of the public understanding of science at Imperial College, London, believes that such public consultation is extremely important in dealing with sensitive issues related to science and technology. "A consensus conference can tell you how disinterested people react when they learn a bit. It can act as a sort of early warning device," he told Physics World.

The UK has held one previous consensus conference, in 1994, when the now thorny issue of plant biotechnology was discussed. If more attention had been paid to the outcome of this, says Durant, then the UK's recent scare over genetically modified foods could have been avoided.

The problem with the biotechnology conference was that it did not feed into government policy. Will this be any different in the case of nuclear waste? A spokesman from the Department of the Environment, Transport and Regions (DETR). said that the conclusions of the panel "showed remarkable insight into the problems facing policy-makers in this area". But the DETR would make no commitment beyond saying that the government would be "considering (the panels) views" when preparing its own consultation document on the subject.

In Denmark consensus conferences often do have a direct political impact. Following meetings in 1989, the Danish parliament banned food irradiation (except for dry spices), and outlawed genetic testing for recruitment and insurance claims. "In Denmark there is a tradition of 'people's enlightenment'," says Lars Kluver of the Danish Board of Technology. "This is a big difference between Denmark and the UK my impression is that people in the UK feel further from parliament." But there are those in the UK who believe that the government should be left to do its job. As evidence to the Lords report, David Fishlock, former science editor of the Financial Times, said that "....the public should not be expected to have an opinion. There are many things for which quite legitimately the public looks to government to make up the mind of 56 million people. Nuclear energy is a matter that is largely in government hands and is a matter for government decision".

Needless to say this was not the view of the panel, who said they were "deeply offended" by this remark. Panel member Pam Phillipou thought that everyone in the panel had gained from their experience. Anna Hiet was equally forthright: "Apart from marrying my husband, this is the most exciting and rewarding thing I've ever done."

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NEW MEMBERS, ADDRESS CHANGES

Address changes of Members :

Full details of the following Members' address changes are listed in the Members' Contact Details, accessible from the home page.

Dr Kenneth J Adams, *U.S.A.*	Mr Noorddin Ibrahim, *Malaysia*
Prof Shetha Selman Al-Dargaelli, *U.K.*	Dr John R Johnson, *Canada*
Dr Barun Kumar Chatterjee, *U.S.A. (previously India)*	Dr Emico Okuno, *Brazil*
Dr Ramesh Desai, *India*	Mr Swapan K. Saha, *U.S.A. (previously India)*
Dr Issa I.D.I. Fitian, *U.S.A.*	Dr David A Schauer, *U.S.A.*
Dr Huaiqun Guan, *U.S.A.*	Dr Ruquing Wang, *U.S.A.*

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