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IRPS BULLETIN

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FROM THE EDITOR

Dudley Creagh

Happy New Year!!

It seems incredible that yet another year has gone, and this, the last issue of the IRPS Bulletin, is somewhat late.

The year 2000 was an extremely busy year, with the ISRP 8 Conference as the highlight. Planning is now proceeding for ISRP 9, to be held in Capetown, South Africa in October 2003. Professor Dan Jones is Chairman of the Organizing Committee and our President, Professor Malcolm Cooper and I are jointly in charge of the Programme Committee.

We are very interested in receiving suggestions from the members about topics and speakers for the meeting. It will be slightly different from the usual meeting in that it will be preceded by a two-day workshop on "The Use of Photon and Particle Beams for Analysis of Materials". The subject areas remain the same as for the ISRP 8 Meeting.

If members wish to make suggestions they can do so to me :

d-creagh@adfa.edu.au

or to Malcolm :

csmc@spec.warwick.ac.uk.

This is my last editorial. The next issue will be edited by Dr Paul Bergstrom (NIST). I shall replace Mic Farquharson as Associate Editor. Mic will have the duty of acting as Membership Secretary and will work closely with Shirley McKeown who will continue to manage the distribution of the IRPS Bulletin and maintain its web page which will remain at the University of Canberra.

With my best wishes for the year 2001

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PRESIDENT'S COLUMN

Malcolm Cooper

There never seems to have been a good period for the public understanding and appreciation of science. At the moment we are experiencing an IT revolution, which is changing all aspects of our lives. It relies on scientists rapidly transforming exotic and exciting physics into mundanely exploitable methods. For example the discovery that the magnetisation of cobalt in a thin film could be cycled with a period of less than 200 picoseconds (Science 290, p492, 2000) shows recording speeds may get higher and higher. It is all taken for granted as long as it is viewed as benign: quantum dots or colossal magentoresistance do not make news. Of course the Higgs boson does, but there the media interest is really about a race between Europe and the US being lost by the former just when, tantalisingly, the finishing post appears to be in sight. The science is almost incidental and certainly remains obscure to the general reader, not to mention yours truly.

On the other hand when scientists get things wrong, or simply don’t have enough evidence to give a considered verdict, they are suddenly in the news. Recent examples in Europe put the biologists in the firing line with GM crops and mad cow disease, while physicists are in the dock over radiation from mobile phones, overhead transmission lines and, of course, anything scary to do with ionising radiation – and everything to do with ionising radiation is viewed by the media as scary, even beneficial diagnostic and therapeutic medical applications.

In Britain it is rare to find newspaper articles about science, as opposed to technology, even in the more respectable broadsheets. I wonder how it is in your country? I work frequently in France and am pleasantly surprised to see that science there is treated more like other cultural human activities, not something just for ‘boffins’. I have in front of me the Science and Medicine page from an August issue of the French newspaper “Le Figaro”. It contains articles about the new Director General of the CNRS, the French national science research council, and her immediate headache problems which included deciding where to site their new synchrotron, assuming that the Prime Minister would agree to funding it (which he did 2 months later). Another article discussed the eclipse of the old French rocket system ARIANE by Boeing’s DELTA 3 and there was one on embryo cloning.

However most space was given over to a long piece speculating about a radiation laboratory in the Dordogne, which might have been set up by Irene and Frederick Joliot-Curie when they fled from Paris in 1940. Irene stayed at a sanatorium in the Dordogne while her husband retrieved 185kg of heavy water from safe storage in a prison (!) in central France. Apparently he had previously acquired it from Norway in order to thwart the Germans. He took it to Bordeaux and hence onward to England. The real newspaper story concerned what the ailing Irene might have been doing. It was thought that all the uranium stocks of the Curies’ laboratory, which amounted apparently to 5-8 tonnes, had been shipped to Morocco, but now, at the sanatorium in Clairvivre, contamination due to actinium has been found. The radiation levels due to it are reportedly 100 times greater than the background levels. Now actinium should only be present as a decay product of uranium, which was not found in the contaminated ground, so what was Irene Joliot-Curie really doing? Perhaps we shall never know, despite an official enquiry, but it’s an intriguing story, well told and doesn’t set out to chastise the Curies for leaving a radioactive mess!

Examples of dispassionate science reporting are rare and I wonder whether we, individually or collectively through the IRPS, should be doing more to promote the understanding of “Radiation Physics”. Recently I conducted a survey of all the attendees of our Prague Symposium and one suggestion that came back was that we should institute a ‘web-based forum’ where we could help to put radiation physics research workers in touch with each other, find potential collaborators etc. I wonder whether we should also create a forum to respond to enquiries from the general public on issues involving radiation physics? Do you think that would be a good idea?

REPORTS FROM MEMBERS

- Superconducting Electron Laser Generates its First Radiation - *Lief Gerward*
- SESAME Site selected in Jordan - *Lief Gerward*

Superconducting Electron Laser Generates its First Radiation

Lief Gerward

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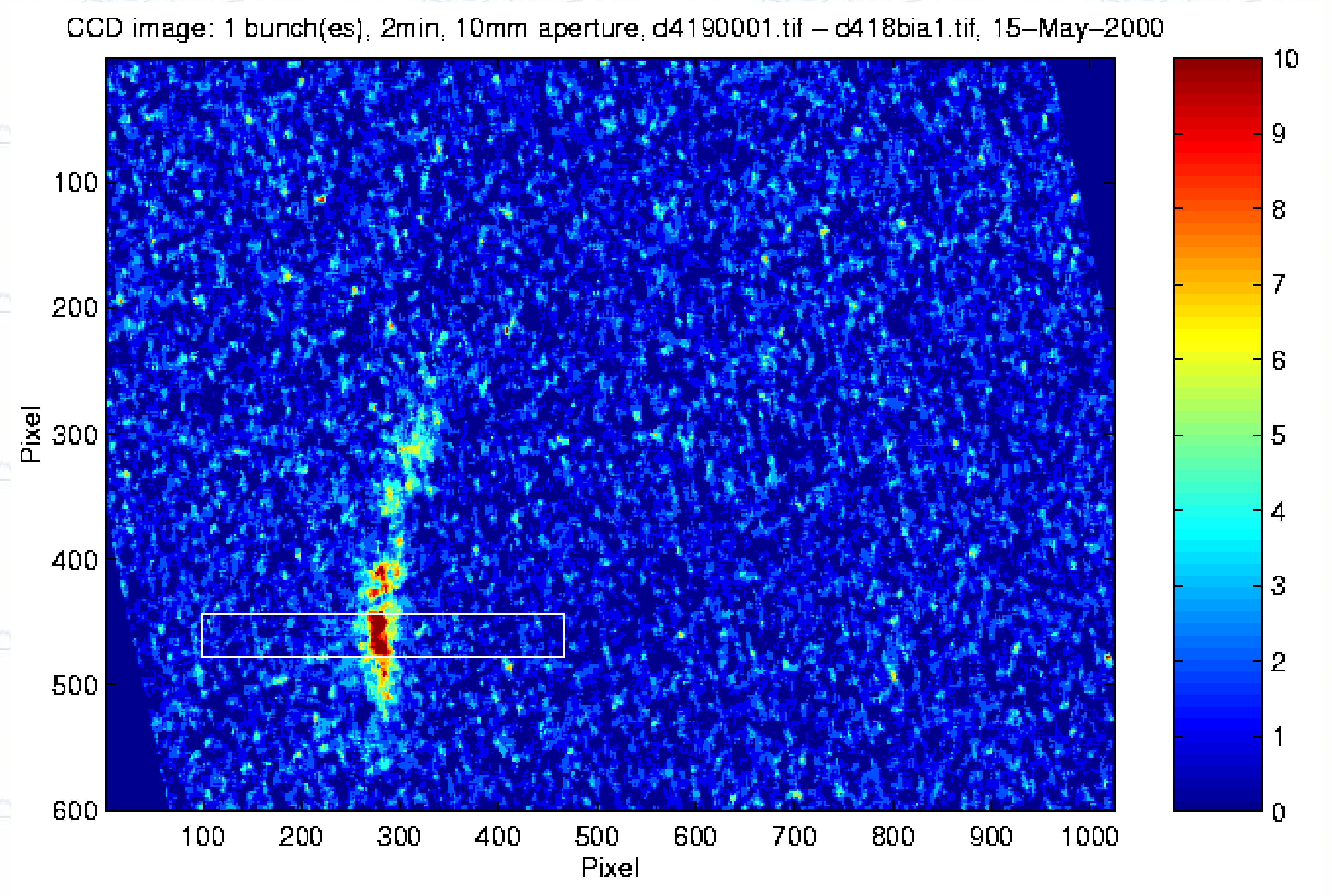
Today, lasers deliver radiation of nearly any wavelength. However, up to now there have been no high-intensity X-ray lasers. Yet, X-ray lasers should be of special interest for science. For instance, they would allow taking high-contrast pictures of atomic structures. X-ray lasers would give new in-depth information about living cells and structural materials.

The so-called Free-Electron Laser (FEL) makes use of high-energy electrons from an accelerator. An undulator, i.e. a sophisticated arrangement of magnetic fields, forces the electrons to follow a zigzag path, causing them to emit tightly focused laser-like radiation. In most present free-electron lasers for wavelenghts above 200 nm, the light from several passages of the electrons through an undulator is stored in an optical cavity. Extending these devices to shorter wavelengths poses problems, because of the lack of mirrors for VUV and X rays. Recently, it has become possible to consider another mode of operation, based on a linear accelerator and a single pass of an electron bunch through a long undulator. No optical cavity is needed, and laser action is achieved by a self-organizing process called Self-Amplified Spontaneous Emission (SASE) (see the IRPS Bulletin 12(2) 1998, pp. 6-8).

In the SASE mode, the laser starts up from noise. In the first part of the undulator, the electrons radiate incoherently, the power growing linearly with distance. Later, the interaction between the radiation and the electron beam leads to an amplification of the spontaneous emission, giving rise to coherent radiation. The power will then grow exponentially with distance until saturation is reached. Up to now the basic concept of SASE has been demonstrated experimentally for microwaves and infrared and visible light only. An experimental verification in the short-wavelength range has been slow due to the tight requirements on the electron beam characteristics. Serious considerations on the realization of VUV and/or X-ray Free-Electron Lasers are now carried out at accelerator centers around the world.

On Tuesday morning, February 22, 2000, an international team of scientists at the Research Center DESY in Hamburg, Germany, succeeded in producing ultraviolet radiation with a wavelength about 100 nanometers using a Free-Electron Laser. This was the first proof that the SASE principle, on which the laser is based, also works in this wavelength range. On April 18, 2000, another world record was set by the DESY team. For the first time ultra-violet radiation with wavelength 80 nm was generated. This is the shortest wavelength ever achieved with a Free-Electron Laser. The wavelength was then increased stepwise to 180 nm, thus demonstrating the tunability of the source.



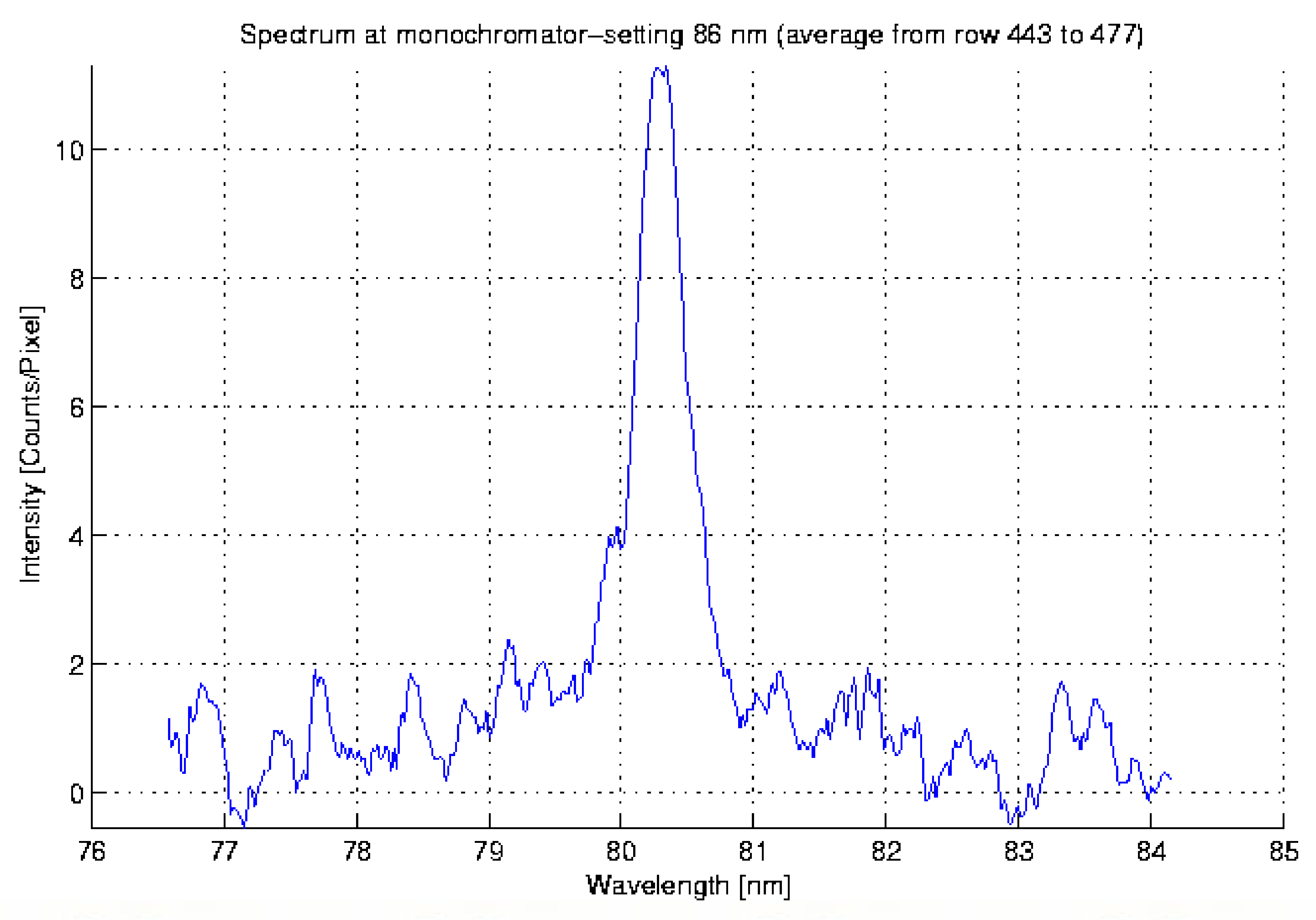


Fig. 1. CCD image and spectrum of Free-Electron Laser beam with wavelength about 80 nm.

SESAME Site selected in Jordan

Lief Gerward

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SESAME stands for Synchrotron-light for Experimental Science and Applications in the Middle East. The project is intended to be the Middle East's first international research center and will have as its centerpiece a synchrotron radiation source. The SESAME project reached a major milestone with the selection of a site in Jordan at a meeting of the SESAME Interim Council in Amman, Jordan on 21-22 June 2000.

SESAME is based on an upgrade of the BESSY I facility, offered as a gift by Germany now that it is decommissioned due to the start of BESSY II. The 0.8 GeV BESSY I and its 1.9 GeV successor, BESSY II, are at present located in Berlin, about 16 km apart, in the West and East parts of the city, respectively. The suggestion that the German government offer BESSY I to the Middle East was originally made in September 1997 by Herman Winick (SSRL/SLAC) to Gus Voss (DESY) at a meeting of the BESSY II Machine Advisory Committee. Since then, the idea has been brought to the German Science Ministry and UNESCO with encouraging responses. The program is now well underway, led by an Interim Council and Technical and Scientific Committees. It is noteworthy that a project similar to SESAME has been launched in Thailand, where construction of the National Synchrotron Research Center is nearing completion at the Suranaree University of Technology in Nakhon Ratchasima, about 150 km northeast of Bangkok. This facility is based on an upgrade of the 1.0 GeV SORTEC ring, which was given to Thailand by the Japanese government.

Led by Voss, a team of scientists from Germany and the US has proposed that the BESSY I injection system and storage ring be upgraded to operate at 1.0 GeV, with the ring circumference enlarged from 62 m to 101 m so that four insertion devices can be accommodated. It is planned to construct 10 beam lines over 5 years: six from two 13-pole, 1-m long, 7.5 T superconducting wigglers (critical energy 5.0 keV), and four from bending magnets (critical energy 1.25 keV). With a stored current of 700 mA and an emittance of 50 nm rad, SESAME is a very powerful broad spectral range source from infrared to hard x-rays up to about 20 keV. For protein crystallography and many other hard x-ray experiments, SESAME is quite competitive with most higher-energy sources. One of the goals is to develop a world-class program for structural molecular biology at SESAME.

A controlled and documented dismantling of BESSY I is now underway by a team that includes knowledgable personnel from synchrotron radiation laboratories in Novosibirsk, Russia, and Yerevan, Armenia, and with funds supplied by the SESAME member countries and UNESCO. Programs for training SESAME scientists, engineers and future users are also well underway. The SESAME Scientific Committee has identified seven programs and associated contact persons as follows:

- Powder Diffraction (Engin Ozdas, Turkey)
- Structural Molecular Biology (Gitay Kryger, Israel)
- EXAFS (Irit Sagi, Israel)
- LIGA (Adel El-Nadi, Egypt)
- X-ray Microscopy (Constantinos Christophides, Cyprus)
- XPS (Sefik Suzer, Turkey)
- Infrared Spectroscopy (Abderrahmanne Tadjeddine, France/Algeria)

The site selected for SESAME is in the village of Allaan at an elevation of about 850 m in a lovely, wooded area of rolling hills near Salt City, about 30 minutes drive from Amman and 30 minutes from the Allenby Bridge crossing into the West Bank and Israel. A community college now exists on the sitebut it will be moved in the next year. The government of Jordan has given SESAME very high priority with a pledge of $1M/year towards the operations budget, in addition to offering the land at no cost.

SESAME now has 11 member countries: Armenia, Cyprus, Egypt, Greece, Iran, Israel, Jordan, Oman, Morocco, the Palestinian Authority, and Turkey. Moreover, Bahrain, Yemen and Tunisia have expressed intention to join and will be considered at the November 2000 meeting of the SESAME Interim Council.

Professor Herwig Schopper (CERN), President of the SESAME Interim Council, has characterized the project as a renewal of a dream which became a reality after World War II when CERN was created in Geneva, Switzerland, with the tasks of promoting science but also to build confidence between the states which had been involved in the war. The political success of CERN was largely due to its foundation under the umbrella of UNESCO. Later, CERN has become the cradle of other international organizations like EMBL and ESO, which are now followed by SESAME. Hopefully, the SESAME initiative will carry the tradition further by promoting peace and understanding in the Middle-East region through cooperation in science and technology.

More information about SESAME can be obtained from the SESAME web site

http://www.sesame.org.jo/

(Source: Synchrotron Radiation News)

AN INVITATION ....

You are invited to participate in

SPIE's new Penetrating Radiation Discussion Forum

The International Society for Optical Engineering (SPIE)

The forum is open to anyone, and provides a communication channel for research, development, engineering, and applications.

It is open to anyone with common interests in methods of multichannel detection and signal processing, nonrefractive optics (collimators, coded apertures, etc.), sensor characteristics, detector materials and image reconstruction techniques.

SPIE Technical Forums provide the optical community with a knowledge resource by offering points of contact and expert opinions. Discussion topics, news items, or questions are welcome.

The forum supports SPIE's Penetrating Radiation Technical Group, but membership in the group is not required. We hope you will participate. To post a message, you'll need to log in – creating a user account takes only a few seconds. There are options that allow subscribers to be notified by e-mail of activity in the forum (see "subscribe to this forum" after you're logged in).

In the last few months, SPIE has launched more than 20 similar forums for all SPIE Technical Groups and several additional interest areas addressed by SPIE. We encourage you and your colleagues to explore the forums as an easy way to communicate with others with similar interests. We think you'll find our forums well-designed and easy to use, with many helpful features such as automated email notifications, easy-to-follow "threads," and searchability. For more details on how to use the forums, there is a full FAQ (Frequently Asked Questions) available from the web site:

http://spie.org/app/forums/tech/

As new Technical Group forums are launched they will be added to the site.

Any questions or suggestions to :

forums@spie.org

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WORLD NEWS

- Weapons Laboratory Helps Target Cancer
- New Beam Energizes Indian Research

Weapons Laboratory Helps Target Cancer

Peter Gwynne
Boston, MA, USA

(Source : Physics World, Vol.13, No 11, p7)

A physics-based technique to help doctors in the fight against cancer has been approved by the Food and Drug Administration, the body that oversees all medical treatments in the US. The computer-based system, called Peregrine after the patron saint of cancer patients, allows doctors to target radiation at tumors more accurately than in the past. It will allow medical teams to tailor radiation treatments to individual patients, increasing the dose of radiation aimed at tumors while minimizing damage to healthy tissue.

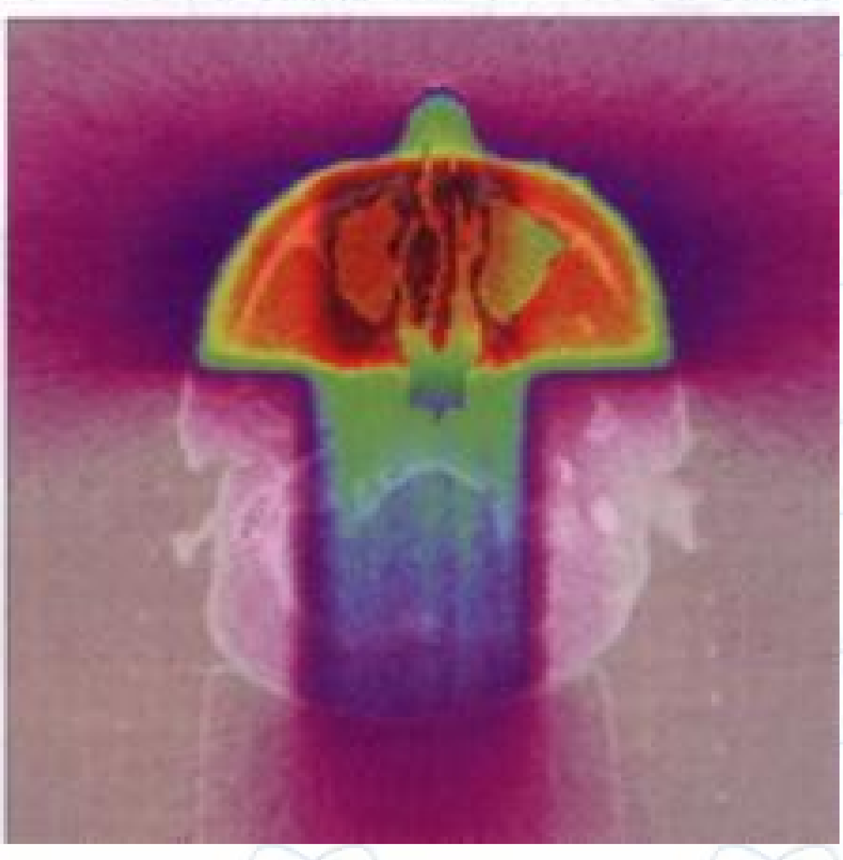
Peregrine was developed by a team of physicists, computer scientists and electrical engineers at the Department of Energy (DOE) Lawrence Livermore National Laboratory in California, which is better known for its nuclear-weapons work. The Livermore team has worked on Peregrine since 1994, along with researchers from the University of California at San Francisco, the National Cancer Institute and NOMOS Corporation, a company that supplies medical radiation equipment. DOE boss Bill Richardson said that the collaboration was "an excellent example of turning swords into ploughshares".

Currently, more than 100,000 cancer patients in the US die every year while still receiving radiation treatment. Peregrine offers hope that doctors will be able to attack cancerous tumors more efficiently and effectively. "Peregrine will touch lives," said Christine Hartmann Siantar, the principal Livermore researcher on the project. "It is a breakthrough technology that can be used in treatment clinics everywhere."

NOMOS Corporation has already incorporated Peregrine into its CORVUS treatment system, and the Livermore researchers plan to develop a stand-alone version that can be used in other treatment-planning systems.

Peregrine relies on a mathematical method called Monte Carlo to predict the dose and targeting of radiation treatment for individual patients. Monte Carlo techniques are widely used throughout physics, in particular to predict the movement of particles and photons through materials. The Monte Carlo method relies on taking a random sample of a large number of events.

In the course of a single radiation treatment, a patient receives trillions of radiation particles (usually X-ray photons). To determine how best to target these particles, the Monte Carlo method selects a random sample of millions of particles, and then tracks them in a computer model of the patient that has been derived from a CT scan. The system then develops a detailed map of the radiation dose to be deposited in the patient, which it presents as a graphical display. Doctors use the display to plan a treatment procedure that will focus the maximum amount of radiation on the tumor and the minimum on healthy tissue.



On target: Monte Carlo simulation for three radiation beams focused on the sinus region

This application of Monte Carlo calculations is hardly new. Scientists have known for more than 40 years that they provide extremely accurate measurements of radiation doses. Until recently, however, a full Monte Carlo analysis for a single patient took roughly 200 hours. By using parallel processing on several small desktop computers, the Peregrine system is able to reduce this time to 10 minutes.

www.llnl.gov/peregrine/montecarlo.html

(See also "The physics of radiation treatment" by Steve Webb, Physics World, Nov. 1998, p39)

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New Beam Energizes Indian Research

Ganapati Mudur
New Delhi, India

(Source : Physics World, Vol.13, No 11, p7)

Indian physicists are celebrating the production of the country's first radioactive ion beam. They are dubbing it a modest land-mark that marks India's entry into a growing area of nuclear research that has applications in fields such as astrophysics and medicine.

The beam of the radioactive isotope beryllium-7 was produced at the Nuclear Science Centre (NSC) in New Delhi.

"Right now this is the best beryllium-7 beam available for experiments anywhere in the world," says Girijesh Mehta, NSC director.

Physicists from the NSC have joined forces with researchers from universities and three national laboratories in using the beam to study a key nuclear reaction in the Sun. By bombarding a deuterium target with the beryllium-7, they hope to extract the rates of beryllium-proton fusion, one of several nuclear reactions that contribute to the solar neutrino flux (neutrinos are emitted in the decay of boron-8, one of the products of the fusion reaction).

"The beryllium-proton fusion reaction rate is the most poorly known quantity in the entire chain of fusion reactions in the Sun," says Radhey Shyam of the Saha Institute of Nuclear Physics in Calcutta. "The NSC experiment should help us resolve uncertainties associated with this key solar reaction."

The 10-year-old NSC is India's only inter-university laboratory that provides accelerator facilities to university researchers who competitively bid for beam time. Its major facility is a pelletron accelerator that can accelerate ions of all elements up to energies of 250 MeV. Since the accelerator was installed in 1990, NSC physicists and university researchers have added a scanning tunnelling microscope, an array of gamma detectors and a mass spectrometer called the Heavy Ion Reaction Analyser (HIRA).

The spectrometer was primarily intended to study nuclear reactions, particularly those involving weak processes, but a research team at the NSC used ion optics to tailor HIRA to produce the beryllium-7 beam, which is 99.9% pure.

A primary ion beam produces radioactive products and the mass spectrometer selects the radioactive species to create the secondary radioactive-ion beam.

This approach limits the range of beam that the NSC can produce. "We will be able to extract only light radioactive-ion beams," says Arnit Roy, a physicist at the NSC and member of a government panel preparing a proposal for a new facility exclusively for research on radioactive-ion beams in India.

The NSC now plans to use HIRA to produce other exotic beams such as lithium-8, carbon-11 and fluorine-17.

NEW MEMBERS, ADDRESS CHANGES

Welcome to New Members :

Professor Israel Ayo Babalola, *BOTSWANA*

Dr Nayak N Govinda *INDIA*

Mr P Andrew Karam, *U.S.A.*

Mr H M Mahesh , *INDIA*

Mr Ernesto Mainegra-Hing, *CANADA*

Professor Armando Ponce de Leao Policarpo, *PORTUGAL*

Professor Dragana Popovic, *YUGOSLAVIA*

Mr Bassam Zuhdi Othman Shakhreet, *MALAYSIA*

New Members' addresses are listed in the Contact Members' Details (click on country next to name)

Address changes of Members :

Dr Mahmoud I Abbas, *now EGYPT*

Professor P Andreo, *now SWEDEN*

Dr Mario Ivo, *HUNGARY*

Dr Imre Kasa, *HUNGARY*

Dr George A Sandison, *now U S A*

Dr Yoshitomo Uwamino, *JAPAN*

Members' new addresses are listed in the Contact Members' Details (click on country next to name)