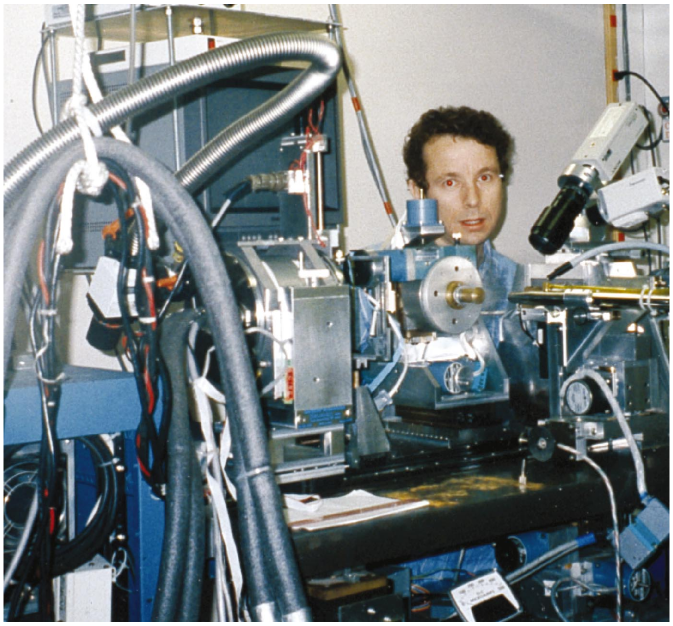
current events

This section carries events of interest to the synchrotron radiation community. Works intended for this section should be sent direct to the Current-Events Editor (s.hasnain@dl.ac.uk).

Nobel Committee recognizes SR work for the second time

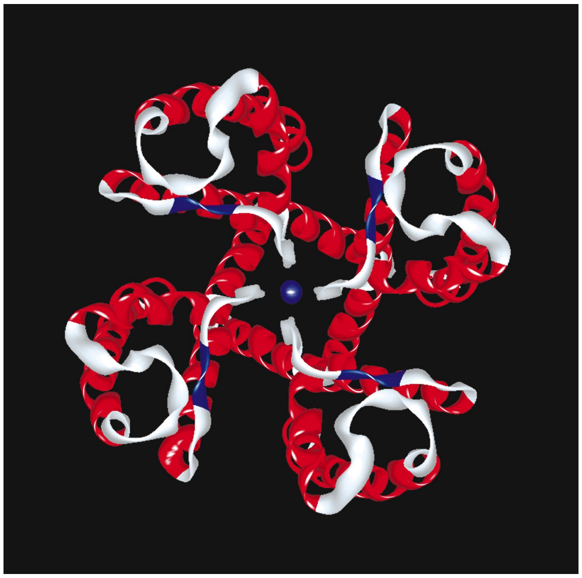
The Nobel Prize in Chemistry for 2003 was shared by Peter Agre from John Hopkins University and Roderick MacKinnon from the Rockefeller University ‘for discoveries concerning channels in cell membranes’. Peter Agre was recognized ‘for the discovery of water channels’ while Roderick MacKinnon was given one half of the prize ‘for structural and mechanistic studies of ion channels’.



Rod MacKinnon at the Cornell Synchrotron on MacCHESS facility F-2 during one of his data-collection trips.

The structural work of MacKinnon was carried out primarily at the Cornell High Energy Synchrotron Source (CHESS) and the National Synchrotron Light Source (NSLS) at Brookhaven. CHESS is a first-generation SR source while NSLS is a second-generation SR source which came on line in the early 1980s with the initial second-generation SR sources including the Daresbury SRS (UK) and the Photon Factory (Japan). The award for MacKinnon’s work is now the second recognition of SR work by the Nobel Committee. The Nobel Prize to Sir John Walker in 1997 was the first Nobel Prize for SR work where the structural work on F1-ATPase was carried out on the Daresbury SRS.

The first description of an ion channel protein (potassium channels) was given by MacKinnon in 1998 (*Science*, 3 April 1998) which was based on his work carried out at CHESS and completed during the Christmas period of 1997, the year when Sir John Walker received his Nobel Prize for the work he undertook at the SRS. The crystal structure of potassium channels was a crucial step forward for this field and sparked much new research. The magazine *Science* (Vol. 282, 18 December 1998, page 2158) cited the structure of the K+ channel as ‘one of the breakthroughs of 1998’ and ‘the first physical characterization of the membrane protein responsible for the selective movement of K+ into and out of cells. After decades of wondering, electrophysiologists can now understand such riddles as how the potassium channel manages to keep out wrong ions, such as sodium, while shuttling an amazing 100 million potassium ions per second across the membrane. The structure reveals that the ions must pass through a narrow filter, where potassium ions fit snugly and briefly bind to the protein. The slightly smaller sodium ions cannot form this bond, making the filter an energetically unattractive place for them’. The rapid recognition of this work by the Nobel Committee is a clear demonstration of the extraordinary importance of this work even from the standards of the Nobel Committee. The ion channels are important for, among other things, the function of the nervous system and the muscles. What is called the action potential of nerve cells is generated when an ion channel on the surface of a nerve cell is opened by a chemical signal sent from an adjacent nerve cell, whereupon an electrical pulse is propagated along the surface of the nerve cell through the opening and closing of further ion channels in the course of a few milliseconds.



A view of the structure of potassium channels with the K + in the centre (PDB reference: 1BL8).

MacKinnon acknowledges the crucial role that the two synchrotron facilities, Cornell Synchrotron (CHESS/MacCHESS) and NSLS, have played in his research on the protein crystallography of membrane channels. He said, ‘Without exaggeration that most of what is known about the chemistry and structure of ion channels has come from experiments carried out at these SR centres’. MacKinnon’s SR experiments started from the use of CHESS in 1997. Needing powerful X-ray beams, when MacKinnon starting to knock on doors of synchrotron light sources, CHESS Director Sol Gruner offered him a rare allotment of Director’s discretionary time to get the first X-ray measurements off the ground. Gruner, commenting on the happy occasion of MacKinnon’s Nobel Prize said, ‘Little did MacKinnon know that his first X-ray experiments in 1997 at the Cornell High Energy Synchrotron Source would lead to 30 more visits over the course of six years for a sum total of 1500 hours of X-ray beam time’. The MacCHESS director, Dr Quan Hao, expressing his delight on recognition of MacKinnon's work said, 'MacKinnon's style is well matched to the culture at CHESS where he participates in taking most of the X-ray data, working together with his students and postdocs. It is routine for a CHESS operator to find MacKinnon at the station collecting data through the night'. On the day the Current Events Editor, Samar Hasnain, spoke to Rod MacKinnon, he had just returned from a beam-time trip to NSLS's X-25.

MacKinnon is a biophysicist and is a self-taught X-ray crystallographer. Prior to taking up crystallographic work in the early 1990s, he was engaged with biophysical studies of ion channels. He is currently a Professor at Rockefeller University. A native of Massachusetts, born in 1956, MacKinnon was drawn to science from childhood by his love of solving puzzles and his fascination with the natural world. He received a BA degree in biochemistry from Brandeis University in 1978 and an MD from Tufts University in 1982. Choosing to pursue a career in basic research, he returned to Brandeis in 1986 for postdoctoral studies working on biophysical aspects of ion channel function, focusing on the protein selective for potassium ions, and continued these studies at Harvard Medical School, whose faculty he joined in 1989. He moved to Rockefeller University in 1996 and became an investigator of the Howard Hughes Medical Institute in 1997.

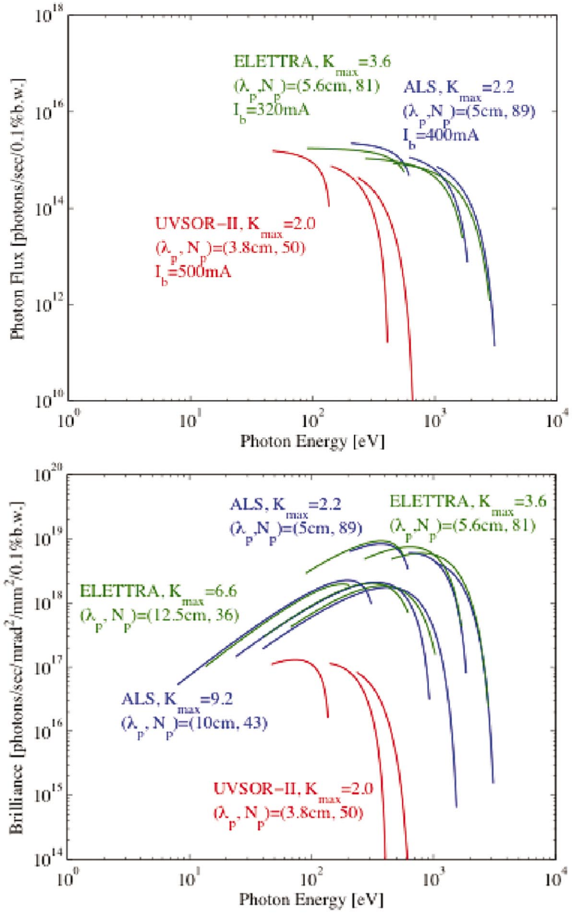
Barcelona gets its Machine Director

Dieter Einfeld, the Technical Director of SESAME since 2001, will be joining the Synchrotron Light Centre (LLS) at Barcelona as its Technical Director in March 2004. Prior to joining SESAME he was the head of the machine group and was responsibe for the construction of the synchrotron radiation source ANKA at Karlsruhe during 1996–2000. He retired from Karlsruhe in spring 2001. Einfeld's passion for the design and optimization of storage rings began some 25 years ago when he became involved with the design of an electron storage ring for production of synchrotron radiation at the Physikalisch Technische Bundesanstalt (PTB), Berlin, and preliminary design work on BESSY, Berlin, in 1978. During the last two years he has worked towards converting the original concept of SESAME into a third-generation storage ring, where the machine energy has been raised to 2.5 GeV, with a circumference of 125 m, an emittance of 24.6 nm rad and 40% of the circumference available for insertion devices. His appointment at the LLS is likely to provide a major boost to the Barcelona project which already enjoys the vast experience of Joan Bordas in synchrotron radiation, who is its Project Director and is also a member of the SESAME Beamlines Committee.

Dieter Einfeld.

UVSOR transforms into a third-generation UV source

UVSOR, a second-generation synchrotron light source at the Institute for Molecular Science, Okazaki, Japan, has been successfully upgraded to UVSOR-II, providing a smaller emittance and a larger number of straight sections for insertion devices. The reconstruction of the accelerators was completed earlier this year and UVSOR-II has just become operational for users. The original UVSOR (UVSOR-I), a 750 MeV storage ring, had operated for about 20 years as a national VUV light source in Japan. Its circumference was 53 m with a four-fold symmetry and a double-bend achromat magnetic lattice. The beam emittance of UVSOR-I was 160 nm rad. The magnetic lattice of the storage ring has been modified to have a much smaller emittance of 27 nm rad with eight straight sections, six of which are available for insertion devices. The circumference has been kept the same. The quadrupole triplets between the bending magnets have been replaced by two quadrupole doublets and a short straight section of length 1.5 m. To save space, sextupole magnets have been integrated into the quadrupole magnets. The doublets on both sides of the longer straight sections have also been replaced. As a result, the lengths of the straight sections have been increased from 3 m to 4 m.



The photon flux and brilliance of UVSOR-II compared with other third-generation storage rings.

On 30 July, UVSOR-II succeeded in operating in the low-emittance mode of 27 nm rad. In the first week of September, operation for users was started at UVSOR-II with a filling beam current of 300 mA. An upgrade of the RF cavity is planned for the fiscal year 2004. At present, UVSOR-II has three undulators: a helical undulator and two in-vacuum short-period undulators. The test operations of the in-vacuum undulators have shown that these devices can be operated with narrow pole gaps of 15 mm without reducing the beam lifetime. Spectral flux and brilliance for the UVSOR-II are comparable with some of the most brilliant devices on third-generation storage rings.