ANNUAL REPORT TO COUNCIL: 2002

NATIONAL COMMITTEE FOR: **Radio Science**

CHAIR **Dr. Phil Wilkinson**

PERIOD COVERED IN THIS REPORT: January 2002 – January 2003

Meetings of the National Committee and sub-Committees

The National Committee met:

The National Committee held its Annual Meeting on 19 February 2002, at Mercure Lodge, Leura, in conjunction with the WARS02 meeting.

The following subcommittees also met during 2000:

The WARS02 sub-committee met before the WARS02 meeting in mid-February. There were no other sub-committee meetings during the year.

The following meetings are proposed for 2002:

The National Committee will hold its Annual Meeting on 26 February 2003, and is planning to hold a further WARS meeting within 12 months.

Business Plan and 2003 Activities

The main activity planned for the NCRS in the next year is the next WARS meeting and its Annual Meeting. A web based directory of radio science activities in Australia has been commenced and will be completed during this period. No formal plan has been offered with this report, as one has not yet been developed. This will be addressed after the Annual NCRS Meeting, February 2003.

Activities

Meetings relevant to the NCRS:

- The IEEE Frequency Control Symposium will be held jointly with the 17th European Frequency and Time Forum in Tampa, Florida, USA in May 2003.
- The 16th International Conference on Laser Spectroscopy will be held in Palm Cove, Queensland, in July 2003.
- A proposal for Australia to host the next Triennium Open Symposium in 2004 was accepted by the URSI Commission F Business Meeting on August 23 at the URSI General Assembly. The venue will be in Queensland, possibly in Brisbane or Cairns. The suggested time for the Open Symposium is April to May, 2004. The Triennium Open Symposium attracts over 100 visiting scientists from the majority of URSI member countries. The scientific topics cover all aspects of radio propagation and remote sensing.
- In July 2003 the General Assembly of the International Astronomical Union will be held in Darling Harbour, Sydney. This includes several Symposia and Joint Discussions that are being organised by Australian URSI Commission J members, as listed below, and will also mark the election of Australia's Prof. Ron Ekers to the position of President of the IAU. The planning of this GA, with an expected attendance of about 2000 people, is occupying the resources of a number of people, including John Whiteoak, Dick Manchester, and Ron Ekers. In addition, a number of Australian radio-astronomers are actively involved in organising symposia or joint discussions at the IAU GA, including George Hobbs, Dick Hunstead, Dave Jauncey, Barbel Koribalski, Ray Norris, Wayne Orchiston, D.J.Pisano, Lister Staveley-Smith, and Tony Wong. Full details are on http://www.astronomy2003.com/ .

Meetings of International Organisations Affiliated with ICSU

In 2003 there will be General Assembly of:

- International Union of Geomagnetism and Geodesy, IUGG, (Sapporo, Japan, June 2003)
- International Astronomical Union, IAU, (Sydney, July 2003)

The next GENERAL ASSEMBLY of URSI will be held in New Delhi, India, 23 – 29 October 2005. An Australian delegation is not usually appointed before the year of the Assembly.

Australian Office Holders in ICSU and Affiliated Bodies

Australians who currently hold offices are:

Person	International Body	Position	Term
John Brooks	IAA SETI post-detection committee	Member	2003-06
Wim Brouw	IAU SOFA Review Board	member	1997-
Wim Brouw	IAU working group on astronomical data	member	2000-
W. N. Christiansen	Honorary President URSI		
David Cole	Study Group 3, Radiocommunication Sector, ITU	Chair	
David Cole	Australian Radiocommunication Study Group 3,	Member	
Peter Dyson	PSMOS Steering Committee, SCOSTEP	Member	
Peter Dyson	URSI-COSPAR Working Group on the International Reference Ionosphere	Member	2002-2005
Ron Ekers	IAU	President-elect, member of exec. committee.	2000-2003
Ron Ekers	IAU	President,	2003-06
Ron Ekers	URSI Global VLBI working group	Member	
Ron Ekers	IAU working group on "large scale facilities"	member	2000-2003
Brian Fraser	Scientific Discipline Representative SCOSTEP		
Brian Fraser	S-RAMP Steering Committee SCOSTEP 1999-2004	Member	
Brian Fraser	IUGG / IAGA	Australian Delegate	2003
Brian Fraser	Working Group on Solar-Terrestrial and Astrophysical Research SCAR	Member	
Anne Green	IAU Division X.	executive committee	
Don Melrose	IAU commission 10 (Solar activity)	Vice-President	2000-03
Ray Norris	IAU working group on astronomical data	Chair	2000-03
Ray Norris	IAU Commission 5	executive committee	2000-03
Ray Norris	CODATA	IAU representative	2000-03
Wayne Orchiston	IAU Comm. 41, ,	Secretary	
Wayne Orchiston	History of Radio Astronomy Group	Co-ordinator	
Wayne Orchiston	IAU / IUHPS Inter-Union Commission for History of Astronomy	Secretary	2001-2003
John Reynolds	IAU WG on reference Frames	Member	

Elaine Sadler	IAU commission 28 (Galaxies)	vice-president	2000-2003
Michelle Storey	IAU Working Group on Publishing	Chair	2000-2003
Michelle Storey	UNESCO/ICSU conference on electronic publishing Feb 2001	IAU delegate	2001
Michelle Storey	IAU Comm. 50, Protection of Existing and Potential Observatory Sites Organising Committee	member	2000-2003
Elaine Sadler	IAU commission 28 (Galaxies)	Vice-President	2000-03
Tasso Tzioumis	ITU Radiocommunication Study Group 7 (Sciences Services).	Member	2001-03
Tasso Tzioumis	URSI representative on IUCAF	Voting delegate of URSI	2002-2005
Tasso Tzioumis	IAU working group on interference mitigation	Chair	2000-2003
Richard Thompson	International Space Environment Services (ISES)	Member	
Bruce Ward	URSI-COSPAR Working Group on the International Reference Ionosphere	Member	2002-2005
Carol Wilson	Australian Radiocommunication Study Group 3,	Chair	
Phil Wilkinson	URSI Commission G Working Group 1, Ionosonde Network Advisory Group	Secretary	2002-2005
Phil Wilkinson	URSI-COSPAR Working Group on the International Reference Ionosphere	Member	2002-2005
Phil Wilkinson	URSI Commission G Working Group 4, Ionospheric Research to support radio systems	Chair	2002-2005
Phil Wilkinson	URSI Standing Committee on Publications	Member	2002-2005
Phil Wilkinson	URSI representative on FAGS (Federation of Astronomical and Geophysical Data Analysis Services)	Member	2002-2005
Phil Wilkinson	S-RAMP Committee on Space Weather, SCOSTEP	Member	

Nominations being made in 2003 are:

None have been notified in advance.

Membership of National Committees and sub Committees

The membership of the NCRS will be determined after the Annual Meeting in February, 2003.

Activities of the National Committee

I submit the following report to Council on the activities of the National Committee for Radio Science (NCRS) in 2002.

NCRS Mailing list

The NCRS electronic mailing list currently has 612 members. It can be joined at http://www.ips.gov.au/mailman/listinfo under the heading *ncrs-general*. The NCRS website, at http://www.ips.gov.au/IPSHosted/NCRS/, has links to the WARS'00 and WARS02 Conference Proceedings. The site has also been registered and archived with Pandora; the electronic archiving facility operated by the National Library of Australia.

WARS02

The fourth residential WARS (Workshop on the Applications of Radio Science) Conference was held at the Mercure Resort, in Leura NSW, 20 – 22 February, 2002. The train connection from Sydney Airport has made the Blue Mountains a very convenient destination and the Mercure staff reinforced this as an attractive location for a Conference with a difference. The Conference was organised by the NCRS and was sponsored by CSIRO, University of Technology Sydney and IPS Radio and Space Services and attended by 82 delegates. There were 58 poster presentations and five keynote addresses:

- Professor Brenton Watkins "A review of the HAARP facility and research program";
- Professor Jim Schroeder "Automatic target recognition using synthetic aperture radar imagery";
- Professor Paul Edwards "The Telstra Tower / University of Canberra Quantum Cryptographic Telecommunications Link";
- Dr Colin Waters "Using Commercial Satellite Data for Space Weather Studies"; and
- A/Professor Mike. Tobar "Microwave Frequency Standards: Tools for Testing the Foundations of Physics in the Laboratory and on Board the International Space Station".

An Information and Discussion session on the Square Kilometer Array (SKA) was lead by Dr Graeme James. The prize for the best student poster was won by David Smith, University of Technology Sydney, for his paper titled: "An application of a generalised Jakes model for MIMO channels". The Proceedings, of refereed papers and extended abstracts, was published on CD-ROM (ISBN 0-9580476-0-X) and distributed at the meeting. It is also available on the NCRS Website at http://www.ips.gov.au/IPSHosted/NCRS/.

URSI General Assembly

The URSI General Assembly was held in Maastricht, in August 2002. There were roughly 36 Australian delegates attending and they presented 32 papers. Members of the NCRS were the National delegates to the URSI Commission Business Meetings during the URSI Assembly. A full report on the URSI Assembly is available on the URSI Website; www.ursi.org, along with other information on URSI.

Other NCRS Activities

The Chair, NCRS, attended the Academy of Science meeting on National Committees, held 30th April 2002, and prepared subsequent follow-up requests arising out of the meeting. In October, a further short note was prepared for the Academy of Science on the role of the NCRS and its membership. The NCRS was then advised that the Academy of Science no longer wish National Committee membership to exceed eight, including the Chair. The final membership of the NCRS will be decided after its next Annual Meeting.

Other Activities relevant to the NCRS (2002)

A sample of the many radio science activities in Australia is bullet-pointed in this section. The list is organised by Commission.

A. Activities at the Department of Physics, University of Western Australia, (www.fsm.physics.uwa.edu.au) include
   - Development of a liquid nitrogen secondary frequency standard based on: (a) sapphire-rutile whispering gallery mode resonator. (b) A newly patented idea based on the difference frequency between orthogonal polarized modes in anisotropic crystals;
   - Improvement of a liquid helium secondary frequency standard based on a sapphire whispering gallery mode resonator;
   - Implementation of the above secondary frequency standards as pump oscillators to drive the atomic resonance of some atomic primary frequency standards at the quantum limit in collaboration with French Institutes;
   - A new test of relativity (local Lorentz Invariance), which confirmed relativity by a factor of 30 better than previous, by comparing a sapphire clock with a Hydrogen maser;

- The group became official members of the Atomic Clock Ensemble in Space Mission, which will Implement quantum limited primary standards and new secondary frequency standards to perform some fundamental physical experiments on board the international space station (ISS);
- First phase noise measurement below the Standard Thermal Noise Limit.

A An Australian Research Council Centre of Excellence for Quantum-Atom Optics will be established in 2003. The Australian National University is the administering institution, with the other Australian participants being the University of Queensland, and Swinburne University. The Centre has been granted funding of $10.9M over 5 years.

A CSIRO NML (www.nml.csiro.au) is conducting regular Two-Way Satellite Time and Frequency Transfer sessions with the Communications Research Laboratory (Tokyo, Japan), the National Institute of Standards and Technology (Boulder, USA) and the Telecommunications Laboratory (Taipei, Taiwan).

B Electromagnetic theory underpins work in all the URSI Commissions and yet is a topic for research in relatively few universities and institutions in Australia. It is a challenge to relate electromagnetic research directly to technology that will produce economic benefits for Australia – perhaps for this reason it is not a popular subject with students – but there are a number of places where this challenge has been met and an active and well-supported research group is maintained. Highlights from a few of these places, give a flavour of the diversity and strengths of electromagnetic research in Australia.

B The Radio Science Laboratory at Griffith University (www.griffith.edu.au) has directed most attention to the use of switched parasitic antennas as the basic building blocks for smart antennas – that is null steering and beam steering. The book *Switched parasitic antennas for cellular communications* by Thiel and Smith was published by Artech House at the end of 2001, and this has led to considerable interest in switched parasitic antenna technologies. The advances of the technique lie in the small footprint (relative to phase arrays), the constant input impedance when operated symmetrically about a single feed element, no RF feed switching requirements to a capability to handle significant power, and relatively simple direction finding software to support the antenna. Much of the antenna design has been optimised using genetic algorithms and NEC, HFSS and FDTD as the solution engines. The use of a ground plane skirt of approximately quarter wavelength can control the elevation angle of a monopole array, and the use of dielectric embedding material can reduce the size of the array substantially. Most results have already been published in the international scientific literature.

B In the Macquarie University Electronics Department (www.elec.mq.edu.au), the electromagnetics research group has designed and tested a variety of broadband antennas (including hybrid-resonator antennas, stacked-patch antennas and E-patch antennas) for wireless communication applications. Their recently developed closed-form theoretical method for Green's functions of microstrip substrates was extended for thick substrates. In collaboration with the Physics Department, the finite-difference time-domain method was developed to analyse and design photonic band gap structures made out of 2D and 3D photonic crystals. Excellent results were achieved for waveguides, bends and junctions in photonic crystals. A microwave resonator antenna based on a 3D photonic crystal was fabricated and tested in collaboration with the CSIRO.

B The University of Sydney (www.physics.usyd.edu.au) has concentrated on the diffraction of millimetre waves, including the formation of beams with phase singularities, Bragg scattering of surface electromagnetic waves by a photo-induced plasma grating, conversion of linear polarization to circular polarization by strip gratings. Gyrotrons are a specialty product; particularly low power and tunable up to 800 GHz. Associated quasioptical antennas are also developed to match the gyrotron sources.

B Other universities continue research in electromagnetics. At Adelaide University a surface-integral approach has been used to solve complex propagation problems. The University of Technology, Sydney is developing antennas comprising stacks of interacting patches and is investigating near-field effects in antenna arrays. The RMIT University also has a background in patch antennas, and is working on deployable reflector antennas and feeds for space applications. The University of Queensland (www.epsa.uq.edu.au) has wide-ranging interests in the general area of smart antennas.

B The Defence Science and Technology Organisation has wide interests in communications, radar technology, and propagation in various environments. As a result there are research programs in array technology, polarimetric radar, stealth antennas, and other areas relevant to Commission B.

B The CSIRO Division of Telecommunications and Industrial Physics (www.tip.csiro.au) maintains an active group oriented towards space and satellite communication systems and dependent on a core of electromagnetic know-how. A success story in 2002 was the MultiBeam Antenna that is able to access up to 19 geostationary satellites using dual shaped reflectors and multiple feed horns. This was approved for transmission by Eutelsat following qualification tests supported by Intelsat, which has resulted in world-wide interest in the technology. Demand for specialised reflector, feed, and microwave system design has allowed continuing development of underpinning computational electromagnetic methods. A trial application of modern software technology has encouraged further development of object-oriented software for electromagnetic methods. Anticipated benefits include rapid scripting of new applications that require a combination of computational electromagnetic techniques, and painless deployment of applications on a parallel computing environment.

B Also note the points regarding Fedsat below.

D Dr Le Binh, the Australian delegate to URSI Commission D, acting on behalf of the NCRS, made contact and liaised with several institutions in Vietnam responsible for research, operating and education in the specialized fields of the URSI commissions. The following institutions have been approached: the Research Institute of Post and Telecommunications and the Institute of Posts and Telecommunications of Vietnam Telecommunications Corporations, The Department of Telecommunications and Automation of the University of Cantho (in Mekong Delta region – equivalent to the Pay Bas of the Netherland), the telecommunications division of the Faculty of Information Technology of the University of Hue. A Vietnamese interim committee has now been established under the chairmanship of Dr. Nguyen Kim Lan, Vice President of the Research Institute of Posts and Telecommunications. The NCRS, thorugh Dr Le Binh, will continue to assist the admission of the Vietnamese Committee into URSI.

D During 2002 there has been a continuation in the worldwide downturn in photonic technology and optical communications engineering in developed countries, but significant development of optical communications infrastructures in developing countries, such as Vietnam, Laos etc.

D In Australia integrated photonic technology and on-going development work on ultra-fast integrated optical modulators has been conducted in universities. With the commission of the synchrotrons in Victoria and Queensland, a beam source could be used for processing of advanced integrated photonic devices in Australia towards the end of this decade. Modern integrated photonics and electronics with perfect periodic photonic crystals allowing switching, bending and manipulating of light beams at very short distance, in micro-meters instead of millimeters, as in present integrated photonic devices.

D Continuing with the progress made in 2001, the Center of Advanced Quantum Electronics and Telecommunications of the University of Canberra, together with Monash university and RMIT University, have gained a major ARC linkage grant to demonstrate further an advanced transmission systems for quantum keys teleportation between the Telecom tower on Black Mountain in the A.C.T. to the University with an optical modulation rate increasing up to 40 Gb/s. The initial achievement of the transmission systems was reported by Paul Edwards in the WARS02.

D The Photonics and Optical Communications group of Sydney University and Monash University have developed theoretical and practical demonstrations of several photonic signal processors for applications in beam forming antenna systems and photonic routers for photonic transport layer of the future for all optical transport networks. These optical signal processing techniques are under considerations for applications in signal transportation in the Australian networks of the SKA projects.

G IPS Radio and Space Services (www.ips.gov.au) is developing a Space Weather Plan for monitoring space weather for forecasting purposes. The draft plan was circulated to members of the STP community for comment. As part of the objectives of this plan, IPS has been endorsed by the World Data Center (WDC) community and is now a WDC for Solar Terrestrial Science.

G TIGER (Tasman International Geospace Environment Radar) (www.tiger.latrobe.edu.au) is now entering its third year of operation as a component of the international SuperDARN (Super Dual Auroral Radar

Network). A 5-member delegation attended the SuperDARN Workshop in Venice in May 2001 to present results and participate in planning future SuperDARN operations. The 2002 SuperDARN meeting was held in Valdez, Alaska, USA in May 2002.

- In August 2001, a Major National Research Facilities, MNRF, consortium led by Ray Norris was awarded a $23.5m grant under the Major National Research Facilities program of the Federal Government's "Backing Australia's Ability" initiative. Together with matching funding from the various participants, including commercial partners, the total project size is about $50m. About half of this will be invested in developing technology for the Square Kilometre Array (SKA), as detailed below, and about half will be invested in enabling additional Australian access to the Gemini optical telescopes. On the SKA side, a strategy is being employed under which the technology developers are being used to upgrade existing Australian radiotelescopes such as the CSIRO's Australia Telescope Compact Array and Sydney University's Molonglo telescope. An overarching strategic goal of the MNRF is to unify the various segments of the Australian astronomical community, so that we might, for example, mount a pan-Australian bid to build a major new astronomical instrument. More information is on http://www.atnf.csiro.au/projects/mnrf2001/
- The SKA is a $2 billion internationally-funded project to build the next-generation radiotelescope, which will be about 100 times more sensitive than any existing radio telescope, and which will be capable of studying the earliest phases of the Universe which are currently inaccessible to any existing telescope. Construction of the SKA will not start until 2010, but a decision on where it will be built will be made in 2005-2007. The SKA will need to use advanced technology that does not yet exist, and development of this technology has attracted considerable interest from commercial companies in the communications sector. A significant Australian effort is being invested in (a) developing technologies for the SKA, and (b) mounting a case for it to be hosted in Australia. The Australian SKA effort is coordinated by the Australian SKA Consortium (ASKAC), chaired by Bob Frater, and the technological development is led by Peter Hall, who also chairs the SKA International Engineering and Management Team. Australian scientists and engineers are also active in a number of other areas, such as the International Science Working Group. More information is available on http://www.atnf.csiro.au/projects/ska/
- LOFAR (Low Frequency Array) is an internationally-funded low-frequency telescope (20-250 MHz) which will open up new areas of observational phase space, and is also in many ways a technological precursor to SKA. A joint submission has just been submitted to the LOFAR consortium by the state of WA and by CSIRO to host LOFAR in Australia. The LOFAR steering committee visited Australia in February 2003 to visit potential sites and examine options with Australian representatives. A local meeting (The Low Freqeuncy Universe) was held at the University of Sydney, 30-31 Janaury 2003, to review Australian interest and support for LOFAR. It was attended by over 60 people encompassing all aspects of astronomy (radio, optical, theoretical) and ionospheric physics. This meeting preceded a one day meeting with the LOFAR steering committee representatives. More information on LOFAR is on http://www.lofar.org/ . Australian LOFAR project leader is Michelle Storey.
- The Australian Virtual Observatory is a Grid Computing project which will be an integral component of the International Virtual Observatory (IVO). This will link the archives of all the world's major observatories into one distributed database, with powerful tools to optimise the extraction of science from the data. As a result, data from all the world's major observatories will be available to all users. A user can simply request some data or an image of some particular part of the sky, or perhaps the result of some operation on several data sets, and the IVO will provide the result to the user. A consortium has been set up involving the University of Melbourne, CSIRO, and other Australian observatories and University departments, with funding from ARC, CSIRO, and elsewhere, and is being led by David Barnes. For more information see http://www.aus-vo.org/
- SEARFE (Students Exploring Australia's Radio Frequency Environment) (www.searfe.atnf.csiro.au) is a hands-on radio science experiment for high school students, which has now been installed in 11 schools, and is planned to expand further in 2003. Students use special-purpose hardware and software, partially sponsored by IBM, to investigate the usage of the radio-frequency spectrum in their locality. As well as being an outreach project, teaching students about the value and use of the radio frequency spectrum, the data from this project will help build up a database of the spectrum usage in Australia, contributing towards planning for SKA, LOFAR, and other projects. The project is driven by Anne Green and Michelle Storey.

J 2001-2002 saw the installation of prototype millimetre receivers on the Australia Telescope Compact Array, resulting in the first Southern Hemisphere millimetre-wave array telescope, with several resulting science highlights. The planned installation of the final 12mm receivers will go ahead as planned in 2003, while the final 3 mm receivers have been delayed until 2004. These receivers are built around world-leading InP MMIC technology developed jointly by CSIRO and TRW, and are attracting intense interest from around the world. The team that developed these chips was also awarded a CSIRO medal in December 2002.

J ATNF has agreed with NASA to use its Parkes dish to help track Mars spacecraft in late 2003. As part of this contract, the Parkes dish will be upgraded to boost its performance at short wavelengths. In the longer term, as a result of its expertise in array technology, ATNF has contracted with NASA to explore possibilities to develop the next-generation Deep Space Network. Other key initiatives being pursued at ATNF include the MNRF, SKA, LOFAR, and Virtual Observatory, described elsewhere in this report. The ATNF annual report is available on http://www.atnf.csiro.au/the_atnf/annual_reports/

J Frank Briggs (formerly of the University of Groningen, The Netherlands) joined the staff of ANU Research School of Astronomy and Astrophysics (RSAA)in a position funded jointly with the ATNF, and is working on observing redshifted hydrogen in the early Universe, a topic which is a key motivator for SKA and LOFAR. During 2001-2, Briggs served as technical consultant to the OECD Task Force on Radio Astronomy. Two ATNF staff are now also based at RSAA. Other areas of radio astronomy being pursued at RSAA includes studies of the radio emission from galaxies in the early Universe, neutral hydrogen in local galaxies, and the study of radio emission from infrared-luminous galaxies. RSAA astronomers also play key roles in some of the SKA science and management committees. See http://www.mso.anu.edu.au/ for more details.

J Swinburne University operates a Centre for Astrophysics and Supercomputing, led by Matthew Bailes, which conducts research in several areas, notably the use of supercomputers in addressing computationally challenging astronomical projects such as pulsar searches over a wide range of parameter space. Swinburne is also being funded under the MNRF program to construct a software simulation of the SKA system. See http://astronomy.swin.edu.au/ for more details.

J The Molonglo telescope of the University of Sydney is continuing with its SUMSS project to produce deep radio images of the entire southern sky at 843 MHz. The Molonglo telescope is also being upgraded under the MNRF program (see above) to become a technology demonstrator for the SKA. See http://www.physics.usyd.edu.au/astrop/most/ for more details.

J The University of Sydney's Mt Pleasant 26m antenna participates in weekly geodetic VLBI observations as part of the CORE program to measure Earth rotation parameters, and University of Tasmania will also join the IVS (International VLBI Service for Geodesy and Astrometry). Major projects include using interstellar scintillation to probe the structure of active galaxies at unprecedented resolutions using the new Earth orbit synthesis technique, and studying the physical conditions in high-mass star formation regions through multi-transitional OH and methanol maser observations. More information is on http://kerr.phys.utas.edu.au/

J UNSW hosts one of Australia's strongest groups in millimetre-wave astronomy, and have been active in a number of projects, such as the collaboration with CSIRO ATNF to develop the Mopra telescope. As well as contributing financially to the upgrade of Mopra, UNSW astronomers have also been provided suer support to visiting scientists. It is planned to continue this high level of collaboration as we move towards full operation of the ATCA at millimetre wavelengths.

J UNSW astronomers have also been site testing at the South Pole and at Dome C at a wavelength of 350 microns. The observations confirm the very good conditions known to exist at the Pole, and also suggest that Dome C may actually be significantly better - making it the best site on earth for sub-mm astronomy. Further data will be taken at Dome C during 2003. See http://newt.phys.unsw.edu.au/RESEARCH/astro.html for more details.

K Scientists from the Institute of Medical and Veterinary Science (IMVS) (www.imvs.sa.gov.au) in Adelaide published the results of a new study, which found no increase in the cancer rate in genetically engineered cancer prone mice from digital mobile phone emissions. Importantly, the new study also did not find any

increase in tumours in the normal (non-genetically engineered) mice also studied. The study was published in *Radiation Research* 158, 357-364 (2002) and is a significantly enhanced follow-on study to an earlier pilot study [Radiation Research 147, 631-640 (1997)]. The study tested whether exposure of digital mobile phone emissions increased tumour incidence in cancer prone mice and included normal mice as well. The study used 1600 mice compared to the 200 mice used in the 1997 study. The mice were exposed to radiofrequency levels of 0.25, 1.0, 2.0 and 4.0 W/kg for an hour per day for 24 months compared to a single daily dose and 18-month period of the 1997 study. The current study tested the same central hypothesis of the 1997 study, but was refined to address the criticisms and shortcomings of the pilot study.

- K The Australian Government announced the establishment of a Centre of Research Excellence in Radiofrequency Electromagnetic Energy to study the possible health effects of electromagnetic energy emissions from mobile phones and mobile phone towers. The Centre can be either a single physical entity or institute, or a virtual institute linking a collaborative research effort from several different organizations. The National Health and Medical Research Council will provide the funding of $500,000 a year for up to five years. Further information is available at: http://www.health.gov.au/nhmrc/media/2002rel/mobileph.htm
- K The Australian Radiation Protection & Nuclear Safety Agency (ARPANSA) published a new standard for exposure to radiofrequency energy in the range 3 kHz to 300 GHz. The new standard is based on the guidelines of the International Commission for Non-Ionizing Radiation Protection or ICNIRP. An electronic copy of the standard can be downloaded from http://www.arpansa.gov.au/
- K The Australian Communication Authority (ACA) has registered a new industry code of practice designed to improve consultation by telecommunications carriers when they are planning and installing new facilities, such as mobile phone towers. Registration of the code, *Deployment of Radiocommunications Infrastructure Code*, means that it is now compulsory for mobile carriers to abide by it. The Australian Communications Industry Forum (ACIF) as well as representatives of carriers, the community and local government developed the Code. More information is available on the ACA website http://www.aca.gov.au.

FEDSAT

A most significant space and radio science initiative was the successful launch of the FedSat 58kg microsatellite on 14th December 2002 from the NASDA Tanegashima Space Centre in southern Japan by an HIIA rocket (www.itr.unisa.edu.au/crcss/FedsatLaunch.htm). This is an outstanding achievement, being the first Australian satellite launched since 1967. All onboard systems are functioning well and GPS, magnetometer and communications payloads tested. These experiments will be fully commissioned in early March 2003.

The project, involving several URSI Commissions, included the design, manufacture, and space qualification of the microsatellite *FedSat* by the Cooperative Research Centre for Satellite Systems (www.crcss.csiro.au/overview.htm, www.auspace.com.au/projects/fedsat.htm).

FedSat carries research and development payloads comprising a fluxgate magnetometer for space science and space weather studies (www.crcss.csiro.au/launch/boom.html); a Global Positioning System receiver for navigation, precise orbit and upper atmospheric research; an Adaptive Instrument Module for experiments in reconfigurable computing on space platforms; and a complex Communications payload for carrying out tests and research in Ka, UHF, and VHF bands. Telemetry is at S-band. The design of the Ka-band horn antenna and electromagnetic modelling and measurement of the effect of the satellite body on antenna performance were of significant electromagnetic interest.

FedSat – the first satellite built in Australia in more than thirty years – will be one of the first Low Earth Orbit satellites to operate at Ka band. Details of the FedSat network have been provided to the ITU by the Australian Communications Authority. The controlling ground station is at the CRCSS in Adelaide.

One sub-program of the CRCSS is using electromagnetic propagation models to predict GPS multipath errors for the on-board GPS receiver. GPS multipath is one of the accuracy limiting factors for on-board GPS-based orbit determination and attitude determination for spacecraft. A Parabolic Equation 2D Electromagnetic propagation model has been developed to predict the amplitude and phase of reflected signals. This model is combined with a structural model of the spacecraft and current attitude information to determine the multipath content of the

GPS signal. The PE model is based on the Helmholtz scalar wave equation. A Fourier Time Synthesis implementation has been developed to allow the Multipath Channel Impulse Response (MCIR) to be determined from the time-invariant PE model.

Suggestions re activities to celebrate the Jubilee (50th)

The NCRS feels it should be able to mount some SKA or LOFAR related event by then which would emphasise the cross-disciplinary nature of the exercise. This will be developed during the NCRS Meeting in February.

Budget

Expenditure by the NCRS after a general Assembly year is usually low. The NCRS has no budget requests for this year.