NEWSLETTER

Volume 07

January 2005

P.O. Box 2, 7990 AA Dwingeloo, The Netherlands
Oude Hoogeveensedijk 4, 7991 PD Dwingeloo
Tel.: +31 (0) 521 595 270/271
Fax: +31 (0) 521 597 332
www.skatelescope.org

FROM THE INTERNATIONAL PROJECT OFFICE

Much has happened on the international SKA front in the last six months. Real progress has been made in the science, engineering, and management of the project. Many of the developments are mentioned in the Newsletter, but let me summarise them here.

First of all, the science case - Science with the SKA , edited by Chris Carilli and Steve Rawlings - has been published by Elsevier as a separate issue in New Astronomy Reviews Vol. 48, pp989-1563, Dec2004). This is a monumental achievement on the part of all those who contributed, some 92 seperate authors or co-authors in all. The Science Working Group will now concentrate on developing a new "compliance matrix" to evaluate the potential of the different candidate technical designs to carry out the Key Science Projects.

The engineering side of the project has been busy as well. The papers presented during the Penticton Engineering Working Group retreat and at SKA2004 have been written up and submitted for publication as a separate issue in the refereed journal Experimental Astronomy. This means that by May 2005 when the EXPA volume is published, the SKA project will have two formal publications to its name setting out the current science and engineering cases. The EWG has taken on the task of generating White Papers on all the system aspects of the project as a prelude to the preparation of the System overview Document in 2006.

The Site Evaluation Working Group spent many hours preparing the Request For Proposals for siting the SKA at SKA2004 in Penticton and in the month thereafter. Following approval by the ISSC, the ISPO formally sent the RFP to the five candidate countries on 1 September. In the first half of 2005, the SEWG will produce guidelines for the evaluation of the proposals submitted by the deadline of 31 December 2005. In the course of 2005, each of the candidate sites will be monitored for radio frequency interference (RFI) for a month by an ASTRON team under contract to the ISPO. This will serve as a reference to compare the sites and as calibration of the local RFI monitoring equipment.

The Simulations Working Group is also playing an important role in the site selection process. The Configuration Simulation Task Force has generated a set of guidelines for site proposers to use when generating configurations for the SKA in their country/region. The Task Force has also created a set of example configurations to serve as starting points for the site proposers.

Our website is a great success judging by the several thousand hits per month. The material available is continually under review, and is updated regularly by our webmaster, Stephanie Voegele. The website also serves as a repository for SKA memos, presentations, papers, and as a working environment for the SKA committees and working groups. The Outreach Committee is currently working on a 20-page booklet summarising the science and engineering.

All these efforts are being supported by the global radio astronomy community at national and institute level. Over 120 people in 17 countries are actively involved in the international SKA Committees, Working Groups and Task Forces, and there are many more in the institutes carrying out the technical development work. It is an impressive level of commitment!

Much has also been achieved on the management front during the last six months. A new Memorandum of Agreement on Collaboration in the Development of the International Square Kilometre Array (SKA) was adopted by the ISSC in October last year and came into force on 1 January 2005. Amongst its provisions it recognises the ISPO, expands the ISSC membership from 18 voting members to 21, and raises the ceiling for the annual contributions to the ISPO to 40000 Euro per ISSC membership. The additional memberships will be taken up by South Africa, France and the USA. At the Penticton meeting, the ISSC approved the implementation of the management plan I outlined in the last Newsletter, and the Working Groups and Task Forces have now begun work as part of the ISPO. The ISSC also approved the MoU between the ISPO and ASTRON on the RFI Monitoring program, as well as the ISPO budget for 2005.

Richard Schilizzi
Project Director

NEWS FROM THE COMMITTEES

EWG - ENGINEERING WORKING GROUP

Quite a bit has happened in the international engineering area since the last Newsletter. Most significantly, the International Engineering and Management Team (IEMT) has completed its evolution into the larger Engineering Working Group (EWG). The EWG has a number of roles as set out in the SKA Management Plan and summarized on the relevant web page (http://www.skatelescope.org/pages/com_ewg.htm). In practice, the most significant activities of the Group over the next 18 months are the preparation of white papers on key aspects of SKA engineering and a continuing review of international technology demonstration activities. Outcomes of this work will be especially important in an external review of SKA engineering, currently scheduled for late 2006.

To broaden the input to the international engineering group and to make tractable the increased workload associated with the whitepapers and reviews, the EWG has a number of Task Forces, each of which is chaired by a Group member. For reference purposes, a full list of EWG members and chairs is given in the table below. Links to task force web pages (showing full membership) will soon be available via the above-referenced page on the international SKA web site.

Table 1 – EWG Members

S. Ananthakrishnan National Centre for Radio Astronomy India	Frank Briggs RSAA Australia	Ron Beresford CSIRO/Australia Telescope National Facility Australia
Tim Cornwell National Radio Astronomy Observatory USA	Larry D'Addario National Radio Astronomy Observatory USA	David DeBoer SETI Institute USA
John Dreher SETI Institute USA	Steve Ellingson Virginia Tech USA	Peter Hall (Chair) International SKA Project Office
Colin Jacka CSIRO/ICT Australia	Dion Kant ASTRON The Netherlands	Rendong Nan National Astronomical Observatories China
Parbhu Patel ASTRON Netherlands	Ralph Spencer University of Manchester and Jodrell Bank Observatory, UK	Richard Thompson Retired (formerly National Radio Astronomy Observatory) USA
Bruce Veidt Dominion Radio Astronomy Observatory Canada	Sander Weinreb Caltech/JPL USA	

Table 2 – EWG Task Force Chairs

Task Force	**Chair**
Antennas	Parbhu Patel
RF Systems	Sandy Weinreb
Systems	Dick Thompson
Signal transmission	Ron Beresford
Signal processing	Larry d'Addario
Interference mitigation	Frank Briggs and Steve Ellingson (joint)
Software engineering	Tim Cornwell
Industrial liaison	Peter Hall

The EWG met for the first time at a three-day engineering retreat held immediately prior to the Penticton SKA 2004 meeting. Several other invited participants, including the SKA Director, were also present. The main business of the retreat was to (i) finalize the reviews of SKA demonstrator projects, (ii) consider various proposals for hybrid SKA designs, and (iii) review first efforts at SKA system definition and cost estimation. EWG commentary on demonstrators and hybrids is now available via the

web in SKA memos 55 and 56, while memo 57 describes the initial system definition work. Two current technical issues were highlighted at the retreat. The EWG re-iterated the IEMT's concern at the rate of progress in the demonstration of phased arrays for aperture and focal plane applications. The Group also expressed its concern at the high degree of optimism and the lack of international uniformity in estimating system temperatures for various SKA concepts. (The estimate is, of course, central to specifying the amount of built area, and hence cost). To help address this issue the Antenna Task Force is in the process of finalizing a draft SKA memo (written by Germán Cortés Medellín of Cornell University) which presents standard models and assumptions to be used by the international project.

Additional stimulating material relating to "optimum" expenditure division across SKA sub-systems was presented by Jaap Bregman, while Tim Cornwell summarized first thinking on SKA software engineering and related computing cost issues. From a chairman's perspective, my impression was that the retreat was characterized by enthusiastic (some might say cut-throat!) debate, fair-mindedness, and good humour. Special thanks to Bruce Veidt and his DRAO colleagues for attending so well to the logistics of the meeting.

The EWG and invited guests hard at work during a session at the July 13-15 2004 retreat, held at DRAO.

An important additional task for the EWG involves providing the main review panel for a forthcoming special issue of Experimental Astronomy. This volume will focus on SKA engineering and related issues; over 35 papers have now passed first-round refereeing. If authors and reviewers can finalize revised papers by the advertised deadline of January 1, publication in April 2005 is possible. Papers in the special issue cover the full range of SKA interests and include expositions of the previously-mentioned work of Bregman and Cornwell. (Note that the earlier versions of the Cornwell papers are also available as SKA memos 49 to 51).

Attendees at SKA 2004 will recall that the groundwork done by the EWG was important in stimulating discussion on SKA technology, timelines and system design issues (including hybrids). Software and data processing received particular attention, with Colin Lonsdale and colleagues adding interesting and provocative new material (see SKA memo 54 and the EXPA special issue) to that tabled by Tim Cornwell and co-workers. It is clear that the forthcoming software and computing whitepaper will be especially important to the development of an SKA project plan. Initial efforts at SKA system definition were well-received at both the EWG retreat and SKA 2004, and the project now faces the challenge of finding the resources to maintain momentum in this vital area.

It is fair to say that, with more groups now tackling SKA demonstrators and prototypes, there was a more sober note to the SKA 2004 presentations. Collectively facing real-world engineering challenges is proving a valuable way of achieving consensus on achievable outcomes and viable risk levels in an SKA project having deliverables in 2015.

Peter Hall,
Chair Engineering Working Group

OUTREACH COMMITTEE

The past six months have seen activities of the outreach committee on various aspects and the committee itself has recently seen a change in its membership.

The previously reconstructed web-pages have been filled with new material, relying again heavily on the superb help of Stephanie Voegele from Astron. In particular, the huge Science Book is now available with all its chapters, including Key Science Projects and introductory material. Printed copies of the book will be distributed to over 400 addresses.

The number of presentations available on the web-site is also increasing and two templates are now available for you to construct your own. A Thank you goes to all who have contributed.

The SKA booklet is in preparation and should be ready for April 2005 when an informational meeting on SKA for government officials is planned. The current plan is to produce a single booklet presenting SKA science and technology. It will be prepared in close collaboration with the Engineering Working Group and the Science Working Group. If you have some striking pictures demonstrating the science or technology of the SKA, we would like to have them!

The outreach committee is also working on a short animation which is to be presented at the IAU General Assembly in Prague in 2006. The animation will highlight the capabilities of the SKA and will present the Key Science Projects, and possibly sky simulations in collaboration with the simulations group.

It was decided to increase visibility of the SKA Newsletter by sending it to about 100 libraries and informing librarians that they can also order an electronic version.

Finally, we regret to announce that Heino Falcke stepped down as the Chair person of the Outreach Committee to find more time for his other commitments. We are grateful to Heino for all the hard work he put into chairing the committee but are glad he remains on the committee. Peter Wilkinson resigned from the Committee, we thank him for all his contributions over the past few years, starting off with the generic SKA powerpoint presentation. Michael Kramer has agreed to take on the job of Outreach Committee chair, and Jill Tarter has agreed to be vice-Chair. In addition, Rainer Beck from the MPIfR and Ian Morison of Jodrell Bank have joined the committee to provide further assistance to the group.

Michael Kramer
Chair Outreach Committee

SEWG – SITE EVALUATION WORKING GROUP

The SKA Site Evaluation Working Group met in Penticton, Canada in July 2004 and completed a draft Request For Proposals for siting the SKA document for the approval of the ISSC. The ISSC decided to send the RFP to five countries that seem to have adequate sites for the SKA: Argentina, Australia, China, South Africa and the United States of America. The deadline for receiving final proposals was set for December 31, 2005. All invited countries have indicated that they would participate in the site competition.

The ISSC also organized independent RFI monitoring of the proposed sites via a contract with ASTRON in the Netherlands. This activity is being coordinated by the ISPO with Peter Hall being the liaison engineer.

The SEWG has now the following membership:

Yervant Terzian (USA) (Chair)
Wim Brouw (Australia) (Vice-Chair)
S. Ananthakrishnan (India)
Marcelo Arnal (Argentina)
Willem Baan (The Netherlands)
Steve Ellingson (USA)
Bernie Fanaroff (South Africa)
Marcus Price (USA)
Michelle Storey (Australia)
Shengyin Wu (China)

The SEWG will work with two Task Forces: (a) RFI Measurements (Chair: Steve Ellingson), and (b) Regulatory Issues (Chair: Willem Baan). The second Task Force is preparing three technical memos; 1. RFI Thresholds, 2. Setting RQZs, and 3. RFI from Artificial Satellites.

The SEWG is advising the ISPO on questions by the various site proposers concerning the interpretation of the siting RFP. The SEWG is also in the process of preparing evaluation criteria to serve as guides to the evaluation process of the site proposals.

Yervant Terzian
Chair, SKA Site Evaluation Working Group

SimWG – SIMULATIONS WORKING GROUP

At the 2004 International SKA Workshop, held in July in Penticton, the SimWG met during the scheduled breakout session. The main topic of discussion at this meeting was the (then draft) Request for Site Proposals, in particular the types of configuration simulations that site proposers would be required to undertake and present as part of their submission.

As a result of this meeting and other discussions during the week of the workshop, it was decided that guidelines for site proposal configuration simulations were required. Following the ISSC meeting in Penticton, the ISPO instructed the SimWG to put together the Configuration Simulations Task Force (CSTF), charged with the task of producing the guidelines. The CSTF consists of representatives of all site proposal

teams, as well as representatives of all SKA concept teams, the Chairs of the other major SKA working groups, and the ISPO.

Over the last few months the guidelines have been produced; they are currently under revision. Once finalized by the CSTF, the guidelines will be passed to the ISPO and ISSC for final approval. In summary, the guidelines: detail the constraints upon proposers in choosing an SKA configuration (for the purposes of siting); offer example configurations as a starting point for proposers; define a number of figures-of-merit for SKA configurations; and describes the evaluation and comparison of the different configurations as part of the site selection process.

The overall aims of the guidelines are to make the requirements on proposers clear and allow a fair, transparent, and uniform comparison of the different site proposals (from the configuration point of view), following the proposal deadline in December 2005.

In other SimWG news, the latest in the series of Australian SKA simulations meetings was held in September at the Swinburne University of Technology, in Melbourne. This meeting had an international flavour, with participants from New Zealand, South Africa, and the USA, as well as Australia.

Steven Tingay,
Chair, Simulation Working Group

SWG - SCIENCE WORKING GROUP

Since the last SKA newsletter, the major achievement of the International Science Advisory Committee (ISAC) has been the writing of the new SKA science case in the form of a recently published book.

This mammoth effort, totaling more than 600 pages of detailed SKA science, is already available electronically and will shortly be available in all good astronomical libraries.

The autumn of 2004 saw the formation of the new SKA Science Working Group (SWG). Rising, phoenix-like, from the ashes of the ISAC, the remit of this group will be wide ranging with activities planned for 2005 including further development of the science case, organizing worldwide advocacy for the SKA, and providing information on the trade-offs between the science achievable with the SKA and site and design choice. Several reports will no doubt get written!

The new SWG is a mixture of some familiar faces from the ISAC -- such as old ISAC Chair Chris Carilli, new SWG Chair Steve Rawlings, and new SWG Vice-Chair Bryan Gaensler -- and some fresh faces like Chris Blake from the University of British Columbia in Canada and Kavilan Moodley from the African Institute for Mathematical Sciences.

Much SWG activity in 2005 will focus around the so-called Key Science Projects (KSPs), which are described in loving detail in the first few chapters of the new science case book. Two `shepherds' for each KSP have been identified on the SWG, and these people will be responsible for organizing international conferences on the KSP areas in 2005. The purposed of these meetings will be two-fold: (i) to publicise

SKA science to the wider community; and (ii) to firm up the site and design requirements of the KSPs.

Steve Rawlings
Chair, Science Working Group

MEETINGS

PENTICTON

SKA 2004 Conference in Penticton, BC, Canada, 18-25 July 2004

SKA 2004
========

In late July 2004, the Dominion Radio Astrophysical Observatory of the National Research Council of Canada Herzberg Institute for Astrophysics, located in Penticton, British Columbia, played host to three meetings related to the Square Kilometre Array project.

The first three days were a retreat for the International Engineering Management Team (IEMT), to discuss and review the 5-year project plans for the different technology concepts for the SKA. Thanks to Bruce Veidt for organizing this productive meeting.

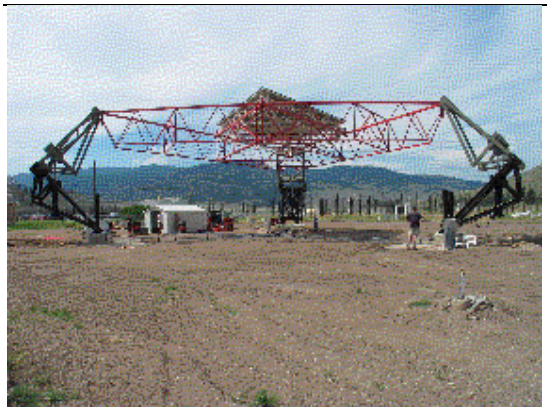
Immediately following the IEMT retreat was a Radio Frequency Interference Workshop, co-sponsored by IUCAF and the SKA. This meeting was focused on both the technical and regulatory approaches to RFI, bringing together engineers and those who represent radio astronomy at national and international regulatory meetings. Attendance was originally expected to be about 20 people, so we were happily surprised when close to 80 delegates signed up. Such a large number filled the DRAO seminar room to capacity, and with two and a half-days of a full programme, including a tour of the DRAO campus, everyone was busy. A proceedings of the meeting will be forthcoming. Thanks to all who helped make this meeting such a success.

Lastly, the annual gathering of the SKA consortia from around the world took place at the Penticton Lakeside Resort and Casino. SKA2004 had 160 delegates, making this the largest SKA meeting to date.

The first days talks concentrated on bringing everyone up to speed on the progress being made on many fronts in the SKA project, particularly on the various concepts being developed around the world.

The key science areas targeted by the SKA were then discussed the following day. 'Science day' marked the end of a two-year process of refining the first SKA science case (eds. Taylor & Braun, 1998), which culminated with the publication of "Science with the Square Kilometer Array", in New Astronomy Reviews (eds. Carilli & Rawlings) in December 2004. For those eager to discover more, the chapters can be recovered from the SKA web site.

True to form, the opening two days of SKA2004 were very full, so many participants were relieved that the Wednesday morning brought a somewhat more relaxed pace, with a small number of talks aimed at addressing some of the many different engineering challenges faced by the project. As an example, one of the well-received talks was given by David Halliday of AMEC Dynamic Structures on the role of industry in large science projects, especially fostering and organizing industrial partnerships. During the afternoon, delegates were taken to DRAO to see the on-going work on the Large Adaptive Reflector, the ACSIS correlator, the Galactic Plane Survey, and to see the new DRAO building, a first for many of the delegates. The only-just-completed (the day before the meeting began!) Actuated Structure Unit (see picture) was a big hit, with many delegates standing slack-jawed as the prototype LAR surface element was raised and lowered 6 metres. The conference dinner followed the tour, which was held outside at one of the local wineries. Thankfully, the weather was perfect, with a beautiful Okanagan summer evening to enjoy dinner!



A prototype section of the LAR reflector, called an "Actuated Structure Unit" (ASU). The red triangular structure measures 20m on a side, and sits on three actuated legs that can extend up to 6.5m. The white triangular structures are two triangular reflector panels, each 10m in size. Note the structure is built from readily-available materials, commonly used in the building trade (compare with your local supermarket). The ASU is a collaboration with AMEC Dynamic Systems and Bosch-Rexroth. The picture shows the first actuation of the ASU a few days before SKA2004 started. The engineers in the picture show the scale of the prototype.

The morning of the last day was set aside for break-out meetings, and the meeting closed with a plenary discussion of how to bring all the various groups together to work toward a single technical concept (or a combination of concepts) for the SKA. For those who may be interested, the programme from the SKA meeting can be found on http://www.drao-ofr.hia-iha.nrc-cnrc.gc.ca/ska2004/, presentations can be found on the SKA international web site at
http://www.skatelescope.org/pages/conf%20_pentincton.htm

In closing, from my own perspective as LOC chair, the SKA meeting went off very smoothly and is a testimony to the hard work of many people at DRAO, especially the LOC who did a fantastic job. Special mention has to be made of the tremendous effort of Donna Morgan in organizing much of the three meetings, and to Jason Shrivell for arranging not one, but three(!) social events in the space of six days. Thanks to all the LOC members - it would have been impossible without your extraordinary efforts.

Sean Dougherty
SKA2004 LOC Chair

GUIYANG ISSC — 13 Meeting

The ISSC-13 meeting in China is to be held in Guiyang, the capital city of Guizhou province, which the Chinese SKA Group has proposed to the SESC as a potential SKA site, and where FAST will be built as a National Megascience project.The dates for the meeting: March 16 to 20 in 2005. The program include a meeting of the SEWG, a visit of the Shangjiachong depression and the ISSC meeting itself.

Bo Peng
Chair LOC

PUNE

SKA 2005 Conference in Pune, India, October-November 2005

The SKA 2005 Conference will be held in Pune, India from October 31 to November 3 (including a one day trip to GMRT), followed by the International SKA Steering Committee meeting on November 4-5.

Planning for the meeting is underway and details are on the meeting website http://www.ncra.tifr.res.in/ska_pune , with a link from the international SKA webpage.

The SOC members are as follows:
- Peter Hall
- Michael Kramer
- Ken Kellermann
- Pramesh Rao (LOC Chair)
- Steve Rawlings
- Richard Schilizzi (SOC Chair)
- Yervant Terzian
- Steven Tingay
- Peter Wilkinson

The SKA meeting will be preceded by the URSI General Assembly in New Delhi, India which runs from October 23-29. Weather in Pune (and in Most of India) during the period should be dry and temperate. Hotel accommodation in Pune can be difficult to get at short notice. Block bookings at concessional rates is being arranged in a few hotels in different price ranges but the reservations will have to be made by May-June to avail of these rates.

For more information contact ska_pune@ncra.tifr.res.in or pramesh@ncra.tifr.res.in

A. Pramesh Rao,
Chair LOC

NEWS FROM THE CONSORTIA AND INSTITUTES

ARGENTINA

After the ISSC approved last August the addition of Argentina to the list of candidate sites for the location of the SKA, the efforts of the local SKA Committee are focused on the one year-long RFI campaign to be conducted along the forthcoming year.

An almost fully automatic RFI monitoring system is currently under test at Instituto Argentino de Radioastronomia. We are slightly behind schedule due to minor delivery delays with the diesel generators that will powered the system after installing it at CASLEO, province of San Juan, Argentina.

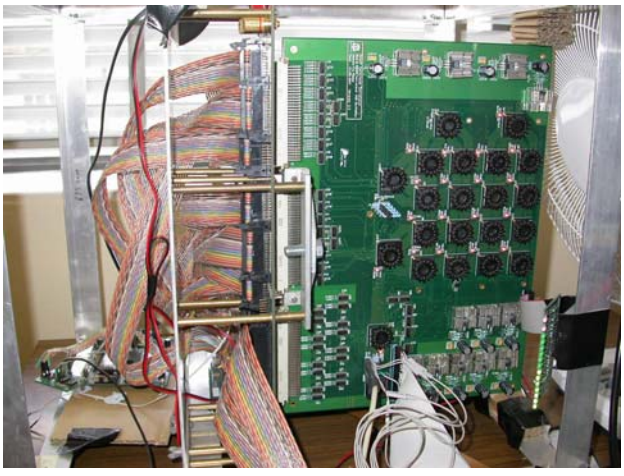
The measurement will be conducted at the northern extreme of Pampa del Penasco. This site, located at longitude 69 degrees 16 minutes West and latitude 31 degrees 42 minutes South, is located some 12 km north of a previously surveyed area.

AUSTRALIA

1. Highlights from Australian SKA Concept Demonstration Projects
SKA Molonglo Prototype (SKAMP)

The SKAMP Continuum Correlator, together with the ADC samplers and delay and phase units, are nearing test & debug completion, and are expected to be installed at the University of Sydney's Molonglo Observatory Synthesis Telescope (MOST) in early 2005. When installed the correlator will provide 7.3MHz BW, 96 station, single polarisation, single frequency channel correlation. The sampling and delay phase units will provide a 96 x 8 bit (4b real/4b imag) beam steered signal for correlation.

In order to prototype SKAMP II/III Feed designs, a rapid prototyping telescope is being built at MOST. It uses the same shape and focal length cylindrical paraboloid as the MOST, and will allow for easy testing of linefeed designs without interrupting the operation of the entire array. Construction is expected to begin in late Dec 2004. Prototypes of a Delay switching network have been built for the SKAMP II/III linefeed.



The SKAMP Correlator. Photo credit: Tim Adams, University of Sydney, Australia

For regular updates see: http://www.physics.usyd.edu.au/astrop/ska/

SKA New Technology Demonstrator (NTD) Project

After withdrawal, in 2004, of the Luneberg Lens concept as a candidate SKA design, ATNF has been working on re-shaping its SKA New Technology Demonstrator Project (funded by the Australian Government as part of the Australian Astronomy Major New Research Facilities Program). It has been decided by the Australian SKA community that the NTD will be a technology demonstrator for wide field-of-view SKA solutions operating in a remote, radio-quiet site. The revised project will concentrate on the development of focal plane array technology in association with parabolic reflectors for the antenna systems. The NTD team is being led by by Dr Colin Jacka from the CSIRO ICT Centre, and managed by Dr Tony Sweetnam, also from the CSIRO ICT Centre. The project just successfully completed a concept design review. The technology objectives of the NTD are:

1. 10x10 Focal Plane Array (FPA) operating over the frequency range 800-1700 MHz, with 1 to 3 parabolic reflector antennas (probably 15 m diameter)
2. RFI and spectral line ripple cancellation using FPA (commercial applications are possible)
3. RF and IF beam-forming to give extremely wide fields of view
4. Polarization purity
5. Correlation of large number (at least 20) of independent beams
6. Wide band operation with low rfi levels
7. Proof of infrastructure in remote desert environment (power supply, on-site data transport).

Enhanced technology objectives with additional funding include:

1. Modular upgrade path. Twenty parabolic reflectors equipped with 10x10 FPAs.
2. Correlation of a large number of (typically 20) antenna stations, and 20 independent beams being formed
3. Real-time VLBI using high speed fibre-optic data links with other antennas forming long baselines on the continent of Australia
4. Multiplexed VLBI exploiting wide field-of-view and multiple beams
5. Special purpose signal processors (eg for pulsar searches) using phased array beams
6. Operational and processing software development.

A visualization of what the SKA could look like if constructed from the technology being considered for the New Technology Demonstrator project. Photo credit: Chris Fluke, Centre for Astrophysics and Supercomputing, Swinburne University of Technology, Australia.

The scientific objectives of the NTD project are:
(a) *Using existing (MNRF) funding:*

1. VLBI: 3000 km baseline: Double the available resolution at 1.6 GHz, including the option of simultaneous calibration using an independent beam
2. IDV monitoring to 50 mJy
3. Time-critical experiments requiring flexible scheduling

(b) Enhanced Science Objectives with additional funding:

1. HI emission survey to z ~ 0.1
2. HI absorption to z = 1
3. Transient source searches and continuum survey 1.2 – 1.4 GHz
4. Galactic HI emission
5. Pulsar survey (with new backend)
6. Probe galactic and extragalactic magnetic fields
7. Multiplexed VLBI on faint sources in deep imaging over wide field-of-view, with phase referenced calibration
8. OH megamasers to z ~1.

A secondary purpose of the NTD is to establish a significant presence at a remote low RFI ("Radio Frequency Interference") site, highly suitable for the SKA and other Pathfinder instruments leading to SKA. This presence may also include the Low-frequency Demonstrator project led by MIT Haystack Observatory, that may share backend digital hardware and infrastructure with the NTD.

Swinburne University of Technology SKA Program

The success of the Swinburne software correlator work (reported in the last International Newsletter) has led to a new collaboration with the University of Western Australia, the ATNF, and Cray Pty Ltd. In this collaboration the Swinburne software correlator code will be ported to a Cray XD-1 machine and programmed for high speed graphics processing units (GPUs), to give an anticipated factor of 200 – 300 speed-up in correlation time over conventional processors. This collaboration led to a proposal to the Western Australian government which was funded for $180,000 over a 12 month period and will support further development of the software correlator.

The third Australian SKA simulations meeting was held at Swinburne in September.

2. Australian SKA Siting Activities

ASKACC National SKA Site Selection

In September 2004 the Australian SKA Consortium Committee (ASKACC) was invited by the International SKA Steering Committee to submit a proposal for a site for SKA, conforming to a set of criteria contained in a formal Request for Proposals (RFP). Conditions in the RFP required ASKACC to select a single Australian candidate site from the 3 proposed in the Initial Australian Site Analysis Document. Following processes and protocols agreed to by all stakeholders, the Governments of Western Australia and NSW decided to participate in ASKACC's site selection process.

The ASKACC Siting Working Group analysed and evaluated submissions received by the State Governments, and on the basis of the results, ASKACC has concluded that the Western

Australian site at Mileura Station is the more internationally competitive choice for SKA based on the criteria. In reaching this decision, ASKACC identified the following as key determining factors:

- The lower population density and greater geographic isolation of the WA site lead to lower levels of interfering man-made radio waves at the high sensitivity levels of the SKA

- The flexibility of placement of outer array-stations favours the WA site. These also need to be in a low radio-noise environment, including satisfying the RFP requirement for a range of baselines up to and beyond 3000km.

The level of commitment demonstrated by the WA Government, by Local Governments in WA, and community (including indigenous) groups over a number of a years, has given ASKACC confidence in the ongoing support in WA for the life of the project. The Government of Western Australia, industry partner Connell Wagner, and ATNF will now prepare a final submission for siting the SKA in Australia.

Long-term Radio-frequency Monitoring

SKA engineer Ron Beresford is leading a project to conduct long-term radio-frequency monitoring on the Western Australian site. He is currently (as of December 2004) installing rf-monitoring equipment in a solar-powered trailer that will be capable of remote operation, continuously providing data on the background radio-frequency levels on the Australian candidate site.

SKA Radio-quiet Zone Establishment

Following a recommendation, in June 2004, from the Australian Prime Minister's Science, Engineering and Innovation Council Working Group on Astronomy, a Federal Government Forum on establishing an Australian radio-quiet zone was held in the Australian Parliament House in August 2004. Key stakeholders from Federal and State Government Departments and Agencies, together with local community representatives, attended the Forum. The Forum expressed support for working towards the establishment of an appropriate radio-quiet zone over the Western Australian SKA candidate site. ATNF is continuing to work with the relevant Agencies to define functional requirements for a radio-quiet zone for SKA, and to determine how such requirements can be implemented.

Australian SKA Consortium Committee

CANADA

The Canadian LAR project.

Before the dust had settled from SKA2004, LAR project work was back to full speed. In addition to our well-established aerostat and reflector programmes, work is now rapidly advancing on the LAR receiver array and its associated subsytems.

PHAD - Phased Array Feed Demonstrator

The LAR team have begun work on a Phased Array Feed Demonstrator (called PHAD) at DRAO. The goal of this project is to develop an engineering demonstrator

which will permit off-line optimisation of beam-forming algorithms, and to build a focal plane feed that is at least as efficient as traditional designs, leading to the design of a science-capable array.

PHAD will be a focal-plane array consisting of several hundred Vivaldi elements operating somewhere between 1 and 6 GHz. Receivers will be constructed using radio-frequency integrated circuits originally developed for wireless communications. A commercial data acquisition system will digitise and store data from all the active receiver channels. Beamforming will be done off-line on general-purpose workstations. It is planned to install PHAD initially on the DRAO 26-m dish, potentially followed at a later date with tests on a telescope with larger f/D ratio.

By performing beamforming off-line, development time will be shorter and we will have enormous flexibility to manipulate the data, either for testing different beamforming algorithms or for performing diagnostics.

This project will answer many questions concerning the feasibility, performance, and cost of phase-array feeds. We hope to have initial results in late-2005. Collaborators in this project include Walter Brisken at NRAO and Christophe Craeye at Université Catholique de Louvain, Belgium.

Receivers to the Beamformers

One of the challenging aspects of the LAR concept is the development of a system that can take the RF output of a Vivaldi feed-array and get the output data to ground level. The major challenge is to attain the required data capacity yet keep the mass of the system sufficiently low.

We have just issued a design study contract to Breconridge Manufacturing Solutions in Ottawa to carry out an investigation of the system architecture, the critical subsystems, and to develop a physical concept for the complete system to be used in the LAR Feed.

This contract is an essential step to establishing the feasibility of the LAR feed system.

Tethers

During August and September tests of a low modulus main tether (aka bungee!) between the feed platform and aerostat were conducted. Francois Deschenes, a master's student from McGill University who conducted the simulations and designed the bungee for testing, was on hand in Penticton to assist with the tests. The tether that was tested was a custom-made bungee-jump style bungee. Simulations had shown that a significant reduction in vertical motion of the instrument platform could be achieved by using a low modulus tether to allow the aerostat freer vertical movement. Unfortunately the wind conditions during these tests were either erratic, making it difficult to compare with non-bungee flight data or dead calm so we were not able to make a clear judgment of the effectiveness of the concept. One thing that became clear though the field trails was the operational issues could well outweigh any benefits. This novel idea has been put aside for the time being.

Preparations are under way currently to conduct the first flights with dynamic winch control of the tethers. Over 2 km of optical fibre and wire has been laid out to connect the winches to the central controller. The system is operational but a few details such as emergency stop controls and the of loading tethers on to the winches are being

completed before flights begin. Our plans call for open loop frequency response tests and step input tests will be conducted initally, in order to characterize the system. We will then close the control loop. GPS position feedback is fed into control algorithms developed at McGill University by Casey Lambert which then send velocity commands to the three winches. The flights represent a major project milestone, and without doubt, will be an exciting time for the LAR flight crew.

Reflector and hydraulics

After the major effort put in by the LAR group, AMEC Dynamic Systems and Bosch-Rexroth to complete the installation of the test reflector section, known locally as the Acutated Structure Unit (ASU), in time for SKA2004, a number of details remained.

The installation of the hard stops and other safety systems completed the construction. The hydraulic system has now been thoroughly tested and tuned and can be operated under computer control, either from the control building or remotely. Investigation of a number of different measurement systems is now underway.

New Faces

With the large amount of work that is being done on a number of different LAR sub-systems, we are happy to welcome three more engineers to the project - Gary Hovey and Tom Burgess are both digital engineers fresh from the ACSIS correlator project that DRAO just shipped to the JCMT, and Gordon Lacy, a newly hired mechanical engineer.

Sean Dougherty
Canadian LAR project

CHINA

In the second half of 2004, there has been progresses mainly on FAST modeling and RFI (Radio Frequency Interference) monitoring related to siting the SKA in China.

Progress on the FAST active main reflector

There have been two different approaches on designing FAST active main reflector, mechanical rigidity supporting or cable-supported mesh reflectors. Firstly for the mechanical rigidity supporting, a sliding down problem on reflector panel supports, caused by heavy back structures near edge of the main reflector, could arise, we therefore proposed a possible solution by using Sarrus mechanism. A model of 3 m in size based on a CAD simulation of Sarrus mechanism was constructed and shown in Fig. 1 on such efforts, which should also improve the mechanical efficiency and reliability, simplify the manufacture process and reduce the costs of FAST main reflector construction and system maintenance. This is led by a FAST group in Beijing University of Aeronautics and Astronautics. Some experiments are undergoing to test its dynamics and kinematics.

Fig1a. A model of a Sarrus supporting reflector

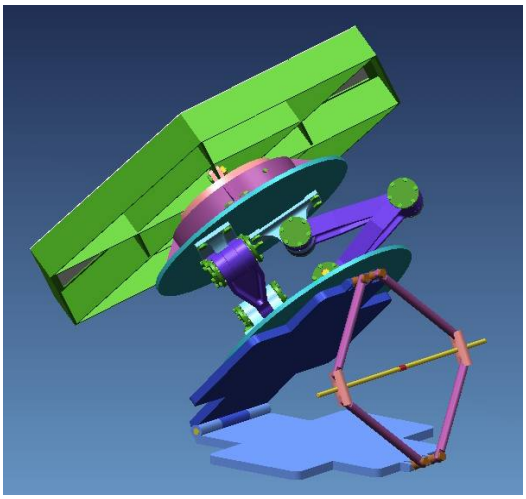


Fig1b. The CAD map of Sarrus mechanism

Secondly, for cable-supported mesh reflector, the theoretical analysis and design are almost completed, and a small scaled model is under construction before applying the design to the Miyun FAST demonstrator (MyFAST). The MyFAST is to be built to demonstrate all FAST major technical components, including a cable-car feed support system, a cable-supported mesh reflector, a high positioning equipment, and a L-band receiver etc. Fig.2 shows a sub-structure of six triangle panels and a connection node between these triangles, Fig.3 presents the force sensors developed for the cable strain measurements, all are made recently by the FAST project group in Harbin Institute of Technology (HIT), which is located in Heilongjiang province of northeast China.

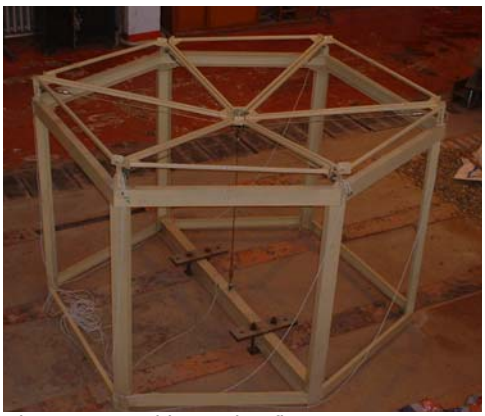


Fig2a FAST cable-mesh reflector: a sub-structure model

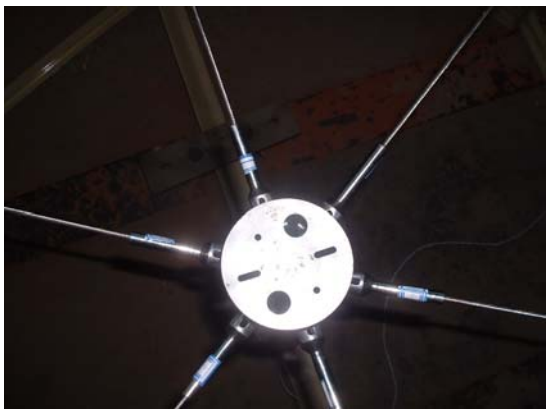


Fig2b FAST cable-mesh reflector: node structure

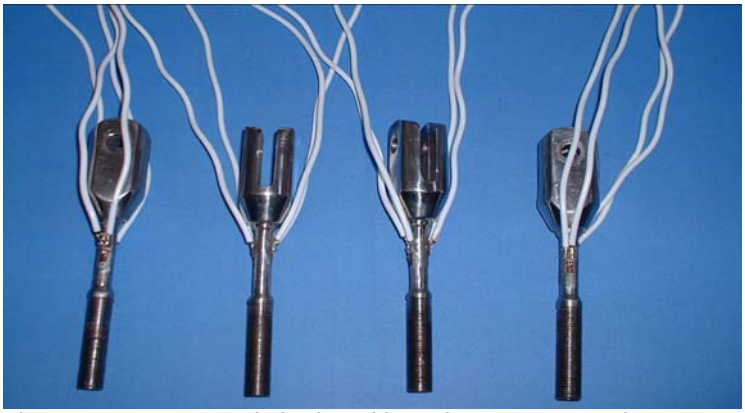


Fig. 3 Force sensors made for the cable strain measurements by FAST group in HIT.

Measurement technology

A technical review on measurement technology for FAST focus driven was held in Zhengzhou, capital city of Henan province in middle China, on November 3 in 2004. The evaluating committee was consisted of experts from NAOC, Wuhan University and Zhengzhou Institute of Surveying and Mapping. In order to achieve more accurate positions of the feed supporting system, some measuring systems of high sampling rate and high time stability have been looked into, such as, the feasibility on using the pseudo GPS and detailed study on total station (laser ranging) etc.

RFI monitoring activities

The RFI measurements following the “RFI Measurement Protocol for Candidate SKA Sites” were carried out for both modes one and two during November 3-16 in 2004 in Guizhou province. It was performed by the FAST team of Radio Monitoring Station of Guizhou at one of the SKA candidate sites, Shangjiachong depression in Puding county, which is about 149 km away from the proposed central area around Dawodang depression in Pingtang county, Shangjiachong depression is the site to be visited by members of the ISSC (International SKA Steering Committee) and SEWG (Site Evaluation Working Group) in March 2005. A photo demonstrating these observations is shown in Fig.4. The same but new monitoring program just started on November 25 at Miyun radio astronomy observatory in Beijing, which is about 1900

km away from the central area in Pingtang county. Furthermore, an approach to make RFI measurements more automatically (also means more costy) is under development, including software developments on observation (with some hardware) and data reduction. The current schedule is to re-start our RFI monitoring campaign for a year at the central site at Dawodang depression in the end of this year.

Fig.4 Observations at Shangjiachong depression in Puding county during Nov.3-15 in 2004: A log-period antenna (HL050) equipped on the RFI monitoring van (left), plus two accommodation tents (right).

Other news

Much of 2004 was spent in fund raising which is also time consuming for our limited manpower at the NAOC (National Astronomical Observatories, Chinese Academy of Sciences). The funding application for FAST design study from the National Natural Science Foundation of China (NSFC) was officially approved last October with a limited budget of 3 M RMB (Chinese yuan), but the main funds expected from the Ministry of Science and Technology (MoST) has not yet been granted.

There is little progress on re-constructing the FAST focus driven system at Miyun county in Beijing, which has slowed down the efforts on establishing the MyFAST due to various reasons, such as, the lack of budget and the land renting problems.

FAST Group in China

EUROPE

Status of the European SKA Design Study (SKADS)

The European SKA Design Study (SKADS), involved 32 organisations in eight EC countries (the main contributors being the UK, The Netherlands, France and Italy) and four non-EC countries (Australia, South Africa, Canada and Russia). The proposal was submitted to the EC for funding within its Framework 6 (FP6) programme in early March 2004. The total resource requested for SKADS amounted to about €38M and we sought €18M from FP6, leaving the remaining €20M to be sought from national sources. The heart of SKADS is the EMBRACE aperture array demonstrator, of area ~500 m^2, and this part of the programme will be led by ASTRON with significant involvement from France and from other partners. To ensure a timely completion of this large deliverable, EMBRACE will be a development of the ASTRON THEA system and will be restricted to a single polarisation. The EC assessors liked the SKADS proposal a lot and recommended that it be supported by the EC at a level of €10M (the advertised maximum for the FP6 Design Studies budget).

The current situation (mid-January) is that we are confidently expecting the EC to fund SKADS up to a total of ~€10M – this automatically implies that the major national funding agencies in Europe have agreed that the SKA is high on their national scientific priorities and hence that SKADS will attract "matching" funds. However, since the EC wishes the scope of programme not to change, we must increase the total of national contributions to €28M.

The EC has also told us that the SKADS work programme needs to:

- Provide a convincing case for the selected technology (based on phased arrays) for radio astronomy
- Provide proof of R&D readiness for the selected technology at the end of the Study
- Generate a science requirements document
- Generate an architectural design document and a preliminary project plan
- Target the costing issue (for the whole SKA) head on.
- Organise the community with an adequate level of industry participation – we interpret the latter as being a call to increase the participation compared with that in the original proposal

The EC has also stressed the importance to the EC of studies and actions in respect of large-bandwidth data transport and distributed processing across Europe.

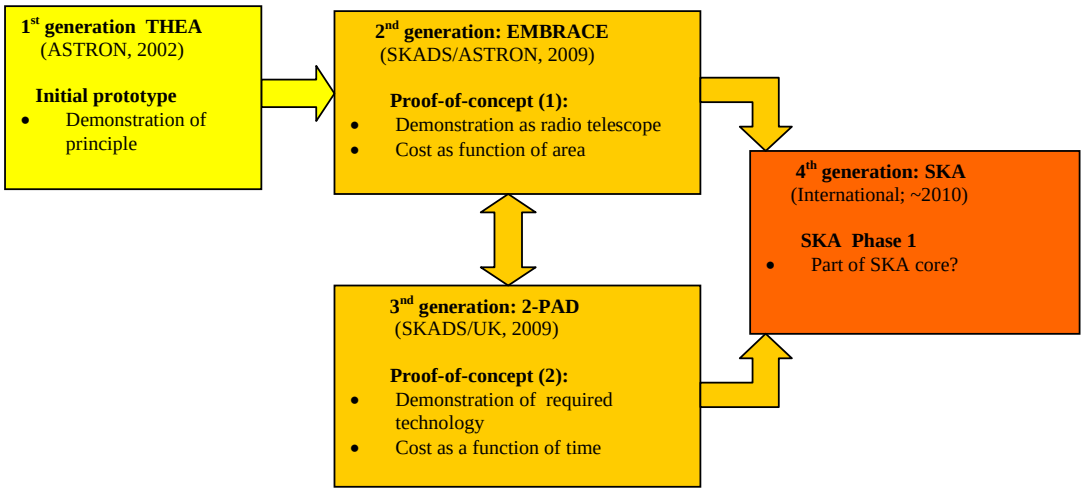
Coordinated by Arnold van Ardenne (ASTRON), the SKADS partners are now engaged in a careful scrutiny of the various aspects of the work originally proposed in order to respond directly to the EC's feedback. The formal requirement is to produce a "Description of Work" in preparation for the contract negotiations with EC – which are expected to start in February and to conclude in April/May. The Description of Work (not a rewritten proposal) has to contain clear statements on:

- Scope and objectives,
- Project methodology
- Roles of individual participants
- Milestones & deliverables and work planning schedules
- Manpower allocations and a full project management scheme

The European partners have a lot of experience in drawing up these documents, having run cooperative projects within Frameworks 3, 4 & 5 and most recently the large RadioNet programme in Framework 6. During the course of the discussions leading to the "Description of Work" we are having to take into account significant changes to the task structure which have occurred since the SKADS proposal was submitted 10 months ago. It is not appropriate to mention them all here but it is worth identifying three which have emerged:

DS3, which was originally designed only to be a set of paper exercises on the "Network and its Output Data" , will now involve a hardware R&D component to develop the technique of coherently transferring clock and LO signals via optical fibres over distances of 100s km.

DS4: which was originally designed as a series of tasks to push the sub-system technologies required for phased arrays to a generation after EMBRACE, will now include a deliverable. The UK SKA Consortium (which will include industrial involvement) intends to build and test a dual-polarisation all-digital tile ("2-PAD"); the basic R&D for 2-PAD will still, however, be carried out within the existing DS4 tasks. The following diagram makes the link between the various phased array developments clear.



Finally DS6, in Italy, will now principally be regarded as a test-bed for sub-systems for large area aperture arrays, rather than as a specific development of the cylinder concept. We have to demonstrate that the behaviour of phased array-based systems is predictable when working at higher sensitivity levels (and hence with more sources in the beam) than EMBRACE. This is a generic requirement and does not, to first order, depend in detail on the technology solution adopted. Re-engineering parts of the Northern Cross will enable us to test the characteristics of a complex beam-forming system on a collecting area of 8000m^2.

The European SKA Consortium MoU

A new ESKAC Memorandum of Understanding has just been agreed which sets out the basis on which the wider community of European radio astronomers (not just the SKADS partners) will cooperate to further the SKA project. The more immediate aims of the MoU are: 1) to validate the ESKAC chairman's signature of the 2005-2006 ISSC MoA on behalf of ESKAC and 2) to set out the basis on which the European ISSC members will be chosen for the next two years. Four ISSC members (from Netherlands, UK, France, Italy – the largest SKADS contributors) will be decided "by country" – by the national SKA consortia; two ISSC members will automatically be selected by "by position" (the coordinators of RadioNet and SKADS) and one other member will be selected *ad personam* by the ESKAC Board following a standard nomination and voting procedure. The formalisation of the European ISSC representatives will be completed before the next ISSC meeting in China.

Peter Wilkinson
Chair ESKAC

INDIA

News from India

Preloaded Parabolic Dish (PPD) project update

Activities related to this project are progressing on various fronts. While the receiver and control systems are being assembled and tested in the Raman Research Institute, Bangalore, the mount for the dish and the mechanical drive system are being fabricated by M/s. Jog Equipments Pvt. Ltd., Pune. Civil work has also picked up at the installation site in Gauribidanur. Meanwhile, various tests are being carried out on the dish at RRI in collaboration with the Central Power Research Institute (CPRI), Bangalore.

A single polarization 4 to 8 GHz front-end receiver being characterized in the field. The testing of the control system has been completed. To provide redundancy and flexibility in the system, we have investigated two approaches, one using a Programmable Multi Axis Controller (PMAC) and the other using a LINUX-based PC.

Modal analysis of the 12m PPD to determine its dynamical characteristics like resonant frequencies, damping values and patterns of deformation, has been carried out in collaboration with engineers at the Central Power Research Institute (CPRI), Bangalore. Based on the analysis carried out using NASTRAN FEM software and measurements on the assembled dish, it was decided to install stiffeners between the central hub and alternate spokes (Refer Fig. 2). This increased the resonant frequencies of various modes from 1.4Hz to 2.2Hz approximately. For modal analysis, the dish was set into vibration by a mechanical shaker (Modal shaker of 50 pounds capacity - See Fig. 2) and the system response to a driving force input was acquired using a special purpose data acquisition system. The average damping measured during the above modal testing is 0.98. Detailed analysis of the data to determine different mode shapes is under progress.

Test setup for modal analysis showing the shaker

A New Cluster Antenna Array at the GMRT Campus

A joint project is being initiated by NCRA and RRI to build at the GMRT site, a compact array with eight or more low cost parabolic antennas similar to the 12m PPD antennas, operating in the frequency range of 500MHz to 8 GHz. This would provide a realistic cost estimate for the mass production of PPD antennas and address several critical design and fabrication issues. The array will be a test bed for playing with new technologies that will be of interest for both GMRT upgrades and SKA.

The project is also of interest to local astronomers since it can complement observations at GMRT by providing short spacing information and greater frequency coverage. A need has been felt for a dedicated facility for regular flux monitoring of variable sources and pulsar timing, which are difficult at GMRT because of user pressure. An immediate goal for the array would be to complement ASTROSAT, the Indian X-ray/UV satellite that is scheduled to be launched in 2007.

A study is being carried out by the Tata Consulting Engineers to optimize the design and fabrication procedures for the 12m PPD dish in order to minimize building and maintenance costs. Studies are also under way at RRI, to optimize the configuration of the antennas, given the different requirements.

N. Udaya Shankar (RRI)
A. Pramesh Rao (NCRA-TIFR)

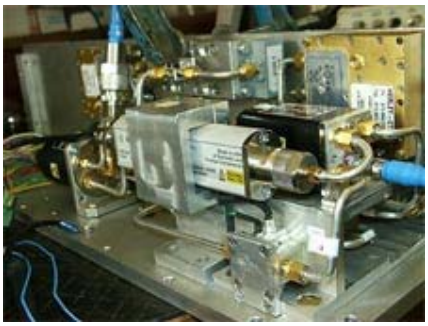
SOUTH AFRICA

Site Evaluation

The South African SKA project team have responded to the site RfP issued by the ISSC and work has begun in earnest on critical aspects of the RfP such as RFI measurements and array configuration.

On the RFI front, a team lead by RFI project leader Gerhard Petrick has assembled, tested and installed the measurement instrumentation to be used at the fixed station located at our representative core site. The team includes George Nicolson, Justin Jonas, Paul Manners (an MSc student), and engineers and technicians at HartRAO. This equipment, which is designed to be fully automated to allow unattended operation, has started to acquire Mode 1 and Mode 2 data at the core site in order to ensure a full year's coverage as required by the RfP.

Japie Fourie and Paul Manners checking the masthead unit that contains LNAs, mixers, local oscillators, noise diode and support electronics



Close-up image of the components and "plumbing" in the masthead unit.

The site is on the farm Losberg in the remote and arid Karoo region of the Northern Cape province of South Africa. The geographic coordinates for the site are 21°19'17" E, 30°42'22" S. The farm owners, Jan and Ronelle Louw, have provided invaluable assistance in establishing the site and its infrastructure on their property. The site infrastructure includes a prefabricated office with three individually airconditioned rooms, a 20 kVA 3-phase diesel generator and a satellite communications link (telephony and internet). The ASTRON RFI team will be visiting the site early in 2005.

View of the mobile office at the RFI measurement site on the farm Losberg. The antenna and mast assembly for RFI measurements is visible to the right of the container.;

Construction of two identical sets of RFI measuring equipment is underway. These sets will be used as mobile measuring stations that will be used to obtain "snapshot" measurements at proposed remote station sites, and to make a grid survey of the proposed core and central regions.

The SA configuration team has been interacting with and participating in the activities of the SKA configuration subcommittee lead by Steve Tingay. A reference configuration for the SA site proposal has been generated that will be used to determine construction and operation cost models. Further iterations of the configuration will continue in consultation with the SKA configuration subcommittee.

Because the South African configuration proposal includes sites in countries throughout Africa it has been essential for the establishment of partnerships with these countries. During October a second workshop was held with government and scientific representatives from Namibia, Botswana, Mozambique, Madagascar and

Mauritius to discuss cooperation with regard to the SA SKA site proposal. Site visits to these and other relevant countries will be made in the first quarter of 2005.

Group photograph of delegates at the regional SKA workshop held in Pretoria during October 2004.

The "Karoo Array Telescope"

The Department of Science & Technology has commissioned the SA SKA project team to design and build a radio telescope in the Karoo region that is closely linked to the SKA science goals and includes elements of the proposed SKA technology concepts. The telescope will be an array of dishes with focal plane array feeds operating in the 700-1750 MHz band. Multi-beaming will be a key feature of the telescope, with maximum use of reconfigurable digital hardware being used in all subsystems.

The development of this telescope is intended to be a full collaborative project with the South African development team working closely with existing international SKA technology programs. In particular, the development of the digital focal plane array will be closely linked to the EU SKADS project. The South African demonstrator development team is currently being recruited, and further technology partnerships are to be investigated once this team is up and running. This team will be draw from academic and industrial institutions. Close scientific partnerships are also being pursued, and the scientific goals of the telescope will be developed in conjunction with and international reference panel.

Justin Jonas
South African SKA Project Team

USA

US SKA Consortium

Early in 2004 the US SKA Consortium submitted, via Cornell University/NAIC, a Technology Development Proposal for the SKA Large Number of Small Dishes concept to the National Science Foundation. In October 2004 the TDP leaders met with a special NSF appointed evaluation panel and discussed the merits of the proposal and answered various key questions. We are now waiting advise and comments from the NSF.

Meanwhile, large US delegation attended actively the various SKA related meetings last summer in Penticton, Canada, and the US SKA Consortium has had an official meeting on October 8, 2004 at Virginia Tech.

Development work for the LNSD design is progressing well through our current NSF grant. Among other advances the process for hydroforming precise reflectors has been empirically developed by Andersen Mfg. Co. In addition, a versatile 12m/16m antenna was conceived with a hydroformed inner 12m diameter for frequencies up to 35 GHz surrounded by a 2m wide mesh surface to form a 16m reflector for frequencies under 2 GHz. This doubles the sensitivity of the US SKA concept in the frequency range 0.1 to 1.4 GHz of great scientific interest. This design was described by Sandy Weinreb at the SKA 2004 Penticton meetings. Mechanical engineering for the mount design for this concept is in progress.

In the area of wideband feed designs, a log-periodic feed with a phase-center which does not change with frequency was invented by Per-Simon Kildal at Chalmers University in Sweden, and he and his group have been contracted to test the feed for the SKA application.

The SKA requires very low noise amplifiers with decade bandwidth. Monolithic Microwave Integrated Circuits (MMIC) technology seems to be the choice, and in addition all the decade bandwidth feeds have balanced output which require differential input LNA or active balun. These devises have been successfully designed and tested by Sandy Weinreb and N. Wadefalk.

In other developments, a complete 12m antenna to be delivered by mid 2005 has been ordered by JPL for the Deep Space Network Array from the Patriot Company of Albion, Michigan. The antenna has a 0.3mm rms surface tolerance sufficient for efficient operation to 40 GHz and is being designed for relatively low-cost mass production. Patriot is a volume manufacturer of small antennas and is currently delivering 6000 units per month.

The NSF Advanced Technology and Instrumentation grant (2002-2005), in addition of the work mentioned above, has supported development of the SKA simulator software at Haystack Observatory (and now transferred to Swinburne). Work on RFI characterization and mitigation has taken place at Cornell, Haystack and Virginia Tech and has included analysis of data acquired at Arecibo and the Green Bank Telescope. Results of this work were reported at the Penticton RFI2004 meeting in July 2004 and more results are forthcoming.

Progress at the ATA site where 32 antenna pedestals have already been completed and the dishes will be installed early in the new year.

Work has also been done in wide-field surveys for pulsars and transient radio sources. In particular, estimates of some of the processing requirements for wide-field, fast-dump imaging and beam - forming have been made and survey metrics for completeness have been devised. A report on this work is now in preparation.

Other aspects of SKA Technology development are also taking place at MIT/Haystack, Cornell/NAIC, Berkeley/SETI/ATA, and NRAO, among other centers.

Yervant Terzian
Chair, US SKA Consortium

OTHER NEWS

WORLD YEAR OF PHYSICS 2005

Happy New Einstein Year!

The 100th anniversary of Albert Einstein's "Miraculous Year" is celebrated this year which has been named the "World Year of Physics". Events and media coverage are aimed to raise the worldwide public awareness for physics and also physical science.

Indeed, Einstein's legacy still fascinates not only physicists but also members of the public alike. In particular, the question about physics beyond Einstein's theories is grabbing the attention. For example the question as to whether the Theory of General Relativity remains the last word in our understanding of gravity or not -- a question that was also included as one of eleven questions raised in ``Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century'' -- is pursued with with great efforts. The construction of gravitational wave detectors or the launch of sophisticated satellite missions like Gravity-Probe B represent only some of those. The answer to this question about gravity is important as it will have a huge impact for our attempts to formulate a theory of quantum gravity, as flaws discovered in general relativity would change our view about gravitation dramatically.

Astronomy, and in particular radio astronomy, has played and will continue to play an important and irreplaceable role in unravelling the mysteries our Universe and the physical laws that governs it. The three Nobel Prizes for Physics awarded to radio astronomers for the detection of the Microwave Background, the discovery of pulsars and the verification of the existence of gravitational waves are excellent examples that illustrate how radio astronomy probes fundamental physics and the prediction of seemingly untestable theories.

The Square-Kilometer Array (SKA) will continue this tradition as Key Science Projects probe the mysterious Dark Energy, study the first black holes and the pulsars discovered around stellar black holes are used to test general relativity in the ultra-strong field regime. Indeed, pulsar-black hole systems will provide unprecedented probes of relativistic gravity with a discriminating power that surpasses all its present and foreseeable competitors. The recent discovery of the first double pulsar illustrates beautifully how present limits on the validity of general relativity can be pushed to new extremes when new exciting discoveries are made.

While these are brilliant examples how the SKA will produce breakthroughs at the forefront of scientific research, the amount of wonderful physics that we will be studying with the SKA is even much larger. Fundamental questions about the origin and evolution of cosmic magnetism, the evolution of galaxies and large-scale structures, the birth of planets and life are only a few topics among the 50 or so chapters that the science book includes. Almost every part of physics is represented and World Year of Physics offers a wonderful opportunity to promote this.

Michael Kramer
Chair Outreach Committee

EUROPEAN INDUSTRY DAY REPORT

The SKA Project has a policy of increasing its interaction with industry and, as part of this initiative, a one-day forum for European industry was held at Dwingeloo on Friday 3 December 2004. Organized by the ISPO and ASTRON, the day attracted about 40 people, including about 10 representatives of large trans-national companies. The program, presentations and other details can be found on the Web at http://www.skatelescope.org/IndustryDay/index.htm A notable feature was the video recording of the sessions, an initiative suggested by Harvey Butcher and financed by ASTRON. Selected video excerpts will soon be available via the Web site and the wider SKA community is likely to find the afternoon sessions of particular interest.

Goals of the industry day were to present the SKA project to major potential industry partners and stimulate early interest; to highlight European SKA activity; to look for examples of best-practice in industry-science links; to air the issues surrounding intellectual property and other legal issues; and to seek input to the development of a strategy for SKA-industry liaison.

Companies represented at the gathering included Alcatel, Cisco, HP, IBM, MAN and Philips. The day was framed as an informal briefing and discussion forum, with the ISPO giving initial disclaimers relating to the forum's link to any future commercial liaisons. Current direction in the SKA project were described by a number of speakers including Harvey Butcher, Richard Schilizzi, Peter Hall, Arnold van Ardenne, Jan-Geralt bij de Vaate, Parbhu Patel and Peter Wilkinson. After presentations by the SKA speakers, company representatives were invited to give their views on the project, including their perspectives on how it may interest the industry sector(s) in which they operate. Michel Apers (Program Manager, Business Unit Observation and Sciences, Alcatel Space), Ruud Haring (Team Leader, Blue Gene Chip Design, IBM Research) and Brett Biddington (Space Initiatives Manager, Global Space Team, Cisco Systems) gave brief presentations, all of which raised interesting technical and logistical issues to be faced by the SKA project.

An advantage of holding the Industry Day at ASTRON was the readily-available experience of those actually building a new-generation telescope, namely LOFAR. Eugene de Geus (Director, External Affairs, ASTRON) did the SKA project a great service by outlining LOFAR experiences to date, including experience flowing from R&D programs which are tightly integrated with industry. Eugene also chaired an interesting afternoon panel discussion which focused on logistical and legal issues in multi-national projects. Panel members Niels Eldering (ESA Technology Transfer and Promotion Office), Stephen Kahn (ProContra bv) and Jan Reitsma (LOFAR Project Manager) provoked a spirited discussion which extended well into an informal drinks function held after the close of the sessions.

Logistical and financial support for the Industry Day came from the ISPO and ASTRON. In particular, Astrid Marx and Stephanie Voegele provided valuable behind-the-scenes assistance.

A few specifics to emerge from the day include:

- Advances in high performance computing will make it increasingly attractive to consider HPC as at least a partial replacement for “traditional” DSP techniques. The processing rates demanded by SKA are easily consistent with predicted peak computation speeds and there will be substantial gains in the average speeds of clusters. HPC gains beyond ~2010 will no longer come from device scaling, nor will they come easily from any other single path. Instead, speed gains will arise from a succession of one-off “tricks”, system-level (not just chip) optimization, and advances in high-speed I/O technology (e.g. active equalization). Power consumption (dissipation) and reliability will be issues, but probably resolvable ones.

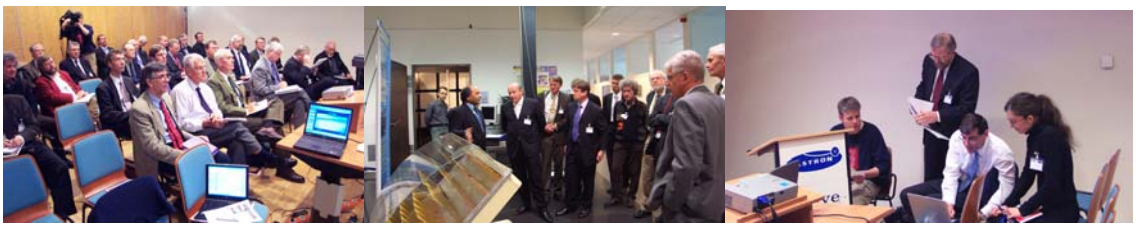
- The massive deployment of networked RF identification systems and other wireless sensors will dramatically affect low-cost RF systems and network design, leading to much greater development in “edge-server” architectures: architectures in which large amounts of pre-processing are done at the edge of a network which ultimately feeds data to hubs. Some of this development may be applicable in very large distributed systems such as the SKA, either in the context of system monitor and control (based around new-generation internet protocol standards) or, more interestingly, for signal or data processing.

- The SKA is a big enough project to influence substantially the national networking strategies of some countries. Dual scientific and commercial use of some SKA communications infrastructure is an obvious route but the project influence extends to e.g. impacting government and market views of alternative carriers, such as satellite and military operators.

- There are substantial challenges in meeting international legal requirements for a project needing industry involvement in both pre-competitive and procurement phases. Without care, and a diligent arm of management devoted to the challenges, it is possible to lock-out early collaborators from participation in later procurement activities. Rules are similar in principle in major blocs such as the European Union and the USA but there are differences in detail. Nevertheless, there are examples of successful collaboration: the European contribution to HST was mentioned as one of them. Framing the SKA project to make possible observance of, for example, World Trade Organization rules, could dictate the way work packages are allocated and performed and, effectively, the structure of the project. It is even possible that the project structure, incorporating industry participation in various phases, will influence the system architecture: the idea of defining some system blocks in terms of what can be developed and procured via an interested industry partner is one pioneered by LOFAR.

- Several industry attendees expressed a view to the effect that, to meet advertised milestones with industry involvement or even vocal support, the SKA project office now requires a strong industry and international legal branch.

- On a lighter note, the audience was grateful to Brett Biddington for adding three important overlays to the usual seven networking layers. Sitting on top of the applications layer was religion (“that’s how we’ve always done it”), politics (“its my data!”) and economics (“we can’t afford it”). Those present resolved be wary of these mind-sets when planning the SKA.



A few images from the European Industry Day – more are available via the Web. The audience heard briefings from both SKA project and industry attendees, and had the opportunity to view phased array development work. Collaboration between the ISPO and ASTRON made the day possible and allowed a Web record of proceedings.

The European industry day was undoubtedly successful in airing and raising many issues for the SKA project. Concrete technical collaborations with national consortia offer the best short-term possibilities for industry involvement. In addition, industry participation in EWG and other international Task Forces is encouraged, and forums such as that held at Dwingeloo are useful in highlighting these opportunities. The next stage is for the SKA project to form an additional EWG sub-group, to be known as the Industry Liaison Task Force and chaired by the International Project Engineer, with the role of advising the project on industry matters. The ILTF will generate a second whitepaper on industry policy by the end of 2005, extending the commentary of SKA memo 52 beyond pre-competitive alliances. The suggestion from those present in Dwingeloo to expand the industry linkage role of the ISPO were well-taken; this of course is a challenge to a project still seeking funding for technical and scientific management but it may, nonetheless, be essential if engineering and funding milestones are to be met.

Finally, it is clear that there is a place for future SKA-industry forums, including gatherings to address the legal and trade issues which have now been partially exposed. Several attendees from trans-national companies expressed interest in a North American forum and this suggestion will be followed up by the ISPO.

Peter Hall
SKA Project Engineer