

Report of the Radio Astronomy Committee, June 2007

1) A RAC telecon was held May 2, 2007. Attending were: Sean Dougherty, James di Francesco, Martin Houde, Judith Irwin, Ingrid Stairs (Chair), Ken Tapping

2) Old business:

a) We are still concerned with the imminent need to find a replacement for Ken Tapping on spectrum management. Ken has sent a email to Tom Landecker and Greg Fahlman indicating that he will likely step down as spectrum manager as of Jan. 1, 2009, leaving only 1.5 years to train a replacement. At least one person within NRC could be trained to take over the job. We again ask for the Board's support on this issue.

b) We have again been approached by OIRAC with regards to a proposed merger of our two committees into one ground-based astronomy committee. We still feel that we have plenty of work to do in supporting and promoting Canadian radio astronomy, and moreover feel that our role also includes a large advocacy component, to ensure that projects such as MIRANdA and the SKA go forward in Canada as well as on the international stage. Therefore we strongly believe that the RAC needs to continue to exist as a separate committee.

3) RAC administration:

Judith Irwin is stepping down from the RAC; we thank her for her long and effective service and chairship. We have asked Gilbert Holder of McGill University to replace her, and he has agreed to join. We request that the Board endorse his membership in the RAC.

Ingrid Stairs is willing to stay on as chair of the RAC for one more year (with the understanding that this requires staying on for another year beyond that to overlap with the next chair), and none of the other members have objected. James di Francesco will also stay on for one more year. We request that the Board approve these reappointments.

With Judith leaving the RAC, the RAC webpages need to be moved from Queen's. James di Francesco is investigating hosting the pages at the University of Calgary.

4) Canadian Square Kilometre Array Science Advisory Committee (CSSAC):

It was time to refresh the membership of the CSSAC, as the terms of many members had expired and some had left the country, etc. As of April

2007, the membership and expiry dates were:

Name	Term	End Date
Gilles Joncas	3 yrs	Spring/06
Norbert Bartel	3 yrs	Spring/06
Don Campbell	2 (ren)	Spring/07
Sean Dougherty	3 yrs	Spring/06
David Halliday	3 yrs	Spring/06
Judith Irwin	2 (ren)	Spring/07
Vicky Kaspi	3 yrs	Spring/06 (CASCA rep to the board)
Ue-Li Pen	3 yrs	Spring/06
Russ Taylor	continuing	
Meyer Nahon	3 yrs	Fall/07
Chris Blake	3 yrs	Spring/08
Gil Holder	3 yrs	Spring/08
Claude Carignan	3 yrs	Spring/08

(Ren=renewed at the request/agreement of the individual.)

Some members graciously agreed to renew their appointments; others felt it was time to leave. The departing members are:

Don Campbell
Chris Blake
Judith Irwin
Vicky Kaspi
Meyer Nahon

We have not heard from David Halliday and may need to assume that he will depart also.

The following people have agreed to start serving 3-year terms on the CSSAC; we ask the Board to endorse these new members:

Mike Bietenholz, York University
Jo-Anne Brown, University of Calgary
Ingrid Stairs, UBC
Jasper Wall, UBC

The full proposed CSSAC roster is then:

Name	Term	End Date
Gilles Joncas	2 yrs(ren)	Spring/09
Norbert Bartel	2 yrs(ren)	Spring/08 Chair
Sean Dougherty	2 yrs(ren)	Spring/09
Ue-Li Pen	2 yrs(ren)	Spring/08
Russ Taylor	continuing	

Gil Holder 3 yrs Spring/08
Claude Carignan 3 yrs Spring/08
Mike Bietenholz 3 yrs Spring/10
Jo-Anne Brown 3 yrs Spring/10
Ingrid Stairs 3 yrs Spring/10
Jasper Wall 3 yrs Spring/10

(Ren=renewed at the request/agreement of the individual.)

We note that we propose to retain Vicky Kaspi as the CASCA representative on the CSKA Consortium Board.

5) CCAT: We have been asked for our opinion on the funding strategies for the CCAT telescope, the proposed ~\$100M USD facility/proposal 25-m submillimetre telescope to be situated near ALMA and with the possibility to do lots of 200-micron observations. So far Mike Fich and Mark Halpern represent the Canadian interest in this telescope. The RAC thinks that if the timescale for construction is less than roughly 4 years, it makes sense for the Canadian contributors to forge ahead and secure as much private funding as possible. The wider Canadian community could then be asked if they want to participate. There will be a meeting in July with Caltech/Cornell and the Canadian parties; both funding possibilities and timescales may become clearer at that point. We point out that if this becomes a large publically-funded project, it needs to be incorporated into the next LRP.

5) Telescope and subcommittee reports:

a) Spectrum Management:

1. DRAO Radio Astronomy Protection Zone: For more than a decade, DRAO has been protected by a roughly 250-km protection zone in which the operation of other services is subject to restrictions. This protection zone has not been firmly documented officially. With increasing pressure for accommodating both new users in current services and additional services in a finite amount of spectrum, it has become expedient to better define this protection zone. There is a need for harder and more detailed criteria to apply to licensing issues and in dealing with interference issues, and for something officially embedded in Canadian policy.

DRAO, together with the Industry Canada offices in Kelowna, Vancouver and Ottawa, together with UBC are working together in a study to develop the more detailed definitions. The project comprises two main threads: theoretical modelling of propagation losses for paths from points within and outside the zone to DRAO and measurements made of the actual received signal strength from a

mobile transmitter visiting as many of the calculated paths as possible. This will provide a better understanding of DRAO protection needs than ever before.

At DRAO there will be a calibrated receiver to detect the transmissions and an Industry Canada standard interference monitor operating to see how well the monitor provides information needed to identify interference likely to degrade observatory operations. This will no doubt require a number of iterations, and will no doubt require several months to satisfactorily complete the work.

Protection zones are an important issue these days, and it is hoped that one by-product of this study will be methods and criteria that can be applied more generally in establishing such zones around observatories.

Initially this study will be in the 406.1- 410 MHz radio astronomy band. Serious measurements will start before the end of May 2007. If all goes well the study will be expanded to other frequency bands of interest. There will be a paper presented on this at the URSI Meeting in Ottawa. The USA is interested and wants to do something in parallel, collaborating as appropriate. Mexico may also be interested in relation to the MMT, which recently saw first light.

2. Infrared and Near-Infrared Astronomy: Following the decisions in the last meeting of the RAC, a proposal document was prepared describing some of the problems and protection criteria for astronomy in the infrared and near-infrared bands arising from the advent of interest in using these bands for space and space-Earth communications. The document was taken up by Canada and proposed in Geneva. With minor modifications it was taken up and accepted as a starting point for a major international report on this issue.

3. CORF: Ken is a member of the US Government Committee on Radio Frequencies, which met in Washington on 25-26 April. Some issues arising are: ultra-wide-band radars (the Chilean government has approved their use on cars for collision avoidance); Broadband internet over Power Lines (BPL; going ahead despite concerns raised about interference); international radio-interference protection zones (which are difficult to establish given that countries tend to be protective of their sovereignty).

b) JCMT:

SCUBA-2 is expected to arrive at the JCMT late this summer (September), equipped with engineering grade arrays. It is

scheduled for mounting to the telescope in October. Science grade arrays should in place in time for commissioning in November, December, and January. Four nights per week will be allocated for commissioning during that period. There is apparently still a significant chance for delays.

HARP/ACISIS is working fine for the most part, although there are still a number of small problems. It can currently be used in raster, jiggle, and single pointing modes. The multi-subsystem mode for observing two or more lines simultaneously should be ready soon. Frequency switching is still not available, and there are some problems with the beam switching (chopping secondary) mode where the noise level is not integrating down as expected.

ROVER, the line polarimeter, is still waiting to be commissioned. The software still needs to be developed and somebody (Walter Zwart) was recently hired for this. It is hoped that commissioning will take place in 07B.

Rx W (345 GHz and 690 GHz dual-polarization receiver) was used at the beginning of the current semester. It is still experiencing a lot of problems at 345 GHz, while the 690 GHz mixer is broken and the Gunn oscillator was sent for repair. Repairs to be completed by June 07 with observations starting the following month.

Rx A (230 GHz) is working fine.

ESMA testing at 345 GHz is progressing well. Plans are made for two science demonstration runs (one week in November and another week in January). A call for proposals could be issued in the summer.

c) ALMA:

i) ALMA Personnel News

A) ALMA Project Scientist: Richard Hills. In January, the ALMA Project Scientist, a longstanding open position, was filled by the recruitment of Prof. Richard Hills of Cambridge University. Prof. Hills may be remembered as a key figure in the JCMT, most recently stewarding the completion of the HARP focal plane array.

B) ALMA Deputy Project Scientist: Alison Peck. In February, a Deputy Project scientist was hired to assist the PS with ALMA construction duties. The person hired is Dr. Alison Peck, formerly of the Smithsonian, where she worked as a Staff Radio Astronomer in Hilo responsible for all science and observer scheduling at the Submillimeter Array.

C) Head of Science Operations (in Chile): Lars-Ake Nyman. In December, it was announced the Dr. Lars-Ake Nyman, formerly of ESO, is relocating to Chile to become the Head of Science Operations that will oversee the Assembly, Integration and Verification phase of ALMA.

D) ESO Director General: Tim de Zeeuw. Effective 1 September 2007, Tim de Zeeuw, formerly of Leiden University, will become the next Director General of ESO, replacing Catherine Cesarsky.

E) Director of Nobeyama Radio Observatory; Ryohei Kawabe. In March, Prof. Ishiguro announced that Ryohei Kawabe will be the next Director of the Nobeyama Radio Observatory.

F) ESO Project Scientist: Leonardo Testi. Effective May 1, Leonardo Testi joins ESO as the European ALMA Project Scientist, replacing Tom Wilson who is becoming a manager at ESO.

ii) Major Milestones Met

A) First Fringes at the ALMA Test Facility. On March 2, two ALMA prototype antennas were first linked together as an integrated system to observe an astronomical object, Saturn, and the detection processed by the test correlator. Saturn was tracked for more than one hour. This culminated ~6 months work on holography, pointing and tracking to achieve the first astronomical detections by ALMA systems.

B) Integration of the first cartridges into the ALMA Front End at the North American Front End integration centre. Several pre-production cartridges of all bands have been delivered and accepted. Within the test cryostat, two cartridges have been operated simultaneously. Electromagnetic Compatibility tests have begun. Beam maps have also been made, allowing for corrections to minimize sidelobes. Construction of an upgraded two-station prototype correlator, including Tunable Filter Banks (TFBs) to be deployed at the ATF has begun. Front End #1 (Ser. No. 2) chassis construction and wiring have also been substantially completed. A schedule for the final integration, acceptance tests and delivery of FE #1 to the Antenna Test Facility is under way.

C) Major Review of the ALMA Operations Plan and the NAASC Operations Plan were held at NSF Headquarters in late February 2007. In general, both went rather favourably, with complements given to the teams who worked on each on the level of maturity of the project and the degree of international collaboration

achieved. The reviews were attended by J. Hesser and L. Knee of NRC, who provided context about Canadian participation to the panel. Details of Canadian participation in the NAASC are continuing to be defined with further meetings by NRC and NRAO planned this year. (Note, however, that no new LRP funding was given the most recent Canadian federal budget.) The written Panel reports were given to the ALMA Board in Tokyo in late March, and the JAO is working on its response.

D) First Antenna Hardware in Chile: In late April, the pedestal assembly for the first VertexRSI production telescope arrived in Antofagasta, Chile and will be trucked to the OSF to join the other elements of the telescope, including the backup structure and the invar cone which joins them.

iii) Other News of Interest

A) More than 300 astronomers met in Madrid for the second ALMA conference, Science with ALMA: a new era for Astrophysics, held 13-17 Nov. PDF files containing most of the talks and many posters of the "Science with ALMA" meeting held in Madrid last month are available via the symposium web pages:
<http://www.oan.es/alma2006/>

B) Spain joined ESO officially Feb. 14, 2007. Standard description of ALMA changed to reflect new participation: "The Enhanced Atacama Large Millimeter/submillimeter Array (known as ALMA) is an international astronomy facility. ALMA is a partnership between North America, Europe, and Japan/Taiwan, in cooperation with the Republic of Chile, and is funded in Europe by the European Southern Observatory (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC), and in Japan by the National Institutes of Natural Sciences (NINS) in cooperation with the Academia Sinica in Taiwan. ALMA construction and operations are led on behalf of Japan/Taiwan by the National Astronomical Observatory of Japan (NAOJ), on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), and on behalf of Europe by ESO."

C) Chile construction news. A ceremony was held on March 7, 2007 at the 3000m altitude Operations Support Facility (OSF) to celebrate the completion of the roof structure on the OSF technical facility building. (It is slated to be finished in January 2008.) In addition, construction continues for the VertexRSI Site Erection Facility. At the 5000m Array Operations

Site (AOS) on March 14, 2007, the first internet connection between the AOS and the outside world was made (an email was sent). Also, road layout and antenna pad drawings have been distributed for review.

D) ALMA Design Science Reference Plan V2.0 near complete. The first ALMA DRSP provided info about commonly used modes of ALMA and priority estimates for ALMA science operation planning. A new version has been just completed including new ALMA capacities resulting from Japanese participation (i.e., the ACA, 3 new Bands) and should be available online soon.

iv) Canadian ALMA News

A) Band 3 cartridges. The second Band 3 cartridge has been shipped to the NA Front End Integration Center. Provisional Acceptance In-house (PAI) was successfully concluded for the third cartridge. Acceptance testing for the fourth cartridge is about to start.

B) Doug Johnstone has become the new Canadian member of the ALMA Science Advisory Committee, replacing Christine Wilson. Chris will remain Canada's ALMA Project Scientist, and may participate in ASAC on an ex-officio basis. Doug's first face-to-face ASAC meeting will be in Tokyo, Japan the week of April 6. Chris is also rotating off the ALMA North American Science Advisory Committee, and the Canadian community should provide NRAO Director Fred Lo with some suggestions for replacements.

C) The Band 3 team at NRC-HIA received some press coverage due to a news release describing the Band 3 project. Progress on the remaining 4 pre-production receivers is continuing. A Critical Design Review is expected to be held this spring.

D) The next meeting of the Canadian ALMA Science Steering Committee will be held in Kingston, ON on June 3-4, just prior to the CASCA meeting. Chris Wilson, Canadian ALMA Project Scientist, will chair the Committee, and other members include Doug Johnstone, James Di Francesco, Douglas Scott, Michel Fich and Stephane Courteau and Tracy Webb.

E) The upcoming URSI meeting in Ottawa will have 5 day session on July 22-26 about radio astronomy. Coordinated by Canadian ALMA Project Manager Lewis Knee, the morning of Tuesday the 23rd will be devoted to "Advances for the ALMA" with talks by Christine Wilson and members of the NRC-HIA Band 3 team (Stephane Claude, Frank Jiang & Philip Dindo) among others.

F) Rene Plume of the University of Calgary is planning an two-day "Observing with ALMA Workshop" to be held in Calgary, AB the week after CASCA 2008 (May 26 & 27). This workshop will focus less on the science potential and more on science exploitation of ALMA, by describing its capabilities, and providing hands-on practical demonstrations on planning, executing and reducing ALMA data. A flyer advertising the workshop will be given out at the Kingston CASCA meeting. In addition, an ALMA "primer" containing descriptions of interferometer concepts and concrete examples of ALMA projects will be produced prior to the meeting and distributed to the community. Registration deadline is May 1, 2008 and full travel support is expected for the first 20 graduate students to register!

v) Upcoming ALMA Plans

Still to come in 2007:

- First ALMA receiver packages delivered from NRAO New Technology Center to Antenna Test Facility and to Operations Support Facility
- First transporter at Operations Support Facility
- ALMA bilateral correlator from NRAO New Technology Center installed at the Array Operations Site Technical Building

d) Education and Outreach: Sean Dougherty will present a poster on the EVLA at the CASCA meeting at RMC.

e) EVLA:

The WIDAR correlator project is proceeding as expected at this stage. Testing of correlator chips continues prior to committing to the production stage. The large station and baseline boards that form the backbone of the correlator are also under test currently, with tests proceeding as anticipated. These are the most sophisticated boards that contractor Breconridge Manufacturing Solutions of Ottawa has ever assembled.

Other EVLA news: The Science Advisory Group for the EVLA (SAGE) is holding its inaugural meeting on May 22-23. SAGE was struck by the Director of NRAO to advise him on science priorities during the completion of EVLA construction and will continue to advise on user priorities during the first years of EVLA operations. SAGE consists of 15 members, largely from the US. Canada is represented by Sean Dougherty. The discussion points at the first SAGE meeting are

focused on establishing awareness in the wider astronomy community to the broad, and largely new and unique, science capabilities of the EVLA, and on setting the science priorities for the EVLA as the construction phase comes to an end and the operations phase ramps up. As an example of new capabilities, the broad-band range of the EVLA C-band receivers is being offered to users with the limited number (9) of antennas that have been upgraded to date.

f) SKA:

There is currently a lot of momentum in the SKA project. The EU Framework 7 (FP7) proposal "PrepSKA" has been submitted. PrepSKA is a global endeavor involving funding agencies, scientists and engineers from all nations involved in the SKA project, to explore the appropriate legal, policy and technical frameworks required for the SKA. It proposes to use EU funding (~8MEuros) to facilitate larger levels of matching in-kind contributions (~22MEuros) from countries in Europe, and from the rest of the world. The goals are to produce an implementation plan that leads to the SKA, including:

- i) a costed, top-level design for Phase 1 of the SKA (Phase 1 is a 10% SKA working initially between 0.3 and a few GHz)
- ii) to further characterize the two candidate sites for the SKA (Australia and South Africa)
- iii) provide options for viable governance and the legal framework for the SKA during its construction and operation.

The plan is to execute this work in the 2008-2011 time frame. Canada is playing a significant part in PrepSKA, largely through the R&D on-going at HIA and in universities. Principally, the R&D is on composite antenna technology, phased-array feed development, digital systems, low-noise amplifiers, software simulation and data processing. An integrated part of PrepSKA is the MIRANdA project, the SKA science and technology pathfinder project being advanced in a collaboration between Australia and Canada.

Much of the technical effort in Canada is also being directed at the US Technology Development Project (TDP) proposal that has been submitted to NSF. This proposal requests 19M\$USD over the next 5 years, to support studies of several areas of risk pertaining to performance and cost of the SKA. The TDP R&D theme is to identify technology costs as a function of frequency, so that proper choice of technology can be made for the entire SKA frequency range (0.1 - 25 GHz). Canada is carrying out R&D as part of its participation in the TDP in areas related to antenna fabrication (composite

antennas), feeds and receivers (U of Calgary LNA work) and survey design (U of Calgary Radio Astronomy Group).

The SKA-pathfinder telescope proposed by the Australians, formerly known as MIRA, has now been named MIRANdA (MIRA Large N-small d array). MIRA is now an observatory name that encompasses all of the telescopes envisaged for the West Australian site - of which MIRANdA is one. In March there was a meeting held at ATNF in Sydney, Australia on Focal-Plane Array technology for the SKA, followed by a two-day meeting on Science with MIRANdA. There was strong Canadian participation in both these meetings, with eleven attendees from Canada, including engineers from HIA, and scientists from both the university community and HIA. Following the science meeting, there was a face-to-face meeting of the Australia/Canada MIRANdA collaboration. A result of this meeting was a joint communique, a highlight of which was the affirmation that MIRANdA is on -- and remains on -- the international science and technology path to the SKA and thus it aims to:

- i) prototype technologies central to phase 1 of the SKA, namely 12-15m reflectors and focal-plane array feeds
- ii) significantly advance the areas of science relevant to the SKA
- iii) provide essential site and technology demonstration to inform the SKA (c.f. the PrepSKA process)
- iv) focus international attention of the science potential of the SKA
- v) Engage with Australian and Canadian industry partners as appropriate

Part of attaining these goals is the active participation of Canadian scientists and engineers in both PrepSKA and the TDP.

Ingrid Stairs, Chair RAC