Report of the CASCA Ground-based Astronomy Committee (GAC): May 2018

Membership and Activities

Jon Willis, University of Victoria (2014-2017, Chair 2017-2018)
John Hutchings, National Research Council (2009-2018)
David Patton, Trent University (2016-2019)
Roland Kothes, National Research Council (2016-2019)
James Di Francesco, National Research Council (2016-2019)
Els Peeters, Western (2016-2019)
Ken Tapping: Radio spectrum management
Ivana Damjanov, Saint Mary's (2017-2020)

Future facilities

TMT

The project hopes to have formal building permission at both sites by late this year, and plan for a construction start in spring 2019. The political situation in Hawaii remains on track for this. NSF plans to become a 25% partner in both GMT and TMT, which would help keep both projects on track for completion. Until and if this succeeds, the funding shortfall for the existing partners is uncertain. Construction has begun on the instrument assembly building at DAO, and other hardware activities continue.

SKA

The SKA project continues to move towards its intended treaty organization. Canada, Germany, and New Zealand at this point will remain as associate members. It is possible that issues of this change of organization may delay the construction of SKA1. The precursor arrays in Australia and South Africa are nearing scientific operation, as planned.

Canada's final share in both TMT and SKA may depend on how things evolve, and may thus need to be discussed more widely in the community.

LSST

No updates.

MSE

The Maunakea Spectroscopic Explorer underwent a successful CoDR in January 2018. This positive review places MSE in a strong position to proceed to a Preliminary Design Review, with a costed, construction proposal, within a two year timescale, i.e. potentially well matched to the

timescale of Canada's LRP 2020 process. The costs and resources associated with the PDR phase will be administered under a Statement of Understanding (SoU) signed by the current MSE partners. Formal signing of this SoU by the appropriate Canadian agency would represent an important demonstration of our long-term commitment to this scientifically-valuable project; therefore, an appropriate Canadian agency should be found to sign the SoU.

CCAT-p

The CCAT-p telescope design passed its PDR in March. At the moment the primary issues are sun avoidance (i.e., heating of the dish) and spillover. A CDR is expected in late September or early October, after which fabrication will commence. The project is still on-time for completion and start of science in late 2021.

The proposal for p-Cam, the main camera for CCAT-p, was submitted to NSF in late April. This proposal required a detailed re-examination of the science case. A response from NSF is expected by the end of August. In addition, work on the heterodyne spectrometer (CHAI) is continuing.

Canadian institutions have begun the process of applying for CFI funds in the next Infrastructure Fund competition. CFI has not yet announced a competition but it is expected to do so in the next few months. The Canadian CCAT team has started preparations to apply in this round. All of the other funds required for CCAT-p (e.g., everything except the instruments), beyond the Canadian contribution, have already been committed from the partner institutions.

Several Canadian groups are participating in CCAT-p science planning. The main Canadian facility contribution so far is the observatory software, and this work is led by Mike Nolta (CITA). Contributions to CCAT-p instruments are still under consideration.

(Thanks to Michal Fich for assistance in preparing this report.)

NGVLA

Work on an NGVLA Science Book is continuing, with many Canadians leading and contributing to chapters. Many of these chapters are based on Science Cases collected by NRAO in 2017. The Science Book will be published by ASP Press by the end of 2018.

An NGVLA-themed conference, "Astrophysical Frontiers in the Next Decade and Beyond: Planets, Galaxies, Black Holes, and the Transient Universe" will be held in Portland, Oregon on 26-29 June. So far, about 160 attendees have registered. In addition, a proposal for special session about NGVLA is being considered for the AAS meeting in Seattle, WA next January.

A conceptual design review (CoDR) of the NGVLA antenna design will be held at DRAO in Penticton, BC on 30 May.

NRC has also been working with NRAO to define the requirements for the correlator/beamformer which forms the 'heart' of the instrument, with the intent of providing a costing for a design which meets those requirements in late fall this year. Work also continues on the ngVLA science book -- those interested in contributing are encouraged to contact the project scientist (Eric Murphy, emurphy@nrao.edu) or one of the Science Working Groups. Canadian involvement remains high, with representation on both the Scientific and Technical Advisory Committees and chairmanship of one of the key Science Working Groups (Brenda Matthews, Cradle of Life), in addition to the technical development work mentioned above.

Current facilities

ALMA

Cycle 5 proceeds apace as the 12-m Array antenna configuration has been steadily contracting since the Cycle began on 01 October 2017. The most compact configuration (C43-1) will begin in early June and last until mid-July, after which the configurations will expand again gradually to end the Cycle in a modest configuration (C43-5). The future configuration schedule for ALMA is under debate, with two- and three-year configuration timetables being considered. Since the best weather generally occurs during austral winter, it is difficult to satisfy simultaneously demands for spectral line projects at high frequency and high spatial resolution continuum projects, as these require compact and highly extended configurations, respectively. The Observatory favours a three-year configuration schedule as it will provide significant windows of good observing conditions to a wide variety of projects. In addition, there is a small but significant operations cost savings from fewer antenna moves per year.

Progress on Cycle 5 has been generally good. Observations with the ACA are presently well ahead of schedule (about 28% above target accumulated QA0 pass time) but observations with the 12-m and TP Arrays are slightly behind schedule (about 8% and 27% below target, respectively). For the 12-m Array, there was a delay in resuming operations after the usual February shutdown because repair of a power feeder cable that failed in early 2017 took 1.5 weeks longer than expected. Time for the 12-m Array may be recovered in compact configurations over austral winter should the weather cooperate. In addition, a new automated workflow for data delivery was introduced at the start of Cycle 5. After some early roll-out problems leading to a delivery backlog, the procedure has stabilized and further improvements in data delivery timescales are anticipated.

In April, the ALMA Board approved a development project led by the NRAO to increase by a factor of 8 the number of spectral channels available for users within the presently available bandwidths. This correlator upgrade will allow greater numbers of spectral lines to be observed simultaneously at high spectral resolution. This upgrade will lead to a short cessation of

operations during austral summer of 2022-23 for installation and commissioning, i.e., during a compact configuration in Cycle 10. This project is the first phase of a correlator upgrade path where the second phase will include a doubling of the available bandwidth.

In addition, the ALMA Board approved a pilot program to release raw ALMA data to PIs in advance of QA2 assessment by ARC staff. It will last for 12 months, and 100 randomly selected PIs will be approached to participate in the program. In addition, the ALMA Board considered the implementation of an alternative proposal review scheme as the numbers of proposals and demands on reviewers increase. The Observatory is exploring a version of the Distributed Peer Review model proposed by Merrifield & Saari (2009), with an anticipated test after a supplemental ACA call for proposals during Cycle 7.

The Cycle 6 proposal deadline was 18 April 2018. A total of 1838 unique proposals were submitted worldwide, 177 more proposals than Cycle 5 and a new record. The total time requested for the 12-m array is nearly 19,698 hours, or 3,670 hours more than Cycle 5, for an oversubscription rate of 4.9. All regions showed an increase in oversubscription. For the 7-m and TP arrays, the total time was requested was 10,941 hours and 7,117 hours, respectively, slightly lower than Cycle 5. Anecdotally, Canadian participation in Cycle 6 appears to have been healthy but final numbers are not yet available.

ALMA recently published its 1000th paper, “Spatial variations in Titan’s atmospheric temperature: ALMA and Cassini comparisons from 2012 to 2015,” by Alexander E. Thelen et al. The rate of published ALMA papers has grown since the first data were available, and ALMA is currently producing more papers than HST did at the same stage of its operation.

Sean Dougherty, formerly Director of DRAO in Penticton, BC, began his tenure as ALMA Director in Santiago on 21 February 2018.

(Thanks to Sean Dougherty for assistance in preparing this report.)

JCMT

Recent months have seen cool new science results from the Canadian-built POL-2 instrument on SCUBA-2 (e.g., see Pattle and Ward-Thompson papers from the BISTRO large program). In addition, the first generation Gould Belt Survey with SCUBA-2 has been very productive and published lots of papers, with excellent Canadian participation. Canadians also have a significant role in the new JCMT Transient Survey with some exciting papers and Astronomical Telegrams recently published.

The current Canadian university funding for JCMT operations runs out February 2019. The university community are looking for options to continue, but none are currently obvious. The NSERC program used to obtain the present funding appeared to be an experiment by NSERC and was not repeated in 2018.

Canadian time on the JCMT remains very oversubscribed. The oversubscription rate for the 18B semester was lower than previous semesters, perhaps reflecting the potential end to our PI-led participation.

Currently the CADC operates the JCMT archive and the Canadian community gets some PI observing time in return. Whether or not this access will continue once the university NSERC funding ends needs to be confirmed.

EAO's 5-year agreement to operate the JCMT ends on February 2020. They are considering whether and how to renew for a second five years. New partners or enhanced funding from existing partners would be very welcome. They have indicated that they'd be happy to have Canada continue participation in JCMT if there was some way to continue it.

Canadians will continue to have access to the existing large programs as co-Is. What will happen in the next large program call (if it happens) remains to be seen

(Thanks to Chris Wilson for assistance in preparing this report.)

Gemini

Gemini Observatory is focused on following the Strategic Plan based on the Strategic Vision for Gemini observatory for the decade 2021-2030. The key elements of the Strategic Plan are: enhancement of the PI-driven science, making Gemini South a LSST follow-up facility, and the development of adaptive optics capabilities at Gemini North.

Future instrumentation and current developments:
- OCTOCAM - Dr. Massimo Robberto (STScI, Johns Hopkins) it the new Principal Investigator the instrument that is expected to be delivered by 2022. The preliminary Design Review took place in April 2018.
- Cassegrain unit (built at AAO) for GHOST has arrived at Gemini South.
- Gemini worth Topic Laser Guide Star is to be installed and made available for users by the end of 2018.
- The study on the relocation of GPI to Gemini North is ongoing.

In addition to the Instrumentation and Facility Development, the 2018 Program Operations and Development Plan includes:
- The real-time software upgrade project is expected to be completed by Q3/2018.
- LSST Fiber optics Network Connection between La Serena and Cerro Pachon is at the stage of developing network electronics. The completion of the project is expected by Q2/2018.
- The Science Operations Models Upgrades project continues with the web-page redesign (starting in Q2) and the ongoing work on the external helpdesk (internal helpdesk was rebuilt in 2017).

- The new observatory website is to be delivered by January 2019.
- Data reduction software development: FLAMINGOS-2 Data Reduction Cookbook was released in March 2018; the first Data Reduction for Astronomy at Gemini Observatory North and South (DRAGONS) for supporting facility imagers will be released in June 2108; real-time/next-day reduced imaging products will be available in the Archive by September 2018.

The Science and Evolution of Gemini Observatory 2018 conference will be held in San Francisco July 22-26.

CFHT

SPIRou arrived at CFHT in January 2018. It had its first on sky test run in April 2018. These tests have confirmed that the guiding and tip-tilt system are behaving as expected. More tests of its performance in real conditions are underway.

The next CFHT SAC meeting is scheduled for 17-18 May in Strasbourg France.

CHIME

CHIME is an innovative radio telescope, built at the Dominion Radio Astrophysical Observatory (National Research Council). CHIME will study the expansion history of the Universe by tracing the distribution of atomic hydrogen over the redshift range z = 0.8 to 2.5. It will also search for and study Fast Radio Bursts (FRBs), make accurate and long-term measurements of pulsar timing, search for new pulsars, and study the magnetic field of the Milky Way by mapping the polarized sky. Recent CFI funding will help realize searches for 21-cm absorbers and source-variability. CHIME has been built by a consortium of Canadian universities, UBC, Toronto and McGill, joined by scientists from DRAO. The project involves about 45 people in the Canadian astronomy community.

CHIME is now well into its commissioning phase. All science goals share the signal acquisition system of reflectors, receivers, analog-to-digital converters, and FPGA processing of the 400-800 MHz frequency band into 1024 frequency channels. Reliability of all telescope components is improving, and the telescope is moving steadily towards full operation.

In the cosmology project, a long observing run is underway, intended to provide a substantial body of data for trials of analysis methods. Data are moved to Compute Canada facilities for analysis, but this process continues to be hampered by limited internet bandwidth into DRAO. Highly precise knowledge of CHIME beamshapes is required to reach the cosmology goals: CHIME beams are being measured by interferometry between CHIME and the John A. Galt (26-m) Telescope at DRAO.

FRB events must be identified in real time. The CHIME-FRB pipeline forms 1024 beams on the sky. Subsequent operations increase frequency resolution, flag radio-frequency interference, and de-disperse received signals. Routines for recognition of significant pulsed events follow, with reporting of relevant parameters, and baseband data around each event is stored. Known objects (e.g. pulsars) are recognized in this pipeline. The system is regularly detecting individual pulses from known pulsars on a few nodes of the processing pipeline with high signal-to-noise ratio. The bulk of the 128 computer nodes for the FRB pipeline were installed at the CHIME site in April and May 2018. A review of CHIME-FRB was held at DRAO in early May, focussing on science readiness.

The pulsar processing system, completely independent of the FRB pipeline, is also in the commissioning phase and has successfully detected known pulsars.

JVLA

The JVLA, operated by the National Radio Astronomy Observatory, continues to run normally. Currently the JVLA is observing the 18A semester which runs from March 2018 to September 2018 in A- and D-configuration. The next proposal deadline is August 1 2018 for the observing period from January 2019 through October 2019 in A-, BnA- and B-configuration.

The VLA Sky Survey (VLASS) began observing on September 7 2017. Observations of the first half of the first epoch of VLASS, there will be 3 epochs, are now complete. The figure in this link (https://science.nrao.edu/science/surveys/vlass) shows the approximate coverage of this first half of the first epoch. Low Declination regions were observed in BnA-configuration and High-Declination in B-configuration.

All raw visibility data from the first half of the first epoch are available immediately from the NRAO archive (https://science.nrao.edu/facilities/vla/archive/index), under project code VLASS1.1. "Quick Look" images are posted to the VLA Sky Survey Resources web page (https://archive-new.nrao.edu/vlass/) as soon as they have undergone quality assurance. Better sampled images in Stokes I,Q and U, spectral index maps, and spectral cubes around bright sources (also in Stokes I,Q,U) will be made available on a timescale of 6-12 months.

DAO

No updates.

DRAO

Work is advancing quickly on the upgrade to the Galt telescope. Work on software and firmware for the control system and an interim correlator is nearing completion. This correlator will use a spare Kermode board on loan from the Astronomy Technology group. Discussions

with experts on GPU correlators have identified a path forward for the final correlator hardware configuration, and associated software efforts will soon commence.

In the meantime, most of the old signal-path electronics have been removed from the screened room, leaving only those items necessary for telescope control, as the on-going CHIME calibration observations use their own signal-processing systems elsewhere on site. Two new equipment racks have been installed, with one configured to house temperature-sensitive components. An RF-over-fibre system has been acquired for signal transport. Investigations are continuing into updating cryogenic components on the telescope.

A major item that remains is the design of a feed and an environmental enclosure ("focus box") to house the receiver. These items hinge on the result of a study into the existing tripod legs and receiver mounting ring. Previous focus boxes mounted the receiver above the ring, with the feed attached to a waveguide in order to reach the focus, which lies inside the ring. This method is inadequate for the new receiver, which will need to be mounted on gimbals to fine-tune its alignment with the focus. All options are being considered, ranging from entirely new tripod legs to refitting the existing legs - which, despite being almost 60 years old, have been found to be in good condition - with a wider ring to allow the receiver to be positioned closer to the focus.

Radio Spectrum Management

No updates.