Astronomy NCRIS: 2010/11 Business Plan

Date: 8 June 2010

Contents

Executive Summary

All the projects identified in the Radio and Optical Astronomy NCRIS Investment plan have now been commenced. Recent highlights include the successful completion of the HERMES PDR and commencement of the NCRIS funded phase 2 of MWA.

Australian access to 8m class telescopes continues as planned with Australian astronomers having access to 6.19% of the time on the two Gemini telescopes and 15 nights per year on the Magellan telescopes. The ASKAP digital systems and AAT refurbishment projects are also progressing well.

Following the completion of the PILOT design study and the decision not to proceed further with PILOT, AAL has re-focused Australia's Antarctic astronomy efforts on site characterization, with NCRIS funds being provided towards new robotic observatories for Dome A and Dome F.

Material Changes

There have been several material changes to the Astronomy NCRIS relative to the Astronomy NCRIS Funding Agreement since previous business plans and reports:

- $531,000 of additional NCRIS funding has been provided by DIISR to fund AAL's management of the Astronomy EIF grant during 2011/12 and 2012/13.
- $330,000 of NCRIS interest earnings have been provided by AAL to UNSW towards new robotic observatories for Dome A and Dome F.
- Following the review of the MWA project, phase 2 of MWA has been de-scoped from a 1,024 tile array to 512 tiles. Any extension of MWA beyond 512 tiles is beyond the scope of NCRIS and the viability of MWA beyond 512 tiles would need to be assessed should funding become available.
- $410,000 of funding currently allocated to Aspen instrumentation to be re-allocated to 2011B Magellan access (no further Aspen payments are required).

Risks and their Mitigation

The critical outstanding risk to the Astronomy NCRIS involves the financial shortfall of approximately US$6,000,000 to complete phase 2 of MWA and subsequent commissioning and early science. The major outstanding MWA funding initiative is a request by the USA MWA partners to the NSF. That request is currently being developed and is scheduled to be submitted to the NSF in July 2010.

AAL is proceeding with the release of NCRIS funding in the knowledge of the above uncertainty because the project is strategically important and scientifically valuable, and we cannot de-scope the project below 512 tiles otherwise a bounding limit to the epoch of reionisation is likely not viable. If additional funding is not secured during 2010, the size of the array may need to be de-scoped below 512 tiles.

Status as of 8 June 2010

Astronomy Australia Limited (AAL)

AAL is on track to complete all of its major assignments for the 2009/10 financial year. AAL is also planning for post-NCRIS activities, with its ESO Working Group currently exploring the option of Australian membership of ESO, and a $10M Astronomy EIF Investment plan submitted to DIISR.

AAL is currently operating with 2.3 FTEs at offices provided by Swinburne University of Technology. AAL's fourteen member organisations include all of the major Australian institutions with a research capability in optical/IR and radio astronomy. At AAL's 2009 Annual General Meeting twelve of the members were represented directly and two of the members were represented by proxy.

Anglo-Australian Observatory

AAT Refurbishment

The refurbishment of the Anglo-Australian Telescope facility is approximately halfway through the four-year program, with a number of major projects either completed or close to completion.

The project has so far committed $2.5M of the $4.1M budget on refurbishing or replacing various systems and services. Major projects that have been completed in 2009-10 include:

- The telescope drive system for RA, Dec and Coude 5
- Heating, ventilation and air-conditioning plant
- Main lift controls
- Telescope ancillary systems
- Mirror elevator controls
- Telescope gearbox lubrication system

HERMES

FY2009-2010 was a very active year for the HERMES project, with a number of major activities completed. These activities included re-organising the project team structure for the purposes of preparing performance specifications for the instrument, the appointment of a Project Engineer and an Instrument Scientist, the completion of performance specifications for the instrument, and a fourth channel for the spectrograph was funded and included in these specifications.

The project has received the detectors for three of the four channels, together with a test cryostat. Formal quotations we obtained from vendors for the several major components of the instrument, including the collimator, camera optics, fold mirrors, beam splitters, slit optics, shutters and gratings.

The preliminary design for the HERMES instrument was completed and a Management Review (MR) and Preliminary Design Review (PDR) were carried out to evaluate the health of the project. Both the MR and PDR involved external reviewers. The HERMES team has received a very positive PDR report and has prepared an action plan to address the remaining issues raised by the review panel. A major decision

was taken to proceed with the dual-fibre option for HERMES, and to install a new fibre cable. HERMES is now officially entering the detailed design phase. Major parts of the instrument will be ordered during this phase in order to minimise the impact on the construction schedule of long lead times.

Australian membership of the International Gemini Partnership

Australia has a 6.19% share in the International Gemini Partnership, which provides this level of access to the two Gemini 8m telescopes. The Australian Gemini Office, based at the AAO, coordinates Australian usage of the Gemini telescopes, the Keck 10m and Subaru 8.2m telescopes in Hawaii (via a time exchange with Gemini), and the Magellan 6.5m telescopes in Chile (on which time is purchased through AAL).

As an in-kind contribution to the cost of Australian access to the Magellan telescopes, two Magellan Fellows are employed by the AAO and seconded to the Carnegie Observatories in La Serena, Chile, where they provide observing support and carry out research. During the past year, the first two Magellan Fellows took up their final-year research positions in Australia, and two new Fellows began their two-year support and research postings in Chile.

The demand for observing time on the Gemini and Magellan telescopes remains healthy, with an over-subscription factor of 185% averaged over 2009. A total of 25 refereed papers based on Gemini data and with Australian authors were published in 2009, up slightly from 23 in 2008. A further 8 papers based on Magellan data and with Australian authors were also published, double the number from 2008. Australian Gemini publications have an impact factor (defined as the number of citations to a paper, relative to the median number of citations to all papers appearing in the Astronomical Journal in that same year) of 7.3, the highest of all Gemini partners, and more than twice that of US and UK Gemini papers.

The Australian Gemini Office ran a contest for Australian high school students to win one hour of observing time on the Gemini South telescope. Entries were judged on scientific and aesthetic merit, and the winning entry came from Daniel Tran, a Year 10 student at PAL College in Cabramatta, NSW. His colourful image of the "Glowing Eye" planetary nebula was featured on the cover of Australian Sky & Telescope magazine in January 2010, in the December 2009 issue of Gemini Focus, and as a Gemini websplash.

MWA

To progress the project Mr Wayne Arcus was appointed the MWA Project Manager at Curtin University of Technology and a Project Engineer, Mr Robert Goeke, was also appointed.

The major project milestone of a 32 tile array demonstrator was achieved in January 2010, with the verification report delivered to AAL in February 2010. The criteria for the 32T demonstrator was agreed between the NSF and AAL. The verification report was reviewed by AAL's external reviewers, and was found to be satisfactory. Based on the feedback from AAL's reviewers, two new milestones were imposed on the project. The first milestone is the approval by MWA Board of the Operations

Management Plan. The second milestone is a report of progress against a range of technical issues raised in review of MWA Project Plan and 32T Verification Program.

Major progress on MWA included:

- Completion Receiver Enclosure repackaging design
- Completion of Phase 1 (32-tile) development
- Verification and test tool development
- Systems Integration (laboratory and on-site)
- On site infrastructure upgrades & preparation (e.g., computing, power, storm-damage recovery, tile dressing, hut equipment reinstallation).

Additional detail requested by DIISR:

A summary of the science case for the de-scoped MWA project.

The content for this section has been taken from the MWA Project Management Plan Revision 0006.

The MWA is an inherently versatile instrument with a wide range of potential science goals. Scientific priorities during the early science phase will be determined partly by the evolving instrumental capabilities, and partly by the potential of such studies to accelerate commissioning and the initiation of the key science projects.

In astronomy, the highest priority key science project is detection of red-shifted 21cm signals from HI during the epoch of reionisation (EoR), using power spectral techniques, direct detection of quasar ionised "bubbles", or both. In solar, heliospheric and ionospheric (SHI) research, the highest priority is characterisation of the heliospheric magnetoionic medium via interplanetary scintillation and Faraday rotation propagation effects using background astronomical radio sources.

Secondary key science projects include radio transient detection and monitoring, solar burst imaging, studies of ionospheric phenomena, and a variety of astronomical studies using all-sky survey data (dubbed "galactic and extragalactic" or GEG research). Examples of the latter include Faraday tomography of the interstellar medium, the galactic distribution of cosmic rays, the hidden population of galactic supernova remnants, pulsar emission mechanisms and population statistics, and the low-frequency cosmic web.

Most of these secondary projects can be conducted using data collected during or in support of the two highest-priority key science projects, in part because accurate calibration of the MWA requires comprehensive characterisation of the sky across wide instantaneous fields of view, as well as accurate characterisation of the behaviour of the ionosphere. However, during the first full year of regular operations, observing schedules and scientist access to currently foreseen support resources will be driven by the two high priority projects. Other science will be accomplished by the MWA scientific community on a best effort basis, or via funds acquired separately from the core project budget.

The original science scope included three key science projects. These were the EoR, transients, and SHI. The science scope described here is somewhat more sharply focused, with two important modifications to the earlier goals.

(1) Transient science has been removed as a supported activity due to reprioritisation consistent with the scope contingency. It is anticipated that transient science will occur anyway, particularly for those observing modes that are commensal, given the high level of community interest and the powerful Instrumental capabilities.

(2) SHI science has been more tightly focused, with the key investigations defined as those leading to improved measurements of the heliosphere, and the attendant direct implications for space weather prediction. Solar imaging and ionospheric research have been de-emphasised for initial operations, though the instrumental capabilities that enable these studies will be retained, and the acquisition of data suitable for supporting these investigations will occur as a by-product to the key science observations.

A description of the NCRIS-funded infrastructure to be developed in the de-scoped MWA project; and the relationship between the MWA project elements funded under NCRIS and those to be funded under EIF:

The NCRIS funding relates to phase 2 of the project: system realisation of a 512T array. The EIF funds allocated to the project will be used to pay for 60% of the receiver enclosures, 50% of the delivery and installation of the tiles and beamformers, a contingency for computing hardware, plus one year of a full-time Hardware Installation Engineer.

The initial implementation of the array includes the following major elements (from MWA Project Management Plan Revision 0006):

- 512 antenna tiles, each comprising 16 dual-polarisation wideband dipoles operating between 80 and 300 MHz.
- Analogue beamformer units, one per tile, capable of steering the tile beam in any direction down to 30 degrees elevation.
- Tiles distributed over an area 1.5 km in radius, with one outlier set of 16 tiles providing baselines up to 3km.
- 64 receiver nodes in field enclosures, each connected to 8 tiles via coaxial cable lines, and each connected to the central processing facility by 6 fibre lines. Each node receives centrally generated power, and distributes power to the tiles.
- Distribution of a stable sampling clock signal from a central location to each receiver node, via fibre.

- Transmission of 30.72 MHz of digitised RF bandwidth for each polarisation of each tile from the nodes to the central processing facility via fibre
- A hardware correlator based on FPGAs capable of performing a full cross-correlation of all signals from all tiles. The aggregate input data rate to the correlator is 315 Gbits/sec.
- Output correlator time resolution of 0.5 seconds, and output correlator frequency resolution of 40 kHz, yielding 768 spectral channels. The correlator output data rate is ~40 Gbits/sec, delivered over 64 copper-based gigE lines
- A digital voltage-sum array beamformer function as part of the correlator system, capable of providing up to 32 simultaneous independently pointed array beams on the sky with sample-level time resolution
- A real-time computer (RTC) implemented as a Linux cluster with graphical processing unit (GPU) acceleration for several highly parallel compute-intensive tasks associated with real-time calibration and imaging. Key RTC parameters are:
    - 32 compute nodes
    - 64 GPU units
    - 12 Gbytes of RAM per node
    - Power dissipation 40 kW
    - On-site near-term data storage capacity of a few tens of Tbytes.
- Infrastructure elements provided by CSIRO, consisting of:
    - Shielded, air-conditioned equipment space in a central building.
    - Power generation and delivery of underground power lines to the centre of the MWA array configuration.
    - Fibre connectivity from the centre of the MWA array configuration to the central building, and from the central building to the outside world.
    - The output correlator spectral resolution of 40 kHz.

Organisational roles and responsibilities, and governance structures for the MWA project

The MWA consortium is constituted under two formal agreements. First, a Statement of Intent (SoI), which is signed by all MWA consortium members, identifies the high level intent to collaborate on the MWA, the lead organisations in Australia, the USA and India, and high level governance for the project. Second, a Statement of Collaboration (SoC), signed by the Australian, USA, and Indian lead

organisations, Curtin University of Technology, Massachusetts Institute of Technology – Haystack Observatory, and Raman Research Institute, respectively, sets out details of the MWA collaboration.

The project partners are:

- MIT Haystack Observatory;
- MIT Kavli Institute;
- Harvard-Smithsonian Center for Astrophysics;
- University of Melbourne;
- Curtin University of Technology;
- Australian National University;
- ATNF;
- University of Tasmania;
- University of Western Australia;
- University of Sydney;
- Swinburne University; and
- Raman Research Institute.

The following four paragraphs are a summary of content in the MWA Project Management Plan Revision 0006:

The MWA Board is responsible for the delivery and scientific productivity of the MWA Telescope. The Board makes policy and high-level strategy for the project. The Board is responsible for approving and shepherding through high-level agreements (e.g. legal agreements and memoranda-of-understanding) between the MWA partners and with external bodies. The Board is responsible for approving the Project Management Plan, project science readiness and initiating corrective action to these. The Board is not responsible for the funding agreements between MWA partners and external funding agencies. However aspects of funding proposals that commit the MWA outside the existing Project Management Plan, or which influence the MWA governance arrangements, must be presented to and receive Board approval.

The Project Director has the overall responsibility of leading the MWA project and representing it to the global astronomical community. The Director is responsible for maintaining the Project Management Plan at the strategic level.

The Project Manager is responsible for the MWA partner relationships at the functional level as it applies to the development, commissioning and operation of the telescope. The project manager is responsible for the execution of the approved MWA Project Management Plan including the scope, schedule and cost baselines, the budget, Engineering and Project Management and project delivery including development and commissioning.

The Project Engineer ensures that the project as implemented meets the projects' technical requirements. The Project Scientist is responsible for ensuring that the MWA Instrument delivers its scientific objectives. The Commissioning Engineer will be responsible for the deployment of the telescope.

Access arrangements for Australian researchers to the MWA telescope

Part of the Statement of Collaboration (SoC) says that assigning observing time will be on the following basis:

"(a) During Early Science Operations, the EOR [Epoch of Re-Ionisation] and the SHI [Solar, Heliospheric and Ionospheric] MWA Science Collaborations shall be given priority.

"(b) During Operations, Open Skies shall be the fundamental guiding principle for allocating observing time, giving due consideration to the needs of the Key Science Programs.

"(c) Observing time allocation shall be determined by the MWA Time Allocation Committee, subject to policies set by the MWA Board."

In addition the SoC outlines formulation of publication policies:

"Publication policies shall be formulated by the MWA Science Council, subject to approval by the MWA Board. While every effort shall be made to implement a uniform publication policy across the project, it is recognized that one or more major MWA Science Collaborations may require individual policy provisions.

"Observing time, data access, and publication policies may vary among the Key Science Programs, and may include proprietary periods for MWA Science Collaboration members."

ASKAP

The ASKAP Theme within CSIRO comprises 18 Integrated Product Teams (IPTs). Seven of these are "technical", three are "infrastructure", four are "support" and four are "SKA". The $14.6M NCRIS portion of ASKAP's budget is allocated to funding the Digital Systems IPT.

ASKAP will comprise 36 prime-focus three-axis antennas equipped with Phased Array Feeds (PAFs or "radio cameras"). The first prototype phased array feed (PAF) has been tested on the Parkes Testbed Facility (PTF). The PTF is a newly-built 12-metre antenna near the 64-meter Parkes antenna for ASKAP testing. Results remain promising, indicating the lowest system temperature of any wide-band PAF in

the world and testing is on-going. The first antenna is installed, and microwave holography has provided "first light" and showed that the antenna performance exceeded expectations.

Several keys hires have come on-board or will shortly do so. Key among these are the MRO Site Manager (based in Geraldton), Technical Writer, System Engineer, Digital Engineer and Analog Technicians.

The Digital, Analogue and Computing systems have all recently successfully held Critical Design Reviews that have confirmed the work to-date. The ASKAP Science Survey Team process was immensely successful, garnering excellent proposals from hundreds of researchers across the globe. The methodology used has essentially become the world benchmark. The Tenders for the optical fibre cable from the Murchison Radio-astronomy Observatory (MRO) are being evaluated, and the site infrastructure detailed design is nearly complete and ready to go out to Tender. The Systems Engineering, Integration and Commissioning (SEIC) IPT has been implementing a full-system approach and the Systems Engineer will conduct the formal reviews when that position has started.

The ASKAP digital design is now envisioned to be a fairly straightforward evolution of the Boolardy Engineering Test Array (BETA) design with upgraded Field-Programmable Gate Arrays (FPGAs) and so the ASKAP digital design review structure has changed to reflect this early success. The first full digital engineering system (ES1) is complete and is under test.

Giant Magellan Telescope Design Development Phase

Following the signing of the $88M EIF funding agreement between DIISR and ANU in February 2010, management of Australian-based GMT activities, and payments by Australia to the GMTO, will be managed by ANU. As such, AAL will not be setting any GMT-related technical milestones during 2010/11.

AAL will continue to monitor the international GMT project through its member of the GMTO Board and GMTO finance committee.

Antarctic Astronomy

AAL re-constituted its Antarctic Astronomy Advisory Committee in December 2009 with new focus on developing a strategic plan for Australian Antarctic astronomy, including consideration of possible Australian participation in Antarctic astronomy projects. Prof John Dickey accepted the role of Chairing the Committee from December 2009. The Committee is currently finalizing its new plan for Australian Antarctic astronomy, to be submitted to the mid-term review of the Australian astronomy decadal plan.

A Deed of Variation for $330,000 for the construction of two new PLATOs for Dome A and Dome F in Antarctica was signed with UNSW in April 2010. The PLATOs will be deployed to Antarctica during the 2010/11 summer months.

Expected Progress and Milestones

Astronomy Australia Limited (AAL)

AAL will continue to maintain clear and open communications with the Australian astronomy community through a regularly updated website. Quarterly electronic newsletters, AAL's annual reports, reports to DIISR and other reports of importance to the astronomical community will be made available from this website.

Community input into individual projects is coordinated at the project level.

Period	Activities and Milestones
2010-11 Q1 (Jul10-Sep10)	• Quarterly newsletter published • Fourteenth board meeting held • 2009/10 Annual report published and made available on AAL website • 2009/10 Astronomy NCRIS progress report submitted to DIISR and made available on AAL website. • Poster presentation at the Annual Meeting of the ASA
2010-11 Q2 (Oct10-Dec10)	• Quarterly newsletter published • Fifteenth board meeting held • 2010 Annual General Meeting held. • Appointment of 3 board members and Chair at the AGM
2010-11 Q3 (Jan11-Mar11)	• Quarterly newsletter published • Sixteenth board meeting held
2010-11 Q4 (Apr11-Jun11)	• Quarterly newsletter published • Seventeenth board meeting held

Anglo-Australian Observatory

AAT Refurbishment

The main priority for the project for 2010-11 is addressing the issues associated with the emergency brakes on both the maintenance platform and the main dome shutter. Due to the technical challenges with the brakes, a mechanical engineer has been employed on a temporary basis to lead this project.

Other major projects planned for financial year 2010-11 under the refurbishment project include the replacement of the AAT main dome crane controls and also the standby generator and associated high voltage switchgear. The replacement of the standby generator and high voltage switchgear is a jointly funded project between the ANU and the AAO, which will be managed by the ANU.

Period	Activities and Milestones
2010-11 Q1 (Jul10-Sep10)	• Upgrade telescope hydraulic system • Refurbish telescope focus drives
2010-11 Q2 (Oct10-Dec10)	• Replace standby generator • Replace the main UPS Stan inverter
2010-11 Q3 (Jan11-Mar11)	• Replace dome crane control system • Replace the main high voltage electrical switchgear
2010-11 Q4 (Apr11-Jun11)	• Upgrade the dome shutter and brake control system • Upgrade the maintenance platform brakes and controls

HERMES

During 2010-11, HERMES is scheduled to complete the detailed design for all parts of the instrument and the fibre feeds, and to construct the staging area for HERMES assembly in Epping. Prototyping will be carried out on a number of components, including the volume-phase holographic (VPH) gratings, the fibre slit, and the test cryostat. Ordering of the main parts of the instrument will be completed. The major project milestones for FY2010-11 are:

Period	Activities and Milestones
2010-11 Q1 (Jul10-Sep10)	• Commence ordering materials
2010-11 Q2 (Oct10-Dec10)	• Complete instrument final design • Deliver final design report
2010-11 Q3 (Jan11-Mar11)	• Start preparing Epping assembly & test facility
2010-11 Q4 (Apr11-Jun11)	• Complete test facility at Epping

Australian membership of the Gemini International Partnership

The Australian Gemini Office will continue to coordinate the Australian usage of 8-m class telescopes. It will provide support for usage of Gemini instruments and coordinate Australian usage of Science Verification Time. It will also promote opportunities with the Gemini and Magellan telescopes.

Period	Activities and Milestones

2010-11 Q1
(Jul10-Sep10)
	• Support Australian involvement in 8m-class telescopes by:
	  o managing the Australian time allocation process for 8m telescopes;
	  o the Australian Gemini Scientist (AGS) and both Deputy Gemini Scientists (DGS) performing specified Gemini support duties;
	  o supporting Gemini instruments as required;
	  o maintaining an up-to-date AusGO web site.
	• Promote Australian science, and new opportunities with the Gemini and Magellan telescopes, by staffing a booth at the Astronomical Society of Australia Annual Scientific Meeting in Hobart (Jul 2010)
	• AGS attends Gemini Operations Working Group meeting in Hilo (Aug 2010).
	• Recruit up to 3 Australian Gemini Undergraduate Summer Students (AGUSS) to spend Dec 2010 - Feb 2011 at Gemini South.
	• Unveil winning entry in the 2010 Australian Gemini School Astronomy Contest.

2010-11 Q2 (Oct10-Dec10)	• AusGO supports Australian involvement in 8m-class telescopes. • Coordinate AGUSS travel and projects with Gemini South. • Coordinate technical assessment of Semester 2011A joint proposals on behalf of all Gemini partners. • AusGO hosts 2011A Gemini International Time Allocation Committee meeting at AAO in Epping (Nov 2010).
2010-11 Q3 (Jan11-Mar11)	• AusGO supports Australian involvement in 8m-class telescopes. • Coordinate Australian usage of FLAMINGOS-2 Science Verification time. • Organise AGUSS final seminars via videoconference from Chile. • AGS attends Gemini Operations Working Group meeting in La Serena, Feb 2011. • AusGO launches the 2011 Australian Gemini School Astronomy Contest.
2010-11 Q4 (Apr11-Jun11)	• AusGO supports Australian involvement in 8m-class telescopes. • Coordinate technical assessment of Semester 2011B joint proposals on behalf of all Gemini partners. • Coordinate Australian usage of GSAOI Science Verification time. • Judging panel selects winner of 2011 Australian Gemini School Astronomy Contest. • AusGO organises a Gemini observational techniques and data reduction workshop.

MWA

The goal for Financial Year 2010/11 is to progress towards the completion of Phase 2 of MWA – system realisation of 512T array.

Period	Activities and Milestones
2010-11 Q1 (Jul10-Sep10)	• Supply of Data-Over-Coax (DOC) for 32-T Retrofit • Support System Specification (512-T-MSys-SS.Rev.0001) Completed • Mission System Specification (512-T-MSys-SS.Rev.0001) Completed • Receiver Electronics Development Complete • Update (second of two) on status of funding required to complete phase 2 • Approval by MWA Board of the Operations Management Plan • Report of progress against issues raised in *Review of MWA Project Plan and 32T Verification Program*
2010-11 Q2 (Oct10-Dec10)	• Support System Design Complete • Support System Critical Design Review (CDR) Completed • Commence Factory Acceptance Testing of Tile Elements • System Acceptance Test Plans & Procedures (ATP&P) Completed • Receiver Batch one of three Field Testing Complete • Contracts signed for all funding required to complete phase 2
2010-11 Q3 (Jan11-Mar11)	• Commence Tile Installation (Install Team Deployed to Site) • Mission System Development Complete • Receiver Batch two of three Field Testing Complete
2010-11 Q4 (Apr11-Jun11)	• System Integration Complete

Additional detail requested by DIISR:

MWA project milestones 2011-12 to 2012-13

These milestones are taken from the MWA Project Management Plan.

Date	Description
10 August 2011	Verification Data Collection Complete
12 August 2011	Verification Data Analysis Complete
23 September 2011	Acceptance Test Report (ATR) Complete
17 October 2011	Instrument Practical Completion
19 October 2011	Phase 2 Complete
Phase 3: System Commissioning & Early Science	
19 October 2011	Commence Phase 3
27 April 2012	Phase 3 Complete

ASKAP

Upcoming activities and milestones are focused on developing and testing robust prototypes in the following platforms:

- Marsfield Test and Engineering System (MATES) – mock system based in Marsfield, comprises a full-size to-print wooden mock-up of all parts of the ASKAP antenna (though not fully assembled, called SAPKAP), and receiver and digital system.
- Parkes Testbed Facility (PTF) – the 12-metre antenna at Parkes, which is used in conjunction with the 64-metre antenna to test PAFs
- Boolardy Engineering Test Array (BETA) – the 6-antenna system at the Murchison Radio-astronomy Observatory (MRO), to be ready by the end of 2010.

Period	Period Activities and Milestones - ASKAP	
	Digital System	**ASKAP Overall**
09/10T1 1/7/09 – 31/10/09		• Systems pass Preliminary Design Review

09/10T2 1/11/09 – 28/2/10	• BETA Digital System (ES1) integration test with other IPTs systems	• Data/Signal Transport passes Critical Design Review • Systems pass Critical Design Review • Fibre link installed and verified operational
09/10T3 1/3/10 – 30/6/10	• BETA digital system deployed and verified operational • Digital System installation at MRO (1st Antenna) • Digital System Integration test at MRO with all IPT's sub systems • ASKAP Digital Systems pass Critical Design Review	• Analogue Systems pass Preliminary Requirements Review
10/11	• Digital System installation of BETA antenna sub systems at MRO • Full Digital System Integration test of full 6 antennas array • ASKAP Digital System manufacture commence	• BETA computing installed and verified operational • Complete full imaging simulation • BETA dedication for early science • 12 antennas installed and operational
11/12	• ASKAP Digital System installed and verified operational • Full Digital System Integration test of full 36 antennas array • Full ASKAP Digital System commissioned & accepted for the ASKAP array	• BETA produces science results with the full array for the community on a regular basis. • 36 antennas ASKAP installed and operational • SKA site decision
12/13		• 36 antennas ASKAP complete and ready for shared-risks science operations by Dec 2012

Antarctic Astronomy

The Deed of Variation to the NCRIS contract is for building PLATOs for Dome A and Dome F in Antarctica, following the past two years of successful operation of UNSW's autonomous observatory *PLATO* at Dome A.

A new *PLATO-A* will be deployed to Dome A by the Polar Research Institute of China, with the coordination of the Chinese Purple Mountain Observatory. *PLATO-A* will support *AST3* (a set of three wide-field optical survey telescopes), a THz dish, and a new generation of telescopes and site-testing instruments currently under development by Australian, Chinese and US teams. *PLATO-A* will use multiple generators, an extended solar panel array and wind-power to generate an average of 2,500 watts throughout the year. This higher power (the existing *PLATO* currently generates only ~1kW) is

necessary for *AST3* and the THz receivers, which require mechanical cryocoolers for the CCDs and SIS mixers respectively.

PLATO-F will be deployed to Dome F by the Japanese National Institute of Polar Research (NIPR). *PLATO-F* will initially support a 40 cm infrared telescope and three-colour camera (Tohoku University), plus site-testing experiments developed by Japanese and Australian teams. *PLATO-F* will be similar to the current *PLATO*, though with greater modularity, and will produce an average of 1 kW throughout the year.

Period	**Activities and Milestones**
2010-11 Q1 (Jul10-Sep10)	• Engine module designed and manufactured • Power system designed and manufactured • Instrument module designed and manufactured • Engine sub-system designed • Engine module integration complete • Control system designed and manufactured • Computer and communications system complete • Instrument module integration complete
2010-11 Q2 (Oct10-Dec10)	• PLATO-A tested and shipped to Chinese collaborators for deployment to Dome A • PLATO-F tested and shipped to Japanese collaborators for deployment to Dome F

Proposed governance, management, access and pricing arrangements

The governance arrangements during the period of this Annual Business Plan will be the same as described in section 4, 'Governance Arrangements' of the Project Plan. Specific items during this period will be:

- Retirement of three members from AAL's board of directors, including the Chair, and election of three directors by the members of AAL. (Note: retiring directors are eligible to stand for reelection).
- Advice from the Antarctic Astronomy Advisory Committee (AAAC).
- Advice from the High Performance Computing Working Group (HPCWG).
- Advice from the European Southern Observatory Working Group (ESOWG).
- Advice from the Optical Telescopes Advisory Committee (OTAC).
- Management and reporting for currently active projects will be undertaken by the relevant party:
    - AAO - AAT refurbishment and AAT instrument
    - AAO - Australian Gemini Office (AusGO)
    - Australian Gemini Board Member - Australian Gemini Membership and Aspen Instrument Program
    - CSIRO – ASKAP
    - Curtin University of Technology – MWA

The access and pricing arrangements during the period covered by this Annual Business Plan will be the same as described in section 3, 'Access and Charging Arrangements' of the Project Plan. Briefly, the following principles will apply in relation to access to the facilities and charging for their use:

- Time assignment for the facilities will be merit-based in accordance with established application and peer-review procedures;
- Effective data management systems will be embedded within the facilities, with services including comprehensive on-line archives, pipeline data-reduction tools and researcher access to reduced data products and catalogues to be provided; and

- Access to the facilities will be provide free of charge (although some of the costs entailed in using the facilities – such as travel and accommodation costs – may be borne by users).

Proposed promotional activities

During the period of this Annual Business Plan, AAL will communicate with the Australian astronomical community through:

- quarterly electronic newsletters which provide clear and open communications to AAL's members;
- a regularly updated website which highlights major AAL news items
- presentations where appropriate at committee/staff/community meetings

In addition, some of the projects will also undertake their own promotional activities.

Financial projections (GST exclusive)

Change in cash balance

The Astronomy NCRIS transactions planned for 2010/11 will result in a reduction in the cash balance held by AAL across its Astronomy NCRIS accounts of $11,417,020 (see cash transactions list on following pages for details of receipts and payments):

NCRIS grants to be allocated (30th June 2010):	$11,994,864	(estimate)
Change:	($11,417,020)	(estimate)
NCRIS grants to be allocated (30th June 2011):	$577,844	(estimate)

The 30th June 2011 projected balance of $577,844 consists of $168,500 which is scheduled for the Australia Gemini Office for July until December 2011, and the remainder for 2011B Magellan access.

Note: This amount does not include the projected balance of the NCRIS reserve listed below.

Interest projections

During 2010/11 AAL expects to earn approximately $240,000 in interest from the NCRIS grant. This interest estimate will fluctuate depending upon:

Timing of the receipt of the 2009/10 NCRIS Grant from DIISR;
Interest rates available.

The AAL Board has allocated $19,858 of this interest towards the Magellan Fellows scheme. The remainder of this interest will be held in reserve to be allocated by the AAL Board to one or more of the current Astronomy NCRIS projects.

Balance of NCRIS reserve 30th June 2010:	$289,612	(estimate)
Balance of NCRIS reserve 30th June 2011:	$509,754	(estimate)

The major use of the reserve during 2009/10 was the allocation of $330,000 to partially fund the development of two new PLATOs for Antarctica.

2009/10 Astronomy NCRIS cash receipts and payments – grant allocations (GST exclusive)

Date	Facility	Item	Transaction Type	From / To	Receipts	Payments
1/07/2010	Gemini	Gemini operations	Payments - International Access	NSF (USA)		$1,151,184
20/07/2010	Magellan	Magellan	Payments - International Access	Carnegie		$444,634
15/08/2010	AAO	AAT instrument	Payment - Capital	AATB		$500,000
15/08/2010	AAO	AAT refurbishment	Payments - Operating	AATB		$200,000
15/08/2010	MIRA	ASKAP	Payment - Capital	CSIRO		$2,000,000
15/08/2010	Gemini	AusGO	Payments - Operating	AATB		$81,000
15/08/2010	MIRA	MWA	Payment - Capital	Curtin Uni		$1,527,447
15/11/2010	AAO	AAT instrument	Payment - Capital	AATB		$500,000
15/11/2010	AAO	AAT refurbishment	Payments - Operating	AATB		$200,000
15/11/2010	Gemini	AusGO	Payments - Operating	AATB		$81,000
15/11/2010	MIRA	MWA	Payment - Capital	Curtin Uni		$1,985,679
1/01/2011	AAO	AAT instrument	Receipts	NCRIS	$650,000	
1/01/2011	AAO	AAT refurbishment	Receipts	NCRIS	$400,000	
1/01/2011	MIRA	ASKAP	Receipts	NCRIS	$756,133	
1/01/2011	Gemini	AusGO	Receipts	NCRIS	$337,000	
1/01/2011	Gemini	Gemini operations	Receipts	NCRIS	$907,981	
1/01/2011	MIRA	MWA	Receipts	NCRIS	$2,100,000	
20/01/2011	Magellan	Magellan	Payments - International Access	Carnegie		$444,635
15/02/2011	AAO	AAT instrument	Payment - Capital	AATB		$500,000
15/02/2011	AAO	AAT refurbishment	Payments - Operating	AATB		$200,000
15/02/2011	MIRA	ASKAP	Payment - Capital	CSIRO		$2,000,000
15/02/2011	Gemini	AusGO	Payments - Operating	AATB		$84,250

15/02/2011	Gemini	Aspen	Payments - International Access	NSF (USA)		$424,335
15/02/2011	MIRA	MWA	Payment - Capital	Curtin Uni		$290,382
15/03/2011	Gemini	Gemini operations	Payments - International Access	NSF (USA)		$911,286
15/05/2011	AAO	AAT instrument	Payment - Capital	AATB		$500,000
15/05/2011	AAO	AAT refurbishment	Payments - Operating	AATB		$200,000
15/05/2011	MIRA	ASKAP	Payment - Capital	CSIRO		$2,100,000
15/05/2011	Gemini	AusGO	Payments - Operating	AATB		$84,250
30/06/2011	Magellan	Magellan Fellows	Payments - Operating	AATB		$158,052
					$5,151,114	**$16,568,134**

2009/10 Astronomy NCRIS cash receipts and payments – AAL operations (GST exclusive)

Date	Facility	Item	Transaction Type	From / To	Receipts	Payments
1/09/2010	AAL	AAL Operations	Receipts	AAL members	$193,788	
1/01/2011	AAL	AAL Operations	Receipts	NCRIS	$255,886	
30/06/2011	AAL	AAL Operations	Payments - Operating	AAL		$193,788
30/06/2011	AAL	AAL Operations	Payments - Operating	AAL		$255,886
					$449,674	**$449,674**

2009/10 Astronomy NCRIS Reserve receipts and payments (GST exclusive)

Date	Facility	Item	Transaction Type	From / To	Receipts	Payments
30/06/2011	Magellan	Magellan Fellows	Payments - Operating	AATB		$19,858
30/06/2011	NCRIS reserve	NCRIS reserve	Receipts	Interest	$240,000	
					$240,000	**$19,858**

Astronomy Australia Ltd.

29th June 2010

Prof Matthew Colless
Director
Anglo-Australian Observatory
P.O. Box 296
Epping NSW 1710

Re: Addendum to the 2010/11 Astronomy NCRIS Annual Business Plan

Dear Matthew,

The 2009/10 Astronomy NCRIS Annual Business Plan records that the AAO is committed to contributing $1,300,000 of its own funds towards HERMES. As reported by Mark McAuley, the AAO did not seek to revise this amount in its submission to AAL for the 2010/11 Astronomy NCRIS Annual Business Plan; however, I note that your 2010/11 annual business plan submission was made to AAL on 12th April 2010, while your response to the HERMES PDR is dated 23rd April 2010. I would therefore like to take this opportunity to record the AAO's revised post-PDR financial commitment to the HERMES project:

	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	Total
NCRIS	$1,020,000	$400,000	$2,500,000	$2,000,000	$0	$0	$5,920,000
EIF	$0	$0	$0	$0	$1,260,000	$410,000	$1,670,000
AAO	$0	$0	$1,183,053	$103,494	$2,049,873	$445,625	$3,782,045
Total	$1,020,000	$400,000	$3,683,053	$2,103,494	$3,309,873	$855,625	$11,372,045

Notes:

- The above table refers to the complete HERMES project, inclusive of the infra-red arm.
- The above $1,670,000 of EIF funding is specified in a contract between AAL and DIISR. During the 2010/11 financial year AAL will seek to finalise a sub-contract with the AAO for these funds.

If you agree with the above AAO financial commitment to HERMES, please print, sign and date this letter, and return to the AAL office.

Regards,

Dr Martin Cole, Chair, AAL.

Matthew Colless _____ 29 June 2010 _____

Matthew Colless, Date
Director, Anglo-Australian Observatory

PO Box 2100, Hawthorn, VIC 3122
Telephone: +61 3 9214 5854; Fax: +61 3 9214 4396
ACN: 124 973 584; ABN: 19 124 973 584
www.astronomyaustralia.org.au