

**Mid-Term Review of the Astronomy Decadal Plan 2006-2015**

**Issues Paper**

4 June 2010

**Prepared by the Mid-Term Review Committee of the National Committee for  
Astronomy (NCA)**

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## BACKGROUND AND TERMS OF REFERENCE

The NCA's Astronomy Decadal Plan 2006-2015 was released in late 2005; it is now time to prepare for a Mid-Term Review, with the aim of making this available in late 2010. Following discussions at the July 2009 joint meeting of the NCA and the astronomy Heads of Departments, the December 2009 meeting of the NCA agreed the following terms of reference, process, and timeline for the Mid-Term Review.

### *Terms of Reference*

The Mid-Term Review of the Decadal Plan for Astronomy 2006-15 will:

1. re-affirm the main goals and priorities of the Decadal Plan, and provide a succinct update on the state of Australian astronomy and significant changes since the completion of the Decadal Plan;
2. review the recommendations of the Decadal Plan, reporting on the extent to which they have been accomplished, and whether unfulfilled recommendations remain appropriate or require revision; and
3. review current plans for implementing the original or updated recommendations of the Decadal Plan, and provide revised implementation plans with priorities and contingencies, focussing on the period 2011-2015 but addressing the longer term where appropriate.

### *Process and Timeline*

1. The NCA will appoint a Mid-Term Review Committee to lead the review process. The MTR Committee will be chaired by the NCA Chair and have broad representation across astronomical fields and institutions.
2. The NCA has appointed the following people to the MTR Committee: Elaine Sadler (NCA Chair; Sydney), Lister Staveley-Smith (NCA; UWA), Stuart Wyithe (NCA; Melbourne), Kate Brooks (CSIRO), Scott Croom (Sydney), Darren Croton (Swinburne), Brian Schmidt (ANU).
3. The Committee will meet early in 2010 to form a plan for carrying out the Mid-Term Review in accord with the Terms of Reference. This plan and an associated budget will be submitted to the NCA for review and approval by 19 March 2010.
4. The Committee will provide a first draft of the Mid-Term Review for NCA and community review at the time of the ASA meeting in July 2010, where there will be a half-day session on the MTR.
5. The Committee will complete the Mid-Term Review and submit a final draft to the NCA by 30 October 2010.
6. The NCA will consider this draft at its 6 December 2010 meeting and provide the final version of the Mid-Term Review to the AAS Executive Committee, the ARC and the astronomical community.

## TIMELINE FOR THE MID-TERM REVIEW

The Mid-Term Review (MTR) Committee held its first meeting on 16 March 2010 and drew up a plan for the review. This was submitted (and approved by) to the NCA in early April. We currently envisage the following timeline for the MTR process:

<b>April 2010</b>	Identify key issues from the Decadal Plan, noting which need particular attention and consultation.
<b>May-June</b>	Consult with key advisory committees and the astronomy community
<b>June</b>	Prepare a draft document for presentation and discussion at the ASA Annual Scientific Meeting in Hobart
<b>July</b>	ASA meeting, discussions with NCA, further community input
<b>August/September</b>	Refine the draft document to take into account ASA/NCA discussions and other input
<b>October</b>	Complete final draft for submission to NCA
<b>December 2010</b>	NCA meeting, followed by release of the final MTR document

## AIM OF THIS ISSUES PAPER

This aim of this Issues Paper is to summarize the key goals and recommendations of the 2006-15 Decadal Plan, and the progress made to date on achieving these goals. It is intended to serve as a focus for discussion as the MTR proceeds.

If you feel that there is an important issue which is missing from this paper, please contact a member of the MTR committee and let us know.

## REFERENCE DOCUMENTS

1. *New Horizons: A Decadal Plan for Australian Astronomy 2006-2015* (including volume II, supporting information), online at <http://www.aao.gov.au/nca/decadalplan.html>
2. *Australian National Astronomy Facilities – A guide for decision makers* (“Astronomy roadmap”), online at <http://astronomyaustralia.org.au/publications.html>

## KEY ADVISORY GROUPS

Key advisory groups and individuals who can help us co-ordinate community input for the mid-term review include:

<i>Field</i>	<i>Group/committee</i>	<i>Chair</i>
<b>Radio/mm astronomy</b>	ATNF Steering Committee	Lister Staveley-Smith
<b>Optical/IR astronomy</b>	AAL Optical Telescopes Advisory Committee (OTAC)	Joss Bland-Hawthorn
	AAL/NCA ESO Working Group	Jeremy Mould
	AAO Advisory Committee (AAOAC)	(in place by July 2010)
<b>Antarctic astronomy</b>	AAL Antarctic Astronomy Advisory Committee (AAAC),	John Dickey
<b>Theoretical Astrophysics</b>	ANITA (Australian National Institute for Theoretical Astrophysics) Steering Committee	Darren Croton (convenor)
<b>High-Performance Computing</b>	AAL High Performance Computing Working Group (HPCWG)	Darren Croton
<b>Demographics</b>	ASA Women in Astronomy group	Sarah Maddison
<b>Education and Public Outreach</b>	ASA Council	Lister Staveley-Smith
<b>ARC Funding</b>	National Committee for Astronomy	Elaine Sadler

## DECADAL PLAN GOALS AND PROGRESS

**(A) RADIO AND MILLIMETRE ASTRONOMY**Key Decadal Plan recommendations:

- **Engage in the international SKA at the 10% level**

*"The development of new radio astronomy infrastructure in Western Australia, leading to the start of construction of the SKA Phase 1 at the end of this decade, will be an effective way for Australia to engage in the SKA at the 10% level". (DP page iv)*

- **Continue operation of existing national facility radio telescopes**

*"Continued operational support for the existing ATNF telescopes (Parkes, Mopra and Compact Array) is seen as important throughout the next decade. Nevertheless, over this period, resources from these telescopes will increasingly have to be reprioritised into the development and operation of infrastructure on the roadmap to the SKA if Australia is to maintain its world-leading position in radio astronomy". (DP page 31)*

Progress since 2006:

Significant new funding (over \$200 million for 2006-10) has been awarded for radio astronomy infrastructure and support, particularly in Western Australia: ASKAP, ICRAR, Pawsey Supercomputing Centre, MWA

Key points for the Mid-Term Review:

- Australian radio astronomy currently appears healthy and there is strong government support for SKA and related activities
- Growing number of PhD students and astronomers involved in this area, new sweep of fellowships (Super Science etc.)
- High-level recognition of researchers (Prime Ministers Science Prize, Malcolm McIntosh Prize)
- SKA site decision expected in 2012

**Key Issues:**

- 1) ATNF operations and access in a four-observatory (ATCA, Parkes, Mopra plus ASKAP) model
- 2) Keeping involved with ALMA via international collaborations
- 3) International landscape for current and future low-frequency EoR experiments (MWA, HERA, SKA Phase 1)
- 4) Funding, technical specifications and timescale for SKA phase 1
- 5) What actions to take if the SKA site decision is postponed, or a sub-optimal site is selected

## **(B) OPTICAL/INFRARED ASTRONOMY**

### Key Decadal Plan recommendations:

- **10% membership of an Extremely Large Telescope project**

*"In the optical/infrared domain, 10% membership of an Extremely Large Telescope project is also required". (DP page iv)*

- **Complete and maintain 20% access to an 8m-class telescope**

*"The path to this ELT engagement will require completing and maintaining Australia's 20% access to an 8-m class telescope...". (DP page iv)*

- **Continue operation of the 4m Anglo-Australian Telescope at its current level of capability until 2018**

*"The telescope will continue to be a world leader in survey astronomy for at least the next five years, and beyond that will be critical as the single biggest source of optical/infrared observing time for Australian astronomers". (DP page 29)*

- **Retain and develop the AAO instrumentation program**

*"The instrumentation program at the AAO is one of the very best in the world, and it should be retained and developed as a national asset". (DP page 29)*

### Progress since 2006:

- Australian astronomers have access equivalent of 16.5% share in 8m-class telescopes via Gemini and Magellan until end-2012 (via NCRIS and other funding).
- ANU awarded an \$88 million EIF grant to fund capital costs of GMT membership. This is for construction costs only, and future operations funding will need to be found elsewhere.
- The AAO has achieved security of funding for the foreseeable future, and received NCRIS funding for the HERMES instrument, the primary instrument upgrade intended to maintain the scientific impact of the AAO as envisaged in the Decadal Plan.
- 2008 *Astronomy Roadmap* (developed by AAL at the instigation of DIISR) provides advice to government on likely developments in astronomy infrastructure from 2009-18, and discusses two possible scenarios for future 8m/ELT access (Gemini/GMT or ESO).
- High-level recognition of researchers (Gruber Prize, Shaw Prize)

### Key points for Mid-Term Review:

- Australia has achieved funding for its 10% share of an ELT, though not exactly as envisioned in the Decadal Plan - telescope access is not 10% for the community, but rather a 50:50 split between the ANU and the community. In addition, the Global financial crisis has placed the ELTs on shakier financial ground than previously envisioned.

- Post-2012 there is currently no funded access to 8-m time, leading to a potentially dire situation. The community has a strong preference for solving 8-m access via ESO (an option not available at the time of the Decadal Plan), but joining ESO brings with it many other facilities, and is consequently an expensive option. Solving Australia's 8-m problem remains a significant challenge for the Australian Astronomical community.
- The principal vision of the decadal plan has been successfully translated into the new AAO, though the AAO's long-term future (beyond the AAT) is not yet clear.

### **Key Issues:**

- 1) Availability and long-term security of operational funding for national and international telescopes is an *urgent and critical issue*. The NCRIS scheme was able to fund both capital and operational costs of major infrastructure, but its future after 2011 remains uncertain. As a result there is currently no funded access to 8-m time for Australian astronomers after 2012.
- 2) Which of the longer-term scenarios for optical astronomy set out in the 2008 Astronomy Roadmap (Gemini/Magellan/GMT or ESO) represents the most feasible/desirable way to achieve the Decadal Plan goals?
- 3) In addition to these broad-based scenarios, can the MTR outline in more detail the range of available options for achieving the DP goals, and the risks and opportunities associated with each?

## **(C) ANTARCTIC ASTRONOMY**

### Key Decadal Plan recommendations:

- **Explore the opportunities associated with our Antarctic sites**

*"A smaller project, but of considerable long-term significance is the Australian-led PILOT consortium, which aims to operate a pathfinder telescope on the high plateau in the Australian Antarctic Territory (Dome C)" (DP page 33)*

### Progress since 2006:

- A (\$1 million) Preliminary Design Study for PILOT was funded by AAL in 2007-8. This study found that the cost was higher than had been envisioned and PILOT was not supported in AAL's Strategic Options report or its optical roadmap. A PILOT-like telescope is continuing to be investigated by the European ARENA consortium.

### Key points for Mid-Term Review:

- While the PILOT concept has not received broad support in Australia over the past five years, there is a general feeling that Antarctic astronomy should be supported at a moderate level. Exploitation of Antarctica remains an unfulfilled aspiration of the Decadal Plan.

**Key Issues:**

- 1) What are the current goals for Australian Antarctic astronomy, and what would be required to achieve them?
- 2) What level of international collaboration is appropriate?

**(D) THEORETICAL ASTROPHYSICS**Key Decadal Plan recommendations:

- The Decadal Plan is somewhat vague when it comes to recommendations for theory in the coming decade. It argues that the historical success of theorists in Australia has often been opportunistic, and acknowledges that *"A more strategic approach to planning for theory will be required over the next decade as Australia moves increasingly into very large infrastructure programs."* (DP page 23)

Progress since 2006:

- It is not clear that there has been any significant progress in moving towards a more strategic plan for theoretical astrophysics.

Key points for Mid-Term Review:

- As outlined in the Decadal Plan, theory synergies with ground-based optical and radio astronomy maintain Australia's position as a world-leader in the field. The demographics report commissioned as part of the Decadal Plan revealed that roughly one-third of Australian astronomers are theorists.
- While theoretical astrophysics is presented as a major research strength playing a critical role in the future of Australian astronomy, it was omitted from the funding wedges of proposed resource allocation. This omission reduces the possibilities for strategic development, and also runs contrary to statements within the Decadal Plan that "theorists pose many of the questions that drive the next generation of large facilities, and often lead the interpretation of results."

**Key Issues:**

1. How can theoretical astrophysics be included in future proposed funding allocations and strategically supported at both a national and institutional level?

**(E) HIGH-PERFORMANCE COMPUTING (HPC)**Key Decadal Plan recommendations:

- **Continued investment in computing infrastructure and associated personnel is needed.** (DP page 31)

1. Both general (broad use) and dedicated HPC facilities are needed to meet the demands of the next decade.
2. Computational astrophysics expertise should cluster around specialised HPC resources.
3. Connected facilities are essential and hence investment in data networks should continue in-step with the increasing volume of data capture.
4. Australia should continue to participate in the International Virtual Observatory (VO).

#### Progress since 2006:

- Overall investment in HPC infrastructure has been positive in the past few years. The Australian Government has committed \$80M to the Pawsey Supercomputing Centre in WA (2009-2013). gSTAR is a dedicated GPU based supercomputer (2011) which will provide a specialised facility for the astronomy community, primarily for theory (numerical simulations) but also data processing.

#### Key points for Mid-Term Review:

- Hiring of HPC/theory experts has been positive but unfocused, primarily made through opportunistic university funding or successful grant applications. It has not tended to cluster around or be supported by any one facility or project. Some hiring has occurred at the faculty level, but most hires remain on fixed term contracts . Without continued support, we run the risk of losing this expertise when the contracts expire.
- More information is needed on the quality of the data network available to astronomy and how this will meet the needs of the community in the coming five years. Interest in the VO appears to have waned as astronomers focus in more immediate problems (e.g. collecting data, funding, etc).
- Members of the community have identified a need for a coordinated approach to data processing, archival, curation and access across (primarily) radio and optical astronomy. This will become increasingly important as the volume of data increases exponentially in the coming years.

#### **Key Issues:**

- 1) How can we best secure adequate operational funding and personnel funding to support major new HPC infrastructure such as the Pawsey Centre?
- 2) Is the International Virtual Observatory still useful/relevant to Australian astronomers, and what is the best way to ensure efficient access to large data sets?
- 3) How can we integrate observatories more closely with data archives and virtual observatories?

#### **(F) DEMOGRAPHICS**

##### Key Decadal Plan recommendations:

- **The size of the astronomical community in both universities and national facilities should expand from 2005 levels.**

*"As new facilities become available during the decade, there should be an associated increase in the number of research astronomers in Australia, with a proportional increase in PhD places."* (DP page 15)

Progress since 2006:

- There has almost certainly been an increase in the size of the astronomy community since 2005, with the establishment of major new research groups in Western Australia.

Key points for Mid-Term Review:

- Do we need a more uniform and robust way of collecting and preserving demographic data from one Decadal Plan to the next? It appears that the original data used for the 2005 plan can no longer be found, and only the summary tables are now available.

**Key Issues:**

- 1) How much has the Australian astronomy community grown since 2005, and has the number of PhD students also increased?
- 2) Should we set up a dedicated working group (perhaps as a sub-committee of NCA or ASA) to collect and maintain demographic data on longer timescales.
- 3) How can we turn an upturn in short-term positions (e.g. the recent Super Science Fellowships) into additional long-term astronomy positions?

**(G) EDUCATION AND PUBLIC OUTREACH**

Key Decadal Plan recommendations:

- **Education and public outreach programs are important, and should be supported by adequate funding.**

*"The maintenance and development of programs of public outreach, especially those that support teachers, is an important activity for astronomers... a competitive mechanism is required to reward teaching and research success with an additional funding component to ensure that the latest research results are promptly and effectively communicated to the public."* (DP page 23)

Progress since 2006:

- The International Year of Astronomy (IYA, 2009) saw a wide range of education and public outreach activities and generated a vast amount of material which will continue to be used in subsequent years. If funding were made available for improving access to this material by schools and the public (e.g. a one-stop website), the value could be increased.

Key points for Mid-Term Review:

- The forthcoming National Science Curriculum for K-10 and senior has a significant amount of astronomy/space science, and therefore there is potential for the professional astronomy community to be more involved in teacher education.

- The DP recommended that more effort and funding should be allocated to disseminating research results to the public. There does not seem to be any long-term improvement on this front. It is true that during IYA research results were disseminated through numerous public lectures, but these were in most cases attached to one-off IYA funding.

### Key Issues:

- 1) What is the most appropriate way to fund and support the education and outreach aspirations of the decadal plan?

### (H) ARC GRANT FUNDING

#### Key Decadal Plan recommendations:

- **An increase in ARC grant funding is needed to support new and existing research facilities.**

*"To parallel this investment in facilities and fund research activities across the foundation of the astronomy pyramid, similar levels of growth must be achieved in the funding won by astronomers through the National Competitive Grants Program operated by the Australian Research Council. This should result in the level of competitive grant support being, on average, A\$3M per annum higher than current levels in the first five years of this plan and A\$6M per annum higher in the second half of the decade." (DP page iv)*

#### Progress since 2006:

Analysis of ARC funding data (which will be summarized in the MTR document) shows that:

- The total funding awarded for ARC Discovery Projects in astronomy (\$5.6 million per year) has not increased since 2002. **In terms of 2002 dollars, this corresponds to a decline of more than 25% in ARC DP funding over the past decade.**
- On average, 2.2% of DP funding goes to astronomy (again, unchanged since 2002).
- Within the Physical Sciences sector, the percentage of DPs awarded to astronomers is around 8% and the percentage of dollars is around 9%. Both have large fluctuations from year to year, but there is no sign of any long-term trend.
- Over the past 10 years the success rate of proposals within the Physical Sciences has been at around 23% with fluctuations of around 2% but no obvious trend. The fraction of requested funding has remained steady at around 65%. Thus although we do not have any information on the number of astronomy proposals submitted to the DP scheme, it could be inferred that the funding of astronomy DPs in terms of success rate and funding level has remained consistent over the past decade.
- The recent award of 33 Super Science Fellowships to astronomy represents an additional funding stream of up to \$3.0 million for the period 2010-13.

#### Key points for Mid-Term Review:

- One-off funding schemes like the Super Science Fellowships are very welcome, but lack the flexibility of the ARC DP scheme, which remains the key funding source for

university groups. The fact that DP funding has remained static for the past decade (implying a decrease in real terms) is a matter for serious concern.

### Key Issues:

- What are the prospects for increased ARC funding in the next five years?
- How can university research groups cope with a steady or declining grant budget in an era when the number of researchers is increasing and major new facilities are coming online?

### (I) GRAVITY-WAVE ASTRONOMY

#### Key Decadal Plan recommendations:

- **Gravity-wave astronomy is identified as being of potentially enormous significance, but until gravity waves are detected they remain in the realm of experimental physics, rather than astronomy.**

*“Gravity-wave astronomy is identified as being of potentially enormous significance, but until gravity waves are detected they remain in the realm of experimental physics, rather than astronomy. Australia’s role in the international gravity-wave observatory is best supported through Australia’s subscription to the international Advanced LIGO program. The Australian Consortium for Interferometric Gravitational Astronomy (ACIGA) is developing and testing techniques for next- generation advanced gravity-wave interferometers, and is well-placed to make a significant intellectual contribution to Advanced LIGO. “ (DP page 35)*

#### Progress since 2006:

- Recent and on-going searches for pulsars have dramatically increased the known sample of millisecond pulsars (MSPs), making it feasible to set up a pulsar timing array based on observations of a large number of MSPs, spread over the celestial sphere. The Parkes Pulsar Timing Array ([www.atnf.csiro.au/research/pulsar/ppta](http://www.atnf.csiro.au/research/pulsar/ppta)), commissioned in 2005, is in effect a gravitational wave detector using the Earth as a test mass, and offers the possibility of making the first detection of gravity waves.

#### Key points for Mid-Term Review:

- An opportunity has recently arisen for Australia to host one of the advanced LIGO interferometers. This would be based on a 50/50 cost share with the USA, but would require Australia to provide roughly \$80million to build the facility and 4 to 5 million dollars a year to run it for a minimum of 10 years. These funds would have to be found by early 2011, and interested Australian universities are considering an EIF bid to fund the capital cost.

### Key Issues:

- How should the astronomy community prepare for the possible detection of gravity waves from astrophysical sources in the near future?
- Does the Decadal Plan need updating in this area?

## CALL FOR COMMUNITY INPUT

The Mid-Term Review (MTR) Committee will seek input from the key advisory committees listed on page 5 of this document, but we also welcome comments from other groups or individuals in the astronomy community about any of the issues raised in this paper. If you think there are important issues not listed here, please let us know as soon as possible.

Please keep in mind that the purpose of the MTR is to reaffirm or adjust the direction of the original Decadal Plan (DP) goals, while taking stock of recent developments both in Australia and internationally.

There is no fixed format for sending your comments to the MTR Committee, and all input received will be considered as public unless you request that your submission be kept confidential to the committee.

Please email your submissions to the MTR Committee at  
[astro\\_midterm@physics.usyd.edu.au](mailto:astro_midterm@physics.usyd.edu.au)

The MTR Committee will meet again in late June to prepare material for a special MTR session at the ASA meeting in Hobart in early July.

Community input received up to the end of August 2010 (including comments in response to the ASA discussion) will be considered as we prepare the final plan in August/September.

We also welcome submissions of short ‘Research Highlights’ and images for possible inclusion in the final published MTR report.