

# **Report on SKAMP Project to ASKACC**

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### **Executive Summary**

The *SKA Molonglo Prototype (SKAMP)*, a joint CSIRO/University of Sydney project, is the technology testbed for the Cylindrical Reflector SKA concept proposed by Bunton et al. (2003 SKA White Paper). The capacity of a cylindrical reflector to deliver a very large field of view (50-100 square degrees) at frequencies below 1.4 GHz, make it an enormously fast and powerful survey telescope for redshifted HI.

The demonstration of a low-frequency wide field-of-view instrument at the remote site in Western Australia has now crystallised as the *New Technology Demonstrator (NTD)* project. This project has clear synergies and links with SKAMP.

The rising profile of the Cylindrical Reflector SKA design over the past year has led in turn to increasing pressure on the SKAMP program to demonstrate several key technologies which are necessary for building a CR SKA. These are (i) a wideband feed operating over the entire frequency range 300-1400 MHz, (ii) the beam-forming techniques needed to image a very large field of view, (iii) a high-speed digital correlator and filterbanks, and (iv) effective removal of terrestrial radio-frequency interference (RFI).

At present, the MNRF and other funding allocated to SKAMP is sufficient to provide a 30 MHz bandwidth spectral correlator centred at 843 MHz over a substantial fraction of the collecting area of the existing telescope. Funding is also approved for the final stage of SKAMP, which is a new feed and front-end receiver system, currently envisaged to cover 300 – 1400 MHz, with an instantaneous bandwidth of at least 50 MHz. At least 10% of the telescope will be fitted out. Whether there is some reduction in the final frequency range covered is dependent on the research outcomes over the next 18 months. A moderate reduction (to say 500 - 1000 MHz) would still provide proof of concept for cylindrical reflectors and line feeds. Continuous spectral coverage over this range and an instantaneous bandwidth of at least 50 MHz, would allow the key technologies which underlie the CR SKA design to be demonstrated in advance of the final SKA concept selection which will be made by the ISSC in late 2007.

This report summarises progress to date, including changes to the Team, an update on the Defence Joint Operations Headquarters Facility planned for a site near the Observatory and a request for increased funding that will be submitted to AABoM to accelerate the project.

## **1 Progress Report**

A detailed progress report was given at the recent MNRF Symposium, held on June 8 at ATNF.

1. The digital signal pathway has been established and first fringes from a drift scan have been measured for single baselines. The boards for digital control of the first stage are now being populated. Duncan Campbell-Wilson is managing this part of the project.

2. The continuum correlator board is about to be delivered. The company chosen to produce the board (Entech) will undertake X-ray and optical checking to verify the 10-layer board. Testing will commence within 2 weeks. Tim Adams has responsibility for this part of the project. He has also commenced detailed design of the spectral-line correlator with John Bunton.
3. A prototype element has been built at Argus Technologies that has 2:1 bandwidth capabilities. This is just one possible prototype, part of the initial testing by Martin Leung. Sergey Vinogradov has done simulations of multi-element arrays and is exploring different array geometries.
4. The data acquisition and archiving is being undertaken by Michael Kesteven and is largely complete.
5. The Participation Deed is now agreed between the University of Sydney and CSIRO. Lawyers at both institutions have approved the document. Funding can now be brought up to date.

## **2 Budget – Request for increased funding**

To accelerate progress on the SKAMP project, in particular for the line feed development and improved co-ordination and management of the project's increasingly complex component tasks, we request additional funding from the MNRF Program and from CSIRO over the period of the MNRF project.

### **Funding from CSIRO directly**

The request for a 1.0FTE Feed Engineer (based in Sydney, jointly at CSIRO and Sydney University) is costed at \$85,000 per annum, including oncosts. This is now approved and will be funded by the Emerging Science Program for 1 year. A formal commitment of time from 3 CSIRO staff (0.1FTE for Michael Kesteven & John Bunton, which is already informally committed and 0.2FTE of John Kott's time from ICT Centre or equivalent expertise) is requested. This commitment is essentially in place.

### **Funding request from MNRF**

1. A 0.4FTE Project Manager is requested, to be combined with funding for an equivalent position in the NTD project. The coordination, organisation and reporting requirements of this project require a person with this expertise. It is costed at approximately \$25,000 per annum, including oncosts. The appointment would be for 3 years, totalling \$75,000.
2. The position of RF engineer is now being filled by Adrian Blake. He has optic fibre expertise and with Duncan Campbell-Wilson is implementing the next stage to a full fibre-fed digital IF system. This has left a hole in our team of a software engineer to assist with the implementation of the control software and the digitising for the spectral line system. This person could also assist Tim Adams with the second stage correlator. This request would be for a 1.0FTE costed at \$85,000 per annum, including oncosts, for three years. The total request is \$255,000.
3. An additional \$80,000 is requested to outsource components for the frontend IC and delay striplines, to accelerate project. The original proposal was to manufacture these boards inhouse.

*The total additional request from MNRF funds is \$410,000 and it is estimated that this additional support will advance the SKAMP project, in particular the line feed system by a full 12 months.*

### 3 Personnel Developments

Key personnel changes that should be noted:

1. **A/Prof. Anne Green** will take sabbatical leave from July, 2004 for six months. She will be based at Berkeley and will work closely with the Allan Telescope Array group. **Dr Michael Kesteven** and **Mr Duncan Campbell-Wilson** will jointly manage the progress. Coordination with the NTD project and reporting responsibilities are planned to be delegated to the new Project Manager (see Budget request).
2. **Dr Andrew Parfitt** has a new position at the University of Adelaide, but will still be part of the ARC funded project to develop a line feed. This project also employs Sergey Vinogradov (Research Associate) and Martin Leung (PhD student).
3. **Mr Adrian Blake** is now employed on the project to undertake implementation of the IF fibre network and to assist with the RF/IF interface.
4. **Mr Daniel Mitchell** will undertake RFI testing and software development over the next six months. He will also assist with upgrading the telescope control software. This is not part of the MNRF budget.
5. Approval has been given to employ a 1.0 FTE Feed Engineer under the CSIRO Emerging Science Program. The person would work on generic line feed issues, including array technology, that could be applicable to both the SKAMP and NTD projects. It is my understanding an existing engineer at the ICT Centre can be assigned to this position, from discussions with Dr Trevor Bird. This has not yet occurred.

### 4 Impact of Defence Headquarters Facility

There have been several developments with this project, which now looks inevitable, whatever political party is in Government.

1. The draft Memorandum of Understanding (MOU) between Defence and the University of Sydney was first written in 2003, to manage issues of RFI and mutual interaction. The research program at Molonglo should be adequately compensated if the data are significantly corrupted (by an agreed degree of severity) by the HJOC project. Colonel Greg Baker will meet with Green this week to finalise details of the MOU. The University of Sydney Legal Counsel have the document under review.
2. We made a submission to the Environmental Impact Study (EIS) and the impact on astronomy at the Molonglo Observatory is noted in the subsequent document produced to details relevant concerns.
3. A Parliamentary Standing Committee on Public Works held a meeting on June 18. A written submission was made and we were allocated 30 minutes to present a statement

and answer questions. Our presentation was well-received and the principal recommendations of shielding, planting vegetation on the intervening ridge-line and guidelines for construction work are part of the Defence project specification.

4. The construction and normal operations of HQJOC have the potential to compromise the scientific objectives of the Molonglo Radio Observatory. In the worst possible scenario, if the emissions from HQJOC result in the Molonglo Radio Observatory being rendered non-viable, then provision needs to be made to relocate and re-establish an internationally competitive observatory at another location. We regard this option as a last resort, since it is not in the national interest either to render the present observatory unviable or incur the considerable cost and delay in re-establishment at another site. The issue of how to manage compensation with respect to the University has not yet been addressed.
5. In summary, we are cautiously optimistic that observations will be able to proceed as planned. Our current SUMSS survey is more vulnerable than the SKAMP project, for which we know that RFI mitigation strategies are essential and research is proceeding well.