

Toward VGOS with the AuScope Array

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AuScope

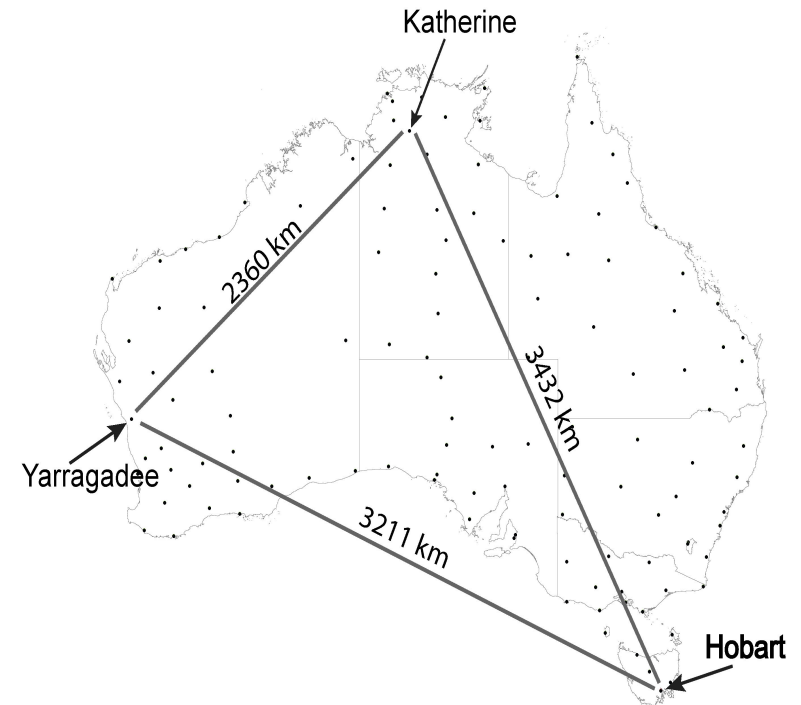


Australian Government

Australian Research Council

The AuScope Array

- Three 12m Telescopes across the Australian continent, currently equipped with S/X feeds
- Observing at a rate of ~230 days per year in 2015
- Katherine, Yarragadee sites remotely operated.
- Talk by Jim Lovell later today on AUSTRAL sessions.
- Posters by Jim Lovell and Lucia Plank (P2-01 and P2-02).



Broadband Upgrade for AuScope

- S/X feeds were intended as an interim measure
- Upgrade to cryogenic broadband feeds and broadband backend systems for all three telescopes in progress for 2016.
- Prototype will be in Hobart for testing mid-2015.
- This talk outlines the system and our preparations.



Full VGOS system

- Cryogenically cooled (Stirling Cycle) broadband receiver (2.3-14 GHz) with noise, phase and delay calibration systems
- RF over Fibre/Downconverter
- DBBC3
- Flexbuf recorder or Mark6
- Correlation facilities able to handle high data rates.

Broadband Feed

- Design chosen is a QRFH being developed by Callisto.
- Frequency range ~2-14 GHz
- Cryogenically cooled, but using Stirling cycle cryogenics (~70K) rather than typical He-system (20K).
- Poster by Rémi Rayet of Callisto shows the most recent results (P1-01)

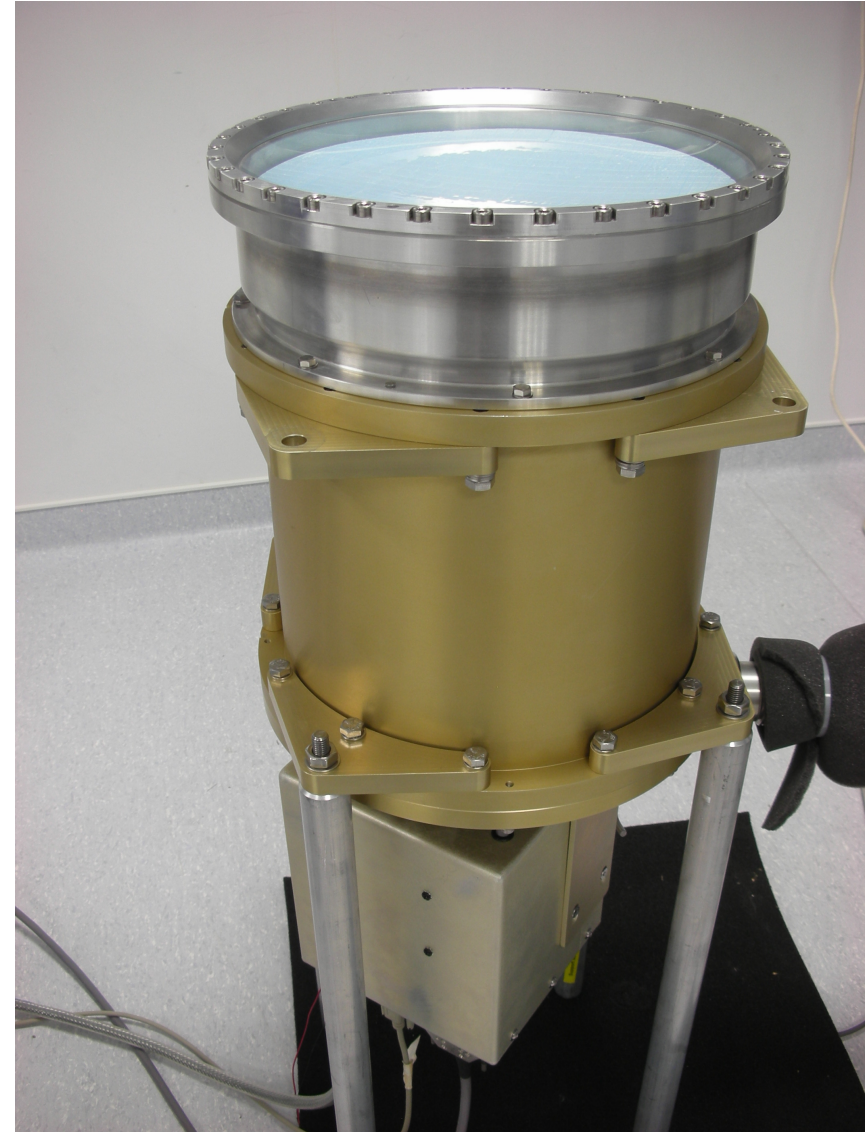


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Broadband feed

- In Hobart for testing middle of this year to test performance on the existing 12m telescopes.
- Aim to test system temperature, aperture efficiencies, performance of the calibration systems.
- Full VGOS backend not available at this time so will be using existing equipment

Preparations at Hobart

- Hobart's Mt. Pleasant observatory will be used for testing – Hb will have prototype feed mounted instead of S/X, existing DBBCs and recorders will be used in place of full VGOS system.

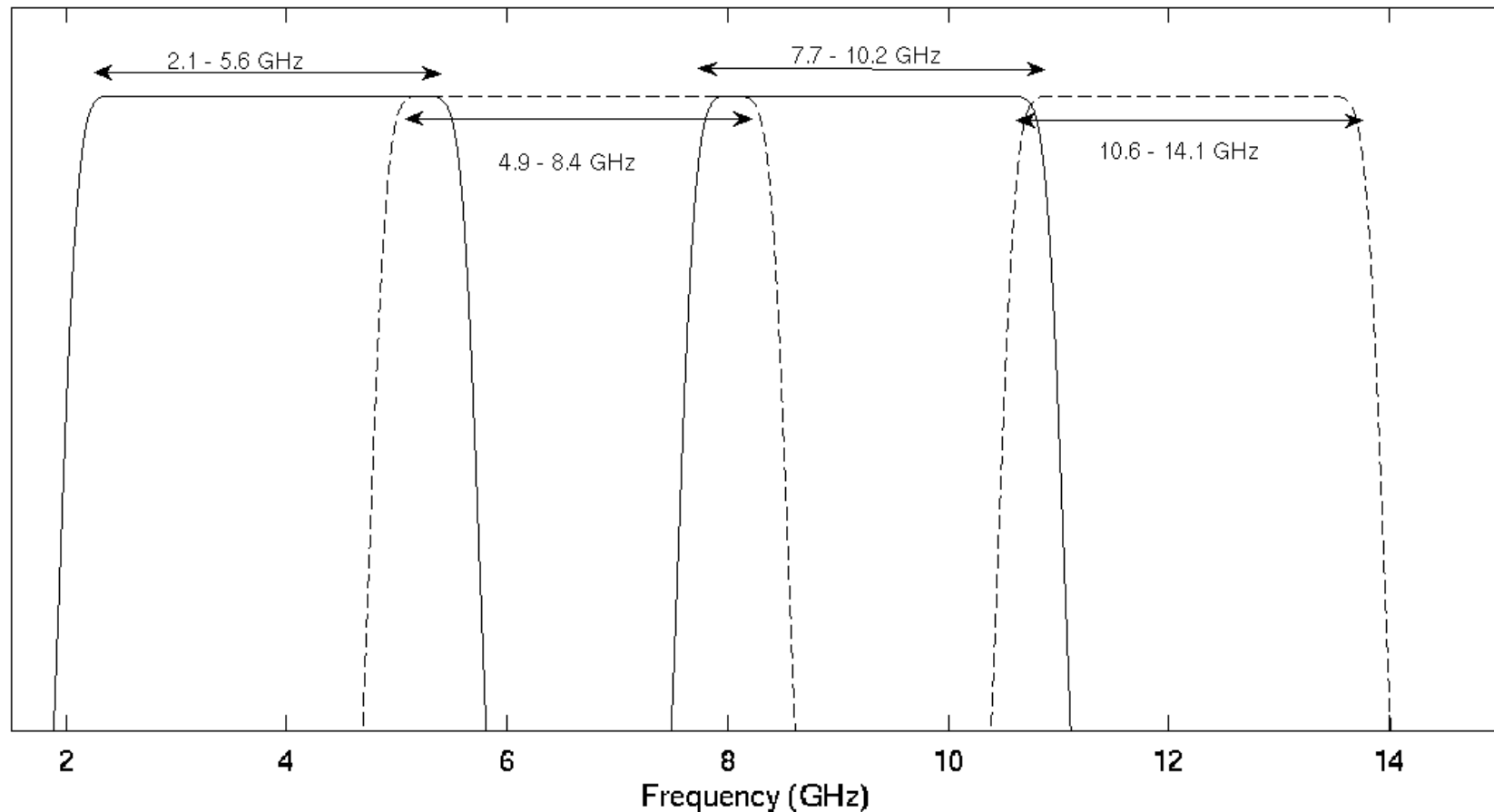


RF-over-Fibre

- We have recently acquired an RF-over-Fibre system at Hobart
- Currently in testing in the lab with broadband noise sources
- Tests planned with Ho26 prior to broadband feed.
- 300m distance between Hb12 telescope and control room.

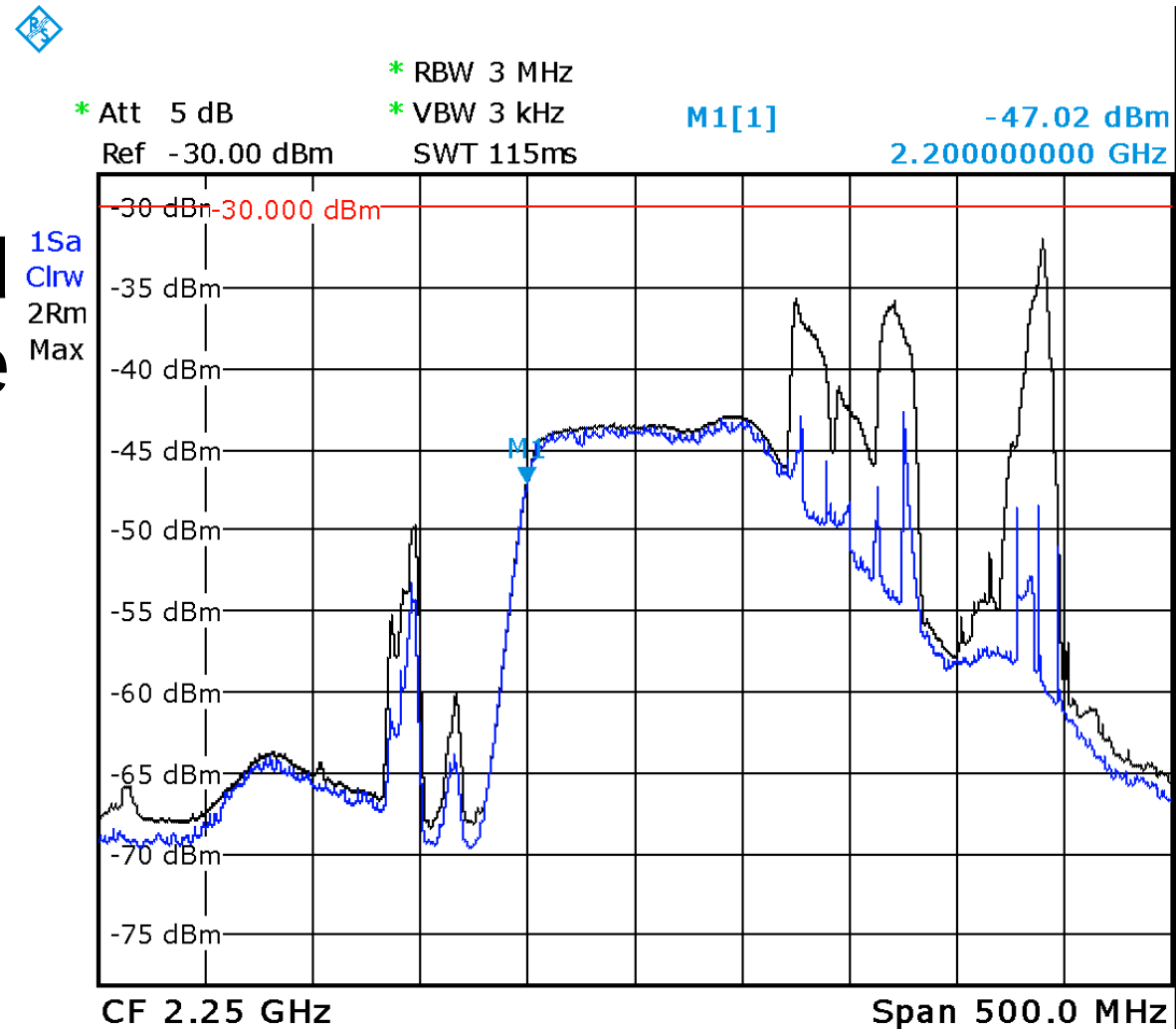
Downconversion

- A custom downconversion system has been built, with 4 output IFs



RFI survey and mitigation

- RFI is already problematic, especially at L- and S-band (Microwave radio link, fixed wireless broadband)



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RFI mitigation

- Hobart and Katherine both near to airports, Yarragadee co-located with SLR and has aircraft radar.
- RFI survey planned (using FSL-18 spectrum analyzer & antenna)
- Have plans to split off the S-band portion of the spectrum.
- Notch filters may be needed for higher frequencies, but undesirable due to harmonics and reduced performance.

DBBCs

- Have DBBC3 systems on order (supporting 4 dual-pol IFs and up to 32 Gbps)
- Initial testing will be conducted with existing DBBC2 units (two available at Hobart, together with a Fila10G)
- Each capable of producing a 4 Gbps data stream with 2x512 MHz PFBs.
- Fila10G operation confirmed with this mode (autocorrelation tests of VDIF data).

Flexbuf

- Built and installed November 2014
- Dual Xeon processor, 64 GB RAM, 36 drives (currently 4 TB each)
- Two 28 TB RAID-5 arrays, remaining disks for VBS recordings.
- 4x 10 GbE interfaces



Flexbuf

- Successfully recorded a month of AUSTRAL experiments (1Gbps) with no issues.
- Also used in astronomical observations with Australian LBA (256/512/1024 Mbps)
- 10 Gbps link to University of Tasmania and data allocation on a shared PB-scale data store.
- 10 Gbps link to the observatories correlation cluster (Hex).
- Also has external SAS capabilities for use with mark6 modules but this has not been tested.

Correlation Facilities

- Recently gained access to HPC facilities at the University of Tasmania
- “Vortex” - 256 nodes each with 8 cores
- Infiniband interconnections, access to large, fast data storage.
- DiFX installed and in benchmarking – initial tests highly promising.
- 2 Gbps S/X observations using the existing DBBCs PFB mode planned.

Future work

- Short-baseline interferometric testing with Ho26 (equipped with separate 2.3, 4.8, 6.7, 8.4 and 12 GHz receivers).
- VLBI fringe-tests with other broadband capable antennas.
- Post-correlation analysis.