

ATNF ATUC Memorandum

To: ATUC
From: Bob Sault
Date: 22 November 2004
Subject: 3mm systems on the ATCA

Summary of 2004

The highlight of the year at the ATCA has been the installation of the 3mm systems on 5 antennas. The first 3 new systems were first used for observing on 10 September, and five systems being available on 20 September. This was appreciably later than the originally scheduled 6 July start to the 3mm season, and was caused by some substantial engineering challenges in the local oscillator system near the end of the project. The new systems were brought into operation as quickly as possible, with limited commissioning time. In some instances, the arrival of the hardware at Narrabri and first use in scheduled observations was on the same day. Scheduled 3-mm observing continued on the ATCA up until 15 October when the “3-mm season” was declared closed. This is dictated by weather: the summer weather pattern was already apparent by that stage. Almost all projects from the time of the installation up until the close of the season were 3mm ones. Scheduled 12-mm observing continued until 28 October.

Performance of the systems was generally good: system temperatures of 200-300K were readily attainable, and the system sensitivity was 22-25 Jy/K. With the limited time between delivery and the end of the season, commissioning tests were being performed in tandem with scheduled observing. Not surprisingly, there were a number of teething problems with the new systems, which were addressed as promptly as possible. A number of the lower priority or more long-term issues remain with us.

The late delivery of the 3mm systems required substantial rescheduling at short notice, which was a disruptive process for all concerned. We thank all those observers who graciously took the need to reschedule in their stride, and assisted us despite inconvenience to themselves.

Although most projects were rescheduled, this was less than optimal for some projects. Additionally only three or four antennas were available to the earliest projects to use the 3-mm system. Expressed as a fraction of total time in the term, 4.6% of projects originally scheduled needed to be cancelled and replaced with other projects, 1.2% observed with a three-antenna system, and 2.6% observed with a four-antenna system. The majority of projects that were cancelled were for 12-mm observations: the installation of the 3-mm system disabled the 12-mm system for a period.

Prospects for 2005

There are many issues that will be addressed over the summer (where possible) with the aim of providing a polished system at the start of the 2005 millimetre season. An appendix to this paper lists some of these polishing tasks.

Some significant issues include:

- The antenna efficiency of CA01 is substantially less than other antennas, and the beam shape is poor. Although good progress has been made to understanding this problem, there is some way to go. We have contracted a photogrammetric survey of the subreflector and main dish of CA01 to be performed on 15-16 December. This should give a conclusive answer. Until this problem is better understood, the subreflector actuation project is on hold.
- The system temperature of CA04 Y polarisation in the band 86-90 GHz is significantly poorer than expected. This continues to be investigated.
- Above 102.3 GHz, system sensitivity abruptly degrades by about a factor of two. The cause is well understood, and options to resolve it are being assessed. It is unlikely that this will be resolved by the 2005 season.
- Although the polishing tasks are expected to give a better system, the “headline” capabilities of the system in 2005 will be the same as in 2004. In particular, the frequency range offered remains essentially unchanged (83.5-106 GHz), and noise diodes will not be installed on the antennas (note that polarimetric observations require the noise diodes). High frequency extension (106-115 GHz) and noise diode calibration will wait at least until their successful demonstration at Mopra.

One expected addition capability in 2005 is the provision of a second pair of 16 MHz filters. This will make dual spectral line observation possible for some set of projects.

At an operational level, we have removed the requirement that 3mm proposals must include a team member with 3mm ATCA experience. At the same time, proposals to use arrays more extended than H214 have been asked to provide a specific justification on technical feasibility and scientific value of using an “extended” array.

Advice sought

- ATUC is invited to consider the list of polishing tasks, and to give feedback on issues that will improve system performance and scientific usefulness of the 3mm systems. Prioritisation of items would be useful.
- More broadly, ATUC is invited to make suggestions on how to best exploit the 3mm systems and to maximise the quality of science produced by them.

Appendix: 3mm polishing tasks

Task

Antenna optics

- CA01 subreflector
- CA02-CA05 subreflector
- Focus

Subreflector actuation

- Project review

Receivers

- Investigate possible compression problems

Correlator and IF Filters

- 2nd pair of 16 MHz filters
- New correlator configurations

System temperature and sensitivity

- Upper sideband characterisation
- Hot/cold system temperature measurements, and assess discrepancy between Epping and on-sky system temperature values.
- Evaluate accuracy/consistency of paddle Tsys
- Characterise CA04-B, CA04-D performance near 88GHz
- Investigate "drop-outs" in "Gain" plot of 27-Sep
- Investigate oscillatory gain of CA05
- Gain/elevation curves
- Bandpass stability

System phase and baselines

- Phase noise in LO system
- Investigate sharp amplitude drop-outs in poor weather
- Baseline calibration software
- Baseline calibration and frequency dependence

Pointing

- Improved pointing model at 3mm
- Assess the accuracy of reference pointing as a function of distance to the pointing calibrator
- Comparison between 3mm, 12mm and 3cm pointing
- Evaluate pointing in windy conditions

On-line software

- Pointing tracks planets
- "CACAL" table differentiation of settings includes L86 frequency
- Improved CATAG

Off-line software

- Calibrator duty cycle tool (web)
- Velocity to frequency calculator (web)
- Miscellaneous improvements to atlod, uvsplit, gpboot, uvplt (Miriad)
- Improved algorithm for applying Tsys in atfix (Miriad)

Baseline-based calibration solutions to account for atmospheric decorrelation (Miriad)

Atmospheric monitoring

Evaluate seeing monitor data - compare models with measurements

Evaluate the WVR as an opacity meter

Calibrators

Improve calibrator grid

Improved characterisation of calibrators at 3mm

Flux monitoring

Bigger questions

Turret roller precision

Phase switching for sideband rejection

Subreflector actuation

Finer frequency setting

Front-end power equalisation