



ALMA TelCal Tests of R1

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1 Introduction

This report covers describes the first tests of the TelCal subsystem. John Richer travelled to Grenoble on 24 and 25 February 2004 to carry out this work, as part of a regular face-to-face meeting of the subsystem. The tests were done with Dominique Broguiere, Fanny Cosson and Robert Lucas. As subsystem scientist, my goals before the test were to

1. Ensure the R1 functionality was complete
2. Test the R1 functionality using ALMA-TI data
3. See if the results can be archived

2 Data

Data for the tests was taken by Robert Lucas at the ATF using the Vertex antenna. The data included single-dish pointing cross scans, focus scans, and calibration data taken by switching between ambient and sky loads. The format is ALMA-TI FITS files.

3 Functionality in R1 to be tested

Functionality in R1 is understandably limited, as most of the effort has gone into setting up the ACS infrastructure and establishing interfaces. Future tests will be more elaborate. The requirements provided for in R1 are to process:

1. Single-dish pointing scans
2. Single-dish focus scans
3. Atmospheric calibrations

4 Testing process

Much of the testing took the form of *demonstration* of functionality because TelCal is not a naturally interactive system. First, the TelCal package was shown running in automatic mode, responding to simulated events, and reducing the data passed to it. The TelCalPublisher component then writes results to the archive in xml format. As far as I can tell, this is working OK but this is hard for me to pass detailed comment on — this would need a software engineer familiar with the whole system.

The next part of the tests involved directly exercising the calibration 'engines' which do the calculations

to solve for focus, pointing and atmosphere. To achieve this, Dominique had written short C++ programmes to instantiate the solvers, read data from ALMA-TI files and write out the results in a format suitable for plotting with GreG. So these tests do directly exercise the engines with real data. The underlying solvers are based on those used at the IRAM telescopes, and so are already well tested over many years; however, they have been enhanced specifically for ALMA use in several ways, for example by the addition of 2-dimensional fitting of the beam in pointing analysis.

4.1 Single-dish pointing and focus

These both worked well. Data files from the ATF were read, and the fitted pointing/focus offsets and associated errors returned. These values were written to test files for inspection with GreG. The only items of note are:

1. The code for pointing assumes point-like sources and a given beam size. For large planets, this code will probably work sensibly, but is not quite optimal. However, this is a rather rare requirement for ALMA but perhaps could be implemented with priority 3.
2. The return values of the code in the case of failure to find adequate solutions, and the way they are handled higher up the chain, was unclear at the moment. Handling situations where no sensible solution is found needs work. This is probably handled by the control system which may have to re-execute a pointing/focus scan.
3. The requirements for graphical output from TelCal are unclear. These will be needed, especially during commissioning, but also for routine operation. This must be true for other subsystems also, and a global solution would seem appropriate rather than each subsystem developing their own.

4.2 Atmospheric calibration

R1 implemented a simple atmospheric calibration scheme as used at Bure. Using measurements of sky and ambient temperature loads, and being given a receiver temperature, it is possible to use the atmospheric model ATM to solve for the atmospheric opacity if the temperature is known or assumed. The initial tests did not find sensible opacity values, but a small modification done by Dominique soon fixed the problem, and the modified code can be deemed to have passed the test.

5 Conclusions

As expected, there are few issues to report at the moment. The re-use of the Bure engines looks in good shape and is a sensible and safe way to proceed. The need for standard graphical output is clear. Finally, atmospheric calibration is working fine, but until the amplitude calibration hardware is specified, there can be no useful progress in this area.