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Project	**:**	**AVN**
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HARTRAO SITE VISIT DOCUMENT

DIGITIAL BACKEND COMMISSIONING

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DOCUMENT APPROVAL

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LIST OF ABBREVIATIONS

AVN	African VLBI Network
NRF	National Research Foundation
RF	Radio Frequency
SA	South Africa
SKA	Square Kilometre Array
VLBI	Very Long Baseline Interferometry

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1. APPLICABLE AND REFERENCED DOCUMENTS

1.1. Applicable Documents

The following documents are applicable to the extent stated herein. In the event of conflict between the contents of the applicable documents and this document, this document shall take precedence.

1.2. Reference Documents

The following documents are referenced in this document.

[1] A0215-1000-0000, AVN Roach Setup Guide DRAFT A

[2] A0200-0001-007, AVN Ghana Phase 1 System Integration and Verification Plan Draft A3

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2. INTRODUCTION

The AVN Digital Backend High Resolution Spectrometer had completed commissioning at the Pinelands office. The next stage of commissioning planned was deployment on the HartRAO 26m antenna system in Hartebeesthoek Radio Observatory.

This document describes the visit, and summarises the results.

Project:	*AVN Ghana Digital Backend Deployment*
Site:	*HartRAO*
Team:	Charles Copley, James Smith
Antenna:	26m
Proposed visit date:	12 April to 17 April

3. OBJECTIVE

VE 3.300 ROACH Integration

3.1. Dry run of shipping entire single dish digital backend for Ghana Deployment

3.2. Demonstrate successful detection of Methanol Maser in parallel with operational system.

4. PRE-REQUISITES

1. Shipping container
2. Delivery of shipping container to HartRAO
3. Fully functional ROACH single dish digital backend system
4. Readout and plotting software
5. 10MHz and 1PPS from HartRAO sub-systems.
6. IF signal band suitably split and pre-conditioned so as not to affect the HartRAO pulsar observations.
7. Suitable desk space.

5. HEALTH AND SAFETY

No hazardous operations. Deployment is entirely within the control room of the 26m. Crate can be moved easily by two people.

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6. CONFIGURATION

The system configuration is captured in the operations document A0215-1000-0000, AVN Roach Setup Guide DRAFT A.

7. WORK PROCEDURES

The system configuration used in the lab is well documented in A0215-1000-000, AVN Roach Setup Guide DRAFT A. No changes were envisaged. Any deviations to be captured in the Site Report.

8. WORK PLAN

Day -4, Wednesday	Ship equipment to Krugersdorp Post Office for timeous arrival at HartRAO
Day 1, Monday	Arrive at HartRAO, Equipment to have arrived. Verify interface power levels, and deploy equipment as per A0215-1000-000, AVN Roach Setup Guide DRAFT A
Day 2, Tuesday	Familiarise ourselves with HartRAO software/hardware and scheduling. Attempt to observe Maser if time permits
Day 3, Wednesday	Observe G.92 Maser. Complete report.
Day 4, Thursday	Additional day for unexpected circumstances (late arrival of goods etc.)
Day 5, Friday	Return to Cape Town

9. REPORT

Introduction:

This document reflects the trip made to HartRAO for the digital backend commissioning. The purpose of the trip was primarily to verify the operation of the maser high resolution spectrometer, but also to have a dry run of packing the system for Ghana.

Description:

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Monday 13 April 2015

1. Arrived at HartRAO ~ 0935 after collecting food from Broederstroom.
2. Verified power levels of the IF signal distribution box built by Ronnie for the test.
3. Keith and Pieter installed 1PPS and 10 MHz to the rack for use with the digital backend.
4. Had difficulty tracking the Speed Services package (no answer on their telephone number) but at about 13h00, the package (containing DBE equipment) showed up at HartRAO.
5. Set up the PC on the network. Forgot to pack DC power adapter for the Samsung monitor, but the rest of the equipment appears to cover all bases.
6. Set up the PC private network
7. Set up the ROACH.
8. Connected the IF power to a splitter, with one output to spectrum analyser, and the other to the ROACH.
9. Verified that the coarse resolution spectrometer operates correctly.
    1. Verified 1PPS operates using ROACH LEDs
    2. Verified that the power spectrum detected on the digital backend and the spectrum analyser are consistent.
10. Started taking data in fine resolution mode (5x1.5MHz bands of 4096 channels each- spectral resolution of about 380Hz) centred at 160MHz to try and detect Masers. The scheduler only observes these in the middle of the night.
11. Familiarised ourselves with the HartRAO schedule logger.
12. Left system recording overnight on setting recommended by Jonathan. Nominal bands being recorded are ~157.0, 158.5, 160, 161.5, 163 MHz with 4096 channels in each.

Tuesday 14 April 2015

1. Began work around 8am. Checked data taken over the evening before. Updated the code to generate plots as part of the interim data logging solution.
2. CJC had AVN integration meeting 10am to 12 am.
3. JNS connected the ROACH to 10MHz and verified that this phase locked the signal generator. This happened successfully and was verified with front panel LEDs.
4. Verified that the warning LEDs on the front of the ROACH work correctly. These include FFT,ADC,Quant overflows, PPS not present.
5. Plots from the evening before did not successfully show maser emission, but we did clearly see very narrow band signals from the VLBI phase cal comb generator. So this confirms the system should be working. Confirmed with Jonathan that previous frequency range was misunderstood, and that we actually expect to see the maser emission at IF frequencies of ~156MHz, and 164 MHz.
6. VLBI observations in the afternoon prevented much work from taking place. Spent afternoon updating software, and labelling various parts of the system.

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7. Agreed with Jonathan that dedicated Maser observation will happen tomorrow for final system verification.

Wednesday 15 April 2015

1. Started the day at 8am. Jonathan ran the receiver through different bands.
2. Confirmed that the frequency switching is by ¼ of the bandwidth. i.e. if the bandwidth is 1MHz, the frequency will switch by +-0.25MHz centred around 160MHz. We can therefore expect the Maser to appear at either 159.75MHz or at 160.25MHz. For other bandwidths this will be different though.
3. Jonathan drove antenna to point at G 9.62 methanol maser. Confirmed observation using HartRAO ATNF correlator. Then confirmed using spectrum analyser (Anritsu portable spectrum analsyser DC-7GHz, RBW=1kHz, with 100 integrations, 5MHZ band centred at 160MHz.).
4. Observed 50 integrations of the fine FFT using command

```
python avnSpectrometerDisplayBroad.py -t 10 -a 50 -e -c 102 carina
```

`-t 10` sets the level of ADC attenuation (5 dB)

`-a 50` sets the number of snaps to integrate (about 130 ms worth)

`-e` plots the adjacent channels on the same scales

`-c` 102 selects the 102nd coarse channel for the centre fine FFT, 160 MHz lies here

5. Successful detection of Methanol maser G 9.62 at ~10h00 SAST.
6. Further observation with 250 integrations confirms the noise floor drops. <TBD> confirm that it drops appropriately for sqrt(N) integrations.
7. Sent out email confirming detection.
8. Took photograph of James, Ronnie, Jonathan, Charles, Pieter and Sunelle.

Thursday 16 April 2015

1. Set up external access - got details from Jonathan.

guest.hartrao.ac.za - 192.96.5.84

2. Jonathan suggests using scheduler.master, tailing that to determine which observations are being run, and then using that to trigger when we want our ROACH to get busy.
3. Figured out “showfile” on how to open the .bin files of the individual observations. Discovered that grep works to an extent because there are ASCII portions within the file.
4. Since we’re on the internet now, we changed the password to something slightly less obvious than “user” - “4vnu$er”
5. Labelled everything that belongs to AVN.
6. Wrote script to read and plot ADC sum ^2 values.
7. Packed our bags and got on the road.

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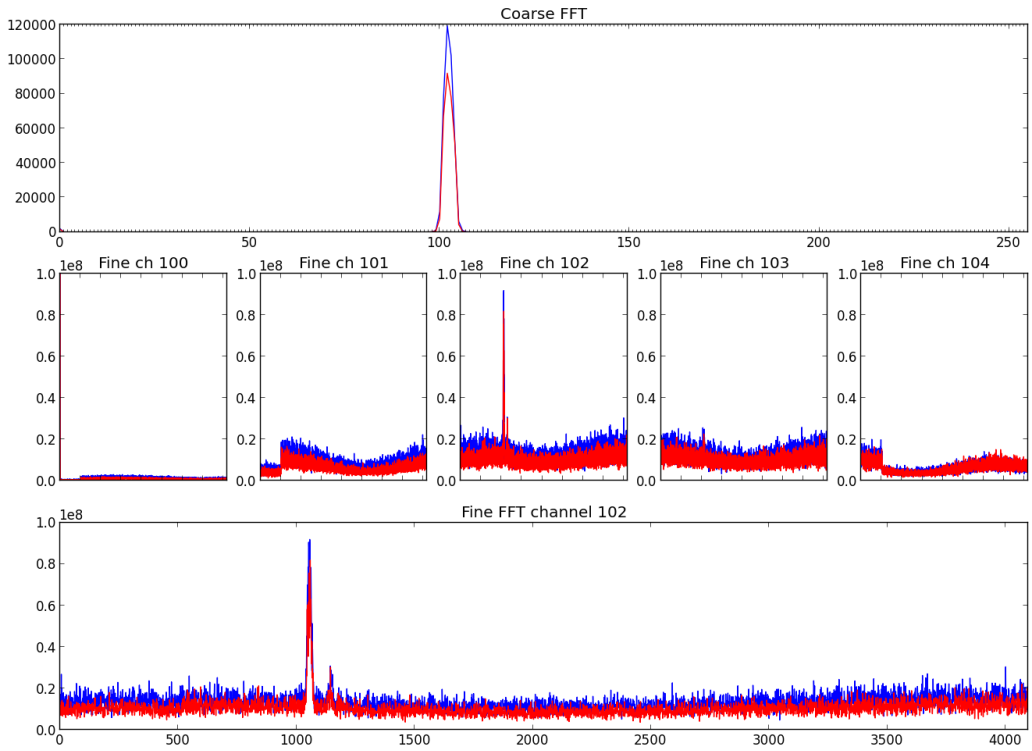

Illustration 1: Detection of G.92 Methanol Maser. Note inversion of X axis. Plots are generated using preliminary observation software. This plot shows the result of 50 integrations using the AVN High Resolution Spectrometer.

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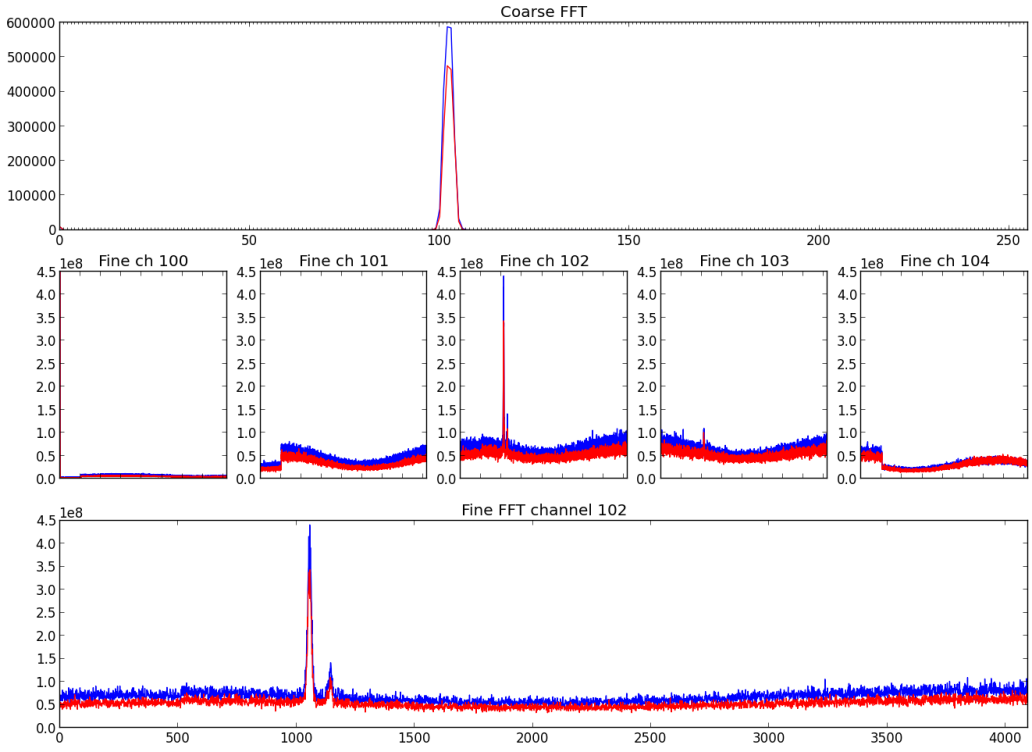

Illustration 2: Detection of G.92 Methanol Maser. Note inversion of X axis. Plots are generated using preliminary observation software. This plot shows the result of 250 integrations using the AVN High Resolution Spectrometer.

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