

## **Hartebeesthoek (Hh) Station Report - TOG Meeting - June 2019**

### **26 m telescope**

The 26 m telescope remains fully operational with its full complement of receivers. However a problem with one of the two Declination shaft bearings has been detected which will necessitate an extended period of downtime to replace. We do not yet have clarity on when this might be done.

Although the subreflector focus positioner upgrade has been completed, the campaign to establish whether active focussing could improve the K-band performance has stalled due to a lack of manpower.. Meanwhile the main antenna shaft encoders urgently need replacement and new higher resolution encoders have been procured. Work on adapting the electronic and software interfaces is ongoing, but shaft end float due to the worn bearing has put a hold on installation.

Although we have suitable components available to implement continuous calibration at L-band and probably S-band, there has been no progress on implementing this as yet. We are still investigating what would be needed for the other receivers.

Beam pattern measurements are still stalled due to lack of manpower.

### **15 m telescope**

The 15 m telescope remains in a fully operational state and is equipped with a dual-polarisation cryogenic co-axial S/X receiver, used mainly to support routine geodetic VLBI observations, thereby freeing up more observing time on the 26 m antenna.

Continuous calibration is available at both S- and X-band on this antenna but some software integration is still needed to automate control of this from the VLBI Field System whereafter we will activate it for use in geodetic observations.

### **VGOS telescope**

Acceptance testing of the new 13.2 m VGOS capable antenna has now been completed and the antenna formally handed over to the observatory. Unfortunately an application for funding to equip the antenna with a suitable wideband receiver and VGOS-capable backend etc. was not successful and integration work has stalled as a result. In the interim we are looking to put together a single polarisation cryogenic X-band test receiver from components already on-hand to evaluate the gain and pointing whilst we explore other funding possibilities. A four bank Mark 6 recorder has been purchased for use with this antenna in due course but the rest of the backend has yet to be defined.

### **EVN Session III – Oct/Nov 2018**

This session was relatively busy for Hartebeesthoek with 23 experiments scheduled, of which 19 were user experiments, comprising some 91% of the 167.56 hours (67.33 hours C-band, 41.5 hours S/X-band, 46.33 hours L-band and 12.4 hours K-band) of recording time and over 94% of the 57.59 TBytes of recorded data. The entire session was recorded on our local Flexbuf with the subsequent electronic shipment to JIVE being completed within 6 weeks of session's end.

There was no data loss during the session, only the usual significant RFI at L-band.

## **EVN Session I – Feb/Mar 2019**

This session was very busy with 32 experiments scheduled, of which 25 were user experiments, comprising some 92% of the 196.91 hours (72.75 hours S/X-band, 20 hours 6.7 GHz methanol, 57.83 hours C-band, 34.33 hours L-band and 12 hours K-band) of recording time and over 94.8% of the 62.22 TBytes of recorded data. The entire session was recorded on our Flexbuf with electronic shipment to JIVE within 2 weeks of session's end.

About 3.5 minutes of data was lost during the session, due to a minor 'jive5ab' software glitch on the Flexbuf and an antenna tracking issue. There was the usual significant RFI at L-band.

## **EVN Session II – May/June 2019**

This session was equally busy with 30 experiments scheduled, of which 25 were user experiments, comprising some 93% of the 184.17 hours (107.87 hours L-band, 19.75 hours 6.7 GHz methanol, 41.05 hours C-band, 12.5 hours K-band and 3 hours X-band) of recording time and over 96.6% of the 76.03 TBytes of recorded data. The entire session was recorded on our Flexbuf with electronic shipment to JIVE still ongoing at this time.

There was no data loss during the session, only the usual significant RFI at L-band.

## **e-VLBI / Connectivity**

Over the period October 2018 to June 2019 Hartebeesthoek participated in 8 e-VLBI sessions, of which 4 were at L-band and 4 were at C-band, comprising roughly 110.75 hours of user data. The dedicated layer-2 'light-path' connection direct to JIVE was used without incident throughout – and there was no local data loss. All of the sessions were transmitted directly from the FiLa10G in the DBBC2 at both 1 Gbps and more recently 2 Gbps.

## **Out of Session experiments**

Additionally the Hartebeesthoek 26 m supported a total of 3 out-of-session RadioAstron imaging observations as part of ad-hoc arrays.

Hartebeesthoek, as part of follow-up of the RadioAstron survey program, also participated in some 44 segments (ranging from 20 minutes to 1 hour in duration) over this period up until RadioAstron's demise with many involving switching from C-band to L-band on-the-fly mid-segment.

## **Frequency Standards**

The Hartebeesthoek 26 m and 15 m continue to operate on our T4Science iMaser-3000 (iMaser-72) during this period. Our backup EFOS-C (EFOS-28) maser remains functional, though the internal heater control circuitry has developed instability issues such that it is not really suitable for use. A service visit, during which this circuitry will be upgraded, has been booked for later this year. Our original EFOS-A maser (EFOS-6) has stopped operating due to the failure of the internal vacuum pump which will be replaced shortly. The sequential failure of our two backup clocks at the start of September 2018 left us very exposed. One has subsequently been repaired and a replacement for the other is now on order. A Vremya VCH-314 two-channel precision frequency comparator is available to allow intercomparison of the three masers.

## **Mark5(B/B+/C) & Flexbuf Recorders**

In April 2017 our Flexbuf system, which is the primary recorder (in VDIF format) for EVN use, was upgraded to a capacity of 258 TB. We also have two Mark5B+ recorders set up to record the two VLBI backends (on the 26m and 15m in Mark5B format) independently. In addition a Mark5C recorder (on long-term loan from the University of Tasmania in support of collaboration with the AuScope array) and an older Mark5B recorder provide an off-line electronic data shipment capability. The former can also be used to record 2 or 4 Gbps VDIF data from either telescope via the built-in FiLa10G's. We have the parts necessary to upgrade one of the Mark5B+'s into a second Mark5C in future should that prove necessary.

## **DBBC Terminals**

The two DBBC2 units (HB1 and HB2) continue to be used in DDC mode as the primary VLBI terminals on the 15 m and 26 m antenna respectively, with full Field System support, now running firmware versions v106 and v107 beta 3 allowing up to 2 Gbps operation. Both are also equipped with an internal FiLa10G cabled in pass-through mode, allowing for simultaneous use of the Mark5B+ recorders (but this prevents use of the newer FiLa10G v4.x firmware). PFB firmware v16 is also available for testing purposes. Both units are equipped with SSD internal disks which would facilitate a Window/Linux dual-boot capability.

## **Software**

Field System: FS 9.13.0-rc2 running on FS Linux 8 (Debian 5.0.x "lenny"), kernel 2.6.26-2-i386

DBBC versions: DDC v106/v107(beta) & PFB v16 running on Windows XP; FiLa10G v3.3.2

Mark5B/B+ version: jive5ab 2.9.0 running on Debian 4.0 "etch", kernel 2.6.18-6-i386

Mark5C version: jive5ab 2.9.0 running on Debian 7.x "wheezy", kernel 3.2.0-4-amd64

Flexbuf version: jive5ab 2.9.0 running on Debian 8.x "jessie", kernel 3.16.0-4-amd64

## **Disks**

No further disk packs have been purchased over this period. However we have upgraded the local Flexbuf with 10 TB disks, re-using the old 4 TB disks to populate some Mark6 disk packs for local test use. The source of future funding for purchasing media remains unclear.

## **Spares**

Currently available VLBI-related (new) spare parts at HartRAO are:

- A spare 2 m VSI-H interface cable.
- A Conduant 10GigE mezzanine board intended for use in upgrading a Mark5B+ to a Mark5C.

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22 June 2019