

## **Hartebeesthoek (Hh) Station Report - TOG Meeting - April 2021**

### **26 m telescope**

The 26 m telescope remains fully operational with its full complement of receivers. However there is an incipient bearing failure at the west end of the Declination shaft that will require replacement in the near future, involving a few months of down time. Should the matching bearing on the east end of the shaft fail, we will be unable to operate until a repair is effected. Unfortunately the ~1M\$ price tag (for replacing both bearings) has been met with little enthusiasm just like in 2008.

Ongoing work to improve high-frequency performance by way of gain and focus curve measurements at K-band suggest that either the feed or the sub-reflector may not be properly centred and displaces further under gravitational load. A new problem developed with the Declination shaft encoder in early October requiring an emergency replacement with older model. Though new higher resolution encoders are in hand and work on adapting the electronic and software interfaces is ongoing, the current shaft end float due to the worn bearing(s) prevents their installation.

Continuous calibration is available at L-band and has been in use since 2020 Session I. Although we have suitable components available to implement continuous calibration at S-band, this has stalled due to staff constraints from the current pandemic. Purchasing of components for a C-band and Methanol implementation is ongoing. We are still investigating what would be needed for the remaining receivers. Only the K-band receiver provides over 1 GHz of bandwidth, though the X-band receiver is some 900 MHz wide. No new receivers are presently envisaged.

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 has not yet been activated as the antenna is mainly used for geodetic observations.

### **13.2 m (VGOS) telescope**

The construction phase of the new 13.2 m VGOS capable antenna has long been completed. Although commissioning of some subsystems has been completed, most of the work is waiting on the equipping of the antenna with a suitable wideband receiver, VGOS-capable backend etc. Funding for such equipment has now been secured and orders have either been placed or are currently being negotiated. We would hope to complete commissioning by mid 2022. In the interim we are working on a single polarisation cryogenic broad X-band receiver from components already on-hand to enable us to evaluate the gain and to allow development of a suitable pointing model.

### **EVN Session I – Feb/Mar 2021**

This session was fairly busy with 29 experiments scheduled, of which 24 were user experiments,

comprising some 92.6% of the 176.06 hours (54.91 hours L-band, 38.98 hours C-band, 60.24 hours K-band and 21.93 hours X-band) of recording time and 91.6% of the 94.47 Tbytes of recorded data. The entire session was recorded smoothly on our Flexbuf with the subsequent electronic shipment to JIVE over the e-VLBI lightpath being completed within three weeks of the session's end.

About 3 minutes of data was lost to brief power interruptions and there was also the usual significant RFI at L-band.

### **e-VLBI / Connectivity**

Over the period November 2020 to April 2021 Hartebeesthoek participated in 5 e-VLBI sessions, of which 2 were at C-band and 3 were at L-band comprising roughly 45.4 hours of user data. The dedicated layer-2 'light-path' connection direct to JIVE was used without incident throughout.. All of the C-band sessions were run at 2 Gbps and the L-band sessions at 1 Gbps directly from the FiLa10G in the DBBC2.

The light-path is currently limited to just above 4 Gbps and the local link is over 10GE. However the cross-country backbone links have recently been upgraded to 100GE, so we may yet be in line for a higher speed connection.

### **Out of Session experiments**

There were no out-of-session experiments with the EVN over this period..

### **Frequency Standards**

The Hartebeesthoek 26 m continued to operate on our T4Science iMaser-3000 (iMaser-72) during this period. Our backup EFOS-C (EFOS-28) maser, though operational, has developed an instability in the internal heaters controller. A replacement controller has been purchased, but current working conditions prevent its installation. Our original EFOS-A maser (EFOS-6) no longer operates despite several attempts to resuscitate it. A Vremya VCH-314 two-channel precision frequency comparator is available to allow intercomparison of the three masers.

### **Flexbuf, Mark5(B/B+/C) and Mark6 Recorders**

Following an upgrade of our Flexbuf system to 258TB in 2019, there are currently no definite plans for further upgrades. However a second Flexbuf system for geodetic use with the 15 m is in the process of being commissioned. We also have two Mark5B+ recorders set up to record the two VLBI backends (on the 26m and 15m) independently. In addition a Mark5C recorder (on long-term loan from the University of Tasmania in support of collaboration with the AuScope array) provides an off-line electronic data shipment capability and can be used to record 2 or 4 Gbps VDIF data from either telescope via the built-in FiLa10G's. An older Mark5B recorder is also available for shipping purposes. We have the parts necessary to upgrade one of the Mark5B+'s into a second Mark5C in future should that prove to be necessary/useful.

In preparation for VGOS operations, we also have a new Mark6 recorder (complete with an expansion chassis) and four 32 TB Mark6 modules sufficient to run as a temporary Flexbuf if required.

### **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 4 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. However both DBBC2 terminals are in need of a power distribution upgrade which HAT-Lab has now supplied for us to fit locally in due course. As a result the V107 beta firmware does not run stably, particularly on unit HB1 which is used on the 15 m antenna.

An order for a fully VGOS-capable DBBC3 unit has been placed with HAT-Lab, of which delivery is imminent, to be deployed on the new VGOS antenna together with the afore-mentioned Mark6 recorder.

Unfortunately we do not have funds for another DBBC3 at this time.

### **Software**

Field System: FS 10.0.0 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 3.0.0 running on Debian 4.0 "etch", kernel 2.6.18-6-i386  
Mark5C version: jive5ab 3.0.0 running on Debian 7.x "wheezy", kernel 3.2.0-4-amd64  
Flexbuf version: jive5ab 3.0.0 running on Debian 8.x "jessie", kernel 3.16.0-4-amd64

### **Disks**

No other disk packs or Flexbuf storage have been purchased over this period. We will now engage with SARA0 on how their 1000TB commitment is to be realised in terms of funding 72 x 14 TB..

### **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.

J.F.H.Quick  
21 April 2021