

Hartebeesthoek (Hh) Station Report - TOG Meeting - May 2020

26 m telescope

The 26 m telescope remains fully operational with its full complement of receivers. However the wear problem with the Declination shaft bearings remains unresolved and will definitely require an extended period of downtime to replace some time soon. We still do not have clarity on when this might happen although the replacement bearings themselves will shortly be delivered.

Although the subreflector focus positioner upgrade has been completed, the campaign to establish whether active focussing could improve the K-band performance remains stalled due to a lack of manpower. The long-standing problem with the current main antenna shaft encoders has been traced to a power supply and resolved. Thereby the urgency of their replacement has fortunately been significantly reduced. Though new higher resolution encoders have been procured and work on adapting the electronic and software interfaces is ongoing, the current shaft end float due to the worn bearings prevents their installation.

Continuous calibration is now available at L-band and was used successfully in 2020 Session I. Although we have suitable components available to implement continuous calibration at S-band, this has not been implemented yet but should be soon. 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 has not yet been activated as the antenna is mainly used for geodetic observations.

13.2 m (VGOS) telescope

Acceptance testing of the new 13.2 m VGOS capable antenna was completed in early 2019 and the antenna formally handed over to the observatory. Due to an initial lack of funding for equipping the antenna with a suitable wideband receiver and VGOS-capable backend etc. integration work stalled for over a year. Funding has now been secured and a DBBC3 backend and RF-over-fibre units are now on order. We intend to work with OAN (Yebes) in building a suitable broadband receiver over the next twelve months. In the interim we are putting together a single polarisation cryogenic broadband 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 III – Oct/Nov 2019

This session was extremely busy for Hartebeesthoek with 31 experiments scheduled, of which 26 were user experiments, comprising some 93.9% of the 224.83 hours (41.5 hours K-band, 32.16 hours S/X-band, 52.67 hours C-band, 29 hours 6.7 GHz methanol and 68.5 hours L-band) of

recording time and over 97.8% of the 94.23 TBytes of recorded data. The entire session was recorded on our upgraded local Flexbuf with the subsequent electronic shipment to JIVE being completed within 6 weeks of session's end.

There was about 3.63 hours of data loss (1.6%) during the session, of which 1.66 hours was the failed C-band NME where no fringes were found and the remainder was due to the antenna getting stuck in the limits, problems with the Declination encoder and servo system, and a short power interruption. There was also the usual significant RFI at L-band.

EVN Session I – Feb/Mar 2020

This session was if anything even more busy with 36 experiments scheduled, of which 31 were user experiments, comprising some 93.7% of the 213.77 hours (36.5 hours S/X-band, 61.9 hours C-band, 43.56 hours K-band, 31.85 hours 6.7 GHz methanol and 37.96 hours L-band) of recording time and over 96.2% of the 82.43 TBytes of recorded data. The entire session was recorded on our Flexbuf with electronic shipment to JIVE within just over 3 weeks after session's end.

About 1.71 hours of data was lost during the session, due to issues with S/X dichroic installation and removal, a subreflector positioning problem and a flaky mixer in the methanol receiver. There was the usual significant RFI at L-band.

e-VLBI / Connectivity

Over the period July 2019 to April 2020 Hartebeesthoek participated in 9 e-VLBI sessions, of which 4 were at L-band, 3 were at C-band, and two adhoc target-of-opportunity sessions were at 6.7 GHz methanol and K-band respectively, comprising roughly 88.83 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 2 Gbps, 1 Gbps or 128 Mbps.

Out of Session experiments

Additionally the Hartebeesthoek 26 m supported 2 other out-of-session observations as part of ad-hoc arrays with the Kvasar network.

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. We are awaiting delivery of a digital heater controller unit which we will install later this year. Our original EFOS-A maser (EFOS-6) is still non-operational as it failed to restart masing following replacement of the internal vacuum pump. The replacement for our secondary backup clocks has arrived and is undergoing commissioning. 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

In April 2019 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 Mark5C can also be used to record 2 or 4 Gbps VDIF data from either telescope via the built-in FiLa10G's if required. We have the parts necessary to upgrade one of the Mark5B+'s into a second Mark5C in future should that prove necessary.

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. A new second Flexbuf (with a storage capacity of 310TB, to be used in support of IVS geodetic experiments and funded by a special infrastructure grant) is on order with delivery expected soon.

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 agreed to supply 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, for delivery in early 2021, which will be deployed on the new VGOS antenna, together with the Mark6 recorder above.

Software

Field System: FS 9.13.2 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 3.0.0 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 or Flexbuf storage have been purchased over this period. 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.

J.F.H.Quick
23 April 2020