Hartebeesthoek (Hh) Station Report - TOG Meeting – September 2025

26 m telescope

The 26 m telescope remains operational with its full complement of receivers. However there is a failed bearing at the west end of the Declination shaft - replacement of which would involve several months of down time. Should the matching bearing on the east end of the shaft also fail, we will be completely unable to operate the 26-m until such a repair were to be effected. We are still waiting on SARAO management for any commitment towards resolving this putative failure, though we believe the argument for doing so has now been accepted by our funding agency.

A problem developed with the Declination shaft encoder in November 2020 requiring an emergency replacement with a lower resolution alternative. Though new higher resolution encoders are in hand and work on adapting the electronic and software interfaces is mostly complete, the current shaft end float due to the worn bearing(s) prohibits their use as a replacement. We will be installing one of the new encoders on the Hour Angle shaft in September, so as to free up one of our original 19 bit encoders for use on the Declination shaft whilst we await the bearings' replacement.

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, and is used mainly to support routine geodetic VLBI observations, though it has been recently established that its poor foundation renders it completely unsuitable for the task. Furthermore it should be noted that the lifetime of a self-supporting single-piece fibreglass-composite dish, such as this, is completely unknown and any failure is likely to be catastrophic in nature ie. be irreparable.

13.2 m (VGOS) telescope

Commissioning of the new 13.2 m VGOS capable antenna, with a proper foundation onbed-rock, has now been completed, and it has been added to the core VGOS network as of August 2025. This antenna is equipped with a dual-linear-polarisation cryogenic broadband (2-14 GHz) receiver, and its VLBI terminal is capable of recording both polarisations of 4 disparate bands simultaneously.

EVN Session III – Oct/Nov 2024

This session was extremely quiet (due to the unavailability of the Efflesberg antenna) with only 11 experiments scheduled, of which 8 were user experiments, comprising some 89.5% of the 86.0 hours (31.0 hours L-band, 18.0 hours C-band, and 37.0 hours K-band) of recording time and 87.8% of the 50.33 Tbytes of recorded data. The session was recorded on our new Flexbuf which continues to drop packets at the highest data rate. The subsequent electronic shipment to JIVE was completed within two weeks after the session had ended.

Over 12.2 hours of data was lost in the final experiment of the session due to an out-of-hours failure of the main receiver power supply. The usual significant RFI at L-band was still evident.

EVN Session I – Feb/Mar 2025

This session was, in contrast, extremely busy with 40 experiments scheduled, of which 35 were user

experiments, comprising some 94% of the 217.96 hours (75.53 hours L-band, 43.85 hours K-band, 31.7 hours X-band, and 66.9 hours C-band) of recording time and 92.4% of the 132.58 Tbytes of recorded data. The electronic shipment to JIVE over the e-VLBI lightpath was completed within 3 weeks after the session ended.

Two hours were lost during the session, one chasing a lack of fringes due to a poorly chosen test source and the other deliberately, in order to support the IM-2 lunar lander mission. There was also the usual significant RFI at L-band.

This session also saw the qualification of MeerKAT's VLBI mode with the 26 m providing the other end of the short-baseline necessary for proper calibration of the array.

EVN Session II – May/Jun 2025

This session was also relatively busy with 32 experiments scheduled, of which 25 were user experiments, comprising 92.4% of the 191.72 hours (10.5 hours X-band, 12 hours M-band, 44 hours K-band, 65.02 hours L-band, and 60.2 hours C-band) of recording time and 91.8% of the 105.72 Tbytes of recorded data. The electronic shipment to JIVE over the e-VLBI lightpath was completed within 3 weeks after the session ended.

Just over two hours were lost due to an operator error (started late) during the session, and the usual significant RFI was experienced at L-band.

e-VLBI / Connectivity

Over the period June 2024 to August 2025, Hartebeesthoek participated in 9 routine e-VLBI sessions, of which 7 were at C-band and 2 were at L-band comprising roughly 101.1 hours of user data, but none made use of the "extra day". 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 session at 1 Gbps directly from the FiLa10G embedded in the DBBC2.

Out of Session experiments

There were 5 out-of-session EVN experiments from four proposals over this period of which 4 were disk-based, being electronically shipped shortly after the experiment and the other was run in e-VLBI mode.

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, is now fully operational, following replacement of the internal heaters controller. 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 masers.

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

Funds for the purchase of a second matching Flexbuf unit were contributed to JIVE during this period. In addition to our local Flexbuf's, 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. 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.

For VGOS operations, we also have a new Mark6 recorder (complete with an expansion chassis) and four 128 TB Mark6 modules operating as a Flexbuf.

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 internal FiLa10G's 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 and have recently been retro-fitted with a power distribution upgrade from HAT-Lab allowing stable operation with the v107 beta 3 firmware.

We also have a fully VGOS-capable DBBC3-L8H8 unit (3HT), deployed on the VGOS antenna together with the afore-mentioned Mark6 recorder.

Funds for a DBBC3-L2H2 (so as to be in line with the EVN technical roadmap's requirements) have now been secured and we intend to place an order before year end.

Software

Field System: FS 10.2.1 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 3.2.0 running on Debian 11.x "bullseye", kernel 5.10.0-35-amd64

Disks

Disks were purchased for the EVN during this period by way of providing funds for JIVE to purchase a second Flexbuf.

Spares

Currently available VLBI-related (mostly 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.
- An old Mark5B recorder (with a failed motherboard).

J.F.H.Quick
27 August 2025