

## **Hartebeesthoek (Hh) Station Report - TOG Meeting - September 2016**

### **26 m telescope**

The 26 m telescope remains fully operational with its full complement of receivers.

Control of the subreflector tilt is now done using a shaft encoder and the pointing model has been updated. K-band observations suggest that the pointing model probably needs further refinement, perhaps including replacement of the main antenna shaft encoders. We still intend to embark on a campaign to establish whether active focussing can assist with K-band performance.

### **15 m telescope**

The 15 m telescope has been non-operational since the last TOG meeting due to a serious wind-induced motor/gearbox failure. The replacement part is expected to arrive before month end.

The 15 m antenna is equipped with a cryogenic S/X receiver and is used mainly to support the majority of routine geodetic VLBI sessions, thereby freeing up more observing time on the 26 m antenna. This antenna has also proved to be very useful for doppler tracking of spacecraft.

### **VGOS telescope**

The tender for the concrete tower structure for the new 13m VGOS capable antenna has now been awarded and construction should commence in early October for estimated completion by year end. Meanwhile MT Mechatronics has just delivered the anchorage ring which will provide the interface between the tower and antenna superstructure and they should commence on-site assembly in January 2017. Site preparation is now nearing completion, including a 11kV electrical feed, instrumentation cabling trench, water and sewerage connections.

### **EVN Session I – Feb/Mar 2016**

This session was extremely quiet with only 8 experiments scheduled, of which 6 were user experiments, comprising some 88% of the 50.0 hours (36.0 hours M-band and 14.0 hours L-band) of recording time and over 90% of the 7.21 Tbytes of recorded data. The average filling factor of the disk-pack was 90% because an 8TB pack was available for use.

Only 1 minute of data was lost during the session due to an antenna drive glitch. However there was the usual significant RFI at L-band.

### **EVN Session II – May/Jun 2016**

This session was reasonably busy with 15 experiments scheduled, of which 11 were user experiments, comprising some 87% of the 93.75 hours (11.0 hours L-band, 17.0 hours C-band, 19.5 hours M-band and 46.25 hours K-band) of recording time and over 87% of the 19.47 Tbytes of recorded/transmitted data. The average filling factor of the disk-pack over 93% because the load matched the available 8 + 6 TB pack combination well. Most of the C-band session was done in e-VLBI mode.

Only 1.5 minute of data was lost during the session due to a power interruption. However there was the usual significant RFI at L-band.

## **e-VLBI / Connectivity**

Over the period February to August 2016 Hartebeesthoek participated in 4 e-VLBI sessions, all at C-band, comprising roughly 52.5 hours of user data. The dedicated layer-2 'light-path' connection direct to JIVE was used without incident throughout, but 4 hours were lost due to an operator error which caused the FS to hang. The most recent e-VLBI session was run at double the data rate ie. at 2 Gbps, without incident.

## **Out of Session experiments**

Additionally the Hartebeesthoek 26 m supported a total of 7 out-of-session RadioAstron imaging observations, 3 as part of the EVN and 4 shorter observations with the LBA.

Hartebeesthoek, as part the RadioAstron survey program, also participated in some 88 segments (typically 40 minutes to 1 hour in duration) over this period with the majority involving switching from C-band to either L-band or K-band on-the-fly mid-segment. Additionally we tracked the RadioAstron spacecraft itself on two occasions to measure the gravitational redshift of its onboard hydrogen maser frequency standard.

## **Frequency Standards**

The HartRAO 26 m continued to operate on our T4Science iMaser-3000 (iMaser-72) during this period. Our backup EFOS-C (EFOS-28) maser remains fully operational and is used as the main frequency standard for the 15 m VLBI system thus allowing us to offset the two telescopes in frequency if required. Our original EFOS-A maser (EFOS-6) is still operational but is no longer reliable. A Vremya VCH-314 two-channel precision frequency comparator is available to allow intercomparison of the three masers.

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

We have two Mark5B+ recorders enabling us to record both the main VLBI backends (on the 26m and 15m) simultaneously. In addition one 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 Mark5B+ into a second Mark5C in future should that prove necessary. Furthermore the JIVE Harrobox on site has been converted into a mini-FlexBuff for test purposes by the addition of four 4 TB disk drives. An order has now been placed for a new 144TB production FlexBuff system, with delivery expected soon and funds for a matching unit transferred to JIVE.

## **Mark5 Terminal**

The original Mark5 acquisition rack has been retired from active duty and continues accumulating a collection of faults which would need rectification before it could be reliably used for observations again. We no longer have a working spare video converter - the unit we have lacks a functional synthesizer/divider module (and probably has several other faults).

## **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 V105\_1/V105E\_1 allowing up to 2 Gbps operation. Both are also equipped with an internal FiLa10G cabled in pass-through mode, allowing for simultaneous Mark5B+ recording. The PFB firmware on HB2 has recently been upgraded to v16 for testing 4 Gbps operation and upcoming FS support. Both units are equipped with SSD internal disks which should facilitate a Window/Linux dual-boot capability.

## **Software**

Field System: FS 9.11.8 running on FS Linux 8 (Debian "lenny") kernel 2.6.26-2-i386  
DBBC versions: DDC v105(E)\_1 / PFB v16 running on Windows XP; FiLa10G v3.3.2  
Mark5B+ version: jive5ab 2.7.1-ack-udfix running on Debian "etch" kernel 2.6.18-6-i386  
Mark5C version: jive5ab 2.7.1-ack-udfix running on Debian "wheezy" kernel 3.2.0-4-amd64

## **Disks**

No further diskpacks have been purchased over this period, with the 2015/6 allocation being diverted to the purchase of FlexBuff infrastructure instead.

## **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+ into a Mark5C.

Used parts from recent upgrades or harvested from obsolete equipment at Haystack are:

- A used Mark5A I/O board with its related external interface.
- Various used boards from a Mark4 formatter (after conversion to a VSI4 sampler unit).
- A used Mark4 IF Distributor unit master control board.
- Several used Mark4 "MAT" ASCII transceiver boards (all faulty).
- Assorted used Mark4 Video Converter unit sub-modules (some faulty).

## **Development of other African Antennas for VLBI**

The AVN project (2 input / 2 Core2 board) DBBC2 and associated Mark5B+ recorder have now been dispatched to Kuntunse in Ghana where they are undergoing qualification in preparation for possible fringe tests later this year.

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