EUROPEAN VLBI NETWORK – TECHNICAL & OPERATIONS GROUP

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Report on VLBI Operations for Jodrell Bank Observatory

1. February/March 2018 Session

The February/March 2018 EVN session for JBO consisted of 26 experiments; 8 at 18/21cm, 6 at 5cm, 6 at 6cm and 6 at 1.3cm. None of the experiments were joint EVN+e-MERLIN for this session. At 18/21cm, 66.5h of observations were scheduled on the Lovell telescope. During the first experiment, the NME N18L1, a fault was discovered in an optical transmitter which disabled the RCP channel for the Lovell telescope. A switch was made to the Mk2 telescope but it was then found that the L-band receiver had warmed. Hence, observations were performed with the reduced capacity Lovell telescope for one user experiment. The optical transmitter was then replaced on the Lovell resulting in 0.5h data loss on the following user experiment. Also at 18/21cm, 0.25h were lost due to telescope communication problems, giving a 1.9% data loss at L-band. At 5cm, 49h of observations were scheduled on the Mk2 telescope. Several experiments were affected by high winds, resulting in 8.5h (17.3%) of data lost. At 6cm, 40h of observations were scheduled on the Mk2 telescope, with 45m (1.9%) lost time due to data recording problems. 37 hours of observations were performed with the Mk2 telescope at 1.3cm, with no reported data loss. In conclusion, a total of 192.5h of observations were performed with JBO telescopes with a total reported data loss of 10h (5.2%), i.e. a success rate of 94.8%.

2. May/June 2018 Session

The May/June 2018 EVN session for JBO consisted of 22 experiments; 3 at 6cm, 7 at 18/21cm and 12 at 1.3cm. One experiment (at 1.3cm) was a joint EVN+e-MERLIN observation with the aim of tying the antenna positions with the celestial reference frame. At 6cm, 17h of observations were scheduled on the Mk2 telescope (since the Lovell telescope was out-of-commission for this entire session). Only 10m of time (1%) was reported lost due to telescope communication errors. At 18/21cm, 38h were scheduled on the Mk2 with no reported data loss at the telescope. At 1.3cm, 118h of observations were scheduled on the Mk2, again with no reported data loss. In summary, 173h of observations were performed with JBO telescopes with a total reported data loss of 10m (0.1%), i.e. a success rate of 99.9%. This session was smaller than average for JBO because of EVN network time at S/X band, during which JBO does not participate.

3. Technical Developments

RF down-conversion improvements: After a throughout investigation of the down-conversion, a sub-optimal LO/mixer-stage was removed, and the DBBC IF changed from 0-0.5GHz to 0.5-1GHz (from upper to lower sideband). This resulted in significant improvement of the signal-to-noise of Jb1 & Jb2 VLBI data, as well as a more uniform response across the IF band. The new setup is used in all observations, recorded as well as eVLBI.

Timing system improvements: As part of a re-organisation of the VLBI timing distribution at JBO, the logging of the maser drift (vs GPS) has been improved. This has resulted in better initial guesses for the clock-offset in all recorded and real-time correlated experiments. We note that a new maser is planned to arrive at JBO in late 2018. This will require some additional changes to the timing distribution (and logging) once the new maser is operational, but should not degrade (but possibly improve) the JBO VLBI timing and/or drift-logs.

Recorded observations: From EVN Session I 2018, JBO is essentially a Flexbuff-only station, although some RadioAstron out-of-session observations may still be recorded on disk-packs using our Mark5B. Our investment in EVN disk-capacity is, however, solely directed towards Flexbuff purchase. In addition to one machine with 202TB storage space at JIVE (after RAID), we currently have 276TB of available recording space at JBO. This is spread across three machines with various RAID configurations. All machines have 10G fibre network interface cards and a verified (jive5ab) disk writing speed of >10Gbps. Disk space can easily be increased by replacing 2TB drives with bigger ones, once 2Gbps (and higher) data rates demand more storage.

eVLBI observations: Since early 2018, we have upgraded our eVLBI capabilities to allow 2Gbps real-time observations through the DBBC/FiLa10G. Due to the current deal with JANET and partners, our current link speed to JIVE is limited to 3Gbps. However, the link actually supports 10Gbps end-to-end. A future extension to 4Gbps should be straight-forward, given that necessary DBBC/FiLa10G firmware exits.

EVN+eMERLIN developments: Significant progress has been made towards including e-MERLIN stations EVN experiments on a regular basis. New WIDAR correlator code (from NRAO) has been deployed, improving out-station VDIF data quality. Following a few test observations, the eVLBI session of 18/19 September 2018 was an important milestone. Three out-stations (De, Kn, Cm) participated in a full eVLBI-run (>24h) at 512Mbps each (64MHz RF bandwidth). Data were streamed from the WIDAR to one of the JBO flexbuff machines, which were running jive5ab in memory-buffer mode and from there to JIVE. This setup allowed JIVE to remotely control the data flows from JBO, which is an important requirement for regular eVLBI observations. The WIDAR can provide 1Gbps (2x64MHz) for 4 out-stations to JIVE already now, but the available bandwidth to JIVE of 3Gbps (Mk2 DBBC used 1Gbps) limited out-station participation this time. To allow for more stations and higher bandwidth in eVLBI, we aim to negotiate for an increased bandwidth in the near future. In addition to shared-risk observing in upcoming eVLBI runs, e-MERLIN stations will take part in several recorded observations in EVN session III 2018 under shared-risk mode. Regular observing with e-MERLIN in EVN is planned to be offered as soon as the few remaining key-issues (e.g. Kn, De R-pol VDIF re-sampling) are solved, hopefully by early 2019.

Field-system TSYS monitoring: Ongoing investigations to improve the JBO *a priori* amplitude calibration have identified multiple issues. These are now all being addressed, and we aim for significant improvements in Tsys values from the field-system controlled telescopes by early 2019.

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