

CORRELATOR REPORT, EVN Correlator at JIVE  
EVN TOG MEETING, June 2019, Jodrell Bank

20 June 2019 (statistics through 14 June)  
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SCIENCE OPERATIONS

Sessions and their Experiments

The following table summarizes the sessions with any activity in their user experiments since [the Nov'18 CBD report] (entries = remaining to do / total).

	N_to.corr	Corr.hrs	N_to.dist	notes
RadAst <=2017	12/13	133/143 hr	12/13	EG089C done
session 3/2016	1/22	6/200 hr	1/22	EK036B
session 1/2017	3/22	11/150 hr	3/22	EK036C; GK049C,D
session 2/2017	1/26	6/233 hr	1/26	EK036D
RadAst 2017	4/4	37.5/37.5 hr	4/4	
session 1/2018	1/9	8/136.5 hr	1/9	see Sess.1/2018 below
session 2/2018	2/21	26/250 hr	3/21	
session 3/2018	10/29	113/285.5 hr	20/29	
Nov-May e-	0/21	0/119hr	1/21	incl. 3 To0, 3 triggers
session 1/2019	26/28	253/277	26/28	incl. 2 OoS in Jan'19; 1 To0 in session
session 2/2019	32	292.5	(prognosis)	

Some landmarks since the [Nov'18 CBD report]:

Session 3/2016 - 2/2017

- \*) all experiments correlated and distributed, except:
- \*) EK036B-D (one per each of the three sessions): now have locations for the multiple phase-center correlations from PI. PI now wants 3-5 correlator passes (one multiple phase center, 2-4 gated passes, with the range depending on how to handle off-pulse correlation in relation to the two passes required for the main pulse and the inter-pulse. Correlation hours above reflect going from two to three passes; each EK036\* epoch could go up another 4hr if five passes apply. mode (2.5 TB of output FITS files). Still awaiting tempo2 \*.par files from which to compute PSR ephemerides for the gated passes.
- \*) GK049C-D (1/2017): Pulsar scintillometry observations of a ms-PSR. The gate-fitting step is done. Gb out completely in one epoch; Ar lost one of two subbands in both parts. Re-observed as GK059E-F in Jan'19 -- not entirely clear on the value of continuing to pursue correlation of these two.
- \*) To avoid tying up disk-packs, the raw data from all of these projects have been transferred to the director's discretionary FlexBuff bought by JIVE (total only 30.1 TB)

Session 1/2018: Now have closure on all projects in terms of PI requests for re-queuing in light of the DBBC E-series firmware issues. In the end, 13 projects (104.5 network hours) requested re-queuing (which will largely be wrapped up in session 2/2019). One experiment not yet correlated did decide to continue to pursue correlation.

Session 2/2018

- \*) All experiments correlated/distributed except:
- \*) EC065: The Jumping JIVE 24-hr geodesy observation (WP6/Deliv.3); Bordeaux has recently finished comparing our correlation of an IVS R1 with Bonn's (an extra step on top of the original work plan), so this is ready to prepare for correlation (using the new sub-netting feature also resulting from the same Jumping JIVE WP).
- \*) EC064: A 2-hr MEX observation, which turned out to have different stations tuning their BBCs to different net sky frequencies (as can be confirmed by where the satellite emission is, and also documented in the FS logs that we have received -- only Hh,Mc,Nt; no Wz,Wn). I'm not at all sure how this could have happened; only Mc seems to have followed the vex-file on vlbeer (BBC tunings at 320.49, 336.49,

352.49, & 368.49 above an LO of 8080 to reach the sky frequencies 8400.49, 8416.49, 8432.49, & 8448.49); Hh,Nt both have 287.49, 303.49, 319.49, & 335.49, also above an LO of 8080, Wz,Wn don't have logs but show the satellite emission in the same place as Hh in their autocorrelations (Nt doesn't show the satellite emission anywhere in the scan looked at). It's possible that there were multiple versions of the schedule (it's v2 currently on vlbeer with the "Mc" tunings), but I have no record of any v1, even in e-mails. v2 does use the setini plug-in we prepared. The correlation of this also wants to be multiple phase-center of near-field targets (two satellites near Mars); still thinking of how best to approach that.

- \* ) ET036A: Distribution of this geodesy-like observation was waiting for PI to specify whether they would compute their own totals using the way Petrov did when initially verifying the geodetic suitability of SFXC (could distribute now) or whether they would want to wait until there's a validated mark4-compatible way from Jumping JIVE. This is the first of a three-epoch project; if it were only one epoch, they'd have already received their data assuming the first approach. In May, they expressed preference for waiting for the mark4-format output.

#### Session 3/2018

- \* ) Correlation ~2/3 through; all observations fully clock-searched except the last 3 K-band with T6, which so far don't have T6 fringes (EP113B, EB064C, ET038H). EP113B also lacks fringes on a few other stations, which appears to be source-related. Significant problems occurred with: T6 packs (the write pointers again went back to 0 after reaching ~14TB and over-wrote earlier observations); the Jb maser (most L-band observations had reasonable fringes with Rb, but the two C-band ones didn't -- not terribly unexpected); and individual disks in the Sr pack (copied what we could over to FlexBuff to avoid hanging trying to read-off the pack).

#### Session 1/2019

- \* ) Two 12-hr epochs on the transient in AT2018cow correlated/distributed, jumping the queue per PI request.
- \* ) Correlation-parameter e-mails in process of being drafted for the other observations.
- \* ) Three-days of a global+LBA experiment, observed as three separate schedules (the target declination was -15, so individual sub-arrays had long gaps between local times of source visibility). Part of the VLBA scans in day {i} overlap with LBA scans in day {i+1}, but these sub-arrays do not appear together in any of the daily observing schedules. Need to recreate a single correlation vex file from the original daily ones. Still waiting for some LBA data to be translated (to Mark5B) and e-shipped to JIVE.

#### Session 2/2019

- \* ) Returns to 2Gbps via DBBC firmware v107 (as successfully tested over the past few months, and successfully used in the March e-EVN day.
- \* ) First excited-OH (6035 MHz) observation since 2014.
- \* ) e-shipping still in progress (~half-way through the K-band sub-session as of the morning of 20june).

#### e-EVN:

- \* ) the March e-EVN day saw the return of 2Gbps data rates, using the new v107 DBBC firmware that had undergone testing in the preceding months.
- \* ) The first use of a KVAZAR station in user e-EVN observations came in the April e-EVN day (Zc at 512 Mbps -- Bd was also planned, but had an antenna problem). Testing with both Zc and Bd was successful in the preceding month, with all three at 1Gbps.
- \* ) The available total bandwidth out of the UK has shown empirical improvement, allowing one home station at 2048 Mbps and 4 out-stations at 512 Mbps or one home station at 1024 Mbps and 5 out-stations at 512 Mbps (a home station at 2048 Gbps and 5 out-stations at 512 Mbps resulted in a minor loss of data).
- \* ) We may be approaching limitations in the incoming network capacity / configuration coming into the building -- a 2Gbps observations with all possible stations (now also including Tr) plus 3 KVAZARs at 1Gbps plus 5 e-MERLIN out-stations at 512 Mbps would likely run into issues.

- \* ) Four target-of-opportunity observations and five triggered observations, from six different proposals, have run since the previous TOG meeting. 2019 has already set a annual record of hours of triggered observations (and even a record by itself for hours of triggered observations in any consecutive two years).
- \* ) The yet-to-distribute e-EVN is EM135B, waiting for the team to identify any FRB pulses and re-correlated any such short segment(s) from the recorded data (i.e., recorded onto FlexBuff in parallel with the real-time correlation).

#### RadioAstron:

- \* ) The fringing algorithm used in detection of the EG089C fringes reported for the previous CBD meeting was ported from the off-line jfring program in glish on the post-correlation processing machine to the on-line fringe-finder tool used for operation clock-searching (which previously had not detected fringes for EG089C). This should simplify the clock-search process for subsequent RadioAstron observations, since intermediate Measurement Sets would not need to be created for every scan to plot the behavior of the residual delays and rates for baselines to the orbiting antenna. (one way in which RadioAstron observations differ from normal EVN ones is that every scan should be clock-searched separately.)

#### USER SUPPORT

Jay Blanchard left JIVE as of the end of February (now at NRAO, Socorro). Two new support scientists joined JIVE: Dhanya Nair (in February, from MPIfR Bonn) and Olga Bayandina (in May, from ASC Moscow).

Various issues w.r.t. to EVN observing FITS file production and data reduction that ultimately affects users have been discussed during Science Support meetings. A sampling of topics included: how to address primary beam correction in the EVN pipeline, initiating work on a CASA-based EVN pipeline, updating standard plots, and pipeline handling of the apparent gain variations across post-correlation "narrow" sub-bands (16 or 32 MHz) resulting from mixed-BW correlation of the native 64 MHz e-MERLIN BBC channels that have gradual pass-band roll-offs at the edges. Based on previous discussions in these meetings, the showlog script was updated to handle multiple phase center and binned pulsar correlations more naturally.

There were two instances of scheduling mistakes that were not caught prior to observing: (i) a spectral-line observation that had Doppler-corrected BBC tunings for the maser target and non-Doppler-corrected tunings for the continuum calibrators, which led to a ~10.78 MHz offset over a total range of 64 MHz (ES084B, jun'18); and (ii) an observation that had the wrong coordinates for one of the bandpass calibrators (RB005, feb'19). The causes of these mistakes have been identified and specific guidelines have been introduced into the schedule-checking check-lists to help find any such instances in the future.

JIVE hosted 3 visitors over 10nov - 5may, and continued to provide PIs with experiment-specific template "setini" blocks and station catalogs, and to follow the new procedure for depositing schedules in which PIs send their key files to JIVE rather than posting sched output directly to the VLBEER server themselves. There were five first-time EVN PIs in session 1/2019 (from ShAO, JIVE, U. Valencia, U. Torun, U. Oxford), including one student, and three first-time EVN PIs in session 2/2019 (from NAOC/BAO, U.Torun, ShAO). The number of first-time proposers from the most recent 1 June proposal deadline is also very encouraging: 12 out of 26 proposals, including 5 students.

The size of FITS files from user experiments on the EVN Archive has now surpassed 62TB.

## NETWORK SUPPORT

There have been 14 test observations conducted since the previous TOG meeting:

- 2 for receivers: Q-band (Ef,T6); P-band (prior to the out-of-session user observation in Jan.)
- 1 for the Santa Maria RAEGE antenna
- 3 for the Dwingeloo antenna
- 2 related to the Wb maser difficulties and repair
- 2 for 4Gbps via DBBC3
- 4 for DBBC2 v107 firmware:
  - 3 for demonstration of operational readiness (leading to the return of 2Gbps user observations in session 2/19)
  - 1 for initial testing of 64MHz channels in DDC personality

By the end of the period, there were 16 antennas operationally e-shipping data to JIVE via the automated system (in addition, e-shipping from the three KVN antennas is still manual; Torun has started using filal0G/FlexBuff in session 2/19, and will also be e-shipped manually -- including these the total rises to 20). There remain some issues with some stations e-shipping operationally without being directly represented in the recent CBD media-purchase plan (e.g., LBAs in EVN/global + LBA observations, e-MERLIN out-stations), and the limitation that Wb has only one 200TB FlexBuff may well become operationally significant soon.

The cause of the occasional delay jumps of ~1 ns in baselines to e-MERLIN out-stations was identified as an effect of the tracking window for fibre delays from the out-stations. Such jumps would complicate phase-referencing observations, so this feature can be turned off. This removed the discontinuities but at the expense of roughly diurnal-period excursions in the correlated delay, which so far has not proved to be a show-stopper. Investigations into how to compensate for measured fibre delays via the a priori station models are beginning.