

30 April 2020 (statistics cover 21 June 2019 - 26 April 2020)  
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SCIENCE OPERATIONS

The table below summarizes projects correlated, distributed, and released from 21 June 2019 to 26 April 2020. The table lists the number of experiments as well as the network hours and correlator hours for both user and test/NME experiments. The definitions of network and correlator hours remain the same as in previous reports. Multiple correlator passes for SFXC typically occur only for phase-referenced spectral-line experiments (separate "continuum" and "line" passes) and for pulsar observations wanting multiple gating/binning configurations. The actual time to correlate a specific observation can of course deviate significantly from the number of "correlator hours", depending on a variety of factors (e.g., bit-rate, mixed-BW modes, multiple phase-centers, pulsar gating/binning, etc.)

	User Experiments			Test & Network Monitoring		
	N	Ntwk_hr	Corr_hr	N	Ntwk_hr	Corr_hr
Correlated	131	1084.5	1275	24	65	65
Distributed	136	1076	1275.5	24	66	66
Released	96	792.5	964	16	43	43

("Released" lags behind "Correlated" & "Distributed" here because the process of systematically releasing observations to free up media for the May/June session hasn't begun at the time of writing this report.

The following table summarizes the sessions with any activity in their user experiments since the previous report (entries = remaining to do / total).

	N_to.corr	Corr.hrs	N_to.dist	notes
RadAst <2017	11/13	123/143 hr	11/13	EG089C-D done
sessions <=2017	3/68	8/583 hr	3/68	EK036B-D
RadAst 2017	4/4	37.5/37.5 hr	4/4	
sessions 2018	3/61	14/678 hr	5/61	EM128D; GK059E-F
session 1/2019	0/25	0/312 hr	2/25	
session 2/2019	1/33	24/322.5 hr	2/33	EC069
session 3/2019	0/30	0/312 hr	2/30	
Nov-Apr e-	0/17	0/109 hr	0/17	Incl. 2 To0, 2 triggers
session 1/2020	28/32	270/323 hr	29/32	

Some landmarks since the previous CBD report:  
(condensed to make room for the covid-19 sub-section)

Session 1/2019:

ER047A: 1st epoch (of 6) of a 761 multiple phase-center observation, with a number of stations significantly greater than in the similar EG078s (18-20 including e-MERLIN out-stations, instead of 12-13) and requiring cross-pols in the FITS files in order to correct linear-pols at some stations in L-band, via polConvert. Production correlation took over 100 hours, and post-correlation processing a few weeks as adaption of various steps was investigated in light of the data volume. In the end, 11TB of FITS files resulted; archiving is waiting for an upgrade to the back-up facility for the archive server.

Session 2/2019:

ER047B: also correlated, similarly over 100 actual hours in production; post-correlation processing awaiting archiving of ER047A  
EC069: Pulsar gating plus multiple phase-centers, with targets having position uncertainties quoted in the proposal as "may be less than 2' ". Since the targets are expected to be sub-mJy even after gating, so the normal scan-based gate-fitting confirmation will likely not return positive results -- we would either blindly use a polyco file provided by the PIs with a single gate/bin, or provide output of separate bins covering the whole period for safety (e.g., as done for the EM128 epochs).

But with the need also to avoid smearing over the large target position uncertainties (512 frequency points per SB/pol, 1/4s integrations to push the 10%-smearing radii out beyond 2'), the output size of the gated pass could become immense (~1.6 TB per bin). Still conferring on how to approach this correlation.

#### Session 3/2019:

All correlated; two observations yet to distribute (the last 2Gbps 5cm observation, and ER047C (as for ER047B, above))  
ER051: another EVN + LBA (Decl. -29(!)), with multiple phase-centers. Tidbinbilla 70m participated; had a 5MHz LO offset, deduced from log information and confirmed by the station (handled in correlation). Three stations had linear pols.  
KVN's participated at 2Gbps with their OCTAD back-ends. Each had a 1 Hz LO offset; handled in correlation and fixed in session 1/2020.

#### Session 1/2020:

Arecibo participated in the L-band NME and a user experiment, via two RDBE back-ends (thus tuning set-ups for EVN+Ar would look like those for globals). In these observations, there were large delay offsets (> 100 us) between channels containing the two different polarizations. This would seem to require being able to apply channel-based a priori clocks during correlation.  
GA043A,B: global Q-band spectral-line observations; phasing-up and pointing calibration for the JVLA led it to have essentially a separate, sub-netted schedule. JVLA was re-introduced into scans for which it overlapped with the rest of the array manually in the vex file that would drive correlation.  
Two ToO's scheduled in the disk session (Ice-Cube neutrinos, maser out-burst).

#### Session 2/2020:

Only the preliminary stages of media planning and observing mode compilation for sched setini plug-in preparation has occurred yet. Some stations have already declared themselves unavailable due to covid-19 restrictions, and some PIs have chosen to defer their observations to later sessions.

#### e-EVN:

New connections to overcome the current bottle-necks arising from separate 10G segments were put in place, but the e-EVN schedules since then have not actually needed to go beyond the previous capacity, owing to fewer stations (Mc,Nt out for maintenance; KVAZARS don't participate in every e-EVN day) and/or observations at L-band (1Gbps).  
Two target-of-opportunity observations and two triggered observations, from four different proposals, ran in this period. Topics included a gamma-ray burst, extra-galactic nuclear transients, FRB localization, and a maser (OH) burst.

#### Covid-19 impacts:

Large-scale working-from-home began on 16 March, but all three shifts of the 17-18 March e-EVN day were able to be manned. Access to the building remains possible, for specific tasks for which approval has been arranged before-hand (via an ASTRON committee). So far, such trips into the building by an operator have been for:  
- starting the first shift of the April e-EVN day  
- processing incoming Mark5 packs from session 1/2020, and swapping out packs for session 3/2019 once all observations had been correlated for the session 1/2020 packs (with only 3-4 stations using packs, it was possible to mount all necessary packs at once for the remainder of sess.3/19 prior to the retreat from the building, and subsequently all packs for sess.1/20)  
- processing incoming NRAO Mark6 packs and mounting them in a Mark6 unit to enable transfer to FlexBuff

Operating the correlator itself and the post-correlation processing has continued remotely. The table below summarizes observations correlated or distributed between 18 March and 26 April:

	N_corr	Corr.hr.	N_dist
sess.3/2019 user	5	54.5	9
sess.1/2020 NME	6	18	6
user	4	53	3
e-EVN	2	17	4
correlator-only	1	2	1

The current covid-19 measures in the Netherlands are expected to continue through at least 24 May. Access into the building in the near future would include preparing Mark5 packs for shipping to KVAZAR stations and starting the 12-13 May e-EVN day (probably not well combinable into a single trip).

## USER SUPPORT

A number of issues data integrity and calibration issues have been identified by users that have been addressed by the support scientists at JIVE. In EB069, the Ys bandpass changed drastically during the experiment, which turned out to be due to firmware reconfiguration. A work-around has been identified to calibrate the data with multiple bandpass solutions. Users reported data losses at Hh due to erroneous entries in the flag table provided by the pipeline. It was due to an encoding problem at Hh resulting in false reports of being off-source. The time range for this error not clear yet, but it was fixed at the station. Users reported KVAZAR telescopes being off in amplitude by a factor of 2x or more, which looked like a persistent problem across several observations. The cause of the error was wrong gain curve values in the ANTAB files -- this has been spotted independently at JIVE. A script was developed to detect typical errors in station antabfs files and from now on, all antabfs files will be checked before compiling the ANTABs. As travel during the winter period was limited, most of the direct support for user projects (i.e., beyond the standard support procedures) was done remotely by the support scientists. This included extended help with scheduling in a few cases, detailed checking of pipeline outputs in some other cases, and in one case imaging target sources from the pipeline data, to identify calibration issues.

The EVN Newsletter is now being compiled by Aukelien van den Poll, the editor is Paco Colomer. New EVN results are being highlighted in the EVN web pages and on social media (Twitter, Facebook). Summer students have been selected for two projects, but due to the COVID-19 situation the ASTRON/JIVE summer student programme have been cancelled.

JIVE hosted seven data reduction visits in this reporting period, five of which were EVN-TNA supported, and including four students (three in the TNA-supported category). There were three first-time EVN PIs in session 1/2020 (from OAN, IRA, T.U. Delft).

JIVE 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.

The size of FITS files from user experiments on the EVN Archive grew to 74.87 TB during this reporting period, gaining 6.13 TB since the previous CBD meeting (not including the 11 TB of FITS files from ER047A that have been prepared).

As a covid-19 measure, we informed PIs who had already received their one-month warning about the expiry of their experiment's proprietary period on the EVN archive and whose proprietary period overlapped with covid-19 restrictions (different time-ranges for China and Europe) that they could request a 3-month extension if they thought that such restrictions hampered their ability to analyze their data. Going forward, new text to the same purpose has been added to the one-month warning, to remain as long as the proprietary period overlaps with the time-range of covid-19 restrictions.

## NETWORK SUPPORT

There were further higher bit-rate tests including the 64MHz filters in the DBBC2 firmware v107, as a means to attain 4Gbps with tunable BBCs: a separate test in November and part of the 5cm NME in session 1/2020. The passband shapes of these filter remain noticeably less rectangular than those from the 32MHz filters. More 4Gbps tests are planned within session 2/2020 NMEs: 5cm using 64MHz subbands and K-band using 32MHz subbands. This latter set-up would require the wastro mode to get 32 channels; at 5cm the Ef configuration does not permit using four IFs in the third Nyquist zone, so that band is currently limited to 16 channels. In all cases, one issue with 4Gbps modes is finding compatible LOs across the stations for the 512 MHz spanned bandwidth.

By the end of the period, all stations other than the KVAZARs, Urumqi, and Robledo were e-shipping, either via the automatic-retrieval process or manually arranged off-line. Tianma is the newest station to have purchased FlexBuff space at JIVE. Kunming was able to e-ship their data from session 1/2020 directly from their Mark5B. The issues with some stations e-shipping operationally without being directly represented in the recent CBD media-purchase plan identified in the previous report remain -- but have not yet caused an operational bottle-neck (Mc and Nt missed session 1/2020, reducing the incoming load for FlexBuffers at JIVE; session 2/2020 should also not be a problem with some PIs choosing to defer their observations).

In session 1/2020, NRAO sent 13 Mark6 packs (including Gb and Yy) for a total of ~170TB. We continue to transfer that data onto local FlexBuff, and to recycle the packs back to NRAO to support their logistical requirements. There was one global in the original session 2/2020 block schedule, but that has been deferred by the PI.

In the longer term, the above three points (a future of higher bit-rate capability beyond 2Gbps, more stations using FlexBuff), if systematically pursued, would require an upward revision of the CBD FlexBuff-purchase plan, or an offsetting decrease in observing hours. This latter option might have consequences for some stations in terms of meeting their quota of access provision in the RadioNet/Opticon Pilot project.