Technical Operations and R&D at JIVE
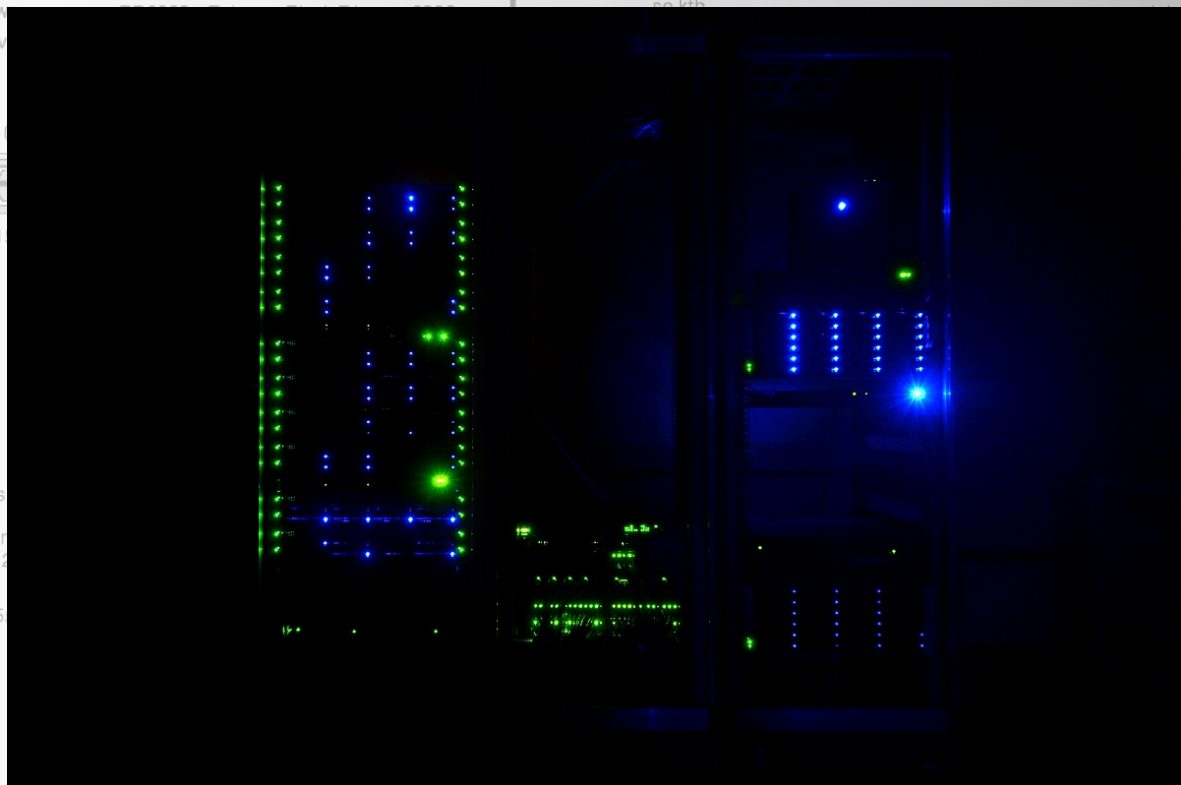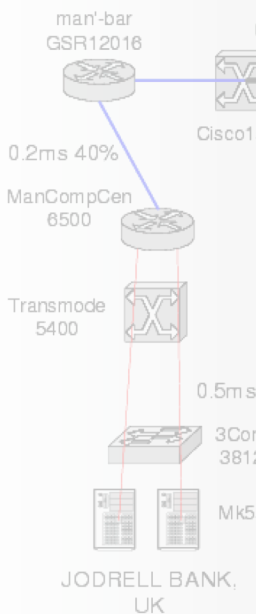
Arpad Szomoru
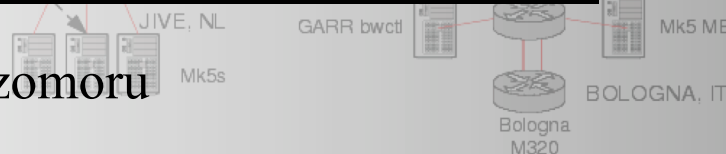
What do we do?

- ## Correlators
  - More capacity, new telescopes, development of AVN, new features, MeerKAT VLBI, SKA VLBI

- ## Data recording/playback/transport
  - Real time/near-real time, higher bandwidths, 2, 4, 32 Gbps (??)

- ## Automated operations
  - Monitoring, automated fringe checking
  - Triggered observations, multi-messenger astronomy
  - EVN light? Frequent observations with sub-set of EVN

- ## Software
  - User software, VLBI with CASA
  - CASA in Jupyter notebooks, containerisation
  - SCHED re-factoring
  - New pipelines, new functionality of archive, VO and EOSC

- ## Time and frequency transfer
  - Transfer over public networks: demo involving Wb, Dw, LOFAR, SURFNet

JIVE R&D

- ## Jive5AB: functioning nice and stable
  - Integration of e-transfer client developed in Asterics

- ## FlexBuff recording still expanding
  - Many new machines
  - 10 TB disks now in general use
  - What next?
  - SSDs still expensive
    - But prices going down (?)
  - Data rates back to 2 Gbps
    - And 4 Gbps possible with new firmware
    - Storage will become a problem again

- ## Two Mark6 units with expansion chassis installed
  - One more soon
  - Will facilitate globals with VLBA

More…

- More hardware, running out of space

SFXC Expansion — 840 cores

Flexbufs (160)

SFXC — 384 cores

(128 cores decomissioned)

Flexbufs (96)

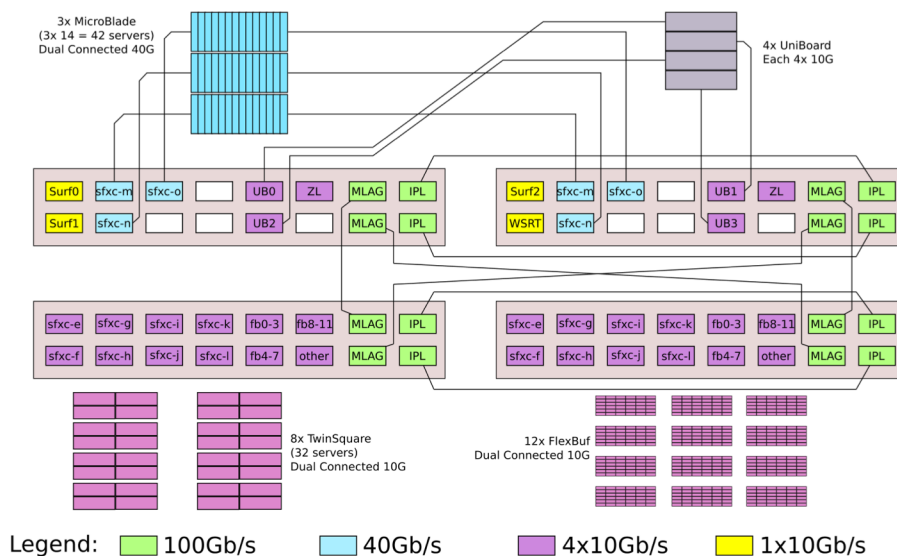SFXC — 512 cores

Before

After

More…

- ## New network still has some problems
  - Has been localised
  - Not yet resolved….

- ## Connectivity is becoming a bottleneck
  - SURFnet 8 about to be connected
  - Equipment in place
  - 100 Gbps for JIVE (?)

JIVE Network v5

More…

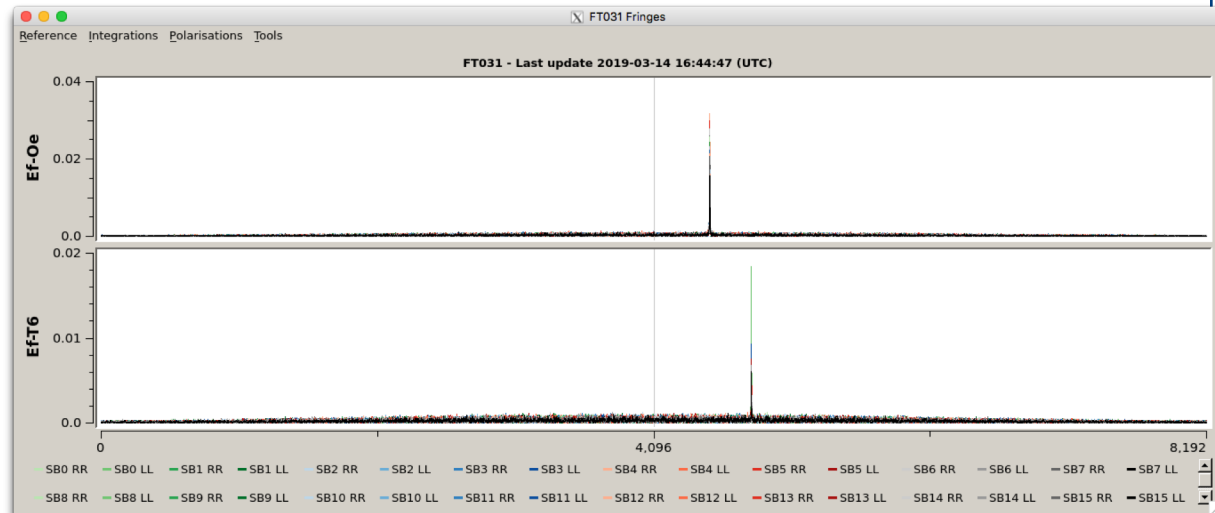- 2 Gbps e-VLBI operational again
- Test at 4 Gbps with DBBC2 last week
  - Operationally impossible without large investment in storage
- First tests towards 32 Gbps
  - Effelsberg, Tianma, Yebes, Onsala
  - Geo dishes at Ys and On
  - Using DBBC3
  - Second test at 4 Gbps already successful
    - Although DBBC3 at Ys died
  - Now waiting for new firmware
  - Should enable 8, 16, 32 Gbps

  - Test next week?

Arecibo upgrade?

- ## Still using a first-generation Mark5A

- ## RDBE, Mark5C and Mark6 all available on site

  - Harro Verkouter spending two weeks at Arecibo to help out:

    - Bring FS up to scratch

    - Upgrade Mark6 OS

    - Re-write Effelsberg "vex2snp.pl" script into Python

    - Modify Ef-specific commands (no need for DRUDG)

    - And fix whatever else does not work

  - Helped by Arun and other local engineers, Uwe, Ed, Chet, Walter

R&D User software development

- ## CASA fringe fitting (talk by Kettenis)
  - in RadioNet RINGS and ESCAPE
  - Basic version available in CASA 5.3
  - First official version in CASA 5.5
  - CASA 5.6 will feature many improvements

- ## Continued support for ParselTongue

- ## OBELICS work package in ASTERICS
  - Minimize re-calculation when changing parameters during data reduction of large data sets
  - Nice results with CASA in Jupyter
    - Containerised: docker and singularity
  - Demo environment available: http://jupyter.jive.nl/
  - Will continue in ESCAPE

Lensing galaxy

R&D User software development
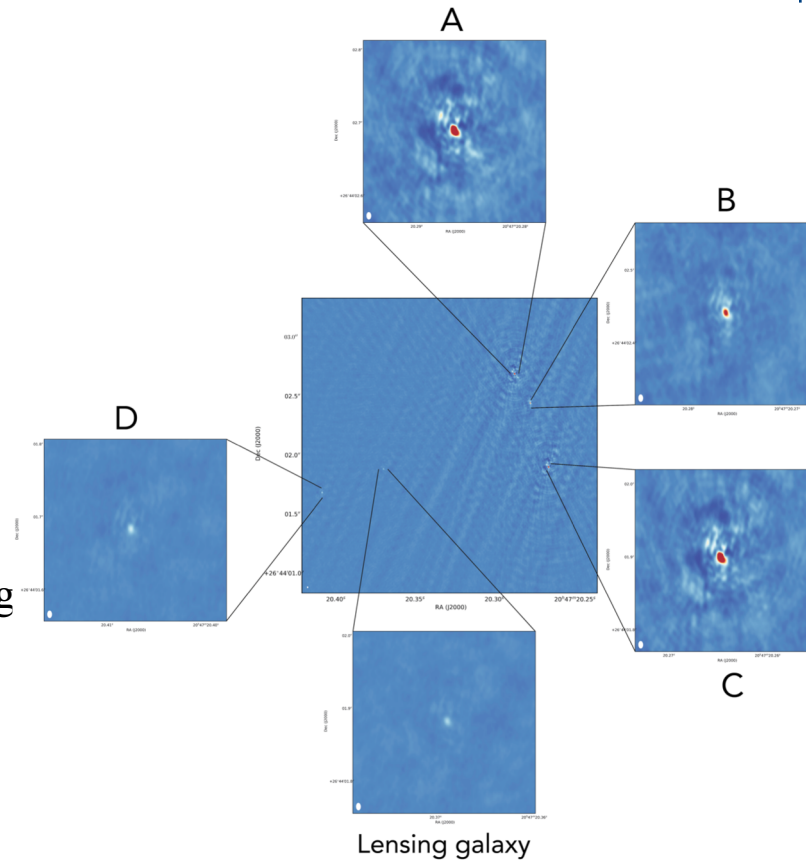
- pySCHED: SCHED re-factoring (talk by Eldering)

- Uses f2py to create Python main loop
  - All fortran routines appear as Python functions
  - Can add new Python functionality

- VEX2 writer was already done, now also re-written VEX1 writer
- QT and Matplotlib available instead of PGPLOT
- Keyin reader re-written
- DBBC2 supported
- DBBC3 partly supported

- Building of system now very easy

System Status Monitor

System Temperatures

Phase Cal Monitoring

Error/Log
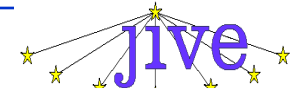
Web-interface

System Status Monitor								
WETTZ13N		2018.148.11:49:17	UT		TEMP	24.6	0552+398	TRACKING
MODE	RATE	11:53:11	NEXT		HUMID	61.4	RA 05h 55m 30.81s	
		SCHED= none		LOG= station	PRES	947.3	DEC 39d 48m	(2000)
		TSYS: IFA IFB IFC IFD			CABLE	0.000000	AZ 130.3863	EL 76.8702
		40 36 21 23			WIND	12.60	DIR 242	
NO CHECK: rx								

Mark 5 Remaining Capacity					
	VSN	Time	GB	%	Check UT
> A BKG+0146		06h29m	2989.675	74.7	07:58:00
B					07:58:00

System Temperatures

Tsys	39.95	(IFA)	36.17	(IFB)
	20.56	(IFC)	23.35	(IFD)

BBC	Freq	Ts-U	Ts-L
01	132.99	52.3	49.1
02	172.99	50.9	
03	272.99	47.4	
04	432.99	52.5	
05	652.99	59.7	
06	772.99	56.0	
07	832.99	63.4	
08	852.99	66.0	64.1
09	205.99	26.8	
10	225.99	25.6	
11	245.99	25.0	
12	275.99	24.0	
13	325.99	24.3	
14	345.99	24.8	
15	0.00		
16	0.00		

Phase Cal Monitoring

	Amp	Phase	Time
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			

Antenna Monitoring
TTW1 ([2018].148.11:49:17:287 (Offset: 0 msec))

Azimuth	Source: Survival	Elevation
90.4813	Actual Pos.	15.0887
	Pos. Graph	
90.4813	Commanded Pos.	15.0887
130.3890	NASA FS Pos.	76.8707
0.0000	Com. Pos. Offset	0.0000
STOP	Status	STOP

Status messages

[Azimuth]
Stop
Stow position
Stow pin retracted

[General]
ACU type: TTW
Master-Slave-Mode: Off
Reduced internal limits che

[Elevation]
Stop
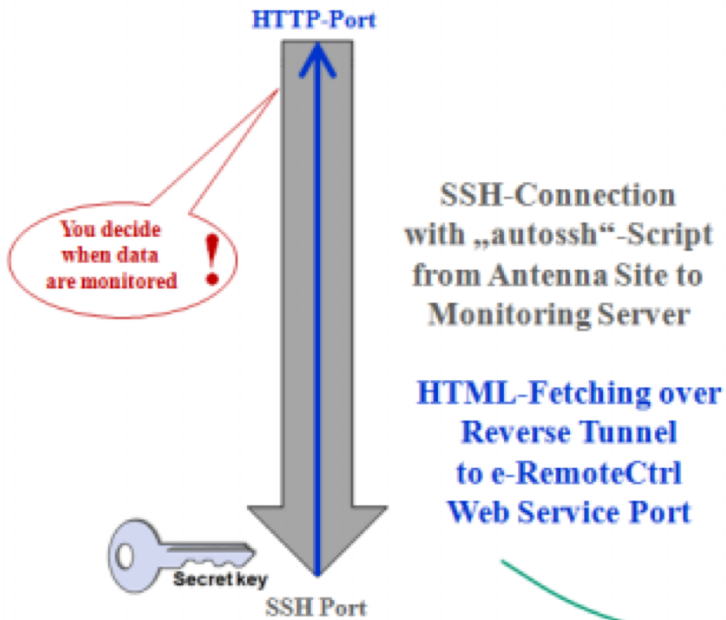Stow position
Stow pin retracted

Error messages

Log

Error
2018.145.15:13:03.26?ERROR qo -301 WARNING: ONSOURCE status is SLEWING!
2018.145.15:13:13.76?ERROR qo -301 WARNING: ONSOURCE status is SLEWING!
2018.145.18:43:33.29?ERROR m5 -900 : Can't do calculations
2018.145.18:43:33.29?ERROR m5 -906 MARK5 return code 6: inconsistent or conflicting request
2018.148.06:45:02.01?ERROR 5h -302 background Mark 5 error(s) detected - see below

Log
2018.148.07:59:43.53;horizon1,0.,10.,360.
2018.148.07:59:43.53;antenna,13.2,720.0,360.0,-90.0,450.0,5.0,115.0,azel
2018.148.07:59:43.53;equip,dbbc_ddc,mk5b,none,none,500.10,3,a/d,101,60,20,none,41,1,in,8bit,cdp,3,return,v105_1,v12,1,1,1,1,15000,15000,15000,15000,32,vsi1-2
2018.148.07:59:43.53;time,0.000,1.000,computer
2018.148.07:59:43.53;flagr,0

Mark 5 Remaining Capacity

Webcam

Antenna Monitoring

plus individual **Station Monitoring**

- Field System acts as web server
- Web pages can be used independently and directly at the observatory
- Field system status on a web browser
- Information tagged to be used by scripts and by a central monitoring

Observatory

Open an SSH connection with individual reverse tunnels

HTTP-Port

You decide
when data
are monitored !

Secret key

SSH Port

**SSH-Connection
with „autossh"-Script
from Antenna Site to
Monitoring Server**

**HTML-Fetching over
Reverse Tunnel
to e-RemoteCtrl
Web Service Port**

https://vlbisysmon.evlbi.wettzell.de

**Remote monitoring and
seamless auxiliary data archive**
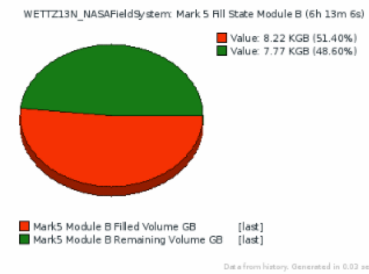
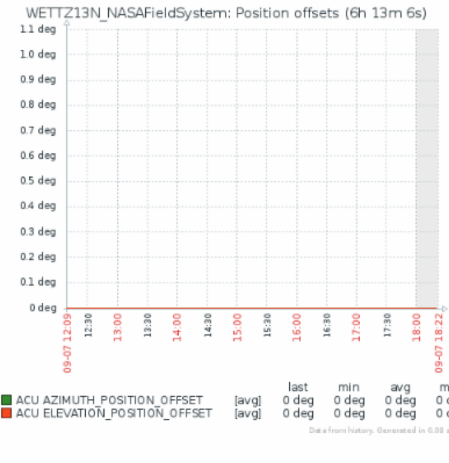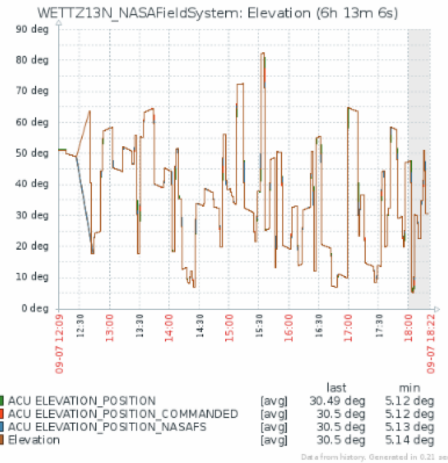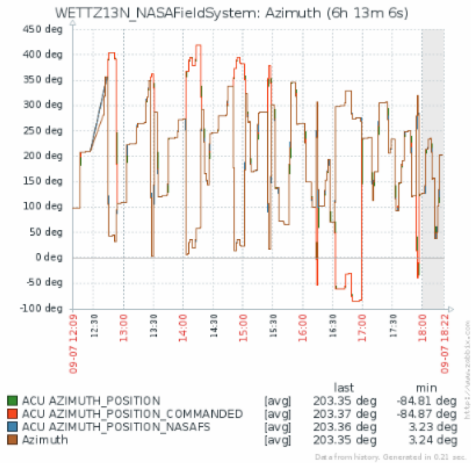**Centralized, World-wide System Status**

ZABBIX &
Wettzell SysMon

Pattern extracting
e.g.
"941.9"
is extracted from
"<!--PRESSURE--> 941.9<!--->"

Task 8.2 of "Jumping JIVE" funded by the European Union under the Horizon 2020 framework programme

JIVE

Over 170 parameters from the Field System can be monitored and plotted
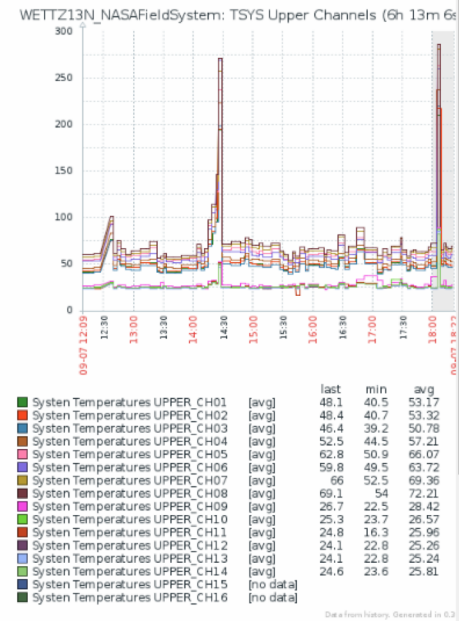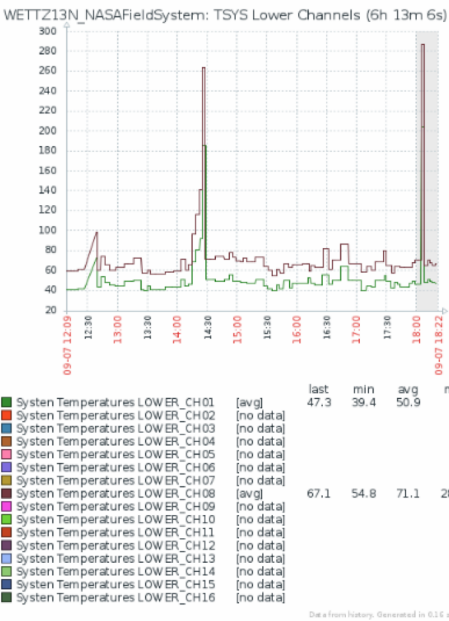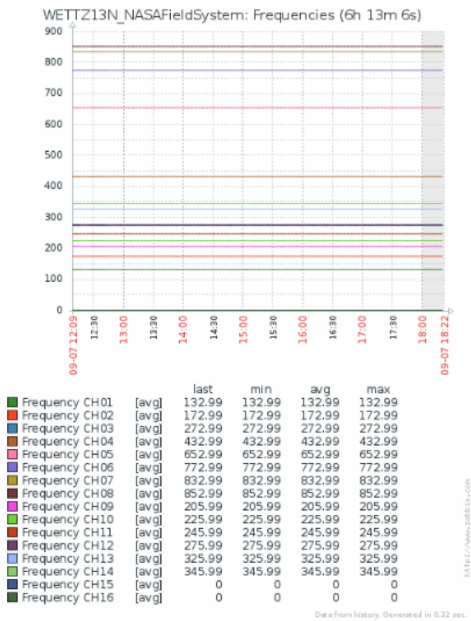
Now: tests with stations

Projects

- ASTERICS: done!
- SKA Signal and Data Transport consortium: done!
- Last Cleopatra deliverable at JIVE:
  - Demo of time and frequency transfer over public network
  - Transfer maser signal from Westerbork to Dwingeloo
    - Needed to lay fiber (last 400 m), build GNU radio backend, fix Westerbork maser
    - What could possibly go wrong?
  - But, fringes between Dwingeloo and many stations detected during NME N19L1
  - Much stronger fringes Dwingeloo – Wb – Jb – Tr, during following separate tests

Projects (continued)

- ## Very last Cleopatra deliverable at JIVE:

  - Demo of triggering of LOFAR and EVN
  - Following simulated trigger (VOevent)
  - LOFAR was unfortunately broken (software update)
  - But EVN triggered very nicely
    - Using (partly) years old software
    - And new automated search of a catalog of choice
    - Select few likely sources around trigger position, generate schedule, send out schedule, observe, correlate in multiple phase center mode
  - Afterwards, automatic return to previous schedule

New project

- ESCAPE (European Science Cluster of Astronomy & Particle physics ESFRI research infrastructures)
  - In some ways, a follow-up of ASTERICS
  - Now involving astronomy, astro-particle *and* particle physics
  - CTA, ELT, EST, FAIR, HL-LHC, KM3NeT, SKA, CERN, ESO, JIV-ERIC, EGO-Virgo
  - Aim to shape and build the EOSC, the European Open Science Cloud
  - Nearly 16 Meuro, ends July 2022

- EVN represented by JIVE, will work on wide range of topics, amongst which:

  - Inclusion of radio astronomy data into the Virtual Observatory (VO)
    - Which itself will become a part of the EOSC
  - New pipelines for VLBI data reduction
  - Modernisation and VO-ification of the EVN archive
    - Adding mechanisms to feed back scientific results
    - Tracking the provenance of data products
  - Further development of VLBI data reduction functionality to CASA and to Jupyter notebooks