



Software Correlation at JIVE & Real-time e-VLBI in the EVN

Bob Campbell, JIVE

- PI Interaction and Operations
- EVN Software Correlation at JIVE (SFXC)
- Real-time e-EVN update
- Solar activity summary/prognosis

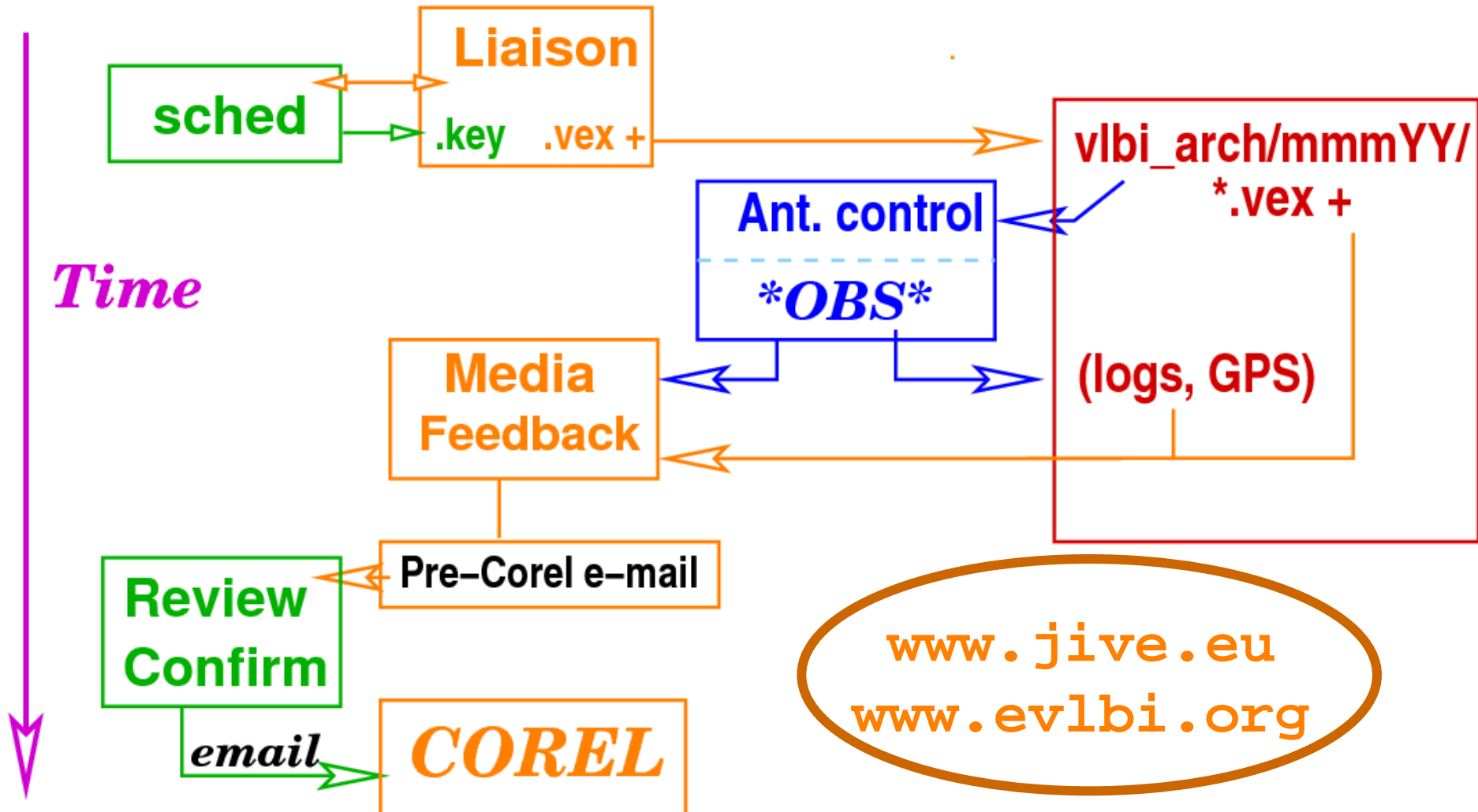
Ops Flowchart (≤ Correlation)

User/PI

JIVE

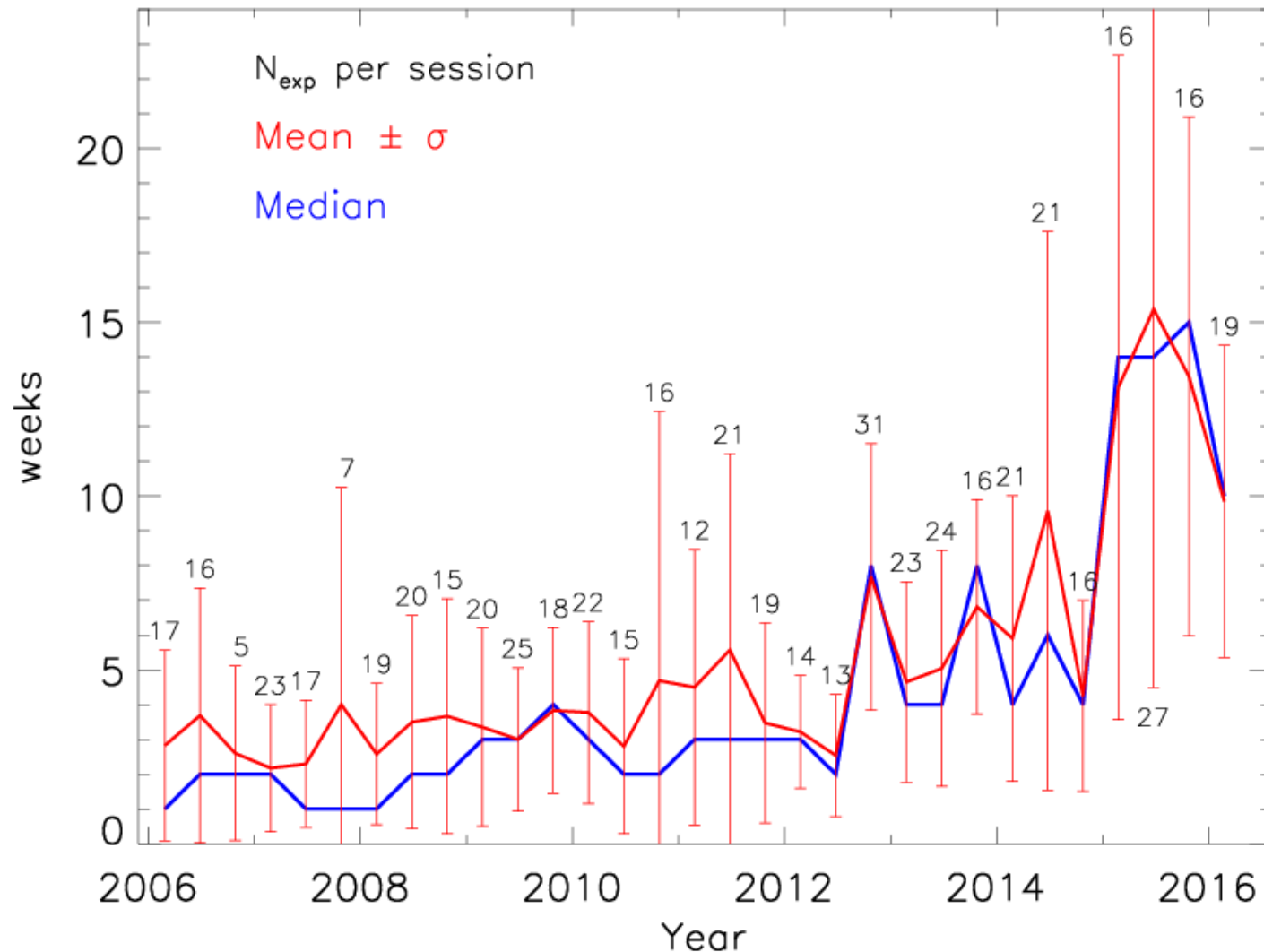
Stations

VLBEER



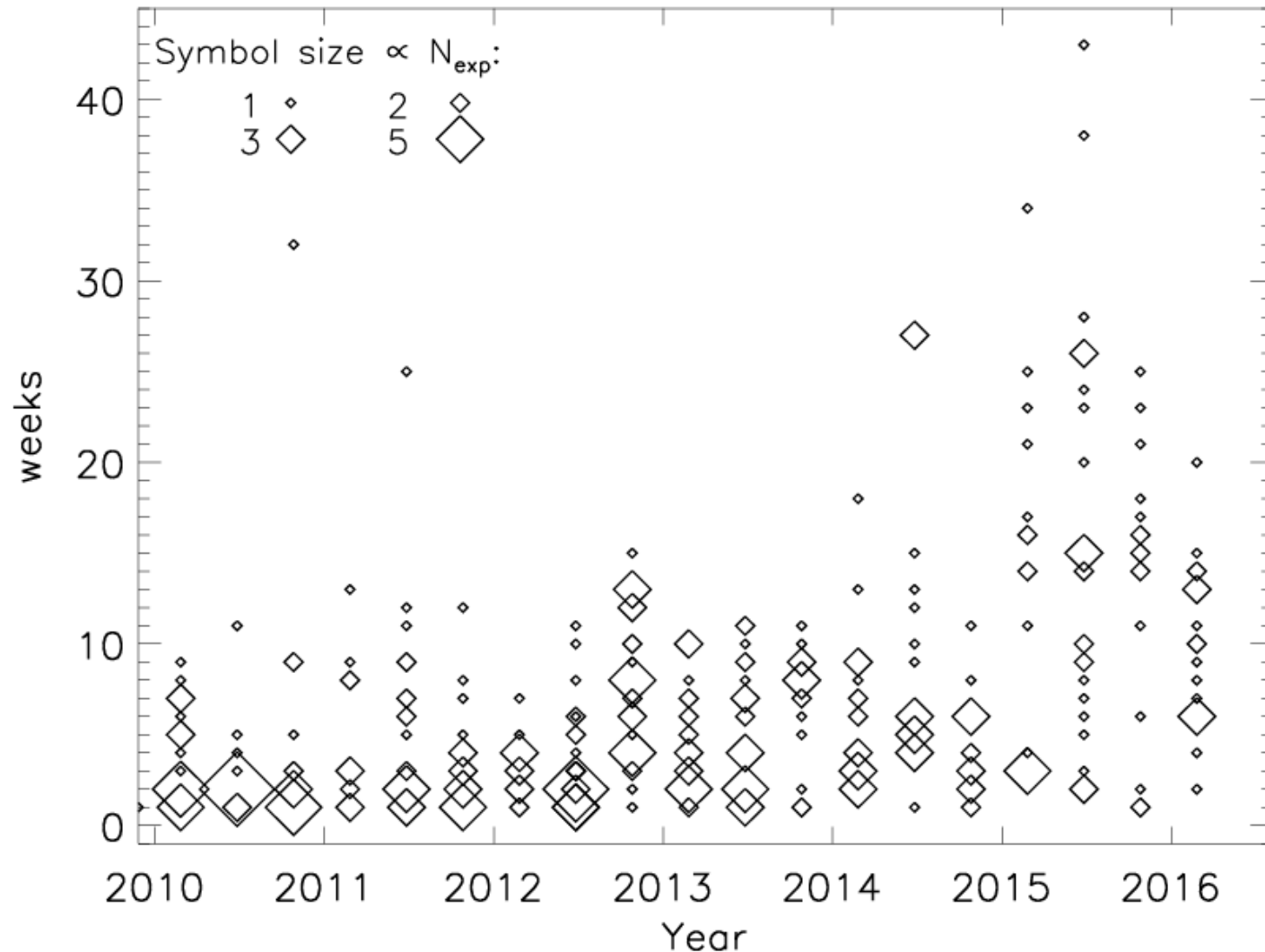
From Correlation to Distribution

time between corr & dist



From Correlation to Distribution

time between corr & dist



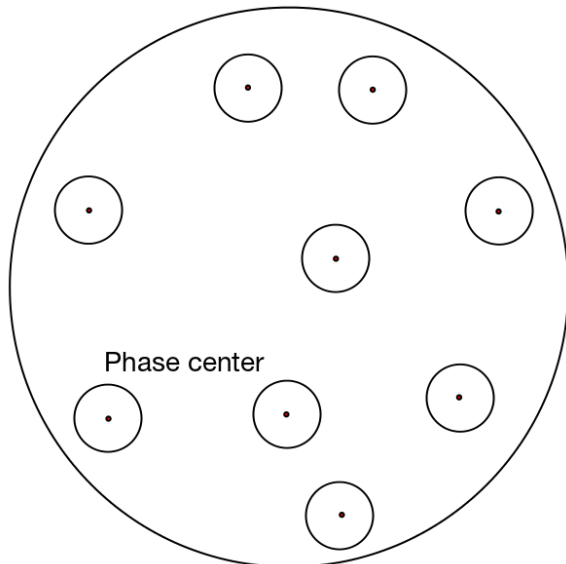
SFXC: Contemporary Capabilities

- Pulsar Gating/Binning
 - Both incoherent and (new) coherent de-dispersion
- Multiple output phase centers within a wider field
- Wide-field mapping (large N_ν , short t_{int})
 - Selectable spectral windowing (Hanning, Hamming, tophat, cosine)
 - Working on baseline-dependent averaging (t , ν)
- Mixed-bandwidth, mismatched-sideband correlation
 - enables inclusion of a wider set of heterogeneous back-ends
- “Phasing up” the EVN
- Space VLBI: near-field target, orbiting antenna

SFXC: Wide-Field Mapping

- Essentially unlimited $\max-N_{\text{frq}}$, $\min-t_{\text{int}} \rightarrow$ can map an area on the sky \sim single-dish beam w/ minimal smearing
 - Price = huge output data sets (record = 5.4 TB of FITS files)
- Multiple phase-center correlation: outputs only subsets of the full area (record = 699 phase centers)

Station Field of View

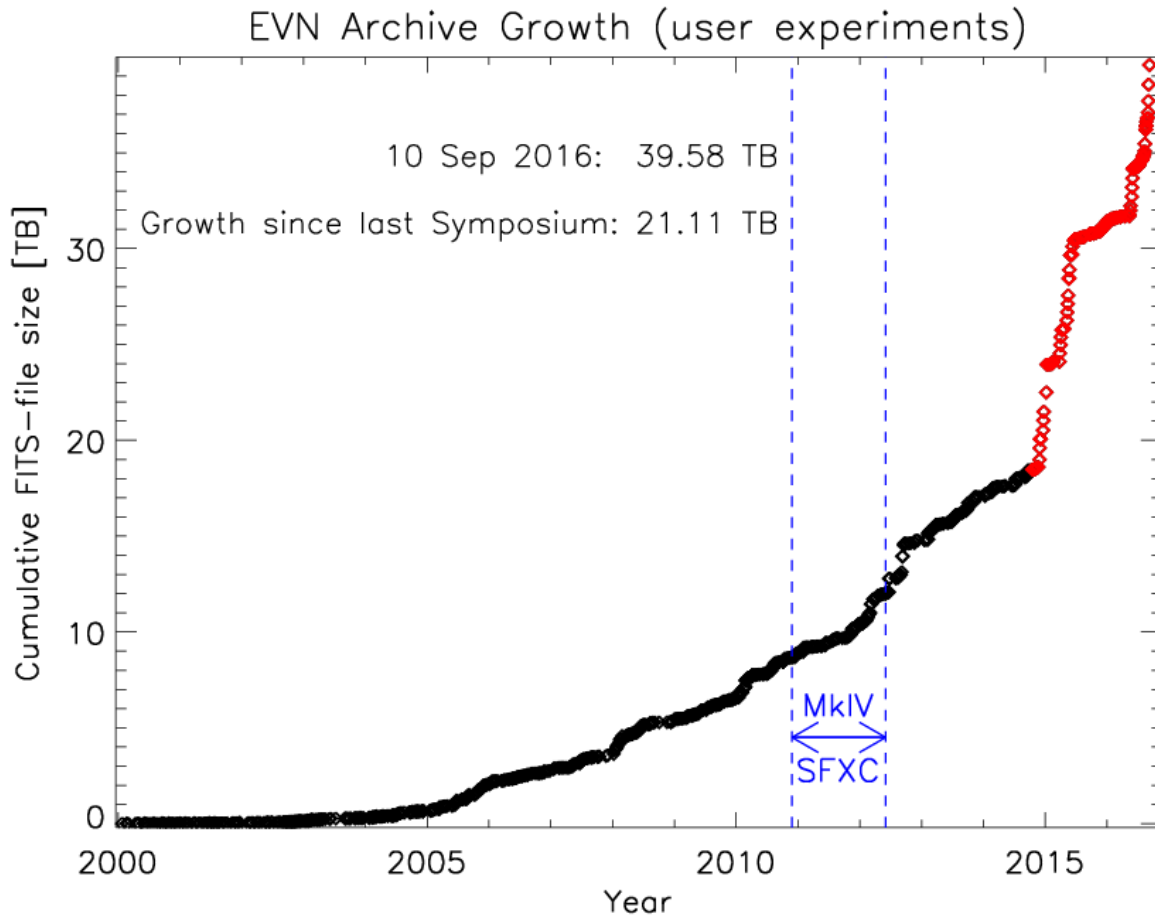


Typical "internal" correlation: $N_{\text{frq}} \sim 16\text{k}$; $t_{\text{int}} \sim 4\text{-}15\text{ ms}$

Correlation-time "penalty" factor small, $\sim 1.5\text{x}$ (for a reasonable number of phase centers) — multiplications much faster than Fourier transforms

("penalty" for 699 phase-centers, 13 stations $\sim 17\text{x}$)

WFM: Effect on the Archive



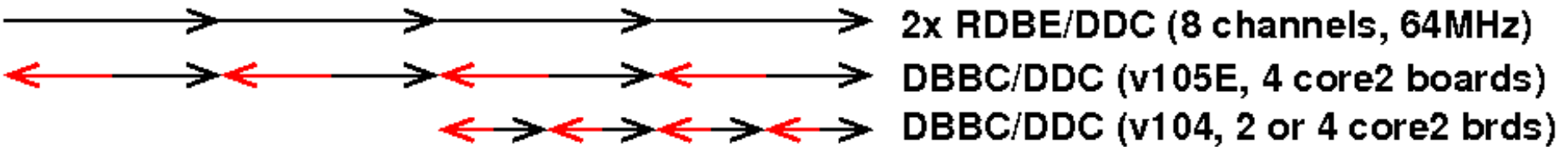
Transition period
MkIV→SFXC
annotated.

Exps. providing
3.7-4.7 TB more
"in the headlights"
(correlated or
observed).

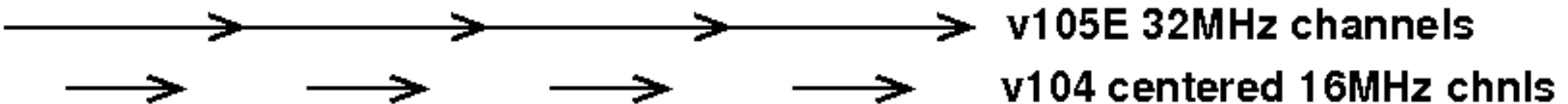
One proposal in
Feb'16 implied an
output = 85TB of
FITS files.

SFXC: Mixed-BW

- K-band global obs: up to 6 different back-ends
- 2 Gbps global:



- Wide-band spectral line (e.g., HI absorption):



- e-EVN with Arecibo:

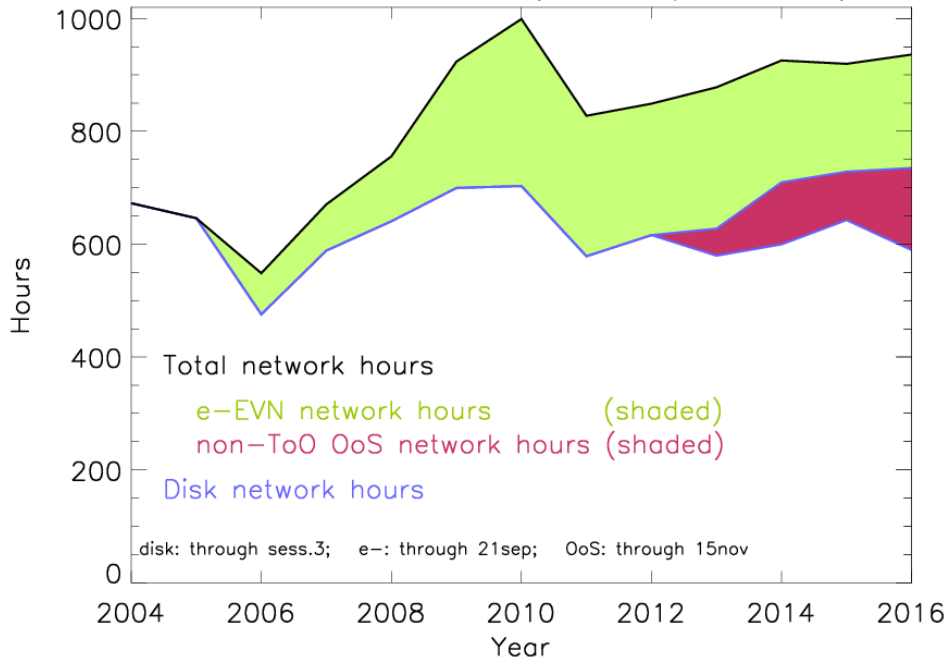


Real-time e-EVN Science

- Proposal-driven e-EVN science observations
 - Nowadays, a network of 10-11 stations at Gbps is routine
 - First 2Gbps e-EVN run in June (6 sta @ 2Gbps + 4 @ 1Gbps)
 - ~27% of EVN observing time since 2009 ('06-'08 = 13.7%)
 - 285 observations from 175 proposals; 71 different PIs
- Evolution of e-EVN procedures
 - ~monthly 24-hour runs (+4hr prelim. test) on fixed dates (10)
 - e-EVN also in ToO's & regular disk sessions (longer runs)
 - Proposals within standard proposal-submission cycles
 - Any EVN or GLOBAL proposal may contain e-VLBI observation(s)
 - Target of Opportunity Observations (69 obs; 43 props; 30 PIs)
 - Proposal Class for "triggered" observations (13 obs; 9 props)
 - New categories: generic trigger, automatic-override trigger

EVN / e-EVN Network Hours

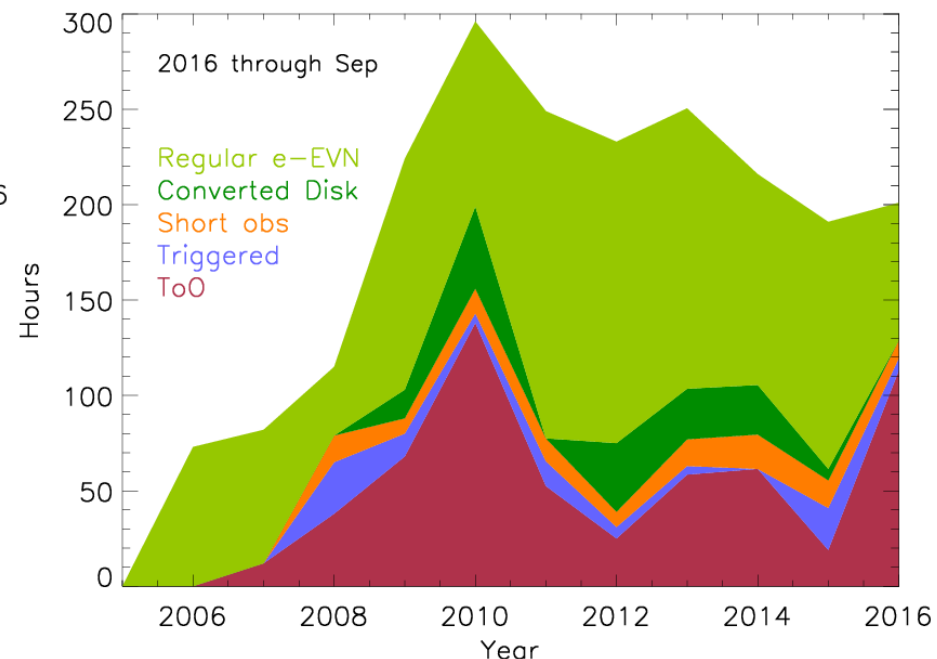
EVN network hours (user experiments)



New category: non-ToO out-of-session: ≤ 12 blocks per yr; max 144 hr/yr (min. block size for accounting = 12hr)

2016 so far: ToO = 113 hr
total = 201 hr
still 3 e-EVN days to come

e-EVN network hours



e-EVN Operational Bandwidth

| Station | Connection |
|--------------|------------|
| Effelsberg | 2048 Mbps |
| Westerbork | 1024 Mbps |
| Jodrell Bank | 1024 Mbps |
| Medicina | 2048 Mbps |
| Noto | 2048 Mbps |
| Onsala | 2048 Mbps |
| Torun | 1024 Mbps |
| Yebes | 2048 Mbps |
| Sh / Tm65 | 1024 Mbps |
| HartRAO | 2048 Mbps |
| Arecibo | 512 Mbps |
| Metsahovi | 1024 Mbps |

LBA (At,Mp,Pa): 1 Gbps

KVAZAR (Zc,Bd): 512 Mbps in
clock-search portion of Jun'16

SRT expected soon

Robledo to start tests

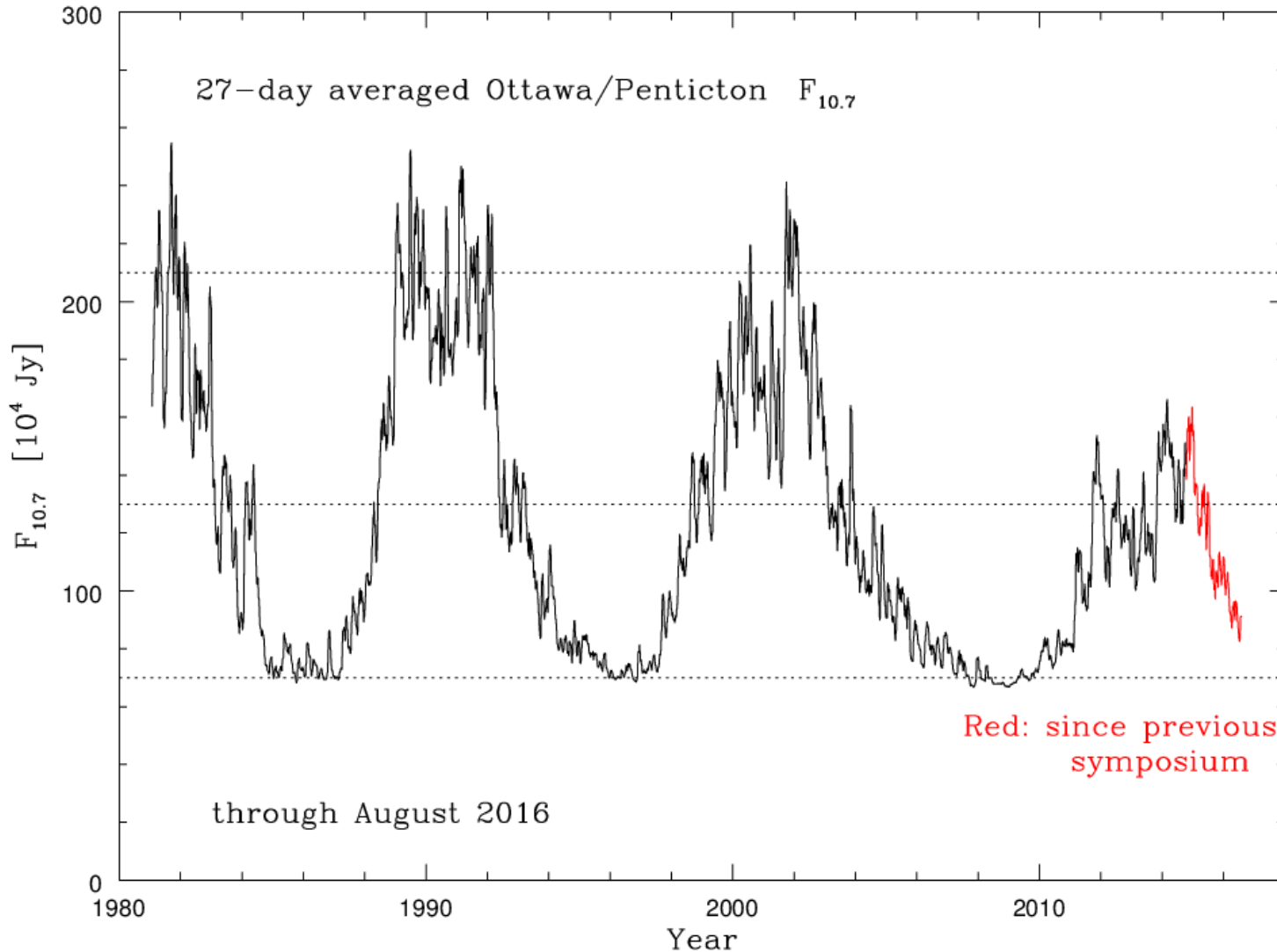
Irbene connection in place

e-EVN & Recording at JIVE

- Limitation: e-EVN had to be real-time correlation
 - No multiple-pass correlation, multiple phase-centers, *etc.*

- jive5ab → correlate real-time & record onto FlexBuff
 - Continuum-/Line-pass spectral-line observations
 - FRB obs: pulse search via auto-correlations or phasing-up; recorrelations of detected pulses with appropriate $t_{\text{int}}, N_{\text{v}}$
 - → Today's target-of-opportunity observation: monitor the actual real-time fringes at:
services.jive.nl/sfxc/fringe.html
 - Torun remote-maser e-tests

Solar Activity

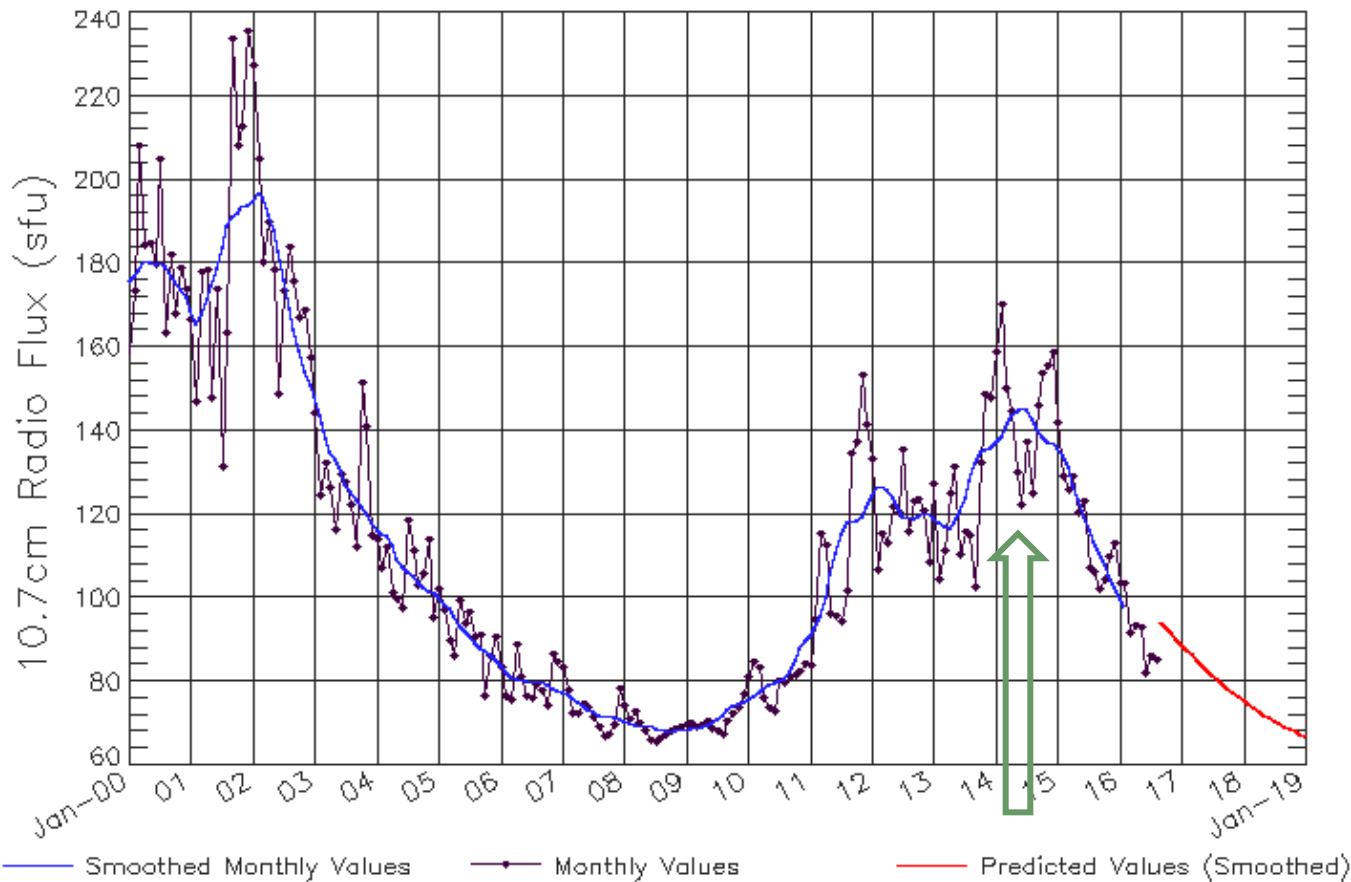


Transition towards solar-min from the weak peak of the current cycle seems truly underway.

L-band astrometry...

Predictions for this Solar Cycle

ISES Solar Cycle F10.7cm Radio Flux Progression
Observed data through Aug 2016



Sep'10 & '12 predictions:
solar max. in
mid-2013 at
140 sfu.

Follows Sep'14
prediction
fairly well

ref: Space
Weather
Prediction
Center, via

www.sec.noaa.gov

Updated 2016 Sep 5

NOAA/SWPC Boulder, CO USA