

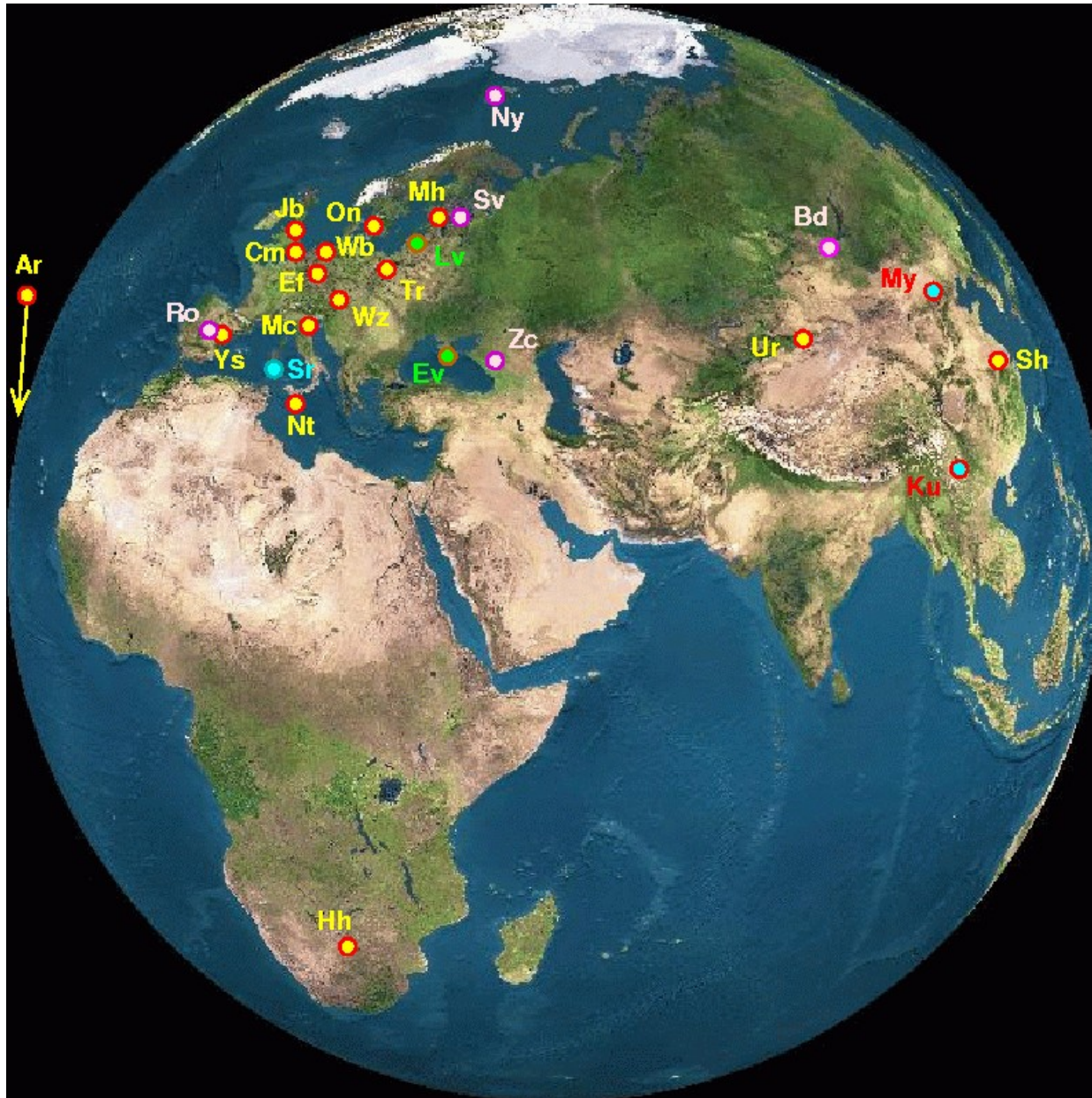


# Recent Results from the EVN MkIV Data Processor at JIVE

Bob Campbell, JIVE

- Operations and PI Interaction
  - Pre-observation / Pre-correlation
  - Post-correlation
- The Correlator
  - Capacities & Tips
  - Astronomical Capabilities

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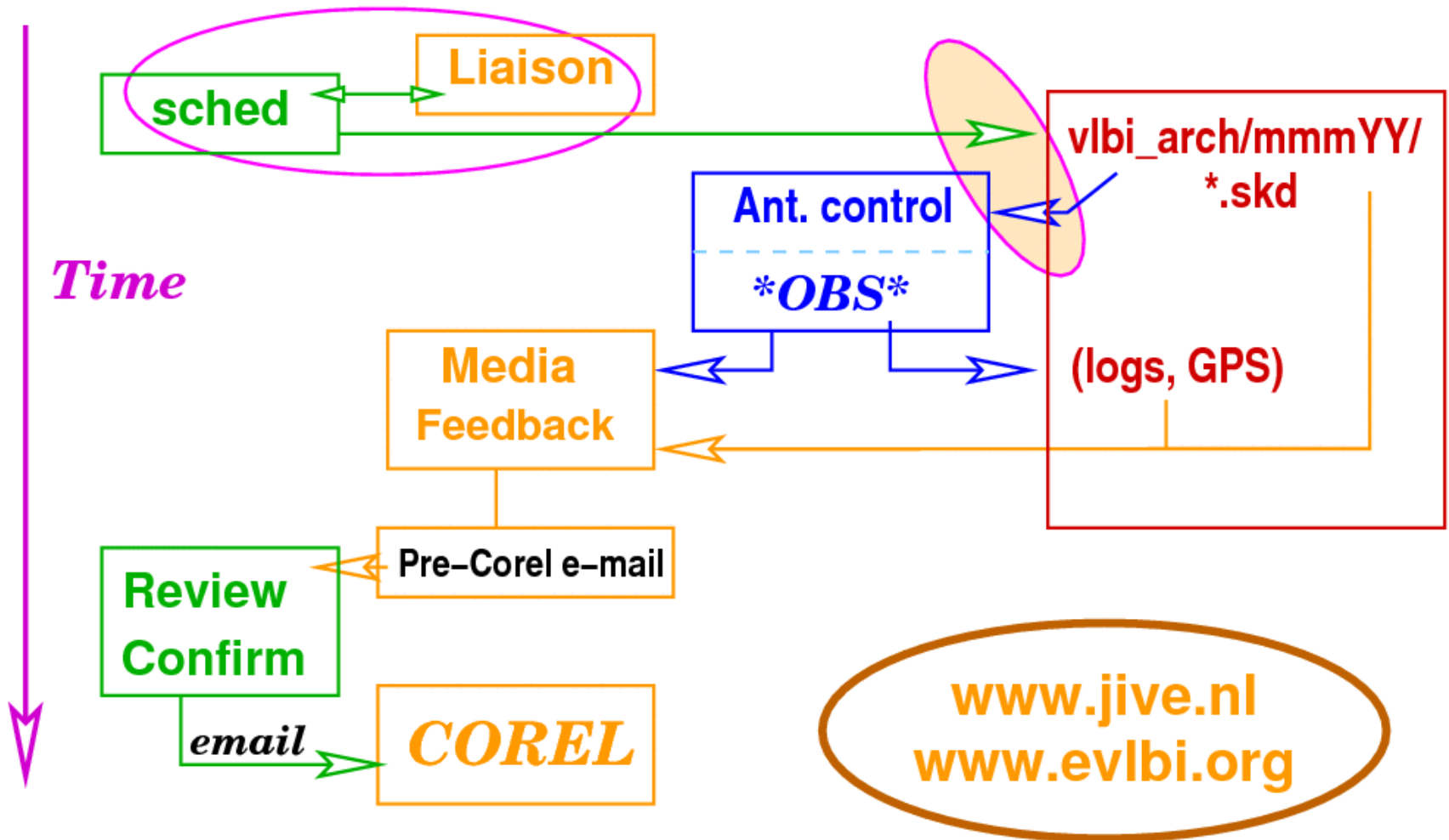
# Ops Flowchart (<=Correlation)

User/PI

JIVE

Stations

VLBEER



# Web-based EVN Proposal Tool

File Edit View History Bookmarks Tools Help

https://proposal.jive.nl/useradminis

openSUSE Getting Started Latest Headlines

Welcome to NorthStar for EVN

EUROPEAN NETWORK

Username:

Password:

Log in

The Northstar application has been developed at ASTRON as part of the EC-funded RadioNet project.

Register as new user Password forgotten? Send Questions/Problems Help

File Edit View History Bookmarks Tools Help

https://proposal.jive.nl/useradministr

openSUSE Getting Started Latest Headlines

Proposal List User account information

User account information

User account:

username:campbell  
password:\*\*\*\*\*  
public key:WeakMtdx8

Change password

Personal contact information:

title:Dr.  
firstname:Bob  
lastname:Campbell  
email:campbell@jive.nl  
phone(first):+31 (0)521-596-534  
phone(second):+31 (0)521-596-500  
fax:+31 (0)521-596-539

Edit

Affiliation:

institute:JIVE  
department:Science Ops & Support  
address:Oude Hoogeveensedijk 4

city:Dwingeloo  
state:  
country:Netherlands  
zipcode:7991 PD  
Website:

Position:  
Remarks:

Edit

Close

Help

proposal.jive.nl/proposal/s

Done

proposal.jive.nl

"NorthStar"



proposal.jive.nl

EVN Proposal

RadioNet JIVE

Community:Everyone  
Category:regular  
Semester:08C

Applicants Justification Observing Request Additional Issues ← 4 tabs

Active Participant	Contact Author	PI	Name	Affiliation	Country	Email	Potential Observer
yes			Dr. Bob Campbell	JIVE (Science Ops & Support)	Netherlands	campbell@jive.nl	<input type="checkbox"/>

Add applicant

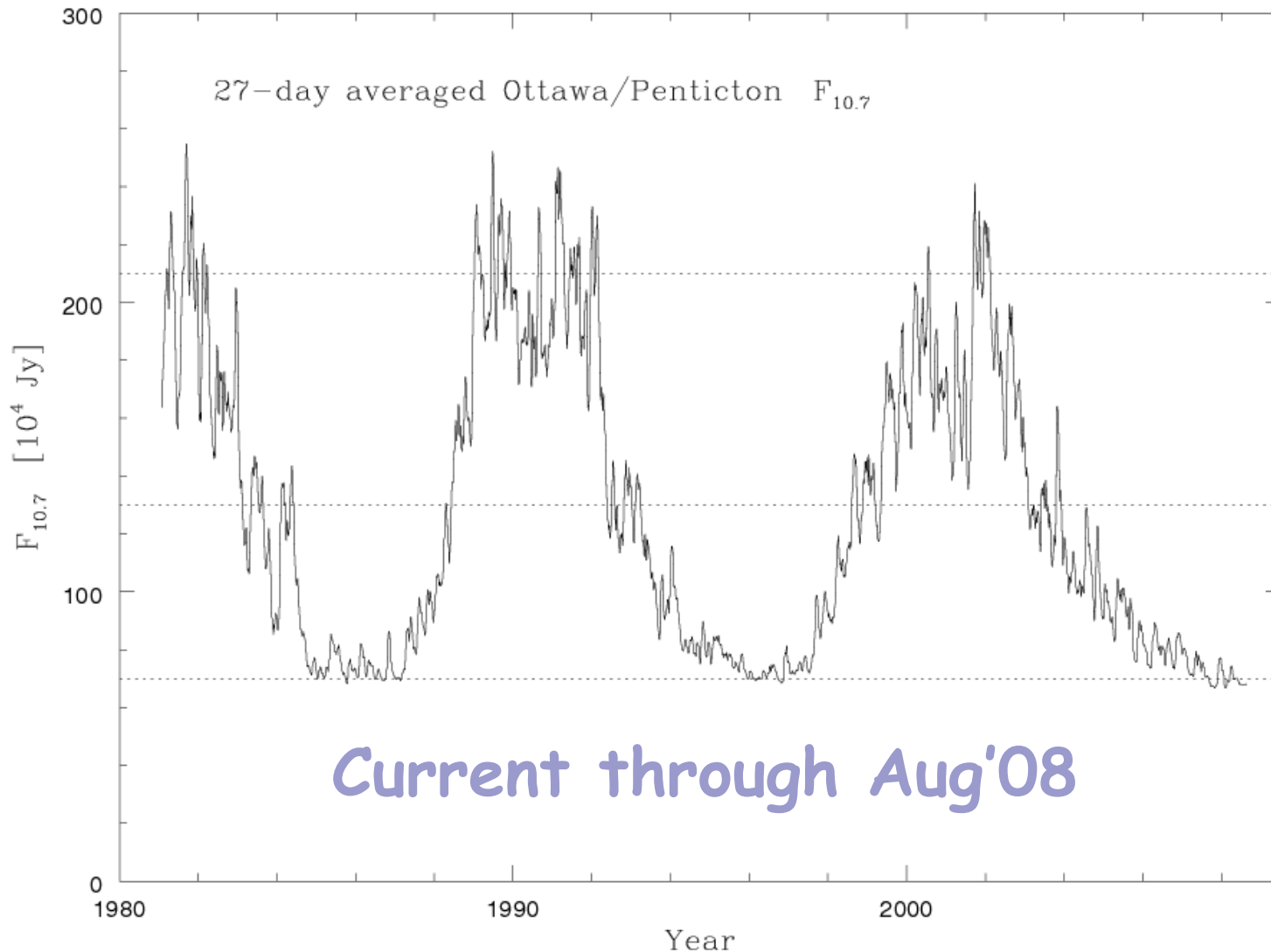
Save and Continue Save and Preview Save and Exit Save and Submit Quit without saving

NorthStar version v3.2.6 (2008-07-21)

Done

proposal.jive.nl

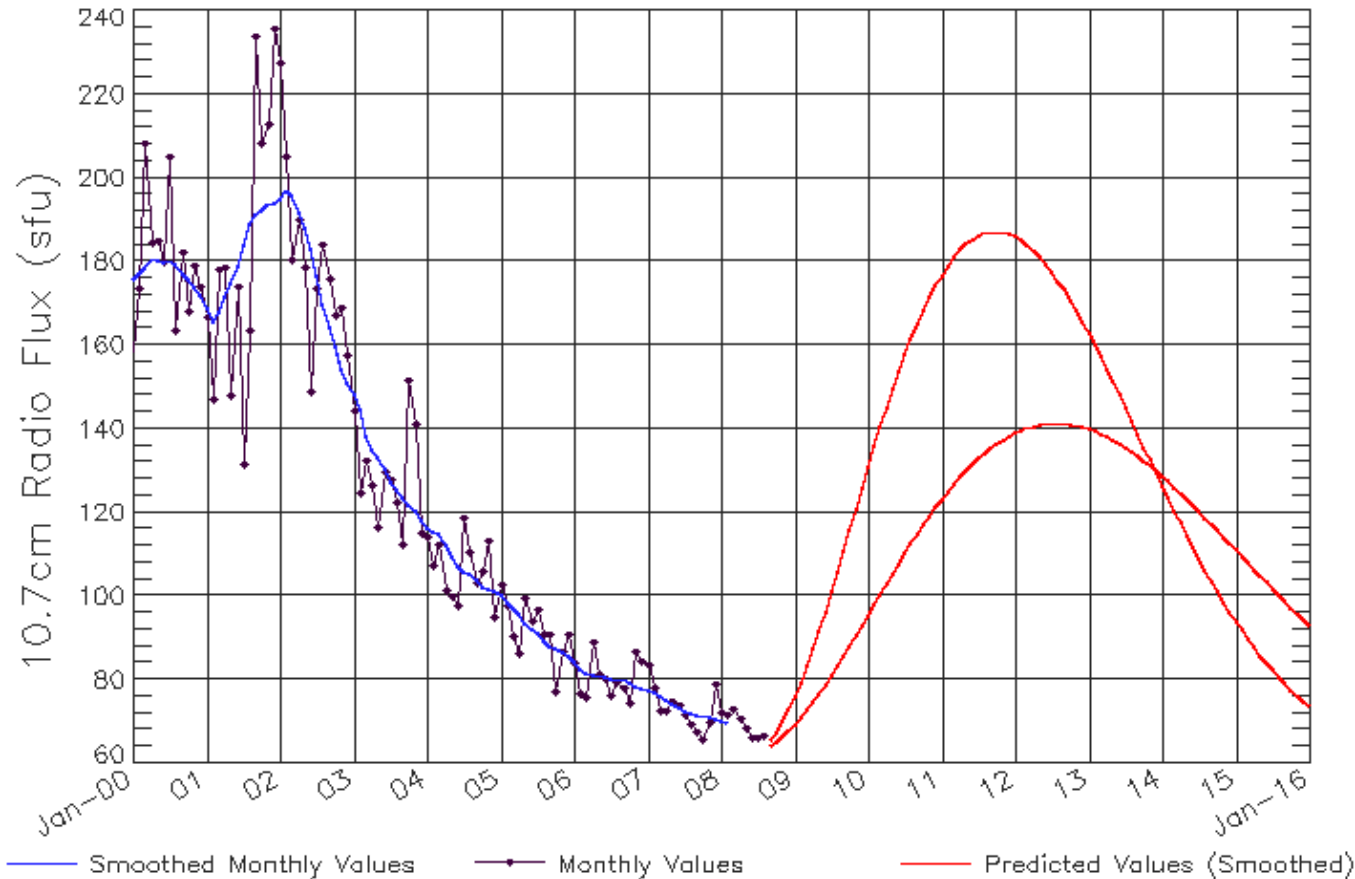
# Still time for L-band phase-ref...



Current solar-min conditions continue to linger, but the upswing to the next solar-max shouldn't be too far off into the future

# Predictions for next Solar Cycle

ISES Solar Cycle F10.7cm Radio Flux Progression  
Data Through 31 Aug 08



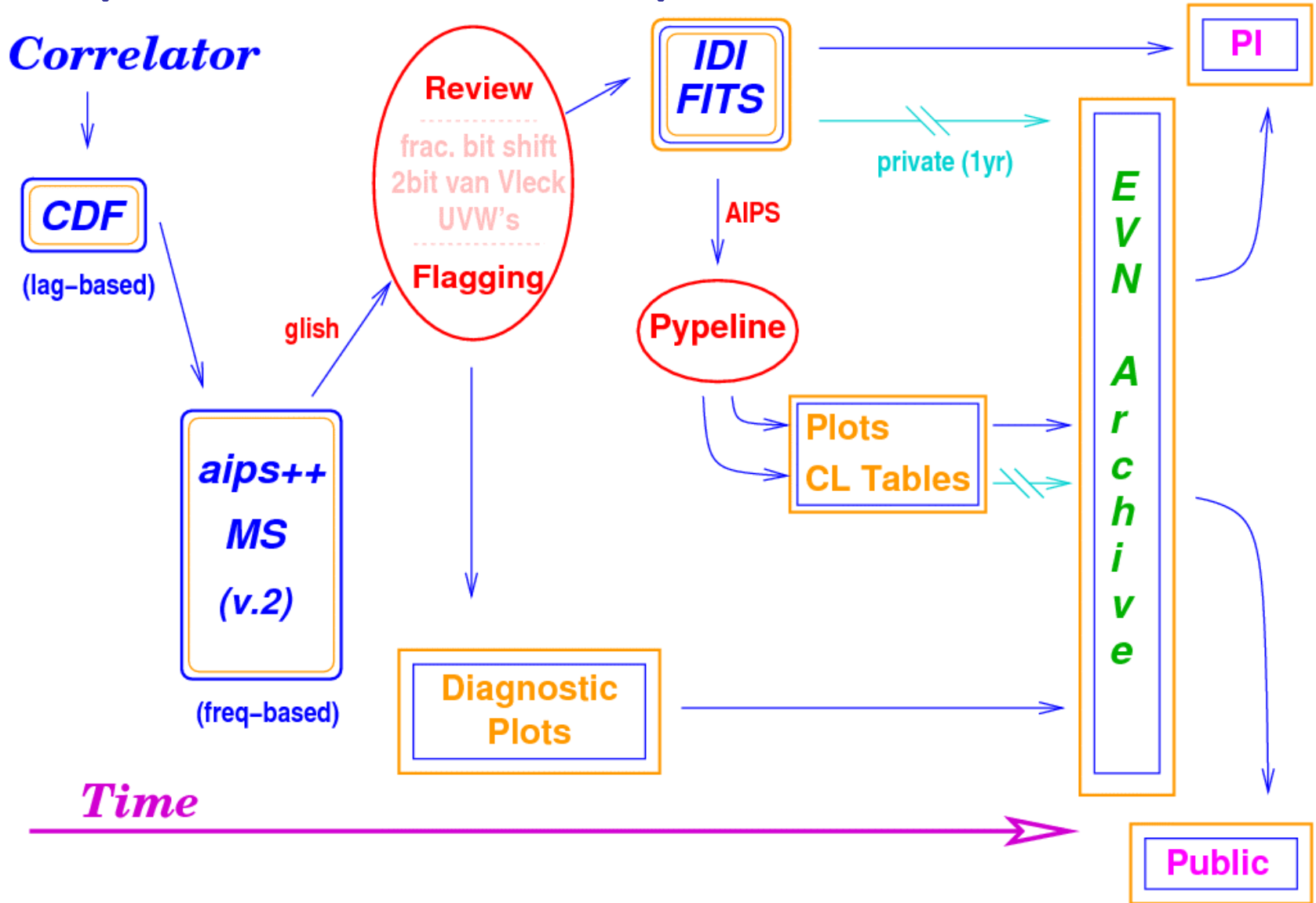
Smoothing =  
13-month

April'07 pred:  
expected the  
solar min. at  
March'08.

ref: Space  
Weather  
Prediction  
Center, via

[www.sec.noaa.gov](http://www.sec.noaa.gov)

# Ops Flowchart (post-Correlation)



# EVN Archive

**EVN Data Archive at JIVE**

The EVN Data Archive at JIVE contains correlated data associated with EVN observations processed at JIVE. The archive includes a growing database of Vibi observations that have entered the public domain.

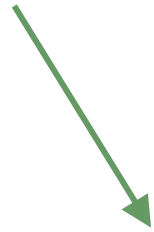
In addition, the archive makes available various correlator and pipeline products that give an impression of the data quality. In some cases, preliminary images of calibrators and target sources are also available. The archive allows these to be combined with external VO resources in a natural way.

Select EVN experiment: GB063B

Ra	Dec	Source	Image	Image
8.8555	61.5085	J0035+6130	evn	
9.1973	63.4839	L1287	evn	
9.2681	62.6093	0037+6236	evn	
11.7518	56.9618	J0047+5657	evn	

Access to EVN archive

- Show experiment GB063B
- Show catalogue of experiments
- Search archive by source name or position
- The Bologna archive of EVN observations



**EVN Standard Plots of experiment GB063B**

Exp. Name : GB063B  
 P.I. Name : Brunthaler  
 Description : Astrometry of Methanol Maser  
 Wavelength : 4cm  
 Stations : JbWBEfM:TiNHhOnYy  
 Plot description : Description

Obs. Date : 080316  
 Completion Date : 080612  
 Distribution Date : 080704  
 Release Date :  
 Support Scientist : Campbell  
 Letter to P.I. : gb063b.pilletter

cross corr. amp/phase	auto corr. amp/phase	amp/phase versus time	weights versus time
gb063b.corr-cross-1a.ps.gz	gb063b.corr-auto-1.ps.gz	gb063b.corr-amp/phase-1a.ps.gz	gb063b.corr-weight-1.ps.gz
gb063b.corr-cross-1p.ps.gz	gb063b.corr-auto-2.ps.gz	gb063b.corr-amp/phase-1p.ps.gz	gb063b.corr-weight-2.ps.gz
gb063b.corr-cross-2a.ps.gz	gb063b.corr-auto-3.ps.gz	gb063b.corr-amp/phase-2a.ps.gz	gb063b.corr-weight-3.ps.gz
gb063b.corr-cross-2p.ps.gz	gb063b.geod-auto-1.ps.gz	gb063b.corr-amp/phase-2p.ps.gz	gb063b.geod-weight-1.ps.gz
gb063b.corr-cross-3a.ps.gz	gb063b.geod-auto-2.ps.gz	gb063b.corr-amp/phase-3a.ps.gz	gb063b.geod-weight-2.ps.gz
gb063b.corr-cross-3p.ps.gz	gb063b.geod-auto-3.ps.gz	gb063b.corr-amp/phase-3p.ps.gz	gb063b.geod-weight-3.ps.gz
gb063b.geod-cross-1a.ps.gz	gb063b.geod-auto-4.ps.gz	gb063b.geod-amp/phase-1a.ps.gz	gb063b.line-weight-1.ps.gz
gb063b.geod-cross-1p.ps.gz	gb063b.line-auto-1.ps.gz	gb063b.geod-amp/phase-1p.ps.gz	gb063b.line-weight-2.ps.gz
gb063b.geod-cross-2a.ps.gz	gb063b.line-auto-2.ps.gz	gb063b.geod-amp/phase-2a.ps.gz	gb063b.line-weight-3.ps.gz
gb063b.geod-cross-2p.ps.gz	gb063b.line-auto-3.ps.gz	gb063b.geod-amp/phase-2p.ps.gz	
gb063b.geod-cross-3a.ps.gz	gb063b.line-auto-4.ps.gz	gb063b.geod-amp/phase-3a.ps.gz	
gb063b.geod-cross-3p.ps.gz	gb063b.line-auto-5.ps.gz	gb063b.geod-amp/phase-3p.ps.gz	
gb063b.geod-cross-4a.ps.gz	gb063b.line-auto-6.ps.gz	gb063b.geod-amp/phase-4a.ps.gz	
gb063b.geod-cross-4p.ps.gz		gb063b.geod-amp/phase-4p.ps.gz	
gb063b.line-cross-1a.ps.gz		gb063b.line-amp/phase-1p.ps.gz	
gb063b.line-cross-1p.ps.gz		gb063b.line-amp/phase-2p.ps.gz	
gb063b.line-cross-2a.ps.gz		gb063b.line-amp/phase-3p.ps.gz	
gb063b.line-cross-2p.ps.gz			

**EVN User Experiment Pipeline Feedback of GB063B**

A description of the pipeline is available from the pipeline homepage. The links will direct you to webpages containing:

- A series of plots produced by the pipeline which should be useful in assessing the antenna performance and data quality in each experiment. (see [pipeline description](#) for details).
- A set of calibration tables (in FITS format) produced by the pipeline. These can be downloaded and applied to the data provided by the EVN correlator. (see the EVN Data analysis guide, available from the EVN user guide, for details).
- A history file associated with the data processed by the pipeline and a summary of what the CL/SN tables contain (typically CL table 2 provides the a priori amplitude calibration and CL table 3 provides phase, phase-rate, delay and amp gain solutions from the calibrators). In addition, the original pipeline script is made available, together with final versions of the ancillary data (ANTAB, UVFLG files etc).

To download all the pipeline products use: `GNU wget (manual)`. It can be obtained from the web, if not available. To get all pipeline products of all passes, copy next line to your commandwindow:

```
wget -445 -t1 -r -nd http://archive.jive.nl/exp/GB063B_080316/pipeline -A "gb063b"
```

Pipeline products of experiment GB063B, pass1

- Pipeline plots
- AIPS calibration tables (FITS Format)
- AIPS history file
- Short summary of CL/SN table contents
- The final pipeline script (Not available)
- Input parameters for script
- Associated ANTAB
- UVFLG flagged data
- UVFLG Band-edge Flagging (Not available)
- The pipeline logfile

**EVN fitsfiles of experiment GB063B**

Download: Use right mousebutton -> Save target.  
 If the connection is slow, try [GNU wget \(manual\)](#). It can be obtained from the web, if not available.

A file selection can be made by filling in the wildcard after the -A option.  
 To get all fitsfiles of GB063B copy next line to your commandwindow:

```
wget -htp-user username -htp-passwd password -445 -t1 -r -nd http://archive.jive.nl/exp/GB063B_080316/fits -A "gb063b"
```

Replace username and password with actual values before executing the command. The checksum file can be used to verify the checksum of all datafiles using: `md5sum -c gb063b.checksum` (on unix systems).

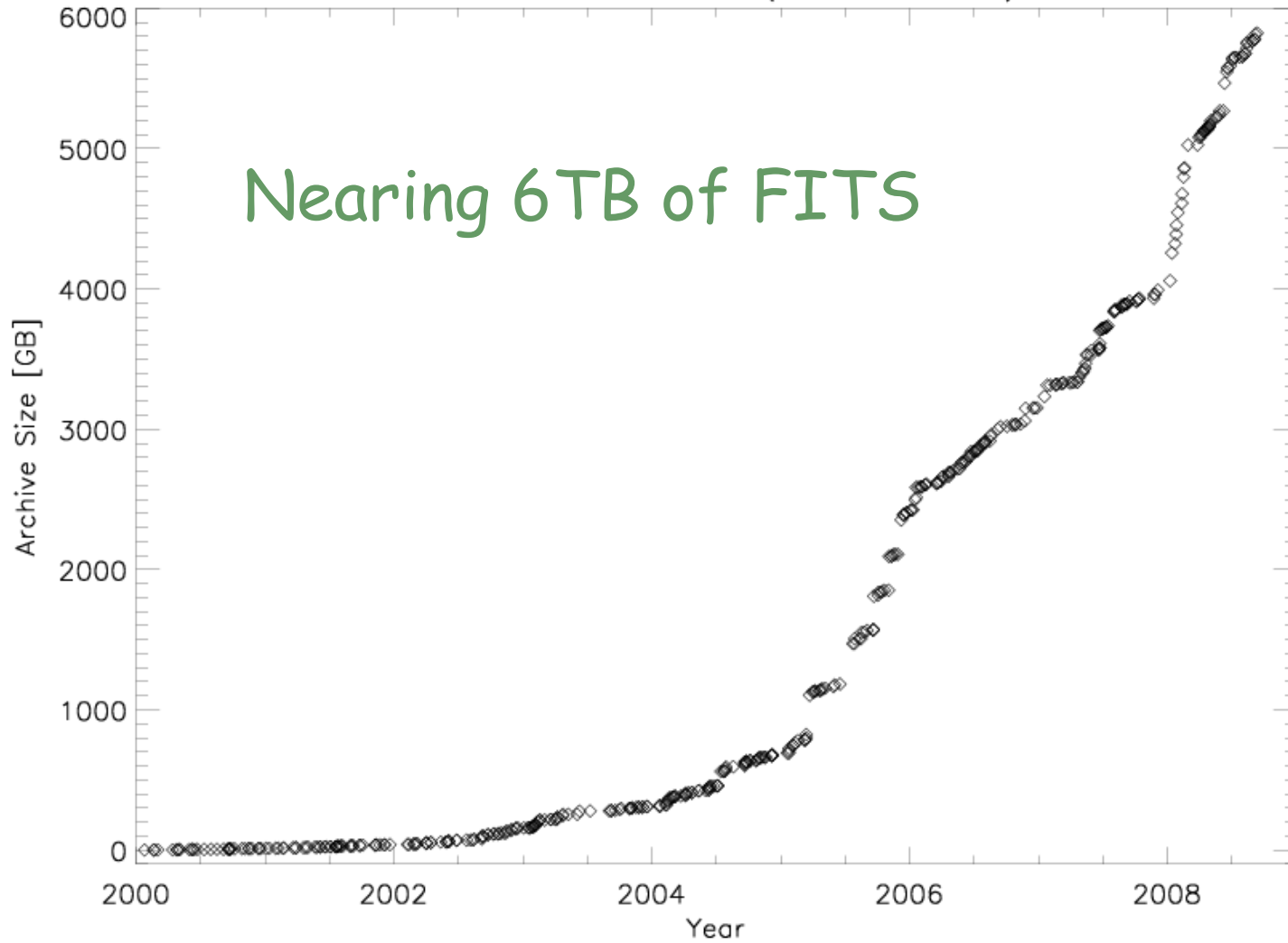
Filename	Length x 10 <sup>6</sup> bytes
gb063b.README	0.00000292
gb063b.checksum	0.000001311
gb063b_1_IDI1	1.927896800
gb063b_1_IDI2	1.927896800
gb063b_1_IDI3	1.927896800
gb063b_1_IDI4	1.927896800
gb063b_1_IDI5	1.66467040
gb063b_2_IDI1	1.927819520
gb063b_2_IDI2	1.927819520
gb063b_2_IDI3	1.927819520

FITS,  
 Pipeline,  
 Plots,  
 Feedback

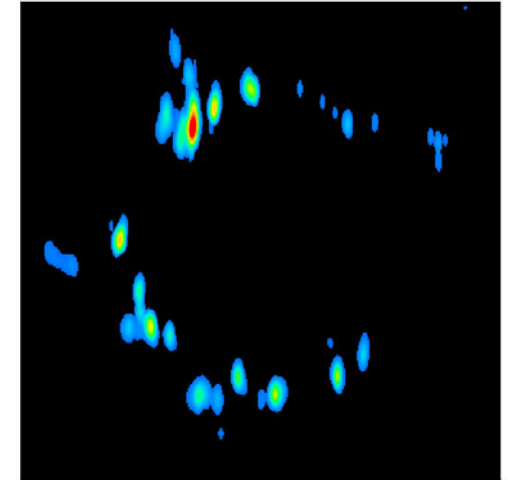
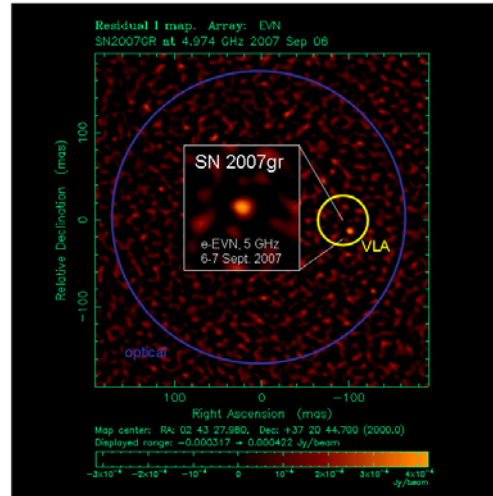
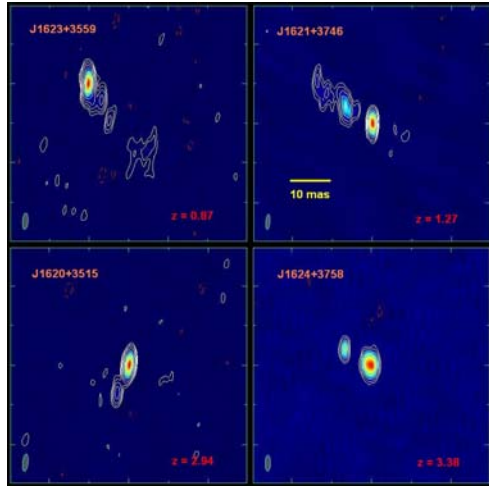


# EVN Archive Growth

EVN Archive Growth (FITS-file size)



# EVN Image Gallery (5 most recent)



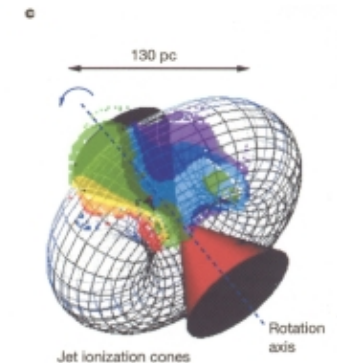
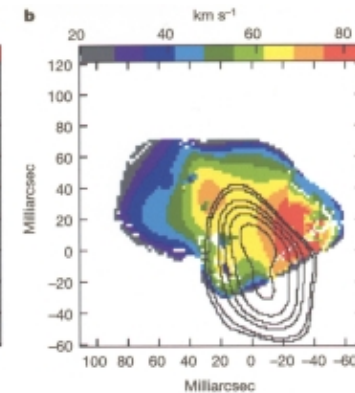
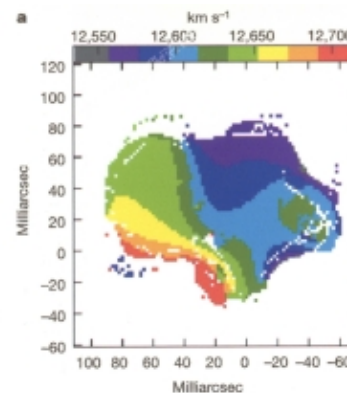
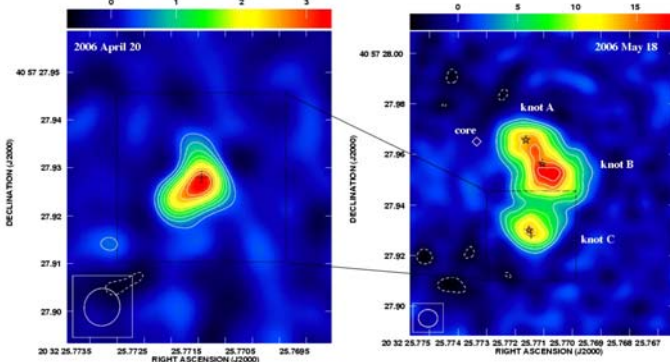
DEVOS (Frey) 2007

SN2007gr (Paragi, e-) 2007

G23.6-0.1 (Bartkiewicz) 2005

Cyg X-3 (Tudose, e-) 2006

Mrk 231 (Kloeckner) 2003



# Specific Correlator Capabilities

- Total observed rates up to 1 Gbps
- 1-, 2-bit sampling (e.g., include VLBA's at 512 Mbps in Gbps obs)
- Full-Stokes polarization output
- Up to 2048 frequency points per SB/polarization
- Full-correlator  $t_{\text{int}} \geq \frac{1}{4}$  sec (half-corr  $t_{\text{int}} \geq 1/8$  sec)
- Oversampling (2, 4x Nyquist  $\rightarrow$  500kHz filters)
- >16 stations through multiple passes
- Improved UVWs; 2-bit van Vleck, frac. bit shift comp.
- A###JHD OOWIP H#HOYOEI#RSHUD WIRQ###?0

Not Fully Operational / Testing Underway:

- Recirculation (time-sharing correlator in low-BW obs)

# Correlator Capacity (Spectral Resolution)

$$N_{sta}^2 \cdot N_{sb} \cdot N_{pol} \cdot N_{frq} \leq 131072 \cdot \text{Recirc}$$

$$N_{sta} = (4, 8, 12, 16); \quad N_{pol} = (1, 2, 4); \quad N_{chan} \leq 16; \quad N_{frqmax} = 2048$$

Examples:

5–8 Sta	1 SB	1 Pol	2048 Frq
9–16 Sta	1 SB	1 Pol	512 Frq
9–16 Sta	8 SB	4 Pol	16 Frq

## Maximal Spectral Resolution (m/s; $N_{frq}=2048$ )

BW <sub>sb</sub> [MHz]	$\Delta v$ [Hz]	$\Delta v_{1420}$	$\Delta v_{1665}$	$\Delta v_{6668}$	$\Delta v_{22235}$
16	7813	1651	1408	351	105
2	977	206	176	44	13
0.5	244	52	44	11	3.3

Recirculation:  $\text{Recirc} \leq 16\text{MHz}/\text{BW}_{sb}$ ;  $N_{frqmax}$  still 2048

# Correlator Output Capacity

## Raw output (local validity):

- lag-space correlation functions (32 kB/brd) + headers (16 kB/brd)
- Full-correlator min.  $t_{\text{int}} = 1/4 \text{ sec}$  (half-corr. min.  $t_{\text{int}} = 1/8 \text{ sec}$ )
  - Max. operational output rate = 6 MB/s

## Approximate growth rate of FITS files:

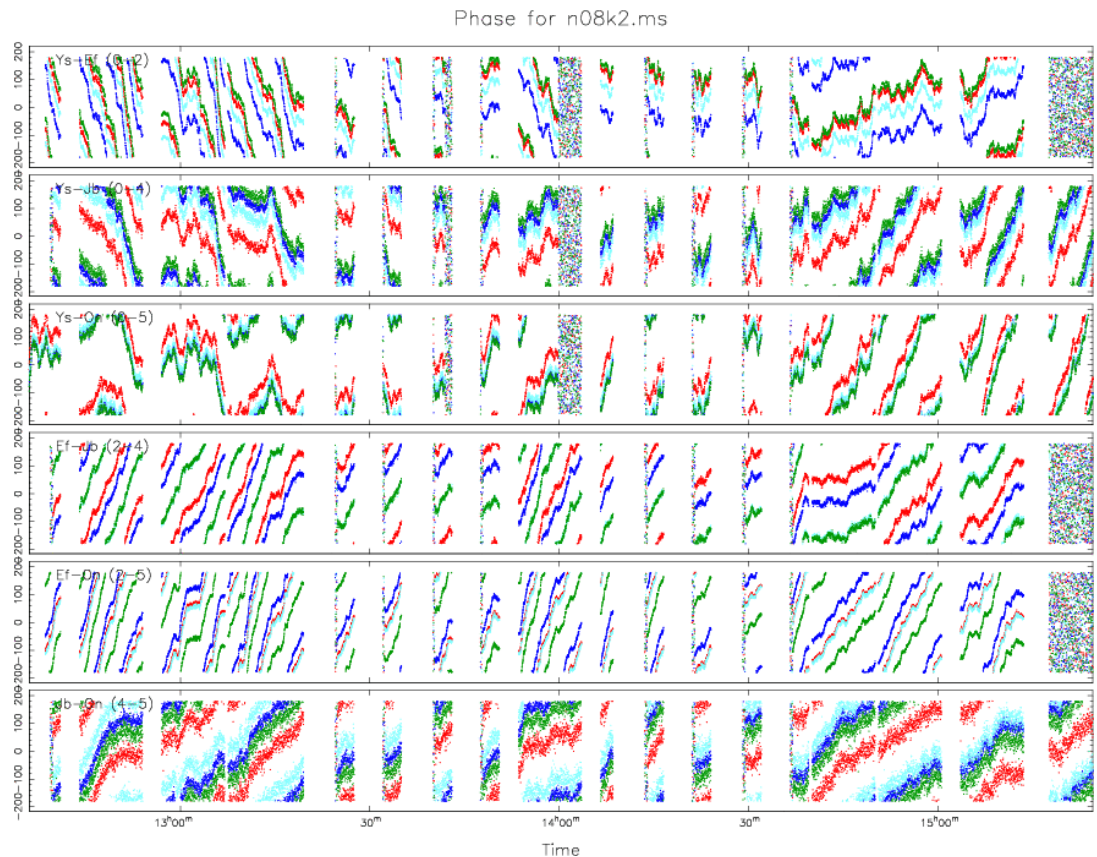
- $\{ 1.75 \kappa f / t_{\text{int}} \}$  GB per hour of observation
  - $\kappa \approx 1-1.7$  (fudge-factor for "efficiency" of FITS storage)
  - $f$  = fraction of correlator used
- Record for a single experiment: 1028.7 GB

Recirculation:  $\text{min. } t_{\text{int}} \rightarrow (\text{min. } t_{\text{int}}) \cdot \text{Recirc}$

# New Stations (Yebees 40m)



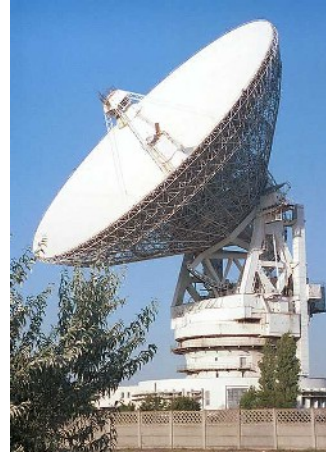
Phs(t) for 4C39.25 in K-band NME  
1<sup>st</sup> 3: Ys-[Ef,Jb,On]; 2<sup>nd</sup> 3: {Ef,Jb,On}



Session 3/2008: also X-band

# New Stations (fringe tests since Torun)

Evpatoria (3-4aug06)  
C-band @ 256Mbps  
(8dual-pol 4-MHz SBs)  
Ev-Mc-Wb (1hr per day)



Irbene (13-14nov06)  
12GHz (methanol)  
Ir-Nt-Tr (1.5hr per day)



# New Stations (III)

- QUASAR Stations (upcoming session S/X,C,L)



Svetloe



Zelenchukskaya



Badary

movie: [www.ipa.nw.ru/PAGE/ENG/film/film.htm](http://www.ipa.nw.ru/PAGE/ENG/film/film.htm)

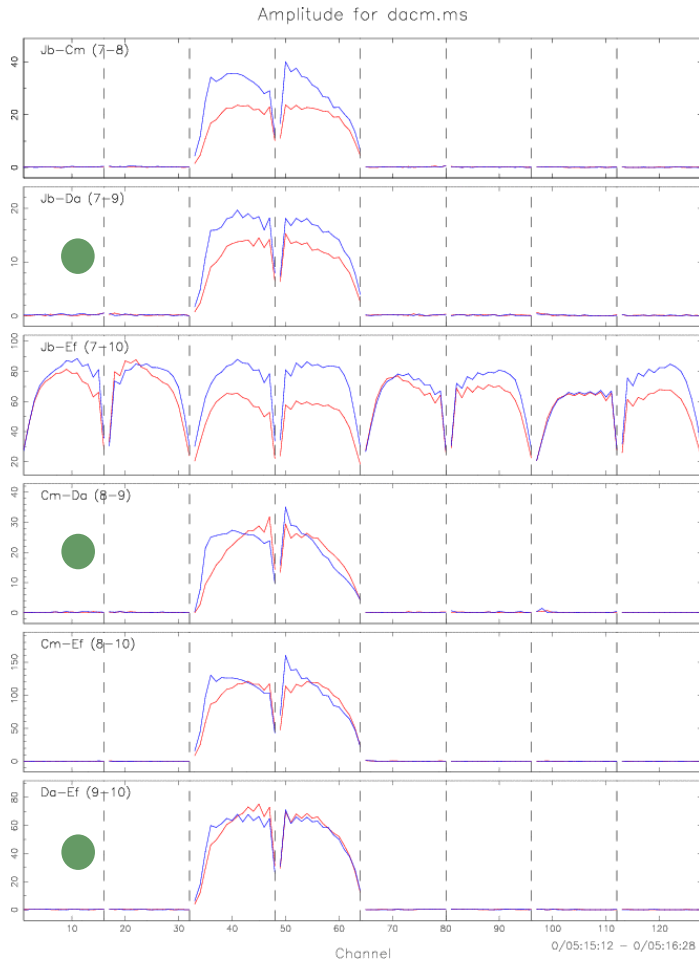
- EVLA & GBT at 5cm (sessions 1/2008, 2/2008)
- Multiple MERLIN out-stations (next slide)



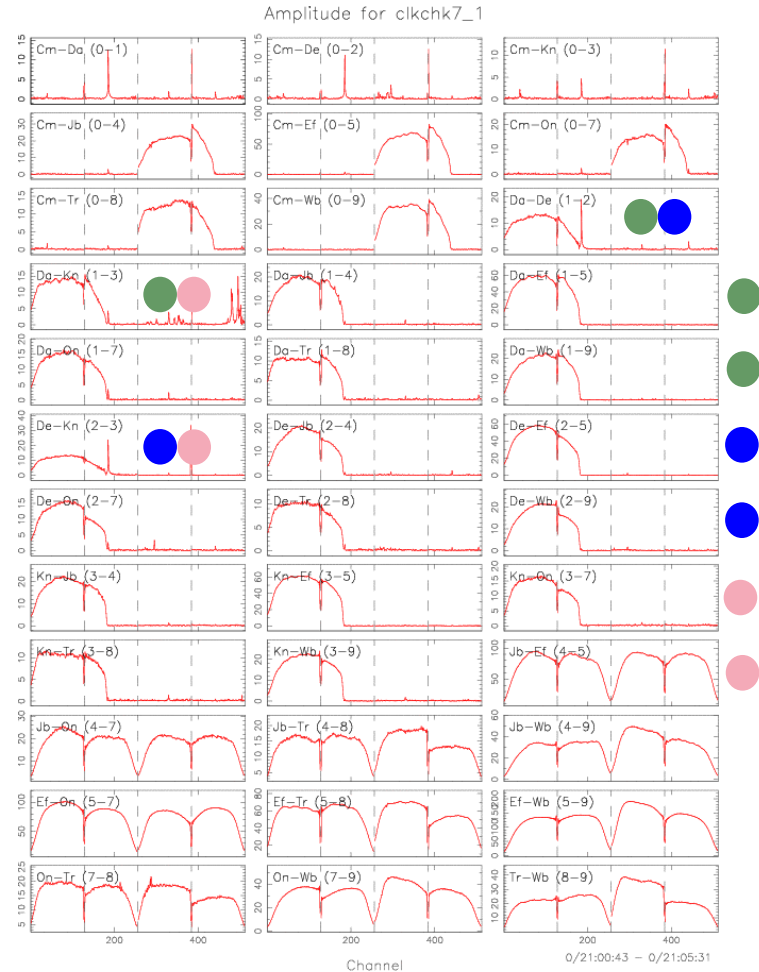
# Multiple MERLIN Out-Stations

- Now, 1 Bsln (Jb-Cm) in common to EVN & MERLIN
- Dual-pol: 2 out-stations via Cm ( $C_m + 1$ )
- Single-pol: up to 4 out-stations via Cm ( $C_m + 3$ )
  - 2 out-stations would have only 1 BBC available each
- Concept of "free subbands"
  - If so, no impact on scheduling
  - If not, "Cm" would need a different, higher-rate schedule
- At Correlation:
  - Multiple N-station Cm pack copied to (N-1) new packs
  - Each additional out-station correlates as a separate station
  - $N_{sta}$  in correlator-capacity equation  $\rightarrow (N_{sta} + N - 1)$
- HYOEI# SSOIFD WIRQ#XQGHU#GHYHORS PHQW

# Multiple MERLIN Out-Stations



RO001B: 512, dual-pol  
Cm & Da

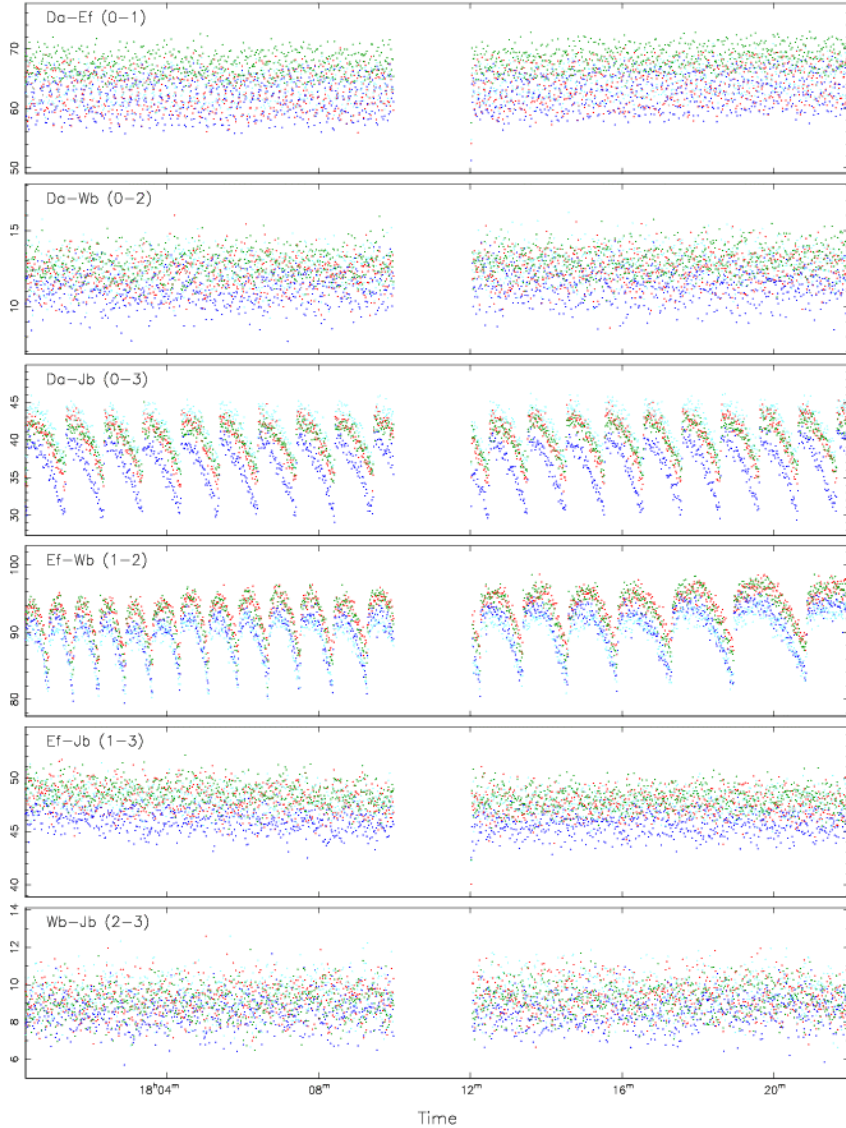


EA038: 128, single-pol  
Cm & Da + De + Kn

# Data Improvements

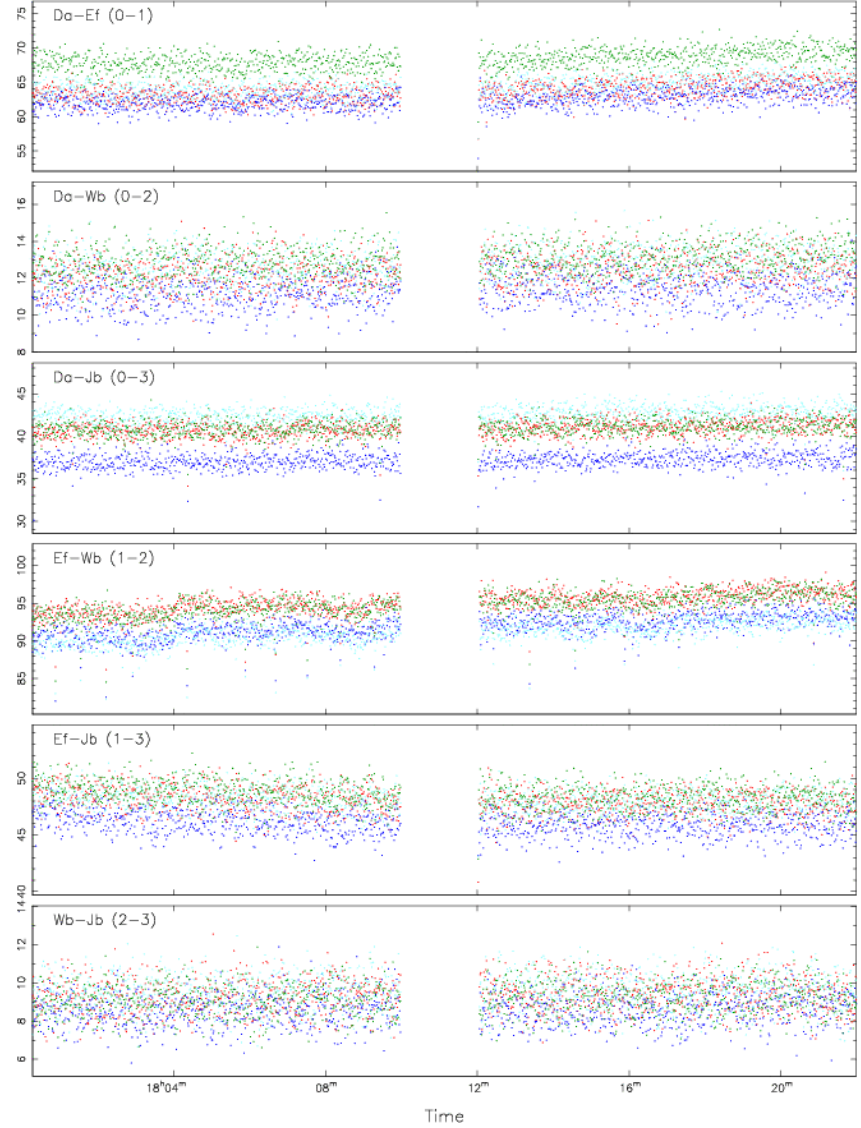
- New CALC version (≥Dec'05)
  - IAU200 nutation; ocean loading; direct UVW's
  - Pathway for surface weather → tropo. ZD comput.
- Better UVW's (≥Dec'06)
  - Now taken directly from CALC run (a priori model)
  - UVFIX unnecessary (cf. V.G. from Torun symp.)
- Better fractional-bit shift correction (≥Mar'07)
- AIPS tables issues
  - Apparent positions in SU table improved
  - Polar Motion units in AN table header (UVFIX)

Amplitude for TST1.master



N06M2: before.....

Amplitude for TST1



& after FBS delay correction

# Summary

- PI Support
  - Pro-active liaison; interactive web tools
  - Archive: feedback, standard plots, FITS, pipeline
- Correlator Capabilities
  - $\leq 2048$  freq.pts per SB/pol; 1/4s integrations
  - H0YOEI#FD SD EIQW\ =##HQD EOHV#QHZ #NIQGV#R I#VFIHQFH
- Network Expansion / Data Improvements
  - New stations
  - More MERLIN out-stations
- Future - EVN2015 talk to come

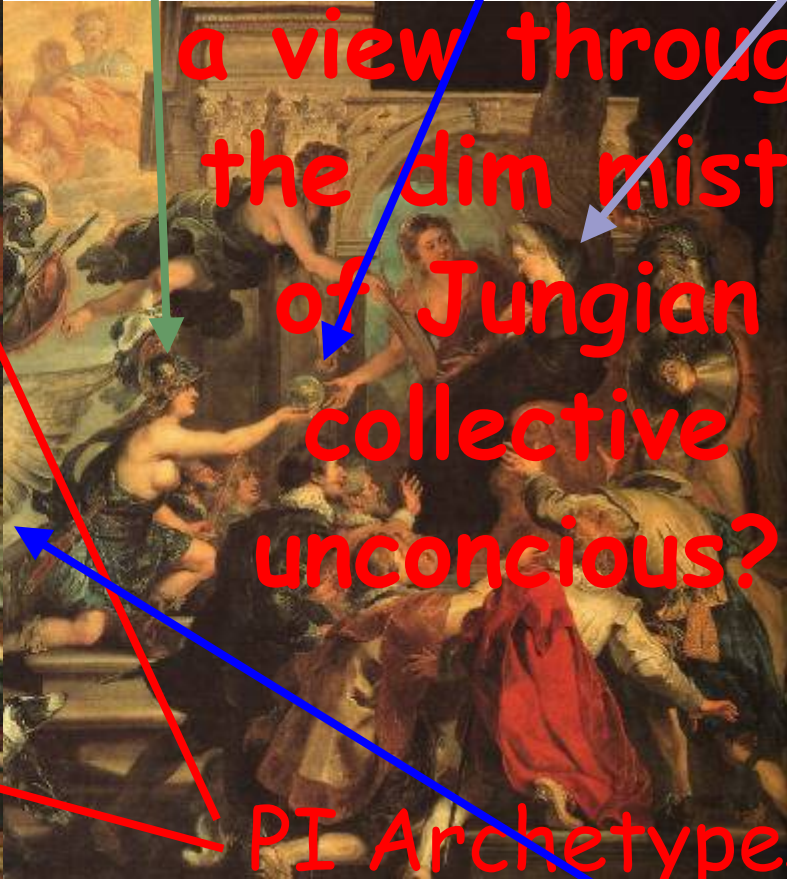


More careful Monte Carlo simulations show:

Successful PI EVN Symposium

EVN obs:

Archive FITS data new PI



a view through the dim mists of Jungian collective unconscious?

PI Archetypes?

??? you tell me.....  
(more detailed study required...)

Z IQJ T VSHHG#I#IOY OEL