The EVN Mk IV Data Processor at JIVE

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— JIVE —

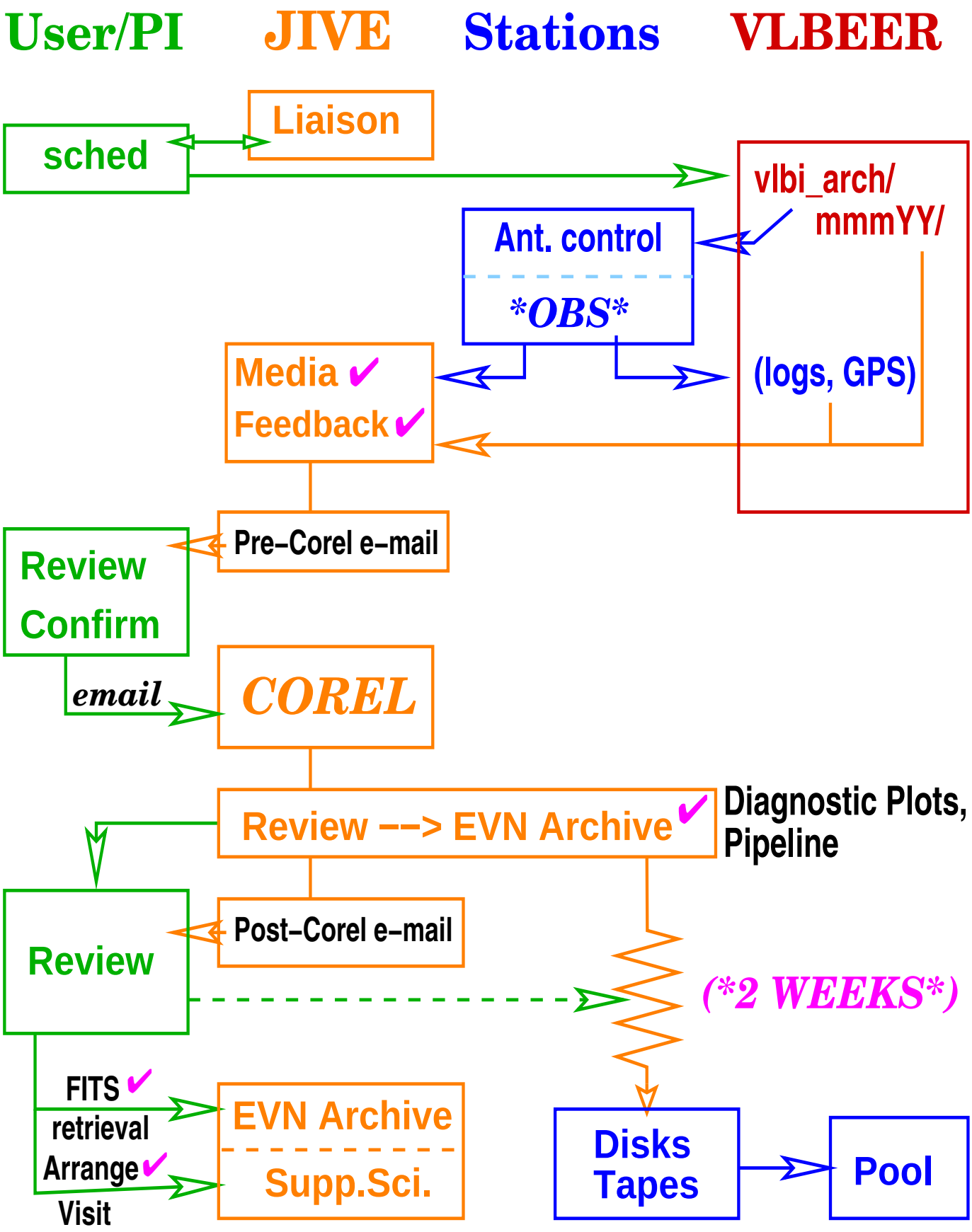
- Operations & PI Interaction
  - New Science Operations & Support Group
  - Pre-observation / Pre-correlation
  - Post-correlation
- The Correlator
  - Features
  - Capacities & Tips
  - New Astronomical Capabilities
- Summary of Recent Enhancements

Science Operations & Support

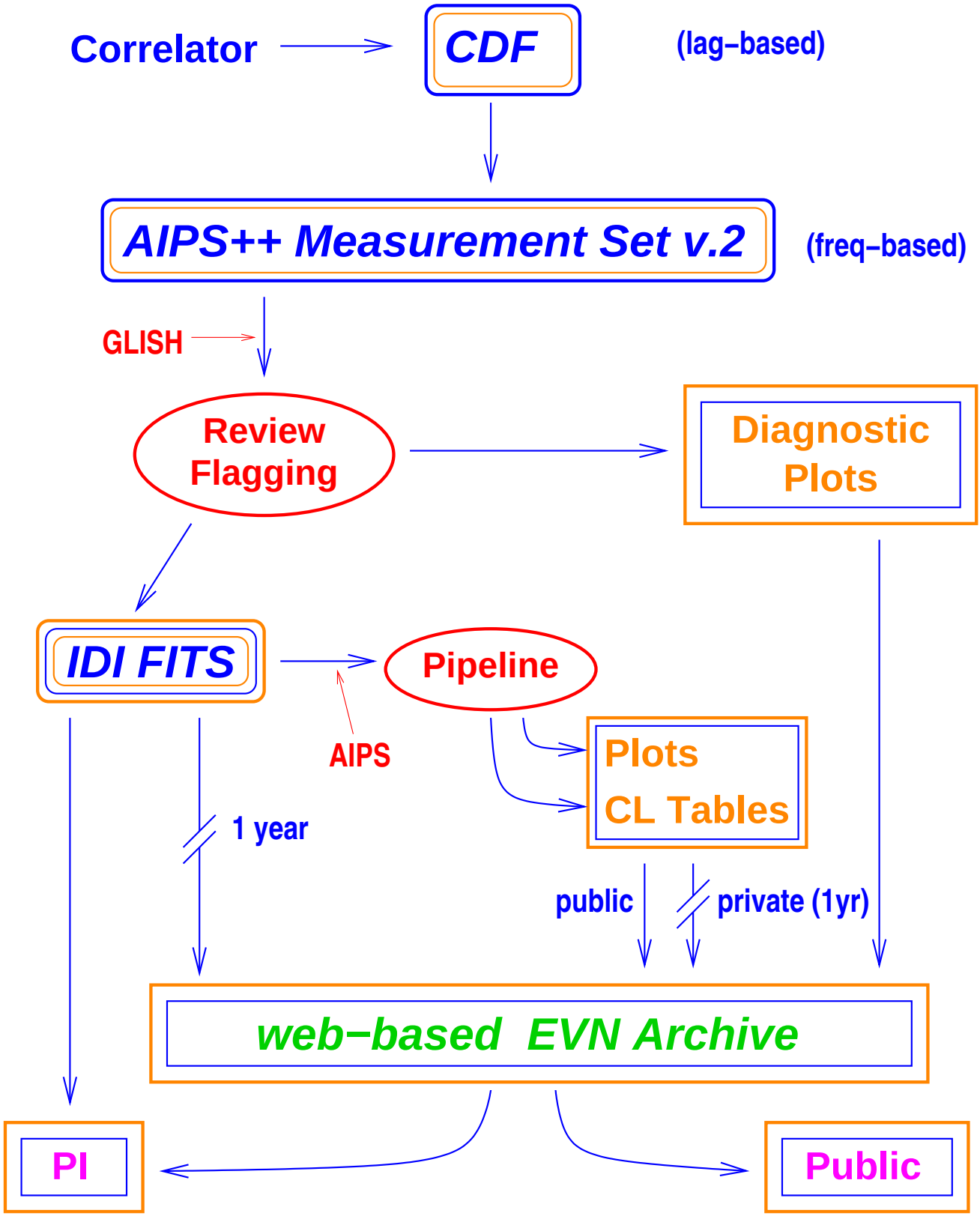
Support Scientists

Correlator Operations

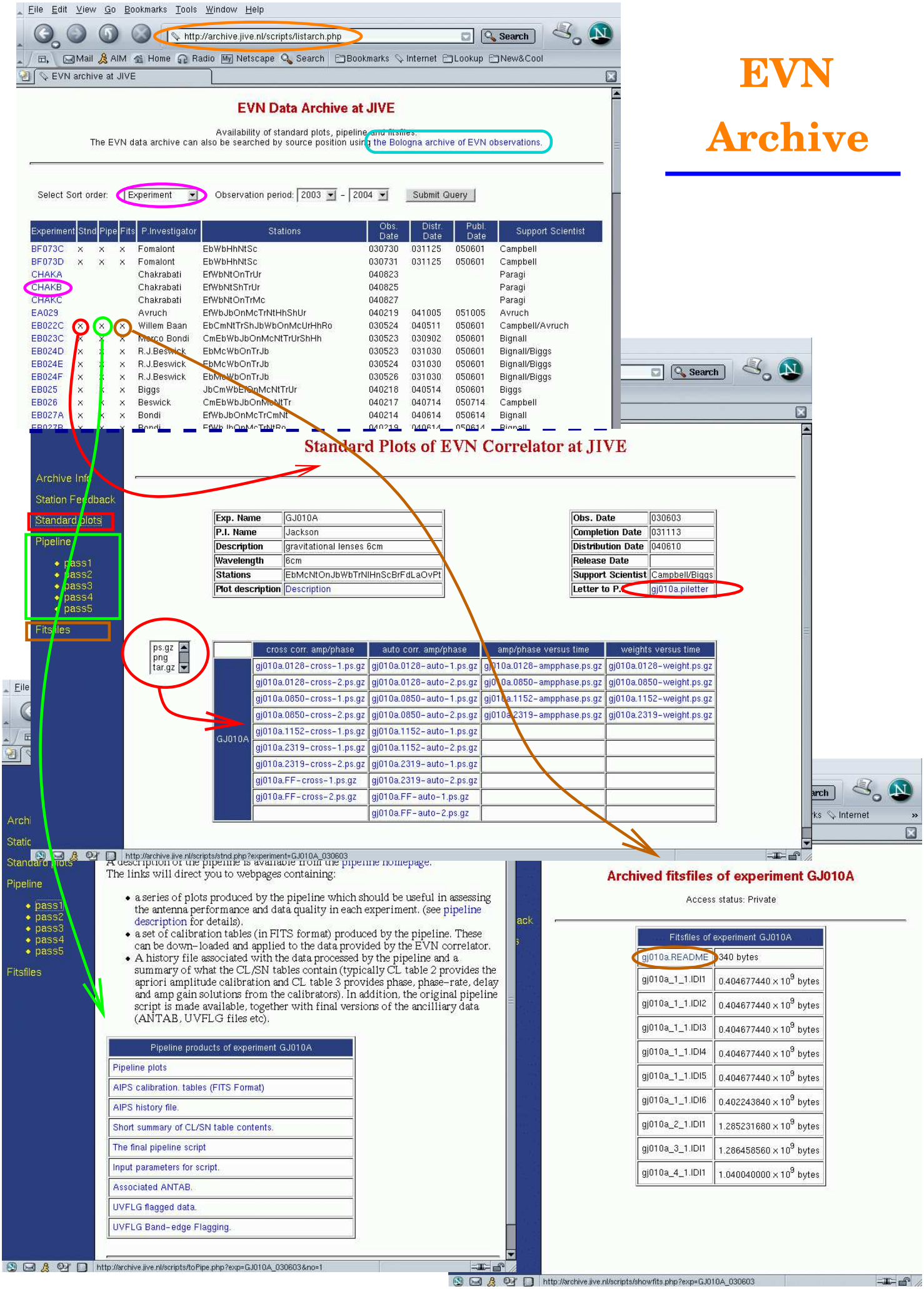
Ops Flowchart



Review Process



EVN Archive


http://archive.jive.nl/scripts/listarch.php
EVN archive at JIVE
EVN Data Archive at JIVE
Availability of standard plots, pipeline and fitsfiles.
The EVN data archive can also be searched by source position using the Bologna archive of EVN observations.
Select Sort order: Experiment
Observation period: 2003 - 2004
Submit Query
Experiment | Stnd | Pipe | Fits | P.Investigator | Stations | Obs. Date | Distr. Date | Publ. Date | Support Scientist
BF073C | BF073D | CHAKA | CHAKB | CHAKC | EA029 | EB022C | EB023C | EB024D | EB024E | EB024F | EB025 | EB026 | EB027A
Standard Plots of EVN Correlator at JIVE
Archive Info
Station Feedback
Standard plots
Pipeline
pass1
pass2
pass3
pass4
pass5
Fitsfiles
Exp. Name GJ010A
P.I. Name Jackson
Description gravitational lenses 6cm
Wavelength 6cm
Stations EbMcNtOnJbWbTrNlHnScBrFdLaOvPt
Plot description Description
Obs. Date 030603
Completion Date 031113
Distribution Date 040610
Release Date
Support Scientist Campbell/Biggs
Letter to P.C. gj010a.piletter
ps.gz
png
tar.gz
GJ010A
cross corr. amp/phase | auto corr. amp/phase | amp/phase versus time | weights versus time
gj010a.0128-cross-1.ps.gz | gj010a.0128-auto-1.ps.gz | gj010a.0128-ampphase.ps.gz | gj010a.0128-weight.ps.gz
gj010a.0128-cross-2.ps.gz | gj010a.0128-auto-2.ps.gz | gj010a.0850-ampphase.ps.gz | gj010a.0850-weight.ps.gz
gj010a.0850-cross-1.ps.gz | gj010a.0850-auto-1.ps.gz | gj010a.1152-ampphase.ps.gz | gj010a.1152-weight.ps.gz
gj010a.0850-cross-2.ps.gz | gj010a.0850-auto-2.ps.gz | gj010a.2319-ampphase.ps.gz | gj010a.2319-weight.ps.gz
gj010a.1152-cross-1.ps.gz | gj010a.1152-auto-1.ps.gz
gj010a.2319-cross-1.ps.gz | gj010a.1152-auto-2.ps.gz
gj010a.2319-cross-2.ps.gz | gj010a.2319-auto-1.ps.gz
gj010a.FF-cross-1.ps.gz | gj010a.2319-auto-2.ps.gz
gj010a.FF-cross-2.ps.gz | gj010a.FF-auto-1.ps.gz
gj010a.FF-auto-2.ps.gz
http://archive.jive.nl/scripts/stnd.php?experiment=GJ010A_030603
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 down-loaded and applied to the data provided by the EVN correlator.
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 apriori 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 ancilliary data (ANTAB, UVFLG files etc).
Pipeline products of experiment GJ010A
Pipeline plots
AIPS calibration. tables (FITS Format)
AIPS history file.
Short summary of CL/SN table contents.
The final pipeline script
Input parameters for script.
Associated ANTAB.
UVFLG flagged data.
UVFLG Band-edge Flagging.
http://archive.jive.nl/scripts/toPipe.php?exp=GJ010A_030603&no=1
Archived fitsfiles of experiment GJ010A
Access status: Private
Fitsfiles of experiment GJ010A
gj010a.README 340 bytes
gj010a_1_1.IDI1 0.404677440 x 10^9 bytes
gj010a_1_1.IDI2 0.404677440 x 10^9 bytes
gj010a_1_1.IDI3 0.404677440 x 10^9 bytes
gj010a_1_1.IDI4 0.404677440 x 10^9 bytes
gj010a_1_1.IDI5 0.404677440 x 10^9 bytes
gj010a_1_1.IDI6 0.402243840 x 10^9 bytes
gj010a_2_1.IDI1 1.285231680 x 10^9 bytes
gj010a_3_1.IDI1 1.286458560 x 10^9 bytes
gj010a_4_1.IDI1 1.040040000 x 10^9 bytes
http://archive.jive.nl/scripts/showfits.php?exp=GJ010A_030603

Specific Correlator Capabilities

Available: (as of 9 Oct 2004)

- 1-, 2-bit sampling
- Cross-polarization
- $\leq$ 2048 frequency points per SB/pol
- Full-correlator integration times $\geq 1/4$ sec
- Total observed data rates ≤ 1024 Mb/s
- Mk III, Mk IV, VLBA, and Mk 5 recorders/formats
- Multiple-mode schedules
- Oversampling (2, 4$\times$ Nyquist $\rightarrow$ 500 kHz filters)
- $>$ 16 station correlation (via multiple passes)
- Improved 2-bit van Vleck correction

Underway / Not Fully Tested:

- Playback at different rate than recording
- Pulsar gating
- Phase-cal detection

Yet to Come:

- Sub-netting
- Recirculation

Experiment Statistics: (as of 9 Oct 2004)

	User	Test
Done & Distributed:	175	104
Undergoing Review:	9	0
Running/Queued/Waiting:	6	1

Correlator Capacity

Governing Formula:

$$N_{\mathrm{sta}}^2 \cdot N_{\mathrm{sb}} \cdot N_{\mathrm{pol}} \cdot N_{\mathrm{frq}} \leq 131072 \times \mathcal{R}ecirc \times 2$$

$$N_{\mathrm{sta}} = (4,\ 8,\ 12,\ 16) \qquad N_{\mathrm{pol}} = (1,\ 2,\ 4)$$

$$N_{\mathrm{sb}} \cdot N_{\mathrm{pol}_{\parallel}} \leq 16 \qquad N_{\mathrm{frq}_{\mathrm{max}}} = 2048 \times 2$$

Examples:

8 Sta	1 SB	1 Pol	2048 Frq
16 Sta	1 SB	1 Pol	512 Frq
16 Sta	8 SB	4 Pol	16 Frq

Spectral Resolution afforded ($N_{\mathrm{frq}} = 2048$):

BW_{SB}	$\Delta\nu$	Velocity Resolutions [m/s]		
[MHz]	[Hz]	Δv_{1420}	Δv_{6668}	Δv_{22235}
16	7813	1651	351	105
2	977	206	44	13
0.5	244	52	11	3.3

The Future:

Recirculation

- $\mathcal{R} \leq 16\,\mathrm{MHz} \,/\, BW_{\mathrm{SB}}$
- $N_{\mathrm{frq}_{\mathrm{max}}}$ unaffected

Local $\longrightarrow$ Global Validity

Output Capacity

Raw output (local validity):

- lag-space correlation functions (32 kB/board)
- headers (16 kB/board)

Full-correlator = 1.5 MB/integration

Full-correlator $t_{\mathrm{int}_{\mathrm{min}}} = 1/4$ sec

Half-correlator $t_{\mathrm{int}_{\mathrm{min}}} = 1/8$ sec

Max. output rate = 6 MB/s

Data Size:

Approximate FITS file growth rate:

$$\frac{1.75 f}{t_{\mathrm{int}}} \text{ GB per hour of observation}$$

f = fraction of correlator used

$\Rightarrow$ Current Record for single experiment $\simeq$ 97 GB $\Leftarrow$

The Future (PCInt):

Full-correlator $t_{\mathrm{int}_{\mathrm{min}}} = 1/64$ s

Maximum output rate = 160 MB/s

Global validity ($\rightarrow$ 64 kB/board of corr.func.)

Expanded Fields of View

Wide-field mapping limitations:

Bandwidth smearing (radial in u-v plane)

Time smearing (azimuthal in u-v plane)

For $\lesssim$10% reduction in point-source response (Wrobel 95):

$$\text{Bandwidth}: \quad FoV \lesssim 49\farcs5 \, \frac{1}{B_{1000\text{km}}} \, \frac{N_{\text{frq}}}{BW_{\text{SB}_{\text{MHz}}}}$$

$$\text{Time}: \quad FoV \lesssim 18\farcs5 \, \frac{\lambda_{\text{cm}}}{B_{1000\text{km}}} \, \frac{1}{t_{\text{int}}}$$

Example:

8 European stations ($B \simeq 2000\,\text{km}$)

2 L-band subbands, $BW_{\text{SB}} = 8\,\text{MHz}$, 1 Pol

$N_{\text{frq}} \leq 1024$; take $N_{\text{frq}} = 512$

$\Rightarrow$ can use half the correlator $\Rightarrow t_{\text{int}} = 1/8\,\text{s}$

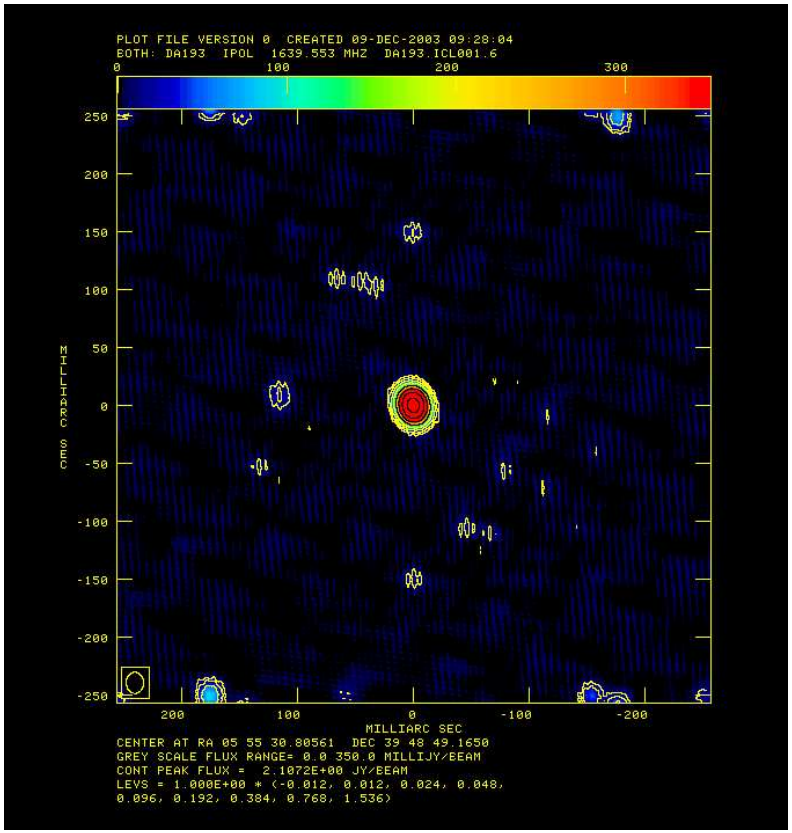
$$FoV_{\text{BW}} \lesssim 26\farcm4$$

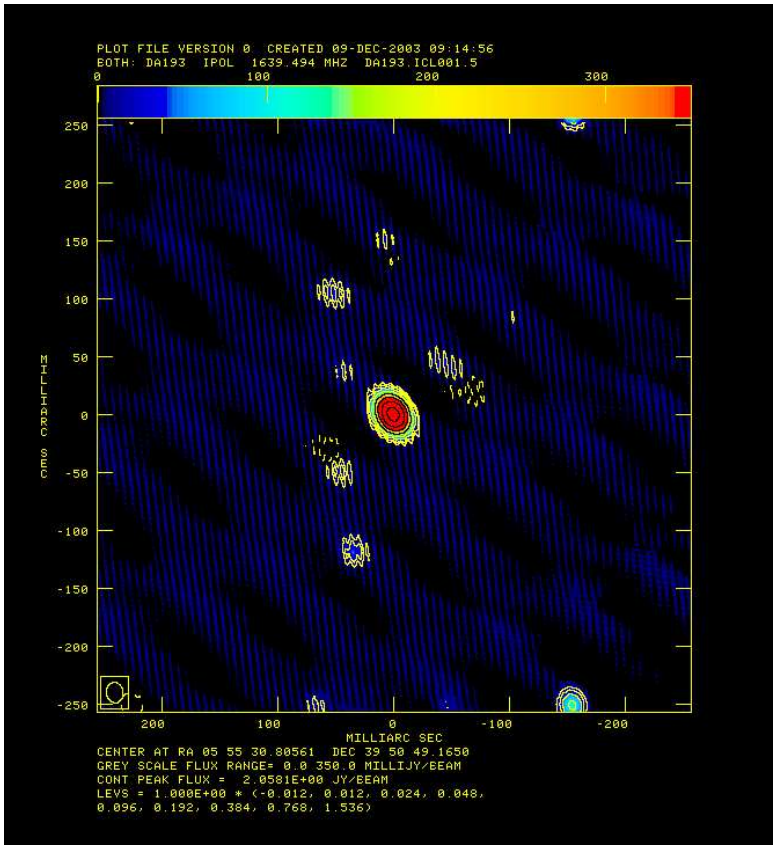
$$FoV_{\text{time}} \lesssim 22\farcm2$$

cf. beam of 25 m antenna $\simeq 24\farcm75$

- www.evlbi.org/user_guide/fov/
- www.evlbi.org/user_guide/limit.html

Wide–Field Mapping Test





DA193: "Normal" Corr.

Pk. FD = 2.0997 Jy/bm

18.67 x 15.65 mas

Corr.Position shifted 120"

Pk. FD = 2.0343 Jy/bm (down ~3%)

19.82 x 15.29 mas (Ax.Rat. down ~8%)

256 Frq.points, 1/4s integrations

Summary of Recent Enhancements

- Streamlined, Vertically Integrated PI Help
  - Pro-active support at all stages
  - Interactive tools on the web
  - Archive: standard plots, pipeline, FITS
  - Disk recording — emphasis on media turn-around
- Spectral Resolution
  - $N_{\mathrm{frq}_{\mathrm{max}}}$ remains 2048 per SB/pol
  - Oversampling $\longrightarrow$ narrower BW_{SB} (to 0.5 MHz)
- Reduced Minimum Integration Times
  - Full-correlator down to 1/4 s
  - Half-correlator down to 1/8 s
- $\sim$ Near Future
  - $N_{\mathrm{frq}} *:= 2\mathcal{R}$ (subject to relevant $N_{\mathrm{frq}_{\mathrm{max}}}$)
    - $\succ$ $\mathcal{R}$ from recirculation (BW_{SB} dependent)
    - $\succ$ 2 from global validity (after Mk5 B)
  - Even lower t_{int} (towards 1/64 s)
  - Better fractional-bit shift correction

Monte Carlo Simulation of VLBI Data Reduction at JIVE

Successful PI Joining
VLBI Illuminati

Delivery of FITS tape

A
Disk

Astronomers getting perhaps a little ***too*** enthused about the whole VLBI experience

e–VLBI (symbolic)