



Writing Proposals and Scheduling

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Outline

- 1. How to plan an experiment
 - Scientific idea
 - Feasibility
 - Choice of the array and its configuration
 - Some useful tools for planning

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- 2. Writing an observing time proposal
 - Scientific justification – general suggestions
 - Proposal submission tools

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 - Scientific idea
 - Feasibility
 - Choice of the array and its configuration
 - Some useful tools for planning
- 2. Writing an observing time proposal
 - Scientific justification – general suggestions
 - Proposal submission tools
- 3. Scheduling & observing file preparation
- 4. After the observations

How to plan an experiment

- Begin with a scientific idea
 - This is the fun part, but remember that the aim must be clear.
- Make a proper literature search
 - has someone already observed our target(s)?
 - Use ADS, CDS, NED and observatory archives
 - Check data from different public surveys

Archives – L17

- Check the telescope archive for earlier observations of your targets
 - Need to re-observe?
 - Use existing data instead starting from scratch?
 - Use to justify feasibility

EVN, eVLBI
(J)VLA, VLBA

`archive.jive.nl`

`archive.nrao.edu`

MERLIN

`www.merlin.ac.uk/archive`

GMRT

`naps.ncra.tifr.res.in/goa/mt/search/basicSearch`

WSRT

`wow.astron.nl`

ATCA

`atoa.atnf.csiro.au/`

How to plan an experiment

1) Type of experiment

- Is it continuum or spectral line?
- If it is spectral line, which is the frequency of the line? Which is the distance of the target source? (Katharine's talk)
- Is it single or full polarization?

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2) Resolution and angular scales

$$\theta \sim \frac{\lambda}{D}$$

$$\theta_{\text{LAS}} \sim \frac{1}{\text{shortest baseline}}$$

- How compact/extended is the target source?
- Which is the largest angular size we want to image?

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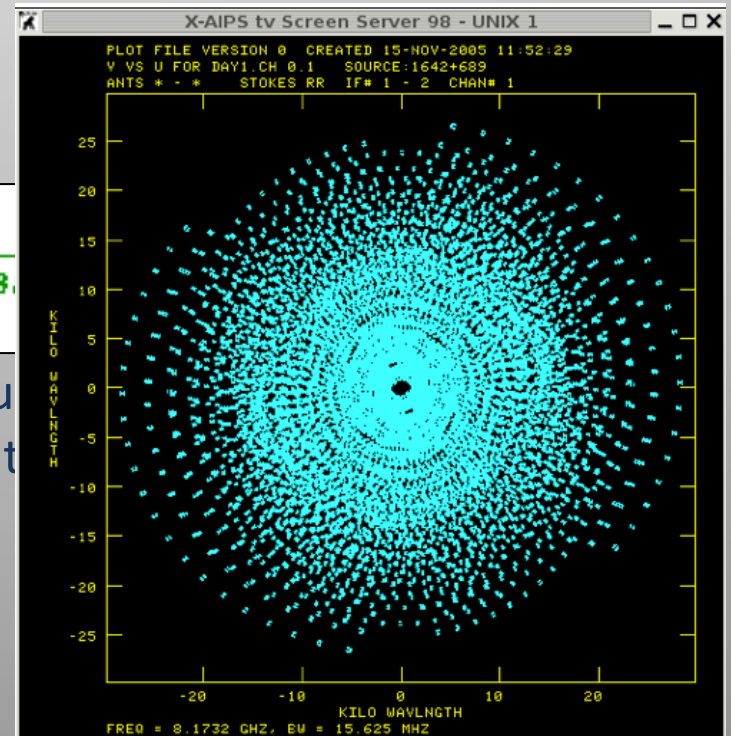
2) Resolution and angular scales

$$\theta \sim \frac{\lambda}{D}$$

$$\theta_{\text{LAS}} \sim \frac{\lambda}{B}$$

- How compact/extended is the target source?
- Which is the largest angular size we want to sample?

All scales need to be sampled



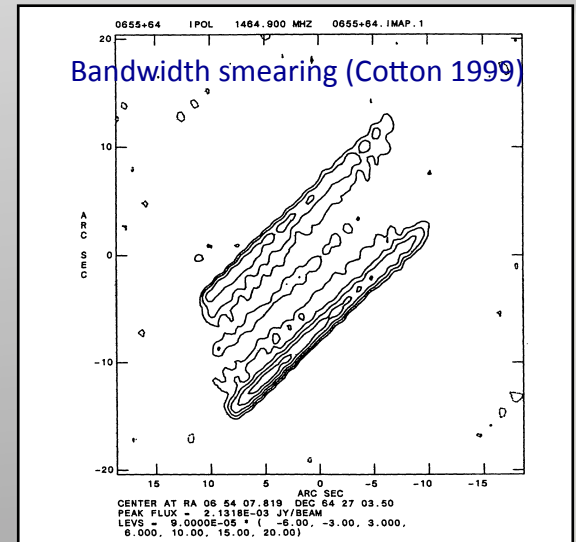
How to plan an experiment

3) Field of view

- How large is the field of view needed?

Is a wide field of view needed?

- Avoid bandwidth smearing -> need high spectral resolution – This is now the norm at most facilities



How to plan an experiment

3) Field of view

- How large is the field of view needed?

Table 7: Default frequencies for "continuum" app sampling			Subband Bandwidth and Spectral Resolution Options							
Band	Range ¹ (GHz)	Default frequencies for continuum IF pair A0/C0	Full polarization products (RR, RL, LR, LL) 64n _{BIBP} spectral channels		Dual polarization products (RR, LL) 128n _{BIBP} spectral channels		Single polarization product (RR or LL) 256n _{BIBP} spectral channels			
			Channel spacing:		Channel spacing:		Channel spacing:			
			128 MHz	38400/v _{GHz} km/s	2000/n _{BIBP} kHz	600/n _{BIBP} v _{GHz} km/s	1000/n _{BIBP} kHz	300/n _{BIBP} v _{GHz} km/s	500/n _{BIBP} kHz	150/n _{BIBP} v _{GHz} km/s
4 m (4)	0.058-0.084	N.A.	64	19200	1000 / n _{BIBP}	300 / n _{BIBP}	500 / n _{BIBP}	150 / n _{BIBP}	250 / n _{BIBP}	75 / n _{BIBP}
90 cm (P)	0.23-0.47 ²	0.236 -- 0.492	32	9600	500 / n _{BIBP}	150 / n _{BIBP}	250 / n _{BIBP}	75 / n _{BIBP}	125 / n _{BIBP}	37.5 / n _{BIBP}
20 cm (L)	1.0-2.0 ³	1.0 -- 1.5 ²	16	4800	250 / n _{BIBP}	75 / n _{BIBP}	125 / n _{BIBP}	37.5 / n _{BIBP}	62.5 / n _{BIBP}	18.75 / n _{BIBP}
13 cm (S)	2.0-4.0	2.0 -- 3.0	8	2400	125 / n _{BIBP}	37.5 / n _{BIBP}	62.5 / n _{BIBP}	18.75 / n _{BIBP}	31.25 / n _{BIBP}	9.375 / n _{BIBP}
6 cm (C)	4.0-8.0	4.5 -- 5.5	4	1200	62.5 / n _{BIBP}	18.75 / n _{BIBP}	31.25 / n _{BIBP}	9.375 / n _{BIBP}	15.625/n _{BIBP}	4.687 / n _{BIBP}
3 cm (X)	8.0-12.0	8.0 -- 9.0	2	600	31.25 / n _{BIBP}	9.375 / n _{BIBP}	15.625/n _{BIBP}	4.687 / n _{BIBP}	7.8125 / n _{BIBP}	2.344 / n _{BIBP}
2 cm (Ku)	12.0-18.0	13.0 -- 14.0	1	300	15.625/n _{BIBP}	4.687 / n _{BIBP}	7.8125 / n _{BIBP}	2.344 / n _{BIBP}	3.906 / n _{BIBP}	1.172 / n _{BIBP}
1.3 cm (K)	18.0-26.5	20.2 -- 21.2	0.5	150	7.8125 / n _{BIBP}	2.344 / n _{BIBP}	3.906 / n _{BIBP}	1.172 / n _{BIBP}	1.953 / n _{BIBP}	0.586 / n _{BIBP}
1 cm (Ka)	26.5-40.0	32.0 -- 33.0	0.25	75	3.906 / n _{BIBP}	1.172 / n _{BIBP}	1.953 / n _{BIBP}	0.586 / n _{BIBP}	0.977 / n _{BIBP}	0.293 / n _{BIBP}
0.7 cm (Q)	40.0-50.0	40.0 -- 41.0	0.125	37.5	1.953 / n _{BIBP}	0.586 / n _{BIBP}	0.977 / n _{BIBP}	0.488 / n _{BIBP}	0.488 / n _{BIBP}	0.146 / n _{BIBP}
			0.0625	18.75	0.977 / n _{BIBP}	0.293 / n _{BIBP}	0.488 / n _{BIBP}	0.146 / n _{BIBP}	0.244 / n _{BIBP}	0.073 / n _{BIBP}
			0.03.25	9.375	0.488 / n _{BIBP}	0.146 / n _{BIBP}	0.244 / n _{BIBP}	0.073 / n _{BIBP}	0.122 / n _{BIBP}	0.037 / n _{BIBP}

Subband bandwidth and spectral resolution options. Note that the table entries refer to the spacing between spectral channels -- that spacing is *before* any frequency smoothing, so these channels are *not* independent.

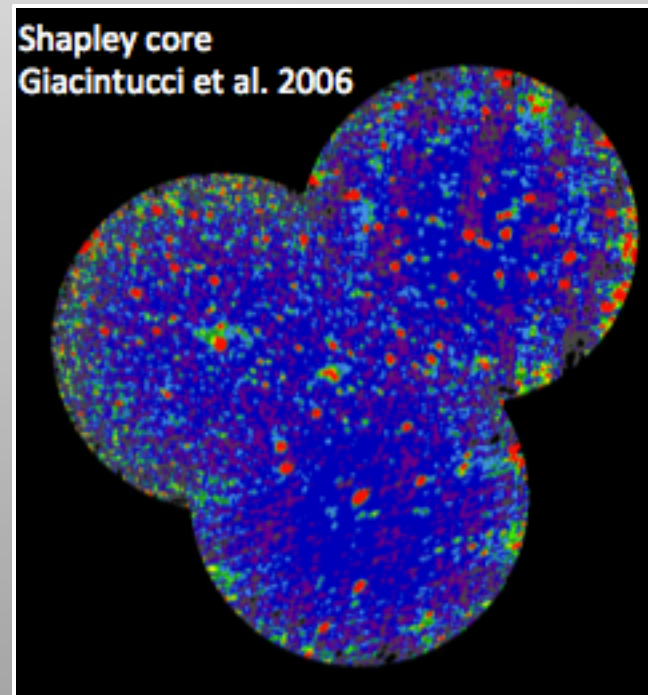
- n_{BIBP} is the number of Baseline Board Pairs assigned to the subband.
- Each subband may have a different number of spectral channels and polarization products, and each may be tuned independently.
- There can be at most 16 subbands per baseband, and n_{BIBP} must be an integer: 1, 2, 3, 4, 5, ..., 64.

How to plan an experiment

3) Field of view

- How large is the field of view needed?
- Is one pointing enough or is mosaicing necessary?

If the field we want to image is larger than the primary beam, then multiple pointing, i.e. mosaicing, may be necessary



How to plan an experiment

4) Frequency required

- Just one frequency or more? If more, should they be simultaneous?
- Frequency agility necessary?

How to plan an experiment

4) Frequency required

- Just one frequency
- Frequency agility

JVLA

Table 7: Default frequencies

Band	Range ¹ (GHz)	Default
4 m (4)	0.058-0.084	
90 cm (P)	0.23-0.47 ²	
20 cm (L)	1.0-2.0 ³	
13 cm (S)	2.0-4.0	
6 cm (C)	4.0-8.0	
3 cm (X)	8.0-12.0	
2 cm (Ku)	12.0-18.0	
1.3 cm (K)	18.0-26.5	
1 cm (Ka)	26.5-40.0	
0.7 cm (Q)	40.0-50.0	

Table 1: Cycle-3 continuum observing capabilities of e-MERLIN

eMERLIN

	1.5 GHz (L-band)	5 GHz (C-band)	Comments
Freq. Range (GHz)	1.23-1.74	4.3-7.5	C-band range eventually will be extended, K-band added.
Resolution (mas)	150	40	Uniform weighting at central frequency
Maximum angular scale (arcsec) ¹	2.0	0.5	Natural weighting, good coverage.
Field of View (arcmin) 25-m dishes ²	30	7	To primary beam FWHM.
Field of View (arcmin) including Lovell ²	12	5	To primary beam FWHM.
Continuum sensitivity rms (μ Jy/bm) in 12 hr on-target, with Lovell	6	7	Good conditions, target above about Dec. 20 deg.
Continuum sensitivity rms (μ Jy/bm) in 12 hr on-target, no Lovell	12	13	
Astrometric performance (mas)	~2	~1	WRT the ICRF (typical 3-deg target-calibrator separation using VLBA Calibrator Survey)

How to plan an experiment

5) Brightness of the target source

$$S_{rms} = \frac{2kT_{sys}}{A_{eff} \sqrt{N_A (N_A - 1) t_{int} \Delta\nu}}$$

- Which sensitivity is needed to image the weakest features in our target source?
- How long is the integration time needed?
- Which bandwidth is necessary?

How to plan an experiment

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- Which sensitivity is needed to image the weakest features in our target source?
- How long is the integration time needed?
- Which bandwidth is necessary?

$$\sigma_{\text{conf,VLSS}} = 29 \left(\frac{\theta}{1''} \right)^{1.54} \left(\frac{\nu}{74 \text{ MHz}} \right)^{-0.7} \mu\text{Jy beam}^{-1}$$

$$\sigma_{\text{conf,Condon}} = 1.2 \left(\frac{\theta}{8''} \right)^{10/3} \left(\frac{\nu}{3.02 \text{ GHz}} \right)^{-0.7} \mu\text{Jy beam}^{-1}$$

How to plan an experiment

In summary

- 1) Type of experiment (continuum, spectral line, polarization)
- 2) Resolution, field of view , largest angular scales
- 3) Frequency
- 4) Brightness sensitivity
- 5) Source location in the sky (declination)

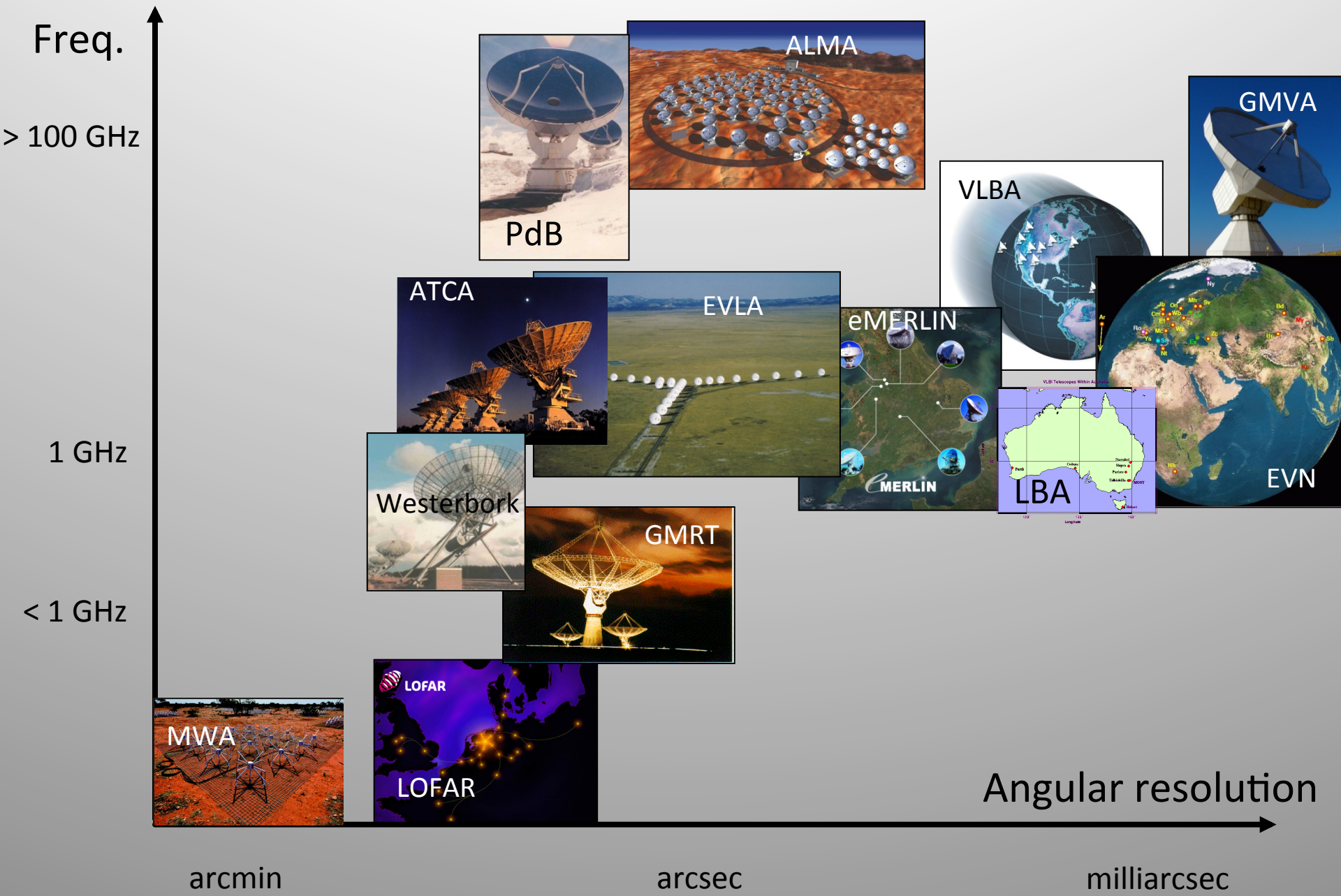
How to plan an experiment

In summary

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... lead to the choice of

- a) the array (if VLBI => choice of the telescopes)
- b) observing band
- c) observing setup
- d) total time on-source



M87 = Virgo A

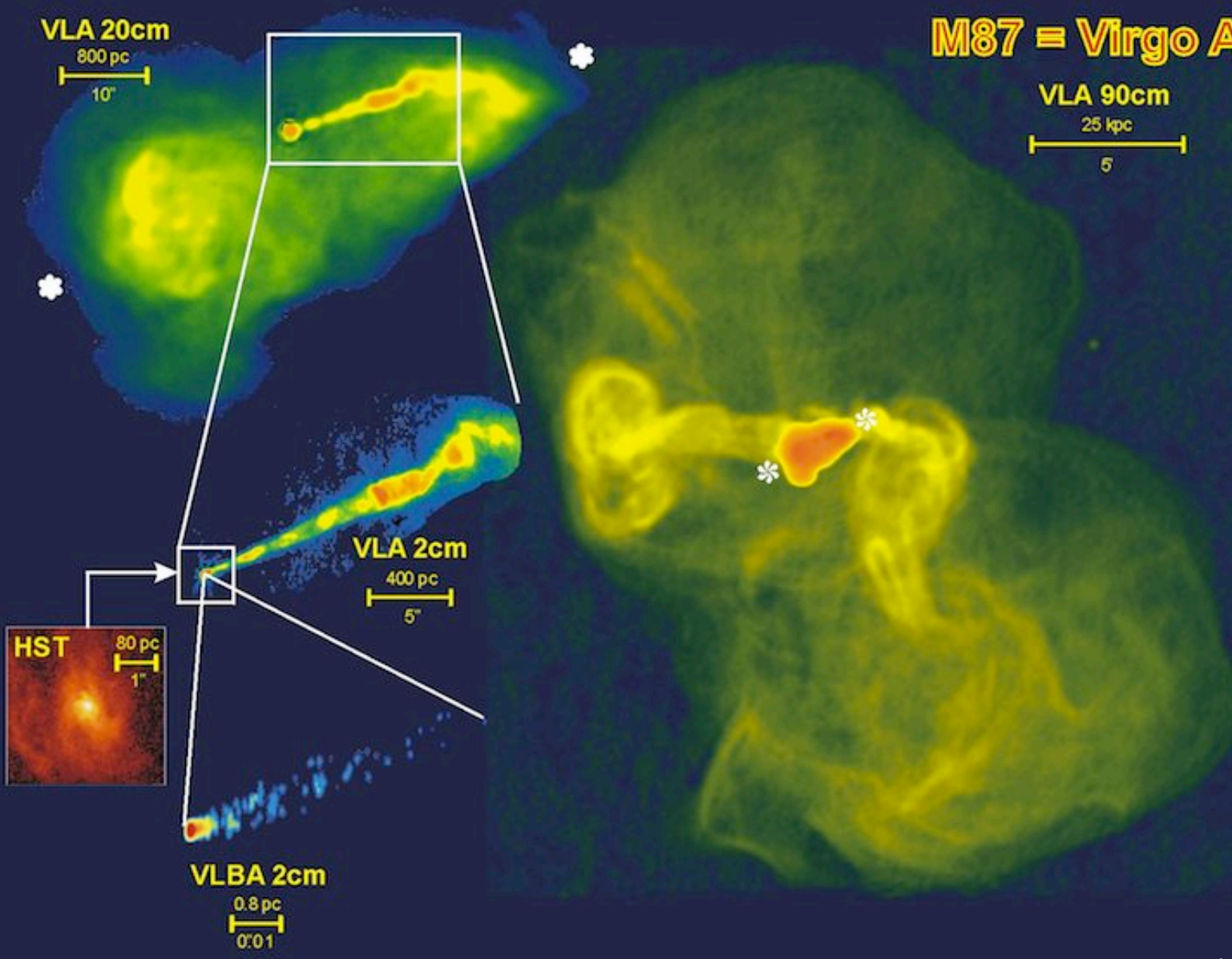


Image courtesy of NRAO/IAU

M87 = Virgo A

LOFAR – 140 MHz
de Gasperin et al. 2013

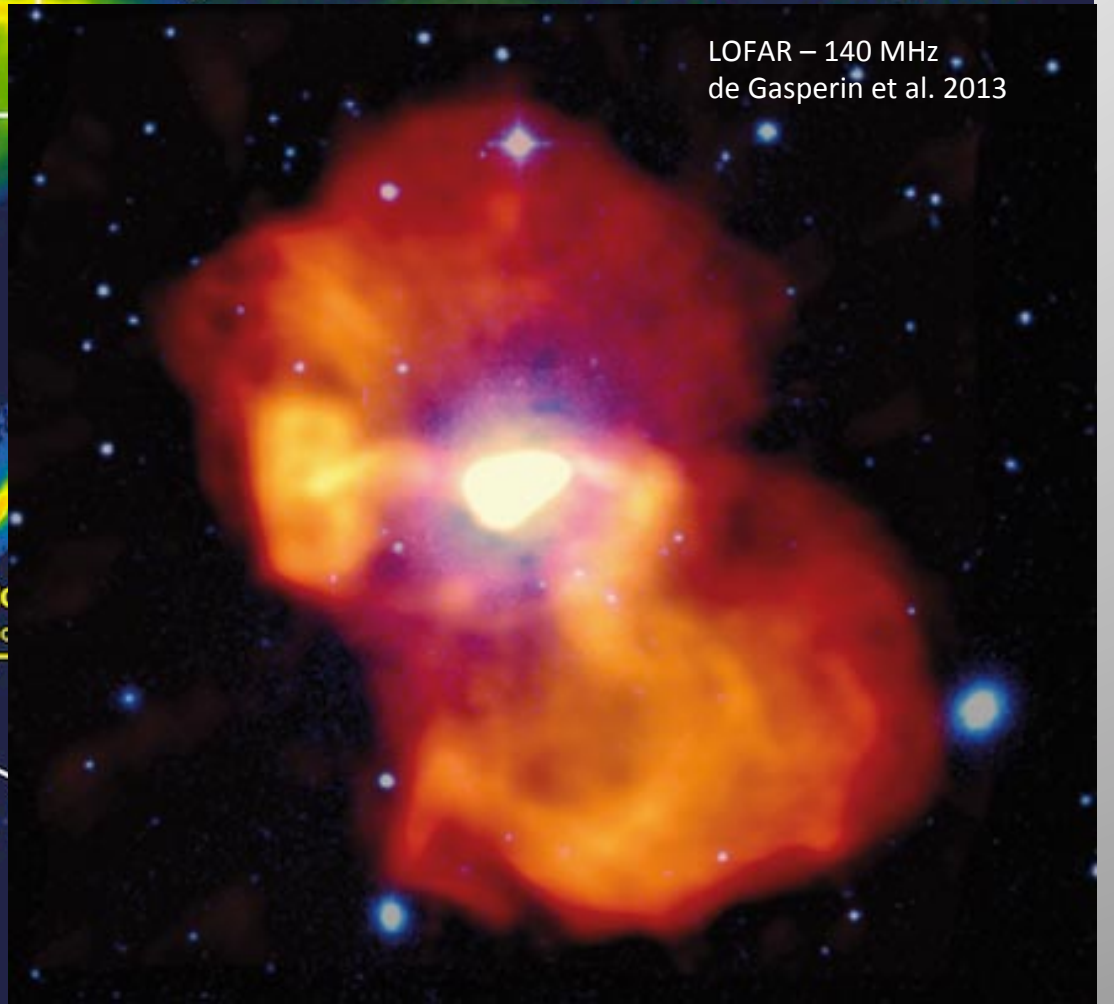
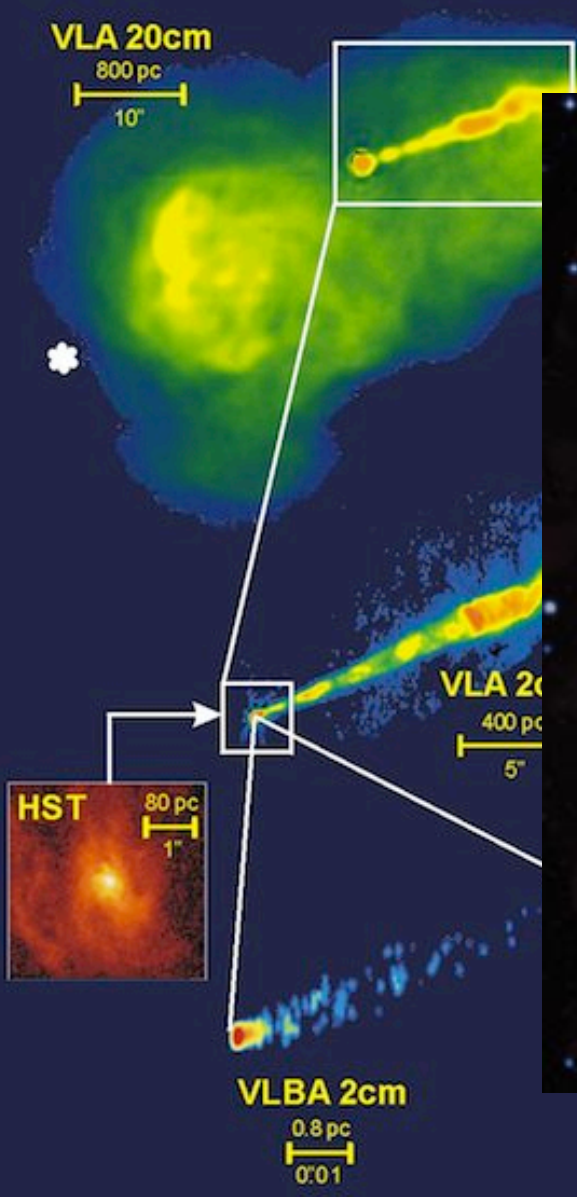


Image courtesy of NRAO/IAU

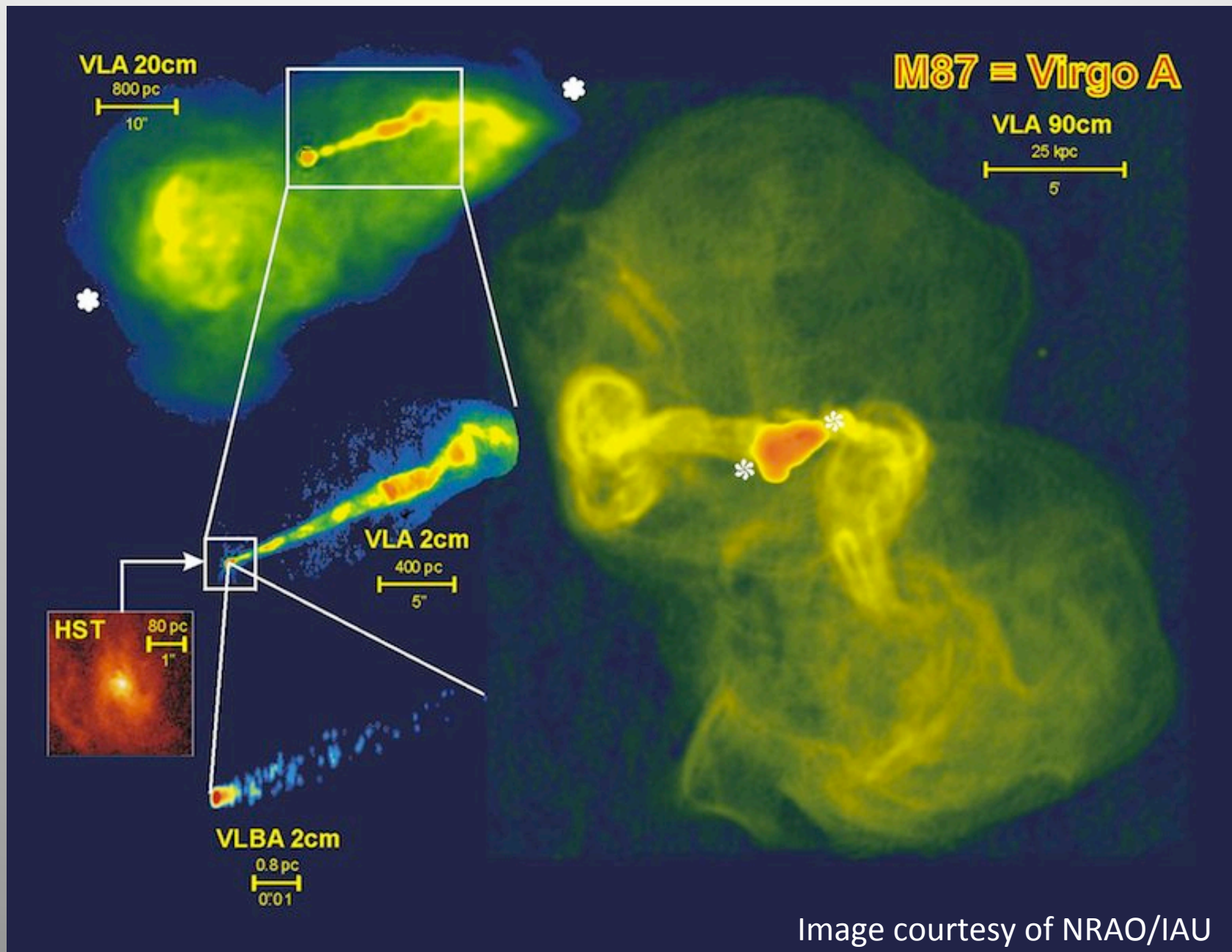


Image courtesy of NRAO/IAU

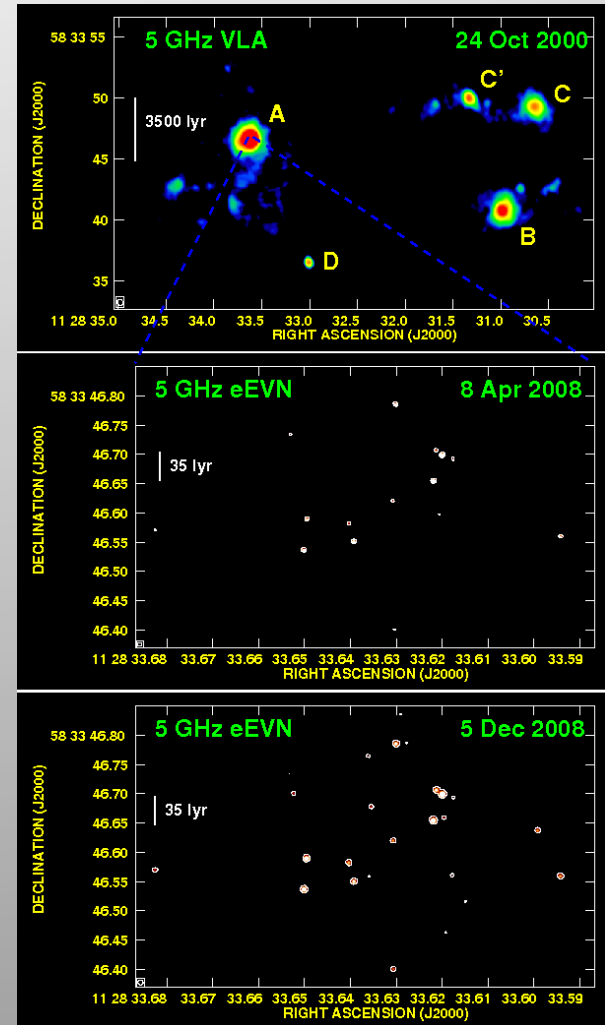
Further considerations

Calibration strategy

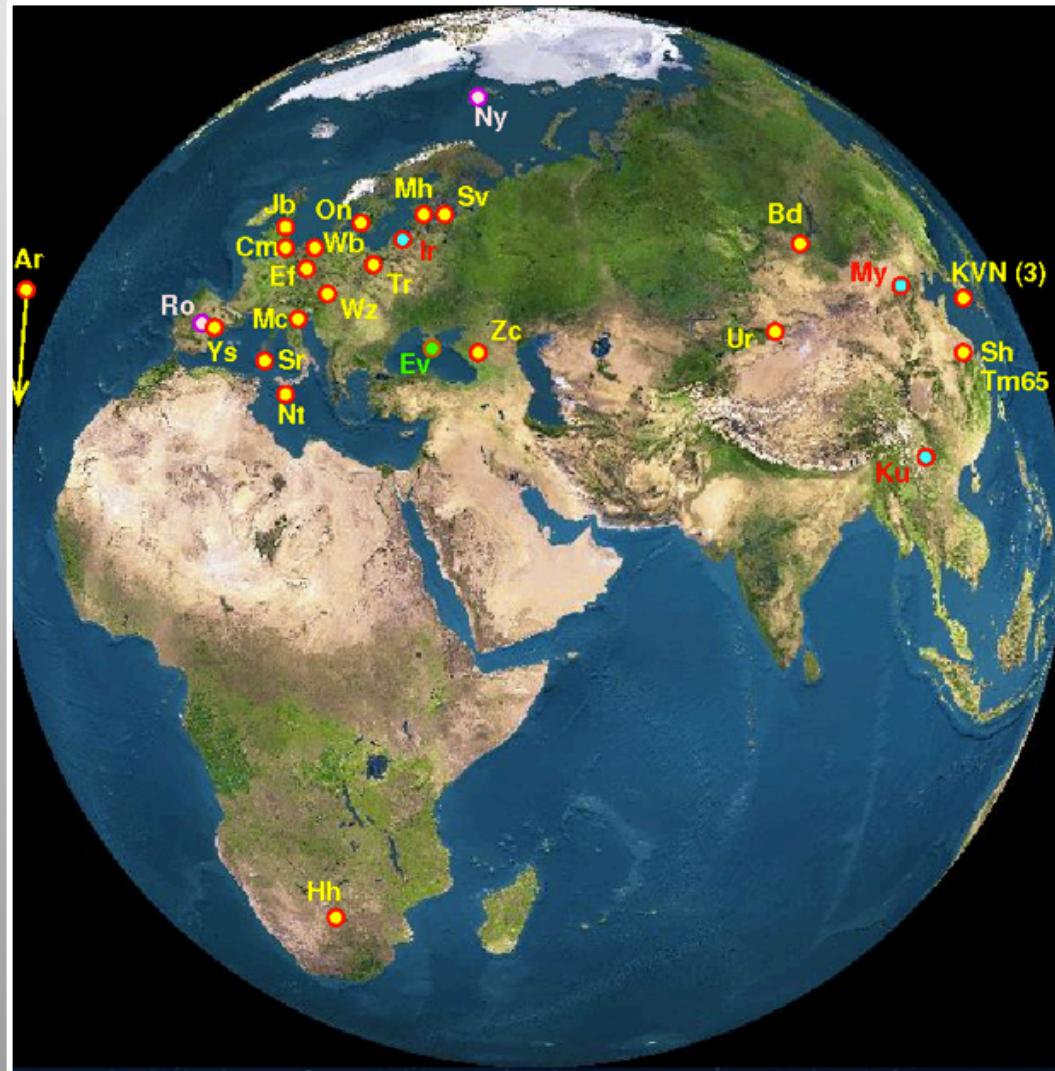
- Phase calibrators / phase-reference sources (see VLBI talk)
- Special needs:
 - Astrometry
 - Polarimetry (antenna leakage terms, EVPA)

Scheduling constraints

- Fixed or dynamic?
- Need for dry atmosphere (at high freq.) or quiet ionosphere (at low freq.)?
- Distance from the Sun
- Coordinated observations with other instruments

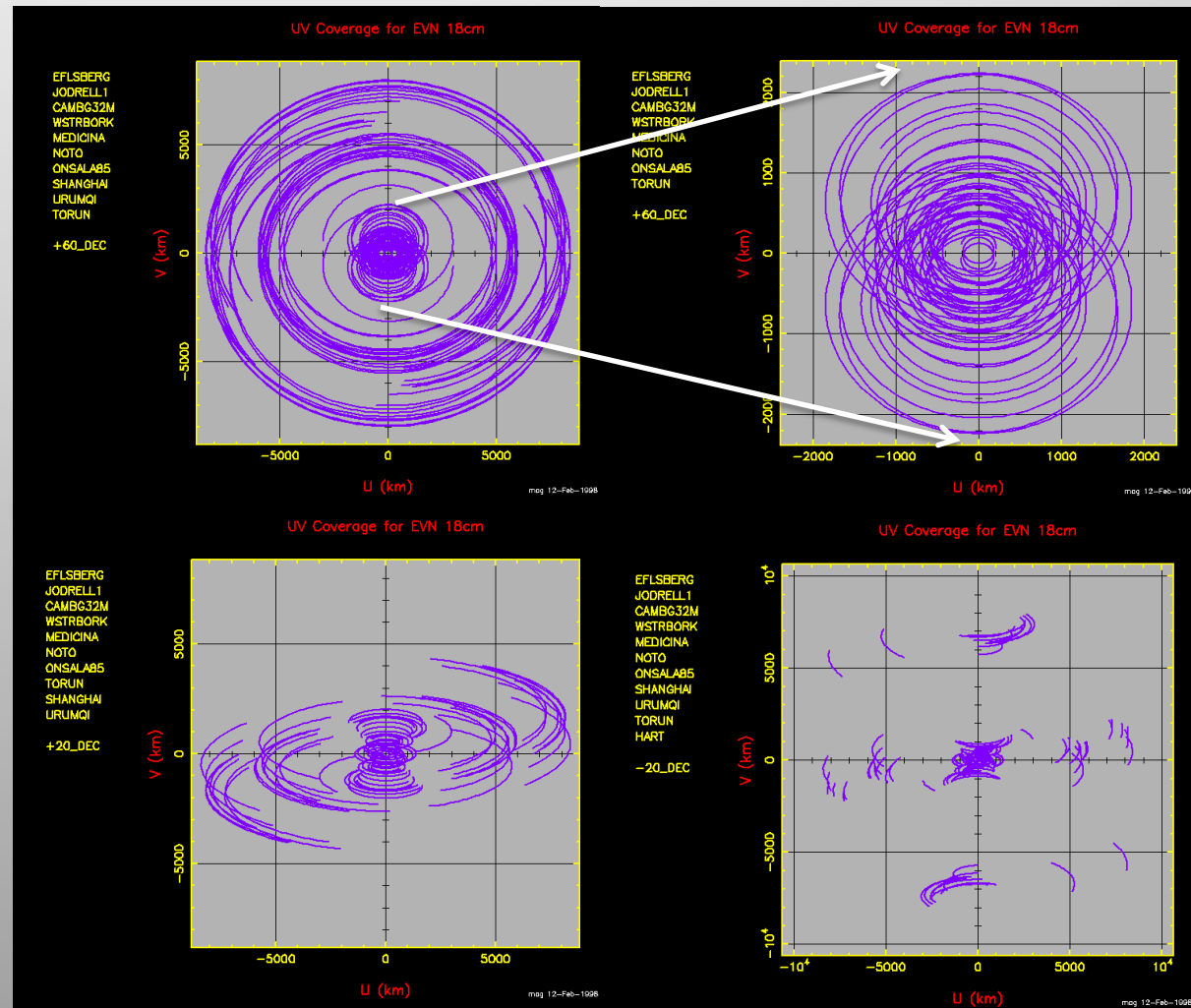


Selection of telescopes for VLBI observations



Selection of telescopes for VLBI observations

- Depending on the required **angular resolution**, **sensitivity**, and **observing band** one may choose **EVN/eVLBI**, **VLBA**, **HSA**, **GMVA**, **LBA** or **global VLBI**
- Check the **u-v coverage** (telescopes and duration of observations)



Examples of EVN (u,v) coverages

Sched for VLBI observations

```
schedules : sched
File Edit View Scrollback Bookmarks Settings Help
bs179.key~      s3125csch.pt      s3125jsch.la      s3125sch.br
bs179.oms       s3125csch.sc      s3125jsch.mk      s3125sch.fd
bs179sch.br    s3125c.sum        s3125jsch.nl      s3125sch.hn
bs179sch.fd    s3125c.v2d        s3125jsch.ov      s3125sch.kp
bs179sch.hn    s3125c.vex        s3125jsch.pt      s3125sch.la
bs179sch.kp    s3125dcrd.br      s3125jsch.sc      s3125sch.mk
bs179sch.la    s3125dcrd.fd      s3125j.sum        s3125sch.nl
bs179sch.mk    s3125dcrd.hn      s3125j.v2d        s3125sch.ov
bs179sch.nl    s3125dcrd.kp      s3125j.vex        s3125sch.pt
bs179sch.ov    s3125dcrd.la      s3125kcrd.br      s3125sch.sc
bs179sch.pt    s3125dcrd.mk      s3125kcrd.fd      s3125.sum
bs179sch.sc    s3125dcrd.nl      s3125kcrd.hn      s3125.vex
bs179.sum      s3125dcrd.ov      s3125kcrd.kp      sched.runlog
bs179.vex      s3125dcrd.pt      s3125kcrd.la      sun_distances.txt
bw086f.key     s3125dcrd.sc      s3125kcrd.mk
bw086f.oms     s3125d.flag       s3125kcrd.nl
tukasa@linux-db67:~/Work/vlbi_data/schedules> sched

Welcome to program SCHED.  Version:  9.40  Release Jan. 13, 2011.

The manual is at http://www.aoc.nrao.edu/software/sched/index.html
Unix users should set $SCHED to the base area where SCHED is installed.
Most run time messages will be in sched.runlog

Some useful commands to give now if running interactively:
  SCHEDULE=<filename>  : Specify input file.
  PLOT                 : Invokes uv, xy, rd, and uptime plotting.
  FREQLIST=lowF,highF : Make frequency list (MHz). Then exit.
  EXIT                 : Leave program.
  /                   : End of inputs - run program (or EXIT).

* sch = bh168.key plot /
```

Sched for VLBI observations

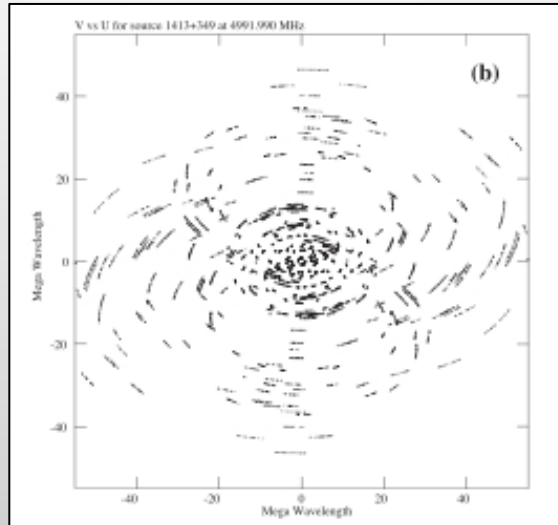
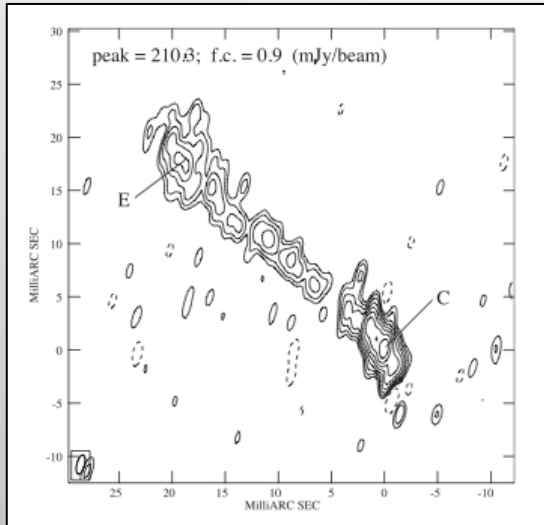
The image displays a software interface for VLBI observation scheduling, consisting of two main windows and a terminal window.

PGPLOT Window 2: This window contains a 3x3 grid of plots. The top-left plot shows a list of observation parameters in cyan text. The other eight plots show various data visualizations, including UV coverage plots (blue dots on a grid) and beam profiles (blue concentric circles). Each plot has a red title bar and a green border.

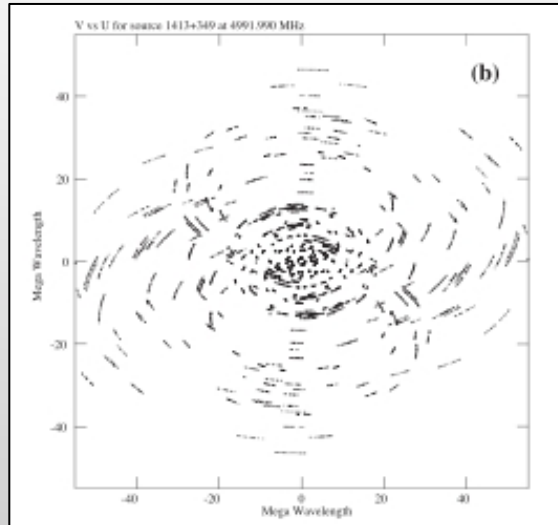
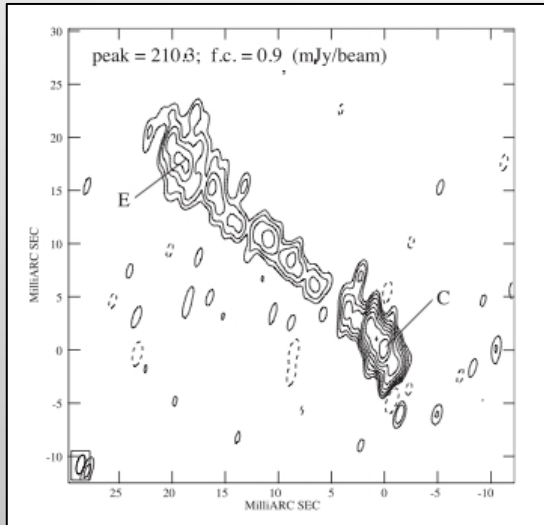
PGPLOT Window 1: This window is a control panel with the following sections:

- SCHED:** A blue button to start the scheduling process.
- PLOT, CLOSE, FILES:** Standard window control buttons.
- AXIS:** A blue button to access axis settings.
- SOURCES, OPTIONS, RESTART, FINISH, TERMINAL:** Buttons for managing the observation schedule.
- EXIT:** A button to close the application.
- Select the Type of Plot to Display:** A section with checkboxes for:
 - UV Plot
 - XY Plot
 - RD Plot
 - Uptime
 - ALL Plot
 - Beam
- Select Plot Axis Types and Scales:** A section with dropdown menus for X and Y axes, both currently set to "Km".
- Set X Axis Min/Max Values:** A section with input fields for minimum and maximum values, both set to "10000".
- Set Y Axis Bottom/Top Values:** A section with input fields for bottom and top values, both set to "10000".
- Lock Sign, Lock Value:** Checkboxes for locking the sign and value of the axis settings.

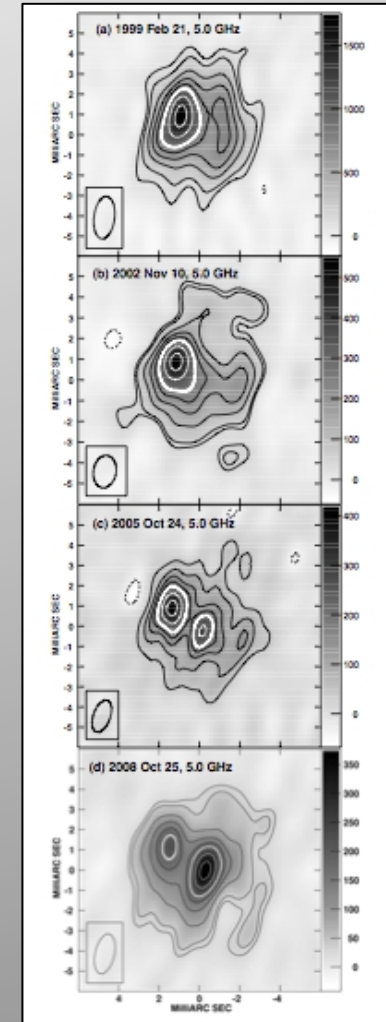
Terminal Window: A small window at the bottom left shows the text "schedules : sched".



Dallacasa et al. 2013 – CSS radio source at 5 GHz, Global VLBI Array of 16 antennas, snapshot mode, total time on source 1.5 hr – Peak 209 mJy/beam



Dallacasa et al. 2013 – CSS radio source at 5 GHz, Global VLBI Array of 16 antennas, snapshot mode, total time on source 1.5 hr – Peak 209 mJy/beam



Bientenholz et al. 2010

Table 1
VLBI Observations of SN 1986J

Peaks ~ 1 mJy/beam

Date	Frequency (GHz)	Antennas ^a	Total Time (hr)	Recording Rate (Mbit s ⁻¹)
2005 Apr 25	22	VLBA, Ef, Gb, Y27	12	256
2005 Oct 24	5	VLBA, Ef, Gb, Y27, Jb, On, Wb, Tr	12	256
2006 Dec 3	8	VLBA, Ef, Gb, Y27	15	512
2006 Dec 10	22	VLBA, Ef, Gb, Y27	15	512
2008 Oct 26	5	VLBA, Ef, GB, Y27, Jb, Mc, Nt, Tr, Wb	18	512

Note. ^a VLBA, ten 25 m dishes of the NRAO Very Long Baseline Array; Ef, 100 m, MPIfR, Effelsberg, Germany; Gb, ~ 105 m, NRAO, Green Bank, WV, USA; Y27, equivalent diameter 130 m, NRAO, near Socorro, NM, USA; Jb, 76 m, Jodrell Bank, UK; Mc, 32 m, IdR-CNR, Medicina, Italy; Nt, 32 m, IdR-CNR, Noto, Italy; On, 20 m, Onsala Space Observatory, Sweden; Tr, 32 m, Torun, Poland; Wb, equivalent diameter 94 m, Westerbork, the Netherlands.

Writing an observing time proposal

General information

- Radio astronomical facilities announce a call for proposals one (i.e. ALMA) two (VLBA, GMVA, VLA, GMRT, WSRT, LOFAR, ATCA) or three (e-EVN) times per year
- ToOs are accepted at any time
- Different over-subscription factors at different observatories and at different LST ranges – keep this in mind

Writing an observing time proposal

A proposal consists of three parts

Cover sheet

It includes basic information, i.e. authors & affiliation, source list, requested time and a technical summary. It is generated by the web-based proposal submission tool.

Scientific justification

Be Clear and concise

Include the necessary background material needed to understand the scientific goal, but not more

Clearly explain how the scientific goal is achieved by making the proposed observations

Use clear, appropriate and readable figures

Avoid unnecessary repetition and jargon

Writing an observing time proposal

A proposal consists of three parts

Cover sheet

It includes basic information, i.e. authors & affiliation, source list, requested time and a technical summary. It is generated by the web-based proposal submission tool.

Scientific justification

TAC Committees usually don't like:

Poorly justified sample sizes (why 10, or 20, or 100?)

Blind fishing

Vague statements

Non-astronomical statements

Proposals exceeding the given page limits

Writing an observing time proposal

Technical justification

Justify the requested time and setup

Required rms

Required u-v coverage/selected array

Required dynamic range

Time needed for calibration

Observational constraints

If non-standard setups or a very stringent scheduling is needed, it is a good idea to consult the observatory staff beforehand. It may turn out that what you are requesting is in fact impossible to do!!! **May be important for VLBI observations**

Some useful tools and links

- EVN sensitivity calculator: www.evlbi.org/cgi-bin/EVNcalc
- ALMA sensitivity calculator:
<http://almascience.eso.org/proposing/sensitivity-calculator>
- VLA exposure calculator: <https://obs.vla.nrao.edu/etc/>
- ATCA CABB sensitivity calculator:
www.narrabri.atnf.csiro.au/myatca/interactive_senscalc.html

VLA Exposure Calculator

Array Configuration	A	
Number of Antennas	25	
Number of Polarizations	<input type="radio"/> Single <input checked="" type="radio"/> Dual	
Type of Weighting	<input type="radio"/> Natural <input checked="" type="radio"/> Robust	
Frequency	0.0000	GHz
Receiver Band	Unspecified	
Approximate Beam Size	Unknown	
Digital Samplers	<input type="radio"/> 3 bit <input checked="" type="radio"/> 8 bit	
Elevation	Zenith (90 degrees)	
Average Weather	Winter	
Calculation Type	<input checked="" type="radio"/> Time <input type="radio"/> BW <input type="radio"/> Noise/Tb	
Time on Source	0h 0m 0s	
Total Time	0h 0m 0s	
Bandwidth (Frequency)	0.0000	GHz
Bandwidth (Velocity)	0.0000	km/s
RMS Noise (units/beam)	100.0000	μJy
RMS Brightness (temp)	0.0000	mK

Help

Save

$$S_{rms} = \frac{2kT_{sys}}{A_{eff} \sqrt{N_A(N_A - 1)t_{int} \Delta\nu}}$$

$$\sigma_{conf, VLSS} = 29 \left(\frac{\theta}{1''} \right)^{1.54} \left(\frac{\nu}{74 \text{ MHz}} \right)^{-0.7} \mu\text{Jy beam}^{-1}$$

EVN Calculator

EVN <input type="radio"/> e-EVN <input type="radio"/> VLBA <input type="radio"/> GLOBAL <input type="radio"/> GMVA <input type="radio"/>	RESET GO
Observing band & data rate [Mbit/s]	On-source integration time [min]
L - 18cm 1024	150
<input type="checkbox"/> Ef <input type="checkbox"/> Nt <input type="checkbox"/> My <input type="checkbox"/> Pv <input type="checkbox"/> Pa <input type="checkbox"/> Hn <input type="checkbox"/> Mc <input type="checkbox"/> Sh <input type="checkbox"/> Km <input type="checkbox"/> Ro70 <input type="checkbox"/> Ho <input type="checkbox"/> N1 <input type="checkbox"/> On <input type="checkbox"/> Tm65 <input type="checkbox"/> Sv <input type="checkbox"/> Ro34 <input type="checkbox"/> Cd <input type="checkbox"/> Fd <input type="checkbox"/> Tr <input type="checkbox"/> Ur <input type="checkbox"/> Zc <input type="checkbox"/> Pb <input type="checkbox"/> Ap <input type="checkbox"/> La <input type="checkbox"/> Jb1 <input type="checkbox"/> Mh <input type="checkbox"/> Bd <input type="checkbox"/> Ku <input type="checkbox"/> Go <input type="checkbox"/> Kp <input type="checkbox"/> Jb2 <input type="checkbox"/> Ys <input type="checkbox"/> Wz <input type="checkbox"/> Ky <input type="checkbox"/> Gb <input type="checkbox"/> Pt <input type="checkbox"/> Cm <input type="checkbox"/> Sr <input type="checkbox"/> Ka <input type="checkbox"/> Kt <input type="checkbox"/> Y1 <input type="checkbox"/> Ov <input type="checkbox"/> Wb <input type="checkbox"/> Ar <input type="checkbox"/> Ny <input type="checkbox"/> At <input type="checkbox"/> Y27 <input type="checkbox"/> Br <input type="checkbox"/> W1 <input type="checkbox"/> Hh <input type="checkbox"/> Tc <input type="checkbox"/> Mp <input type="checkbox"/> Sc <input type="checkbox"/> Mk	<p>A simple guide:</p> <ul style="list-style-type: none"> - one station: SEFD - two stations: baseline sensitivity - more stations: image thermal noise <p>- field of view and EVN MkIV correlator limitations are given below</p>
Number of spectral channels per subband, integration time [s], and maximum baseline length	Number of polarizations, subbands per polarizations, and bandwidth of a subband [MHz]
16 ch 2 s 10000 km (Full EVN)	2 pols 8 sb 16 MHz
Please select an array (N>2) and an observing band.	MkIV Correlator limitations no longer apply.
	RESET GO

Some useful tools and links

- GMRT users observing help:
www.gmrt.ncra.tif.res.in/gmrt_hpage/Users/Help/help.html
- Sched (useful for planning VLBI experiments):
www.aoc.nrao.edu/~cwalker/sched/
- LOFAR tools:
www.astron.nl/radio-observatory/lofar/lofar-tools/lofar-tools
- VLA Calibrator Manual: www.aoc.nrao.edu/~gtaylor/csource.html
- GMRT calibrator search page:
www.gmrt.ncra.tifr.res.in/~astrosupp/calib/vlcal.html

Proposal submission & submission tools

- Electronic submission via web-based tools is now the norm
- Different tools for different observatories
 - EVN, eMERLIN, LOFAR: NorthStar (proposal.jive.nl)
 - VLBA, VLA: NRAO PST (my.nrao.edu)
 - ALMA Observing tool (download from www.almascience.org)
 - ATCA: OPAL (opal.atnf.csiro.au)
 - GMRT: naps (naps.ncra.tifr.res.in)
- Cover & technical justification to be filled on web, scientific justification to be uploaded.
- Changes are possible until the very last minute

Scheduling and observing file preparation

- After the acceptance of the proposal:
 - Preparation of the required observing files using observatory specific tools
 - Observatory staff checks the observing files and schedules the observations (either on a fixed date or dynamically)
- Observing file contains:
 - Array configuration
 - Receiver setups
 - Correlator setup
 - Scans of targets and calibrators
 - Constraints for dynamic scheduling
- Remember to:
 - Check the visibility of the targets and calibrators, and their separation on the sky
 - Duty cycles
 - Be extra careful if using non-standard receiver setups.
 - **Be sure to observe all the required calibrators** (flux, phase, polarization leakage and evpa, bandpass, fringe finder in VLBI observations...)

Search for calibrators

Continuum phase calibrators should be:

- Compact
- Strong at the observing frequency
- As close as possible to the target

The VLA Calibrator Manual

Hop to RA [\[01\]](#) [\[02\]](#) [\[03\]](#) [\[04\]](#) [\[05\]](#) [\[06\]](#) [\[07\]](#) [\[08\]](#) [\[09\]](#) [\[10\]](#) [\[11\]](#) [\[12\]](#) [\[13\]](#) [\[14\]](#) [\[15\]](#) [\[16\]](#) [\[17\]](#) [\[18\]](#) [\[19\]](#) [\[20\]](#) [\[21\]](#)

IAU NAME	EQUINOX	PC	RA (hh,mm,ss)	DEC (ddd,mm,ss)	POS.REF	ALT.NAME
0001+192	J2000	A	00h01m08.621563s	19d14'33.801860"	Aug01	JVAS
2358+189	B1950	A	23h58m34.865400s	18d57'51.753000"		

BAND	A	B	C	D	FLUX (Jy)	UVMIN (kL) UVMAX (kL)
0.7cm	Q	W	W	W	0.18	

0003-174	J2000	T	00h03m21.9969s	-17d27'11.781"		
0000-177	B1950	T	00h00m48.4200s	-17d43'54.000"		

BAND	A	B	C	D	FLUX (Jy)	UVMIN (kL) UVMAX (kL)
90cm	P	X	S	S	7	7
20cm	L	X	X	S	2.2	7

0004+462	J2000	A	00h04m16.127651s	46d15'17.970010"	Aug01	
0001+459	B1950	A	00h01m41.453100s	45d58'36.145000"		

BAND	A	B	C	D	FLUX (Jy)	UVMIN (kL) UVMAX (kL)
0.7cm	Q	W	W	W	0.12	

0004+203	J2000	B	00h04m35.7576s	20d19'42.249"	May01	JVAS
0002+200	B1950	B	00h02m01.6329s	20d03'00.311"		

BAND	A	B	C	D	FLUX (Jy)	UVMIN (kL) UVMAX (kL)
0.7cm	Q	W	W	W	0.21	

0005+544	J2000	A	00h05m04.363531s	54d28'24.926230"	Aug01	
0002+541	B1950	A	00h02m29.056400s	54d11'43.187000"		

VLBA Calibrators Search Form

*

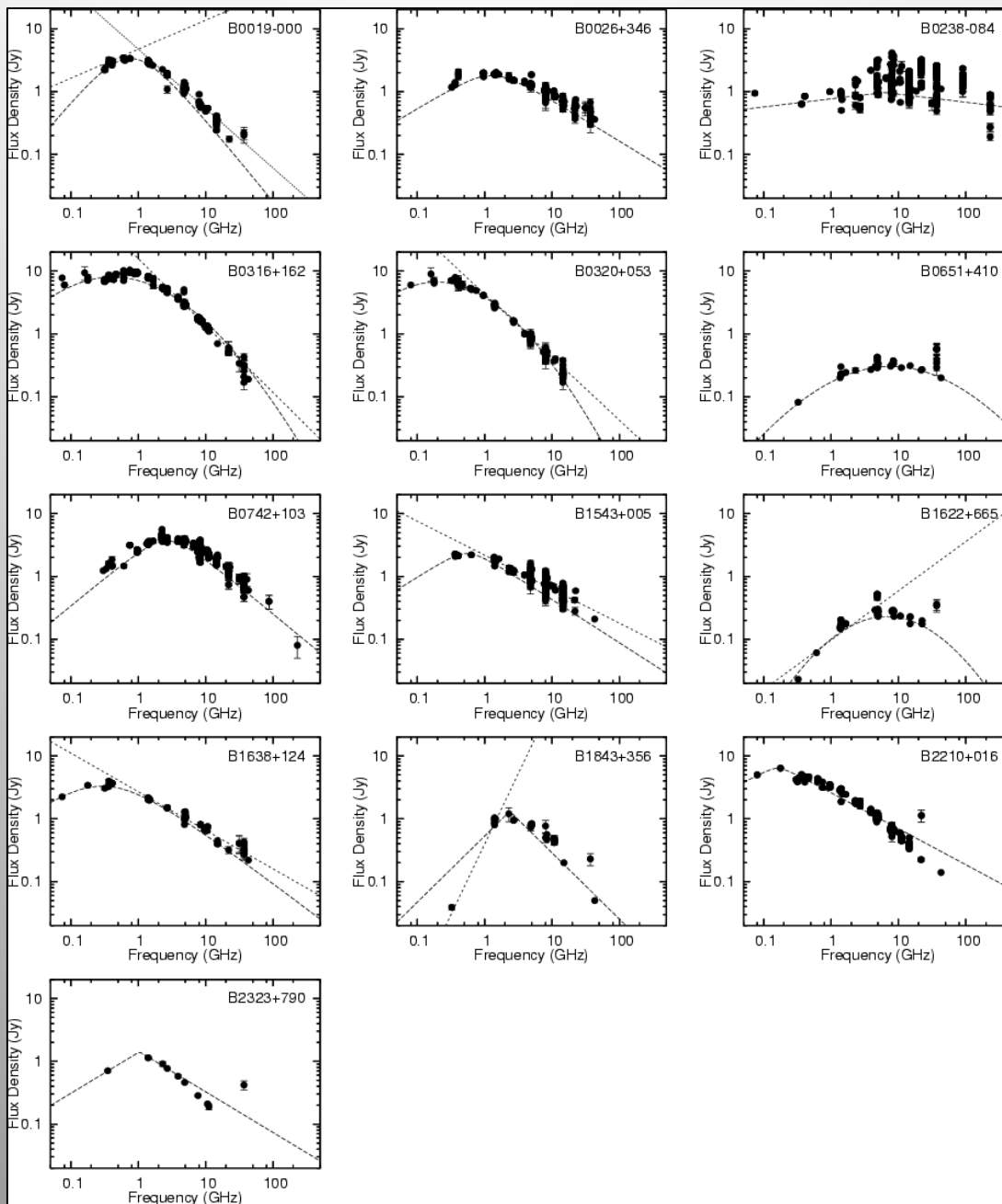
RA :	<input type="text" value="0h0m0.0s"/>	Examples :	RA = 6h45m10.76s DEC = 16d41'57.82"
			RA = 06H45M DEC = 16d42'
			RA = 06:45:10.76 DEC = 0.2914594
DEC :	<input type="text" value="0d0'0.0"/>	<i>A '*' for RA or DEC will not restrict the search on that axis.</i>	
Search Radius :	<input type="text" value="10d"/>	<i>The default search radius is 10 degrees. The maximum search radius is 45.0 degrees.</i>	

Maximum Number of sources returned:

Sort the Resulting list by:



Check images on NVSS, FIRST, VLSS image surveys



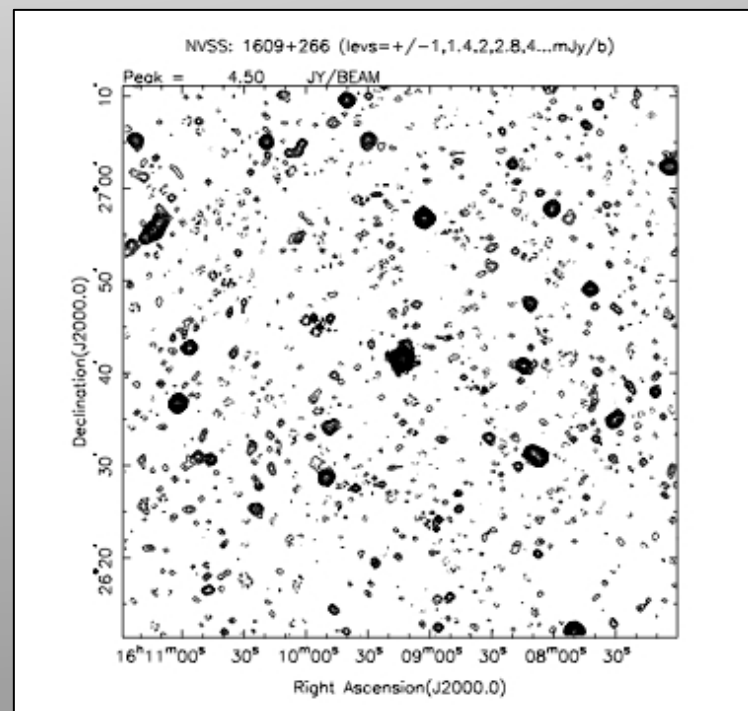
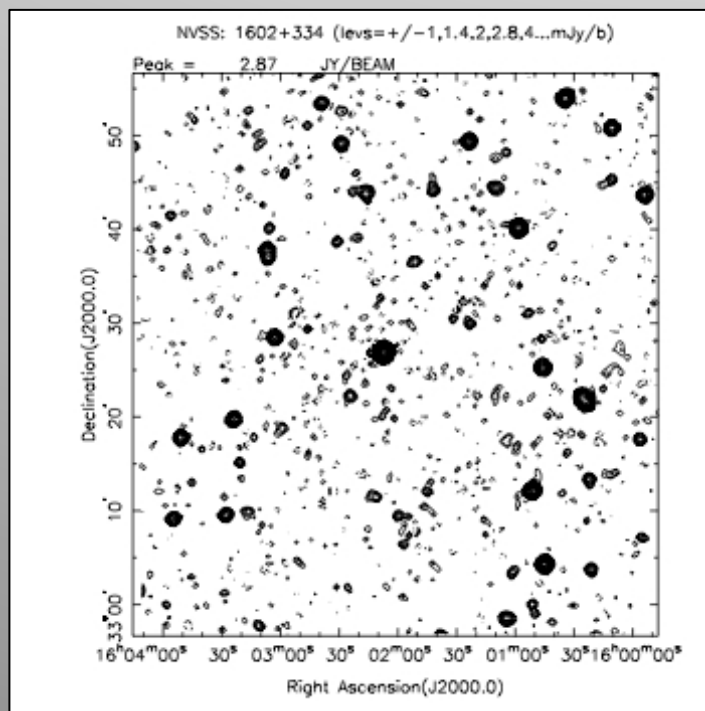
Example:

Calibrator search for GMRT observations of Abell 2142 at 610, 325, 240 MHz

$RA_{J2000}=15\ 58\ 16.1$ $DEC_{J2000}=+27\ 13\ 29$

BAND	A	B	C	D	FLUX(Jy)	UVMIN(kL)	UVMAX(kL)
1602+334	J2000	A	16h02m07.263468s	33d26'53.072670"	Aug01		
1600+335	B1950	A	16h00m11.909300s	33d35'09.593000"			
20cm	L	P	P	P	2.60		
6cm	C	P	P	P	2.00		
3.7cm	X	P	P	P	2.05		
2cm	U	P	P	P	1.40		
0.7cm	Q	W	W	W	0.41		visplot

BAND	A	B	C	D	FLUX(Jy)	UVMIN(kL)	UVMAX(kL)
1609+266	J2000	B	16h09m13.320753s	26d41'29.036380"	Aug01		
1607+268	B1950	B	16h07m09.290100s	26d49'18.658000"			
20cm	L	P	P	P	4.83		
6cm	C	S	P	P	1.70		300
3.7cm	X	S	P	P	0.85		300
2cm	U	X	S	S	0.50		300
0.7cm	Q	X	X	X	0.0		



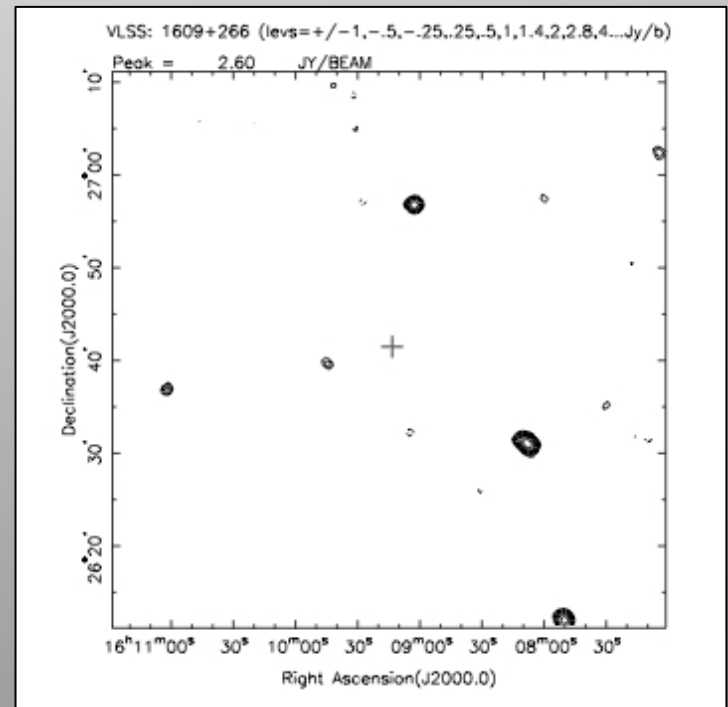
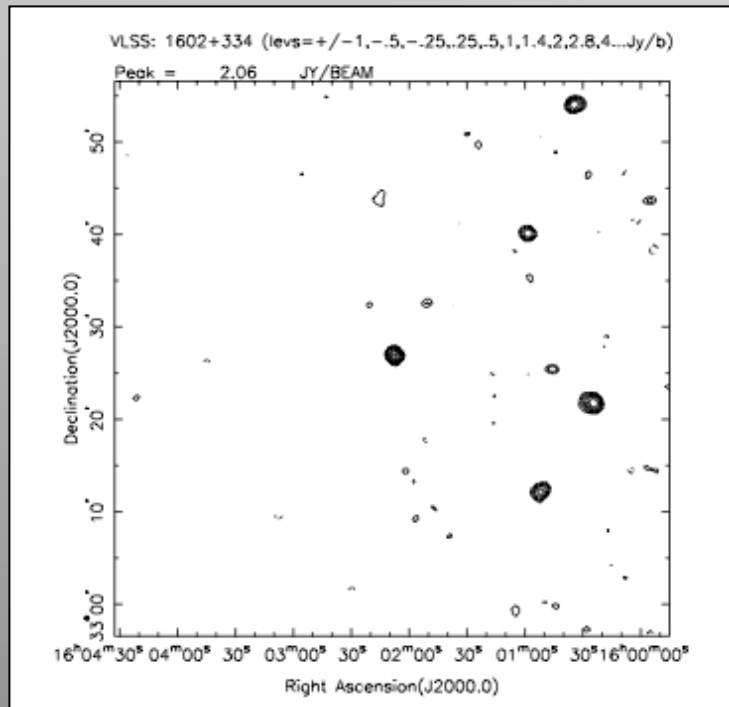
Example:

Calibrator search for GMRT observations of Abell 2142 at 610, 325, 240 MHz

$RA_{J2000}=15\ 58\ 16.1$ $DEC_{J2000}=+27\ 13\ 29$

BAND	A	B	C	D	FLUX(Jy)	UVMIN(kL)	UVMAX(kL)
1602+334	J2000	A	16h02m07.263468s	33d26'53.072670"	Aug01		
1600+335	B1950	A	16h00m11.909300s	33d35'09.593000"			
20cm	L	P	P	P	2.60		
6cm	C	P	P	P	2.00		
3.7cm	X	P	P	P	2.05		
2cm	U	P	P	P	1.40		
0.7cm	Q	W	W	W	0.41		visplot

BAND	A	B	C	D	FLUX(Jy)	UVMIN(kL)	UVMAX(kL)
1609+266	J2000	B	16h09m13.320753s	26d41'29.036380"	Aug01		
1607+268	B1950	B	16h07m09.290100s	26d49'18.658000"			
20cm	L	P	P	P	4.83		
6cm	C	S	P	P	1.70		300
3.7cm	X	S	P	P	0.85		300
2cm	U	X	S	S	0.50		300
0.7cm	Q	X	X	X	0.0		



Examples of observing file preparation tools OPT for EVLA

- Log in at `e2e.nrao.edu`

The screenshot displays the NRAO Observation Preparation web interface. The left sidebar shows a tree view with the following items:

- [New Project]
- [New Program Block]
- [New Scheduling Block], 00:00:00
- STD: [New Scan]

The main content area is titled "SCHEDULING BLOCK DETAILS" and contains the following information:

GENERATED ID	5065125	STATUS	Not Submitted
NAME	[New Scheduling Block]	COMPLETED	0
COUNT	1	TIME PER EXECUTION	00:00:00
TOTAL TIME	00:00:00		
SCHEDULE TYPE	Dynamic		
LST START RANGE	00:00 - 00:00		
EARLIEST UT START DATE (OPTIONAL)	2011/09/08		
SHADOWING LIMIT (MAX)	0.0 m		
IN CONFIGURATION			

Below the table, there is a diagram illustrating antenna configurations. The diagram shows a circular path with a north arrow (N 360° 0°) at the top. Two arcs represent different wrapping directions:

- A red arc labeled "Clockwise (CW) right wrap" with angles 275°, -85°, and 180°.
- A green arc labeled "Counter-clockwise (CCW) left wrap" with angles 85°, 445°, and 265°.

At the bottom of the diagram, there is a red error message:

Error: You must select at least one acceptable array configuration for this scheduling block's program block to select this.

At the very bottom of the interface, the text "ASSUMED ANTENNA STARTING POSITION" is visible.

Examples of observing file preparation tools

Observing file creator for GMRT

- Go to `www.gmrt.ncra.tifr.res.in/gmrt_hpage/Users/Help/sys/setup.html`

Observation Setup

- Project Code :
- Project Title :
- User's Name :
- User's Email :
- Date of Obs. : 2006
- Start Time (IST hours) :
- Integration Time (sec) :
- Correlator Mode :
- Beam Mode (pulsar) :
- Channel nos. :
- Radio Frequency Band :
- Observation Type :
- Spectral line Frequency (MHz) (line obs only) :
- Band Width (MHz) :
- Special Requirement (If any) :

Source List

Source(s) Co-ordinates :-

Source_Name	RA	Dec	Epoch
3C147	05h38m43.50s	+49d49' 42.7"	1950.0
0837-198	08h37m11.18s	-19d51' 56.8"	2000.0
NGC1851	05h14m06.30s	-39d02' 50.0"	2000.0

Command File

- Flux Cal at beginning :
- Target Source(s) & Phase cal(s) Loop :

Scan-Time(minutes)	Target-Name
10	1254+116
30	NGC5435

- Flux Cal at End :

Sched for VLBI observations

- VLBI observing file (*schedule*) is prepared with a program called Sched, which makes control files for all the individual telescopes (www.aoc.nrao.edu/~cwalker/sched/)
- Sched handles automatically a lot of things like calculating the slewing times of different telescopes
- Since VLBI telescopes are distributed around the world, your source transits at different times at different telescopes sites. The schedule has to match the allocated UT slot, which corresponds to the requested GST range. Use sched to check source uptimes already when planning the experiment.
- If preparing VLBI schedule for the first time, seek help from an experienced user.
- Remember to schedule strong and compact “fringe-finder” sources several times during the observation. Try to schedule these when they are observable from all the antennas.
- Send <obscode>.key file to the observatory staff

Sched for VLBI observations

```
schedules : sched
File Edit View Scrollback Bookmarks Settings Help
bs179.key~      s3125csch.pt      s3125jsch.la      s3125sch.br
bs179.oms       s3125csch.sc      s3125jsch.mk      s3125sch.fd
bs179sch.br     s3125c.sum        s3125jsch.nl      s3125sch.hn
bs179sch.fd     s3125c.v2d        s3125jsch.ov      s3125sch.kp
bs179sch.hn     s3125c.vex        s3125jsch.pt      s3125sch.la
bs179sch.kp     s3125dcrd.br      s3125jsch.sc      s3125sch.mk
bs179sch.la     s3125dcrd.fd      s3125j.sum        s3125sch.nl
bs179sch.mk     s3125dcrd.hn      s3125j.v2d        s3125sch.ov
bs179sch.nl     s3125dcrd.kp      s3125j.vex        s3125sch.pt
bs179sch.ov     s3125dcrd.la      s3125kcrd.br      s3125sch.sc
bs179sch.pt     s3125dcrd.mk      s3125kcrd.fd      s3125.sum
bs179sch.sc     s3125dcrd.nl      s3125kcrd.hn      s3125.vex
bs179.sum       s3125dcrd.ov      s3125kcrd.kp      sched.runlog
bs179.vex       s3125dcrd.pt      s3125kcrd.la      sun_distances.txt
bw086f.key      s3125dcrd.sc      s3125kcrd.mk
bw086f.oms      s3125d.flag       s3125kcrd.nl
tukasa@linux-db67:~/Work/vlbi_data/schedules> sched

Welcome to program SCHED.  Version: 9.40 Release Jan. 13, 2011.

The manual is at http://www.aoc.nrao.edu/software/sched/index.html
Unix users should set $SCHED to the base area where SCHED is installed.
Most run time messages will be in sched.runlog

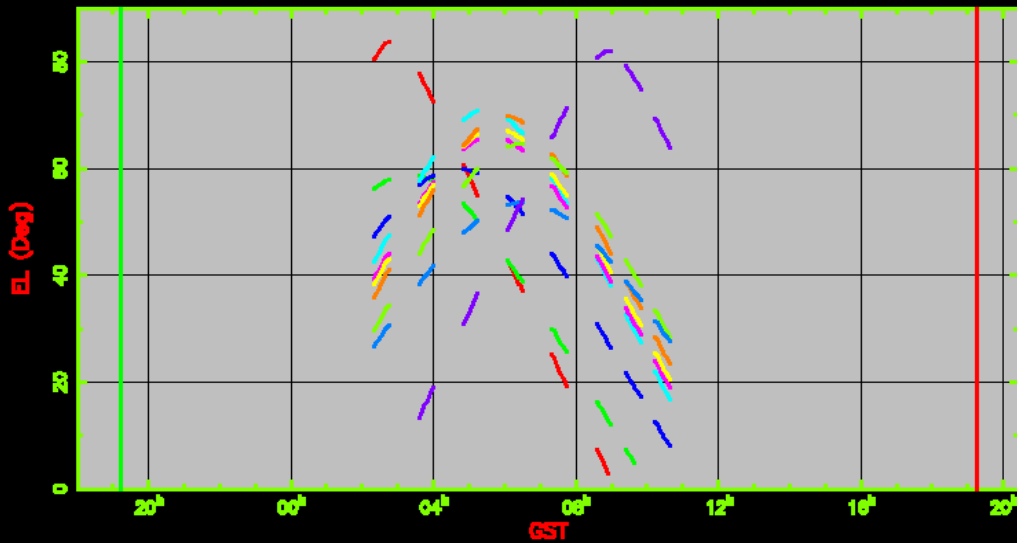
Some useful commands to give now if running interactively:
SCHEDULE=<filename> : Specify input file.
PLOT                : Invokes uv, xy, rd, and uptime plotting.
FREQLIST=lowF,highF : Make frequency list (MHz). Then exit.
EXIT                : Leave program.
/                  : End of inputs - run program (or EXIT).

* sch = bh168.key plot /
```

Sched for VLBI observations

schedules : sched
File Edit View Scrollback Bookmarks Settings Help
PGPLOT Window 2

Experiment code: BH168



VLBA_SC
VLBA_HN
VLBA_NL
VLBA_FD
VLBA_LA
VLBA_PT
VLBA_KP
VLBA_OV
VLBA_BR
VLBA_MK

2230+114

SCHED

PLOT

CLOSE

FILES

AXIS

SOURCES

OPTIONS

RESTART

FINISH

TERMINAL

EXIT

PGPLOT Window 1

Select Stations to Plot and Highlight

- VLBA_SC
- VLBA_HN
- VLBA_NL
- VLBA_FD
- VLBA_LA
- VLBA_PT
- VLBA_KP
- VLBA_OV
- VLBA_BR
- VLBA_MK

Set All

Unset All

Baselines: Both stations selected
 Either station selected

Select Sources

- 1226+023
- 1641+399
- 2134+004
- 2230+114
- 2251+158
- Set All
- 0923+392
- 0945+408
- Unset All



Sched for VLBI observations

```
emacs@linux-db67.site
File Edit Options Buffers Tools Help

=====
! Preferred Dynamic Constraints.  Alter [defaults] as desired.
! =====
! Equipment constraints:
!   Stations.  Below each station code, the "o" indicates an
!   [optional] station that is to be used if it is available.
!   Change "o" to "r" if the station is required or change
!   "o" to "n" if the station is not to be used.
!       SC HN NL FD LA PT KP OV BR MK
!       r o o o o o r o o o r
!   Minimum number of stations [9]: 9
!   May we swap PT for a single VLA antenna? [no]
!   Bands and polarizations.  Below each band code, insert "R"
!   if the righthand polarization is to be used, "L" if the
!   lefthand polarization is to be used, "d" if dual
!   polarizations are to be used, or "o" if the band is in
!   your setups but scheduling should not be constrained by
!   its availability.
!       90cm 50cm 20cm 13cm 6cm 4cm 2cm 1cm 7mm 3mm
!               d   d   d
! Weather constraints:
!   [appropriate for bands marked "L", "R", or "d" above
!   and for at least eight stations]
!
!   Not terrible weather at MK or SC or throughout southwest
!
! Date constraints:
!   Preferred date(s), usually a series start [Any time]
!   Excluded dates plus reason []
!   Preferred interval between segments in days []:
!   Special conditions (e.g., a series with different
!   spacings in time)
!
!   The EVLA experiment TPOL0003 with a source list POLCAL_2 should be
!   scheduled within a few days of this experiment in order to provide
!   EVPA calibration data.  In addition to the usual POLCAL_2 list, we
!   request adding B2230+114 in the EVLA observations in order to have
!   three EVPA calibrators.
!   Please, coordinate with the EVLA scheduler.
!
! =====
! Schedule created by Tuomas Savolainen (07-02-2011).
! =====
--:--- bh168.key      Top (32,25)      (Text Fill)-----
```


Sched for VLBI observations

```
emacs@linux-db67.site
File Edit Options Buffers Tools Help

=====
! Preferred Dynamic Constraints.  Alter [defaults]
=====
! Equipment constraints:
! Stations.  Below each station code, the "o" ind
! [optional] station that is to be used if it
! Change "o" to "r" if the station is required
! "o" to "n" if the station is not to be used.
!   SC HN NL FD LA PT KP OV BR MK
!   r o o o r o o o r
! Minimum number of stations [9]: 9
! May we swap PT for a single VLA antenna? [no]
! Bands and polarizations.  Below each band code,
! if the righthand polarization is to be used,
! lefthand polarization is to be used, "d" if
! polarizations are to be used, or "o" if the
! your setups but scheduling should not be con
! its availability.
!   90cm 50cm 20cm 13cm 6cm 4cm 2cm 1
!           d      d
!
! Weather constraints:
! [appropriate for bands marked "L", "R", or "d"
! and for at least eight stations]
!
! Not terrible weather at MK or SC or throughout
!
! Date constraints:
! Preferred date(s), usually a series start [Any
! Excluded dates plus reason []
! Preferred interval between segments in days []:
! Special conditions (e.g., a series with differe
! spacings in time)
!
! The EVLA experiment TP0L0003 with a source list
! scheduled within a few days of this experiment
! EVPA calibration data.  In addition to the usual
! request adding B2230+114 in the EVLA observatio
! three EVPA calibrators.
! Please, coordinate with the EVLA scheduler.
!
! =====
! Schedule created by Tuomas Savolainen (07-02-2011)
! =====
```

```
emacs@linux-db67.site
File Edit Options Buffers Tools Help

=====
! Frequency setups
=====
! 8 GHz setup for FR polarimetry, 16 x 8 MHz channels with two channels
! per polarization digitized with two bits.
! Central frequency for SEFD 8425 MHz
setinit = 4cm /
nchan = 16
bits = 2
bbfilter = 8.0
freqref = 8125.49, 8125.49, 8125.49, 8125.49, 8250.49, 8250.49, 8250.49, 8250.49,
         8425.49, 8425.49, 8425.49, 8425.49, 8591.49, 8591.49, 8591.49, 8591.49
freqoff = -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0,
         -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0, -4.0
netside = L, L, U, U, L, L, U, U, L, L, U, U, L, L, U, U
pol = dual
/
endset /

! 12 GHz setup for FR polarimetry, 16 x 8 MHz channels with two channels
! per polarization digitized with two bits.
setinit = 2.3cm /
nchan = 16
bits = 2
bbfilter = 8.0
freqref = 12916.99
freqoff = -1.5, -1.5, -1.5, -1.5, 14.5, 14.5, 14.5, 14.5,
         449.5, 449.5, 449.5, 449.5, 465.5, 465.5, 465.5, 465.5
netside = L, L, U, U, L, L, U, U, L, L, U, U, L, L, U, U
/
endset /

! 14 GHz setup for FR polarimetry, 16 x 8 MHz channels with two channels
! per polarization digitized with two bits.
setinit = 2.1cm /
nchan = 16
bits = 2
bbfilter = 8.0
freqref = 14116.99
freqoff = -1.5, -1.5, -1.5, -1.5, 14.5, 14.5, 14.5, 14.5,
         449.5, 449.5, 449.5, 449.5, 465.5, 465.5, 465.5, 465.5
netside = L, L, U, U, L, L, U, U, L, L, U, U, L, L, U, U
pol = dual
/
endset /
```

Sched for VLBI observations

```
emacsbh168.key Top (32.25)
=====
! Preferred Dynamic Constraints
=====
! Equipment constraints:
! Stations. Below each station
! [optional] station that
! Change "o" to "r" if the
! "o" to "n" if the station
! SC HN NL FD LA
! r o o o o
! Minimum number of stations
! May we swap PT for a single
! Bands and polarizations. Be
! if the righthand polarization
! lefthand polarization is
! polarizations are to be
! your setups but scheduling
! its availability.
! 90cm 50cm 20cm 13cm
!
! Weather constraints:
! [appropriate for bands marked
! and for at least eight stations
!
! Not terrible weather at MK
!
! Date constraints:
! Preferred date(s), usually
! Excluded dates plus reason []
! Preferred interval between
! Special conditions (e.g., a
! spacings in time)
!
! The EVLA experiment TP0L000
! scheduled within a few days
! EVPA calibration data. In a
! request adding B2230+114 in
! three EVPA calibrators.
! Please, coordinate with the
!
! =====
! Schedule created by Tuomas Savola
! =====
----- bh168.key 61% (222,0) (Text Ovwrt Fill) -----

! =====
! The schedule
! =====
stations = SC, HN, NL, FD, LA, PT, KP, OV, BR, MK
start = 12:00:00 ! LST
day = 62300
caltime = 60

! In terms of rotation angle, the VLBA feed locations are:
! S / K / C / Ku / Q / W / L / X / (Ka)
! 32 / 78 / 108 / 138 / 155 / 180 / 251 / 323 / 347 degrees

! Rotation cycle X-K-Ku

! Sources: 0923+392 (8), 0945+408 (8), 1226+023 (8),
! 1641+399 (8), 2134+004 (8), 2230+114 (8), 2251+158 (8)

gap = 0

group = 10 repeat = 5
source = '1226+023'
  setup = '4cm' dwell = 150 /
  setup = '1cm' dwell = 359 /
  setup = '2.3cm' dwell = 300 gap = 10 /
  setup = '2.1cm' dwell = 328 /
  setup = '2cm' dwell = 284 gap = 0 /
source = '1641+399'
  setup = '2.3cm' dwell = 300 /
  setup = '2.1cm' dwell = 328 /
  setup = '2cm' dwell = 284 gap = 10 /
  setup = '1cm' dwell = 359 /
  setup = '4cm' dwell = 150 gap = 0 /

group = 10 repeat = 3
source = '2134+004'
  setup = '4cm' dwell = 150 /
  setup = '1cm' dwell = 359 /
  setup = '2.3cm' dwell = 300 gap = 10 /
  setup = '2.1cm' dwell = 328 /
  setup = '2cm' dwell = 284 gap = 0 /
source = '1641+399'
  setup = '2.3cm' dwell = 300 /
  setup = '2.1cm' dwell = 328 /
  setup = '2cm' dwell = 284 gap = 10 /
  setup = '1cm' dwell = 359 /
```

After the observations

In most cases the raw data may be retrieved from the observatory machines.
At this point the the data reduction starts...

Day 1, Sunday September 6		
08:30		Registration
09:20	Robert Laing	Opening/Welcome
09:30	Neil Jackson	L1: A Gentle introduction to Radio Interferometry
10:15	Robert Laing	L2: Fundamentals of Radio Interferometry
11:00		Break
11:30	Robert Laing	T1: Fun with Fourier Transforms
12:15	John McKean	L3: Modern Radio Interferometers
13:00		Lunch
14:00	Anita Richards	L4: Data packages and formats
14:30	Andre Offringa	L5: Data editing and radio frequency interference
15:15	George Heald	L6: Calibration
16:00		Tea
16:30	Andy Biggs	T2: Data loading and editing
18:00	Robert Laing	Introduction to "Writing a Proposal" tutorials
18:15		Close

Future proposal deadlines

- EVN: 1 Oct 2015
- ATCA: 15 Dec 2015
- GMRT: 15 Jan 2016
- LOFAR: 9 Sep 2015
- EVLA, VLBA, GMVA: 1 Feb 2016
- ALMA: Spring 2016?
- IRAM PdB: 17 Sep 2015

WSRT/Apertif transition taking place – Array unavailable for observing time

GOOD LUCK WITH YOUR PROPOSAL PREPARATION!