

# Writing Proposals and Scheduling

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# Outline

- 1. How to design an experiment
  - Scientific idea
  - Feasibility study
  - 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 design 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

- 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	<a href="http://archive.jive.nl">archive.jive.nl</a>
(J)VLA, VLBA	<a href="http://archive.nrao.edu">archive.nrao.edu</a>
MERLIN	<a href="http://www.merlin.ac.uk/archive">www.merlin.ac.uk/archive</a>
GMRT	<a href="http://naps.ncra.tifr.res.in/goa/mt/search/basicSearch">naps.ncra.tifr.res.in/goa/mt/search/basicSearch</a>
WSRT	<a href="http://www.astron.nl/radio-observatory/astronomer/wsrt-archive">www.astron.nl/radio-observatory/astronomer/wsrt-archive</a>
ATCA	<a href="http://atoa.atnf.csiro.au/">atoa.atnf.csiro.au/</a>

# How to design 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? (Ciriaco's talk)
- Is it single or full polarization?

## 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?
- How large is the field of view needed? Is it necessary to prevent bandwidth smearing?  
Is one pointing enough or is mosacing necessary?

# How to design an experiment

## 3) Frequency required

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

## 4) Brightness of the target source

$$\text{rms} \propto (\Delta\nu\Delta t)^{-1/2}$$

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

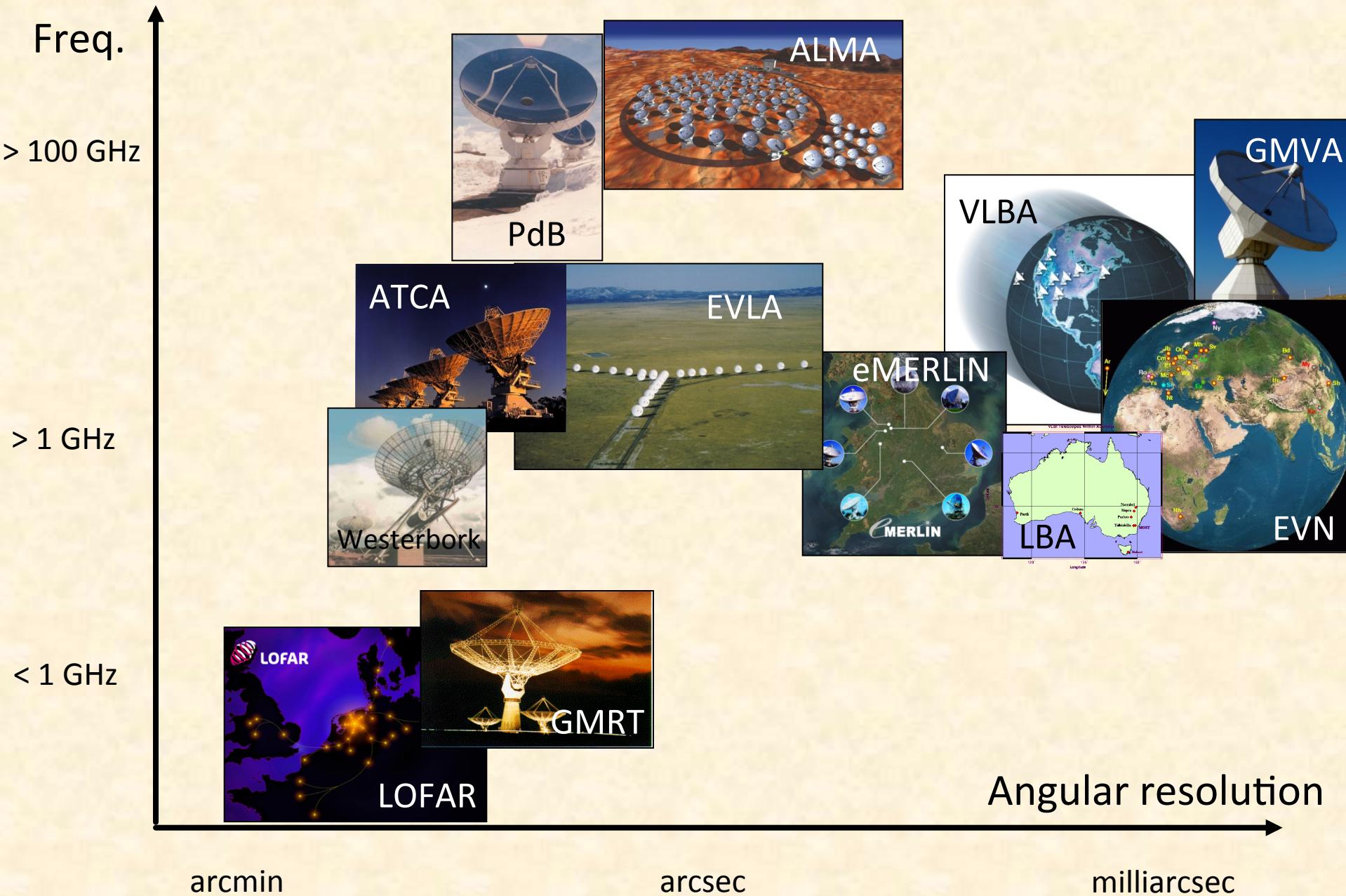
# How to design an experiment

## 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)

... lead to the choice of

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



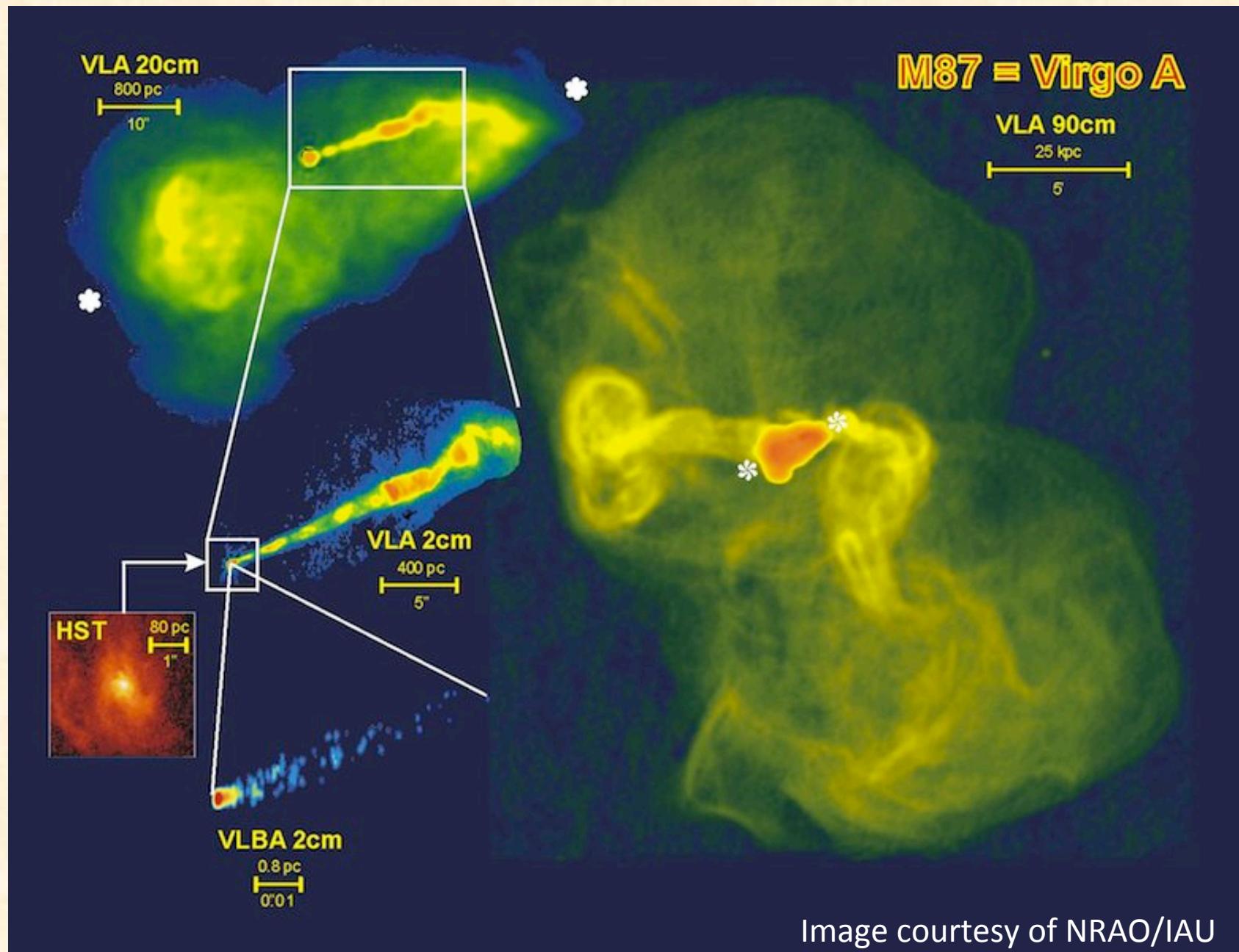
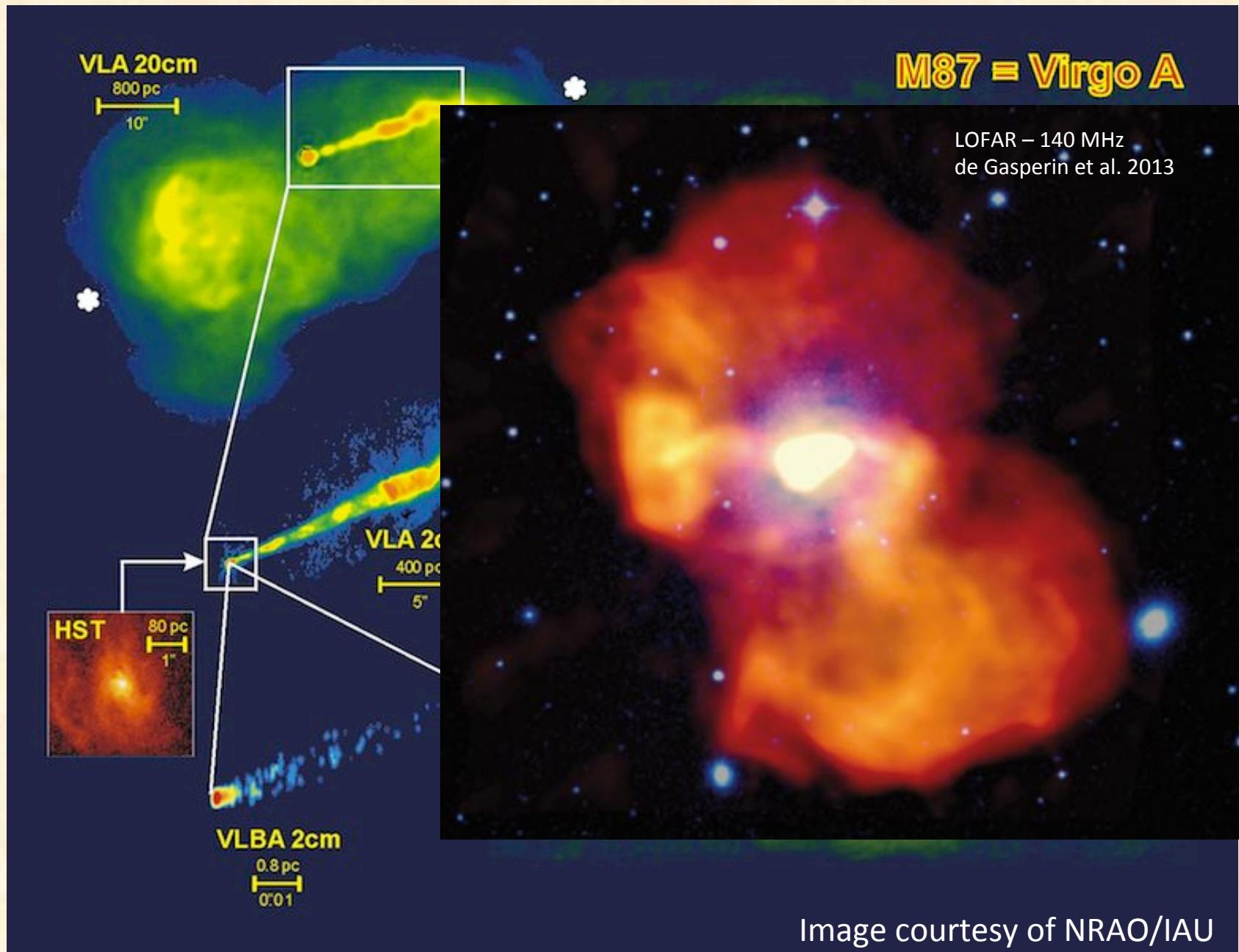


Image courtesy of NRAO/IAU



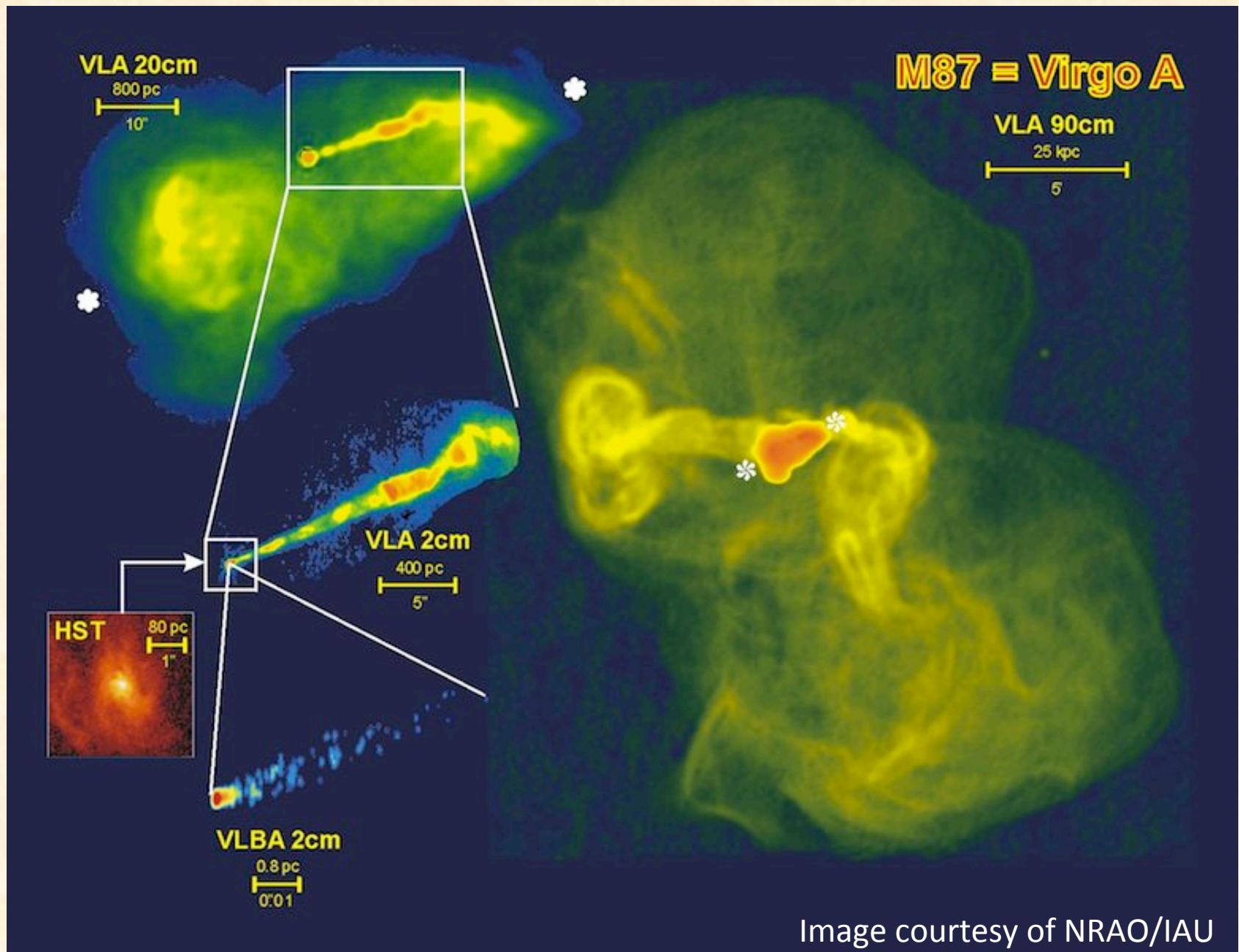
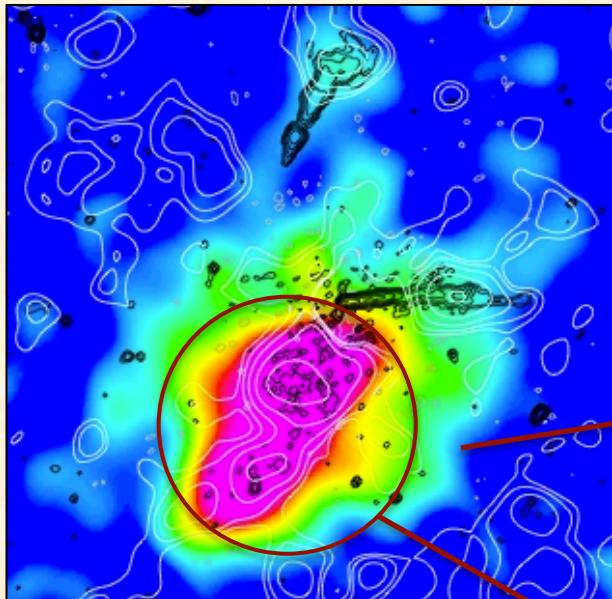
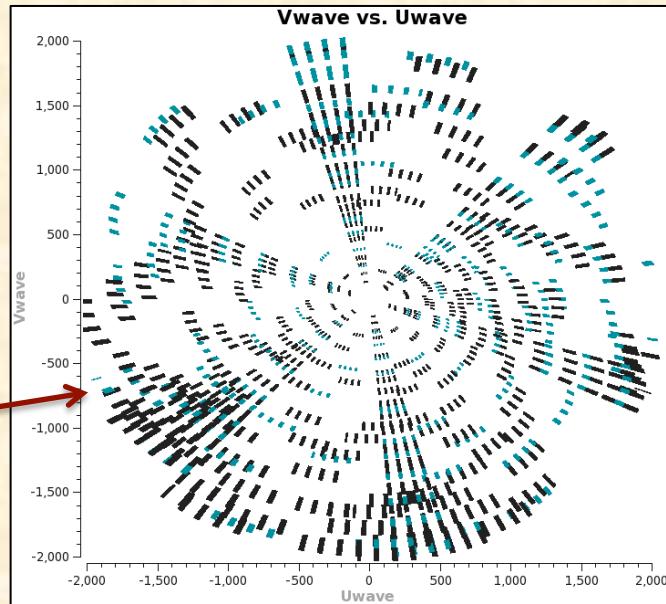


Image courtesy of NRAO/IAU

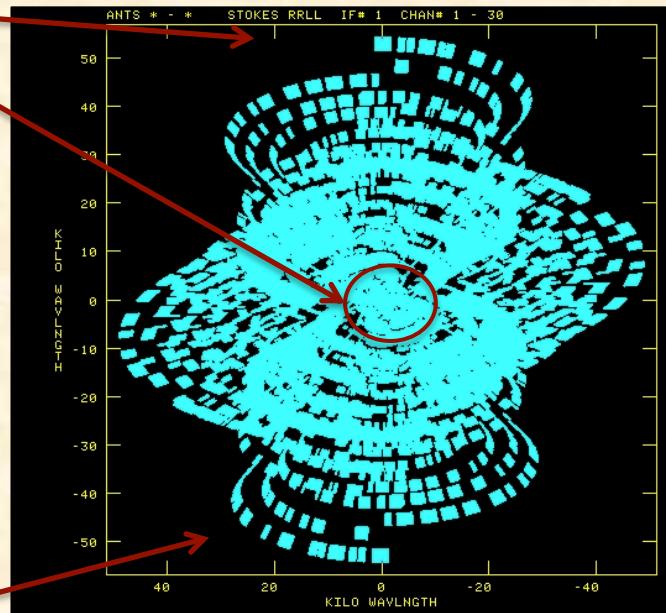
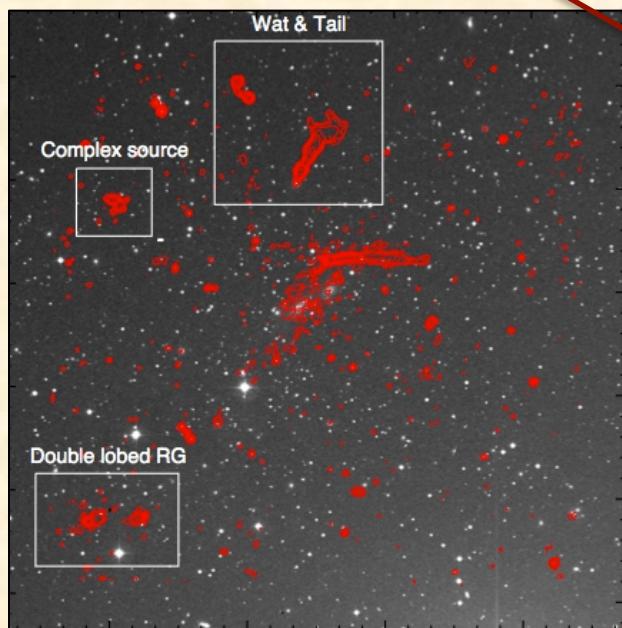
# Galaxy cluster Abell 2142



JVLA-D  
Lband



Vwave vs. Uwave



GMRT  
610 MHz

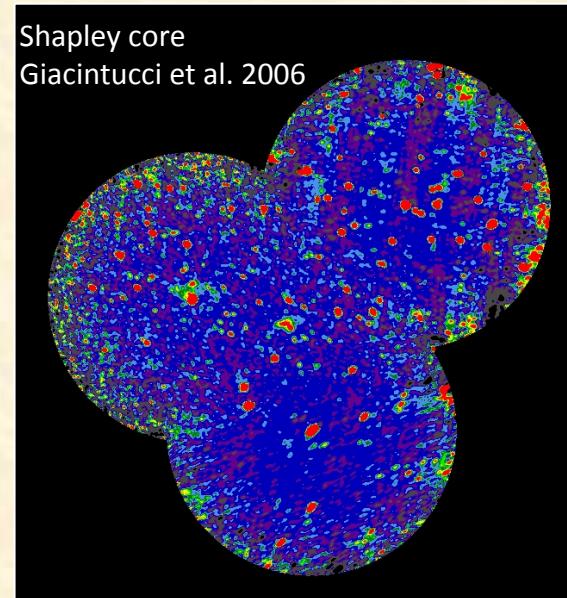
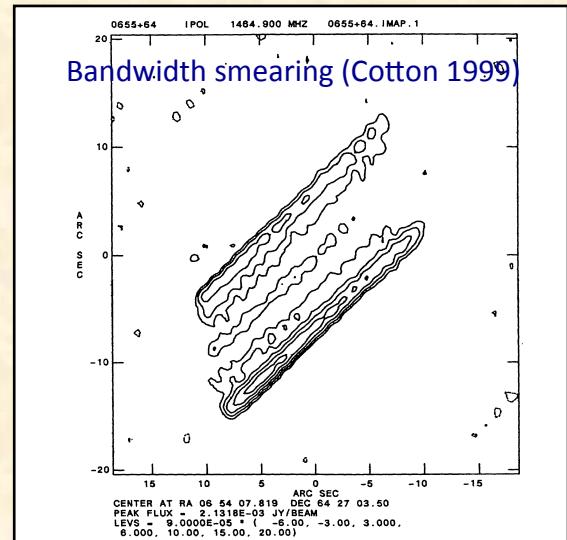
# Feasibility checks

Is a wide field of view needed?

- Avoid bandwidth smearing -> need high spectral resolution
- Larger than the primary beam -> multiple pointings, mosaicing

Be aware that this can generate **a lot of data**: will you be able to handle it?

... Disk space, computing facilities, proper software...



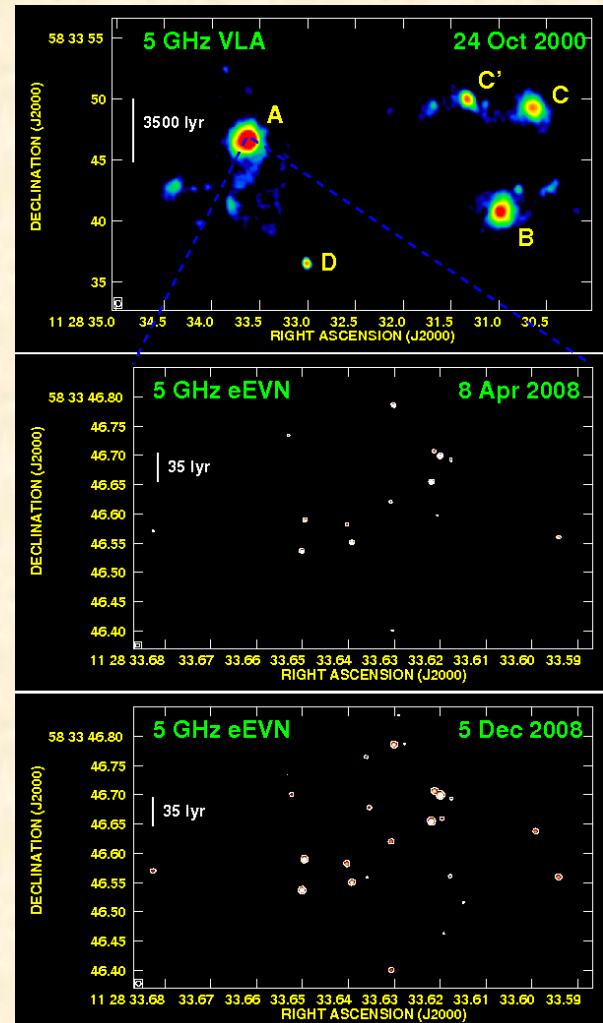
# Feasibility checks

## Calibration strategy

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

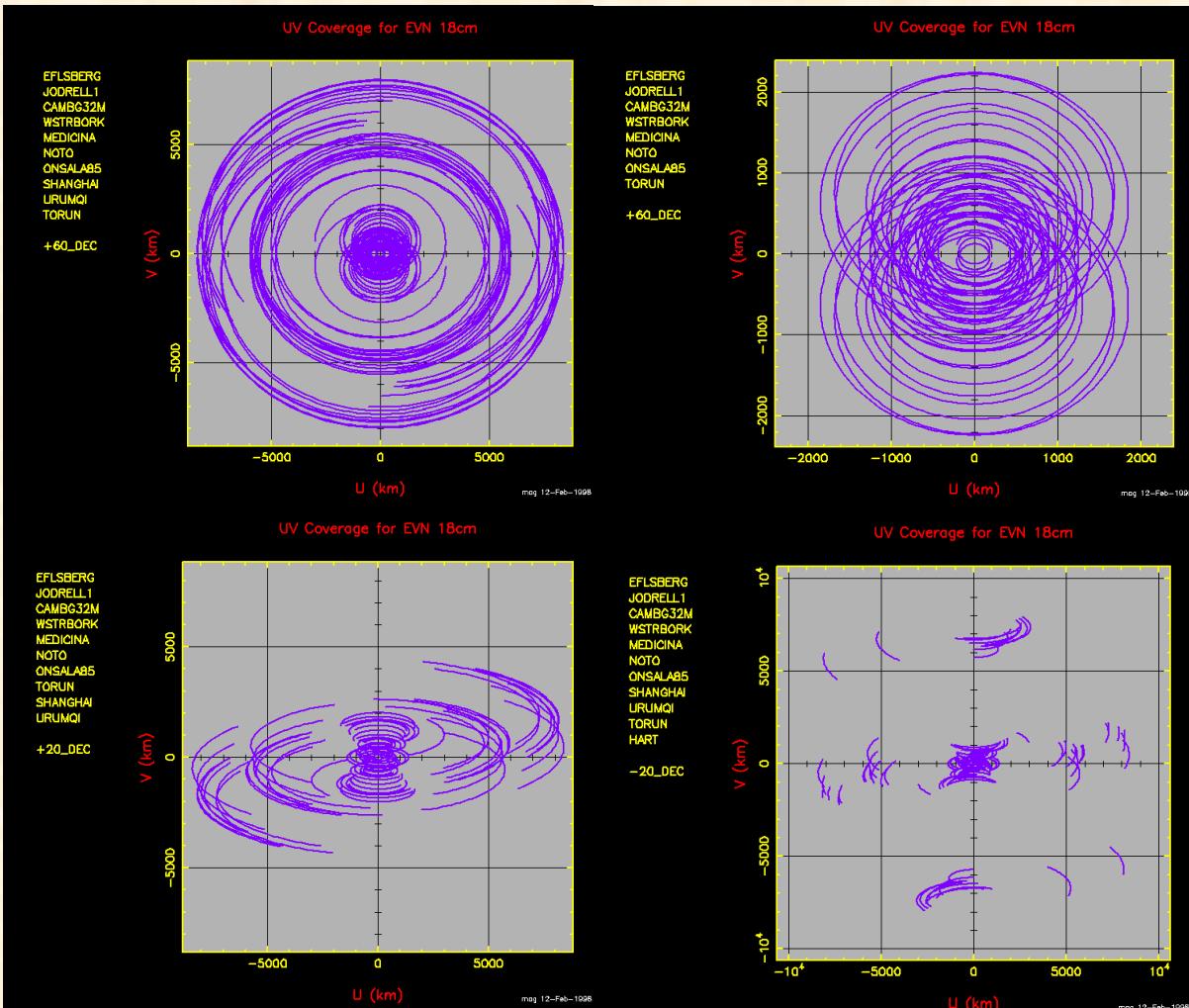
## Scheduling constraints

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



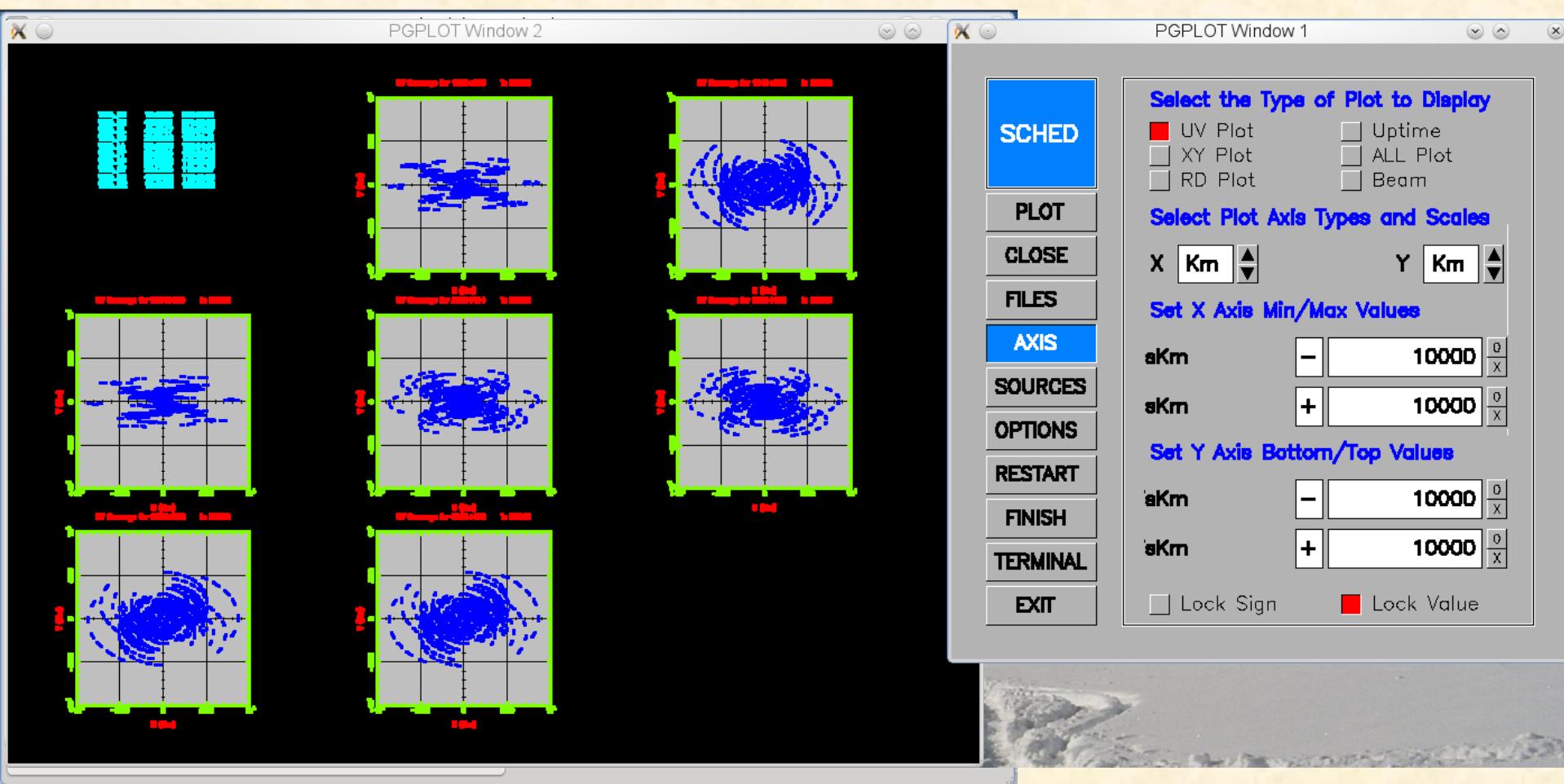
# Selection of telescopes for VLBI observations

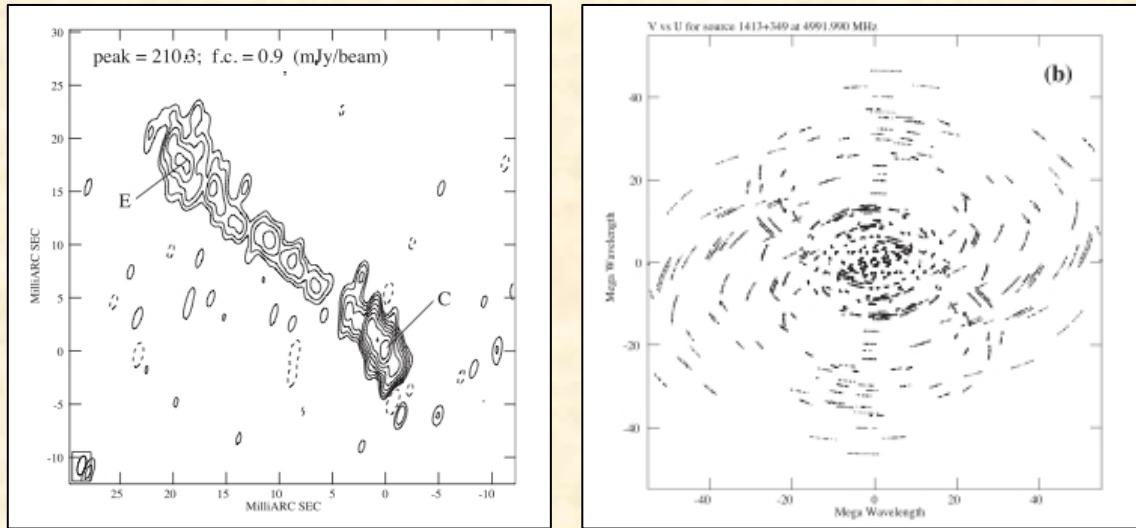
- Depending on the required angular resolution, sensitivity, and observing band one may choose EVN (multiple telescope choices), eVLBI, VLBA, HSA, GMVA, LBA or global VLBI
- Check the u-v coverage (telescopes and duration of observations)



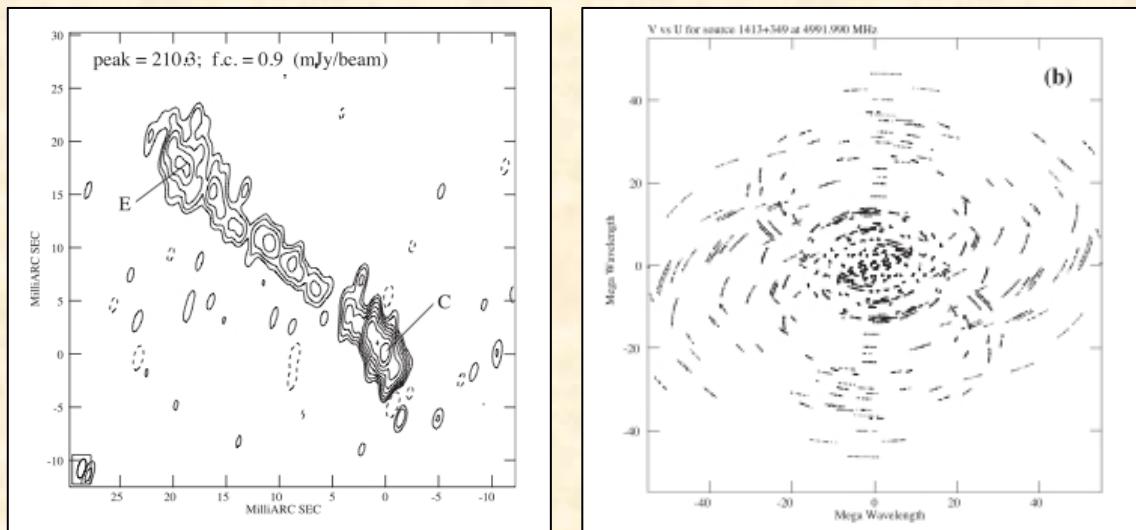
Examples of EVN (u,v) coverages

# Sched for VLBI observations

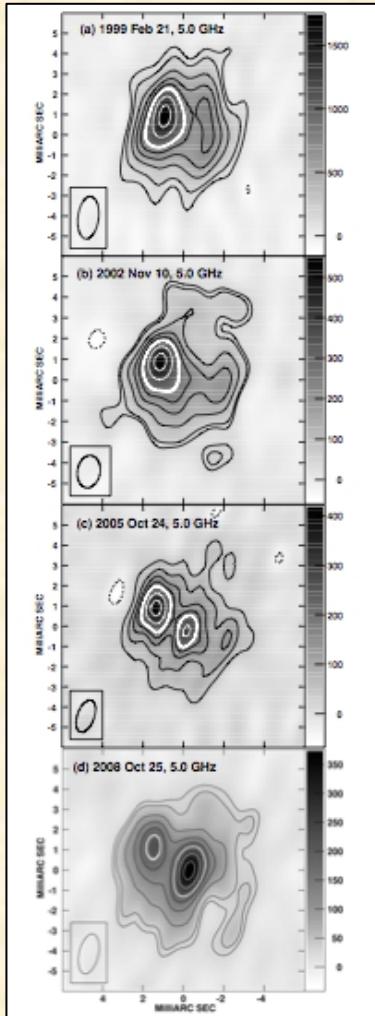




Dallacasa et al. 2013 – CSS radio source at 5 GHz, Global VLBI Array of 16 antennas, snapshot mode, total time on source 1.5 hr – Peak 209 mJy/beam



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



Bentenholz et al. 2010

**Table 1**  
VLBI Observations of SN 1986J

Peaks  $\sim 1$  mJy/beam

Date	Frequency (GHz)	Antennas <sup>a</sup>	Total Time (hr)	Recording Rate (Mbit s <sup>-1</sup> )
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.** <sup>a</sup> 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

- Common radio astronomical facilities usually announce a call for proposals one (i.e. ALMA) two (VLBA, GMVA, EVLA, GMRT, WSRT, LOFAR, ATCA) or three (EVN, eVLBI) times per year
- ToOs are accepted 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 the source list and technical requirements. 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 the source list and technical requirements. 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!!!

# Some useful tools and links

- EVN sensitivity calculator: [www.evlbi.org/cgi-bin/EVNcalc](http://www.evlbi.org/cgi-bin/EVNcalc)
- ALMA sensitivity calculator: [almascience.eso.org/call-for-proposals/sensitivity-calculator](http://almascience.eso.org/call-for-proposals/sensitivity-calculator)
- EVLA exposure calculator: [science.nrao.edu/facilities/vla/docs/manual/propvla/determining/source](http://science.nrao.edu/facilities/vla/docs/manual/propvla/determining/source)
- ATCA observing tools: [www.narrabri.atnf.csiro.au/observing/#tools](http://www.narrabri.atnf.csiro.au/observing/#tools)
- Sched (useful for planning VLBI experiments): [www.aoc.nrao.edu/~cwalker/sched/](http://www.aoc.nrao.edu/~cwalker/sched/)

# Some useful tools and links

- GMRT users observing help: [www.gmrt.ncra.tifr.res.in/gmrt\\_hpage/Users/Help/help.html](http://www.gmrt.ncra.tifr.res.in/gmrt_hpage/Users/Help/help.html)
- LOFAR tools: [www.astron.nl/radio-observatory/lofar/lofar-tools](http://www.astron.nl/radio-observatory/lofar/lofar-tools)
- VLA Calibrator Manual: [www.aoc.nrao.edu/~gtaylor/csource.html](http://www.aoc.nrao.edu/~gtaylor/csource.html)
- GMRT calibrator search page: [ncra.tifr.res.in/ncra\\_hpage/calib.html](http://ncra.tifr.res.in/ncra_hpage/calib.html)

# Proposal submission & submission tools

- Electronic submission via web-based tools is now the norm
- Different tools for different observatories
  - EVN, WSRT, eMERLIN, LOFAR: NorthStar ([proposal.jive.nl](http://proposal.jive.nl))
  - VLBA, EVLA: NRAO PST ([my.nrao.edu](http://my.nrao.edu))
  - ALMA Observing tool (download from [www.alma-science.org](http://www.alma-science.org))
  - ATCA ([opal.atnf.csiro.au](http://opal.atnf.csiro.au))
- 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

## 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 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 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 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 W 0.21

0005+544 J2000 A 00h05m04.363531s 54d28'24.926230" Aug01

0002+541 B1950 A 00h02m29.056400s 54d11'43.187000"

Continuum phase calibrators should be:

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

## VLBA Calibrators Search Form

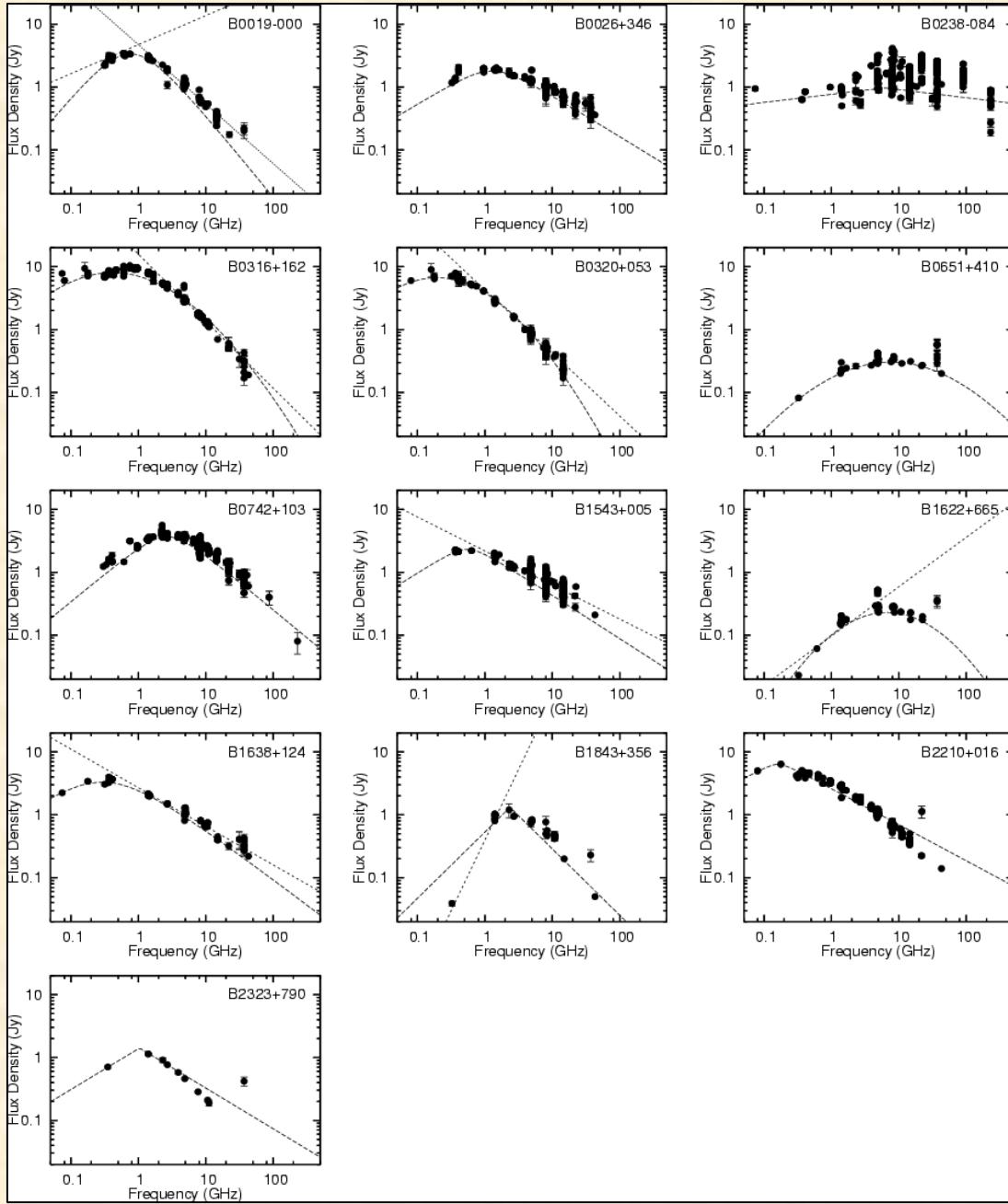
RA :		0h0m0.0s	Examples: RA = 6h45m10.76s DEC = 16d41'57.82" RA = 06h45M DEC = 16d42' RA = 06:45:10.76 DEC = 0.2914594
DEC :		0d0'0.0	A '*' for RA or DEC will not restrict the search on that axis.
Search Radius :		10d	The default search radius is 10 degrees. The maximum search radius is 45.0 degrees.

Maximum Number of sources returned: 5

Sort the Resulting list by: Distance



Check images on NVSS, FIRST, VLSS image surveys



## Example:

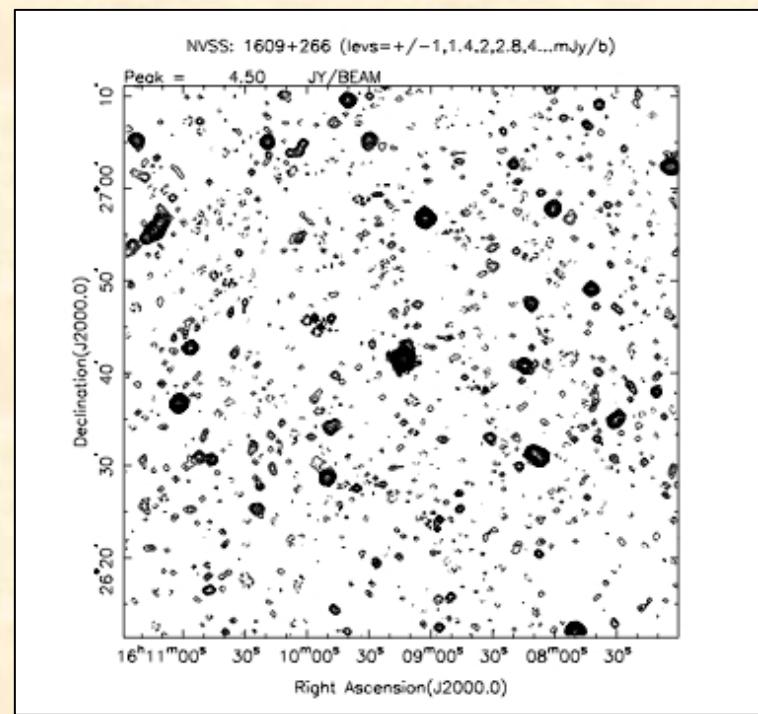
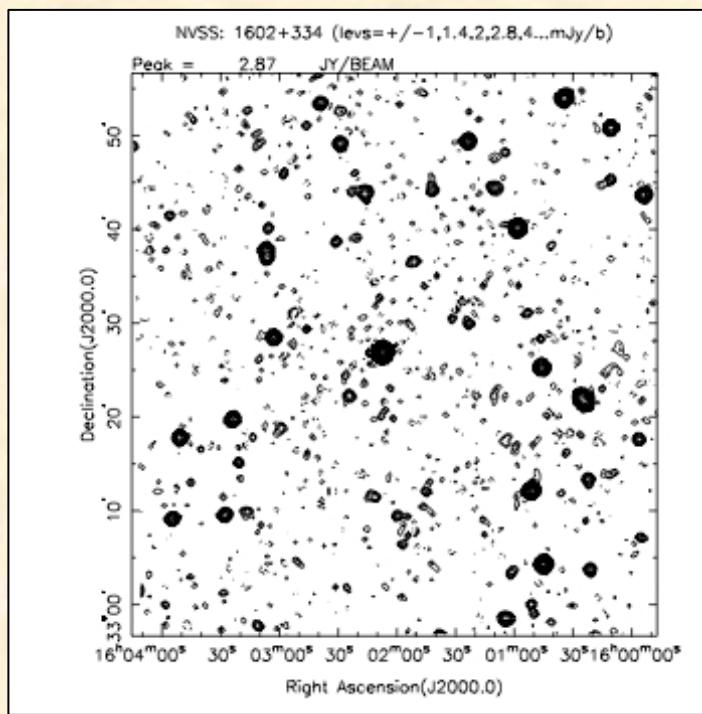
Calibrator search for GMRT observations of Abell 2142 at 610, 325, 240 MHz

RA<sub>J2000</sub>=15 58 16.1    DEC<sub>J2000</sub>=+27 13 29

1602+334	J2000	A	16h02m07.263468s	33d26'53.072670"	Aug01
1600+335	B1950	A	16h00m11.909300s	33d35'09.593000"	
<hr/>					
BAND	A	B	C	D	FLUX(Jy)
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](#)

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



## Example:

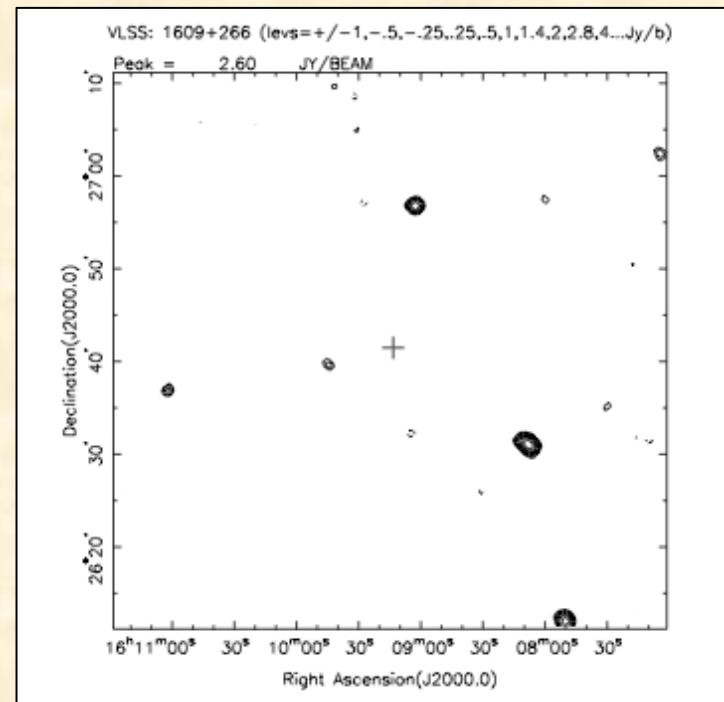
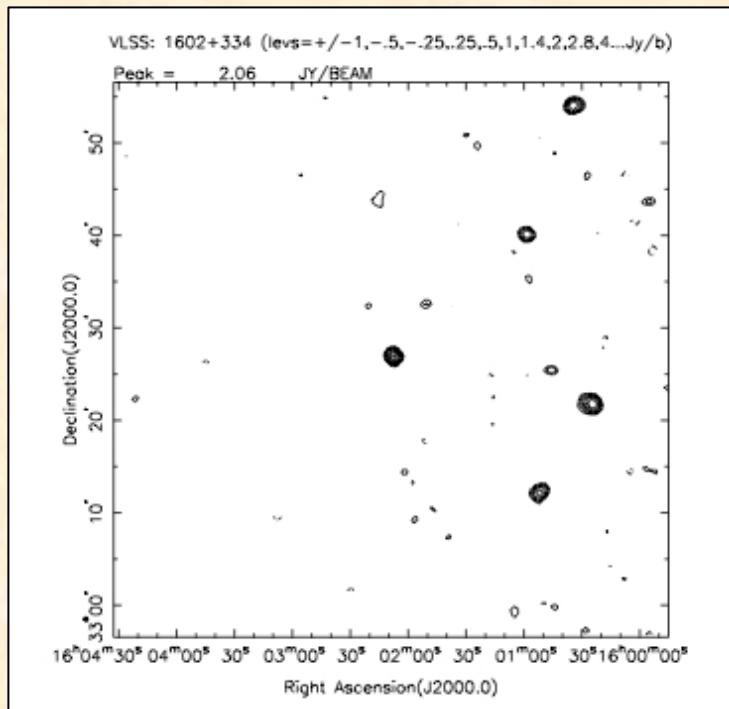
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BAND	A	B	C	D	FLUX(Jy)
20cm	L	P	P	P	2.60
6cm	C	P	P	P	2.00
3.7cm	X	P	P	P	2.05
2cm	U	P	P	P	1.40
0.7cm	Q	W	W	W	0.41

[visplot](#)

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



# Examples of observing file preparation tools OPT for EVLA

- Log in at e2e.nrao.edu

Screenshot of the NRAO User Portal Observation Preparation interface for creating a scheduling block.

**Information Tab:**

- GENERATED ID:** 5065125
- NAME:** [New Scheduling Block]
- STATUS:** Not Submitted
- COUNT:** 1
- COMPLETED:** 0
- TOTAL TIME:** 00:00:00
- TIME PER EXECUTION:** 00:00:00
- SCHEDULE TYPE:** Dynamic

**LST START RANGE:** 00 : 00 : 00 : 00 : 00  
NO CONSTRAINT:

**EARLIEST UT START DATE (OPTIONAL):** 2011/09/08

**SHADOWING LIMIT (MAX):** 0.0 m

**IN CONFIGURATION:** (Error message: Error: You must select at least one acceptable array configuration for this scheduling block's program block to select this.)

**ASSUMED ANTENNA STARTING POSITION:**

The diagram illustrates the angular positions of the antenna starting point relative to North (N). It shows a circular path with various angles labeled: 360° and 0° at the top, 85° and 445° on the right, -85° and 275° on the left, and 180° at the bottom. Arrows indicate clockwise (CW) and counter-clockwise (CCW) directions for wraps around the circle.

# 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](http://www.gmrt.ncra.tifr.res.in/gmrt_hpage/Users/Help/sys/setup.html)

### Observation Setup

• Project Code : 20\_123

• Project Title : Galaxy survey

• User's Name : J K Ram

• User's Email : xyz@abc.res.in

• Date of Obs. : 01 ◄ 01 ◄ 2006 ◄

• Start Time (IST hours) : 00 ◄

• Integration Time (sec) : 16 ◄

• Correlator Mode : Total Intensity ◄

• Beam Mode (pulsar) : OFF ◄

• Channel nos. : 256 ◄

• Radio Frequency Band : 325 -- ( 305 - 345 ) ◄

• Observation Type : Continuum ◄

• Spectral line Frequency (MHz) (line obs only) : 1420.7

• Band Width (MHz) : 33.33 ◄

• 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 : 3C48 ◄

• Target Source(s) & Phase cal(s) Loop :

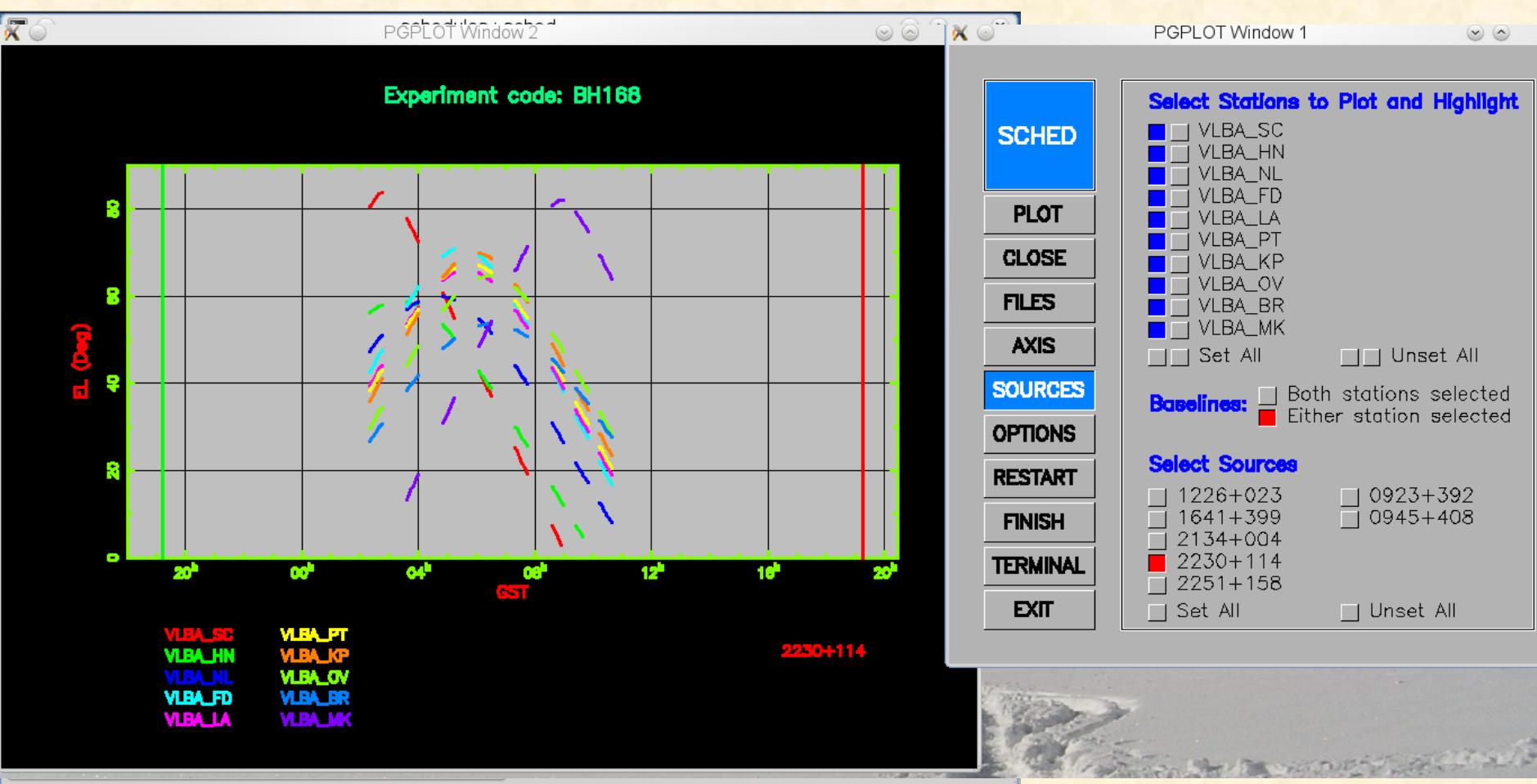
Scan-Time(minutes)	Target-Name
10	1254+116
30	NGC5435

• Flux Cal at End : 3C48 ◄

# 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/](http://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



# Sched for VLBI observations

The screenshot shows two side-by-side Emacs windows. Both windows have a title bar labeled "emacs" and "emacs@linux-db67.site". The left window displays a configuration file for VLBI observations, specifically for the EVLA experiment TPOL0003. The file contains comments starting with "!", sections for "Preferred Dynamic Constraints", "Equipment constraints", "Weather constraints", "Date constraints", and "EVPA calibration data". It specifies stations (SC, HN, NL, FD, LA, PT, KP, OV, BR, MK), start time (12:00:00 LST), day (62300), and caltime (60). It also lists feed locations (S/K/C/Ku/Q/W/L/X/Ka) and source coordinates (0923+392, 0945+408, 1226+023, 1641+399, 2134+004, 2230+114, 2251+158). The right window shows the same configuration file with some parts highlighted in green, indicating specific parameters being modified or reviewed.

```
! =====
! Preferred Dynamic Constraints
! =====
! Equipment constraints:
Stations. Below each static
[optional] station that
Change "o" to "r" if the
"o" to "n" if the station
SC HN NL FD LA P
r o o o o r
Minimum number of stations
May we swap PT for a sing
Bands and polarizations. Be
if the righthand polariz
lefthand polarization is
polarizations are to be u
your setups but scheduling
its availability.
90cm 50cm 20cm 13c
! Weather constraints:
[appropriate for bands marked
and for at least eight stat
Not terrible weather at MK
! Date constraints:
Preferred date(s), usually a
Excluded dates plus reason []
Preferred interval between s
Special conditions (e.g., a
spacings in time)
The EVLA experiment TPOL0003
scheduled within a few days
EVPA calibration data. In ac
request adding B2230+114 in
three EVPA calibrators.
Please, coordinate with the
! =====
! Schedule created by Tuomas Savonius
! =====
```

Left window status bar: bh168.key Top (32,25)

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# After the observations

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

Monday 09/09	
08:50-09:00 Welcome	R. Vermeulen & H. J. van Langevelde
09:00-09:45 1. Interferometric Radio Science	H. J. van Langevelde
09:45-10:30 2. Fundamentals of Interferometry	R. Laing
10:30-11:00 Coffee Break	
11:00-11:45 3. Modern interferometers	J. McKean
11:45-12:30 4. Data acquisition and calibration	D. Dallacasa
12:30-14:00 Lunch	
14:00-14:45 5. From visibilities to images	Tom Muxlow
14:45-15:15 Radio astronomical data formats and packages	A. Richards
15:15-15:45 Coffee Break	
15:45-17:30 Tutorial T1: Calibration	D. Dallacasa
17:30-17:45 Introduction to Tutorials T6 and T10 'Writing a proposal'	T. Venturi, R. Laing, A. Richards
Tuesday 10/09	
09:00-09:45 6. Polarization: data acquisition, calibration, and imaging	M. Brentjens
09:45-10:30 7. Spectral line interferometry: science and principles	M. Verheyen
10:30-11:00 Coffee Break	
11:00-11:45 8. Spectral line interferometry in practice	A. Richards
11:45-12:30 9. Millimeter interferometry	M. Bremer
12:30-14:00 Lunch	
14:00-15:45 Tutorial T2: Imaging - continuum and polarization	J. McKean
15:45-16:15 Coffee Break	
16:15-17:00 10. (Sub)mm observing & data reduction in practice	C. Goddi
17:00-18:45 Tutorial T3: Introduction to CASA: spectral line data reduction	A. Richards
Dinner	

# Future proposal deadlines

- WSRT: Sep 15 2013
- IRAM PdB: Sep 12 2013
- EVN: Oct 1 2013
- ATCA: Dec 15 2013
- GMRT: Jan 15 2014
- EVLA, VLBA, GMVA: Feb 1 2014
- ALMA: December 2013
- LOFAR: September 2014

GOOD LUCK WITH PROPOSAL PREPARATION!