# Archives and Legacy Data

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# From L13

# 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

# Outline

- Literature search
- Images from public continuum radio surveys
- Data release policy and public archives
- Large projects and legacy programs
- Imaging and data archives in other bands
- Use of public surveys and/or archive data in the proposal preparation and writing papers

nedwww.ipac.caltech.edu

NED

News & Featured Updates - July 2015

- Tabular and graphical summaries of NED holdings
- Updated links to SDSS Skyserver in object search results
- GALEX photometry now available in customized output tables
- 278,729 new object links to 830 references
- 9,733 new redshift-independent distances
- Hundreds of new images and spectra
- Latest articles in Level 5

Literature search

Try the new smart box on the main screen of the new user interface, which greatly simplifies common queries. Using a single text entry field, you can search by: object name, object name and search radius, coordinates and search radius, refcode, or (NBASQ) ticket number.

| OBJECTS | DATA | LITERATURE | TOOLS | INFO |
|---|---|---|---|---|
| By Name | Images by Object Name Region | References by Object Name | Coordinate Transformation & Extinction Calculator | Introduction Latest News/Updates |
| Near Name | Photometry & SEDs | References by Author Name | Velocity Calculator | Features FAQ |
| Near Position | Spectra | Text Search | Cosmology Calculators | Brochure (pdf) Best Practices (pdf) |
| IAU Format | Redshifts | Knowledgebase | Extinction-Law Calculators | Source Nomenclature |
| By Parameters | Redshift-Independent Distances | Galaxy Distance Tabulations (NED-D) | Galaxy Environment by Precomputed Parameters Radial Velocity Constraint | Web Links New Interface |
| By Classifications *Types, Attributes* | Classifications by Object Name | Abstracts | X/Y offset to RA/DEC | Glossary & Lexicon |
| By Refcode | Positions | Thesis Abstracts | Batch Help | Team |
| Object Notes | Diameters | | Build Data Table from Input List By Name Near Name/Position (Cross-Matching) | Contact Us or Comment |

If your research benefits from the use of NED, we would appreciate the following acknowledgement in your paper: *This research has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.*

NASA IPAC Caltech

# NASA/IPAC EXTRAGALACTIC DATABASE

Date and Time of the Query: 2015-09-09 T00:14:13 PDT

Help | Comment | NED Home

## You have selected the following parameters to search on:

**Redshift: Unconstrained**
**Include ANY Object Type:**
**Exclude ANY Object Type:**
**Parameters for Distances and Cosmology: $H_o = 73.0$; $\Omega_{matter} = 0.27$; $\Omega_{vacuum} = 0.73$;**
**Derived Quantities use a Redshift corrected to a Reference Frame defined by the 3K CMB**

## NED results within 1.000 arcmin of object ABELL 1656

---

**1311 objects found in NED.**

### SOURCE LIST

**Object list is sorted on Distance to search center**

| Row No. | Object Name (* => Essential Note) | EquJ2000.0 RA | DEC | Object Type | Velocity/Redshift km/s | z | Qual | Mag./ Filter | Separ. arcmin | Refs | Notes | N Phot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Coma Cluster | 12h59m48.7s | +27d58m50s | GClstr | 6925 | 0.023100 | | ... | 0.000 | 1436 | 7 | 31 |
| 2 | COMAi J125948.583+275851.18 | 12h59m48.6s | +27d58m51s | G | ... | ... | | 25.78 | 0.035 | 1 | 0 | 0 |
| 3 | COMAi J125948.922+275852.43 | 12h59m48.9s | +27d58m52s | G | ... | ... | | 24.29 | 0.053 | 1 | 0 | 0 |
| 4 | COMAi J125948.989+275852.70 | 12h59m49.0s | +27d58m53s | G | ... | ... | | 27.38 | 0.068 | 1 | 0 | 0 |
| 5 | COMAi J125949.038+275848.78 | 12h59m49.0s | +27d58m49s | G | ... | ... | | 26.60 | 0.073 | 1 | 0 | 0 |
| 6 | COMAi J125949.080+275849.95 | 12h59m49.1s | +27d58m50s | G | ... | ... | | 26.33 | 0.077 | 1 | 0 | 0 |
| 7 | COMAi J125949.109+275850.79 | 12h59m49.1s | +27d58m51s | G | ... | ... | | 25.80 | 0.083 | 1 | 0 | 0 |

# NASA/IPAC EXTRAGALACTIC DATABASE

Date and Time of the Query: 2015-09-09 T00:16:53 PDT



## You have selected the following parameters to search on:

**Velocity(km/s): Unconstrained**
**Include ANY Object Type:**
**Exclude ANY Object Type:**
**Parameters for Distances and Cosmology: $H_o = 73.0$; $\Omega_{matter} = 0.27$; $\Omega_{vacuum} = 0.73$;**
**Derived Quantities use a Redshift corrected to a Reference Frame defined by the 3K CMB**

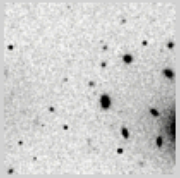
## Detailed Information for Object No. 1

**INDEX for Coma Cluster**

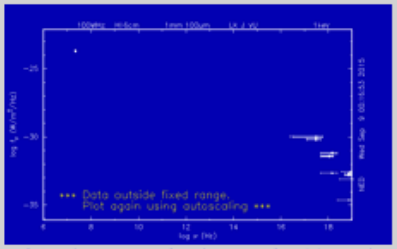
**Essential Data (jump to sub-section of this query report):**



**Detailed Data (NED queries):**



Images




31 Photometric data point(s) and SED

Spectra
Redshift-Independent Distances
1436 Reference(s)
2 Position data point(s)
7 Redshift data point(s)
7 Note(s)

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Velocity(km/s): Ur
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**EXTERNAL ARCHIVES AND SERVICES for Coma Cluster** Help (Back to INDEX)

| **Resources for Object Names** | **Site/Service** |
|---|---|
| Query SIMBAD by primary NED object name -- Coma Cluster | SIMBAD (CDS, Strasbourg, France) |
| Catalogue of Abell and Zwicky Clusters of Galaxies -- ABELL 1656 | VizieR Catalog Query (U.S. mirror, CfA/Harvard) |
| Query GALEX (NUV/FUV) Mission Archive (0.5' search radius) -- Coma Cluster | GALEX Mission Data Archive at MAST |
| Explore IRSA resources with RADAR (10"search radius) -- Coma Cluster | NASA/IPAC Infrared Science Archive (IRSA) |
| **Resources for position 12h59m48.7s, +27d58m50s (J2000)** | **Site/Service** |
| Query Optical and UV Mission Archives (Default search radius) | Multimission Archive at STScI (MAST) |
| Query High Energy Mission Archives (Default search radius) | HEASARC (NASA/GSFC) |
| Explore resources with DataScope (15' search radius) | HEASARC (NASA/GSFC) |
| Query SDSS SkyServer version dr9 | SDSS Sky Server |
| Query IRSA for WISE images (10' search radius) | NASA/IPAC Infrared Science Archive (IRSA) |
| Retrieve 2MASS Atlas Images Band(s): Ks Size: 2' | NASA/IPAC Infrared Science Archive (IRSA) |
| Retrieve IRAS ISSA Images Band(s): 60um Size: 30' | NASA/IPAC Infrared Science Archive (IRSA) |
| 1-D Coadd of IRAS Scans (ADDSCAN/SCANPI) | NASA/IPAC Infrared Science Archive (IRSA) |
| Retrieve NVSS Image Size: 15' (•) Contours (PS) ( ) JPEG ( ) FITS File | NRAO/VLA Sky Survey (NVSS) |
| Retrieve FIRST Image Size: 15' (•) GIF ( ) FITS File | Faint Images of the Radio Sky at Twenty-Centimeters |
| NRAO Archive 1 arcminute search radius (EVLA, VLA and VLBA) | The NRAO Data Archive System |

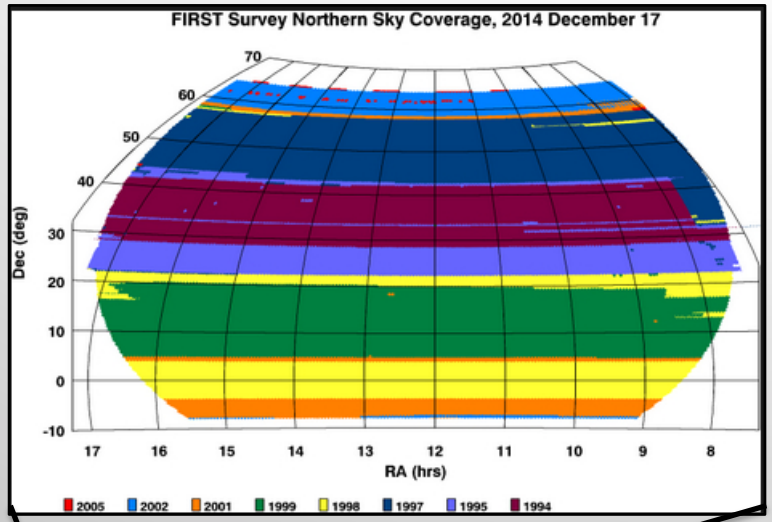
# Images from public continuum radio surveys

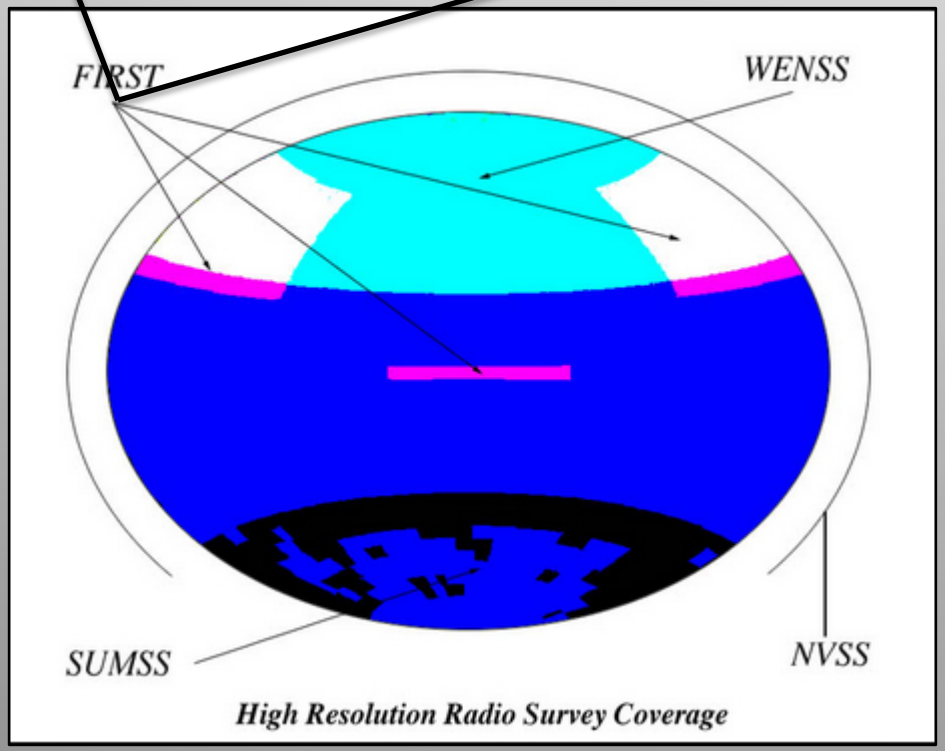
## A real treasury

### Public interferometric radio surveys

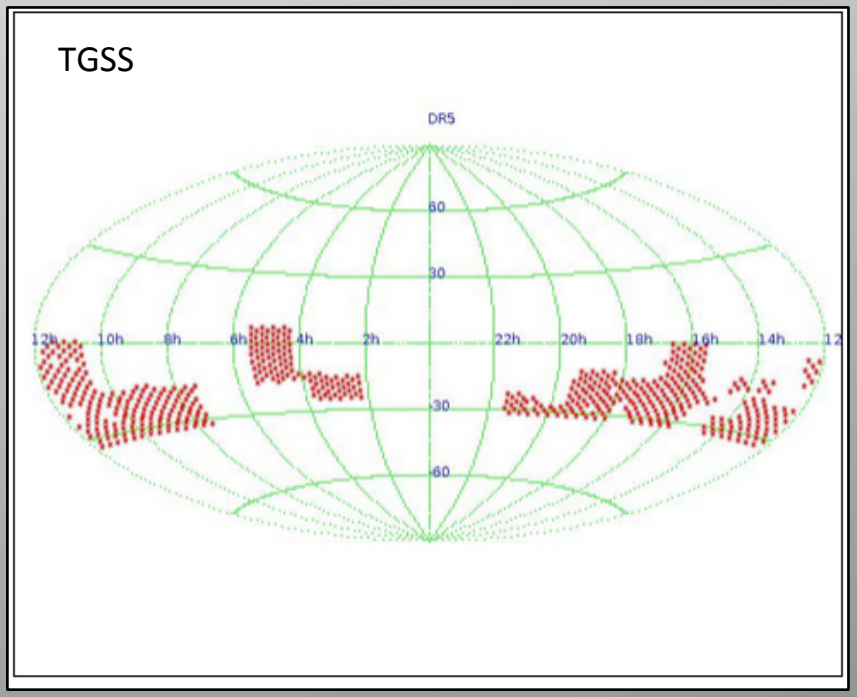
| Survey | ν MHz | Ang. Res. "x" | Sensitivity (1σ) mJy/b | Area deg$^2$ |
|---|---|---|---|---|
| NVSS VLA-D | 1400 | 40x40 | 0.45 | δ > -40° 35000 |
| FIRST VLA-B | 1400 | 5x5 | 0.15 | δ > -10° 10000 |
| SUMSS Molonglo | 843 | 45x45cosecδ | ~ 6 - 10 | δ < -30° 11600 |
| WENSS WSRT | 327 | 54x54cosecδ | 3.6 | δ > 30° 10000 |
| TGSS GMRT | 150 | 20x20 | ~7 – 9 | δ > -35° 32000 |
| VLSSr VLA-B | 74 | 80x80 | 100 | δ > -30° 30000 |

# Sky coverage of the available public surveys

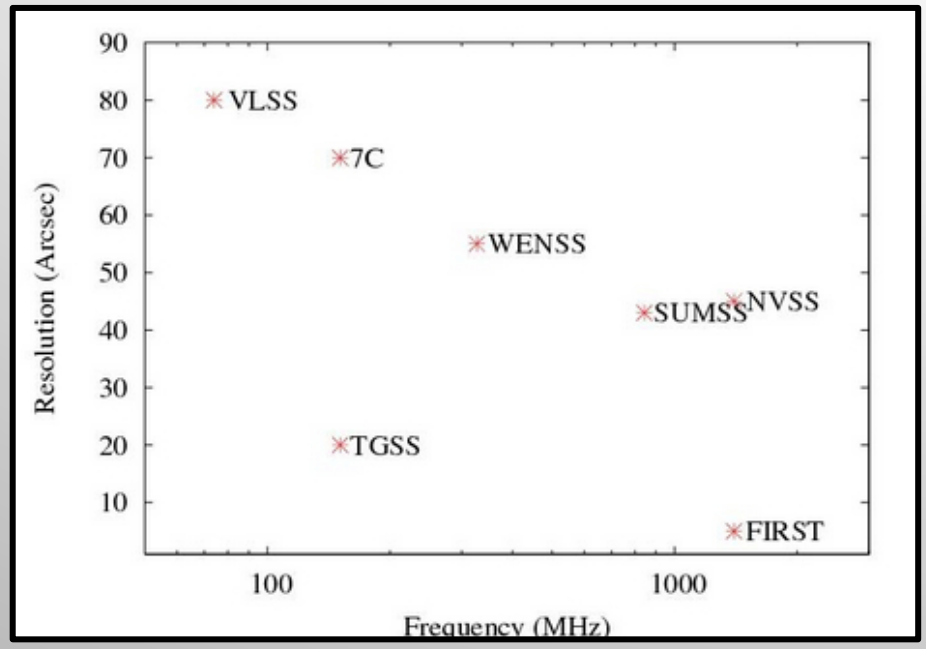


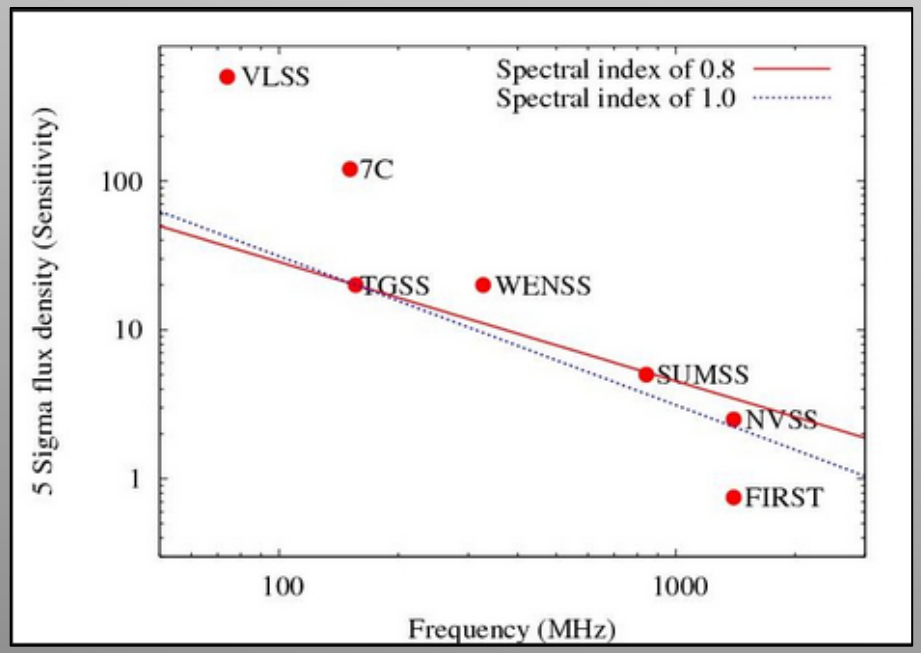




TGSS



# Sensitivity & angular resolutions




# Access & Available data products

- ✓ User friendly web access with postage stamp server/image cutouts
- ✓ Contour plots (ps or jpg)
- ✓ Image in FITS format
- ✓ uv data in FITS format

National Radio Astronomy Observatory

Thursday, September 3, 2015

# NVSS Postage Stamp Server

www.cv.nrao.edu/nvss/postage.shtml

This postage Stamp server for NRAO/VLA Sky Survey (NVSS) returns radio images of the sky in FITS or JPEG format, or as a contour plot. For detailed general instructions or information about this survey, see the Help File under "general"; or use the links on the forms for help about each item.

| | |
|---|---|
| Equinox: | J2000 |
| Polarization: | Stokes I |
| Object name *[optional]*: | |
| Central Right Ascension: | 00 00 00.00 |
| Central declination: | +00 00 00.00 |
| Desired image size (degrees):<br>See Pixel Spacing for size limit. | 0.25 0.25 |
| Pixel spacing:<br>Desired pixel size in arcseconds<br>(Min 0.001; max image size 262144 pixels, e.g. 512 x 512) | 15.0 15.0 |
| Projection: | Sine |
| Desired rotation<br>(N through E) on the sky in degrees. (Use 0.0 for contour plots) | 0.0 |
| Image Type:<br>Don't use "FITS *Image*" unless you have an external viewer configured to activate for fits files in your browser.<br>Also, for JPEG images, you may need to "reload" the image if you've fetched more than one. | JPEG Image |
| Submit! | Clear Form (ALL!) |

# Low frequency sky surveys with next generation interferometers

Not yet fully available for users

**Table 4.** Nominal MSSS parameters and comparison with other surveys

| Survey | Frequency | Sensitivity | Resolution | Area |
|---|---|---|---|---|
| MSSS-LBA | 30–78 MHz | $\lesssim 50$ mJy beam$^{-1}$ | $\lesssim 150''$ | 20 000 □° ($\delta > 0°$) |
| 8C | 38 MHz | 200 – 300 mJy beam$^{-1}$ | $4.5' \times 4.5'$ csc($\delta$) | 3 000 □° ($\delta > +60°$) |
| VLSS | 74 MHz | 100 mJy beam$^{-1}$ | $80''$ | 30 000 □° ($\delta > -30°$) |
| MSSS-HBA | 120–170 MHz | $\lesssim 10$–15 mJy beam$^{-1}$ | $\lesssim 120''$ | 20 000 □° ($\delta > 0°$) |
| 7C | 151 MHz | 20 mJy beam$^{-1}$ | $70'' \times 70''$ csc($\delta$) | 5 500 □° (irregular coverage) |
| TGSS | 140–156 MHz | 7–9 mJy beam$^{-1}$ | $20''$ | 32 000 □° ($\delta > -30°$) |
| WENSS | 330 MHz | 3.6 mJy beam$^{-1}$ | $54'' \times 54''$ csc($\delta$) | 10 000 □° ($\delta > +30°$) |
| NVSS | 1400 MHz | 0.45 mJy beam$^{-1}$ | $45''$ | 35 000 □° ($\delta > -40°$) |

*Note. Sensitivity and resolution values for the MSSS survey components are upper limits corresponding to images produced with baselines shorter than 3 k$\lambda$. Longer baselines are included in the observations as a matter of course, enabling reprocessing toward the production of an updated, higher angular resolution catalog.*

Heald et al. 2015, arXiv:1509.01257v1

www.vo.astron.nl

www.msss.astron.ni

Lo

on

**Table 4.** Nominal MSS

| Survey |
| --- |
| MSSS-L |
| 8C |
| VLSS |
| MSSS-H |
| 7C |
| TGSS |
| WENSS |
| NVSS |

*Note. Sensitivity and r*

*shorter than* 3 k$\lambda$. *Long*

*erage)*

*luced with baselines*

*d the production of an*

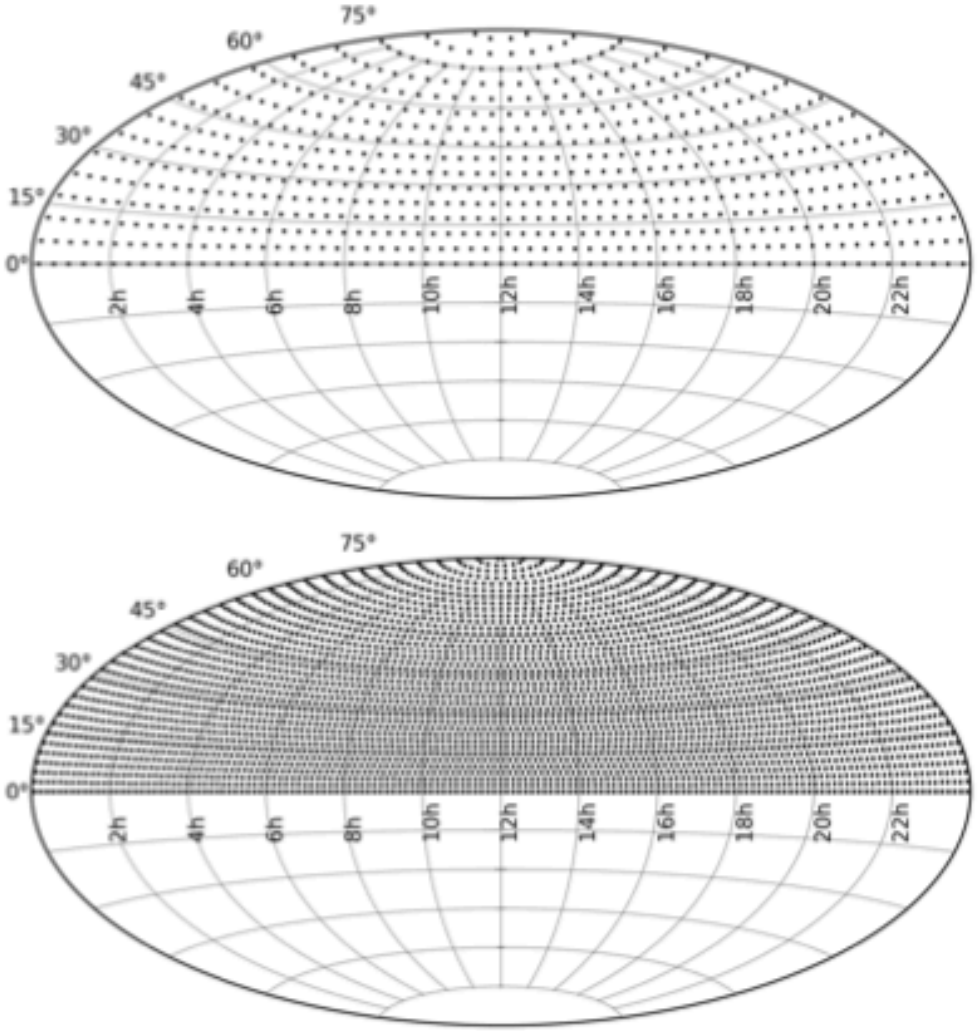



**Fig. 4.** MSSS fields for the LBA (*top*) and HBA (*bottom*) portions of the survey, presented in equatorial coordinates on an Aitoff projection. The LBA survey consists of 660 fields, while the HBA survey consists of 3616 fields.

# Low frequency sky surveys with next generation interferometers

Not yet available for users

Table 4: Summary of radio surveys below 1 GHz substantially covering the southern hemisphere

| Survey | Freq (MHz) | Resolution (arcmin) | Max size (arcmin) | Coverage | Stokes I cutoff (Jy) |
|---|---|---|---|---|---|
| MRC[a] | 408 | $2.6 \times 2.9 \sec(\delta + 35.5°)$ | $\sim 30$ | $+18.5 > \delta > -85,\ \lvert b \rvert > 3$ | 0.7 |
| SUMSS[b] | 843 | $0.75 \times 0.75\ \mathrm{cosec}\lvert\delta\rvert$ | 163 | $\delta < -30$ | 0.006 - 0.01 |
| VLSS(r)[c] | 74 | 1.25 | $\sim 23^{*}$ | $\delta > -40$ | $\sim 0.5$ |
| TGSS[d] | 150 | 0.33 | | $\delta > -30$ | $\sim 0.03$ |
| PAPER32[e] | 145 | 26 | $\sim 300$ | $\delta < 10$ | 10 |
| MSH[f] | 86 | 50 | n/a | $\delta < 10$ | 20 |
| GLEAM | 72-231 | $2.5 \times 2.2 \sec(\delta + 26.7°)^{\dagger}$ | $\sim 600$ | $\delta < +25$ | $\sim 0.1^{\dagger}$ |

[*] Assuming $150\lambda$ is the shortest effective baseline for the VLA B array at 74 MHz.
[†] At 154 MHz.

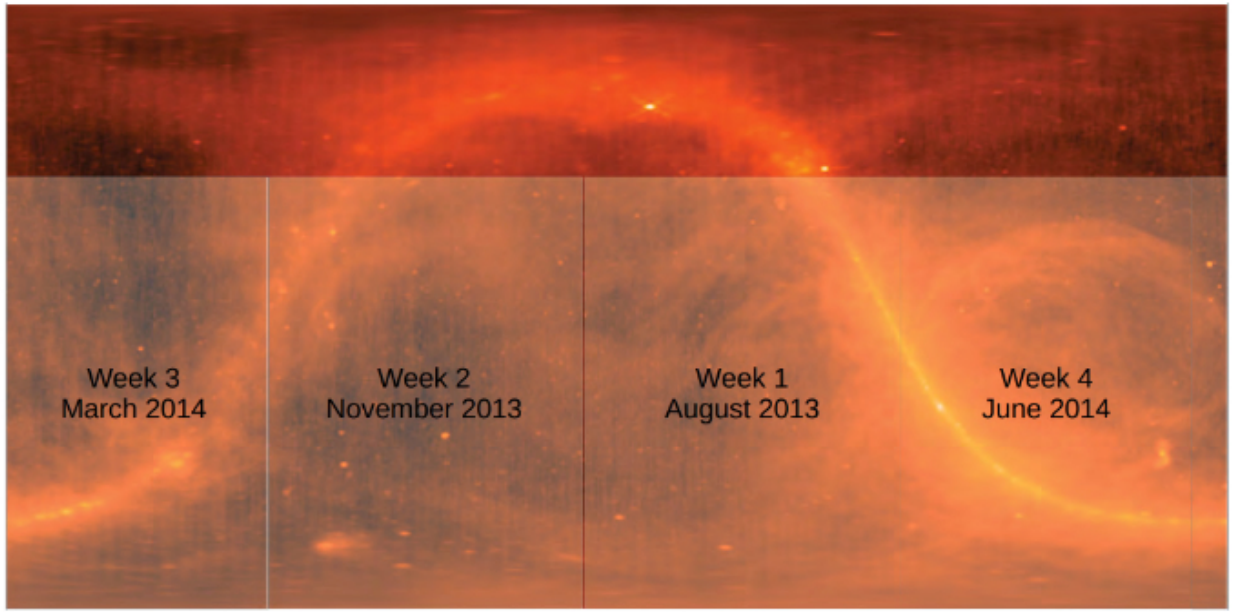
From Wayth et al. 2015

# Low frequency sky surveys with next generation interferometers

Not yet available for users

## GLEAM Sky Coverage

- All observations completed, phase I data processing done & phase II on going.




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

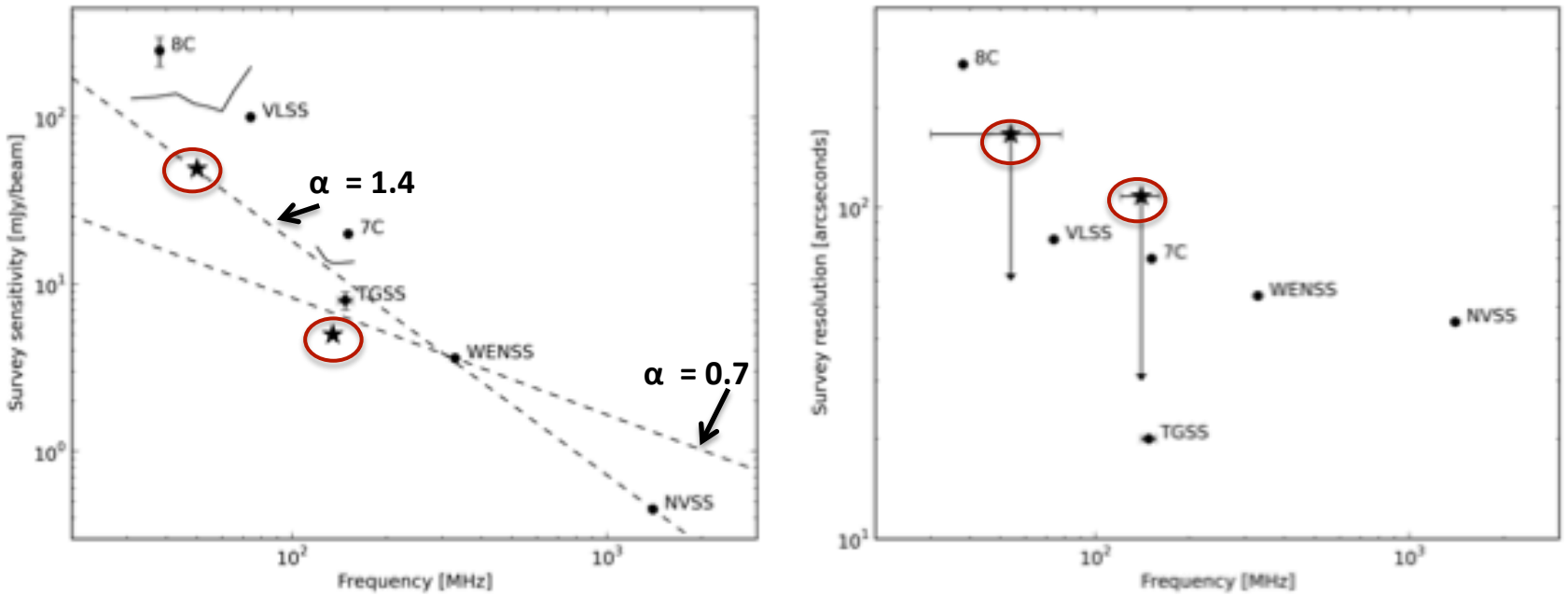



**Fig. 17.** Comparisons between MSSS sensitivities (*left*) and resolutions (*right*) with those of other existing radio surveys as summarized in Table 4. In the lefthand panel, dashed lines indicate representative spectral indices of $\alpha = -0.7$ and $\alpha = -1.4$. The solid black lines illustrate the frequency dependence of the sensitivity in the 8 bands in each of the LBA and HBA survey segments, while the black stars show the frequency-averaged sensitivity demonstrated in §5. In the righthand panel, the downward-pointing arrows indicate that the angular resolution of the initial MSSS catalog is limited with respect to the capabilities of the visibility data. Processing the full array will improve the survey performance.

Heald et al. 2015, arXiv:1509.01257v1

# Data release policy and public archives

EVN, NRAO (JVLA, VLBA), (e)MERLIN, WSRT, GMRT, ATCA, IRAM LPA, ALMA, LOFAR…

- ✓ Ground and space observatories (not only in the radio band) usually adopt a data release policy: Approved observations are accessible to the proposing team for a limited period (proprietary period), after which the data become public.
- ✓ The proprietary period is usually of the order of 12 – 18 months, and can be negotiated only under exceptional circumstances.
- ✓ Data archives have a web interface and can be easily accessed
- ✓ Depending on the facility, raw or pipelined u-v data are made available

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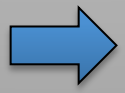
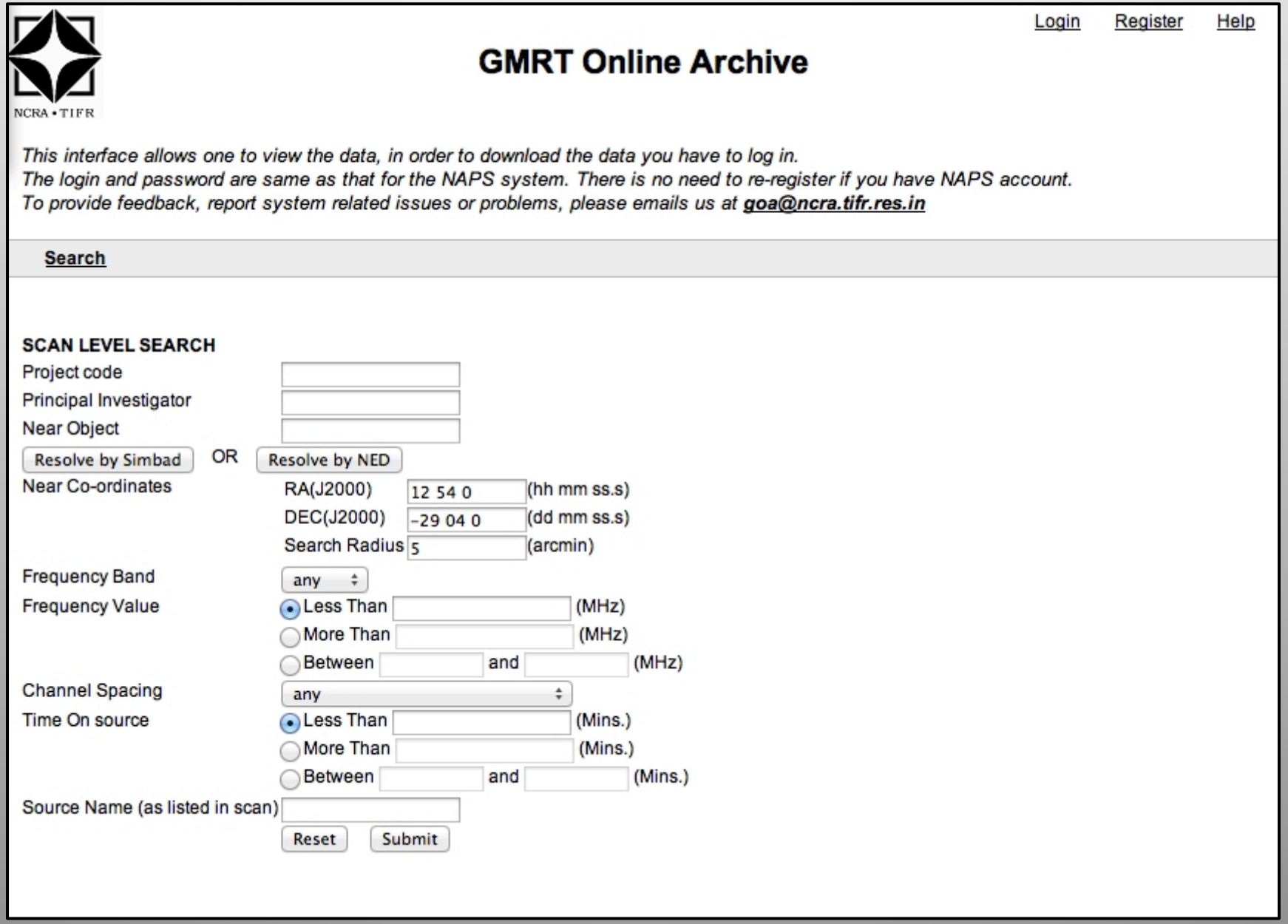
Most likely, a wealth of data for your target is available and accessible even without an observing time request



Can this be useful/is it what you need?
Frequency, resolution, sensitivity, u-v coverage (LAS), FoV …

# Example: GMRT data archive (they are all very similar in concept)



# Example: GMRT data archive (they are all very similar in concept)

Login Register Help

NCRA • TIFR

## GMRT Online Archive

*This interface allows one to view the data, in order to download the data you have to log in.*
*The login and password are same as that for the NAPS system. There is no need to re-register if you have NAPS account.*
*To provide feedback, report system related issues or problems, please emails us at **goa@ncra.tifr.res.in***

**Search**

Scan Parameters :: RA: 12 54 0 DEC: -29 04 0 Radius: 5 Refine Search

**Showing page 1 of 1. Total records: 11**
<< first < prev 1 next > last >> 200

***NOTE: You can download data only if you are logged in. After you log in, links for adding data files to download cart will show up in the 'Add data to cart' column***

| Select all | Project code | PI | Observation No | Add data to cart | Source | RA 2000 | DEC 2000 | Time on src(Mins) | Frequency1 (MHz) | Frequency2 (MHz) | Channel Width (KHz) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 05TVA01 | Tiziana Venturi | 1443 | | A3528_1 | 12h54m20s | -29d2m30s | 29 | 325.0 | 325.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1443 | | A3528_1 | 12h54m20s | -29d2m30s | 35 | 325.0 | 325.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1443 | | A3528_1 | 12h54m20s | -29d2m30s | 31 | 325.0 | 325.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1443 | | A3528_1 | 12h54m20s | -29d2m30s | 49 | 325.0 | 325.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1446 | | A3528_1 | 12h54m20s | -29d2m30s | 59 | 614.0 | 244.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1446 | | A3528_1 | 12h54m20s | -29d2m30s | 47 | 614.0 | 244.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1446 | | A3528_1 | 12h54m20s | -29d2m30s | 25 | 614.0 | 244.0 | 125.0 |
| | 05TVA01 | Tiziana Venturi | 1448 | | A3528_1 | 12h54m20s | -29d2m30s | 23 | 614.0 | 244.0 | 125.0 |

Download details may vary from case to case

30m telescope
NOEMA interferometer
Proposals
- Call for proposals
- Large Program policy
- Director's discretionary time proposals
- Guidelines for observing time
- Data policy
- Proposal templates
- Preparing proposal submission
- Submitting proposals
- Program committee recommendations

Large Programs
Results, Reports and Archives
News
Events

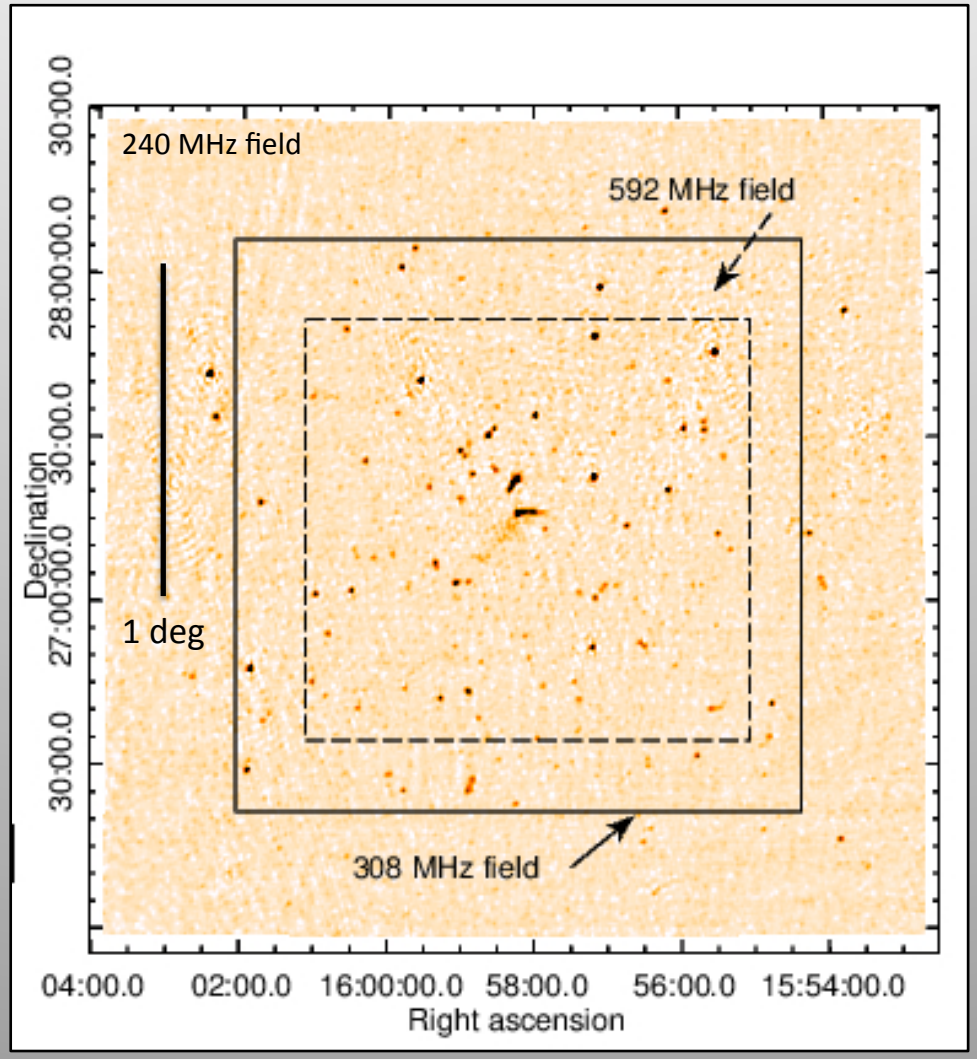
# The IRAM data policy is as follows:

- IRAM organizes storage of raw and online calibrated data for the 30m telescope and storage of raw data for NOEMA/PdB on unlimited time scales.
- Header information of PdB/NOEMA observations later than 1991 can be found at the CDS (*Centre de Données astronomiques de Strasbourg*): http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=B/iram/pdbi
- Header information of 30m observations later than 2009 can be found at the CDS: http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=B/iram/30m
- Observing programs are distinguished between normal programs and large programs. Data from large programs are public in reduced format after an 18 month proprietary period (counting from the end of the last semester of observations) and are accessible through the IRAM Large Program archive.
- Data from normal programs so far had indefinite proprietary time. Following a decision of the IRAM partners in June 2015 the following changes are introduced:
  Raw data from NOEMA/PdB or online calibrated data from the 30m telescope of individual normal programs may be provided by IRAM after a three year proprietary period (again counting from the end of the last semester of observations) and depending on directors decision. Multiple large scale requests are excluded.
  This policy applies to future programs and to programs terminated during the winter semester 2013/14 or later. Data from programs finished before this date can be requested after December 2016.

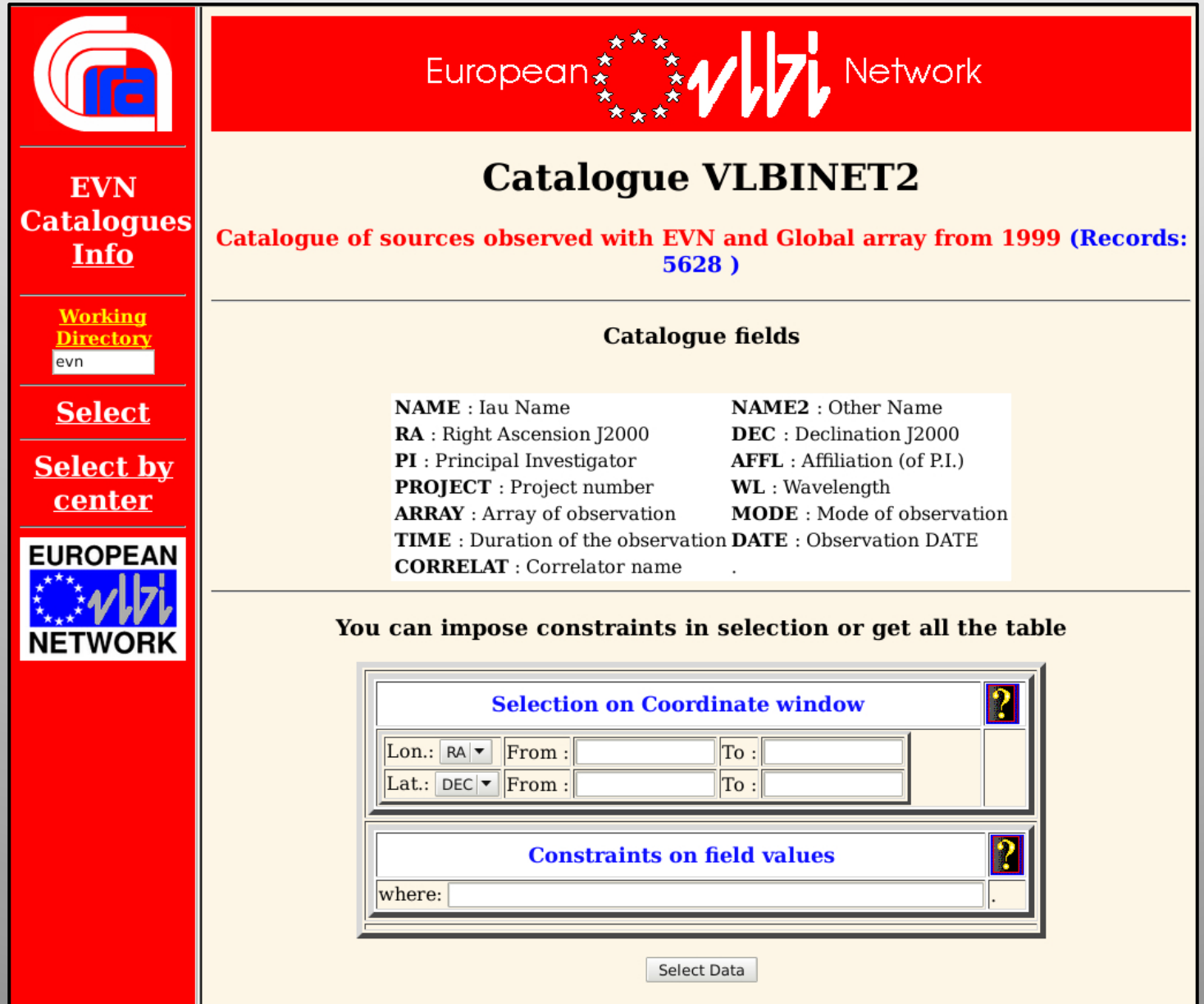
IRAM does not provide support for data reduction of such retrieved data. Referencing of these data should follow the standard IRAM reference (see the Data publication policies) and in addition include at least one reference to publications of the PI team, or the program number in case the data have not yet been published.



Your target may be within the field of view of another observation



# Example: EVN data archive at JIVE



EVN Catalogues Info

Working Directory
evn

Select

Select by center

EUROPEAN VLBI NETWORK

European VLBI Network

## Catalogue VLBINET2

**Catalogue of sources observed with EVN and Global array from 1999 (Records: 5628 )**

### Catalogue fields

| | |
|---|---|
| **NAME** : Iau Name | **NAME2** : Other Name |
| **RA** : Right Ascension J2000 | **DEC** : Declination J2000 |
| **PI** : Principal Investigator | **AFFL** : Affiliation (of P.I.) |
| **PROJECT** : Project number | **WL** : Wavelength |
| **ARRAY** : Array of observation | **MODE** : Mode of observation |
| **TIME** : Duration of the observation | **DATE** : Observation DATE |
| **CORRELAT** : Correlator name | . |

**You can impose constraints in selection or get all the table**

**Selection on Coordinate window**

Lon.: RA From : To :

Lat.: DEC From : To :

**Constraints on field values**

where: .

Select Data

# Example: EVN data archive at JIVE

## EVN Data Archive at JIVE

Availability of standard plots, pipeline and fitsfiles.

Select Sort order: Experiment Observation period: 2014 - 2015 Invia

| Experiment | Stnd | Pipe | Fits | P.Investigator | Stations | Obs. Date | Distr. Date | Publ. Date | Support Scientist |
|---|---|---|---|---|---|---|---|---|---|
| EA053A | x | x | x | Akiyama | JbWbEfMcNtOnShUrTrYsSvZcBdHh | 140304 | 140626 | 150626 | Duev |
| EA053B | x | x | x | Akiyama | JbWbEfMcNtOnShUrTrYsSvZcBd | 140305 | 140626 | 150626 | Duev |
| EA053C | x | x | x | Akiyama | JbWbEfMcNtOnShUrTrYsSvZcBdHh | 140305 | 140626 | 150626 | Duev |
| EA053D | x | x | x | Akiyama | JbWbEfMcNtOnShUrTrYsSvZcBdHh | 140306 | 140626 | 150626 | Duev |
| EA053E | x | x | x | Akiyama | JbWbEfMcNtTrYsHh | 140308 | 140626 | 150626 | Duev |
| EA055A | x | x | x | Argo | EfWbJbOnNtTrSvZcBd | 141030 | 150203 | 160203 | Surcis |
| EA056A | x | x | x | Akiyama | JbWbEfNtOnShTrSvZcBdHhYs | 141026 | 150306 | 160306 | Duev |
| EA056B | x | x | x | Akiyama | JbWbEfNtOnShTrSvZcBdHh | 141102 | 150306 | 160306 | Duev |
| EB052E | | | | Bartkiewicz | YsJbEfMcOnTrNtHhWbSr | 150315 | | | Duev |
| EB052F | x | x | x | Bartkiewicz | YsJbEfMcOnTrNtHhWbSr | 150317 | 150901 | 160901 | Duev |
| EB052G | x | x | x | Bartkiewicz | YsJbEfMcOnTrNtHhWbSr | 150318 | 150901 | 160901 | Duev |
| EB052H | x | x | x | Bartkiewicz | YsJbEfMcOnTrNtHhWbSr | 150319 | 150901 | 160901 | Campbell/Mao |
| EB056 | | | | Biggs | JbWbEfMcO8TrSvBdZcYsHhT6NtAr | 150608 | | | |
| EC044 | x | x | x | Cui | EfWbJbOnNtTrYsT6 | 140616 | 140926 | 150926 | Goddi |
| EC045 | x | x | x | Cseh | EfJbWbOnMcNtTr | 140114 | 140116 | 150116 | Paragi |
| EC047A | x | x | x | Castangia | EfWbOnJbNtSvMcTrZcUrBdSrSh | 150228 | 150624 | 160624 | Surcis |
| EC047B | x | x | x | Castangia | EfWbOnJbNtSvMcTrZcUrBdYsSh | 150311 | 150624 | 160624 | Surcis |
| EC048 | x | x | x | Caccianiga | EfNtOnTrShWbSvBdZcJb | 140601 | 141022 | 151022 | Goddi |
| EC052A | x | x | x | Cseh | EfHhJbNtOnTrWbSh | 141008 | 141014 | 160626 | Paragi |
| EC052B | x | x | x | Cseh | EfHhJbNtOnTrYsWbSh | 141118 | 141120 | 160626 | Paragi |
| EC052C | x | x | x | Cseh | EfHhJbMcNtOnTrWbSh | 150210 | 150213 | 160626 | Paragi |
| EC052D | x | x | x | Cseh | EfJbNtOnTrYsWbHhSh | 150324 | 150326 | 160626 | Surcis |
| EC052E | x | x | x | Cseh | EfHhJbMcNtO8TrWbSh | 150623 | 150626 | 160626 | Paragi |
| EC053 | x | x | x | Coppejans | EfHhJbMcNtOnShTrWb | 150114 | 150115 | 160115 | Paragi |
| EF025 | x | x | x | Frey | EfWbOnMcNtTrShJb | 140221 | 140304 | 150304 | Paragi |

# Example: EVN data archive at JIVE

Archive Info
Station Feedback
Station Logfiles
Standard plots
Pipeline calibration
Fitsfiles

## Contents of EVN archive at JIVE for experiment EA053A

### Products

- The feedback page was filled in by the stations and gives information about local circumstances during the observation.
- The station logfiles, schedfiles etc. point directly to the Bologna archive. They reflect in detail the instumental settings during th observation.
- Standard plots preliminary show the quality of the correlated experiment. The standard plots are produced close after the correla the experiment is finished. The page also contains a link to the P.I. letter, which tells how the correlation was done. The standar are public.
- The pipeline gives a more detailed impression of the quality of the correlation. It contains also plots for each source separately. possible that certain plots are set to private on demand of the P.I.
- The fitsfiles are the final product and are private to the P.I. during a period of 12 months. When a fast internet connection is ava the fitsfiles can be downloaded by the owner of the experiment or by everyone after the expiration date of the protection.

### Archiving Policy

P.I.s have sole right of access to data for their project for a period of 12 months after the distribution to the P.I.
During this period data can only be accessed using a username and password provided by the project support scientist.
The full EVN Data Access Policy can be found here.

# Example: EVN data archive at JIVE

Archive Info
Station Feedback
Station Logfiles
Standard plots
Pipeline calibration
Fitsfiles

## EVN User Experiment Pipeline Feedback of EA053A

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 down-loaded 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 apriori amplitude calibration and CL table 3 provides phase, phase-rate, delay and amp gain solutions from the calibrators).
- The parseltongue pipeline script can be found here .
- In addition, the original pipeline script is made available, together with final versions of the ancilliary 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, copy next line to your commandwindow:

**wget -t45 -l1 -r -nd http://archive.jive.nl/exp/EA053A_140304/pipe -A "ea053a*"**

| Pipeline products of experiment EA053A | |
|---|---|
| Pipeline plots | |
| AIPS calibration. tables (FITS Format) | |
| AIPS history file. | |
| Short summary of CL/SN table contents. | |
| Input parameters for script. | |
| Associated EVN calibration. | |
| Associated VLBA / VLA / GBT file. | (Not available) |

# Large projects and legacy programs

Very large observatory programs, or individual large projects, which are granted observing time under the agreement that the data (usually final data products) will be made available within a short timescale from the observations

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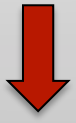
Very large observatory programs, or individual large projects, which are granted observing time under the agreement that the data (usually final data products) will be made available within a short timescale from the observations

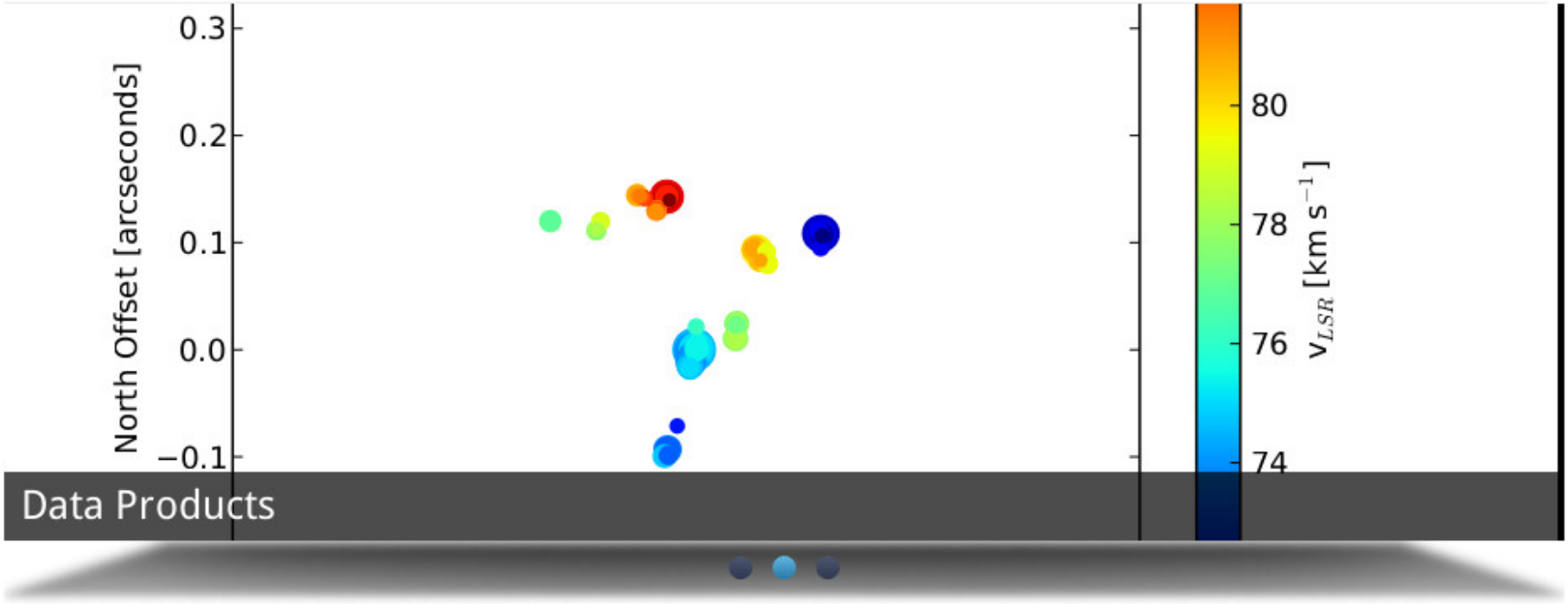


- Check if your target belongs to/is included in a legacy program
- Mind that if you are thinking of a very large proposal, your changes of being granted observing time may increase if you add a legacy value

# Multifrequency & multiepoch monitoring of radio loud AGNs with the VLBA

## Huge database, whose value has become even more relevant in the era of Fermi observations

BeSSeL
Bar and Spiral Structure Legacy Survey, a VLBA Key Science Project

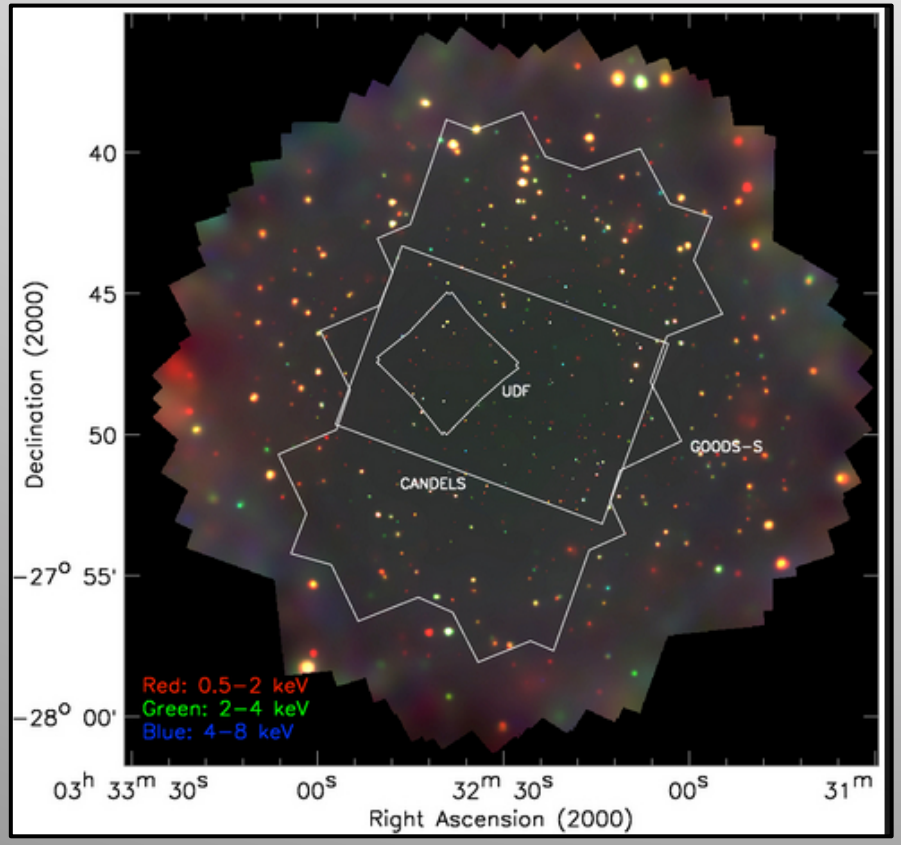



# The Bar And Spiral Structure Legacy (BeSSeL) Survey

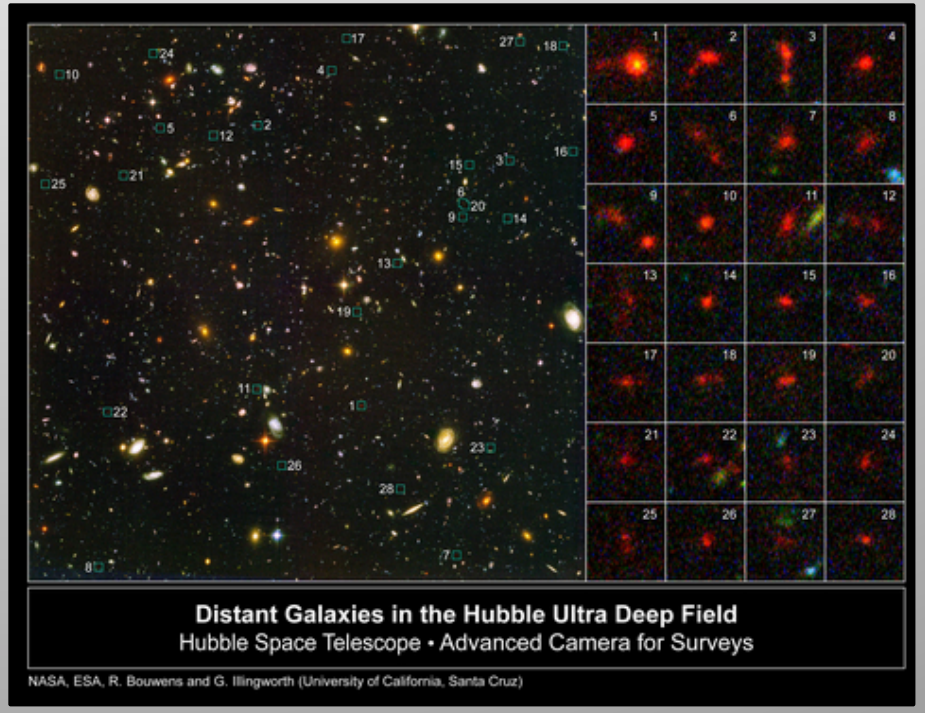
The **BeSSeL** Survey (**B**ar and **S**piral **S**tructure **L**egacy Survey) is a VLBA Key Science project. The survey is named in honor of Friedrich Willhelm Bessel who measured the first stellar parallax in 1838. The goal of the survey is to study the spiral structure and kinematics of the Milky Way.

# Legacy programs are being carried out with all facilities

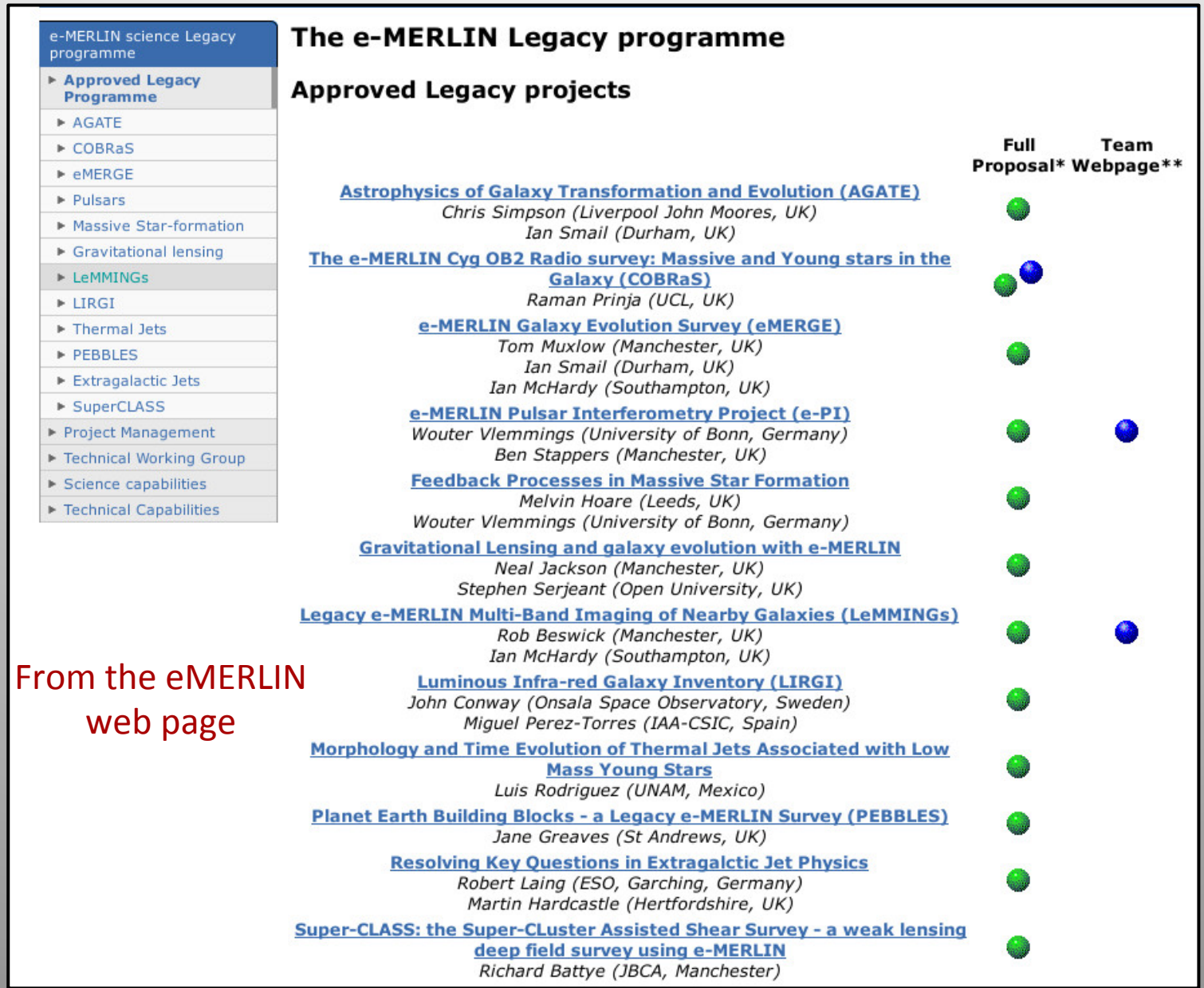
Chandra Deep Field South - 4 Ms




Hubble Ultra Deep Field – 23 days



# Forthcoming legacy projects with new facilities



e-MERLIN science Legacy programme

- **Approved Legacy Programme**
  - AGATE
  - COBRaS
  - eMERGE
  - Pulsars
  - Massive Star-formation
  - Gravitational lensing
  - LeMMINGs
  - LIRGI
  - Thermal Jets
  - PEBBLES
  - Extragalactic Jets
  - SuperCLASS
- Project Management
- Technical Working Group
- Science capabilities
- Technical Capabilities

## The e-MERLIN Legacy programme

### Approved Legacy projects

| | Full Proposal* | Team Webpage** |
|---|---|---|
| **Astrophysics of Galaxy Transformation and Evolution (AGATE)**<br>*Chris Simpson (Liverpool John Moores, UK)*<br>*Ian Smail (Durham, UK)* | ● | |
| **The e-MERLIN Cyg OB2 Radio survey: Massive and Young stars in the Galaxy (COBRaS)**<br>*Raman Prinja (UCL, UK)* | ● ● | |
| **e-MERLIN Galaxy Evolution Survey (eMERGE)**<br>*Tom Muxlow (Manchester, UK)*<br>*Ian Smail (Durham, UK)*<br>*Ian McHardy (Southampton, UK)* | ● | |
| **e-MERLIN Pulsar Interferometry Project (e-PI)**<br>*Wouter Vlemmings (University of Bonn, Germany)*<br>*Ben Stappers (Manchester, UK)* | ● | ● |
| **Feedback Processes in Massive Star Formation**<br>*Melvin Hoare (Leeds, UK)*<br>*Wouter Vlemmings (University of Bonn, Germany)* | ● | |
| **Gravitational Lensing and galaxy evolution with e-MERLIN**<br>*Neal Jackson (Manchester, UK)*<br>*Stephen Serjeant (Open University, UK)* | ● | |
| **Legacy e-MERLIN Multi-Band Imaging of Nearby Galaxies (LeMMINGs)**<br>*Rob Beswick (Manchester, UK)*<br>*Ian McHardy (Southampton, UK)* | ● | ● |
| **Luminous Infra-red Galaxy Inventory (LIRGI)**<br>*John Conway (Onsala Space Observatory, Sweden)*<br>*Miguel Perez-Torres (IAA-CSIC, Spain)* | ● | |
| **Morphology and Time Evolution of Thermal Jets Associated with Low Mass Young Stars**<br>*Luis Rodriguez (UNAM, Mexico)* | ● | |
| **Planet Earth Building Blocks - a Legacy e-MERLIN Survey (PEBBLES)**<br>*Jane Greaves (St Andrews, UK)* | ● | |
| **Resolving Key Questions in Extragalctic Jet Physics**<br>*Robert Laing (ESO, Garching, Germany)*<br>*Martin Hardcastle (Hertfordshire, UK)* | ● | |
| **Super-CLASS: the Super-CLuster Assisted Shear Survey - a weak lensing deep field survey using e-MERLIN**<br>*Richard Battye (JBCA, Manchester)* | ● | |

From the eMERLIN web page

# Forthcoming legacy projects with new facilities

## MeerKAT Key Science Projects

### Priority 1:

- Radio pulsar timing (PI: Bailes)
  - ➡~7900 hrs
- Deep HI field 'LADUMA' (PI: Blythe, Holwerda, Baker)
  - ➡~5000 hrs

## MeerKAT Key Science Projects

### Priority 2:

- MESMER (PI: Heywood)
- MeerKAT Absorption Line Survey (PI: Gupta, Srianand)
- MHONGOOSE (PI: de Block)
- TRAPUM (PI: Stappers & Kramer)
- A MeerKAT HI Survey of Fornax (PI: Serra)
- MeerGAL (PI: Thompson & Goedhart)
- MIGHTEE (PI: Van der Heyden & Jarvis)
- ThunderKAT (PI: Woudt & Fender)

From Van der Heyden (2011)

# Imaging and data archives in other bands

Data archives are available for most ground and space observatories for complementary information

"Imaging" archives – Some examples

- XMM- Newton, Chandra
- ESO-DSS, SDSS, H
- 2MASS, Spitzer
- Planck

Catalogue archives – Some examples

- Fermi, Planck

# Use of public data when writing a proposal

Collect as much as you can from the literature, and from the public continuum radio surveys and data archives relevant to your project

# Use of public data when writing a proposal

KAT-7 Science Request Proposal

**Project Title:**

**An unbiased census of radio halos in massive and low redshift galaxy clusters**

**PIs : Rossella Cassano (INAF-IRA), Gianni Bernardi (SKA SA & Rhodes University), Gianfranco Brunetti (INAF-IRA), Tizian Venturi (INAF-IRA), Daniele Dallacasa (Universita' di Bologna & INAF-IRA), Nadeem Oozeer (SKA SA), Kurt van dey Heyden (University of Cape Town), Oleg Smirnov (Rhodes University & SKA SA), Viral Parekh (University of Cape Town), Virginia Cuciti (Universita' di Bologna)**

KAT-7

- ✓ 1.3-1.7 GHz
- ✓ ~2.5 arcmin resolution
- ✓ only 7 antennas, hence poor u-v coverage
- ✓ located in the Southern Hemisphere

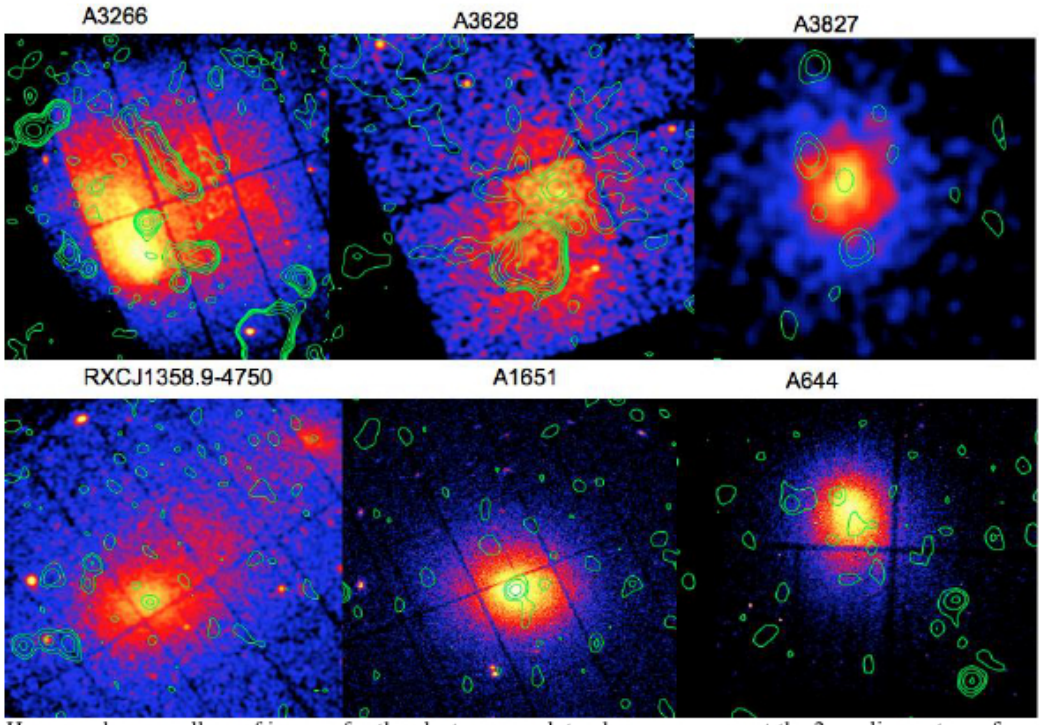
# KAT-7 Science Request Proposal

| | |
|---|---|
| Central frequency | 1900 MHz |
| Minimum number of antennas (Antennas needed) | Minimum 7, but please notify us when 6 antennas (Ant2 & Ant6 or Ant2 & Ant7) are available |
| Minimum elevation (recommended >15°) | >20 deg |
| Bandpass calibrator | PKS 1934-638 |
| Flux calibrator | PKS 1934-638 |
| Gain calibrator | |
| Target(s) | RXC J1407.8-5100 RA(J2000) 14:07:52.5 DEC (J2000) -51:00:33<br>A3628 RA(J2000) 16:31:24.0 DEC(J2000) -75:07:01<br>A3827 RA(J2000) 22:01:56.0 DEC(J2000) -59:56:58<br>RXC J1358.9-4750 RA(J2000) 13:59:01.6 DEC (J2000) -47:50:49<br>A1651 RA(J2000) 12:59:22.6 DEC (J2000) -04:11:49<br>A644 RA(J2000) 08:17:24.5 DEC (J2000) -07:30:46<br>A2420 RA(J2000) 22:10:19.7 DEC (J2000) -12:10:06<br>A3921 RA(J2000) 22:49:57.0 DEC (J2000) -64:25:46<br>A3911 RA(J2000) 02:45:28.7 DEC (J2000) -53:02:08<br>A550 RA(J2000) 05:52:52.4 DEC (J2000) -21:03:25<br>PSZ1G018.75+23.57 RA(J2000) 17:02:22.1 DEC (J2000) -01:00:16<br>A3158 RA(J2000) 03:42:53.9 DEC (J2000) -53:38:07<br>A3822 RA(J2000) 21:54:09.2 DEC (J2000) -57:51:19<br>A3695 RA(J2000) 20:34:47.9 DEC (J2000) -35:49:27<br>A1650 RA(J2000) 12:58:41.1 DEC (J2000) -01:45:25<br>A3266 RA(J2000) 04:31:16.0 DEC (J2000) -61:27:17<br>A2384 RA(J2000) 21:52:18.9 DEC (J2000) -19:34:42 |
| Total time on target | 136 hours |
| LST range | See the sheets below for each individual target |
| Catalogue name | |
| Catalogue Rev.No. committed to svn | |

Clusters selected from X-ray and Planck catalogues

KAT-7 Science Request Proposal

**Expected Output:**

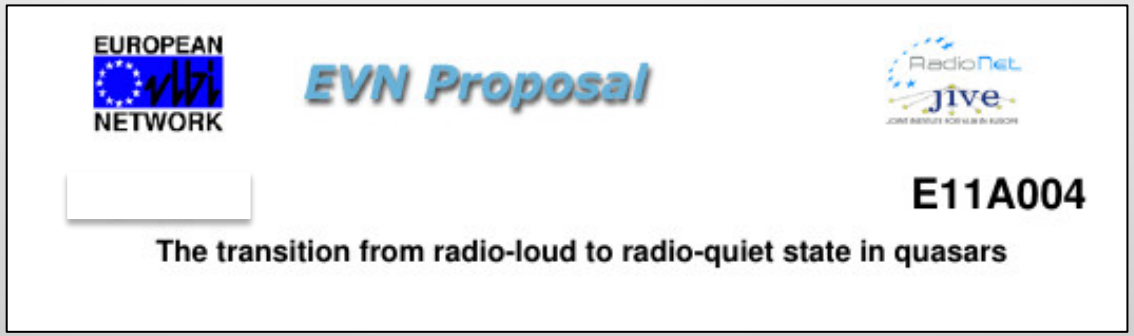



Here we show a gallery of images for the clusters we ask to observe: we report the 2σ radio contours from the NVSS (for clusters with δ >-40°) or SUMSS (for clusters with δ <-40°) surveys overlaid on the Chandra or XMM-Newton cluster images. Radio emission is present in some of the targets: in cases like A3266, the morphology indicates that it is associated with radio galaxies whereas cases like A3827 only show a hint of possible emission. None of the present data support the evidence of RHs in the selected targets. As the presence of compact sources could contaminate the measurement of the fainter, low-surface brightness RH, we plan to either use the NVSS and SUMSS data to remove the known sources from the KAT7 data or to apply for follow up observations of the contaminated targets with the ATCA or the GMRT.

Colour scale: XMM or Chandra archive

Green contours: NVSS or SUMSS

# Use of public data when writing a proposal



Us osal

004

Proposal fully based on a sample selected from FIRST

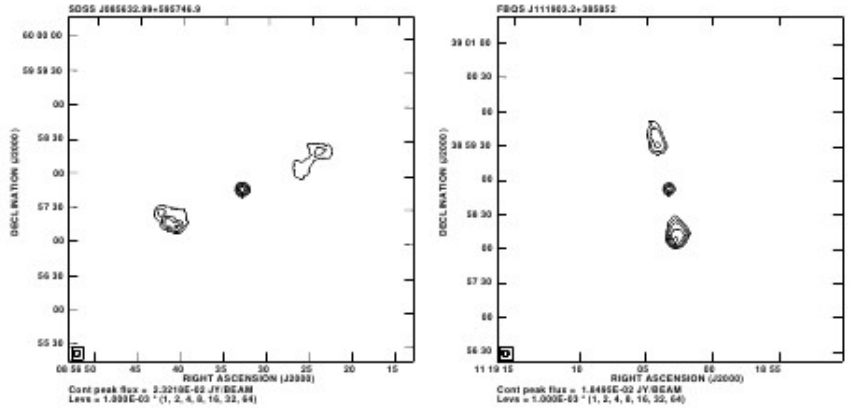



Figure 1: FIRST images of two asymmetric QSOs form quasars.org catalogue.

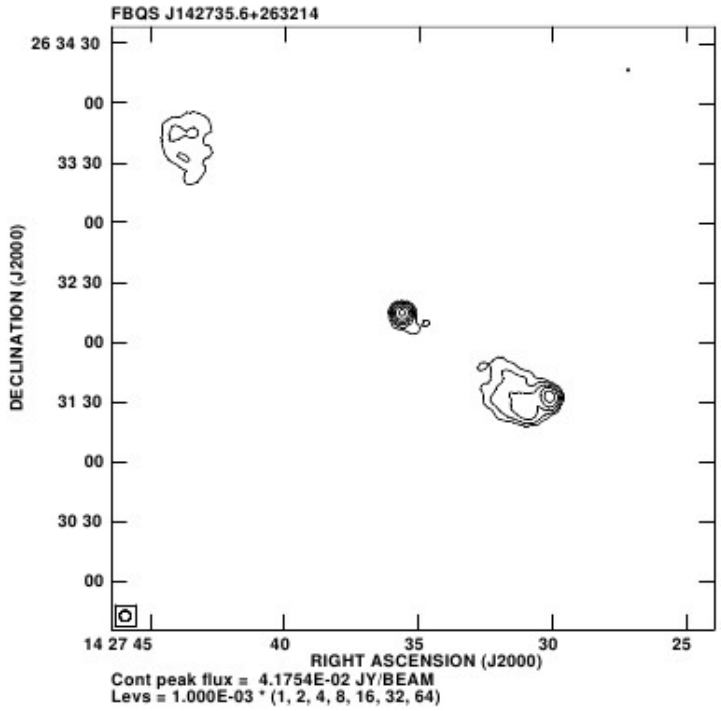



Figure 2: FIRST image of an asymmetric giant radio source identified with a QSO.

# Use of public data when writing a paper

The Astrophysical Journal, 781:9 (20pp), 2014 January 20 doi:10.1088/0004-637X/781/1/9


## NEW DETECTIONS OF RADIO MINIHALOS IN COOL CORES OF GALAXY CLUSTERS

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[3] Astrophysics Science Division, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA
[4] INAF-Istituto di Radioastronomia, via Gobetti 101, I-40129 Bologna, Italy
[5] Naval Research Laboratory, 4555 Overlook Avenue SW, Code 7213, Washington, DC 20375, USA
[6] Dipartimento di Fisica, Universitá di Roma Tor Vergata, Via della Ricerca Scientifica 1, I-00133 Rome, Italy
[7] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
*Received 2013 September 4; accepted 2013 November 19; published 2013 December 27*

### ABSTRACT

Cool cores of some galaxy clusters exhibit faint radio "minihalos." Their origin is unclear, and their study has been limited by their small number. We undertook a systematic search for minihalos in a large sample of X-ray luminous clusters with high-quality radio data. In this article, we report four new minihalos (A 478, ZwCl 3146, RXJ 1532.9+3021, and A 2204) and five candidates found in the reanalyzed archival Very Large Array observations. The radio luminosities of our minihalos and candidates are in the range of $10^{23-25}$ W Hz$^{-1}$ at 1.4 GHz, which is consistent with these types of radio sources. Their sizes (40–160 kpc in radius) are somewhat smaller than those of previously known minihalos. We combine our new detections with previously known minihalos, obtaining a total sample of 21 objects, and briefly compare the cluster radio properties to the average X-ray temperature and the total masses estimated from *Planck*. We find that nearly all clusters hosting minihalos are hot and massive. Beyond that, there is no clear correlation between the minihalo radio power and cluster temperature or mass (in contrast with the *giant* radio halos found in cluster mergers, whose radio luminosity correlates with the cluster mass). *Chandra* X-ray images indicate gas sloshing in the cool cores of most of our clusters, with minihalos contained within the sloshing regions in many of them. This supports the hypothesis that radio-emitting electrons are reaccelerated by sloshing. Advection of relativistic electrons by the sloshing gas may also play a role in the formation of the less extended minihalos.

*Key words:* galaxies: clusters: general – galaxies: clusters: individual (MACSJ0159.8-0849, MACSJ0329.6-0211, A478, ZwCl3146, A1795) – galaxies: clusters: intracluster medium – radio continuum: general – X-rays: galaxies: clusters

*Online-only material:* color figures

# Use of public data when writing a paper



**Table 2**
Details of the VLA Observations

| Cluster Name | Project | Array | Frequency (GHz) | Bandwidth (MHz) | Date | Time (min) | FWHM, PA ($''\times''$, $^\circ$) | rms ($\mu$Jy b$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| MACS J0159.8−0849 | AE147 | B | 1.4 | 50 | 2002 Jul 15 | 48 | 5.7 × 4.2, −17 | 15 |
| | AE117 | A | 8.5 | 50 | 1998 Apr 12 | 19 | 0.3 × 0.2, −28 | 18 |
| MACS J0329.6−0211 | AE142 | B | 1.4 | 50 | 2001 May 05 | 48 | 4.7 × 4.5, 0 | 40 |
| A 478 | AB1150 | A | 1.4 | 25 | 2004 Nov 24 | 320 | 1.3 × 1.3, −12 | 25 |
| | AM938 | C | 1.4 | 50 | 2009 Jul 18 | 190 | 14.2 × 11.8, −49 | 40 |
| | AK685 | C | 4.9 | 50 | 2008 May 19 | 93 | 4.1 × 3.8, −29 | 15 |
| ZwCl 3146 | AB1190 | C | 4.9 | 50 | 2006 Dec 18 | 272 | 4.3 × 3.9, 40 | 10 |
| | AB1190 | C | 8.5 | 50 | 2006 Dec 18 | 102 | 2.5 × 2.4, −34 | 15 |
| A 1795 | AO84 | A | 1.4 | 3 | 1989 Jan 18 | 176 | 1.3 × 1.2, 69 | 40 |
| | AJ215 | C | 1.4 | 6 | 1992 Feb 25 | 130 | 14.1 × 13.4, 40 | 150 |
| RX J1532.9+3021 | AT0318 | A | 1.4 | 50 | 2006 Mar 15 | 72 | 1.4 × 1.1, −29 | 12 |
| | AT0318 | B | 1.4 | 50 | 2006 Sep 11 | 50 | 4.2 × 3.7, −11 | 15 |
| | AT0318 | B | 0.3 | 6 | 2006 Mar 15 | 118 | 5.2 × 4.8, −27 | 500 |
| | AE110 | C | 4.9 | 50 | 1997 Jun 26 | 6 | 4.8 × 3.9, −75 | 20 |
| | AE117 | A | 8.5 | 50 | 1998 Apr 12 | 11 | 0.2 × 0.2, 42 | |
| | AK633 | D | 8.5 | 50 | 2005 Apr 7 | 5 | 8.1 × 7.4, −7 | |
| | AK633 | D | 22 | 50 | 2007 Apr 5 | 4 | 2.9 × 2.6, −7 | |
| A 2204 | AT0211 | A | 1.4 | 25 | 1998 Apr 23 | 123 | 1.3 × 1.3, 1 | |
| | S8398 | B | 1.4 | 50 | 2007 Nov 25 | 102 | 4.7 × 4.2, 38 | |
| ZwCl 1742.1+3306 | AE130 | DnA | 1.4 | 6 | 1999 Jun 10 | 145 | 1.5 × 1.5, 47 | |
| MACS J1931.8−2634 | AT0318 | A | 1.4 | 50 | 2006 Apr 14 | 82 | 2.5 × 1.2, 3 | |
| | AT0318 | B | 1.4 | 50 | 2006 Sep 09 | 49 | 8.4 × 3.8, 0 | |
| | AT0318 | A | 0.3 | 6.3 | 2006 Apr 14 | 120 | 11.0 × 4.5, 1 | |

**Notes.** Column 1: cluster name. Columns 2 and 3: VLA array configuration and project. Columns 4–6: observing frequency, total bandwidth
7: total time on source. Column 8: full width at half-maximun (FWHM) and position angle (PA) of the array. Column 9: image rms level (

*Key words:* galaxies: clusters: general – galaxies: clusters: individual (MACSJ015
A478, ZwCl3146, A1795) – galaxies: clusters: intracluster medium – radio continu
clusters

*Online-only material:* color figures

**Table 3**
List of the *Chandra* Observations

| Cluster Name | Detector | Observation ID | Exposure[a] (ks) |
|---|---|---|---|
| MACS J0159.8−0849 | ACIS-I | 3265, 6106, 9376 | 70 |
| MACS J0329.6−0211 | ACIS-I | 3257, 3582, 6108 | 70 |
| A 478 | ACIS-S | 1669 | 40 |
| ZwCl 3146 | ACIS-I | 909, 9371 | 90 |
| A 1795 | ACIS-S | 493, 494 | 40 |
| RX J1532.9+3021 | ACIS-S, I, S | 1649, 1665, 14009 | 105[b] |
| A 2204 | ACIS-S, I, I | 499, 6104, 7940 | 100 |
| ZwCl 1742.1+3306 | ACIS-S | 11708 | 45 |
| MACS J1931.8-2635 | ACIS-I | 9382 | 100 |

**Notes.**
[a] Total exposure time without filtering.
[b] Total clean exposure from Hlavacek-Larrondo et al. (2013).

# Use of public data when writing a paper



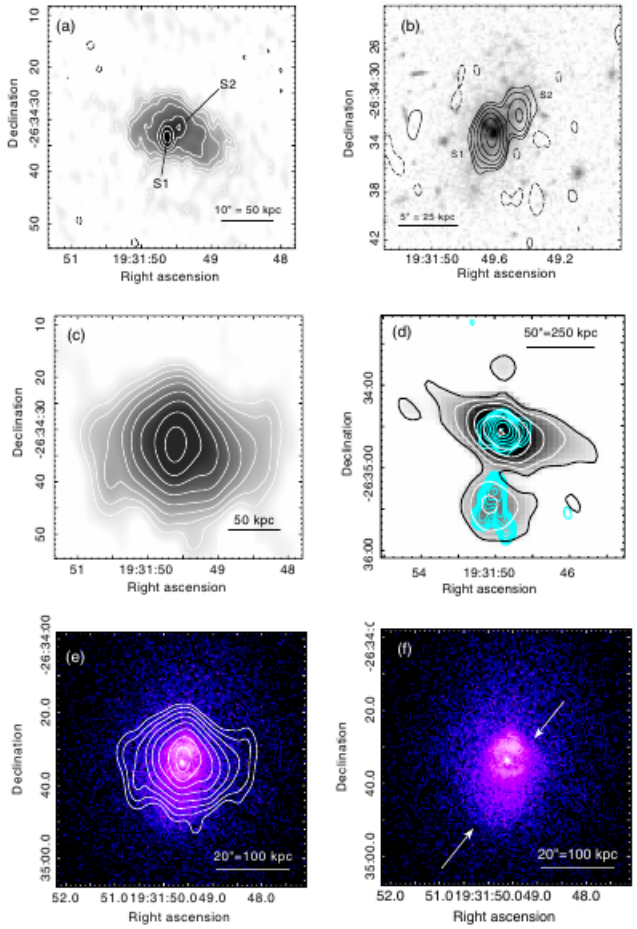


**Figure 9.** MACS J1931.8−2634. In all radio images, contours are −1 (dashed), 1, 2, 4, 8, 16, ...×3$\sigma$, unless stated otherwise. (a) VLA A-configuration image (grayscale and black and white contours) at 1.4 GHz. The beam is 2.5 × 1.2, p.a. 3° and 1$\sigma$ = 30 $\mu$Jy beam$^{-1}$. S1 and S2 are the two central compact sources (see panel (b) and Table 4). (b) VLA A-configuration contours at 1.4 GHz from an image obtained using only baselines longer than 20 $k\lambda$, overlaid on the *HST* WFPC2 image (grayscale). The beam is 2.4 × 1.0, p.a. 2° and 1$\sigma$ = 60 $\mu$Jy beam$^{-1}$. (c) VLA B-configuration image at 1.4 GHz (contours and grayscale). The beam is 8.″4 × 3.″8 in p.a., 0° and 1$\sigma$ = 40 $\mu$Jy beam$^{-1}$. No levels at −3$\sigma$ are present in the portion of the image shown. (d) GMRT 150 MHz image from the TGSS (white contours and grayscale), overlaid with the VLA 1.4 GHz contours (cyan) from panel (c). The beam is 25.″ × 15.″ in p.a., 30° and 1$\sigma$ = 25 mJy beam$^{-1}$. White contours scale by a factor of 2 starting from 100 mJy beam$^{-1}$. No levels at −100 mJy beam$^{-1}$ are present in the portion of the image shown. (e) 1.4 GHz contours (same as in panel (c)), overlaid on the *Chandra* image in the 0.5–4 keV band. (e) *Chandra* image, same as in (e). Arrows show the position of two possible cold fronts. Two small cavities are visible to the east and west of the central AGN (see Ehlert et al. 2011).

(A color version of this figure is available in the online journal.)

doi:10.1088/0004-637X/781/1/9

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December 27

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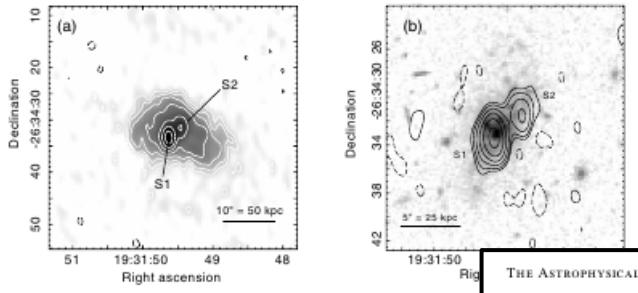


**Figure 9.** MACS J1931.8–2634. In all radio images, contours are $-1$ (dashed), 1, 2, 4, 8, 16, $\ldots \times 3\sigma$, unless stated otherwise. (a) VLA A-configuration image (grayscale and black and white contours) at 1.4 GHz. The beam is $2.5 \times 1.2$, p.a. 3° and $1\sigma = 30\ \mu$Jy beam$^{-1}$. S1 and S2 are the two central compact sources (see panel (b) and Table 4). (b) VLA A-configuration contours at 1.4 GHz from an image obtained using only baselines longer than 20 $k\lambda$, overlaid on the *HST* WFPC2 image (grayscale). The beam is $2.4 \times 1.0$, p.a. 2° and $1\sigma = 60\ \mu$Jy beam$^{-1}$. (c) VLA B-configuration image at 1.4 GHz (contours and grayscale). The beam is $8\farcs4 \times 3\farcs8$ in p.a., 0° and $1\sigma = 40\ \mu$Jy beam$^{-1}$. No levels at $-3\sigma$ are present in the portion of the image shown. (d) GMRT 150 MHz image from the TGSS (white contours and grayscale), overlaid with the VLA 1.4 GHz contours (cyan) from panel (c). The beam is $25'' \times 15''$ in p.a., 30° and $1\sigma = 25$ mJy beam$^{-1}$. White contours scale by a factor of 2 starting from 100 mJy beam$^{-1}$. No levels at $-100$ mJy beam$^{-1}$ are present in the portion of the image shown. (e) 1.4 GHz contours (same as in panel (c)), overlaid on the *Chandra* image in the 0.5–4 keV band. (f) *Chandra* image, same as in (e). Arrows show the position of two possible cold fronts. Two small cavities are visible to the east and west of the central AGN (see Ehlert et al. 2011).

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F GALAXY CLUSTERS

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The Astrophysical Journal, 781:9 (20pp), 2014 January 20 Giacintucci et al.

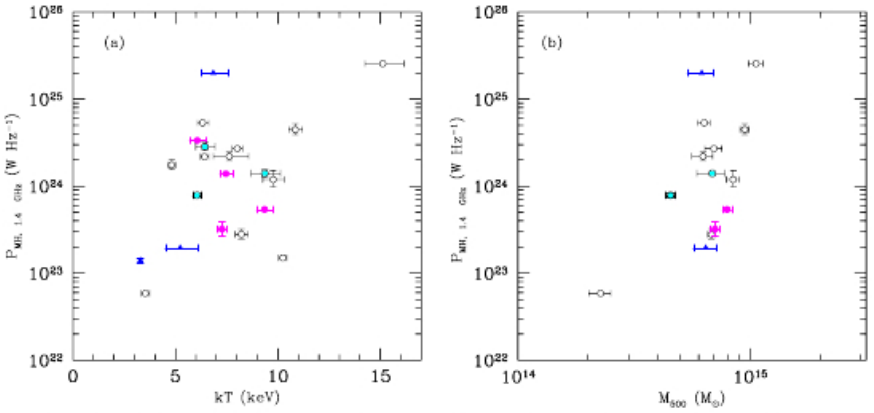


**Figure 11.** $P_{\rm MH,\ 1.4\,GHz} - kT$ (a) and $P_{\rm MH,\ 1.4\,GHz} - M_{500}$ (b); Diagrams for the clusters with previously known minihalos (empty black circle), new minihalo detections (magenta circles), minihalo candidates (cyan circles), and central extended sources whose classifications as minihalos are uncertain (blue triangles). Only error bars corresponding to an uncertainty of >10% on the radio power are plotted.

(A color version of this figure is available in the online journal.)

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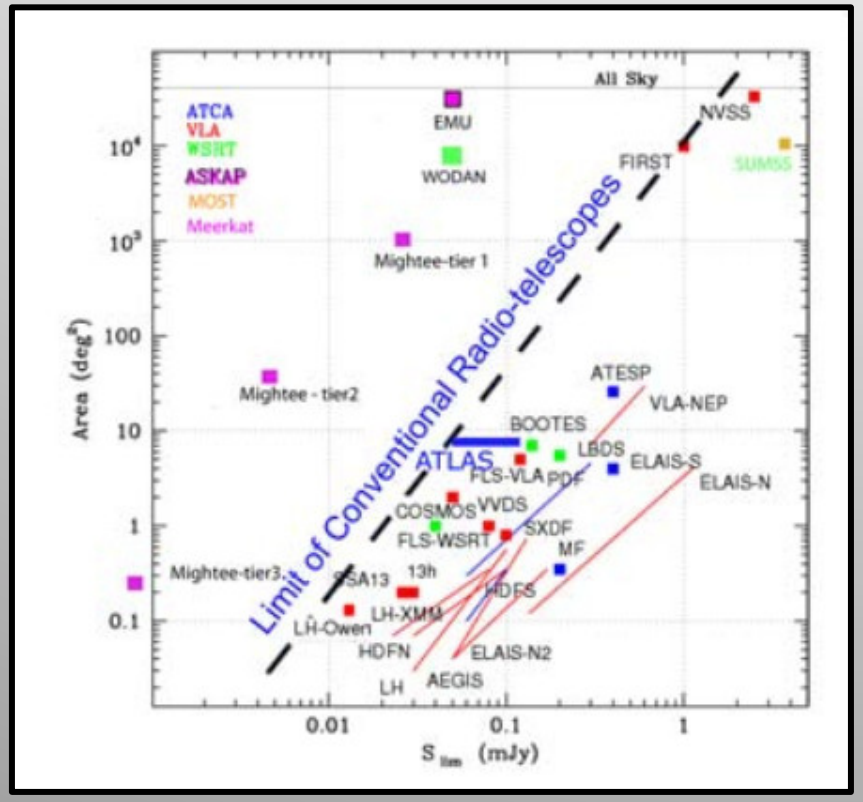
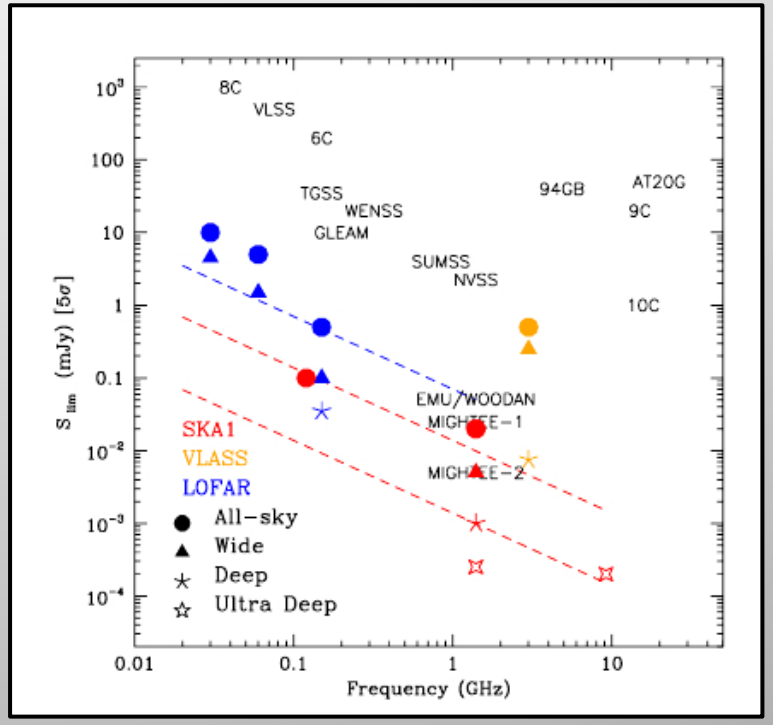
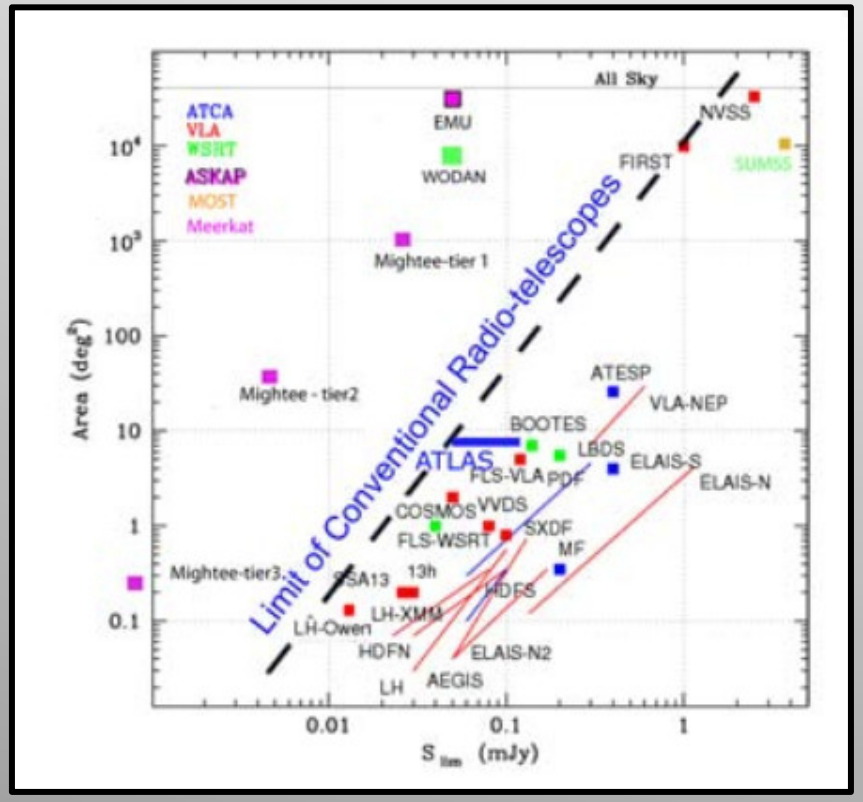
# The future is in your hands



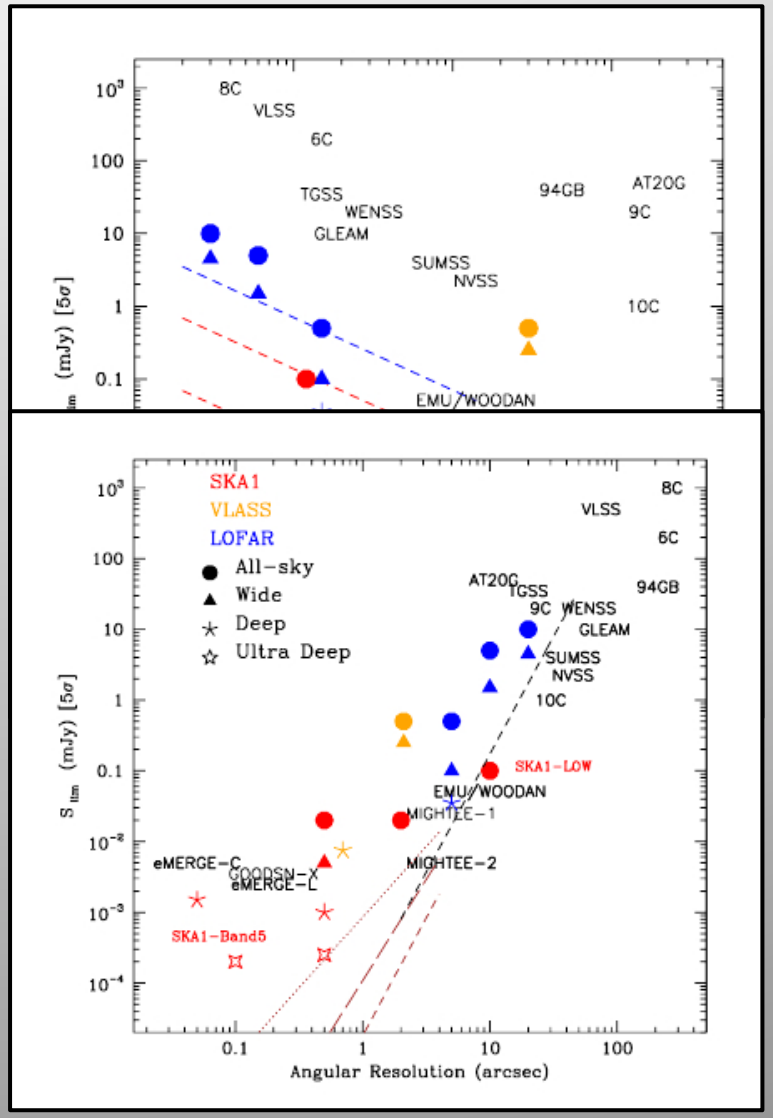

Norris et al. 2013



# The future is in your hands




Norris et al. 2013




Plots from Prandoni & Seymours 2015