WMAP point sources as space-VLBI calibrators

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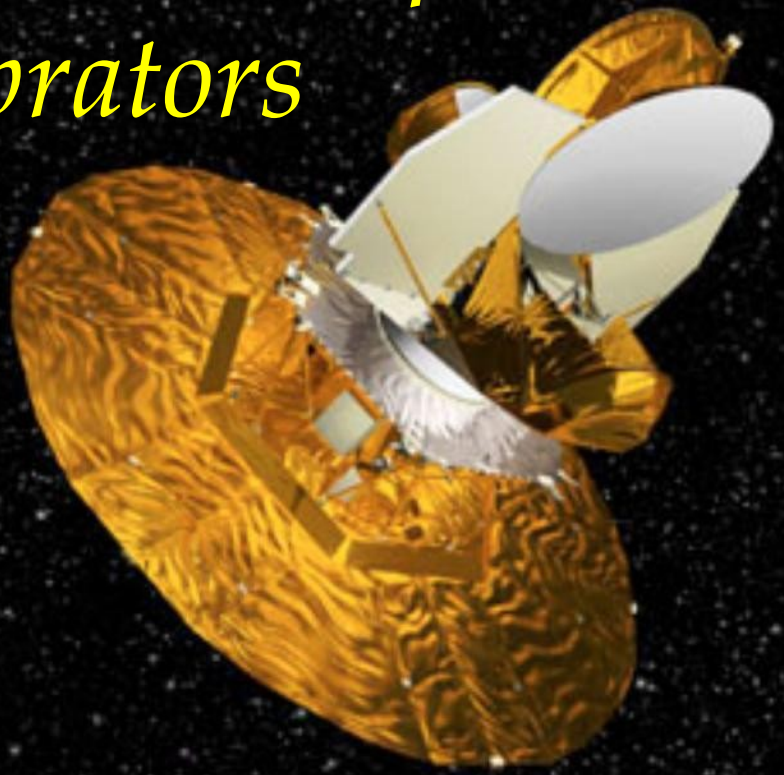


XL YERAC, 2010

Eötvös Loránd University
Hungary

Outline

- WMAP

My thesis

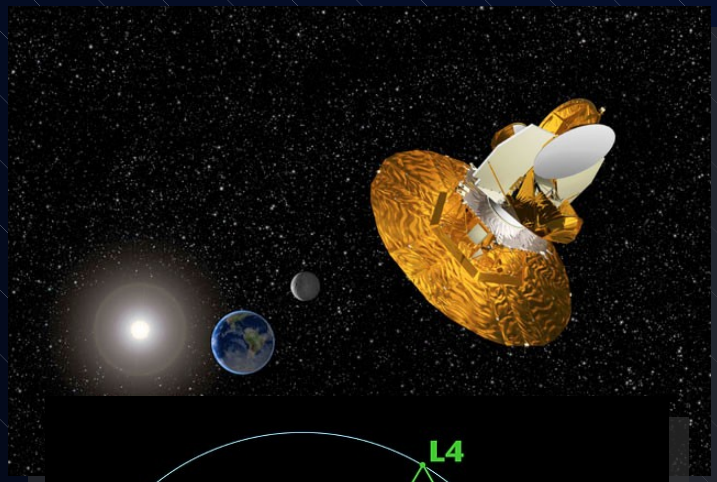
- Introduction
- New potential mm-VLBI targets
- 86 GHz flux densities
- The new catalogue
- Future, ASTRO-G
- Conclusion

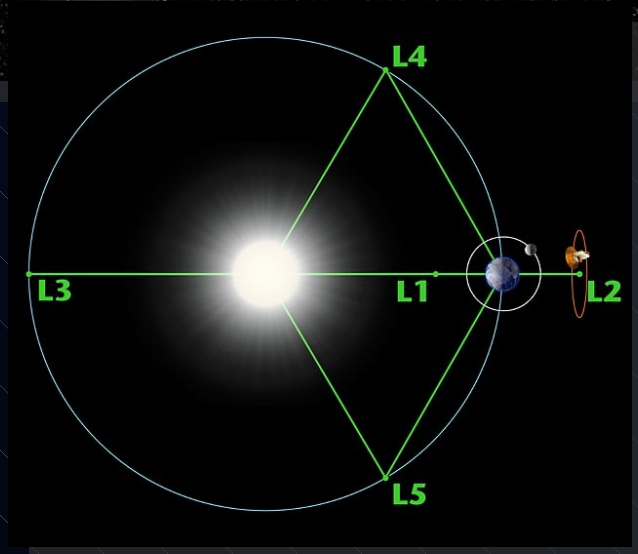
WMAP
(Wilkinson Microwave Anisotropy Probe)

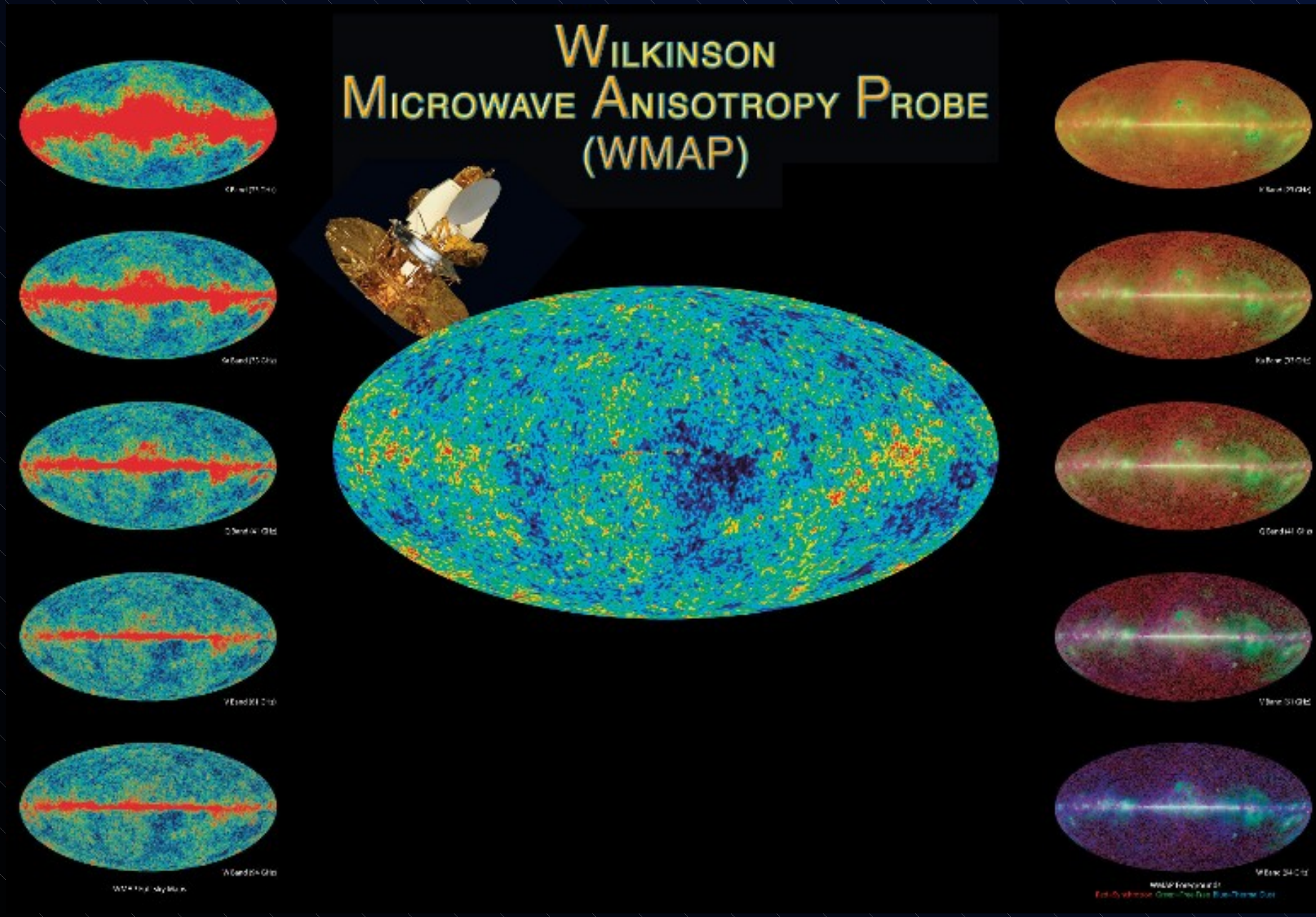
- Aim: to measure the CMB (Cosmic Microwave Background) temperature anisotropy on 5 frequencies: 23, 34, 41, 61, 94 [GHz]

- Position: L2 Lagrange point

- Full-sky millimeter survey






WILKINSON
MICROWAVE ANISOTROPY PROBE
(WMAP)

New potential mm-VLBI targets

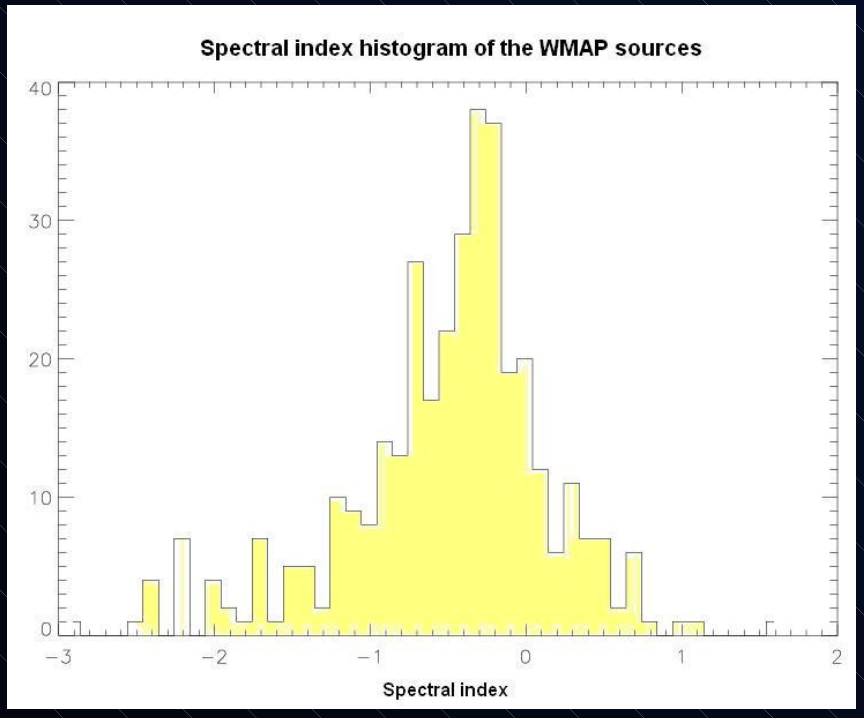
Comparison between the WMAP data and earlier VLBI catalogues →
→ sub-samples

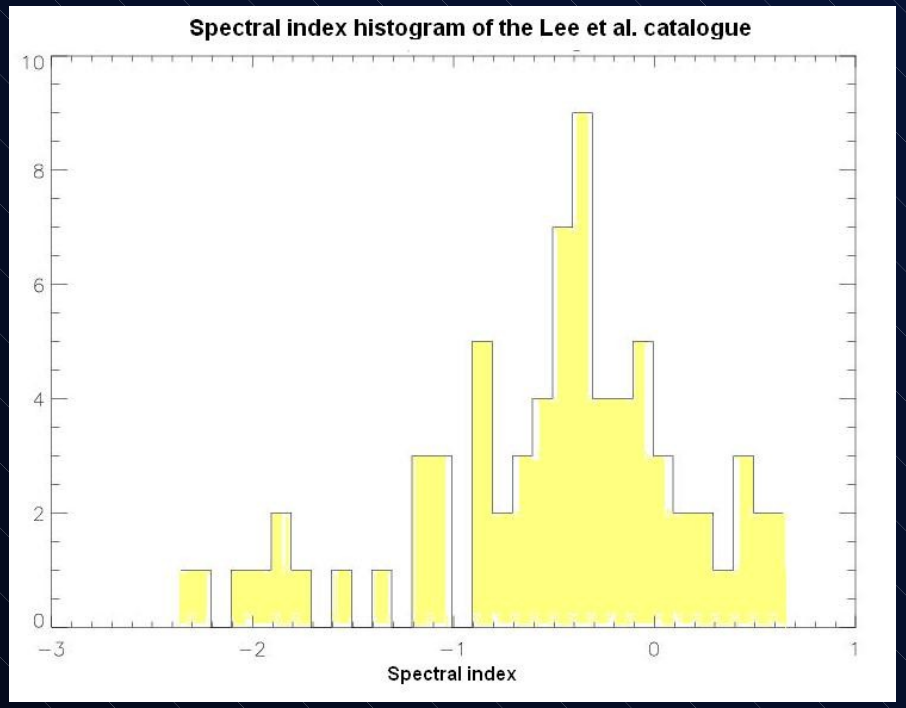
Radio spectrum:

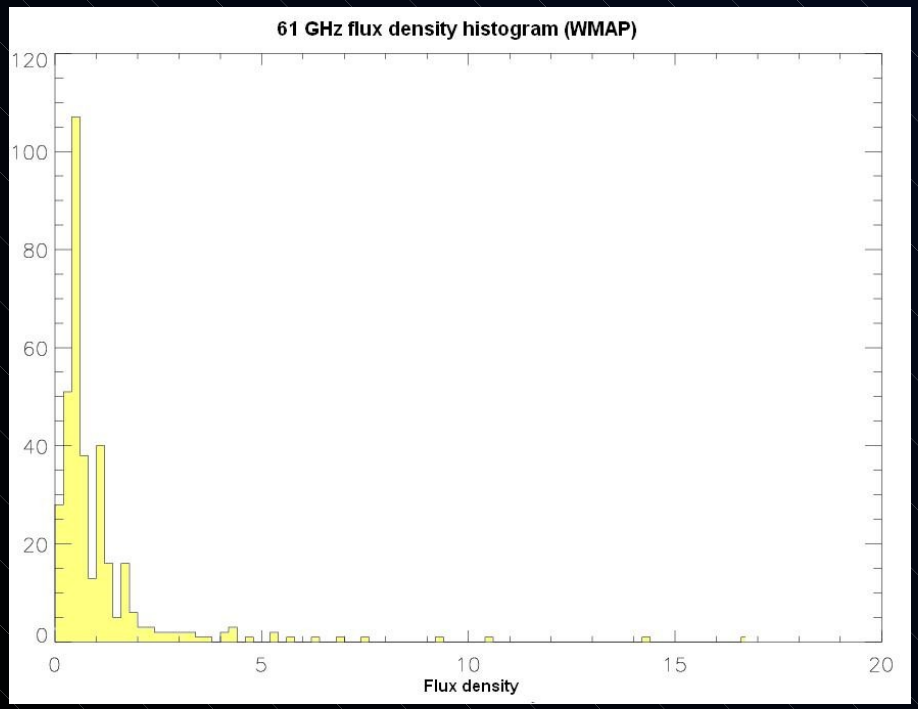
Good approximation: Power law-spectrum $S \sim \nu^{\alpha}$

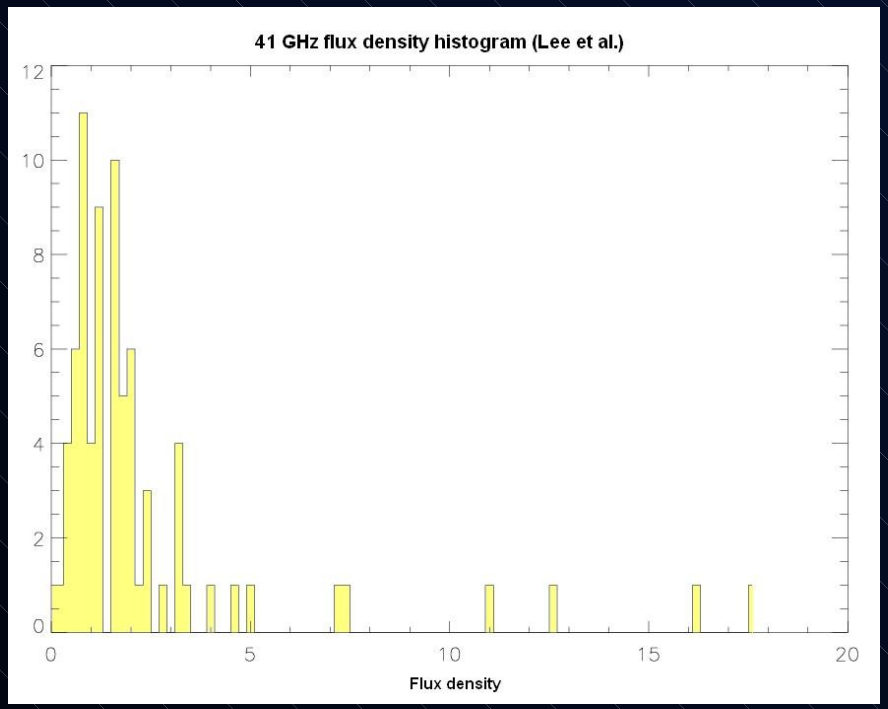
- WMAP catalogue contains the flux densities (41, 61, 94 GHz) for every source
- α: calculated with *linear regression* method

-> Flux-density and spectral index histograms of the WMAP catalogue and some sub-samples.


Spectral index histogram of the WMAP sources
40
30
20
10
0
−3
−2
−1
0
1
2
Spectral index


Spectral index histogram of the Lee et al. catalogue
10
8
6
4
2
0
−3
−2
−1
0
1
Spectral index


61 GHz flux density histogram (WMAP)
120
100
80
60
40
20
0
0
5
10
15
20
Flux density


41 GHz flux density histogram (Lee et al.)
12
10
8
6
4
2
0
0
5
10
15
20
Flux density

86 GHz flux densities

An important aim: to identify new bright quasars, which will be available for observation in the future at 86 GHz with VLBI technique

In WMAP catalogue we have 41, 61, 94 GHz flux densities

➔ 86 GHz flux densities

$$S_{86}=S_{94}\cdot(86/94)^{\alpha}$$

For the new list: method adopted from Lee et al. 2008 AJ 136, 159:

1. sources which have not been investigated before at 86 GHz
2. flux densities above 1 Jy
3. declination above -40°

→ 38 sources

The new catalogue

I used public databases to do the optical identifications in my new list, and I searched for wider band radio spectra, and earlier lower frequency VLBI images. .

For optical identification I used NED (NASA/IPAC Extragalactic Database)[2]

➔ 30 QSO, 5 G, 1 PN, 1 VisS, 1 RadioS

For wider band radio spectra: catalogue (Kovalev et al. 1999, A&AS, 139, 545) of sources between $-30° < \delta < +43°$, observations on 6 frequencies between 1-22 GHz.

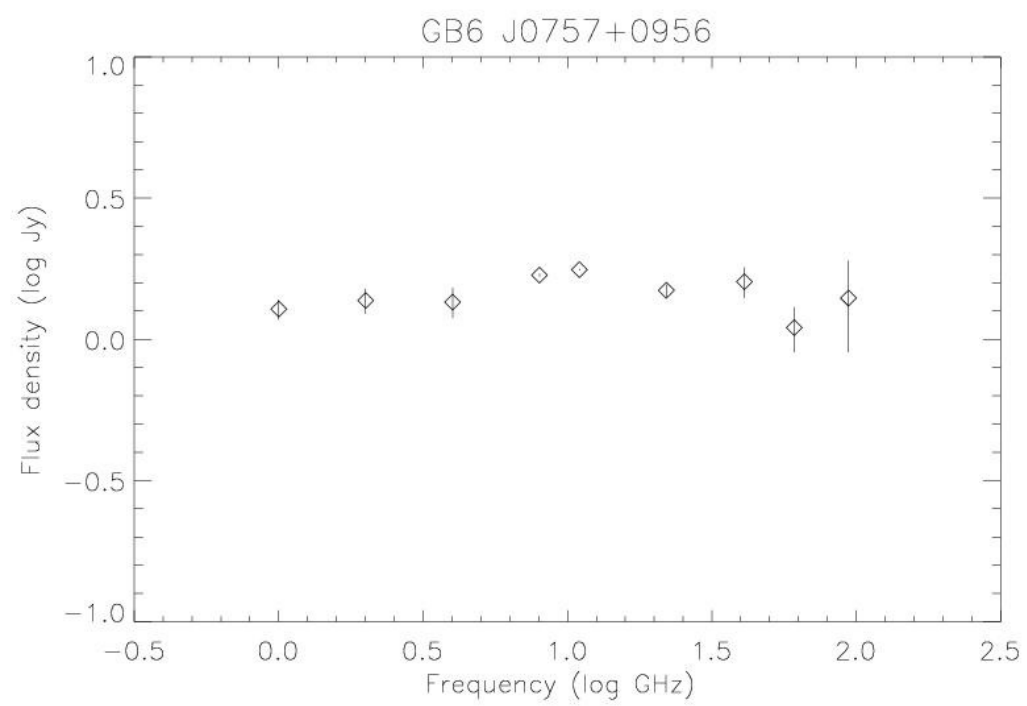
+ NED

+WMAP

To find earlier VLBI images I used the VLBA Calibrator List[3] → 8.6 GHz VLBI images for 36 sources, 2 were not found (PKS J1332+0200, PMN J0527-1241)

[2] http://nedwww.ipac.caltech.edu

[3] http://www.vlba.nrao.edu/astro/calib/index.shtml



alogue

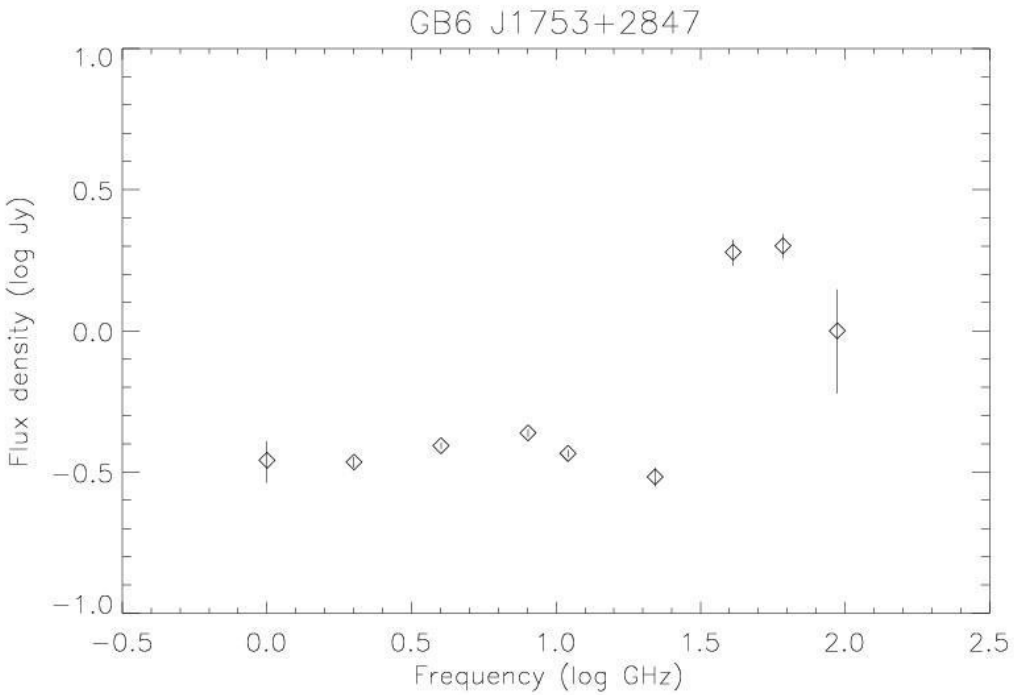
ifications in my new list, and I
l earlier lower frequency VLBI

IPAC Extragalactic Database)[2]

For wider band radio spectra: cata
of sources between -30°< δ <+4
1-22 GHz.
+ NED
+WMAP

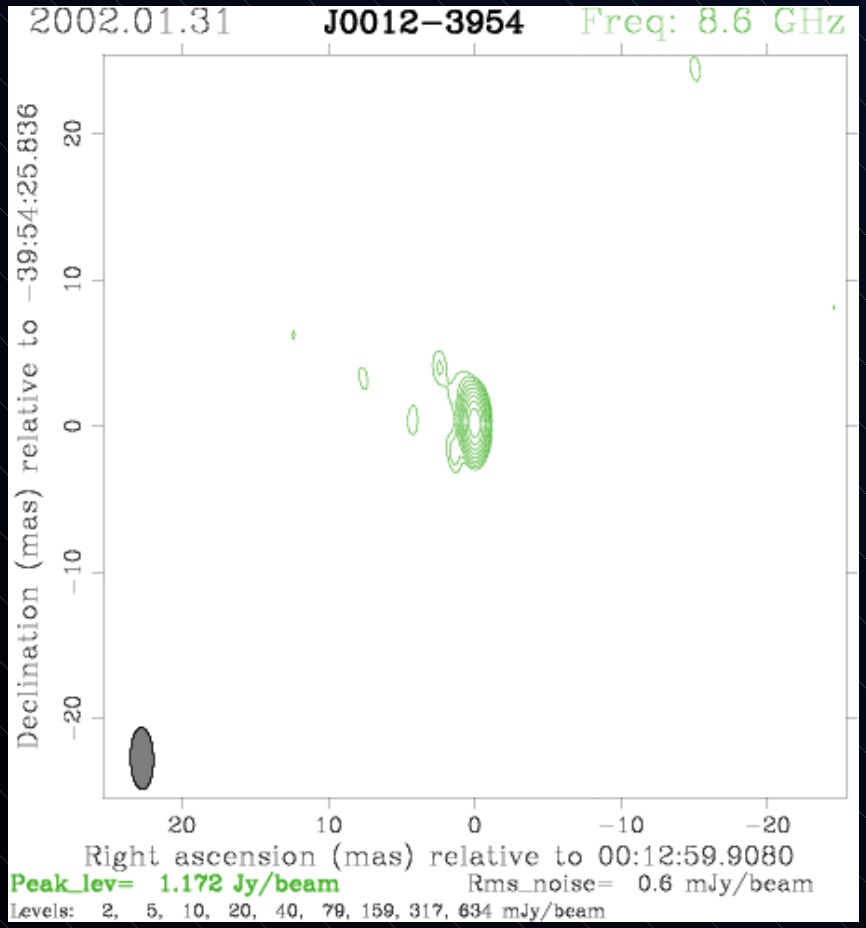
To find earlier VLBI images I used
images for 36 sources, 2 were r

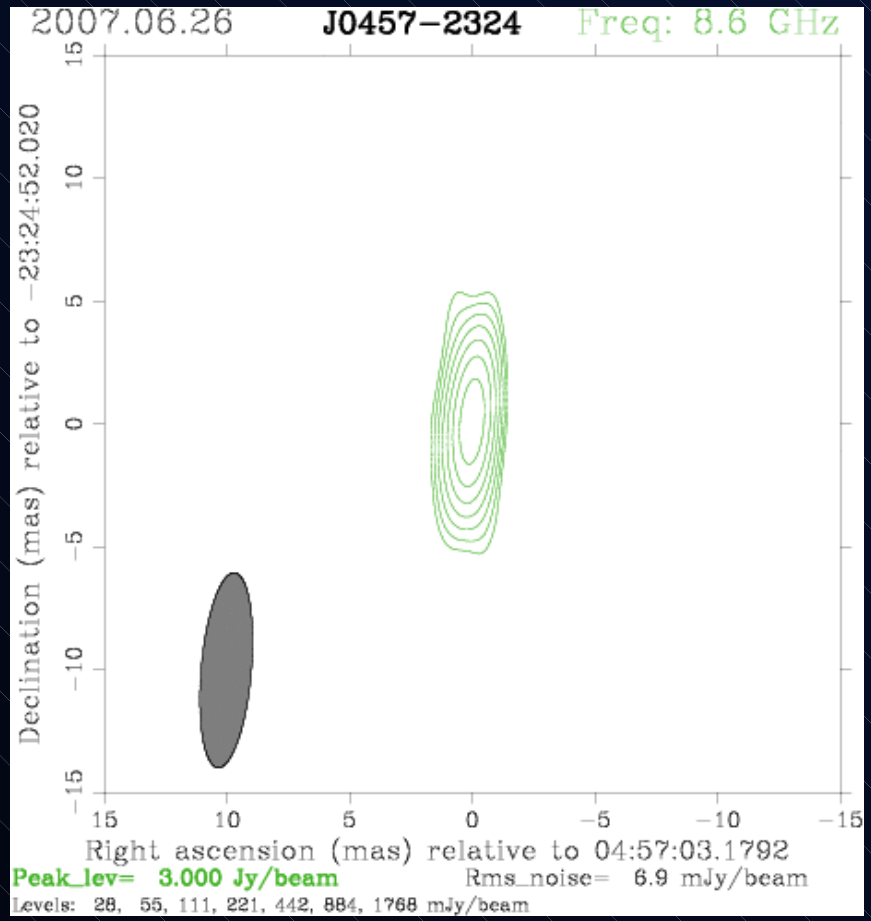
[2] http://nedwww.ipac.caltech.edu
[3] http://www.vlba.nrao.edu/astro/calib/inde



The new catalogue

Earlier VLBI images:

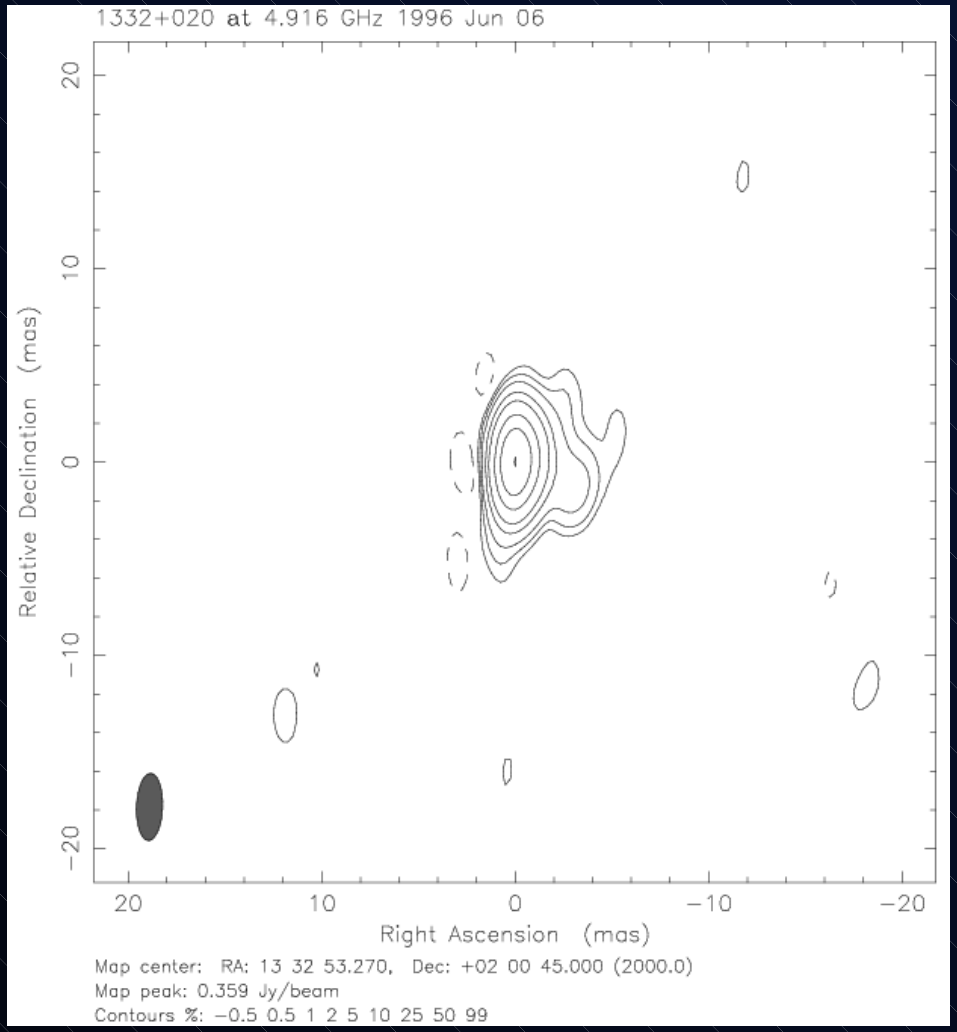




The new catalogue

PKS J1332+0200: earlier 5 GHz VLBA image – double lobe radio galaxy, with a one-sided jet

(Fomalont et al. 2000, ApJS 131,95)



The new catalogue

- PMN J0527-1241: no detection in NED.

  It should have been detected with VERA (VLBI Exploration of Radio Astrometry), but it wasn't → fainter than 0.11 Jy at 22 GHz (Petrov et al. 2007, AJ, 133, 2487)

- What kind of source is it?

  Planetary nebula ➔ Extended source!

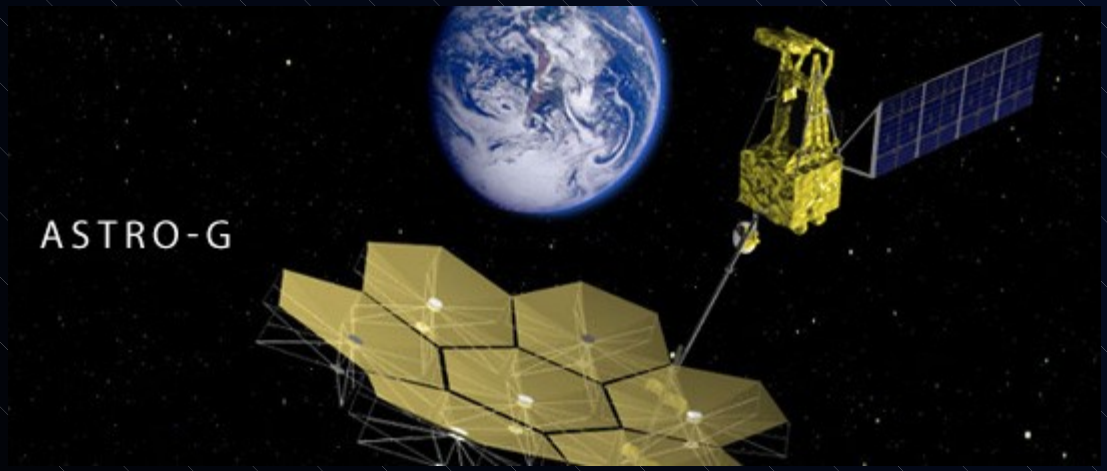
- New list: 37 sources!

Future, ASTRO-G

ASTRO-G (also known as **VSOP-2**) is a planned Japanese radio satellite, it is expected to be launched in 2013

- 8,22,43 GHz
- higher resolution
- better sensitivity (compared to VSOP)

Bright quasars of my new catalogue could be used as calibrators for the observation of faint sources



Conclusion

- Investigation of 5-year WMAP data → sources available for observation with 86 GHz VLBI, and 43 GHz space-VLBI
- 37 compact radio sources, and 1 PN
- This would enlarge the list of known mm-VLBI sources with ~25%

Thank you for your attention!