MM-VLBI Observations of NGC1052

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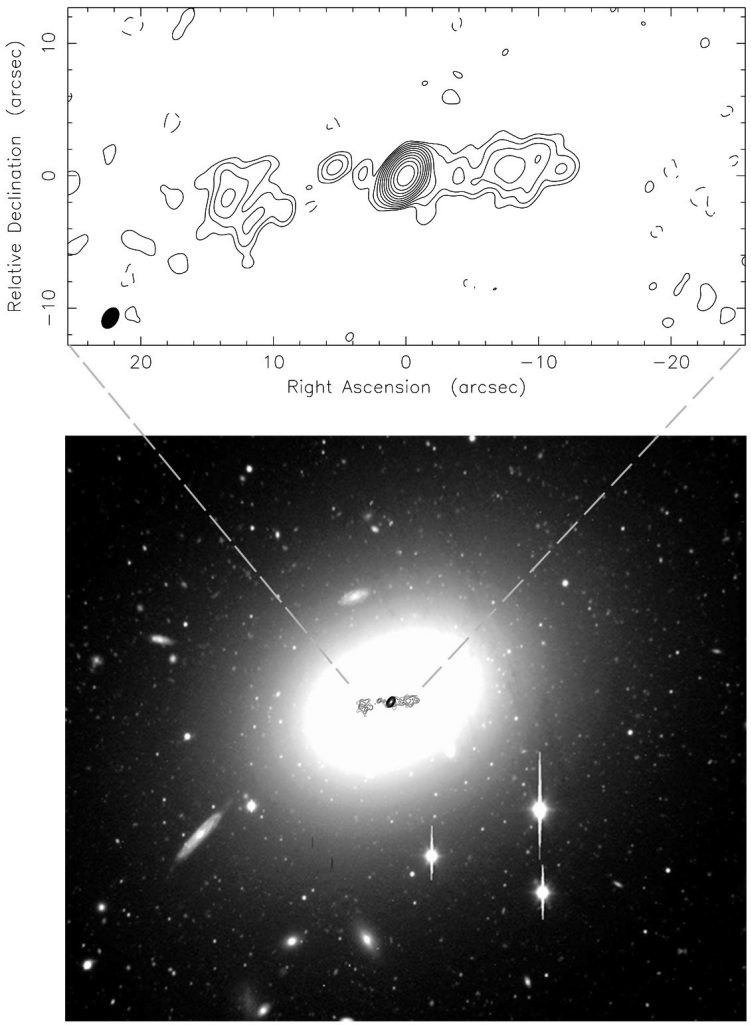
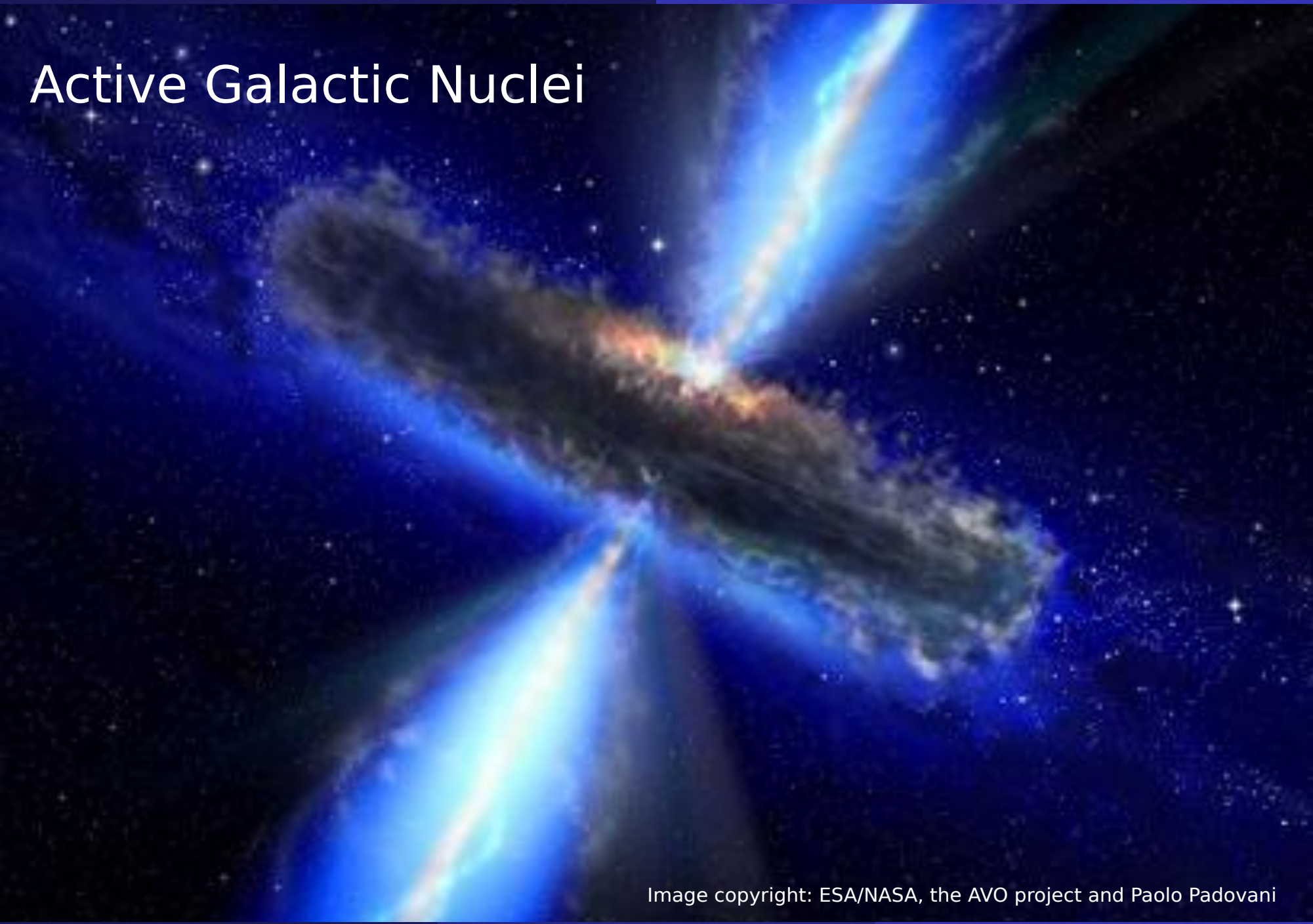
NGC 1052



Forbes et al. (2001), Kadler et al. (2002)

- Distance ~ 20 Mpc
- Large-scale structures up to 3 kpc
- Two jets near the plane of the sky,
- Two lobes
- Core dominated
- Spectral classification: LINER 1.9
  (Ho et al., 1997)

Active Galactic Nuclei



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Zooming into the twin-jet of NGC 1052

Kameno et al. (2001), Vermeulen et al. (2003), Kadler et al. (2002):

Spectral index for central region

$\alpha > 2.5$

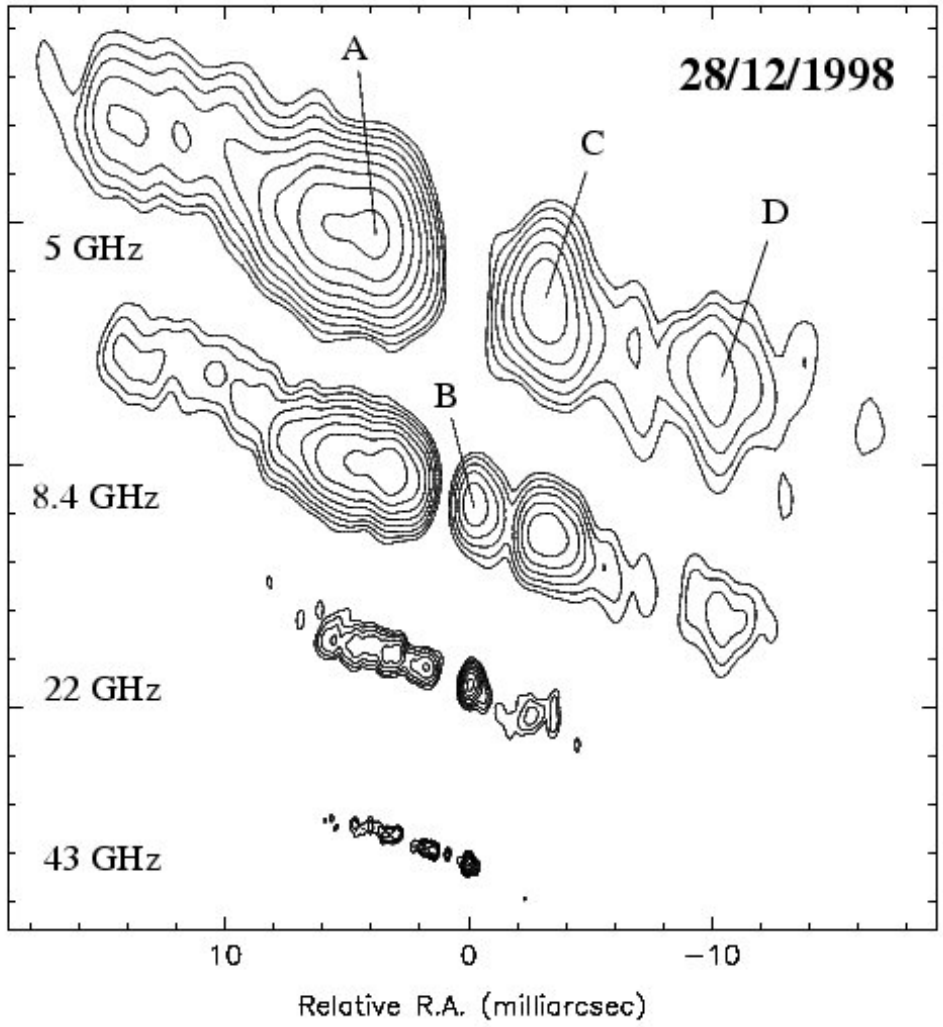
$\rightarrow$ Free-free absorption

$\sim$ 0.1 pc eastern jet

$\sim$ 0.7 pc western jet

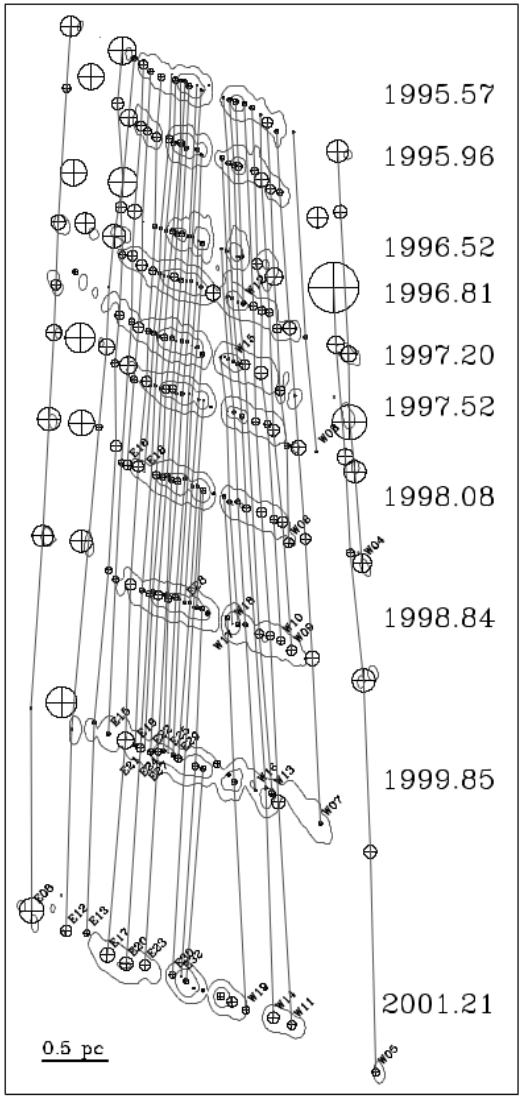
$\rightarrow$ Synchrotron-self absorption in the outer parts of the central region.

$\Rightarrow$ **External absorption in an obscuring torus!**



Kadler et al. (2002)

VLBI kinematic studies



Vermeulen et al. (2003) at 15 GHz

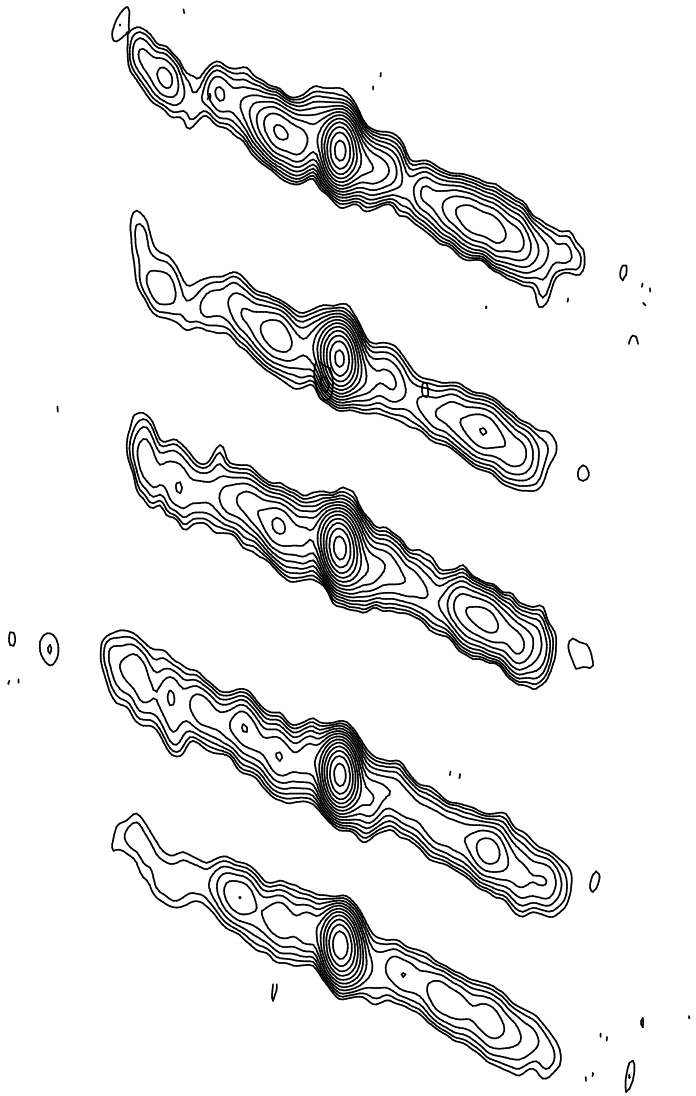
Vermeulen et al. (2003), Boeck (PhD thesis, 2012)

In both jets speed about $\beta = 0.25$

$\Rightarrow$ Small beaming effects

Jet orientation very close to the plane of the sky

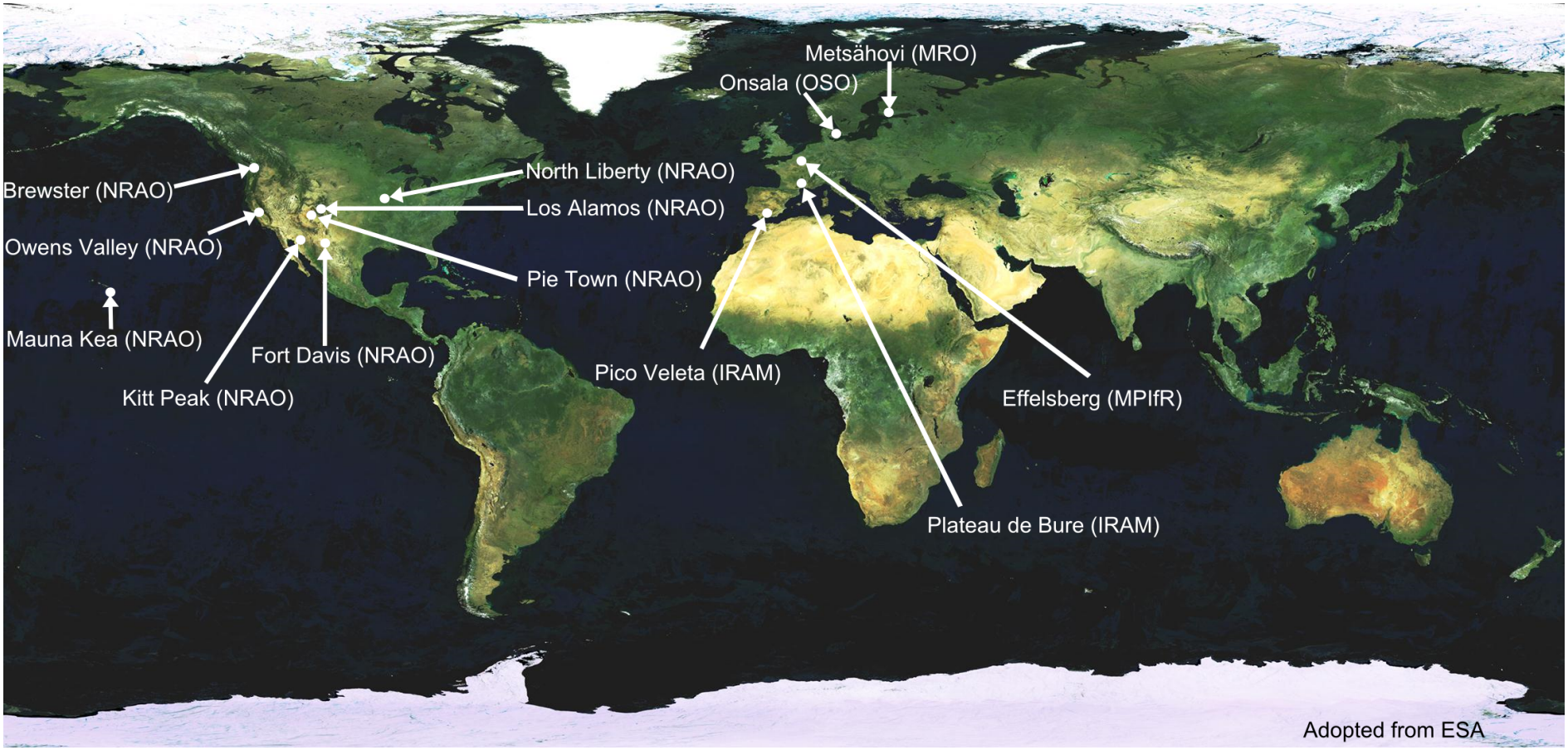
Examples from 4 years of observation at 43 GHz (2005-2008)



- Multi-year monitoring with the VLBA at 43GHz (7mm)
- Central dominant component is a persistent feature
- Almost symmetric structure of the twin-jet system

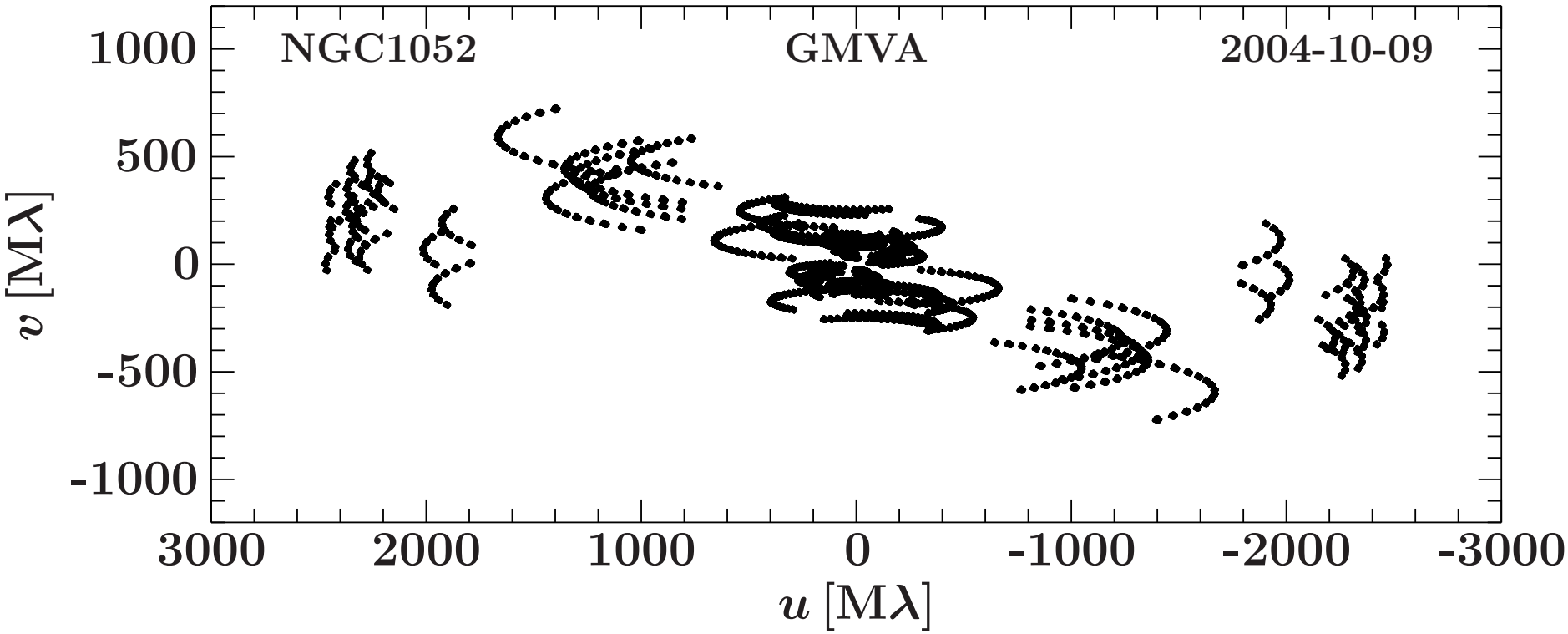
The Global mm-VLBI Array (GMVA)

Observations: on 9/10 October 2004



Metsähovi, Onsala, Effelsberg, Plateau de Bure, Pico Veleta, 8 antennas of the VLBA (NL, FD, LA, KP, PT, OV, BR, MK)

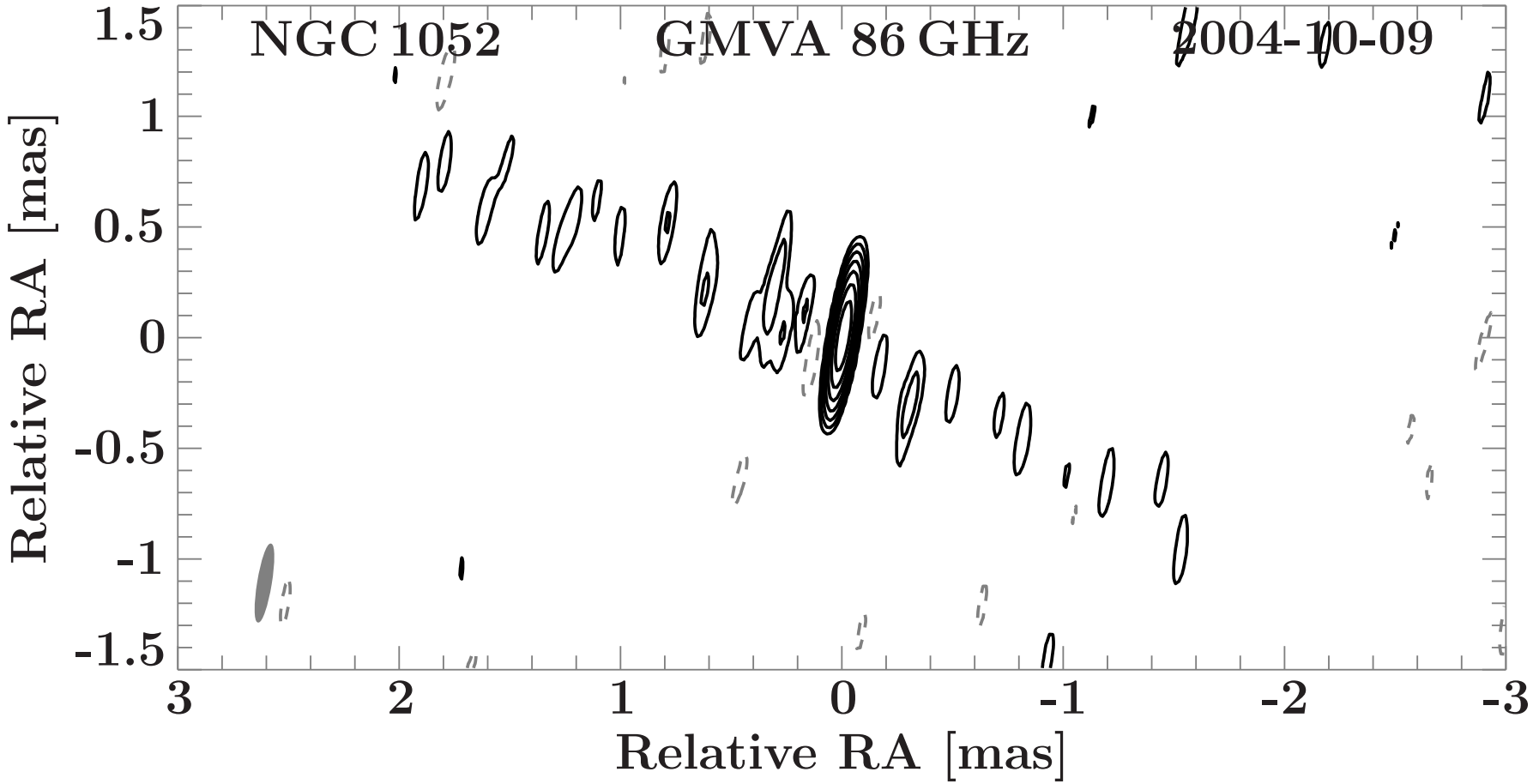
uv-coverage



Low declination $\sim -8^{\circ}$

Very long baselines in east-west direction

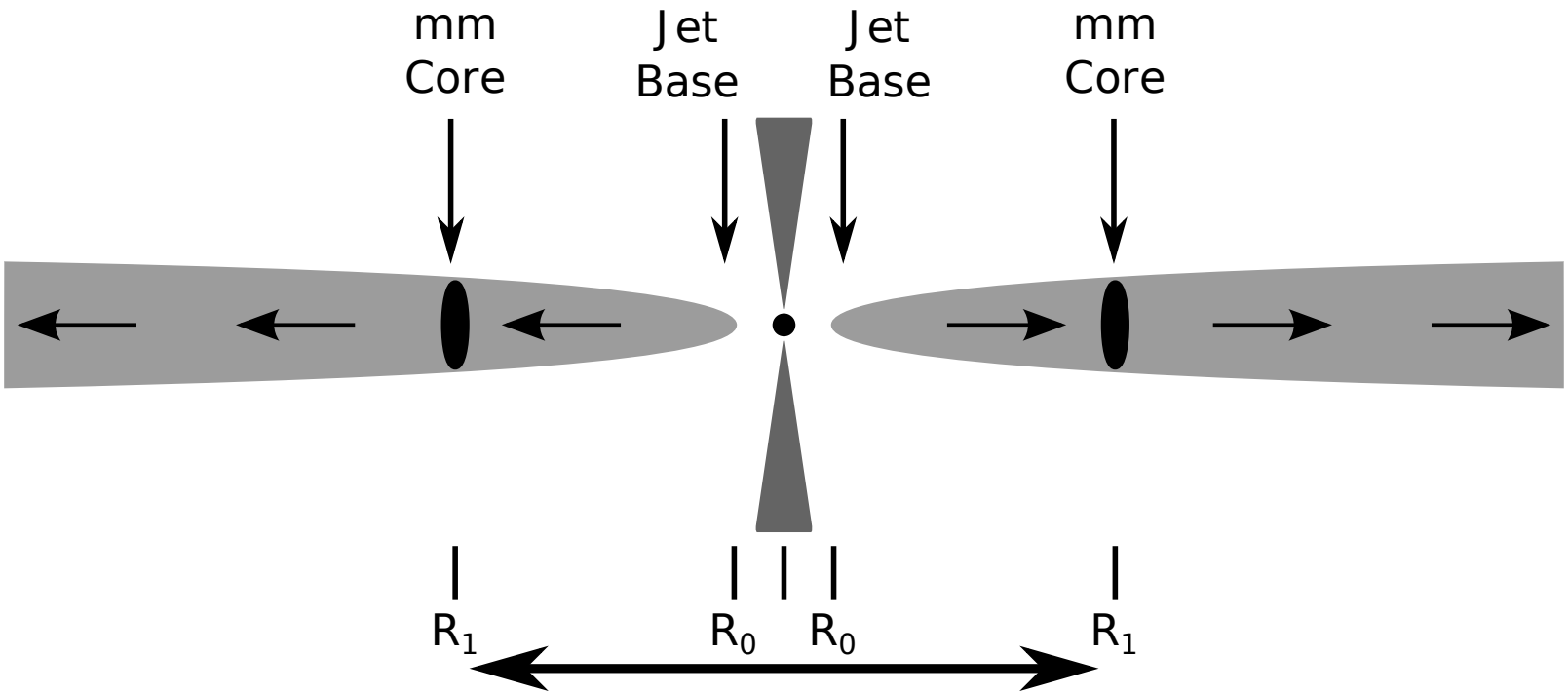
First detection of the twin-jet system of NGC 1052 at 86 GHz

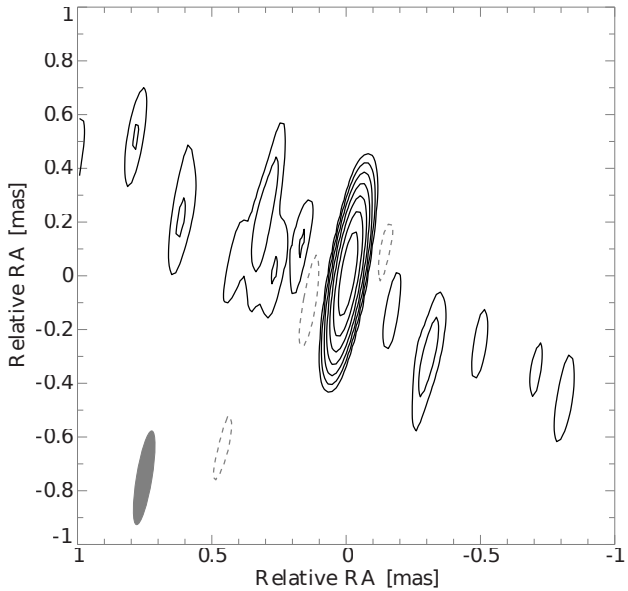


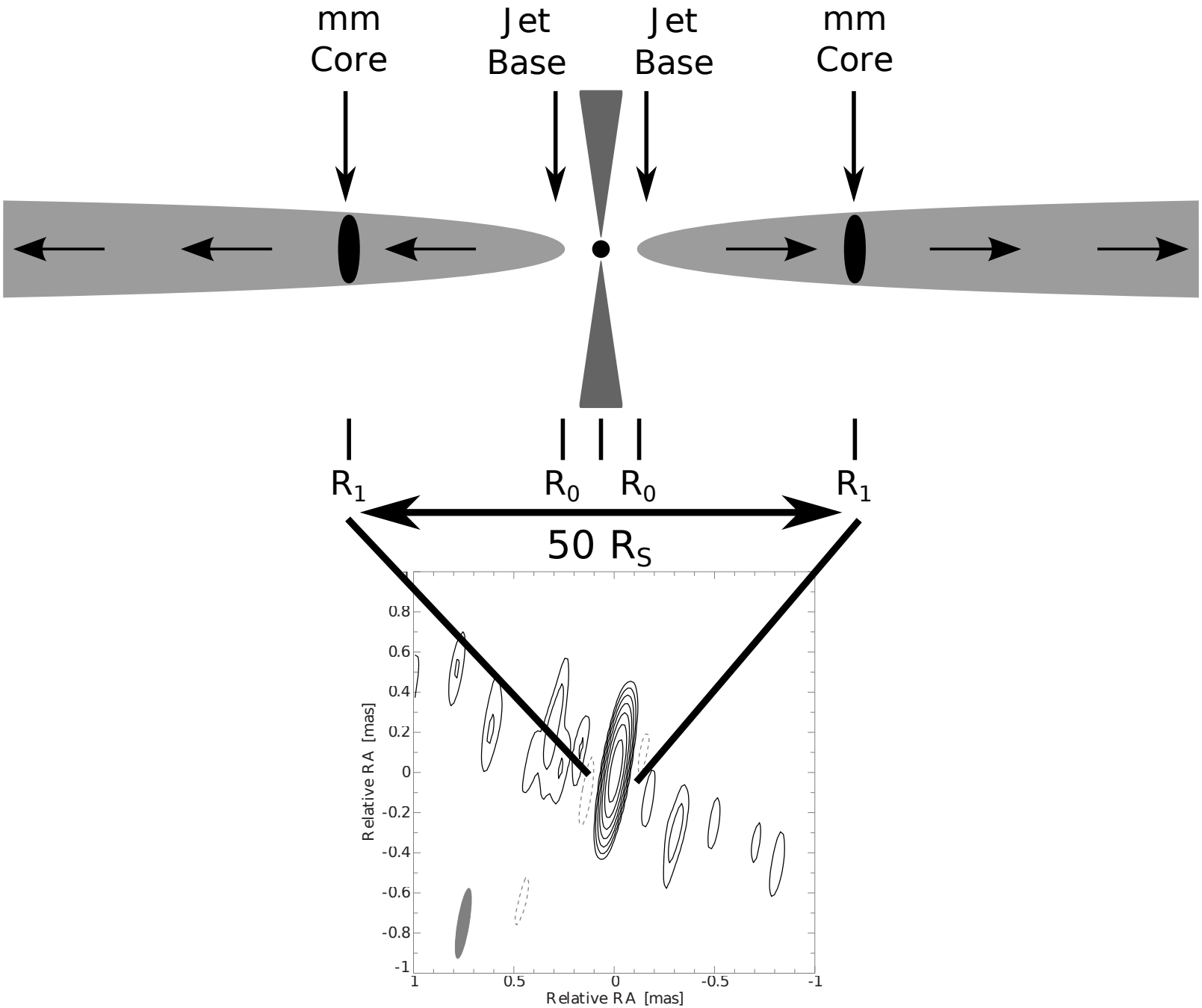
Uniform weighting beam $(353 \times 58)\ \mu$as

$\rightarrow$ resolution in east-west direction 6.2 ltd

Dynamic range of 340:1; image sensitivity of 1.2 mJy/beam


mm
Core
Jet
Base
Jet
Base
mm
Core
R1
R0
R0
R1


Relative RA [mas]
Relative RA [mas]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1
0.5
0
-0.5
-1


mm
Core
Jet
Base
Jet
Base
mm
Core
R1
R0
R0
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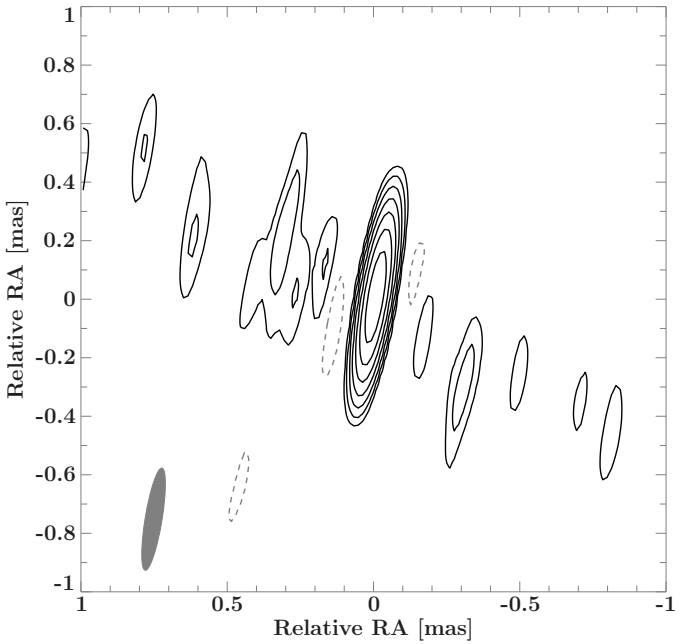
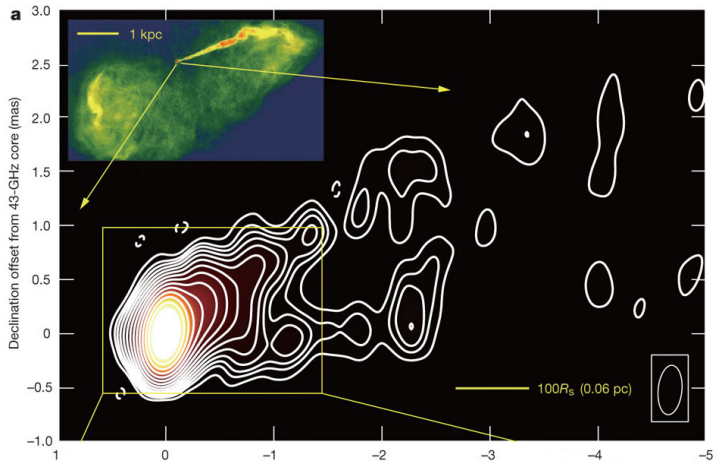
50 RS
Relative RA [mas]
Relative RA [mas]
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1
0.5
0
-0.5
-1

	NGC1052	M87
Distance	$\sim$20 Mpc	$\sim$ 16.7 Mpc
BH mass	$M \sim 10^{8.2}\,M_\odot$	$M \sim 10^{9.8}\,M_\odot$ $^{(*)}$
Inclination angle	close to 90°	$15-25°$ $^{(**)}$

$^{(*)}$ (Gebhardt& Thomas (2009)); $^{(**)}$ (Acciari et al. (2009))



Emission region $\sim 50\,\mathrm{R_S}$

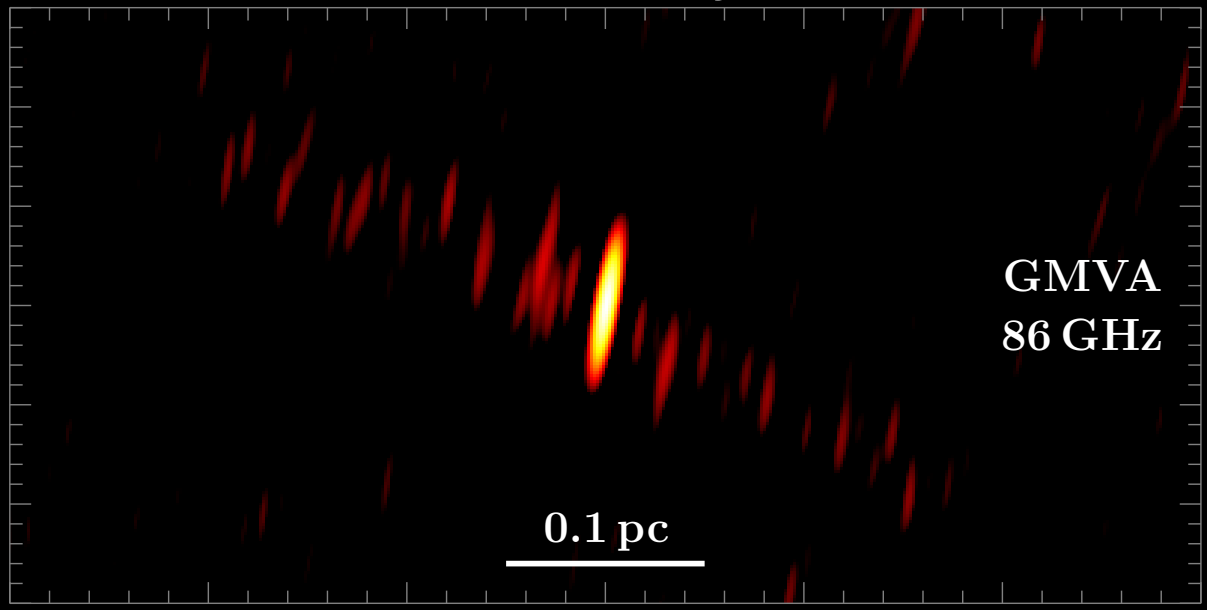


Hada et al. (2011)

Hada et al. (2011): core-shift: central engine within 14–23 $\mathrm{R_S}$ of the 7mm-core, asuming a conical geometry

Doeleman (2012): 1.3mm-core size FWHM of $40 \pm 1.8\mu\mathrm{as} \rightarrow 5.5 \pm 0.4\,\mathrm{R_S}$

Summary



$\Rightarrow$ Brightness temperature of central component: $T_b > 5 \times 10^{11}$ K

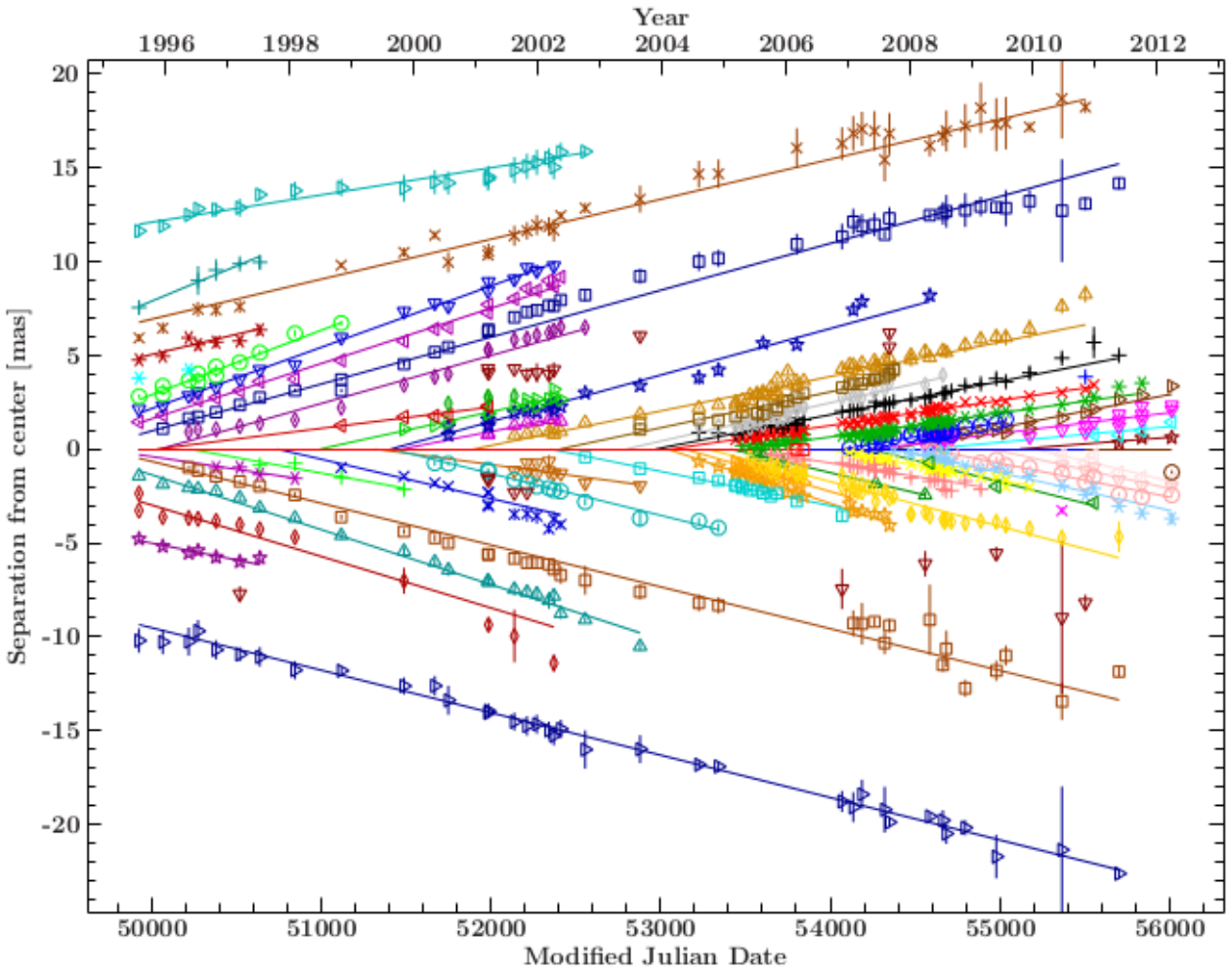
$\Rightarrow$ Emission region smaller than 8.6μas

Blended emission from both jets?

$\Rightarrow$ Distance between black hole and jet base $< 25 R_S$

$\Rightarrow$ **Excellent source for future mm- and sub-mm-VLBI observations**

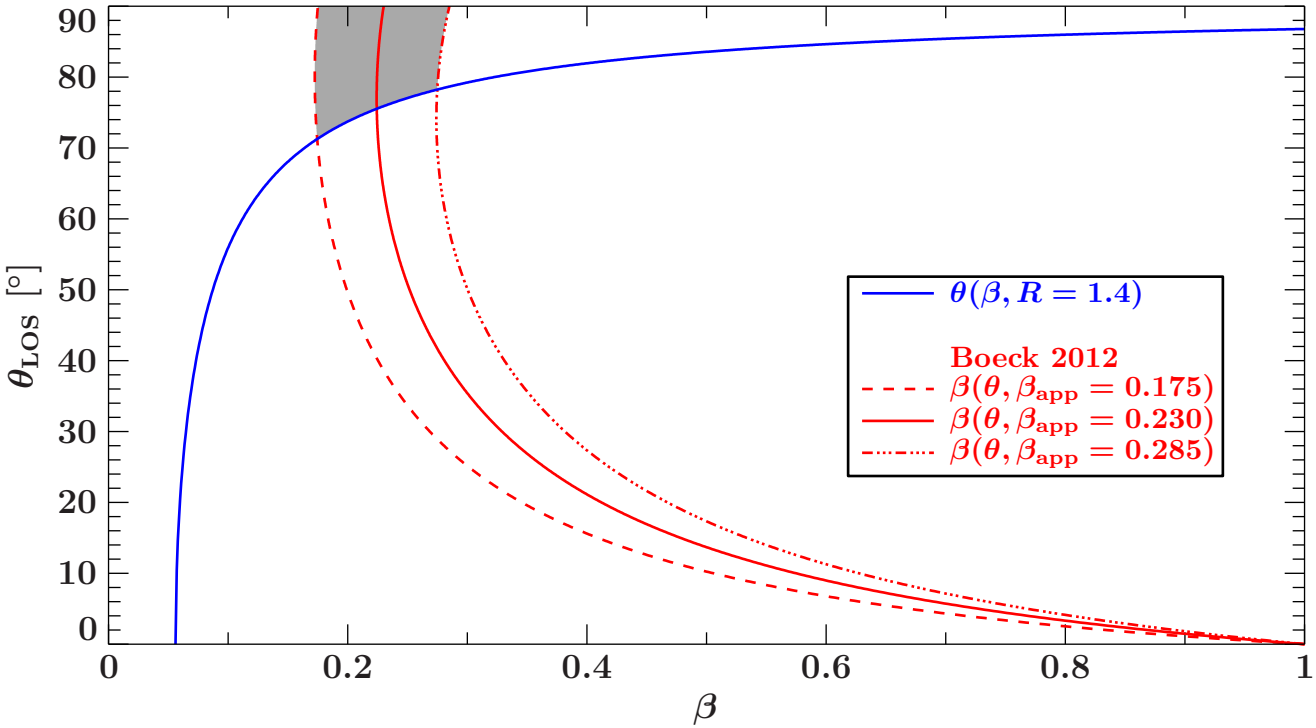
kinemativ studies



$\Rightarrow$ kinematic analysis at 15 GHz is challenging

$\Rightarrow$ jet speed is asumed as $\beta = 0.230 \pm 0.011$ (Boeck PhD thesis, 2012)

Orientation of the twin-jet system



(blue) Multi-epoch 7mm-VLBI observation show jet-to-counter jet ratios ranging from 0.7 to 1.0.

(red) from apparent jet velocities (Boeck 2012(PhD Thesis)).

$\Rightarrow$ suggesting an orientation very close to the plane of the sky.