IMAGING THE JET-LAUNCHING REGION IN NGC1052

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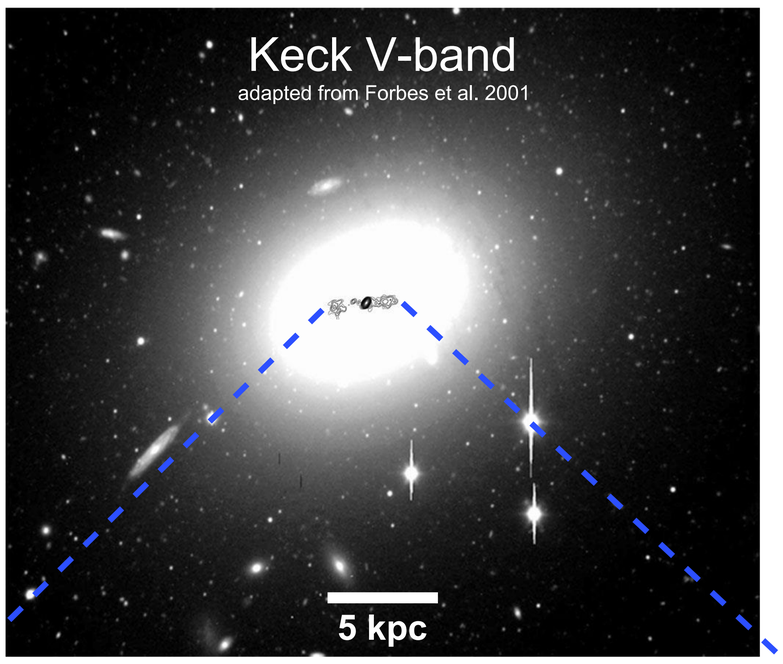
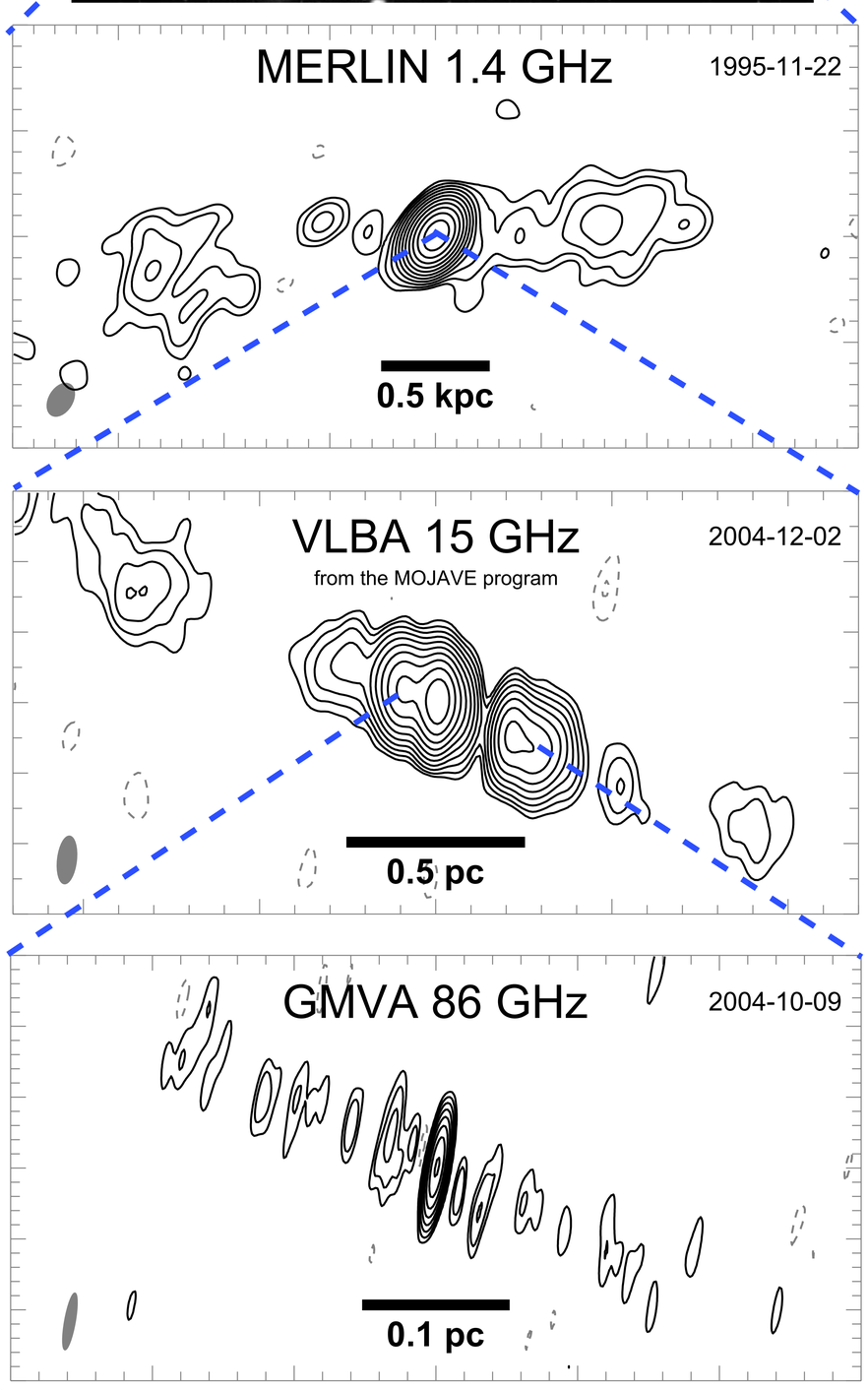
Abstract

The low-luminosity AGN NGC 1052 is located at a distance of only about 20 Mpc and exhibits a twin-jet system oriented near the plane of the sky. The small distance and unique geometry make it an ideal target for mm-VLBI studies of jet formation on the smallest accessible scales. Free-free absorption by a circumnuclear torus obscures the central engine at cm wavelengths. Our mm-VLBI observations at 43 GHz and 86 GHz are able to peer through the torus and reveal one compact central core with a high brightness temperature of $T_b > 8 \times 10^{10}$ K, well above the equipartition limit. If interpreted as a blended feature from the bases of both jets, this constrains the distance to the central engine to be less than 40 Schwarzschild radii.

Zooming into NGC 1052

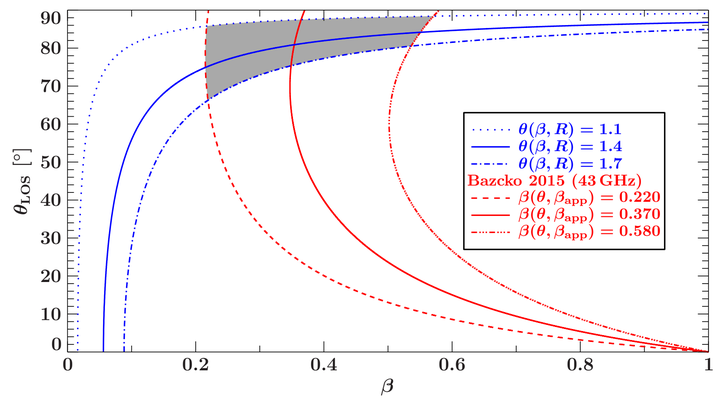


- Low-luminosity AGN
- LINER 1.9
- Distance: ~ 20 Mpc
  (1 mas ~ 0.1 pc)
- Central black hole mass $\sim 1.6 \times 10^8\ M_\odot$
  (Woo & Urry 2002)
- Possible merger event 1 Gyr ago
  (van Gorkom et al. 1986)



- Two-sided jet system extending out as far as ~3 kpc (Wrobel 1984, Kadler et al. 2004a)
- Optical ionization cone and X-ray emission aligned to the synchrotron jet (Kadler et al. 2004a)
- Prominent emission gap at cm-wavelengths between the two jets due to free-free absorption in a circumnuclear torus with optical depth $\tau_{1\mathrm{GHz}} \sim 300 - 1000$ (Kameno et al. 2001, Vermeulen et al. 2003, Kadler et al. 2004b, Sawada-Satoh et al. 2008)
- No significant absorption at 86 GHz
- GMVA observation finds the two jets extending from a single compact core, which is dominating the total flux density

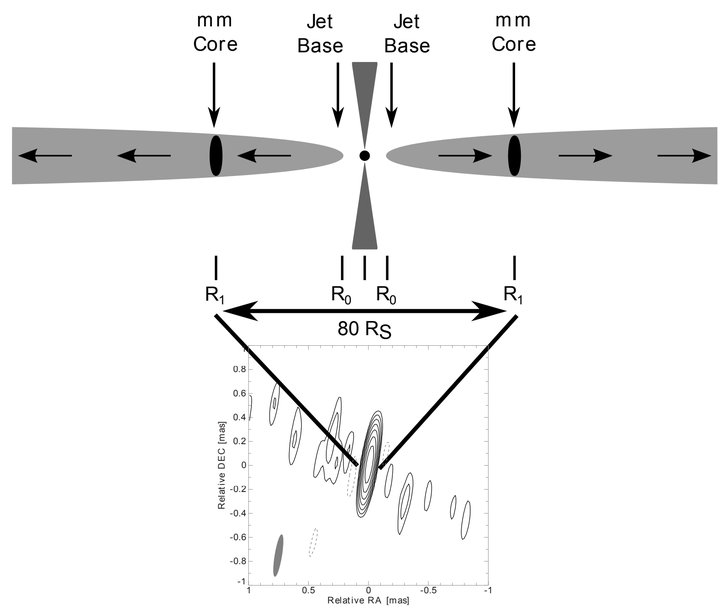
Orientation of the jets at 86 GHz



The shaded region shows the allowed range of the jet angle to the line of sight θ_{LOS} and the intrinsic velocity β determined from the single jet-to-counter jet ratio R measurement at 86GHz and the apparent velocity distribution β_{app} at 43 GHz (assuming $\beta_{\mathrm{app,43GHz}} \sim \beta_{\mathrm{app,86GHz}}$).

$\Rightarrow$ Jet orientation is marginally consistent with 90°

The jet launching region



Properties of the central feature at 86 GHz:

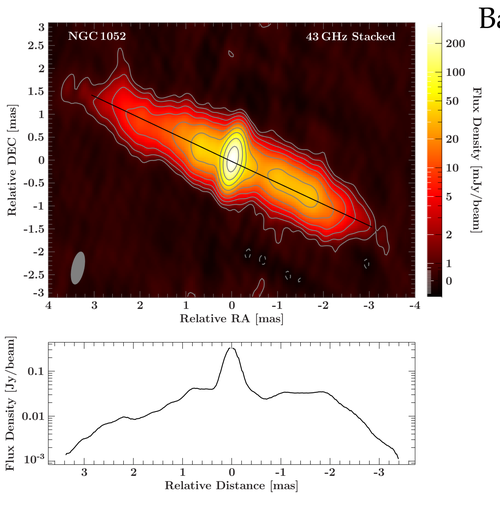
- High brightness temperature of $> 8 \times 10^{10}$ K
- Size of emission region well below 12 μas $\sim 80 R_S$

Blended emission from both jets?

$\Rightarrow$ Distance between central black hole and the jet base $< 40 R_S$

Excellent target for mm-VLBI observations above 86 GHz

Monitoring the twin-jets at 43 GHz with the VLBA



Baczko 2015:

Stacked image of the VLBA observations between 2005 and 2009 with the ridge line along the position angle of the jet plotted below

- No significant localised emission gap
- Western jet brighter than the eastern jet

Multi-epoch and kinematic analysis shows:

- Consistent prominent central peak with high brightness temperature ($> 5 \times 10^9$ K)
- Similar apparent velocities in both jets
- Small changes in the flux density ratio in both jets.

$\rightarrow$ Scan the QR code for a movie of the interpolated jet evolution at 43 GHz:

References

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