

Max-Planck-Institut
für Radioastronomie

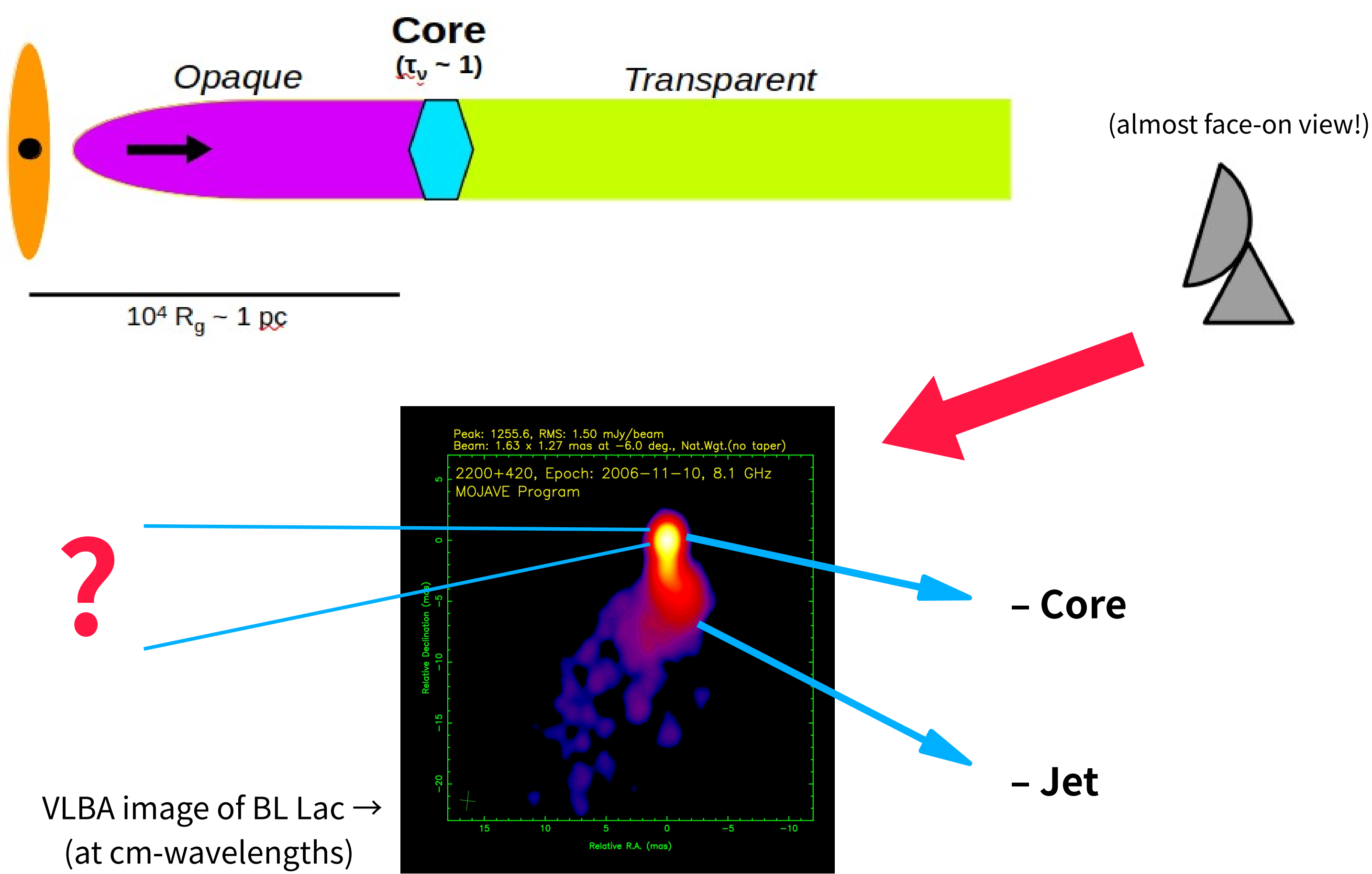
GMVA observation of BL Lacertae when the jet is flaring

D. -W. Kim¹, T. P. Krichbaum¹, E. Ros¹, C. Casadio^{2,3,1}, R. Lico^{4,1}, E. Traianou^{4,1}, and et al.

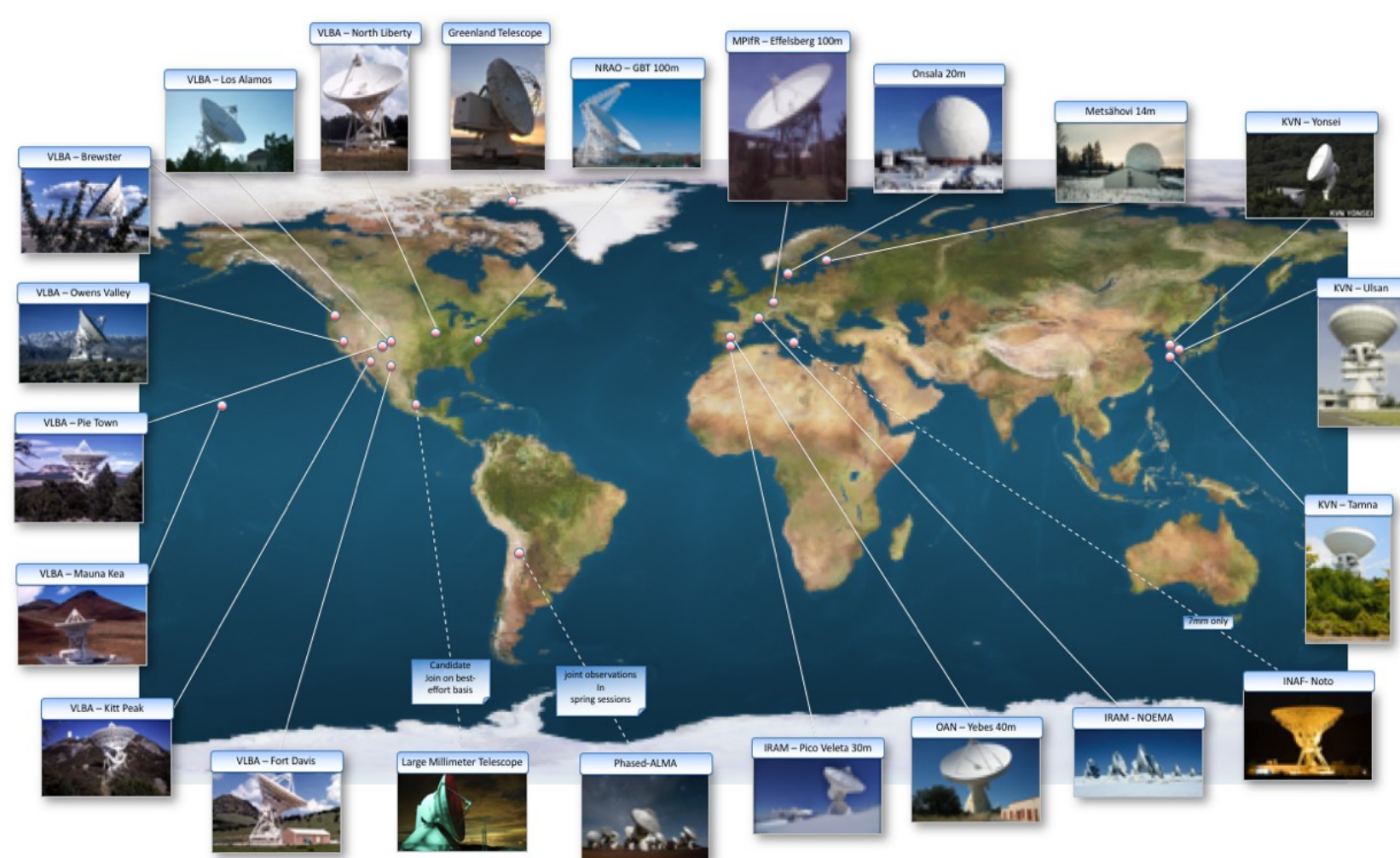


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*The typical core-jet feature of Blazar jets emanating from the SMBH



*Recent observations of BL Lac with Global mm-VLBI Array (GMVA)

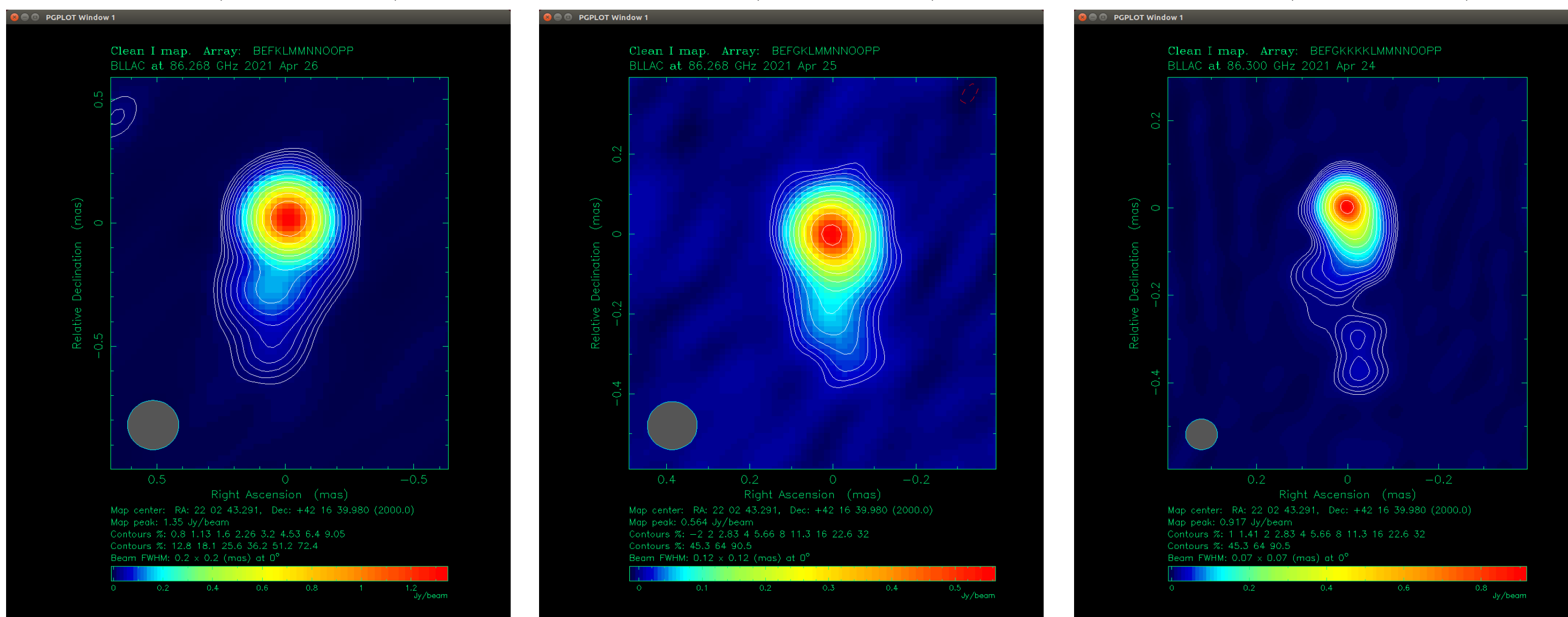


Exp. code	C211a	C211b	C211c
Project code	MB018	POLCAL1	POLCAL2
Obs. date	24.04.2021	25.04.2021	26.04.2021
Antennas	8 VLBA + 5 EU + 3 KVN + GLT	BR, FD, KP, LA, MK, NL, OV, PT	EF, MH, NN, ON, PV
Onsource time	~1.5 hrs	~1.5 hrs	~2 hrs

We calibrated these three GMVA datasets and the results are shown below!

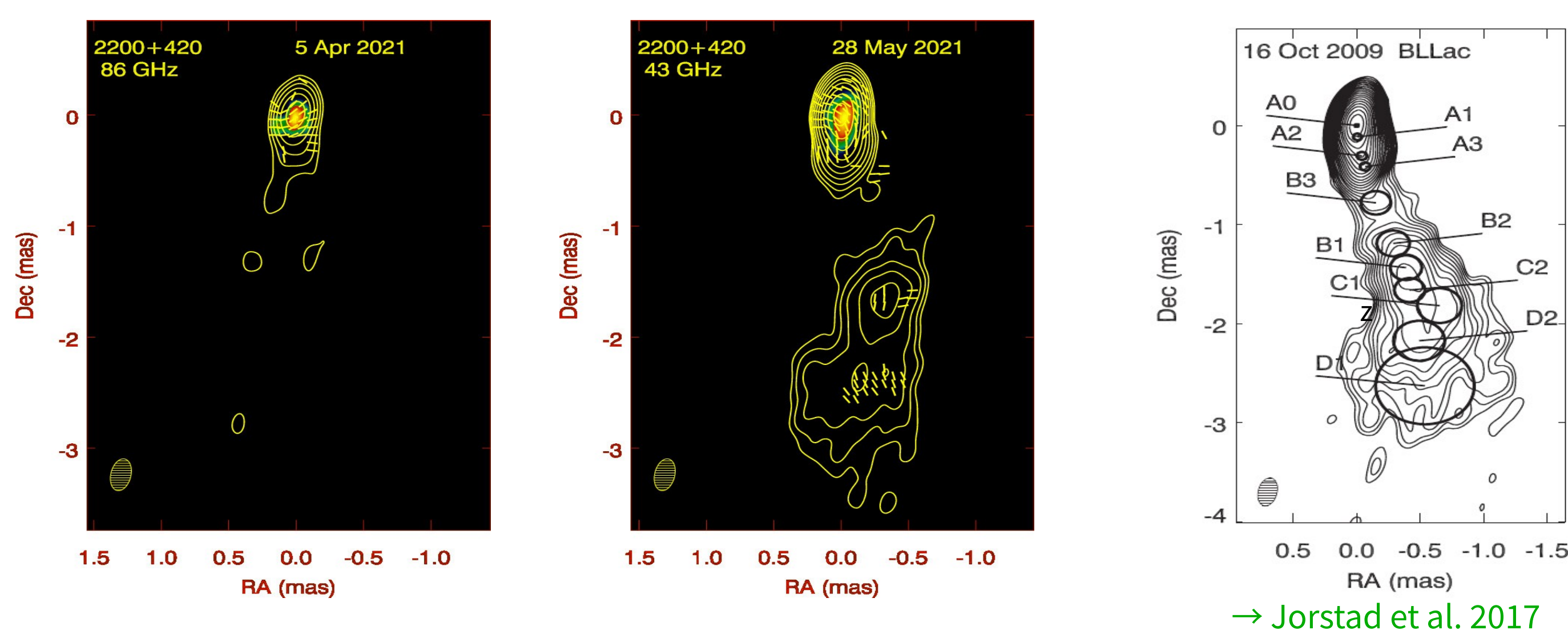
*Our preliminary results of the GMVA datasets: Images of the jet

C211c (26.04.2021) C211b (25.04.2021) C211a (24.04.2021)



- To better describe the structures, the beams were restored from, POL2=0.75x0.16 at -37 / POL1=0.24x0.09 at -26 / MB=0.13x0.04 at -7 (mas & deg.)
- Overall image rms noise ~ a few mJy/beam.
- **Highly complicated, and dynamic jet structures are present.**
- **Multiple bending features depending on the resolution of the array.**

*Comparison with 7mm/3mm images of the BU-BLAZAR program

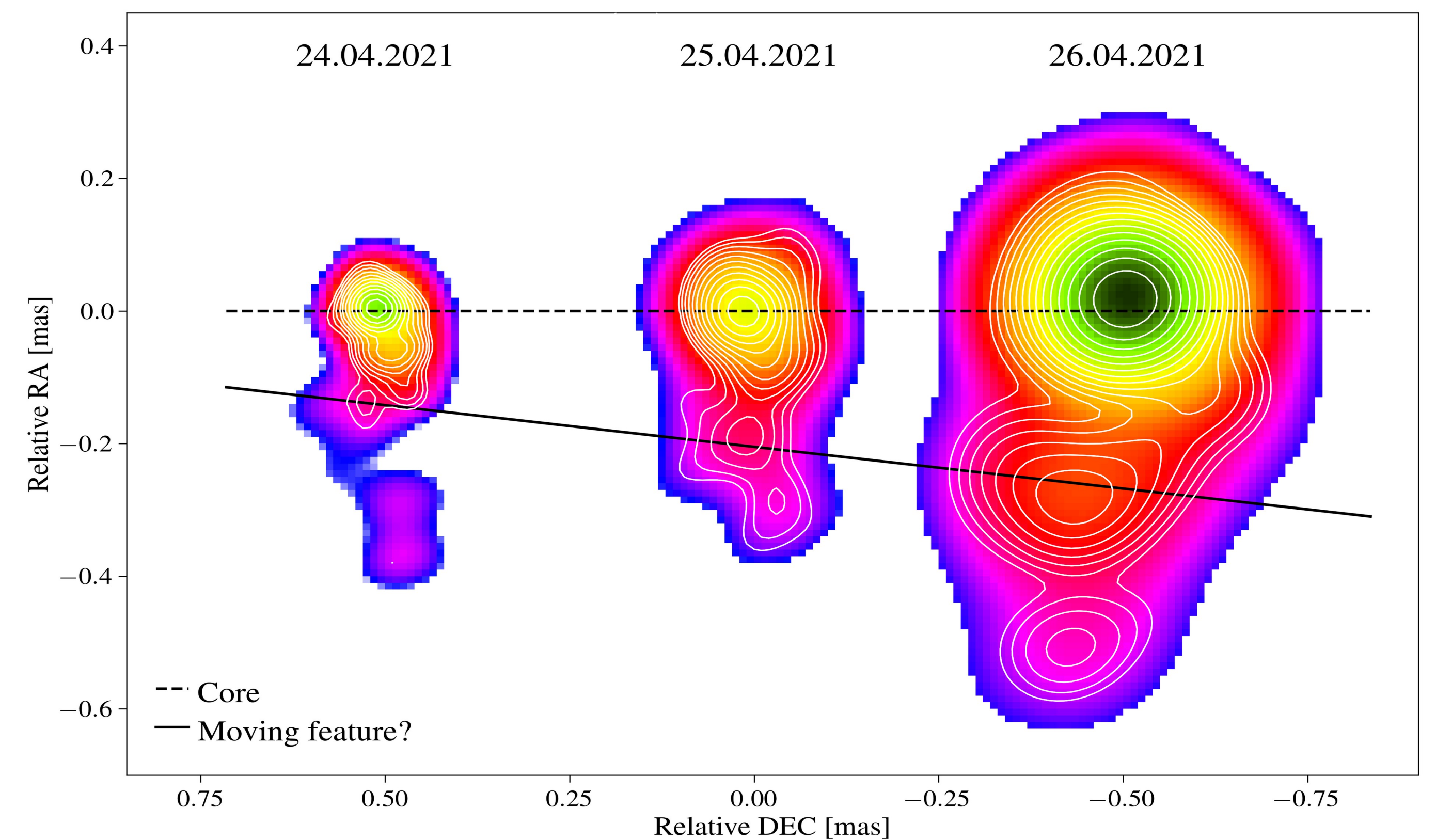


- Jet propagating axis consistent with the EVPAs at the core.
- Oblique standing shocks, rather than recollimation shock? (A1, A2, and A3)

*ABSTRACT

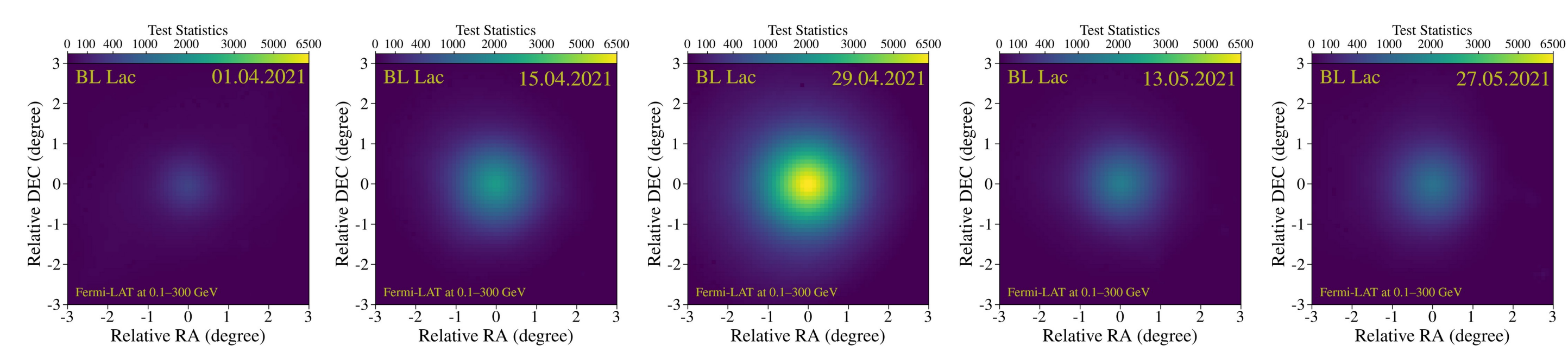
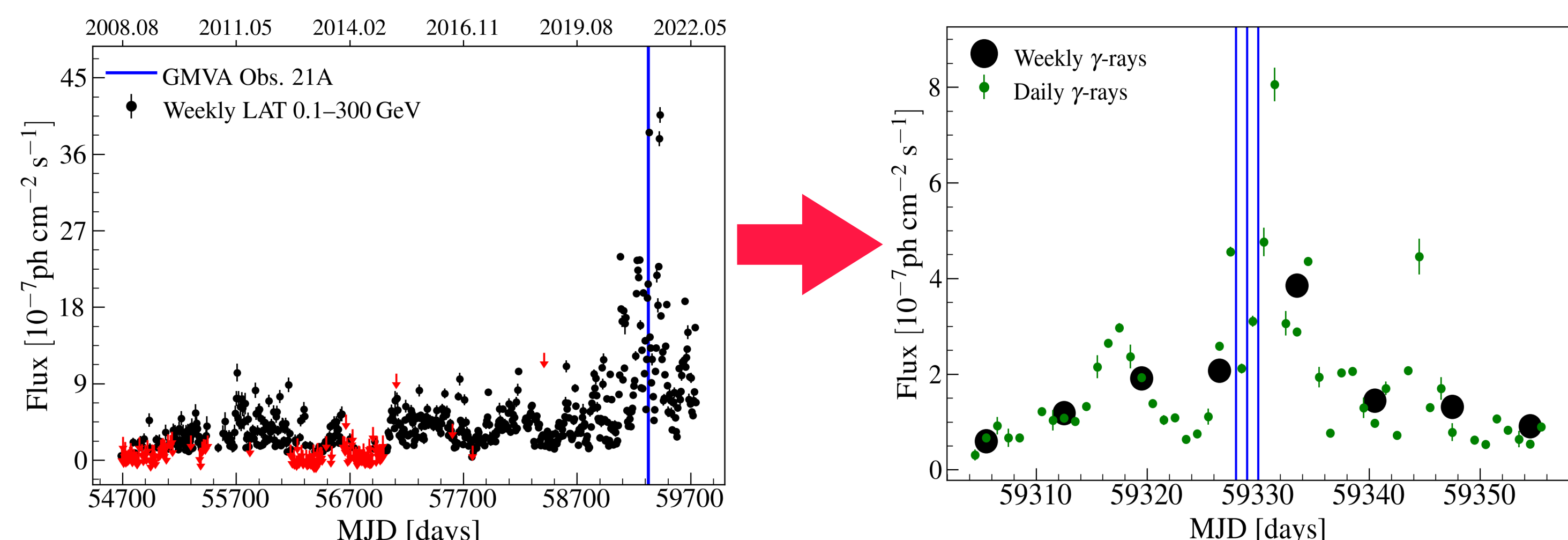
We study the subpc-scale jet of blazar that is an inner (i.e., closer to the central SMBH) jet region poorly understood. With its notable brightness and various phenomena, BL Lacertae (BL Lac; 2200+420) is an excellent target source for the study. This is an ongoing project and here we present our preliminary images of the jet obtained from GMVA observations in 2021. Using the high-resolution GMVA observations, we aim to explore the nature of the inner jet region such as jet structure, emission/acceleration, and magnetic field in the jet.

*Searching for any notable variations in the jet structure



- Background color images: again the three jet images that we obtained.
- Contour maps: the same images but restored with over-resolving beam. POL2=0.12x0.12 at 0 / POL1=0.07x0.07 at 0 / MB=0.045x0.045 at 0 (mas & deg.)
- **The jet flows downstream, changing its axis iteratively: West ↔ East.** (see also Casadio et al. 2021, for a similar pattern)
- **The moving-like feature: either independent emission or moving shock?**

*A recent activity of BL Lac at γ -rays observed by the *Fermi*-LAT



- Upper: A long-term γ -ray light curve of BL Lac (weekly & daily binned).
- Lower: Test Statistic (TS) maps of BL Lac → sqrt(TS) ~ detection sigma level.
- **The historically huge outbursts coincide with the GMVA observations.**
- **Potentially interesting to see if a jet/ γ -ray connection was present.** (e.g., Kim et al. 2021)

*Summary

Here we presented our 3mm GMVA images of the BL Lac jet at subpc scales. As expected from many previous studies, the jet has a number of interesting features that couldn't be revealed by other VLBI observations. We plan to double-check the imaging results and data calibration to be sure on those extreme behaviors of the jet. We will also generate polarization images of the jet to explore the configuration of the inner jet magnetic fields.

¹ Max-Planck-Institute für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany

² Foundation of Research and Technology – Hellas, IESL & Institute of Astrophysics, Voutes 7110, Heraklion, Greece

³ Department of Physics, University of Crete, 70013 Heraklion, Greece

⁴ Instituto de Astrofísica de Andalucía – CSIC, Glorieta de la Astronomía s/n, 18008 Granada, Spain

References

Jorstad, S., et al. 2017, ApJ, 846, 98 / Casadio, C., et al. 2021, A&A, 649, A153 / Kim, D. -W., et al. 2022, ApJ, 925, 64