The Detection of a Compact Radio Feature in a Seyfert 1 Galaxy After an Accretion Rate Change

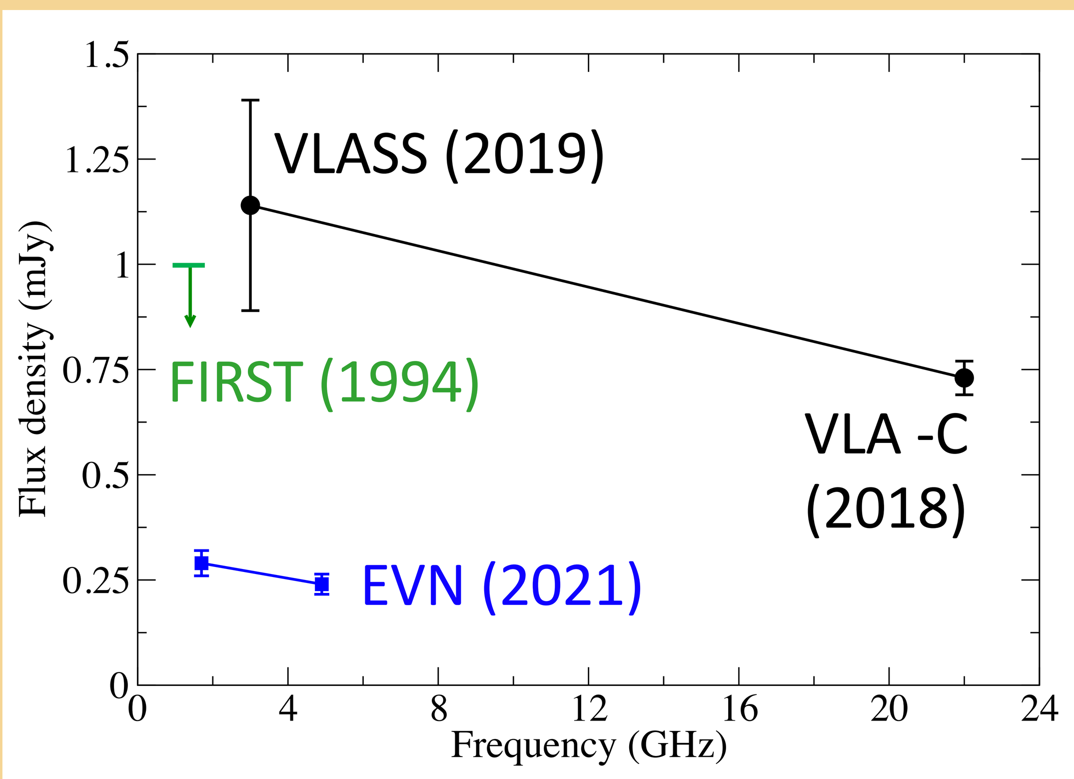
K. É. Gabányi[1,2,3], K. L. Smith[4], S. Frey[3,5], Z. Paragi[6], T. An[7], A. Moór[3]

[1]Department of Astronomy, ELTE Eötvös Loránd University, Hungary, [2]ELKH-ELTE Extragalactic Astrophysics Research Group, ELTE Eötvös Loránd University, Hungary, Hungary, [3]Konkoly Observatory, ELKH Research Center for Astronomy and Earth Sciences, Hungary, [4]Southern Methodist University, Texas, USA, [5]Institute of Physics, ELTE Eötvös Loránd University, Hungary, [6]JIVE, Netherlands, [7]Shanghai Astronomical Observatory, Chinese Academy of Sciences, P. R. China

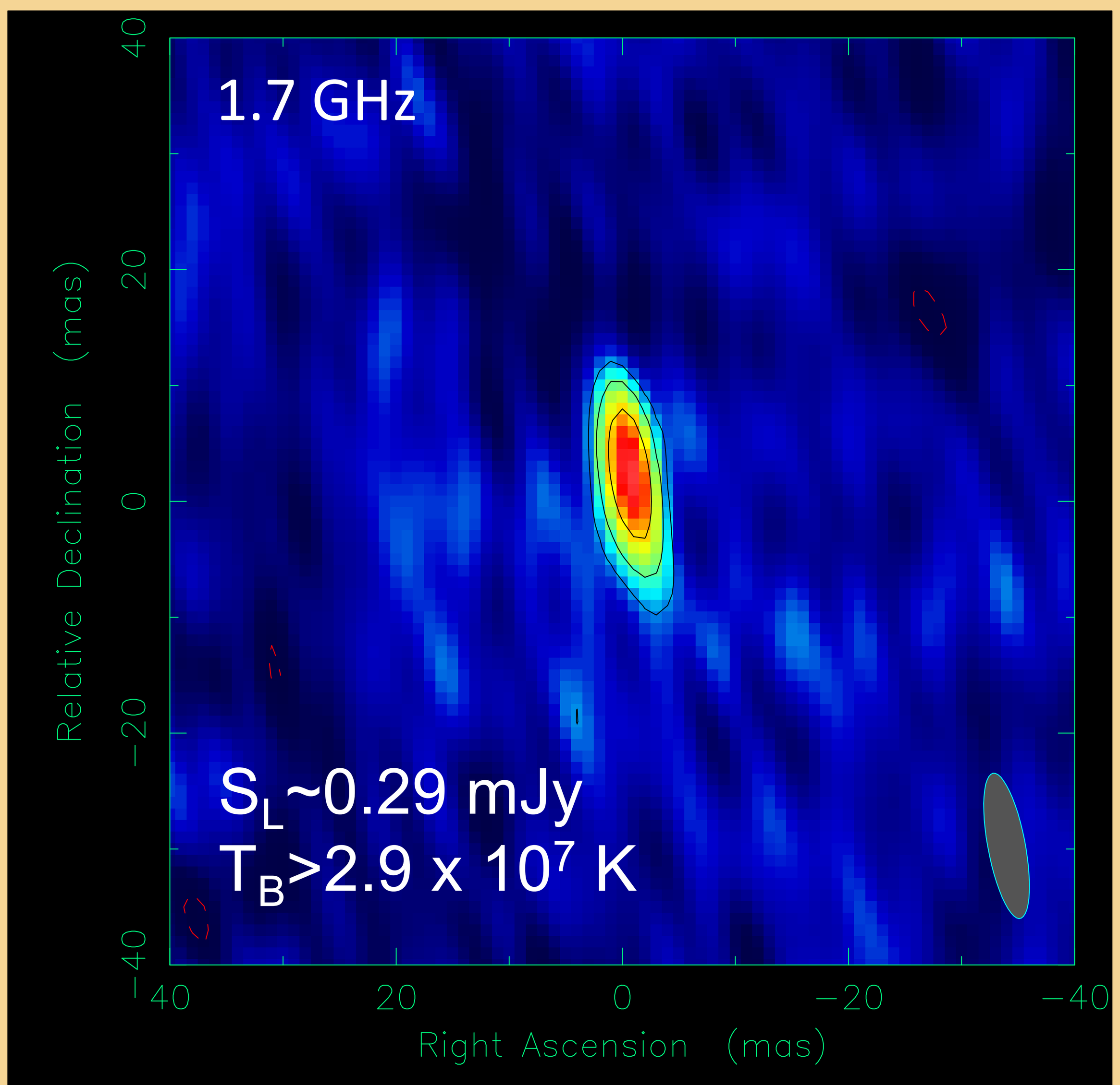
Variability of the optical and X-ray emissions from the nuclei of Seyfert galaxies on timescales shorter than the viscous timescale in a standard thin-disk model is usually attributed either to variations in the obscuration or to sudden changes in the accretion rate. In stellar-mass black hole systems, the complex variability of the X-ray luminosity and the hardness ratio is explained by changes in the accretion disk structure. Synchrotron self-absorbed core-jets are ubiquitous in the hard state, and they are responsible for the X-ray–radio correlation in such systems (Fender et al. 2012). However, it is still **unclear whether and how the disk–corona system of X-ray binaries can be scaled up to describe the optical-UV emissions of the accretion disks of active galactic nuclei (AGN)**.

The Seyfert 1 galaxy KUG1141+371 (z=0.038) has been showing a steadily increasing X-ray flux since 2007 and exhibited variability behavior similar to the state transitions observed in X-ray binaries (Jiang et al., 2021). It **was hypothesized to undergo a rapid boost of mass accretion**. If the X-ray binary analogy holds then the appearance of jet emission can also be expected in KUG 1141+371. While the source was not detected in the Faint Images of the Radio Sky at Twenty-centimeters Survey in 1994 (White et al. 1997), it appears in the VLA Sky Survey in 2019 (Lacy et al., 2021) and at 22 GHz in a VLA observation in 2018 (PI: K.L. Smith, 18B-245) at mJy flux density level.

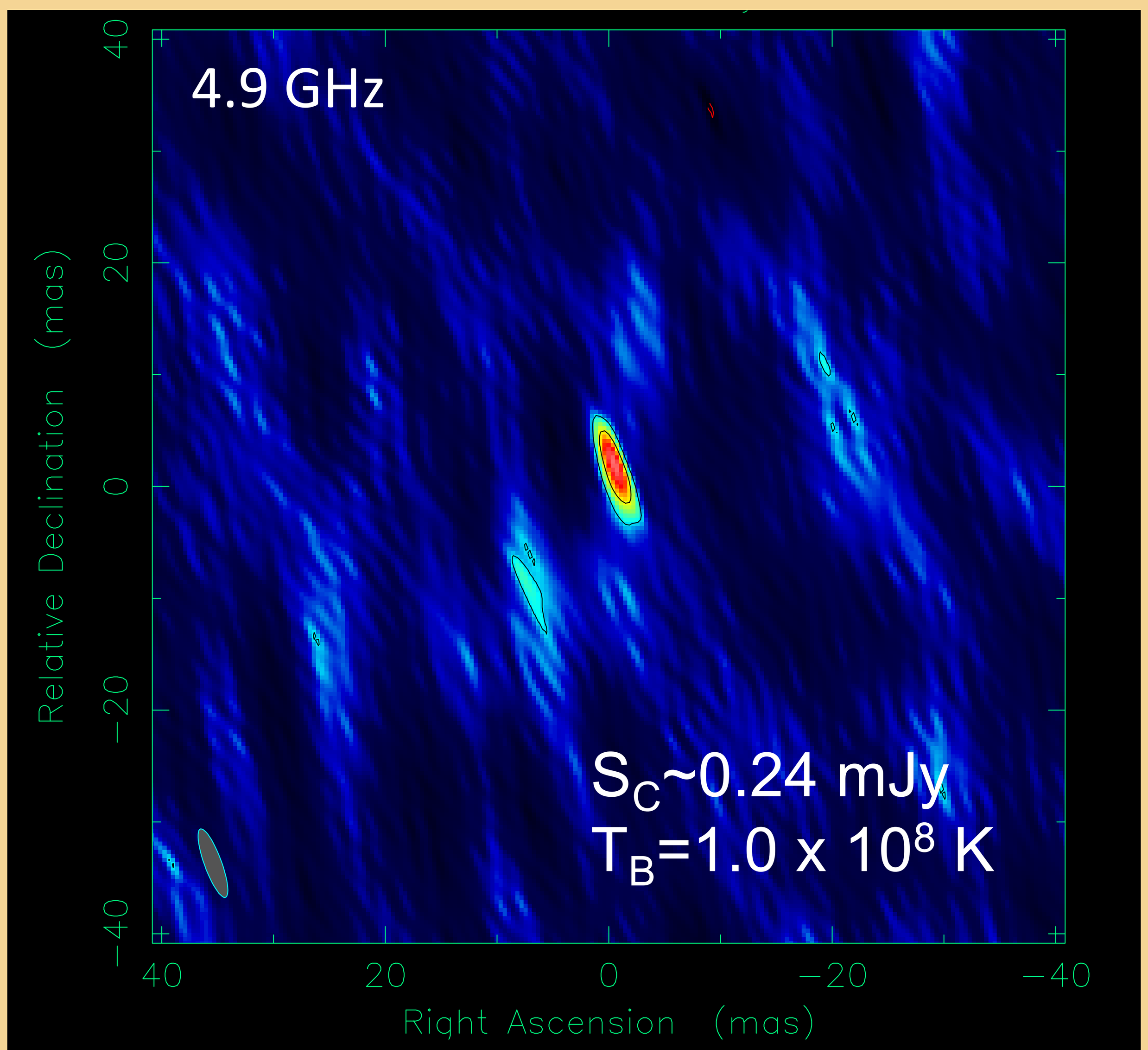
To reveal the nature of the radio emission, we conducted EVN+e-MERLIN observations at 1.7 GHz and 4.9 GHz in 2021 June 4 and May 11, respectively. The phase-referenced observations revealed a compact component with a flat radio spectrum. **The high brightness temperature indicates AGN origin of the radio emission.**



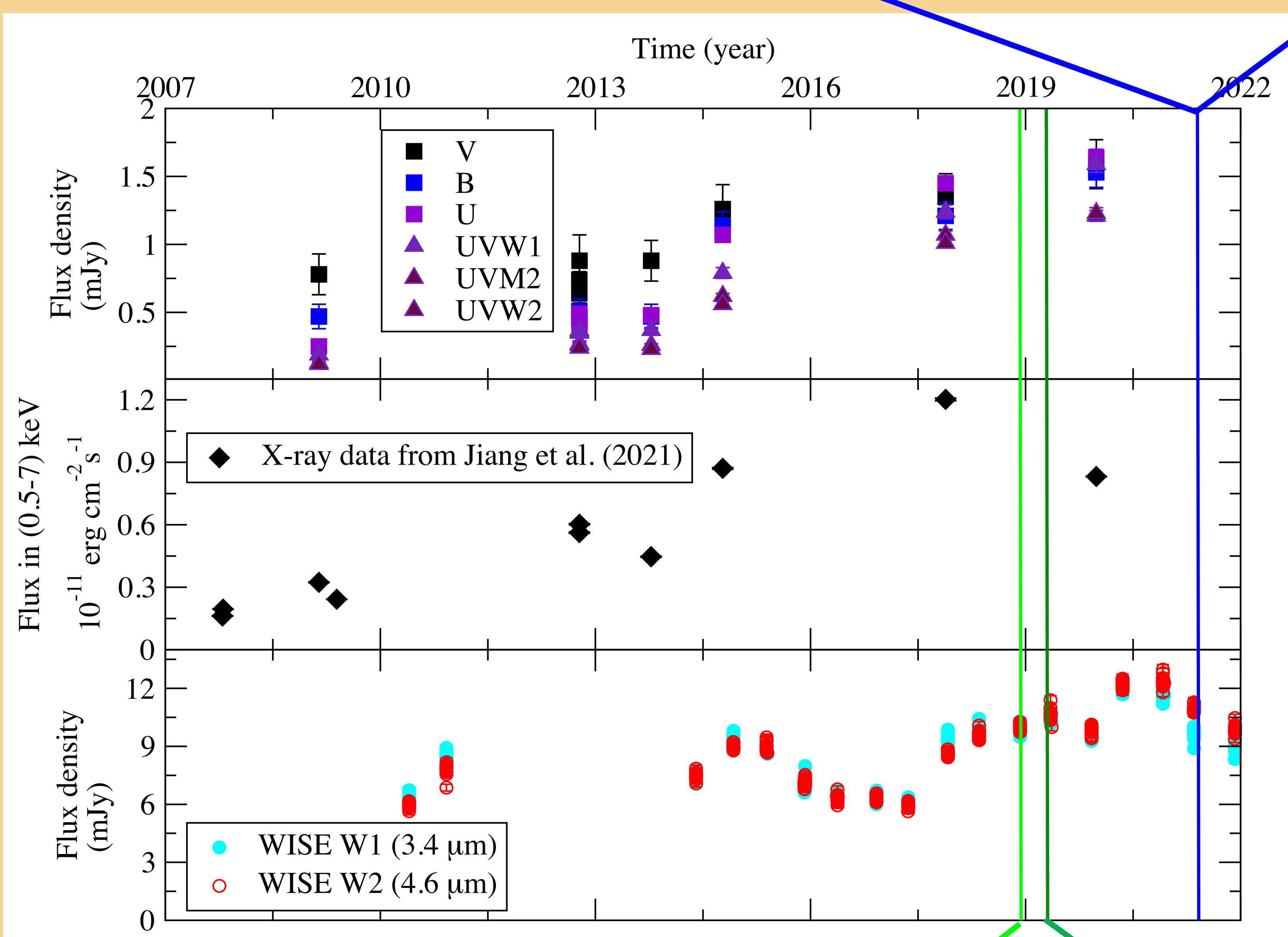
The radio spectrum of KUG1141+371. The VLBI values are well below the VLA flux densities, indicating either significant arcsec-scale emission or variability on a timescale of 2-3 years.



Peak: 0.25 mJy/beam
Contours: 0.036 mJy/beam x (-1, 1, 2, 4)
Lowest positive contour at 4σ
Beam: 12.8 mas x 3.3 mas at 10.9º

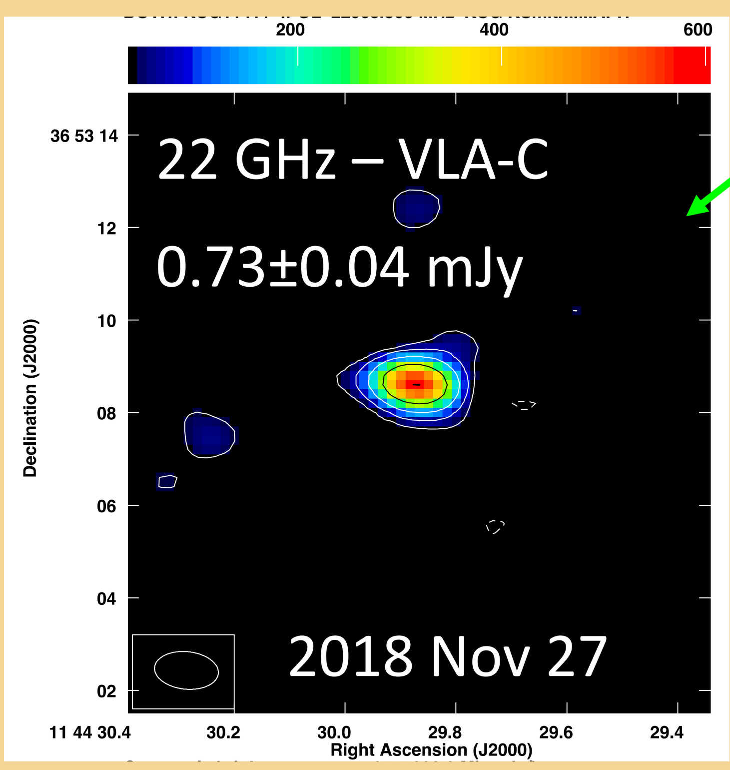


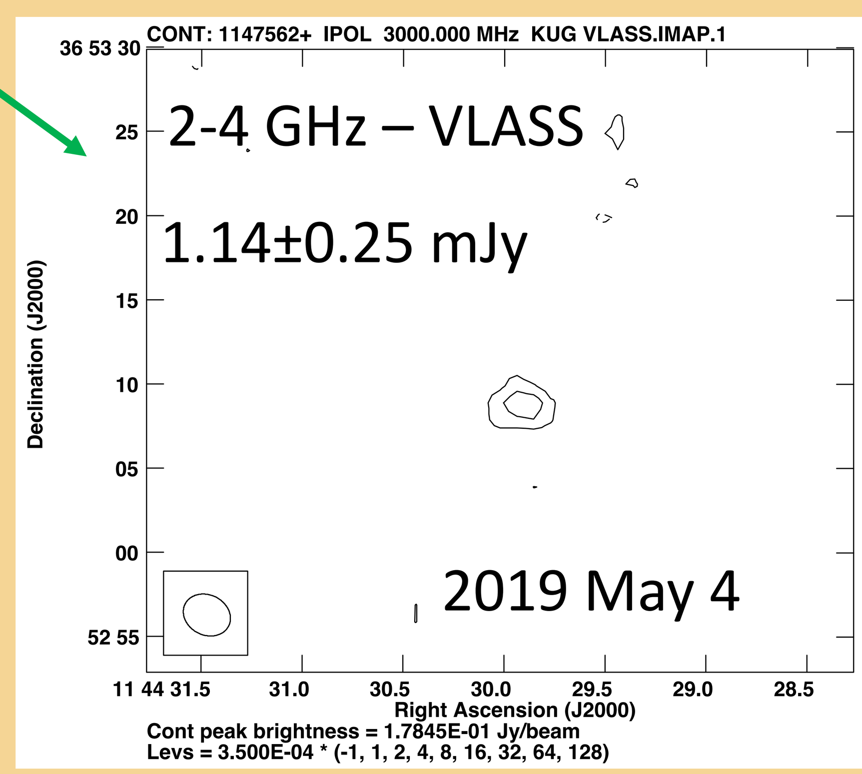
Peak: 0.21 mJy/beam
Contours: 0.053 mJy/beam x (-1, 1, 2, 4)
Lowest positive contour at 4σ
Beam: 6.5 mas x 1.5 mas at 20.2º



Optical and UV flux density of the AGN derived from *Swift* measurements by Jiang et al. (2021).

WISE infrared photometry (Cutri et al., 2013; Wright et al. 2010)





References

Cutri et al. 2013 Vizier Online Data Catalog II/328
Fender et al. 2012, Science, **337**, 540
Jiang et al. 2021, MNRAS, **501**, 916
Lacy et al. 2021, PASP, **132**, 035001
White et al. 1997, ApJ, **475**, 479
Wright et al. 2010, AJ, **140**, 1868

Acknowledgements

The European VLBI Network is a joint facility of independent European, African, Asian, and North American radio astronomy institutes. Scientific results from data presented in this publication are derived from the following EVN project code(s): EG116. This research was supported by the Hungarian National Research, Development and Innovation Office (OTKA K134213).