



Very Long Baseline Interferometry

Prime example of successful international collaboration

By combining telescopes across the globe, VLBI achieves unprecedented sensitivity and angular resolution, enabling cutting-edge astrophysical research that would otherwise be impossible

- Global Nature and Distributed Infrastructure •
- Distributed design needs international cooperation ٠
- Simultaneous observations from geographically • separated radio telescopes across continents.
- Shared Resources, Expertise, and Coordinated • Development





















The European VLBI Network



Global Network	Highest Sensitivity	Wide Frequency Range
EVN consists of 19 radio telescopes primarily in Europe and Asia, with an extension in South Africa	EVN is most sensitive and the sharpest VLBI array in the world at cm wavelengths	It operates from 1.4 GHz to 45 GHz, with some telescopes extending to 90 GHz
Key Science Areas	Real-time Observations	Open Access
Active Galactic NucleiCompact transients	It supports real-time e-EVN observations for immediate	Available to all astronomers worldwide, with regular calls

https://www.evlbi.org/evn-for-astronomers



Science with the EVN

The EVN's unparalleled resolution enables breakthroughs across diverse astrophysical phenomena.

Active Galactic Nuclei (AGN): Studying core-jet regions, compact jet components, and linkages with gamma-ray or neutrino emission, binary black holes (BBH), gravitational lensing, and intermediate-mass black holes (IMBH).

Compact Transients: Investigating gravitational wave events (GWEs), gammaray bursts (GRBs), supernovae (SNe), tidal disruption events (TDEs), X-ray binaries (XRBs), novae, fast radio bursts (FRBs), and pulsars (PSRs).

Non-thermal Stellar Emission: Observing magnetically-active stars, colliding stellar winds, and masers.

Other key areas include AGN/Starburst energy budgets, AGN feedback, celestial reference frames, and near-field/**solar-system** studies.





Keplerian disk with a four-arm spiral birthing an episodically accreting high-mass protostar (EVN, LBA, VLA)

Burns et al. (2023) [incl. G. Orosz]





VLBI and space applications









Space domain awareness



Global collaboration to use of radio telescope antennas and networks to track spacecraft around Earth and in the solar system





Joint Institute for VLBI ERIC













JIVE for the EVN

and for the VLBI community

- Facilitate the best EVN science
- Support the operations of EVN stations
- Support the implementation of new equipment or procedures

Support new institutes to become EVN and JIVE partners

Support to users (science support, training, outreach)

- R&D for a state-of-the-art correlator and VLBI technology
- Provide essential services to the EVN

RADIO

other networks

Engage and represent its partners in relations with the EC,

BLOCKS





ERIS 2024

The tenth European Radio Interferometry School Sep 30 - Oct 4, 2024 Granada, Spain

Fopics covered:

R&D

- Calibration and imaging of interferometry data (continuum, spectral line, and polarization)
- Observational techniques using various arrays
- Strategies for observation planning and proposal writing
- Advanced tutorials on specific topics

SFXC software correlator

- New SFXC science capabilities
- VLBI calibration tools + algorithms
- High-speed data transport + recording
- Jupyter-notebook based processing
- FAIRness of EVN data





EVN technological developments



- Digital Back-Ends & Multi-Band Receivers: Enabling wider IFs and higher data rates
- Higher Bit-Rates & Sensitivity: Improving overall performance and scientific output
- Flexible Frequency Configurations: Enhancing adaptability for diverse observations
- Correlation & Data Processing: Software Correlation & Archiving
- Special-Purpose Correlation Modes: Expanded features for specific scientific needs
- FITS & Measurement Sets; Jupyter Notebooks: Improved data handling and analysis tools
- Expanding the VLBI Network More Stations for Better Sensitivity & u-v
 Coverage: Inclusion of new facilities → MeerKat (South Africa)
- Real-Time e-VLBI Maturation: Enhancing responsiveness with automated overrides
- Improved Coordination in Multi-Wavelength Campaigns: Strengthening crossdisciplinary collaborations
- SKA-VLBI



Radio Astronomy and Industry

Technologies and expertise developed for radio astronomy facilities have wide-ranging applications, offering substantial opportunities for industrial partnerships.

Technology transfer areas:

- Telecommunications: Advanced antenna technologies, high-speed data processing, and signal processing methods can be directly applied to the telecommunications industry.
- Aerospace: High-reliability components and advanced data processing techniques are relevant to the aerospace sectors.
- High-Performance Computing: GPU-based processing and high-speed data transport are valuable to other scientific fields and commercial high-performance computing applications.
- AI/ML Applications: Expertise in AI/ML for signal processing can be leveraged across various sectors.





Science, technology and society

 Advancements in the scientific capabilities of EVN and partner infrastructures

• Better understanding of the universe.

- VLBI infrastructures, works with hi-tech companies, providing them with direct benefits and potentially leading to technology spin-offs
- VLBI creates new technologies and push existing ones in new directions

- Impact beyond technology to wider cultural areas, reflecting society's interest in understanding our place in the cosmos
- Expanding our understanding of the universe, building on the transformative role of radio astronomy over the last 60 years









Potential Collaborations

for strengthen and recovery of Ukrainian astronomy

Ukrainian radio telescope have already been considered as potential addition to the EVN.

Tailored Training and Expertise Transfer: JIVE offers current and prospective EVN users support and training programs. Ukrainian researchers are encouraged to participate to get expertise in utilizing EVN resources.

Joint Scientific and Technical Projects: We encourage joint proposals and R&D activities. In the past, Ukrainian radio astronomers were invited and attended the Technical and Operations Group of the EVN, with the goal of successful joining the network.

Integration into Broader European Initiatives: JIVE can play a key role in integrating Ukrainian radio astronomy into larger European and global research initiatives, such as the EC-funded **RADIOBLOCKS** consortium, which aims to develop common technological building blocks for radio astronomy infrastructures. This would promote shared technical expertise and potentially secure vital resources for infrastructure modernization.

JIVE and the EVN to help ensure that Ukrainian astronomy remains a vibrant and integral part of the global scientific community