



European VLBI Network Newsletter

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Message from the Chairman of the EVN Board of Directors

Dear Colleagues in the European VLBI Network, Dear Users of the EVN,

I would like to wish everyone a happy and scientifically productive 2018; starting with the opportunity to submit EVN proposals for the 1st February deadline (see p 3); and also of course for the subsequent deadlines on 1st June and 1st October. Other dates on the calendar for the coming year include in April the Special Session on future VLBI at the European Week of Astronomy and Space Science (EWASS) in Liverpool and the biennial EVN Symposium in Granada in October - both of these meetings are described on p 13-14.

This newsletter also contains reports from a number of science and technical meetings that were held during the last six months (p 8-12) plus a description of two exciting science results from the EVN (p 4-5). These reports show an EVN community that is very active both scientifically and technically. Together with the very welcome investment by the EU in the EVN via the JUMPING JIVE (p 6-7) project, and also via the RadioNet project, this points towards an exciting future for the EVN.

In addition to the other meetings described in this Newsletter there was also an EVN Consortium Board of Directors (CBD) meeting held in Gothenburg , Sweden in November - at which a number of issues were discussed. In particular a roadmap was agreed to provide for increased recording bitrate for the EVN. While 2 Gbps recording has been possible for a while for a significant fraction of EVN observations the CBD meeting affirmed a goal to reach 2 Gbps default recording rate for continuum observations by June 2019; while also working to develop even higher bitrates.

I would like to end by mentioning a few personnel changes concerning the EVN as of the New Year. From the start of 2018, Antonis Polatidis from ASTRON is the new EVN Programme Committee chair taking over from Michael Lindqvist. I would like to thank Michael for his years of service in this role and welcome Antonis into this key position within the EVN. Michael remains active in supporting the EVN in the capacity of CBD Secretary whose duties include editing this newsletter.

Finally as of 1st January Francisco (Paco) Colomer is the new Director of JIVE, taking over from Huib van Langevelde, see [JIVE news article](#). I would like to thank Huib on behalf of the EVN CBD for his excellent stewardship of JIVE over the last decade. It is also my pleasure on behalf of the EVN CBD to welcome Paco in his new role leading the JIVE organisation; which is of course an indispensable element of the EVN network in its roles running the EVN's main correlator centre and also providing other support services to the EVN and its users.

John Conway,

Chairman, EVN Consortium Board of Directors



Call for EVN proposals

The next deadline for submitting EVN proposal is **February 1, 2018**. The details of the call can be found [here](#).

New features in the February 1 Call for Proposals include:

- The Kunming 40 m telescope is an affiliated EVN station situated on Phoenix Mountain, about 10 km east of the city of Kunming, China. The telescope may be requested on a best efforts basis for EVN disk recording observations at 13, 6, 5 and 3.6 cm wavelengths.
- Based on requests from the EVN user community, the EVN CBD has decided that the abstracts of any proposal (including ToOs and Short observations) submitted starting from the October 1 2017 deadline that receive observing time will become public at the EVN Data Archive (<http://jive.eu/select-experiment>).
- More detailed information about the time available on US antennas (VLBA, GBT, VLA) is included in the call in order to optimally plan Global proposals.

Further information on EVN, EVN+MERLIN, Global VLBI and e-VLBI observations, and guidelines for proposal submission are available at: <http://www.jive.eu/jivewiki/doku.php?id=evn:guidelines>

Antonis Polatidis, ASTRON, EVN PC Chairman



Image by Paul Boven (boven@jive.eu). Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).

EVN science highlights

Probing the gravitational redshift with an Earth-orbiting satellite

An international team of scientists led by Dmitry Litvinov from the Sternberg Astronomical Institute, Russia, have performed a test of general relativity using the 10 m space radio telescope RadioAstron. The ultra-stable on-board hydrogen maser frequency standard and the highly eccentric orbit make RadioAstron an ideal instrument for probing the gravitational redshift effect, which constitutes a test of the Local Position Invariance aspect of the Einstein Equivalence Principle (EPP). RadioAstron's highly eccentric orbit around the Earth evolves due to the gravitational influence of the Moon, as well as other factors, within a broad range of the orbital parameter space (perigee altitude 1,000–80,000 km, apogee altitude 270,000–370,000 km). The large gravitational potential variation, occurring on the time scale of \sim 24 hr, causes a large variation of the on-board H-maser clock rate, which can be detected via comparison with frequency standards installed at various ground radio astronomical observatories, including EVN stations.

[Litvinov et al. \(2017\)](#) presents the techniques as well as some preliminary results. They expect to reach an accuracy of the gravitational redshift test of order 10^{-5} , a magnitude better than that of Gravity Probe A mission, which yielded the best such test to date. All data has been taken and data processing is ongoing, their preliminary results agree with the predictions of the EPP.

Published in: D.A. Litvinov, V.N. Rudenko, A.V. Alakoz et al.: **Probing the gravitational redshift with an Earth-orbiting satellite**, [2017, Physics Letters A, in press](#).

Dmitry Litvinov, Sternberg Astronomical Institute, Russia

Young, active radio stars in the AB Doradus moving group

Precise determination of dynamical masses of pre-main-sequence (PMS) stars is necessary to calibrate PMS stellar evolutionary models, whose predictions are in disagreement with measurements for masses below 1.2 solar masses. To do this calibration, binary stars in young, nearby moving groups are particularly good candidates, since all members share a common age. In particular, stars belonging to the AB Doradus moving group (AB Dor-MG) seem to be optimal for this study: AB Dor-MG is the closest moving group (its mean distance to the Sun is 30 pc), the estimated age is relatively accurate (50–120 Myr), and it contains stars with significant emission at radio wavelengths. This last feature is essential, because it allows the use of radio interferometry techniques to obtain astrometric information.

[Azulay et al. \(2017\)](#) report on observations in phase-reference mode using the Very Large Array (VLA) at 5 GHz and the EVN at 8.4 GHz of the stars HD 160934, EK Dra, PW And, and LO Peg, all belonging to the AB Dor-MG.

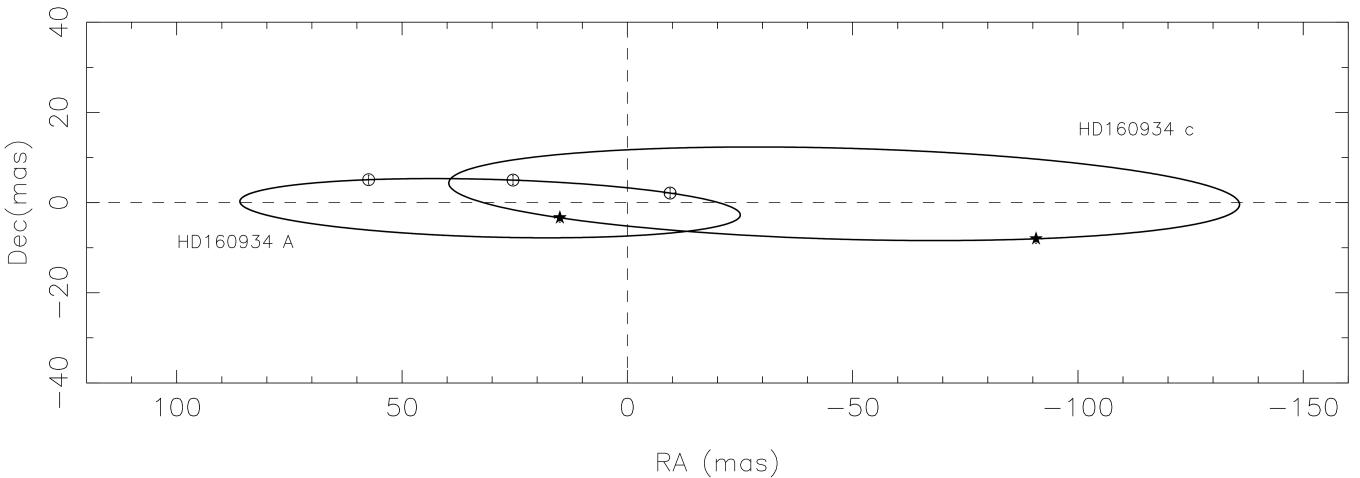


Figure 1. Absolute orbits of the binary components HD 160934 A and HD 160934 c. The positions of the component A (circles) and c (star symbols) are indicated. The centre of mass of the system is placed at the origin.

The orbital information derived from these observations was analysed along with previously reported orbital measurements (mostly based on NIR observations), which allowed them to determine precise, model-independent, dynamical masses of both components of the star HD 160934, A and c (0.70 ± 0.07 solar masses and 0.45 ± 0.04 solar masses, respectively), Fig. 1. Moreover, they revised the orbital parameters of EK Dra and they determine the sum of the masses of the system to be 1.38 ± 0.08 solar masses. They also explored the binarity of the stars LO Peg and PW And, finding a clear detection, but no-binarity, in the case of PW And and finding a non-detection in the case of LO Peg, reflecting the variability of the radio emission.

Comparisons of their dynamical masses with the prediction of PMS evolutionary models confirm that the models underpredict the masses of PMS stars by 10–40 %. They also inferred that the origin of the radio emission corresponds to extreme magnetic activity of the stellar corona that triggers gyrosynchrotron emission from non-thermal, accelerated electrons .

Published in: R. Azulay, J. C. Guirado, J. M. Marcaide, et al.: **Young, active radio stars in the AB Doradus moving group**, [2017, A&A, 602, A57](#)

Rebecca Azulay, Departament d'Astronomia i Astrofísica, Universitat de València, Spain

News from JUMPING JIVE



The EC H2020 JUMPING JIVE project (Joining up Users for Maximizing the Profile, the Innovation and Necessary Globalization of JIVE) has reached the end of its first year, out of a four year programme, and excellent progress has been made across all of the work packages. The overall goals of the JUMPING JIVE programme are described in more detail in the [48th EVN newsletter](#). Over the duration of the project we will be providing a series of regular updates on activity for the EVN newsletter. This is the first of these updates.

In **WP1** ('Management'), Paco Colomer has been appointed as the new director of JIVE, and will replace Huib van Langevelde as project coordinator. We are pleased that Dr. Giuseppe Cimó has agreed to replace Paco as JJ Project Manager. We all thank Huib for his many years of leadership and hard work as the director of JIVE, in particular for the successful application and execution of the JUMPING JIVE project!

WP2 ('Outreach and advocacy', led by Ilse van Bemmel) is developing a brochure to advocate VLBI, and in particular the EVN and JIVE, to the astronomical community. A concerted effort will be made at the EWASS 2018 conference in Liverpool to highlight the VLBI technique during different sessions (this is in addition to the special session organised under **WP7**). Moreover, press releases are being produced, and use of the JIVE and EVN websites is being monitored in preparation for improving these pages.

WP3 ("Building new partnerships", led by Leonid Gurvits) is aimed at broadening the JIV-ERIC base and establishing contacts with new prospective partners of the EVN and JIVE. The activity exercises approaches adjusted to their interests and expertise, in relevant areas of radio astronomy, with the emphasis on VLBI. In some cases, may stimulate expert support from **WP5** (e.g. possible refurbishing of a communication antenna in Azores, etc.).

WP4 ('ERIC scope: The International LOFAR Telescope', led by Rene Vermeulen) has started analyzing the structure and procedures of JIVE and the ILT. Interviews with the directors and heads of departments have been conducted to identify synergies and best practices in aspects such as the structure, governance and operations. This analysis should highlight the possible merits of an ERIC legal structure compared to the current ILT partnership.

WP5 ('Integrating new elements', led by Pablo de Vicente) brings the experience of the EVN TOG to new VLBI stations, allowing them to speed up and reach a high technical level in addressing essential issues such as calibration, maintenance of station equipment and logistics. Consequently, Ghana will participate in the next EVN NMEs, continuous T_{sys} has been implemented at Warkworth (NZ), and internal changes in the ampical portal (<http://www.evlbi.org/session/ampcal/>) provide a large flexibility and the live display of amplitude calibration performance at the stations via a web interface. This new implementation is rather powerful and allows, for example, analysis in a more project oriented approach.

WP6 ('Geodetic capabilities', led by Patrick Charlot) has completed its first deliverable, creating the software required to deal with geodetic observing schedules. This involves the implementation of subarraying, and the software has been successfully tested on archive data. This task is aligned with the developments in **WP8**.

WP7 ('The VLBI future', led by Tiziana Venturi) provides resources to facilitate the preparation of an updated Science Case for the EVN. An expert group has been formed, and the main science topics identified. In order to get feedback from the community, a Special Session is being organized at EWASS 2018 in Liverpool (UK): SS11 "[Exploring the Universe: a European vision for the future of VLBI](#)". The expert group will meet face-to-face this spring, to advance the actual writing of the report.

WP8 ('Global VLBI interfaces', led by Arpad Szomoru) deals with the implementation of telescope system monitoring. As a first deliverable, an extensive overview of existing software packages and possible synergies has been created. The implementation of software packages for system monitoring is now ongoing. Another part of this WP focuses on the modernization of SCHED, the scheduling software used by VLBI arrays around the world. Written in Fortran, maintenance and modification of this software is becoming increasingly difficult. In order to address this, selected parts of the program are re-written in Python, keeping as much of the original code as possible. As a first step a Python Key-in reader and a VEX2 writer have been created.

WP9 ('Capacity for VLBI in Africa', led by Rob Beswick) is organizing a training residence in Dwingeloo, with a total duration of 12 weeks, in combination with ASTRON/LOFAR. A call for applications, open to researchers and technical staff in Africa, was published on the JIVE website, and will remain open until 31 January 2018. This effort in training has synergies with **WP4**, and **WP5**. <http://www.jive.eu/traineeship-science-operations-massive-arrays>

WP10 ('VLBI with the SKA', led by Zsolt Paragi and Antonio Chrysostomou) is active at the SKA office in Manchester to identify the optimum SKA-VLBI Operational Model, and to help develop global VLBI science cases. For this purpose, a workshop was held on November 20-24 2017 at the Lorenz Center (Leiden, NL) entitled "The Quest for Multiple Supermassive Black Holes" which included a study of the impact of SKA-VLBI and other facilities in the study of SMBH binaries and multiplets, in synergy with **WP7**.

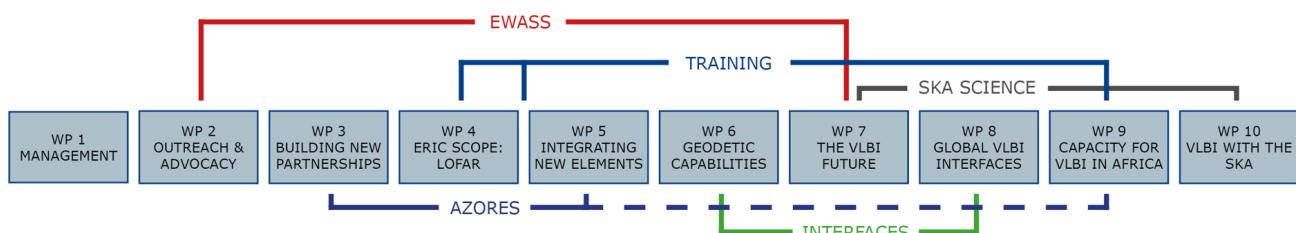


Figure 2. Synergies between the different work packages in JUMPING JIVE.

Paco Colomer, Joint Institute for VLBI ERIC

Reports from Meetings

6th International VLBI Technological Workshop

The sixth IVTW meeting took place in Bologna in October 2017 and gathered more than 65 people from many institutions involved in VLBI across the world, Fig. 3. The workshop was focused on developments at stations and correlators. The agenda of the meetings and presentations are available at the web page: <https://indico.iraf.inaf.it/event/2/timetable/#20171009>



Figure 3. The sixth IVTW meeting in Bologna, October 9-11, 2017.

The talks covered many topics but some specific ideas emerged from the conference: the wide adoption of broad band receivers and simultaneous frequency bands in the future, the usage of higher frequencies at telescopes usually working in the cm wavelengths, the importance of shared correlation and usage of already existing cluster computer centers, the transfer of data and reference signals via Internet and an increase in the number of VLBI telescopes in the world in the near future, mainly in Asia (China and Korea). There were updates on stations developments (A. Orfei, A. Orlati, C. Reynolds, T. Natusch, T. Wakasugi, K. Takefuji, B. Woon Son) and correlators (C. Zhong), the latter talk also mentioning the usage of VLBI for the Chinese lunar program.

The adoption of broad band receivers comes with secondary effects that need to be addressed and that were mentioned in several talks: ground and space RFI (C. Reynolds, K. Takefuji) and strategies to mitigate it like the development of customized high temperature super conductor filters and schemes to deal with linear polarizations since broad band requires linear polarization receivers. In that sense visibilities can be converted from linear to circular polarization (I. Martí-Vidal) or polarizations can be converted at the backends (G. Tuccari). It was also mentioned that an optimum location of samplers and channelizers is being studied at the VLBA (J. Romney) and a study was presented on the multibit scheme strategy to minimize saturation by strong RFI signals (C. Philips). Also future VLBI backends adapted to broad band receivers (G. Rajagopal, E. Nosov, G. Tuccari) were presented.

The transfer of data and reference signals via Internet and optical fibers is an important issue and was discussed in several presentations. There were talks on less prone and high reliable methods to transfer data (H. Verkouter), and some experiences with data transfer at Radioastron (M. Shastkaya), Russian stations (I. Bezrukov) and the Italian Network (M. Stagni), the transfer of reference signals via Internet (R. Ricci) and the measurement of phase using optical fibers at Onsala (L. Helldner) and developments on recording at high speed (S. Oh). We also learnt about correlators using cluster computers in Australia (C. Reynolds) and Austria (J. Gruber).

There were talks on water vapour radiometry using direct RF sampling (N. Kawaguchi), implementation of VLBI capabilities at current software packages (CASA) (M. Kettenis), astrometry using C and K bands (A. de Witt), status of VGOS analysis and observations (C. Ruszczyk) and the future trends in the VLBA (J. Romney) and global VLBI in the SKA era (A. Szomoru).

The meeting also held two interesting panel discussions. One was concerning VLBI backends compatibility. This discussion had its origin in the last TOG meeting in Latvia and was continued in the IVTW. The basic goal was to reach a consensus on VLBI backends compatibility, minimum technical requirements, and a common control and command syntax. Chet Ruszczyk, from Haystack Observatory was in charge of producing a document to be distributed to different parties for comments. The discussion will continue in the months to come. The second discussion was focused on future VLBI technologies, collaboration, coordination and common projects between different observatories and correlators. It was led by Jon Romney from the VLBA. He will also produce a draft document to be distributed among several attendants representative of different VLBI institutes.

In summary the meeting was interesting, useful, proceeded smoothly and it facilitated the communication among the attendants. VLBI will become global in the future and requires coordination and cooperation among the different partners. This series of annual IVTW meetings are an excellent tool to achieve a better VLBI in the future.

Pablo de Vicente, EVN TOG-chair, Observatorio de Yebes (IGN), Spain

Astrophysical Masers: Unlocking the Mysteries of the Universe



Figure 4. Participants in “Astrophysical Masers: Unlocking the Mysteries of the Universe” meeting in Cagliari, September 4-8, 2017.

IAU Symposium 336 “Astrophysical Masers: Unlocking the Mysteries of the Universe” was held in Cagliari (Sardinia, Italy) on 4-8 September, 2017, Fig. 4.

This is the sixth of a series organised every 5 years, where scientists from around the world gather to discuss the latest advancements in the field. The program includes many aspects of maser research, with a strong presence of VLBI results. Since the last meeting in South Africa in 2012, there has been an explosion of work on masers, especially related to the cosmic distance scale, the structure of the Milky Way, star formation and evolution, and the masses of (AGN) black holes. The very high resolution VLBI results provide key information, complementary to that of other astronomical techniques.

The IAUS336 conference included some very good examples of the application of VLBI to the study of astrophysical masers. It was reported how water megamasers can be used to test the unified model in AGNs, the need of a torus, and the physics of the AGN central engine; actually, they currently provide the only way to map the structure of circumnuclear accretion disks within a parsec of AGN supermassive black holes. Maser distance estimations can also be used to measure H₀ accurately, and constrain dark matter (Braatz, MCP). OH megamasers can probe magnetic fields in starburst galaxies (Robishaw).

Many interesting results on star formation are being provided by instruments like VERA, in combination or cooperation with the EVN and VLBA, like the measurement of hundred trigonometric parallaxes and proper motions for masers associated with young, high-mass stars (Honma, Braatz, Nakagawa). Maser astrometry provides parallaxes with accuracies of ± 10 microarcseconds (Reid), capable to significantly reduce the uncertainty in tests of gravitational radiation predicted by general relativity; VLBI observations of OH, H₂O and SiO masers can provide accurate distances and a critical check on Gaia parallaxes (Zhang).

Methanol class II masers at 6.7 GHz are well known tracers of high-mass star-forming regions. Studies with the EVN have provided high sensitivity images with milliarcsecond angular resolution (Moscadelli). VLBI imaging of a 44 GHz class I methanol maser was performed by KaVa (Kim); polarization has been studied on G10.34-0.14 (Kang). Magnetic fields can be traced also by SiO masers in the near stellar environment of late-type stars (Tobin), and using water masers, like the case of the synchrotron protostellar jet in W3(H₂O) (Goddi).

Observations of SiO masers performed in various vibrational and rotational transitions by VLBI techniques have provided extremely valuable information on the spatial structure and dynamics of the inner circumstellar shells around AGB stars. The observed total intensities and spatial distributions of all lines are being accurately measured thanks to very good relative astrometry (Imai, Yoon). Line overlap seems to be a basic phenomenon to explain the observed properties and models explain them, at least qualitatively. However, all VLBI observations are affected by large maser missing flux (Desmurs), an issue that still needs to be understood.

Recent developments in instrumentation, like multifrequency KVN-type and broadband receivers, make now possible to study several maser lines simultaneously (Colomer, Cho, Dodson). We look forward to have these capabilities fully deployed in all VLBI networks.

Paco Colomer, Joint Institute for VLBI ERIC

CASA-VLBI Workshop

For some time now JIVE (Des Small, Mark Kettenis and Ilse van Bemmel) have been working on making VLBI data reduction with CASA possible. The main motivation is that AIPS is no longer the dominant software package for doing radio astronomy. Learning to use it, just to be able to reduce VLBI data is becoming somewhat of a hurdle.

Small has been working on implementing a proper fringe fitter in CASA. Fringe fitting is an essential step for VLBI data reduction that usually isn't needed for connected-element arrays like the VLA or ALMA. This is why it was not (yet) implemented in CASA. The fringe fitter has been implemented as a completely new task (with the very original name "fringefit"). It replicates the basic (global) fringe fitting functionality of the AIPS FRING task. It is completely integrated in the CASA calibration framework such that all the CASA methods to do data selection and a-priori calibration are available to the user.

Kettenis has mostly been working on amplitude calibration, which is done quite a bit differently in VLBI compared to connected-element arrays. This involved proper handling of Tsys information and gain curves when loading data using the importfitsidi task and during calibration. This also includes a new "accor" task to normalize data from the VLBA and other VLBI arrays that use the DiFX correlator.

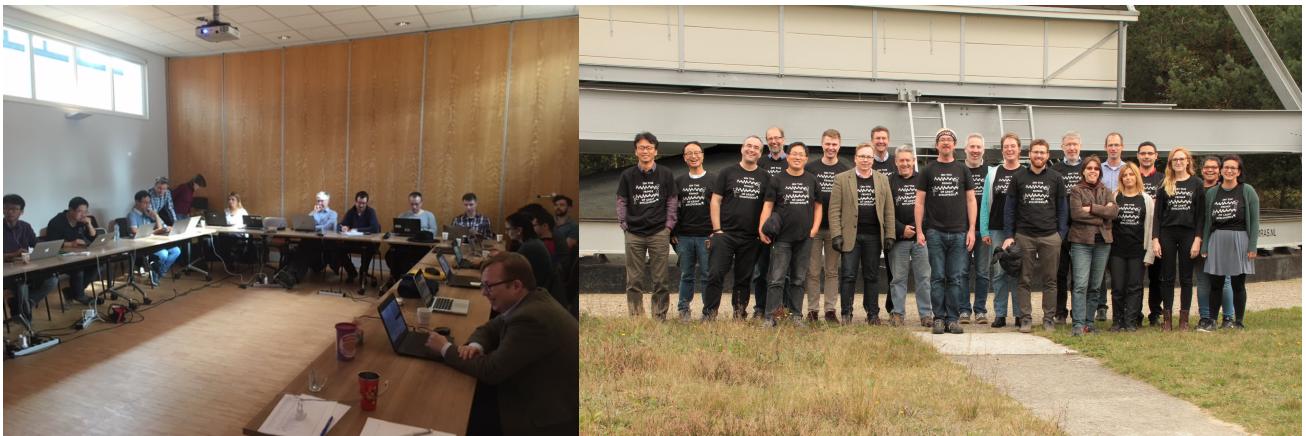


Figure 5. Participants in the CASA-VLBI workshop at JIVE, October 2-6, 2017.

van Bemmel has done a lot of work on verifying our code, both on real data and by doing simulations. She also was the main driver behind the first CASA VLBI workshop that JIVE organised during the first week of October, Fig. 5. During this workshop experts on VLBI, e-MERLIN and long-baseline LOFAR from all over the world spent a week working with a pre-release of our software on their own data. This helped a lot in identifying remaining bugs and missing functionality. The overall verdict seems to be that we are very close to having usable (but basic) VLBI support in CASA.

This work was funded through the BlackHoleCam ERC grant and the SKA-NL project. Work continues in the RadioNet RINGS work package, where JIVE is working on adding support for dispersive terms (to correct for the effect of the ionosphere) and support for wide bands.

JIVE hope to include basic VLBI support into CASA 5.3, which is planned to be released in spring 2018. Do not expect all the bells and whistles that AIPS accumulated over 25 years of development to be there yet though.

Mark Kettenis, JIVE, The Netherlands

Upcoming Meetings

Exploring the Universe: a European vision for the future of VLBI



The joint European Week of Astronomy and Space Science (EWASS) and National Astronomy Meeting (NAM) will take place in Liverpool, United Kingdom, on 3-6 April 2018 (<http://eas.unige.ch/EWASS2018/program.jsp>). Within that week (April 4) we are organising a Special Session on:

Exploring the Universe: a European vision for the future of VLBI

The aim of this special session is to discuss and position the role of VLBI at radio wavelengths in the context of the challenges and open questions of astrophysics as we approach the next decade. VLBI arrays are the only radio instruments capable of reaching millisecond scale resolution and below, and in this special session we aim at addressing those astrophysical key areas where VLBI will prove to be crucial for a major improvement of our knowledge. This special session is part of an ongoing effort to shape the VLBI roadmap for the next decade, and it will be an excellent chance to gather many experts within and outside the VLBI community, to discuss the most fundamental astrophysical questions VLBI will be able to address, complementing the other main forthcoming astronomical facilities.

All the talks in this session have been arranged by invitation, but we do strongly encourage and welcome participation and poster submission to further feed the process.

The following topics will be addressed:

- **Observational Cosmology:** Cosmology and Gravity; Galaxy and AGN co-evolution
- **Extreme Physics:** Towards the horizon of events; Transient events
- **The Local Universe:** Masers, stars and planetary systems
- **The Future of HighResolution Radio Astronomy in Europe**

Confirmed invited speakers:

G. Anglada-Escude, A. Brunthaler, J. Conway, H. Falcke, J. Hessels, A. Merloni, T. Muxlow, S. Nissanke, H. Olofsson, M. Perez-Torres, T. Sbarato, C. Spingola

The SOC:

Tiziana Venturi, INAF, IRA, Italy

Michael Lindqvist, Onsala Space Observatory, Sweden

Zsolt Paragi, JIVE, The Netherlands

The 14th EVN Symposium



The 14th [European VLBI Network \(EVN\)](#) Symposium and Users Meeting will be hosted by the [Instituto de Astrofísica de Andalucía-CSIC](#) in Granada (Spain) on behalf of the EVN Consortium Board of Directors. The meeting will take place on October 8-11, 2018 at the main auditorium of the [Parque de las Ciencias of Granada](#), the science museum of the city, within walking distance from the historic areas of Granada.

This biannual meeting is the main forum for discussion of the latest very long baseline interferometric scientific results and technical and technological developments within the [EVN](#) member countries. At this meeting there will also be a chance for user input into the future Science Vision for the EVN.

Topics to be discussed include:

- Powerful AGN science
- LLAGN, starburst galaxies and extragalactic masers
- Stars and planetary systems, supernovae, and stellar masers
- Pulsars and non-AGN transient sources
- Astrometric, geodetic & space applications
- VLBI technology developments
- Users feedback
- Current and future VLBI facilities and international cooperation

Moreover, **the meeting will also focus on** the role of EVN on:

- Very high-sensitivity VLBI with SKA
- Future multi wavelength and multi messenger astronomy including high angular-resolution astronomy at other wavelengths.

The weather and the city environment in Granada is typically excellent for the period selected for the conference. A number of social activities have been organized, including (among others) a welcome reception at [Nazari Palace "Cuarto Real de Santo Domingo"](#) (October 7th, evening), a visit to the historic [Alhambra](#) palaces and gardens (October 9th, evening), a visit to the [IRAM 30m millimeter Radiotelescope](#) (October 10th, afternoon; if weather allows), and the conference dinner in the historic rooms of [Palacio de Santa Paula](#) (previously the Santa Paula Convent and the Casa Morisca, in the XVI and XII centuries, respectively, in October 10th, evening). Further information regarding the meeting and details about [relevant dates](#), [the venue](#), [accommodation](#) and [travelling to Granada](#) is available on the [conference web site](#) at: <http://EVNSymp2018.iaa.es>

Ivan Agudo on behalf of the [SOC](#) and the [LOC](#)