



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

# Report of the Review Committee for the Joint Institute for VLBI ERIC (JIV-ERIC)

2023

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## Executive Summary

The review panel assesses the performance of JIVE during the last 5 years to be uniformly excellent, with strong performances on a variety of fronts. The core mission of the institute in terms of operational support to the EVN and comprehensive user support has been discharged with impressive efficiency, despite significant challenges from the pandemic, and from budgetary stringencies. Scientific productivity, from the EVN generally as facilitated by JIVE, as well as generated internally by JIVE staff, has been very strong. Successful proposals for EC funds have proven essential to the health and viability of JIVE, and the team is to be commended for those successes.

While the past performance is certainly impressive, significant challenges lie ahead that will require re-evaluation of the core JIVE mission, and likely also the funding model for the institute. Along with these challenges are also rich and exciting opportunities, and JIVE is technically well positioned to exploit those opportunities to great effect. If adequate and stable resources can be identified, the panel sees a bright future for the European VLBI community enabled by JIVE and its highly talented and experienced team. The recommendations of the panel are aimed at helping to find a path leading to that bright future.

# 1. Introduction

The review panel was charged with assessing the performance of JIVE over the last 5 years (evaluation period December 2018 – December 2022), in the context of the core mission, which is to provide correlation and related services to the institutes and users of the European VLBI Network (EVN). In support of that core mission, JIVE performs research and development functions to maintain and enhance the capabilities of the EVN, conducts independent in-house scientific research using VLBI, and fosters coordination and collaboration with a range of entities relevant to different aspects of the mission.

In addition, the panel was asked to review the financial and governance status of JIVE, their human resource policy, education and outreach activities, and options for future technical and operational development.

The panel discussed – as requested - future challenges and opportunities in depth. The analysis of challenges and opportunities reported in section 3 suggests that a careful review and potential update of both the JIVE core mission and the funding model to support that mission may be appropriate at this time.

We include our evaluations in 5 areas of JIVE activity in section 2, as prescribed in the review Terms of Reference (Annex 1). Detailed consideration of future opportunities and challenges, with implications for mission, governance and funding, is presented in section 3. Our recommendations are summarized in section 4.

# 2. Evaluations

We are writing this report in the face of a unique global situation. There is the backdrop of COVID-19 over the last four years, which has impacted every scientific institute on the planet. We are currently in a rapidly changing radio astronomy landscape globally, with VLBI becoming a more mainstream technique and new facilities like the SKA Observatory (SKAO) ramping up quickly towards operations. The VLBI technique is also evolving quickly, as exemplified by the progress of the Event Horizon Telescope (EHT). Our ratings on the five areas below reflect the performance of JIVE over the last five years, taking into account the challenges both from COVID-19 and from budgetary limitations, but we stress that this will not necessarily reflect success in the future scientific landscape. The areas themselves need to be assessed for future relevance, and our recommendations focus on positive changes for JIVE's sustainability as an institute in the future. We offer our views on the future challenges and opportunities, for consideration by the JIVE Council and Management team, and these are described in some detail in section 3 of this report.

Rating scale used:

*Exceptional performance - exceeds expectations - meets expectations - needs improvement – unsatisfactory*

## *2.1. Effectiveness of JIVE operations, in particular EVN support, specifically correlation, user services, support of the network*

*Rating: Exceptional performance*

The review panel commends JIVE for conducting excellent operations and support in the review period. The panel was impressed by the quality and professionalism of the user support facilities, which are world-leading. The panel recognizes that JIVE operation for EVN services (EVN support, correlation, user service, and network support) is well organized and efficient. In particular, considering the relatively small size of JIVE's staff, these achievements are very impressive, showing their expertise and risk management excellence based on internal and external communication with EVN members and users.

Correlation is at the heart of JIVE's core business and JIVE staff have adapted admirably to keep up with the growing complexity of experiments, the challenges of remote working during COVID-19 restrictions, and external challenges such as the Ukraine war that resulted in a reduction of the current number of telescopes in the EVN. The JIVE-led JUMPING JIVE program to prepare the organization and its users for Global VLBI in the upcoming SKA era was very successful.

It is clear that the JIVE user support in the form of in-person data reduction visits is exceptional, even though this has been impacted over the review period by COVID-19 travel restrictions for in-person visits. It is commendable that online materials and remote resources were created in response to this, with an EVN Support+ Pilot programme. These types of programmes are helpful in broadening the user base, in particular for users who are unable to travel (e.g., lack of funding, caring responsibilities). However, they seem to have been dropped after COVID-19 restrictions with no solid plans to continue them. In light of a continued desire to increase the user base, the panel recommends that JIVE maintain and advertise this kind of online user support in addition to the in-person support.

Looking ahead, and taking into account the EVN upgrade, SKA-VLBI and the implementation of the Global VLBI Alliance (GVA), the panel foresees growing demand from the community and hence recommends that JIVE prepare for securing human resources to meet these evolving needs.

## *2.2. The science output of JIVE and EVN*

*Rating: Exceptional performance*

The VLBI technique has now become mainstream astronomy, leading the field where it has been a niche before. VLBI observations have yielded major breakthroughs in recent years, in the realm of multi-wavelength and multi-messenger astronomy. Time-domain approaches have been gaining high importance with respect to the study of gamma-ray bursts, the follow up of gravitational wave events, and the understanding of fast radio bursts (FRBs). JIVE has done an excellent job in quickly responding to these new opportunities by supporting e-VLBI and triggering observations, making substantial contributions that have culminated in JIVE authors participating in high-impact papers (e.g. Ghisellini et al. 2019, *Science*, 363, 968; Marcote et al. 2020, *Nature*, 577, 190).

While the JIVE focus on frontier science topics is exciting and of very high impact, steady support of and contribution to well-established VLBI science capabilities is regarded as equally important by the panel. Over the 2018-2022 time period, JIVE reports contributing to 221 refereed publications, spanning a

broad range of scientific topics including AGN/blazars (high-energy; high-redshift; space-VLBI); masers (star formation; evolved stars; structure of Milky Way; astrometry); transients (of all types: stellar/extragalactic; slow/fast). This represents a satisfactory level of science productivity.

The panel took note of the number of publications per approved project, which is lower than might be considered ideal. Specifically, JIVE reports 256 projects with at least one observation, but only about 30% of these have led to one or more publications through mid-September 2023. The panel is aware that the effect of COVID-19 might well be lengthening the time required to publish for a large fraction of observations made during the last five years. To further increase the science output, the panel recommends implementing a new requirement for a report on outcomes from prior EVN observations in new proposals. Proposal referees should be advised to take the effectiveness of proposing teams in publishing EVN results into account in their evaluation.

Finally, the panel highlights the JIVE contribution in the arena of space sciences. Given the demonstrated synergies with ESA, the panel encourages the JIVE MT and Board to evaluate continued support of this area for inclusion among the core missions of JIVE. Global coordination of forward-looking development efforts is a topic of particular relevance to JIVE, and is discussed in section 3.2 below.

### *2.3. The research and development activities, specifically on digital technology, connectivity, space science applications and astronomical software*

*Rating: Exceptional performance*

The JIVE Research and Development (R&D) Team is commended for their exceptional leadership in terms of the FAIR principles: that data should be **F**indable, **A**ccessible, **I**nteroperable, and **R**eusable. These principles are becoming critical as the community moves to large, data-driven projects, and will only become more important as time goes on. JIVE is one of the more advanced organisations regarding R&D in the radio astronomical field. JIVE's best practices include making all of their code open-source in a version-controlled environment (Github). The best example of adherence to FAIR principles is the fact that the R&D team has added the EVN Data Archive to the International Virtual Observatory Alliance (IVOA), which means that the data are searchable using standard tools. Furthermore, each project has its own landing page with DOI, and there is the possibility for scientists using the data to publish their data processing scripts linked to this DOI. Enacting FAIR principles is challenging but necessary work, and JIVE has done an exceptional job and is a clear leader in this area.

The JIVE team has good reason to be proud of their record of innovation in the area of software correlation. The high-profile successes in near-field (solar system and space science) observations, high time-resolution work, and support and enablement of effective and routine real-time VLBI to cite some examples, are all testament to the vision and skills of the correlation and data handling team.

R&D achievements in real-time processing are particularly noteworthy. This requires the ability to comprehensively manage a series of processes that involve monitoring observations and status of EVN telescopes (e.g., EVN monitor), transmitting the data produced from them to the correlator (e.g., jive5ab, etransfer), and processing them in real time (e.g., SFXC software correlator). EVN, the world's only VLBI network that supports e-VLBI, has achieved unique scientific outcomes based on its

connectivity and real-time capabilities. These products of JIVE's expertise and leadership are being disseminated to other VLBI networks.

For all this work, the complexity level is high, and the expertise and experience of the staff is clearly up to the task. It is critical that sufficient resourcing is made available to meet all routine operational demands, while simultaneously allowing this talented team to sustain effort on advancing and expanding the technical capabilities of JIVE as a world-class VLBI center. Such developments plant the seeds of future prosperity for the organization.

JIVE has identified CASA as the primary platform of choice for post-processing and analysis, and has invested in making CASA functional for VLBI work, a capability that was long delayed in the package. This is a welcome and valuable contribution to the VLBI community, providing access to a wide range of analysis tools for investigators. Nevertheless, CASA performance issues remain a concern for many, and VLBI-relevant cutting-edge algorithms for calibration and imaging are under active development elsewhere, and outside of legacy packages like AIPS, Difmap and CASA. Resources permitting, the panel points out that it is important for JIVE personnel to keep well abreast of such development efforts, and to identify opportunities to engage in or contribute to such work.

## *2.4. JIVE's activities as a research infrastructure and its ability to implement EC programmes in the interest of the EVN and its user community*

*Rating: Exceptional performance*

JIVE's performance as a research infrastructure to the EVN and the broader VLBI users community has been excellent over the reporting period. Its main purpose is providing support to the EVN and the broader European VLBI community. This comprises providing services such as scheduling and data correlation for the EVN, but also user support, keeping an active and relevant science profile, or contribution to open-source projects.

JIVE participated in a broad portfolio of EC programmes during the reporting period, having secured leading roles in all of them. In particular the JUMPING JIVE project, led by JIVE, was crucial in supporting the scientific, technological and societal goals of VLBI. It succeeded in solidly establishing JIVE and the EVN as globally recognized centers of excellence in radio astronomy. The currently ongoing programmes (OPTICON RadioNet Pilot, RADIOBLOCKS) underscore JIVE's capacity to continue playing leading roles in successful funding proposals. The committee recommends that JIVE focuses on the successful implementation of important VLBI-related developments started through EC projects (e.g. SKA VLBI implementation) and on reinforcing its VLBI leadership role at the European level, maintaining a primary and undistracted focus on VLBI.

The committee is concerned about the sustainability of the current relationship between JIVE and EVN, going into the future. JIVE is under-resourced for the core task of providing correlation for the EVN, and crucial activities related to this core task. This situation is causing resource shortages within JIVE, endangering continued high-quality service for the EVN. Therefore, the panel is of the opinion that EVN must provide sufficient financial support to enable JIVE's core correlation service. The committee recommends that JIVE starts/continues discussions with EVN members emphasizing the need for proper



resourcing for EVN-related core missions. Essential technical advancements in support of the EVN and its community cannot be based on European Commission (EC) funds alone. This adds delays and risks associated with the need to wait for an appropriate EC call and submitting a successful proposal. With respect to EC funds, the committee is also worried by the fact that funds for Transnational Access could be not granted anymore.

## 2.5. In-house scientific research, educational activities, and outreach

*Rating: Exceeds expectations*

JIVE astronomers make significant academic contributions in the field of radio astronomy, both through authorship of journal publications and the supervision of students in universities. The supervision of students by VLBI specialists is important for training and recruitment of staff to JIVE, and also for the development of the field generally. The leadership of JIVE staff in the drafting of the “EVN Science Vision” document is evidence that they keep abreast of current scientific advances in the field. We reiterate the importance of JIVE’s unique and excellent contributions to Space Science, as highlighted in section 2.2 above.

JIVE has been playing a major role in advocating VLBI to a wider user base and to support VLBI scientists across the world. During the 2018-2022 reporting period, JIVE has had a presence at the annual meetings of the European Astronomical Society, organizing sessions to promote VLBI to a multi-messenger and multi-disciplinary audience. In addition, JIVE has organized CASA-VLBI workshops that are of crucial importance given the leading role that JIVE is playing in the development of CASA-VLBI software. We also highlight the JUMPING JIVE’s contributions to the development of new research communities specializing in radio astronomy across African countries through collaboration with the UK DARA initiative.

JIVE's outreach activities through the JUMPING JIVE program have been systematically executed and remarkably active. The scientific meetings, website redesign, media coverage, and especially social media activities have effectively communicated JIVE's achievements and activities to a wide audience, in both researchers and the public. These efforts have helped JIVE to be recognized as a world-leading organization in this field.

## 3. Opportunities and challenges

### 3.1 Growth of VLBI Scientific Relevance

The panel is unanimous in the view that the profile of VLBI in astronomy research is swiftly rising, and that this in turn can be anticipated to sharply increase the significance and importance of the JIVE mission.

This conclusion is based on multiple factors and trends. Most fundamentally, sensitivities are improving across the electromagnetic spectrum. This is particularly true for VLBI because recording data rates still have plenty of headroom to expand, and at relatively modest cost, and also because major new instruments with large increases in collecting area are anticipated (SKA and ngVLA). For decades, low sensitivities and high brightness temperature limits restricted VLBI to a relatively small number of



accessible sources exhibiting intense non-thermal radio emission. The overlap with large optical, IR, UV, and X-ray catalogs tended to be small or non-existent, making VLBI a powerful technique relevant only to specific niche areas of astrophysics. These included AGN cores, pulsars in specific instances, masers in circumstellar envelopes and AGN accretion disks, supernovae, and unique objects in a few other areas.

More recently, this has been changing as sensitivities improve across the board, and as a larger number of observable VLBI targets, and a wider range of object types, fall within the scope of multi-waveband studies. Due to the nature of overlaps of this type, the process is nonlinear, supporting rapid growth of target lists. The unique and unmatched angular resolution and astrometric precision provided by VLBI add critical dimensions to astrophysical studies, and, as the target list grows and broadens, scientific demand will grow steadily for the foreseeable future. Examples of such growth are already prominent in the JIVE scientific portfolio.

The importance of VLBI in time-domain astrophysics is continuously growing, driven by advances in neutrino and gravitational-wave astronomy, high-energy astrophysics and transient facilities. This has been acknowledged by JIVE both in science and development. The panel was particularly impressed by new opportunities opened up by the EVN-lite programme and recommends advancing this into a more routine observing mode. This context also holds potential for further enhancing the visibility of VLBI and expanding on the VLBI user community, e.g. through joint-proposal opportunities with X-ray and gamma-ray facilities.

Set against this backdrop, JIVE must be viewed as an entity on the threshold of externally-imposed profound change, facing both the challenge of overhauling the operational status quo and adapting to that change, as well as the opportunity to exploit the coming evolution of VLBI from a niche blackbelt-only specialty into a uniquely potent and mainstream astronomical technique.

The critical timescale for these transitions is, in the estimation of the panel, the next 5-10 years. During the early part of this period, ongoing sensitivity gains, which are technically if not financially fairly straightforward, will fuel a robust and steady growth in VLBI relevance. In the latter part of the period, the addition of new collecting area will start to transform the scientific landscape at a brisker pace. To properly support that transformation, actions need to be taken immediately.

### *3.2 Global VLBI Coordination*

The EVN encompasses not just Europe, but has (or has had) footholds in four continents. In this sense, the EVN represents a preponderance of the global cm-wavelength VLBI scientific capability, made possible by the technical and organizational coordination role of the EVN nerve center, namely JIVE. Of all organizations that practice VLBI in the world, JIVE is the one with the most experience and success melding a heterogeneous and widely distributed set of telescope assets into a functioning and productive global array. This positions JIVE as an obvious entity to play a central, and potentially a leading role, in future efforts to unify and strengthen VLBI techniques and operations in order to exploit the rich scientific opportunities that are foreseen. In partnership with entities like the Global mm-VLBI Array (GMVA), EHT, the Korean VLBI Network (KVN), the Very Long Baseline Array (VLBA), geodetic VLBI networks, technology development centers, and other relevant organizations, and with the advent of SKA and ngVLA firmly in view, JIVE has a clear opportunity, through vision and proactivity, to help nucleate a cohesive and potent global approach to future VLBI science.

The panel notes that the above list of potential partnership organizations is significantly broader than that comprising the current GVA. Given the engagement of JIVE in the GVA, including leadership of the associated IAU Commission B4 working group, it would be appropriate for JIVE to lead an effort to review the GVA for inclusiveness and potential accretion of interested parties as the VLBI technique continues to expand in scope.

### *3.3 Space-based Opportunities*

JIVE has strong experience in handling the complexities of VLBI beyond the normal case of fixed antennas on the ground observing sources at infinity. The use cases of VLBI with space-based antennas, as well as for precise spacecraft position determination, will expand over time. These applications have long lead times, but with steeply falling projected launch costs and rapidly advancing optical technologies for high volume data transport to/from space, strong growth in this area seems assured on timescales on the order of a decade. JIVE is well positioned to benefit from this growth, but to realize the potential it is important to maintain leadership and competencies in the relevant technologies and correlation capabilities. Opportunities are likely to crop up in the relatively near term in the context of burgeoning lunar exploration and exploitation activities, and on a longer timescale in the context of a possible ramp-up in Mars exploration.

### *3.4 EVN and the JIVE Mission*

The panel notes the close interdependence between the EVN and JIVE, to the extent that, in most practical respects, they can be viewed as a single entity with different labels for different parts of the operation. Both are fundamentally necessary for a functioning VLBI array, one supplying telescopes and observing time, the other providing unified VLBI technical expertise, correlation services and various types of user support. The JIVE funding model relies extensively on individual contributions from some but not all EVN observatories, but these contributions do not come close to covering the full cost of an operation that is already lean, and the demands on which are set to grow strongly in coming years.

The panel is concerned that boundary conditions that existed when JIVE was created in 1993, or when it became an ERIC in 2015, may have changed, incrementally but profoundly, to the extent that a re-evaluation of the JIVE core mission and associated funding mechanisms is warranted. The reach of EVN+JIVE has, de-facto, become more global in nature, with participation of, and support provided to, telescopes and institutes far beyond European borders. JIVE has led the way on multiple fronts of innovation in VLBI technology and techniques, which are generally not specific to the core EVN array. The advent of ngVLA and SKA presage a major shift in the scientific potential, development requirements, and prioritization of VLBI investments going forward.

Given this landscape, it is incumbent on the JIVE Council to carefully examine the current JIVE mission and determine if and how it should be modified or expanded to meet the challenges of the future. JIVE is already stressed financially and organizationally by changes to date, and the panel views the current situation as likely unsustainable for much longer. In conjunction with possible mission revisions, changes in associated financial needs must be assessed, and a funding model to meet those needs must be devised. Currently, JIVE meets evolving and growing needs through proposals to the EC for certain development efforts, to execute a de-facto mission that seems to have become less well defined over time as the VLBI enterprise itself evolves. It is also important to mention that securing funding through EC proposals has its challenges, as (1) the focus of the proposals is driven by the calls and not by JIVE's

mission, (2) funds become more scarce given the growing number of partners associated with most EC projects. To facilitate effective long-term planning, a stable, well-understood and adequately resourced multi-component core mission is essential.

### *3.5 JIVE Involvement in the SKA Project*

The Horizon 2020 JUMPING JIVE project has greatly helped to establish a framework for the SKA-VLBI implementation. This JIVE-led project allowed the definition of key SKA-VLBI science goals and use cases, the operational model, as well as the VLBI interfaces and specific requirements for the SKA telescopes. As a result, a new SKA VLBI Science Working Group was established in 2019.

However, the committee stresses that all these achievements need a continuous and appropriate investment of human resources to allow the SKA-VLBI to become truly operational. Even if it is now agreed that the SKA will provide calibrated VLBI beams, it is up to a still undefined SKA-VLBI consortium to make SKA-VLBI observations concretely possible and practical by collaborating with SKAO. It is necessary to agree who will take care of the whole data chain (proposal handling, scheduling and execution, carrying out of the observations, correlation and user support) and to make it operational. The committee recommends that JIVE keeps a leading role in these developments, of paramount importance for future EVN-SKA connections, and that this becomes part of the core mission of JIVE.

In such a framework, the panel encourages JIVE to make a plan for engagement with SKA in multiple ways. The panel suggests the following actions:

- proactively engage in discussions with the SKAO Management Team.
- provide a defined package of expertise and associated FTEs that fulfills the role of the external VLBI partner (Design Authority) required by SKAO to conclude the interface control document (ICD) and lead the development of the SKA-VLBI observation mode. This package might, but not necessarily, be structured as a SAFE team. There is some urgency to this because the SKAO systems engineers and telescope delivery teams are presently looking to conclude the VLBI ICD. Prompt involvement will also facilitate getting SKA VLBI from a plan to a reality on the desired timescale, possibly by 2026 (timeline for the first SKA science verification).
- participate in the current effort of shaping the future SKA Regional Center Network (SRC-Net). This latter activity should be conducted in close connection with other SKAO partners, and in particular initially with ASTRON. The SRC-Net could benefit from JIVE's experience in terms of their R&D work, where JIVE has already addressed many of the challenges SRC-Net faces: data logistics (i.e. transportation), data curation and archiving (e.g. DOIs for projects in the EVN archive).
- use MeerKAT-VLBI as prototype of SKA-VLBI.

The committee is convinced that all expertise needed for these actions is already in house and stresses the fact that having JIVE proactively coordinating the international participation to SKAO-VLBI developments is an urgent action.

## 4. Recommendations

### Major Recommendations:

1. **Review funding model** - JIVE should vigorously engage in discussions with EVN member institutes, with a view to identifying and implementing a flexible and robust funding model. An updated model should support stable resourcing of the core JIVE mission, both now and into a changing and scientifically expanding future (sections 2.4 and 3.4).
2. **Augment human resources** - The profile of VLBI in astronomy will grow. JIVE should be preparing to augment human resources to meet this expanding challenge (sections 2.1 and 3.1).
3. **Review JIVE mission** - The JIVE Council should critically review the JIVE mission, building upon the current core business, but in recognition of the evolving landscape and expanding, diversifying needs. Specifically, the panel feels that a stable, well-understood and properly resourced multi-component core mission is essential (section 3.4).
4. **EC projects fitting core business** - JIVE development efforts should focus on implementation of important VLBI capabilities, in some cases started through EC projects. JIVE should be wary about diluting its focus beyond a core VLBI-based mission, and engage in broader activities only if and when compelling reasons to do so are identified and agreed (section 2.4).
5. **Involvement in SKA** - JIVE should take immediate proactive steps to integrate VLBI more organically into solidifying SKA plans and roadmaps. This is seen as urgent (sections 3.1 and 3.5).

### Other, less major but still important recommendations include:

6. JIVE should maintain and advertise the remote (online) user support tools developed during the COVID-19 pandemic, in addition to in-person support. While the latter is preferred, the former nevertheless adds significant value (section 2.1).
7. It is suggested that new EVN proposals should have a required section for a report on outcomes from prior EVN observations (section 2.2).
8. The panel encourages continued robust support in the area of space sciences, and for JIVE to seek continuation of a leading role in this growth area (section 2.2).
9. The development team is talented and capable. Resourcing for routine operational demands should be robustly maintained so that productive development team members are not spending excessive time on simpler tasks (section 2.3).
10. Strong innovation, particularly in calibration and imaging, is occurring outside of JIVE and outside of CASA. The JIVE team should strive to stay abreast of such developments (section 2.3).
11. JIVE is in a strong position to play a leading role in global VLBI coordination initiatives. Building on, or restructuring and refreshing the Global VLBI Alliance effort is recommended (section 3.2).
12. The panel recommends pushing for further advances in flexible sub-array observing opportunities building on the successful EVN-lite programme and joint-proposal opportunities with high-energy telescopes, noting that this can broaden the user base (section 3.1).
13. Space based VLBI is an obvious long-term growth area, and JIVE should work to maintain leadership and competencies in the relevant technical areas (section 3.3).
14. A comment regarding evaluation processes - the panel was asked to conduct essentially a retrospective review, and the cadence is quite long, at 5 years. It is offered for consideration that greater benefit might be found through an advisory panel that convenes more frequently in the face of an ever more swiftly evolving landscape, perhaps every two years. This would provide some degree of membership continuity across reviews, allow for valuable panel memory, and promote connected and consistent guidance from review to review.

## Annex 1: Review Terms of Reference

### Terms of Reference for the review of the Joint Institute for VLBI ERIC (JIVE) on behalf of its partners under coordination of NWO

Version 1.1, 20 January 2023 - Agnieszka Słowikowska, JIVE

The review will consider and assess developments and operations at JIVE since the time of the last review of JIVE, published in November 2018, until December 2022. It will address the possible development of JIVE over the next funding period 2025-2029, as well as of its mission on a longer-term perspective, particularly in view of the advent of the SKA, the progress of EHT and the development of the VLBI alliance. In making its reasoned judgment on the mission, strategy, and performance of JIVE, the review panel will consider both JIVE's mandated role to support the operations of the European VLBI Network (EVN) and its in-house programme, both for astronomy as well as technical research and development.

In making the review it will consider:

- The satisfaction of the partners in JIVE and their wishes for the development of JIVE services,
- The financial implications foreseen on the basis of these wishes,
- Options for future technical and operational development at JIVE towards its mission,
- The scientific achievements of JIVE staff obtained in the past years,
- The science case for the future, in a worldwide context,
- Governance issues for JIVE and European radio astronomy.
- Educational activities and outreach.
- Open science.
- Human resources policy: inclusion, diversity, talent management.

In the review, the panel will distinguish a number of aspects of JIVE. The panel is asked to provide a rating for all of these aspects separately, as well as an overall rating. The specific elements for consideration are:

1. Effectiveness of JIVE operations, in particular EVN support, specifically correlation, user services, support of the network,
2. The science output of JIVE + EVN,
3. The research and development activities, specifically on digital technology, connectivity, space science applications and astronomical software,
4. JIVE's activities as a research infrastructure and its ability to implement EC programmes in the interest of the EVN and its user community,
5. In-house scientific research, educational activities, and outreach.

The review panel is expected to base its review and evaluation on:

- Documents provided by JIVE: annual reports and additional specific documentation,
- A self-assessment document by the JIVE management,
- Statements by the JIVE partners,
- A site visit to JIVE and meetings with its staff.

The JIVE Council shall establish the review panel. Financial support for the panel is provided directly from JIVE’s general funds. The report of the Review shall be issued as a public document by the JIVE Council.

## Annex 2: Composition of the JIVE Review Panel

Dr. Colin Lonsdale (Chair)	MIT Haystack Observatory, USA
Dr. Alessandra Corsi	Texas Tech University, USA
Dr. Chiara Ferrari	Observatoire de la Côte d’Azur, France
Prof. Marijke Haverkorn	Radboud University, the Netherlands
Prof. Justin Jonas	Rhodes University, South Africa
Dr. Taehyun Jung	Korea Astronomy and Space Science Institute, South-Korea
Prof. Matthias Kadler	Würzburg University, Germany
Dr. Leah Morabito	Durham University, UK
<b>Secretary:</b>	
Dr. Katrien Uytterhoeven	Dutch Research Council (NWO), the Netherlands

## Annex 3: Review Agenda

Wednesday 6 September 2023				
Oort Room, ASTRON/JIVE, Dwingeloo				
<i>Time start</i>	<i>Time end</i>	<i>#</i>	<i>item</i>	<i>speaker/responsible</i>
12:30			Pickup at hotel (or direct transport to JIVE)	
13:00	14:00		Lunch	
14:00	14:30		Welcome; panel closed session	Colin Lonsdale
14:30	14:45		Welcome and introduction	Pablo de Vicente Colin Lonsdale Aga Słowikowska
14:45	15:30	1.0	Progress Report	Aga Słowikowska
15:30	16:00		Tea break	
16:00	16:30	2.0	User’s experience	

		2.1	Deciphering high energy transients and gravitational wave counterparts through radio observations	Giancarlo Ghirlanda
		2.2	Unravelling the birth processes of high-mass stars	Anna Bartkiewicz
16:30	17:30	3.0	JIVE structure and partnership	Aga Słowikowska
17:30	18:00		Tour of Facility	
18:00			Return to hotel	
18:30			Dinner (Panel only)	

Thursday 7 September 2023

**Oort Room, ASTRON/JIVE, Dwingeloo**

9:00			Pickup at hotel	
		4.0	Current activities	JIVE MT
9:30	9:55	4.1	Correlator Operations	Bob Campbell
9:55	10:20	4.2	Research & Development	Marjolein Verkouter
10:20	10:50		Interaction with JIVE staff & coffee break	
10:50	11:15	4.3	Space Science and Innovative Applications	Giuseppe Cimò
11:15	11:40	4.4	JIVE Support and Science	Zsolt Paragi
11:40	12:00		Questions	
12:00	13:30		Interaction with JIVE staff & Lunch	
13:30	14:30	5.0	Strategy and future	Aga Słowikowska
14:30	15:30		Panel Closed session	Colin Lonsdale
15:30	16:00	6.0	Tea break	
16:00	17:00		JIVE Director, JIVE MT, and JIVE Council chair available for questions	
17:00	18:00		Panel closed session	Colin Lonsdale



18:00			Return to hotel	
18:30			Dinner (Panel + Users)	
<b>Friday 8 September 2023</b>				
<b>Hulst room, Hotel Wesseling, Dwingeloo</b>				
9:00	11:30		Panel Closed session	Colin Lonsdale
11:30	12:30		Preliminary feedback to director and council	Colin Lonsdale
12:30			Lunch, Adjourn	