

VirgoLab Organisation Proposal

Version to be amended for 17 February 2025 Implementation Committee.

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The Council of the European Gravitational Wave Observatory (EGO) put in place an Organisational Review of EGO and Virgo, with a report provided by the review committee in March 2024 including recommendations in seven relevant areas. Following this report, EGO Council mandated the Implementation Committee to follow-up on these recommendations.

The following proposal is taking up on the recommendations related to the Organisation and Governance of EGO/Virgo. In particular, it lays out the organisation of the detector operation, commissioning and upgrade of the Virgo interferometer as a distributed laboratory, called VirgoLab in the following, and specifies its governance. The creation of VirgoLab is inspired by LIGOLab, the operating structure of the US gravitational wave antennas, yet taking into account the differences arising from the European funding structure and research landscape. VirgoLab is also meant to fit into the transition from the Virgo Collaboration to IGWN.

The current draft document reflects the work in progress and is under construction. It addresses the definition of VirgoLab, the outlay of the organisational structure, the governance bodies and the management positions. An additional section laying out some procedures that will be necessary will be amended. The proposal is based on the current structure of the Virgo collaboration.

1. Definition of VirgoLab

1.1 Purpose

VirgoLab is mandated by the EGO Council to operate, commission and upgrade the Virgo interferometer for the production of calibrated, high-quality strain gravitational wave data, to be provided to the Virgo Collaboration¹, in coordination with the LIGO-Virgo-KAGRA* (LVK) Collaboration. The aim of VirgoLab is to ensure that the Virgo interferometer reaches sensitivities and produces observational data in order to be a cornerstone of the worldwide network of gravitational wave observatories. All members of VirgoLab are deeply committed to the purpose of VirgoLab and to the existence and operation of a gravitational wave interferometer in Europe. To fulfil its ambitious mission, VirgoLab requires steady and adequate financial support from its funding bodies.

The data analysis for research in the fields of fundamental physics of gravitation and astrophysics is carried out by the Virgo Collaboration*. The Virgo Collaboration* is in charge of the publication of scientific results and of providing low-latency GW-candidates alerts.

¹ * Indication where modifications should be introduced with the creation of IGWN.

Scientists and engineers from VirgoLab are members of the Virgo Collaboration and can participate in the full range of its activities.

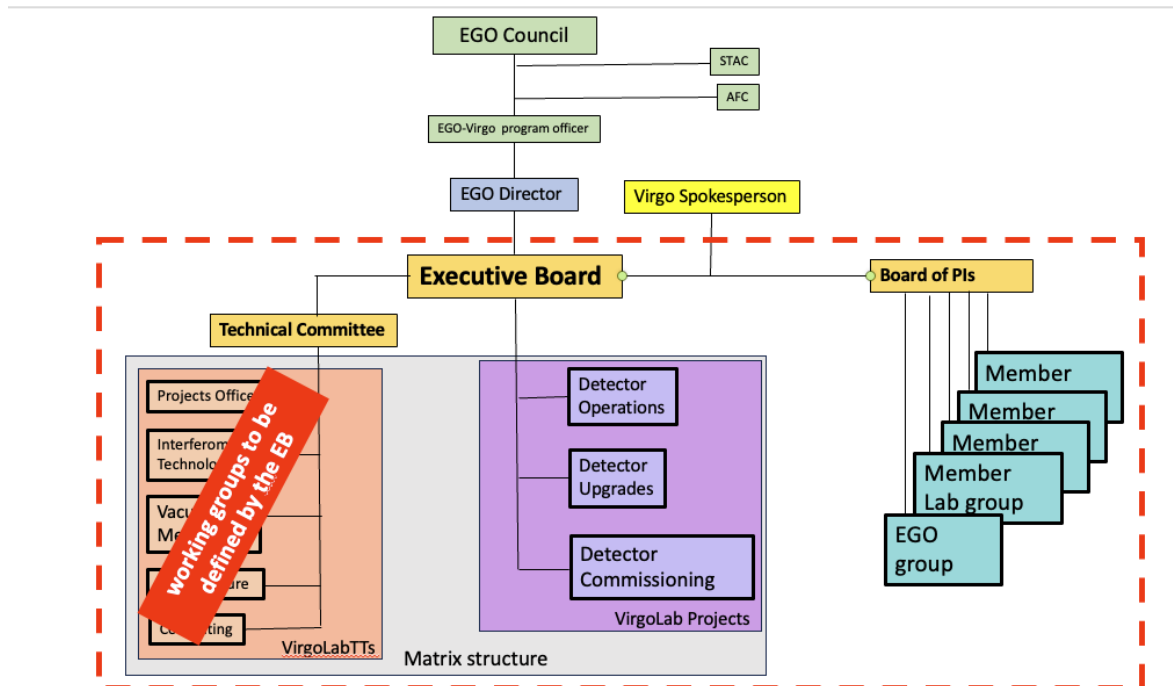


Fig 1: Organisational chart as proposed for VirgoLab as a strong Matrix structure. The structure of the Technical Teams will be defined in detail by the Executive Board.

1.2 Organisation

VirgoLab is organised as a distributed laboratory with participations from EGO and the laboratories, institutes and university departments involved in the Virgo Collaboration*, referred to as Member Labs. EGO, as the responsible legal entity, acts as a host Lab for VirgoLab in accordance with the EGO statutes. Participation in VirgoLab is specified through MoAs between EGO and the Oversight Organisations of the Member Labs.

The organisational chart of VirgoLab (Fig. 1), sketched by the Organisational Review Committee, is proposed to be implemented as a strong matrix organisation: Detector Upgrades, Operations and Commissioning are organised as VirgoLab Projects supported by VirgoLab Technical Teams that focus on the core technical areas. The structure of the Technical Teams will be proposed in detail by the Executive Board.

1.3 Resources

VirgoLab consists of cross-institutional VirgoLab Projects and VirgoLab Technical Teams with contributions from EGO and the Member Labs.

Financial resources are allocated by EGO Council, national funding agencies or research organisations to EGO or to the Member Labs. VirgoLab benefits from the contributions of the EGO member states to EGO and to payments made to the Common Fund. The contributions are managed through EGO or directly allocated to the Member Labs.

The contributions of Member Labs to the VirgoLab are defined by a Memorandum of Agreement (MoA) between EGO and their representing legal entities. Member Labs are in charge of maintaining and operating the equipment they provide, as part of a collaborative effort as all equipment and aspects of the Virgo interferometer are a VirgoLab-wide matter.

The property of instrumental equipment installed in the Virgo Interferometer on site is

transferred to EGO as the responsible legal entity. The maintenance, operation and performance of the equipment is monitored by the EB, with regular reviews, in particular through the annual resource review procedure, specified in section 5.1. In case, resource allocations should be changed in between the annual resource reviews, the EB and the concerned PIs have to agree on the modifications.

EGO is engaged to allocate the necessary resources to facilitate the local support and logistics for collaborators of Member Labs while coming on site.

2. Organisational structure of VirgoLab

The proposed matrix structure balances the functional responsibilities within each VirgoLab TT with the specific needs of each VirgoLab Project. It enables personnel to contribute their technical expertise to multiple projects while maintaining their development and long-term role in their functional area. The proposed structure implies some complexity and needs therefore to be implemented in the most effective way. Project Coordinators and technical Team Leaders have deputies such that ideally one of them is on-site and the other off-site. This should allow to have a permanent on-site presence of at least one person, while taking into account the needs of off-site teams to contribute efficiently.

2.1 VirgoLab Projects (Project structure)

The core activities of VirgoLab are proposed to be organised around three major projects:

Detector Operations: Focused on the daily operations of the interferometer, ensuring smooth running and prompt troubleshooting if any issue arises. Operations include the production of calibrated, high-quality strain data as well as the computing infrastructure required to carry out strain data production. Provisionally, Detector Operation is supposed to include all activities in the current Operations Division (low latency, computing, detchar, calibration, open Data...).

Detector Upgrades: Responsible for planning and executing major upgrades to the interferometer's systems, with a focus on improving sensitivity and performance. Innovative long-term R&D is carried out in the scientific collaboration, guided by VirgoLab and becomes part of the Detector Upgrades project depending on its readiness level (e.g. as soon as the baseline design is being established - to be discussed).

Detector Commissioning: Manages the process of bringing new systems online, tuning the interferometer after upgrades or maintenance, and ensuring it meets the required operational standards.

This proposed structure will be presented to the Virgo Steering Committee (VSC) and be approved by the EGO Council. Modifications to the project structure at a later stage are presented by the EGO director to the VirgoLab Board of PIs and approved by the EGO Council.

Each of these projects will be led by a Project Coordinator (i.e., Project Manager). The Project Coordinator will manage all aspects of the project, from planning and resource allocation to execution and delivery. These projects require collaboration across the VirgoLab Technical Teams, leveraging expertise and resources from each. The Project Coordinators, will put in place a more detailed project structure, and have the general oversight on the project execution and resource loading in agreement with the MoA with the concerned Member Labs. They will

be in charge to assure that project deliverables, deadlines, and milestones are met. VirgoLab members participating in a project will report through the project structure for project-specific work.

The Project Coordinators are proposed by the EGO Director with the input from the Virgo Spokesperson, the VirgoLab board of PIs and the VirgoLab members concerned by the project. The proposed candidates are presented to the VirgoLab Board of PIs and appointed by EGO Council. The Project Coordinators are appointed for a renewable fixed term (in line with the term of the EGO director), and in case of a change in Project Coordination it is preferable to allow for a reasonable overlap time. If a change should become necessary during the mandate of the EGO Director, the EGO Director will present the change to the Board of PIs and will seek approval from the EGO Council.

2.2 VirgoLab Technical Teams (Functional Structure)

The VirgoLab technical Teams (VirgoLab TTs) coordinate and support technical activities driven by the needs of the projects. The Virgo Lab TTs can be understood as overarching working-groups on technical subjects, fostering the exchange between the different Member Labs and EGO, as well as enhancing the underlying expertise and facilitating the cross-fertilization of technical aspects between the projects. The VirgoLab TTs are distributed, cross-institutional teams, integrating personnel from EGO and from Member Labs.

The structure of the VirgoLab TTs is elaborated by the Executive Board and presented to the VirgoLab Board of PIs and the EGO Council. Areas of activities that should be covered by the VirgoLab TTs are:

- **Projects Office:** Oversees the overall system design and integration, including risk management and quality control, ensuring the coherence of all subsystems.
- **Interferometer Technology:** Focuses on the technical aspects of the interferometer, including optics, photonics, electronics and detector components.
- **Vacuum & Mechanics:** Responsible for the vacuum system and mechanical structures essential to Virgo's operation.
- **Infrastructure:** Manages site-specific infrastructure, including buildings, power systems, and environmental controls.
- **Information Technology:** Handles Computing infrastructure, data management, software development, and cybersecurity.

Changes to the VirgoLabTT structure should be presented to the VirgoLab Board of PIs and the EGO Council.

The definition of workmanship standards will be a key responsibility of VirgoLab TTs, ensuring consistency, quality benchmarking, and risk reduction in project outputs. Those standards also form the foundation for training and skill development, guiding personnel to meet quality expectations and supporting continuous improvement in technical capabilities.

Each VirgoLab TT is headed by a Team Leader who will coordinate the functional expertise and resources of the team and put in place a substructure if appropriate. The Team Leaders ensure that the defined workmanship standards are applied in all projects. The Team Leaders will also be responsible, in collaboration with the home institution or EGO departments, for appropriate training and competence development of its members. Team Leaders are particularly in charge to ensure all means that allow members of the Member Labs to contribute

efficiently. The VirgoLab Technical Team Leaders are proposed by the EB, and ratified by the VirgoLab board of PIs.

VirgoLab members participating in a TT will report through the structure of the TT on their activities and for their technical development and skill training. This ensures that personnel receive the necessary resources and guidance from their technical area.

3. Governance bodies

VirgoLab has three high-level governance bodies:

Executive Board (EB) is responsible for making key decisions on all aspects of VirgoLab, in particular technical decisions, resource allocation, strategic priorities, and long-term planning, ensuring alignment across both functional and project-based activities.

Technical Committee (TC) provides technical guidance to the EB and the VirgoLab Projects. The TC ensures that technical challenges are addressed collaboratively and that resources are deployed effectively to meet project goals.

Board of VirgoLab PIs is in charge of the pledging, allocation and use of resources from their groups, and offers input on the VirgoLab strategy.

3.1 Executive board

3.1.1. Key responsibilities

The EB is in particular in charge of:

Operational and Upgrade Decisions: The EB takes all decisions concerning the operation, commissioning and upgrades of the Virgo interferometer.

Resource loading: The EB establishes the necessary resources for the projects and manages the available resources to reach the best performances of the Virgo Interferometer.

Organisation and oversight of internal and external project reviews: Internal project reviews will be organised by the projects themselves and the outcome reported to the EB. External project reviews will be organised by the EB and the outcome reported to EGO Council and the VirgoLab Board of PIs.

On-site equipment: The EB oversees the installation and proper functioning of all equipment in the Virgo Interferometer.

3.1.2 Composition

The EB consists of 7-8 individuals, representing the operational and technical leadership of VirgoLab. Its membership includes:

- EGO Director (Chair)
- Upgrades Coordinator

- Commissioning Coordinator
- Detector Operation Coordinator
- Chair of the Technical Committee
- Virgo Spokesperson*
- Chair of the Virgo Lab Board of PIs

The composition has to ensure that all aspects of Virgo's operation and future upgrades are covered by the appropriate expertise. Changes to the composition of the EB will be presented by the EGO director to the VirgoLab Board of PIs and approved by the EGO Council. The members of the EB are on site on a regular basis, typically a few days a week and more if the situation requires it.

3.1.3 Meetings

The EB is chaired by the EGO Director, who calls the meetings, proposes the agenda and leads the discussions. The board meets **typically** on a weekly basis to assess and make critical decisions regarding both the day-to-day operations and the long-term upgrades of the interferometer. In case of critical and urgent matters, the EB meets as frequently as necessary.

3.1.4 Decision-Making

The EB is committed to striving for consensus in its decisions. In practice, this means that members will work collaboratively to find solutions that everyone can agree upon, leveraging the collective expertise of the board. In the event that the EB cannot reach consensus on a particular issue and no decision by means of discussion, including votes, can be reached, the EGO Director has the final authority. This ensures that the board's deliberations do not lead to operational delays or indecision, with the EGO Director empowered to make the necessary calls for the project's success.

3.1.5 Reporting

The EGO Director, in their capacity as chair of the Executive Board reports to the EGO Council on the decisions of the EB and the activities of VirgoLab. The members of the EB report the relevant decisions to the entities they are responsible for.

3.2 Technical Committee

3.2.1. Key Responsibilities

The TC is in particular in charge of:

Technical Advice: Comments on technical proposals, system performance, and upgrade plans.

Coherent Technical Solutions: Elaborates common technical solutions that may span over several subsystems.

Risk Management: Assesses **and advises** on technical risks and mitigation strategies.



Oversight of Training and Safety procedures: Is responsible for the adequate training and safety procedures to be in place

3.2.2 Meetings

The TC Chair calls the meetings, proposes the agenda and leads the discussions. The TC meets typically on a monthly basis, additional meetings can be scheduled as needed, in particular on request of the EB.

3.2.3 Composition

The TC consists of the VirgoLab Team Leaders and the Chair of the Technical Committee (TC Chair), additional Experts are invited as needed. The TC Chair is designated by the TT leaders.

3.2.4 Decision-Making

The TC seeks consensus for the advice it provides, but all perspectives are presented to the EB in order to enrich its decisions. The TC also oversees the coordination among the VirgoLab TTs. In case no consensus can be reached, the TC Chair decides on the priorities to be presented to the EB.

3.2.5 Reporting

The TC reports directly to the EB, providing technical recommendations. Final decision-making rests with the EB and the EGO Director. Decisions taken by the EB or the TC are reported by the Team Leaders to their respective teams.

3.3 Board of PIs

3.3.1. Key responsibilities

The Board is in particular in charge of:

Resource Review Process: Receives an annual report given by the EGO director, in their capacity as chair of the EB, of the use of the resources provided by the Member Labs to VirgoLab. It reviews the resource requested for the upcoming year and liaises with the funding institutions for pledges of resources to be provided from the Member Labs to VirgoLab.

Membership: The Board of PIs is responsible for examining the participation of new groups to VirgoLab and oversees the establishment of the MoA between EGO and a new group.

Personnel Matters: The Board of PIs is represented in the search committee of the EGO director either through its chair, members or designated persons. In addition, the Board of PIs expresses its vision on a geographically balanced scientific representation in IGWN in advance of the selection of the IGWN Spokespersons.

Publication Policy: The Board of PIs oversees the publication policy and process, as well as the authorship criteria and the authorship list of the VirgoLab activities.

VirgoLab Life: The Board of PIs will organise regular meetings of the VirgoLab community.

While the Board of Virgo Lab PIs plays an important advisory **and oversight body, it does not take executive decisions.** The EGO Director and Executive Board retain ultimate authority over operational and technical decisions. The board's role is to provide informed input, in **particular through the BPI Chair in the EB,** that can help shape these decisions.

3.3.2. Composition

The Board of PIs is the representation of the groups contributing to VirgoLab. The EGO Director, the Virgo spokesperson **and National Representatives, who are not PI,** attend the meetings. The PIs are appointed by the groups **or their Oversight Organisation.**

3.3.4 Decision-Making

The Board of PIs strives for consensus in its decision-making. On matters such as the approval of the annual report, membership and personnel matters, as well as for the election of its chair, the following voting rules will be put in place:

- annual report and budget forecast: simple majority of all present and voting. The vote may be held openly unless otherwise requested;
- membership: $\frac{2}{3}$ majority of all members. The vote is held secretly.
- personnel matters: $\frac{2}{3}$ majority of all present and voting. The vote is held secretly.

3.3.3 Meetings

The Board elects a chair who calls the meetings, proposes the agenda and leads the discussions. The Board of PIs typically meets **typically** three to four times a year.

An electronic voting system will be put in place.

3.3.5 Reporting

While advisory in nature, the Board's feedback is communicated to the EB through the Chair of PIs to ensure that the perspective of the groups is considered in strategic decisions. The board of VirgoLab PIs does not have decision-making authority over the operational activities of the VirgoLab.

3.4 Other committees

VirgoLab will also benefit from the advice of committees already in place, such as the EGO Administrative and Finance Committee for the resources spending and allocation concerning VirgoLab and in particular, the Scientific and Technical Advisory Committee.

The STAC provides periodic reviews of the scientific and technical aspects of EGO to the EGO Council. With the creation of VirgoLab, which will be the major scientific and technical activity of EGO, the STAC should be mandated to review the performance of VirgoLab. The STAC should assess if VirgoLab meets the scientific and technical milestones and even if EGO Council is its primary recipient, the relevant findings will also be made available to the VirgoLab EB and the VirgoLab Board of PIs.

The VirgoLab technical activities are also overseen by the Virgo External Technical Committee.

4 Management Positions

4.1. EGO Director

The EGO Director holds the primary executive authority of EGO as defined in the EGO statutes. They are therefore responsible for all activities conducted at the EGO site, ensuring that the Virgo interferometer meets its operational and technological goals. The EGO Director plays a key role in overseeing the organisation's operations, ensuring the smooth execution of its scientific objectives, and liaising with external advisory bodies. As Chair of the VirgoLab EB, the EGO Director is particularly engaged in VirgoLab, which is the Director's principal activity; other responsibilities may be delegated (e.g site management, non-VirgoLab projects,...).

4.1.1. Key Responsibilities

In view of the organisation of VirgoLab, the EGO Director has the final authority on all decisions concerning the operation and maintenance of the Virgo interferometer. They take ultimate responsibility for the success or failure of Virgo's mission, ensuring that both operational and technological objectives are met.

The EGO Director is the chair of the VirgoLab Executive Board (EB). In this function, they are in particular in charge of establishing a constructive technically driven and consensus-oriented discussion in order to take the strategic technical decisions within the EB. The EGO Director has a pivotal function between EGO Council, the Board of PIs and the Scientific Collaboration. They are in particular in charge together with the Council representatives, the Chair of the Board of PIs and the Scientific Spokesperson to leverage expertise and resources from the Member Labs.

The EGO Director represents VirgoLab in the EGO Council as well as in the scientific collaborations and attends the VirgoLab Board of PIs. As such, the EGO Director supports the actions of PIs to obtain funding in their respective organisations.

4.1.2 Mandat

The Director's term is fixed and renewable once, with the renewal decision being taken by the EGO Council and in consultation with the Board of PIs.

4.1.3 Appointment

The EGO Director is appointed by the EGO Council after an international recruitment process operated by a search committee. This search committee includes representatives of the Board of PIs, of the scientific collaboration and the EGO Council. Selection criteria include leadership capacities, management skills, and expertise in gravitational wave science and interferometry.

4.1.4 Reporting

The EGO Director reports to the EGO Council, at the EGO Council meetings and on a regular basis through the EGO-Virgo Program Officer. As chair of the VirgoLab EB, the EGO Director attends the meetings of the Board of PIs.



4.2. EGO-Virgo Program Officer

The EGO-Virgo Program Officer should insure the liaison between EGO Council and the EGO director. Even though their responsibility is not only focused on VirgoLab, overseeing the activities of VirgoLab would be the major part of their mission.

4.2.1. Key Responsibilities

The Program Officer should act as a strong link between the EGO Council and the EGO director. The main mission of the Program Officer will be to follow the activities and decisions of the VirgoLab EB. The Program Officer will oversee the implementation of EGO Council decisions, in particular concerning VirgoLab. In case of difficulties, the Program Officer could be the first level of information and exchange, before calling EGO Council whenever necessary.

4.2.2 Mandate

The mandate of the Program Officer is defined by EGO Council.

4.2.3 Appointment

The Program Officer will be appointed by EGO Council. The person should have no involvement in the VirgoLab or associated scientific collaboration.

4.2.4 Reporting

The Program Officer exchanges on a weekly basis with the EGO director and reports to the EGO Council President.

5 Procedures

5.1 Resource Review Procedure

A possible outlay of the resource review procedure could look like the following:

The EGO Director, in their capacity as chair of the VirgoLab EB, will present an annual report on the use of the financial and human resources provided to EGO and to the Member Labs and allocated to VirgoLab; a proposal for the resources for the coming year; and a forecast of the resources required for the next five years to the Board of PIs.

After examination by the STAC and the AFC, to the EGO Council for a final approval in a special Council Session where the institutions contributing to the Common Found are represented and participating.

The role of the PIs is to liaise with their funding body to secure the necessary resources, both financial and human, between presentation to the Board of PIs and final approval by the EGO Council. A document summarising the pledges of each group, will then be approved by EGO Council and is the basis of the commitment for the upcoming year.

In case of non-fulfilment of the pledges by a group, and after discussion with the PI concerned, the EGO Director may inform the concerned Council members or the funding agency representatives of the difficulties encountered in order to find a solution for the missed engagement.

5.2 Selection procedure for the EGO Director

The EGO Council is steering the procedure to select a new EGO director. One year before the end of the term of the EGO director, EGO Council decides on a prolongation. If a new EGO director has to be appointed, EGO Council Chair proposes the composition of the search committee to the EGO Council for approval. **The search committee could comprise:**

- The Chair of the VirgoLab Board of PIs or someone appointed by the VirgoLab Board of PIs
- The Virgo Spokesperson or their representative (IGWN spokesperson)
- The Chair of the EGO Council or a representative from EGO Council
- (The Chair of the STAC and the AFC)
- Between 2 and 4 additional expert members proposed by the Board of PIs to EGO Council

The search committee shall include at least one member who is outside the Virgo and EGO community.

An open, international call for candidates is published by EGO Council.

The search committee receives candidatures, that can be:

- individuals answering the call
- members of EGO Council proposing potential candidates
- members of the VirgoLab Board of PI proposing potential candidates
- members of the search committee proposing candidates.

From this extended list of potential candidates, the search committee contacts the candidates and invites them to send their application, which should comprise a CV and vision statement. The received applications are reviewed by the search committee, who establishes a list of candidates to be auditioned.

After the auditions, the search committee presents a candidate/a list of at least 3 candidates to the EGO Council.

EGO Council interviews the candidate(s) and designates the EGO DG elect.

The whole process should not take more than 6 months in order to have sufficient overlap time with the incumbent EGO director.

5.3 Process for the admission of new groups

Any new group that would like to join VirgoLab should send an application letter to the EGO Director, the EGO Council Chair, the Virgo Spokesperson and the Chair of the Board of PIs, giving precisions on the involvement they would like to have in VirgoLab.

A dedicated meeting of the PI of the candidate group, the EGO Director, the Virgo Spokesperson and the two chairs should be held, in order to discuss the future contributions.

The PI of the applicant group will then give a presentation of the group and their potential contributions to the Board of PIs.

The Board of PIs will then vote on the interest of VirgoLab on the admission of the new group. In case of a positive vote, the EGO director and the PI of the new group will then work-out a MoA, or an addendum to an existing MoA for the new group or its funding agency.

The MoA is presented to the EGO Council for approval and is sent to the VirgoLab Board of PIs for information, before being signed by the EGO Director and the relevant institution.

5.4 Publication policy and process

The VirgoLab will maintain an author list for publications concerning the Virgo detector. The VirgoLab author list includes, in alphabetical order, all VirgoLab members who are physicists



or engineers. In order to be part of the author list, a person needs to be a member of VirgoLab for at least 1 year.

When leaving the collaboration, authorship is maintained for at least one more year.

The VirgoLab Board of PIs may set up an authorship committee to establish and maintain a list of authors. The author list should be regularly updated.

The VirgoLab Board of PIs may set up an Editorial Committee. All publications on technical description and performance of the Virgo instrument, and data quality characterisation based on non-public strain h(t) Virgo data shall use the VirgoLab author list.

In keeping with the goal of the VirgoLab to promote the visibility of its members to the scientific community at large, there may be cases where a limited author list is more appropriate. The publication policy therefore allows for waivers to the rule by petitioning the Virgo Editorial Committee. However, papers granted an exception should have a methodological purpose, should not include new observational results, or should avoid characterising the detector performance over significant portions of an observing run.

Technical or methodological papers on Virgo components reporting on a part or subsystem of the Virgo hardware (design, construction, commissioning) even when based on non-public data from auxiliary channels (with the exclusion of strain data) can use a short author list.

By default, publications using public Virgo data that have been released can use a limited (or short) author list, unless they would pre-empt VirgoLab planned publications.

Short author list papers are expected to welcome and include all contributors that made the work possible through an opt-in option which is made available to all the members of the Collaboration when the internal review process is initiated.

Should the author list exceed 10% of the VirgoLab default authors, the paper can be said to represent the entire Collaboration. In this case, the full VirgoLab list should be used.

Short author list papers shall cite standard Virgo detector references and acknowledge the usage of public data.

Decisions on whether or not a petition is granted will rest with the Virgo Editorial Committee chair in consultation with the chair of the board of PIs.

Any author of VirgoLab should be automatically entitled to sign the publications related to the data produced by VirgoLab for the Virgo or LVK Collaborations.