

Letter of Intent

To: EGO Director - EGO Council Chair - Virgo Spokesperson

Date: 09/05/2025

From: LMA-IP2I

7, Avenue Pierre de Coubertin

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Contact Jérôme Degallaix (j.degallaix@lma.in2p3.fr)

Subject: Expression of Interest to join VirgoLab

Dear Sir/Madam,

This letter serves as a formal expression of interest by the LMA-IP2I group to join the VirgoLab, as described in VIR-1025B-24. We understand that VirgoLab operates, commissions, and upgrades the Virgo interferometer, and we are willing to contribute to its mission and to the achievement of its goals.

1. Introduction

The LMA-IP2I group is composed of physicists and engineers from two research entities in Lyon: the Laboratoire des Matériaux Avancés (LMA), a CNRS research support facility and the Institut de Physique des 2 infinis de Lyon (IP2I), a joint research unit from CNRS and the University of Lyon I. The LMA-IP2I group is among the historical groups in Virgo and has contributed to Virgo for more than two decades. Both entities of the group belong to the Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), the leading institute of CNRS regarding gravitational wave science. While LMA is specialised in the process and characterisation of very low-loss optical coatings on large surfaces, IP2I has a much broader spectrum. With a staff of 250 people, including 60 PhDs and postdocs, IP2I research activities ranges from subatomic particles to large scale structures of the Universe. It has a strong theoretical group as well as technical departments in electronics, instrumentation and mechanics, and computing.

We believe that our participation in VirgoLab would be mutually beneficial, allowing us to commit our skills and resources to the advancement of gravitational wave science in Europe and beyond, while also providing our members with valuable experience and opportunities within a leading international collaboration.

This letter outlines our main areas of interest and potential contributions to VirgoLab.

2. Scientific and technological contributions

Our group has a strong background in optical coatings on large substrates, ranging from R&D on optical materials, very low-loss coating to optical and mechanical characterisations. The group has also been involved for a long time in optical simulations and optical characterisation. Data acquisition is a new activity in the group: it started in 2024 and will ramp up in the coming years

with scientific and technical contributions. The group also plans to maintain its implication in DetChar and Computing activities.

- **Coating R&D and production and mirror characterisation:** The LMA has a long, worldwide-acknowledged, expertise in coating R&D, especially in the development of very low-loss coatings on large optics. In particular, LMA has coated all the test masses of the current gravitational-wave ground-based laser interferometers (LIGO, Virgo and KAGRA). The LMA plans are twofold: to actively contribute to the development of new coatings, and to coat the most critical optics for Advanced Virgo and its upgrades, ranging from small optics for the injection, detection or squeezing systems, to the main large test masses. Our participation would primarily align with the Optics & Light sources Technical Team. The LMA would be mainly involved in the Detector Upgrades project; however, it could also participate in the Detector Operation if the need of new coated optics should arise.
- **Optical simulations and optical characterisation:** the group will also contribute to the development and exploitation of optical simulations. These activities range from contributing to design upgrades of the detector to the support of commissioning activities after the installation of those upgrades. For the latter point, optical characterisation is crucial to tune the simulations in order to have a more realistic understanding of the interferometer. Our expertise would be relevant to the Control & Simulation Technical Team, with a focus on the projects Commissioning and Detector Upgrades.
- **Detector characterization and data quality control (DetChar):** The group includes the current and previous Virgo DetChar coordinators. It will build on this unique expertise to continue contributing to the DetChar working group, both at the Virgo/VirgoLab and LVK/IGWN levels. This includes maintaining, upgrading and operating existing tools (like the Data Quality Report for vetting online and offline transient gravitational-wave candidates), and developing new algorithms (including machine learning techniques) to find correlations between glitches, or for some noise across multiple channels. The Virgo part of the iDQ package used for glitches identification will remain supported and improved by the group as well. We are also leading the effort to define the Virgo dataset for offline analysis, with contributions from the calibration team. These contributions will be incorporated in the Computing & Software Technical Team and will span the three projects of VirgoLab.
- **Data Acquisition (DAQ):** in 2024, the group started to be involved in the Virgo DAQ subsystem and shortly thereafter a member of the group took the role of manager of this activity. The group is foreseeing to increase its commitment to this activity, both on the hardware and software fronts. That effort would be part of the Sensing and Actuation Technical Team.
- **Virgo detector Operations and management:** Through the current Virgo deputy spokesperson, the current Virgo run coordinator & Virgo Operations Division chair, and the current Virgo DetChar coordinator, the group is deeply involved in the Operations of the Virgo detector. The associated commitments range from technical expertise on the running of the detector or the dataflow, to the high-level management of the O4 run in the validation of new gravitational-wave events. This activity is expected to continue within

the group even when the responsibilities of individual members would have changed. For several years, members of the group were also weekly commissioning coordinators and shifters to help vetting gravitational-wave candidates in low-latency (the Rapid Response Team). Such contributions are expected to continue within the VirgoLab.[¶]

- **Low-latency analyses:** IP2I has been historically in charge of the MBTA CBC pipeline offline analyses for the gravitational-wave transient catalog. However, the practical details of running that pipeline during the O5 run are still under discussion within the collaboration search teams, and options to run the low-latency search offsite are under study. In this context, IP2I could consider getting involved in low-latency searches as well.
- **Computing:** Contributions to the VirgoLab Technical Team “Computing & Software” are expected from people who are involved in Virgo/LVK software development (DetChar, data production and transfer), and/or the support of Virgo activities at the CC-IN2P3 Virgo Tier1 computing center.

3. Cost, Calendar and Resources

Initially, our contribution would primarily involve the effort of our existing personnel, which currently covers around 7 FTE (a rough estimation of VirgoLab-related activities based on the validated reports in the VMD for 2024).

We understand that the successful accomplishment of VirgoLab tasks, particularly the timely installation and commissioning of the O5 upgrade, will demand strong and continual presence at EGO site. Our group commits to support that effort as much as reasonably possible and within its expertise.

We understand that Member Labs are in charge of maintaining and operating the equipment they provide, and those responsibilities will be included in Memorandum of Agreement (MoA).

We are aware that financial resources are allocated by EGO Council, national funding agencies, or research organizations. We will explore potential funding opportunities through our institution and national agencies to support our involvement in VirgoLab.

We are prepared to work towards the establishment of a MoA with EGO should our application be successful.

5. Stakeholders and Requirements

Our primary stakeholders are Institut de Physique des Deux Infinis de Lyon and Laboratoire des Matériaux Avancés, as part of IN2P3/CNRS and University of Lyon.

We understand that as a contributing group, our main requirements would be to have effective communication channels within VirgoLab, opportunities for our members to actively participate in relevant projects and technical teams, and recognition for our contributions to the scientific and technical advancements of Virgo.

We are committed to adhering to the policies and procedures of VirgoLab, including those related to resource allocation and publications.

We are ready to discuss our potential participation further and provide any additional information that may be required. We look forward to the possibility of joining the VirgoLab and contributing to its continued success.

Sincerely,

J. Degallaix on behalf of the LMA-IP2I group.

09/05/2025