Letter of Intent

To: EGO Director - EGO Council Chair - Virgo Spokesperson

Date: May 09, 2025

From: Irène Joliot-Curie Laboratory of Physics of the 2 Infinities (IJCLab), Université Paris-Saclay, CNRS/IN2P3, 91405 Orsay, France.

Contact: Florent Robinet, florent.robinet@ijclab.in2p3.fr

Subject: Expression of Interest to join VirgoLab

Dear Sir/Madam,

This letter serves as a formal expression of interest by Irène Joliot-Curie Laboratory of Physics of the 2 Infinities (hereinafter referred to as "IJCLab") 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

IJCLab is a laboratory of physics of the two infinities under the supervision of the CNRS, the Paris-Saclay University and the Paris-Cité University. The gravitational-wave group in IJCLab is among the historical groups in Virgo and has contributed to Virgo from more than two decades, from the detector to the scientific exploitation of the LIGO-Virgo-KAGRA network. Our technical expertise covers the design of optical and mechanical systems, the management of computing hardware and software, and the characterization of detector's data. Our expertise and ongoing research activities are highly relevant to the operation, commissioning, and potential upgrades of gravitational wave interferometers.

We believe that our participation in VirgoLab would be mutually beneficial, allowing us to contribute our knowledge 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 / Technological Context and Proposed Contribution

- Our group has a strong background in the development and implementation of innovative **squeezing techniques** that could enhance the sensitivity of the Virgo interferometer. In particular, our group is developping frequency-dependent squeezing methods which could be implemented in Virgo. This research relies on the CALVA facility which hosts currently a 50 m suspended cavity where many optical developments are studied. This installation can made available to Virgo members for research and development.
- Our group has a strong background in the development and implementation of **Optical design, sensing and control systems**. We have designed and implemented optical systems to control cavities in interferometers. Recently, we contributed to developing and

maintaining the auxiliary laser system to lock the cavities of Virgo. This effort continues by studying locking methods in the CALVA facility. We plan to use this expertise in VirgoLab and the relevant technical teams. In particular, we will continue to offer PhD thesis positions to work on this topic and to send students to the site.

- The CALVA facility is primarily meant to support a R&D effort. Recently, we have opened CALVA to also train Virgo members to work in **commissioning the detector**. The CALVA facility is controled using the same software environment as in the Virgo detector, which offers a unique test bench for a newcomer to learn the basics of interferometer control. We plan to periodically organize training sessions for VirgoLab members.
- From the early science runs of Virgo to today, our group has made a significant contribution to the **detector characterization work**. We have developed many software packages to study the data quality, the origin of glitches and to enhance the sensitivity of gravitational-wave searches. We will continue to contribute to the Detector Operations and Maintenance project, particularly in the area of data quality characterisation. We also think that every PhD student joining our group should work on a well-defined detector characterization project.
- The IJCLab group is developping and maintaining one critical pipeline to search for gravitational waves from binary mergers with low latency: PyCBC. We are also involved in multi-messenger astronomy by maintaining the infrastructure managing the cross-analysis with triggers from external observatories (e.g. SVOM). More generally, we plan to further contribute in the infrastructure delivering the gravitational-wave alerts to the astronomical community and its content (localization, enrichment with external triggers and cross-analysis). For these topics, we believe our expertise can be relevant, in the context of the Detector Operations and Maintenance project, to **analyze the Virgo data with low latency and to produce alerts for the external community**.
- Occasionally, for well-defined projects, our group can also contribute in **mechanical-design tasks and computing/software projects**. Indeed, two technical departments in our laboratory (mechanical design and computing/software) can be sollicitated to conduct specific tasks and help VirgoLab in these two areas when needed.

3. Costs, Calendar and Resources

Initially, our contribution would primarily involve the effort of our existing personnel, that is roughly 3 FTE. As explained in the previous section, we also plan to have a systematic participation of PhD students and post-doc in detector work.

We anticipate the need for travel funds for the IJCLab staff to come to the Virgo site. We understand that Member Labs are in charge of maintaining and operating the equipment they provide, and we are prepared to discuss the provision of any potential equipment or resources the group might offer, as part of a 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.

4. Stakeholders and Requirements

Our primary stakeholders are the French research agency, CNRS, and the Paris-Saclay University.

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,

Florent Robinet On behalf of IJCLab

May 09, 2025