

Letter of Intent

To: EGO Director - EGO Council Chair - Virgo Spokesperson

Date: 10 May 2025

From: KU Leuven, Oude Markt 13, 3000 Leuven, Belgium

Subject: Expression of Interest to join VirgoLab

Dear Sir/Madam,

This letter serves as a formal expression of interest by KU Leuven (hereinafter referred to as "KUL") 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 achieve its goals.

1. Introduction

KUL is a public research university in the city of Leuven, Belgium, with over 60,000 students across 15 faculties grouped into Humanities and Social Sciences, Science, Engineering and Technology, and Biomedical Sciences. The Leuven Gravity Institute is a multidisciplinary research environment that brings together scientists, engineers, and other researchers to propel the gravitational wave revolution forward. The group comprises more than 50 scientists, of whom approximately 10 actively participate within the Virgo Collaboration. KU Leuven is also part of the Einstein Telescope Collaboration and the LISA Consortium.

Our areas of expertise include:

- Data Analysis
 - Searches: low-latency pipelines eg. gstlal and spiir; burst searches e.g. cWB
 - Inference: LALInference, bilby, and machine-learning inference algorithms
 - Scientific Exploitation: tests of general relativity, gravitational-wave lensing, and core-collapse supernovae
- Coatings
 - Coating Method: Molecular Beam Epitaxy for growing crystalline oxide
 - Thin-film characterisation: Electron microscopy, x-ray characterisation infrastructure
 - Simulation: modelling the behaviour of crystalline materials to explore new coating materials

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 Case or Context of Opportunity

Our group is motivated by the goal of enabling optimal gravitational-wave and multi-messenger astronomy by delivering precise and low-latency insights from gravitational-wave detectors, and by the development of crystalline coatings to improve current and next-generation gravitational-wave detectors.

Our specific achievements and their relevance to VirgoLab include:

- Data Analysis
 - Developer of gstlal
 - Reviewer and contributor to spiir
 - Contributions to searches for core-collapse supernovae
- Coatings:
 - First investigations on crystalline corundum coatings
 - First mechanical loss measurement of a crystalline oxide coating

Our expertise aligns with the VirgoLab technical teams in the following areas:

- Data Analysis: low-latency searches, contributing to the Detector Operations and Maintenance VirgoLab Project and the Computing & Software Technical Team.
- Coatings: Optics & Light sources Technical Team

3. Description of the Proposed Contribution

Our proposed involvement in VirgoLab encompasses the following contributions:

- Data Analysis: We will contribute to (low-latency) data analysis and data quality infrastructures, with a particular focus on compact binary coalescences and core-collapse supernovae, within Detector Operations and Maintenance VirgoLab Project and Computing & Software Technical Team. This includes algorithm development, software implementation, and testing on Virgo data.
- Coatings: We will advance the development of crystalline coatings within Optics & Light sources Technical Team, including simulation, prototyping, and testing at our facilities, as well as thin-film characterisation.

We are also open to contributing to other areas based on the evolving needs of VirgoLab and the expertise within our group. In particular, we highlight the following groups with KUL and topics for potential future collaboration:

- MICAS: Specialising in micro- and nano-electronic systems, with expertise in sensor design and fabrication. This may align with the Sensing & Actuation Technical Team.
- LMSD: Expertise in engineering dynamics, focusing on noise, vibration, and harshness control, signal processing, and system control, with possible applications in vibration isolation. This may align with the Mechanics & Vacuum and Controls & Simulation Technical Teams.

We are keen to engage with the existing VirgoLab Technical Teams and Projects to identify areas where our skills and resources can be most effectively utilized.

4. Costs, Calendar and Resources

Initially, our contribution will primarily involve the effort of our existing personnel, currently delivering a total of around 5 FTE among 13 members (including PhD students) to the Virgo Collaboration. We understand that the successful accomplishment of VirgoLab tasks, particularly the timely installation and commissioning of the O5 upgrade, will demand a strong and continual presence at the EGO site. Our group commits to supporting that effort as much as reasonably possible.

Our specific resource requirements are:

- Data Analysis: access to data and computing infrastructure
- Coatings: collaboration with other VirgoLab members and access to their coating characterisation infrastructure

We are prepared to discuss the provision of our coating and characterisation facilities, and data analysis codes as part of a Memorandum of Agreement (MoA). We are aware that financial resources are allocated by the EGO Council, national funding agencies, or research organizations, and 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 KU Leuven and the Research Foundation Flanders (FWO), which aims to be the leading funding partner for researchers in Flanders by offering financial support and promoting international cooperation to create a favourable climate for world-class scientific research.

As a contributing group, our main requirements are 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 VirgoLab and contributing to its continued success.

Sincerely,



Tjonnie Li, Associate Professor

On behalf of KU Leuven, 10 May 2025