gianluca.gemme@ge.infn.it

Da: Tomek Bulik <tb@astrouw.edu.pl>
Inviato: lunedì 5 maggio 2025 09:56
A: Gianluca Gemme
Oggetto: Letter of interest to join VirgoLAB

Dear Gianluca,

This letter serves as a formal expression of interest by Polgraw (hereinafter referred to as "Polgraw", if applicable) 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 **Polgraw Consortium** is a leading Polish research network coordinated by the Institute of Mathematics of the Polish Academy of Science (IMPAN), specialising in gravitational wave detection and multi-messenger astronomy. Our subgroups propose distinct contributions:

- **Polgraw-EnvSens**: Focuses on environmental noise monitoring and mitigation for gravitational wave detectors, with expertise in seismic, acoustic, sensor technologies.
- **Polgraw-MagNoise:** magnetic sensor technologies, measurements and expertise in ELF (Extremely Low Frequency) electromagnetic wave global propagation.

All groups have actively contributed to the LIGO-Virgo-KAGRA (LVK) Collaboration, including detector characterisation and data analysis during Observing Runs O1, O2, O3 and O4.

2. Scientific / Technological Case or Context of Opportunity

Our group develops high-precision environmental sensors to monitor and mitigate terrestrial noise sources affecting Virgo's sensitivity. Key achievements include:

Polgraw-EnvSens

- Design of low-noise seismic sensors deployed at the Virgo site during O4 to track ground motion correlations.
- Collaboration with the Virgo Infrastructure team.

These activities align with VirgoLab's Detector Commissioning project and the Infrastructure and Mechanics and Technical Teams.

Polgraw-MagNoise

- Upgrade of the global magnetic field monitoring system to enhance detection and suppression of noise caused by external electromagnetic interference.
- Accurate monitoring of ELF impulses, including their propagation characteristics and potential impact on LVK measurements.

These activities align with VirgoLab's Detector Commissioning project and the Infrastructure Technical Team.

3. Description of the Proposed Contribution

Our proposed involvement in VirgoLab would encompass the following potential contributions:

Polgraw-EnvSens

- **Noise Mitigation:** Deploy advanced sensor networks at the Virgo site to monitor seismic, acoustic, disturbances, integrating data into Virgo's environmental monitoring system.
- **Hardware Development:** Collaborate on next-generation vibration isolation systems for the **Detector Upgrades** project, leveraging our experience in compact sensors.
- **Commissioning Support:** Participate in noise-hunting campaigns to identify and mitigate novel noise sources during O5 commissioning.

Polgraw-MagNoise

- **Noise Mitigation:** Monitoring ELF electromagnetic activity in the Earth's ionosphere, which may induce correlated disturbances in signals recorded by the LVK detectors.
- **Hardware Development:** Upgrading the global network of ELF monitoring stations, with improved magnetometer sensitivity and time resolution.
- **Commissioning Support:** Contributing to multi-institutional efforts aimed at precise characterization of ELF impulses and their actual impact on LVK measurements during the O5 commissioning phase.

We are also open to contributing to other areas based on the evolving needs of VirgoLab and the expertise within our group. 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

Currently, the members of the Polgraw-EnvSens, Polgraw-MagNoise, Polgraw-DataProc groups are responsible for a number of tasks related to the maintenance of the sensor infrastructure as well as the software. These efforts are funded by grants from the e.g. Polish National Science Centre, the Foundation for Polish Science, or directly from the Polish Ministry of Science and Higher Education.

Our contribution would primarily involve the effort of our existing personnel: Polgraw-EnvSend 2 engineers, 2 scientists, 1.5 FTE, Polgraw-MagnNoise 1 engineer, 3 scientists, 0.7 FTE.

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.

We anticipate the need for travel to EGO,and access to the 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 technical support for the seismic and infrasound monitoring 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.

5. Stakeholders and Requirements

The Polgraw Consortium operates within a well-defined network of stakeholders critical to the success of its proposed contributions to VirgoLab. The Nicolaus Copernicus Astronomical Center (CAMK PAN), as the consortium's host institution, provides essential infrastructure, including laboratory space for sensor calibration and high-performance computing resources for data processing together with Academic Computer Centre Cyfronet AGH.

Our other important stakeholders are University of Warsaw, Jagiellonian University, Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences. And funding agencies: Polish Ministry of Education and Science, Polish National Science Centre, The Foundation for Polish Science.

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,

Prof. Tomasz Bulik

On behalf of Polgraw

5.5.2025

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