

Letter of Intent

To: EGO Director - EGO Council Chair - Virgo Spokesperson

Date: 9 May 2025

From: Prof. Vincenzo Pierro on behalf of the UniSannio/UniSalerno Group.

INFN di Napoli, Gruppo Collegato di Salerno. pierro@unisannio.it

Subject: Expression of Interest to join VirgoLab

Dear Sir/Madam,

This letter serves as a formal expression of interest by UniSannio/UniSalerno Group, INFN Napoli-Gruppo collegato di Salerno, 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 UniSannio/UniSalerno Group operates at the following locations: the University of Sannio in Benevento, the University of Salerno, and the University of Basilicata, across which the group's laboratories and experimental facilities are distributed

In addition, our members are part of the following departments:

Department of Engineering (DING) at University of Sannio, Dipartimento di Fisica "E. R. Caianello" and Dipartimento di Ingegneria industriale (DIIN) at Università di Salerno, School of Engineering of the Università della Basilicata, Dipartimento di Ingegneria Industriale, Elettronica e Meccanica (DIIEM) at Università degli Studi di Roma Tre.

Our expertise and ongoing research activities are highly relevant to the operation and upgrade of the 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 Case or Context of Opportunity

Our group has a strong background in many areas relevant to VirgoLab's activities. The group has expertise in material science, optics, wave physics, global optimization, artificial intelligence and computing. Furthermore, we have expertise in the development of simulation tools for advanced optical design. Our group's significant contributions to the field include the introduction of the optimized coating design currently used in LIGO and Virgo to minimize thermal noise. We also pioneered the concepts of nm-layered glassy-oxide mixtures and ternary coating mirrors, alongside several innovative ideas in GW data analysis. In addition, our group has deep and established experience in thin film deposition by both electron beam and sputtering. This experience is demonstrated by the numerous coatings produced for the other groups in the Virgo and LIGO collaborations, both in the form of nanostratified and single films.

The group has acquired and upgraded a numerically controlled dual e-beam plasma assisted thin film deposition facility (Uni Sannio), and owns state of the art facilities (SEM, AFM, XRD) for thin film morphology and structural characterization (UniSalerno) as well as an ellipsometer (Uni Bas) and a QDPI (Uni Salerno).

3. Description of the Proposed Contribution

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

- **Mirror prototype/simulation and Optical Coating R&D**
 - In house thin film deposition of amorphous oxides. In particular nm-layered glassy oxide composites based on Silica/Alumina, Silica/Titania, Titania/Zirconia, Titania/Hafnia, Titania/Tantala, Alumina/Hafnia, Silica/Germania, Titania/Germania.
 - nm-layered material characterization studies in collaboration with other VCR&D groups (Genova, Pisa, and Perugia-Camerino)
 - A QDPI system is being developed and commissioned (thermal noise measurement).
 - Morpho-structural characterization of these prototypes by AFM, XRD and SEM, in particular studies of nucleation (crystallization) as a function of annealing temperature and nanolayer thickness (XRD); surface roughness and uniformity (AFM and FeSEM).
 - Test measurements on ellipsometric devices for optical characterization of multi-material coating and nano-coatings.
 - Modeling/Simulation (mixture theory) and m-ary (multimaterial) coating optimization. Studies in collaboration with other VCR&D groups (Genova), LMA Lyon and MIT.

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

Initially, our contribution would primarily involve the effort of our existing personnel: Guerino Avallone, Giovanni Carapella, Francesco Chiadini, Roberta De Simone, Rosalba Fittipaldi, Vincenzo Fiumara, Veronica Granata, Gerardo Iannone and myself.

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 believes it can support this effort by leveraging its expertise, currently well-employed in our research laboratories, to develop the ancillary work necessary for Virgo's proper functioning.

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 Optotec Deposition System, AFM, XRD, SEM, TEM, QDPI, and Ellipsometer facilities 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

Our primary stakeholders are Universities of Sannio, Salerno, Basilicata and Roma Tre, and the above-mentioned departments, as well as the INFN Sezione di Napoli - Gruppo collegato di Salerno.

Obviously, any future formal commitment will have to seek approval from the departmental structures to which we in the UniSannio/UniSalerno group are affiliate.

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,

Vincenzo Pierro



Professor of Electromagnetic Field

Dipartimento di Ingegneria (DING)

Università del Sannio

On behalf of UniSannio/UniSalerno Group

9 May 2025