UNIVERSITY OF NAPLES FEDERICO II

DEPARTMENT OF STRUCTURES FOR ENGINEERING AND ARCHITECTURE
PHD PROGRAM IN
STRUCTURAL, GEOTECHNICAL ENGINEERING AND SEISMIC RISK

CYCLE XXXVII

The undersigned prof. Andrea Prota, Giovanni De Lellis

(Full ■ Associate □ Researcher □) Department of Structures for Engineering and Architecture / Department of Physics "Ettore Pancini"

S.S.D. (*write code and full name ICAR O9 - Structural Engineering*; *FIS 01 – Experimental Physics*)

ASK

to be included in the list of tutors for cycle XXXVII.

1. Curriculum vitae (max 500 words)

Andrea Prota, Full Professor at UNINA, Head of the Department of Structures for Engineering and Architecture, received his PhD in Civil Engineering in 2001 at the University of Napoli Federico II. His research activities consists in the theoretical and experimental research in the following fields: nonlinear behavior of reinforced concrete and masonry structures, seismic retrofit of concrete and masonry structures with composites, behavior of concrete structures reinforced with composite bars, reinforcement bars behavior under monotonic and cyclic compression actions, polymeric and composite structures, protection of structures subjected to fast dynamic loads, strategies and techniques to reduce seismic risk of built environment..
He is currently member of: ACI 440, head of the subcommitee 400M; fib TG 5.1; RILEM TC on Composite Materials, ISO/TC 71 /SC 6, CNR DT 200, DT 203, fib bulletin 14,40, 90, ACI 440. ASTM D7331.
He was coordinator of the WP 2 Reinforced Concrete Structures within the DPC-ReLUIS project 2014-2016, 2016-2018. He was involved in many research projects founded by national or international agencies or private companies. He is scientific coordinator of different projects. He is reviewer of Technical Papers for the many journals.
He is author of more than 500 publications, with more than 200 ISI papers. Other indicators:
- h-index 42/51 and 6104/9051citations (Scopus/Google scholar);
- Supervisor of 30 concluded PhD and 48 MSc theses;
- R&D Projects: 15 as PI and 37 as team member;
- Supervisor of 11 concluded Postdoc projects.

Giovanni De Lellis, Full Professor of Experimental Physics at the University "Federico II", Naples, Italy. He got his PhD degree in 2001 in Fundamental and Applied Physics, Faculty of Science, University Federico II, Naples, Italy. He is a lecturer in many physics' courses. He is a member of the Editorial Board of the "Open Physics" Journal. He is involved in the organization of different scientific conferences and workshops. He supervised 9 Postdocs/11 PhD/17 Master Students. While on leave of absence from Naples, he got a Scientific Associateship at CERN for 15 months from November 2018.

FELLOWSHIPS AND AWARDS
2009 Visiting Scientist at the Laboratory for High Energy Physics, University of Bern, Switzerland.
2001 Fellowship funded by the Japan Society for the Promotion of Science, Nagoya University, Japan.
2000 Fellowship funded by the "Della Riccia" Foundation for a stay at CERN, Switzerland.
1999 Scholarship funded by CERN within the CERN-Asia Program for a stay at the Department of Physics, Nagoya University, Japan.
INSTITUTIONAL RESPONSIBILITIES
2017 – Responsible for the International Agreement between the University Federico II of Naples and the National University of Science and Technology in Moscow.
2005 – 2014 Faculty Member for the Ph.D. courses in Fundamental and Applied Physics, University Federico II, Naples, Italy.
MAJOR COLLABORATIONS
Member of several international Collaborations for physics experiments: CHORUS at CERN, OPERA at Gran Sasso in Italy, PEANUT-T952 at Fermilab (USA), SHiP and SND@LHC at CERN, FOOT GSI, the NEWSdm R&D at Gran Sasso.
Major positions of responsibility include:
• Spokesperson of SND@LHC Collaboration since 2020 and OPERA Collaboration (2012-2019);
• Principal investigator of the NEWSdm R&D (2015-2021).

2. PhD students of whom the undersigned has been a tutor in the last three years

	specify the type of scholarship: university funds, PON, POR, etc.
n. 1	*Molitierno Carmine (Phd program in Structural and Geotechnical Engineering and Seismic risk, XXXVI cicle, ongoing); grant: Ateneo; tutor: Prof. A. Prota*
n. 2	*Mele Annalisa (Phd program in Structural and Geotechnical Engineering and Seismic risk, XXXV cicle, ongoing); grant: Ateneo; tutor: Prof. A. Prota*
n. 3	*Autiero Francesca (PhD program in Industrial Product and Process Engineering, XXXVI cicle); grant: Ateneo; tutor: Prof. A. Prota*
n. 4	*Antonio Iuliano, Ph.D. in Physics, XXXIII cycle; tutor: Prof. G. De Lellis*
n.5.	*Artem Golovatiuk, Ph.D. in Physics, XXXIII cycle; tutor: Prof. G. De Lellis*

3. Title of the proposed research

Structural design of the Decay Volume and BIM integration for the multidisciplinary

SHiP project

4. Field of study

Geotechnical Engineering □

Structural Engineering ■

Seismic Risk □

5. Summary of the research project (max 500 words. State of the art, short program planned for the activities, etc.)

The Search for Hidden Particles (SHiP) experiment aims to create a new infrastructure at the CERN (European Organization for Nuclear Research) Super Proton Synchrotron accelerator with the aim of searching for new particles associated with the so-called hidden sector, including a dark matter candidate.

The integrated design of the various components of the experiment and in particular the structural design of the Decay Volume, a conical steel structure of more than 2000 m3 under vacuum which should host different particles detection systems, will be supported by a Building Integration Model approach (BIM), essential in order to ensure a correct design of a specific component within the multicomponent system of the experiment.

The integrated design in BIM will cover all phases of the Decay Volume project, from conceptual planning to the construction phase. In fact, the Decay Volume project will have to take into account the interaction with the other disciplines involved in the volume project. Some design constraints are linked to the results of the physical simulations regarding the trajectories of muon flows and the efficiency of the "liquid scintillator" (necessary for the identification of the "hidden" particles), as well as the results of the hydraulic simulations about the passage of this liquid inside specific cells obtained inside the structure. Therefore, the classical structural design will be integrated with information from the other design involved disciplines (mechanical engineering, hydraulic engineering, etc.). This integration will take place in BIM environment, ensuring interoperability between the BIM models and the finite element models (FEM) necessary for structural design.

Moreover, the simulation of the assembly process of the Decay Volume, both in factory and on site, will be studied. This activity will be accompanied by the development of prototypes using direct BIM models with numerical control machines in order to test the feasibility of the objects and the margins of imperfection. These prototypes will be also used for more classic structural tests, thanks to the equipment present at the Department of Structures for Engineering and Architecture.

The final step will be the BIM integration of the entire experiment. The proposed tool for coordinating all disciplines involved in the project is a powerful and consolidated BIM-oriented system capable of

optimally managing the progress of all planned activities. The main objective of the 3D BIM integration activity concerns the evaluation of interferences between the various components of the project and the development of a detailed forecast of the times and costs of implementation. The use of collaborative platforms between the various stakeholders responsible for the design of the various sub-components of the project, will also support the exchange of ideas, as basis of a highly multidisciplinary and complex project. In summary, the ultimate goal is to have an integrated BIM design of each sub-component of the experiment in order to have a complete and multidisciplinary integration of a highly complex project.

6. Research publications

[1] Bonivento, W., Boyarsky, A., et al. Proposal to search for heavy neutral leptons at the SPS. arXiv preprint arXiv:1310.1762, 2013.
[2] Anelli, M., Aoki, S., et al. A facility to Search for Hidden Particles (SHiP) at the CERN SPS. arXiv preprint arXiv:1504.04956, 2015.
[3] Akmete, A., Alexandrov, A., et al. The active muon shield in the SHiP experiment. Journal of Instrumentation, 2017, 12(05), P05011.
[4] Ahdida, C., Albanese, R., et al. The experimental facility for the Search for Hidden Particles at the CERN SPS. Journal of Instrumentation, 2019a, 14.03: P03025.
[5] Ahdida C., Albanese R., et al. SHiP Experiment | Progress Report. CERN-SPSC-2019-010, 2019b.
[6] Ahdida, C., Albanese R., et al. Fast simulation of muons produced at the SHiP experiment using Generative Adversarial Networks. Journal of Instrumentation, 2019c, 14(11): P11028.
[7] Ahdida, C., Akmete, A., et al. Measurement of the muon flux from 400 GeV/c protons interacting in a thick molybdenum/tungsten target. The European Physical Journal C, 2020, 80, 1-11.
[8] Ehlert, M., Hollnagel, A., et al. Proof-of-principle measurements with a liquid-scintillator detector using wavelength-shifting optical modules. Journal of Instrumentation, 2019, 14(03): P03021.
[9] Salzano A., Miano A., Porfidia G., Fiorillo A., Prota A. and Jacobsson R. The BIM-based Integrated Design of the SHiP Project Decay Volume. IOP Conference Series: Materials Science and Engineering, Volume 1044, 6th International Conference on Architecture, Materials and Construction (ICAMC 2020), 27th-29th October 2020, Lisbon, Portugal, https://doi.org/10.1088/1757-899X/1044/1/012009.
[10] Miano, A., Fiorillo, A., Salzano, A., Prota, A., and Jacobsson, R. The structural design of the decay volume for the Search for Hidden Particles (SHIP) project. Archives of Civil and Mechanical Engineering, 2021, 21(1): 1-19.
[11] C. Ahdida et al., Sensitivity of the SHiP experiment to light dark matter, JHEP 04 (2021) 199.

7. Funded research projects in which the proposed research fits

Task Force di Ateneo (TFDA), Università degli Studi di Napoli Federico II, per la "Search for Hidden Particles nuova frontiera di scienza e tecnologia al CERN – (SHiP-Fed)". Scientific supervisor: Prof. Giovanni De Lellis.

8. Funds available for research grants, equipment, missions, etc.

Task Force di Ateneo (TFDA), Università degli Studi di Napoli Federico II, per la "Search for Hidden Particles nuova frontiera di scienza e tecnologia al CERN – (SHiP-Fed)". Scientific supervisor: Prof. Giovanni De Lellis.

9. Information related to the research period abroad (min. 3 months) provided for the PhD student (please indicate University/research institution and professor/researcher of reference) (max 300 words)

Herein, the details relating to the period abroad, which will be carried out at CERN, European Organization for Nuclear Research, Geneva, Switzerland, are provided.
Activities tutor: Dr. Richard Jacobsson, technical coordinator of the SHIP project;
richard.jacobsson@cern.ch.
Permanence time: 6 months.

10. Collaborations with companies on the research topic (if available) (max 300 words)

The research activity of the PhD student will see the participation of the company CASTALDO SPA, a leading company in the sector of infrastructure, civil and industrial construction, alternative energy and metal carpentry. The prototypes design will be carried out in close synergy with the company in order to better test all the structural and construction aspects, crucial for the correct realization of the

Naples, 30/04/2021

SIGNATURE

Andrea Prota

Giovanni De Lellis

This form must be filled and sent to the e-mail address phd.dist@unina.it no later than Friday 30/04/2021.