UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DOTTORATO DI RICERCA / PHD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

Activities and Publications Report

PhD Student: Davide Cuneo

Student DR number: DR996967

PhD Cycle: XXXVIII
PhD Chairman: Prof. Stefano Russo

PhD program student's start date: 01-01-2023
PhD program student's end date: 31-12-2025

Supervisor: Pasquale Arpaia
e-mail: pasquale.arpaia@unina.it

Co-supervisor: Pedro M. Ramos
e-mail: pedro.m.ramos@tecnico.ulisboa.pt

PhD scholarship funding entity:
Innovative Research Infrastructure on applied Superconductivity (IRIS)

General information

Davide Cuneo received in year 2022 the Master Science degree in Mechanical Engineering from the University of Tuscia, Viterbo. Within the PhD program in Information Technology and Electrical Engineering, he attended a curriculum in Electromagnetic Fields, Electric and Electronic Measurements. He received a grant from the PNRR project "Innovative Research Infrastructure on applied Superconductivity (IRIS)".

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organizer(s)
1st	Statistical Data Analysis for Science and Engineering Research	Ad hoc course	3	Roberto Pietrantuono	ITEE
1st	Lectures for Superconducting Magnets Test stands, Magnet Protections and Diagnostics	Other courses	6	Series of lecturers from different laboratories	Hugo Bajas (EPFL), Responsible of the Lectures and Marta Bajko (CERN)
1st	Data Uncertainty	Other courses	6	Prof. Leopoldo Angrisani	ITEE
1st	Introduction of Computational Fluid Dynamics	Other courses	6	Prof. Alessandro Veneziani (Emory University)	Scuola Superiore Meridionale
1st	Normal- and Superconducting Magnets	Other courses	13	CERN invited guests	CERN
2nd	Modelli Numerici per i campi	MS course	9	Prof. Massimiliano D'Aquino	UniNa, DIETI
2nd	U.S. Particle Accelerator School: Magnetic Systems for Accelerators, Detectors and Insertion Devices	Other courses	4.5	Ross Schlueter, Diego Arbelaez and Soren Prestemon, LBNL	U.S. Particle Accelerator school
3rd	U.S. Particle Accelerator school: i) Superconducting Accelerator Magnets & ii) Optimization and Machine Learning for accelerators	Other courses	12	Paolo Ferracin (LBNL), Maxim Marchevsky (LBNL), Soren Prestemon (LBNL), Ezio Todesco (CERN)	U.S. Particle Accelerator school

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organizer(s)
1st	PhD school "Italo Gorini"	Florence, Italy	4	04/09/2023 – 08/09/2023	Prof. Marcantonio Catelani, Prof. Lorenzo Ciani

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organizer(s)
1st	Towards teleporting quantum images	0.2	Dr Bereneice Sephton	University of Naples Federico II	Domenico Montemurro
1st	NIST on a Chip: bringing precision metrology out of the lab and into the field	0.2	Barbara Goldstein	NIST, Physical Measurement Laboratory	INRiM
1st	Nuove frontier dell'esplorazione lunare e delle comunicazioni quantistiche via satellite	0.2	Dott. Mario Musmeci e Daniele Dequal	Universita' La Sapienza di Roma, ASI	InRiM
1st	Multi-robot Control of Heterogeneous Herds	0.2	Eduardo Montijano	Universidad de Zaragoza	Francesco Bajardi
1st	Discrete De Giorgi Theory: Analysis and Applications	0.2	Prof. Endre Suli	University of Oxford	Giacomo Ascione
1st	Printable Thermoelectric devices	0.2	Prof. Andrea Reale	Universita' Roma Tor Vergata	INRiM
1st	Grad-Shafranov equations in elliptical systems and Heun equation	0.2	Prof Artur Ishkhanyan	Institute for Physical Research, Armenia	University of Tuscia, DEIM – Prof. Crisanti
1st	Phenomenology of Planck-scale physics	0.2	Giulia Gubitosi	University of Naples Federico II	Francesco Bajardi
1st	How to publish Under the CARE-CRUI agreement with IEEE	0.2	Prof. Nino Grizzuti	University of Naples Federico II	Prof. Nino Grizzuti
1st	2nd Workshop on Instrumentation and Diagnostics for Superconducting Magnets (IDSM 02)	3	Maxim Marchevsky	Lawrence Berkeley National Laboratory	INFN: Istituto Nazionale di Fisica Nucleare
1st	Simulation, AI & Beyond	0.2	CERN invited guests	CERN CAS	CERN
3rd	Update on Superconducting Magnets & Devices Development at CERN,	0.2	Dr. Arnaud Devred	CERN	Lawrence Berkeley National Laboratory
3rd	Fast normal zone propagation velocities in stacks and CORC cables made with CFD REBCO-tapes	0.2	Prof. Frédéric Sirois	Polytechnique Montréal	Lawrence Berkeley National Laboratory
3rd	Exploiting novel liquid sheet targets for the generation of bright MeV proton beams	0.2	Dr. Charlotte Palmer	Queen's University Belfast	Lawrence Berkeley National Laboratory

3rd	The challenge of designing HTS magnets: could that trigger synergies among the fusion and the particle physics communities?	0.2	Prof. Laura Savoldi	Politecnico di Torino	Lawrence Berkeley National Laboratory
3rd	Machine Learning for Predictive Modeling and Process Optimization in Advanced Manufacturing	0.2	Nandana Menon	Lawrence Berkeley National Laboratory	Lawrence Berkeley National Laboratory
3rd	AC loss issues in all-superconducting rotating machines for aircraft applications	0.2	Zhenan Jiang	Robinson Research Institute	Lawrence Berkeley National Laboratory
3rd	Next-gen magnet insulation: NI and MIT technologies at PSI campus	0.2	Mattia Ortino	EPFL-SPC	Lawrence Berkeley National Laboratory
3rd	Towards High-Performance, Low-Overhead Integrity Authentication for Secure-Memory in Embedded and Heterogeneous Computing Platforms	0.2	Rakin Muhammad Shadab	University of Central Florida	Lawrence Berkeley National Laboratory
3rd	Distributed Architecture for FPGA-based Superconducting Qubit Control	0.2	Dr. Neelay Fruitwala	ATAP - BACI Program, LBNL	Lawrence Berkeley National Laboratory
3rd	Real-Time FPGA Data Processing Pipelines with High-Level Synthesis: Case Studies from PANDA and DUNE Experiments	0.1	Dr. Akshay Malige	Brookhaven National Laboratory	Lawrence Berkeley National Laboratory
3rd	Cryogenic Safety	0.2	Dr. Robert Fagaly	IEEE Council on Superconductivity	Lawrence Berkeley National Laboratory
3rd	Development and operation of high field cryogen-free superconducting magnet at HFSLM	0.2	Dr. Satoshi Awaji	Institute for Materials Research, Tohoku University	Lawrence Berkeley National Laboratory
3rd	Development of cryogenic propulsion powertrain for zero emission electric aircraft	0.2	Professor Weijia Yuan	University of Stratchlude, UK	Lawrence Berkeley National Laboratory
3rd	Providing AI expertise as an infrastructure in academia - Setup, Methods and Examples	0.2	Dr. Till Korten and Dr. Peter Steinbach	Helmholtz-Zentrum Dresden-	Lawrence Berkeley National Laboratory

				Rossendorf (HZDR)	
3rd	Status of Superconducting Magnet Projects and R&D at KEK	0.2	Prof. Toru Ogitsu	High Energy Accelerator Research Organization (KEK), Japan	Lawrence Berkeley National Laboratory
3rd	Nonlinear Spectral Modeling from Data	0.2	George Haller	ETH Zürich	ITEE
3rd	Emergent dynamics of nonequilibrium systems with nonreciprocal couplings	0.2	Sabine Klapp	Technical University Berlin	ITEE
3rd	5G & Digital transformation: a view from an unconventional perspective	0.2	Dr. Maurizio Irlando	TIM Group Cloud Factory	ITEE
3rd	Emergent dynamics of nonequilibrium systems with nonreciprocal couplings	0.2	Moti Fridman	Bar-Ilan University	ITEE
3rd	Health aware control and remaining useful life control of degrading controlled systems	0.2	Christopher Berenguer	University of Grenoble Alpes	ITEE
3rd	Magnet Technology Conference	4	NA	NA	IEEE CSC
3rd	Forum Nazionale delle Misure 2025	3.6	NA	NA	GMEE/GMMT

Research activities

Davide Cuneo participated in the research activities within the framework of the IRIS project, focusing on the development of advanced instrumentation for High-Temperature Superconducting (HTS) magnets. During the first year, he joined the Magnetic Measurement Group at INFN-LNF, for a training on magnetic measurements, contributing to experimental campaigns for the characterization of normal conducting magnets for particle accelerators. The research subsequently expanded through collaborations with INFN-LASA and Lawrence Berkeley National Laboratory (LBNL), addressing the critical challenges of magnet stability. The candidate designed a dedicated measurement station for AC losses, supported by a Monte Carlo uncertainty analysis. A significant portion of the work was dedicated to the realization of the first HTS coil prototype in "uni-layer" configuration using CORC® wire. This prototype was developed with a dual purpose: serving as a demonstrator to prove the feasibility of winding ReBCO-based wires in this configuration for small-aperture magnets with minimal current degradation and providing a realistic platform for testing advanced instrumentation. In this context, the candidate designed

and experimentally validated an innovative ultrasonic waveguide sensor for distributed quench detection. Finally, the study involved the application of Machine Learning models for quench analysis on HL-LHC superconducting quadrupoles.

Tutoring and supplementary teaching activities

None

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	38	5	20	0
2nd	13.5	0	30	0
3rd	12	11.5	50	0

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2nd	Lawrence Berkeley National Laboratory (LBNL), Berkeley, California	Jose Luis Rudeiros-Fernandez, Paolo Ferracin	01/03/2024 – 28/02/2025	The activities that were carried out during the period abroad of one year were i) design, fabrication and test of the first HTS particle accelerator magnet prototype in the innovative "uni-layer" configuration and ii) design and validation of an ultrasonic waveguide for quench detection and localization for superconducting magnets.

PhD Thesis

In the PhD Thesis, Davide Cuneo contributes on addressing the critical challenges posed by the use of HTS in particle accelerator magnets by proposing advanced instrumentation. First, he presents the design of a dedicated system for AC-losses measurement in ramped magnets, supported by a Monte Carlo analysis to evaluate associated uncertainties. Second, the candidate introduces the first HTS coil prototype in a "uni-layer" configuration. Developed using CORC®-based wires, this prototype serves a dual purpose: demonstrating the viability of this configuration for small-aperture magnets with minimal current degradation and providing a realistic platform for testing advanced instrumentation. Third, the study proposes an ultrasonic waveguide sensor for distributed temperature monitoring. The thesis details the sensor's design, its integration through co-winding, and its validation within the magnet-like prototype across multiple experimental

configurations. Finally, the research adopts Machine Learning models for quench detection and localization. These models are benchmarked against state-of-the-art interpretable models on an LTS dataset, establishing a solid basis for their future extension to HTS magnets.

Research products

Research results appear in 3 papers published in international journals, 0 papers published in national journals, 3 contributions to international conferences, 0 contributions to national conferences, 0 patents.

List of scientific publications

International journal papers

Arpaia, D. Cuneo, A. Esposito, A. Gilardi, P. M. Ramos,
An Overview on Quench Detection Techniques for High-Temperature Superconducting Cables and Magnets [Roadmap for Measurement and Applications],
IEEE Instrumentation & Measurement Magazine,
vol. 27 (9), pp. 29–37, Dec. 2024, DOI: 10.1109/MIM.2024.10772016.

Arpaia, D. Cuneo, E. De Matteis, A. Esposito, P. Ramos,
Design and Uncertainty Analysis of an AC Loss Measuring Instrument for Superconducting Magnets,
Instruments,
vol. 9 (8), 2025, DOI: 10.3390/instruments9020008.

Cuneo, J. L. Rudeiros Fernández, P. Ferracin, M. Marchevsky, A. Esposito, P. Arpaia,
Design and implementation of an acoustic waveguide quench detection and localization sensor for the HTS Uni-layer magnet prototype,
IEEE Transactions on Applied Superconductivity,
2025, DOI: 10.1109/TASC.2025.3627164.

International conference papers

Trigilio, I. Balossino, L. Capuano, D. Cuneo, M. Del Franco, L. Petrucciani, L. Sabbatini, A. Selce,
Measurements of hysteretic effects and eddy currents on a FeCo magnet for the design of a novel ion gantry,
IPAC'24 (International Particle Accelerator Conference),
Nashville, TN, USA, May 2024, pp. 1766–1769, DOI: 10.18429/JACoW-IPAC2024-TUPS47.

Vannozzi, G. Armenti, I. Balossino, L. Capuano, A. Casamatta, D. Cuneo, F. Iungo, S. Martelli, L. Petrucciani, L. Sabbatini, F. Sardone, et al.,
Magnetic measurements for Halbach-type permanent quadrupoles using a single-stretched wire system,
IPAC'24 (International Particle Accelerator Conference),
Nashville, TN, USA, May 2024, DOI: 10.18429/JACoW-IPAC2024-THPS54.

Manzo, P. Arpaia, M. Balato, D. Cuneo, F. Mancino, S. Minucci, N. Moccaldi, C. Petrarca,
FEM-based Parametric Optimization of a Measurement Setup for Sensitivity Improvement in Insulin Absorption Assessment,
2024 IEEE International Instrumentation and Measurement Technology Conference (I2MTC),
Glasgow, Scotland, UK, May 2024, pp. 1–6, DOI: 10.1109/I2MTC60896.2024.10560806.

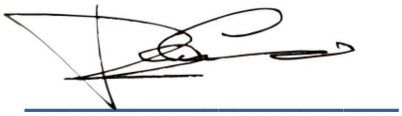
Patents and/or spin offs

None

Awards and Prizes

U.S. Particle Accelerator school scholarship.

Date 15/12/2025

PhD student signature 

Supervisor signature