Scientific and Academic Curriculum

Paolo Lazzaroni

paolo.lazzaroni(at)pv.infn.it
thezep96
Paolo Lazzaroni

Education and academia

2023 – now	Junior Technological Researcher – Level 1 **Istituto Nazionale di Fisica Nucleare**, Pavia *Title*: "Characterization of integrated circuits and modules developed for hybrid pixel readout at the CMS Inner Tracker" *Coordinator*: Gianluca Traversi *Keywords*: ASIC design, PCB design, FPGA design, data analysis, ASIC characterisation
2020 – 2024	Doctor of Philosophy (Ph.D.) -- Engineering and Applied Sciences **Università degli Studi di Bergamo**, Bergamo *Thesis*: "Design of a pixel readout processor for nano-meter resolution x-ray ptychography" *Advisor*: Massimo Manghisoni, Lodovico Ratti *Field of research*: Microelectronics for High Energy Physics *Keywords*: Radiation detection, front-end electronics, low noise, x-ray ptychography *Final Grade*: Excellent
2018 – 2020	Master of Science (M.Sc.) -- Computer Engineering (Mechatronics) LM-32 **Università degli Studi di Bergamo**, Bergamo *Thesis*: "Characterization of a Modular System for the Realisation of the Si(Li) Tracker of GAPS experiment" *Advisor*: Massimo Manghisoni, Elisa Riceputi, Mauro Sonzogni *Keywords*: GAPS, Front-end Electronics, Analogue IC Design, Data Analysis *Final Grade*: 110/110 cum laude
2015 – 2018	Bachelor of Science (B.Sc.) -- Computer Engineering LM-8 **Università degli Studi di Bergamo**, Bergamo *Thesis*: "Analysis of Reinforcement Learning Algorithms for Control in OpenAI Gym Simulated Environment" *Advisor*: Fabio Previdi, Mirko Mazzoleni *Keywords*: Machine Learning, Reinforcement Learning, Control, OpenAI Gym *Final Grade*: 107/110
2010 – 2015	Technical Certificate – Accounting & IT for Entreprise **Istituto di Istruzione Superiore "Lorenzo Lotto"**, Trescore Balneario (BG) *Final Grade*: 100/100

Scientific activity

The scientific activity and research interest of Paolo Lazzaroni fall mainly in the design and characterisation of low-noise, low-power analogue front-end integrated circuits for semiconductor detector readout in particle tracking, photon science, and astroparticle physics application.

The research activity to date encompasses the following:

1. **Development of readout electronics for x-ray imaging**

   Paolo Lazzaroni has developed a pixel readout processor for ptychography, pFREYA16, in a $65\,\mathrm{nm}$ CMOS technology in the frame of the FALCON project, an international collaboration between Argonne National Laboratory (ANL, Chicago, USA), University of Bergamo, and University of Pavia (both part of Istituto Nazionale di Fisica Nucleare, INFN, section of Pavia, Italy).

   The main challenges posed by the design of chip lie in the strict requirements on both noise and power, together with the high rate, $1\,\mathrm{MHz}$, at which each hybrid pixel needs to operate.

2. **Testing of front-end circuitry for XFELs and astrophysics**

   Paolo Lazzaroni has been testing and analysing data coming from low-noise front-end circuitry for HEP. The two main frames in which this activity is pursued are GAPS (General AntiParticle Spectrometer) collaboration (Front-End Board and ASIC testing) and DESY's DSSC camera (sensor and ASIC testing and validation).

3. **Design and development of affordable IoT solutions**

   The activity is collateral to the main topic of Paolo Lazzaroni's research and consist of designing efficient, precise, and smart IoT infrastructures to address different needs and developing machine learning solutions both on the back-end and on the IoT node.

   The main achievement to date coming from this activity is the first prize at Bosch SensorTec's "Making SensorTec" challenge for a smart IoT system to monitor domestic boilers, together with the microlab team.

4. **Testing of electrically conductive cotton fabric coatings**

   The activity was pursued together with "A. J. Zaninoni" textile technology laboratory at the University of Bergamo.

   The research work consists in performing high-precision, low-current measurement on different types of cotton coatings – based on carbon nanotubes and tungsten selenide – in order to check their conductivity properties against different temperature, humidity levels, and their reversibility after repeated test cycles.

Scientific publications

Paolo Lazzaroni is author or co-author of 9 scientific publications. More details are found in the ORCID profile at the link:

https://orcid.org/0000-0002-8443-1101

The list of publications is given in the appendix.

Oral communications at scientific conferences

Paolo Lazzaroni gave oral communication at 3 international scientific conferences.

2023 | "Characterisation of the pFREYA16 ASIC for low-noise ptychography applications," *2023 IEEE Nuclear Science Symposium, Medical Imaging Conference and Room Temperature Semiconductor Detector Conference*, Vancouver (Canada), 04 – 11 November 2023

2022 | "A low-noise readout channel for x-ray ptychography applications," *2022 IEEE Nuclear Science Symposium, Medical Imaging Conference and Room Temperature Semiconductor Detector Conference*, Milano (Italy), 05 – 12 November 2022

2022 | "FALCON readout channel for x-ray ptychography applications," *2022 17th Conference on Ph.D Research in Microelectronics and Electronics (PRIME)*, Villasimius (Italy), 12 – 15 June 2022

Reviewer activity for journals and ASIC design

Paolo Lazzaroni serves as reviewer for conferences in the field of microelectronics and electronics design

ApplePies | International Conference on Applications in Electronics Pervading Industry, Environment, and Society

MOCAST | International Conference on Modern Circuits and Systems Technologies on Electronics and Communications

He also served as an ASIC reviewer for Cornell University Detector Group.

Projects

CMS | (2023 – today) CMS collaboration at CERN.
Characterisation of integrated circuits and modules developed for hybrid pixel readout at the CMS inner tracker.

FALCON | (2020 – today) ANL, UniPV, and UniBG collaboration.
Design of a pixel readout processor for nano-meter resolution x-ray ptychography.

GAPS | (2020 – today) GAPS collaboration.
Testing and verification of the performance of the Si(Li) tracker of the experiment.

DSSC | (2021 – 2023) EuXFEL, DESY, and INFN (Milano and Pavia) collaboration.
Testing and verification of the performance of the DEPFET sensors and ASICs.

National and International Scientific Collaborations

ANL | Argonne National Laboratory, Chicago, USA

FNAL | Fermi National Accelerator Laboratory, Chicago, USA

INFN | Istituto Nazionale di Fisica Nucleare, Pavia, Italy

UniPV | Università degli Studi di Pavia, Pavia, Italy

Awards and recognitions

2023 | Bosch SensorTec "Making SensorTec!" challenge winner
First prize awarded to the University of Bergamo microlab team for the development of an intelligent IoT infrastructure for boiler monitoring, alert managing, and data analysis. The team was invited to present the work both at Bosch SensorTec (BST) in Milan, Italy, and at the BST headquarters in Reutlingen, Germany.

2023 | PRIME 2022 Bronze Leaf Certificate
Certificate awarded to the paper "FALCON readout channel for x-ray ptychography applications" as one of the top 30% paper of the PRIME 2022 conference.

Academic activity

Teaching activity

Starting from 2021, Paolo Lazzaroni has carried out teaching assistant activities for Computer Engineering and Mechanical Engineering degree at the University of Bergamo and Medicine and Surgery degree at the University of Milano-Bicocca. A detailed list of the aforementioned activities, with the corresponding academic year, follows:

2023 – 2024 | Teaching assistant for the course "Fundamentals of Electronics" (9 CFU).
Teaching assistant for the course "Sensors" (6 CFU).
Teaching assistant for the course "Electronics and Elaboration of Biomedical Signals" (6 CFU).
Lecturer for the course "Prosthesis and Rehabilitation in Practice" (1 CFU).

2022 – 2023 | Teaching assistant for the course "Fundamentals of Electronics" (9 CFU).
Teaching assistant for the course "Sensors" (6 CFU).
Lecturer for the course "Prosthesis and Rehabilitation in Practice" (1 CFU).

2021 – 2022 | Teaching assistant for the course "Fundamentals of Electronics" (9 CFU).
Teaching assistant for the course "Electronics and Elaboration of Biomedical Signals" (6 CFU).
Teaching assistant for the course "Sensors" (6 CFU).
Lecturer for the course "Prosthesis and Rehabilitation in Practice" (1 CFU).
Lecturer for the summer school "Non Linear Life".

2020 – 2021 | Teaching assistant for the course "Fundamentals of Electronics" (9 CFU).
Teaching assistant for the course "Electronic Instrumentation" (6 CFU).

Tutoring activity

Paolo Lazzaroni has been the co-advisor for 2 M.Sc. theses and for 2 B.Sc. thesis at the University of Bergamo.

Memberships

2023 – today | Staff associate II
Columbia University, New York
Construction and testing of the GFP, the GAPS Functional prototype, as part of the GAPS experiment.

2020 – today | INFN Member
Istituto Nazionale di Fisica Nucleare, Pavia
Member of INFN CSN5 group as Technological Ph.D., section of Pavia.

2020 – today | SIE Member
Società Italiana di Elettronica, Bergamo
Member of SIE, section of Bergamo.

2020 – today | IEEE Graduate Student Member
Institute of Electrical and Electronics Engineers, Italy
Graduate student membership.

2020 – today | IEEE NPSS Member
Institute of Electrical and Electronics Engineers, Italy
NPSS member.

Scholarships and certificates

2020 – 2023 | Ph.D. Scholarship
Università degli Studi di Bergamo, Bergamo

2016 – 2019 | TOP 10 Student Program 2015/2016, 2016/2017, 2017/2018, 2018/2019
Università degli Studi di Bergamo, Bergamo
Fee exemption awards issued by Università degli Studi di Bergamo to best students.

2018 | C1 Advanced (Grade B)
Cambridge Assessment English, Cambridge

Other work experiences

03/2019 – 03/2020 | Computer Engineer at ASST Papa Giovanni XXIII, Genetics Department, Bergamo
System administrator and programmer
Winner of a scholarship given by ASST Papa Giovanni XXIII to a computer engineer for RARE (Rapid Analysis for Rapid carE) project.

01/2017 -- 08/2018 | Apprentice Computer Engineer at ASST Papa Giovanni XXIII, Genetics Department, Bergamo
System administrator and programmer
Administrator of 2 Linux-based servers (Ubuntu, Redhat). Software development on Linux and Windows (mainly Python, Java, bash scripting).

Languages

Italian: Mother tongue
English: Fluent (C1)
French: Intermediate (B2)
Russian: Intermediate (B2)
Japanese: Beginner (A2)

Interests and activities

Technology, Electronics, Space, Nuclear Physics.
Music, Books, Travels.

List of publications

Articles in journal

[J1] V. Re, L. Ghislotti, P. Lazzaroni, M. Manghisoni, E. Riceputi, L. Ratti, M. Boezio, G. Zampa, and L. Fabris, "A mixed-signal processor for x-ray spectrometry and tracking in the GAPS experiment," *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, vol. 1045, p. 167617, 2023.

[J2] M. Manghisoni, L. Ghislotti, P. Lazzaroni, V. Re, E. Riceputi, L. Ratti, L. Fabris, M. Boezio, and G. Zampa, "A 32-channel readout ASIC for x-ray spectrometry and tracking in the GAPS experiment," *IEEE Transactions on Nuclear Science*, vol. 71, no. 1, pp. 96–105, 2024.

[J3] L. Ghislotti, M. Boezio, L. Fabris, P. Lazzaroni, M. Manghisoni, L. Ratti, V. Re, E. Riceputi, and G. Zampa, "Energy threshold calibration of the GAPS experiment Si(Li) tracker readout electronics," *Il Nuovo Cimento C*, vol. 47, no. 3, pp. 1–1, 2024.

[J4] S. Botticini, E. Comini, S. Dello Iacono, A. Flammini, L. Gaioni, A. Galliani, L. Ghislotti, P. Lazzaroni, V. Re, E. Sisinni, M. Verzeroli, and D. Zappa, "Index air quality monitoring for light and active mobility," *Sensors*, vol. 24, no. 10, 2024.

Conference proceedings

[C1] P. Lazzaroni, M. Hammer, M. Manghisoni, A. Miceli, L. Ratti, and V. Re, "FALCON readout channel for x-ray ptychography applications," in *2022 17th Conference on Ph.D Research in Microelectronics and Electronics (PRIME)*, 2022, pp. 193–196.

[C2] E. Riceputi, M. Boezio, L. Fabris, L. Ghislotti, P. Lazzaroni, M. Manghisoni, L. Ratti, V. Re, and G. Zampa, "The 32 analog channels readout for the long-flight GAPS balloon experiment tracking system," in *Proceedings of SIE 2022*, G. Cocorullo, F. Crupi, and E. Limiti, Eds. Cham: Springer Nature Switzerland, 2023, pp. 27–32.

[C3] P. Lazzaroni, M. Hammer, M. Manghisoni, A. Miceli, L. Ratti, V. Re, and G. Torilla, "A low-noise readout channel for x-ray ptychography applications," in *2022 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC)*, 2022, pp. 1–6.

[C4] E. Riceputi, M. Manghisoni, V. Re, L. Ghislotti, P. Lazzaroni, L. Ratti, L. Fabris, M. Boezio, G. Zampa, M. Xiao, E. Cavazzuti, and V. Vagelli, "Experimental results from the characterization of a 32-channels mixed-signal processor for the GAPS experiment," in *2023 IEEE Nuclear Science Symposium, Medical Imaging Conference and International Symposium on Room-Temperature Semiconductor Detectors (NSS MIC RTSD)*, 2023, pp. 1–1.

[C5] P. Lazzaroni, M. P. Hammer, M. Manghisoni, A. Miceli, L. Ratti, V. Re, and G. Torilla, "Characterisation of the pFREYA16 ASIC for low-noise ptychography applications," in *2023 IEEE Nuclear Science Symposium, Medical Imaging Conference and International Symposium on Room-Temperature Semiconductor Detectors (NSS MIC RTSD)*, 2023, pp. 1–1.

[C6] M. Verzeroli, A. Galliani, L. Ghislotti, L. Gaioni, P. Lazzaroni, and V. Re, "Empowering smart mobility with a component-based data acquisition system for multi-sensor readout," in *2024 19th Conference on Ph.D Research in Microelectronics and Electronics (PRIME)*, 2024, pp. 1–4.

[C7] L. Ghislotti, P. Lazzaroni, M. Manghisoni, and E. Riceputi, "Low-noise wide dynamic range charge sensitive amplifier in 65 nm cmos technology for the second flight of the gaps experiment," in *2024 19th Conference on Ph.D Research in Microelectronics and Electronics (PRIME)*, 2024, pp. 1–4.