

Avviso di Seminario

Dott. Gianluca Milano

Istituto Nazionale di Ricerca Metrologica (INRiM)

Computing with physical laws in neuromorphic hardware

Mercoledì, 15 Gennaio 2025, h. 14.00

Sala Wataghin, Dipartimento di Fisica, via Pietro Giuria 1, Torino

Webex: <https://unito.webex.com/meet/ettore.vittone>

Abstract

Artificial Intelligence needs a hardware revolution to sustain the ever-growing demand of computing power in our society, where the huge energy consumption and environmental impact of computation with current technologies is unsustainable. In the race toward future computing, brain-inspired technologies have been shown as promising hardware solutions for computing beyond the Turing model and the classical von Neumann architecture. Going beyond transistor-centered hardware solutions, the research community is exploring new device concepts and architectures that leverage physical phenomena for computing “in materia” (i.e. directly at the matter level) through physical laws.

Besides providing examples of unconventional physical substrates for computing and recent results obtained on self-organizing networks of nanowires [1,2], the seminar will discuss open challenges of this research field that will be tackled in the interdisciplinary MEMBRAIN project [3]. This project will aim to develop a new physical substrate for computing by establishing an hardware-software codesign approach that lies at the crossroad between physics, nanotechnology, machine learning and neuroscience.

[1] Milano, Gianluca, et al. “In materia reservoir computing with a fully memristive architecture based on self-organizing nanowire networks” *Nature materials* 21.2 (2022): 195-202.

[2] Milano, Gianluca, et al. “Tomography of memory engrams in self-organizing nanowire connectomes.” *Nature Communications* 14.1 (2023): 5723.

[3] ERC Starting Grant “Memristive self-organizing dendrite networks for brain-inspired computing” – MEMBRAIN – PI: Gianluca Milano

The speaker



Gianluca Milano is currently a permanent researcher at the Italian National Institute of Metrological Research (INRiM). After receiving his bachelor's and master's in Physics at the University of Torino, he received a Ph.D. in Physics cum laude from Politecnico di Torino, in collaboration with the Italian Institute of Technology (IIT). His main research interests and activities focus on i) the investigation of electronic and ionic transport properties and physicochemical phenomena in nanodevices and low dimensional systems; and ii) memristive devices and architectures for memory and neuromorphic applications, from material synthesis to device characterization, modeling, and implementation of unconventional and brain-inspired computing paradigms in neuromorphic architectures. He is recipient of the ERC Starting Grant “MEMBRAIN” aiming to develop new hardware platforms for neuromorphic computing, and he was coordinator of the European project EMPIR MEMQuD that involves 15 european partners, including Universities, research centers and industries, that focus on the development of memristive devices working in the quantum regime. He is Associate Editor of APL Machine Learning. For his work on in-materia implementation of reservoir computing in self-organizing networks of nano objects he received the NEST prize for Nanoscience 2021.