UNIVERSITÀ DEGLI STUDI
DI TRENTO

Dipartimento di Fisica

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Monday 13th July 2026 - 2:00 p.m.

Room A209 – Polo Ferrari 1

Brain-like Computation with Percolating Networks of Nanoparticles

Abstract:

Self-assembled networks of nanoparticles have emerged as important candidate systems for brain-like (or neuromorphic) information processing. The essence of the approach is to take advantage of the intrinsic dynamical properties of these networks to implement brain-inspired approaches to computation. Both the structural and dynamical properties of the networks have been shown to be brain-like and, in particular, avalanches of neuron-like spiking events have been shown to be critical. Criticality is a key feature of the biological brain that has been related to optimal information processing capability. We have explored brain-like computation with PNNs in two regimes, beginning with simulations that allow us to understand the processes and refine parameters, and then moving to experimental demonstrations. At low voltages, we focus on reservoir computation and we have successfully demonstrated time series prediction, non-linear transformation and spoken digit recognition. In the high voltage regime, the neuron-like spiking behaviour has been exploited to perform Boolean logic and hand written digit classification, and, most recently, optimization tasks such as integer factorisation. Current work is focused on
achieving neuron-like and synapse-like behaviour simultaneously, in order to demonstrate new kinds of learning behaviour.

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