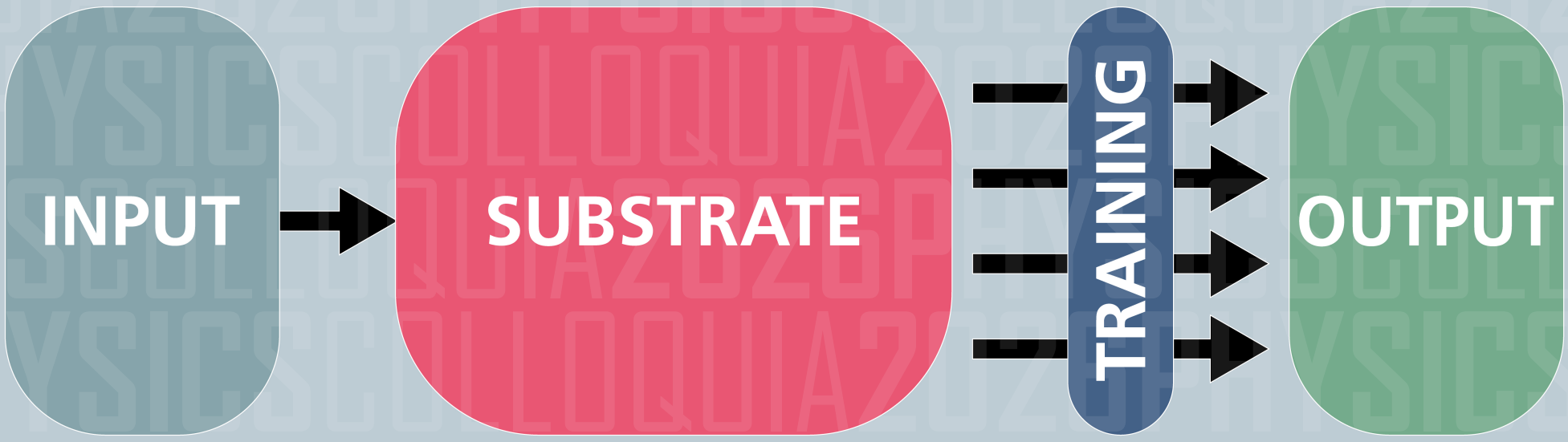
PHYSICSCOLLOQUIA2026



Machine learning plays a crucial role in a variety of temporal tasks, ranging from forecasting chaotic systems to speech recognition.
Rather than using conventional gate-based neural networks,
the inherent dynamics of analogue complex systems can be exploited to efficiently perform these tasks.
One curious example is the use of a bucket of water as a physical reservoir computing substrate, and many optical,
electric and spintronic devices have actually been reported for processing temporal data.
Quantum reservoir computing (QRC) is a promising machine learning framework that uses a quantum system as a high-dimensional
computational reservoir and leverages quantum coherence to extract complex temporal correlations.
Unlike conventional computing, this neuromorphic approach bypasses the von Neumann bottleneck,
providing in-memory computational power while maintaining a compact physical implementation that is easy to train.
Recent pioneering works have reported photonic, atomic and superconducting circuit implementations.
Notably, QRC enables the online processing of both classical inputs,
such as stock prices and weather data, and quantum inputs, such as quantum states.
In this talk, I will introduce the principles of classical and quantum neural networks and reservoir computing,
discuss the main open challenges and potential advantages of QRC, and review the current state of affairs and future directions.

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QUANTUM COMPLEX SYSTEMS FOR MACHINE LEARNING

JUN 16

3:00 p.m. | **CLASSROOM A** | Via Celoria 16 | Milan

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