

## PRESS RELEASE

# Predicting complex data with light-based quantum artificial intelligence

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Researchers from the [Kastler Brossel Laboratory](#) in Paris (LKB – École normale supérieure, Sorbonne University, Collège de France, CNRS) and the Institute for Cross-Disciplinary Physics and Complex Systems in Palma de Mallorca (IFISC) have developed a quantum photonic reservoir computer, equipped with memory, capable of learning and predicting complex time series. More advanced versions of reservoir computing are being considered for climate and financial market forecasting. This collaboration marks a significant milestone in quantum science and paves the way for machine learning which harnesses the resources of quantum physics. The results have been published in the journal [Nature Photonics](#).

### Predicting phenomena that evolve over time

From financial markets to climate data and brain activity, many phenomena rely on time series analysis, i.e. data that changes over time. Modelling and predicting them remains a major challenge for science and technology.

This new experimental protocol was developed at the Kastler Brossel Laboratory by Valentina Parigi's research team as part of the ERC COQCOoN project (Continuous Variable Quantum Complex Networks), with support from the PEPR OQuLus programme (Light-based quantum computers in discrete and continuous variables). The theoretical framework was developed at the Institute for Cross-Disciplinary Physics and Complex Systems Roberta Zambrini's research group.

### “Reservoir computing” based on entangled quantum light

The method, known as “reservoir computing,” harnesses the natural dynamics of a complex physical system, called the reservoir, to process the input data, without having to train the entire system. Only the output layer is adjusted, which considerably simplifies the learning process.

In this experiment, the reservoir consists of a multimode quantum state of light, in which several frequency bands are correlated with one another through entanglement. In practical terms, the researchers use a light beam whose various components interact within a non-linear material, forming a system capable of processing information. The approach relies on the continuous variables of light, where information is encoded in the properties of the light field (such as its amplitude and phase) and measured using detectors operating at room temperature.

### Integrated memory via feedback

To process temporal data, the system must be able to retain a record of the past. The researchers introduced a feedback mechanism where measured signals are fed back into the system control for the subsequent stage. This process gives the device a 'fading memory' which allows past inputs to influence future states. This property is essential for capturing the temporal dependencies in the data.

### **Superior performance to conventional approaches**

The researchers demonstrated that using the entangled multimode structure of light improves both the system's memory and expressiveness, which is the amount of information that can be used for learning. This means that complex time series can be learnt with fewer errors than with equivalent conventional systems. The researchers also demonstrated that its capacities rapidly increase when the system is scaled up, making it a promising avenue of research.

These results pave the way for new machine learning systems (forms of artificial intelligence) based directly on the laws of quantum physics. Ultimately, this technology could address complex problems more efficiently.

#### **Further reading:**

Link to the [article](#) in *Nature Photonics*.

Paparelle, I., Henaff, J., García-Beni, J. et al. Experimental memory control in continuous-variable optical quantum reservoir computing. *Nat. Photon.* (2026). <https://doi.org/10.1038/s41566-026-01880-9>

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