Call for an assistant professor in neuromorphic photonics

Title of the call	Assistant Professor in Experimental Physics within the Nanoscience Laboratory –Department of Physics (http://nanolab.physics.unitn.it/) in the group of Prof. L. Pavesi
Call	The fixed-term researcher hired as a result of the present evaluation will carry out research and teaching activities in the field of photonics. The position is for a three-year period, renewable once for two further years. The annual gross salary is about 35,000 Euros. **Requested research duties**: in the field of integrated silicon photonics applied to machine learning with recurrent neural networks, in particular made with complex circuits of optical micro-resonator systems. The activity will include both simulation and system design and measurement and analysis of data in high frequency regimes. This research will be part of the the research project BACKUP: Unveiling the relationship between brain connectivity and function by integrated photonics financed by the European Research Council (ERC). **Requested teaching duties**: in accordance with the annual didactic planning, could concern the teaching on the area relevant to the ERC research project in the MSc and Ph.D. courses of the Physics Department, specifically in photonics and its applications, for a maximum of 48 hours / year. The overall annual hours of work for research, teaching and office hours for students within the areas indicated above equal 1,500 hours per year. The teaching activities of the contract holder are defined by the Department Council when it plans the teaching programme, according to the University regulations. **Foreign language required:** excellent level of English **Knowledge of Italian:** not required Maximum number of publications to be presented: **12**
Target group	4-10 yrs after a PhD
Application procedure	Candidates should apply through the online procedure that University of Trento provides. Application must be submitted online at: http://www.unitn.it/ateneo/bandi-dr-valcomp/attivi Application must be received at the latest 30 days of the publication of the call on the Gazzetta Ufficiale (publication date 22 june or29 june 2018) The web site will be opened after the pubblication on the Gazzetta
Starting date	1 november 2018

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ABSTRACT PROJECT BACKUP	BACKUP will address the fundamental question of which is the role of neuron activity and plasticity in information elaboration and storage in the brain. Within an interdisciplinary team, BACKUP will develop a hybrid neuromorphic computing platform. Integrated photonic circuits will be interfaced to both electronic circuits and neuronal circuits (in vitro experiments) to emulate brain functions and develop schemes able to supplement (backup) neuronal functions. The photonic network is based on massive reconfigurable matrices of nonlinear nodes formed by microring resonators, which enter in regime of self-pulsing and chaos by positive optical feedback. These networks resemble human brain. Backup will push this analogy further by interfacing the photonic network with neurons making hybrid network. By using optogenetics, we will control the synaptic strengthening and the neuron activity. Deep learning algorithms will model the biological network functionality, initially within a separate artificial network and, then, in an integrated hybrid artificial-biological network. BACKUP aims at: 1. Developing a photonic integrated reservoir-computing network (RCN); 2. Developing dynamic memories in photonic integrated circuits using RCN; 3. Developing hybrid interfaces between a neuronal network and a photonic integrated circuit; 4. Developing a hybrid electronic, photonic and biological network that computes jointly; 5. Addressing neuronal network activity by photonic RCN to simulate in vitro memory storage and retrieval; 6. Elaborating the signal from RCN and neuronal circuits in order to cope with plastic changes in pathological brain conditions such as amnesia and epilepsy. The long-term vision is that hybrid neuromorphic photonic networks will (a) clarify the way brain thinks, (b) compute beyond von Neumann, and (c) control and supplement specific neuronal functions. This project has a strong interdisciplinary content. We primarily address computing, photonics, electronics and photonics integrated circuits, photonic applications to biology and networks. However, we do also address the issue of interfacing neurons with condensed matter by using light, which is a topic peculiar to biophysics. In this research, we will develop photonic circuits that provide the light signal to genetically modified neurons in order to control their activity. Moreover, our intention is to use light in order to both strengthen synapses along specific light circuits and to restore or induce specific neuron interconnections, to achieve specific neuronal functions. BACKUP results will be applied to predict and control the mechanisms behind complex neurological diseases as amnesia and epilepsy.