“Quasi-Instantaneous online trigger based on optical neural network”

D. Sanvitto[1], G. Chiodini[2], V. Ardizzone[1], D. Bachas[2,3], D. Ballarini[1], A.P. Caricato[2,3], A. Lanotte[1,2], G. Marsella[2,3], M. Martino[2,3], S. Spagnolo[2,3], G. Cataldi[2], E.J. Schioppa[2,3], G. Gigli[1,3] and D. Martello[2,3]

[1]CNRNANOTEC, Institute of Nanotechnology, Via Monteroni 73100 Lecce, Italy

[2]INFN, National Institute of Nuclear Physics – Lecce Unit- Via Arnesano 73100 Lecce, Italy

[3]Department of Mathematics and Physics “E. De Giorgi”, University of Salento 73100 Lecce, Italy

Abstract

The trend in particle physics experiment is to move the off-line analysis to real-time analysis and even to first-level trigger. The most powerful approach would be an hardware implement of machine learning techniques. Nowadays, this goal is limited by the computing power, power consumption and processing speed of traditional computing elements.

A novel approach is to use a neural network based on highly-nonlinear optical nodes to implement in real-time the necessary first-level trigger algorithms. Here we propose to develop an hardware implementation of machine learning techniques for nuclear physics experiments based on a lattices
of exciton-polariton condensates which already proved to be able to out perform any previous hardware implementation. In fact, one of the proponent (D. Sanvitto, Nanotec Lecce, ERC winner) already realized a physical neural network based on exciton-polariton condensates able to perform data processing in a much faster and energy-efficient way than the state-of-the-art technology.

The success of this program will have a strong impact not only for experiment at the energy frontier and intensity frontier but also to the cosmic frontier.