# An "Artificial Retina" Processor for Track Reconstruction

Riccardo Cenci

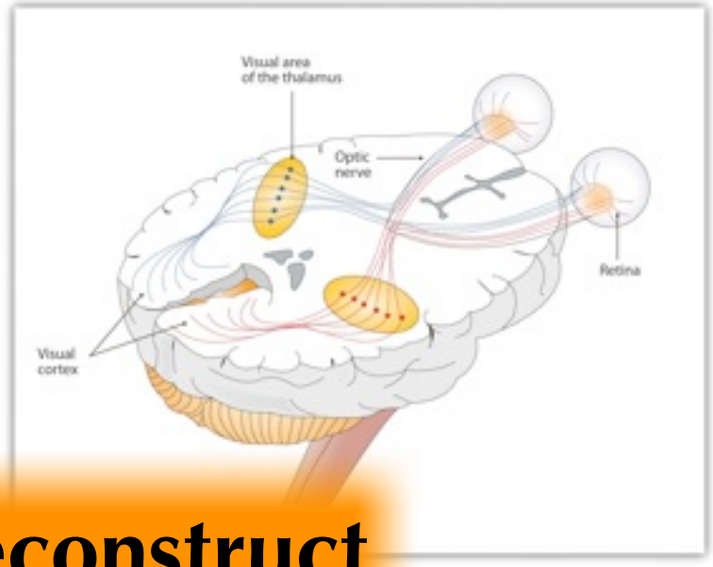
SCUOLA NORMALE SUPERIORE

INFN Istituto Nazionale di Fisica Nucleare

**Problem: trigger efficiently hadronic events at very high luminosity (>$10^{34}$ $cm^{-2}s^{-1}$)**

## The "Artificial Retina" algorithm

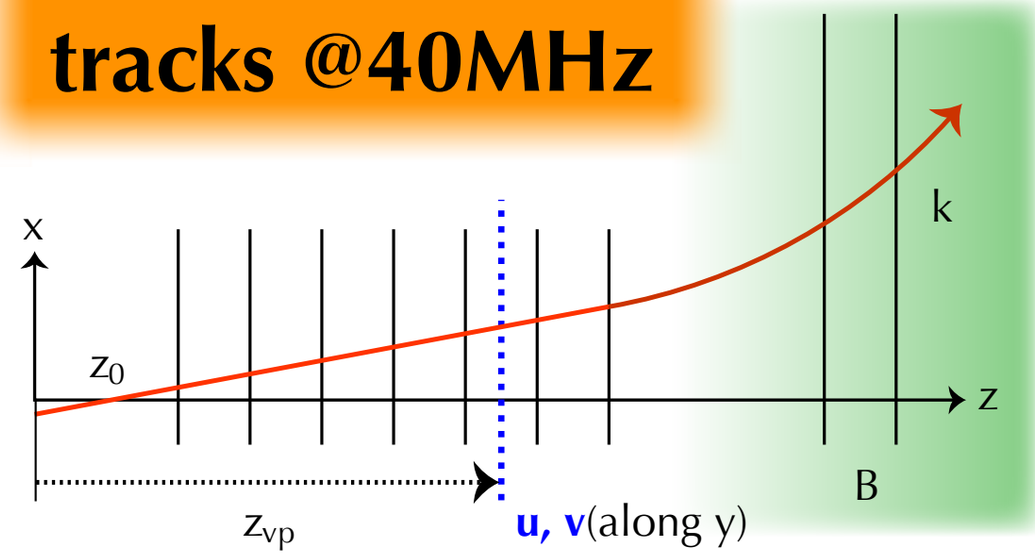
- **Highly-parallel** algorithm inspired to quick detection of edges in mammals visual cortex
- **Continuous response** with limited number of pre-calculated patterns, which allows a coarser grid mapping of parameters
- Reconstruction of charged-particle trajectories (tracks) at LHC collisions frequency with **few μs latency**, which allows to trigger hadronic events




**Goal: reconstruct tracks @40MHz**

## Study for a real-detector application

- Forward spectrometer, **pixel silicon tracker** with fringe magnetic field
- To be implemented in few tenths of common FPGA's, less than 150 clock cycles per event
- **Reconstruction performances equal to offline algorithms**



# An "Artificial Retina" Processor for Track Reconstruction

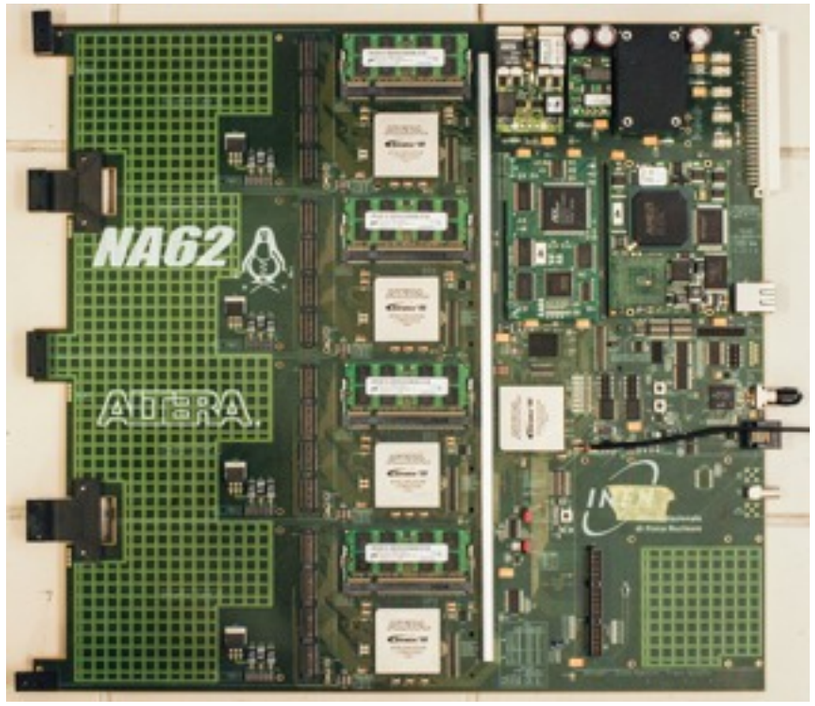
Riccardo Cenci

SCUOLA NORMALE SUPERIORE

INFN Istituto Nazionale di Fisica Nucleare

## First prototype (goal: minimum event rate 1 MHz)

- Simplified tracker with 6 single-coordinate layers (x silicon strips)
- Implemented on **Altera Stratix III** FPGA using the **Tel62** board developed by INFN for NA62
- The system fits on **one crate** (8 boards, 32 FPGA's)
- **More than half of the system has been already designed, simulated and it is running on the real board with an event rate larger than 1 MHz**




**Results shown in the poster have been achieved by "*Retina*", a 3-year project funded by INFN, Division of technological research experiments (CNS5)**

*Participants*: A. Abba[4,6], F. Bedeschi, F. Caponio[4,6], R. Cenci[1,3], M. Citterio[4], A. Cusimano[4,6], J. Fu[4], A. Geraci[5], M. Grizzuti[4,6], N. Lusardi[4,6], P. Marino[1,3], M. J. Morello[1,3], N. Neri[4], D. Ninci[1,2], M. Petruzzo[4,5], A. Piucci[1,2], G. Punzi[1,2], L. Ristori[7], F. Spinella[1], S. Stracka[1,3], D. Tonelli[8], J. Walsh[1]

[1]INFN Pisa, [2]Università di Pisa, [3]Scuola Normale Superiore di Pisa,
[4]INFN Milano, [5]Università di Milano, [6]Politecnico di Milano, [7]Fermilab, [8]CERN