Real time tracking with a silicon telescope prototype using the “artificial retina” algorithm

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Overview:

- The first prototype of a tracking system with “artificial retina” is presented
- Highly parallelized and pipelined architecture, implemented on commercial FPGAs (Xilinx Kintex 7)
- Real time track reconstruction with offline-like quality and sub-μs latencies
- Modular system: can be designed to work at 40MHz LHC rate

Retina Algorithm:

- Inspired from neurobiological mechanism of edge recognition in visual cortex
- A pool of “cellular units” compares the hits from telescope different track hypotheses in parallel

![Cellular units covering the tracking region](image)

Higher “Weight function” for better matching tracks

Best matching track

Tracks are identified by local maxima of the “Weight function”
- Custom DAQ board based on Xilinx Kintex 7
  FPGA → MAMBA (“Most Advanced Multi Beetle Acquisition”) board
- ADC, Zero suppression and hits clustering
- **On-board Retina Algorithm**
- MAMBA board and telescope designed and produced in Milano

- 2D tracking telescope
- 8 single-sided silicon strip sensors:
  - \(~10\times10\text{cm}^2\) active area
  - \(183\mu\text{m}\) pitch,
  - \(500\mu\text{m}\) thickness

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**Results and future plans**

- Artificial retina algorithm implemented on custom DAQ+Retina boards, equipped with commercial FPGAs (Xilinx Kintex 7)
- Retina architecture successfully tested up to 40 MHz track rate with FPGA simulation
- Real time track reconstruction with offline-like quality and sub-µs latencies
- Full prototype functionalities to be tested on beam this summer

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