Track finding algorithms in emulsions of the OPERA experiment

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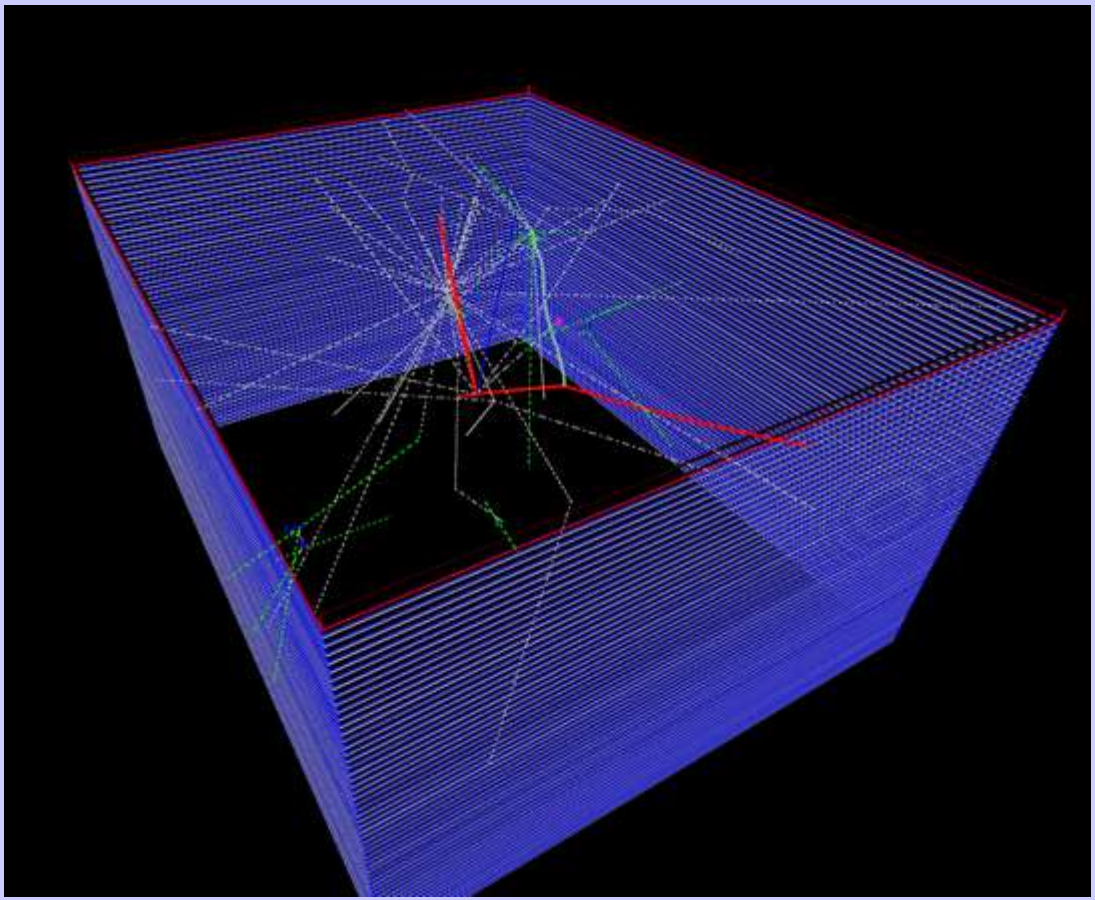
The OPERA experiment

- Experiment studies $\nu_\mu \rightarrow \nu_\tau$ oscillations
- The main goal of the experiment is to obtain Δm^2_{23}
- Appearance of tau neutrinos in the muon neutrino beam is to be measured
- Photo emulsion is used to study the neutrino interaction vertex and tracks

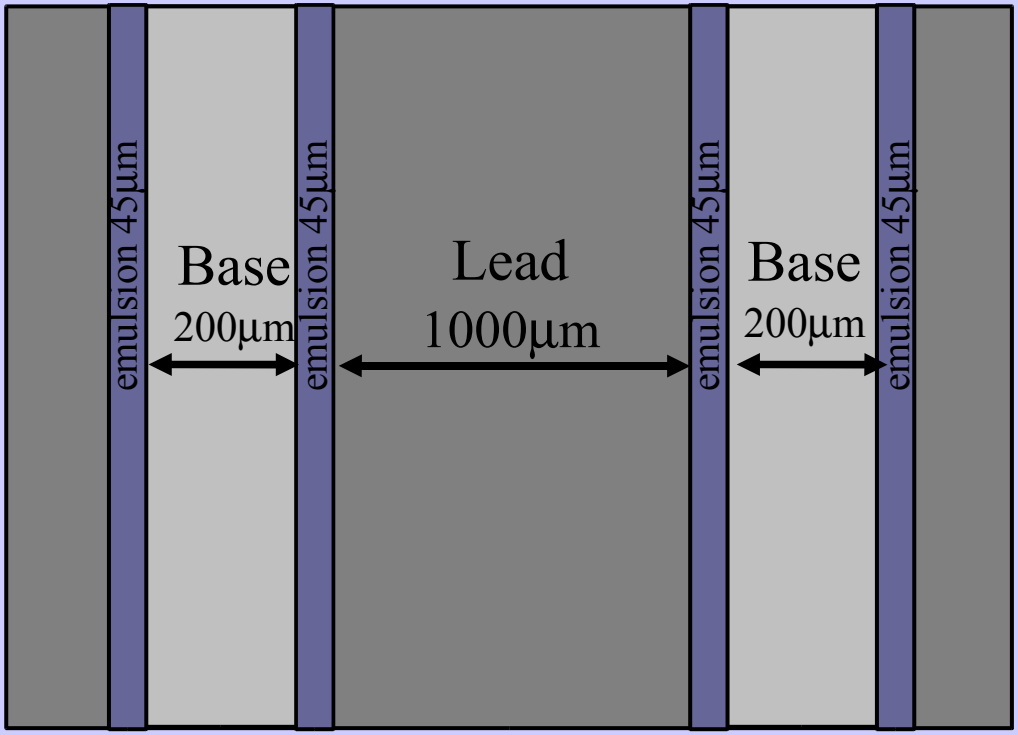


OPERA Brick

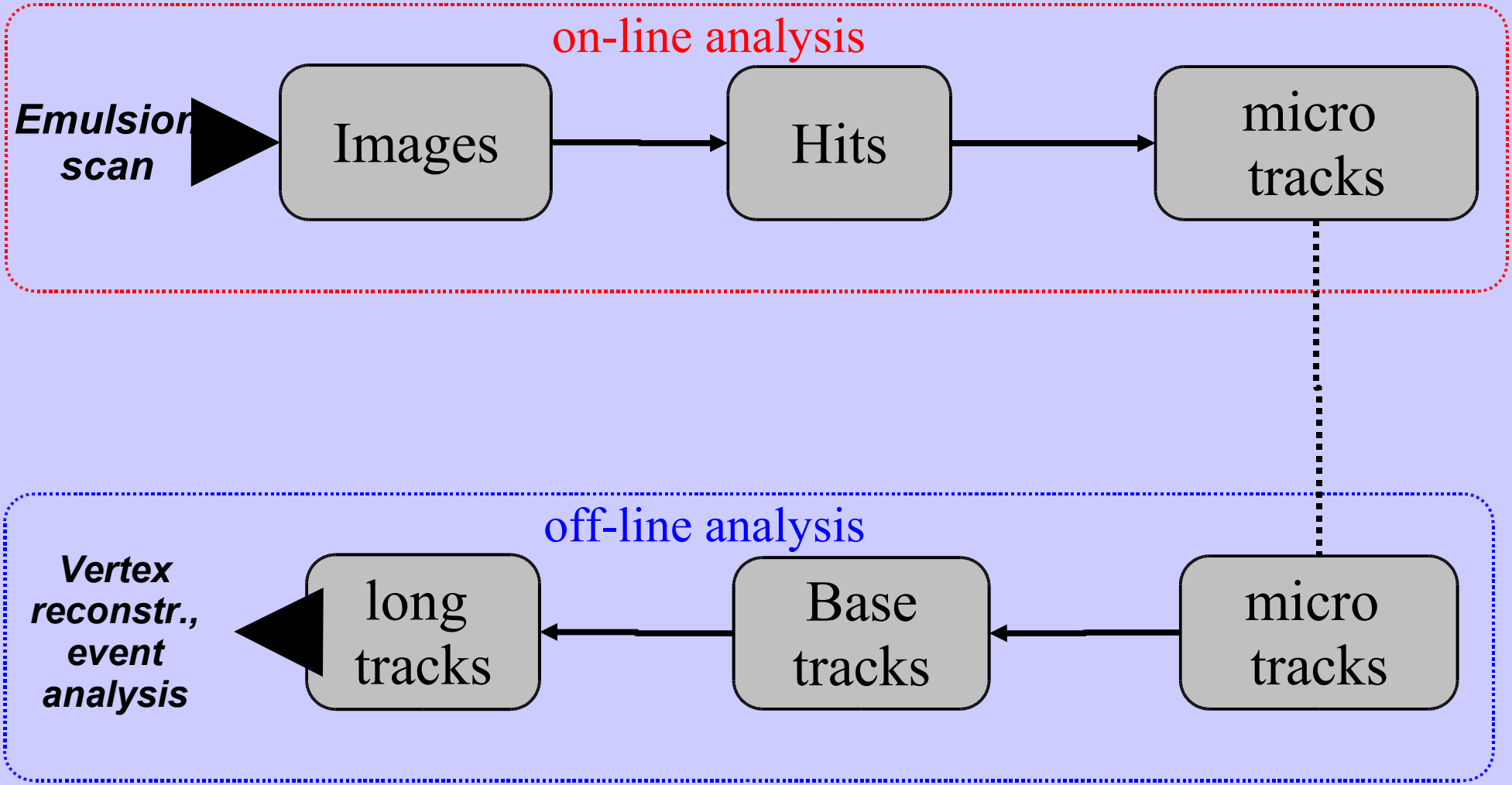
- The OPERA Brick: 102mm*127mm*75mm

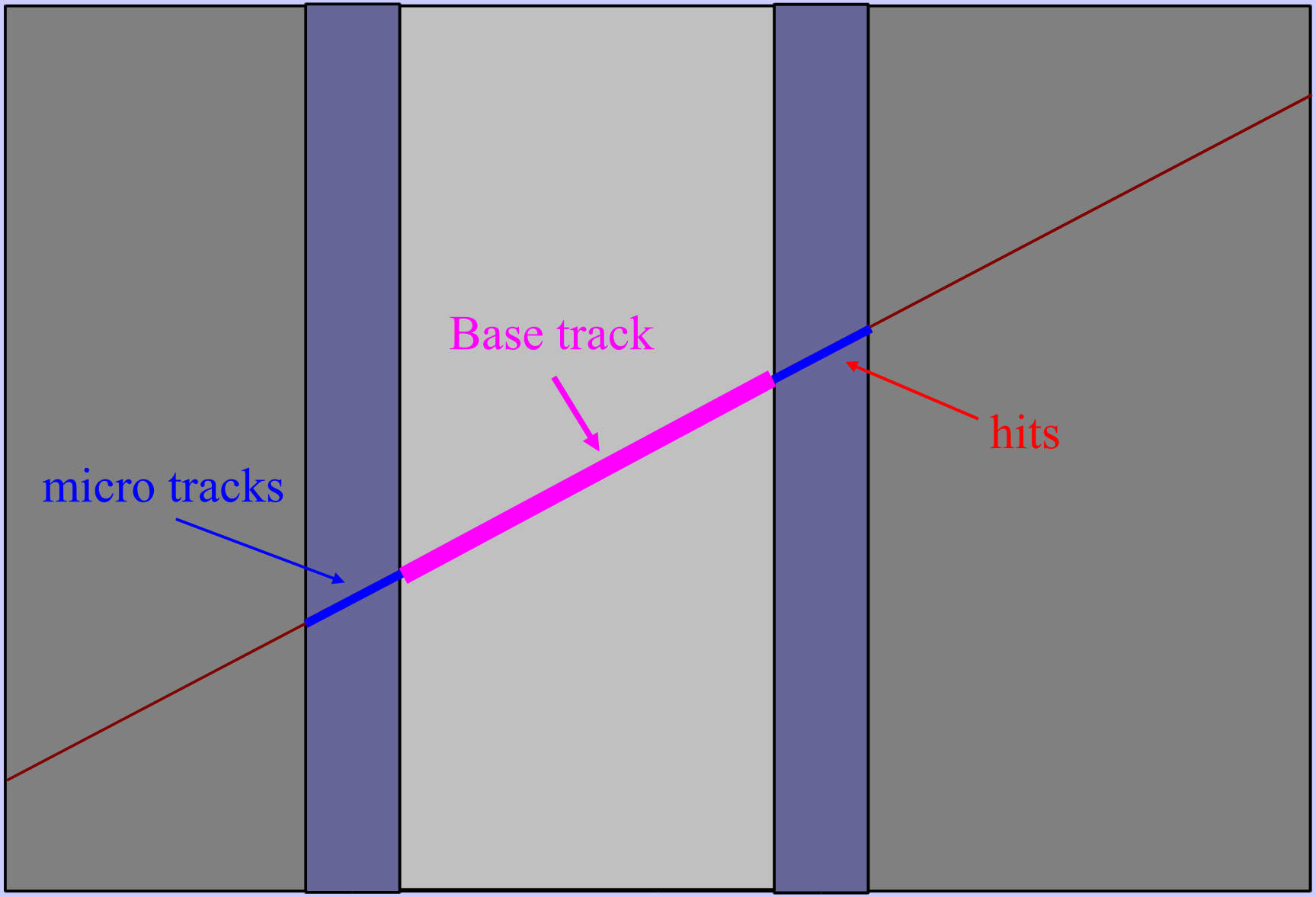
- It contains 56 plates with 2 emulsion layers each

- Each emulsion layer is scanned - 16 images

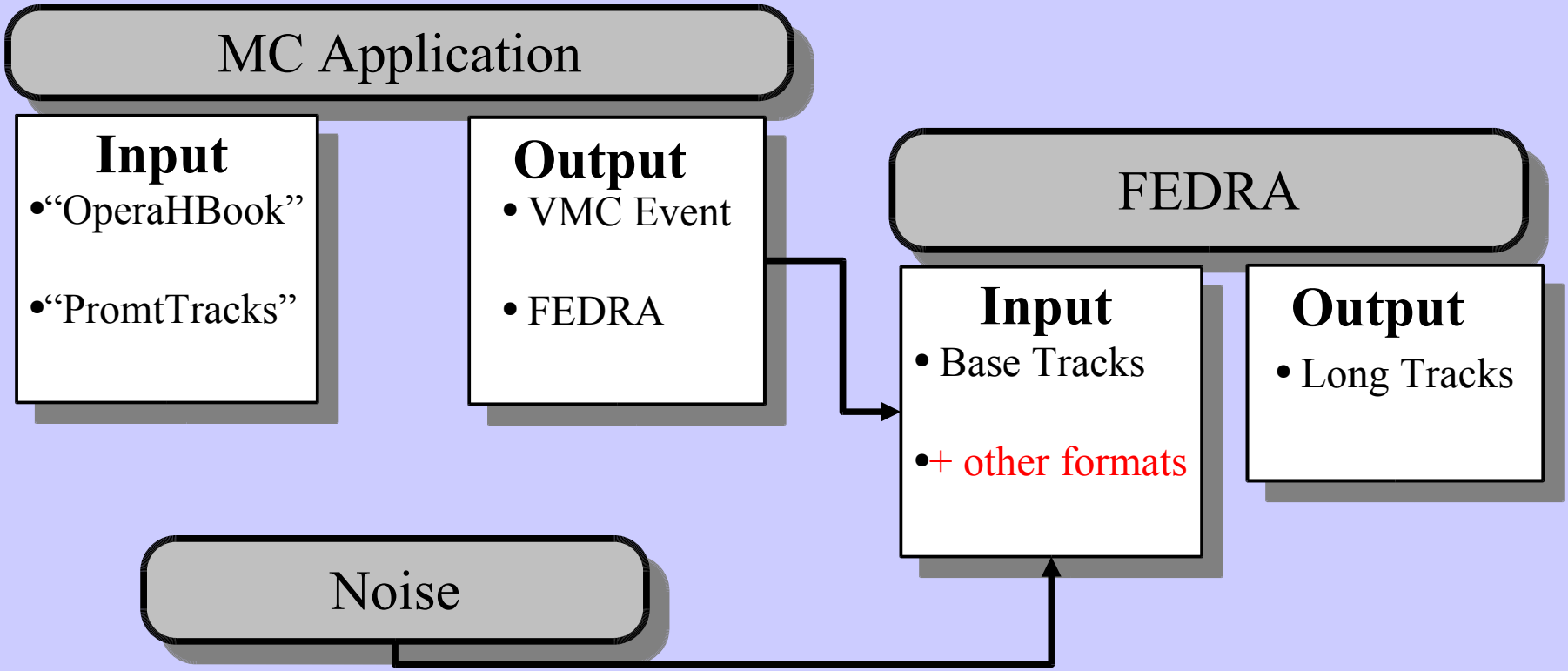


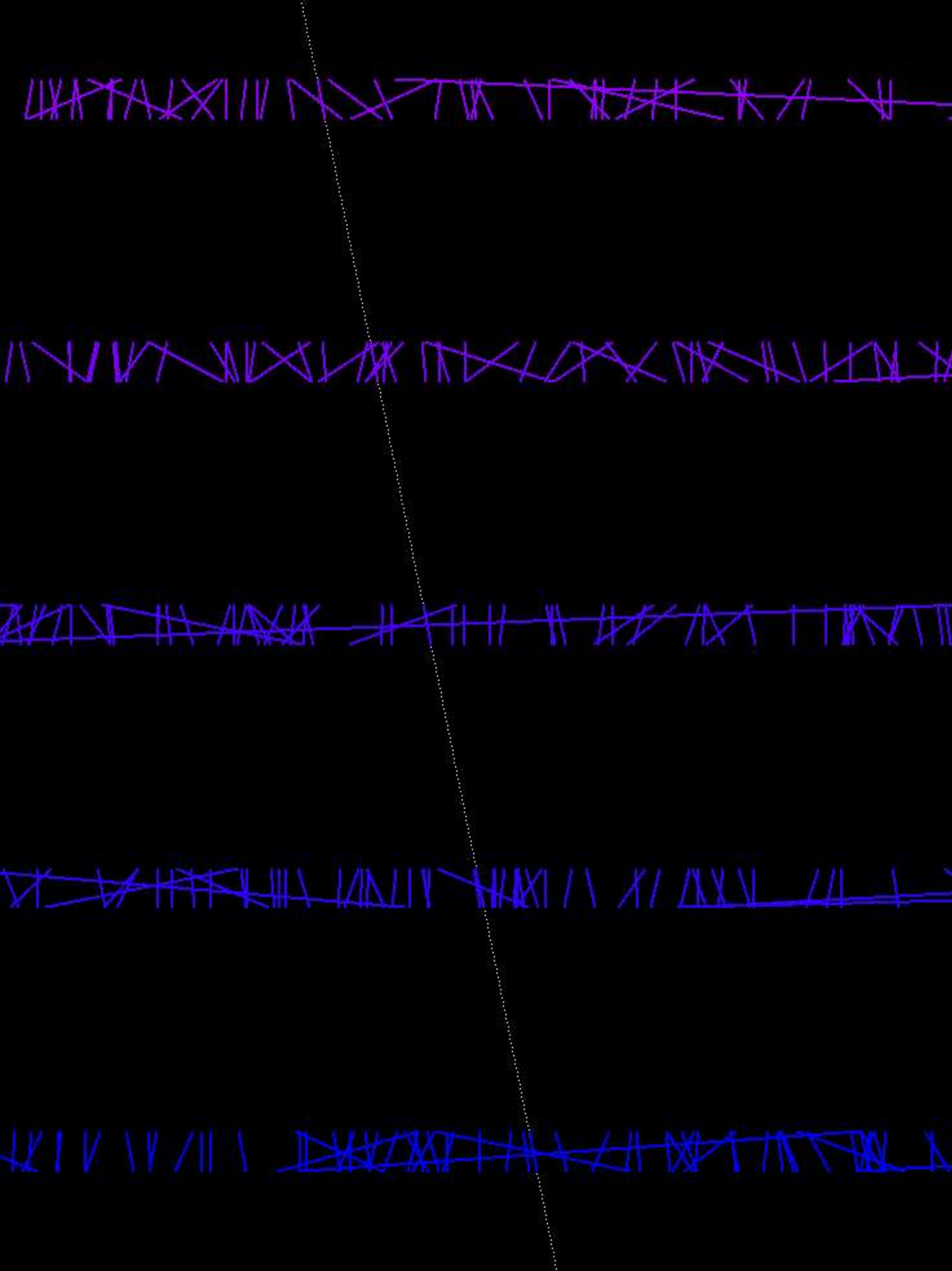
Emulsion analysis scheme

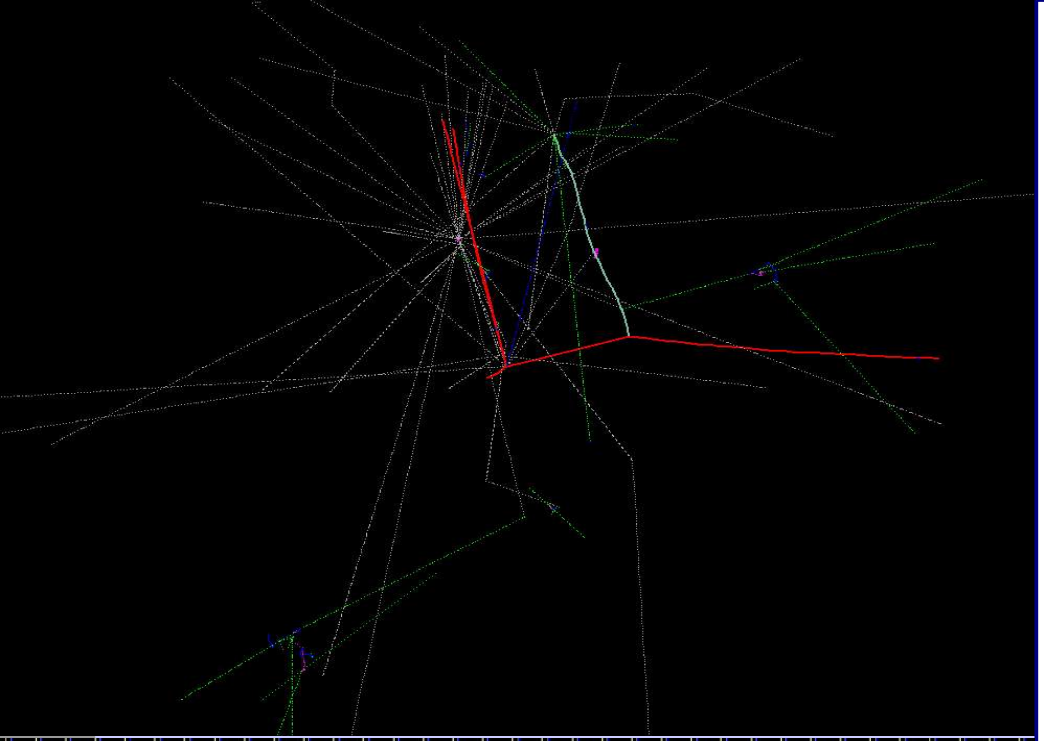
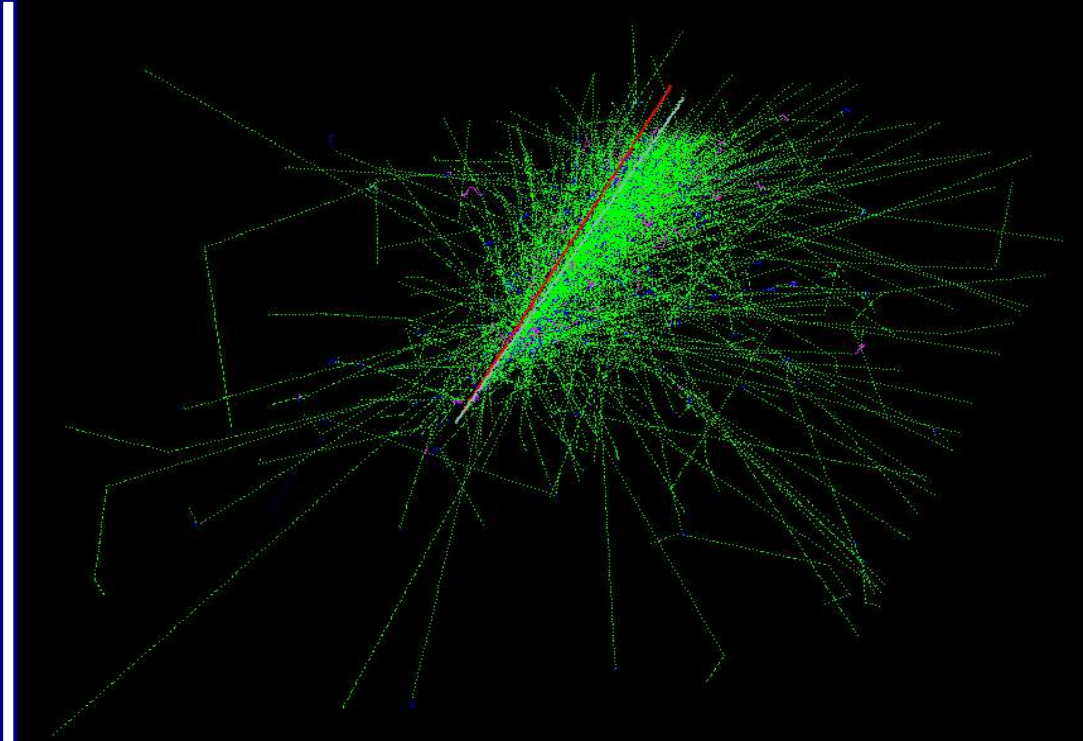
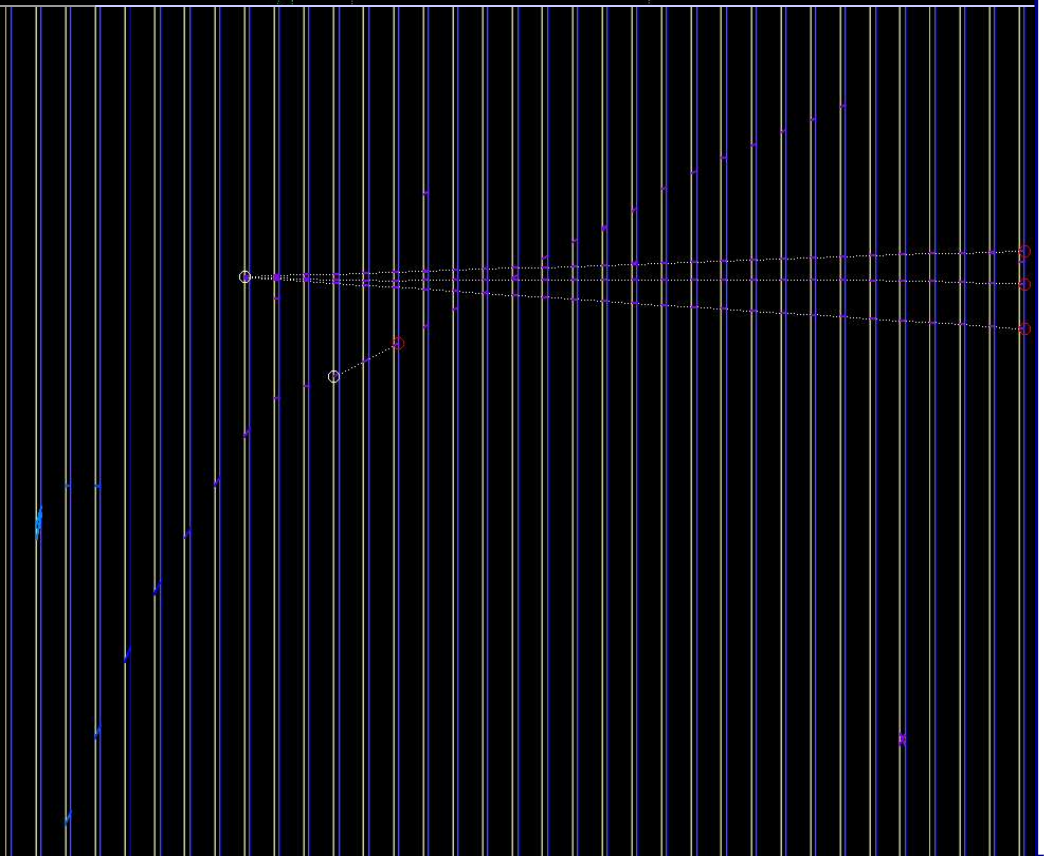
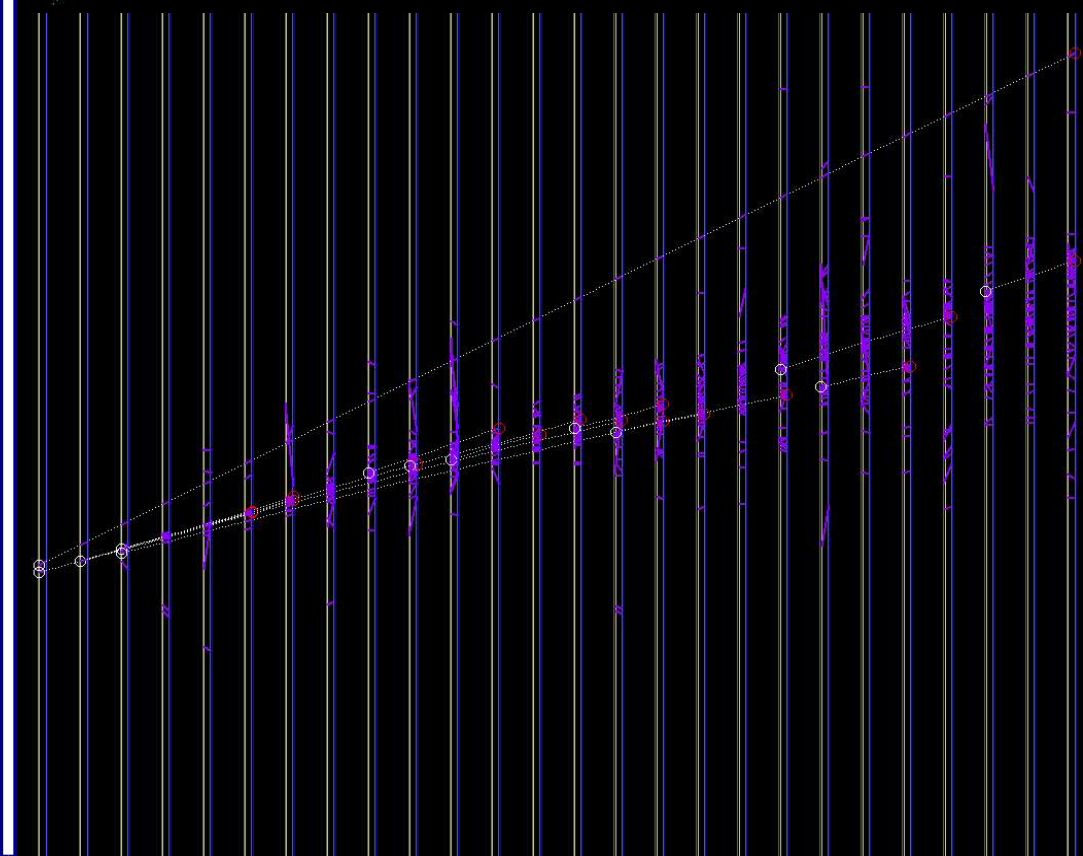



Base track
micro tracks
hits

Simulation scheme





Efficiencies definitions

We compute reconstruction efficiency for a chosen simulated track as:

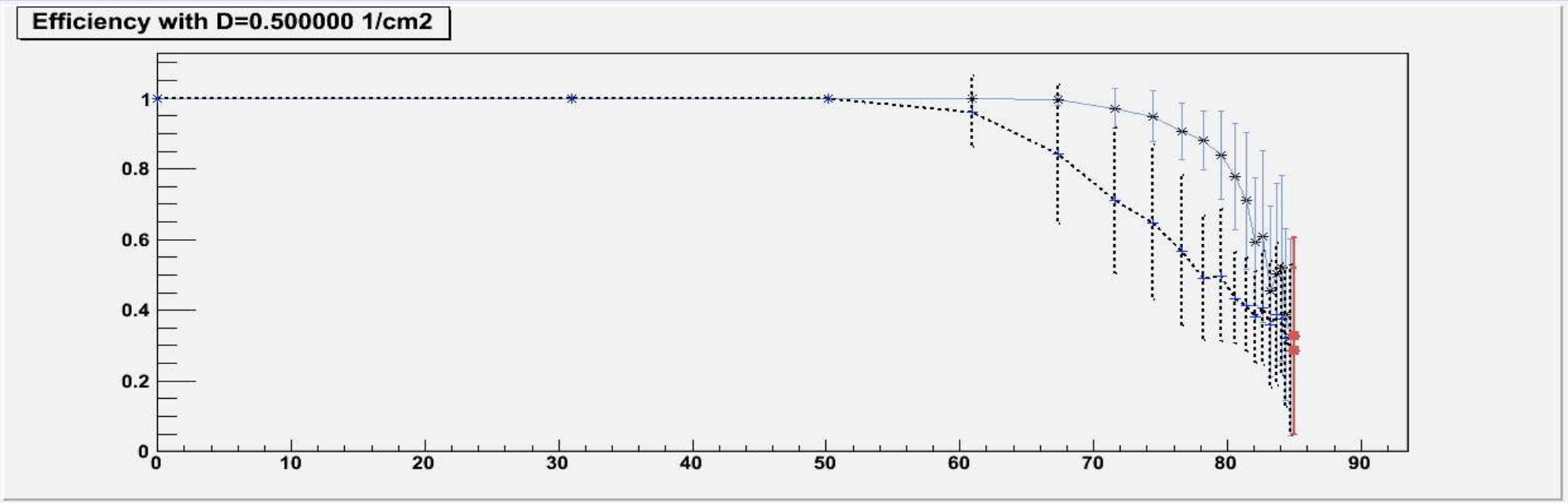
- Eff1=n1/**N,** where n1 is the number of simulated base segments associated to any reconstructed track.

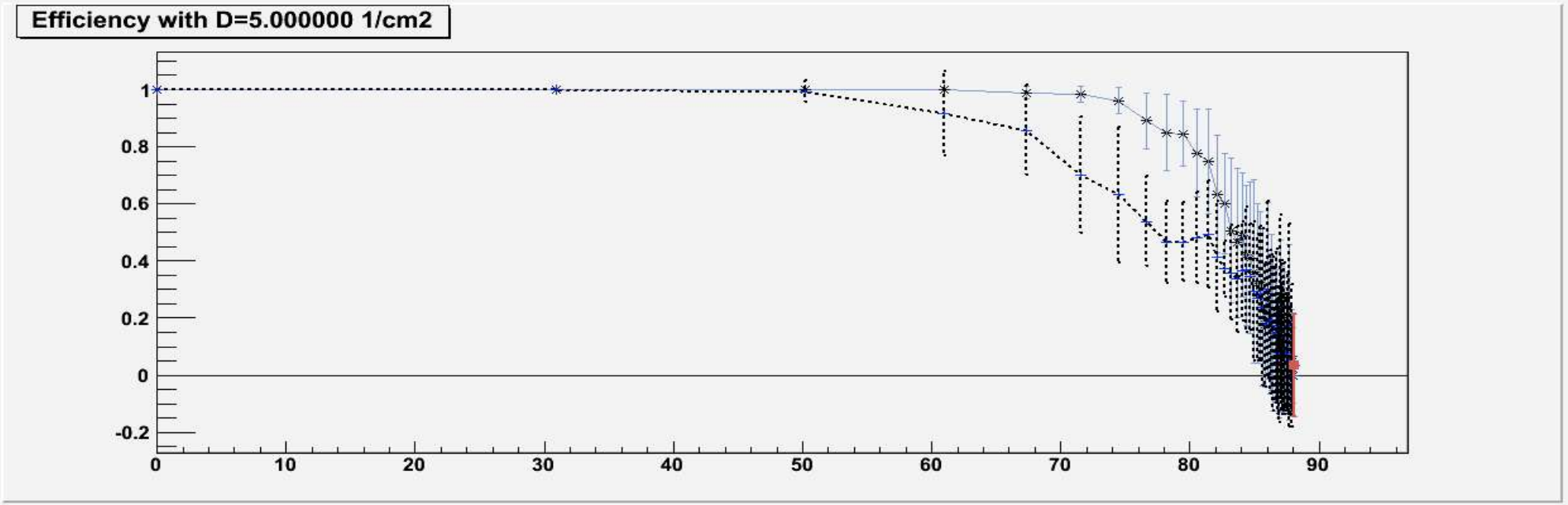
- Eff2=n2/**N**, where n2 is the maximal number of base segments which belong to the same reconstructed track.

N is the total number of simulated base segments.

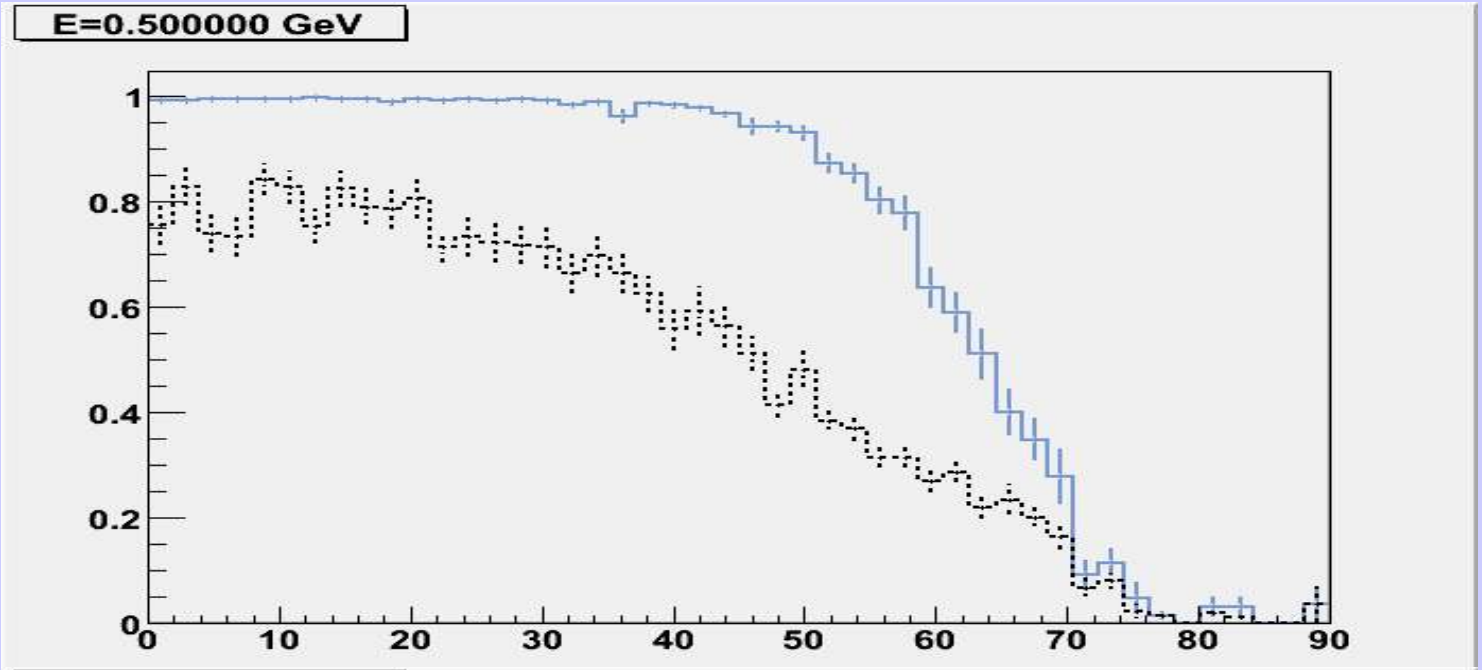
In this analysis we do not consider tracking accuracy

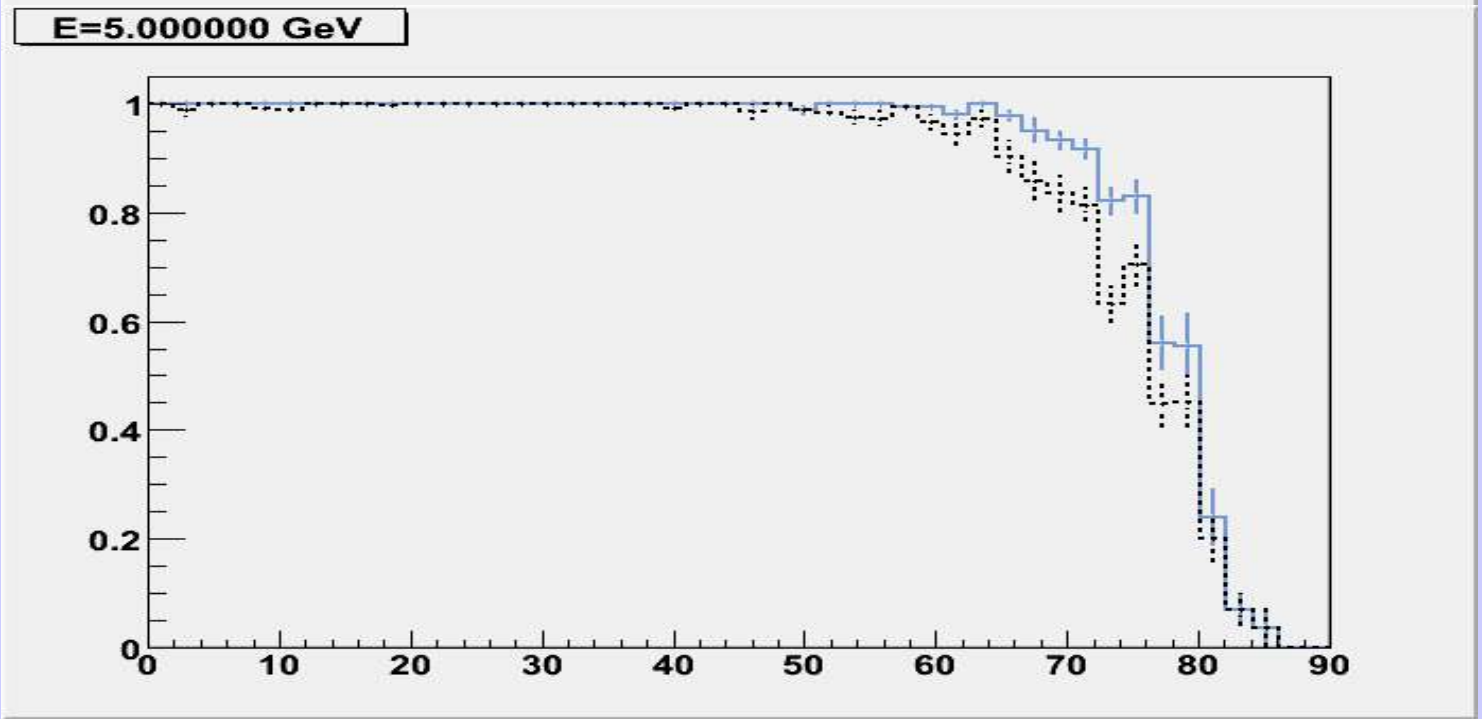
Effectiveness for FakeTracks





Effectiveness for muons





Further work

- Study FEDRA built-in reconstruction algorithms and define all relevant efficiencies (vs track length, noise level, energy, etc)

- Possible improvement of FEDRA algorithms

- Build end-to-end simulation-reconstruction-analysis chain and study OPERA sensitivity to neutrino mixing angle and mass squared difference.
    - study specific channels of tau decays (lepton + hadron [pion]) – part of my diploma work


THE END