Filtering/reducing combinations with a retina-based algorithm

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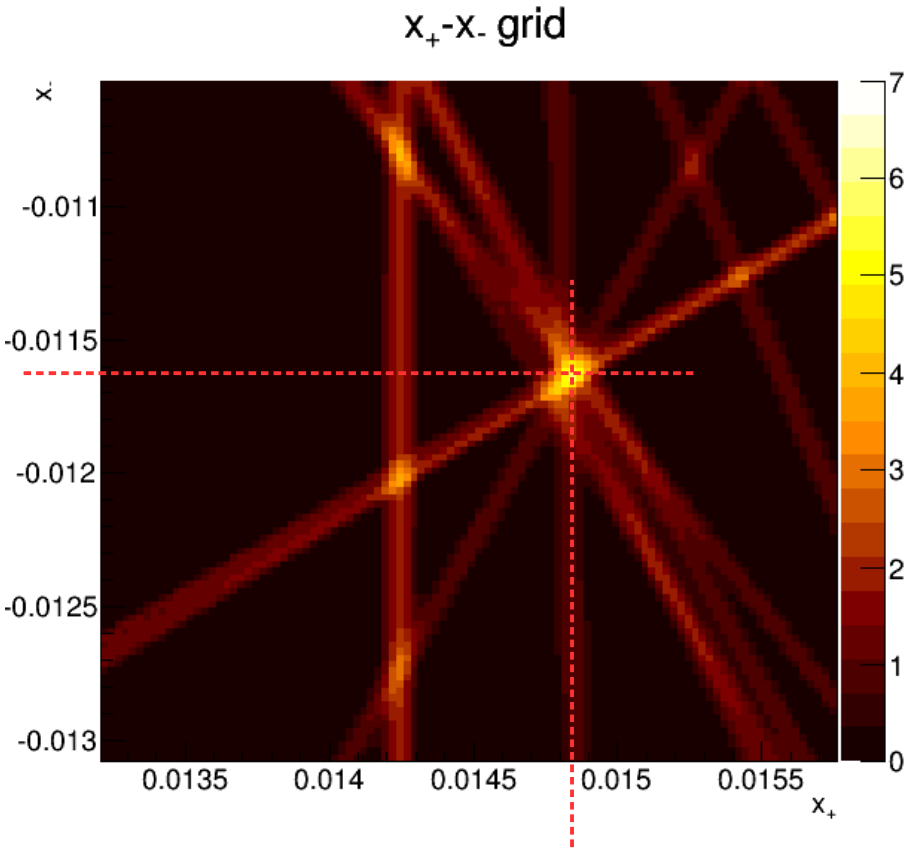
The principle

- One of the most powerful features of the retina algorithm is its ability to identify and use the stubs associated to a track:



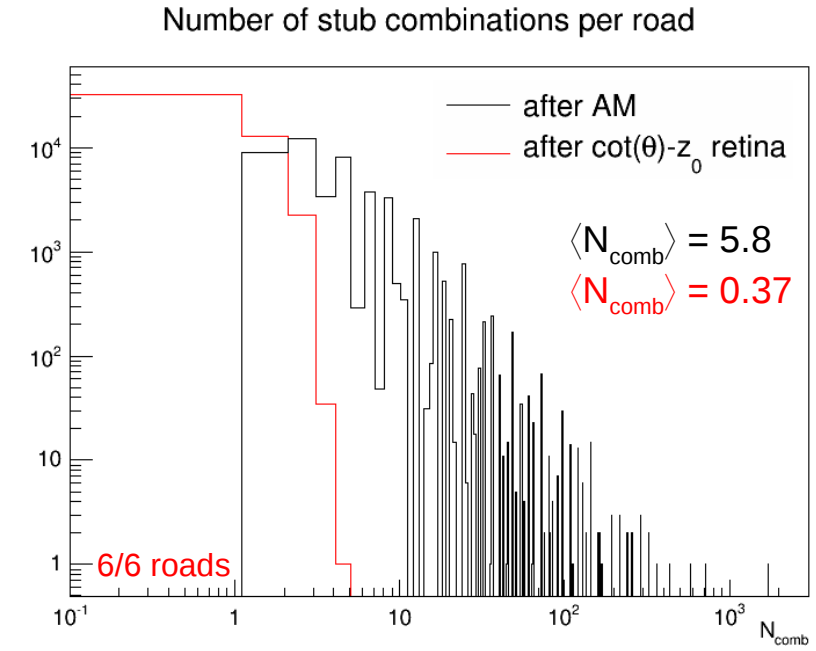
- in the track-parameter space stubs are represented by straight lines;
- lines corresponding to the stubs aligned along the tracking-particle trajectory cross at a point.

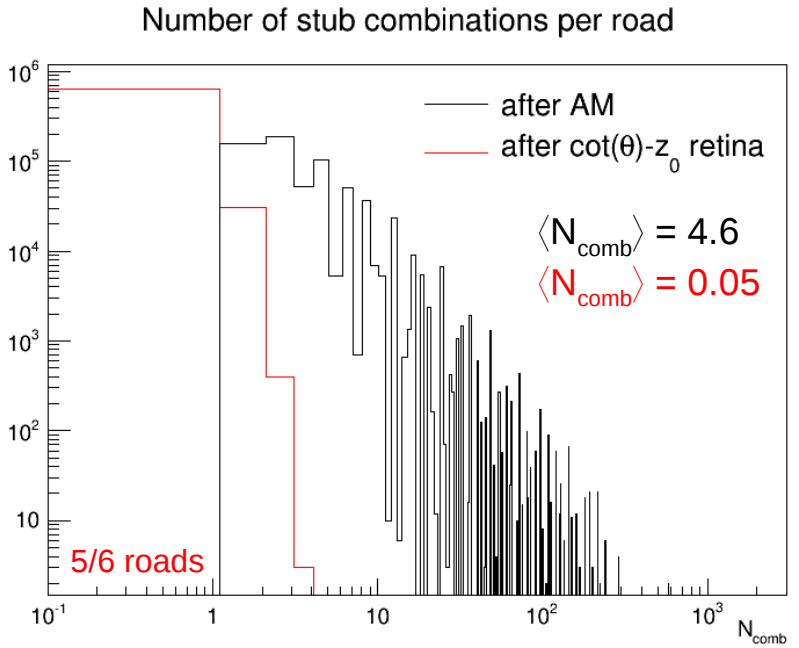
Current status

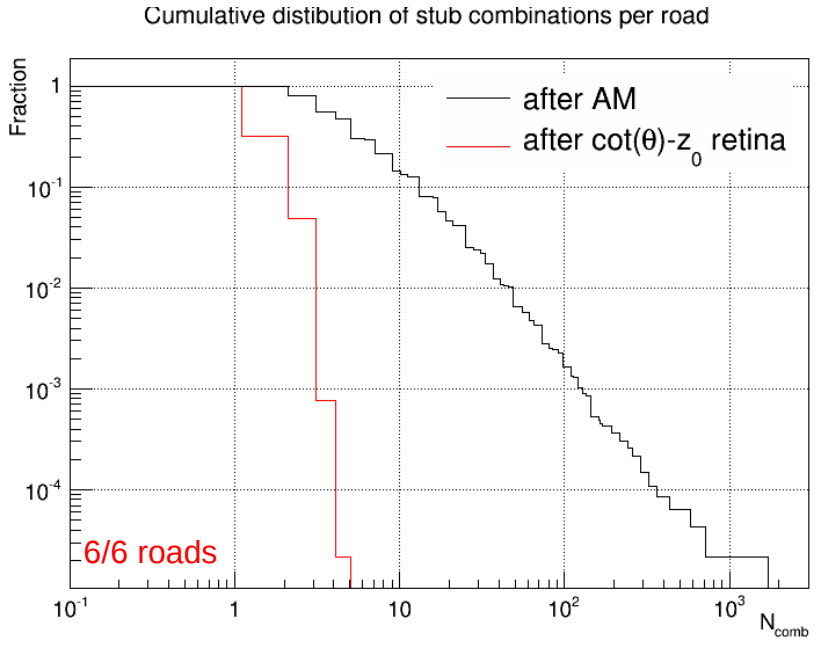
- This study is still at the level of floating-point C++ simulation.
- Lots of feedback and clever suggestions form Luciano Ristori.
- Using FNAL/UF ntuples:
  - fountain patterns: SF = 1, n_z = 1, p_T > 3 GeV/c;
  - single muon, single muon + PU140, minimum bias w/ PU140, and 4 top + PU140 samples;
  - only central tower 27.
- For each road:
  - build a 20x20 retina in cot(θ) – z_0 covering the whole tower phase space;
  - find maxima and associate stubs to maxima;
  - count stub combinations.

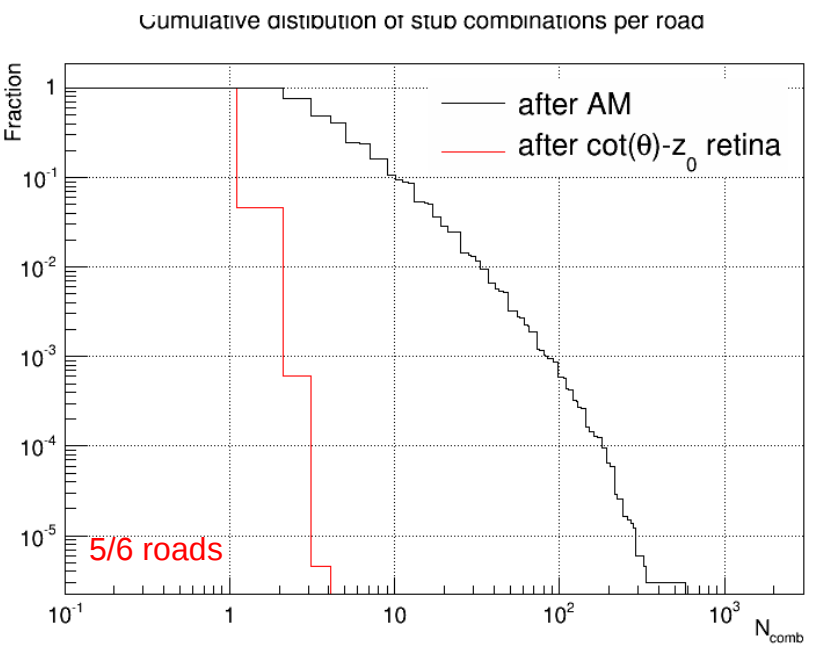
Number of stub combinations per road

Neutrino_PU140_tt27_sf1_nz1



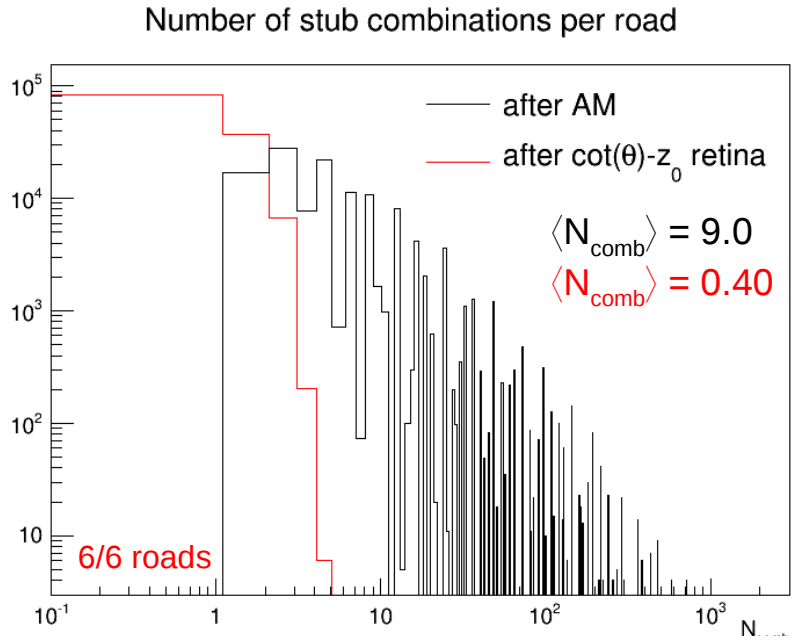


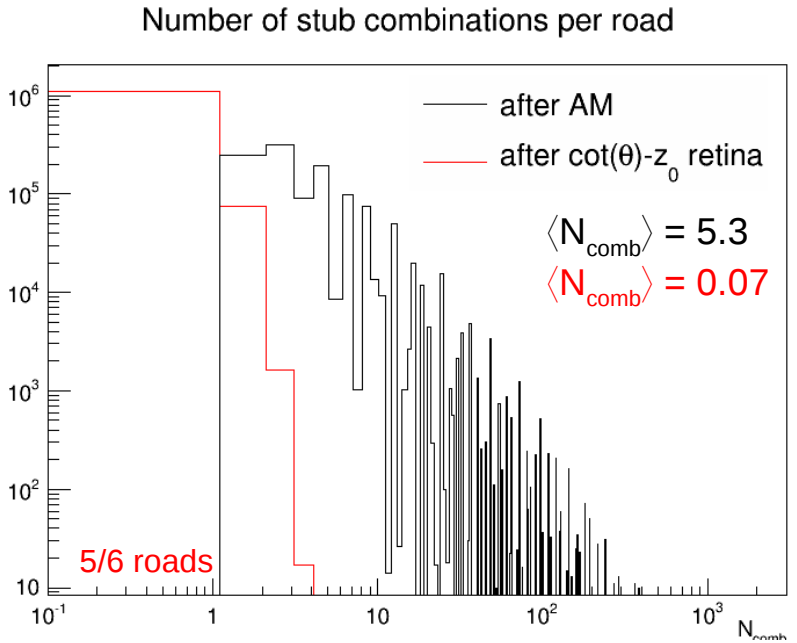


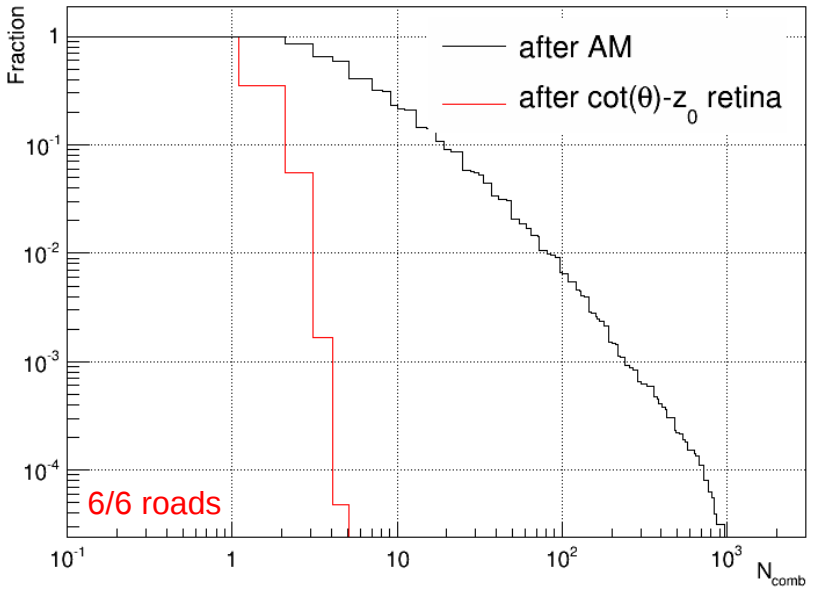


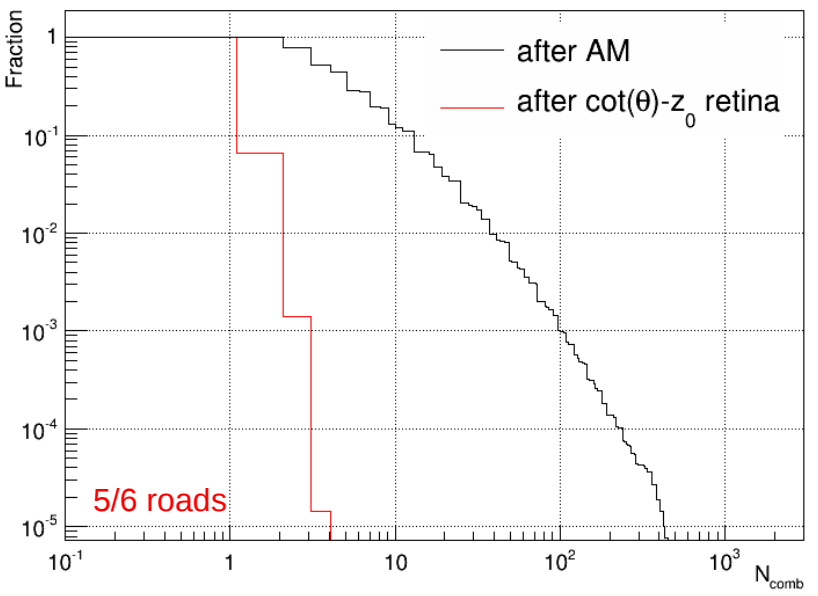
Number of stub combinations per road

TTbarTTbar_PU140_tt27_sf1_nz1



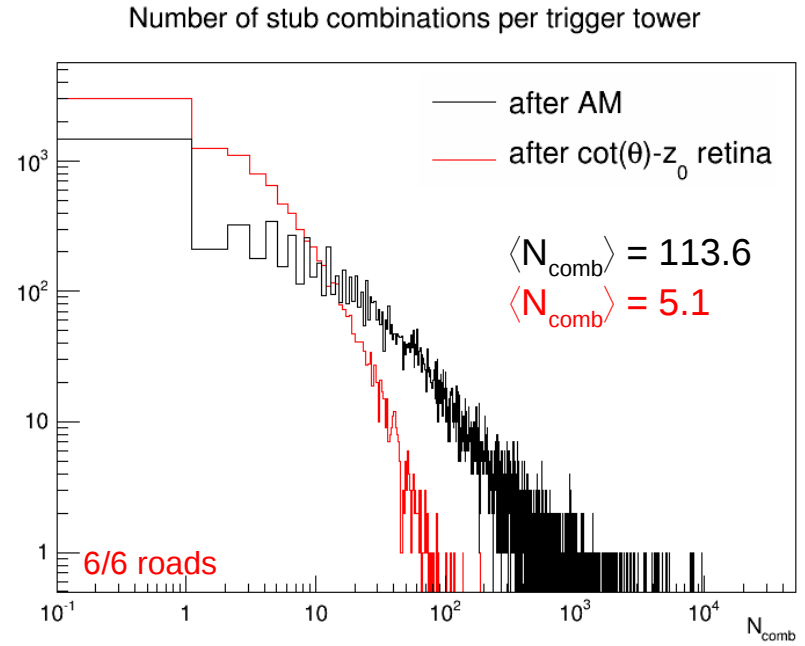


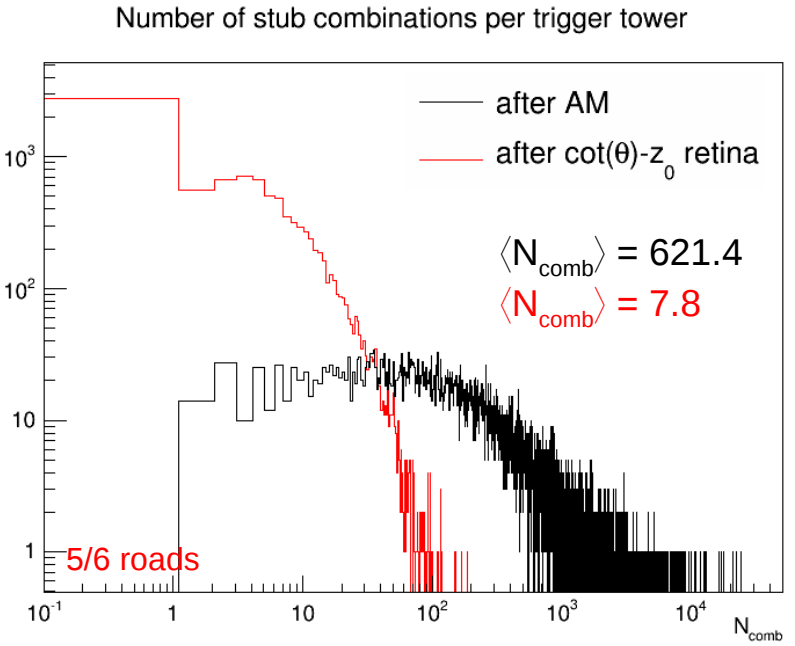


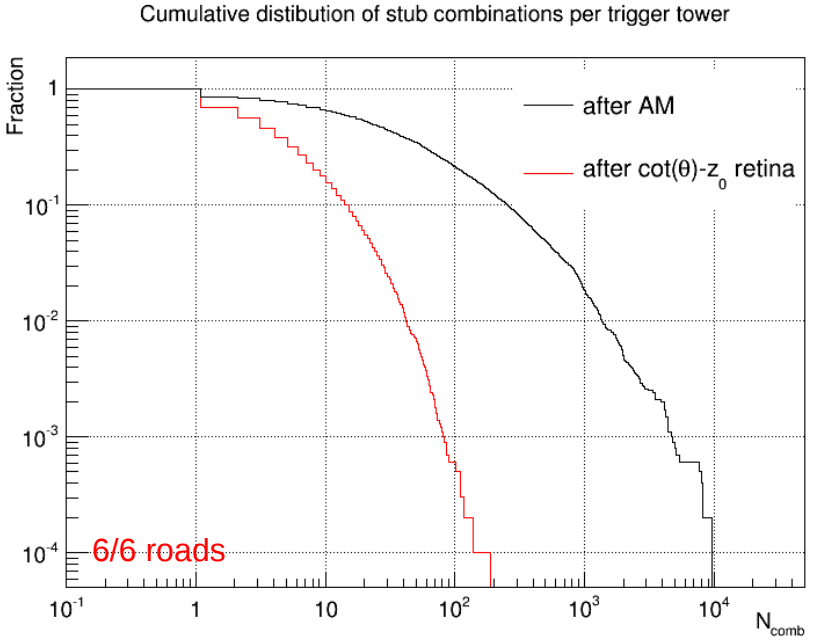


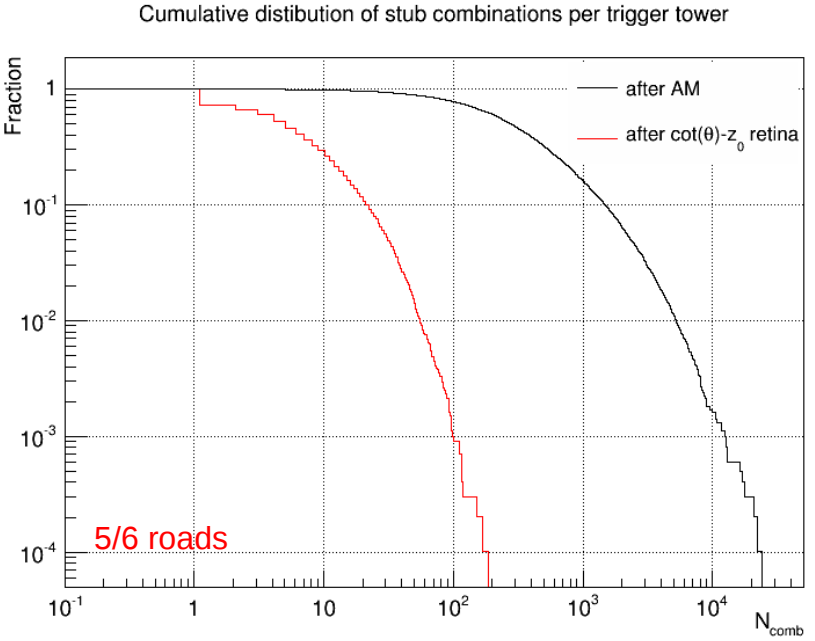
Stub combinations per trigger tower

TTbarTTbar_PU140_tt27_sf1_nz1









Retina filtering efficiency

- Efficiency defined as:

$$efficiency = \frac{number\ of\ true\ roads\ after\ the\ retina\ filter}{number\ of\ true\ roads}$$

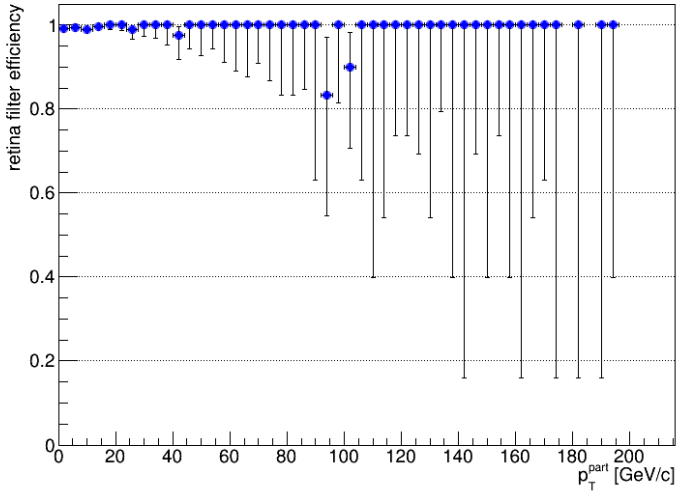
where

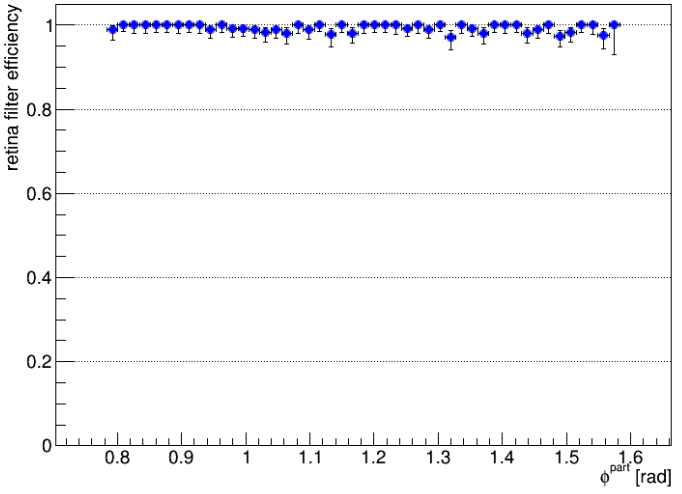
true roads = roads with at least 5 true stubs (stubs associated to the same tracking particle).

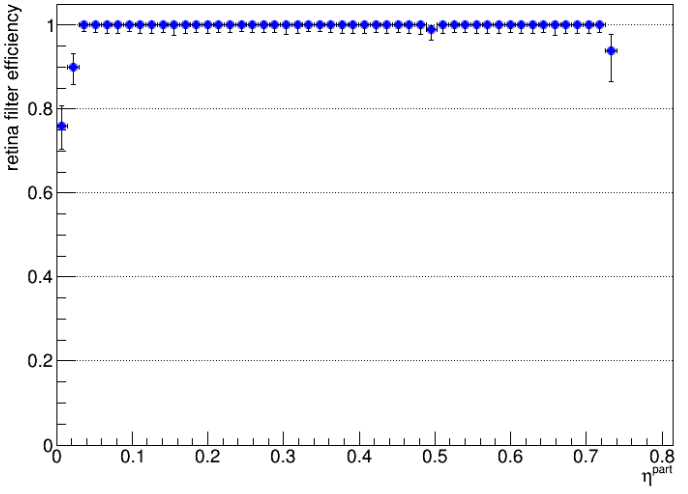
Retina filtering efficiency

SingleMuon_noPU_tt27_sf1_nz1

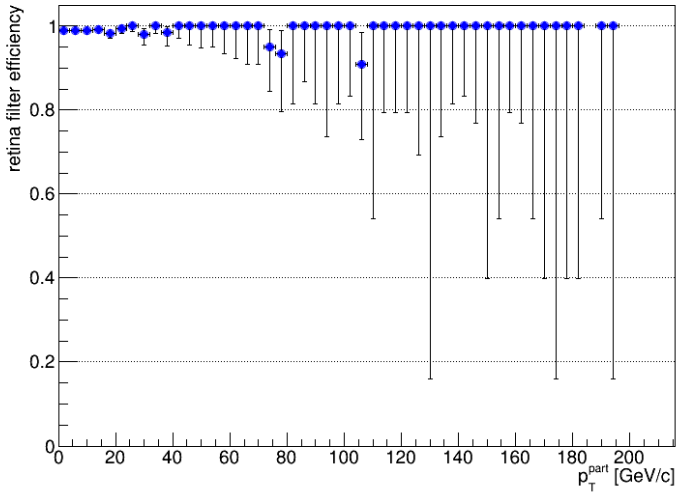
6/6 roads

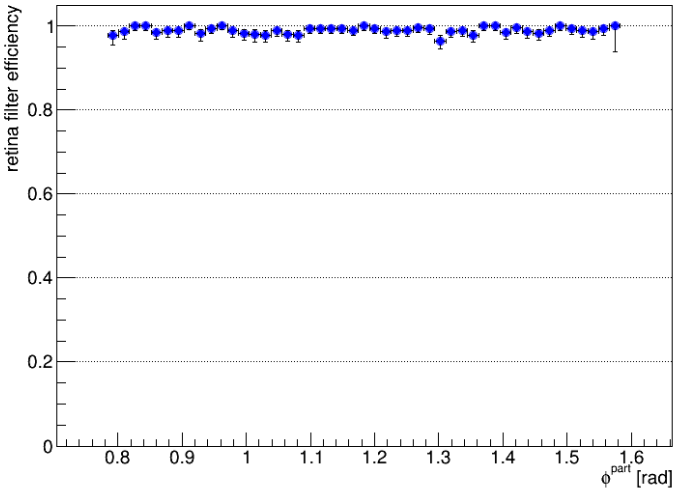


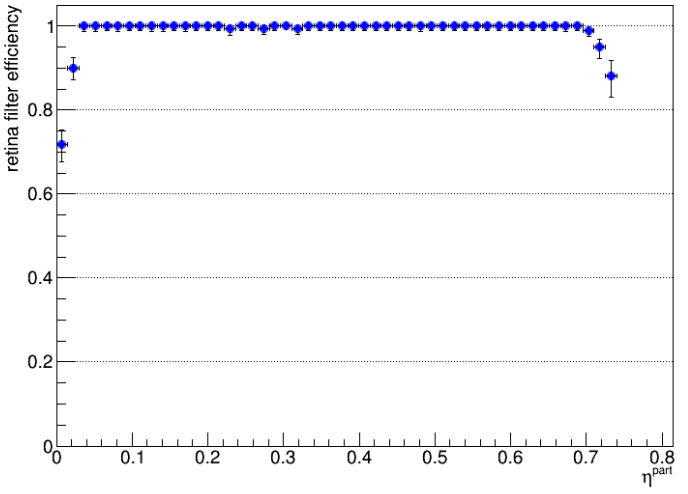




5/6 roads



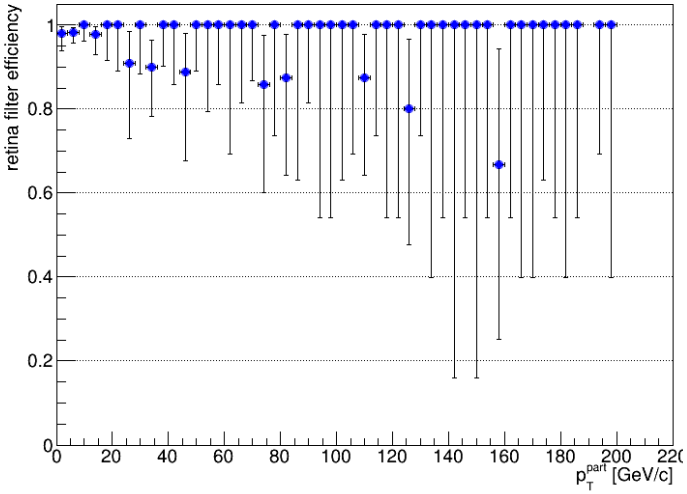


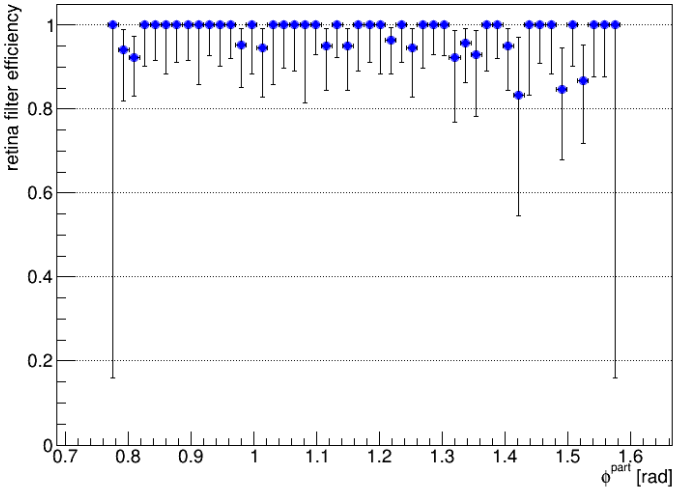


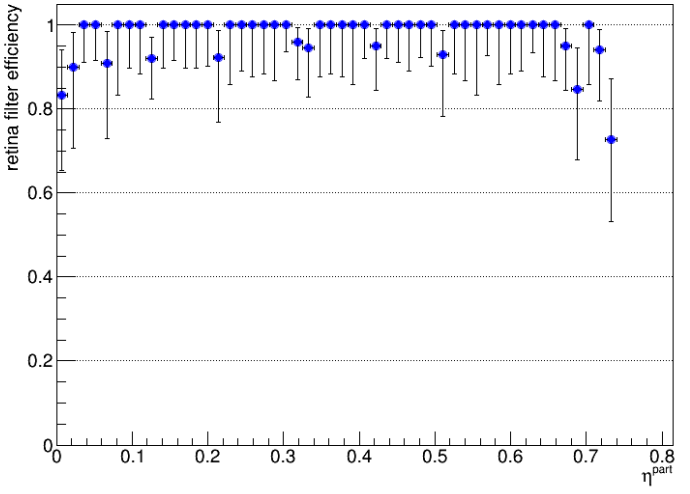
Retina filtering efficiency

SingleMuon_PU140_tt27_sf1_nz1

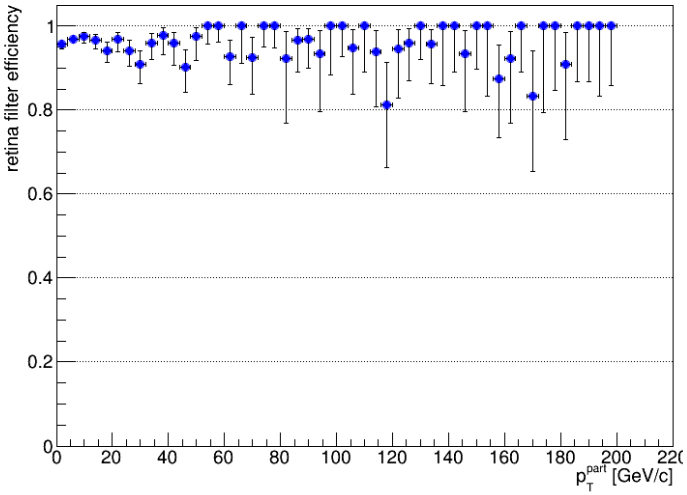
6/6 roads

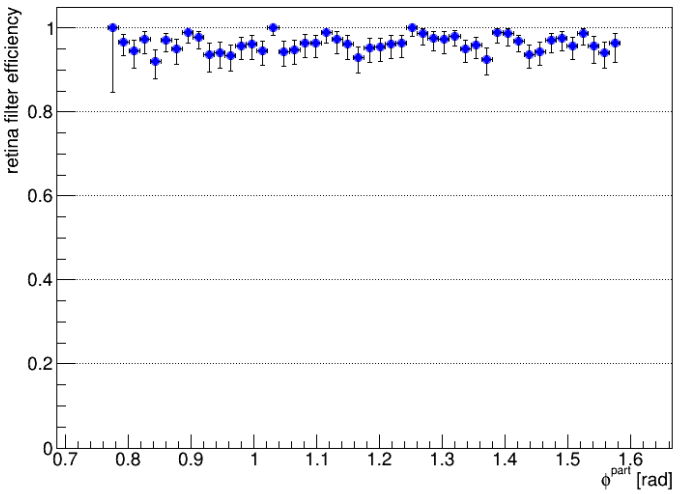


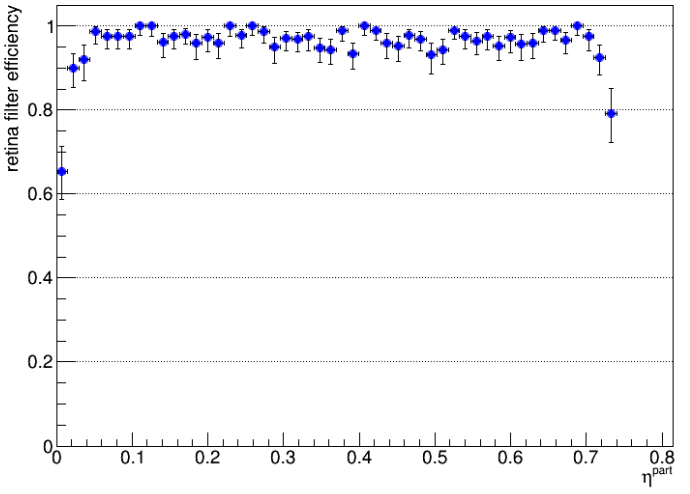




5/6 roads



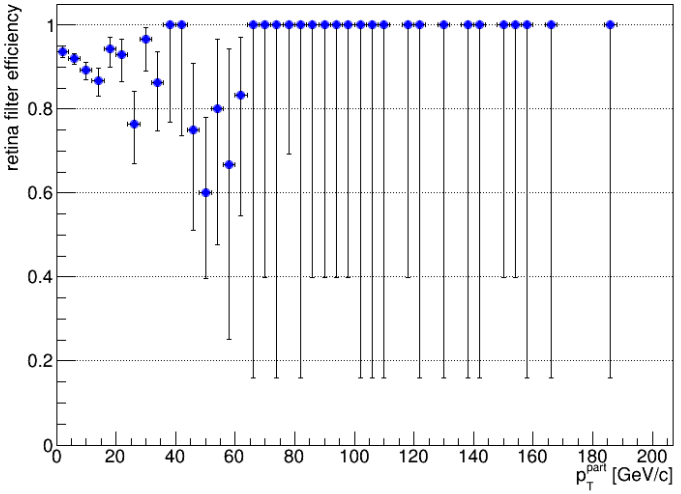


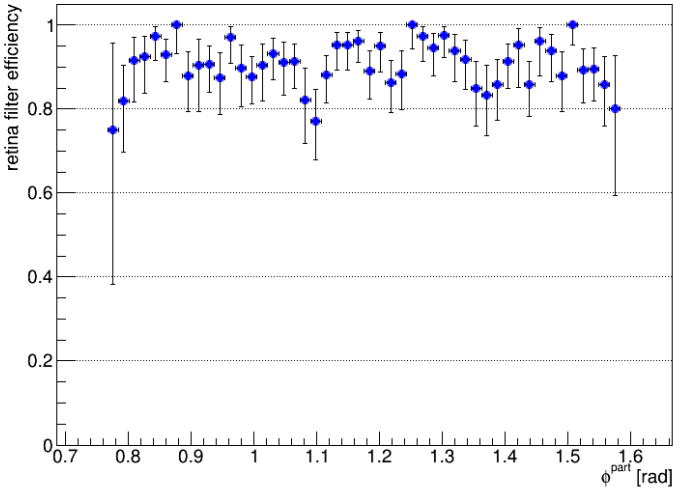


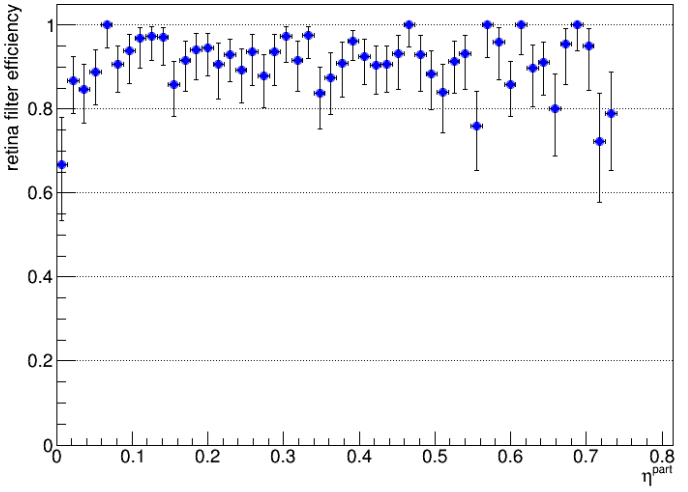
Retina filtering efficiency

TTbarTTbar_PU140_tt27_sf1_nz1

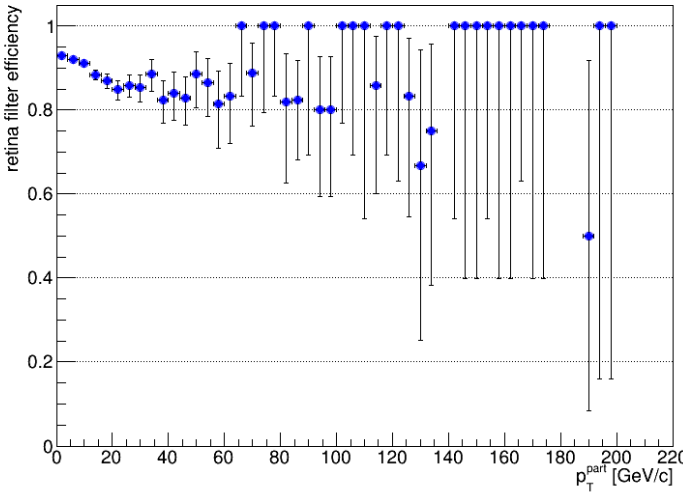
6/6 roads

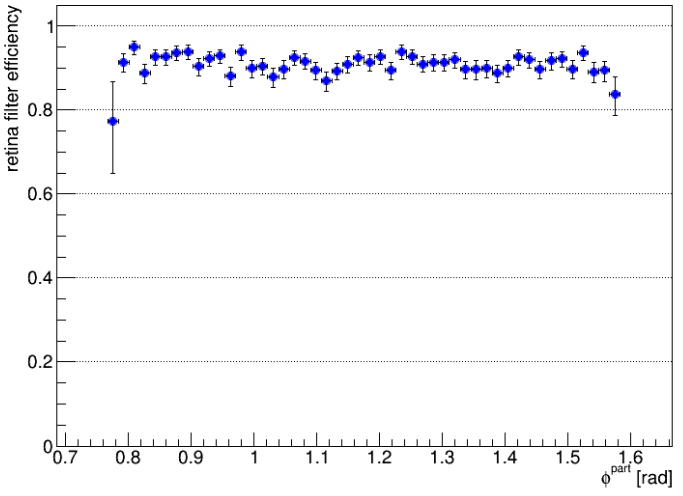


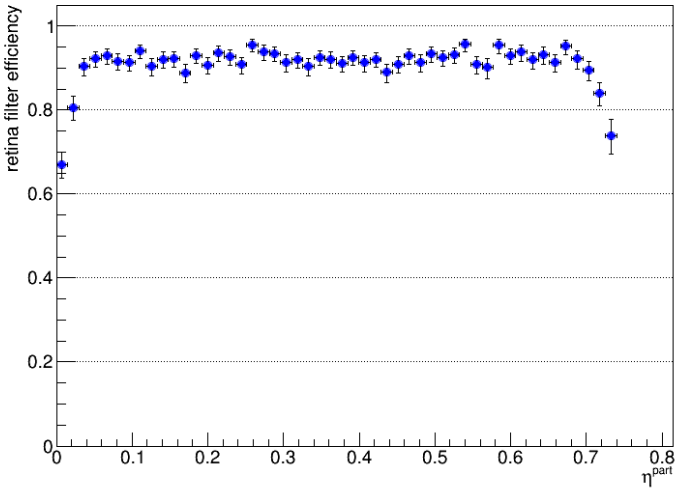




5/6 roads







Conclusions

- This flavour of the retina algorithm is powerful and looks very promising.
- Further steps (some non-trivial) need to be accomplished in order to make it usable:
  - investigate and understand the inefficiencies;
  - estimate the fakes;
  - move to pattern banks segmented longitudinally;
  - simplify the algorithm.