Fast Pixel Simulation

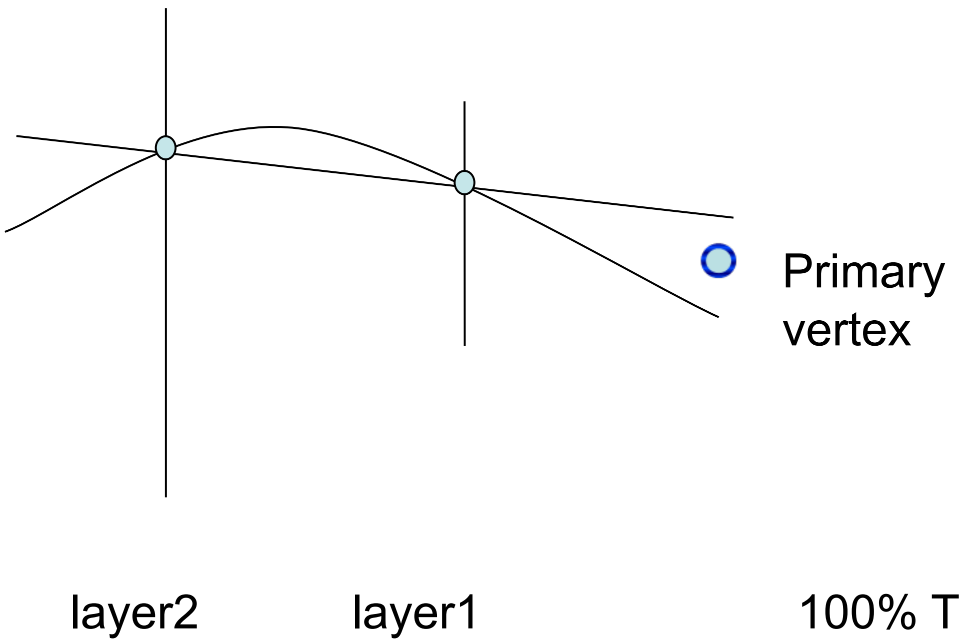
Howard Wieman, Xiangming Sun
Lawrence Berkeley Lab

outline

- Approximation
- Processes in simulation
- Cut set and cut optimization
- Compare between detectors
- Summary

Approximation

- track: hits in two pixel layer build a line

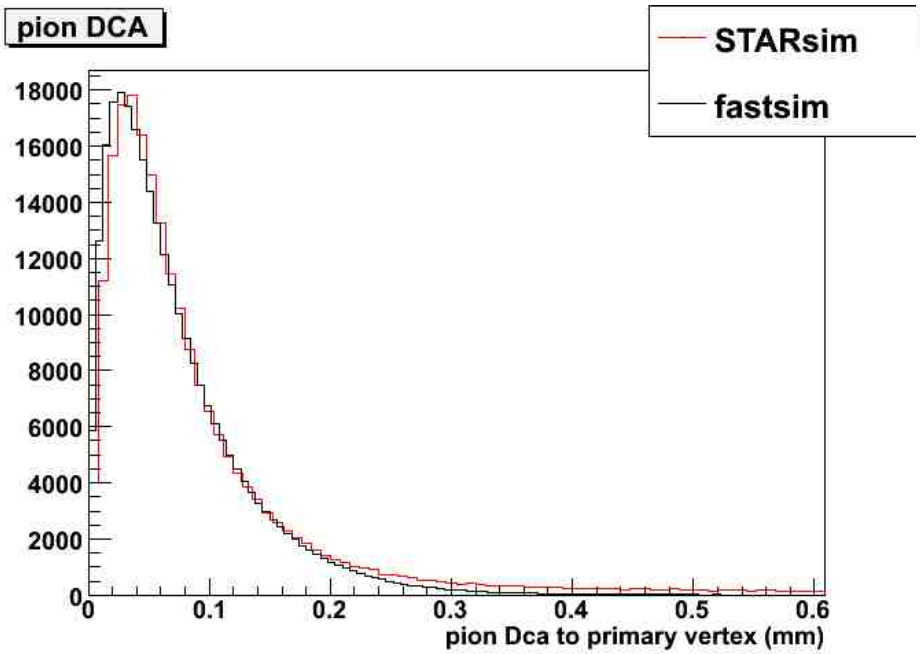


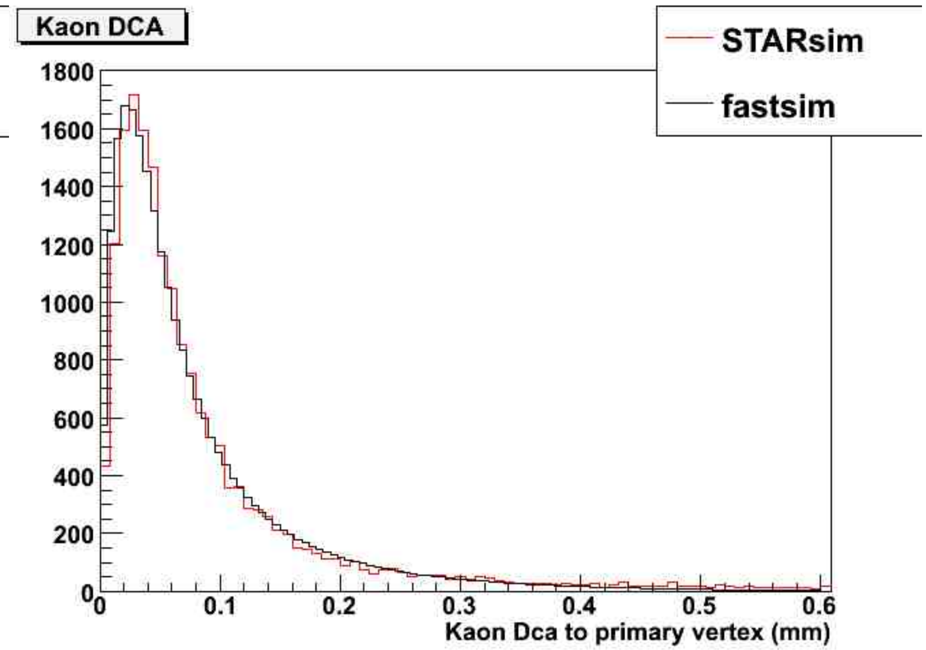
100% TPC match efficiency
100% tracking efficiency
5% momentum resolution
Perfect PID

Processes in simulation

- D0 generation and decay
- Position dispersion in two layers for secondary particles (pixel resolution)
- Coulomb scattering in layer1
- Background generation
- analysis

DCA Distributions for primary particle





Compare DCA distribution between fast simulation and Geant in STAR.

The agreement shows the approximation is reasonable

Cut set

- η cut -1,1
- Invariant mass cut 1.6 GeV, 2.2 GeV

Cosθ cut
kaon DCA to Primary Vertex
pion DCA to Primary Vertex
DCA between kaon and pion

Kaon and pion DCA to Primary Vertex cut is set the same value in the analysis

Cut optimization

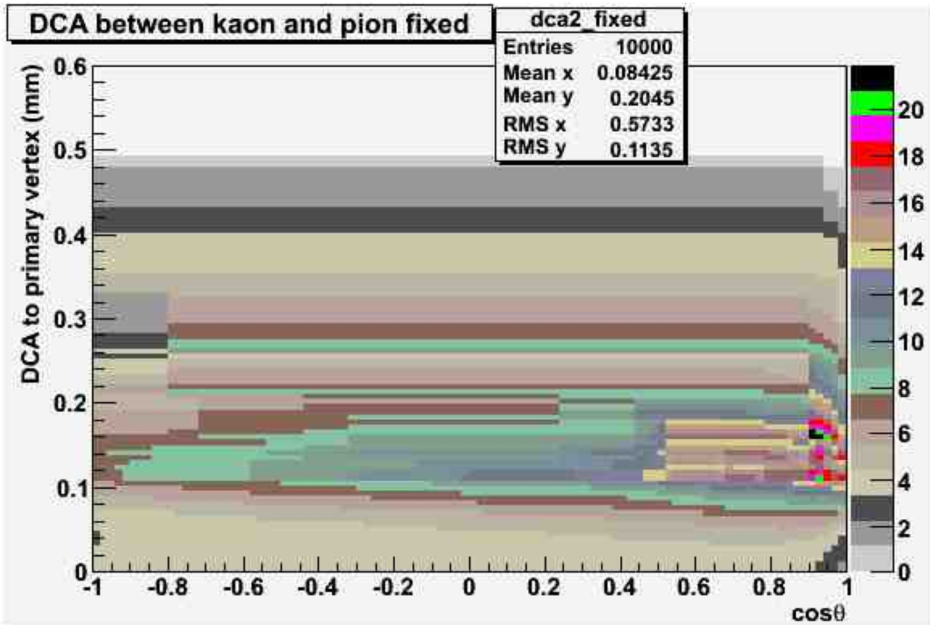
CDR cuts:
Cosθ cut >0.98
kaon DCA to Primary Vertex >50um
pion DCA to Primary Vertex >50um
DCA between kaon and pion <50um

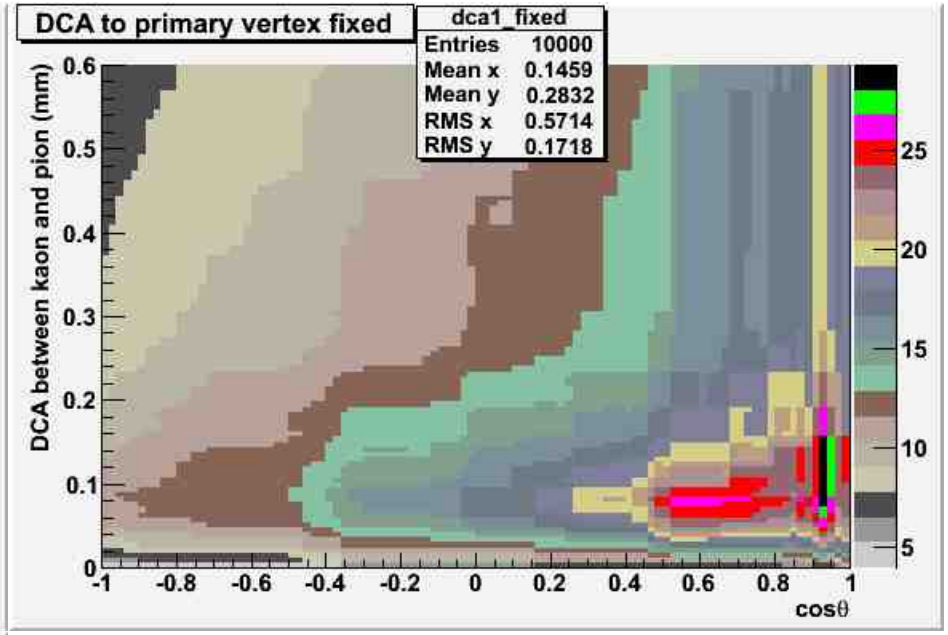
Significance=S/sqrt(S+B)

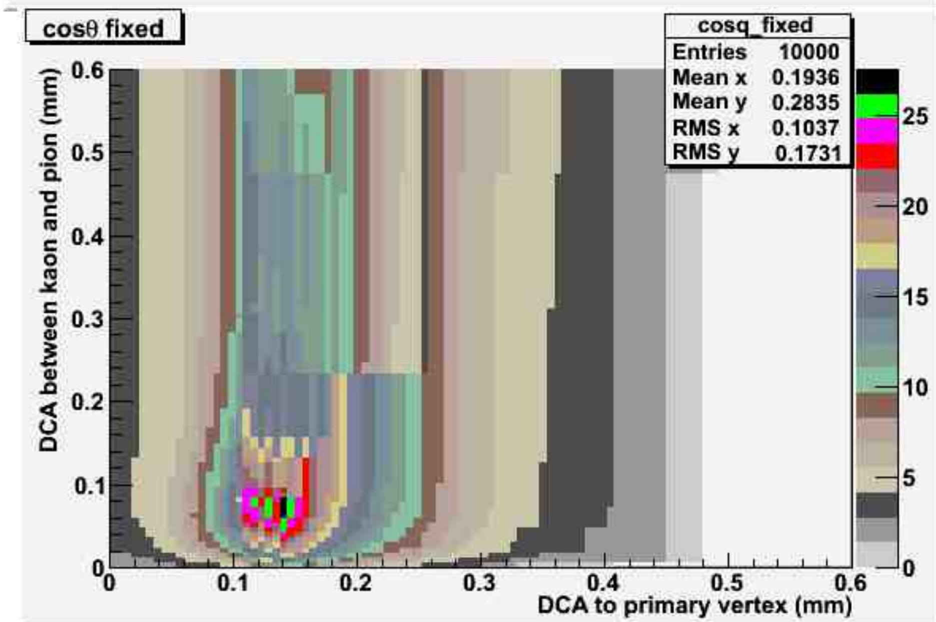
S signal ;B background

How Significance varies with cuts?
fast simulation allows to do this

Cut optimization

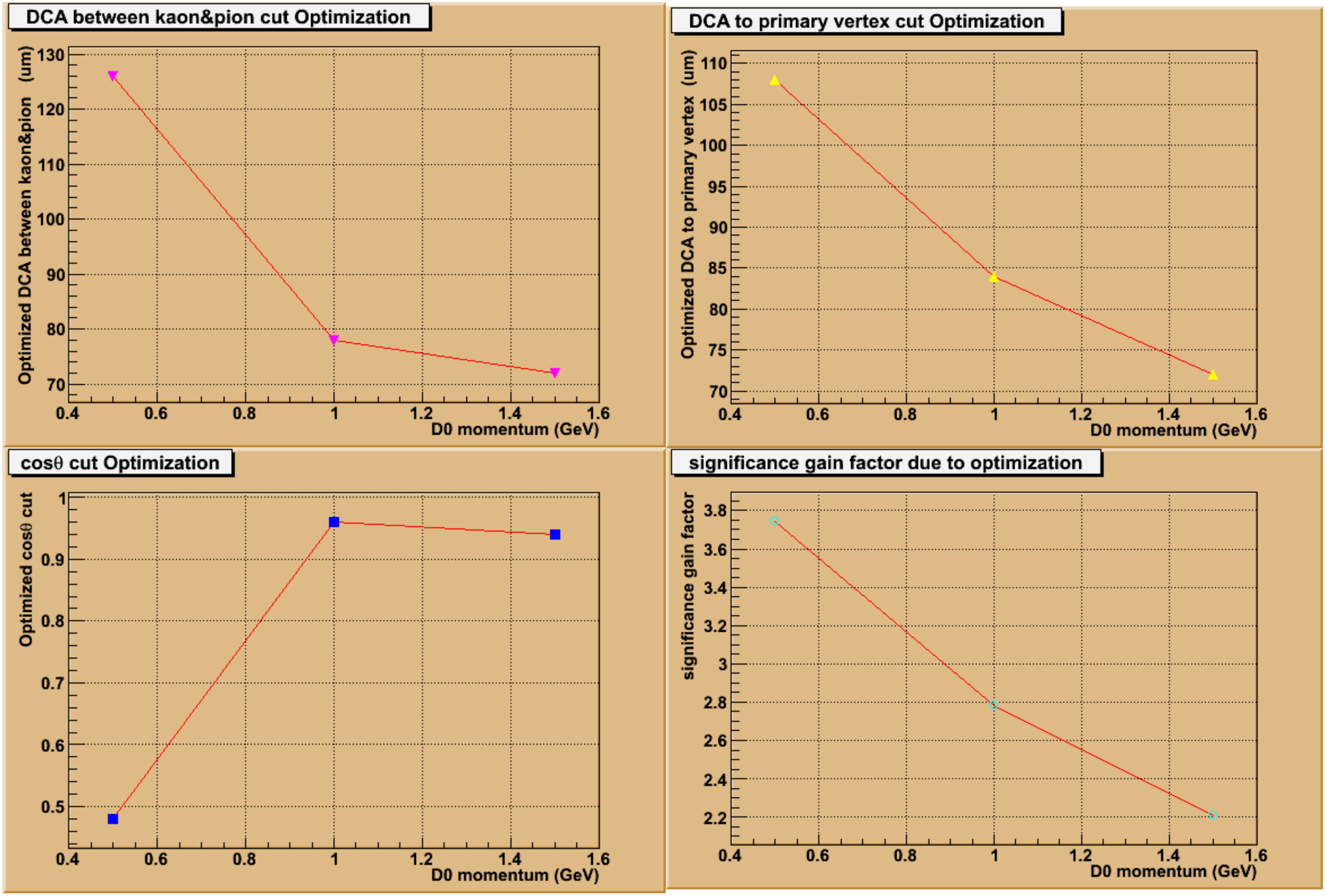






Significance distribution with cut at 500MeV for PIXEL

Cut optimization



Optimized cut value for PIXEL

Compare between detectors

PIXEL

equ. pixel size r 27 um

equ. pixel size z 27 um

Radiation length 0.583%

hybrid

equ. pixel size r 50 um

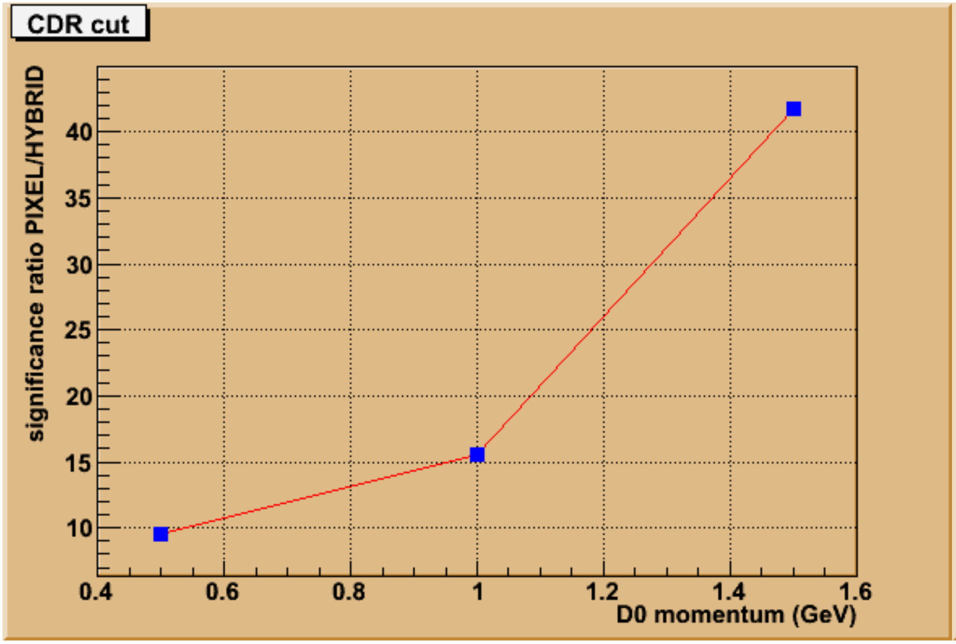
equ. pixel size z 450 um

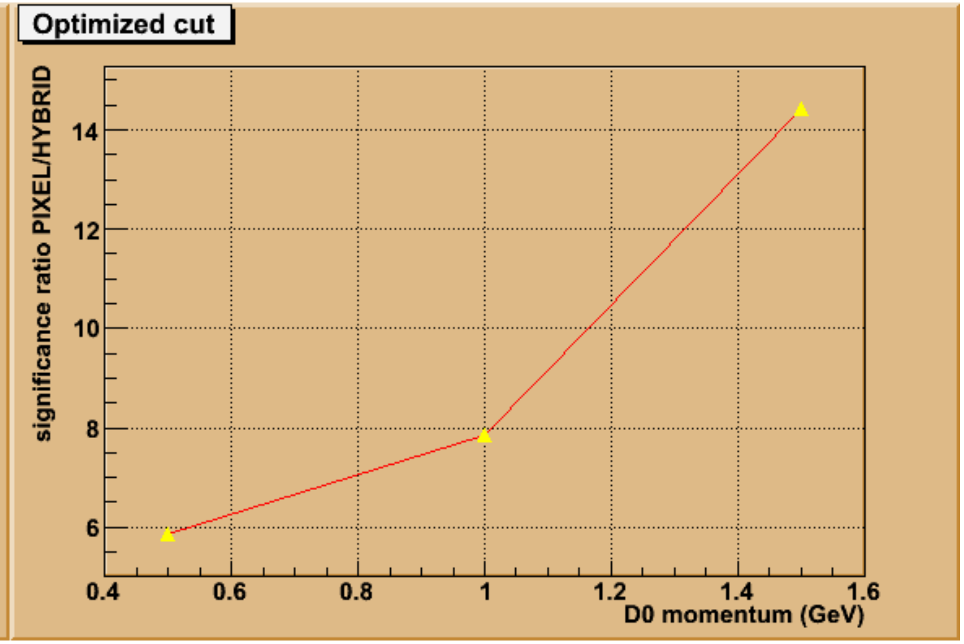
Radiation length 1.413%

Cut optimization is treated on hybrid detector too

The significance ratio between two detectors is compared

Compare between detectors





After optimization significance ratio is very high

The significance ratio increase with D0 momentum at 0.5-1.5 GeV

tracking efficency ratio 76.5%

Summary

Fast simulation generates similar DCA distribution with STARsim. The basic idea is reasonable.

Cut optimization gives significance improvement of a factor of 3.7 in 500 MeV D0. 2.2 for 1.5 GeV

Comparing between PIXEL and hybrid with the cut optimization,

significance ratio is 4.6 for 500 MeV D0, 11 for 1.5 GeV(include tracking efficiency)