Monte-Carlo Study for STAR High Level Trigger

Hongwei Ke[1,2]

(for the STAR Collaboration)

1. Institute of Particle Physics, Central China Normal University, China
2. Brookhaven National Laboratory, USA

Outline

- Overview of the STAR High Level Trigger
- Monte-Carlo simulation framework for the STAR HLT
- HLT tracking efficiency w.r.t. offline tracker
- A GPU version of secondary vertex finder for the HLT
- Preliminary study of using HFT hits in the HLT

Motivation

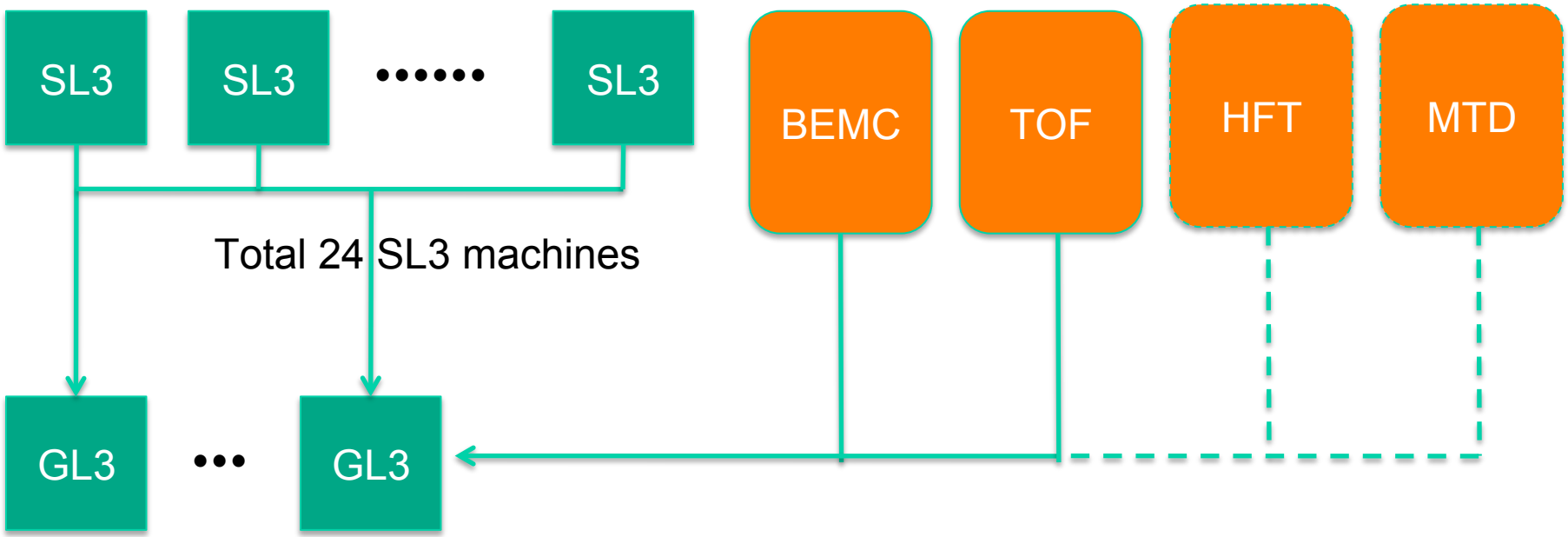
The increasing luminosity of RHIC over the coming years will impose challenges for STAR on computing, storage and final analysis cycle.

By implementing a High Level Trigger it will be possible to reduce the amount of data written to the tape by selecting desired events while still maintaining a high sampling rate to fully utilize the delivered luminosity for a wide range of triggers.

Physics interests: Di-electron, high p_T particles and charge=2

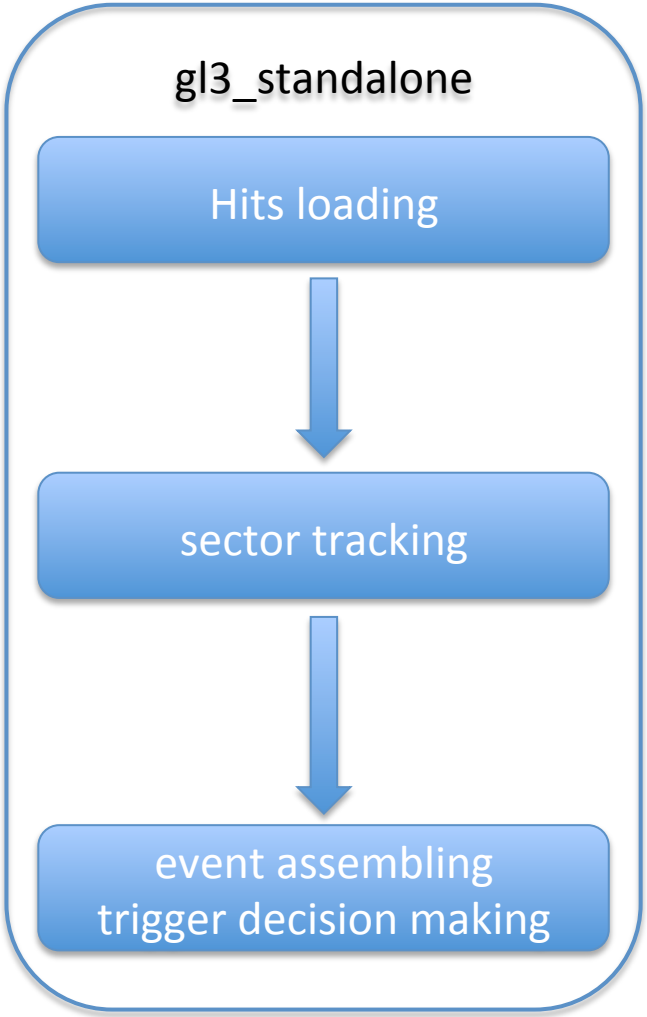
see talks given by Zhangbu (B4.00002) and Hao (H7.00007) as well as the talk given by Declan at GHP2011 (parallel session 4).

HLT Architecture

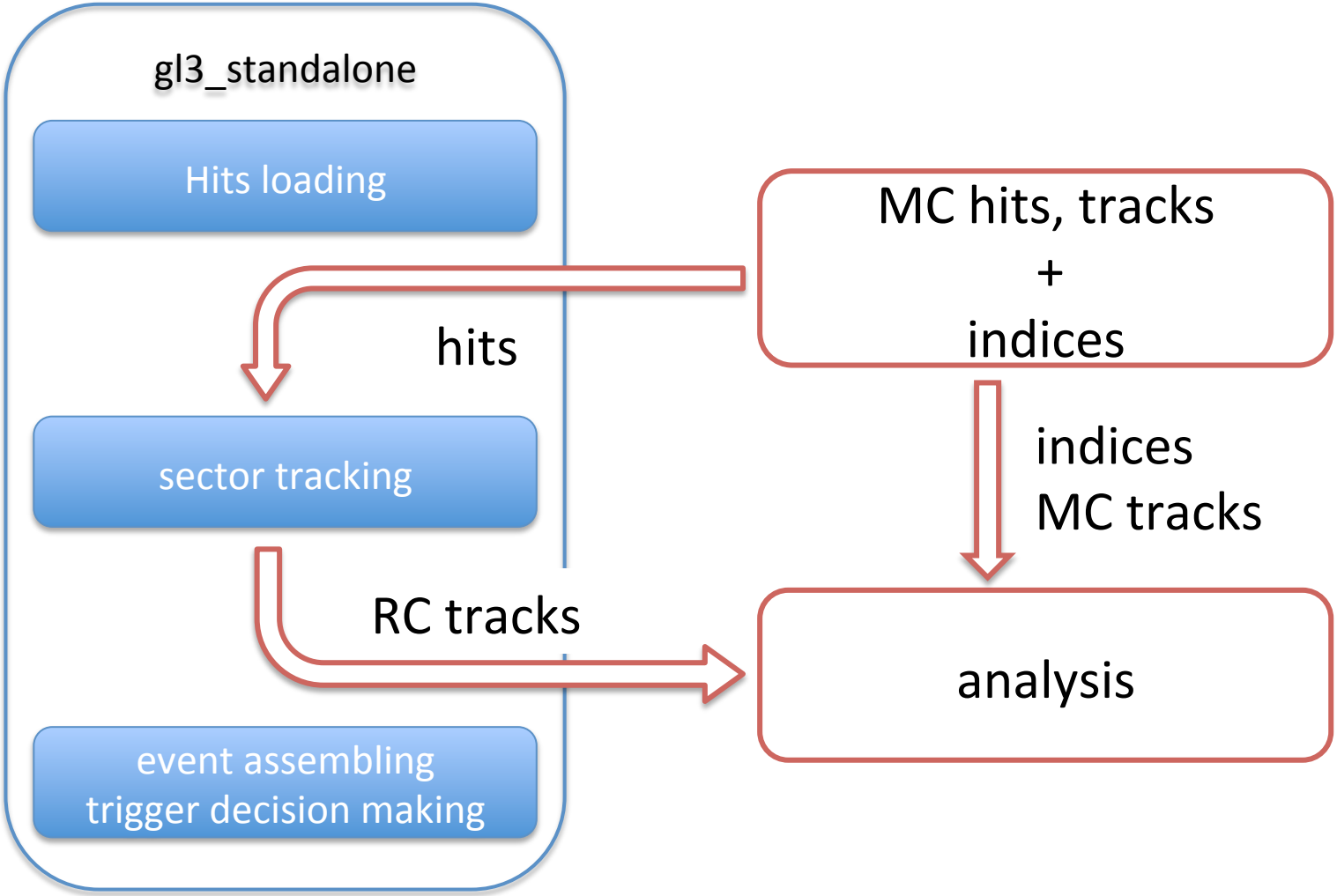


- Sector tracking (SL3) in DAQ machines (24 in total, each for a TPC sector).
- Information from subsystems (SL3 and others) are sent to Global L3 machines (GL3) where an event is assembled and a trigger decision is made.

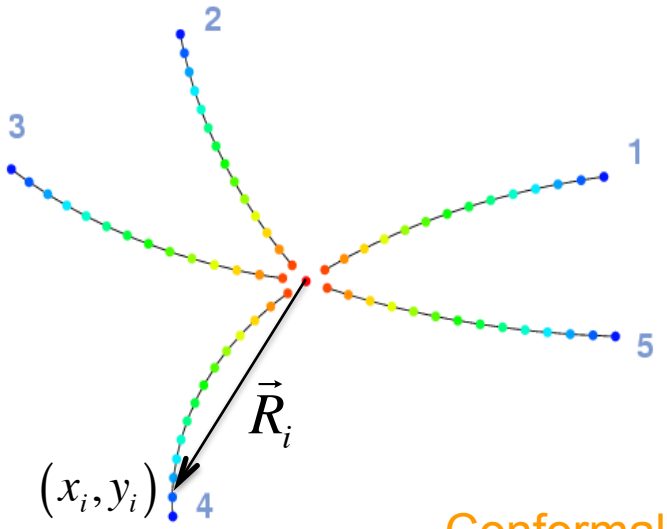
Framework of MC environment for the HLT

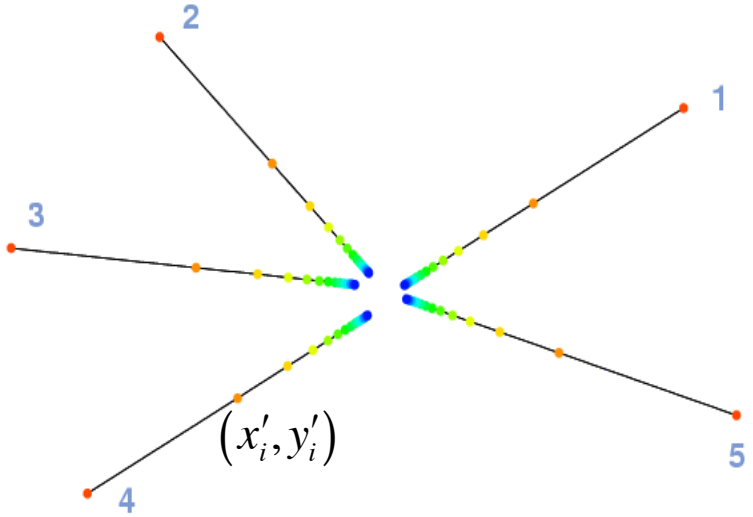


Framework of MC environment for the HLT



HLT tracking





Conformal Transformation

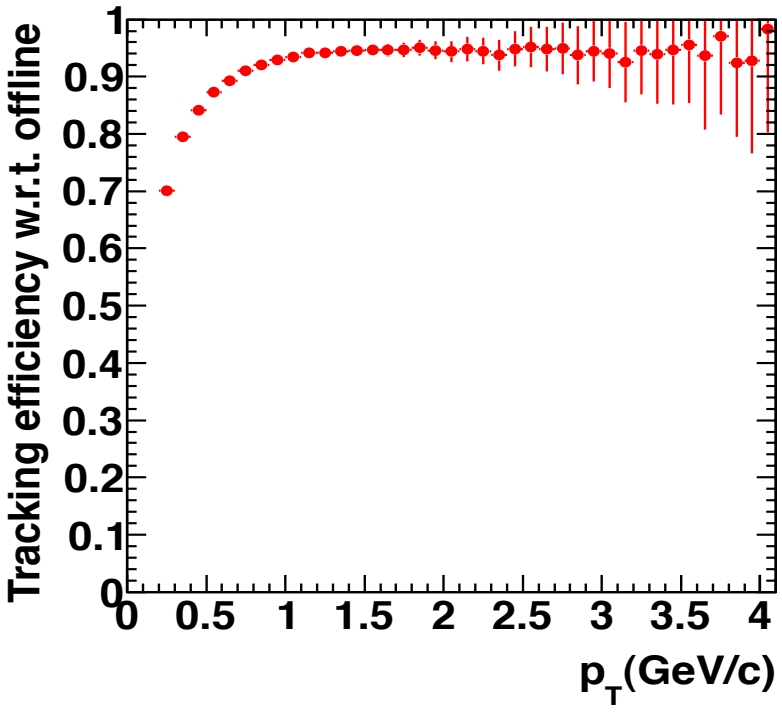
$$x_i^{'} = \frac{x_i}{R_i^2}, y_i^{'} = -\frac{y_i}{R_i^2}$$

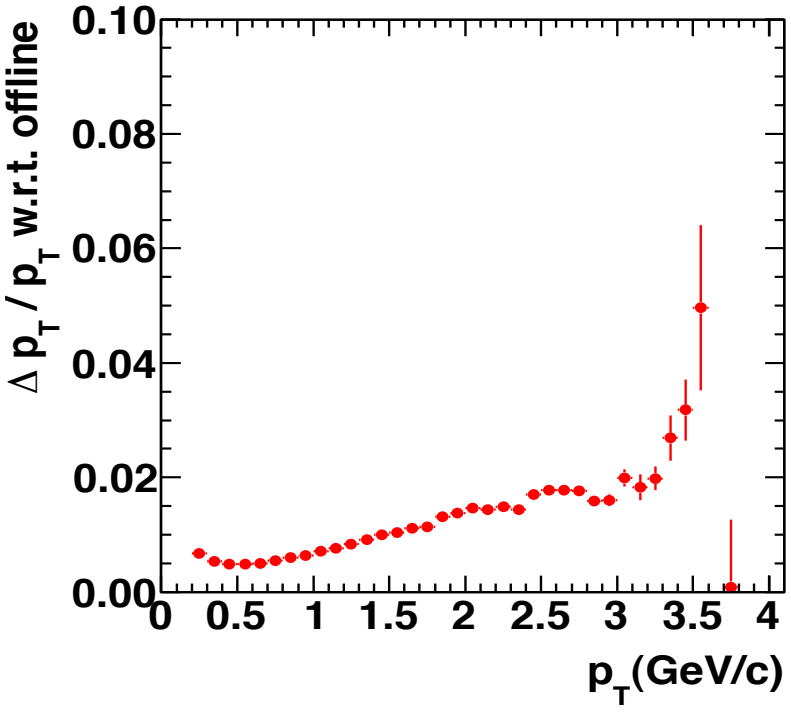
- Fit straight lines instead of curves
- Seed from TPC outer layers
- Finally fit with helix model in the real space
- Fast tracker with acceptable accuracy

HLT tracking efficiency w.r.t. offline tracker

Load the offline reconstructed hits and tracks into the HLT tracker and test the tracking efficiency w.r.t. offline tracker.

(Here we assume the offline tracking efficiency is 100%.)

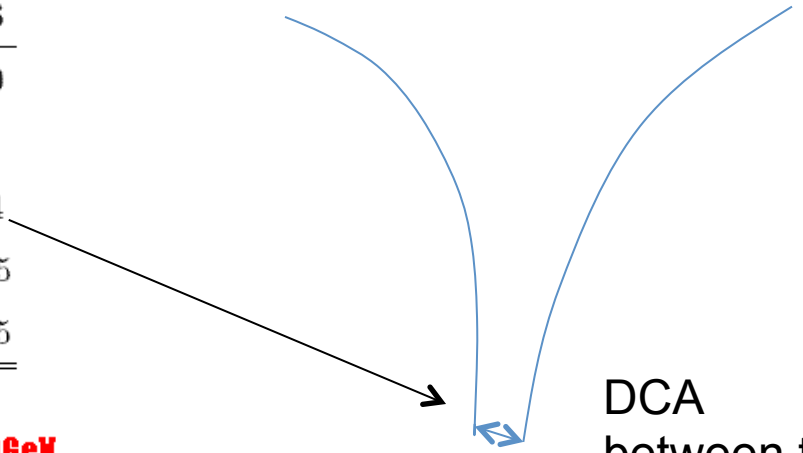




Test the HLT secondary vertex finder

p_T (GeV/c)	< 0.8	0.8-3.6	> 3.6
π dca to primary vertex (cm)	> 2.5	> 2.0	> 1.0
p dca to primary vertex (cm)	> 1.0	> 0.75	> 0
dca between daughters (cm)	< 0.7	< 0.75	< 0.4
dca from primary vertex to V0	< 0.7	< 0.75	< 0.75
decay length (cm)	4-150	4-150	10-125

Cuts selection for Lambda (AntiLambda) at Au+Au 200GeV



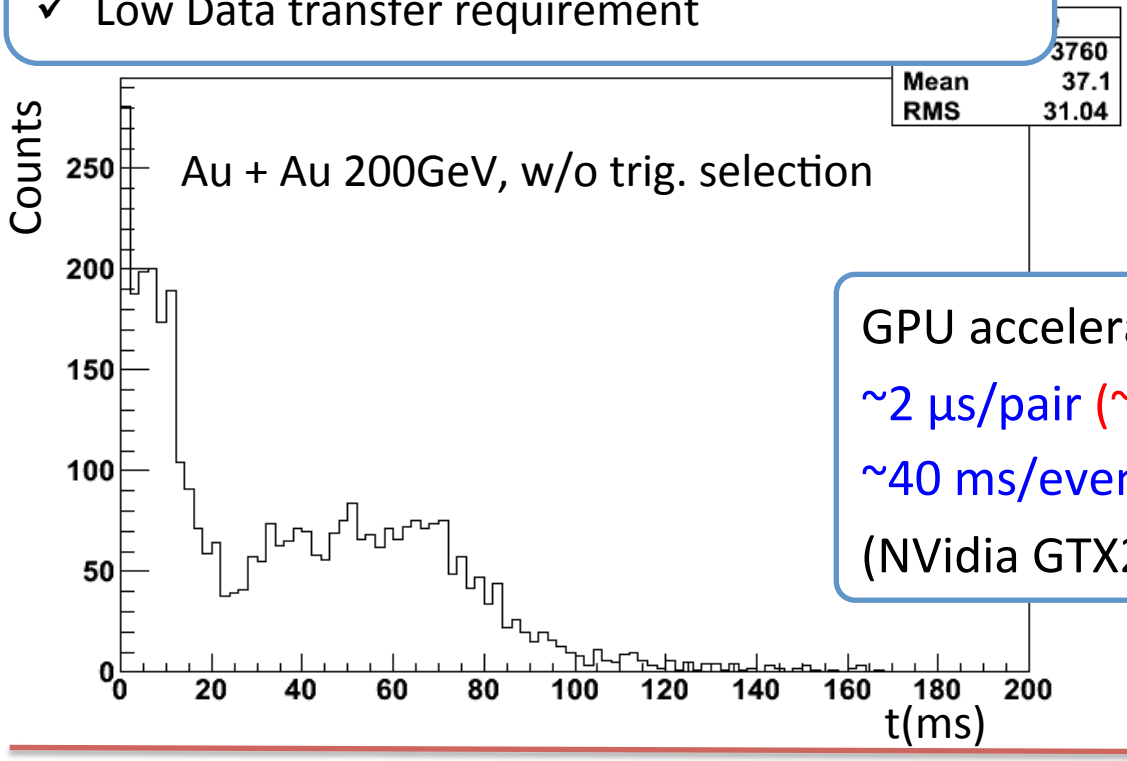
DCA between two helices

DCA between daughters is the most time consuming part

1. Calculation of DCA between daughters is time consuming
2. Number of candidates can be huge

Test the HLT secondary vertex finder

- ✓ DCA calculations are independent tasks
- ✓ Each calculation is worth a thread
- ✓ Enough tasks to make Graphics Processing Unit busy
- ✓ Low Data transfer requirement



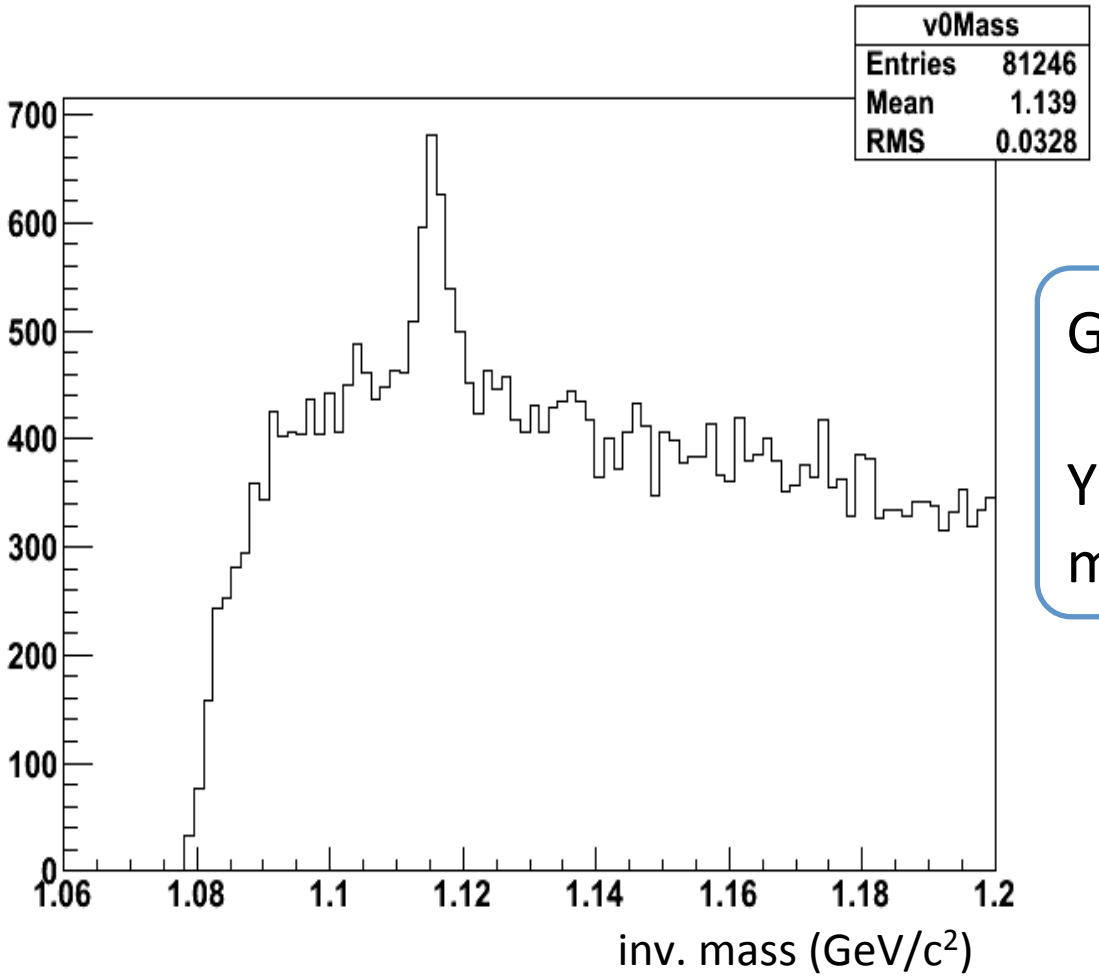
GPU acceleration and algorithmic optimization

~2 µs/pair (~60 times faster DCA calculation.)

~40 ms/event (w/o trig. selection)

(NVidia GTX280 vs. CPU 2.8GHz single thread)

Test the HLT secondary vertex finder



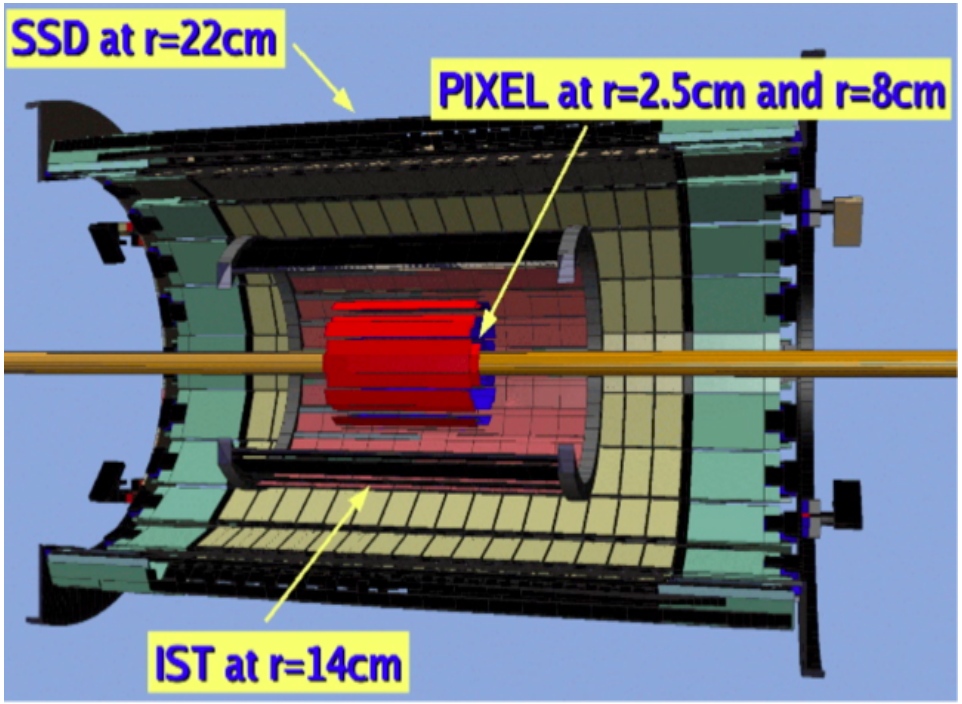
GPU reconstructed $\Lambda(\bar{\Lambda})$

Year 2010 AuAu 200GeV mini bias events

Preliminary study of using HFT hits in HLT

Heavy Flavor Tracker a micro vertex detector being developed and will be ready for 2014.

- direct identification of charm hardons

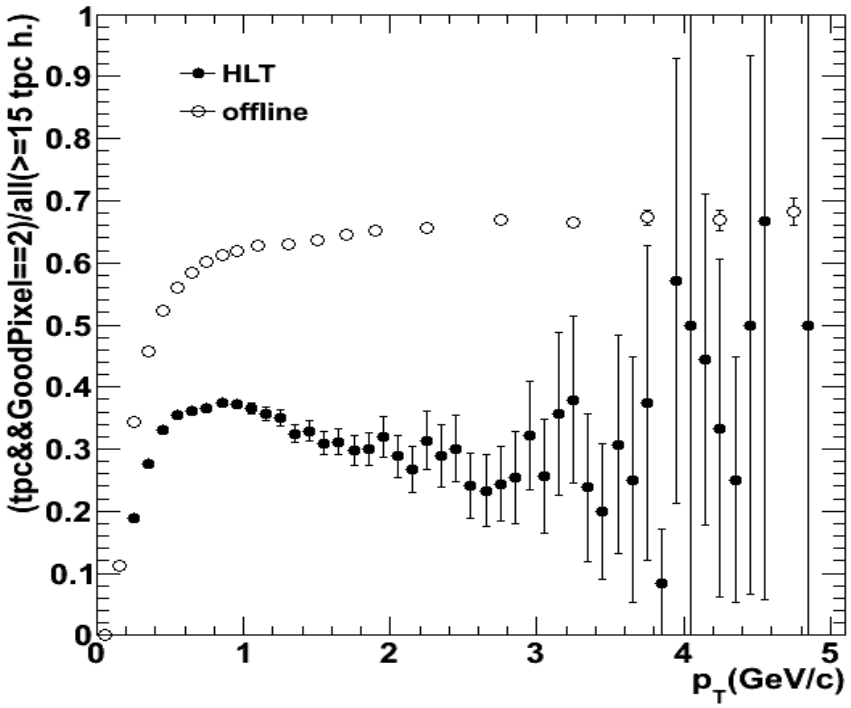


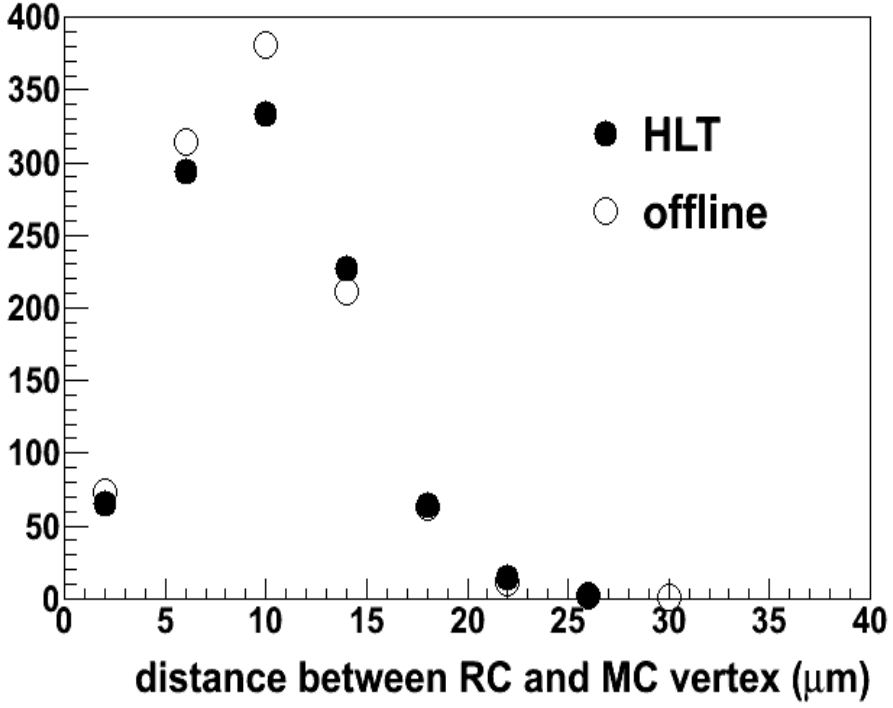
for HLT test

- Extend tracks from TPC to HFT using helix model
- Hijing + HFT
- Pixel pile-up at RHIC II luminosity

Preliminary study of using HFT hits in HLT

(tpc && GoodPixel=2)/all(tpc h. > 15)





Single track efficiency for pions, ~35%

Primary vertex reconstruction

Summary & To do

Summary:

- A Monte-Carlo environment for the STAR HLT is under development
- HLT tracking efficiency w.r.t. offline tracker is about 95%, p_T > 1GeV
- A GPU version of HLT secondary vertex finder is implemented
- Using the HFT hits in HLT, we got a single tracking efficiency of about 35% and accurately reconstructs primary vertices.

To do:

- Refine the tracking efficiency measurement procedure
- Measure the tracking efficiency using embedding data
- Install and test the GPU version of secondary vertex finder online
- Refine the tracking procedure when using HFT hits

Thank you!