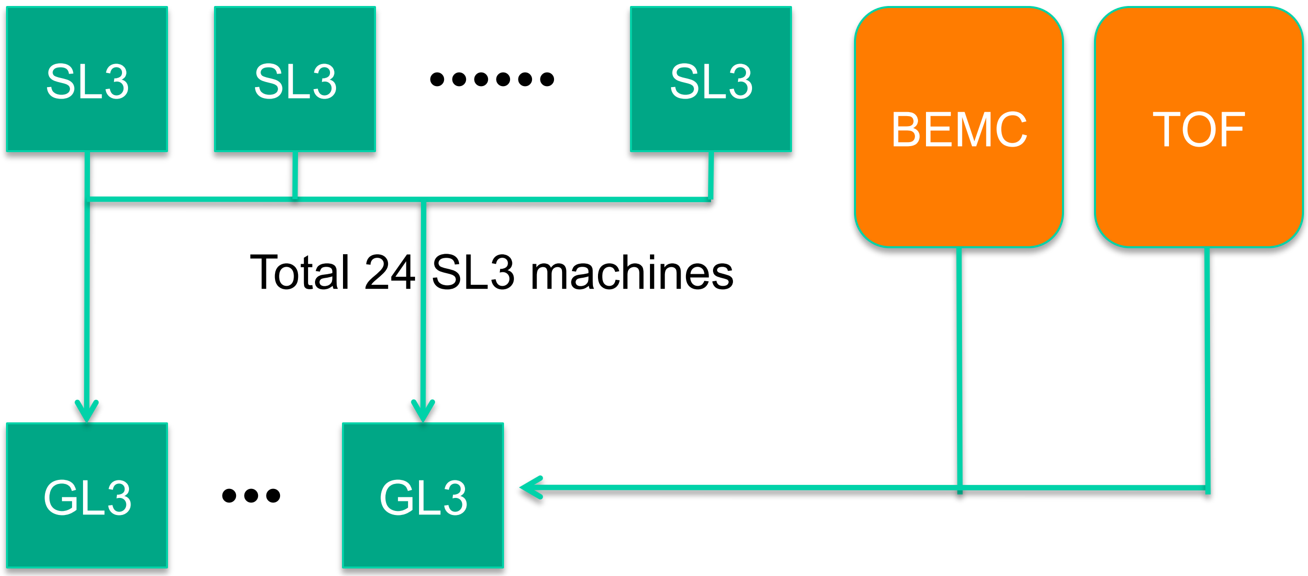
HLT Status and HLT-HFT considerations

Oct. 1st, 2010

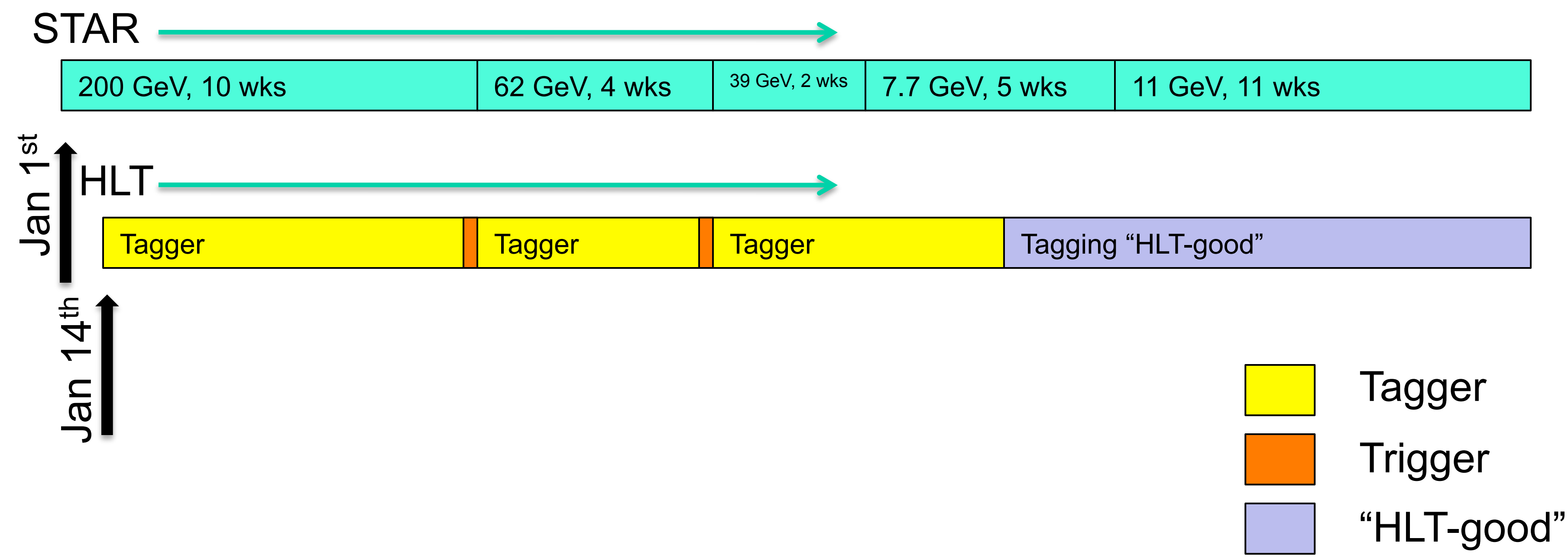
HLT-2010 setup



Major chance since 2009 :
1) TOF added.
2) HLT is decoupled from L2. Instead, HLT receives BTOWs from Tonko/Jeff.

Trigger implemented :
1) di-Electron
2) High p_t
3) Charge-2
4) HLT-good

HLT-2010



- Jan 9th. First TPX and TOF calibration ready.
- Jan 14th. HLT is up and running.
- Jan 15th. L2 crashed. HLT running with TPX and TOF only for some period.
- Feb. 05. HLT is decoupled from L2. Instead, HLT receives BTOWs from Tonko/Jeff.

Trigger Efficiency from 39 GeV data

Charge -2

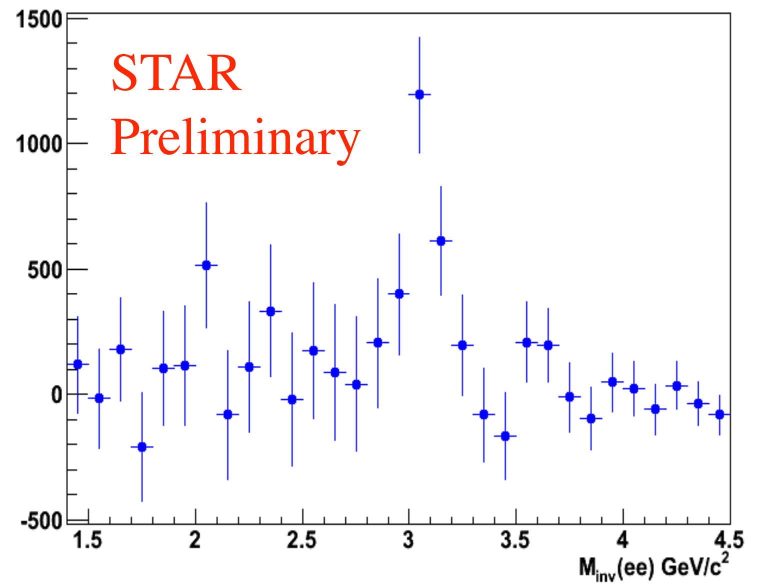
Rigidity (GeV/c)	0.5-1.0	1.0-1.5	1.5-2.0
St_hlt	543 +/- 23	414 +/- 20	225 +/- 15
St_physics	615 +/- 25	420 +/- 20	227 +/- 15
Trigger efficiency	88 +/- 5 %	99 +/- 7 %	99 +/- 9 %

Trigger Efficiency from 39 GeV data

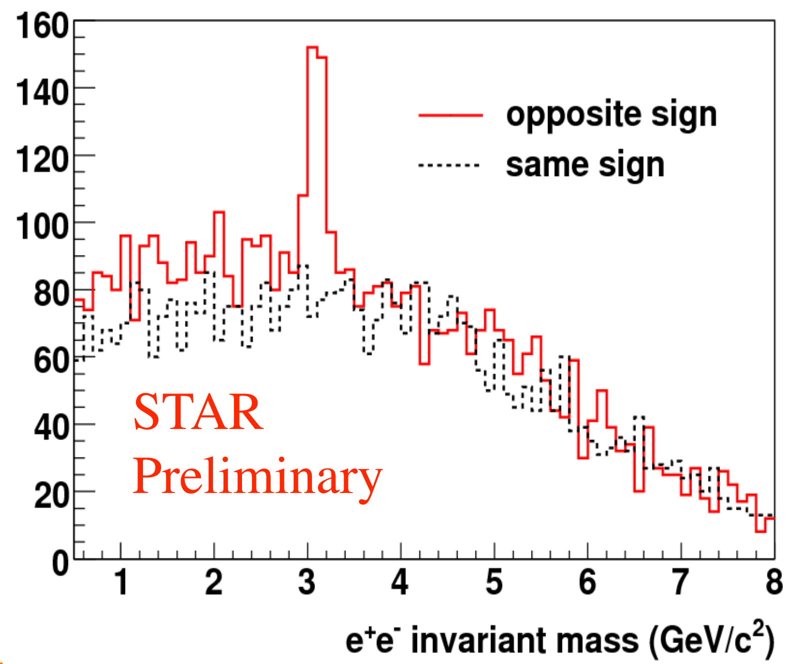
Di-electron

	Number of J/ψ	Number of e^+e^- pairs from γ conversion
St_physics	13 +/- 7.9	129 +/- 11.7
St_hlt	7 +/- 5.6	91 +/- 9.8

Di-electron from HLT online QA



- From HLT online QA:
- A total of > 2400 J/ψs are selected



- The first J/ψ signal seen at p_t > 5 GeV/c in AuAu 200 GeV collisions

Speed Performance

Year	2010	2011E	2012E	2013E	2014E	2015E
Peak L ($10^{26}cm^{-2}s^{-2}$)	40	45	55	55	67	72
# TPX hits (minbias, central)	35.5k, 69.0k	36.1k, 69.9k	37.3k, 71.5k	37.3k, 71.5k	38.7k, 73.5k	39.3k, 74.3k
Rate that HLT can handle (minbias, central)	2.1 kHz, 1.1 kHz	2.0 kHz, 1.0 kHz	2.0 kHz, 1.0 Hz	2.0 kHz, 1.0 kHz	1.9 kHz, 1.0 kHz	1.9 kHz, 1.0 kHz

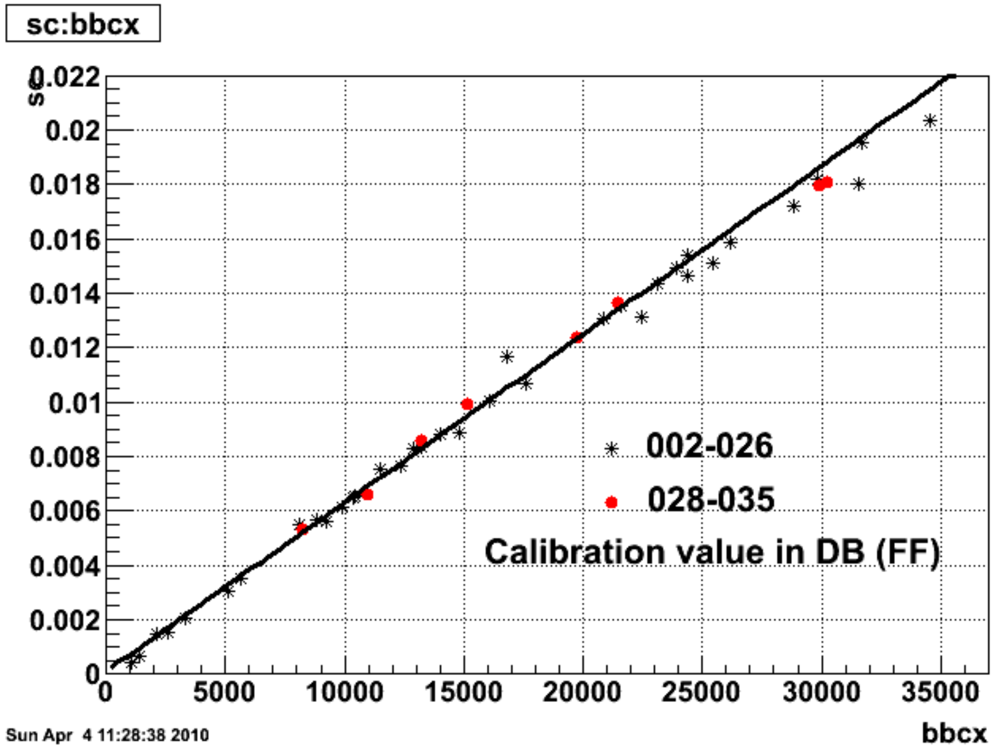
We expect that HLT can handle 1k Hz for Au+Au collisions in RHIC-II era.

Speed Performance

Year (beam Energy)	2011E (100 GeV)	2011E (250 GeV)	2012E (250 GeV)	2013E (250 GeV)	2014 (250 GeV)
Peak L ($10^{30}cm^{-2}s^{-2}$)	52	160	278	376	514
#TPX hits	12k	86k	172k	243k	343k
Rate that HLT can handle	6.1k Hz	860 Hz	430 Hz	300 Hz	215 Hz

There could be a problem handling p+p events in RHIC-II era.
Solutions : Seeding with TOF hits, Upgrade DAQ machines etc.

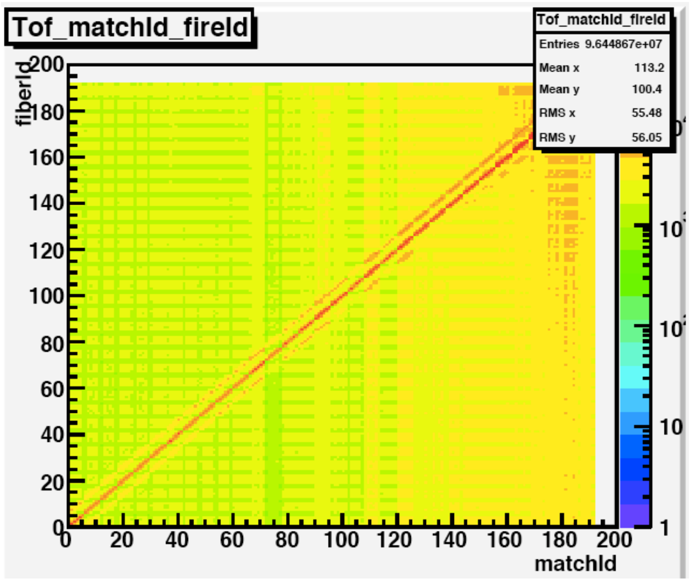
Online Calibration

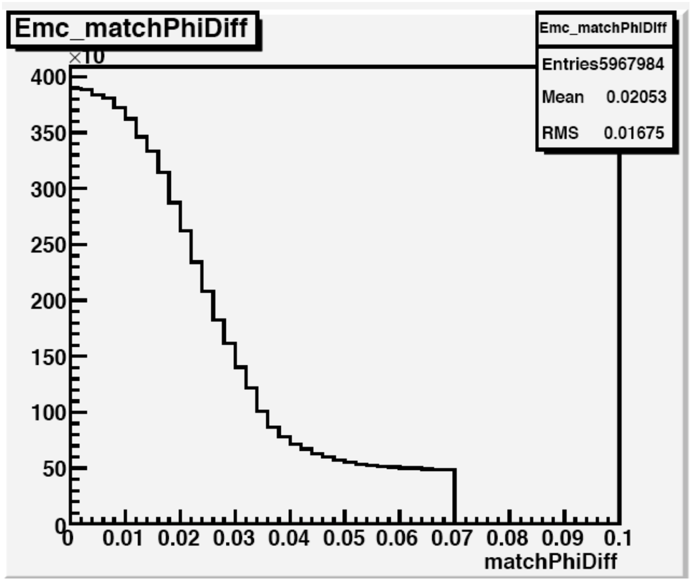


HLT calibration and offline computing are mutual beneficial.

Identify issues early (for example, the TOF Time Over Threshold issue)

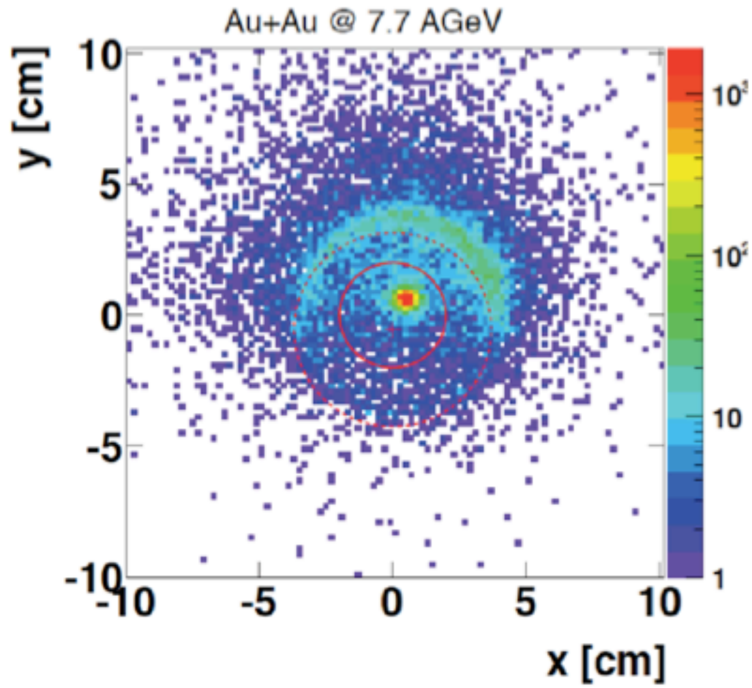
Online Monitoring



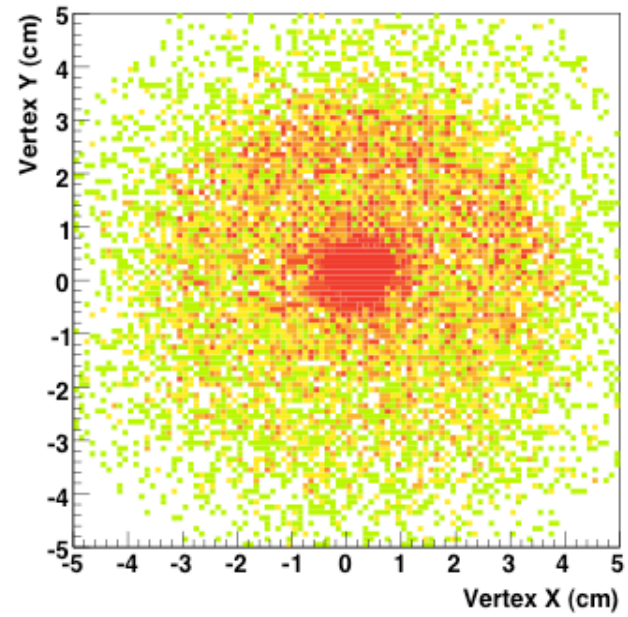


Early discovery for possible run condition changes

HLT and BES



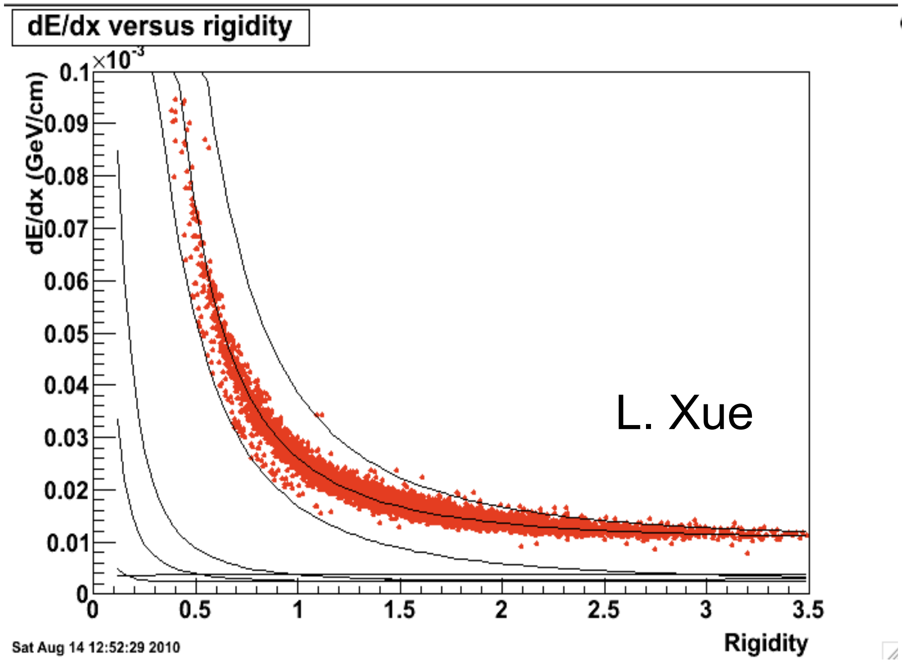
Off-line

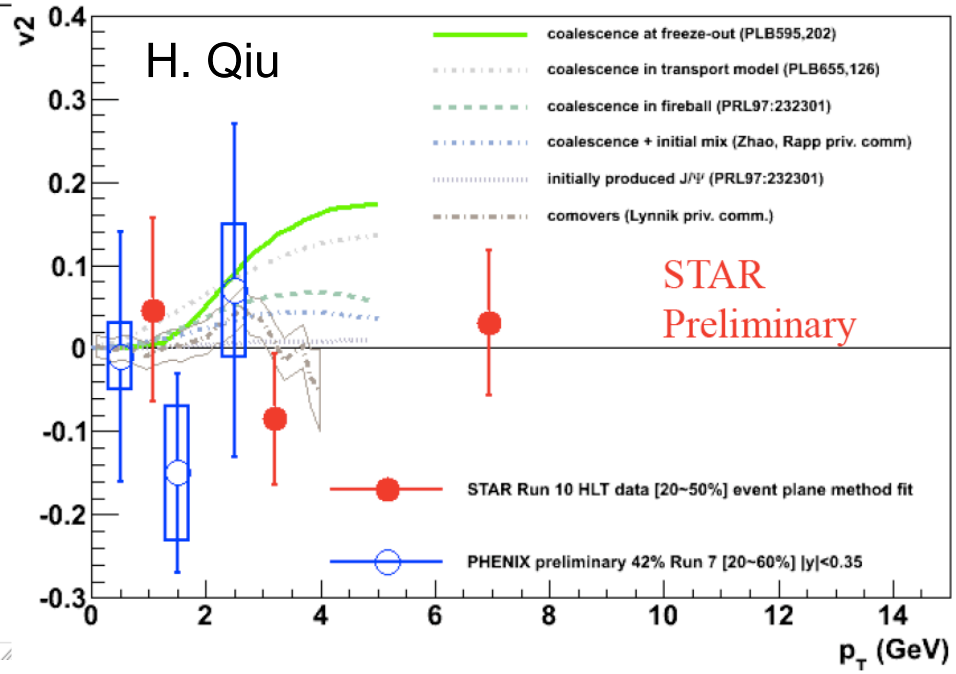


On-line

"HLT-good" purity and efficiency w.r.t. offline are both ~95%.

Physical Results from run 2010



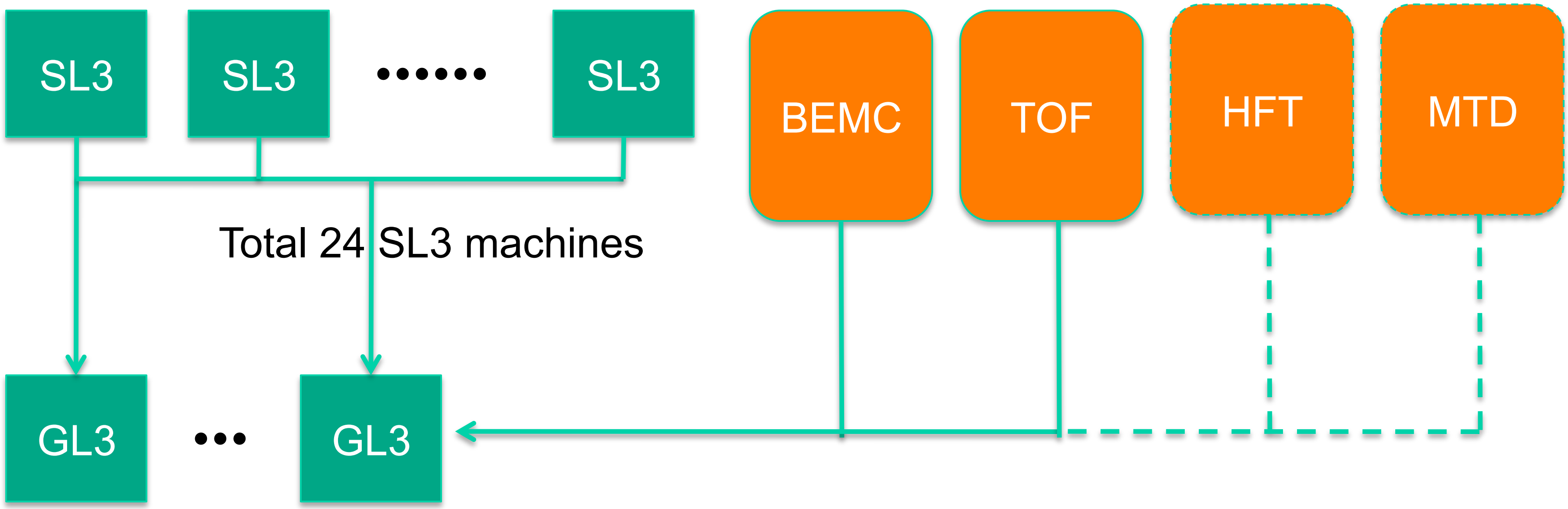


Strong anti-α candidates seen.
The heaviest anti-matter ever produced by mankind

J/ψ v_2 helps discriminating models.

Preliminary results obtained while the mass production of run10 data has not yet begun.

HLT future setup



The plan is to add HFT and MTD in the future.

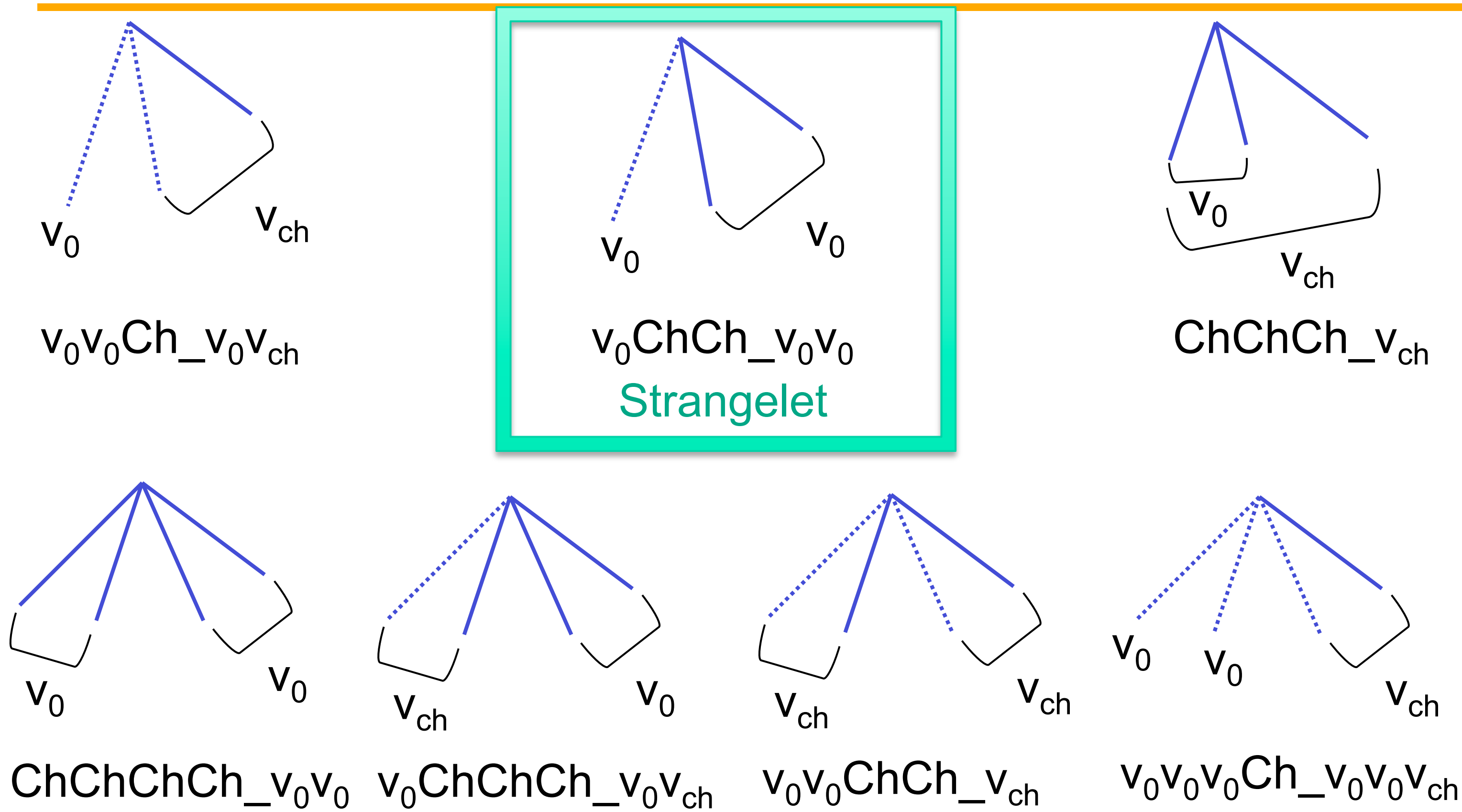
Motivation for the addition of HFT to HLT

Heavy quarkonial signal by e^+e^- pairs

Open charm at large pt

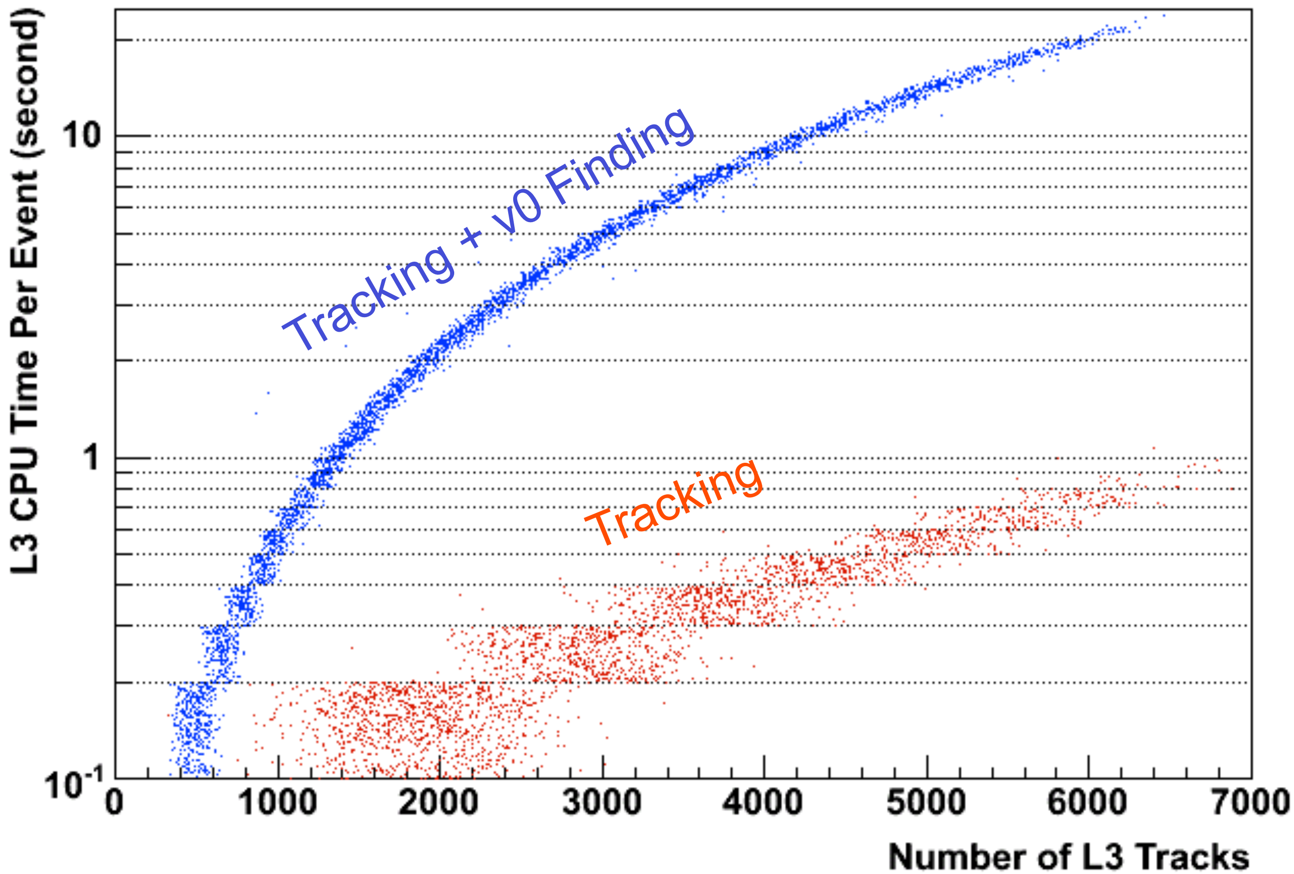
Exotic search (next slide)

Trigger on Secondary vertice : Search for strangelets and other exotics



Good potential for new discoveries (Strangelets, di-Ω etc.)
In the future we will upgrade GL3 to trigger on secondary vertice.
v_0 reconstruction is CPU intensive (~M^2). Good news : preliminary study shows that GPU v_0 finder is **70** times faster.

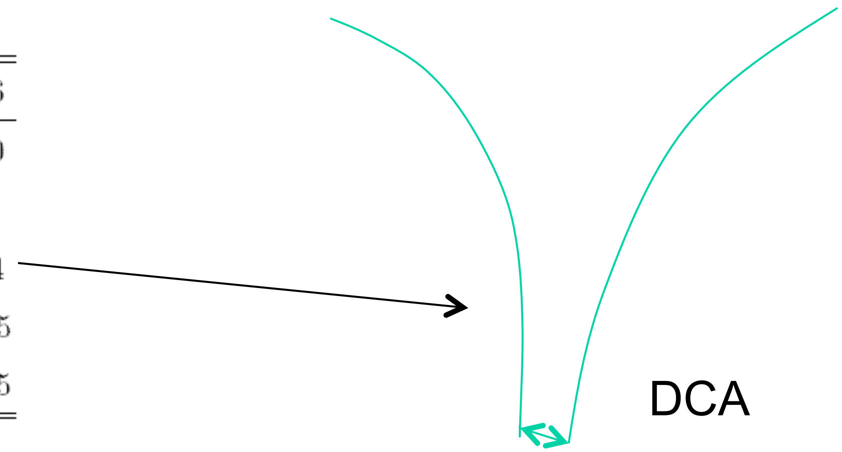
Secondary Vertex Finder



v_0 reconstruction is CPU intensive (~M^2).

Secondary Vertex Finder with GPU

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

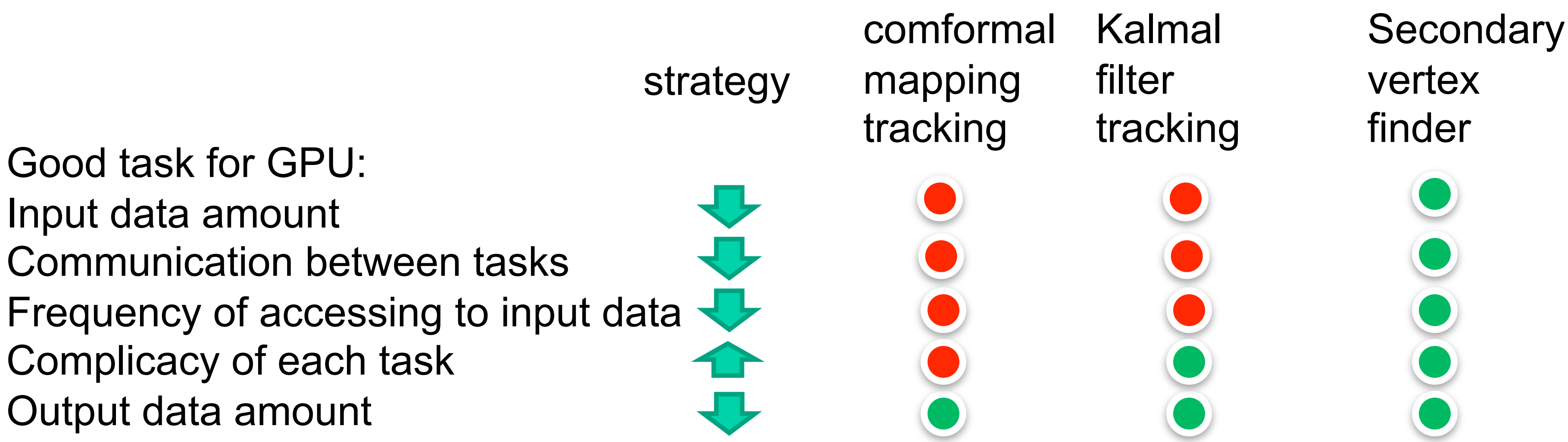


Cuts selection for Lambda (AntiLambda) at Au+Au 200GeV

Dca between daughters is the most time consuming part.

1, Calculation of dca between daughters is more complicated than other parameters

2, The combination of candidates is much higher that other parameters.



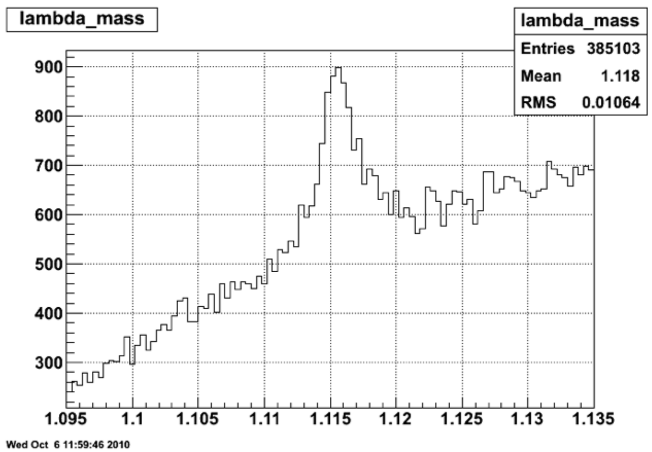
Secondary Vertex Finder is best candidate suited for GPU acceleration

Test result:
GTX280 VS 2.8CPU

	CPU	GPU(GeForce GTX 280)
clock	2.80GHz	1.3GHz
Time cost	93us/pair	1.3us/pair

GPU is 70 times faster than single CPU core considering data transmission.

GPU is 120 times faster than single CPU core for nude calculation.



Lambda reconstructed by HLT tracking (TPC only)

X. Sun

Sun & Ke

Precision Consideration

See Hongwei Ke's Talk.

Future Developments

- Continue R & D for including HFT hits in tracking, and secondary vertex finding with GPU.

- Hope to have more interactions with HFT experts on Calibrations, Integrations, etc.