Online Reconstruction and Data Quality Check @ BESIII

HEP Software Workshop 2013

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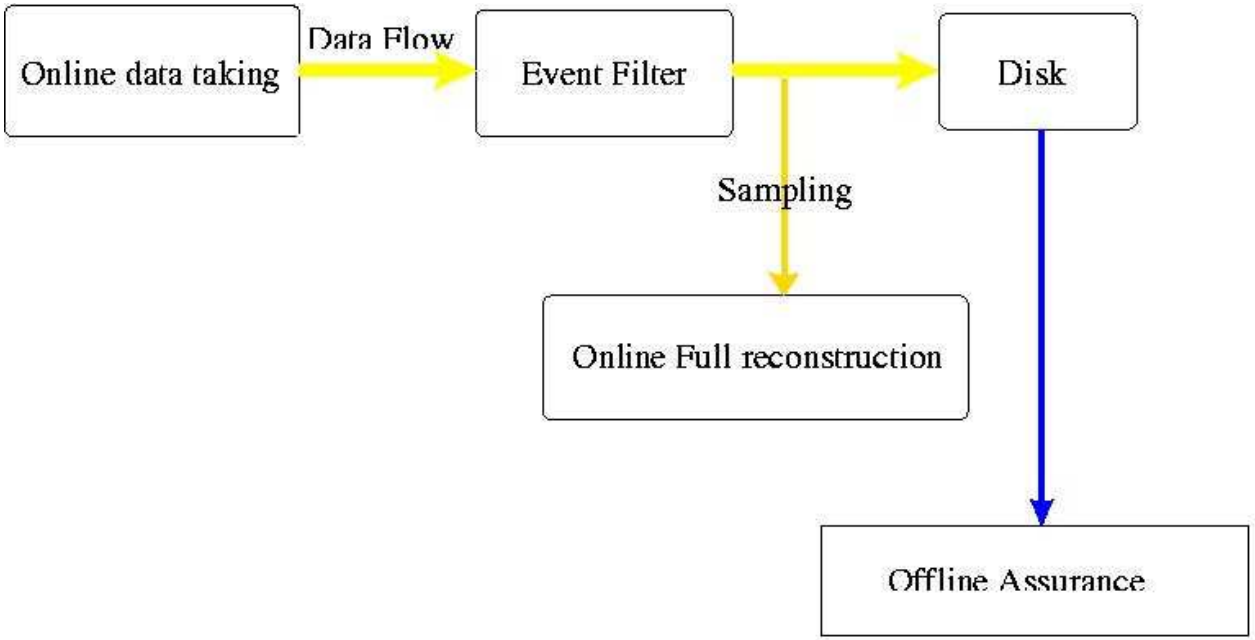
Overall data flow structure

- Data Acquisition(DAQ):Online data taking
- Data Quality Monitoring(DQM):Online full reconstruction
- Data Quality Assurance(DQA):Offline full reconstruction



Outline

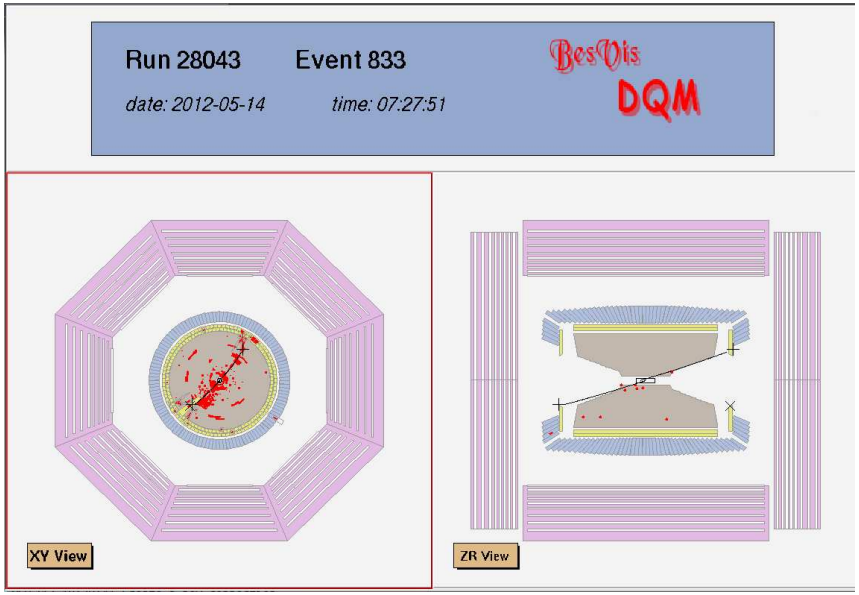
- An introduction to DQM system including online reconstruction
- An introduction to DQA system
- Data quality checks on DQM and DQA systems
- Summary

What can DQM Results do?

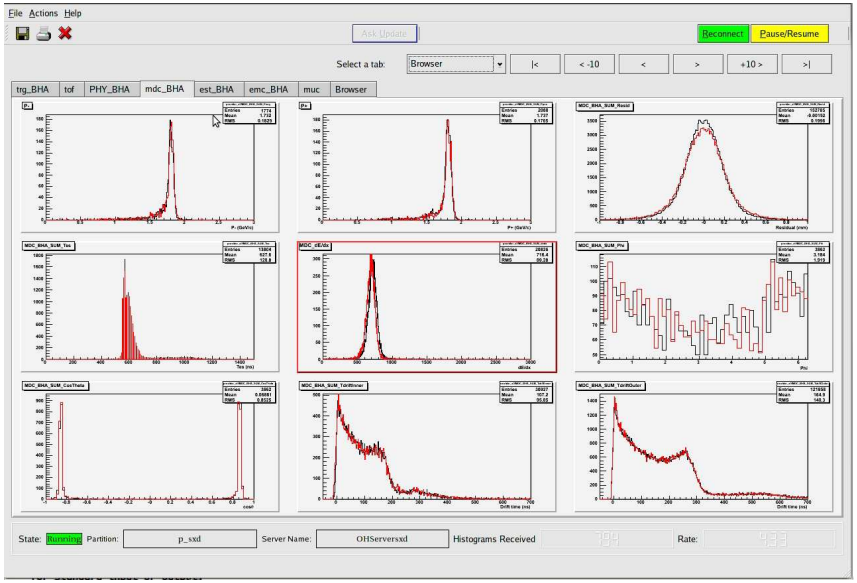
- Real time do everything below
- Single event display
- Full reconstruction and analysis
- Monitor the quality of sub detectors:TRG,MDC,TOF,EMC,MUC
- Monitor the quality of physic events:Bhahba,Dimu,Hadronic...
- Examples:
  - Pub vertex infomation (very useful for accelerator person)
  - Get mean and resolution of MDC, TOF, EMC, MUC...
  - Get the N_{Bhahba}/N_{total}, N_{Hadron}/N_{total}, N_{2prong}/N_{total}...
- All of the real time results can be found from website or database...

DQM Results Display

- Single Event Display and Online Histogram Display of DQM



Event Display

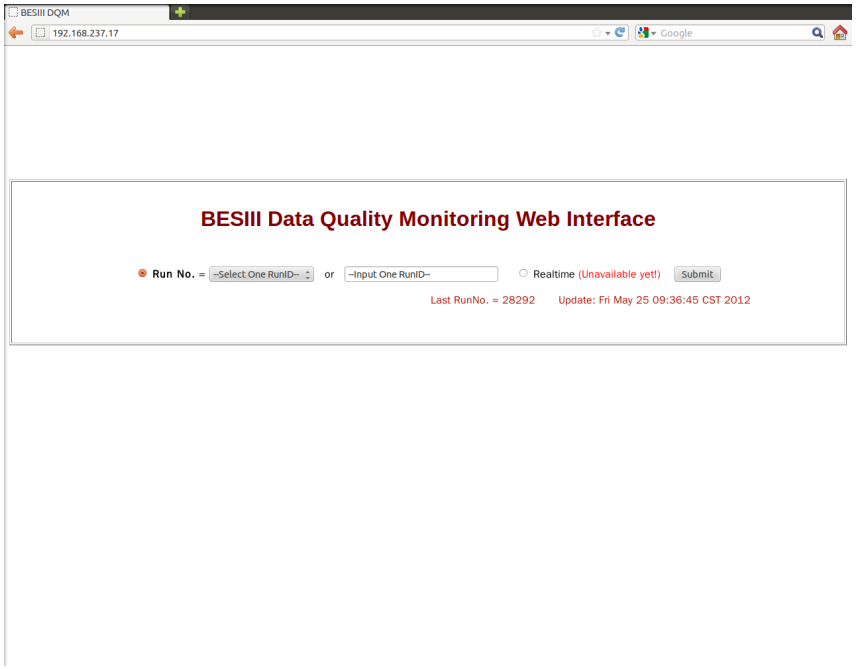


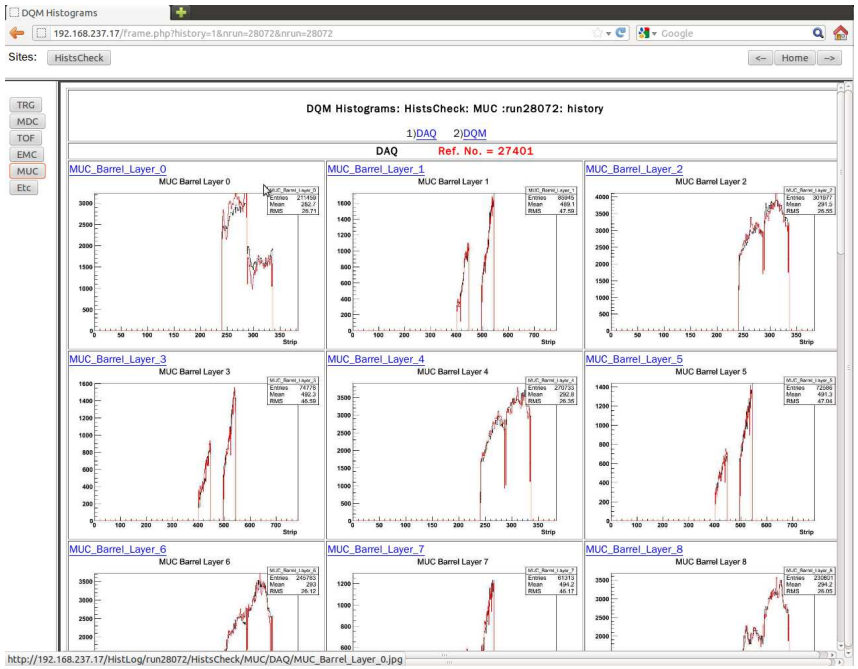
Hist. Display

Real Time

DQM Web Interface

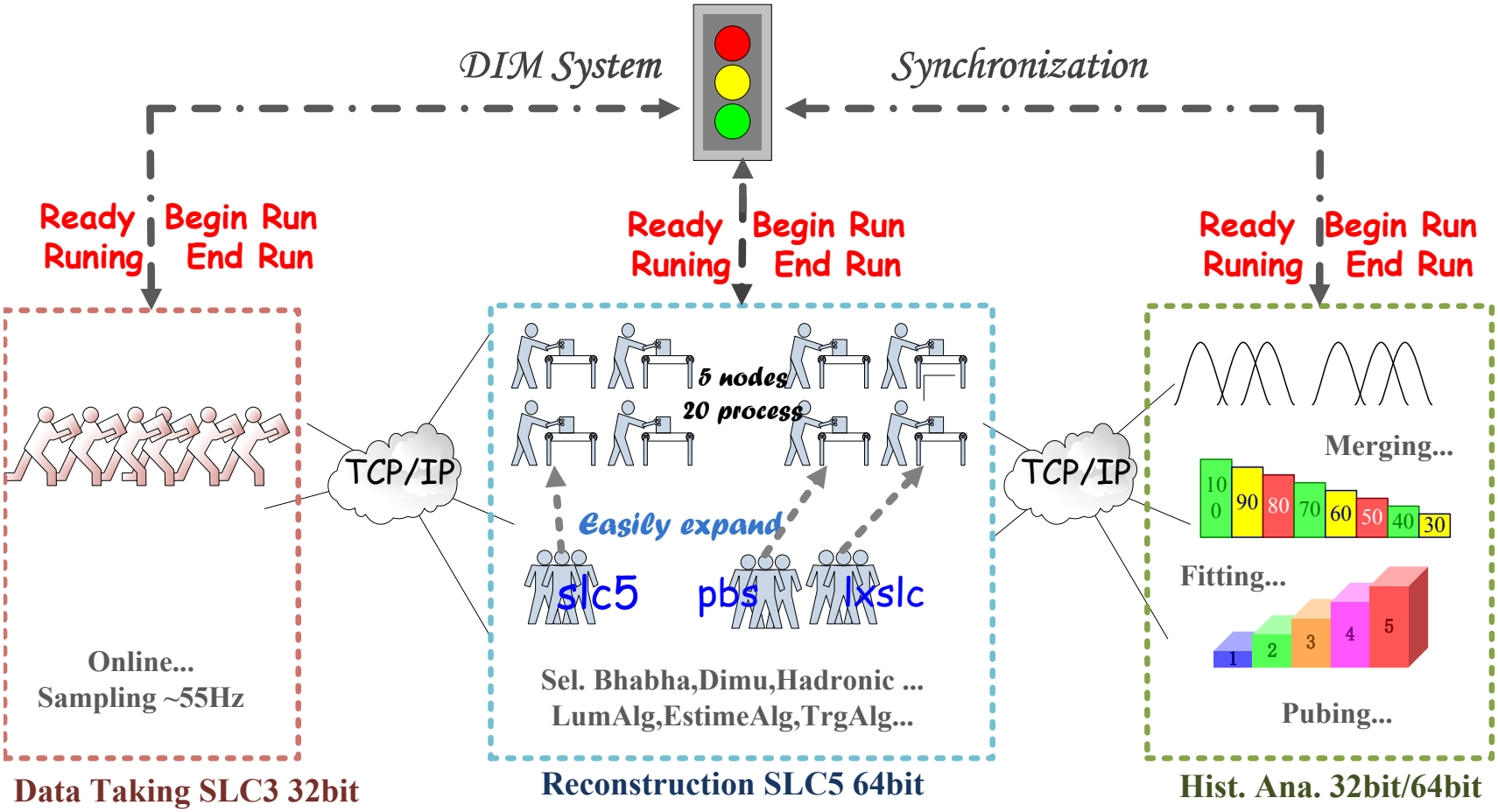
- Check all DQM and DAQ histogram history from Website
- Automatic compare all the histogram between the real time run and the reference run(implemented partially)
- Manually compare any two run of histogram





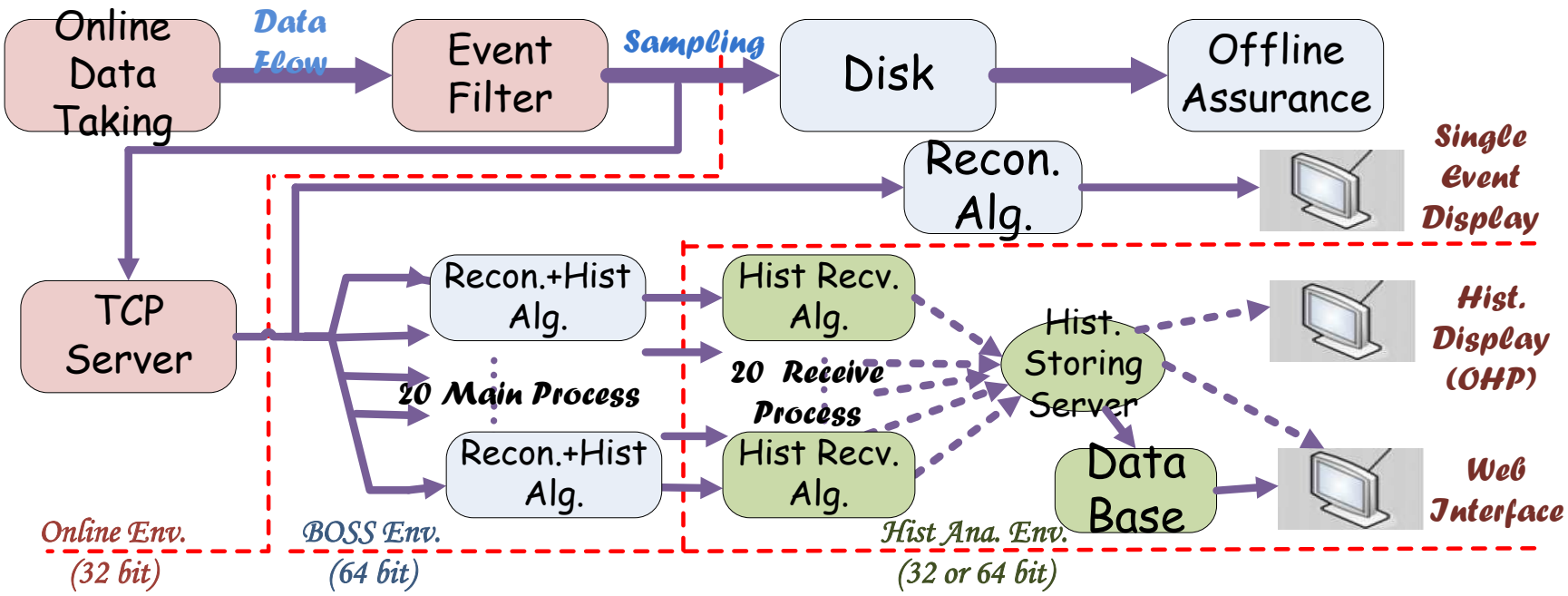
An Overall of DQM System

- Independence of each sub system
- Increase Compatibility
- Easily Expand
- More Efficiency



DQM Framework

- 3 sub system in DQM
  - Online Environment Sys.: SLC3 32bit (Sending Raw Data)
  - Boss Environment Sys.: SLC5 64bit (Fully Reconstruction)
  - Hist Analyse Env. Sys.: SLC4 32bit (Analyzing Histogram)
- The data transmission based on TCP/IP protocol, sampling(~55 Hz), and synchronization based on DIM
- Real time; Online full reconstruction



Properties of DQM System

- Stability of DQM System

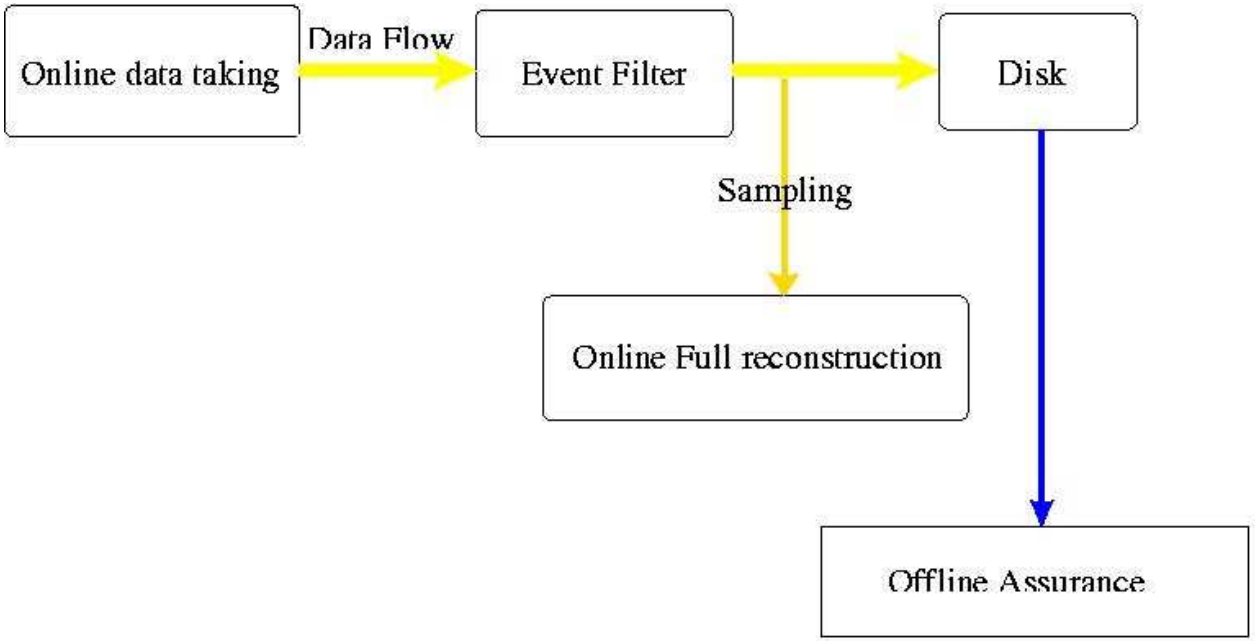
Sub Algorithm	Stability
Single Event Display	> 7day
Reconstruction Alg.	$\sim$15day
Histogram Sub Alg.	$\sim$15day
Online Hist Display	> 5day

- Source usage

Algorithm	CPU Time	CPU Util.	Memory Used	Virtual Memory
Reconstruction	6h32min	$\sim 99\%$	~ 350MB	~ 1300MB
Histogram	2min	$< 0.5\%$	~ 75MB	~ 200MB

An introduction to DQA system

- Run after data is reconstructed offline
- Output histograms run by run
- Histograms are stored in root files
- The difference between DQM and DQA:
  - DQM: Online full Reconstruction, sampling data on real time
  - DQA: Offline full Reconstruction, all data for precise results



Control samples used in DQA system

- Inclusive hadrons
- Inclusive $K_s, K^*(892), \Lambda, \phi$
- Dtag
- Bhabha
- Di-muon
- $J/\psi \to \rho\pi$
- $J/\psi \to p\bar{p}\pi^+\pi^-$
- $J/\psi \to K_s K\pi$
- $\psi' \to \pi\pi J/\psi, J/\psi \to l^+l^-$
- ... ...

Data quality checks on DQM and DQA system

- The data quality checks are available on both DQM and DQA system
- Data quality checks on DQM focus on sub-detectors' performance of BESIII and basic physics results
- Data quality checks on DQA focus on the validation of offline software release (BOSS) version, more detailed physics results and common systematic errors for physics analyzing

Items in Data Quality Checks

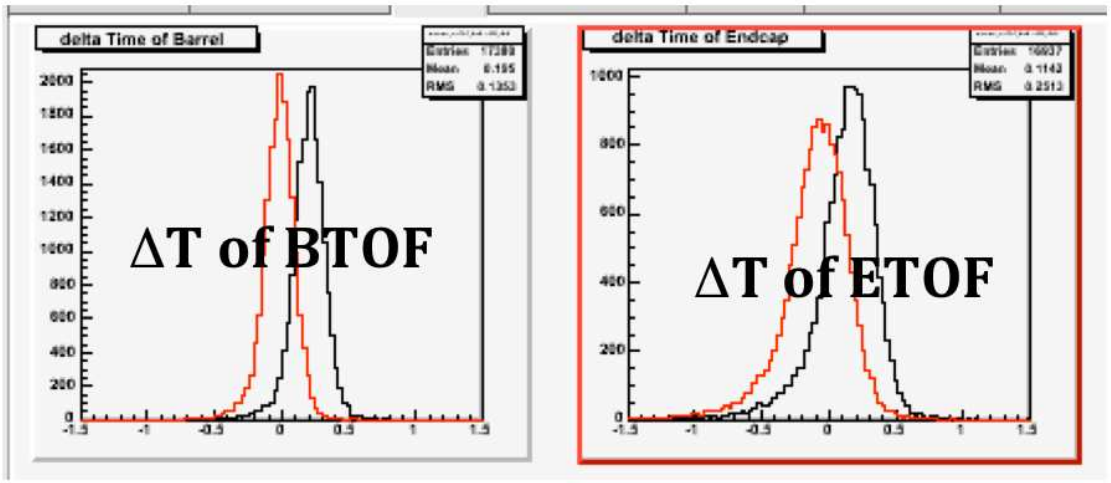
- The mean and resolution of MDC, TOF, EMC, MUC...
- The N_{Bhahba}/N_{total}, N_{Hadron}/N_{total}, N_{2prong}/N_{total} ...
- BOSS release Validation
  - Software validation (MC)
  - Data & MC comparison

Items in BOSS release Validation

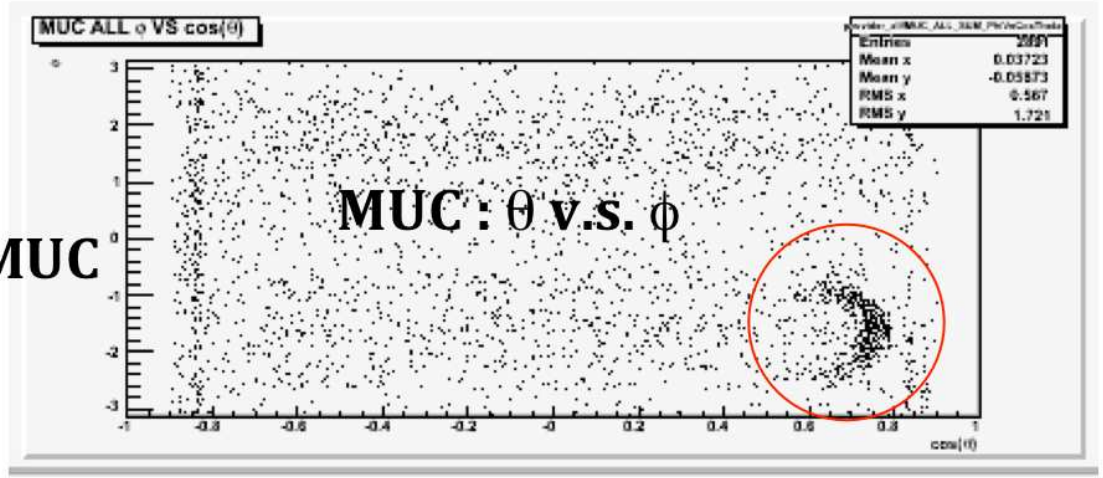
- MC production, FSR simulation
- Vertex distribution
- Mass shift
- Tracking efficiency
- dE/dx χ distribution (mean,sigma)
- TOF ΔT distribution (mean,sigma)
- PID efficiency
- Kinematic fit efficiency
- Event selection efficiency
- ... ...

Examples of Data Quality Checks

ΔT shift 0.2 ns
Since accelerator problem



A hot channel in MUC



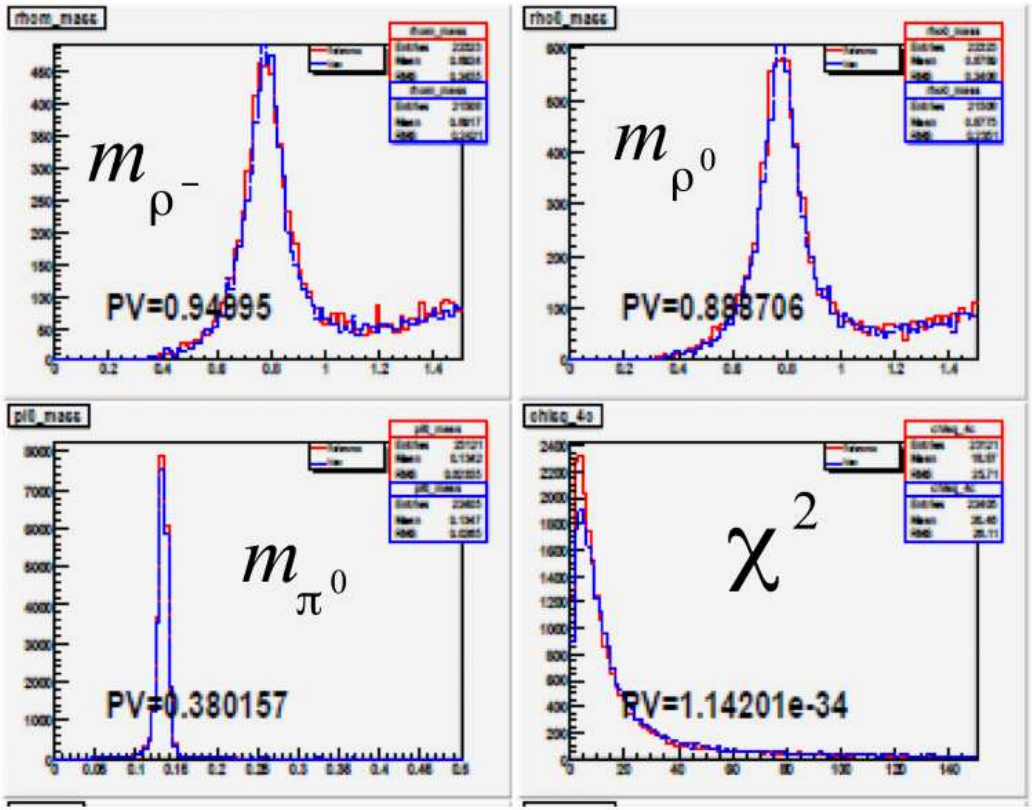
Examples of Data Quality Checks

Software Validation Results

April 13, 2010

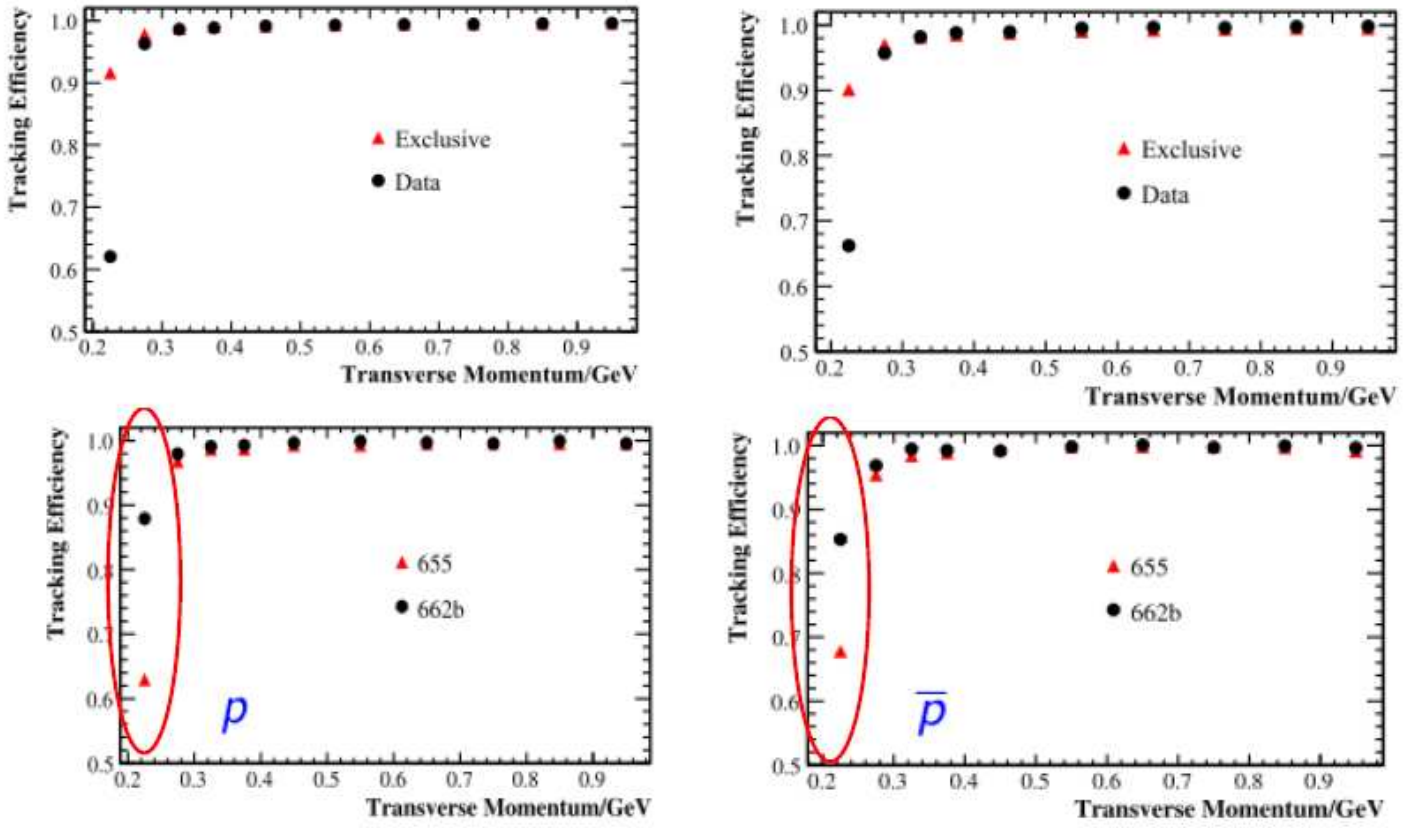
J/ψ ® $\rho\pi$

Contents



Examples of Data Quality Checks

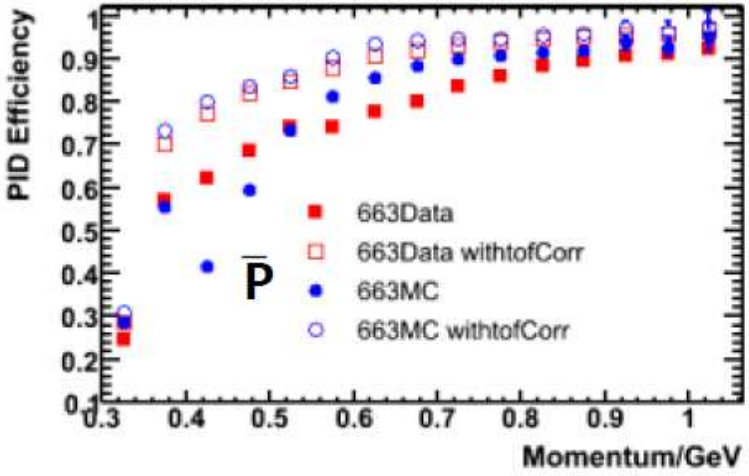
Tracking efficiency (p from $J/\psi \to \bar{p}p\pi\pi$)

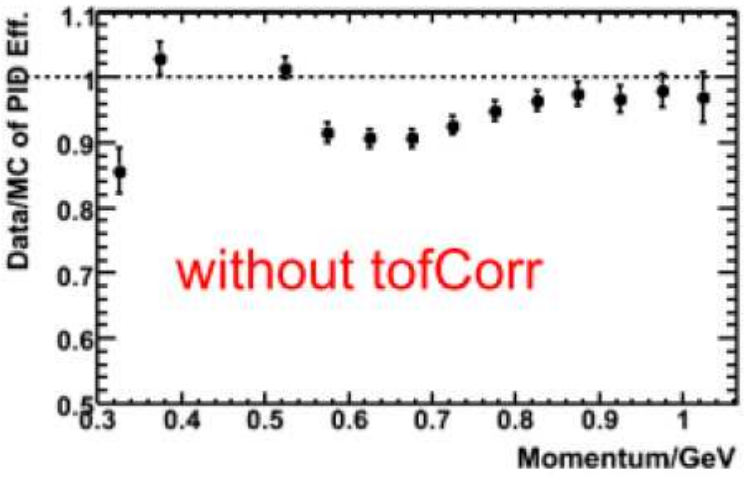


- tracking efficiency for low momentum p, $\bar{p}$ ~40% higher due to the fix of overflow problem.

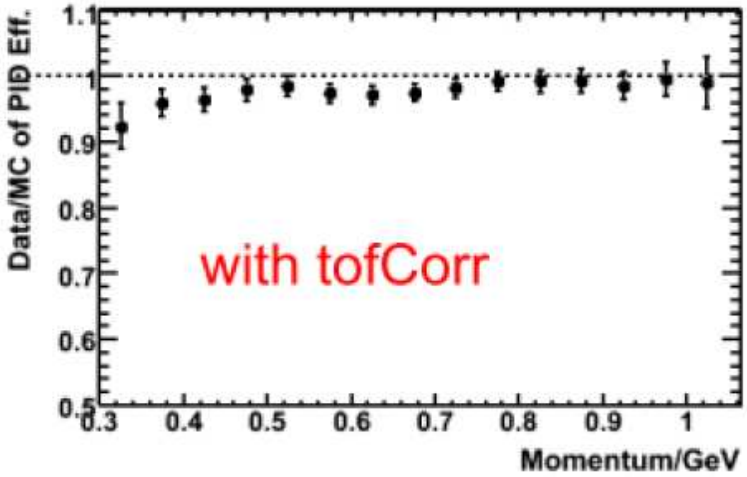
Examples of Data Quality Checks

TOF PID efficiency





- With tofCorr, the PID efficiency improved significantly
- MC/data is more consistence



Summary

- The Data Quality Monitoring(DQM) and Data Quality Assurance (DQA) systems have been introduced, which are based on online and offline reconstruction respectively
- The data quality checks are available on both DQM and DQA system, which ensures the successful and robust data taking and physics analysis on BESIII.

Thank you!