Online Monitoring, Calibration and Reconstruction in the PHENIX experiment

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Outline

- The PHENIX experiment
- Monitoring
- Filtering
- Calibration
- Reconstruction

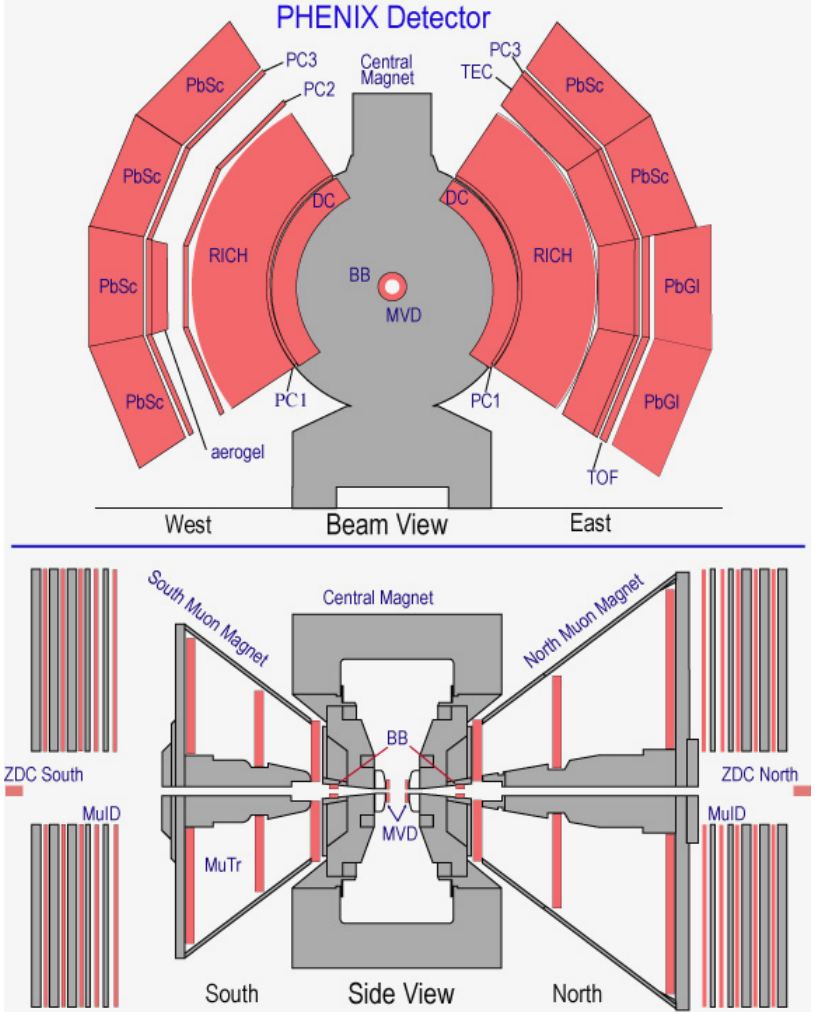
The PHENIX detector

Spectrometer, designed to measure Electrons Muons Photons and Hadrons

It targets rare Event Physics and is therefore designed to take the highest luminosities and make use of selective lvl1 triggers

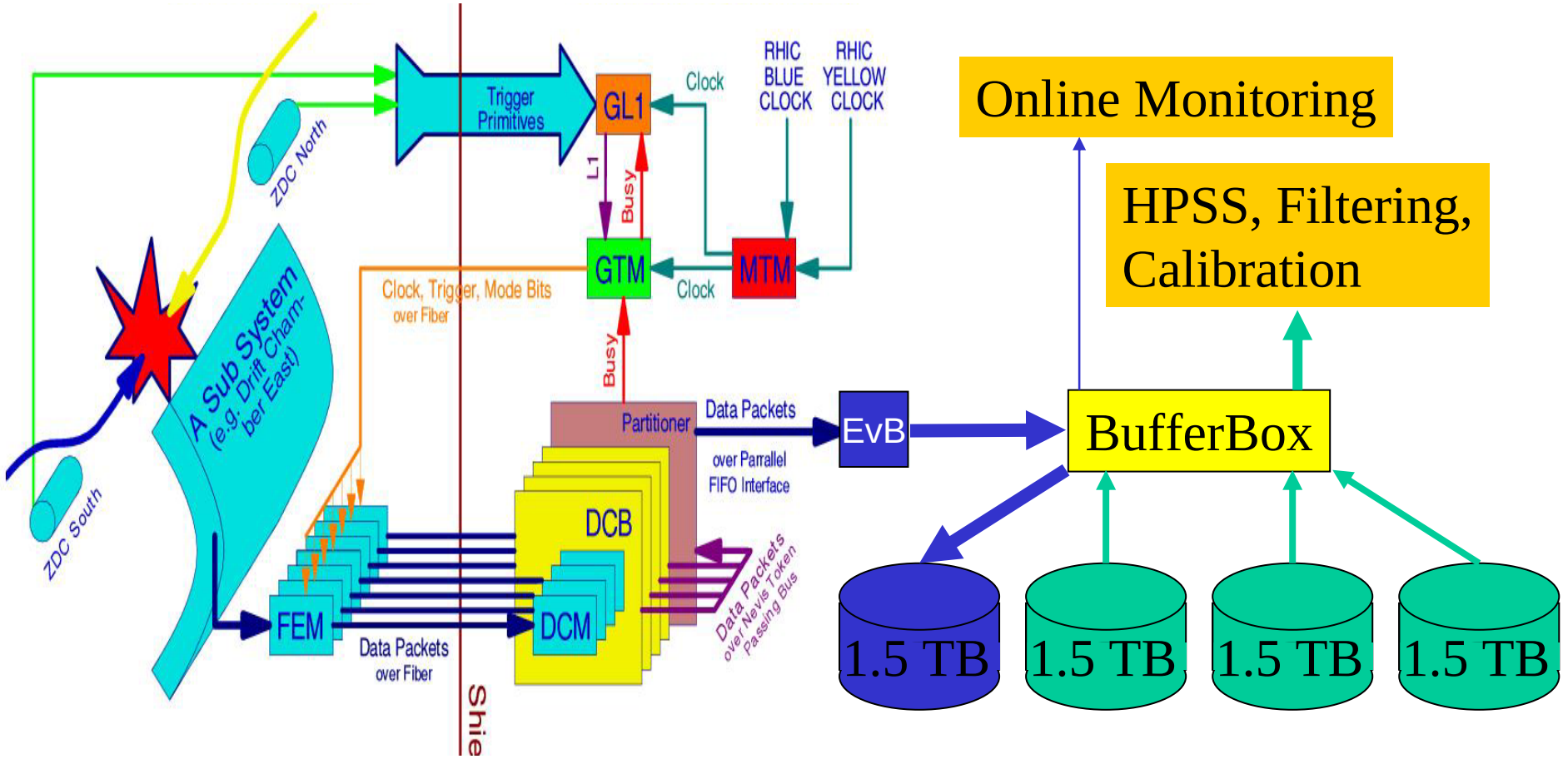
Many many different detector types

So far no two Runs with the same configuration



→Whatever we do in terms of monitoring/calibration/reconstruction
It better be flexible

Data Acquisition



6 BufferBoxes, 6 TB each distributed over 4 filesystems COTS Hardware

5 kHz Event rate, 600MB/s Data rate, currently limited by frontend

Run 5 (2004-2005)

CuCu @ √s= 62GeV ~0.8*10^9 Events

CuCu @ √s=200GeV ~2.2*10^9 Events

Pp @ √s=200GeV ~7.4*10^9 Events

Computing resources

Phenix Counting House :
~80 fast cpus, easy access to all data, ~10 TB local storage

Rhic Computing Facility (rcf):
~1000 cpus, hpss storage, much disk space, 200 MB/sec link

Computing Center Japan (CCJ):
~1000 cpus, hpss storage,
60 MB/sec link, Mickey Chiu, Dantong Yu

Herans Farm, ORNL:
~50 cpus, ~4 TB disk space, David Silvermyr

Online Monitoring

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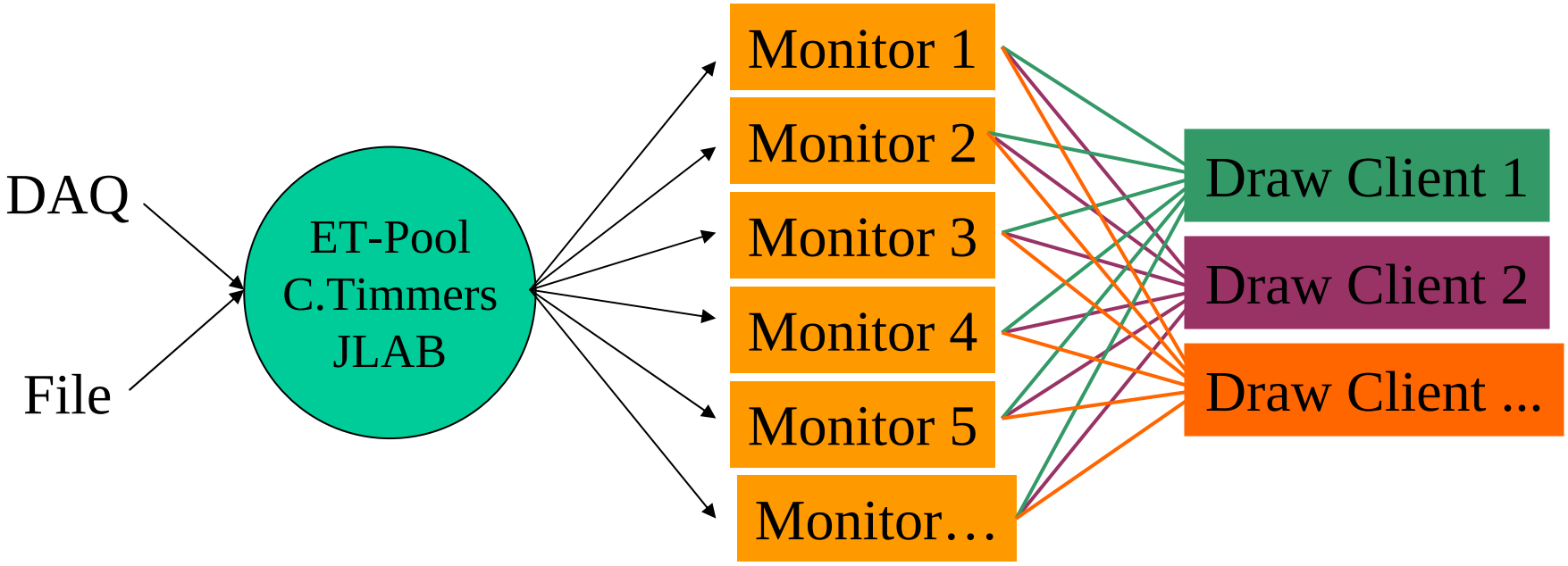
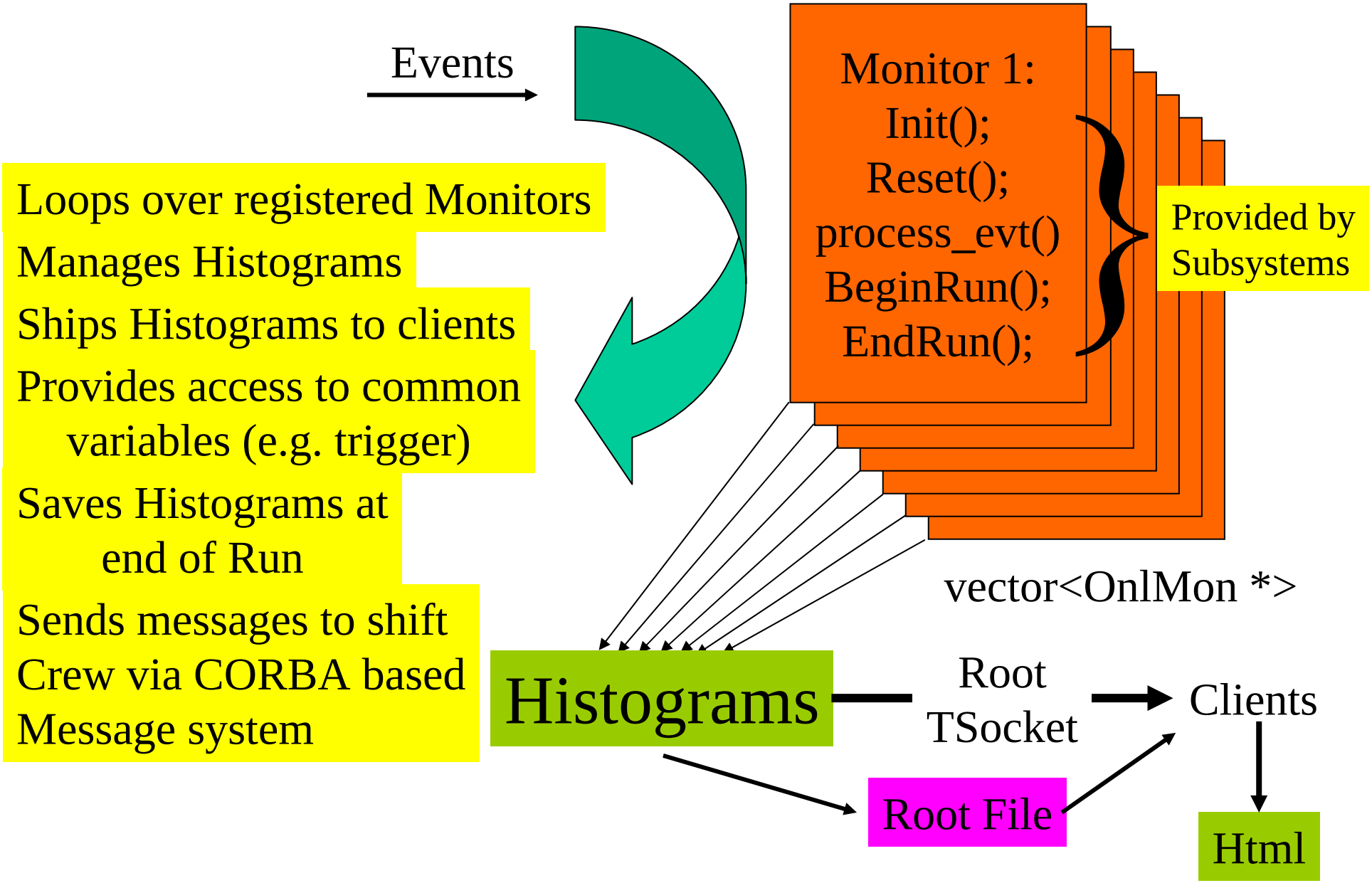
Online Monitoring Dataflow

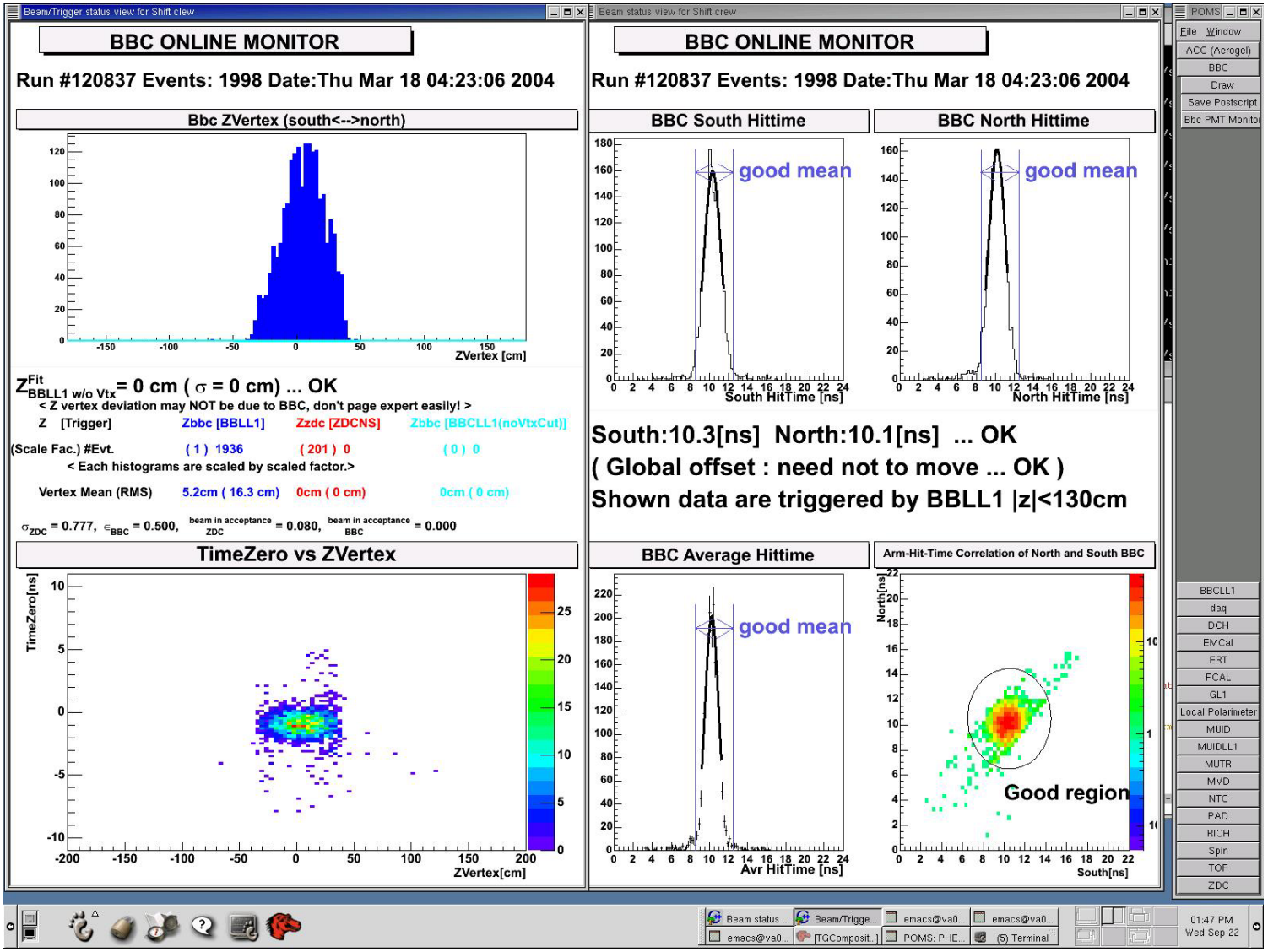


Simple client server architecture
Information is passed via Root histograms
Users only interact with the clients, no Pilot errors interfere with the monitoring
The monitoring code has to survive millions of events

The Server


Events
Monitor 1:
Init();
Reset();
process_evt()
BeginRun();
EndRun();
Provided by Subsystems
Loops over registered Monitors
Manages Histograms
Ships Histograms to clients
Provides access to common variables (e.g. trigger)
Saves Histograms at end of Run
Sends messages to shift Crew via CORBA based Message system
vector<OnlMon *>
Histograms
Root TSocket
Clients
Root File
Html

Shift Crew Gui

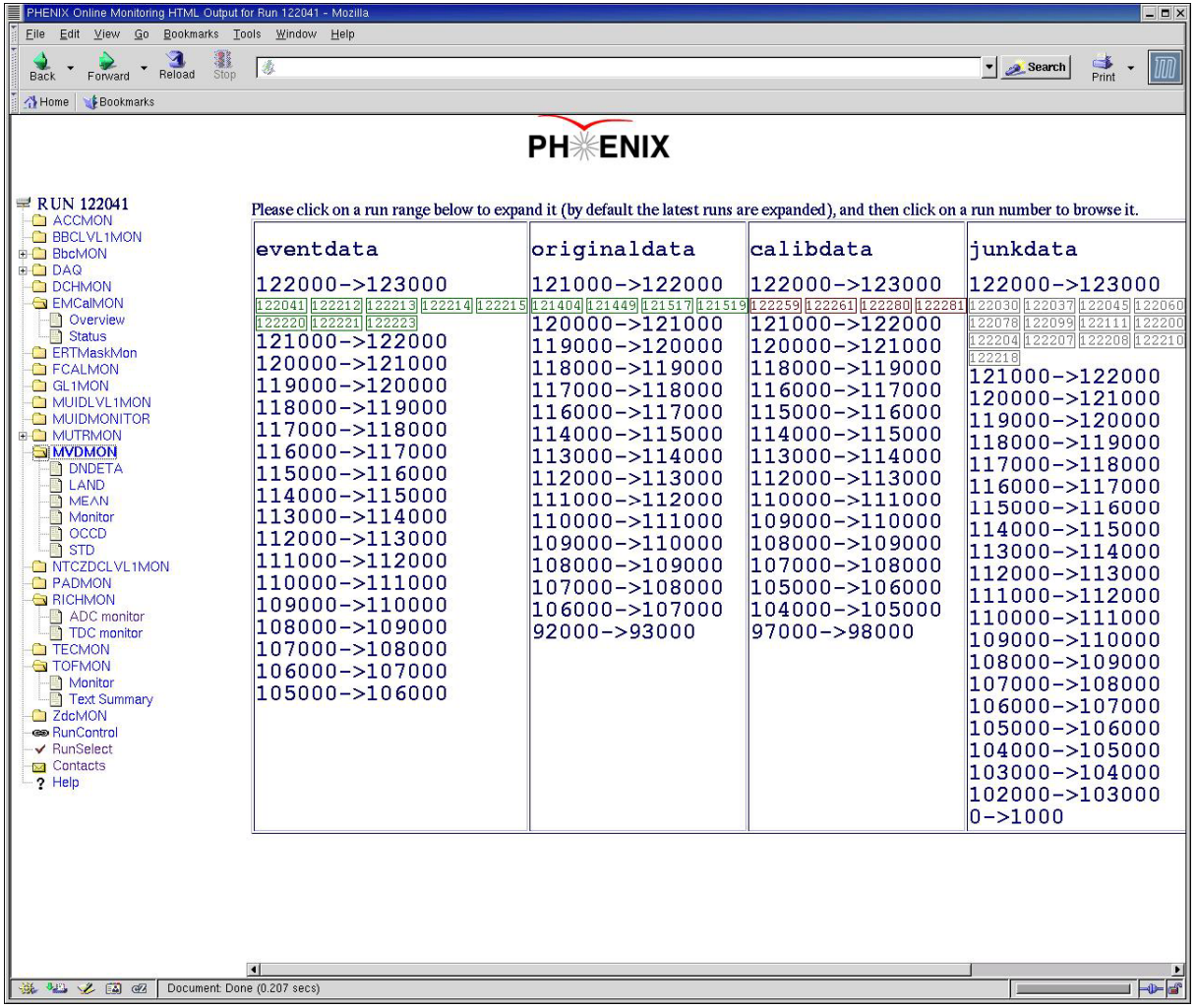


The shift crew uses this simple gui to monitor the all subsystems

Internally it just executes small Root macros

Courtesy of C. McCain

Archiving on the Web



The output of the online monitoring is archived on the web for later reference. Subsystem can add additional plots which are not part of the standard shift crew monitoring

This output is solely generated from the saved root histograms, enabling recovery of this in case of crashes/accidents

Courtesy of
L. Aphecetche

Filtering

No one wants to wait for 6-12 months to start with Physics for which PHENIX was designed

We employ lvl2 trigger algorithms offline to select interesting events for priority reconstruction

We ran 3 lvl2 algorithms
$J/\Psi \rightarrow \mu^+ \mu^-$
$J/\Psi \rightarrow e^+ e^-$
High pt Photon

And for convenience extracted the Laser events (1-2 Hz) which are needed for the calorimeter online calibration

The algorithm rejections are in the order ~500

The resulting much smaller dataset can easily be transferred off site For processing

Online Calibration

Like with the Online Monitoring, limited scope:

Provide ***good enough*** calibrations to run the global tracking, which is the main cpu consumer during reconstruction

This reduces the required calibrations to provide ***accurate enough hit positions*** (but e.g. no fine tuned tof or emc timing).

These calibrations are applied in terms of ***afterburners***, which run as part of our "***Analysis Train***", their impact on cpu consumption is minimal

Even though it is an overkill, we calibrate every run which makes the bookkeeping much simpler in terms of which run is ready for reconstruction

→That leaves drift chamber (drift velocity), pad chamber (noisy channels), emc (energy for clustering), tec (gain) All others are optional (but welcome to join)

Online Reconstruction

The filtered data set is small enough that it can be transferred to A small farm without mass storage for reconstruction like ORNL

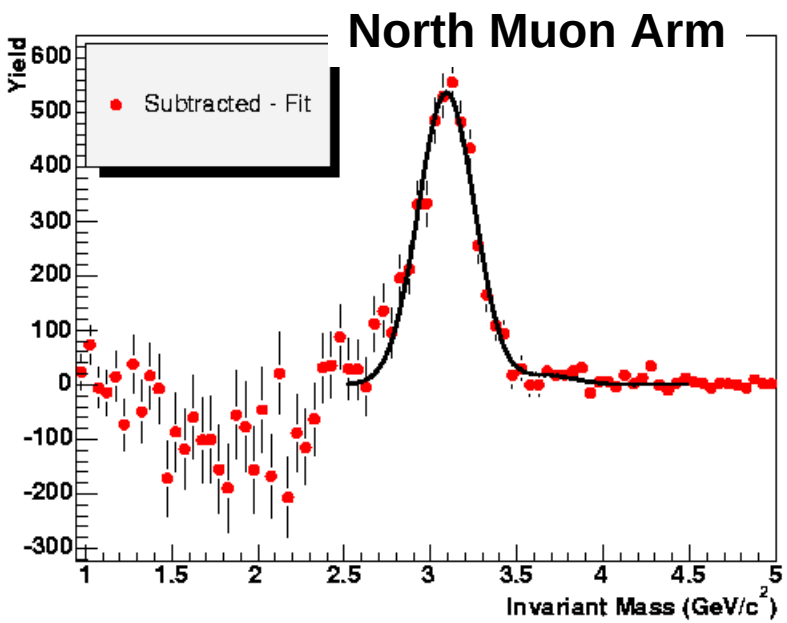
Files were fetched by bbftp and reconstructed as soon as the online calibration was successful. All of this was done by scripts which were run by David Silvermyr when new filtered data became available, the results were available on the web (for the collaboration)

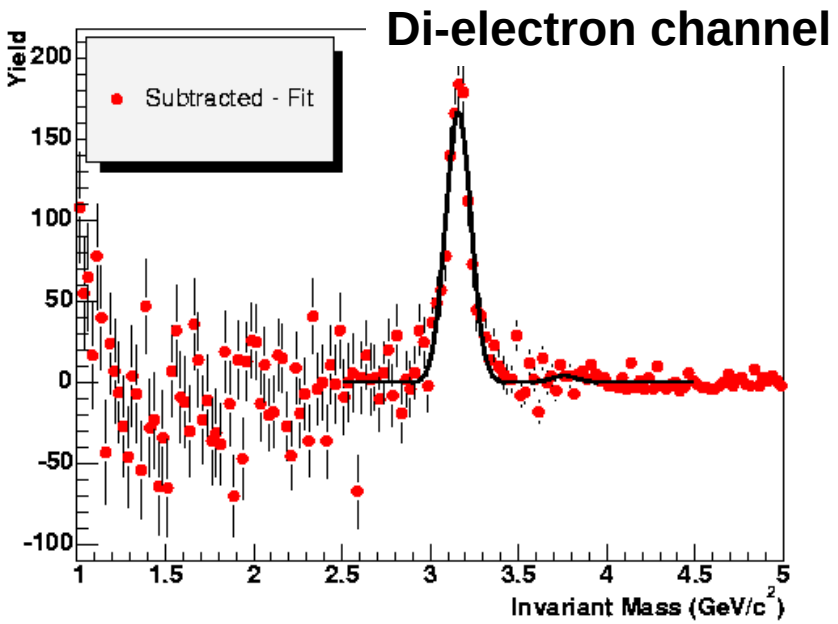
The PHENIX counting house farm provided the reconstruction of minimum bias data which are needed to understand the biases introduced by the filtering.

Both farms use Condor as batch system with only minor glitches

The Choreography

Guis are for show, the real work is done with scripts….





Preliminary results were presented at QM05, 3 months after the run ended

All processes write their status into postgreSQL tables and the shift crew supervises their status via php scripts.

Summary

- Phenix processed 500TB of data in Run5
- Online Monitoring fairly mature and working reliably
- Calibrations for tracking done online
- First time (quasi) online Filtering of the complete data set
- First physics results 4 weeks after beam off
- Testing with Code Checkers (currently valgrind/insure anyone got others?) is essential for surviving millions of events – code which doesn't pass this, doesn't run – period
- It still required to many separate interventions by the shift crew, for this Run we'll try to automatize the complete process, triggered by a file system switch

Our code does so much more than just compile