PhAT

The PHOBOS Analysis Toolkit

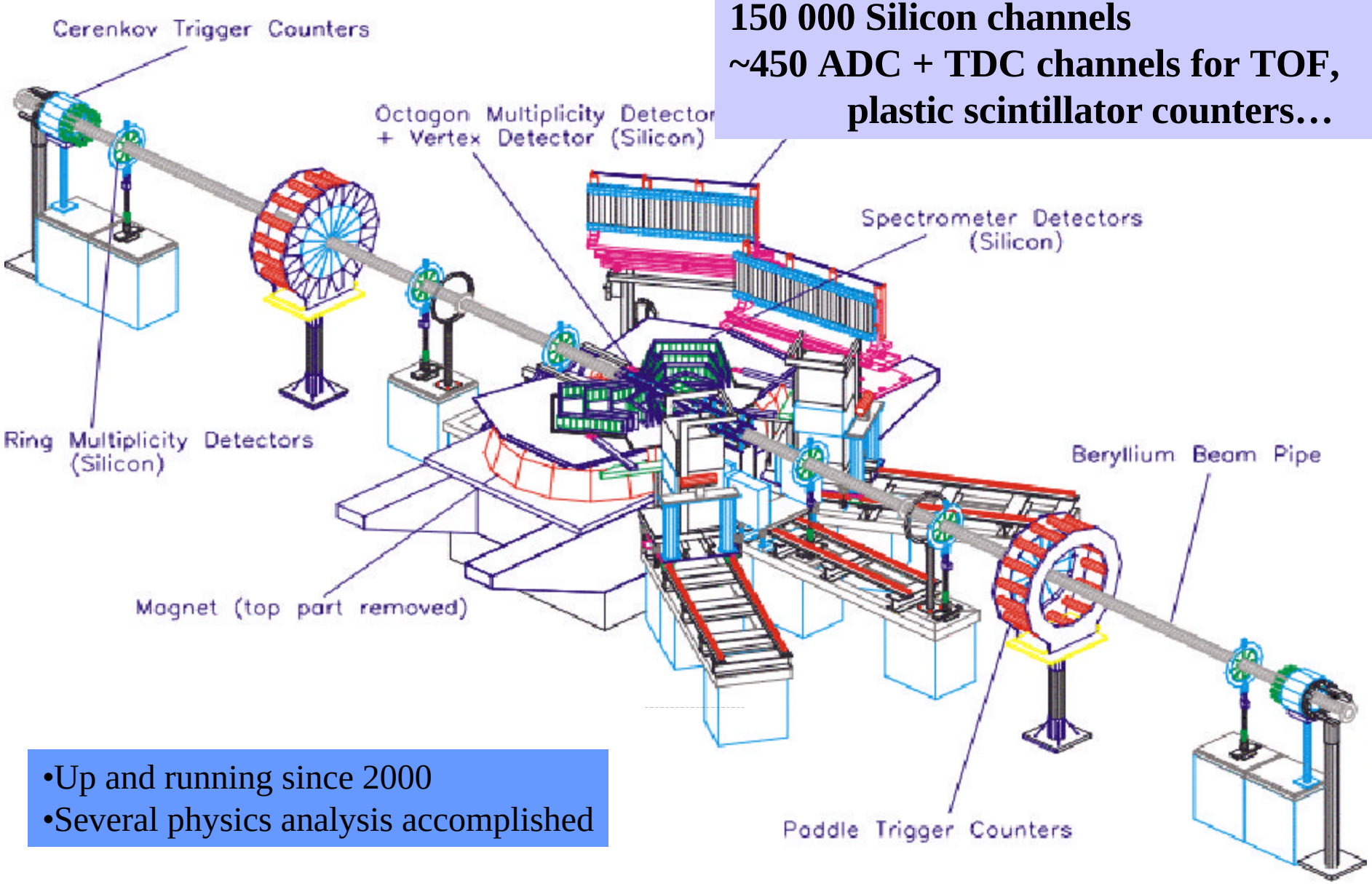
Judith Katzy (MIT)

for

the PHOBOS Collaboration

The PHOBOS experiment at RHIC

150 000 Silicon channels
~450 ADC + TDC channels for TOF, plastic scintillator counters…



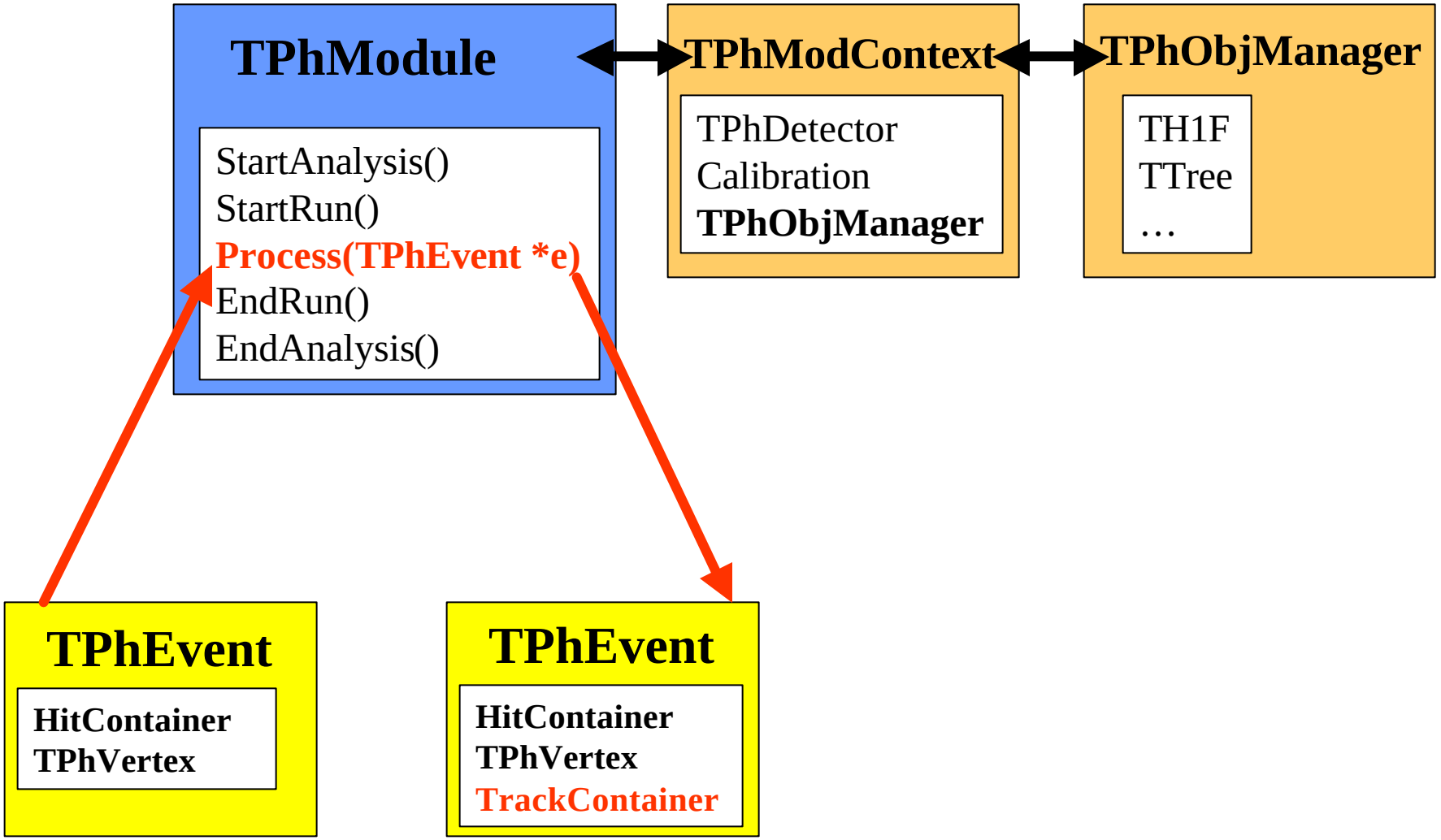
- Up and running since 2000
- Several physics analysis accomplished

The Phobos Analysis Toolkit

- Based on ROOT version 2.25 (upgrade to 3.01 in process)
- About 400 classes
- About 15 developers
- Makes full use of ROOT (I/O, Graphics, Containers, auto documentation, inter-process communication,..)
- Used for all PHOBOS data processing & persistent data, online, PhatDAQ
- Interface to Oracle (G.Heintzelman)
- Interface to GEANT (A.Olszewski, A.Trzupek,K.Wozniak)

Phat Analysis Components

P.Decowski, MIT, G.Heintzelman, BNL, G.Roland, MIT, P.Steinberg, BNL



Reconstruction & Analysis Chain

Design Criteria:

- definition of standard processing chains
- bookkeeping of module parameters during standard reconstruction
- change of processing chains and module parameters without recompilation

Realization:

TPhModule: Smallest processing unit
Example: noise calculation

TPhSuperModule: Processing chain = list of modules in specific order to perform a comprehensive processing task
Example: silicon signal processing

ModuleLibrary: Class with a list of Modules and SuperModules
Filled by default after compilation using setup-macros
Versioning via CVS version stamps

Setup-Macros: Set module parameters
Add modules into supermodules,
Write (super)modules to module lib

Implementation: 152 Modules, 14 Supermodules

TPhDSTs

(P. Decowski, MIT, N.George, ANL , K.Gulbrandsen,MIT,
M.Reuter,UIC, P. Steinberg, BNL)

Design Criteria:

- **quickly read in partial events**
- **selectable tags**
- **keep original interface (TPhEvents)**

Old storage design:

Stream TPhEvents into file
Read back using GetNextEvent()

→ slow with increased data volume

The Solution:

- **Tree based TPhDST underneath data file**
- **Tree stores "SubEvents" = part of event including all pointer dependence**

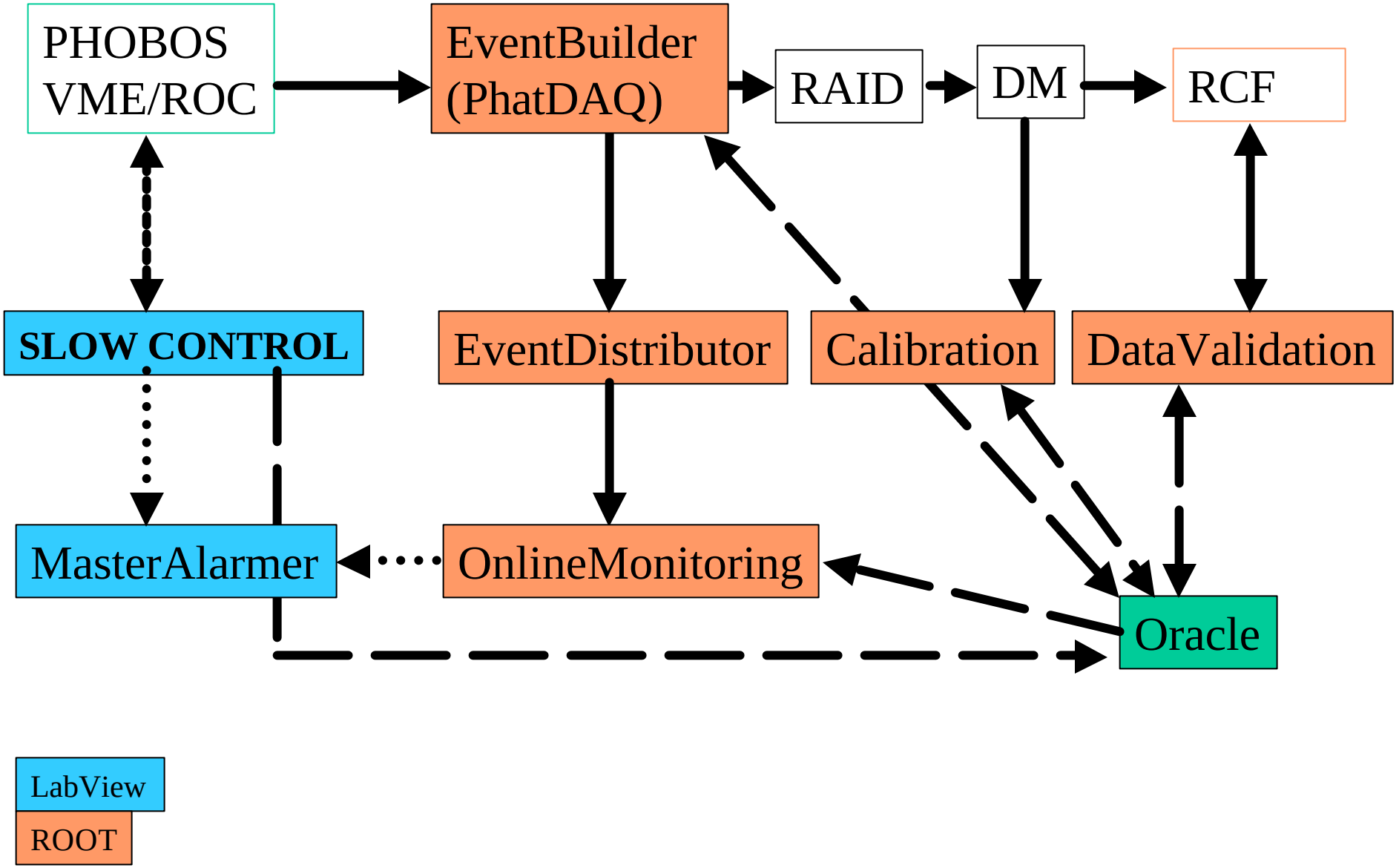
→ **TPhEvent with selected info can be dynamically reconstructed**

- **Tree stores "TagDB" = basic types containing relevant physics information**

→ **drawable to perform first analysis / data selection**

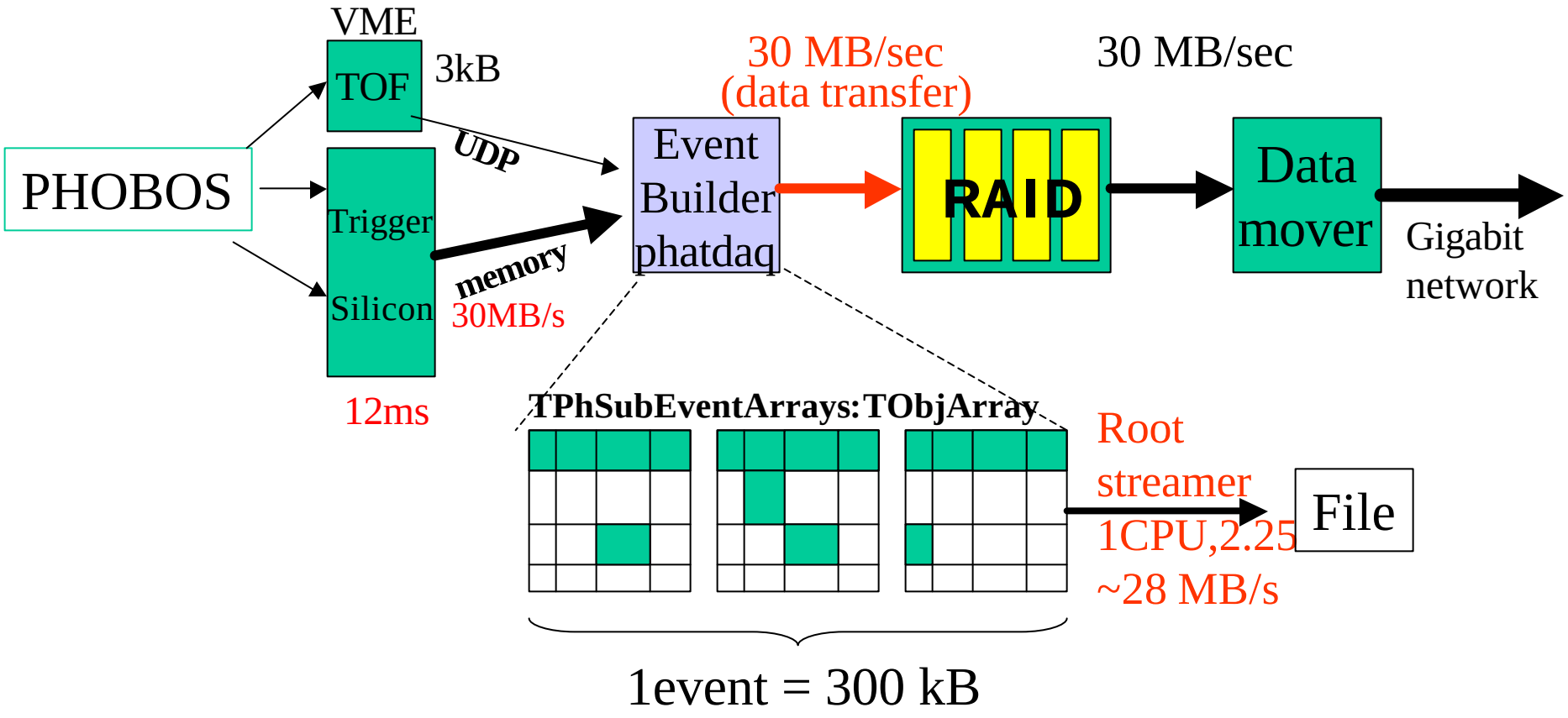
about 10 % overhead in data volume

PHOBOS Online Data Flow



PHOBOS Data acquisition - PhATDAQ

(P.Sarin, MIT, A. Sukhanov,BNL)



- Currently Data transfer rates not limited by ROOT streamer!

Online Monitoring - Design

(B.Holzman, BNL, J.Katzy, MIT, G.van Nieuwenhuizen, MIT, P.Steinberg BNL)

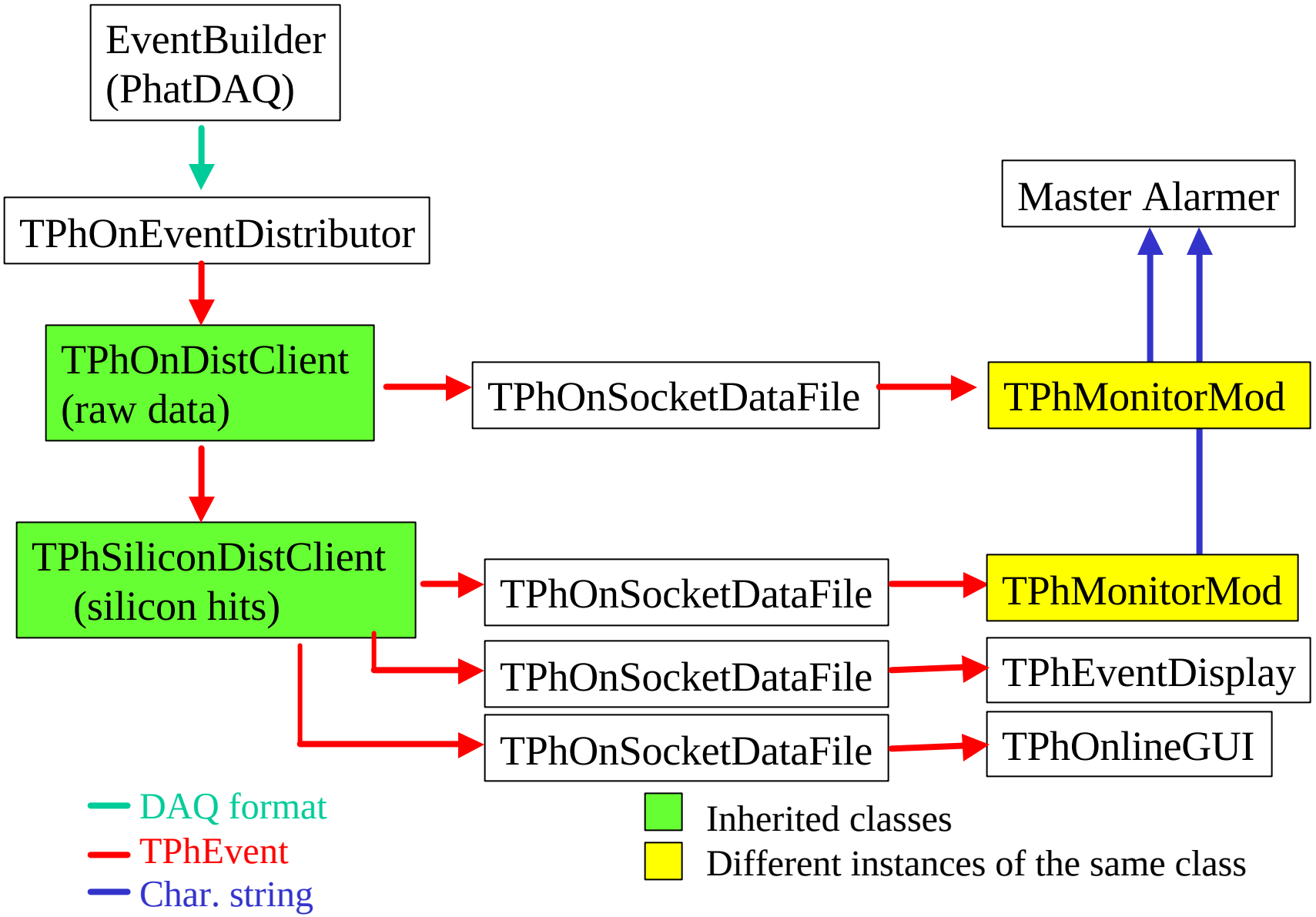
Online Monitoring Needs:

- direct access to data from DAQ
- CPU optimized data reconstruction
- (fast) data analysis & warning mechanism
- event display
- histogram display with easy&fast access

Solution:

- all data transfer via unix socket (poll/push)
- distributed processing
- separate clients for each controlling task
- master alarmer for all (LabView&ROOT) process status display
- master GUI with navigator to access histograms and choose from available event displays

Online Monitoring – Implementation



File management based on ROOT Daemon

P.Decowski

- **Basic idea:** **Access distributed disks on a linux farm using rootd & TNetFile. Have one central place where all nodes can find information about the data file location.**

- **DB :** ASCII file, ORACLE
- **Hardware:** IDE disk
  $5k / TB ("distributed IDE")
  compare to >$ 30k / TB (one central RAID)
- **Data Transfer:** rootd(aemon) transfers data to actual node with 4.5 MB/sec
  disk read/write 6-7 MB/sec (cpu bound)
  comparable with nfs
- **User interface:** Transparent to the user (TPhDST("rootd:/….")
  Database (RootDB) knows location of files (ASCII file, Oracle DB)
- **Experience:** 12-node "pharm" used as production environment for last 12 month
  accessing 2.5 TB of files on disk
  moving to 80-node farm at RCF with ~ 9TB of disks accessible
- **Outlook:** still moving data to CPU – ideal application for PROOF

Summary

- Phat is a framework build on top of ROOT
- Phobos DAQ and online system based on ROOT
- Phobos' DST structures TTree based
- rootd fast & cheap solution for disk management
- Have a look at www.phobos.bnl.gov and www.rhic.bnl.gov/~phobos/PhatSrc/USER_Index.html

The Wish List

- PROOF functionality
- Poll/Select functionality in TSocket
- Allowing cross reference pointers
  across branches in TTrees

Benchmarking File I/O

The test: 2300 events, read in a event loop, no selection, file access via rootd

The result:	Real Time(s)	CPU Time(s)
Files containing TPhEvents:	202	133
Files containing trees with SubEvents and SummaryParameters all Branches:	305	157
Summary+Vertex+Trigger	50	36
Summary+Vertex+Trigger+Spectrometer	201	93