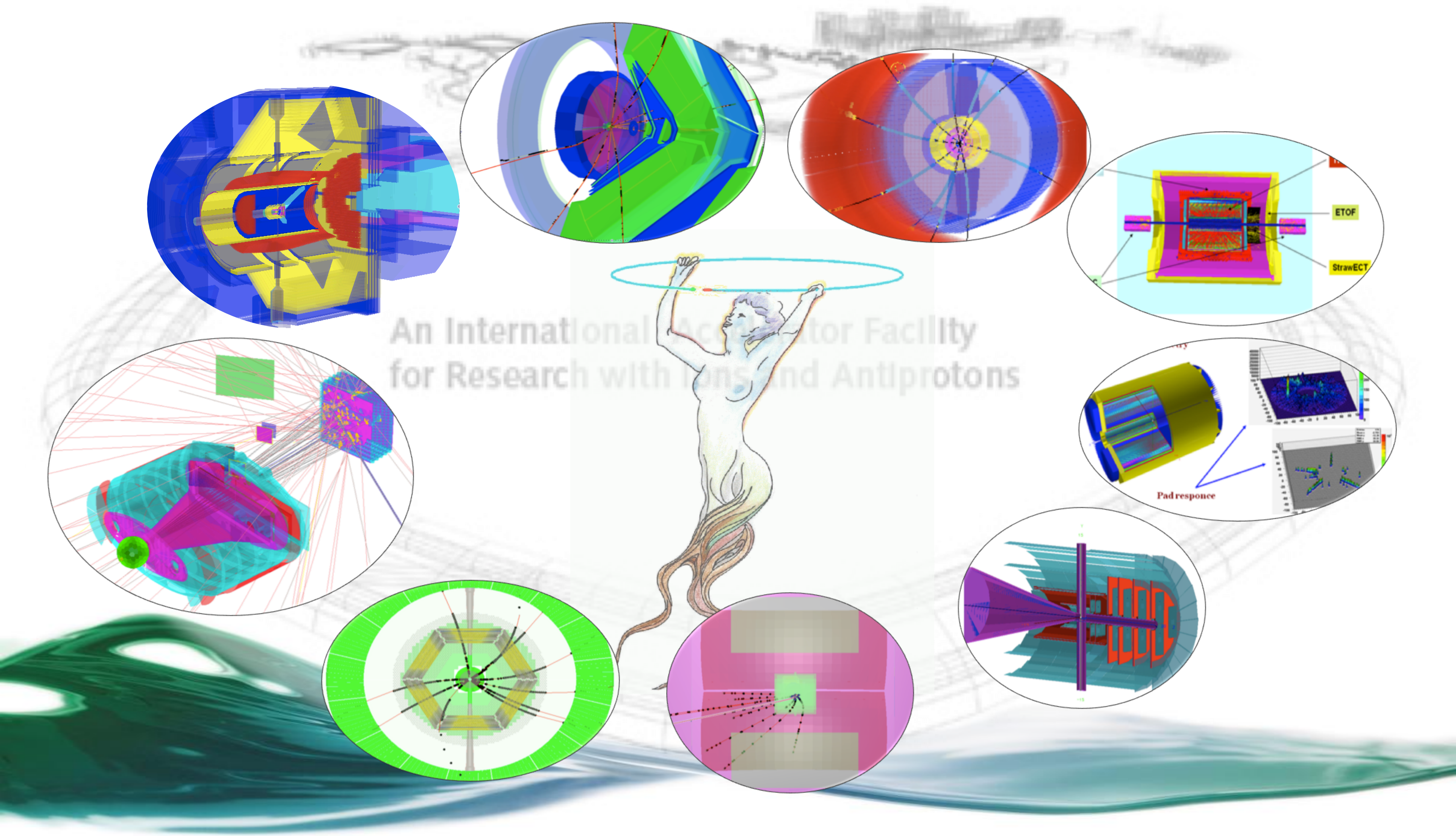
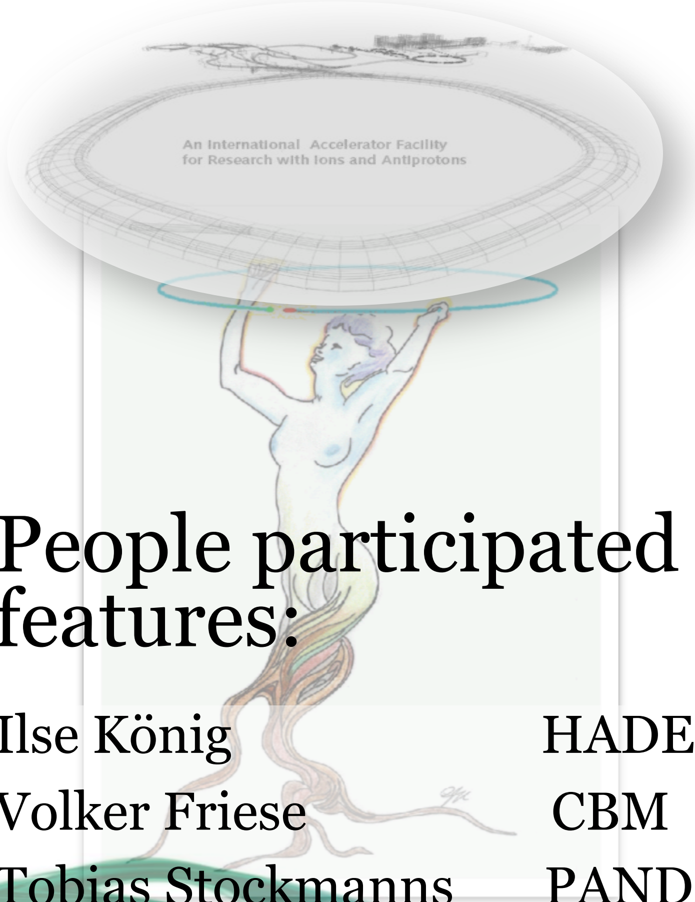
FairRoot Status Report


An International Accelerator Facility
for Research with Ions and Antiprotons
ETOF
StrawECT
Pad responce

FairRoot Developers:

Core Team:

Mohammad Al-Turany	GSI-IT	2003
Denis Bertini	GSI-IT	2003
Florian Uhlig	CBM/IT	2006
Radek Karabowicz	PANDA/IT	2008
Dmytro Kresan	R3B/IT	2011

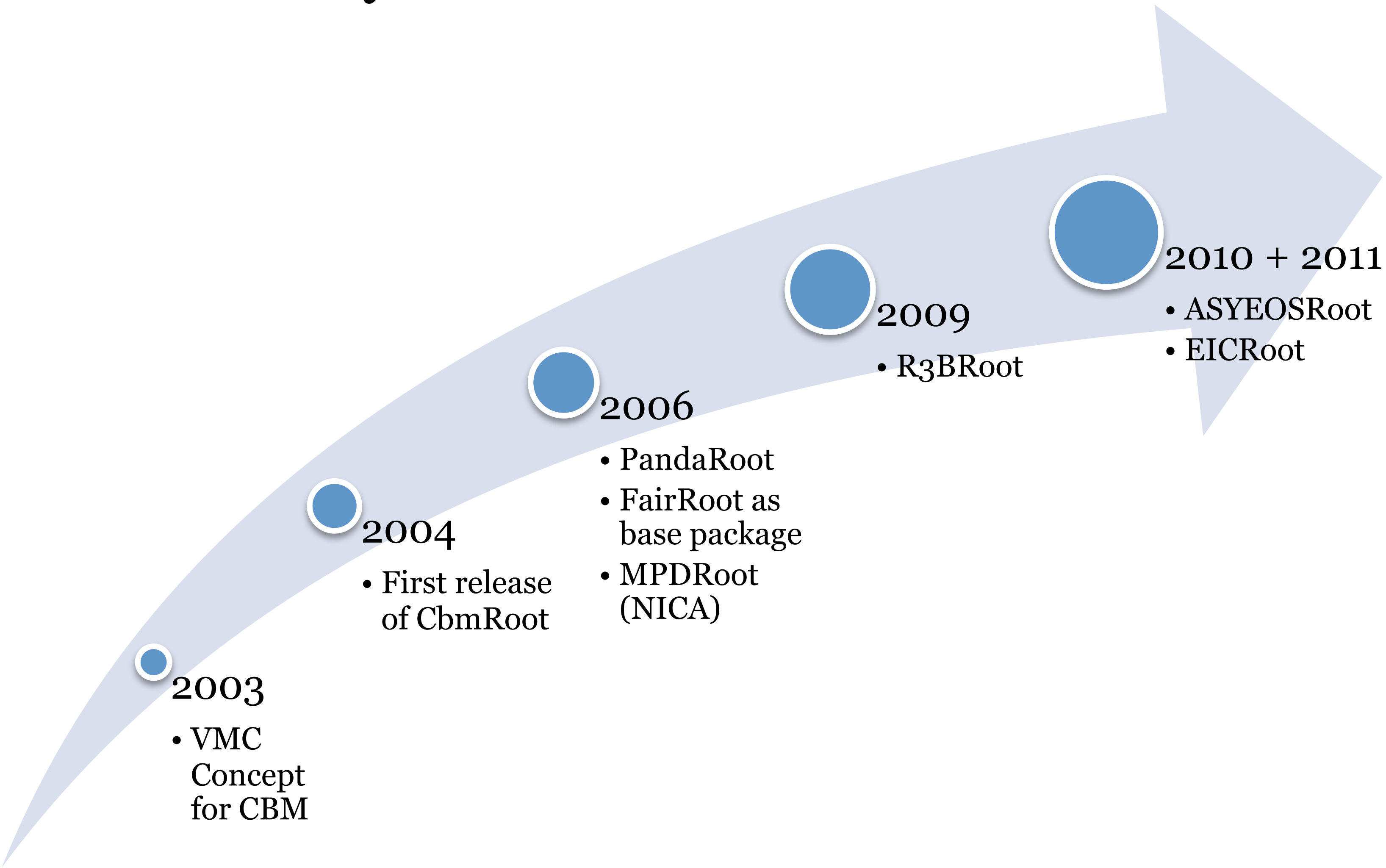

An International Accelerator Facility
for Research with Ions and Antiprotons

People participated to major features:

Ilse König	HADES
Volker Friese	CBM
Tobias Stockmanns	PANDA

long list of people who have contributed pieces of code to FairRoot since the project started end of 2003

FairRoot history



2003

- VMC Concept for CBM

2004

- First release of CbmRoot

2006

- PandaRoot
- FairRoot as base package
- MPDRoot (NICA)

2009

- R3BRoot

2010 + 2011

- ASYEOSRoot
- EICRoot

Experiments using FairRoot at FAIR-GSI

- Panda, CBM
  - Should be known
- ASYEOS
  - Measurement of the symmetry energy for asymmetric nuclear matter
  - Running experiment at GSI using the Aladin Magnet and the Land detector
- NUSTAR
  - Adopted by **R3B** and other nuclear physics experiments (ELISE, ASYEOS, EXL (Active Target), RIBRAS (Sao Paulo)…)
  - Adopted by the **NUSTAR SWG** as the main framework for simulation and analysis
  - Chosen as the main framework for the Joint Research Activities **JRA05 of ENSAR** (**SINuRSE:** Simulations for Nuclear and Structure in Europe)

Experiments using FairRoot outside FAIR-GSI

- MPD
  - Multi Purpose Detector at the Nuclotron-based Ion Collider fAcillity
  - study of hot and dense baryonic matter
  - http://nica.jinr.ru/
- EIC
  - Electron Ion Collider

EIC

- Proposed new accelerator at the Brookhaven National Lab
- Energy ranges:
  - 5-30 GeV elctrons
  - 50-325 GeV polarized protons or up to 130 GeV/u gold ions
- Some nice statements taken from a talk given by Yulia Zulka

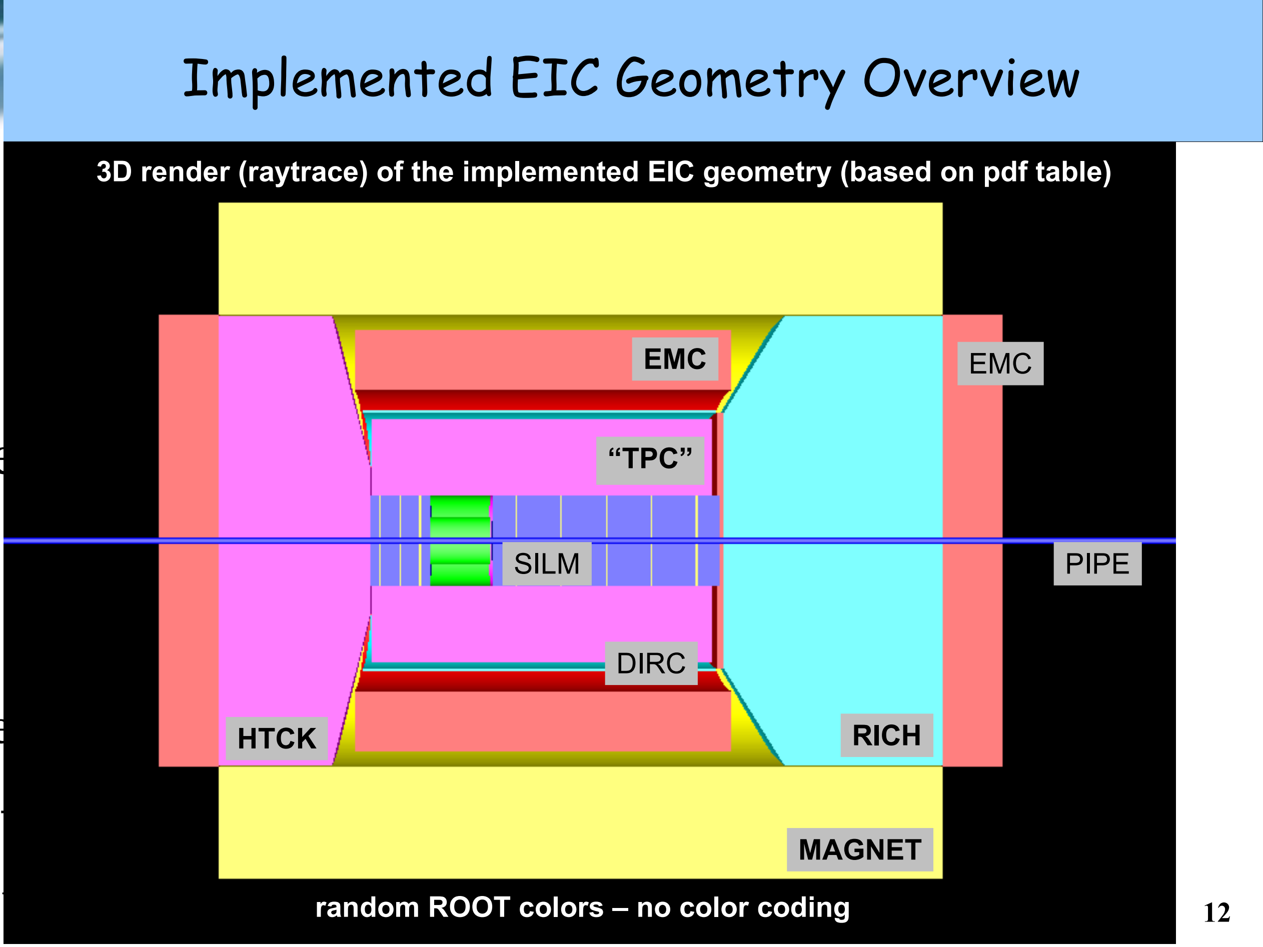
  http://www.phenix.bnl.gov/WWW/publish/elke/EIC/TF-Meetings/

- EICRoot opens path forward to detailed simulations and core concept verifications, so we can make stronger case for Letter of Intent / CDR, utilizing newest software designed for HEP, using single software package.
- Well-designed underlying framework (FairRoot) allows rapid progress with simulations. Some basic checks were described in this presentation. Large user base allows “borrowing” detector geometries from other experiments for testing, with minimal effort.

EIC

- Proposed new accele
- Energy ranges:
  - 5-30 GeV elctrons
  - 50-325 GeV polarize
- Some nice statemen

  http://www.phenix.



Implemented EIC Geometry Overview

3D render (raytrace) of the implemented EIC geometry (based on pdf table)

random ROOT colors – no color coding

12

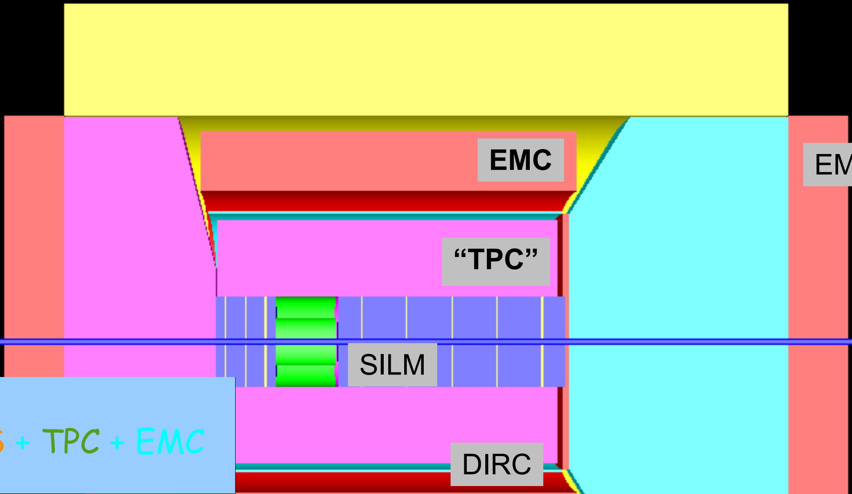
- EICRoot opens path forward to detailed simulations and core concept verifications, so we can make stronger case for Letter of Intent / CDR, utilizing newest software designed for HEP, using single software package.
- Well-designed underlying framework (FairRoot) allows rapid progress with simulations. Some basic checks were described in this presentation. Large user base allows "borrowing" detector geometries from other experiments for testing, with minimal effort.

EIC

- Proposed new accele
- Energy ranges:

Implemented EIC Geometry Overview

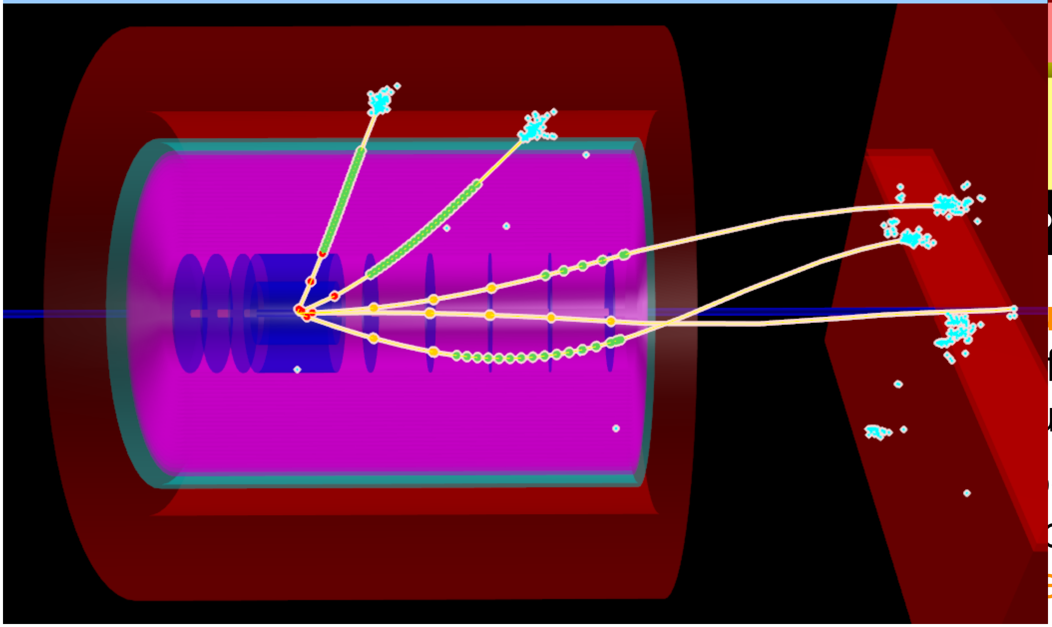
3D render (raytrace) of the implemented EIC geometry (based on pdf table)



m ROOT colors – no color coding

12

MC Hits display: five e^- generated hits in SIT + TRS + TPC + EMC



FairBoxGenerator: 5 electrons with p = 1 GeV, fired at random eta / phi for a hit test

13

lations and core concept for Letter of Intent / CDR, using single software package.

ot) allows rapid progress with ped in this presentation. Large etries from other experiments

New and ongoing developments:

- Proof Integration in FairRoot (See talk by Radek)
- MBS API is now in FairRoot:
  - Reading lmd files (ready)
  - Communicating with the DAQ directly (API is available)
- Event time:
  - During Simulation (old)
  - After Simulation (new)
- Signal-Background mixing (event or time based)
- Time dependent simulation (See talk by Tobias)
- New concept for Database connectivity
- GPU usage
- Webtools

PROOF in FairRoot

- PROOF - Parallel ROOt Facility:

  - Extension of ROOT allowing transparent analysis of large sets of ROOT files in parallel on remote computer clusters or multi-core computers (ROOT Users Guide)

  - The data processed with PROOF can reside on local computer, PROOF cluster disks or grid

- PROOF integration to FairRoot - goals:

  - implement the necessary FairRoot changes in the base classes (accessible to all experiment codes using FairRoot)

  - minimize changes, which the user has to implement in order to run on PROOF (both in users’ code and the starting macros)

Fully integrated in FairRoot

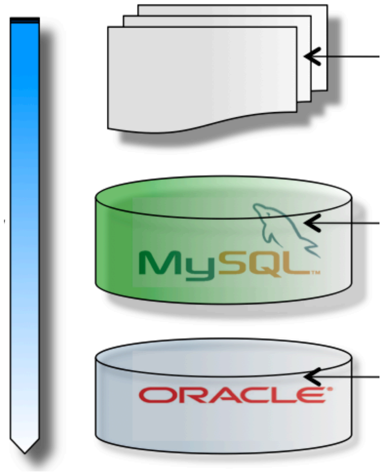
- No changes in user code
- Changes in macro: fRun->Run(start,end,"proof");
- Using PROOF pays off for analysis of large amounts of data
- For results please see Radeks talk

Time dependent simulation

- Monte-Carlo simulations deliver events that can be treated completely independent of each other and time between events does not play a role.
- This is not the reality in experiments:
  - Sensor elements are still blocked from previous hits
  - Electronic is still busy
  - Hits too close in time cannot be distinguished
  - …
  - PANDA and CBM:
    - Continuous beam with Poisson statistics -> many events with short time between them
    - No hardware trigger

FairRoot Database connectivity (Concept)

- **Fast varying** setup in nuclear physics experiments, urging the framework to support Database connectivity
- **New Database interface design** based on RDBC (TSQLServer) as lowest level API which provides uniform interface to Oracle, MySQL, PgSQL, SapDb.



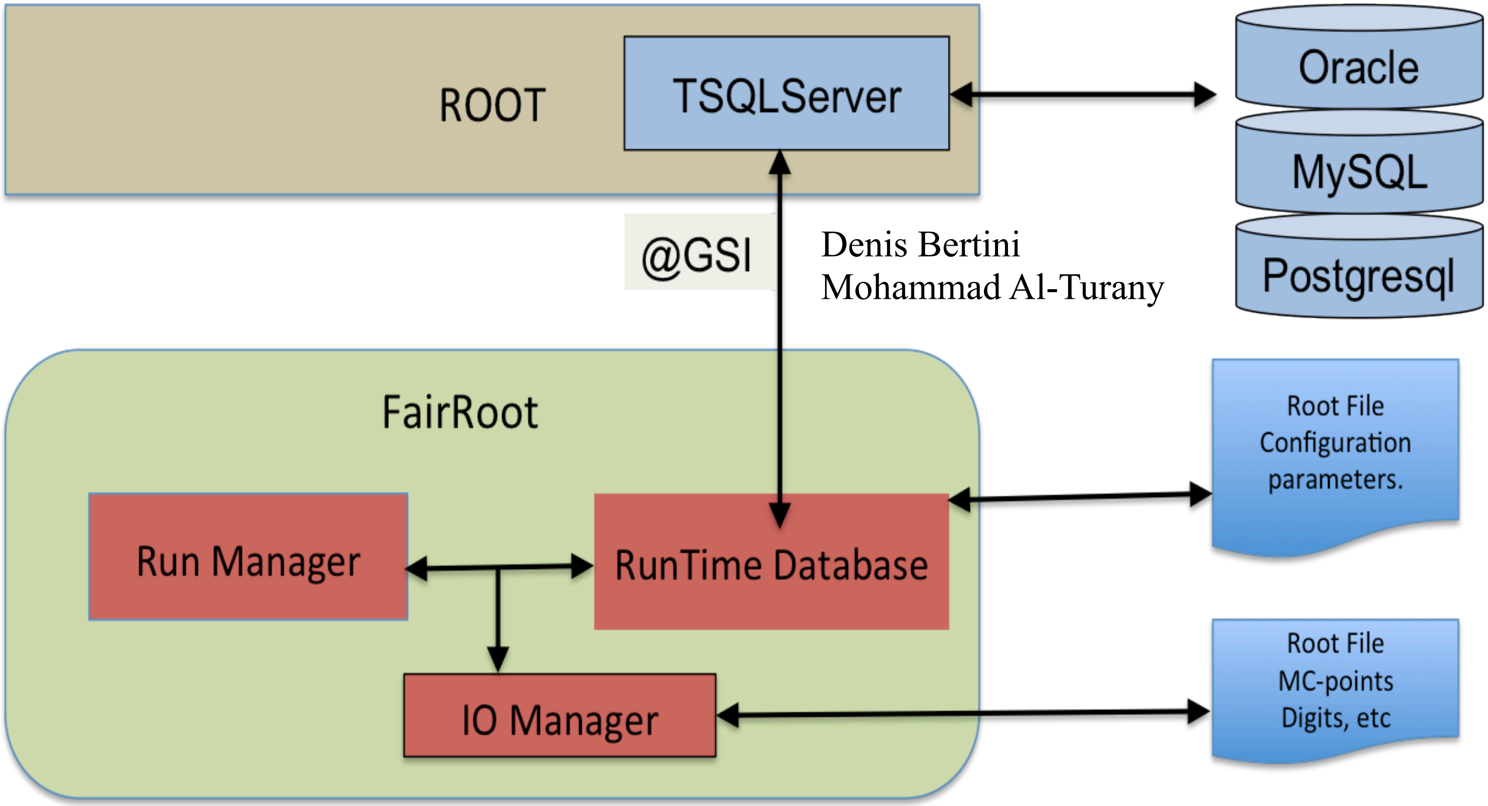
Query order

Ascii tables: for testing of new and non standard data

Local MySQL: for standard production work data

Remote ORACLE: As archiving store

Database connection (concept)



@GSI

Denis Bertini
Mohammad Al-Turany

Runtime Database

- *RootFileIo*
- AsciiFileIO
- TSQLIO(Generic & detector pars)

@KVI

Mohammad Babai

FairRoot Database connectivity (Status)

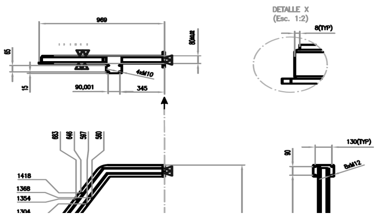
- Remove the HADES Oracle implementation from repository
- Keep the Run time data as interface
- Replace the Oracle IO classes by a TSQLServer based implementation
- Experiments are free to choose data there favorite data base, design the tables and choose how to validate

CAD to Root converter

- Each experiment (Panda, CBM and R3B) has his own converter
- Is it possible to join the efforts?

R3BRoot : CAD to ROOT a practical approach

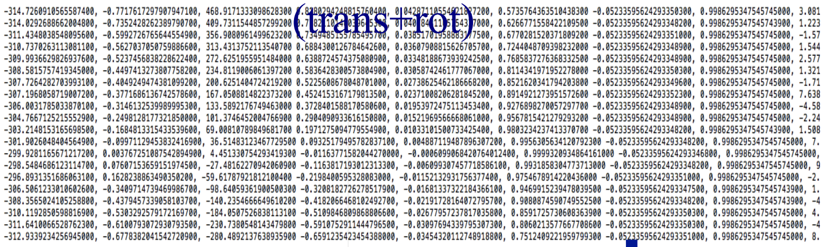
CAD model



(ISO)
STEP-214
exchange
format

Geo. information extracted using perl scripts:
alveolus and crystal dimension and positioning

(trans+rot)



```
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-314.0292688662004800, -0.7352428262389790700, 409.7311544857299200 0.7782110140396453300, 0.0407840110515437000, 0.6266771558422109500 -0.05233595624293348200, 0.9986295347545743900, 1.223
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```
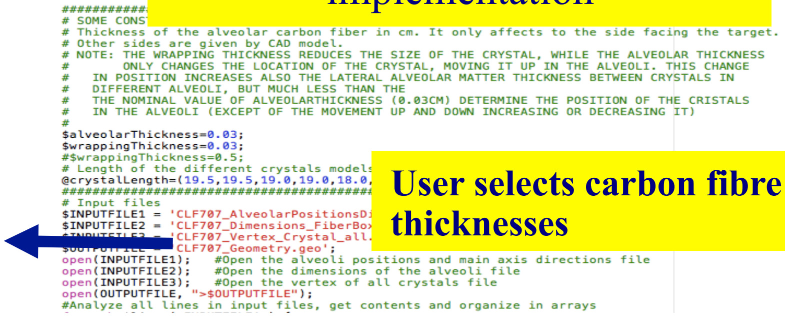
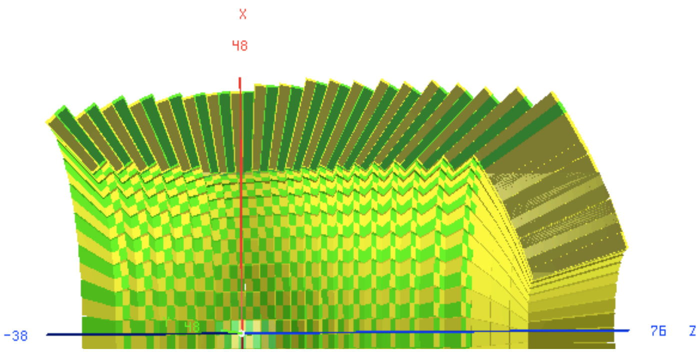

User configurable perl script
generates Root (C++) geo
implementation



```
############
# SOME CONS
# Thickness of the alveolar carbon fiber in cm. It only affects to the side facing the target.
# Other sides are given by CAD model.
# NOTE: THE WRAPPING THICKNESS REDUCES THE SIZE OF THE CRYSTAL, WHILE THE ALVEOLAR THICKNESS
#       ONLY CHANGES THE LOCATION OF THE CRYSTAL, MOVING IT UP IN THE ALVEOLI. THIS CHANGE
#   IN POSITION INCREASES ALSO THE LATERAL ALVEOLAR MATTER THICKNESS BETWEEN CRYSTALS IN
#   DIFFERENT ALVEOLI, BUT MUCH LESS THAN THE
#   THE NOMINAL VALUE OF ALVEOLARTHICKNESS (0.03CM) DETERMINE THE POSITION OF THE CRISTALS
#   IN THE ALVEOLI (EXCEPT OF THE MOVEMENT UP AND DOWN INCREASING OR DECREASING IT)
#
$alveolarThickness=0.03;
$wrappingThickness=0.03;
#$wrappingThickness=0.5;
# Length of the different crystals models
@crystalLength=(19.5,19.5,19.0,19.0,18.0,
##########################################
# Input files
$INPUTFILE1 = 'CLF707_AlveolarPositionsDi
$INPUTFILE2 = 'CLF707_Dimensions_FiberBox
$INPUTFILE3 = 'CLF707_Vertex_Crystal_all.
$OUTPUTFILE = 'CLF707_Geometry.geo';
open(INPUTFILE1);   #Open the alveoli positions and main axis directions file
open(INPUTFILE2);   #Open the dimensions of the alveoli file
open(INPUTFILE3);   #Open the vertex of all crystals file
open(OUTPUTFILE, ">$OUTPUTFILE");
#Analyze all lines in input files, get contents and organize in arrays
```

User selects carbon fibre and wrapping thicknesses

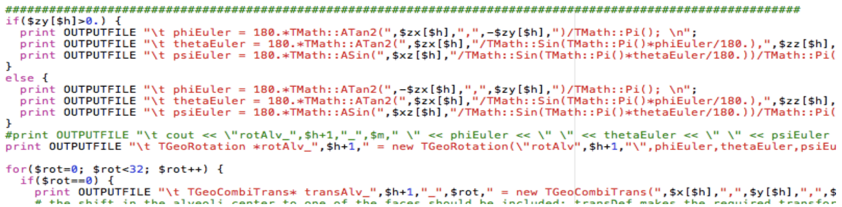


Geometry support in R3BRoot:

- support for different geometrical version recompilation, ((R3BCalo *)calo)->SelectGeometryVersion(6)

-crystal geo parameters available in the code R3BCaloHitFinder::GetAngles(Int_t iD, Double_t* polar, Double_t* azimuthal, Double_t* rho);

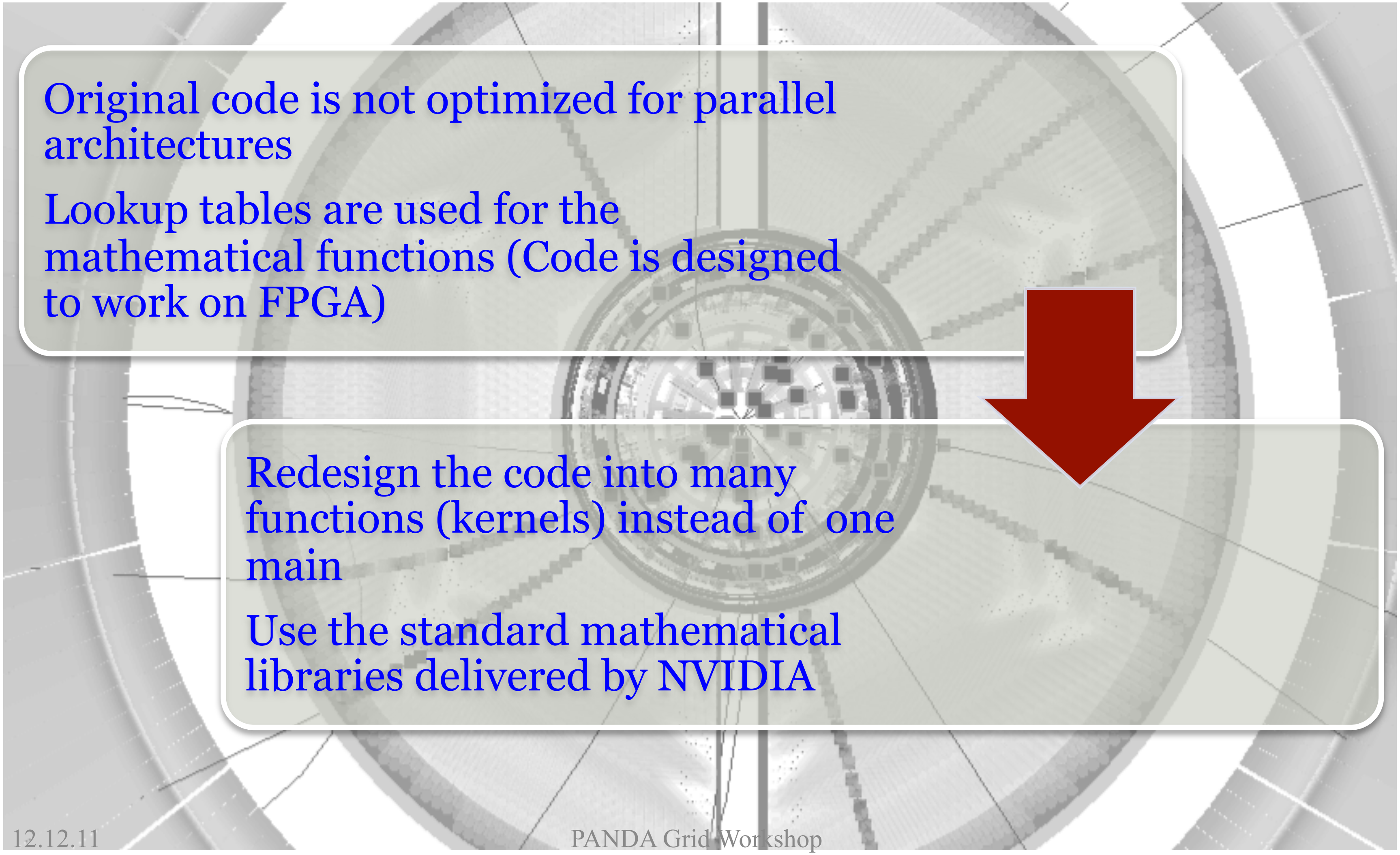
…



```
#########################################################################################
if($zy[$h]>0.) {
  print OUTPUTFILE "\t phiEuler = 180.*TMath::ATan2(",$zx[$h],",",-$zy[$h],")/TMath::Pi(); \n";
  print OUTPUTFILE "\t thetaEuler = 180.*TMath::ATan2(",$zx[$h],"/TMath::Sin(TMath::Pi()*phiEuler/180.),",$zz[$h],
  print OUTPUTFILE "\t psiEuler = 180.*TMath::ASin(",$xz[$h],"/TMath::Sin(TMath::Pi()*thetaEuler/180.))/TMath::Pi(
}
else {
  print OUTPUTFILE "\t phiEuler = 180.*TMath::ATan2(",-$zx[$h],",",$zy[$h],")/TMath::Pi(); \n";
  print OUTPUTFILE "\t thetaEuler = 180.*TMath::ATan2(",$zx[$h],"/TMath::Sin(TMath::Pi()*phiEuler/180.),",$zz[$h],
  print OUTPUTFILE "\t psiEuler = 180.*TMath::ASin(",$xz[$h],"/TMath::Sin(TMath::Pi()*thetaEuler/180.))/TMath::Pi(
}
#print OUTPUTFILE "\t cout << \"rotAlv_",$h+1,"_",$m," \" << phiEuler << \" \" << thetaEuler << \" \" << psiEuler
print OUTPUTFILE "\t TGeoRotation *rotAlv_",$h+1," = new TGeoRotation(\"rotAlv",$h+1,"\",phiEuler,thetaEuler,psiEu

for($rot=0; $rot<32; $rot++) {
  if($rot==0) {
    print OUTPUTFILE "\t TGeoCombiTrans* transAlv_",$h+1,"_",$rot," = new TGeoCombiTrans(",$x[$h],",",$y[$h],",",$
    # the shift in the alveoli center to one of the faces should be included: transDef makes the required transfor
```

GPU usage examples in FairRoot

Porting track finder/Fitter to CUDA



Original code is not optimized for parallel architectures

Lookup tables are used for the mathematical functions (Code is designed to work on FPGA)

Redesign the code into many functions (kernels) instead of one main

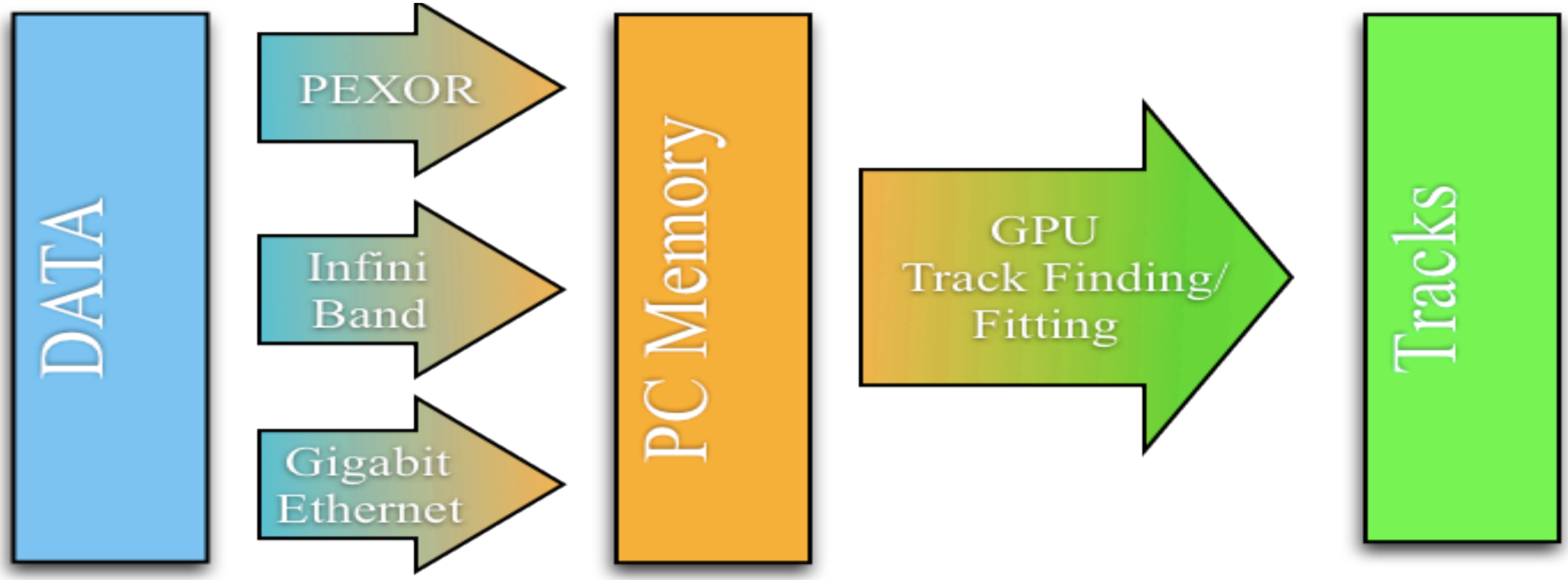
Use the standard mathematical libraries delivered by NVIDIA

A total improvement of factor 200 compared to the original code on an Intel Xeon CPU W3505 @ 2.53 GHz

	CPU (ms)	GPU (ms)	Improvement	Occupancy	Notes
total runtime (without Z-Analysis)	117138	590	199		
startUp()	0.25	0.0122	20	2%	runs (num_points) times
setOrigin()	0.25	0.0119	21	25%	runs (num_points) times
clear Hough and Peaks (memset on GPU)	3	0.0463	65	100%	runs (num_points) times
conformalAndHough()	73	0.8363	87	25%	runs (num_points) times
findPeaksInHoughSpace()	51	0.497	103	100%	runs (num_points) times
findDoublePointPeaksInHoughSpace()	4	0.0645	62	100%	runs (num_points) times
collectPeaks()	4	0.066	61	100%	runs (num_points) times
sortPeaks()	0.25	0.0368	7	2%	runs (num_points) times
resetOrigin()	0.25	0.0121	21	25%	runs (num_points) times
countPointsCloseToTrackAndTrackParams()	22444	0.9581	23426	33%	runs once
collectSimilarTracks()	4	2.3506	2	67%	runs once
collectSimilarTracks2()				2%	runs once
getPointsOnTrack()	0.25	0.0187	13	33%	runs (num_tracks) times
nullifyPointsOfThisTrack()	0.25	0.0106	24	33%	runs (num_tracks) times
clear Hough space (memset on GPU)	2	0.0024	833	100%	runs (num_tracks) times
secondHough()	0.25	0.0734	3	4%	runs (num_tracks) times
findPeaksInHoughSpaceAgain()	290	0.2373	1222	66%	runs (num_tracks) times
collectTracks()	0.25	0.0368	7	2%	runs (num_tracks) times

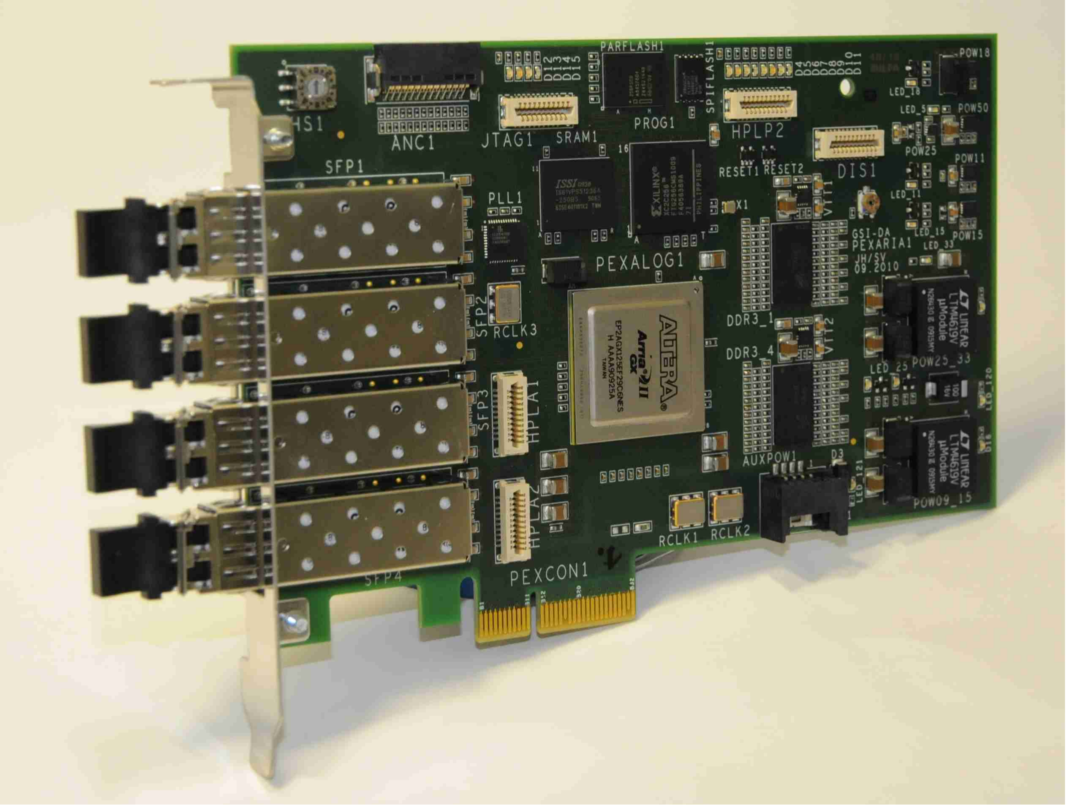
Plans for the Online:
Online track finding and fitting with GPU

- In collaboration with the GSI EE, build a proto type for an online system
  - Use the PEXOR card to get data to PC
  - PEXOR driver allocate a buffer in PC memory and write the data to it
  - The GPU uses the Zero copy to access the Data, analyze it and write the results



PEXARIA (PCI-Express To Optical Link Interface)

- The GSI PEXOR is a PCI express card provides a complete development platform for designing and verifying applications based on the Lattice SCM FPGA family.
- Four 4 gigabit optical transceivers.

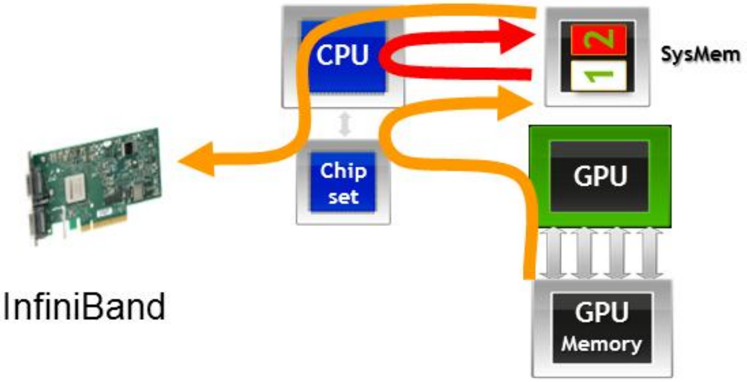


NVIDIA GPUDirect™

Without GPUDirect

Same data copied three times:

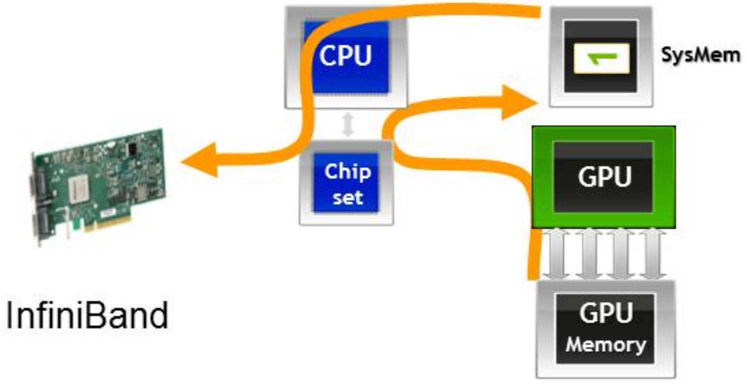
1. GPU writes to pinned sysmem1
2. CPU copies from sysmem1 to sysmem2
3. InfiniBand driver copies from sysmem2



With GPUDirect

Data only copied twice

Sharing pinned system memory makes sysmem-to-sysmem copy unnecessary

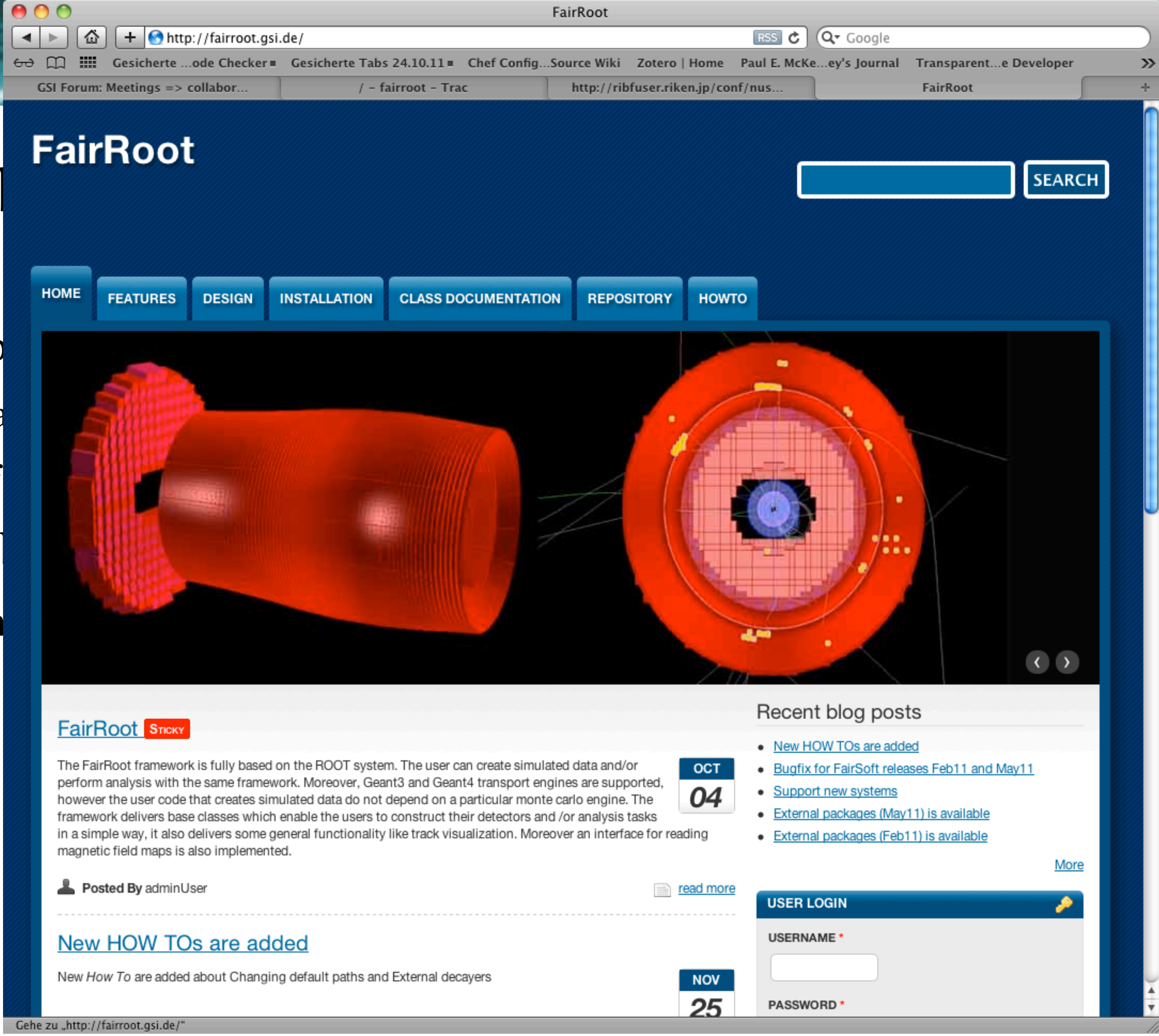


New Webpage

- Own webserver with Drupal as Content Management System
  - More easy to maintain then old system
  - Most of the old content was already moved to the new server
- Same webpage as before: fairroot.gsi.de
- Please check and give feedback

New Wel

- Own web
  - More ea
  - Most of
- Same we
- Please ch


FairRoot
http://fairroot.gsi.de/
RSS
Google
Gesicherte ...ode Checker
Gesicherte Tabs 24.10.11
Chef Config...Source Wiki
Zotero | Home
Paul E. McKe...ey's Journal
Transparent...e Developer
GSI Forum: Meetings => collabor...
/ – fairroot – Trac
http://ribfuser.riken.jp/conf/nus...
FairRoot
FairRoot
SEARCH
HOME
FEATURES
DESIGN
INSTALLATION
CLASS DOCUMENTATION
REPOSITORY
HOWTO
Gehe zu „http://fairroot.gsi.de/"

FairRoot Sticky

OCT 04

The FairRoot framework is fully based on the ROOT system. The user can create simulated data and/or perform analysis with the same framework. Moreover, Geant3 and Geant4 transport engines are supported, however the user code that creates simulated data do not depend on a particular monte carlo engine. The framework delivers base classes which enable the users to construct their detectors and /or analysis tasks in a simple way, it also delivers some general functionality like track visualization. Moreover an interface for reading magnetic field maps is also implemented.

Posted By adminUser

read more

New HOW TOs are added

NOV 25

New *How To* are added about Changing default paths and External decayers

Recent blog posts

- New HOW TOs are added
- Bugfix for FairSoft releases Feb11 and May11
- Support new systems
- External packages (May11) is available
- External packages (Feb11) is available

More

USER LOGIN

USERNAME *

PASSWORD *

New Dashboard

- Also a new webserver for the DashBoard
- New version of the software
  - could not be installed on the old server
  - Provides new functionality
- Old data will not be migrated
  - Can still be accessed on the old server
- Experiments can move to the new server at any time

New Dashboard

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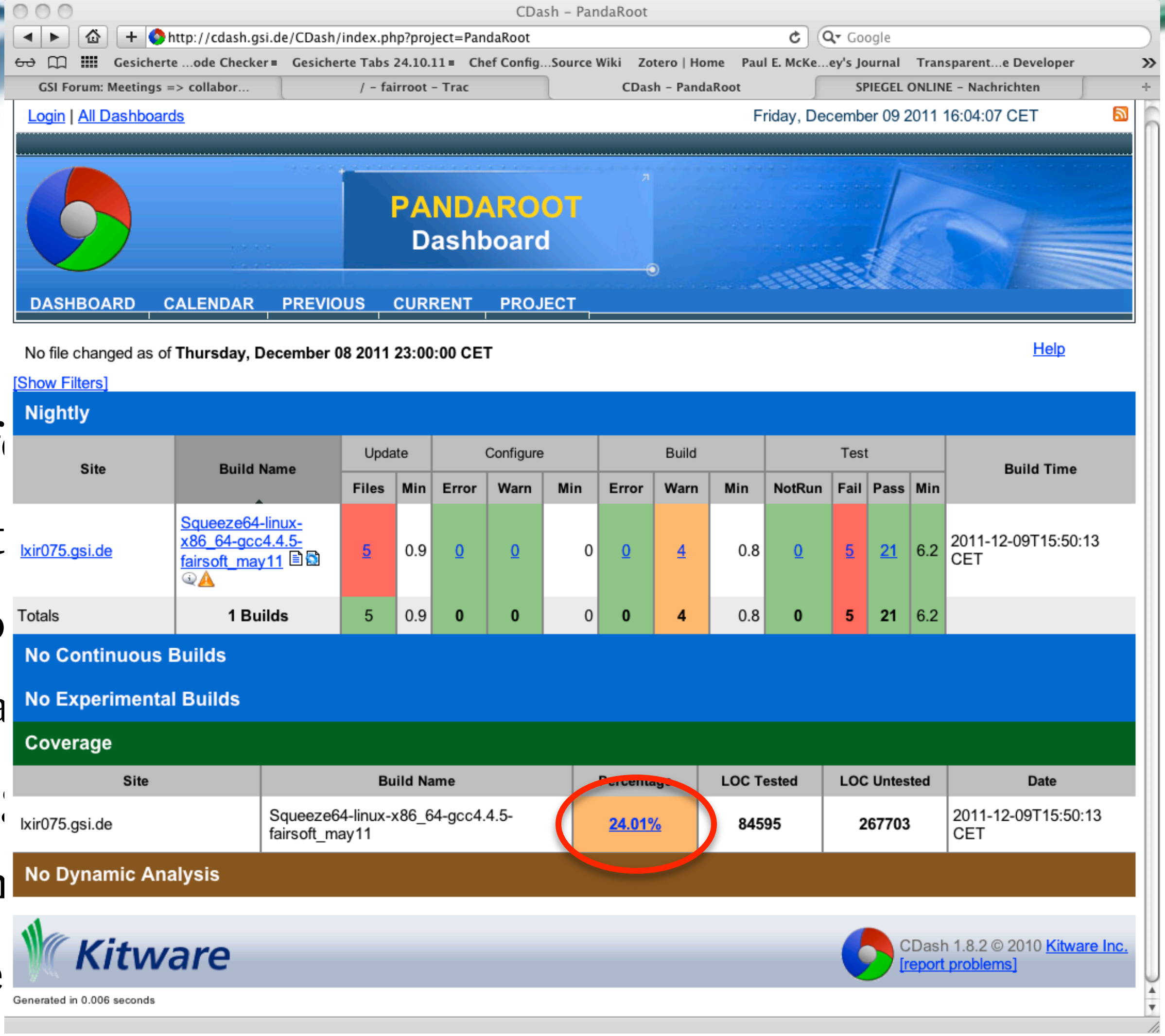

CDash – PandaRoot

http://cdash.gsi.de/CDash/index.php?project=PandaRoot

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/ – fairroot – Trac
CDash – PandaRoot
SPIEGEL ONLINE – Nachrichten

Login | All Dashboards

Friday, December 09 2011 16:04:07 CET

PANDAROOT
Dashboard

DASHBOARD
CALENDAR
PREVIOUS
CURRENT
PROJECT

No file changed as of **Thursday, December 08 2011 23:00:00 CET**

Help

[Show Filters]

Nightly

Site	Build Name	Update		Configure			Build			Test				Build Time
		Files	Min	Error	Warn	Min	Error	Warn	Min	NotRun	Fail	Pass	Min	
lxir075.gsi.de	Squeeze64-linux-x86_64-gcc4.4.5-fairsoft_may11	5	0.9	0	0	0	0	4	0.8	0	5	21	6.2	2011-12-09T15:50:13 CET
Totals	1 Builds	5	0.9	0	0	0	0	4	0.8	0	5	21	6.2	

No Continuous Builds

No Experimental Builds

Coverage

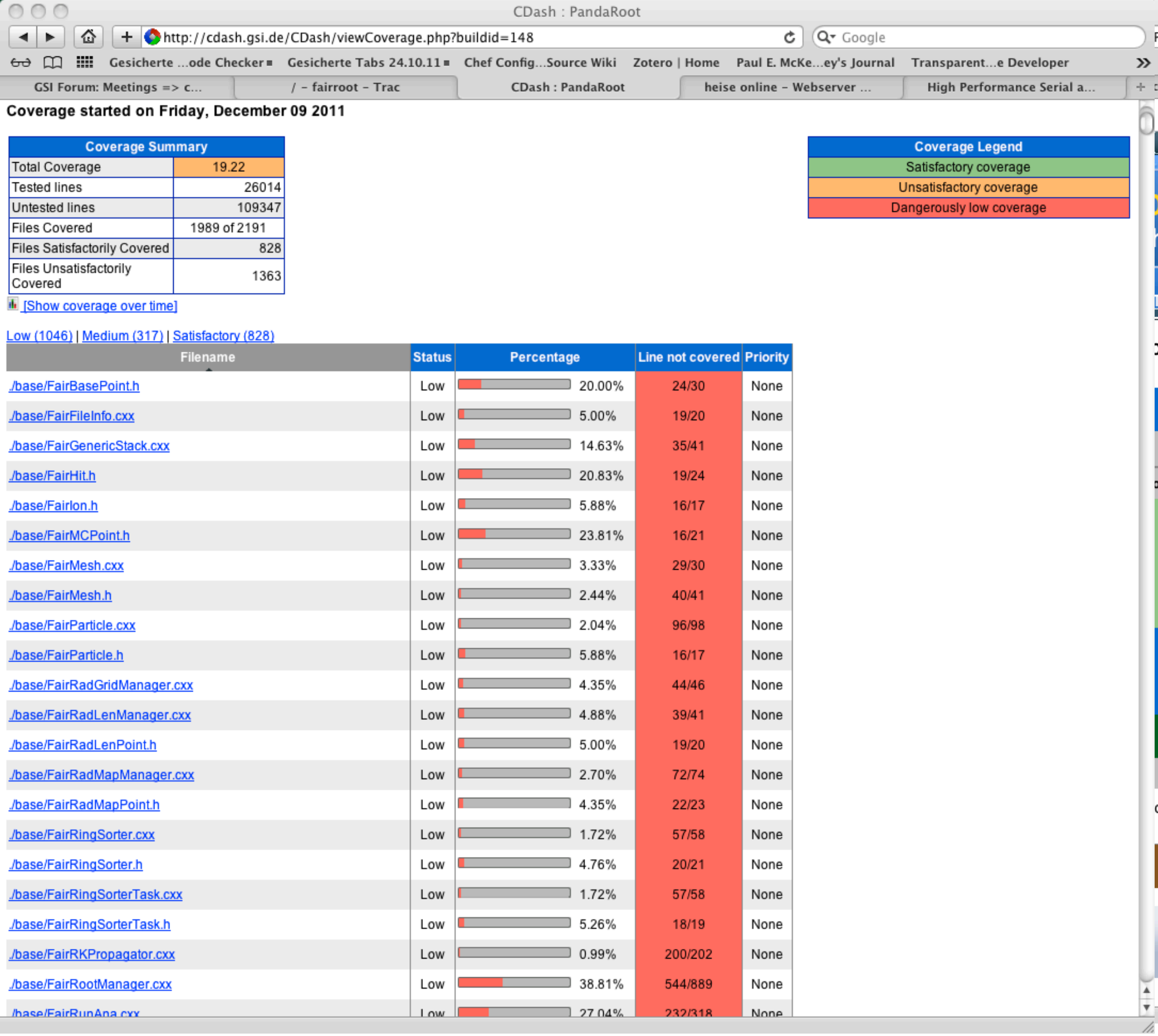
Site	Build Name	Percentage	LOC Tested	LOC Untested	Date
lxir075.gsi.de	Squeeze64-linux-x86_64-gcc4.4.5-fairsoft_may11	24.01%	84595	267703	2011-12-09T15:50:13 CET

No Dynamic Analysis

Kitware

CDash 1.8.2 © 2010 Kitware Inc.
[report problems]

Generated in 0.006 seconds


CDash : PandaRoot
http://cdash.gsi.de/CDash/viewCoverage.php?buildid=148
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Transparent...e Developer
GSI Forum: Meetings => c...
/ – fairroot – Trac
CDash : PandaRoot
heise online – Webserver ...
High Performance Serial a...

Coverage started on Friday, December 09 2011

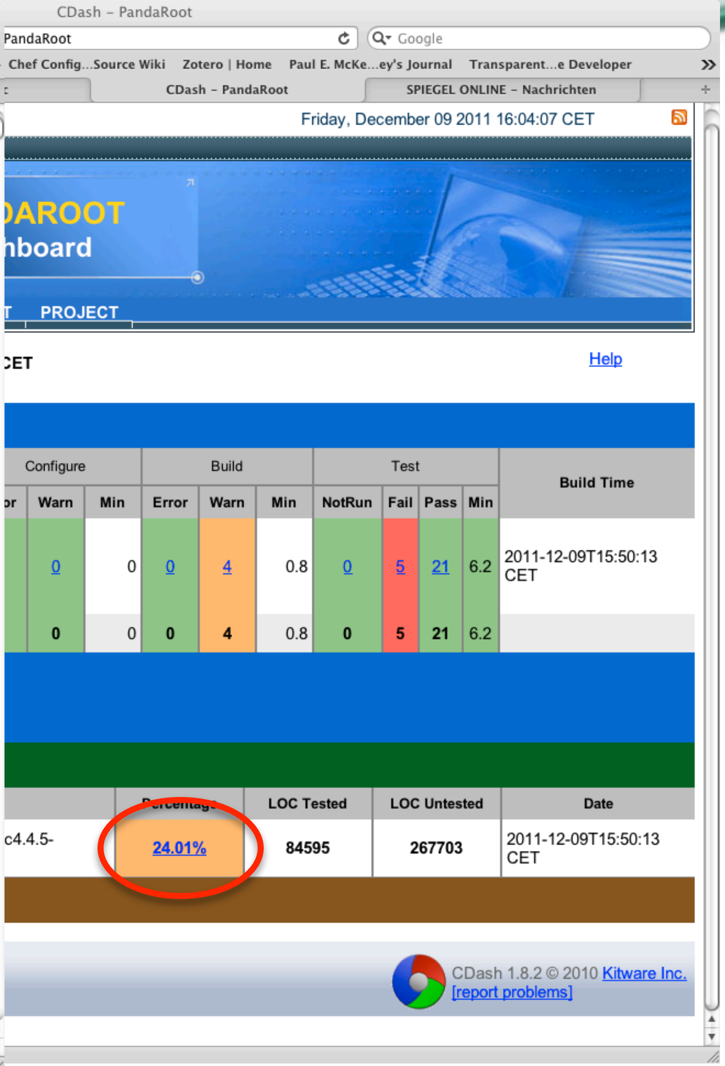
Coverage Summary	
Total Coverage	19.22
Tested lines	26014
Untested lines	109347
Files Covered	1989 of 2191
Files Satisfactorily Covered	828
Files Unsatisfactorily Covered	1363

[Show coverage over time]

Coverage Legend
Satisfactory coverage
Unsatisfactory coverage
Dangerously low coverage

Low (1046) | Medium (317) | Satisfactory (828)

Filename	Status	Percentage	Line not covered	Priority
./base/FairBasePoint.h	Low	20.00%	24/30	None
./base/FairFileInfo.cxx	Low	5.00%	19/20	None
./base/FairGenericStack.cxx	Low	14.63%	35/41	None
./base/FairHit.h	Low	20.83%	19/24	None
./base/FairIon.h	Low	5.88%	16/17	None
./base/FairMCPoint.h	Low	23.81%	16/21	None
./base/FairMesh.cxx	Low	3.33%	29/30	None
./base/FairMesh.h	Low	2.44%	40/41	None
./base/FairParticle.cxx	Low	2.04%	96/98	None
./base/FairParticle.h	Low	5.88%	16/17	None
./base/FairRadGridManager.cxx	Low	4.35%	44/46	None
./base/FairRadLenManager.cxx	Low	4.88%	39/41	None
./base/FairRadLenPoint.h	Low	5.00%	19/20	None
./base/FairRadMapManager.cxx	Low	2.70%	72/74	None
./base/FairRadMapPoint.h	Low	4.35%	22/23	None
./base/FairRingSorter.cxx	Low	1.72%	57/58	None
./base/FairRingSorter.h	Low	4.76%	20/21	None
./base/FairRingSorterTask.cxx	Low	1.72%	57/58	None
./base/FairRingSorterTask.h	Low	5.26%	18/19	None
./base/FairRKPropagator.cxx	Low	0.99%	200/202	None
./base/FairRootManager.cxx	Low	38.81%	544/889	None
./base/FairRunAna.cxx	Low	27.04%	232/318	None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Friday, December 09 2011 16:04:07 CET

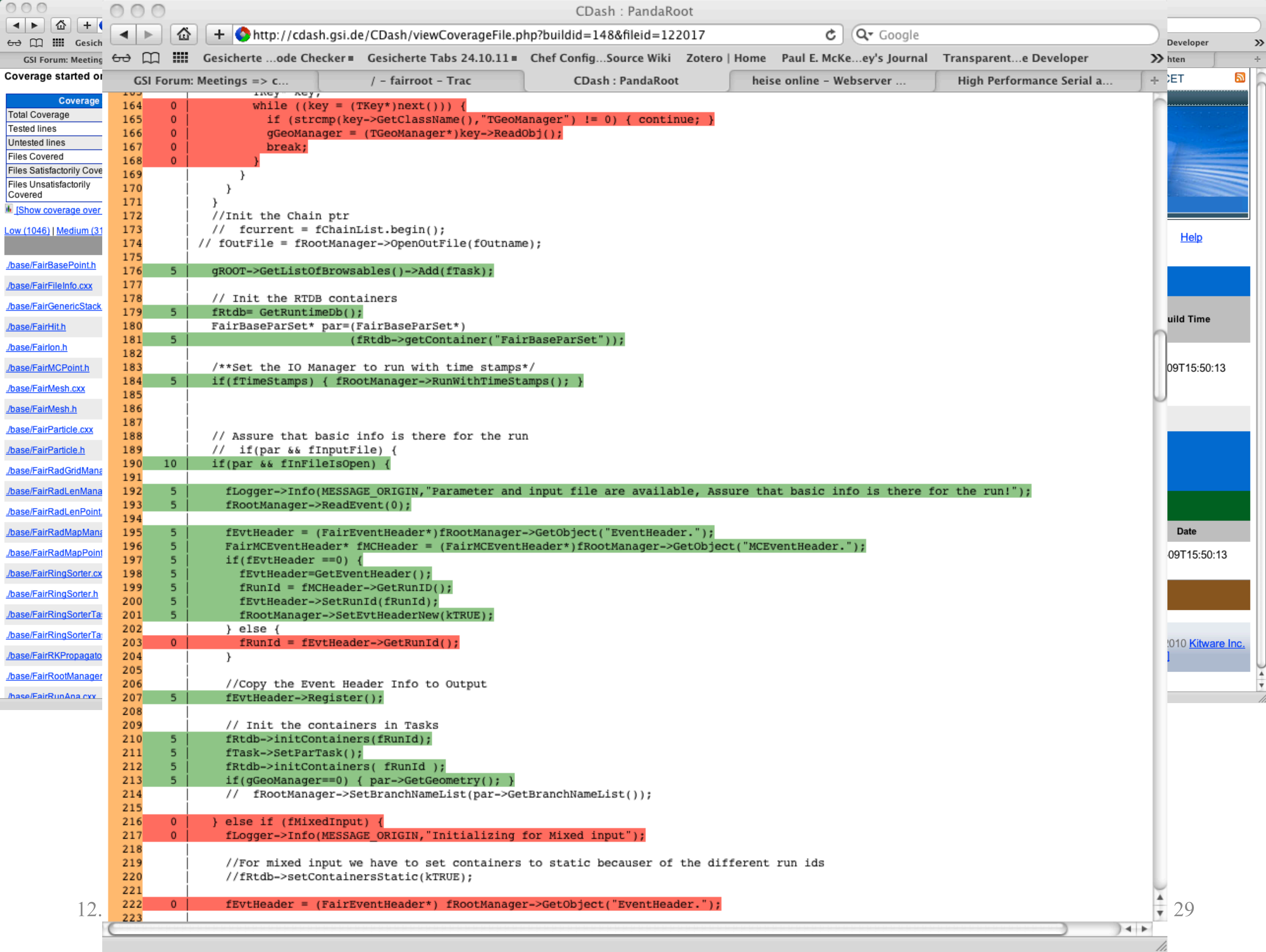
CET

Help

Configure			Build			Test				Build Time
or	Warn	Min	Error	Warn	Min	NotRun	Fail	Pass	Min	
	0	0	0	4	0.8	0	5	21	6.2	2011-12-09T15:50:13 CET
	0	0	0	4	0.8	0	5	21	6.2	

	Percentage	LOC Tested	LOC Untested	Date
c4.4.5-	24.01%	84595	267703	2011-12-09T15:50:13 CET

CDash 1.8.2 © 2010 Kitware Inc.
[report problems]



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http://cdash.gsi.de/CDash/viewCoverageFile.php?buildid=148&fileid=122017
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Files Unsatisfactorily Covered

[Show coverage over

Low (1046) | Medium (31

./base/FairBasePoint.h
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./base/FairGenericStack
./base/FairHit.h
./base/FairIon.h
./base/FairMCPoint.h
./base/FairMesh.cxx
./base/FairMesh.h
./base/FairParticle.cxx
./base/FairParticle.h
./base/FairRadGridMana
./base/FairRadLenMana
./base/FairRadLenPoint.
./base/FairRadMapMana
./base/FairRadMapPoint
./base/FairRingSorter.cx
./base/FairRingSorter.h
./base/FairRingSorterTa
./base/FairRingSorterTa
./base/FairRKPropagato
./base/FairRootManager
./base/FairRunAna.cxx

```
    |    TKey* key;
  0 |    while ((key = (TKey*)next())) {
  0 |     if (strcmp(key->GetClassName(),"TGeoManager") != 0) { continue; }
  0 |     gGeoManager = (TGeoManager*)key->ReadObj();
  0 |     break;
  0 |    }
    |   }
    |  }
    | }
    | //Init the Chain ptr
    | //  fcurrent = fChainList.begin();
    |// fOutFile = fRootManager->OpenOutFile(fOutname);
    |
  5 | gROOT->GetListOfBrowsables()->Add(fTask);
    |
    | // Init the RTDB containers
  5 | fRtdb= GetRuntimeDb();
    | FairBaseParSet* par=(FairBaseParSet*)
  5 |           (fRtdb->getContainer("FairBaseParSet"));
    |
    | /**Set the IO Manager to run with time stamps*/
  5 | if(fTimeStamps) { fRootManager->RunWithTimeStamps(); }
    |
    |
    |
    | // Assure that basic info is there for the run
    | //  if(par && fInputFile) {
 10 | if(par && fInFileIsOpen) {
    |
  5 |  fLogger->Info(MESSAGE_ORIGIN,"Parameter and input file are available, Assure that basic info is there for the run!");
  5 |  fRootManager->ReadEvent(0);
    |
  5 |  fEvtHeader = (FairEventHeader*)fRootManager->GetObject("EventHeader.");
  5 |  FairMCEventHeader* fMCHeader = (FairMCEventHeader*)fRootManager->GetObject("MCEventHeader.");
  5 |  if(fEvtHeader ==0) {
  5 |   fEvtHeader=GetEventHeader();
  5 |   fRunId = fMCHeader->GetRunID();
  5 |   fEvtHeader->SetRunId(fRunId);
  5 |   fRootManager->SetEvtHeaderNew(kTRUE);
    |  } else {
  0 |   fRunId = fEvtHeader->GetRunId();
    |  }
    |
    |  //Copy the Event Header Info to Output
  5 |  fEvtHeader->Register();
    |
    |  // Init the containers in Tasks
  5 |  fRtdb->initContainers(fRunId);
  5 |  fTask->SetParTask();
  5 |  fRtdb->initContainers( fRunId );
  5 |  if(gGeoManager==0) { par->GetGeometry(); }
    |  //  fRootManager->SetBranchNameList(par->GetBranchNameList());
    |
  0 | } else if (fMixedInput) {
  0 |  fLogger->Info(MESSAGE_ORIGIN,"Initializing for Mixed input");
    |
    |  //For mixed input we have to set containers to static becauser of the different run ids
    |  //fRtdb->setContainersStatic(kTRUE);
    |
  0 |  fEvtHeader = (FairEventHeader*) fRootManager->GetObject("EventHeader.");
    |
```

ET

Help

uild Time

09T15:50:13

Date

09T15:50:13

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Tests and Code Coverage

- Only small part of code base tested at all
- What about the other part?
  - Not needed? → Could be removed !
  - Bugs inside ? → Nobody knows !!
- Test coverage should be increased
  - Not possible when testing the full program (to time consuming)
- But even if the program runs and comes to an end, how do one knows that the result is correct?

Unit Tests for FairRoot

- Solution: Unit Tests
  - Test only small blocks of code at the same time
  - Check if the result is correct
- Several Unit Test frameworks available
  - Evaluation is work in progress
  - CxxTest, CppUnit, CppUTest, CppTest (need to be tested)
  - Boost Unit Test, GoogleTest (in the testing phase)
- Most promising up to now is the GoogleTest framework
  - Easy to use
  - All needed functionality up to now
  - Test coverage for test case is above 90%

Summary

- The Framework which started with two people in 2003 as a test for CBM is now the standard software for at least 3 large collaborations
- Meanwhile a core team of 5 developers and more than 70 registered developers from the different experiments
- QA system, Ticket system, Wiki, discussion forum are actively used.
- Development of general interest usually finds its way to other experiments by moving from the specific experiment implementation to FairRoot (more general things goes even back to ROOT and VMC):
  - CAD TO ROOT converter
  - Event Display
  - Geane track propagator
  - Monte-Carlo validation package
  - Event generators

http://fairroot.gsi.de

Synergy

Event Time In Simulation

Can be set via the FairPrimaryGenerator :

- Set the min and max limit for event time in ns

  SetEventTimeInterval(Double_t min, Double_t max)

- Set the mean time for the event in ns

  SetEventMeanTime(Double_t mean)

- Set the time function for event

  SetEventTime(TF1 timeProb)*

Event Time after simulation

Can be set via the FairRunAna

- Set the min and max limit for event time in ns

  SetEventTimeInterval(Double_t min, Double_t max)

  (Time set via Uniform Random between min and max)

- Set the mean time for the event in ns

  SetEventMeanTime(Double_t mean)

  (Event time is an exponential deviate.)

Event Time

- In simulation event time is saved in
  - *FairMCEventHeader*
- After simulation it is in
  - *FairEventHeader*
- In all cases event time can be access via:
  - *FairRootManager::GetEventTime()*

File Header

- Run Id
- List of TObjStrings presenting the class names of tasks used to produce this file
- List of FairFileInfo presenting the input files used to produce this file

FairFileInfo class

- Full path of the file
- Size of file in bytes
- File identifier used
- File order in the chain

Event Header

- Run Id
- Event Time
- Input file identifier, the file description is in the File header
- Monte-Carlo entry number from input chain

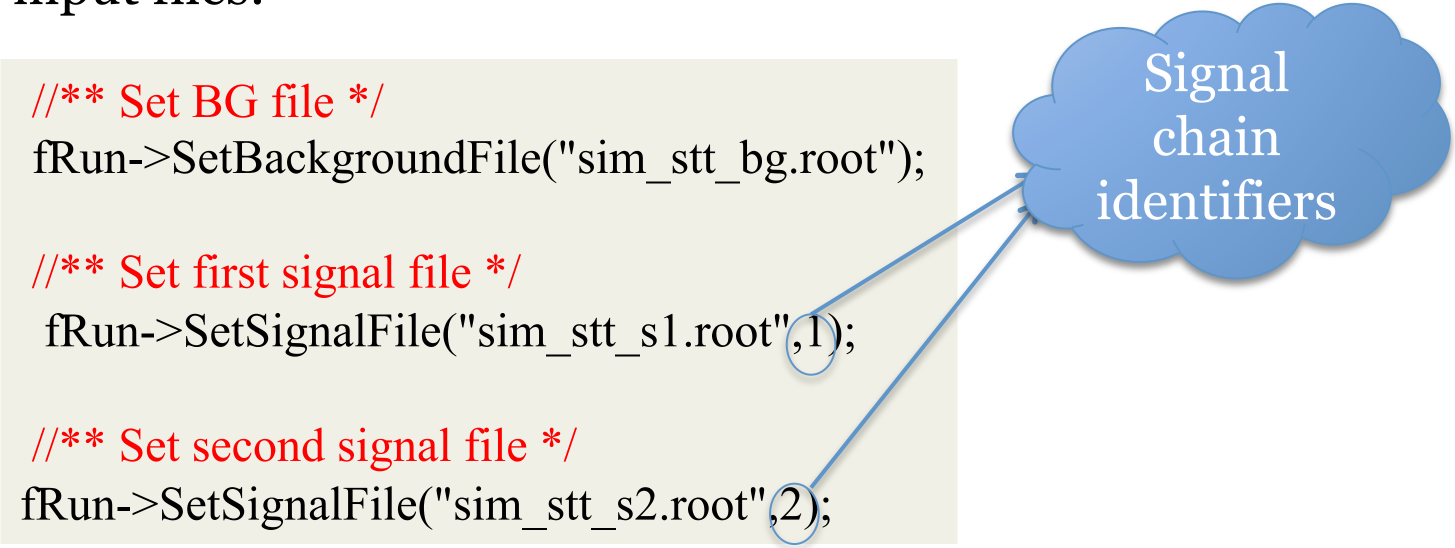
Signal-Background mixing

- After simulation
- At the moment we only check that the all input trees contain the same branches (further checks needed!)
- All can be done from the macro

Example of a mixing digi macro

See “Pandaroot/macro/run/example_mix”

- Setting the input files:



```
//** Set BG file */
fRun->SetBackgroundFile("sim_stt_bg.root");

//** Set first signal file */
 fRun->SetSignalFile("sim_stt_s1.root",1);

//** Set second signal file */
fRun->SetSignalFile("sim_stt_s2.root",2);
```

Signal chain identifiers

Example of a mixing digi macro

- Adding more files to the signal and background chains:

```
//** Set BG file */
fRun->AddBackgroundFile("sim_stt_bg1.root");

//** Set first signal file */
 fRun->AddSignalFile("sim_stt_s1_1.root",1);

//** Set second signal file */
fRun->AddSignalFile("sim_stt_s2_1.root",2);
```

Signal chain identifiers

Example:
Mix using entries

- For each ~20 entries background one entry from signal chain 1 should be read

  fRun->BGWindowWidthNo(20,1)

- for each ~30 entries background one entry from signal chain 2 should be read

  fRun->BGWindowWidthNo(30,2)

Example:
Mix using time

- Set the event mean time, event time will be a random number generated from (1/T)exp(-x/T)

  fRun->SetEventMeanTime(10);

- Each ~100 ns background 1 entry from signal chain 1 will be read

  fRun->BGWindowWidthTime(100,1);

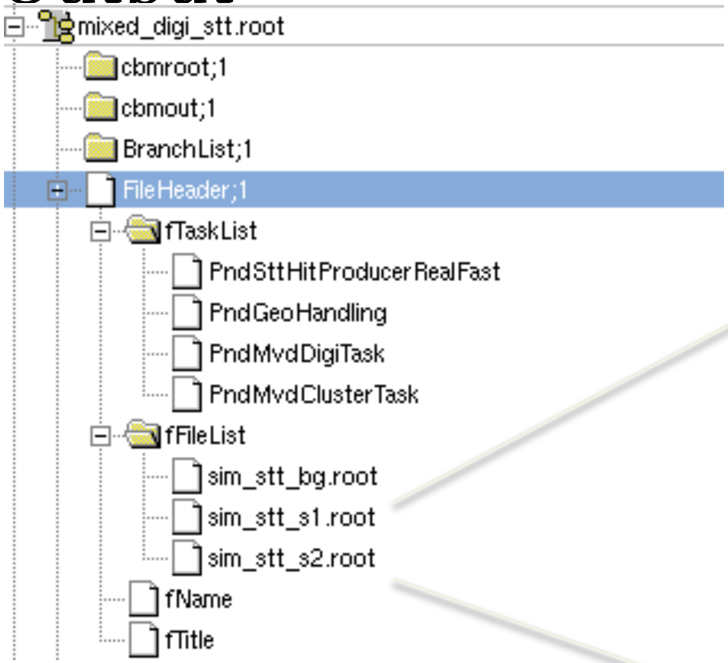
- Each ~60 ns background 1 entry from signal chain 2 will be read

  fRun->BGWindowWidthTime(60,2);

Running the macro

```
[INFO   ]   Maximum No of Event was set manually to :  120 , we will check if there is enough entries for this!!
[INFO   ]   Signal chain  No 1  has  :  2  entries
[WARNING]  No of Event in signal chain 1 is not enough, the maximum event number will be reduced to : 20
[INFO   ]  Signal chain  No 2  has  :  20  entries
[WARNING]  No of Event in Background chain is not enough for all signals in chain  2
[INFO   ]  Maximum No of Event will be set to :  20
```

Output



```
mixed_digi_stt.root
    cbmroot;1
    cbmout;1
    BranchList;1
    FileHeader;1
        fTaskList
            PndSttHitProducerRealFast
            PndGeoHandling
            PndMvdDigiTask
            PndMvdClusterTask
        fFileList
            sim_stt_bg.root
            sim_stt_s1.root
            sim_stt_s2.root
        fName
        fTitle
```

```
class=FairFileInfo
fPath           /pandaroot/macro/run/example_mix
fSize           52607
fIdentifier     1
fInChainId      0
fName           sim_stt_s1.root     object identifier
```

```
class=FairFileInfo
fPath           /pandaroot/macro/run/example_mix
fSize           243274
fIdentifier     2
fInChainId      0
fName           sim_stt_s2.root     object identifier
```

To Do

- More checks before mixing:
  - Parameters
  - Geometry
- Mixing signal in a sub-set of the detector with the full back ground simulation