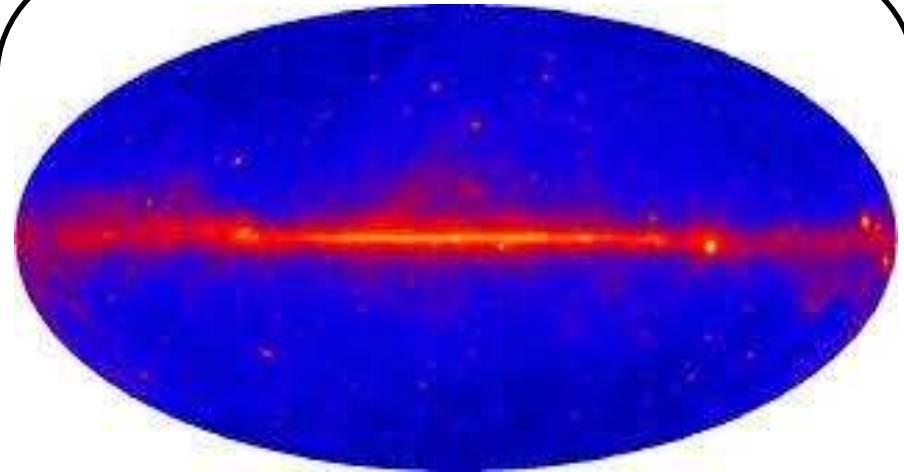


Background



M. Eng.: Low energy trajectories design, using
Lagrangian Coherent Structures

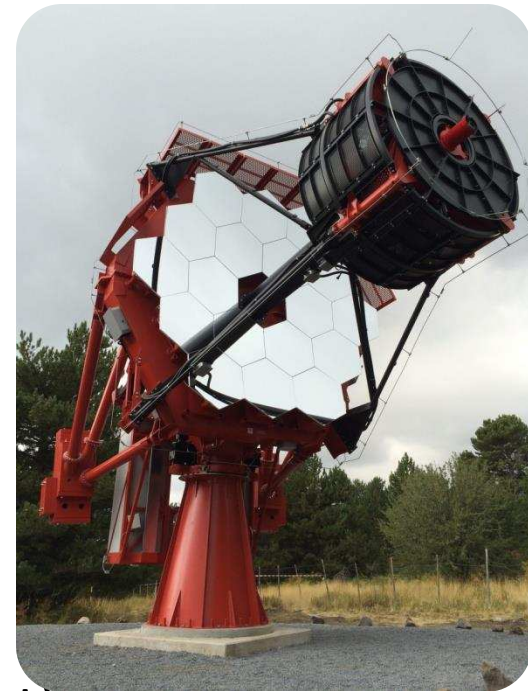


Accelerated maximum likelihood
computation applied to Fermi LAT data

Current Research

Data Reduction and Analysis Pipeline for the ASTRI Prototype IACT

- Targets datacenter and low-power platforms
- Written in C++, runs on x86, ARM and GPU
- Exceeds predicted real-time requirements
- My tasks:
 - Image cleaning and parametrization
 - Machine learning algorithms (Random Forest)
 - Code parallelization



Scientific computing in my research activity

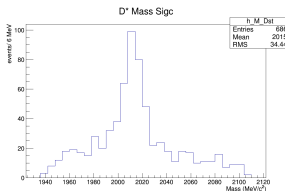
Emanuele Michielin

Università di Padova

ESC15 School

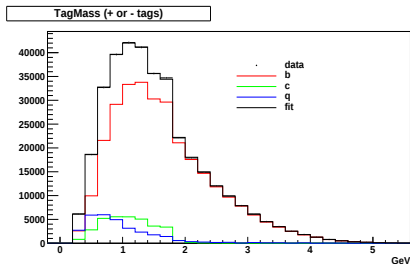
Development and implementation of a trigger line for LHCb

- Development of an algorithm for the on-line inclusive selection of candidates with D^* and Σ_c particles
- Multivariate technique (BDT from the TMVA package) for a better discrimination between signal and background
- Need for a fast response, BDT too slow to run in an on-line environment:
 - Discretization of the input variables
 - The response values of the BDT is converted into a simple one dimensional look up table
 - Speeds up the whole system
- Trigger nowadays implemented and in data taking



Search for multi-b resonances at CDF

- CDF experiment at Tevatron, data taking until 2011
- Trigger update in 2008: new trigger for b-jets developed with online b-tagging and low E_T thresholds
- Sample rich in b-jets still to be analyzed
- Analysis: search for multi-b resonances both at low and high invariant mass
- All the analysis made using the c++ framework Root



Parallel Monte Carlo Tree Search for HEP

S. Ali Mirsoleimani

Leiden Centre of Data Science, Leiden University
Nikhef Theory Group, Nikhef
The Netherlands

ESC 2015 – Bertinoro, Italy – October 2015



Outline

Introduction

Monte Carlo Tree Search

Summary



HPGAME

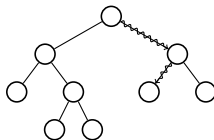
- HEPGAME is about solving very large expressions in High Energy Physics using combinatorial methods from Artificial Intelligence.
- Use MCTS to find near optimal Horner scheme, which reduces the number of operations the most



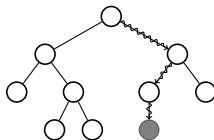
MCTS

It has four steps:

-Selection

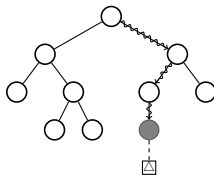


-Expansion

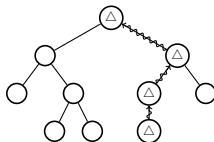


MCTS

-Playout or Simulation



-Update



Conclusions and Future Work

- The scalability of parallel MCTS on the Xeon Phi has been studied successfully
- Go from threads to tasks
(To do load balancing for large number of cores)
- Exploit possible vectorization
(To fill the gap between CPU and Phi)
- Wait for Intel Knights Landing Xeon Phi
(To have more powerful cores)



Thank You

Questions!

<https://github.com/mirsoleimani/paralleluct>



ESC15
School,
Bertinoro 25-
31/10/2015

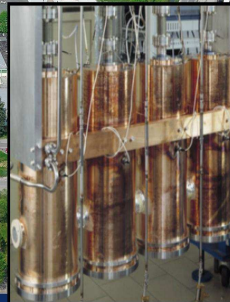
Stefano
Pavinato

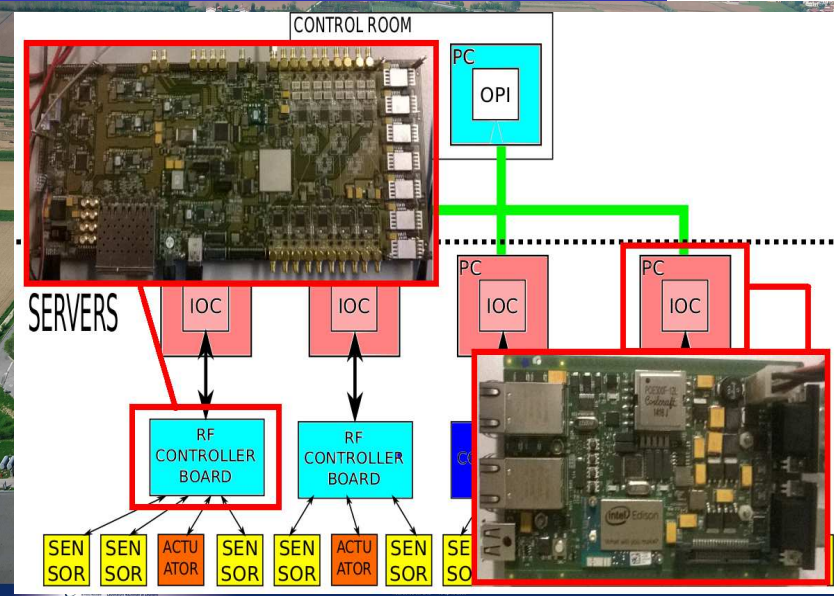
Stefano Pavinato

- Phd Student @ LNL;
- Electronic Engineer;
- Fellowship subject : *The design and the qualification of a controller (IOC) for the phase and amplitude stabilization of the electric field in the cavity and RFQ.*

RF cavity

- $\vec{E}$ oscillates at a $F_{Resonance}$;
- Timing the arrival of particles
 $E = E_{MAX} \cos(\theta)$;
- IOC compensates amplitude and phase fluctuations due to microphonics.





ESC15
School,
Bertinoro 25-
31/10/2015

Stefano
Pavinato

What I did

- Part of the hardware design;
- Bit banging the board (Python and C++).

What I'll do

- what I did;
- Firmware for the FPGA (VHDL and SystemC);
- IOC epics, especially the interface to the hardware (C++).

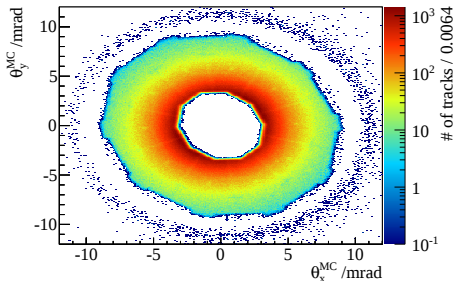
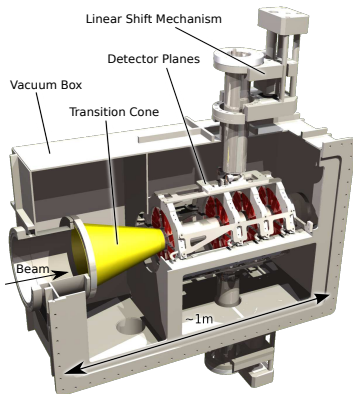
My Research Activity

S. Pflüger

Helmholtz Institute Mainz

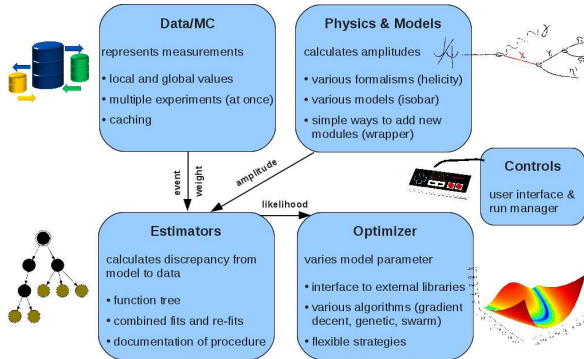
October 26, 2015

LUMINOSITY DETERMINATION - 2D FITTING



- ⊙ simulations on cluster environments
- ⊙ 2D modeling very computation intensive
- ⊙ using multithreading (thinking of vectorization)

ComPWA - PARTIAL WAVE ANALYSIS



- ⊙ implementing helicity formalism (trying cache optimizations)
- ⊙ focus on modularity and program design
(<https://github.com/ComPWA/ComPWA>)
- ⊙ speed via function trees, GPUs and multithreading

OPERA Experiment

Marco Roda

INFN – Padova
&

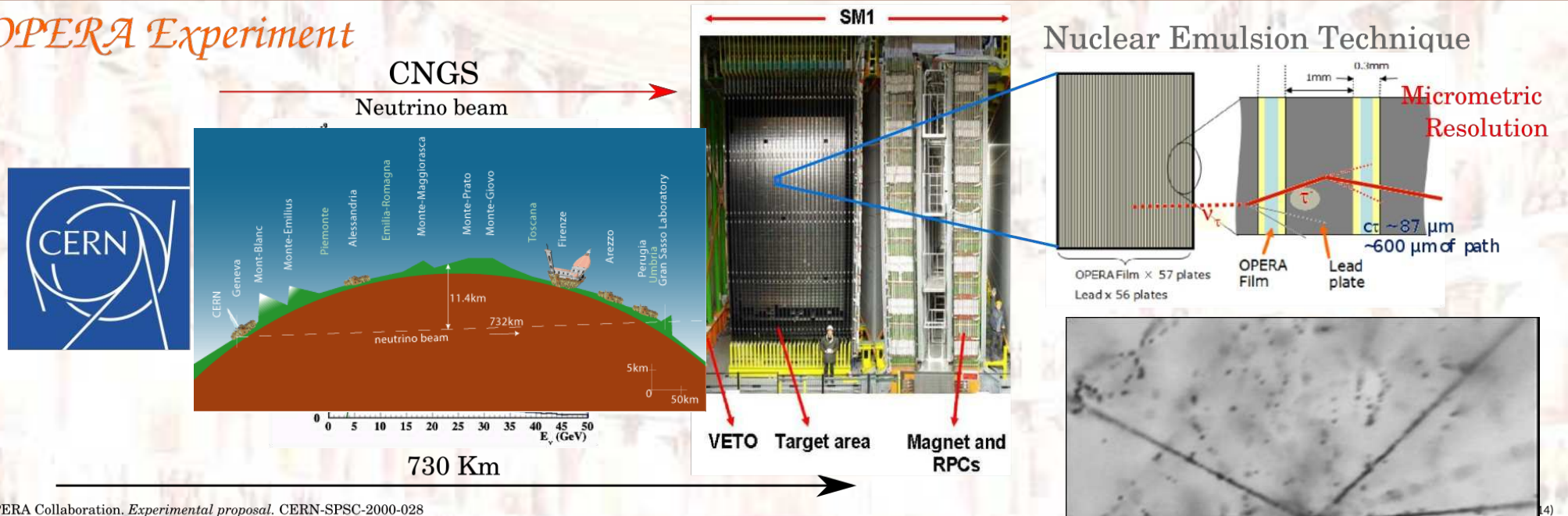
Padova University

marco.roda@pd.infn.it



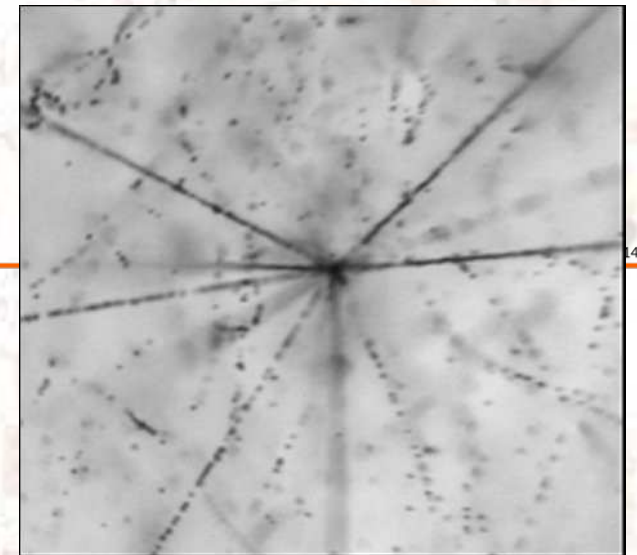
The Experiment

OPERA Experiment



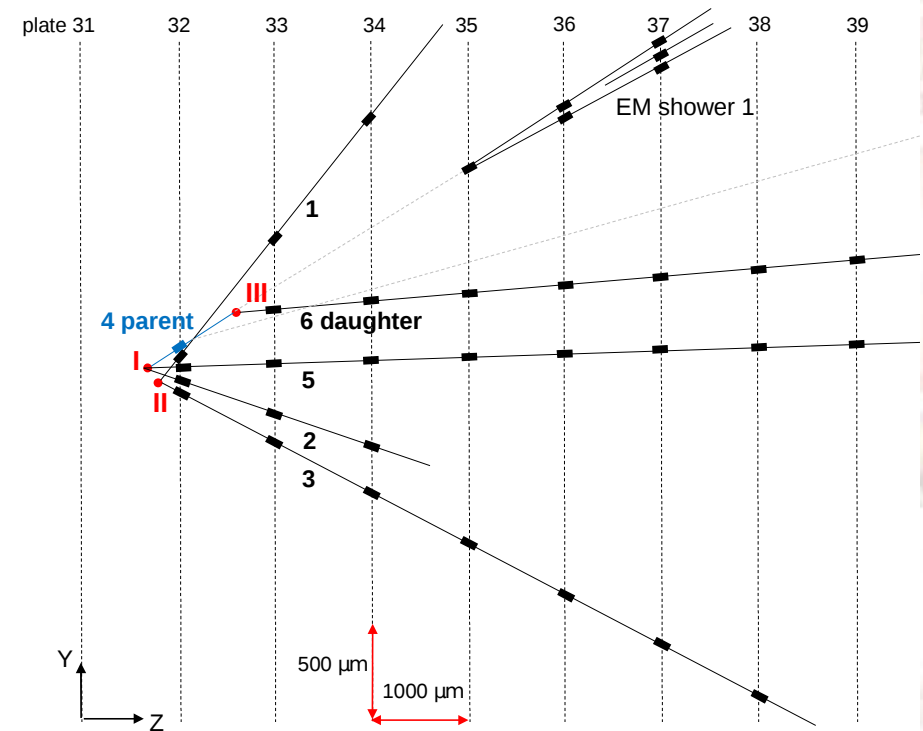
Neutrino Oscillation experiment $\nu_{\mu} \rightarrow \nu_{\tau}$

- Recently reported the 5σ discovery
- 5 tau candidates reported



Why extensive computing

- Heavy Monte Carlo Simulation
 - Deal with images
 - Very detailed reconstruction
 - Strong Background reduction
- **Interest in scientifing computing**
 - Parallel programming
 - Experiment requirements
 - DAQ coding
 - Personal interest
 - I've done a few times
 - Maybe my next job



> 300 million MC event generated



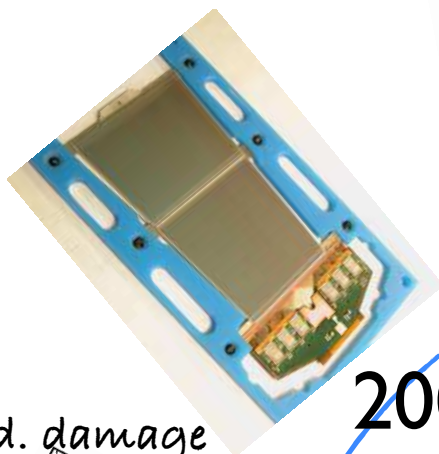
Shaun Roe



SCT cabling



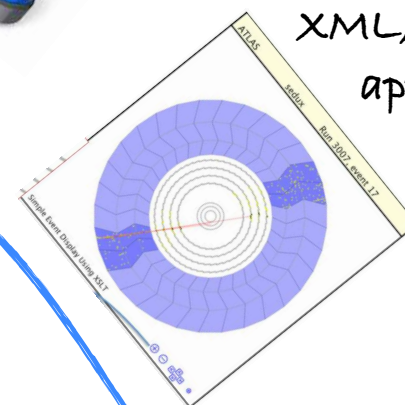
Construction



SCT Database applications



XML, web apps



2007

Rad. damage studies



2000

1993

Coverity®



S/ware quality coordinator,
Tracking,
Physics validation

2015



1963

NA62 L0 trigger

Dario Soldi - INFN Torino

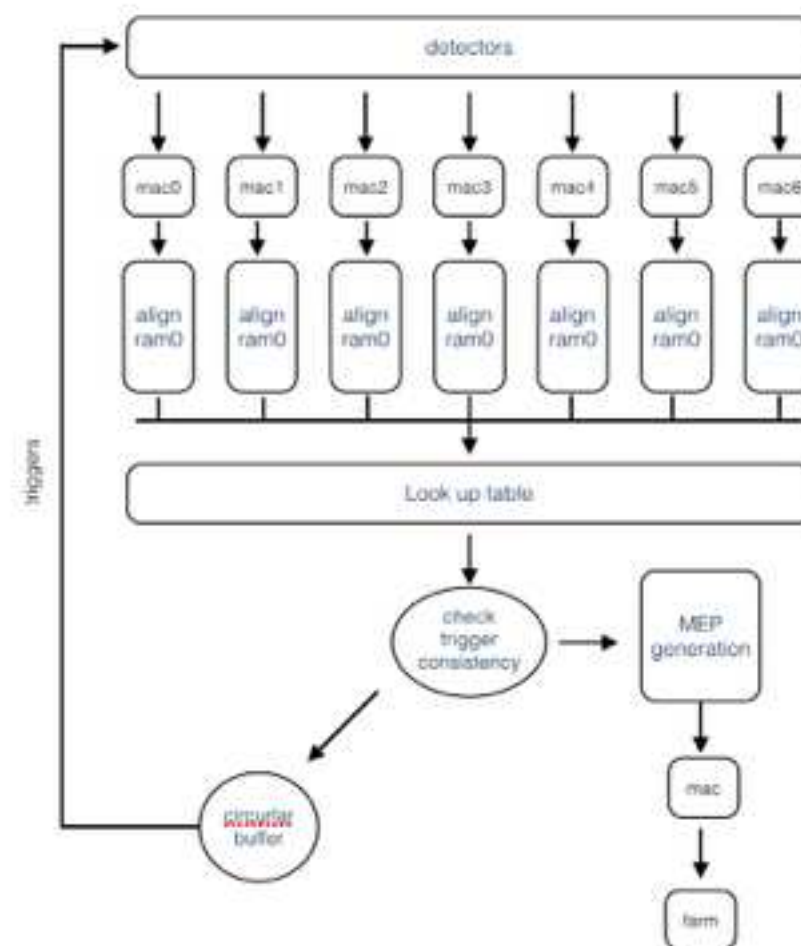
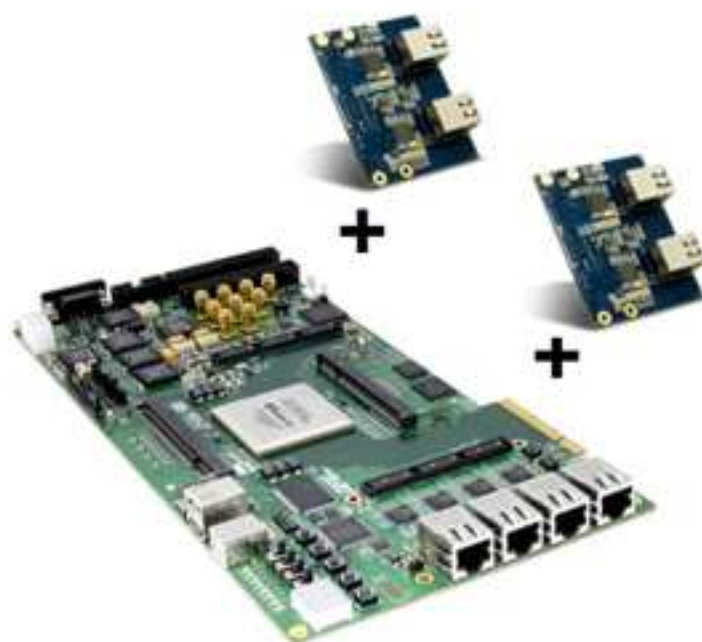


- NA62 goal: measure $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ (BR $\sim 10^{-10}$) with a precision of 10%.
- High intensity SPS 400 GeV/c protons to beryllium target.
- ~ 750 MHz of Kaons.
- High-performance trigger and data acquisition to scale from 10 MHz of detectors input rate to 1 MHz of triggers.

NA62 L0 trigger



- Fully digital.
- Based on a standard gigabit ethernet communication between the detectors and the L0 Board.
- Terasic DE4, mounting an Altera Stratix IV FPGA.
- 8 gigabit ethernet links.
- PC-Board communication via USB socket.



development



- C++ based test bench (generation of fake detector data, check of trigger outputs, monitoring, simulations...);
- VHDL simulation (using modelsim);
- Hardware implementation;
- commissioning @ CERN.
- Check of the data quality.
- Used in the current data taking

...future...

- Possibility to interface the board with a PC via PCIeexpress.
- Possibility to develop a software trigger matching (already developing in our collaboration).

Na62 Farm



Farm has to:

- Handle all frames sent from the detectors
- Reconstruct the events
- Reject unuseful events

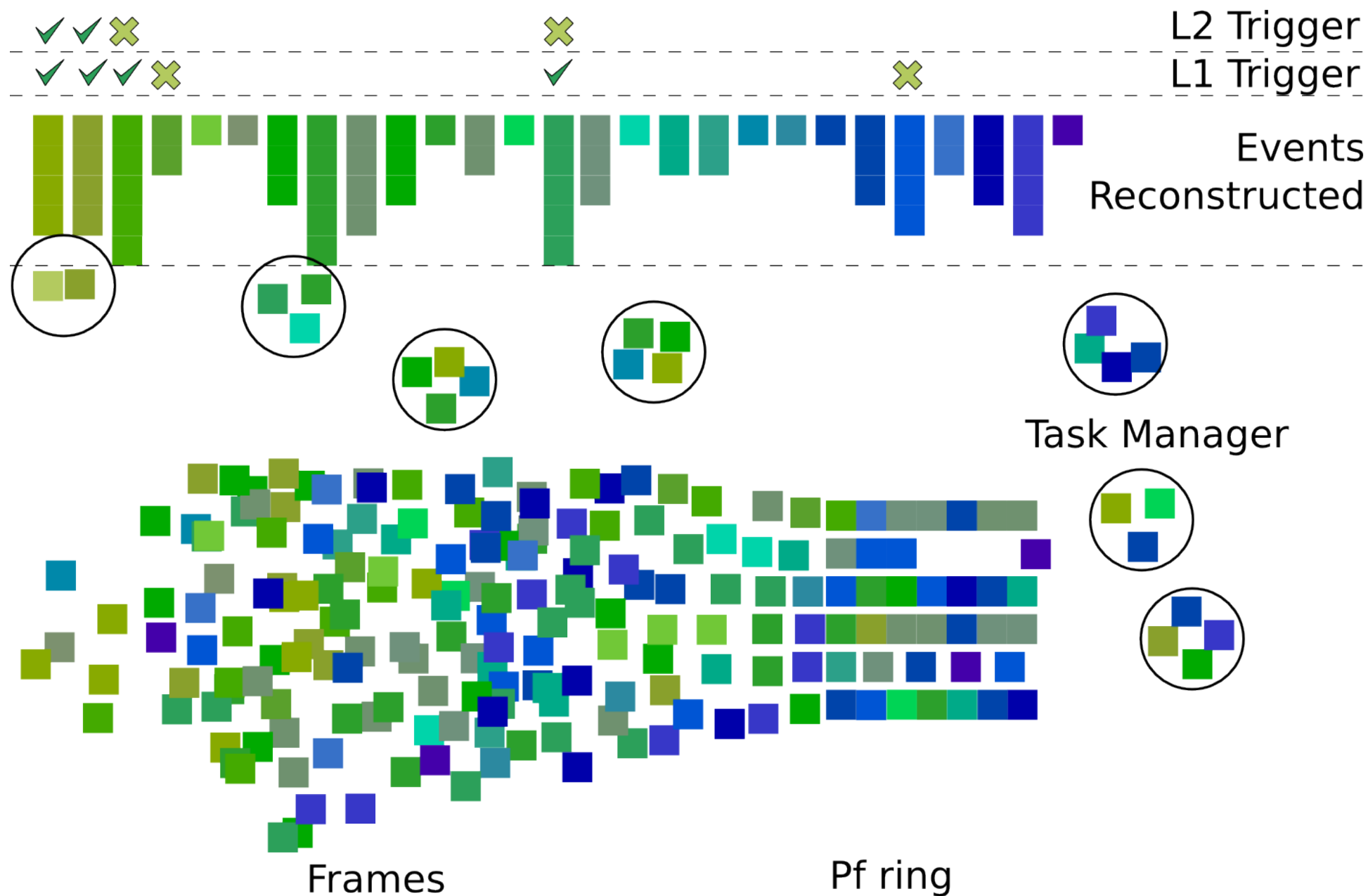
Design goal: handle **3 M events/burst**

1 event is made by **~500 packets**

computers = 30

Packets/computer = 50 M packets/burst

Na62 Farm Workflow



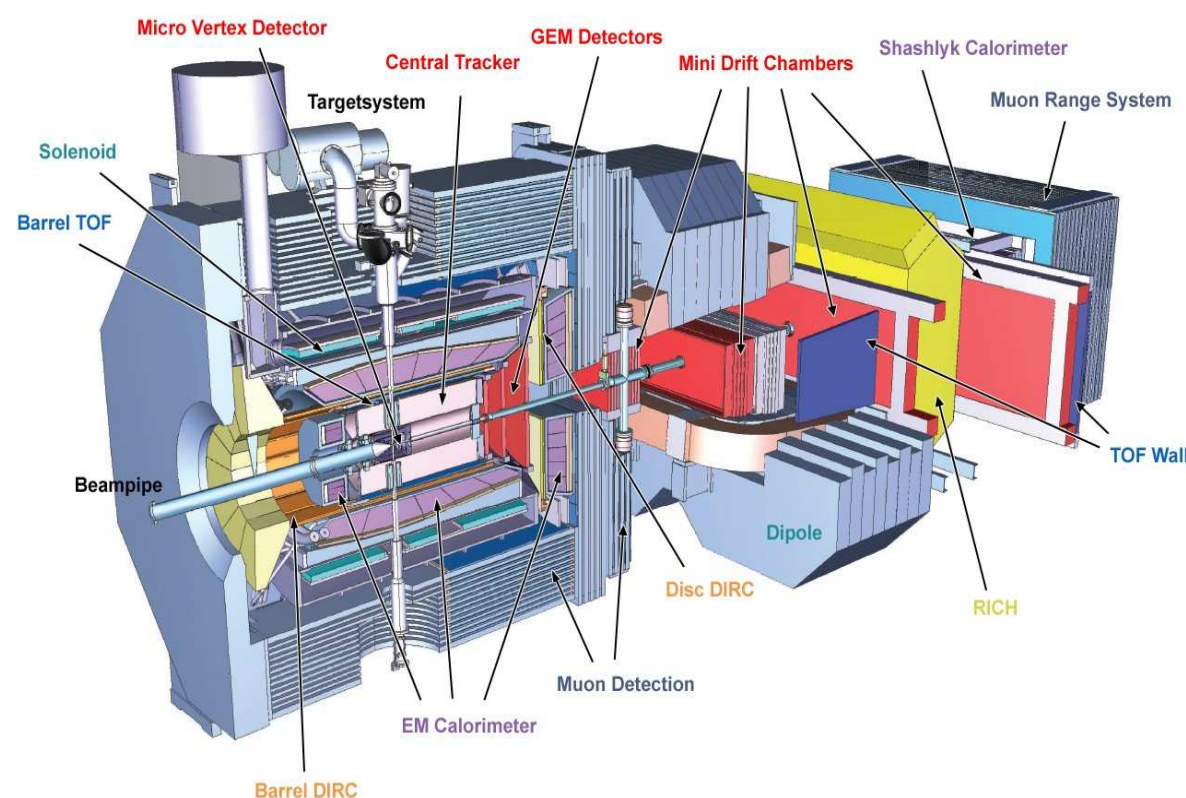
Next features



- Memory optimization
- Works at high rates
- **Create a mechanism to test the farm with the same sequence of frames**

Scintillator Tile Hodoscope for PANDA

Dominik Steinschaden



The PANDA spectrometer

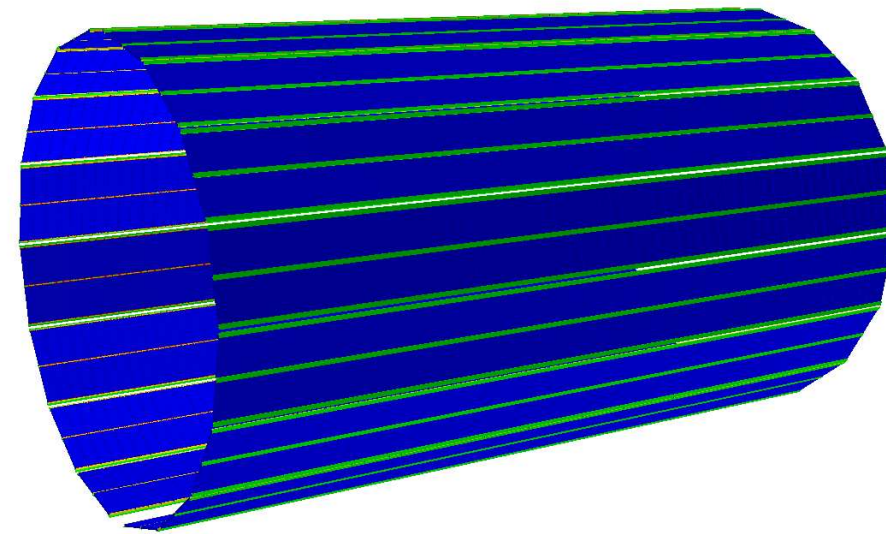
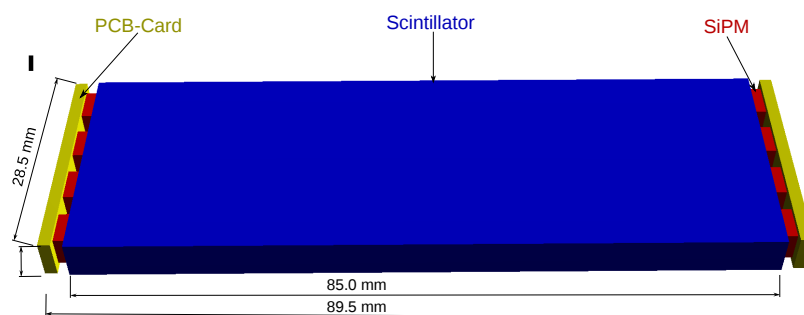
PANDA:

- Fixed target collision
- Antiproton- Proton
- Physics programm:
 - Hadron spectroscopy
 - Exotic hadrons
 - Hadrons in nuclear matter
 - Hypernuclear research
 - Hadron structure

Scintillator Tile Hodoscope (SciTil)

Motivation:

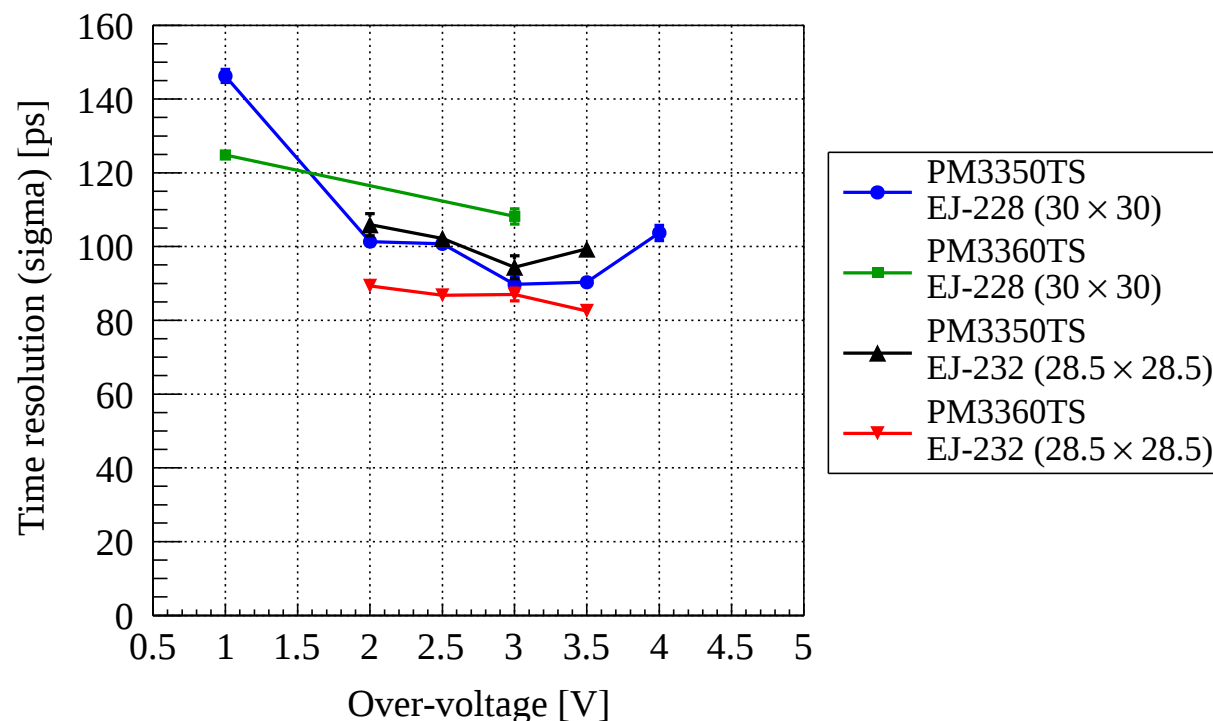
- Online software trigger
- Disentangle the event mixing at high collision rates
- Relative time-of-flight
- Particle identification below the Cherenkov detector (DIRC) momentum threshold
- Gamma conversion detection in front of the EMC



Requirements:

- Time resolution below $\sigma < 100$ ps
- Fast readout and signal processing
- Minimum material budget
 - 2% of a radiation length
 - 2 cm radial thickness
- Large angular acceptance ($22^\circ \leq \theta \leq 140^\circ$)

Scintillator Tile Hodoscope (SciTil)



Measured time resolution with KETEK
SiPMs and 30x30x5 mm³ ELJEN
scintillators. $\sigma = 82.5 \pm 1.7$ ps

Current activities:

- Optimization of the design
 - Laboratory tests using lasers, radioactive sources, test beams
 - Monte Carlo simulations
- Implementation in PandaRoot
 - Simulation framework based on ROOT
- Implementation of the SciTil in Tracking and Analysis

Pavlo Svirin, ALICE Offline team

- Integration for different computing element types into ALICE distributed computing environment (htCONDOR CE, Nordugrid ARC, PBS, PanDA)
- Redesign for AliEn software from PERL to Java
- Xrootd integration
- Testing modules development for Nagios monitoring system

ORNL Titan integration into AliEn infrastructure

A project on integration of one of the most powerful supercomputers of the world.

Problems:

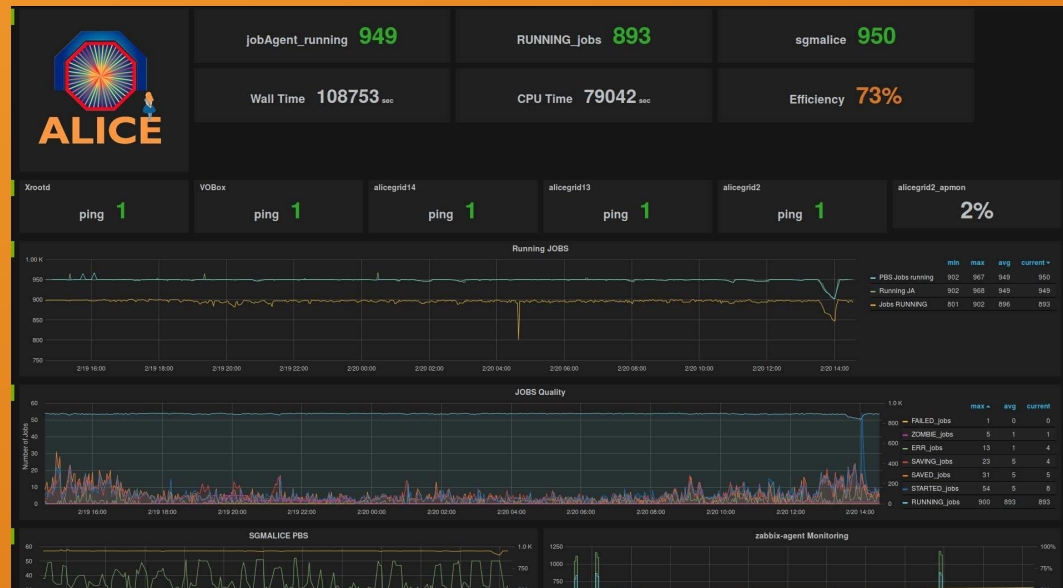
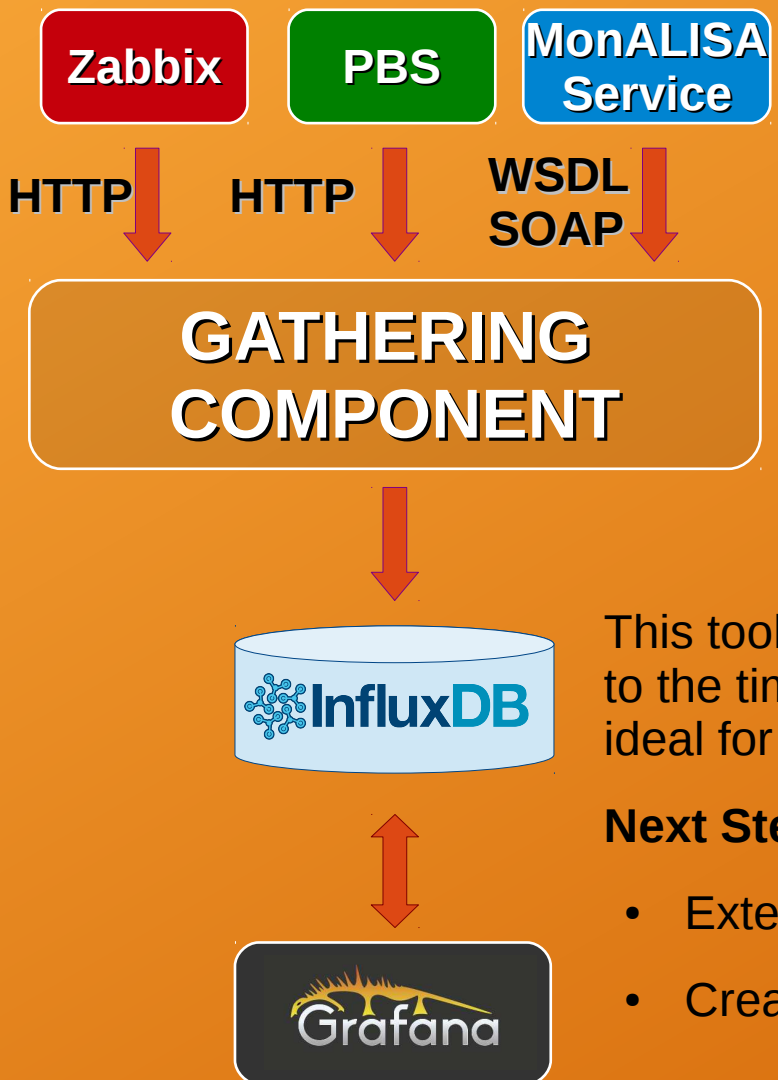
- CRAY OS, all of the binary ALICE software has to be recompiled for a new platform
- no network access on worker nodes
- interaction with the outer world only through the file system (LustreFS)

Activities with Bogolyubov Institute of Theoretical Physics (Kyiv, Ukraine)

- Research for integration cloud infrastructure into ALICE computing environment
 - PROOF (Parallel ROOT Facility)
 - OpenStack platform
 - CEPH
 - control for the cloud infrastructure from the side for ALICE distributed environment software
- Research for power management in cloud environments
- Apply interests for parallel computing to astronomy or to medical stuff (somehow in the future)

• DASHBOARD FOR THE ALICE TIER-2 in BARI

(Project developed within the Postgraduate course in “Development and management of data centers for high performance scientific computing”, PRISMA PON04a2_A)



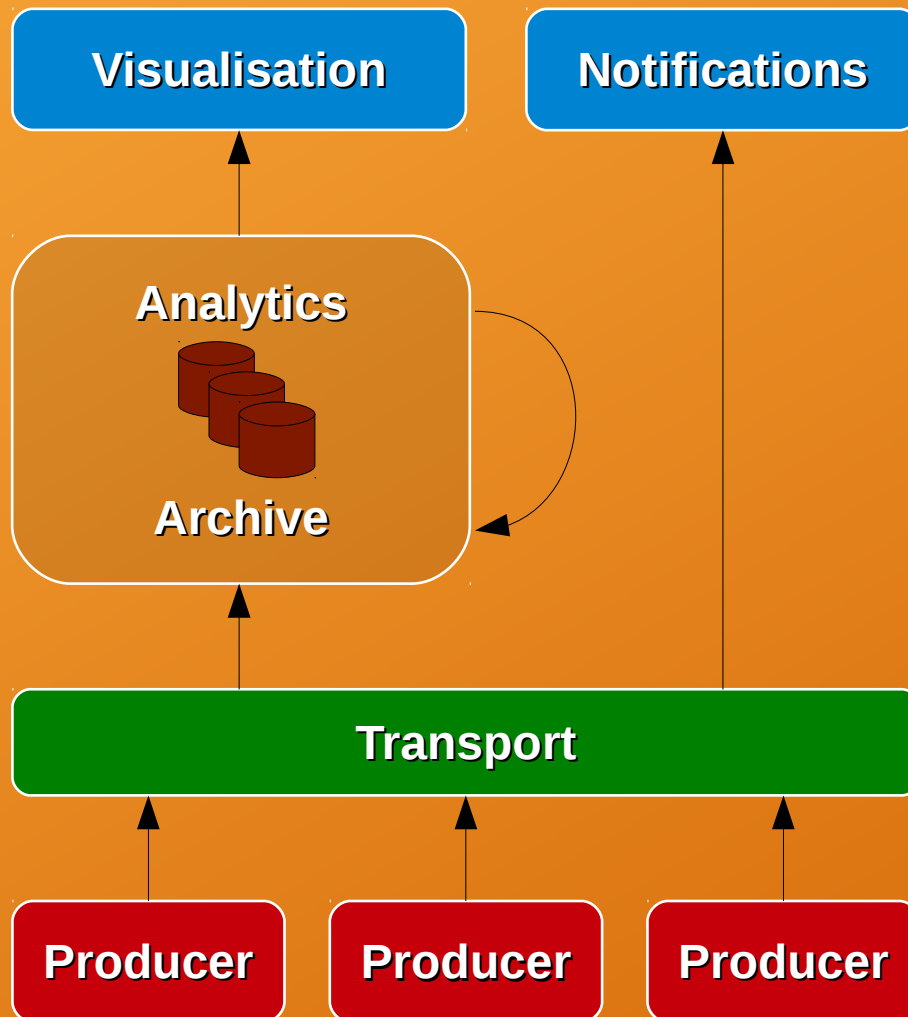
This tool shows responsiveness and low disk usage, thanks to the time-series database InfluxDB, features that make it ideal for statistical, debugging and monitoring purpose.

Next Step:

- Extend the facility to the other ALICE Italian sites;
- Create a dashboard for the Italian ALICE computing.

• MONITORING SYSTEM FOR GEOGRAPHICAL DISTRIBUTED DATACENTERS BASED ON OpenStack

(Project presented to the GARR Consortium - Borse di studio "Orio Carlini")

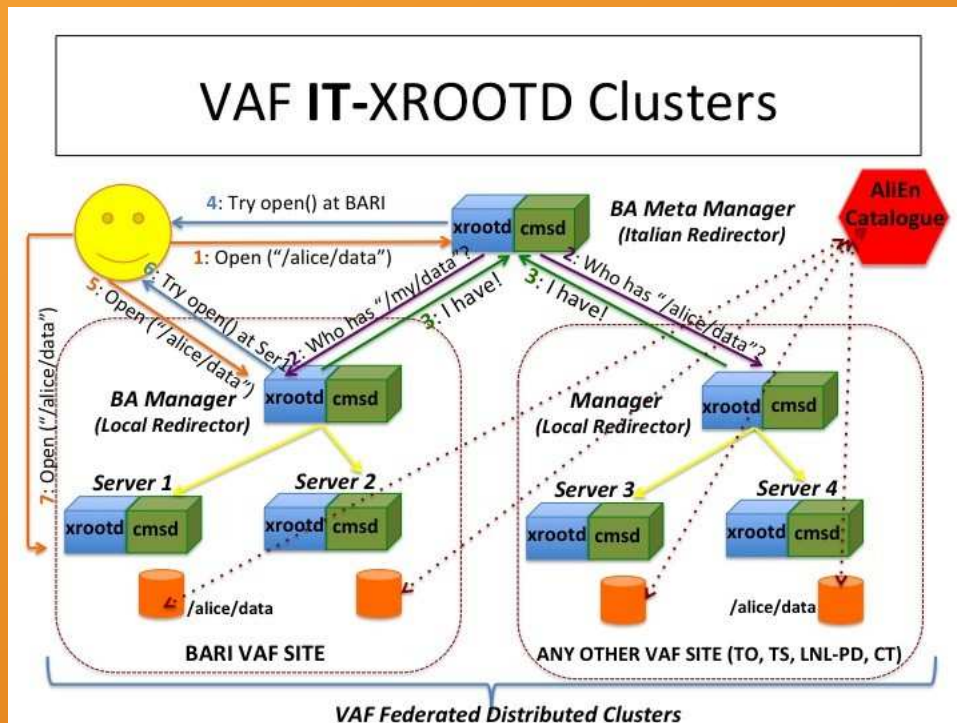


- Monitoring a cluster of Cloud-based datacenters using a single tool;
- Collect all informations from all the different levels, like chiller, storage controller, OpenStack and services status;
- Manage different kind of data;
- Execute automatic analysis to extract useful information on the site performance / status;
- Adopt open source software only

Also currently ongoing:

- Cloud-based Virtual Analysis Facility (VAF) within STOA-LHC PRIN

Main Activity: Data Federation using XRootD



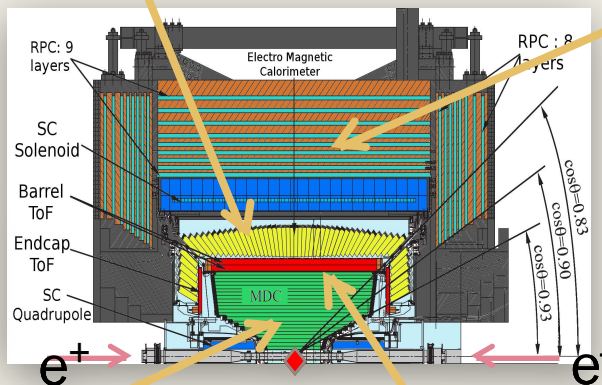
- A VAF is a dedicated PROOF-based cluster of Virtual Machines using the μ CernVM image;
- PROOF (Parallel ROOT Facility) is an extension of the ROOT data analysis framework that allows interactive analysis on a local cluster parallelizing tasks;
- The VAF-IT XRootD Cluster is composed of a global Italian redirector, a local redirector and some servers, dedicated to data storage;
- The dataset is staged locally by system administrator from the AliEn Catalogue.

- Monitoring and support for the ALICE Tier-2 site within the new ReCaS datacenter
- Participation to INDIGO and PERSON Projects



EM Calorimeter

Muon system

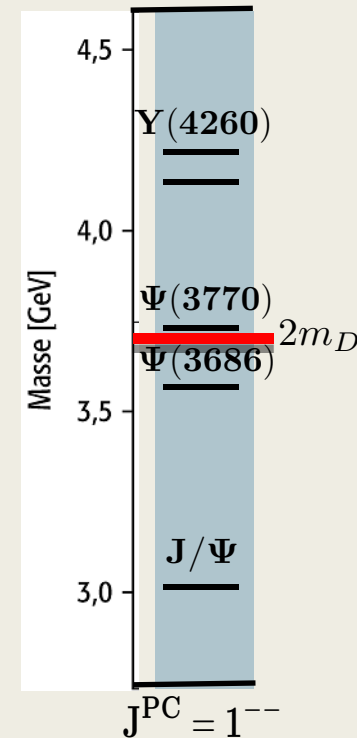
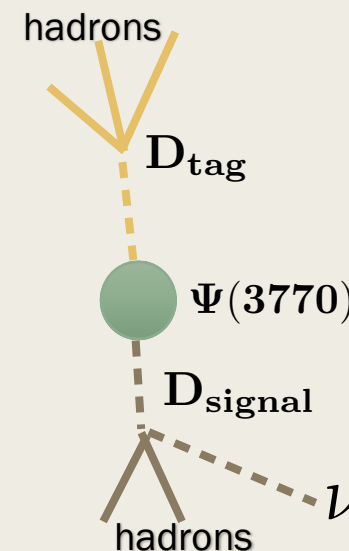


Multi-wire drift chamber

Time-of-flight

- e^+e^- storage ring BEPC2 @ IHEP(Beijing)
- Charm physics @ 3.77 GeV
 - Special topology
 - Clean environment
 - D tagging - determine flavour or CP of D^0

Ideal conditions for charm physics



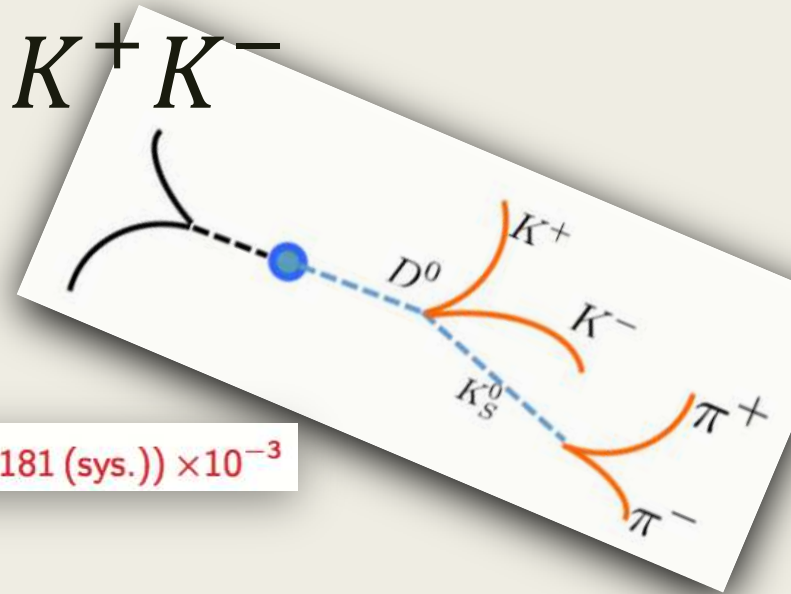
Analysis of $D^0 \rightarrow K_S^0 K^+ K^-$

- Measurement of branching fraction
- $\sim 12k$ events (*untagged analysis*)

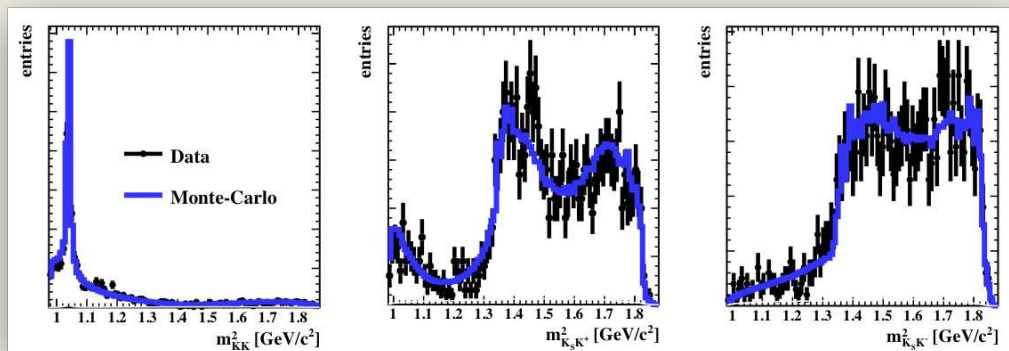
$$BF_{data}(D^0 \rightarrow K_S^0 K^+ K^-) = (4.622 \pm 0.045 \text{ (stat.)} \pm 0.181 \text{ (sys.)}) \times 10^{-3}$$

(preliminary)

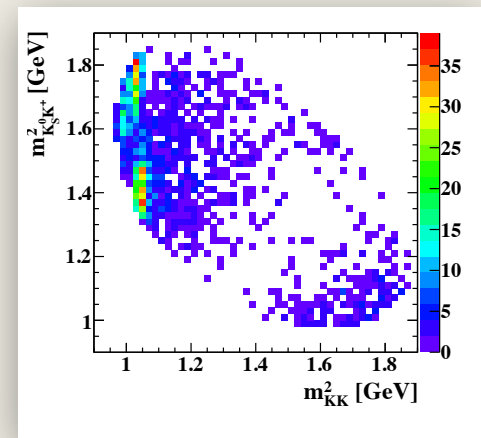
- Dalitz plot analysis
- *tagged analysis (D^0 flavour)*
- *Amplitude model (coherent sum of Breit-Wigner)*
- *Technically: ComPWA framework*



Dalitz plot projections



Dalitz plot (~ 2000 events)



ComPWA

■ Common-Partial-Wave Analysis Framework

- Publically available at:
<https://github.com/ComPWA/ComPWA>
- Modular design
- Minimization with (up to) 100 Parameters on large datasets
- *Efficiency calculation of likelihood function critical*

■ Tasks for the future:

- Code in some parts not thread-safe
- *Parallelization*
- Room for efficiency improvements
- Minimization if GPU(?)

