

Development of innovative methods and tools for real-time control system in fusion devices.

Tautvydas Maceina 2014-01-07



Academic supervisor: Paolo Bettini

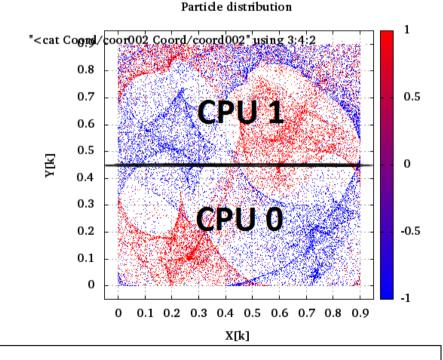
RFX supervisor: Gabriele Manduchi



Current aim of the work:

studying various hardware architectures and learning code parallelization

- PIC code: serial and parallel version being developed
- PIC method
- MPI parallelization



Remaining work:

hybrid programming (+OpenMP), GPU extention (Cuda C), universal framework

Diego Michelotto

ESC 14

Me

 Graduated in Computer Science at the University of Ferrara in 2011

 I work at the INFN for the CNAF section, in Bologna from 2011

I'm member of the R&D Operations group

What I Did and Do

- I have developed for Italian NGI a General purpose Portal for the easy access to Grid and cloud resources.
- Now I'm involved into StoRM and VOMS developers team

Thanks

Introduction

Mihaly Novak

October 20, 2014

Past

- Monte Carlo simulation of low (1-10 000 eV) energy electron-solid interactions
- surface plasmon excitations, seconder electrons from surface plason decay, photo and Auger electron transport, elastic interactions
- 2008 PhD Institute for Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary
- Postdoc 2009-2013, ULB, Brussels, Belgium
- some publications:
 - Electron supersurface scattering on polycrystalline Au, Physical review letters, 110, 086110, (2013), W. SM Werner, M. Novak, F. SalvatPujol, J. Zemek, P. Jiricek
 - Secondary-electron emission induced by in vacuo surface excitations near a polycrystalline Al surface, Physical Review B, 88, 201408, (2013), W. SM Werner, F. Salvat-Pujol, A. Bellissimo, R. Khalid, W. Smekal, M. Novak, A. Ruocco, G. Stefani
 - Local versus nonlocal description of the energy loss of electrons via plasmon excitation backscattering from solid surfaces, Physical Review B, 80, 045406, (2009), M. Novak
 - Monte Carlo simulation of energy loss of electrons backscattered from solid surfaces, Surface Science, 602, 1458, (2008), M. Novak

Present

Job:

- Fellow at CERN SFT(SoFTware Development for Experiments) group, simulation team (since 2014)
- GeantV project: develop a highly optimised physics simulation toolkit by exploiting all optimisation opportunities ('V' stands for "vector")
- physics simulation part, EM physics, multiple scattering (theoretical phase)

Hobby:

- machine learning; kernel methods; LS-SVM formalism of various multidimensional, non-liner statistical algorithms
- unsupervised learning, clustering large-scale and big dataset, developing sparse algorithms (low rank kernel matrix approximations with incomplete Cholesky decomposition, Renyi entropy maximisation)

example

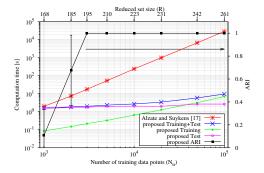


Figure: The gain by changing the mathematics ("Fast kernel spectral clustering based on incomplete Cholesky factorization for large scale data analysis", M. Novak, C. Alzate, R. Langone, J.A.K. Suykens, under publication)



ESC14 Davide Pedretti

Electronics Engineer at INFN - LNL

Control systems for the accelerators of the SPES project. Design of a microprocessor-based Input Output Controller.

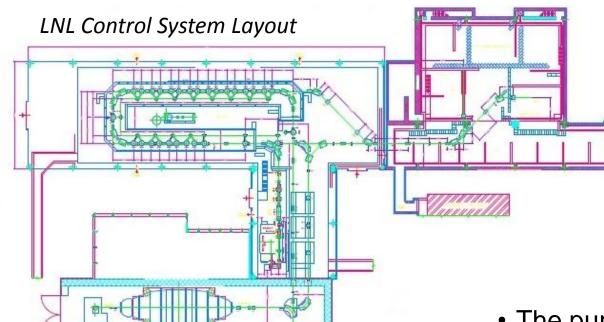
IOC overview



- It consists in a custom COM Express carrier board and it is the basis on which to build an Embedded Computer System.
- The IOC development is aimed to provide almost all the peripherals needed in the control system of a big physics facility.
- State of the art:
 - > The HW architecture has been finalized.
 - ➤ Starting to develop the firmware and the software support for all the on board peripherals.
- An IOC represents a local intelligent node in the control system network. We can develop an application specific database for each IOC installed in the complex in order to monitor the relevant process variables.

IOC – Automatic Beam Transport System

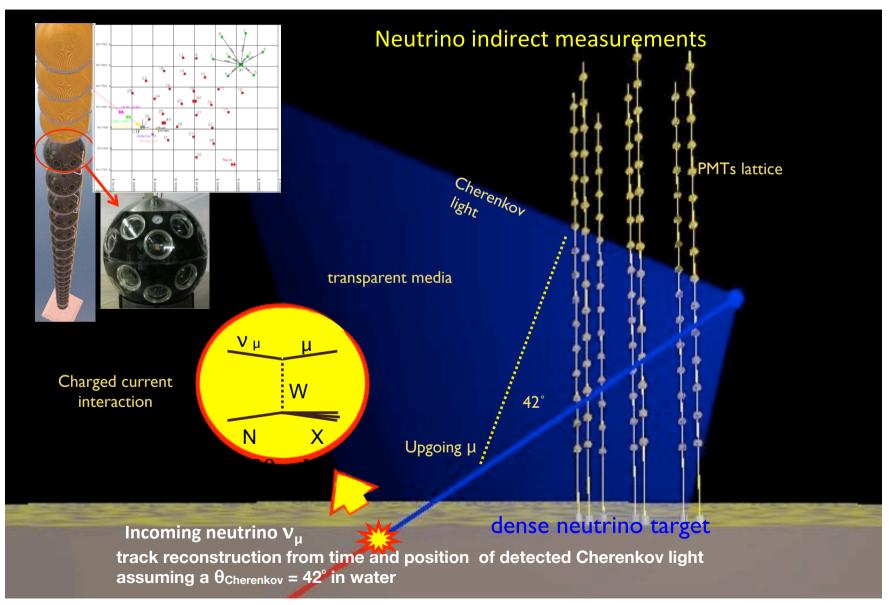




 IOC are autonomous computational entities which are part of a distributed computing system.

 The purpose of the distributed programming process is to achieve an Automatic Beam Transport System which guarantees a stable and of quality beam.

Detection principle of KM3NeT (cubic kilometer neutrino telescope)



Very high background/throughput

Signal-to-noise ratio extremely disfavored:

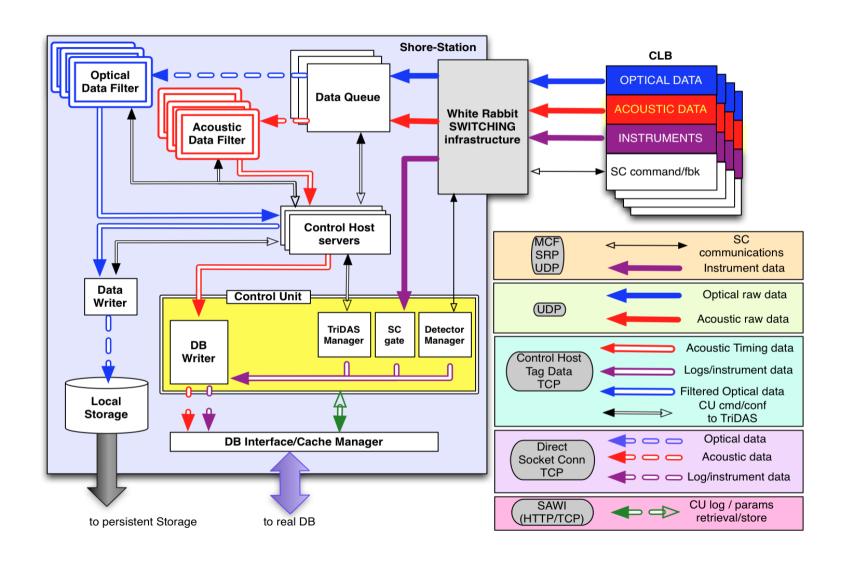
- Atmospheric muon rate: 100 Hz/km³
- 40K decays (constant): 50 kHz/PMT (10", 0.5 p.e. thld)
- Bioluminescence (occasional): up to some MHz/PMT (10", 0.5 p.e. thld)



Case		Expected	Conservative	Maximum
		$(v_{\text{single}} = 6 \text{ kHz})$	$(v_{\text{single}} = 10 \text{ kHz})$	$(v_{\text{single}} = 15 \text{ kHz})$
3" PMT (0.25 p.e. thresh.)	(Mbps)	0.3	0.5	0.7
DOM (31 PMT)	(Mbps)	8.9	15.0	22.0
String (18 DOM)	(Mbps)	160.0	270.0	400.0
Phase 1 (24 strings)	(Gbps)	3.7	6.2	9.4
Block (115 strings)	(Gbps)	18.0	30.0	45.0
Phase 1.5 (230 strings)	(Gbps)	36.0	60.0	90.0
Phase 2 (690 strings)	(Gbps)	110.0	180.0	270.0

Need for on-line filtering!

KM3NeT-EU Trigger and Data Acquisition System (TriDAS)



ALICE

Few words about me

- Currently PhD student @ Università di Torino
- I am working on the reconstruction software for the new silicon tracker of ALICE (ITS Upgrade)
 - Development of a fast primary vertex reconstruction algorithm
 - Study of the feasibility of Huffman compression for the reconstructed hits information
 - Development of a track reconstruction algorithm
- Lately I started also an analysis on the flow of light nuclei in PbPb collisions with the current detector.



Tracking algorithm for ITS Upgrade

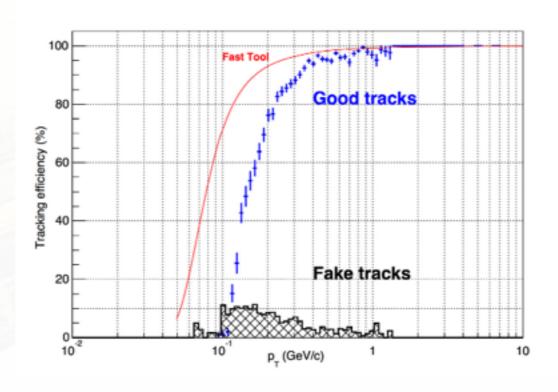
The tracking algorithm for ITSU is based on Cellular Automata.

Some desired features are:

- High reconstruction efficiency at low transverse momenta (down to 50 MeV/c)
- Online reconstruction capability: the target is to cope with interaction rate up to 100 kHz in PbPb collisions

Current CPU time per central PbPb event: 0.8s on my laptop.

Looking at vectorisation and parallelisation to speed up the code

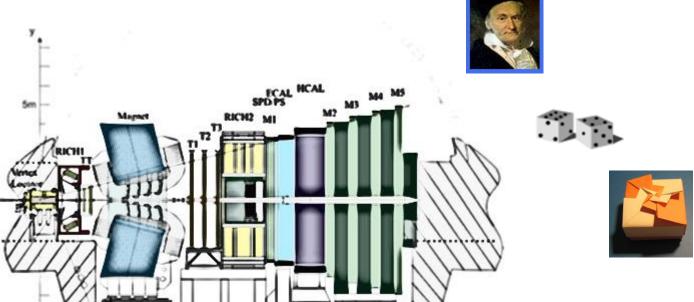


Monte Carlo simulations production @ LHCb experiment



Bartłomiej Rachwał 4nd year PhD





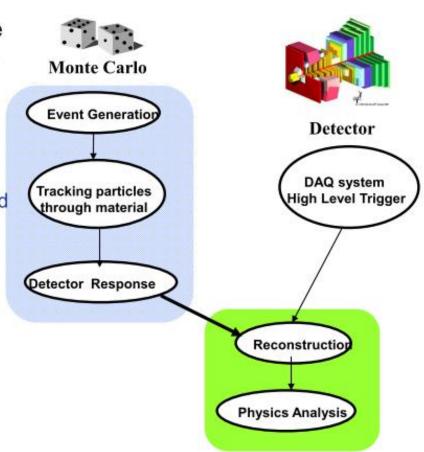
ESC14, Italy, Oct 20th, 2014

The experiment



The Monte Carlo simulation role is to mimic what happens in the spectrometers to understand experimental conditions and performance.

- Monte Carlo data are processed as real data in Reconstruction and Physics Analysis
 - . BUT we know the "truth"
- Comparing the simulation with what is measured in reality we can interpret the results



The local production

Setup LHCb software by CernVM-FS filesystem as a shared software area





Cluster Zeus:

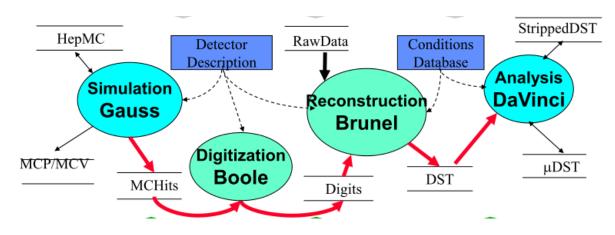
OS: Scientific Linux 6

configuration: HP BL2x220c

Processor: Intel Xeon

Operational memory: 23 TB

Computational power: 169 TFlops



The search for the Higgs with the associate production of intermediate boson:

$$HW^{\pm} \rightarrow b\bar{b} + l^{\pm} + \bar{\nu}_{l}$$

$$HZ^{0} \rightarrow b\bar{b} + l^{+} + l^{-}$$

Prepare Monte Carlo samples for signal and background:

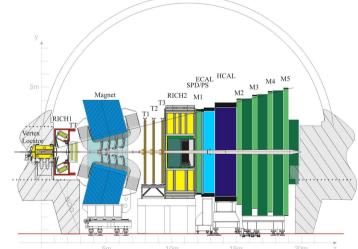
$$HW^\pm/Z^0, t\bar t$$
 , $W^\pm Z^0$, Z^0Z^0 , $W^\pm + b\bar b$, $\gamma/Z^0 + b\bar b$, t

~ several mln events in total!

My presentation: Lorenzo Sestini

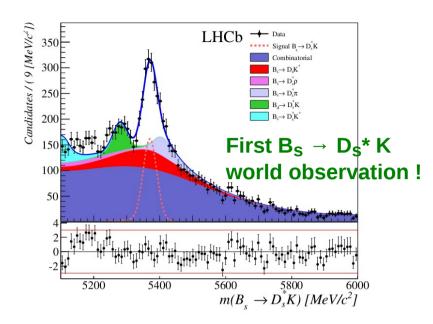
- I am Lorenzo Sestini, a first year Phd student at the University and INFN of Padova.
- I am working for the LHCb experiment with the LHCb group in Padova.
- LHCb is located at Cern, Geneve, in the LHC tunnel. It is a single-arm spectrometer, dedicated to the quark b and quark c physics.
- LHCb consists in several sub-detectors. It has a tracking system (a Vertex Locator and five planes of silicon sensors) and a particles identification system (RICH1 and RICH2, hadronic and electromagnetic calorimeters and muon chambers).
- For my master thesis I studied the calibration of flavour tagging algorithms. Now I am working on the measurement of the γ angle in b → c channels and on the development of a trigger system running on GPUs.



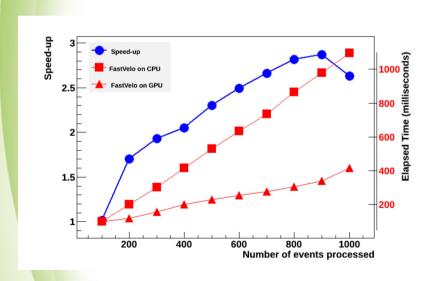


Analysis activities

- y is the least well known parameter of the CKM matrix (quarks mixing). It is an important CP violation observable.
- It can be extracted in many B mesons decay channels, performing time-dependent analysis.
- For this purpose we are studying the B_s → D_s K and the B_s → D_s* K decays.



R&D activities



- We are developing tracking algorithms running on GPUs.
- We need excellent time performances for a faster trigger system.
- For now with our FastVeloGPU algorithm we have a x3 speed-up respect to the CPU time performances (Nvidia GTX TITAN vs Intel(R) Core(TM) i7-3770).

SONIA TANEJA

INFN-CNAF Bologna

CURRENT ACTIVITIES

- Research fellow at INFN-CNAF since March 2013
 - Member of User Support Team at CNAF-Tier1
 - Contact person for CMS, Belle2 and LHCf experiment at CNAF
 - Maintaining and monitoring the VO specific services
 - CMS cloud Contextualization of VM with respect to resource specification@CNAF
 - Installation/configuration of grid components on cloud@CNAF testbed



PREVIOUS EXPERIENCE

- PhD student at IMT Institute for Advanced Studies Lucca, Italy (March 2008 - July 2012)
 - Thesis: A Game-Theoretic Analysis of Grid Job Scheduling
- During my PhD I was also part of projects
 - **EU IST ASCENS** Cloud Computing and Global Computing (Feb 2011 Feb 2012)
 - Design and development of an optimized hardware and software environment for the data analysis of the CMS experiment (June 2010- Jan 2011)
 - EU IST SENSORIA Grid computing and Global computing (March 2009 - Feb 2010)
- Project fellow at UNIPI on Development of Grid Tools for CMS (Feb 2007- Jan 2009)
- Experience revolves around the integration of Science and Computing



Massimo Venaruzzo INFN - LNL

Self-presentation Talk

My research activity - 1

- Member of the ALICE Experiment at LHC
- Postdoc at the INFN LNL on the Reasearch Project of National Interest (PRIN) STOA-LHC:

«Development of computing technologies for the optimisation of access to LHC data and for the technology transfer towards other research areas using the grid and cloud computing approach»

Goal: creation of an elastic cluster for the interactive analysis. No resources preassigned and static but dynamic allocation and release (virtual machines created and destroyed) taking into account the workload and the single user needs.

The user:

- Use his own GRID certificate as access credentials to the VAF
- Has his own workspace (sandbox) completely independend from those belonging to other users
- «Builts» his own cluster asking, with simple shell commands, for resources and releasing them whe the work is done.
- Possible failures in the single user cluster don't propagate to the other user's clusters.

VAF structure: 1 head node + scalable number of workers

Tools

- uCernVM: SO on demand SL6 compatible
- CERNVM-FS: http based file system
- CernVM online: simple graphic interface for the VAF creation and configuration
- HTLcondor: workload management system
- PROOF: ROOT based framework dedicated to the parallel and interactive analysis

My research activity - 2

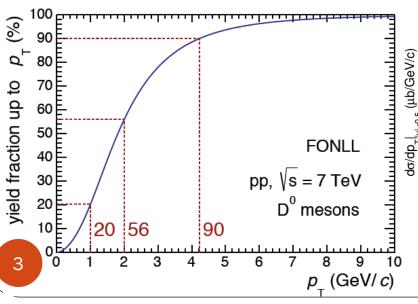
Physics Analysis: reconstruction of the charmed meson D0 in the region of low transverse momentum with combinatorial background evaluation techniques with ALICE Detector at LHC

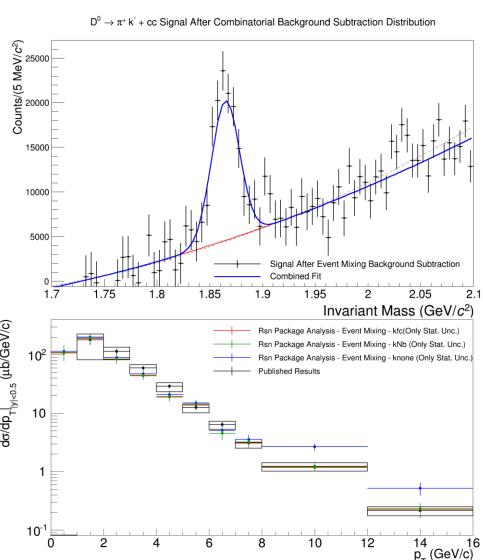
- Full kinematic reconstruction of $D^0 \rightarrow K \pi + c.c. (BR = 3.88\%)$
- Typically exploiting decay topology using secondary vertexing
- Current measurement limited to pT > 1 GeV/c in pp and p-Pb as efficiency for topological selection drops fast at low pT $L = \beta \gamma c \tau = \frac{p}{mc} c \tau$

Motivation for low pT region:

- > 50% of D⁰ yield below 2 GeV/c
- R_{AA} / R_{pPb} and flow at low pT

Goal of this analysis: measure D^0 down to pT = 0





Enrico Vianello

ESC 14

> whoami



• Specialistic degree in Computer Science – 2011 University of Ferrara

As Associated to INFN-Ferrara

- I've been part of Distributed Computing team (SuperB project)
 - Implementation of a Grid simulation jobs submission system for small/medium-sized Virtual Organizations.

See Exploiting grid resources for data simulation by using a general-purpose framework

> whoami



Grid Middleware developer @ INFN-CNAF since 2012

StoRM http://italiangrid.github.io/storm/index.html

StoRM provides data management capabilities in a Grid environment to share, access and transfer data among heterogeneous and geographically distributed data centres. StoRM works on each POSIX filesystems but it also brings in Grid the advantages of high performance storage systems based on cluster file system (such as GPFS from IBM or Lustre from Sun Microsystems) supporting direct access (native POSIX I/O call) to shared files and directories, as well as other standard Grid access protocols. StoRM is adopted in the context of WLCG computational Grid framework.

VOMS http://italiangrid.github.io/voms/index.html

It's at the core of the WLCG authorization stack and is used daily to authorize access to storage and computing resources used by thousands scientists worldwide.

> whoami



Recent updates:

- I'm part of the Research & Development group @ INFN-CNAF
- I'll work on Open City Platforms project testbed

- Andrea Zoli
- National institute of Astrophysics (INAF) - IASF Bologna Department
- CTA Cherenkov Telescope Array
- Onsite real-time analysis of CTA.

