

Data & Storage Services



Geoffray Adde

CERN-IT *Data Storage Services* Group System Developer Geneva

- What am I working on?
- Why am I here?





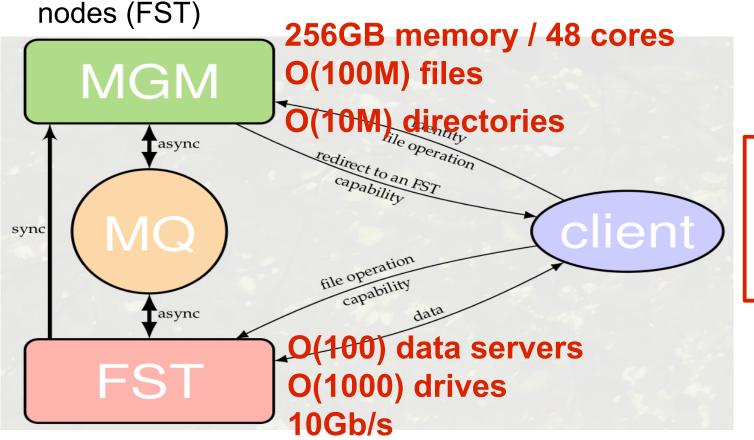


EOS Storage System



- Simplified POSIX semantics filesystem.
- Main use case: Physics Analysis
 low latency, high throuput, high availability

Simple architecture 1 head node (MGM) hundreds of storage



Instance size 35PB

Topics of interest



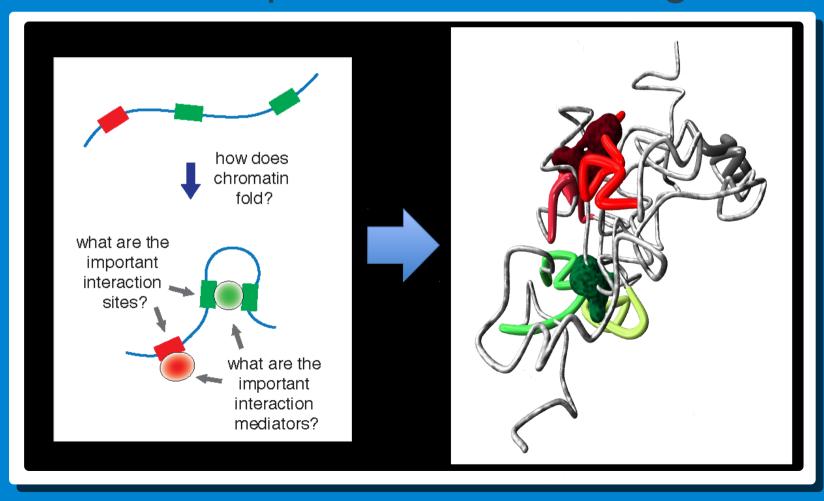
Large scale computing in general

- Understand evolution of storage IO requests
 - To adapt the storage system to the IO requests
 - To promote adapting IO requests to storage systems

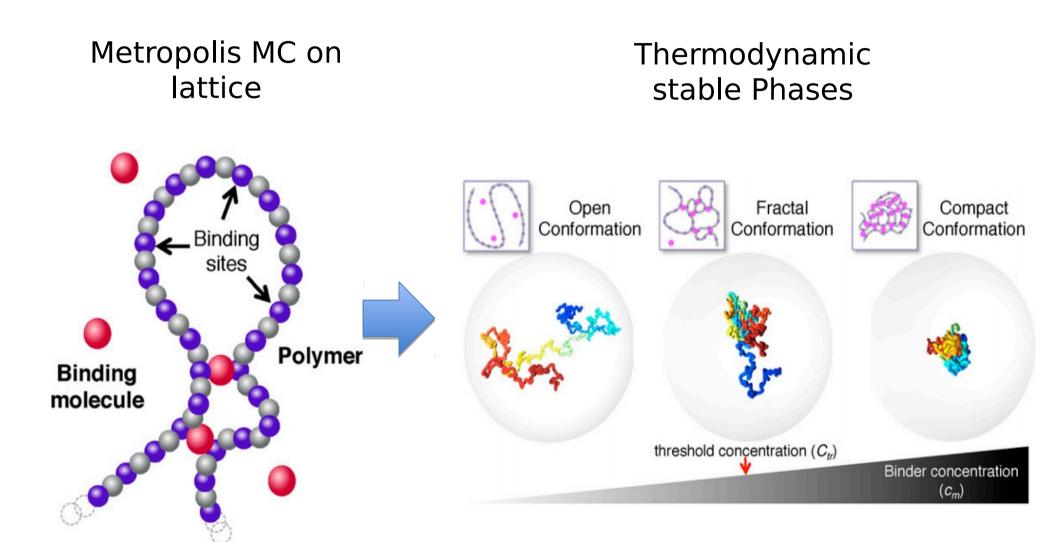


Mariano Barbieri Ana Pombo Lab Bertinoro 2014

Principles of DNA Folding

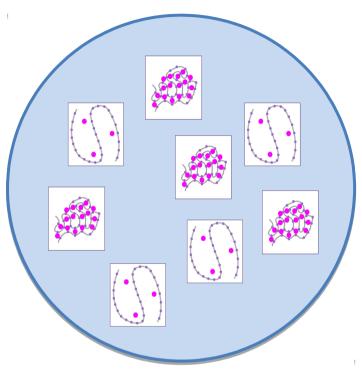


Monte Carlo on polymer physics model

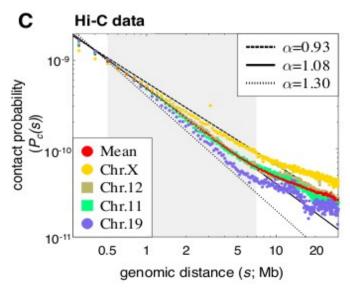


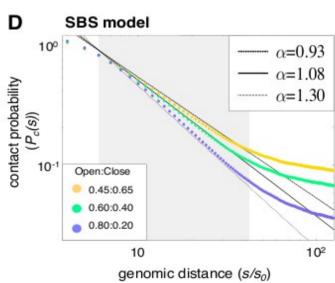
Experimental Comparison

The Cell is in a Mixture of Phases

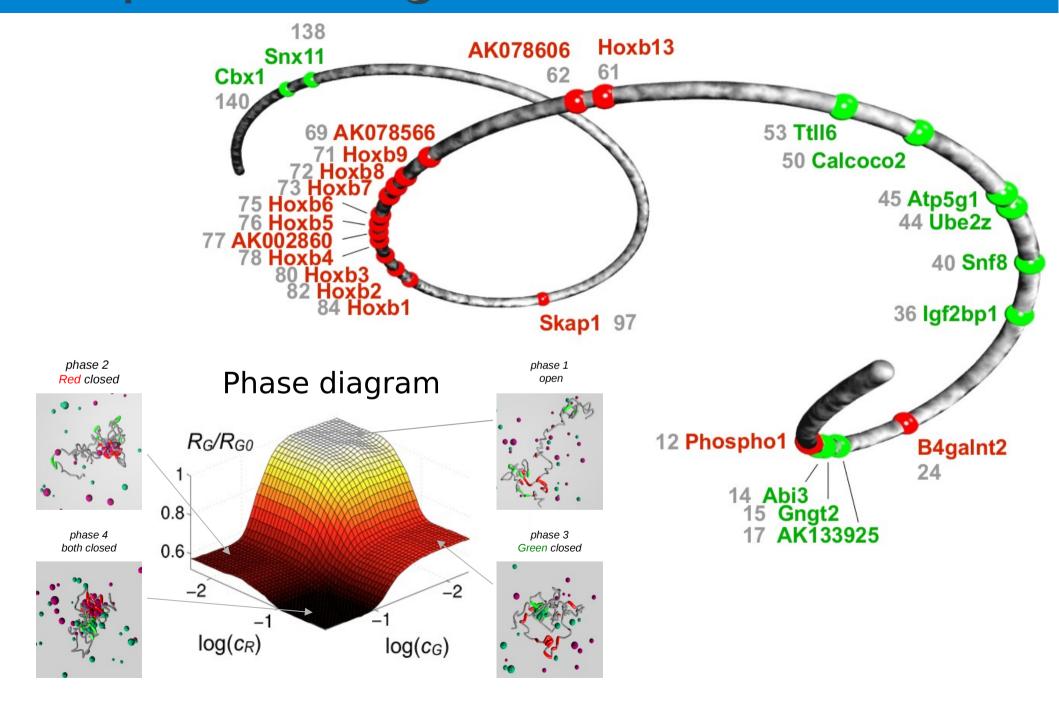


Scaling exponents are caught (PNAS 2012)

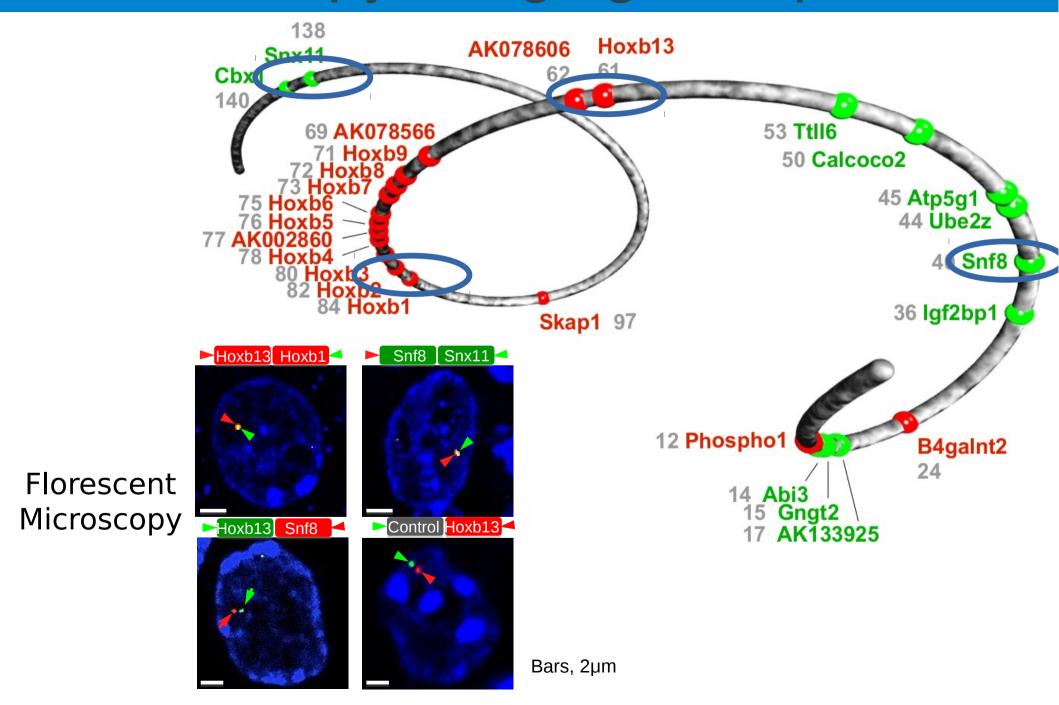




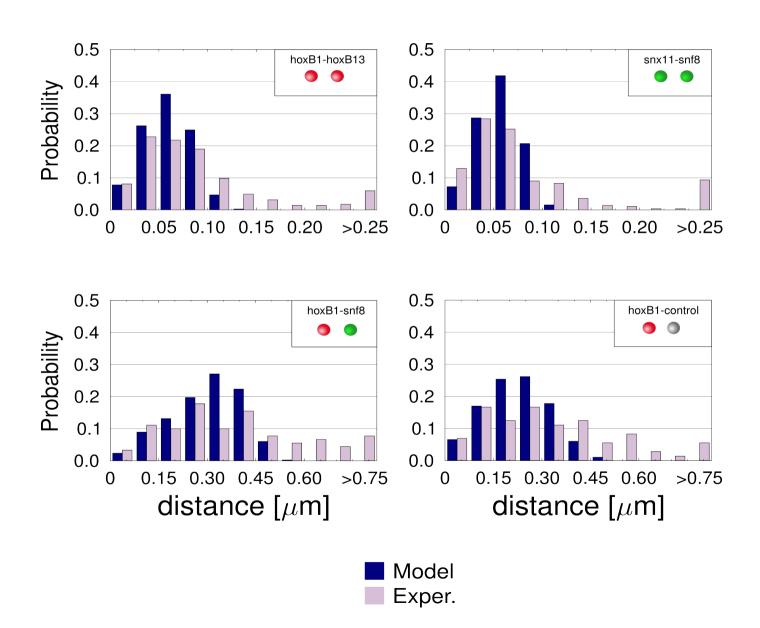
Specific Region of Chromosome



Microscopy Imaging Comparison



Distance Distribution



Possible Improvements

How to improve to address whole-cell scales?

Collective motion

Use matrix multiplication to perform global contemporary changes

Local but Contemporary

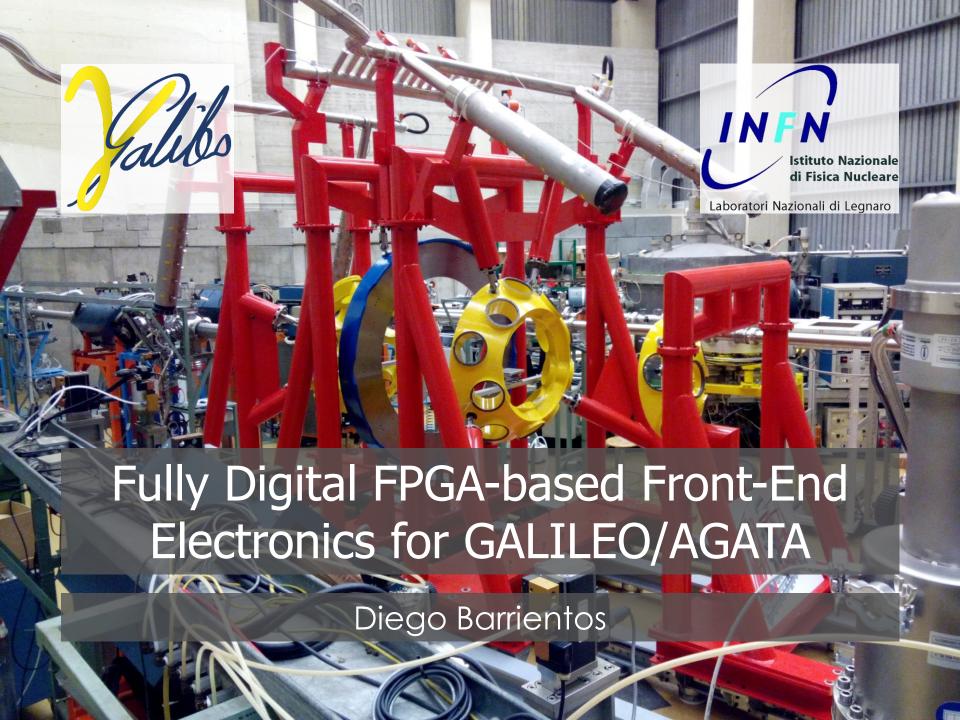
Divide the system's phase space in different (almost) independent regions to contemporary explore

Acknowledgments

Biology
MDC Berlin & MRC London
Ana Pombo's lab

Physics
INFN Section of Napoli
Mario Nicodemi

Computing
ScoPE & GRID



HPGe detector

Preamplifier

BGO scintillator

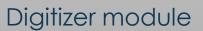
Signal adapter

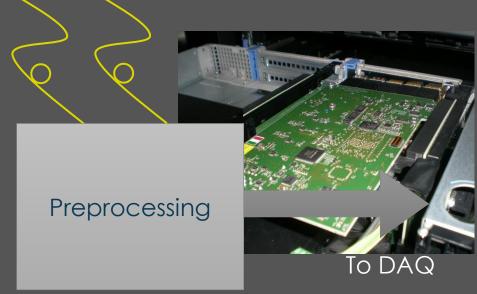
. . .

HPGe detector

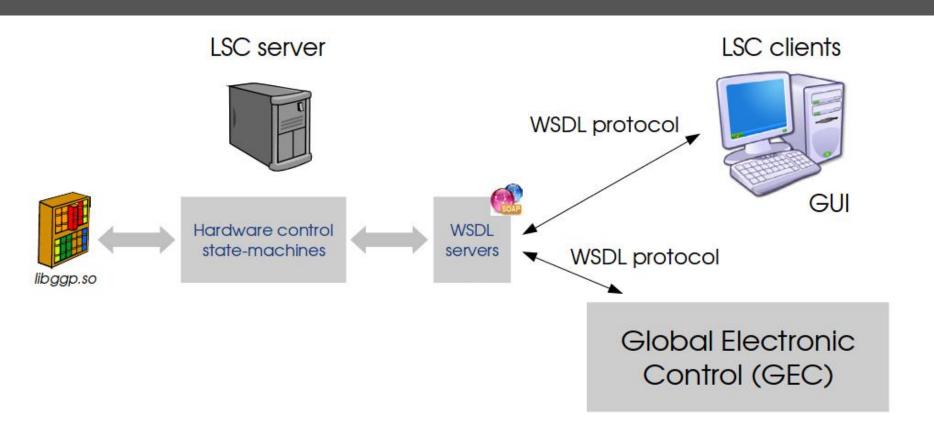
Preamplifier







Slow control

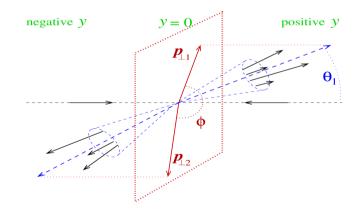


Dimitri Colferai (Univ. Firenze)

Phenomenology of QCD

High-energy jets

- Differential cross section
- Azimuthal correlation



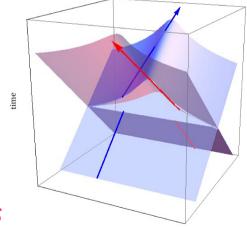
Computing tools

- Event generation
- Multidimensional integration

Gravity at high energy

Scattering of 2 particles

- Deflection angle
- **Graviton** radiation



- Special funcs
- High-precision mathematics
- Ordinary and partial diff.eqs.
- Integro-differential eqs.

Antonio Falabella

ESC2014

My current activities

- Since February of 2014 I'm fellow researcher at **INFN-CNAF** in Bologna.
 - My activities consist of:
 - Member of the CNAF-TIER1 User Support Team as contact person at the TIER1 for the LHCb experiment. Which means monitoring the status of the services running at CNAF that are relevant for LHCb and act promptly in case of problems or issues
 - I'm also part of an **R&D** project for the LHCb upgrade. The aim of this project is to develop a new event building the can deal with the high data acquisition frequency foreseen for the upgrade.
 - The technology that is under investigation is **Infiniband**, that guarantees the required throughtput and latency performances.

Former experience

- Before start working at CNAF I was physics Ph.D. student at University of Ferrara (from January 2010 to March 2014).
 - My thesis was about the Flavour Tagging
 Algorithms used for the physics data analysis of the LHCb experiment.
 - I also spent a period at Cern (18 months)
 supporting Grid activities with the LHCb offline
 group

Former experience

- I studied at the University of Ferrara also for the bachelor(degree 2007) and master thesis courses (degree 2010):
 - In these period I was involved in the LHCb experiment. At the time the experiment were not taking data (Run 1 started in 2010). I worked on MC simulations to estimate the correct alignment for muon detector of the LHCb detector.



I present myself

- My name is Andrea Favareto and I have a Post-Doc position at Università degli Studi di Genova from June 2013
- My main activity is the design and development of ATLAS Event Index
 - ▶ ATLAS (A Toroidal Lhc ApparatuS): ATLAS is a high-energy particle physics experiment at the LHC (proton-proton collider) at CERN in Geneva that aims to shed light on many issues that have not yet been answered about the origin of mass and fundamental forces governing nature.
 - Event Index: it is a complete event catalogue for experiments collecting large amounts of data



- Modern scientific experiments collect very large amount of data
 - ▶ ATLAS: e.g. 2 billion real and 4 billion simulated events in 2011 and 2012
- A catalog of data is needed according to different point of view
 - multiple use cases and search criteria
- A database that contains the reference to the file that includes every event at every stage of processing is necessary to recall selected events from data storage systems
 - ▶ In ATLAS an *EventTag* database already exists
 - designed in the late 1990's
 - Oracle databases with separate tables for each reprocessing cycle. Implementation in Oracle particularly labor-intensive
 - each event is recorded several times, once for each cycle of reconstruction
 - ▶ EventTag is potentially very useful but very little used, at least in its DB format
- GOAL: design a more agile system ("NoSQL" databases) that keeps the functionality of skimming by keeping only the pointers (currently GUIDs) to the files where the event in question can be found at every stage of processing and eliminating other variables of lower importance

ESC2014

Introducing MySelf
Matteo Favaro

My Current Activies

- Since October 2011 I'm a fellow researcher at INFN-CNAF in Bologna
 - Starting from October 2014 my mainly activities are:
 - Developing the KM3 experiment framework called TriDas using c++ technologies and external libraries as Boost and ZeroMQ
 - I'm part of Monitoring group at CNAF. I'm developing a simple "portal" to view the entire status of the T1 services, storage, resources and network statuses.

Former experiences

- Before October 2014 my mainly activies were:
 - within the Storage Group I develop a
 Benchmarking tool for testing parallel and
 distributed filesystem and I have presented a
 paper at HPCS2014

During the fellow I also became a Ph.D student at Ferrara University.

ISBN HPCS2014: 978-1-4799-5313-4/14©2014 IEEE

Former experiences

 Before the Fellow I obtained a degree at Ferrara University developing a dynamical wrapper for the submitted analysis jobs on the grid related the SuperB experiment.

Valentina Fioretti

- I have a PhD in Astronomy
- I am a postdoctoral fellow at the INAF Institute of Space Astrophysics and Cosmic Physics (IASF) in Bologna
- my research focuses on the technological development of telescopes for the study of the high energy emission from the Universe



- I am currently working on CTA (Cherenkov Telescope array), the next generation groundbased very high energy Gamma-ray observatory
- In particular, I am participating to the development of a Real Time Analysis prototype.
- I am member of the AGILE collaboration (the Italian Gamma-ray satellite), working on Geant4 simulation and collaborating to the scientific pipeline
- Through the years, I participated to the proposal and the feasibility study of the the Simbol-X, NHXM, IXO, Gamma-Light and GAMMA-400 missions, working on the Monte Carlo simulations and the study of the space radiation environment, which was also the topic of my PhD research activity.
- The main research product of my Ph.D. is the development of the BoGEMMS (Bologna Geant4 Multi-Mission Simulator) project for the simulation of present and future high energy missions.



Github page: https://github.com/vfioretti, website(in progress): www.valefioretti.it



Andrea Gozzelino

INFN LNL

Self-presentation talk

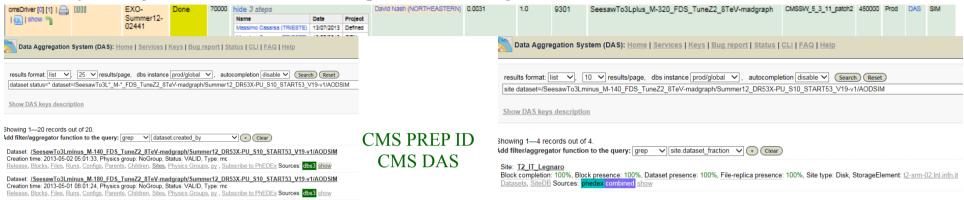
ESC14 School, Bertinoro 19-25/10/2014



Research activity: PhD thesis Thesis defense on April 14th 2014

Search for heavy lepton partners of neutrinos in the context of type III seesaw mechanism in 2012 LHC CMS data [CMS EXOTICA]

1. Study the signal in MADGRAPH and produce it through CMS Full Simulation



- 2. Run CMSSW code on Standard Model backgrounds, signal and 2012 pp data samples doing the analysis.
- 3. Macros written in ROOT give plots and results of "cut and count" experiment (tables).

The Padua farm hosts13 machines (t2-ui-XX) in interactive use with up to 32 cores and disk space. Updated CMSSW versions, Large Hadrons Collider Computing GRID software, editors and compilers are installed. All signals and most of the backgrounds and data are copied on distributed Tier2 Legnaro-Padova.

```
/ssh -XY agozzeli@t2-ui-05.pd.infn.it
cd/lustre/cmswork/agozzeli/SEESAW 2012/CMSSW 5 3 11/src/Analysis Seesaw/Seesaw Analyzer/
cmsenv Analysis code --> /src/Seesaw Analyzer.cc
Compile with scram b - i 20
                                                                                 Handle<std::vector<pat::Muon> > MuonColl;
Configuration code --> /pvthon/seesaw analyzer cfi.pv
                                                                                 iEvent.getByLabel(MuoTagSrc_, MuonColl);
Run the analysis --> cmsRun seesaw analyzer SIGNAL codetest cfg.py
                                                                                 for(vector<pat::Muon>::const_iterator it=MuonColl->begin(); it!=MuonColl->end(); ++it) {
14-Oct-2014 16:02:04 CEST Initiating request to open file dcap://t2-srm-02.lnl.
                                                                                        if(it->pt()>LepTh && fabs(it->eta())<2.4) {</pre>
SeesawTo3Lplus M-140 FDS TuneZ2 8TeVmadgraph/patTuple PF2PAT 1 1
                                                                                        pat::Muon mu=*it;
%MSG-i DCacheFileInfo: file open 14-Oct-2014 16:02:04 CEST pre-events
Run all the analysis --> source script launch.sh 6 SeesawTo3Lminus M-140 FDS TuneZ2 8TeV-madgraph AZh Prod6
Merge the output root files source script merge.sh <number of folder in test> <new dir name>
Make plots with selections on physics variables and pick numbers for tables (ROOT Macro) → x seesaw analysis.C
```

4. Results interpretations Statistics tools to calculate limits, Mathematica

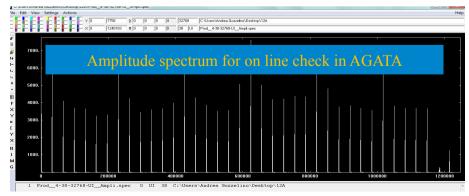


Data taking in Compact Muon Solenoid and in LNL experiments

cDAQ shifter learns how the CMS data-acquisition system works; it has key role CMS commissioning and data taking.



- ✓ Start & stop run with Level 0 Function Manager
- ✓ [L0 FM sends commands to sub-detectors FMs]
- ✓ Read and solve errors (DAQ Doctor and HandSaw help)
- ✓ Verify the application status with XDAQ
- ✓ Check the data transfer to the Storage Manager
- ✓ Document activities with ELOG
- ✓ Monitor the data flow (rate, trigger, bandwidth, ...)





People in Legnaro works on RCMS for CMS. The software structure is reused by many local nuclear experiments, as AGATA and GALILEO.

The DAQ and trigger systems are between physics and computing science.

I have NOT a position for year 2015, but ...

The CBM First Level Event Selector (FLES)

on detector Front-end **FEE FEE FEE FEE** Electronics Data **GBT GBT GBT GBT** Combiners counting **Data Processing** DPB **DPB** Boards x 1000 **FLIB FLIB** green cube Input Input First-level Node Node **Network Event** Proc. Proc. Selector Node Node Permanent Storage Storage

Self-triggered front-end All hits shipped to FLES

FLES Input Interface

- 1 TByte/s total input data rate
- FPGA-based PCle board
- Preprocessing and indexing for timeslice building

Online Event Selection

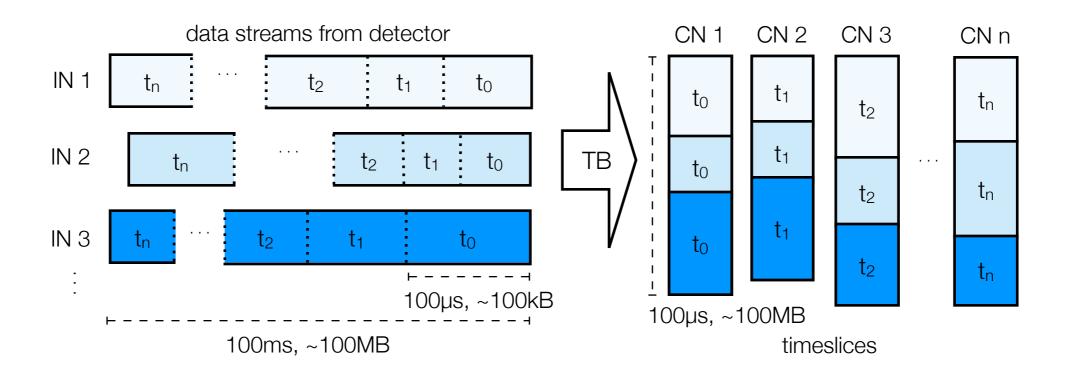
- Performed in HPC cluster
- High-throughput online analysis
- Full event reconstruction
- 10⁷ Events/s
- Heterogeneous system architecture
- ~ 1000 nodes, **60.000 cores**

Timeslice Building

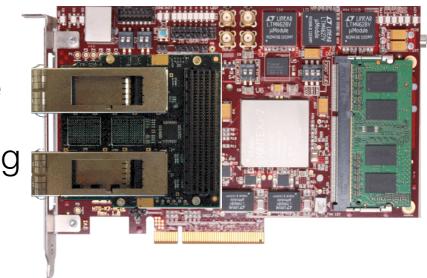
- Global interval building
- Microslice-based
- InfiniBand FDR network

Dirk Hutter – <u>compeng.uni-frankfurt.de</u>

FLES Timeslice Building



- FPGA-based PCle board and fast InfiniBand network
- High input data rate of > 10 Gbit/s sustained per node
- Optimized data scheme for zero-copy timeslice building
- Large buffer memory for partial timeslice building and de-randomisation



Energy-efficient scientific data analysis in heterogeneous computing environment

Kashif Nizam Khan Doctoral Candidate Aalto University, School of Science Finland

Research Focus

- Main focus Energy efficiency in computing in increasingly heterogeneous computing environment
- Heterogeneity
 - Inside the cores (i.e Big- little)
 - NUMA Different memory access speeds
 - Micro-architectures Intel vs ARM
 - Data-Center available computing and

software platforms, momentary load, computational costs, and energy availability





NEXT GENERATION



PRESENT NEXT GENERATION

O SCIENTIFIC INTERESTS:

- Gamma-Ray Astrophysics with Cherenkov Telescopes: TeV sky population / Origin of CRs / γ-ray propagation / Fundamental Physics / GRBs
- Indirect Dark Matter searches in local dwarf galaxies

PRESENT TECHNICAL ACTIVITIES:

- MAGIC data analysis and software maintenance/optimization (C++)
- New data analysis algorithms development (C++)
- Software development for next Cherenkov Telescopes (C++ / CUDA)

UPCOMING TECHNICAL CHALLENGES:

- Handling increasingly large amount of data (up to few GB/s)
- Optimizing/Parallelizing demanding MC data simulation and multi-levels data reduction (to be performed on-site/on-line)



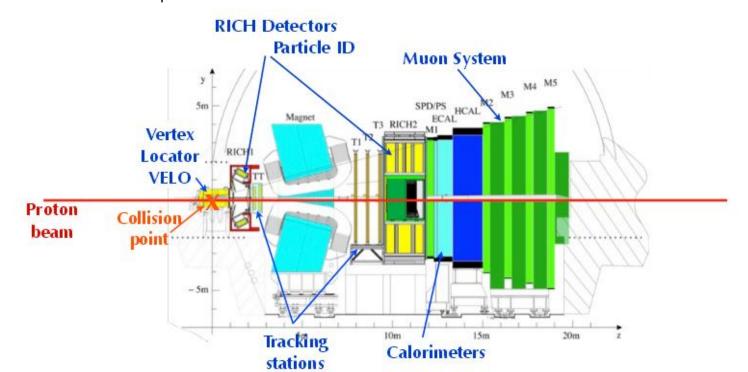
Saverio Lombardi, INAF - ASDC, 20/10/2014, ESC14



- I'm Anna Lupato.
- I'm collaborating with LHCb experiment.

· LHCb experiment:

- -It is a specialized b-physics experiment;
- It aimed to measure the parameters of CP violation in the interactions of b-hadrons
- . Such studies can help to explain the Matter-Antimatter asymmetry of the universe.
- It searches Physics beyond Standard Model, the model which describes the interaction between particles



Current research activity

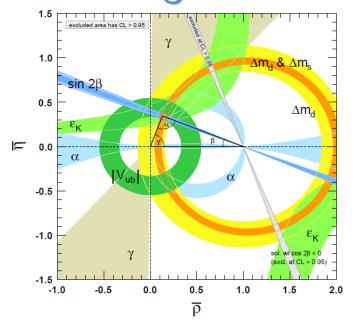
1. First observation of decay channel:

$$B_s^0 \rightarrow D_s^* K(\pi)$$

First measurement of:

$$R^* = \left[\frac{BF(B_s \to D_s^* K)}{BF(B_s \to D_s^* \pi)} \right]$$

Goal: measurement of weak phase y



- 2. The High Level Trigger tracking study for the LHCb experiment, focusing on testing the performances of a GPU-based trigger system.
- · GOAL: Toperforma LHCbtracking on GPU.

In the next years the number of events for second at LHCb will increase -> a solution to perform the tracking of many events per second will be parallel tracking;

I'm interesting also to perform fit using parallel computation.