Track 2 Summary

(Data Analysis, Algorithms & Tools)

Weidong Li, IHEP
Katharine Leney, University of the Witwatersrand

Data Analysis

The automated matrix element methods and its applications at the LHC (1)

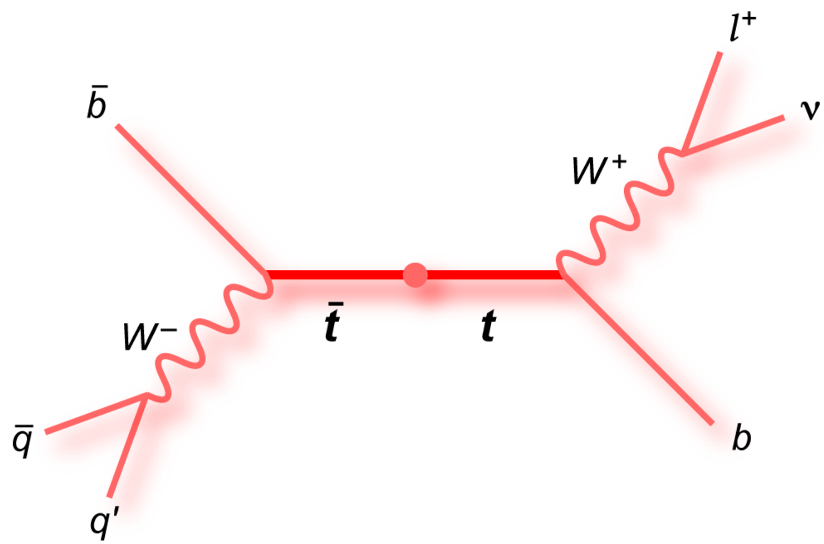
Alexandre Mertens

Matrix Element Methods (MEM) powerful multivariate analysis technique.

- Most theoretically motivated MVA method.
- Widely used for top measurements at the Tevatron, and Higgs sector at the LHC.

MadWeight is a program aimed at automating the calculation of the Matrix Element Method

- Effective treatment for ISR
- Can be used to test any hypothesis in the Standard Model or beyond (provided that the corresponding model is available in MadGraph 5)



b Charge Association

Measure CP violation with tt events at the LHC:

- **mixing** : $N(b \to \bar{b} \to \ell^+) - N(\bar{b} \to b \to \ell^-)$
- **direct** : $N(b \to \ell^-) - N(\bar{b} \to \ell^+)$

Find out which are b and $\bar{b}$ initially

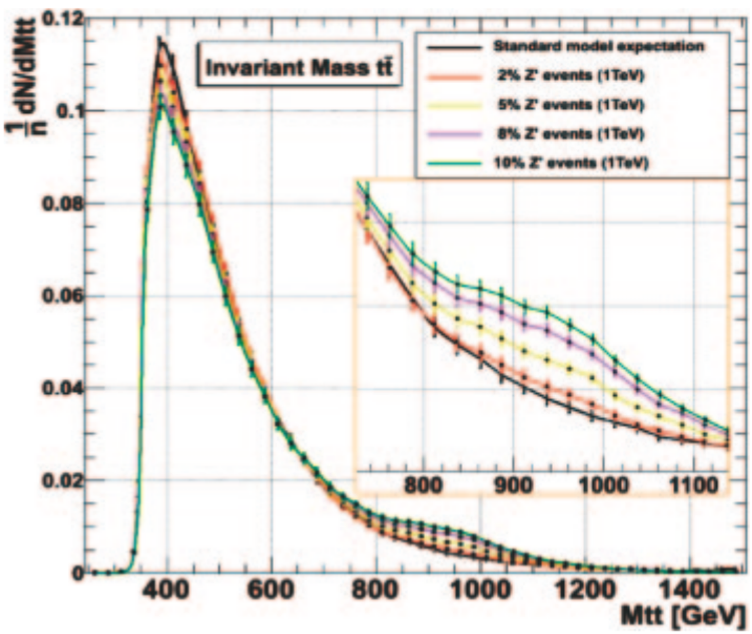
For each event, probabilities P_1 and P_2 of two possible choices of the b-charge can be computed.

Can achieve ≤ 10% mis-association rate with ≈ 70% signal efficiency.

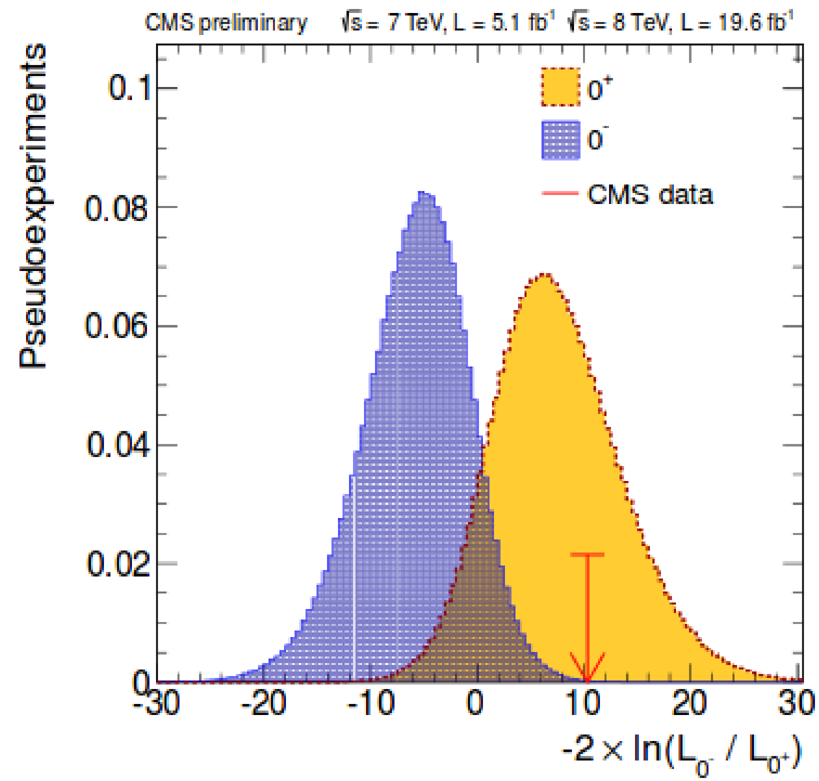
The automated matrix element methods and its applications at the LHC (2)

Alexandre Mertens

Differential tt cross-section measurement and search for resonances:



Parity measurement of new boson:



Good discriminating power

Advanced Analysis Techniques in the Search for Production of a Higgs Boson in Association with Top Quarks at CMS (1)

Jason Slaunwhite

Overview of this talk

- In this talk, we will see that TTH production is a challenging measurement because:
  - Signal production rate is small compared to backgrounds
  - Uncertainties are large
  - No single variable gives great discrimination
- We can overcome these issues using multivariate analysis techniques:
  - To identify the objects associated with ttH decay with high efficiency and purity
  - To distinguish ttH events from background

Advanced Analysis Techniques in the Search for Production of a Higgs Boson in Association with Top Quarks at CMS (2)

Jason Slaunwhite

ANN Design and Training

- We use Artificial Neural Networks (ANN) to combine multiple variables into a single discriminant
  - Multi-layer perceptron as implemented in ROOT and TMVA
- Create one ANN per category with own set of input variables
- Structure: N inputs, 2 hidden layers, one output
  - Hidden layer 1: N nodes
  - Hidden layer 2: N-1 nodes
- Training
  - 50% Signal = ttH, M(H)=120
  - 50% Background = tt
  - Reserved testing sample for overtraining check

Categories of variables
Kinematics of objects, single and composite
Kinematics of jet pairs
Event shape
Btag CSV discriminant

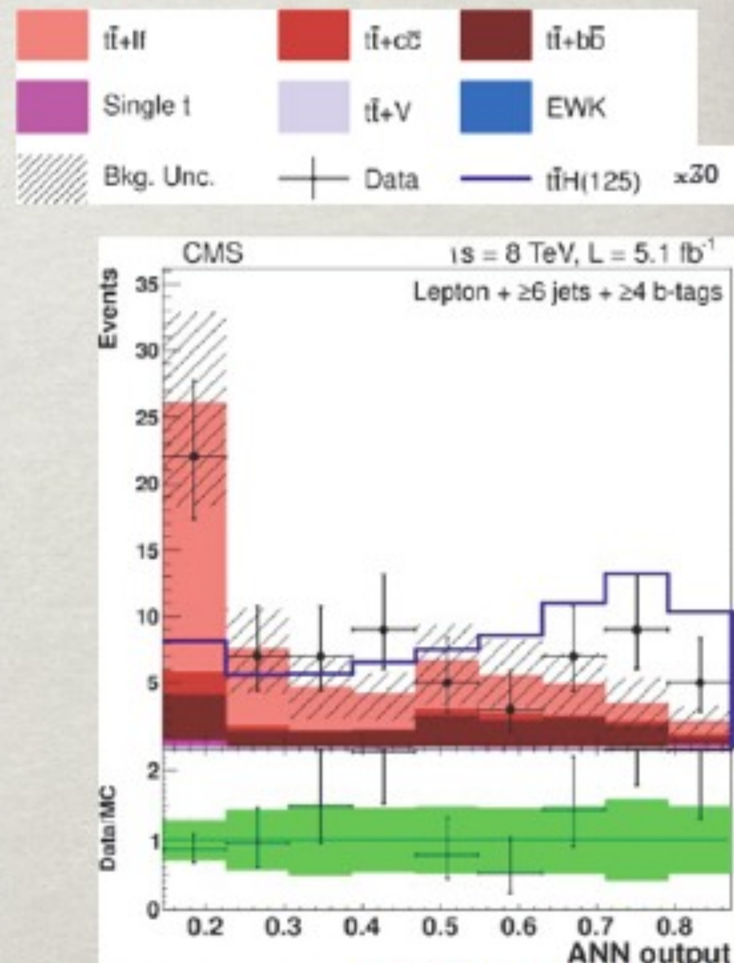
UNIVERSITY OF NOTRE DAME

Jason Slaunwhite

Example ANN: One lepton 6 jets and 4 tags

11 input variables in total

Variable	Category
Mass (lep, MET, Jets)	Kin. of composite obj
Mass (j,j) closest jets	Jet pairs
Mass (j,j) best	Jet pairs
Average ΔR(tag, tag)	Jet pairs
Minimum ΔR(lep, jet)	Shape
Sphericity	Shape
H2	Shape
H3	Shape
Average CSV*	Btag*
2nd-highest CSV	Btag
lowest CSV	Btag



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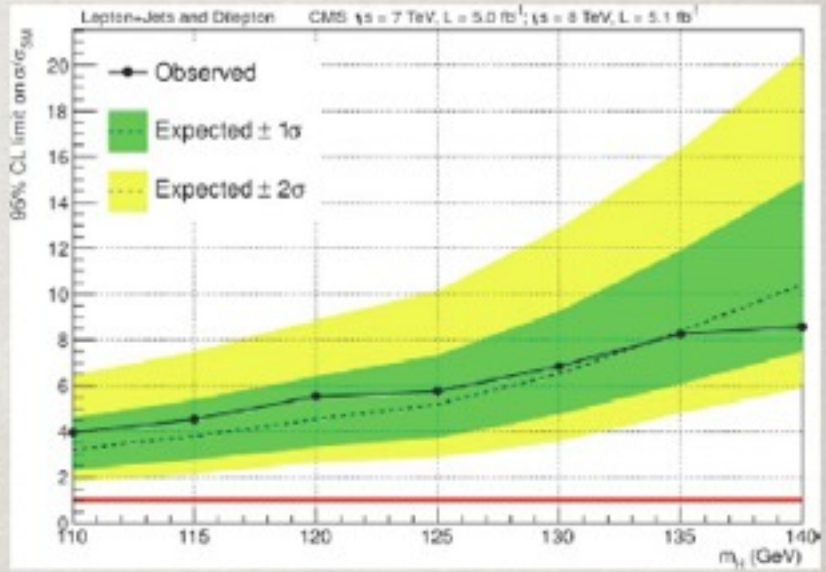
Limit Results

- Fit NN output distribution simultaneously in all 9 categories to extract overall limit
- 5.2xSM expectation at M=125
- 27% improvement over single variable
- Equivalent to increasing data collected by 60%
  - Effectively 3/fb additional in this dataset
  - Effectively 12/fb on full dataset
  - Worth half a year of data taking

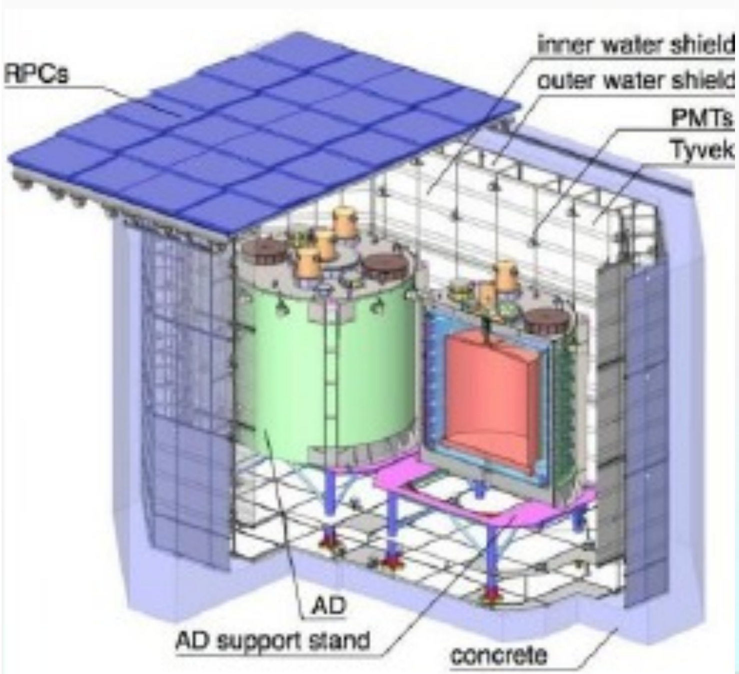


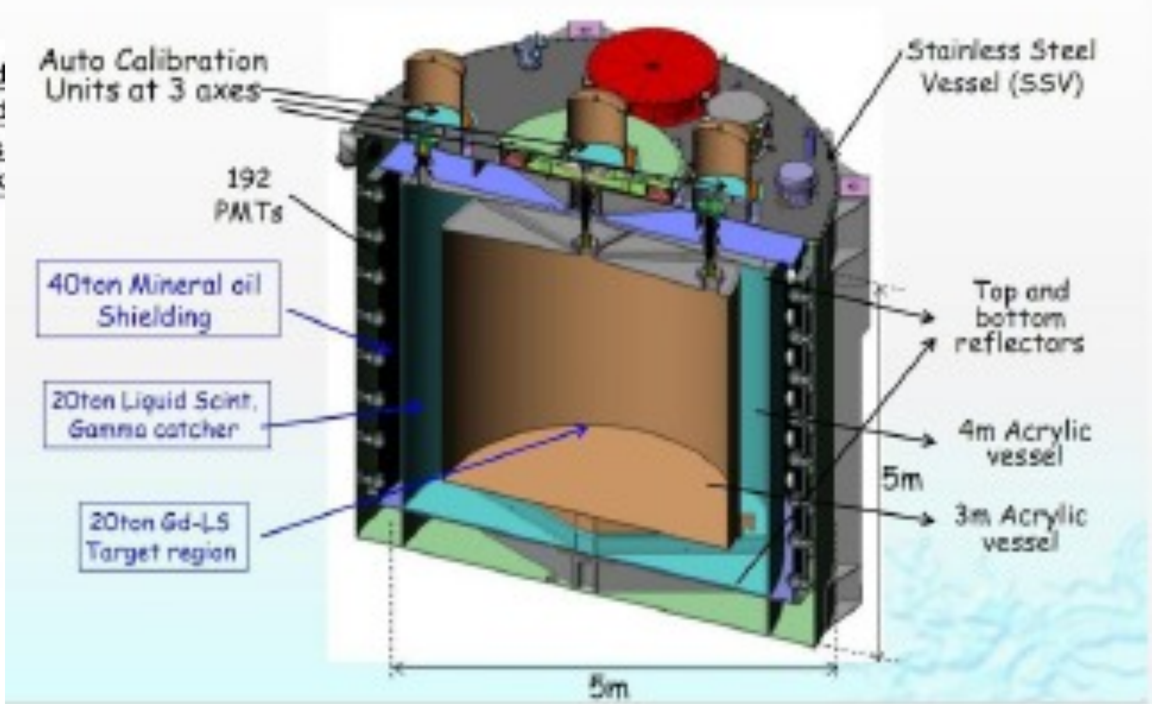
Expected @ 125: 5.2xSM
Observed @ 125: 5.8xSM

Maximum likelihood reconstruction in the Daya Bay Reactor Antineutrino Experiment

Dongmei Xia

- The Maximum Likelihood reconstruction is based on the optical model of the Antineutrino Detector (AD).
  - The energy and vertex are reconstructed with the obtained charges of 192 PMTs.
  - Can be used to understand the energy response of AD and distinguishing the external background with the reconstructed vertex.
  - Can help identify flashers and monitor the attenuation length of the liquid scintillator in AD.

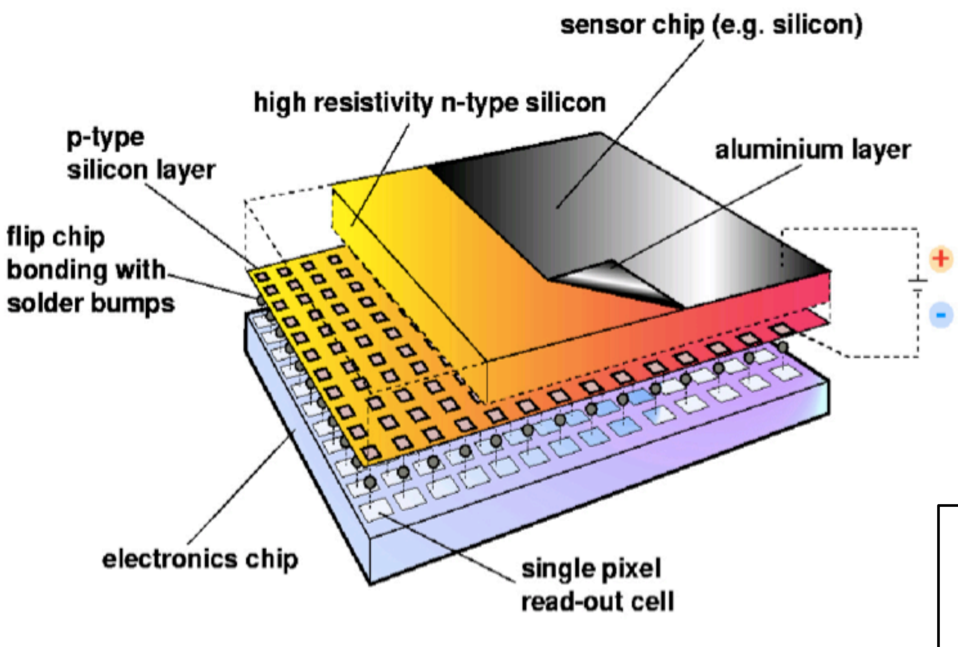


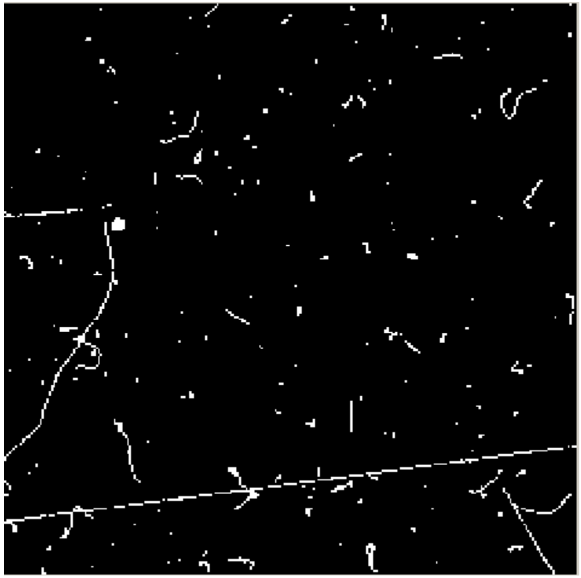


Data Analysis of Tracks of Heavy Ion Particles in Timepix Detectors (1)

Son Hoang

- Develop a Space Radiation Dosimeter
- Characterize ionizing radiation in space
  - Detect and visualize primary and secondary radiation
  - Identify a source of a heavy ion particle
  - Measure energy





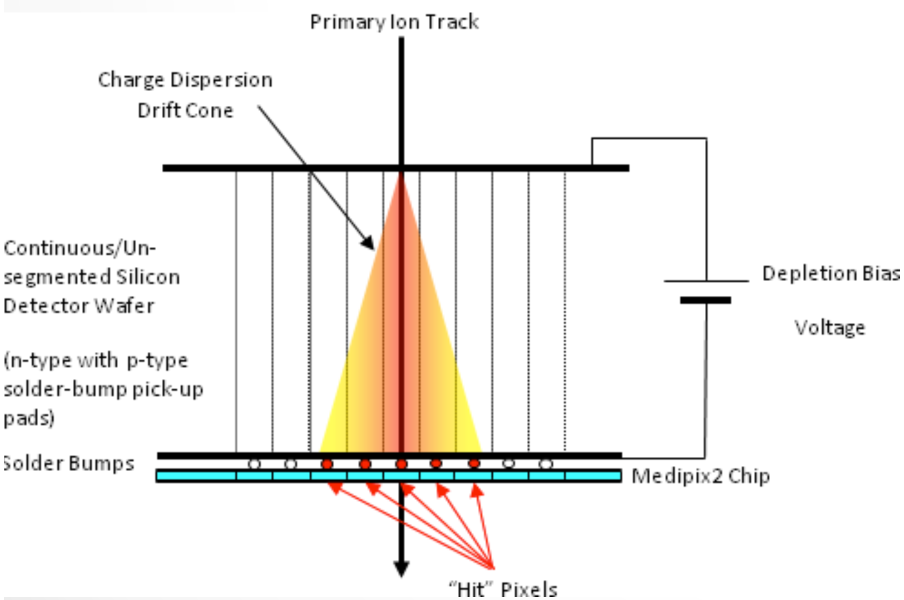
- 256 x 256 square pixels
- 55 μm square pixel

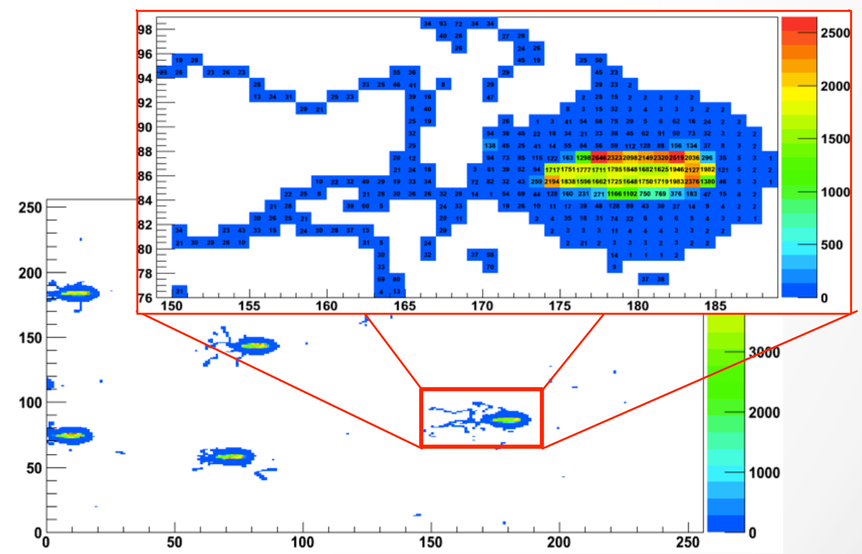
Functions as an active nuclear emulsion, allowing the visualization of the individual tracks created as the different incident particles traverse the detector.

Data Analysis of Tracks of Heavy Ion Particles in Timepix Detectors (1)

Son Hoang

- A charged particle ionizes atoms along its path
- A core of charge carriers is produced
- Charges drift along and diffuse perpendicular to an applied bias-voltage field
- Charges collected by the underlying pixels
- 256x256 pixel image





Timepix output

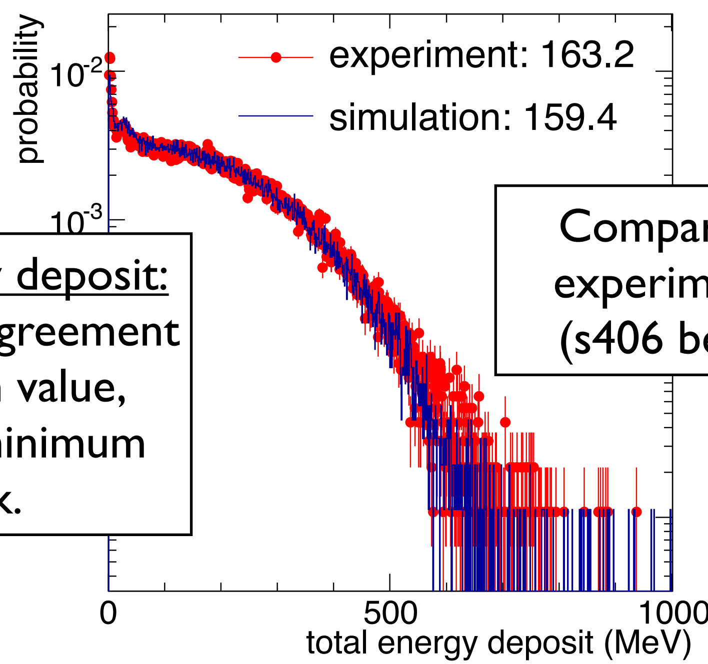
- Detection and visualization of primary and secondary particles.
- Calculation of angle, equivalent dose, plasma effect correction, identify interactions...
- Development of data analysis tools for processing HIMAC ISS data.

Event Reconstruction and Analysis in the R3BRoot Framework

Dmytro Kresan

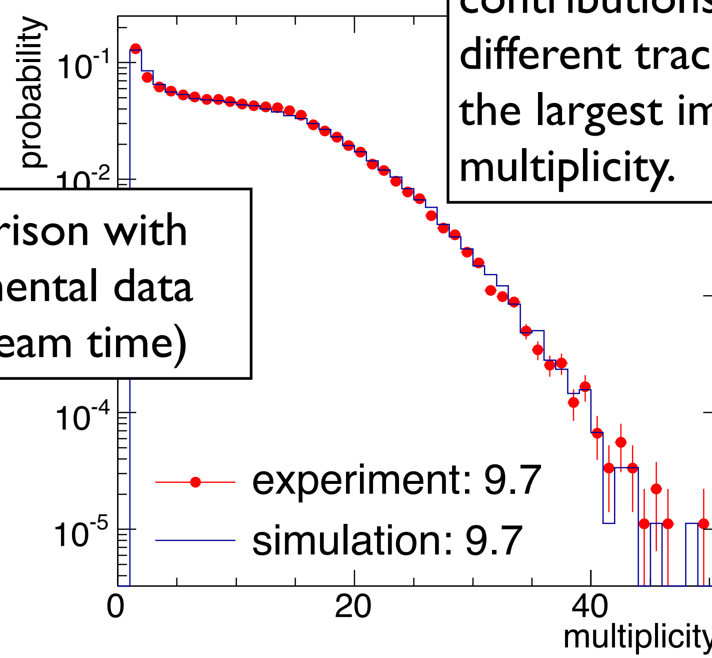
The R3B (Reactions with Rare Radioactive Beams) experiment will be built within the future FAIR project to be built at GSI (Darmstadt, Germany).

- Scientific program devoted to the physics of stable and radioactive beams at energies between 150 MeV and 1.5 GeV per nucleon.
- R3BRoot software framework is under development, delivering detector simulation, reconstruction and data analysis.



<u>Total energy deposit:</u> Very good agreement of maximum value, shape and minimum ionizing peak.

Comparison with experimental data (s406 beam time)



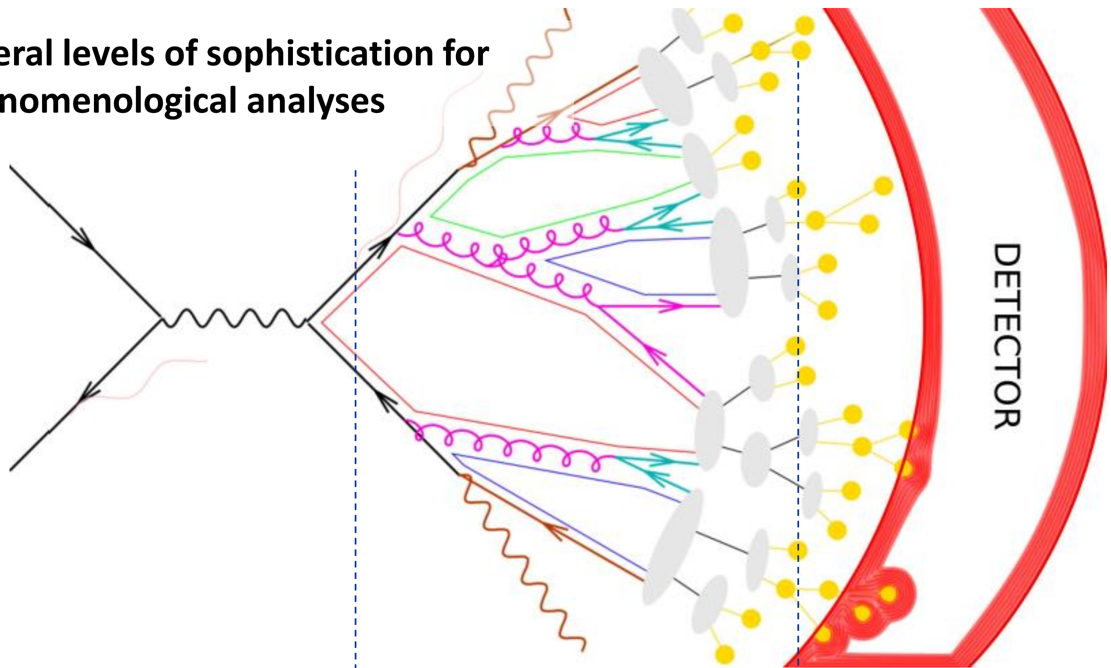
<u>Multiplicity:</u> Integration time of contributions from different tracks has the largest impact on multiplicity.

MadAnalysis 5: a framework dedicated to phenomenological investigations at the LHC (I)

Eric Conte

MadAnalysis 5 is a new, unique and publicly available analysis package allowing to handle phenomenological analyses at any steps of the simulation chain in a very flexible fashion.

Several levels of sophistication for phenomenological analyses



Parton level	Hadron level	Reconstructed objects level
LHE files	**STDHEP/HEPMC files**	**LHCO files**

A unique framework : MadAnalysis 5

MadAnalysis 5: a framework dedicated to phenomenological investigations at the LHC (2)

Eric Conte

- **MadAnalysis 5 = a unique framework with two ways to use it :**
  - **Normal mode:** python interface with intuitive commands.
  - **Expert mode:** requiring programming skills (C++, ROOT).

- **Interfaced to FastJet**, MadAnalysis 5 can:
  - launch a specified **jet clustering** sequence to hadronic events.
  - save samples to «simplified» LHE format (LHCO format very soon).
  - achieve and display the **plots validating the jet merging procedure**.

- **Some leads for further developments:**
  - More and more user-friendly (**tutorials)**.
  - Integration into MadGraph 5 / aMC@NLO
  - Interfaces to physics-relevant packages : **fast-simulation** (Delphes), **showering**

ma5team@iphc.cnrs.fr
https://launchpad.net/madanalysis5
Comput. Phys. Commun. 184 (2013) 222

Algorithms

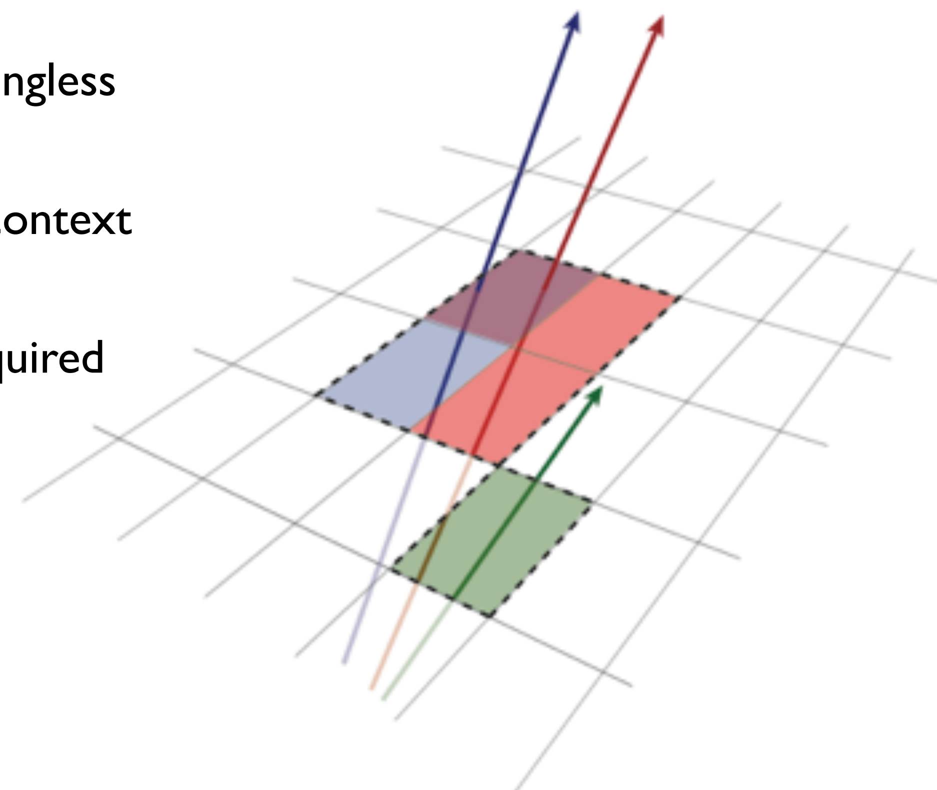
A Neural-Network Clusterisation Algorithm for the ATLAS Silicon Pixel Detector (1)

Katharine Leney

Use a set of artificial neural networks to identify and split merged measurements created by multiple charged particles in the ATLAS pixel detector.

Neural networks are a good choice for pixel clustering algorithm:

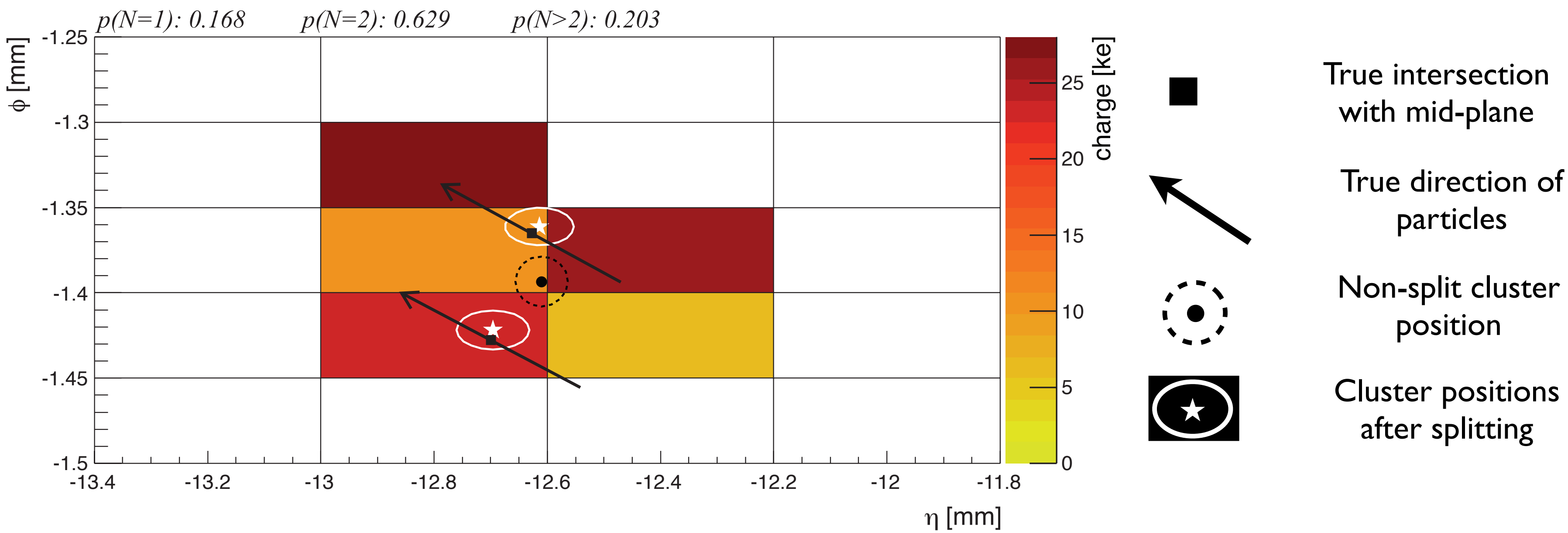
- Many cluster properties are nearly meaningless when alone (e.g. charge of a single pixel).
- Combine cluster properties to put into context (e.g. knowing charges of adjacent pixels).
- Variables then contain all information required for successful pattern recognition.



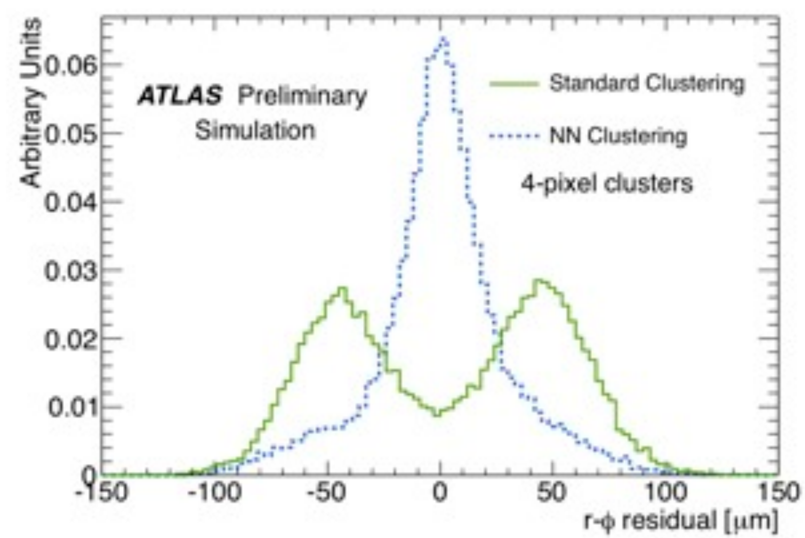
Neural networks used to compute:
- Number of particles per cluster.
- Cluster position and error.

A Neural-Network Clusterisation Algorithm for the ATLAS Silicon Pixel Detector (2)

Katharine Leney



- Ambiguities reduced by order of magnitude when using neural network.
- 15% improvement in longitudinal impact parameter.
- Dramatic improvement in cluster resolution (resolve single peak in track-to-measurement residuals).



The Alignment of the CMS Silicon Tracker (1)

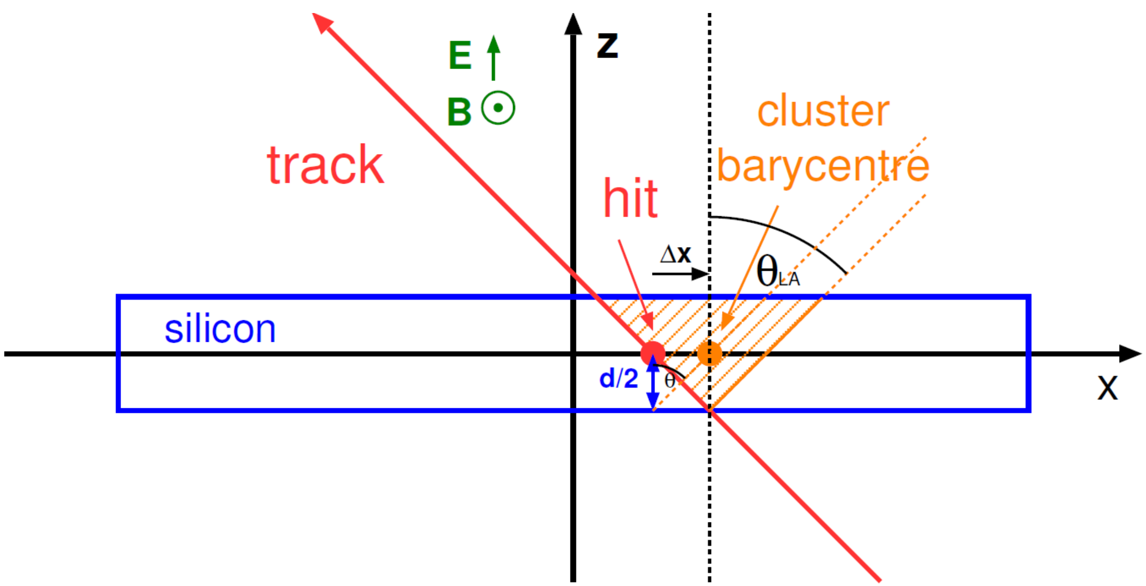
Tapio Lampén

- The CMS all-silicon tracker consists of 16588 modules, embedded in a solenoid magnet providing a field of B = 3.8 T.
- The targeted performance requires that the alignment determines the module positions with a precision of a few micrometers.
- Ultimate local precision is reached by the determination of sensor curvatures, challenging the algorithms to determine about 200k parameters simultaneously with the Millepede II program.
- Global distortions are controlled by adding further information (e.g. the mass of decaying resonances or track data taken with no magnetic field).
  - Cooling failures and ramping of the magnet can induce movements of large detector sub-structures. These movements are now detected in the CMS prompt calibration.
  - Take Lorentz angle into account in the alignment procedure.

The Alignment of the CMS Silicon Tracker (2)

Tapio Lampén

- Charge drift in magnetic field affects the measured hit position as $\Delta x = \tan(\theta_{LA}) * d/2$
- Most precise way to correct this is integration of θ_{LA} calibration to Millepede II alignment procedure
- Data with magnetic field ON and OFF used simultaneously: 60 M tracks (isolated muons, $Z_0 \rightarrow \mu^+\mu^-$, cosmic ray muons and field OFF collision data)



Granularity:
3 layers
8 rings
65 periods of time
→ 1560 additional parameters

Recent extension – not yet used in full 2012 alignment

The Alignment of the CMS Silicon Tracker (3)

Tapio Lampén

- Alignment with Millepede II of 200.000 alignment parameters used routinely for 2 years
- Quick response to data taking with **run-by-run alignment** of large structures
- **Improvements** in 2012:
  - Sensor bows widely used
  - Prompt Calibration Loop operational (end of 2012)
  - Curvature bias modes in better control with $Z_0 \rightarrow \mu^+\mu^-$ events
  - Alignment framework extended to treat calibration parameters
  - Lorentz Angle calibration integrated to alignment

Boosted deconvolution algorithm

- Iterative positive definite de-convolutions (Gold, Richardson-Lucy, Muller and MAP) converge to stable states.
- It is useless to increase the number of iterations, the result obtained practically does not change.
- Instead of it we can stop iterations, apply a boosting operation and repeat this procedure. Boosting operation should decrease sigma of peaks.
- Then, the algorithm of boosted Gold or other iterative de-convolutions is as follows:

1. Set the initial solution $\boldsymbol{x}^{(0)} = [1, 1, \ldots, 1]^T$
2. Set required number of repetitions R and iterations L
3. Set the number of repetitions r=1
4. According to either Gold, or other iterative algorithms for $n = 0, 1, \ldots, L-1$ find solution $\boldsymbol{x}^{(L)}$
5. If r=R stop the calculation, else
   a. apply boosting operation, i.e., set $x^{(0)}(i) = \left[x^{(L)}(i)\right]^p \quad i = 0, 1, \ldots, N-1$

      p is boosting coefficient >0, $p \approx 1.1 - 1.2$

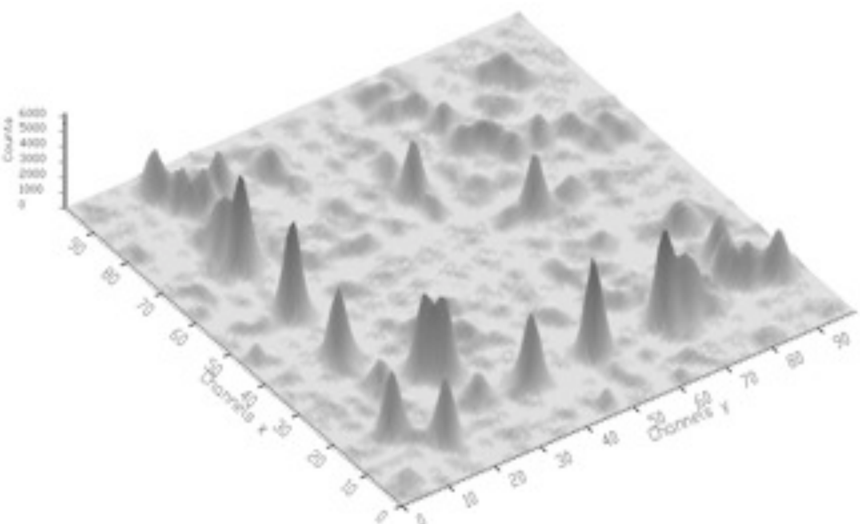
   b. r=r+1

   c. continue in 4.

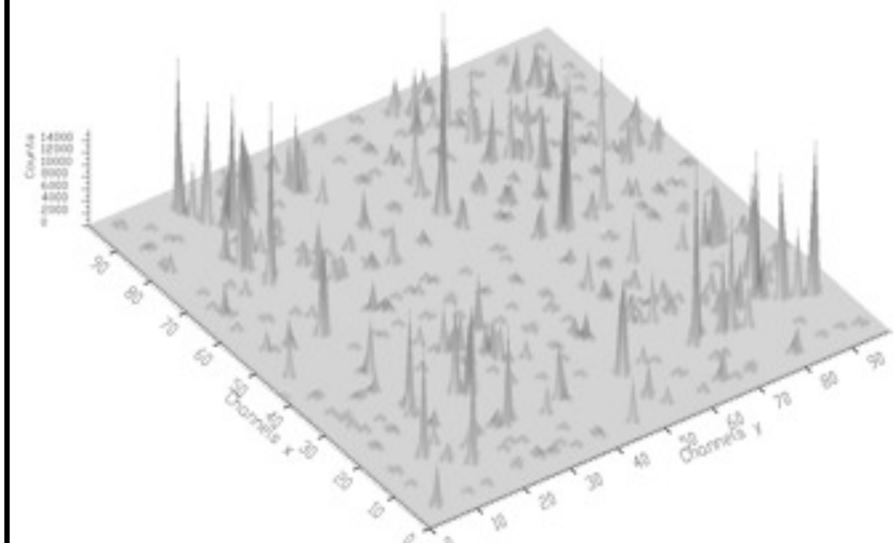
Sophisticated high-resolution deconvolution algorithms for data processing in nuclear spectroscopy (2)

Vladislav Matoušek

Using boosted algorithms we are able to decompose the overlapped peaks practically to delta-functions while concentrating the peak areas to one channel.



Experimental gamma-gamma-ray spectrum (after background elimination).



Spectrum after boosted Gold deconvolution (50 iterations repeated 20 times).

Multidimensional polynomial regression and fit function uncertainty (1)

Peter Kövesárki

Polynomial regression is performed by solving a linear equation using the empirical moments of the sample.

- Parametrisation viewpoint: using the most important averages

$$p = (\langle yx^0 \rangle, \ldots, \langle yx^d \rangle, \langle x^0 \rangle, \ldots, \langle x^{2d} \rangle)$$

- Central Limit Theorem: tells us the likelihood of the true parametrisation

$$\mathcal{L}(p^{\text{true}}) = \text{Prob}(p|p^{\text{true}}) = \frac{1}{\mathcal{N}} \exp\left(-\frac{1}{2}\left(p_k - p_k^{\text{true}}\right)\left(\Sigma_{kl}^{\text{est.}}\right)^{-1}\left(p_l - p_l^{\text{true}}\right)\right)$$

- Bayesian step: using the derived likelihood to calculate the probability of the residual (the divergence of the fit from the minimum) and residual differences:

$$\text{Prob}(\chi^2 \text{ of } F^{\text{true}} \text{ at } p|p)$$

- Decision step: using the polynomial degree that is
  - expected to be the best
  - significantly better than the others
- Repeat the steps on smaller input space if needed

Multidimensional polynomial regression and fit function uncertainty (2)

Peter Kövesárki

- Fast polynomial regression is done based on the moments of the distribution
- The uncertainty of the fit function is estimated from data analytically
- No need for :
  - separating training and testing samples
  - bootstrapping
  - parametric knowledge of the distribution (as for Fisher information)
- Multivariate analysis can be done with given (approx.) significance level
- Variable preselection for the MVA is possible
- There is still room for improvement for speed and accuracy

Quasi-optimal weights: a versatile tool of data analysis (1)

Fyodor Tkachov

Best ν mass bound from Troitsk-ν-mass (arXiv:1108.5034).

Had been plagued by "Troitsk anomaly" for ~10 years.

Anomaly went away after a reanalysis that was made possible by **two enabling technologies**:

quasi-optimal weights (covered in track 2)

Oberon technologies (covered in track 1)

- Quasi-optimal weights (Tkachov, 2000, 2006) is a powerful alternative to maximal likelihood, least squares etc.
- Matches ML in regard of statistical quality of the results, but circumvents its problems.
- Much more flexible in terms of both program implementation and adaptation to non-standard situations.
- Talk summarised the practical experiences of using the method in the context of the Troitsk-nu-mass experiment (the regular data fitting and the anomaly search).

Quasi-optimal weights: a versatile tool of data analysis (2)

Fyodor Tkachov

Implementation is straightforward

solution of systems of equations instead of optimum search

MC tests: equivalent to ML

Churns out results where MINUIT collapses ("narrow valleys")

Can easily accomodate information about Poisson etc.

(actually, this was the initial concern)

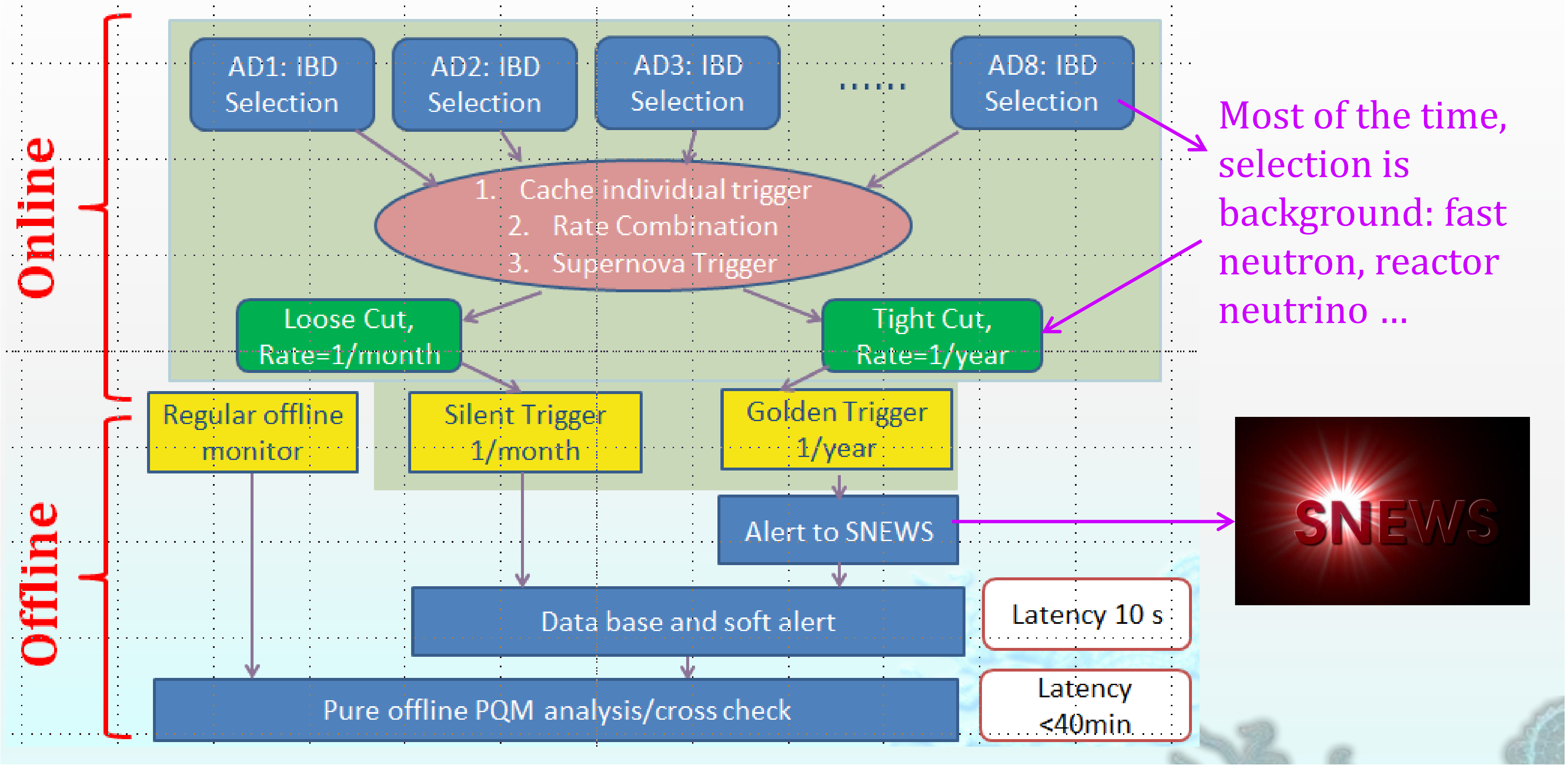
With poor statistics multidimensional systems of equations may not have a solution;
in practice this was not a problem but some research may be called for (same for Student-type correcting factors).

Triggers

Supernova Trigger in the Daya Bay Reactor Neutrino Experiment (1)

Hanyu Wei

Designed a fast (<30 s) supernova trigger to enable a prompt detection of a coincidence of the neutrino signals via an inverse-beta-decay (IBD) within a 10-second window. Provides a robust early warning of a supernova occurrence.



Supernova Trigger in the Daya Bay Reactor Neutrino Experiment (2)

Hanyu Wei

Daya Bay Reactor Neutrino Experiment has advantages on supernova online trigger

- Better energy resolution
- Time accuracy
- Low energy threshold
- Low time latency
- Background suppress with 8AD deployed in 3 sites

~100% sensitivity to Galaxy center and ~90% to Milky Way edge with 6-AD data, 8-AD adds ~8% to Milky Way edge.

Test run preliminarily implies the Daya Bay's supernova online trigger works.

Daya Bay officially in SNEWS in near future.

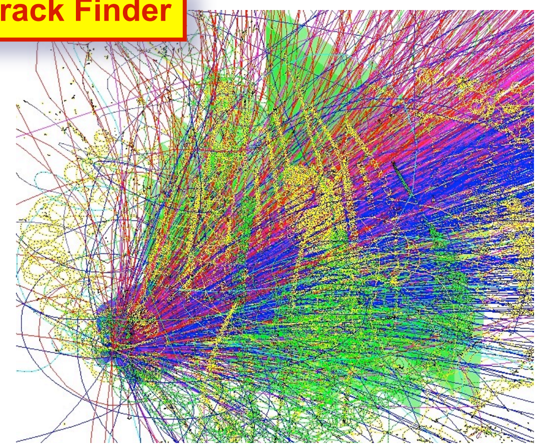
FLES: First Level Event Selection Package for the CBM Experiment (1)

Ivan Kisel

- Compressed Baryonic Matter (CBM) Experiment.
- Future fixed-target heavy-ion experiment.
- 10^7 Au-Au collisions/sec.
- ~1000 charged particles/collision.
- Non-homogeneous magnetic field.
- Double-sided strip detectors.
- (85% fake space-points)

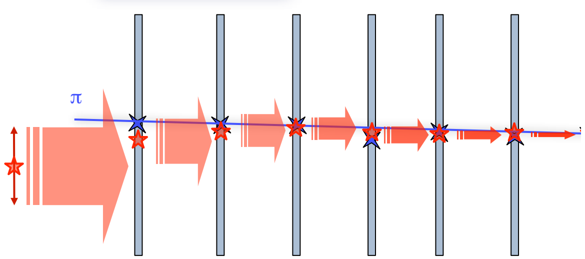
Track reconstruction and displaced vertex finding required at the first level trigger

1 // Track Finder



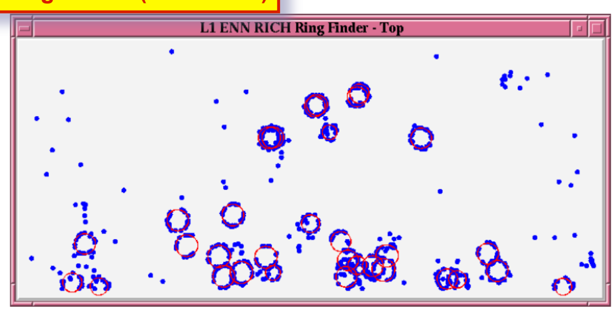
- Cellular Automaton
- Track Following

2 // Track Fitter

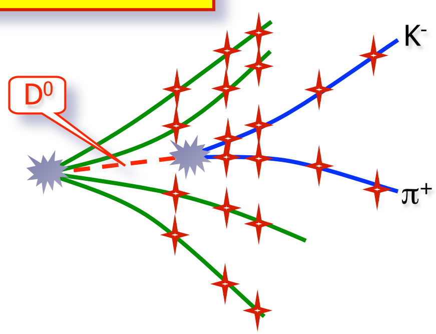


- Kalman Filter

3 // Ring Finder (Particle ID)



4 // Short-Lived Particles Finder

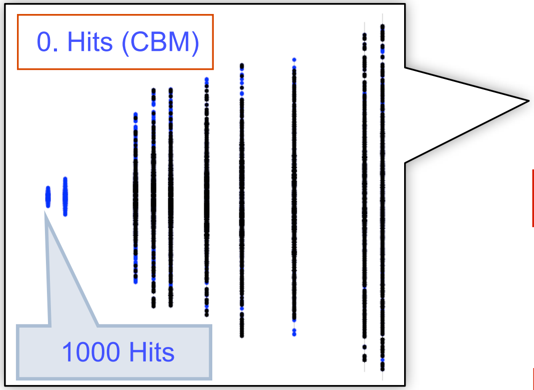


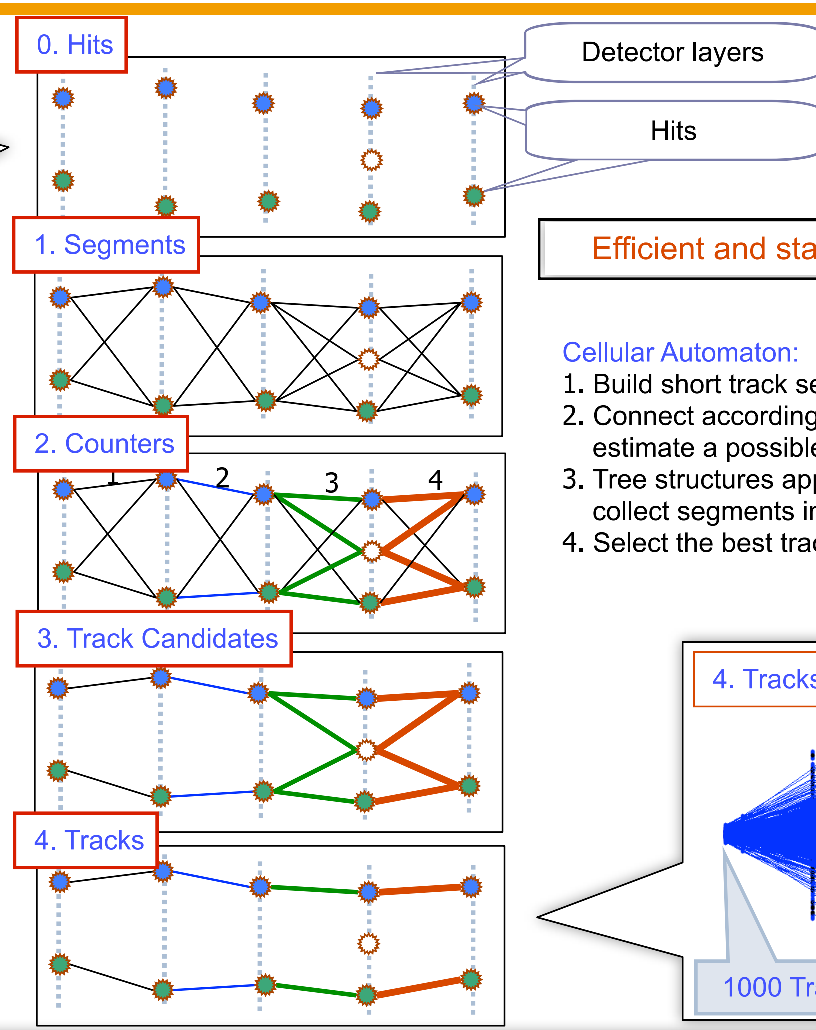
- Kalman Filter

FLES: First Level Event Selection Package for the CBM Experiment (2)

Ivan Kisel

Cellular Automaton as Track Finder

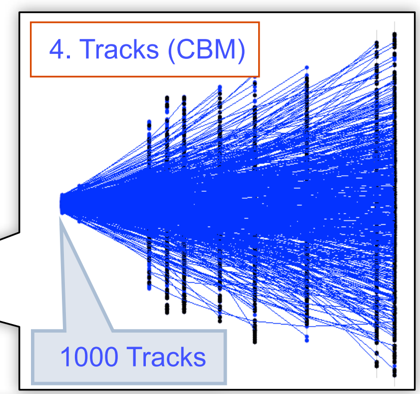




Efficient and stable event reconstruction

Cellular Automaton:

1. Build short track segments.
2. Connect according to the track model, estimate a possible position on a track.
3. Tree structures appear, collect segments into track candidates.
4. Select the best track candidates.



Cellular Automaton:

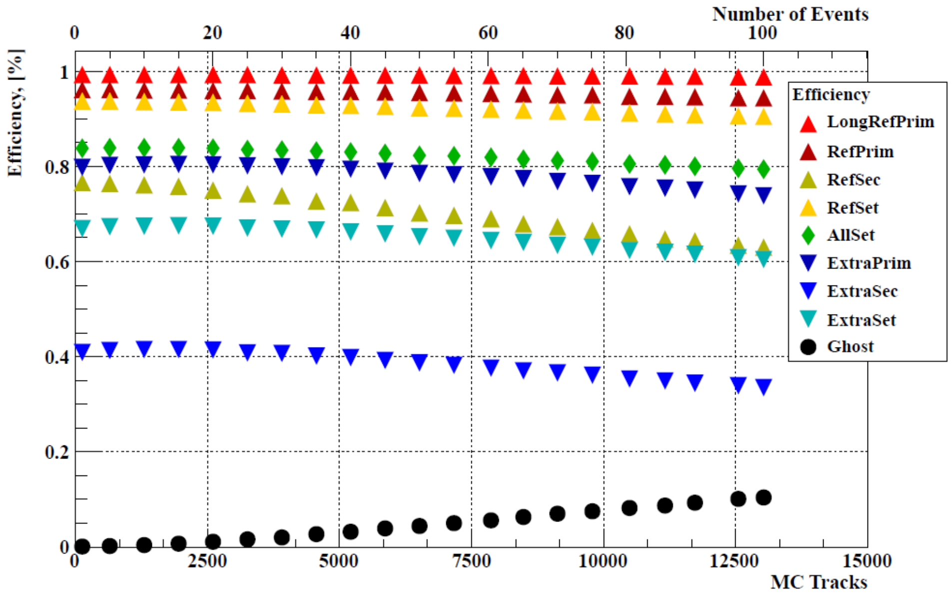
- local w.r.t. data
- intrinsically parallel
- extremely simple
- very fast

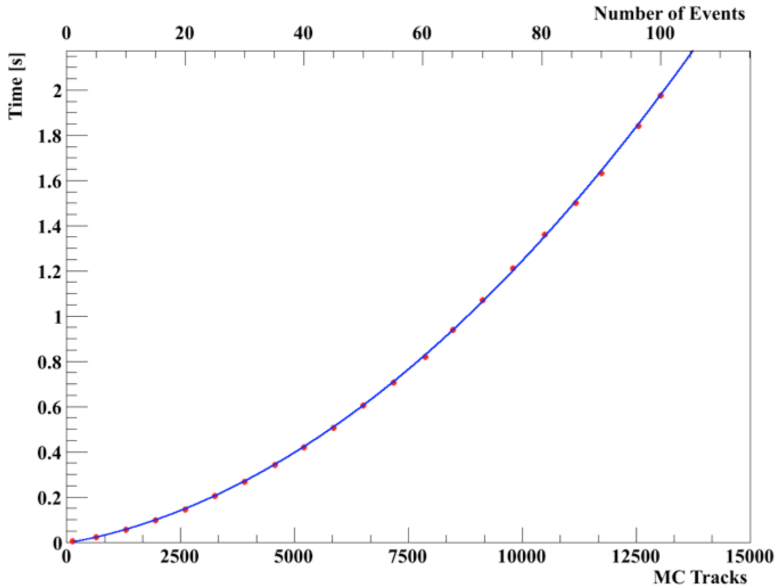
Perfect for many-core CPU/GPU !

Useful for complicated event topologies with large combinatorics and for parallel hardware

FLES: First Level Event Selection Package for the CBM Experiment (3)

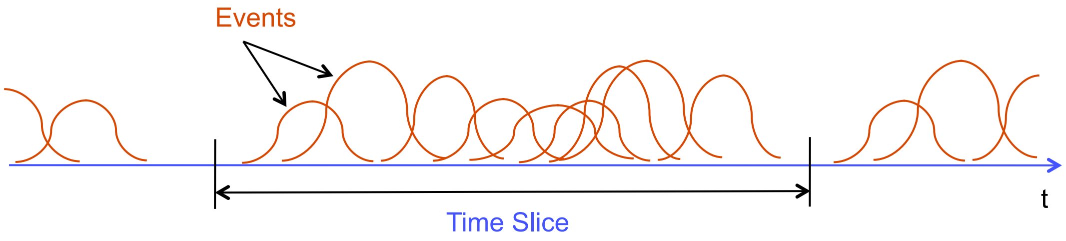
Ivan Kisel





Stable reconstruction efficiency and time as a second order polynomial up to 100 minimum bias events in a group

The beam in the CBM will have no bunch structure, but continuous. Reconstruction of time slices rather then events will be needed. Measurements in this case will be 4D (x, y, z, t).



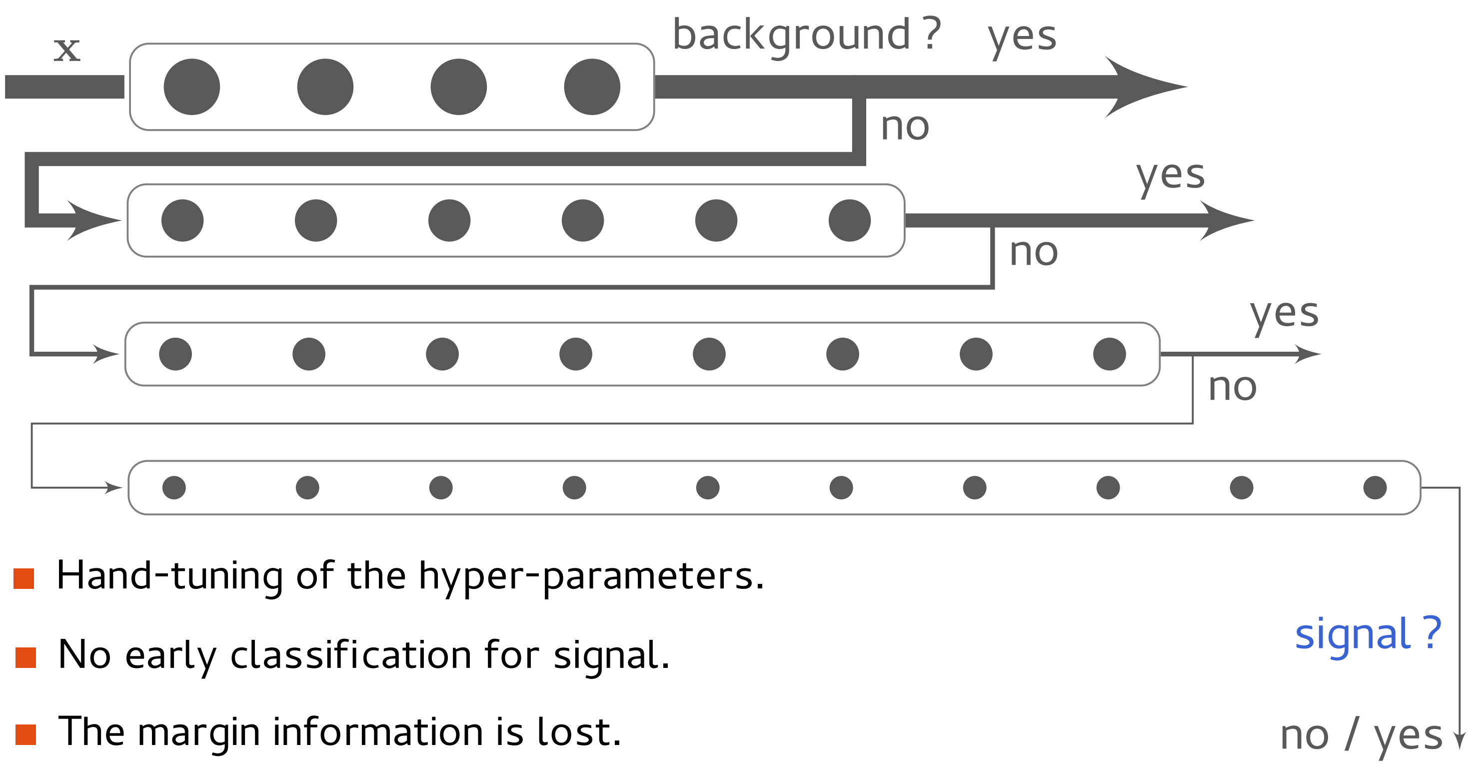
- A first version of the FLES package for CBM has been developed

Designing DAG-shaped classifiers for fast triggers (I)

Djalel Benbouzid

- Develop high level trigger using fast classification.
- Same technologies as for facial recognition and webpage ranking.

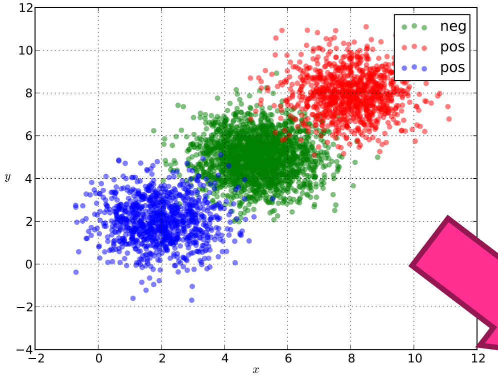
Chaining classifiers:



- Hand-tuning of the hyper-parameters.
- No early classification for signal.
- The margin information is lost.
- No straightforward extension to multi-class classification.

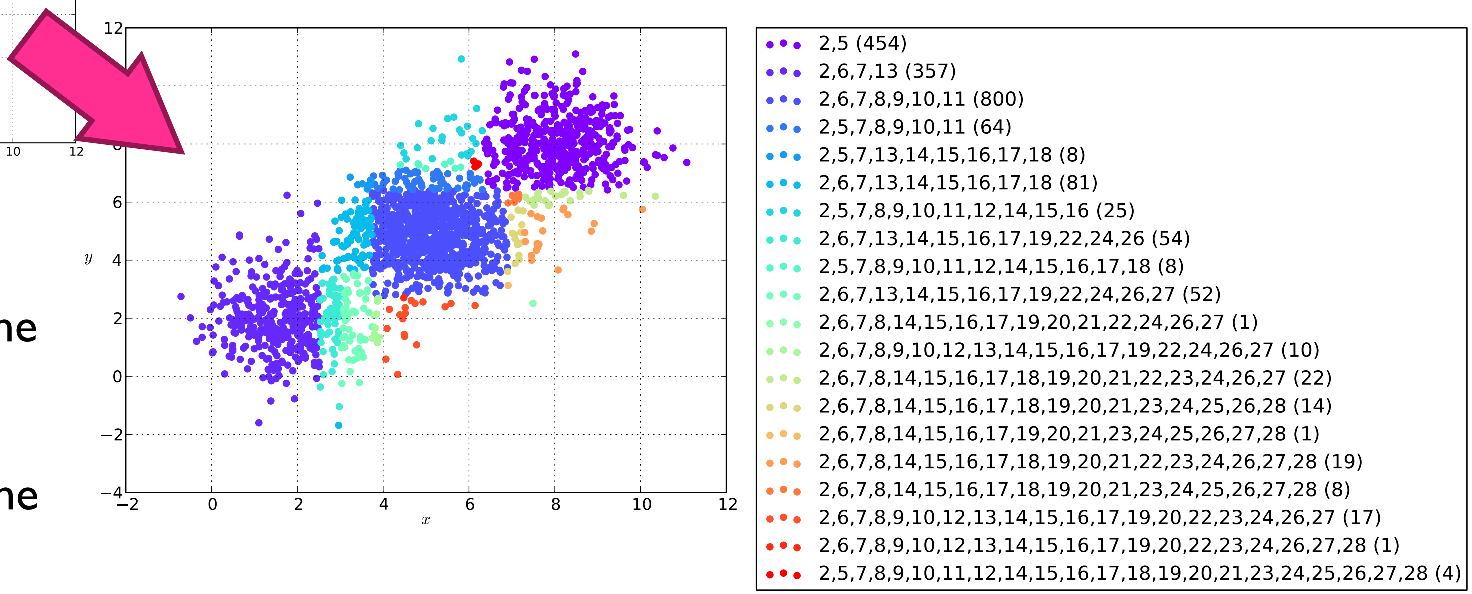
Designing DAG-shaped classifiers for fast triggers (2)

Djalel Benbouzid

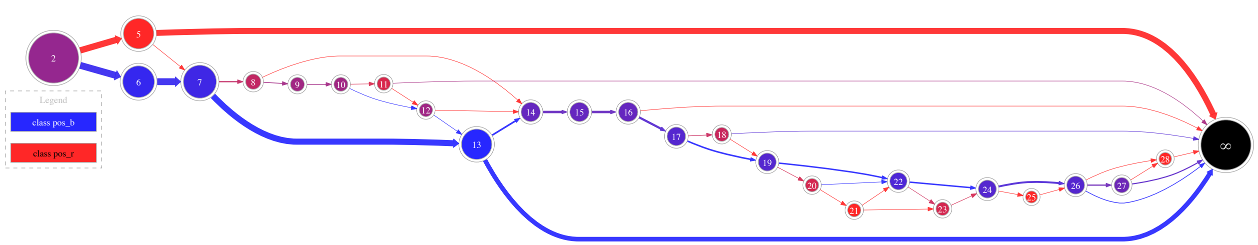


Directed Acyclic Graph (DAG): Each event takes a path along the DAG which is the most "suitable" for a correct classification while trying to save evaluation time.

Different types of events do not necessarily need the same subset of features to be evaluated during the classification.



Especially appealing when background can be quickly discarded with little information



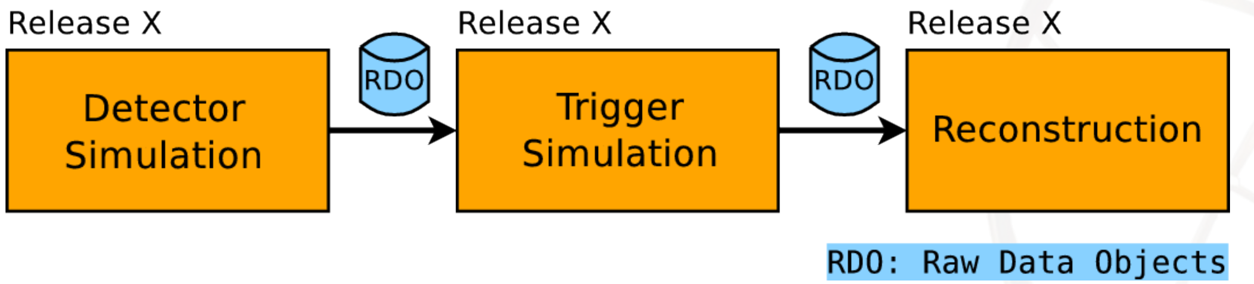
ATLAS Trigger Simulation with Legacy Code using Virtualization Techniques (1)

Gorm Galster

Several scenarios will require trigger response to be re-simulated:

- Improved detector response
- Improved offline reconstruction
- Introducing new physics triggers
- Introduction/test of new event generator

MC production doesn't store trigger result - starts from scratch and requires re-simulation of trigger.



Run trigger simulation reflecting past conditions at which data was taken.

- Need to find viable way to run trigger using old release of ATLAS software
- Use virtualization technology to future-proof trigger software against hardware/software developments.
- Prefer to have minimal changes and maintenance.

Using old releases means we don't need to maintain legacy trigger code in new releases.

ATLAS Trigger Simulation with Legacy Code using Virtualization Techniques (2)

Gorm Galster

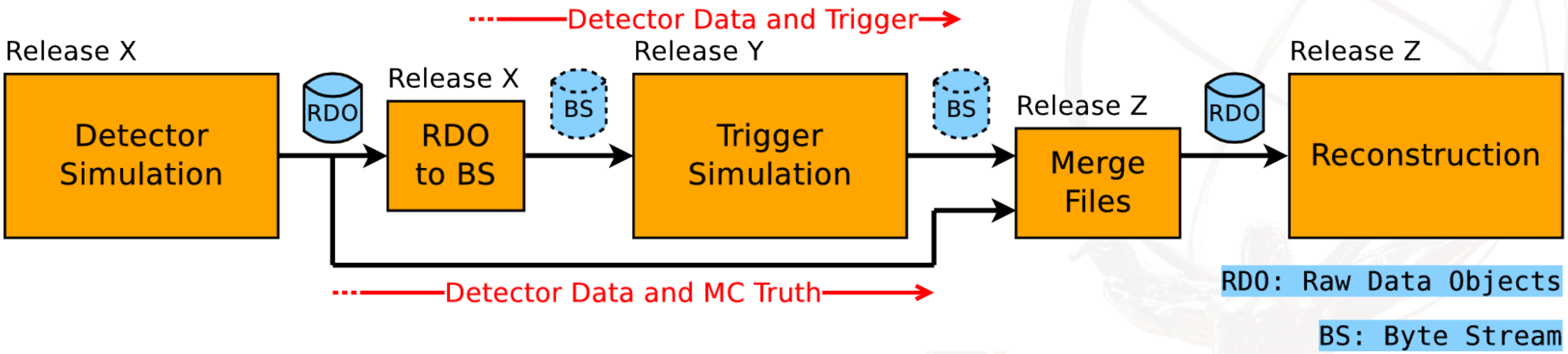


Figure 2: Schematic of modified simulation chain for running old Trigger Simulation. This chain requires two additional steps and uses an intermediate byte stream (BS) file.

BS format supports all raw data necessary for running trigger simulation.

Backwards compatibility is guaranteed.

- This simulation chain solves the legacy data format challenges, provided new releases can write old detector payload.
- The proposed solution does not account for other external storage services which might become upgraded or obsolete.
  - Oracle DB.
  - Geometry data.
  - Conditions data.

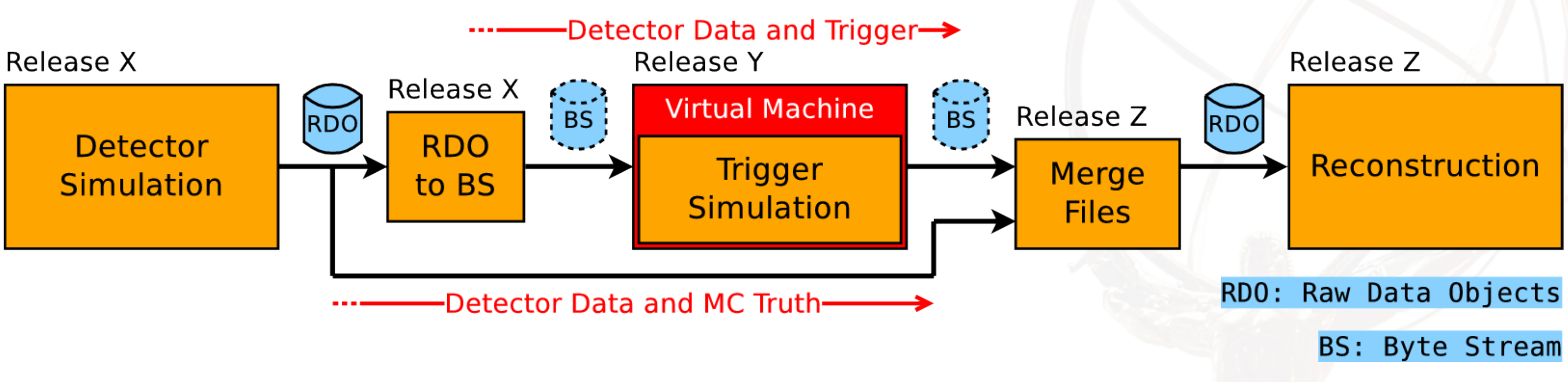
ATLAS Trigger Simulation with Legacy Code using Virtualization Techniques (3)

Gorm Galster

Over a period of time we can expect that:

- New hardware technologies are introduced.
- Operating systems change.
- Compiler and core components change.

Virtualisation elegantly solves this by abstracting the hardware and encapsulating the software environment.



Encapsulate the trigger response simulation in a virtual machine (CERN VM):

- Store definition of entire machine in a text file.
- Give this to another machine and it can recreate the environment.

Tools

DELPHES 3: A modular framework for fast-simulation of generic collider experiments (1)

Michele Selvaggi

- Simulation of a multi-purpose detector response, including:
  - Track propagation system embedded in a magnetic field
  - Electromagnetic, hadronic calorimeters
  - Muon system.
- Written in C++ and interfaced with the most common Monte Carlo file formats (LHEF, HepMC, STDHEP).
- New modular version allows to easily produce the collections that are needed for later analysis, from low level objects such as tracks and calorimeter deposits up to high level collections such as isolated electrons, jets, taus, and missing energy.

<u>Full simulation (GEANT):</u>
Simulates particle-matter interaction (including e.m. showering, nuclear int., brehmstrahlung, photon conversions, etc ...) → **10 s /ev**

<u>Experiment Fast simulation (ATLAS, CMS ...):</u>
Simplifies and makes faster simulation and reconstruction → **1 s /ev**

<u>Parametric simulation (**Delphes**, PGS):</u>
Parameterize detector response, reconstruct complex objects → **10 ms /ev**

<u>TurboSim</u>
No detector, parameterize object response, parton ↔ reco

DELPHES 3: A modular framework for fast-simulation of generic collider experiments (2)

Michele Selvaggi

What do we expect from Delphes parametric detector simulation ?
→ Fast, realistic enough, flexible detector geometry, user-friendly, flexible I/O (modular).

When do you need Delphes?
→ More advanced than parton-level studies
→ Scan large parameter space (SUSY-like ...)
→ Preliminary tests of new geometries/resolutions (upgrades, Snowmass)
→ Testing analysis methods (multivariate/Matrix Element)
→ Educational purpose (master thesis)

Delphes 3 is out, with **major improvements**:

- modularity
- pile-up implementation
- revamped particle flow algorithm
- new visualization tool based on ROOT EVE
- default cards giving results on par with published performance from LHC experiments
- now fully integrated within MadGraph5

Concepts and plans towards fast large scale Monte Carlo production for ATLAS (1)

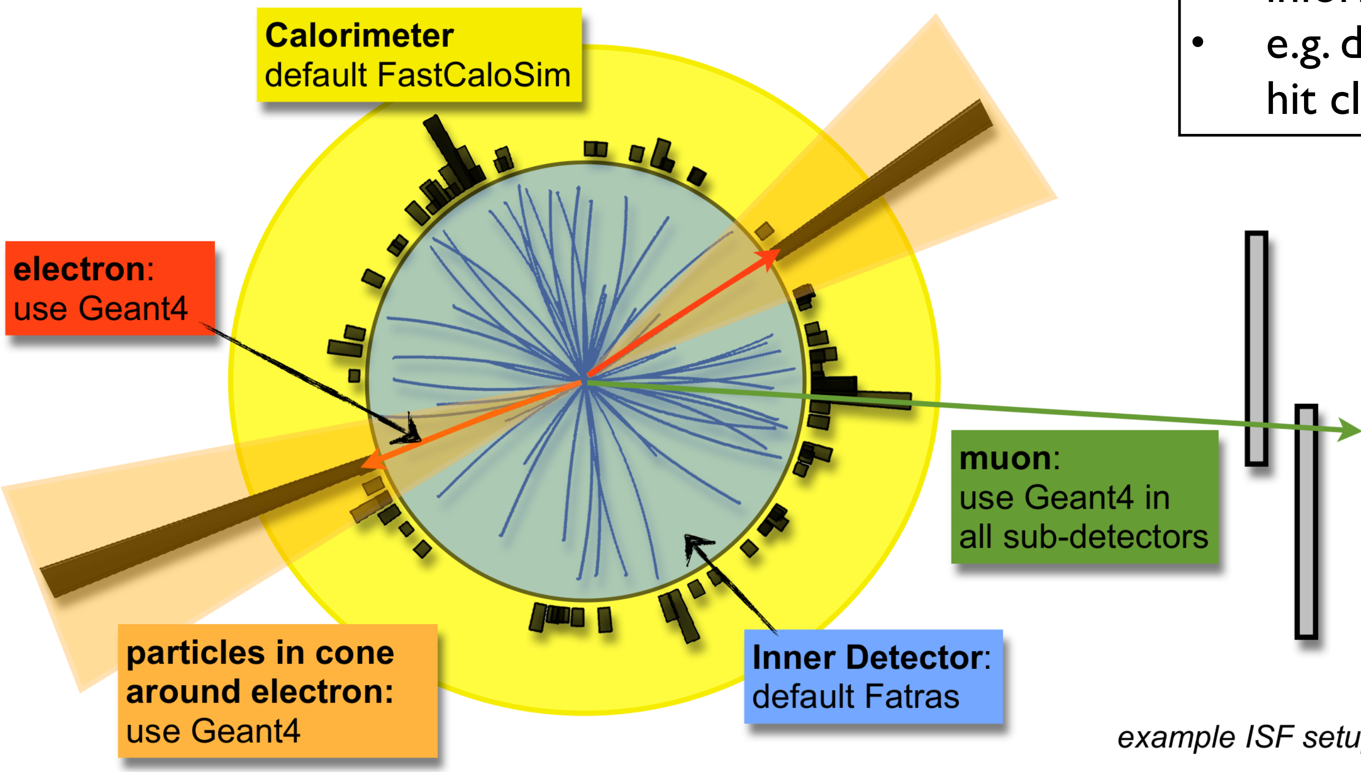
Elmar Ritsch

<u>ISF – Integrated Simulation Framework</u>

- Mixing of different simulation engines, partial event simulation, region of interest simulation.
- Flexible rules for particle→simulator assignments.

<u>Fast Digitization</u>

- From simulated hits to calibrated tracking information.
- e.g. drift circles, silicon hit clusters.



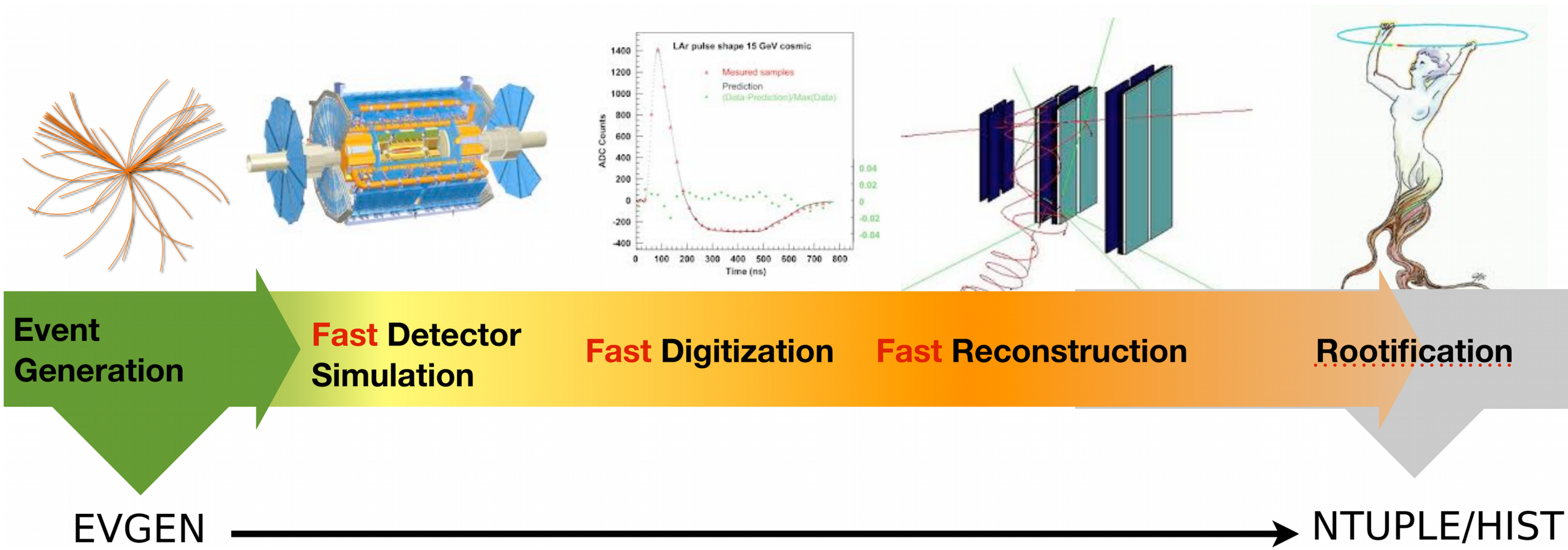
<u>Fast Reconstruction</u>

- Track seeding using MC truth.
- Parameterized calorimeter response.

example ISF setup

Concepts and plans towards fast large scale Monte Carlo production for ATLAS (2)

Elmar Ritsch



- Combining fast simulation/digitization/reconstruction efforts
- From four vectors to ROOT histograms in one go
- No intermediate output files (minimizes file I/O overhead and disk space).
- Up to factor 3000 speed up compared to current full sim.
- Estimated processing time: few seconds per event ! → Allows for private MC production in larger scales.

Optimizing the ATLAS code with different profilers

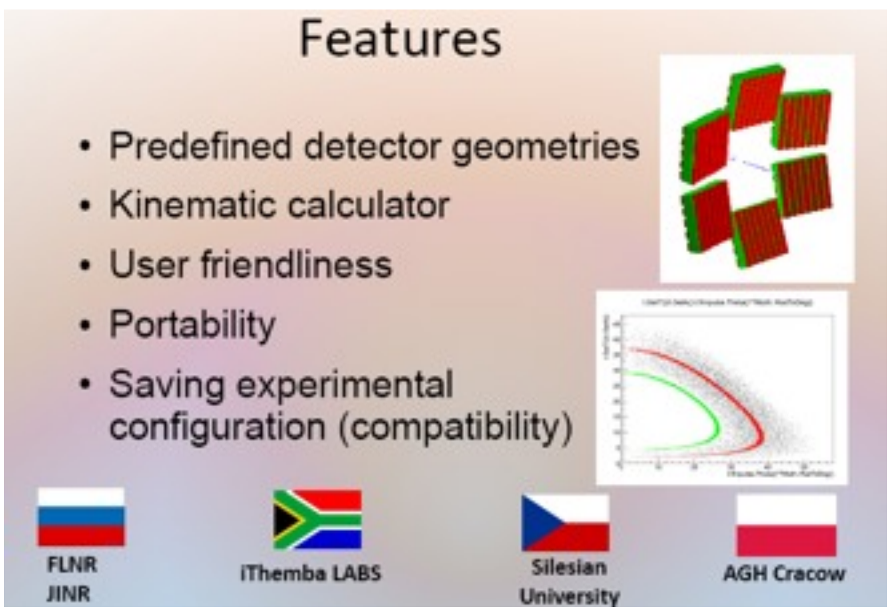
Sami Kama

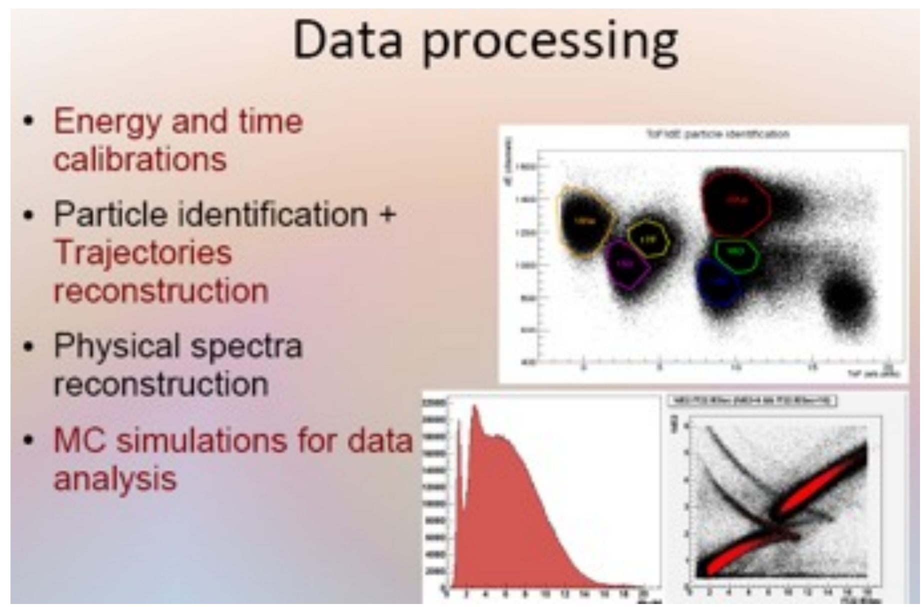
- ATLAS has successfully identified points to improve in its huge codebase using profilers such as GOODA and Pin tools
- GOODA is an open source, performance profiling tool giving valuable insight about bottlenecks in the program
- Pin is very good at finding out the details of actually executed code. It makes analysis of large code bases easier
- Information gained from Pin enabled us to choose optimal vector library
- Some results are already implemented and improved performance up to 20%
- Studies are ongoing, many more improvements to come

Simulations of Nuclear Experiments Framework

Bartlomiej Hnatio

- Programming framework SIMONE (SIMulations Of Nuclear Experiments) is being developed in collaboration of FLNR JINR and iThemba LABS.
- Based on ROOT Data Analysis Framework and using Geant4 toolkit.
- It indents to be a tool of great help and convenience for nuclear physicists planning experiments and analysing resulting data.





Simulation-aided optimization of detector design using portable representation of 3D objects (1)

Jan Balewski

Bring together software used by physicists (GEANT4) and engineers (CAD) for detector design and modeling.

Exchange geometry between systems (Standard Tessellated Language)
Removes need for both parties to implement changes from other during detector design phase.

GEANT 4	**CAD**
Preferred technology	Realistic material budget/price tag
Provides detector response	Detailed construction plan
Build using mathematical shapes (e.g. sphere, torus).	Build using tessellated surfaces.
Very challenging to build complex shapes.	Trivial to model complex shapes.
Conflicts (e.g. overlapping material) very difficult to diagnose.	Conflicts much easier to diagnose

Change requirements because of simulated response, price tag etc

Revised design and price tag

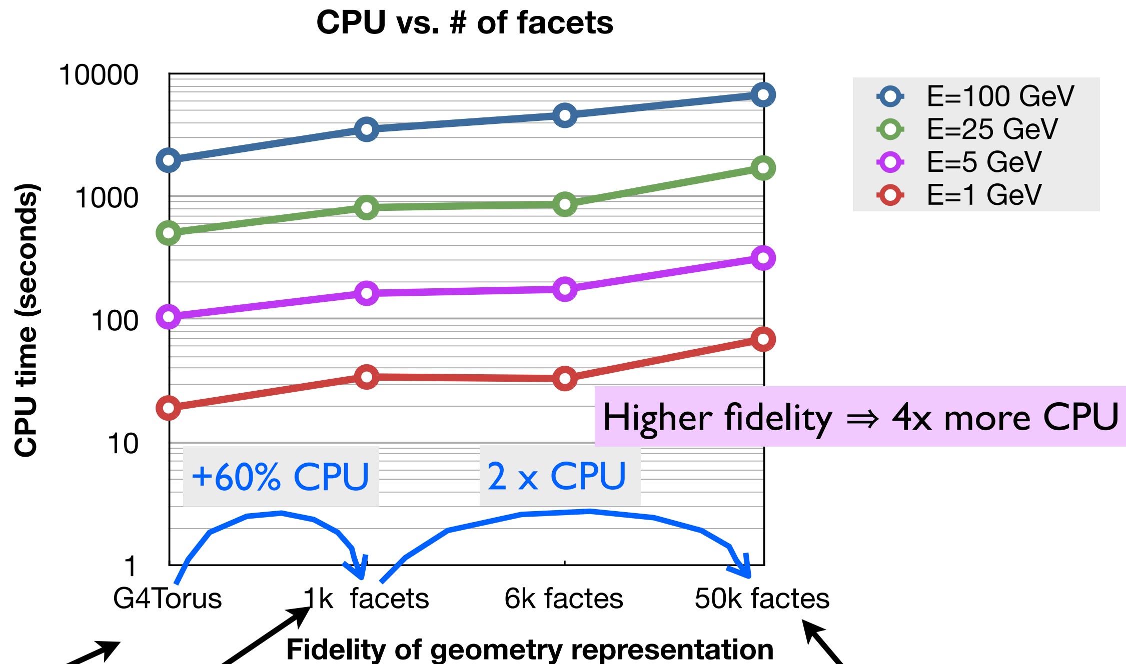
Simulation-aided optimization of detector design using portable representation of 3D objects (2)

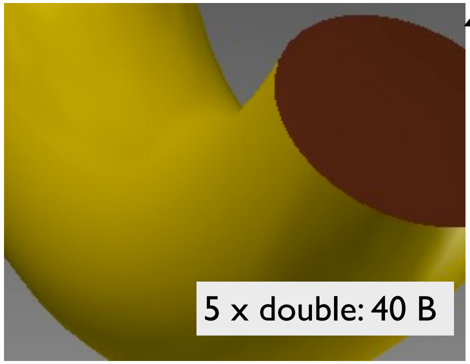
Jan Balewski

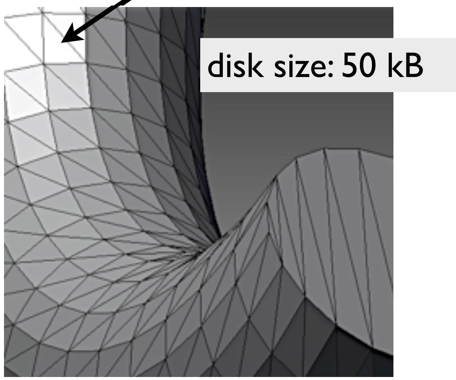
Limitations:

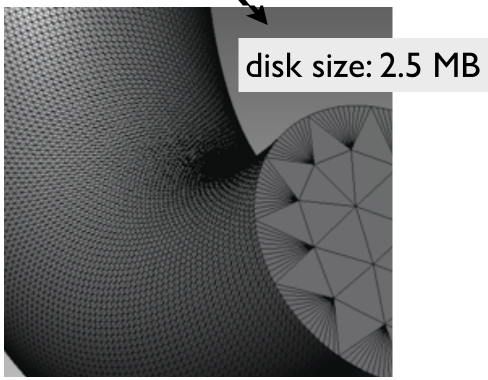
- Necessary to re-position and re-define materials of elements in GEANT after porting from CAD.
- Need to decide how accurately to define complex elements in CAD (higher precision = more CPU).

G4 simulation time for 400 positrons with selected energies (E)





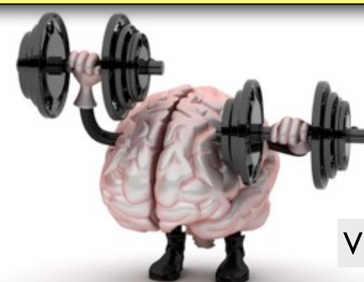




Simulation-aided optimization of detector design using portable representation of 3D objects (3)

Jan Balewski

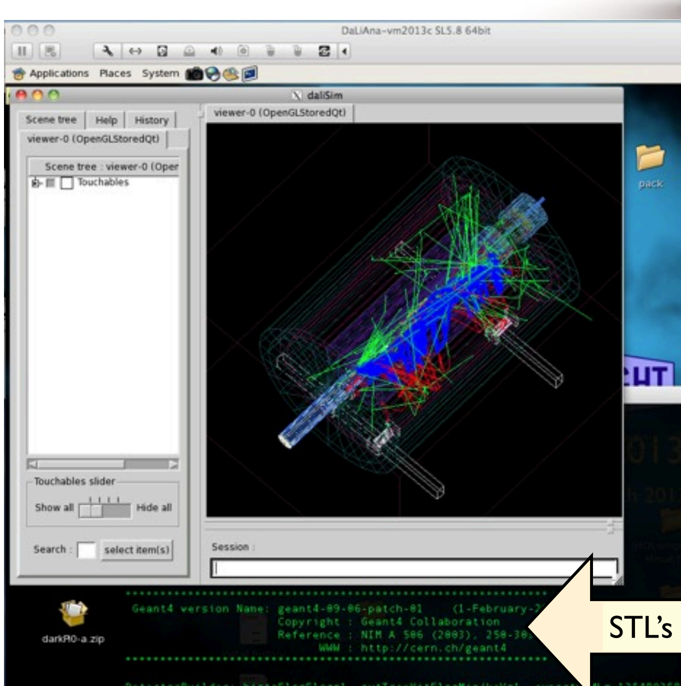
CAD+Geant4 on one laptop



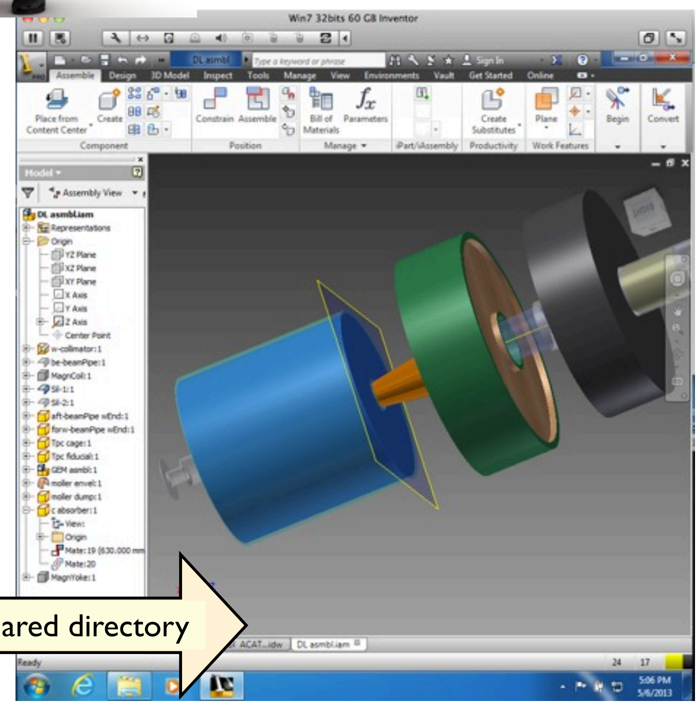
Simplifies automatic translation of solids from CAD to G4

Shorter design-to-simulation cycle

Virtual Machine #1 : Linux/Geant4



Virtual Machine #2 : Windows/AutoCAD



STL's in shared directory

Very useful for detector design phases when geometry is changing frequently.

A Wavelet Based Analysis System for Monitoring Information (1)

Iosif Legrand

MonALISA (Monitoring Agents in A Large Integrated Services Architecture) framework provides a set of distributed services for monitoring, control and global optimization for large scale distributed systems.

- Very large amount of monitoring information is currently collected.
- The users want more and more monitoring information, but very difficult to analyze all the collected data.
- Deleting older data or keeping only long term mediated values is not really a solution.

The wavelet transformation framework provides an effective approach to analyze very large amounts of monitoring data at the global level and to help better understand the behavior of complex distributed computing systems.

$$\mathrm{CWT}_x^{\psi}(\tau, s) = \Psi_x^{\psi}(\tau, s) = \frac{1}{\sqrt{|s|}} \int x(t) \bullet \psi^{*}\left(\frac{t-\tau}{s}\right) dt$$

Translation

(The time location of the window)

Scale

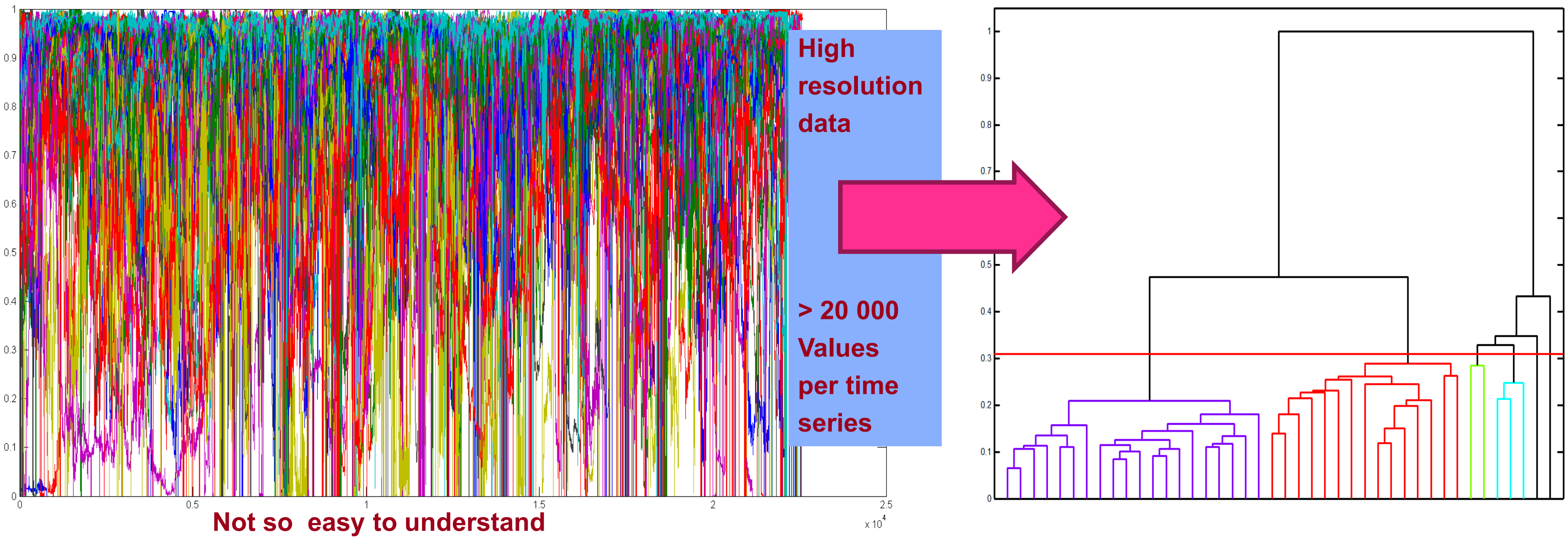
Mother Wavelet

Scale is generalized local frequency

A Wavelet Based Analysis System for Monitoring Information (2)

Iosif Legrand

Two months history for the efficiency on all Alice grid sites



The Wavelet transformation is very effective in compressing monitoring information and preserving details for signals with rapid variations.

- Powerful tool to analyze complex monitoring information.
- Time-frequency representation can help to understand the dynamics of complex systems.
- Dedicated modules (agents in the MonALISA system) can be used to automatically detect unexpected behavior from different systems and possible to take appropriate actions.

Summary

- Track 2 had lots of interesting talks covering a wide range of topics.
- Please check out the slides/talk to speakers if something took your fancy!