Highlights from CHEP 2001

Software methodologies & tools, simulation, data analysis

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Outline

- Software Methodologies (track 8)
  - Software process
  - Collaborating frameworks
  - Tools for software management
- Areas of application
  - Simulation (track 5)
  - Data analysis tools (track 3)
- Comments

Software methodologies (track 8)

- Software process
  - 8-008 (G.Cosmo), 8-003 (H.P.Wellisch)
- Frameworks
  - 8-042 (A.Pfeiffer), 8-037 (A.Dell'Acqua), 8-051 (I.Hrivnacova),
  - 5-009 (I,Belyaev)
- Software management & QA
  - 8-006 (C.Arnault), 8-032 (N.Ratnikova), 8-024 (L.A.Tuura)
- … will not cover:
  - Simulation production & farms
  - Detector description & XML
  - Java tools

Software process

"*A set of interrelated activities, which transform inputs into outputs*" (*ISO 12207)*

- Need to adopt a reference model for SP
  - ISO-15504 adopted in Geant4 and CMS
  - Do not adopt it blindly, but tailor processes according to the project needs * *see 8-008*
  - Very effective and suitable for the HEP environment
  - Are we different in HEP? No! * *see 8-003*
- Software Process Improvement
  - Very pragmatic and highly successful in CMS
  - Make it life-cycle driven (continuous improvement)

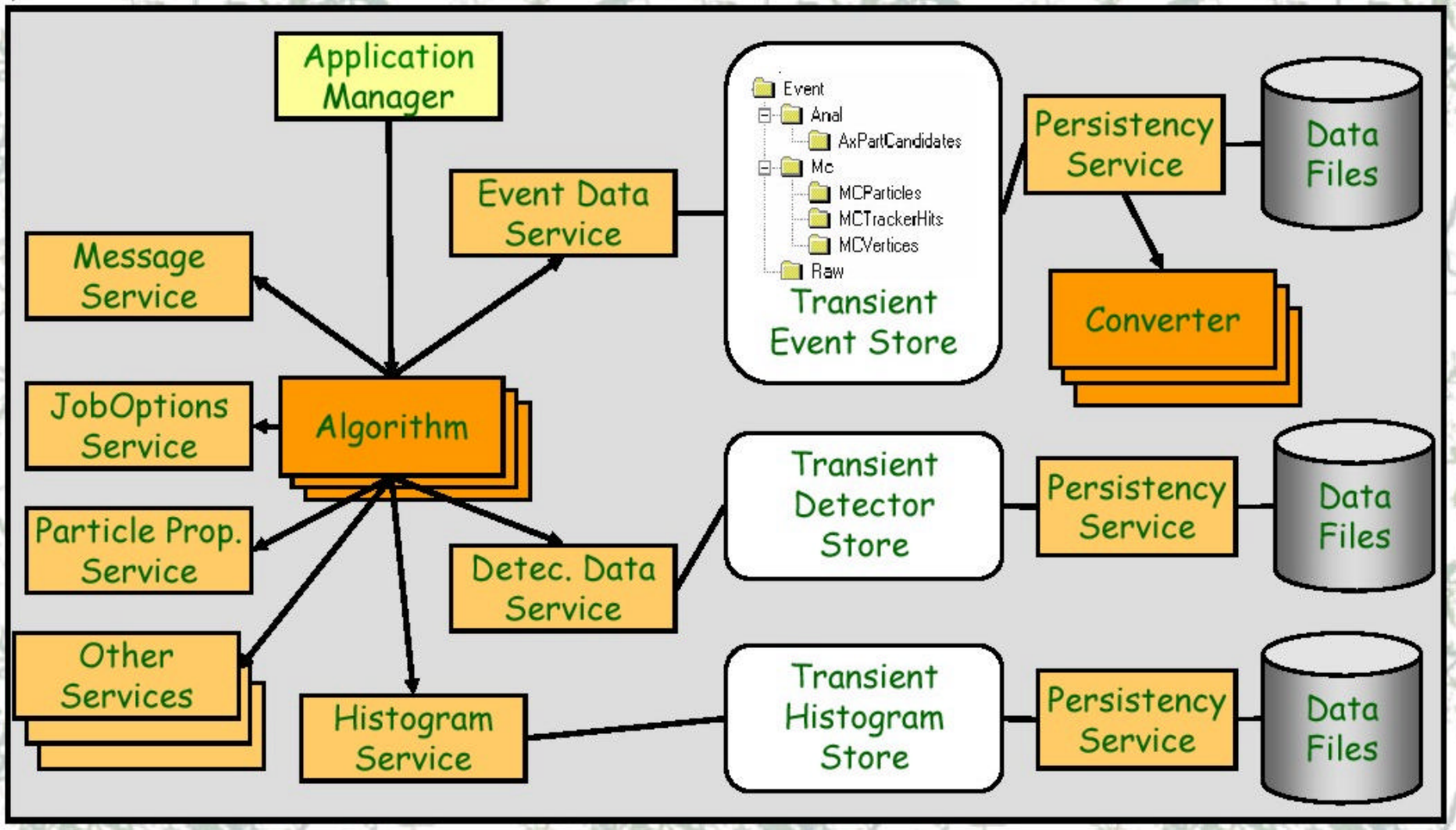
Frameworks

- Need for: flexibility, scalability, maintainability
- The answer: * *see 8-042*

Collaborating frameworks

- Made of loosely coupled components
- Maximize *re-use*
- Adoption of ***abstract interfaces***
  - Flexibility through implementation independence
  - Maintainability through independent evolution of components
- Integration of Geant4 into specific frameworks
  - Goofy (ATLAS) * *see 8-037*
  - AliRoot (ALICE) * *see 8-051*
  - Gaudi (LHCb) * *see 5-009*

Gaudi Object Diagram



* See 5-009

Software management & QA

- CMT * *see 8-006*
  - Adopted by ATLAS, LHCb
    - Also experienced in the context of GRID
  - *Recurrent semantics* for software packages
    - Management, interface, policy packages
  - Provides a wide set of configuration *patterns*
    - Test deployment, build options, utilities…
    - Automatic document generators
- SCRAM * *see 8-032*
  - Adopted in CMS: provides with CVS an efficient way to install and distribute experiment-specific software
    - Assures the same consistent environment to users
    - Installation kit on CD-ROM. Distribution on bootable hard-disk
- ➢ Common problem: site-specific configuration issues

CMT

Management team:
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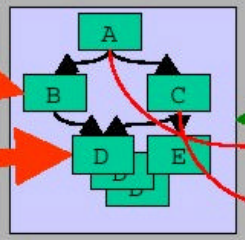
Bruno Mansoux mansoux@lal.in2p3.fr
Antoine Pérus perus@lal.in2p3.fr

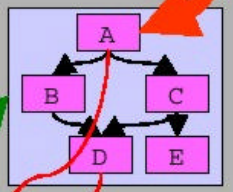
http://www.lal.in2p3.fr/SI/CMT/CMT.htm

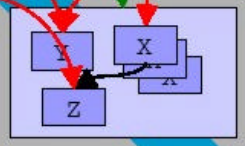
LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

Organizing teams

CVS







Developing software

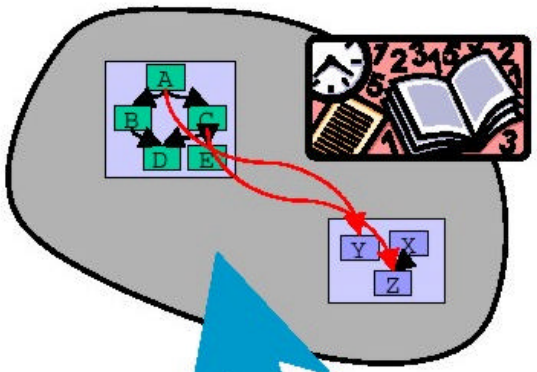
Integration management

Software configuration

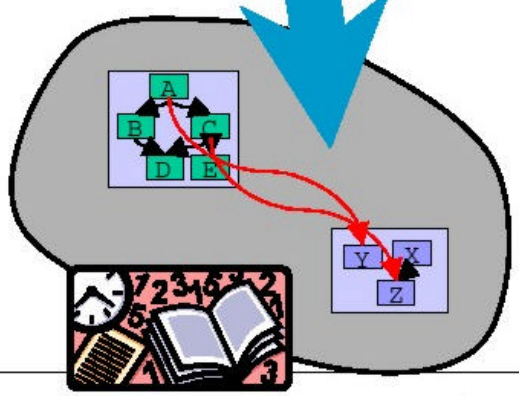
Structuring projects

Managing site specific configuration

Distributing & Deploying projects



Managing application configuration at run time



Use relationship

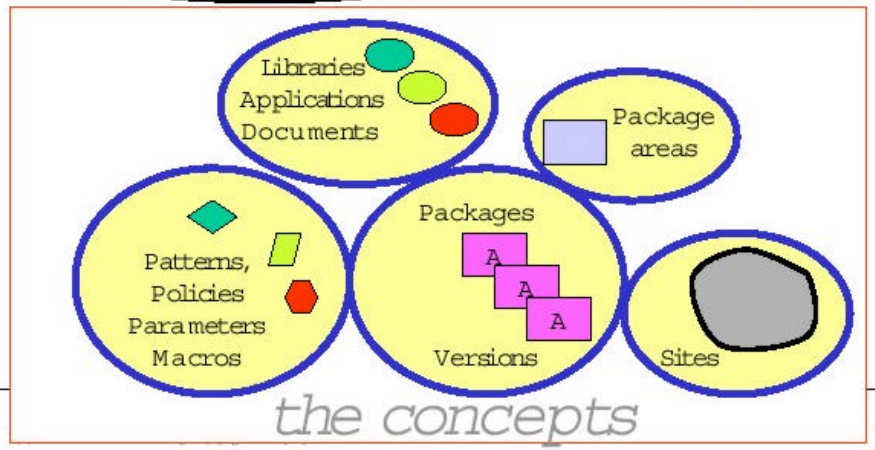
Project

A Package

Development

Usage

Distribution



the concepts

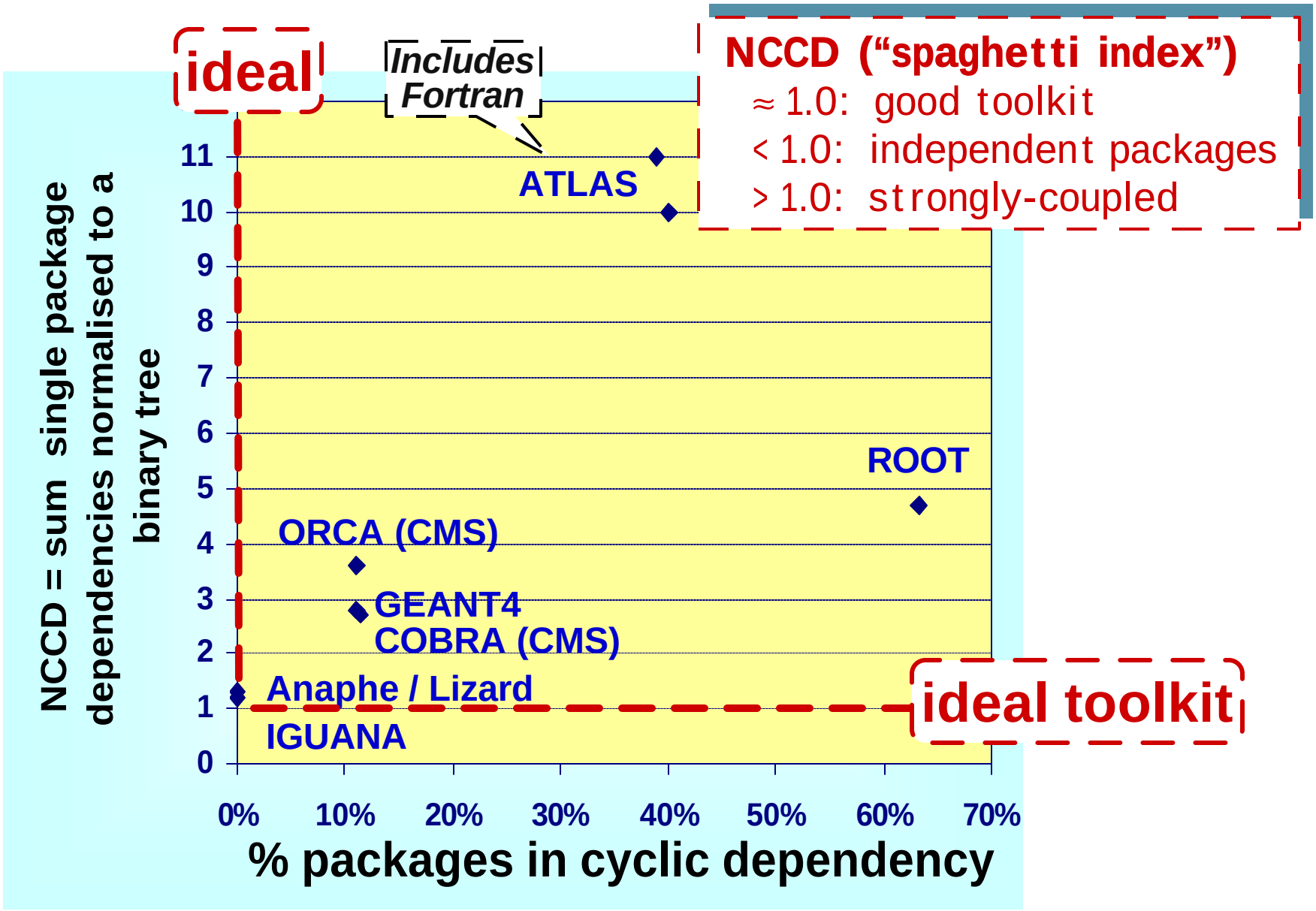
QA: Ignominy

* *see 8-024*

a tool to quantify modularity

- Flexible tool
  - Can be configured and applied to packages, entire projects with granular control
- Performs metrics analysis
  - Reports statistics and generates graphs
  - Evaluates dependency, coverage, structure match and complexity of the software
  - Provides interpretation of the possible *origin* of the complexity and software *properties* (J.Lakos, Large-Scale C++ Programming)
- Exercised on some HEP packages/projects
  - ANAPHE, Geant4, ATLAS (offline), CMS, ROOT

Ignominy analysis



Simulation (track 5)

- Geant4 related talks
  - 3-068 (P.Arce), 5-005 (D.Salihagic), 5-004 (J.P.Wellisch),
  - 5-001 (M.G.Pia), 5-002 (A.Brunengo)
- EGS4, MCNP
  - *See 5-006* (B.Liu), *5-007* (Y.Liu)
- Other topics:
  - Tools for building detector geometries
    - Gbuilder * *see 5-008* (E.Tcherniaev)
  - Tools for debugging geometries
    - Integrated in Oscar (CMS) * *see 3-068*

Geant4

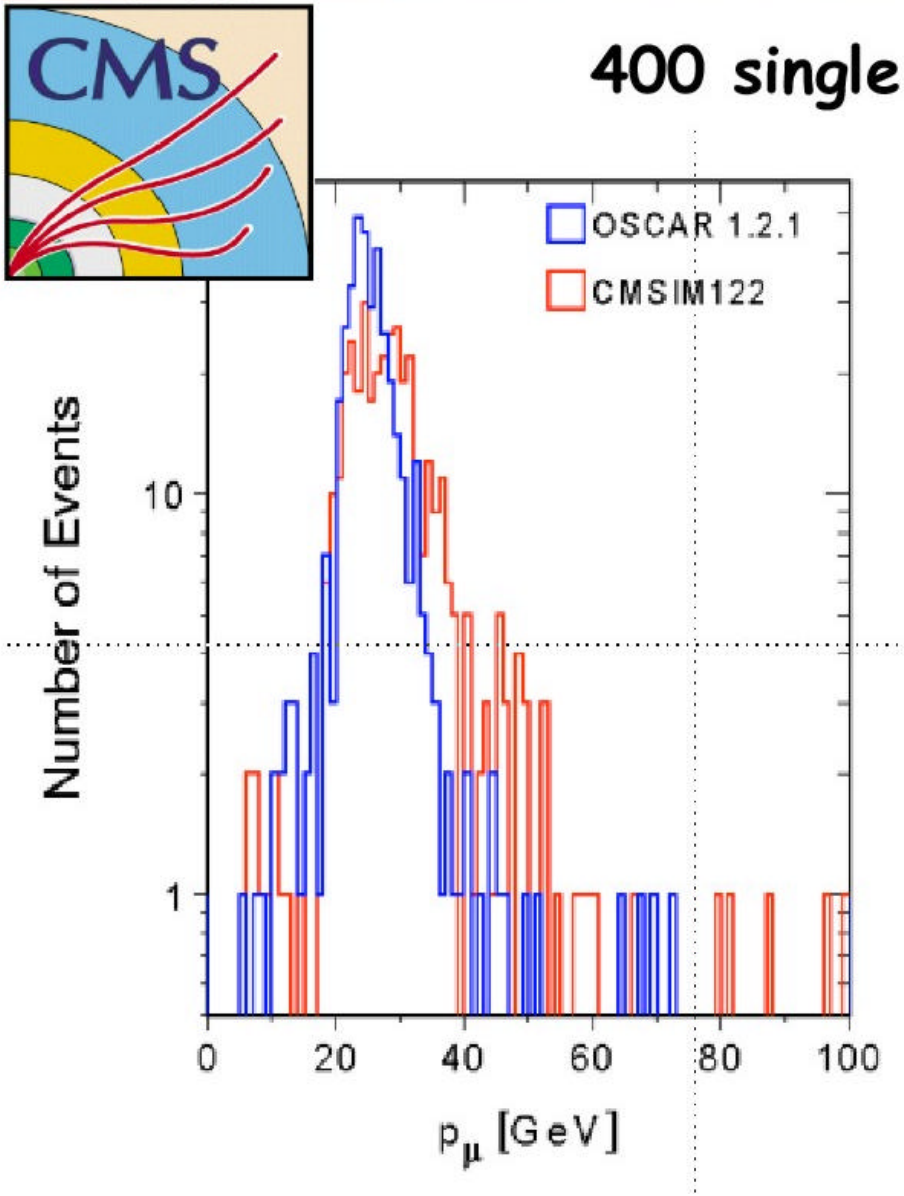
- Experiments start use it in production
  - HARP, ATLAS testbeam, BaBar
- Other HEP experiments on the move
  - ATLAS, CMS, LHCb, Alice, LCD, BES III,...
- Application on a large variety of low-energy experiments, from medical applications to astro-physics studies
- Stable: 10^7 events produced by BaBar
  - Very low crash rate
- More and more comparisons with data
- New hadronic models on validation *see 5-004

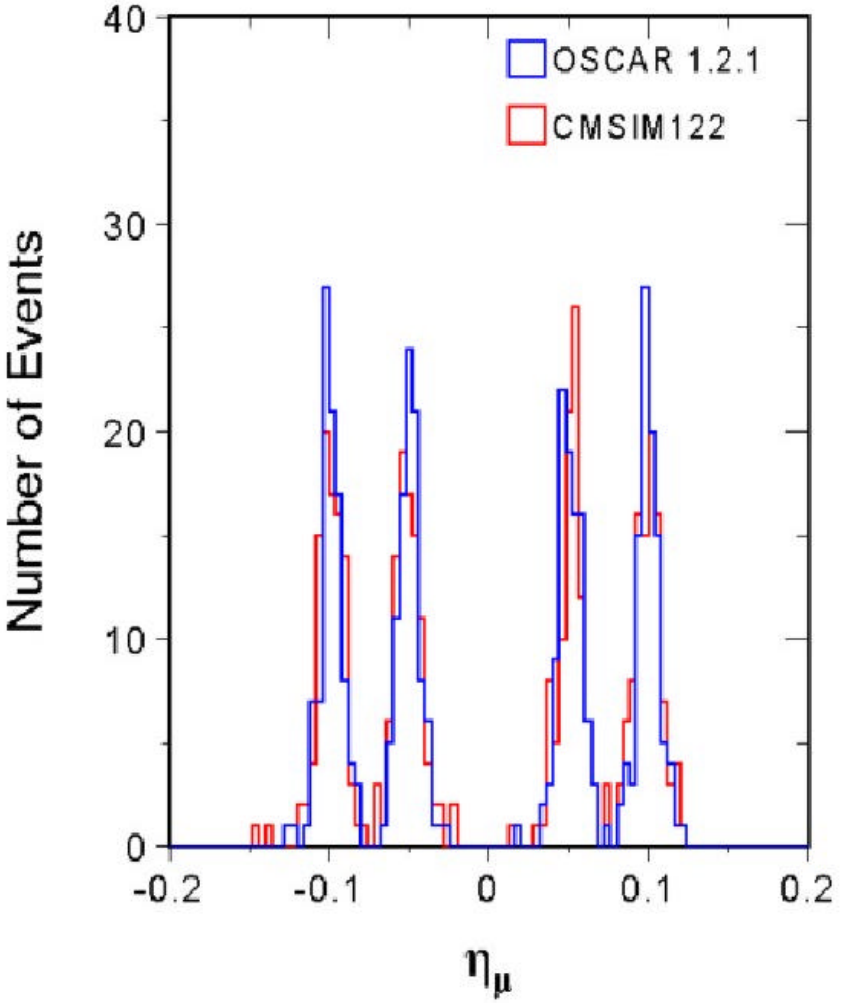
P. Arce
3-068

OSCAR simulation + ORCA reconstruction

400 single muon events

Fully integrated in Framework: COBRA

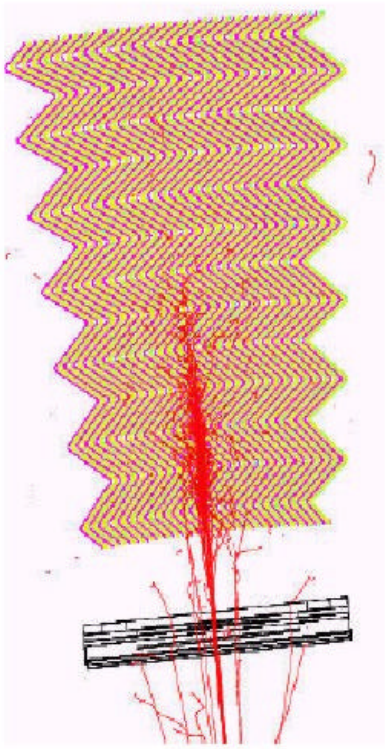


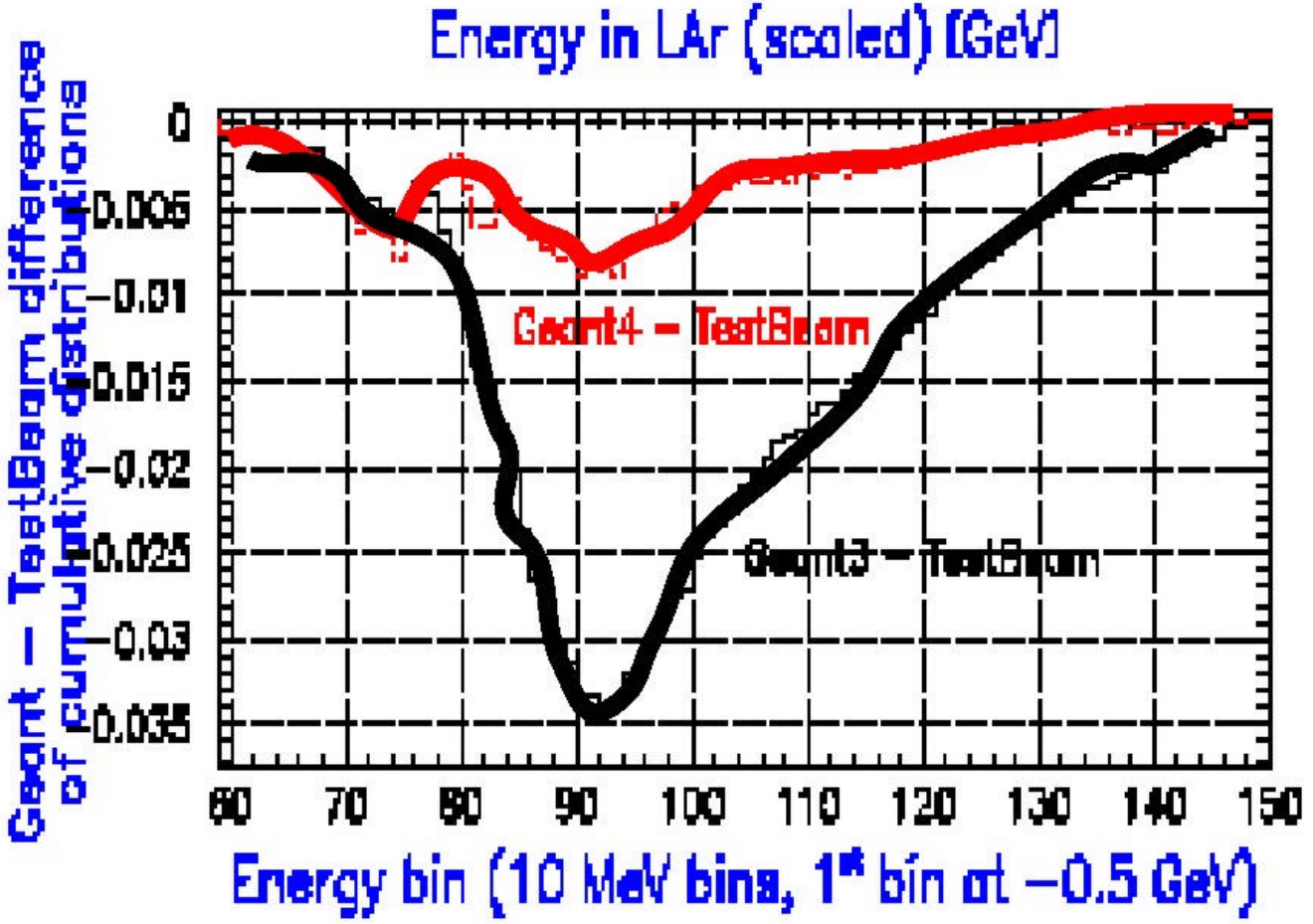


D. Salihagic
5-005

Atlas Calorimeter in Testbeam

100 GeV single muon in barrel Ecal





Agreement of Data and Geant3/Geant4 within **3.5%/1%**

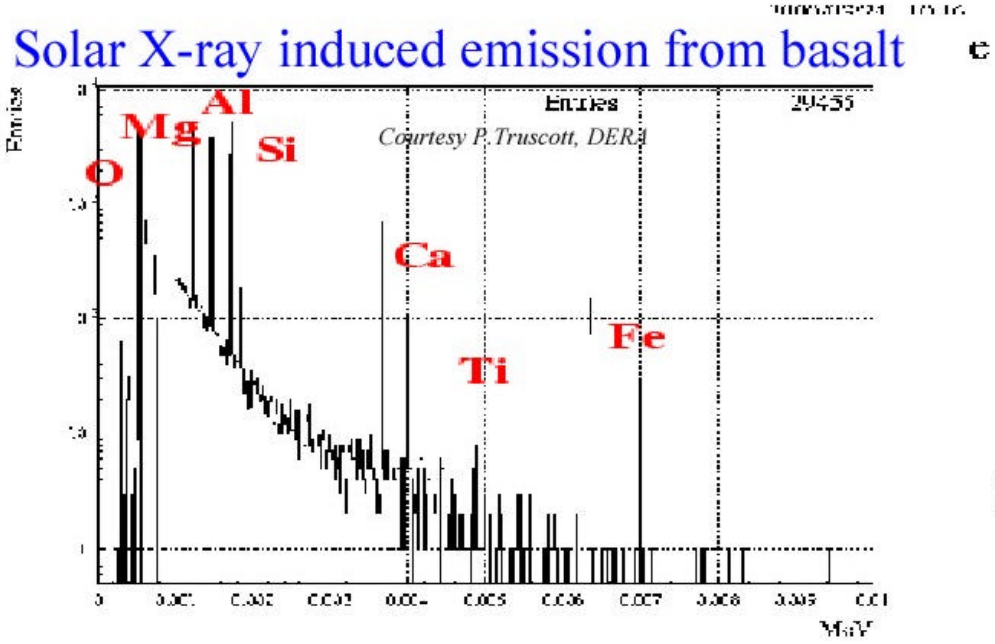
Geant4 e/m at low energies

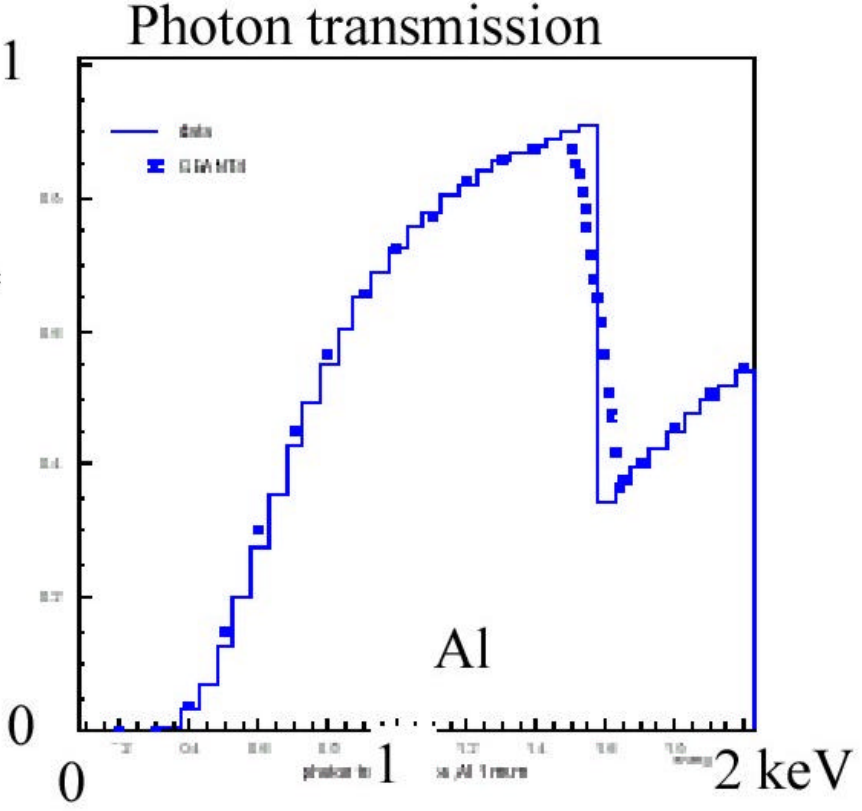
- Electron/photons down to 250 eV, hadronic to 1KeV
  - Photo-electric, Compton, Raleigh, Ionisation, fluorescence

M.G. Pia
5-001

- Radiation in space
  - underground detectors
  - Xray telescopes

A. Brunengo
5-002





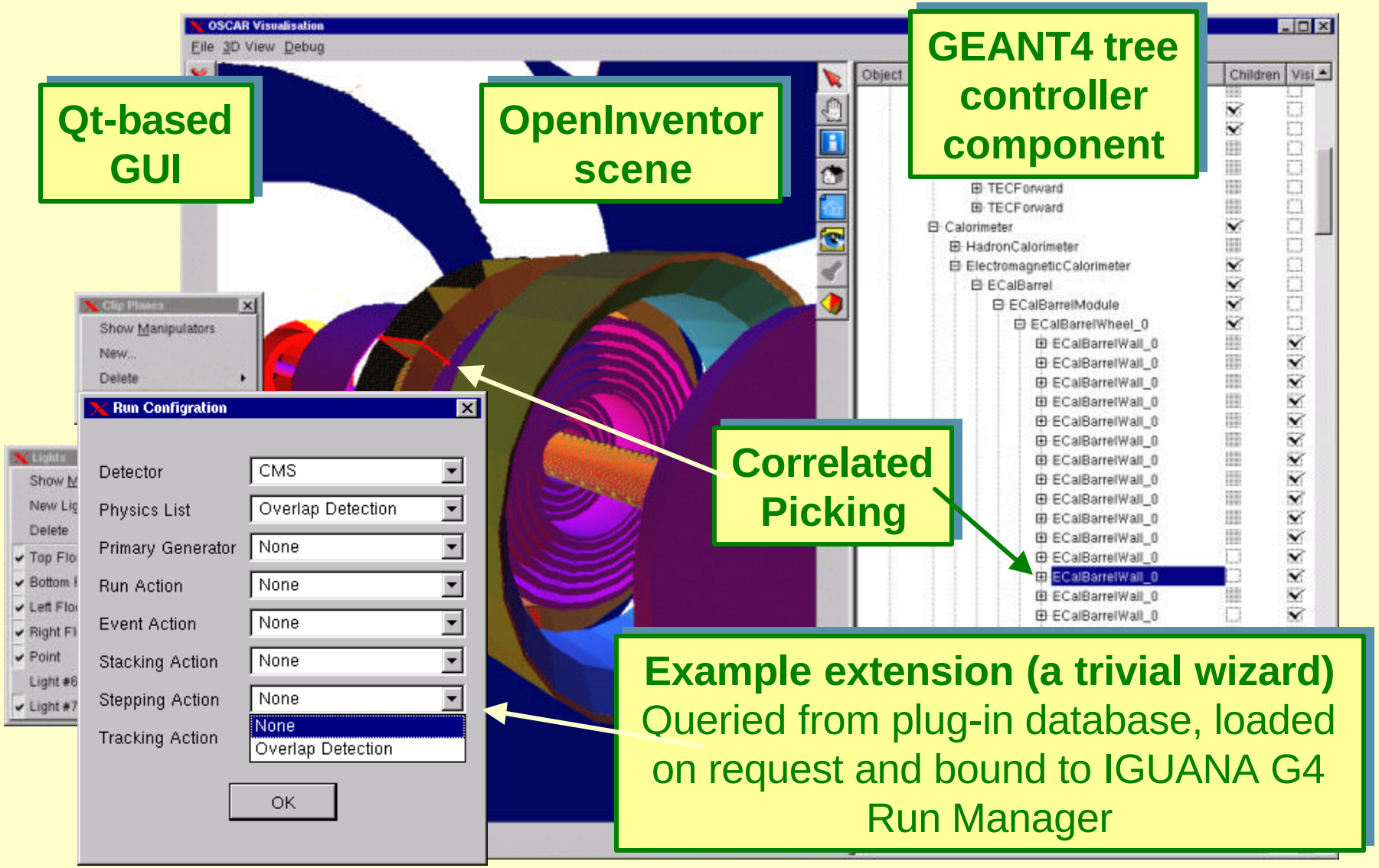
Data analysis tools (track 3)

- Organised in 3 sessions:
  - Architecture and Frameworks
    - AliROOT; GAUDI; IGUANA; PHENIX (*3-050*); Offline frameworks - H1, SND (*3-047, 3-006*)
  - Experiments' Analysis Environments
    - CMS (*3-041*), BES III (*3-059*), GSI (*3-003*), LCD (*3-076*)
  - Generic Analysis Tools
    - Anaphe/Lizard, IGUANA, JAS, ROOT

Architectures and Frameworks

- AliROOT * *see 3-070 (F.Carminati)*
  - C++ framework based on ROOT
  - Testing with data challenges
    - 110TB written to CASTOR tape system
  - DataGrid: working on PROOF
- GAUDI * *see 3-064 (P.Mato)*
  - Architecture-centric, abstract interfaces
  - Many new services: resource monitoring (dynamic loading, histo/ntuple persistency, Python scripting), Object Definition Language (XML, IDL), Geant4 integration
  - Plan: “Grid-capable” not “Grid-dependent”
- IGUANA * *see 3-039 (L.A.Tuura)*
  - Open architecture: thin portability layer, tiny kernel
  - Plug-ins approach (drivers, browsers, extensions, …)

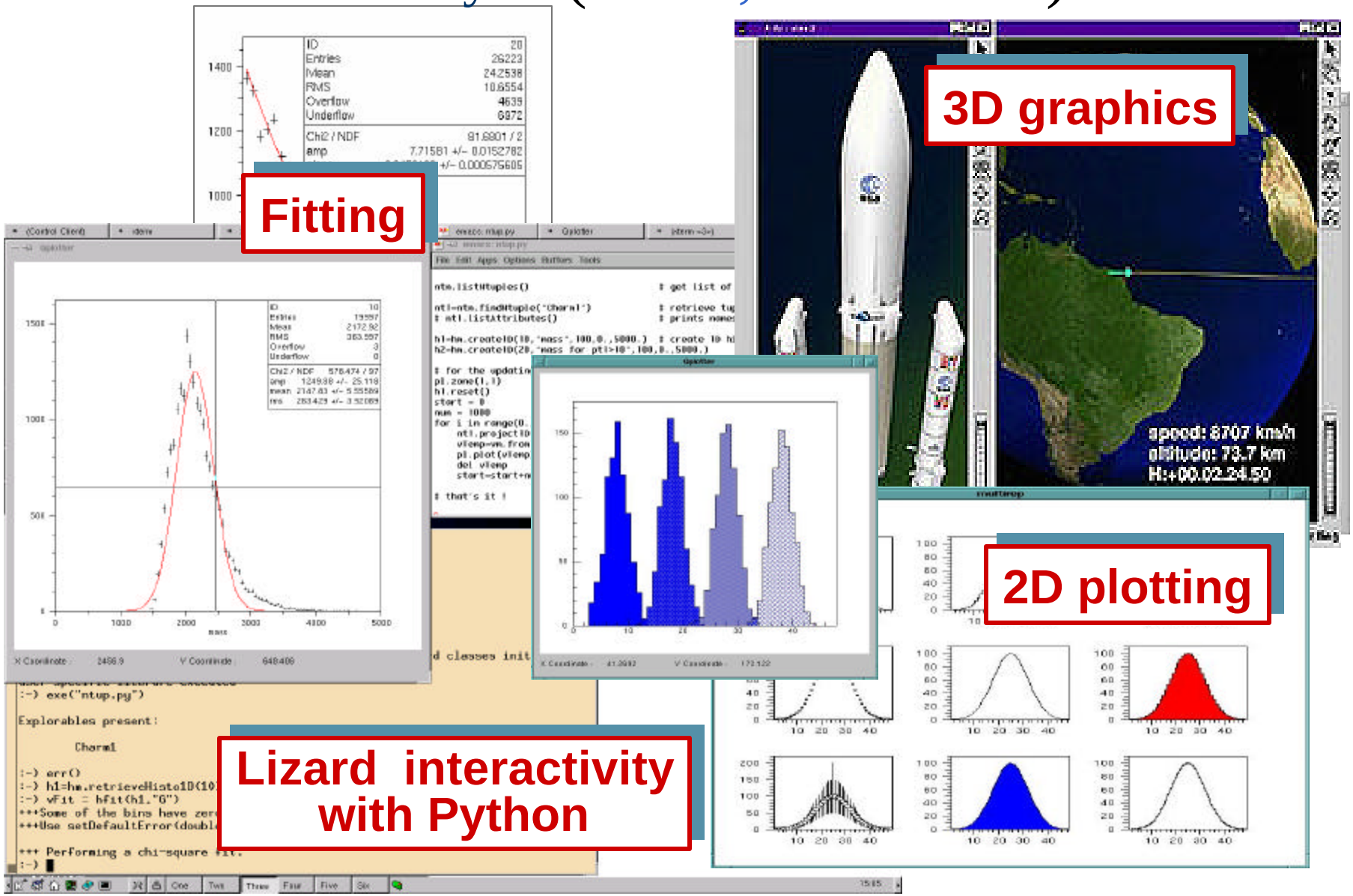
IGUANA example: Interactive GEANT4 Browser



Generic Analysis Tools

- Anaphe/Lizard ** see 3-072 (A.Pfeiffer), 3-070 (J.Moscicki)*
  - Based on AIDA: **abstract interfaces** approach, provides a full set of AIDA-compliant packages (also license-free!)
  - OO replacement for CERNLIB (former LHC++)
- IGUANA interactive analysis ** see 3-040 (I.Osborne)*
  - Based on the IGUANA open architecture: set of C++ event display tools (HEPVis, SoQT/QT, OpenInventor, OpenGL)
  - Integrated browsers for Geant3 and Geant4
- Java Analysis Studio (JAS) ** see 3-022 (N.Graf)*
  - Integrated environment: rich GUI (built-in editor & compiler)
  - **Plug-ins** and **Data Interface Modules** (DIM's)
  - AIDA-compliant, new DIM for ROOT files, *tuple* explorer
  - Plans: integrate with GRID services (with e.g. "BlueOx")
- ROOT ** see 3-022 (F.Rademakers)*
  - Many new graphics functionalities
  - Functional in-house GUI, rich canvases and 2D primitives
    - Will it migrate to modern graphics packages (Qt, OpenGL, …) ?

Anaphe - OO Libraries and Tools for Data Analysis (3-070, J.Moscicki)



Comments, impressions … 1

- In general
  - Very quiet conference, few questions
  - Software quality barely mentioned
  - Interest for adopting ***Software Processes*** and suitable ***Methodologies***…
    - … but, very little and sometimes ‘distorted’ knowledge of what it means !
  - ***Collaborating Frameworks*** rather than a single all-powerful framework
    - Progress towards modular architectures (“abstract interfaces”, “components”, “plug-ins”,…)
  - Software is becoming free !
    - Good support, well documented

Comments, impressions … 2

- Simulation
  - Emerging standard: ***Geant4***
    - After 3 years of its first release, experiments start using it in production also for full simulation
    - More comparisons with test data
      - and doing fine
    - New physics models
      - improvements required and still ongoing
    - A lot of interest and activities in the low-energy domain
      - technology transfer (*8-012, M.G.Pia*)
  - Integration in experiments' frameworks
    - Through abstract interfaces

Comments, impressions … 3

- Data Analysis tools
  - Emerging HEP standards
    - AIDA for analysis tools interfaces
      - ROOT and Hippodraw do not participate
    - QT (GUI toolkit), OpenGL/Inventor (low/high-level graphics) for HEP graphics toolkits
    - Python (scripting language) as “software glue”
      - ROOT with CINT makes the exception. Developers and users seem happy
  - DIM’s for reading ROOT files (C++, Java)
  - Several prototypes for remote analysis
    - Java clients: BlueOx, Clarens, JAS,…