

# CRISTAL

Andrew Branson

University of the West of England



# Introduction – What is CRISTAL ?

- A **long-running** research project (1997-present) between UWE, CERN and CNRS (France).
- That has developed **data models and software** using state-of-the-art technologies.
- To address the **data management and process control** needs of a distributed community of experimental physicists.
- Which has yielded **academic output** and software that is being **commercially exploited**.



# Requirements – CMS ECAL at CERN

- Electromagnetic CALorimeter: Scintillating  $\text{PbWO}_4$  crystals to measure energy of charged particles.
- Crystals characterized during **decade-long** construction schedule. Final calibration data is generated from construction data for running detector.
- Production process nor data schema were finalized when production began.



# Our solution: CRISTAL

- CRISTAL is a flexible platform for collecting data managed through execution of **object lifecycles** (workflows).
- All workflow and data structures defined at run-time: '**Descriptions**'
  - Workflow: XML-marshalled Java objects
  - Data format: XML Schema
  - Application logic: Scripts, wrapped in XML with metadata.



# Object Oriented Workflows

- Each workflow is executed in a context that collects its resulting data: an '**Item**'.
- All **descriptions are also Items**, and have their own **lifecycles**, which manage **development** and maintenance.
- All change of state in the system mediated by activities, all recorded in events.
- **Full traceability of development and execution.**



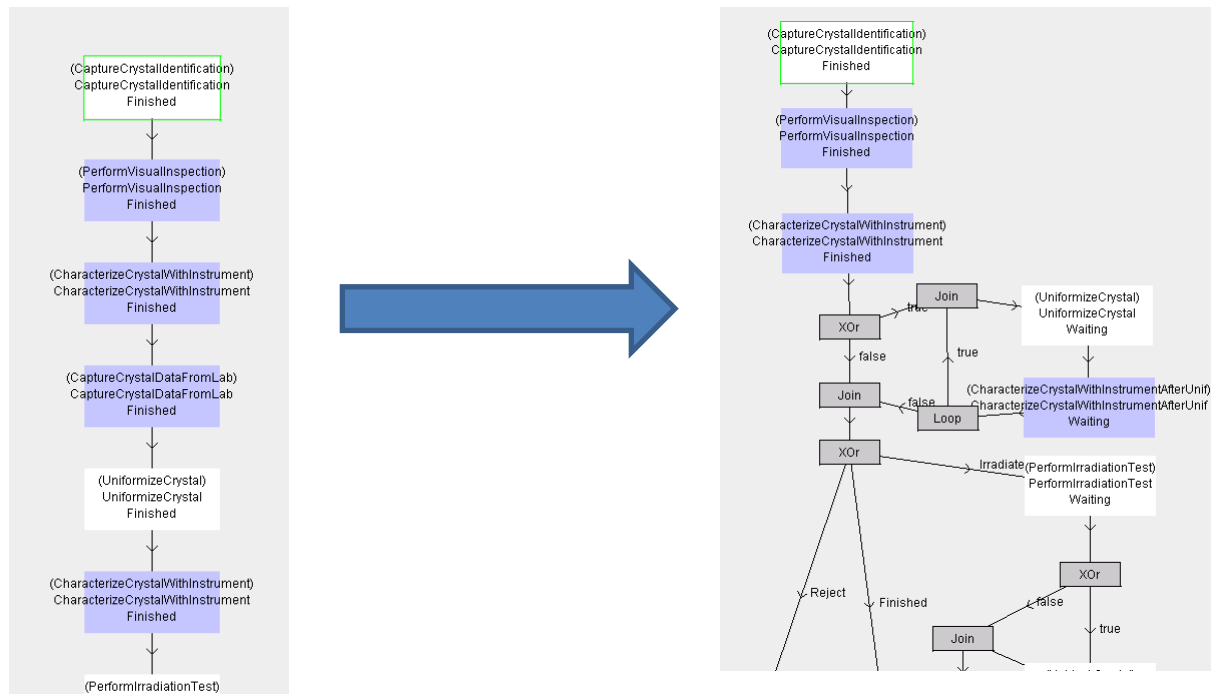
# Data Management

- CRISTAL object model for lifecycles, activities, events and event data: 'Outcomes'
- Fixed model for all objects but Outcomes, which conform to activity defined XML Schema.
- Pluggable persistency:
  - Read and/or write for each object type.
  - Original: LDAP (index) RDBMS (query) XML Files
  - Latest: LDAP + eXist XMLDB



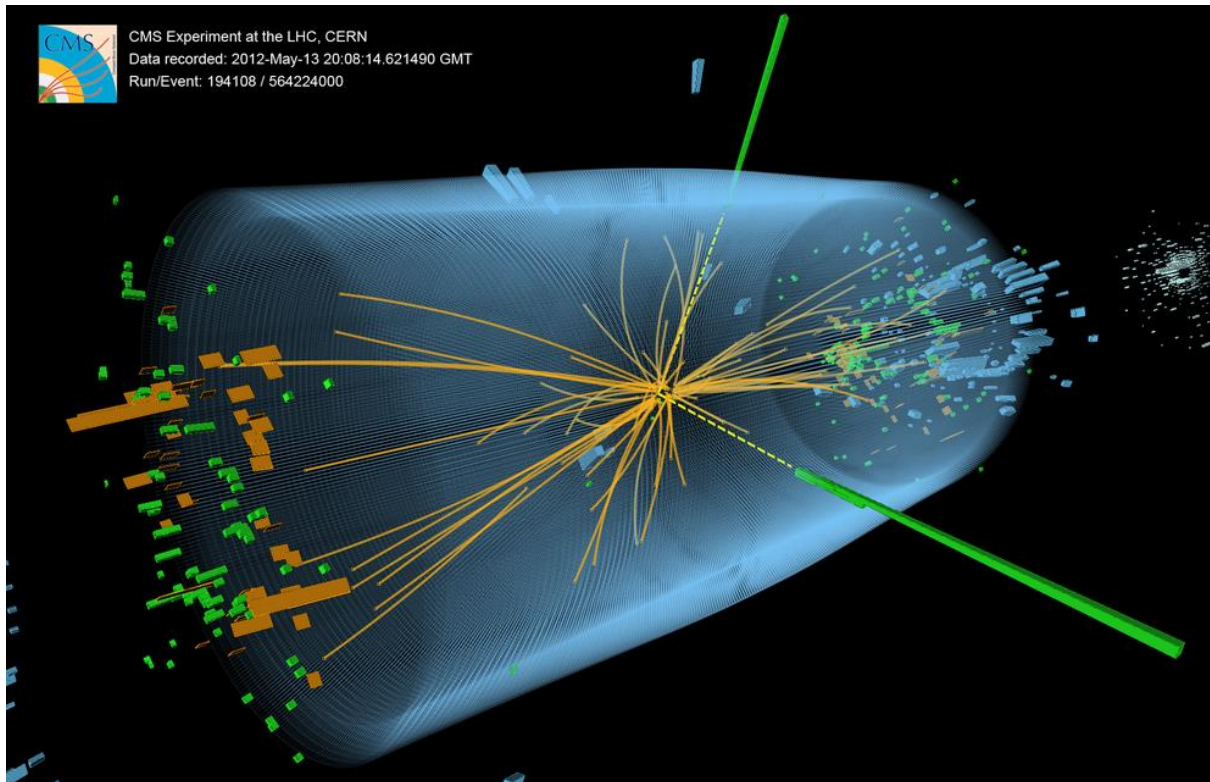
# Result – CMS ECAL

- All product lifecycles evolved considerably during execution (2003-2008)



# Result – CMS ECAL

- Calibration data was generated from all crystals, across process and schema versions.





# Current usage

- Commercial:
  - Agilium: since 2003.
    - Focus on process. Advanced **BPM** design tool.
    - FP7 IAPP to improve CRISTAL expertise
  - Technoledge: since 2011
    - Data integration
    - Data stream archival
    - Research Resource Planning



# Current usage

- Academic
  - Neugrid & N4U: Analysis service
    - Managing neuroimaging analyses on the Grid.
    - “Data Atlas”: Catalogue of datasets & pipelines
  - CERN
    - More crystal characterisation for PET scanners
- Future: LGPL



End

