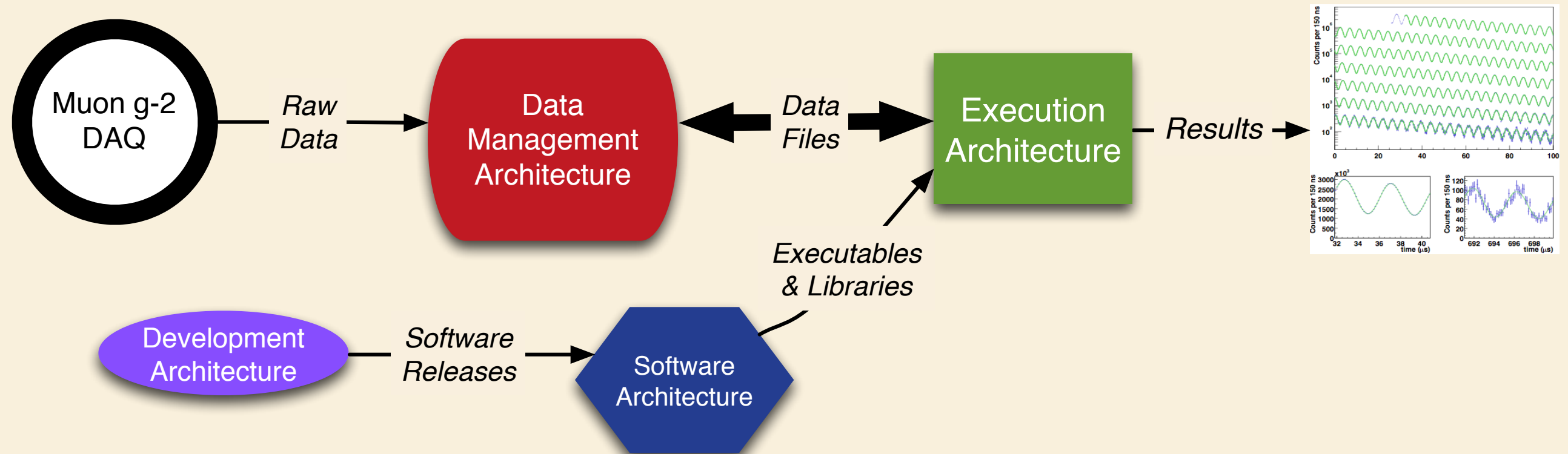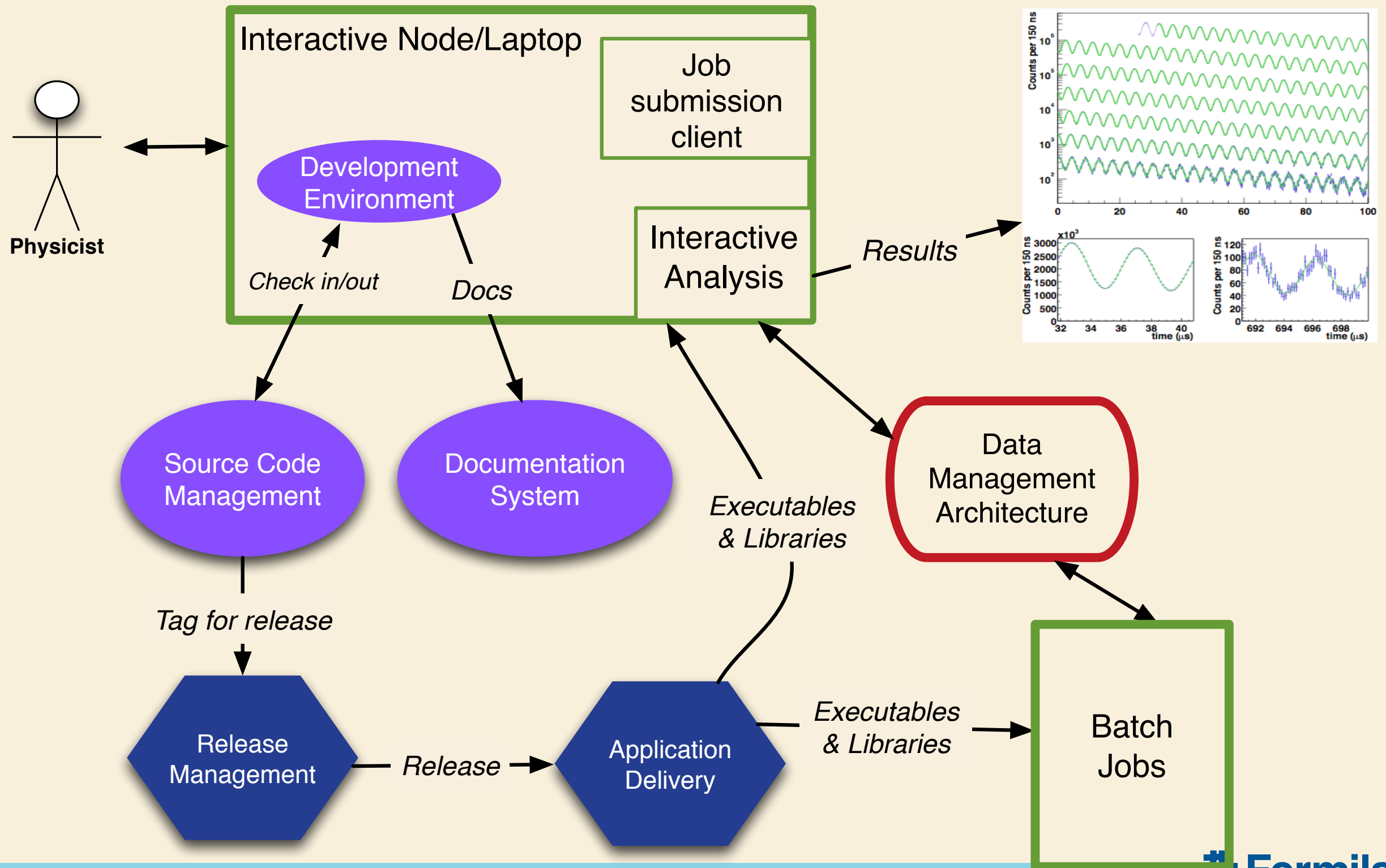# *Physics & Software*

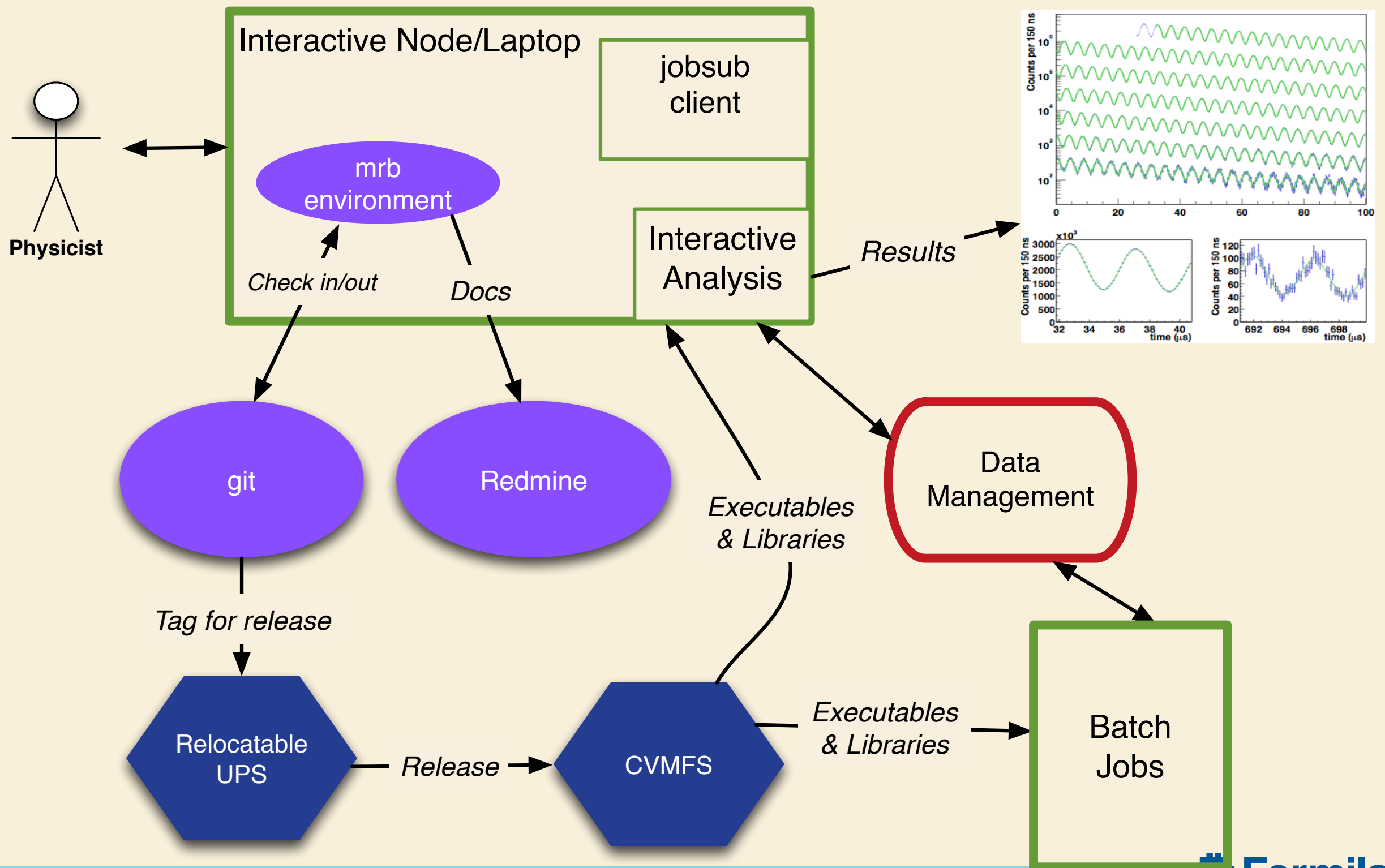## Adam Lyon

More architecture/implementation

Software & Development Arch

Physicist

Interactive Node/Laptop

Job submission client

Development Environment

Interactive Analysis

Results

Check in/out

Docs

Source Code Management

Documentation System

Executables & Libraries

Data Management Architecture

Tag for release

Release Management

Release

Application Delivery

Executables & Libraries

Batch Jobs

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Software & Development Impl

Physicist

Interactive Node/Laptop

jobsub client

mrb environment

Check in/out

Docs

Interactive Analysis

Results

git

Redmine

Executables & Libraries

Data Management

Tag for release

Relocatable UPS

Release

CVMFS

Executables & Libraries

Batch Jobs

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Data Management Architecture

Muon g-2 DAQ

Control

Catalog

Robust file archiver

Archive

Central Data Cache

Archive-backed

Scratch

Satellite Caches

Calib/Conditions DB

DB Cache

Software Architecture

Batch Jobs

Interactive Analysis

Project Storage & Home Area

Raw Data

Data Files

Data Files

Data Files

Data Files

Analysis Files

Analysis Files

Data Files

Constants

Executables & Libraries

Executables & Libraries

Files

Results

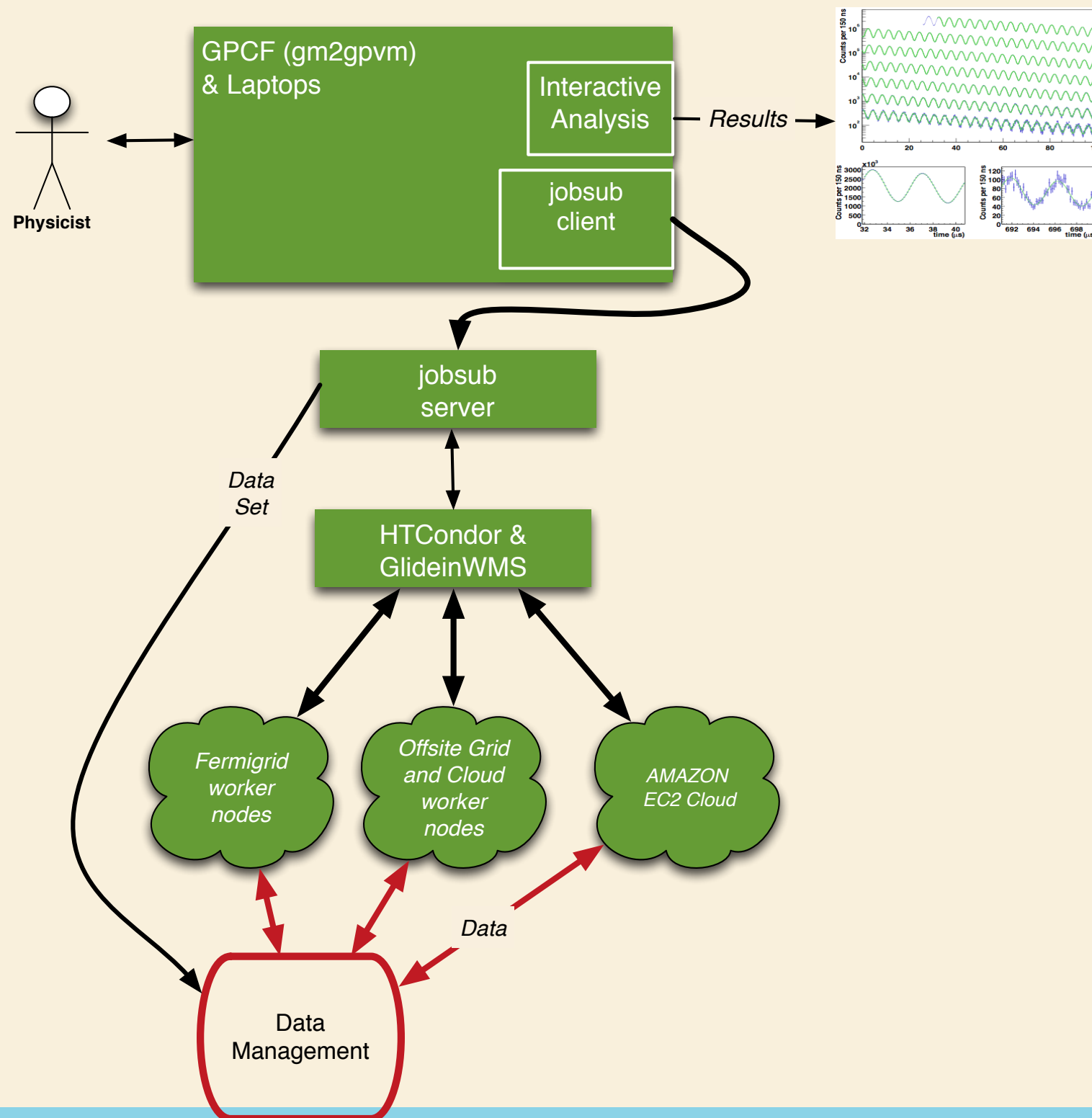🟦 **Fermilab**

Data Management Implementation
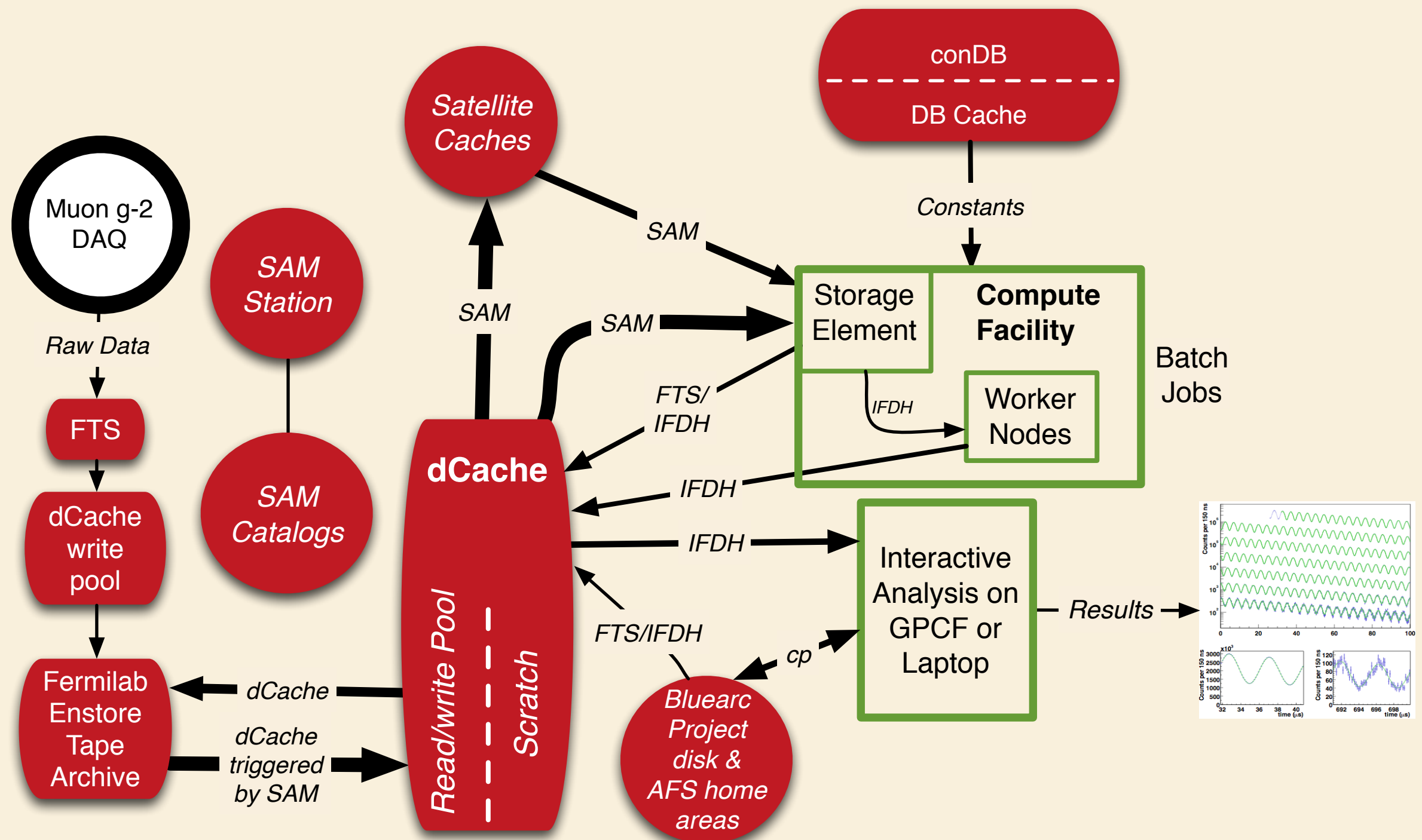
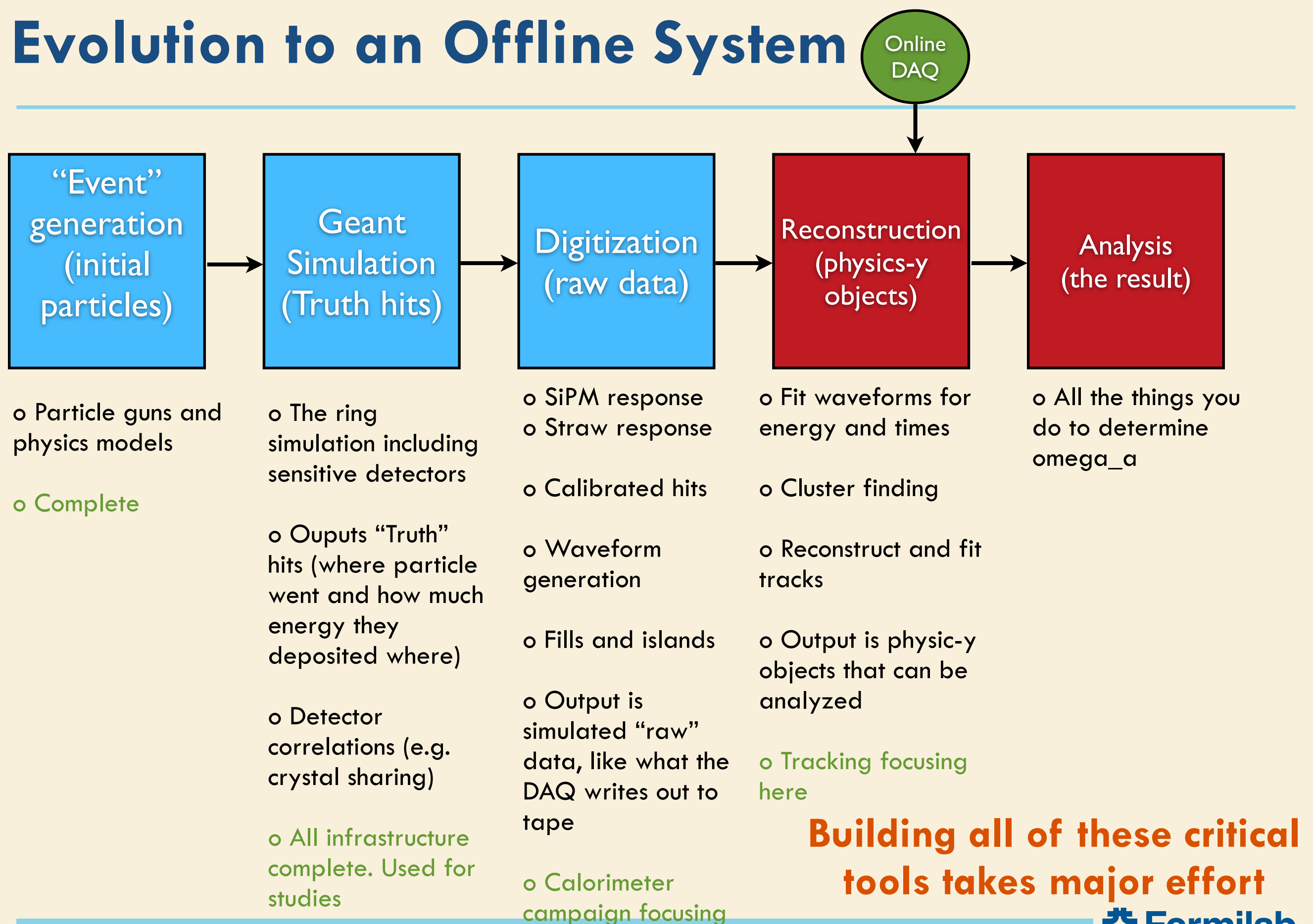# Execution Architecture
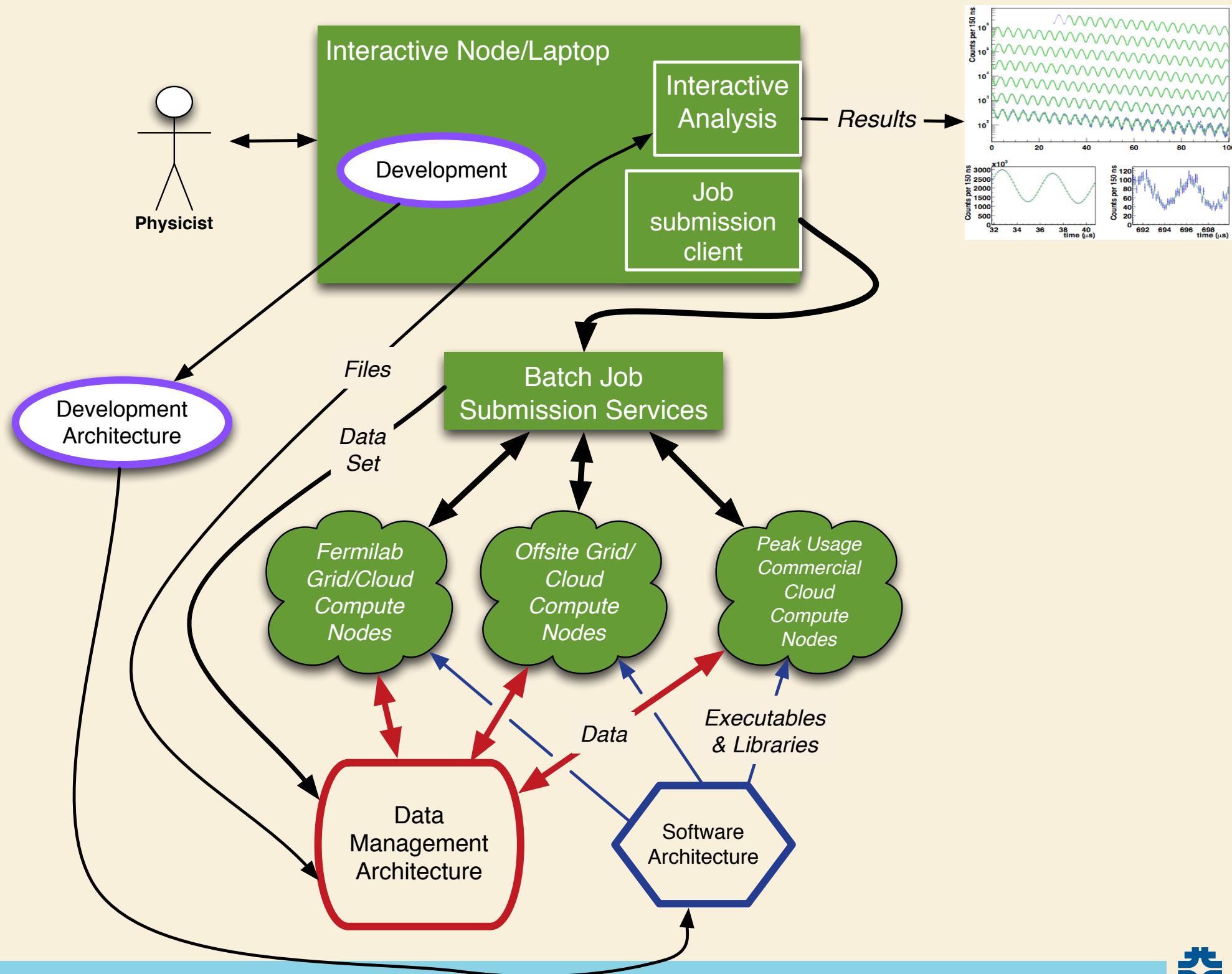
Execution Implementation

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What about Physics

This software stuff is nice, but what about the Physics?

The simulation and offline software are tools to achieve results

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Evolution to an Offline System

Online DAQ

"Event" generation (initial particles)	Geant Simulation (Truth hits)	Digitization (raw data)	Reconstruction (physics-y objects)	Analysis (the result)

o Particle guns and physics models

o Complete

o The ring simulation including sensitive detectors

o Ouputs "Truth" hits (where particle went and how much energy they deposited where)

o Detector correlations (e.g. crystal sharing)

o All infrastructure complete. Used for studies

o SiPM response
o Straw response

o Calibrated hits

o Waveform generation

o Fills and islands

o Output is simulated "raw" data, like what the DAQ writes out to tape

o Calorimeter campaign focusing here

o Fit waveforms for energy and times

o Cluster finding

o Reconstruct and fit tracks

o Output is physic-y objects that can be analyzed

o Tracking focusing here

o All the things you do to determine omega_a

Building all of these critical tools takes major effort

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Physics studies

See Hertzog list

See Morse list (TDR page 112)

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A Program

Where can new people fit in? Priorities? Ordering?

1) End-to-end Rate Study
   o Receive muons/distributions from G4Beamline
   o Ensure fields are correct
   o Ends with tracks and clusters
   o Measure efficiencies

2) Calorimeter
   o Need shower library
   o Understand materials
   o Accurate waveforms
   o Cluster finding
   o Q method

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Physics Program

3) Tracker
- o **Pattern recognition**
- o **Track fitting**
- o **Momentum, pitch angle, decay position resolutions**
- o **Rates given pileup, fast rotation and variances**
- o **Sensitivity to EDM**

4) Beam
- o **mu- and mu+**
- o **Scraping, lost muons**
- o **Inflector, kicker, quads, time-dependent fields**
- o **Optimal scraping**
- o **Beam dynamic systematics**
- o **Lost muons**

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Physics Program

5) Verification
- o Geometry and fields correct?
- o Visualization
- o "Standard candles"
- o Tomography

6) More computing stuff to do
- o Release art 1_11_00, upgrade code accordingly
- o Fix circular dependencies
- o Use SAM, new Jobsub,
- o Restructure fields to allow for non-Geant use
- o Use build facility
- o Write tests
- o Event display

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A lot to do

How can you help?

1) Learn Art
2) Practice best practices
3) Collaborate freely
4) Pick a sub-group (calorimeter, tracking, verification) and help
5) Don't be afraid to ask questions

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