Ideas for a Reconstruction Group

Adam Lyon 2 October 2015

The PAC wants you!

Fermilab Physics Advisory Committee Meeting
June 22-25, 2015
Comments and Recommendations

Fermilab may want to consider creating a forum for exchanging ideas and for aiding progress on LAr event reconstruction. The issue is not just providing a common software platform (this is clearly critical) but also facilitating a forum where scientists (especially young ones) can discuss common issues. Fermilab may want to encourage the major LAr collaborations to consider mechanisms for effective and efficient parallel development and transfer of knowledge.

The common solution theme

- Grid and data management (HEPCloud)
- Simulation
- Framework (art/CMSSW)
- LArSoft

The activities provide common solutions to multiple experiments at Fermilab

Can this idea apply to Reconstruction as well?

Common reconstruction?

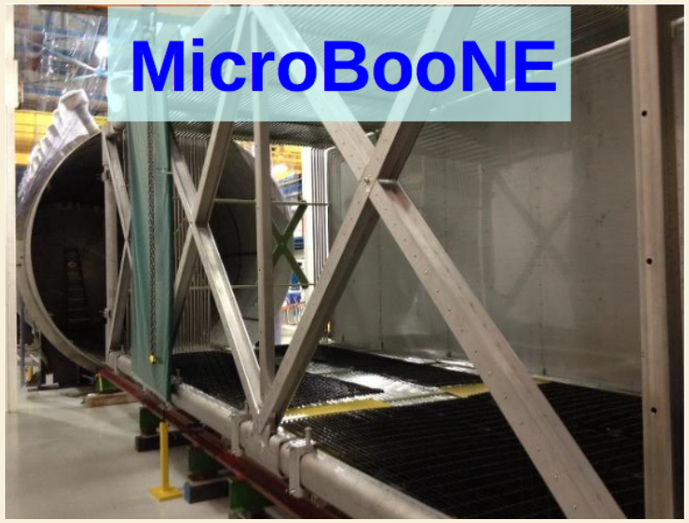
Common reconstruction is more difficult…

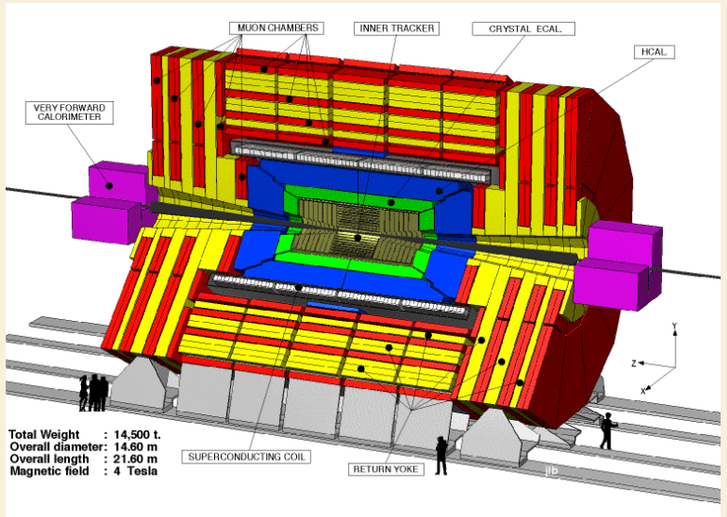
Particulars of detectors get in the way

Can't run CDF reconstruction at DØ

Can't run MicroBoone reconstruction at LArIAT

Can't run LArIAT reconstruction at CMS





BUT…

Algorithms are similar

- Clustering, Track finding
- Kalman filtering
- LAr reconstruction
- Particle flow
- Image processing
- Signal processing

Focus on the similarities of algorithms and techniques with a goal of common libraries for our common platforms where possible

Fermilab SCD doesn't want to…

- Take over experiment's reconstruction tasks
- Compete with experiments and university groups
- Steal post-docs/students
- Solely drive reconstruction R&D
- Teach basic C++ or art/CMSSW through this group

Fermilab SCD does want to…

<u>Assist and augment</u> the efforts of experiments

Help you develop and design your algorithms (profiling and validation)

Help you keep up with emerging computing architectures

Help you explore new ideas and techniques

Connect you to our relationships to outside expertise

Tap into interns, undergrad and co-op students

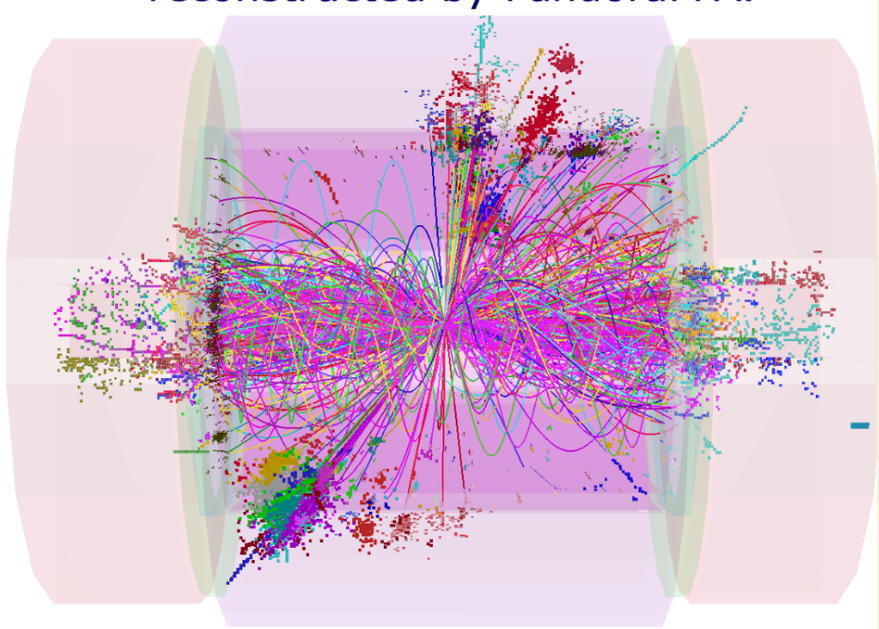
We want to help you write fast, modern, innovative, and validated reconstruction

An example: Pandora

Pandora

- **Pandora is a software toolkit for developing and running pattern recognition algorithms. It provides the following:**
  - Tools for analysing the topology of particle interactions.
  - Template algorithms for reconstructing tracks and showers, using topological information.
  - An environment for building reconstruction algorithms.
  - Visualisation tools
  - A set of robust APIs for running reconstruction tasks.
  - A set of reconstruction objects, managed using STL containers.
- **A single-library C++ framework.**
  - No dependencies (other than ROOT-based event display).

H^+H^- production in CLIC detector, reconstructed by PandoraPFA.



$e^+e^- \rightarrow H^+H^- \rightarrow t\bar{b}b\bar{t} \rightarrow 8$ jets

https://svnsrv.desy.de/viewvc/PandoraPFANew/

Andy Blake, John Marshall, Mark Thomson (Cambridge University) LAr Reconstruction, Slide 3

CMS Particle Flow

LAr Reconstruction

We've hired Lindsey Gray (CMS) who has worked on Pandora developing particle flow

Interfaces to LArSoft

http://arxiv.org/abs/1506.05348

Common tools are possible

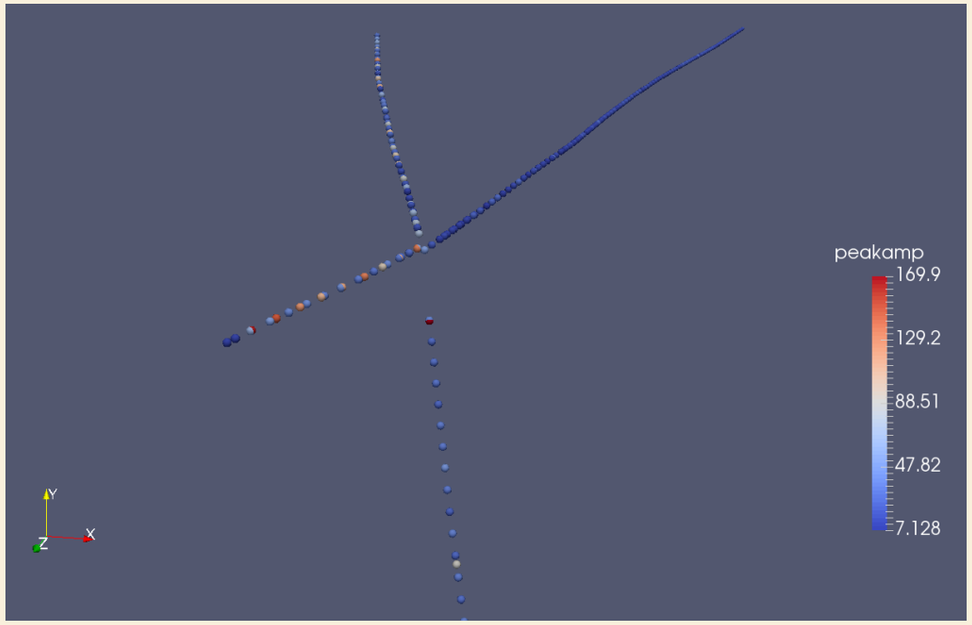
An example: ParaView

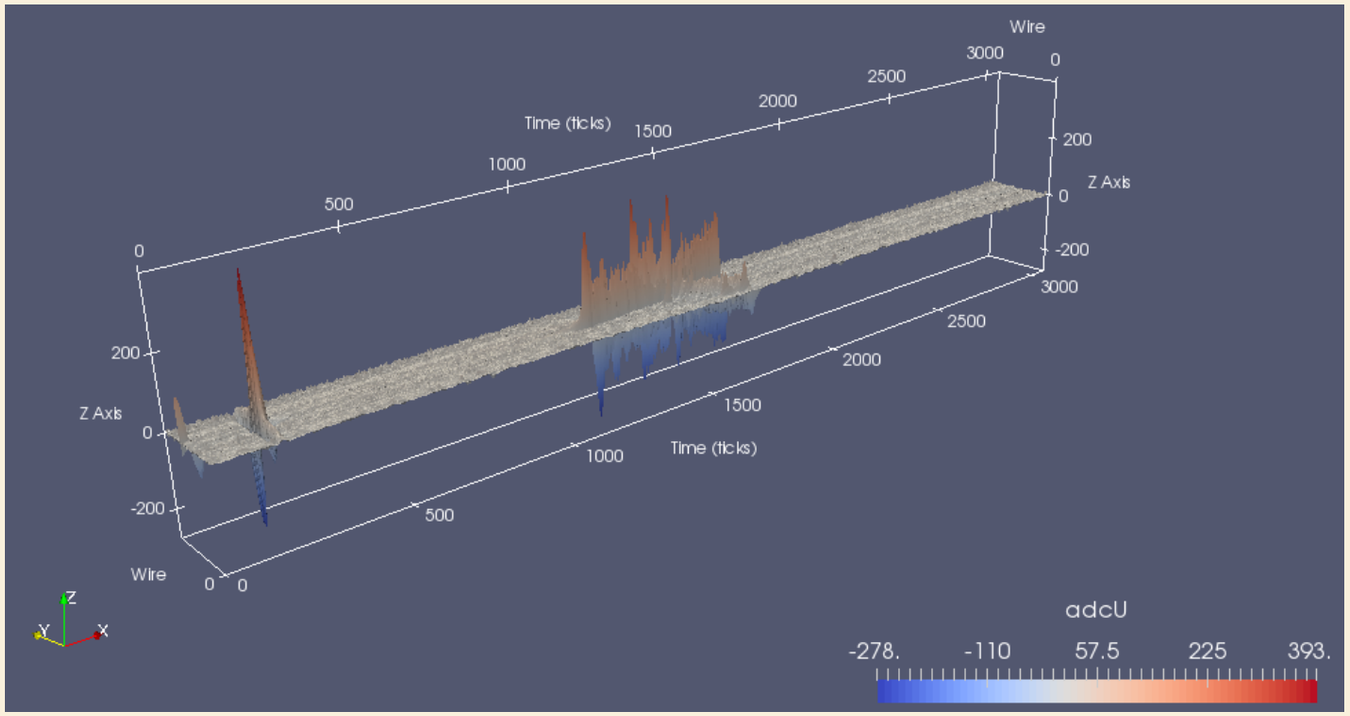
Very fast and powerful 3D Visualization

An open source DOE-ASCR funded application from the high performance computing visualization community

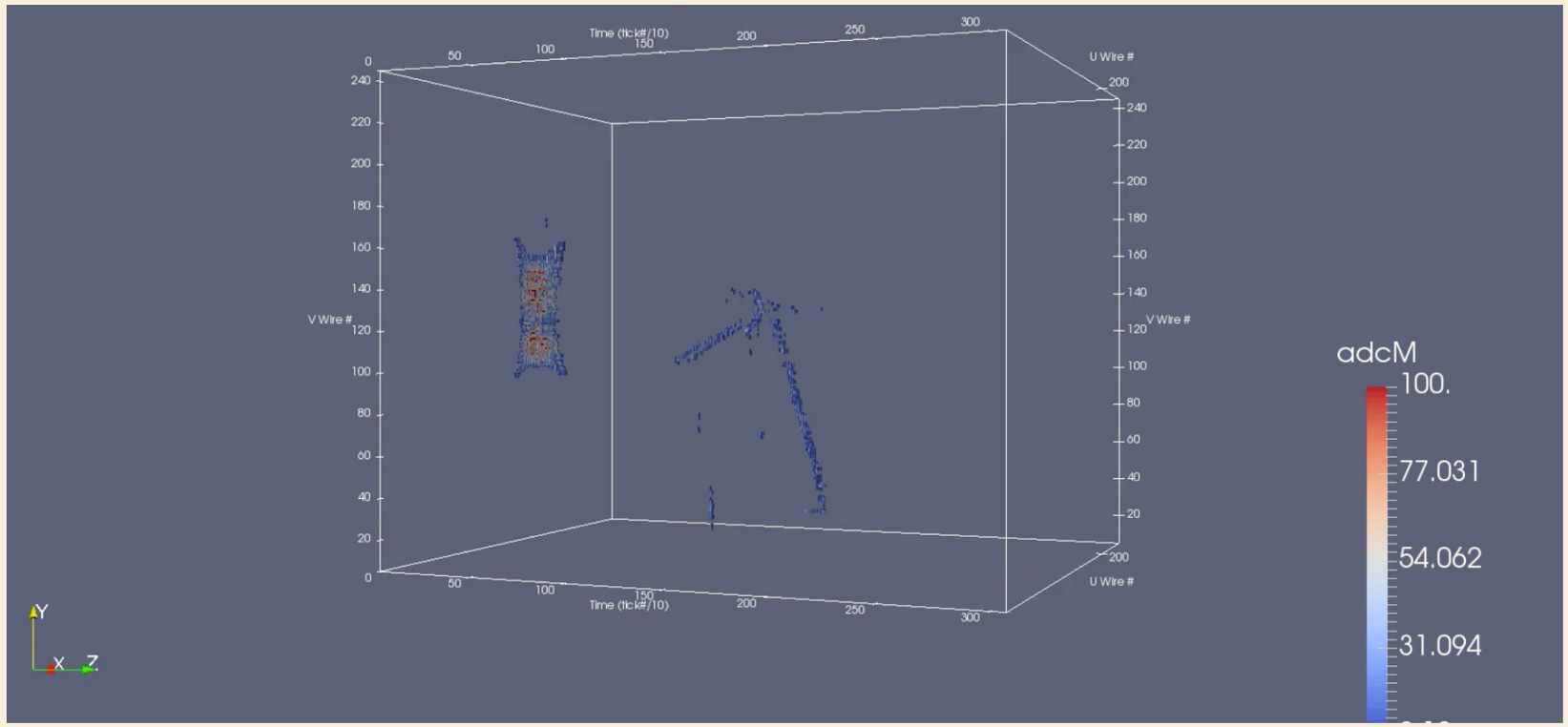
Useful for debugging and validation

[Some fun with a LArIAT event - Jim Kolwalkowski & me]



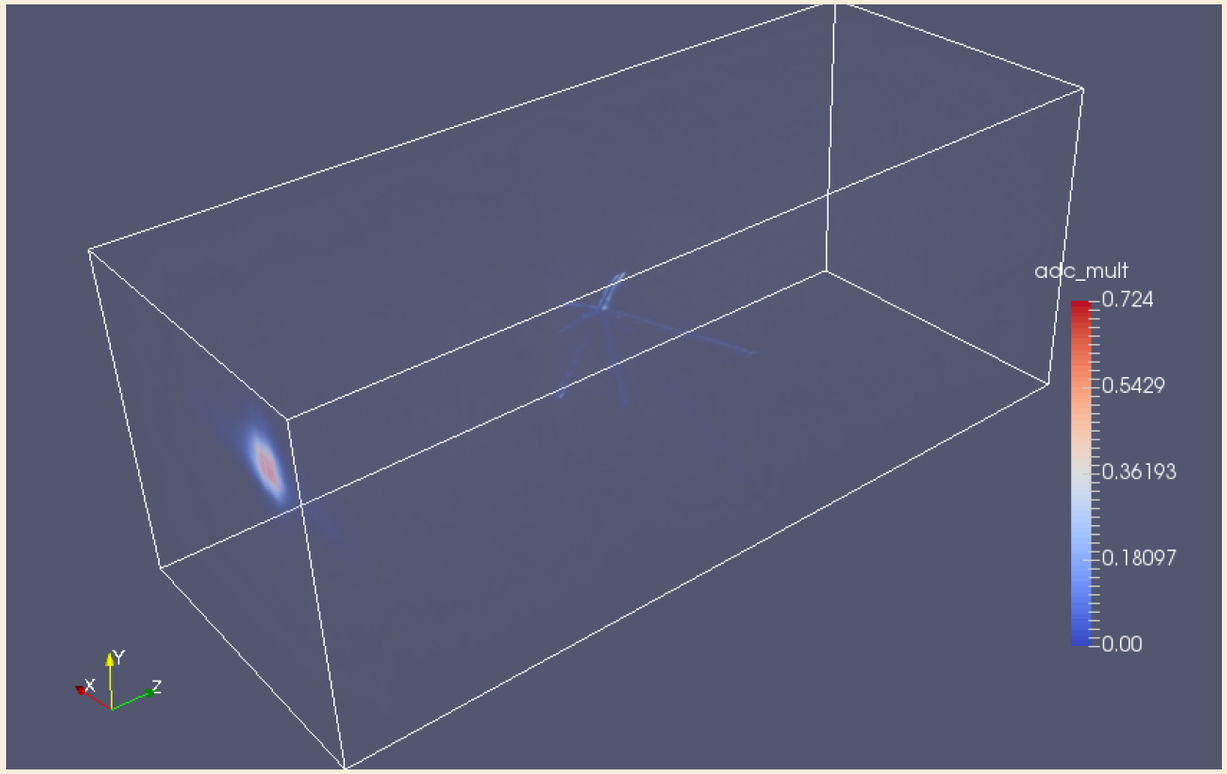


ParaView



www.paraview.org

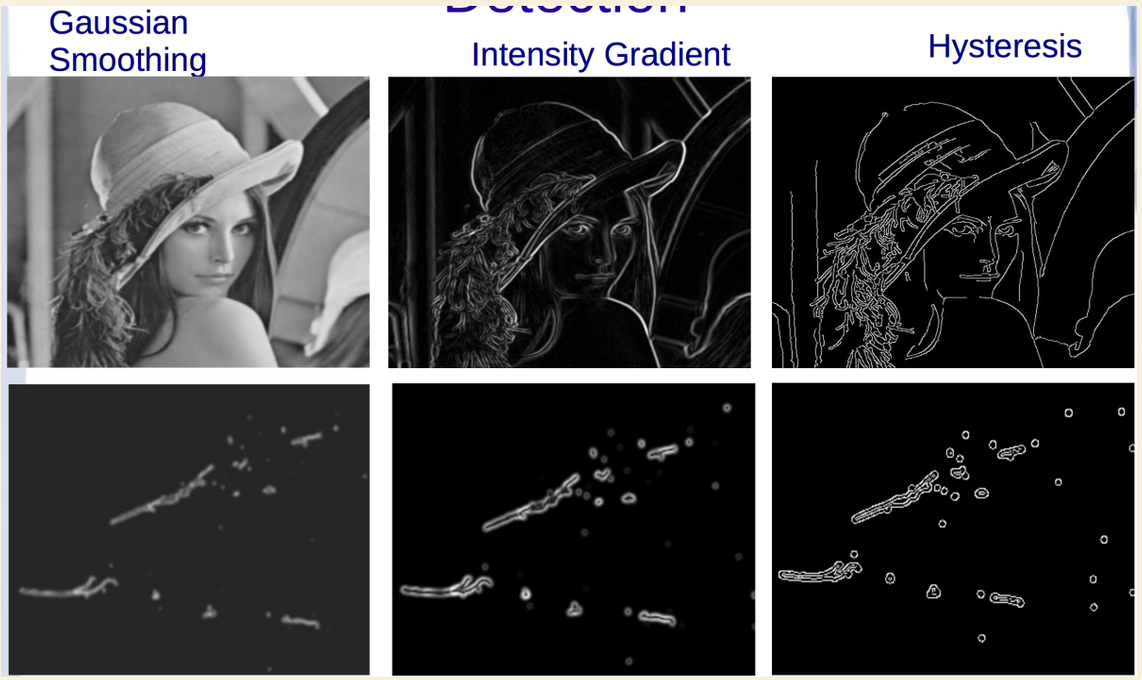
I'll be presenting more on ParaView in early November at a Computing Techniques Seminar



177M cells!

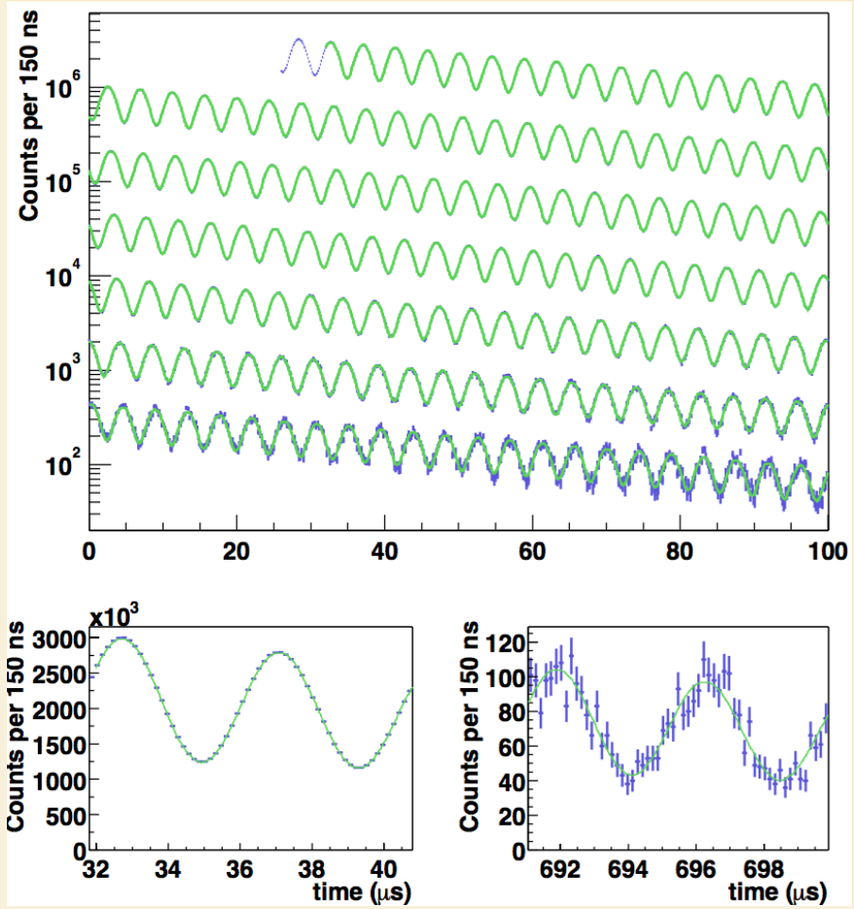
New techniques

Image processing?



From Jessica Esquival (MicroBooNE)

Signal processing?



The Reconstruction Group

Possible Vision Statement

The Fermilab Reconstruction group augments and assists the efforts of experiment collaborators from universities and labs for reconstruction algorithm development. Benefitting a broad variety of experiments, it also aids in development of common solutions, performs research on new reconstruction techniques, and leverages Fermilab's computing resources and expertise in, for example, new architectures, integration with frameworks, iterative development, profiling, and validation.

Make up of the group:

Several SCD Scientists (Neutrino, Muon, CMS);
Perhaps ND/PPD scientists in ()

Under the Scientific Software Infrastructure Department in the Systems for Scientific Applications Quadrant
[That's where LArSoft is located in the organization]

Why are you here?

Your input and buy-in are crucial for success

It's important to feel that there's no us & you - we are all a part of this effort

We need your ideas, your enthusiasm, and maybe you yourself!

A bottoms-up plan for this group

Questions

What's your take on this idea?

How can this group help you and your experiment?

What kind of topics would you have the group tackle?

How can you and your friends support the group?

What are the boundaries of the reconstruction group (e.g. what's algorithm help & what's art help)?

How does this group function in our era of "do more with less"?

What is a good first deliverable that will generate success?

Answers

Let's discuss…

Probably few answers today – and that's ok

Stop by and talk to Rob Kutschke and myself (we're both on WH9W). Or e-mail or phone.

Based on your input, the SCD will make a proposal for the group. We'll meet again to review it

My goal is to have the group up and running no later than January