

LArSoft Work Plan for 2017

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Introduction

This document records the LArSoft work plan for 2017 as of early January. Progress on specific items going forward will be recorded in redmine issues, not in this document.

Erica and Katherine met with each of the Offline leads in a series of productive meetings in December that detailed their plans for the next year, the implied requirements for LArSoft, and how LArSoft could help, as well as what the experiments might be able to contribute to LArSoft code. Some items were raised by LArSoft, not a particular experiment.

Based on those discussions, LArSoft proposes short-term and long-term priorities outlined below.

Short-term priorities; happening concurrently

These are happening concurrently. The order does not imply priority.

1. Re-factoring of LArG4
 - o Purpose: Separate GEANT4 functionality and LArSoft-specific parts into different units
 - Simplifies interface between material modeling and detector simulation
 - Clarifies maintenance responsibilities

- Easier to introduce or modify models of various detector effects
 - Resources: GEANT4 team: Hans Wenzel and Krzysztof Genser
<http://cdcv.s.fnal.gov/redmine/issues/14454> - 48 done / 170 total hours
- 2. Track fitting / data product improvements
 - Purpose: Provide data structures to store track fit information, and re-organize existing data structures to better match algorithm workflows
 - Provides the additional flexibility needed to accommodate the reconstruction steps downstream of pattern recognition
 - Also working to standardize the information to be produced by any track reconstruction workflow
 - This is part of a longer-term effort aimed at establishing uniform policies for the output of reconstruction
 - Resources: LArSoft team: Giuseppe Cerati, Gianluca Petrillo, Erica Snider
 - <http://cdcv.s.fnal.gov/redmine/issues/14047>- 70 done / 400 total hours
- 3. ProtoDUNE / ICARUS integration
 - Purpose: To provide the code and interface changes needed to extend LArSoft support to ProtoDUNE and ICARUS simulation and reconstruction
 - Resources: Gianluca Petrillo, Erica Snider and Robert Sulej
 - <http://cdcv.s.fnal.gov/redmine/issues/15086>- ?? total hours
- 4. SPACK - new build system for *art* and LArSoft
 - Purpose:
 - To migrate to a standard set of build tools that have broad community support
 - To address portability and configurability issues raised by experiments with the current build system
 - To allow continuing use of Mac OSX as a LArSoft development platform within the context of Apple's System Integrity Protection system
 - Resources: Jim Amundson, Patrick Gartung, Lynn Garren
 - <http://cdcv.s.fnal.gov/redmine/issues/15313> - ?? total hours
- 5. Documentation improvements such as a training page, updates to wiki pages, new LArSoft notes
 - Purpose: Keep the LArSoft Collaboration aware of changes in tools and process. Highlight information produced within LArSoft Collaboration.
 - Resources: Katherine Lato
 - Various redmine issues throughout the year. 40 -120 hours
 - As an example: <http://cdcv.s.fnal.gov/redmine/issues/14691> - LArSoft notes for January
- 6. Packaging NuWro. Note, a helper like GENIEhelper might require a fair amount of work and is probably not within the effort LArSoft has available.
 - Purpose: To package NuWro as a UPS product that is distributed with the LArSoft suite.

- A more ambitious level of support would be to provide a direct interface to NuWro within LArSoft, much like GENIEHelper does for GENIE, but that work isn't being estimated here.
 - Resources: LArSoft code management: Lynn Garren
- Note: the original request also included integrating NuWro into GENIEHelper or a similar new class. While evaluating the costs and benefits of that part of the request, we intend to address this accessibility issue.

7. CI improvements

- Purpose: Migrate the LArSoft CI system to the new system and produce a second tier of CI tests.
 - The new system has significantly improved reporting and email messaging that will enhance usability and allow the system to send emails with error reports directly to developers
 - Support for the current version in use by LArSoft is ending
- Resources: Vito Di Benedetto and experiment contacts for the CI tests
- <http://cdcv.sfnal.gov/redmine/issues/15125> - ?? hours
- <http://cdcv.sfnal.gov/redmine/issues/15124> - ?? hours

Longer-term priorities

A. Concurrency -

- Purpose:
 - To use multi-threading to address memory usage issues and provide flexibility in resource utilization
 - To introduce vectorization to those components of the code where speed improvements could be obtained, and to make use of currently unutilized resources
- Resources: LArSoft team and (proposed) experiment effort
 - LArSoft and users need to be educated about concurrency, and the coding rules that apply to candidate code.
 - Multi-threading will depend on support within art. LArSoft may be asked to provide realistic scenarios to test their changes.
 - MicroBooNE has already contributed effort to this project

B. Architectural changes to define algorithm interfaces for layered algorithms.

- Purpose: Provide a well-defined set of interfaces for layering algorithms within a framework that allows for run-time configurability below the level of art modules, e.g., the art "tool" currently under development
 - The primary target for this change are the algorithms used to generate, process and deconvolve raw signals from the detector
 - A major thrust is to provide a set of tools that will allow algorithms that are currently detector dependent to be generalized and incorporated into the core LArSoft code
- Resources: The LArSoft team and (proposed) experiment effort.

- DUNE has already contributed effort to a similar project
 - Note: new architectures do not need to be base around the art “tool. This is primarily about agreeing what certain interfaces look like.
- C. TPC topology / locality in the Geometry service.
 - Purpose: To provide a mechanism to efficiently determine the TPCs adjacent to a given TPC, as would be needed to follow tracks and showers that cross TPC boundaries
 - Resources: The LArSoft team and (proposed) experiment effort
 - <http://cdcv.s.fnal.gov/redmine/issues/9818> -- requested by DUNE

Note:

- No effort is available to work on Event Display at this time. It is, however, a nagging issue.
- Need someone to lead an analysis on deep learning and integrating Convolutional Neural Networks (CNNs) before initiating this project. LArSoft should be available to consult, but isn't in a position to lead this effort.

Work began in 2016, continuing into 2017

Here are the LArSoft assigned projects actively being worked on:

1. <http://cdcv.s.fnal.gov/redmine/issues/14454> - Refactoring LArG4
2. <http://cdcv.s.fnal.gov/redmine/issues/14047> - Data product review ("phase II")
3. <http://cdcv.s.fnal.gov/redmine/issues/14363> - Support detectors with drift direction different than x axis (ProtoDUNE)
4. <http://cdcv.s.fnal.gov/redmine/issues/11994> - Enable use of Kalman Filter as final fitter
5. <http://cdcv.s.fnal.gov/redmine/issues/12237> - Usability: add facilities for better/easier use of associations
6. <http://cdcv.s.fnal.gov/redmine/issues/14048>- Provide a uniform recommendation for physic vector data structures in LArSoft data products

Other work:

- User support
- Continue to have code analysis
- Continuous architecture improvement
- Yearly workshop. Concurrency - multi-threading and vectorization options

Background (how priorities were set)

Erica and Katherine met with each of the Offline leads in a series of productive meetings that detailed what their plans were for the next year, the implied requirements for LArSoft, and how LArSoft could help, as well as what they might be able to contribute to

LArSoft code. Some items were raised by LArSoft, not a particular experiment. Meetings were held with: Roxanne Guenette, Andrzej Szcel – SBND, Tom Junk – DUNE, Tingjun Yang - ArgoNeuT, Brian Rebel - LArIAT, Wes Ketchum – MicroBoone.

Note, when defining work, we include items that can be done by members of the collaboration. There is a cost associated with making things workable for other experiments, but the benefit is that other experiments develop software that is useable by all experiments. The more this happens, the more all experiments benefit.

Potential Work Items from Offline Leads meetings in December:

1. Want a more stable Event Display with interactive capability. (“Interactive capability” here implies only those that are currently available in the LArSoft event display, which were considered as sufficient for their needs.) All the basic features that are available in Event Display will be available in ParaView such as changes to the viewing configuration and re-drawing the event, re-running some set of modules with possibly modified fcl parameters. There discussed in the past, but that aren’t being planned include features to select hits to be included or excluded from tracks and showers, and writing that result to an output file. (LArIAT)
2. LArSoft will propose re-architecting portions of the reconstruction to follow a design pattern based around the use of common interfaces for layered algorithms and a plug-in infrastructure that allows run-time configuration of a workflow that is internal to art modules. This was used by DUNE for data preparation in 2016. This design of this plug-in infrastructure will be based on the art “tool” concept currently under development . (LArSoft)
3. Better support for NuWro, a lightweight alternative to Genie that doesn’t currently have a UPS product. This support would include at a minimum packaging NuWro as a UPS product that is distributed with the LArSoft suite. A more ambitious level of support would be to provide a direct interface to NuWro within LArSoft, much like GENIEHelper does for GENIE. (Argoneut)
 1. Note: the authors of [NuWro](#) seem to be in agreement on being packaged as a UPS product. Gianluca talked with Jan Sobczyk, one of the authors and they are interested in interacting with LArSoft.
 2. Means having the same compiler as UPS and using libraries common to the Fermilab environment.
 3. To use it within LArSoft, there might need to be additional libraries distributed with UPS.
4. Deep learning and integrating Convolutional Neural Networks (CNNs) into LArSoft is an important issue. The question of how to do this, or identifying a common framework for such an integration needs to be explored. (MicroBooNE)
5. Weekly releases cause work for release managers and users. Investigate ways to reduce the effort required to maintain releases. In particular, determine how various automation tools or the new SPACK-based build system for LArSoft can be used to minimize the workload placed on experiment release managers and users. (DUNE)

6. Improve gallery support with detailed tutorials and examples of how to do complicated things. (MicroBooNE) DUNE also found a lack in the documentation when they looked at it in July of 2016.

Note, working with Marc Paterno, created: <http://art.fnal.gov/gallery/>

1. Marc will be cleaning up the examples so that the GitHub pointed to is clear.
 2. Added links to the gallery information to the LArSoft redmine pages.
7. Would like a list of all the commands that are needed to use LArSoft with short documentation on UPS since people struggle with UPS and MRB and how they work. (SBND)
 1. Note, there is:
https://cdcv.s.fnal.gov/redmine/projects/ups/wiki/Getting_Started_Using_UPS
 2. A link to the above information has been added to LArSoft documentation in several places.
 3. Experiments might want to link to it in their experiment-specific quick start information.
https://cdcv.s.fnal.gov/redmine/projects/larsoft/wiki/Quick_Links
 4. May want to ask for a new alias to get ups list -aK+ more easily, such as ups list -all. Or to have it be able to be configured with a global configuration file. Need to balance backward-compatibility with making it easier to use going forward.
 8. AuxDetGeo living inside Geometry has been deprecated for a long time. LArSoft should remove it completely now. (LArIAT)
Note: this already is a redmine issue. <https://cdcv.s.fnal.gov/redmine/issues/10937>
 9. Shower Reconstruction from MicroBooNE (this is a LArSoft/LArLite Integration task that lives with the experiment. LArSoft has a role in coordinating, but integration not a LArSoft project.) (LArIAT) DUNE has placed in LArSoft a version of shower reconstruction -- BlurredClusterAlgorithm and EMShower.

Other topics under consideration to work on include the list of accepted, but not assigned, redmine issues. (Next time will include items assigned, but no time for, as well.) These issues originated from a combination of problems identified by the experiments and those identified by the core LArSoft team.

1. <https://cdcv.s.fnal.gov/redmine/issues/13711> Concurrency: Explore multi-threading and vectorization options
2. <https://cdcv.s.fnal.gov/redmine/issues/9818> Add knowledge of TPC topology in GeometryCore
3. <https://cdcv.s.fnal.gov/redmine/issues/12778> LArSoft needs an error handling policy -
4. <https://cdcv.s.fnal.gov/redmine/issues/13563> Obsolete LArSoft code -
5. <https://cdcv.s.fnal.gov/redmine/issues/12785> review typedef cryo_tpc_view_hitmap -

6. <https://cdcv.s.fnal.gov/redmine/issues/12602> Add a compact representation for the plane ID, TPC ID and cryostat ID -
7. <https://cdcv.s.fnal.gov/redmine/issues/12785> - review typedef cryo_tpc_view_hitmap
8. <https://cdcv.s.fnal.gov/redmine/issues/11872> - Establish a standard way to represent particle identification results
9. <https://cdcv.s.fnal.gov/redmine/issues/11871> - Decay products in pandora do not start from the same vertex, while Projection Matching Algorithm's do
10. <https://cdcv.s.fnal.gov/redmine/issues/11066> - Load geometry from ROOT file instead of GDML file
11. <https://cdcv.s.fnal.gov/redmine/issues/10937> - Remove references to AuxDetGeo objects from Geometry service and related classes
12. <https://cdcv.s.fnal.gov/redmine/issues/9818> - Add knowledge of TPC topology in GeometryCore

Topic for discussion

Infrastructure that benefits a lot of people could be the target for collaboration effort. This may be a big thing that needs lots of people, or it could be smaller but the core project can't develop it, so experiments need to contribute. Discuss how experiments might contribute on things that have broad application or impact across the community, but that are not typically or easily pursued by any single experiment.