



LArSoft Work Plan for 2018

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Background

This document records the LArSoft work plan for 2018 as of December, 2017. Progress on specific items going forward will be recorded in redmine issues.

Erica and Katherine discussed 2018 priorities with the Offline leads starting in October and through November. The experiments 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. 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.

Short-term priorities; happening concurrently

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

1. Investigate having a new Event Display framework common to all experiments. Some important features:
 - a. Provides a simple, intuitive means to navigate through large events and multi-TPC detectors.
 - b. Ability to zoom and pan with a data density that matches the screen resolution.

- c. Provides basic interfaces to art for controlling runs and events, the geometry service, run conditions services. Re-running reconstruction workflows and displaying the result should be possible.

This work does not cover development of drawing routines. It is expected that the core event display users within the experiments will provide this code. Arrangements for this follow-on work will be part of this project.

Resources: ?? + pre-arranged people from the experiments

2. Pixel-detectors within LArSoft. The simulation moves to LArG4 phase 2. The reconstruction piece has two possible scenarios.
 - a. Pattern recognition algorithms shared between pixel and SP/DP LArTPCs. This requires agreeing on a common data format to represent 3D data, whether obtained directly from a pixel detector, or inferred from 2D views in SP/DP detectors. There will likely be implications for the geometry interface, which will then need to support both conventional and pixel-based detectors. Some study will be needed to determine whether these constraints can be met. If code is shared, then support for the development of those algorithms will also be needed.
 - b. No sharing of pattern recognition algorithms between pixel and conventional SP/DP LArTPCs. The code bases in this case diverge, so no further work is required aside from the normal support for data product, service and algorithm development.

Resources: ??

3. Use of SIMD vectorization to optimize LArSoft algorithms. Introduce vectorized types to redesign some existing LArSoft data structures and modify existing algorithms, with the goal of exploiting vectorization opportunities to significantly improve performance of existing LArSoft algorithms. This project involves profiling real use case scenarios, redesigning data structures and applying changes to the most performance-critical algorithms, documenting performance comparisons and other studies, preparing reports and writing documentation as needed. <https://cdcv.sfnal.gov/redmine/issues/17920>
 - a. Addresses in part the 2017 long-term priority on concurrency

Resources: Guilherme Lima

4. Optimization / profiling work. Profile production LArSoft workflows to identify problem areas and potential solutions. This work includes:
 - a. setting up an application to run LArSoft
 - b. identifying a major production workflow that will be the target of the profiling work
 - c. preliminary profiling of LArSoft applications, looking for opportunities for optimization if provided

- d. promoting ease of use for profiling tools. --
<https://cdcv.sfnal.gov/redmine/issues/17921>

Resources: Soon Jun

- 5. Error handling policy for LArSoft. The policy should also prescribe what common conditions constitute an “error” versus a “warning”, etc. An education campaign will then be needed to disseminate this information.
<https://cdcv.sfnal.gov/redmine/issues/12778>
 - a. Resources: Katherine Lato, Erica Snider, ??
- 6. Introduce support for global wire coordinates. The requirements for this work are documented in <https://cdcv.sfnal.gov/redmine/issues/11522>. At present, DUNE has implemented an ad hoc solution to provide global wire coordinate functionality. This project will provide a native LArSoft solution.
 - a. Addresses in part the 2017 long-term priority of the TPC / locality interface and optimization in the Geometry service.

Resources:

- 7. Architecture-dependent libraries. Support is needed to allow coexisting builds that include / exclude, support for different computing backends under a given OS flavor.
 - a. An immediate goal will be to allow the standard setup procedure to support a generic library as well as one built with avx2, or other vectorization technologies
 - b. More generally, there are a number of areas that might benefit from this feature, such as allowing use of GPU backends when available, or selecting the optimal SIMD instruction set for a given computing node. The types of backend support required needs to be studied, and appropriate tools adapted or developed to allow the required setup procedures.

Resources: ??

- 8. LArG4 re-factoring work.
 - Phase 1: Continuing with existing plan to deliver equivalent functionality to the current code, but re-structured so as to de-couple various models from LArG4 and, where possible, from Geant4, and to expose the result of energy deposition by Geant4, and more generally by upstream particle interaction simulation.
 - Phase 2: Abstract the anode simulation model, which is required to handle conventional single-phase, dual-phase, and pixel based detectors within the common framework.

Resources: Hans Wenzel and William Seligman for phase 1.

- 9. SPACK - new build system for art and LArSoft (deferred from 2017).
Purpose:

- a. To migrate to a standard set of build tools that have broad community support
- b. To address portability and configurability issues raised by experiments with the current build system
- c. To allow continued full support of Mac OSX as a LArSoft development platform within the context of Apple's System Integrity Protection system

Resources: Chris Green <http://cdcv.sfnal.gov/redmine/issues/15313>

Longer-term priorities

We welcome input from the Steering Group to help shape the long-term priorities of LArSoft.

A) Concurrency -

- Purpose: To use multi-threading to address memory usage issues and provide flexibility in resource utilization - working with art on this, starting with understanding thread safety issues in the LArSoft use cases for art services.
- To introduce vectorization to those components of the code where speed improvements could be obtained, and to make use of currently unutilized resources - see short-term item above
- Resources: LArSoft team and (proposed) experiment effort

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

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.sfnal.gov/redmine/issues/9818> -- requested by DUNE
- 11/15/17 - asking DUNE for priority call on this.

Other topics under consideration to work on include the list of accepted, but not assigned, redmine issues.

These can be found under [accepted redmine issues](#).

