LArSoft Work Plan for 2017

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Background

This material is for the 8/31/17 Steering Committee meeting with monthly status indicated after each major item.

Short-term priorities; 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
o Resources: GEANT4 team: Hans Wenzel and Krzysztof Genser
http://cdcvs.fnal.gov/redmine/issues/14454 - 2/2/17 - 48 done /170 total hours
3/2/17 - 90/170
3/30/17 - worked on putting changes into GEANT4, need to test those.
4/27/17 - 124/170
6/1/17 - 124/170
6/27/17 - 148/230
7/27/17 - The original plan was to incrementally replace parts of the LArG4 code with the updated Geant 4 functionality and interfaces. But it looks like it is easier to do a full replacement. This has affected the work and schedule.
8/29/17 - 163/230, Have meeting scheduled on 8/31 to discuss this.

2. Track fitting / data product improvements - phase II
o 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
o Resources: LArSoft team: Giuseppe Cerati, Gianluca Petrillo, Erica Snider
o http://cdcvs.fnal.gov/redmine/issues/14047-
2/2/17 - 70 done / 400 total hours
3/2/17 - 130/440
4/27/17 - 130/440 - working on other things (like ProtoDUNE/ICARUS integration)
6/1/17 - 130/440 - still working on other things and vacation-time.
6/27/17- 130/440 - scheduled a meeting Giuseppe, Gianluca, Erica to discuss what should happen with this.
7/27/17 - July meeting determined to return to the original scope for phase II on the tracking, instead of trying to capture parts of phase III in this earlier work.
8/2/17 - Discussion with Erica, Gianluca and Katherine where we descoped or moved all phase 3 work that had slipped into the phase 2 work plan, and some non-track work, due to lack of resources.
   1. We rejected (without prejudice, we just don't have the resources in LArSoft to do this) the following tasks:
a.   https://cdcvs.fnal.gov/redmine/issues/14061 - Provide an interface to access a complete reconstruction of the event
b.   https://cdcvs.fnal.gov/redmine/issues/14265 - Provide an interface for access of reconstructed cluster information
   2. We moved phase 3 work into a new milestone - https://cdcvs.fnal.gov/redmine/issues/17338 - Phase 3 Tracking Data Product with a couple of subtasks.
   3. Left with 200 hours as part of 14047. Phase 2 focuses on making it easy to navigate information associated to tracks where the associated data products are a direct product of the pattern recognition.
8/29/17 - 110/200

3. DONE - ProtoDUNE / ICARUS integration
o 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
       o http://cdcvs.fnal.gov/redmine/issues/15086- 2/2/17 - not estimated yet,
       3/2/17 - subtasks added,
       4/27/17 9/12
       6/1/17 still 9/12
       6/27/17 - subtasks are done

Also, ProtoDUNE work -
https://cdcvs.fnal.gov/redmine/issues/14363 + other work
   • 4/27/17 112/130 (Note, estimate doesn't include Robert Sulej's work)
   • 6/1/17 112/130

- 6/27/17 - 136/136 - from the LArSoft core team. Note, there are tasks in this milestone for ProtoDUNE people to work on. These are not being estimated nor tracked by LArSoft. There may be work to support their efforts on demand. This is like other work and is tracked as it comes up.
- DONE (for LArSoft)

ICARUS work -
https://cdcvs.fnal.gov/redmine/issues/16031
4/27/17 - 8/12 hours
6/1/17 - 8/12 hours
6/27/17 - 8/12 done

Total work + lots of meetings between LArSoft people & ICARUS people. Expect estimate of effort to increase.
4/27/17 - 129/154 estimated. Estimate may still increase as full scope of work is understood, but not necessarily.
6/1/17 - in-depth conversation in person to further understanding and ran tests with Tracy Usher
6/27/17 - don't believe they are waiting for anything from the LArSoft core team at this point.
7/6/17 - requested input on https://cdcvs.fnal.gov/redmine/issues/15086 by end of July.
    8/2/17 - No reply, so marked it resolved.

4. SPACK - new build system for *art* and LArSoft
o 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
o Resources: Jim Amundson, Patrick Gartung, Lynn Garren
o http://cdcvs.fnal.gov/redmine/issues/15313 - 2/2/17 - no estimate of hours, nor by 3/30, nor by 4/27, promised by early May, still no estimate by 6/1/17
6/27/17 Not estimated, running late.
8/30/17 Not estimated, running late, but assigned to Chris Green, expect a plan in early September.

5.   Ongoing Documentation improvements such as a training page, updates to wiki pages, new LArSoft notes
o Purpose: Keep the LArSoft Collaboration aware of changes in tools and process. Highlight information produced within LArSoft Collaboration.
o Resources: Katherine Lato
o Various redmine issues throughout the year. 40 -120 hours
o As an example: http://cdcvs.fnal.gov/redmine/issues/14691 - LArSoft notes for January
3/2/17 - 9 hours done, extra hour to update redmine pages related.
3/2/17 - drafted LArSoft notes for March. https://cdcvs.fnal.gov/redmine/issues/15716
    4/3/17 - https://cdcvs.fnal.gov/redmine/issues/15716 - 9 hours total done
4/3/17 - https://cdcvs.fnal.gov/redmine/issues/15816 - New document on Geometry (6/23 hours)
    4/27/17 - 17/35 hours (new estimate, involving Erica & Gianluca)
    6/1/17 - 29/40
    6/27/17 - 29/40 - Tom Junk is reviewing material.
    8/24/17 - 40/40 - done
https://cdcvs.fnal.gov/redmine/projects/larsoft/wiki/Geometry_Package

6/22/17 - new LArSoft notes on workshop with videos
   6/27/17 - 12 out of 21 hours done
   8/3/17 - 21 out of 21 hours done https://cdcvs.fnal.gov/redmine/issues/16933

6. DONE Packaging NuWro. Note, a helper like GENIEhelper might require a fair amount of work and is probably not within the effort LArSoft has available.
o 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.
o Resources: LArSoft code management: Lynn Garren
https://cdcvs.fnal.gov/redmine/issues/15448
o 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.
3/2/17 - 8 / 8 - done (no further updates on this item)

7. CI improvements
o 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
o Resources: Vito Di Benedetto and experiment contacts for the CI tests
o http://cdcvs.fnal.gov/redmine/issues/15125 - `done`
o http://cdcvs.fnal.gov/redmine/issues/15124 - in progress
3/2/17 - Have related tasks assigned. Anna tracking details.
4/3/17 - done with 15125
4/26/17 - ⅗ out of 15124 related task, one done, but may be another one.
6/1/17 - no estimate on second subtask in CI system. (Vito tracking.)
6/27/17 - Two subtasks in the CI system are being tracked for this item. Are at 8 hours out of 25 for both of them. (One is mostly done, the second hasn't been started.)
7/27/17 - 10/25 done.
8/17/17 - work was required to get a more stable grid support. This work was not done in the LAr CI, but in the general CI infrastructure. Now the grid support is mature enough to start to implement the functionality.
8/29/17 - this remains not finished, 10/25 hours done.

Longer-term priorities

A. Concurrency -
  o 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
  o 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. - 7/6/17 update -- There was a session on concurrency at the 6/20/17 LArSoft Workshop. Slides and video are available at: http://larsoft.org/larsoft-workshop-on-tools-and-technologies/
- 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 based around the art "tool". This is primarily about agreeing what certain interfaces look like.
  - 6/1/17 - There are efforts within DUNE and MicroBooNE to implement this strategy. See David Adams presentation on tool interfaces -- https://indico.fnal.gov/conferenceDisplay.py?confId=14491 that occurred at the LArSoft Coordination Meeting. There is a MicroBooNE one as well. LArSoft needs to get involved to ensure there is an accord across the project on interface definitions.

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://cdcvs.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.
- 8/29/17 update - Paraview work has been experimental, not supported by SCD. (They don't support any event display.) Someone worked over the on a Paraview driver in Geant, much faster, almost done. Last summer's work laid the groundwork. But won't get additional effort for that. Need someone from an experiment to take it on.

Work began in 2016, continuing into 2017

Here are the LArSoft assigned projects actively being worked on:
1. http://cdcvs.fnal.gov/redmine/issues/14454 - Refactoring LArG4 - covered in item 1 above

2.	http://cdcvs.fnal.gov/redmine/issues/14047 - Data product review ("phase II") - covered in item 2 above
3.	http://cdcvs.fnal.gov/redmine/issues/14363 - Support detectors with drift direction different than x axis (ProtoDUNE)
	6/1/17 update - 112
	8/29/17 update - 136 hours spent by Gianluca, more tasks assigned (to non-LArSoft core team members) for this work.
4.	http://cdcvs.fnal.gov/redmine/issues/11994 - Enable use of Kalman Filter as final fitter
	As of 3/30/17 What is left is to provide the documentation needed.
	Still to do as of 8/29/17.
5.	http://cdcvs.fnal.gov/redmine/issues/12237 - Usability: add facilities for better/easier use of associations

6.	http://cdcvs.fnal.gov/redmine/issues/14048- Provide a uniform recommendation for physic vector data structures in LArSoft data products - part of item 2 above

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

Other Topics

Other topics under consideration to work on include the list of accepted, but not assigned, redmine issues. These issues originated from a combination of problems identified by the experiments and those identified by the core LArSoft team.
1.	https://cdcvs.fnal.gov/redmine/issues/13711 Concurrency: Explore multi-threading and vectorization options - assigned to Erica on 2/20/17 - part of long term priorities.
2.	https://cdcvs.fnal.gov/redmine/issues/9818 Add knowledge of TPC topology in GeometryCore - Assigned to Gianluca, and made a milestone
3.	https://cdcvs.fnal.gov/redmine/issues/12778 LArSoft needs an error handling policy - Assigned to Katherine, starting work on this.
4.	https://cdcvs.fnal.gov/redmine/issues/13563 Obsolete LArSoft code -
5.	https://cdcvs.fnal.gov/redmine/issues/12785 review typedef cryo_tpc_view_hitmap -
6.	https://cdcvs.fnal.gov/redmine/issues/12602 Add a compact representation for the plane ID, TPC ID and cryostat ID -
8.	https://cdcvs.fnal.gov/redmine/issues/11872 - Establish a standard way to represent particle identification results
9.	https://cdcvs.fnal.gov/redmine/issues/11871 - Decay products in pandora do not start from the same vertex, while Projection Matching Algorithm's do
10.	https://cdcvs.fnal.gov/redmine/issues/11066 - Load geometry from ROOT file instead of GDML file
11.	https://cdcvs.fnal.gov/redmine/issues/10937 - Remove references to AuxDetGeo objects from Geometry service and related classes - assigned to Saba

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.