This is a draft.

If you see stuff that

looks like this

it's something to be addressed.



BNL Report

Brett Viren

Physics Department

BROOKHAVEN NATIONAL LABORATORY

LBNE S&C Review
May 14, 2014

Outline

Introduction

BNL Progress in LBNE Software and Computing

BNL Future Software and Computing Plans

Support and Infrastructure for LBNE at BNL

Summary

Introduction

BNL feels that a dependable and useful Software and Computing (*S&C*) base is critical to successfully performing a modern High Energy Physics experiment in general and for LBNE in particular.

A major element for success is to assure the LBNE *S&C* foundation enables and supports collaborating University and Lab scientists to access experiment data, make use of and contribute to the software and ultimately perform Physics analyses.

Our strategy is to provide organizational and technical leadership to identify missing or problematic aspects of LBNE *S&C* and, in collaboration, provide effort to develop solutions.

BNL has experienced scientists and computing professionals that have contributed to the *S&C* effort of other HEP that have been recognized by the DOE as exemplary.

need reference to bolton's presentation stating this about ATLAS and Daya Bay

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Progress - Organization

D. Adams Recently joined LBNE, primary author and editor for BNL Report document for this review, expertise in reconstruction and analysis tools in ATLAS.

M. Potekhin LBNE Software & Computing (*S&C*) Organization co-coordinator, co-developed organizational structure for *S&C*, developed LBNE *S&C* requirements document, expertise in distributed processing and geometry information systems.

B. Viren past WCD L3 Computing project manager, current co-coordinator of the Software Infrastructure and the Collaborative Tools *S&C* groups, developed LBNE *S&C* requirements document, member of the Continuous Integration working group. Expertise in software building, geometry, s/w frameworks, simulation, reconstruction, data model.

Progress - Software Infrastructure

- Provided an easy to use method of installing LBNE software at all institutions (*worch*, as described this morning)
- Collaborated with Fermilab to introduce using *worch* to improve how they build inter-experiment, shared software packages.
- Began to define and enact procedures to produce organized releases of LBNE software suites.
- Identified the need for a continuous integration system for LBNE and worked with Fermilab to develop a common system (as described earlier).
- Provided support to all LBNE software suites for build and installation, repository management and migration.
- Developed an automated document build system for the book "LBNE, Exploring Fundamental Symmetries of the Universe" which will simplify production of all future publications.

Progress - Sim/Reco/Ana

- BNL led the oscillation physics group and systematic task force, and
- Led the Beam Simulations group up to 2012,
- Performed important Physics studies for LBNE reconfiguration, for Snowmass, P5 and LBNE publications,
- Simulated the impact of different beam configurations, proton energy, decay pipe geometry,
- Carried these studies forward to demonstrate how they improve mass hierarchy and CP violation sensitivity, and
- Pushed for and got improved beamline design changes based on them.
- BNL performed baseline studies showing 1300km is optimal for CPV and
- Produced rigorous mathematical analysis and toy MC study of the proper statistics for mass-hierarchy sensitivity.
- BNL used 35t detector simulations for cosmic muon trigger design optimizations.
- BNL hosted two long term students from UK and Italy who did background studies for the surface detector option. On study is the subject of a UK Ph.D.
- BNL developed an innovative event display allowing a more intuitive understanding of interactions in LAr.

Do I try to put names here?

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Overview of BNL Plans for LBNE *S&C*

- Provide organizational and technical leadership.
- Facilitate access to LBNE software and data by all collaborators so that they may easily contribution to software development and data analysis.
- In collaboration with all of LBNE, identify gaps in our *S&C* foundation, develop solutions and provide implementation effort where it matches our expertise.

Major areas of effort:

- Reconstruction and simulation
- Physics software support
- Software installation and release management
- Distributed production and data distribution
- Contribute to the organization of the global *S&C* effort.

Our strategy for collaborating on significant new initiatives:

1. Document requirements with input from subject experts.
2. Propose solution to address requirements, gain collaboration acceptance.
3. Implement design and integrate with existing software or systems.

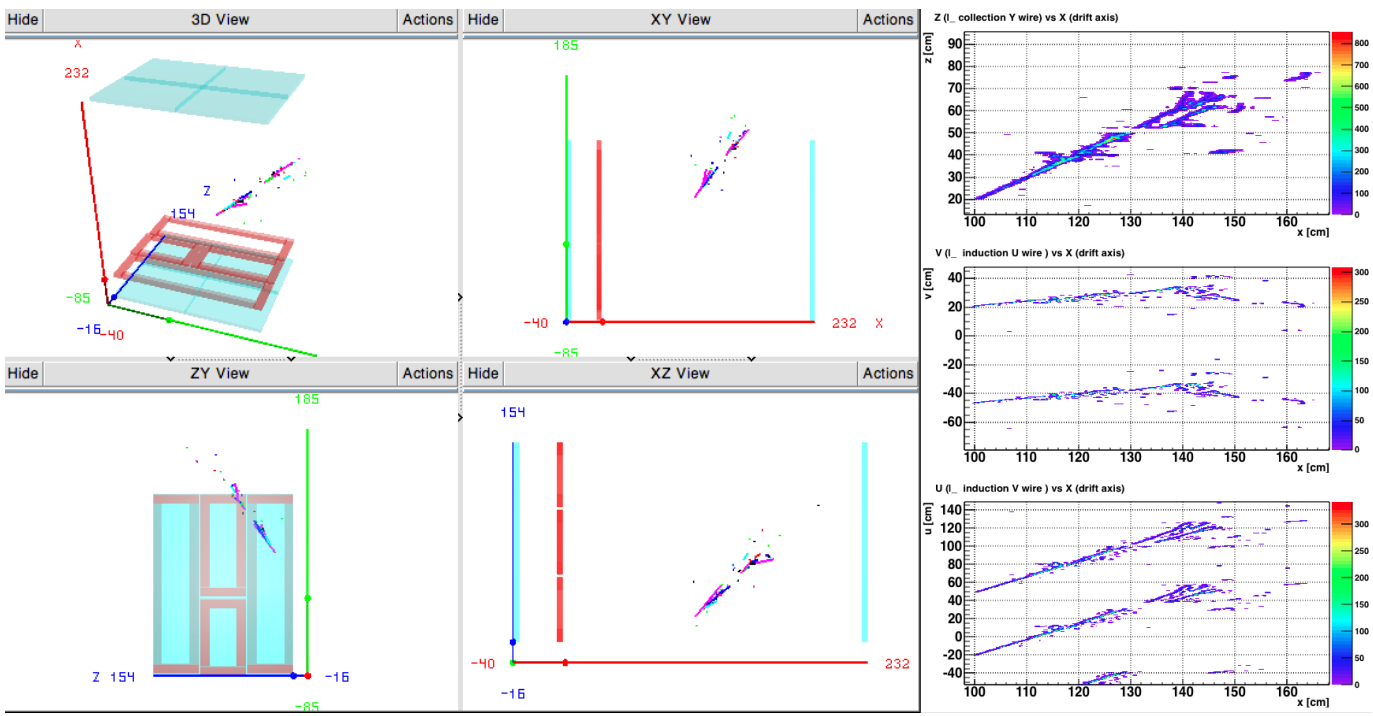
Is this needed here, kind of repeats the first bullets?

Reconstruction and simulation

- Leverage commonalities with BNL involvement in MicroBooNE (eg, both share LArSoft)
- Work on simulation of TPC and its electronics

  Get something for Craig's electron drift measurement?

- Analyze 35t prototype data and fold results into the LAr detector simulation.
- Further develop of the BNL event display.



Physics Software Support - Architecture

BNL has expertise in developing the architecture for successful HEP analysis software. With that we plan to:

framework evaluate existing FD sim/reco framework on its own and in light of expanding the scope to encompass ND and to satisfy full-experiment, long-term requirements.

tools design and implement interfaces to required services including event data, geometry information and databases. These will be framework/application-independent, will take into account current usage patterns and will allow their smooth inter-application operation.

data model evaluate existing data representations, design and propose optimization, work with DAQ/online to design "raw" data representation starting with the 35t prototype. Coordinate this work with other efforts in this area (eg, ANL metadata, LBNL & BNL data distribution, SLAC DAQ/online).

Physics Software Support - Unified Geometry

BNL will produce a unified geometry information management system for use by all LBNE simulation and reconstruction applications and modules.

- Currently:
  - each application does it's own thing
  - mostly Geant4 C++ hard-code, some GDML
  - lack of rich visualization and validation coverage
  - little version control and provenance information
- Will leverage experience from ATLAS and Daya Bay in established (AGDD, VGM, GDML, DetDesc, ROOT) and custom designed systems.
- Develop requirements and design to address these problems
- Develop implementation and user interfaces
- Develop plan for converting existing geometry information and integrating new service in to existing applications.
  - BNL will take on much of this integration effort and
  - Work with application experts to assure smooth integration.

Code management

- Continue maintenance of *worch* and extend it to automate the building and installation of all LBNE software suites.
- Integrate build and validation jobs into the Fermilab continuous integration system.
- Continue collaborating with Warwick University in developing an improved native build system for packages based on *art* so that they can be easily built by all collaborators and work with the *art* team and other packages developers to integrate the build system in their future development.
- Continue to develop and enact release management procedures and tools for all LBNE software suites.

Distributed computing

A critical piece of the BNL strategy is to assure that the collaboration has access to the data and to the necessary computing resources to process and analyze it.

Leveraging experience at BNL we plan to work on these aspects:

processing Evaluate existing distributed processing solutions (such as PanDA), deploy and evaluate prototypes running LBNE jobs, select a solution and develop infrastructure needed integrate it into LBNE use.

data Evaluate the use of *xrootd* to provide to the collaboration on-demand, low-latency and high-throughput access of LBNE data. BNL's computing facility (RACF) will be used as a host for evaluating this system. We will stage a modest disk server hardware upgrade to support this. This work will be coordinated with the other, complementary data management efforts proposed by LBNL.

monitoring Experience in ATLAS and other experiments has demonstrated that monitoring the operation of such systems is critically important and BNL will develop a system to do this. This monitoring system will be part of a cohesive experiment-wide monitoring strategy.

Organization

The LBNE collaboration spans the globe. Significant effort is needed to assure that *S&C* activities are coordinated in an efficient and productive manner. This coordination is often a thankless task but it is crucial for success.

BNL plans to leverage its substantial experience in software and computing organization to continue its effort to contribute to this coordination:

- BNL will continue to provide one of the two LBNE software and computing co-coordinators.
  add details of what the coordinator will do?
- In collaboration, BNL will lead the development of the LBNE Computing Model and LBNE Computing Implementation documents.

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Support and Infrastructure

Beyond its LBNE group, Brookhaven National Lab provides strong support and infrastructure for LBNE *S&C*.

- Home to many ATLAS, Daya Bay and RHIC computing experts from which LBNE may draw expertise.
- In particular, the Physics Application Software group has considerable experience in *S&C* in general and distributed computing in particular as well as in *S&C* management.
- The RHIC/ATLAS Computing Facility is a world-leading, efficient and powerful center which supports LBNE in a very cost-effective way, has $\sim$ 24K-cores in $\sim$ 2K-nodes with 11 PB spinning disk and a high-throughput, mass storage system (HPSS).
- The Brookhaven lab network provides a low-latency, high bandwidth network connection of 100 Gbps physically near NYC, a major national and international hub. It has experience in making use of this bandwidth for high-throughput transfers as an ATLAS Tier 1 site and host to the data-intensive RHIC experiments.
- The BNL/LBNE research group hosts long-term and summer students from the US and abroad as well as other visitors.

Summary

BNL has made significant progress in the area of LBNE *S&C*:

- Developed an easy to use, flexible, automated software installation tool
- Assisted LBNE software projects with s/w building and release mgt
- Developed and applied simulation, reconstruction and analysis software
- Organized the *S&C* efforts on multiple levels

BNL has a strategy and plans for continued support of the collaboration through *S&C* by exploiting BNL expertise:

- Continue key contributions to simulation, reconstruction and analysis
- Develop architecture to support collaborative and integrated use of existing frameworks and applications, tools to provide easy access to data services and to further develop the data model.
- Produce a geometry information management system that is used in a unified manner by all LBNE software suites so that the collaboration can assure geometry validity and provenance.
- Continue supporting the use and development of LBNE software by all collaborators at their institution through automated software installation systems and organized release management.
- Develop distributed process and data distribution systems and their monitoring to enable all collaborators access to the data and the means by which it can be analyzed.