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# **Summary of LAr TPC Reconstruction Assessment and Requirements Workshops**

Ornella Palamara – Ruth Pordes

LBNC meeting

23 October 2015

# Coordination on LAr TPC reconstruction

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- LBNC met with SBN, DUNE and LArIAT spokespersons in early Sept
  - Discussed steps to achieve greater coordination on automated LAr reconstruction, starting with an **assessment workshop** in October leading to development of a longer-term strategy
  - Contiguous to a **LAr TPC framework requirements workshop** jointly sponsored by the SBN/DUNE collaborations and Fermilab computing division
  - Workshops will involve all the stakeholders

# LAr TPC Reconstruction Assessment and Requirements Workshops

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- Held on Oct. 19-20 at Fermilab
- Organized by the LArSoft Steering Group/Collaboration – spokespeople of most LArTPC experiments, ND and SCD heads, LArSoft leads
- Very good attendance. ~40 attendees locally, 8 attendees remotely, 63 on the mail list. MicroBooNE, ICARUS, SBND, LArIAT, DUNE – including ProtoDUNE, WA105, 35ton – , CERN Neutrino Platform, Scientific Computing Division
- <https://indico.fnal.gov/conferenceDisplay.py?confId=10394>









# Reconstruction Assessment Workshop - Goal

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- Goal to assess the current status of LAr TPC event reconstruction and analysis solutions - including human, process and software components.
  - Presentations from experiments that have taken or are taking data on the status of their reconstruction and analysis, including the **challenges** and **lessons learned** that will be informative to current and future experiments.
  - Presentation from selected software providers.

# Reconstruction Assessment Workshop - Agenda

Monday, October 19, 2015

- 09:00 - 12:30 Reconstruction Assessment  
Convener: Dr. Ornella Palamara (Fermilab)
- 09:00 **Introductory Remarks** 10'  
Speaker: Dr. David MacFarlane (SLAC National Accelerator Lab)  
Material: [Slides](#) 
- 09:10 **ArgoNeUT** 30'  
Speaker: Tingjun Yang (FNAL)  
Material: [Slides](#) 
- 09:40 **Icarus (LNGS)** 30'  
Speaker: Christian Farnese (INFN)  
Material: [Slides](#) 
- 10:10 **MicroBooNE** 30'  
Speaker: Tracy Usher (SLAC)  
Material: [Slides](#) 
- 10:40 **LArIAT** 30'  
Speaker: Jennifer Raaf (Fermilab)  
Material: [Slides](#) 
- 11:10 **Break** 30'
- 11:40 **Pandora software** 30'  
Speaker: Prof. Mark Thomson (University of Cambridge)  
Material: [Slides](#) 
- 12:10 **LArSoft software** 20'  
Speaker: Dr. Erica Snider (Fermilab)  
Material: [Slides](#) 
- 12:30 - 14:00 Lunch
- 14:00 - 15:00 Discussion  
Material: [slides](#) 

# Reconstruction Assessment Workshop - Summary

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- Very good participation across the collaborations.
- Very informative presentations.
  - Reconstruction of events in LAr-TPCs is challenging since the fine-grained tracking and calorimetric aspects of LAr-TPCs provide a large amount of information on each neutrino event. Taking full advantage of this information requires a precise, efficient, and automated event selection and reconstruction package.
  - ICARUS collaboration has a legacy data analysis and reconstruction framework.
  - Reconstruction algorithms developed by all the other collaborations are in the LArSoft framework, that provides a common infrastructure for sharing physics code across Liquid Argon TPC experiments.
- **Common reconstruction and analysis framework** is the first step for interconnections/synergies and effective use of resources between different collaborations and it is crucial for the joint analysis of the three SBN LAr TPC experiments.

## LBNC request post the reconstruction workshop

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- Ambitious: will take time and effort beyond these two days!
- A comprehensive summary of the current status of and future plans for further development of automated reconstruction efforts:
  - Basic physics information, such as event classes and topologies, backgrounds for each experiment, performance requirements, etc.;
  - Current state-of-the-art, including quantified performance of the reconstruction;
  - Leadership for the current effort and the level of effort across the collaboration;
  - Degree to which the effort relies on common software tools, such as analysis framework development, etc. and their further development;

# LBNC request post the reconstruction workshop

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- Timeline, milestones, deliverables and level of effort required for further development;
  - Linkages to hardware system development and experience with neutrino and test beam data
  - Assessment of areas of commonality with other SBN or LBN experiments; and
  - Assessment of resource limitations and impact of bringing additional targeted help, either from Fermilab or in cooperation with other science collaborations.
- Workshop should consider mechanisms for sharing the results of development progress on a more continuous basis
    - e.g., though an ongoing joint steering committee, a regular forum for exchange on development progress, and/or future more extensive workshop devoted to LAr reconstruction



# Action items after the assessment workshop

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- Answer to LBNC questions
  - Write a document to describe current performances and strategy for flagship analyses reviewed by all the stakeholders
    - Reconstruct event classes relevant to the different experiments with adequate precision. (ex.  $\nu_e$  appearance analysis: electron ID and neutrino energy reconstruction)
  - names organizing/leading this will be provided by each collaboration early next week
- Sharing of the results on a continuous base. Mechanism to be decided.

# Requirements Workshop

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- Goal to write **Requirements** for LArTPC reconstruction software, computing hardware, and human interaction (ecosystem)
- Start from **Use Cases** and from them derive the appropriately scoped requirements

## Outcomes and Next Steps

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- Complete the document, reviewed by all attendees, signed off by the LArSoft Steering Group/Collaboration, by November 26<sup>th</sup> (Thanksgiving)
- Follow with an initial Plan for Implementation based on requirements including resources needed
- Head of LBNC will organize request/charge to the LArSoft Collaboration for an external Review of architecture and code, to meet the requirements, for early 2016
  - Outcome of review will be used by experiments to determine their adoption of LArsoft framework for the near/medium term
  - Identify areas where things can be improved and an estimate of the resources.