

Committee Report on LArIAT Mini Review

January 11, 2013

A mini-review of the proposed Liquid Argon TPC in A Test beam (LArIAT) was held on December 20, 2012 at the request of Fermilab Office of Program Planning. The committee review and our comments relate only to Phase I of LArIAT, denoted as LArIAT-I. The charge to the committee, committee members and review agenda appear in the appendices of this document. The committee heard two well-constructed and sound talks - one on the motivations and other addressing the proposed technical implementation, cost, schedule and risks. The quality of the talks and the strength (and enthusiasm) of the collaboration were impressive.

Given the large investments that the U.S. is making in neutrino and dark matter programs that depend on LAr TPC technology we consider LArIAT-I to be a very worthwhile investment. The Phase 1 plan use of the ArgoNeut detector and the tertiary beamline developed for MINERvA testbeam are logical choices. The biggest concern for the reviewers is the schedule risk presented by the need for engineering resources for the cryogenic system. For LArIAT-I to be successful, the cryogenic engineering and technical resources that are in short supply due to many concurrent projects in PPD need to be identified quickly. Work on the cryogenic design needs to start by the beginning of April for LArIAT-I to operate before the end of calendar 2013.

Specific responses to the charge questions:

1. Are the goals well defined, attainable, and worthwhile?

The review committee was charged with addressing only Phase 1 of the two stage LArIAT program. The aim of phase 1 is to understand the behavior of individual particles of different types at energies appropriate for MicroBooNE and LBNE, using the ArgoNeut detector. This will be the first comprehensive exposure of the LArTPC technology to particles of a known energy. Such an exposure is a logical step and timely for any new particle detection technology, particularly one which provides such a large amount of information per track. There is a growing interest in LAr TPC both for neutrino experiments and for DM experiments. Having clean, unambiguous data as the basis for simulations is important for effective use of the investments in those experiments.

The stated goals for Phase 1 are well defined, attainable, and worthwhile. We believe that the exposure is bound to reveal unexpected or unrealized aspects of the performance of the LArTPC. The goals for phase I are based on the premise that phase II will occur on an appropriate time-scale. We would encourage the collaboration to consider what further could be achieved in phase I.

ArgoNeut has operated and produced results and one can be reasonably confident that it will perform in the test beam. Still operation of high purity systems with low noise electronics is not trivial and one should not underestimate the need for the right expertise. The collaboration is strong and clearly has the right expertise. A worry is that there will be conflicting calls on the experts resulting in some delays relative to the schedule shown.

2. Is the technical approach for beam and experiment sound?

The overall approach, using the beam line constructed for MINERvA and the existing ArgoNeut detector, is appropriate for this first phase. There have been problems with the slow spill beam duty factor and the Accelerator Division needs to ensure that the spill quality is reasonable.

The approach for the detector, including use of cold electronics with a range of pulse-shape times, is sensible. The measurements that one can obtain from such a system will go a long way to obtaining most of the information that is needed to validate larger TPC designs. The system could also be used in the future to test alternative TPC readout systems as well as wire geometries.

3. Are the collaboration and laboratory resources needed to succeed with LArIAT well understood, and are the requested resources adequate?

The LArIAT-I proponents identified the work required and provided credible resource estimates based on the considerable and growing experience of LArTPC projects at the laboratory. Two alternatives for the cryogenic system were described: i) designing a new system for liquid recirculation and filtration like LAPD and MicroBOONE or ii) a fallback of reusing the ArgoNeut gas phase filtration system with modifications to improve filtration and to fit in the MCenter building. A preliminary estimate of the required engineering and technical labor for the full new system has been made but a more detailed estimate is not available due to a shortage of engineering resources. No estimate of the resources required for reuse of the old system has been made but it is assumed to be smaller. Based on the history of difficulties in maintaining electron lifetime during previous ArgoNeut operation, we recommend pursuing the LArIAT plan for a new liquid recirculation system. If this cannot be completed in a timely fashion and the fallback option is pursued, a careful analysis of filtration improvements should be carried out.

We note that MCenter is a “green field” site with regard to cryogenic infrastructure so the scope of work necessary to implement a new cryogenic system is large. The question of whether a liquid recirculation and purification system is implemented is primarily a question of the availability of appropriate engineering and technical resources rather than cost. As such, the decision whether to adopt such a system will be based on schedule. It is important that a realistic schedule for the development of LArIAT be used

when making this decision. The collaboration will then have to balance the risk of a delay to the start up with the benefit expected from the new cryogenics system.

The collaboration is adequate and, as mentioned, enthusiastic for this opportunity to work on a new technology in a small-scale project on a short time-scale. The scientific resources are engaged in other projects but given the exciting nature of what LArIAT is to accomplish, enthusiasm and time from the scientific resources should not be a problem.

4. Are the cost and schedule risks well identified, and what are they?

The ArgoNeut detector has been run before and so the risks associated with the detector itself are small. If a liquid recirculation system is decided on, there should be little technical risk. If a gas-only system is used, there is a risk that the electron drift lifetime will affect the quality of the measurements and/or that the system will require more operational intervention and thus more time to achieve the experiment goals. We did not hear what improvements are proposed to the cryo-system (for example vacuum insulation of the filters), or the internals of the detector (to reduce the amount of out-gassing) if the existing gas-circulation system is to be used.

The major risk for LArIAT is the current lack of sufficient engineering and technical resources for design and fabrication of a new or modified cryogenic system. This lack of resources could impact both the schedule and cost. The design of the cryogenic system is only conceptual at this stage and the scope of work (both SWF and M&S) could be underestimated. Even a decision on which solution to choose is delayed by the lack of engineering resources. If sufficient resources do not become available from Fermilab some of the effort could be contracted from outside but this could increase the cost.

A significant slippage of the schedule could put the LArIAT-I project in parallel with the start up of MicroBooNE. About one third of the LArIAT-I group members listed in the MOU are also working on MicroBooNE.

The issue of a decent beam spill duty factor has been mentioned in answer to question 1 as affecting the ability to collect data efficiently.

Appendix A – Charge

The Liquid Argon TPC in A Test beam (LArIAT) collaboration proposes to install and operate a LAr TPC in a new test beam at MCenter. LArIAT is being proposed as a two---phase program, with the first phase using the existing ArgoNeut cryostat and TPC. The first phase will inform the design of the second phase. It is important that the Liquid Argon TPC test beam program (i) is well motivated, (ii) is an integral part of the overall LAr R&D program within the U.S. and at the laboratory, and (iii) that

its scope is matched to available resources.

We would like the committee to focus on Phase 1 of LArIAT and address the following:

1. Are the goals well defined, attainable, and worthwhile?
2. Is the technical approach for beam and experiment sound?
3. Are the collaboration and laboratory resources needed to succeed with LArIAT well understood, and are the requested resources adequate?
4. Are the cost and schedule risks well identified, and what are they?

We would like a brief written report addressing these points by January 14th, 2013.

Appendix B – Committee Members

David Lissauer
Stephen Pordes
Russ Rucinski
Peter Wilson

Appendix C – Agenda

LArIAT Mini Review is on Thursday, Dec 20, 2012 from 3:30 pm to 5:00 pm

Opening remarks	Greg Bock / Steve Geer
LArIAT Goals, Plans and Request	Jennifer Raaf / Flavio Cavanna
Questions & Discussion	

Copy of the agenda, charge and other documents can be found at:

<https://indico.fnal.gov/conferenceDisplay.py?confId=6198>