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Title: Design and operation of LongBo: a 2 m long drift liquid argon TPC

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Referee report

This manuscript describes the design and operation of LongBo, the first LArTPC in the United States to obtain a 2m drift distance. With a demonstrated >6 ms drift electron lifetime, this work is an important development for future, large scale, high energy neutrino detectors.

This work should be published. However, the manuscript needs to be improved to better convey the important information, to be elaborated below.

1. Introduction

Page 1, first paragraph: "Conventional liquid argon vessels are evacuated to remove water, oxygen and nitrogen contaminants" Here it is necessary to cite the "Conventional liquid argon vessels" such as ICARUS, Argontube, etc.

Page 1, second paragraph: Since the authors wants to stress that LongBo is the longest argon TPC in the states, it can help to mention argontube at the U of Bern, which achieved a 5m drift distance.

General comments for the introduction: It may help to give a technical overview of LAPD (1 paragraph or so with a figure like Figure 7) either in the introduction or in the operation section. It will help the readers get relevant background information without going to the LAPD publication. For example, when the authors talk about the flange limitation and the muon trigger system, it would help to have the LAPD information at hand.

2. Construction of the LongBo TPC

Generally I feel that this paper lacks a good description of the field uniformity, which is crucial for a long TPC. I am particularly interested in the effects of 1) the joints between two cages, 2) the exposed resistor leads, and 3) the fact that the resistors are inside the field cage.
I would appreciate an explanation of how the field cages are jointed and how much field distortion is expected.

This might be personal, but I would expect the authors to talk about the field cage before the signal read out system.

Page 2, first paragraph: Since the paper discusses the channels numbers later, it would be helpful to mention how many wires/channels per sense plane.

Page 2, second paragraph: About the redundant resistor chain, if one resistor is burned, the field will be distorted. I am not sure if data acquired with a non-uniform field is worthwhile. Can the authors comment on this? Do the authors have a way to monitor the chain integrity and correct the non-uniformity?

Figure 2: is it for Bo or LongBo?

3. The High Voltage System

Page 3, second paragraph: The trip current is set to be 1.1mA, can the authors compare this with the normal operation current (explain why this value was chosen)?

Figure 3: Again, on the electric field, can the authors comment on the dis-

tortion of the field by the exposed HV at the bottom of the feedthrough? I foresee it is not negligible.

Page 3, third paragraph (and Figure 4): Out of curiosity, how did the authors remove the shielding cups from the HV feedthrough in the middle of runs?

4. Electronics

Generally I feel the information in this section is confusing. The authors needs to better explain 1) the history/motivation for the development of new preamplifiers, 2) the functionality of each component, and 3) how the components were connected.

Page 4, first paragraph: Do the authors have a reference for the statement that "at the 87 K temperature of liquid argon there is less intrinsic noise in a MOSFET preamp than in the best warm preamp"

I assume the preamps are integrators? What about the bipolar induction signals?

Does Bo use cold or warm readout modules? Based on "the Bo [2] and ArgoNeuT [5] TPCs. These systems employed preamplifiers positioned outside of the cryosta" I would expect Bo to use warm preamps. However, the authors later say "A cold MOSFET preamp-filter deployed on the Bo TPC" it sounds like that Bo uses cold preamps.

144 channels for the Bo TPC: I am not sure if this information helps My general opinion is that if a number doesn't help the readers understand the work to be reported, take it out.

Page 5, first paragraph: I think LBNE is called LBNF/DUNE now

This was mentioned before, but if the authors want to talk about channels numbers for the electronics, they need to say how many readout channels are needed in the TPC description section.

Can the authors explain which channels are read out by the ASICs and which channels are read out by CMOS? which induction plane (there are

two in total I suppose)? are they used for the channels in the center or on the sides? do the authors expecting the position of the channels to affect the S/N study? I found some information from the second paragraph of page 7, but it should be discussed early on.

Page 5, fourth paragraph: "The signal strength was extracted from straight muon tracks acquired with the cosmic ray muon trigger." I suggest referring to the muon trigger description section.

4.3 Trigger: Is it possible to show the muon coincidence system in a figure? It will help the readers understand the trigger and the data analysis. This information can be added to figure 7.

6. Results

Page 10. Can the authors briefly explain how the cut values (RMS<6.3cm, off-track hits#<11) were selected?

Page 11, first paragraph: Since it is important to assume an uniform energy deposition by the muons in the TPC, can the authors comment on the efficiency of delta ray removal?

Figure 13 is referred to in the text before Figure 12, and there is not much description of this figure in the text.

Can the authors include 1 figure showing the >6ms electron lifetime (similar to Figure 11 a or c)? If the authors want to stress the confirmation of >6ms lifetime observed by LAPD, it would be more appropriate to show such a figure in the paper.

LongBo confirms the >6ms electron lifetime result from LAPD, meaning the LAPD measurement may have large uncertainties; can the authors compare the overall uncertainty values (stats + sys) by both measurements? It should suffice to have some more text describing Figure 13.

6.2 High Voltage Stability

It is not clear to me what the authors mean by saying "The TPCs resis-

tive chain was likely damaged before data taking began." This should be simple to have a direct test of the chain. There could be many reasons for HV breakdowns in noble liquids, and a broken resistor chain is only one (minor) possibility.