

---

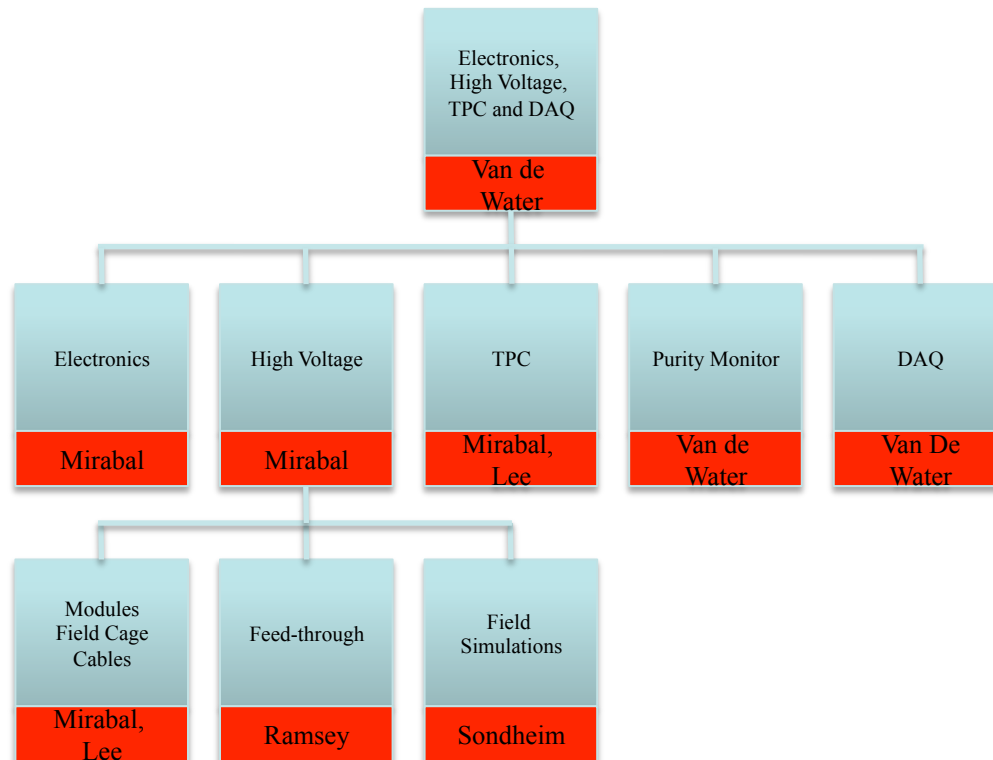
---

# Electronics/DAQ

January 31, 2013  
R. Van de Water, J. Mirabal

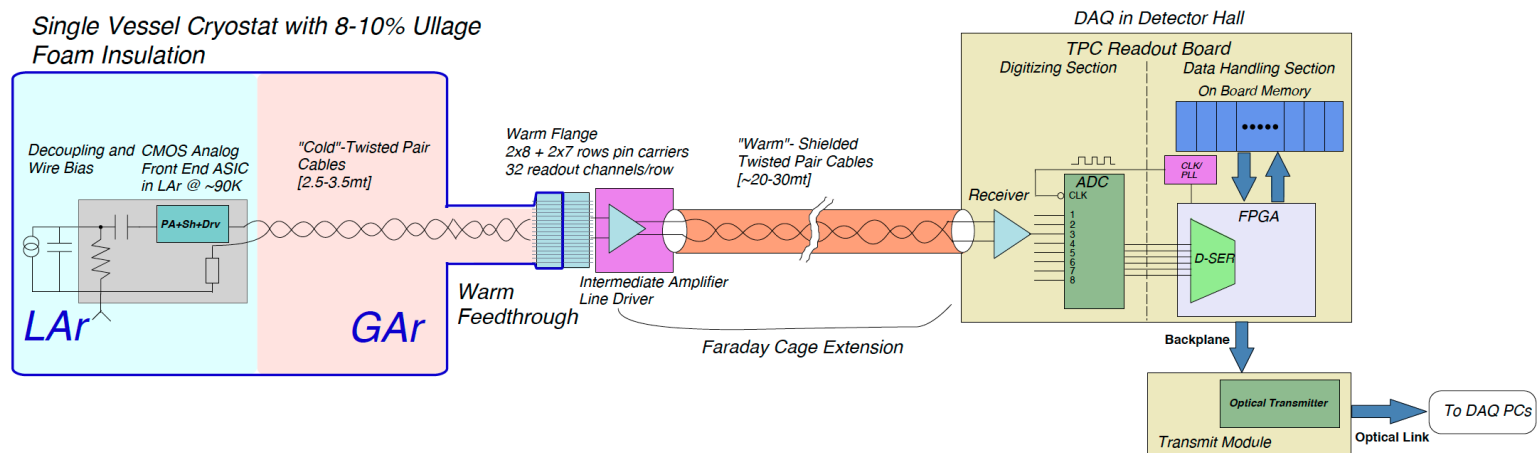
# Project Organization

## Electronics, HV, TPC, and DAQ Work Breakdown Structure



# Why BNL/Nevis TPC electronics?

- MSU scheduling conflicted with our deliverables
- BNL electronics and MSU electronics cost estimates were the same
- End-to-end testing has been completed by BNL
- Close collaboration with MicroBooNE important
- LANL postdoc involved in DAQ development

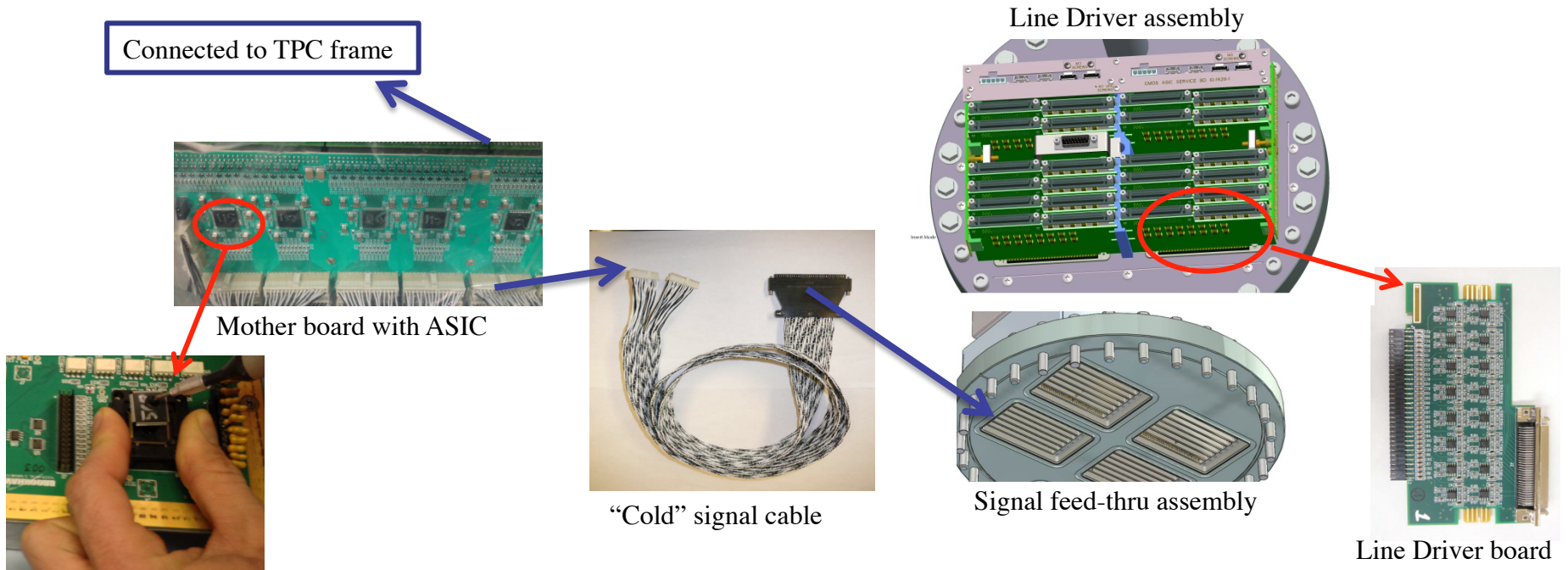


# MicroBooNE Electronics/DAQ Specs

Electronics & DAQ Requirements		
Parameter	Value	Motivation
Dynamic Range	< 500:1	Physics signal dynamic range * 10:1 signal/noise requirement
Noise	ENC < 660 electrons with 1 $\mu$ s shaper peaking time	Distinguish 3 fC wire signal (1 MIP) from noise with high efficiency at the longest drift time (1.6 ms) with an electron lifetime of 1.6 ms.
Beam trigger readout time	4.8 ms	The TPC drift time is 1.6 ms. Samples are taken 1.6 ms before and 1.6 ms after a beam spill to reconstruct out-of-time cosmic muons
Shaper peaking time	$\sim 1 \mu$ s	The average electron diffusion over a the drift distance is $\sim 1.4 \text{ mm} = \sim 1 \mu$ s.
ADC sampling rate	$\sim 2 \text{ MHz}$	The sampling rate should be at least $4/(\text{shaper peaking time})$ .
ADC resolution	$\sim 12$ bit	Minimize the rate of ADC overflow for low momentum, highly ionizing particles
Data buffer storage	Accelerator events: none Supernova events: one hour	Sufficient time for supernova notification by SNEWS



# Front End Electronics (~2000 channels)



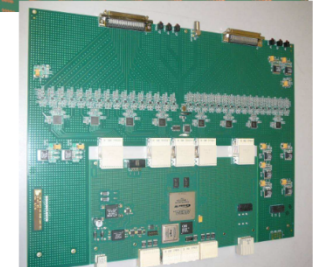
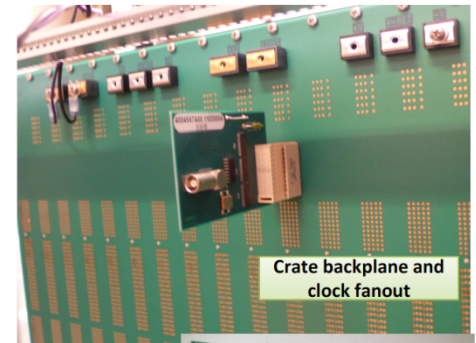
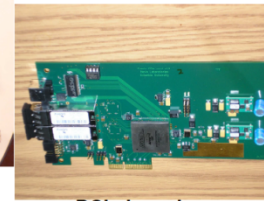
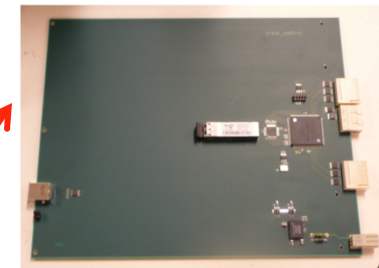
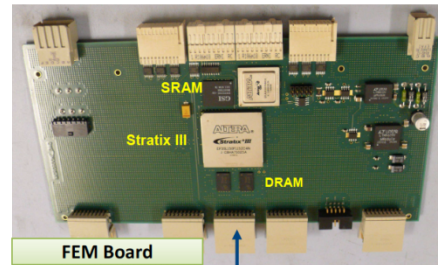
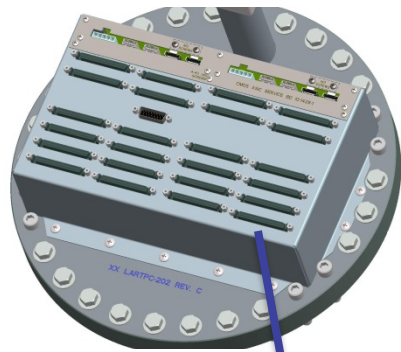
# Front End electronics details

---

---

Component	Procurement Process	Order Date	# needed
ASIC	LANL RRB	February 2013	200
Signal Feed thru's	LANL RRB	February 2013	6
Cold Cables	LANL RRB	February 2013	72
Mother Board	LANL RRB	March 2013	12
Line Driver board	LANL RRB	March 2013	32

# Back End Electronics



# Back End electronics details

Component	Procurement Process	Order Date	# needed
ADC board	LANL RRB	March 2013	32
Warm Cables	LANL P-card	April 2013	32
DAQ Computers	LANL BOA	April 2013	2
FEM board	LANL PO	January 2013	32
Crate Controller	LANL PO	January 2013	2
PCIe board	LANL PO	January 2013	2
Electronics Crates	LANL PO	January 2013	2

# DAQ Development

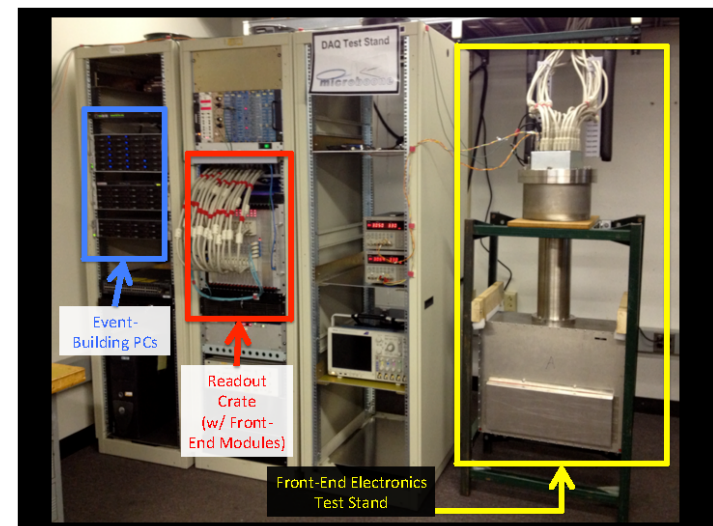
**DAQ Development (work in progress at FNAL).  
Our Directors funded postdoc Wesley Ketchum is  
heavily involved in developing MicroBooNE.**

Eric Church will give  
detailed DAQ talk

## DAQ:

- Developing the readout of the front-end modules (FEMs) that receive the data from the TPC.
- Develop software to configure and run in a continuous readout mode (the "supernova" mode) as well as triggered modes (from both internal and external triggers).
- Developing and implementing a serialized data format for complete events.
- Automating readout and error-handling procedures to be used during operation.
- Developing the framework in the DAQ for performing and analyzing calibration tests of the front-end electronics

**MicroBooNE DAQ/electronics test stand**

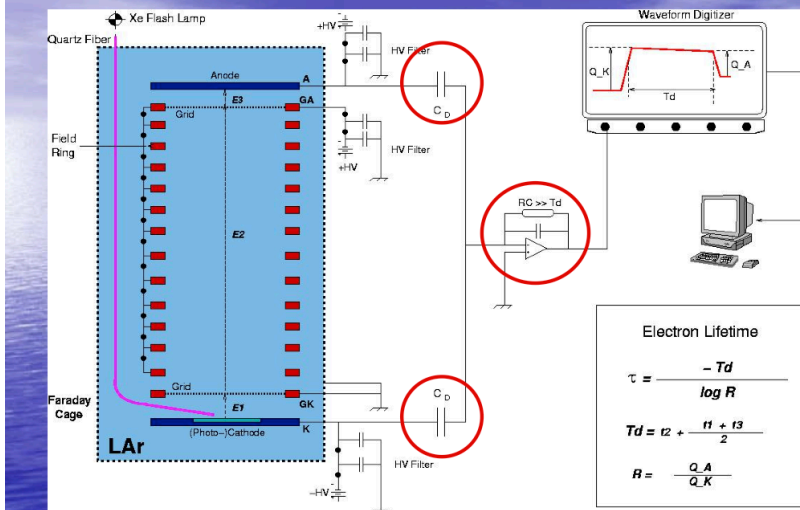




# Purity Monitor

## ICARUS Design

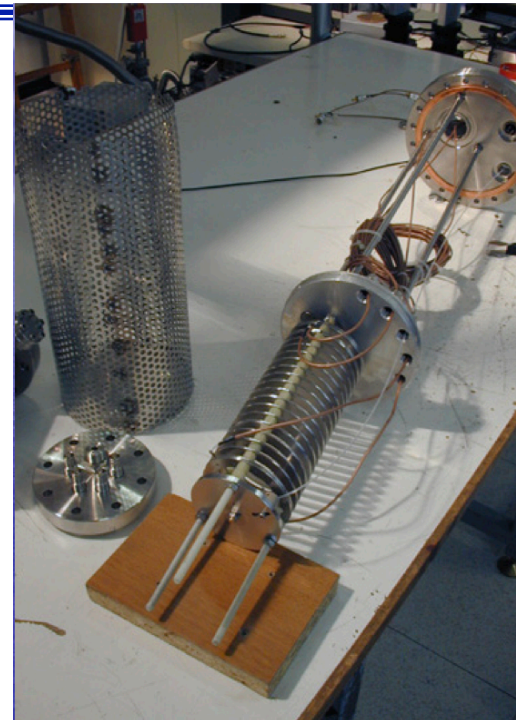
The purity monitor: principle of operation



20/06/2007

C. Cattadori- Geel GERDA meeting

7



- Purity Monitors are straight forward to build, and low cost (< \$30K)
- Will be collaborating with FNAL for LANL design.

# Future Electronics Possibilities

---

---

- MircoBooNE detector welded shut the end of 2013.
  - Full testing of the electronics with our small TPC (~1000 channels) would be advantageous and might spot problems before uBooNE detector closed.
  - We can access the inside of the detector to debug electronics problems.
- The LANL LAr detector can also be re-instrumented at a later date with new cold designs that are being developed, e.g. cold ADC.

# Summary

---

---

- Our plan is to use existing Electronics and purity monitor designs from other LAr detector experiments to reduce costs and meet schedule requirements -e.g. MicroBooNE
- We have witnessed end-to-end test of electronics
- ASIC warm testing has been completed by BNL, with cold testing on schedule to be completed February 2013
- The procurement process for each component has been identified and planned with an expected delivery date of June 2013
- Remaining electronics procurements will be ordered through the same vendors as MicroBoone electronics to minimize risk
- Back End (warm) readout electronics from NEVIS have already been procured, delivery date April 2013
- All testing equipment has been procured e.g. Oscilloscopes, power supplies, etc.
- Can leverage heavy involvement in MicroBooNE to acquire DAQ code/ infrastructure and analysis software



---

---

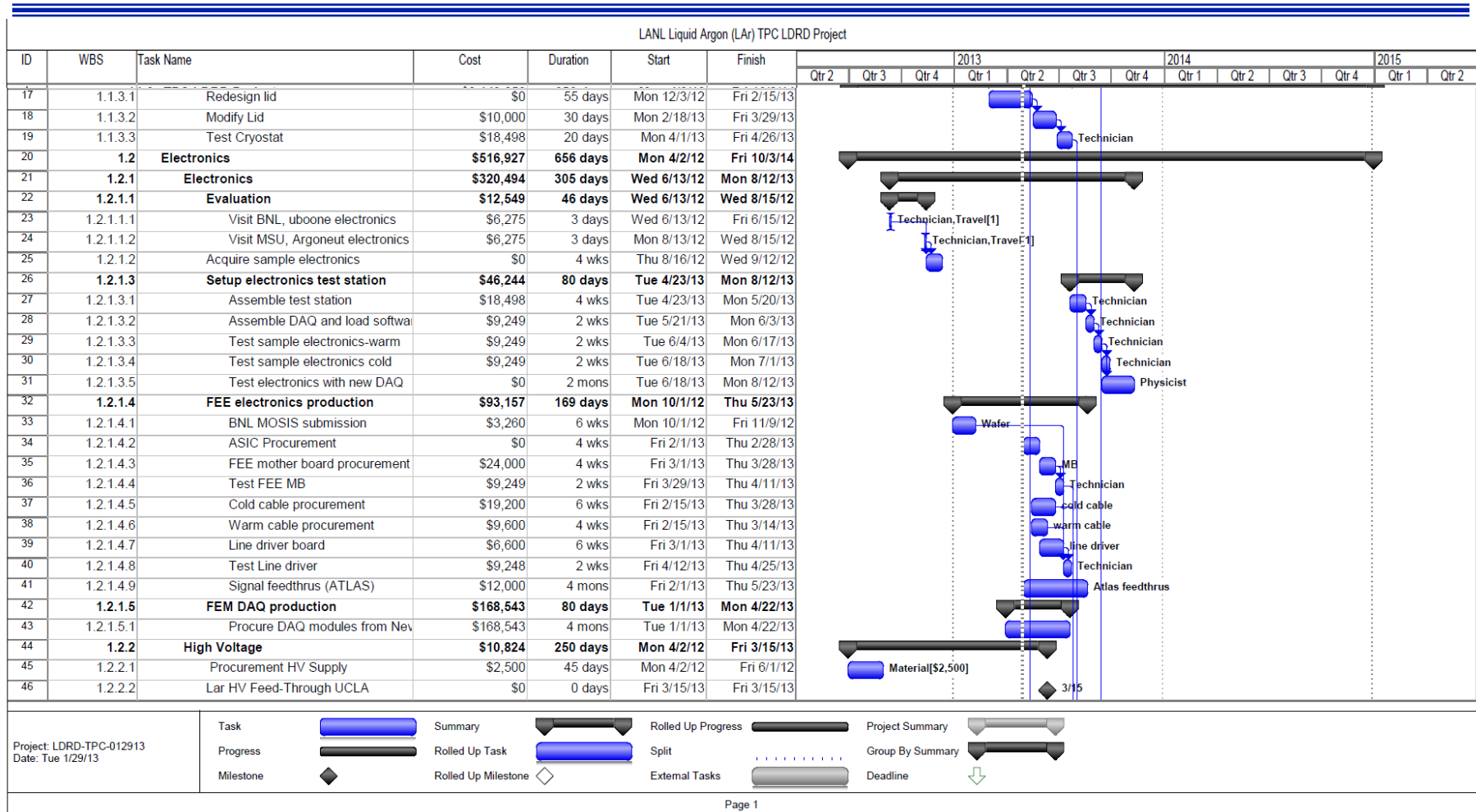
# Questions?

---

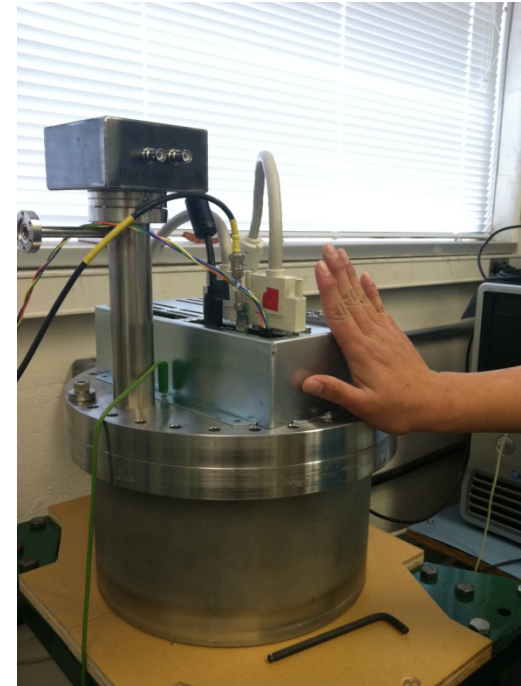
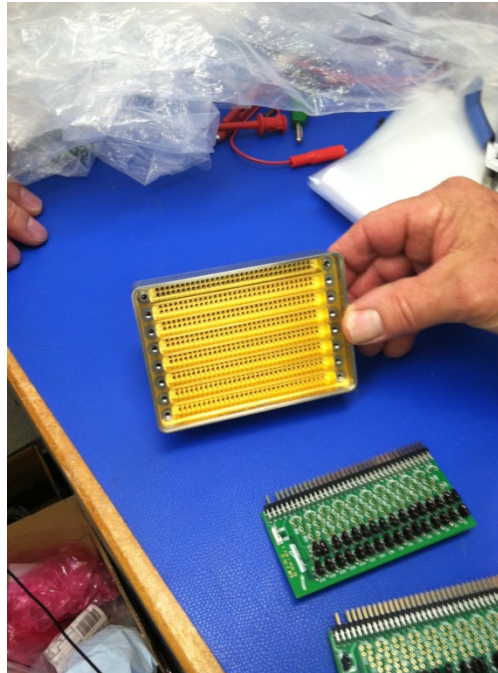
---

# Back-up Slides

# Electronics RLS details



# ATLAS Signal feed-thru's



# LAr Electronics testing

---

---





# Cold Cable Shells

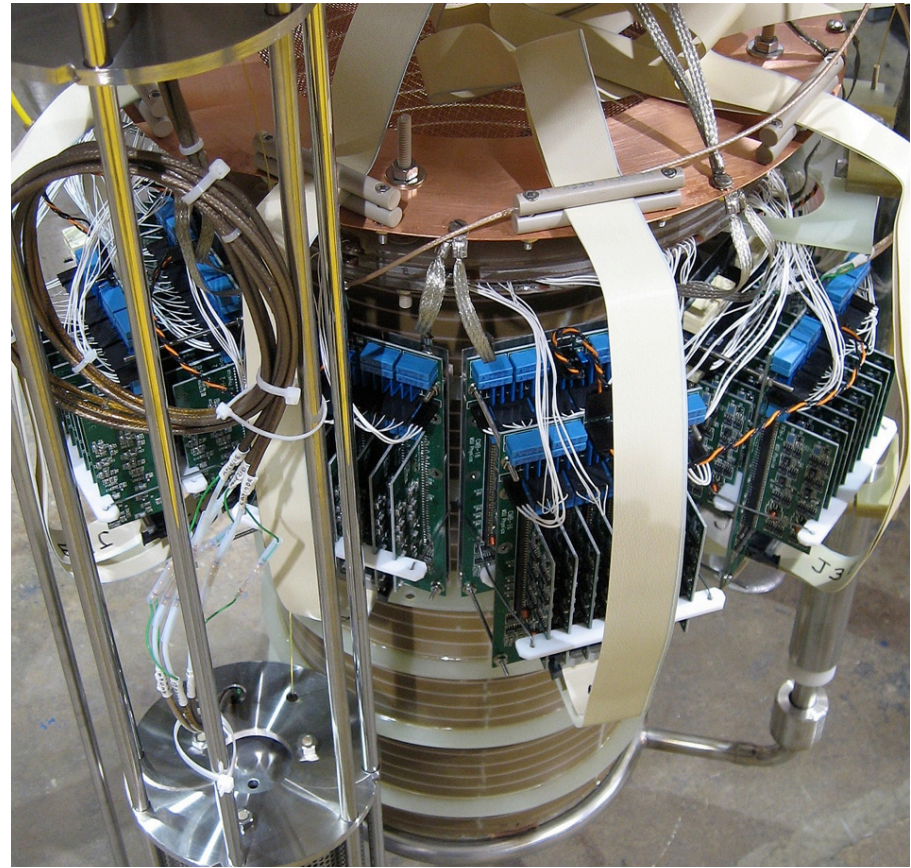


L.Camilleri, H.Chen---MicroBooNE Collaboration Meeting

# FEE test stand



L. Camilleri, H. Chen---MicroBooNE Collaboration Meeting



S. Pordes Institutional Review