Electronics/DAQ

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

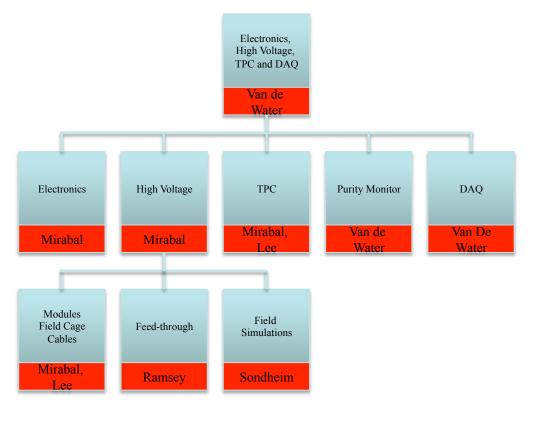


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Project Organization

Electronics, HV, TPC, and DAQ Work Breakdown Structure



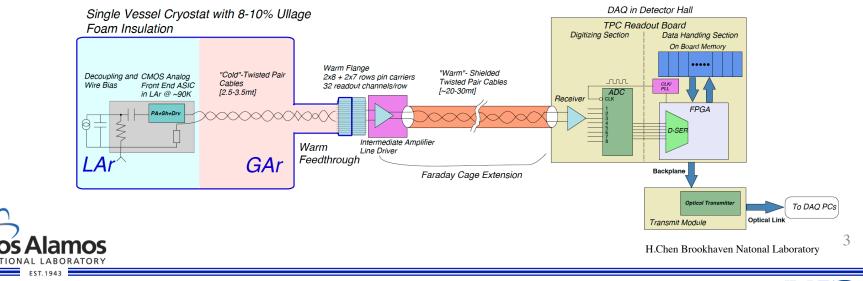




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Why BNL/Nevis TPC electronics?

- 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



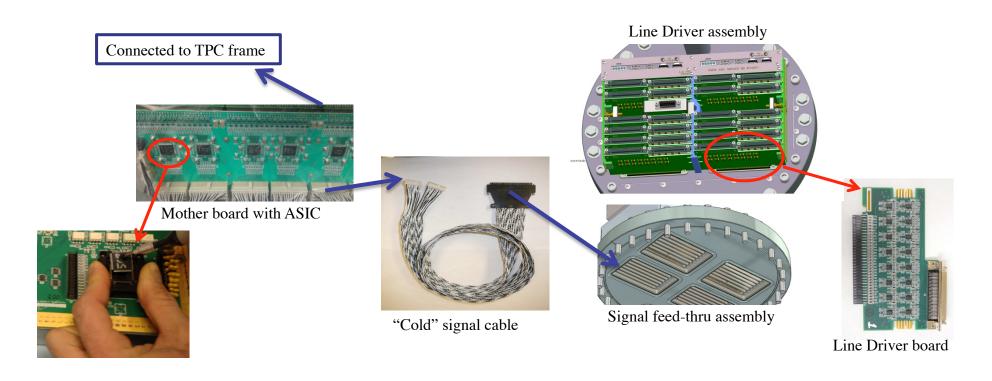
MicroBooNE Electronics/DAQ Specs

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 μs 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	~1 µs	The average electron diffusion over a the drift distance is ~1.4 mm = ~1 μ s.						
ADC sampling rate	~2 MHz	The sampling rate should be at least 4/(shaper peaking time).						
ADC resolution	~12bit	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)







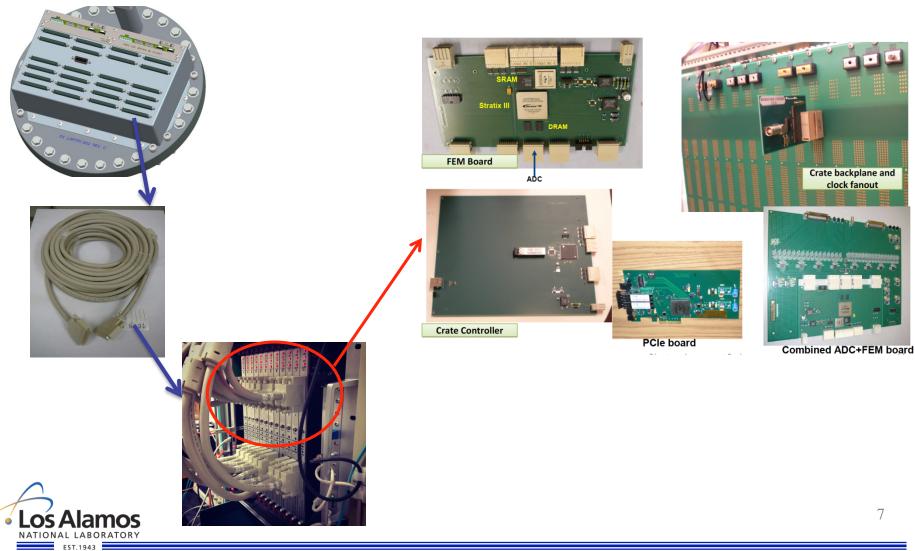
Front End electronics details

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.

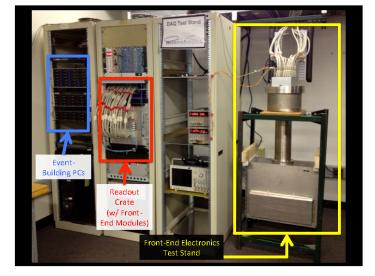
DAQ:

- -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



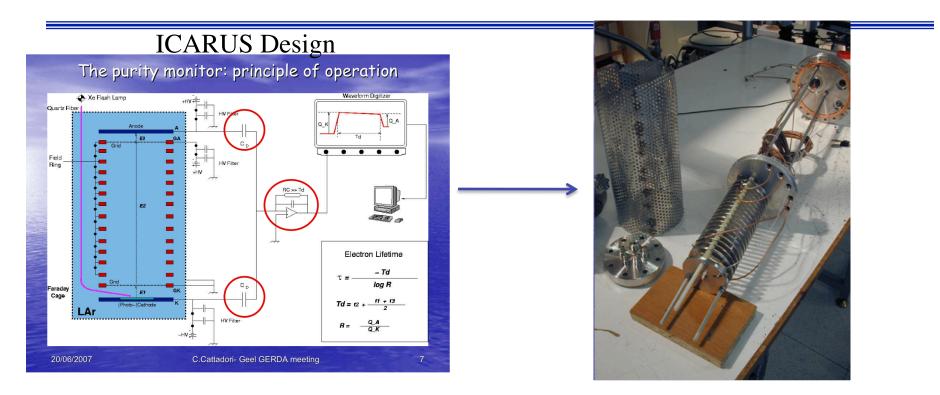
Eric Church will give detailed DAQ talk

MicroBooNE DAQ/electronics test stand





Purity Monitor



- 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 reinstrumented 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



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Questions?



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Back-up Slides



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Electronics RLS details

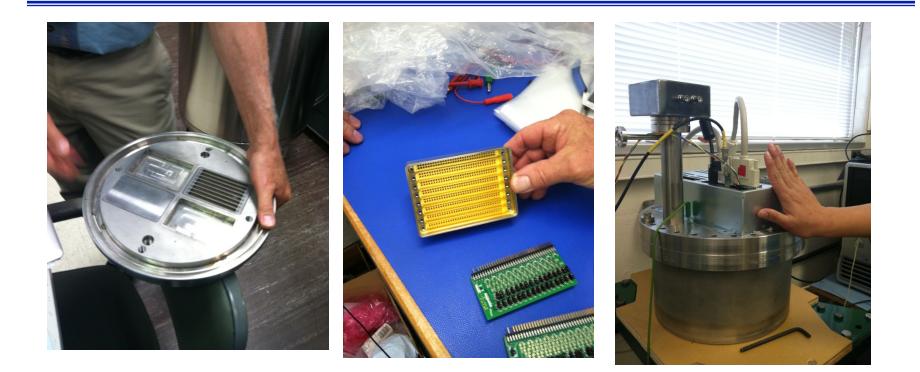
	WBS	Task Name	Cost	Duration	Start	Finish		2013			2014			2015
							Qtr 3 Qtr 4	Qtr 1	Qtr2 Q	ltr3 Qtr4	Qtr 1	Qtr2 (Qtr3 Qtr4	4 Qtr1
	1.1.3.1	Redesign lid	\$0	55 days	Mon 12/3/12	Fri 2/15/13								
8	1.1.3.2	Modify Lid	\$10,000	30 days	Mon 2/18/13	Fri 3/29/13								-
19	1.1.3.3	Test Cryostat	\$18,498	20 days	Mon 4/1/13	Fri 4/26/13				Technician				
20	1.2	Electronics	\$516,927	656 days	Mon 4/2/12	Fri 10/3/14		:			-			
21	1.2.1	Electronics	\$320,494	305 days	Wed 6/13/12	Mon 8/12/13			-					
22	1.2.1.1	Evaluation	\$12,549	46 days	Wed 6/13/12	Wed 8/15/12				-				
23	1.2.1.1.1	Visit BNL, uboone electronics	\$6,275	3 days	Wed 6/13/12	Fri 6/15/12	Technician	n,Travel[1]						
24	1.2.1.1.2	Visit MSU, Argoneut electronics	\$6,275	3 days	Mon 8/13/12	Wed 8/15/12	Tec	hnician,Trave	Ē1]					
25	1.2.1.2	Acquire sample electronics	\$0	4 wks	Thu 8/16/12	Wed 9/12/12	<u> </u>							
26	1.2.1.3	Setup electronics test station	\$46,244	80 days	Tue 4/23/13	Mon 8/12/13	-	-						
27	1.2.1.3.1	Assemble test station	\$18,498	4 wks	Tue 4/23/13	Mon 5/20/13		:		Technician				
28	1.2.1.3.2	Assemble DAQ and load softwa	\$9,249	2 wks	Tue 5/21/13	Mon 6/3/13			I	Technicia	n			
29	1.2.1.3.3	Test sample electronics-warm	\$9,249	2 wks	Tue 6/4/13	Mon 6/17/13				Technici	an			
30	1.2.1.3.4	Test sample electronics cold	\$9,249	2 wks	Tue 6/18/13	Mon 7/1/13		-		Techni	cian			
31	1.2.1.3.5	Test electronics with new DAQ	\$0	2 mons	Tue 6/18/13	Mon 8/12/13		-		Ph	nysicist			
32	1.2.1.4	FEE electronics production	\$93,157	169 days	Mon 10/1/12	Thu 5/23/13		_						
33	1.2.1.4.1	BNL MOSIS submission	\$3,260	6 wks	Mon 10/1/12	Fri 11/9/12		Wafer		•				-
34	1.2.1.4.2	ASIC Procurement	\$0	4 wks	Fri 2/1/13	Thu 2/28/13		—						
35	1.2.1.4.3	FEE mother board procurement	\$24,000	4 wks	Fri 3/1/13	Thu 3/28/13		-	Т МВ					-
36	1.2.1.4.4	Test FEE MB	\$9,249	2 wks	Fri 3/29/13	Thu 4/11/13			H	echnician				
37	1.2.1.4.5	Cold cable procurement	\$19,200	6 wks	Fri 2/15/13	Thu 3/28/13		1		d cable				
38	1.2.1.4.6	Warm cable procurement	\$9,600	4 wks	Fri 2/15/13	Thu 3/14/13		-	warm	i cable				
39	1.2.1.4.7	Line driver board	\$6,600	6 wks	Fri 3/1/13	Thu 4/11/13				ne driver				
40	1.2.1.4.8	Test Line driver	\$9,248	2 wks	Fri 4/12/13	Thu 4/25/13		1		Technician				
41	1.2.1.4.9	Signal feedthrus (ATLAS)	\$12,000	4 mons	Fri 2/1/13	Thu 5/23/13		-		Atlas feedth	nrus			
42	1.2.1.5	FEM DAQ production	\$168,543	80 days	Tue 1/1/13	Mon 4/22/13								
43	1.2.1.5.1	Procure DAQ modules from Nev	\$168,543	4 mons	Tue 1/1/13	Mon 4/22/13		1						
44	1.2.2	High Voltage	\$10,824	250 days	Mon 4/2/12	Fri 3/15/13								
45	1.2.2.1	Procurement HV Supply	\$2,500	45 days	Mon 4/2/12	Fri 6/1/12	Material[\$2,5	500]	•					
46	1.2.2.2	Lar HV Feed-Through UCLA	\$0	0 days	Fri 3/15/13	Fri 3/15/13			🔶 3/1	5				
		Task	Summary		Rolled Up Pr		Project Summary							
roject [.] I	LDRD-TPC-0129		,		• ·									
	e 1/29/13	Frogress	Rolled Up Task		Split			· •						
		Milestone 🔶	Rolled Up Milestone	\diamond	External Tas	ks (Deadline	\mathcal{T}						



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ATLAS Signal feed-thru's





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LAr Electronics testing

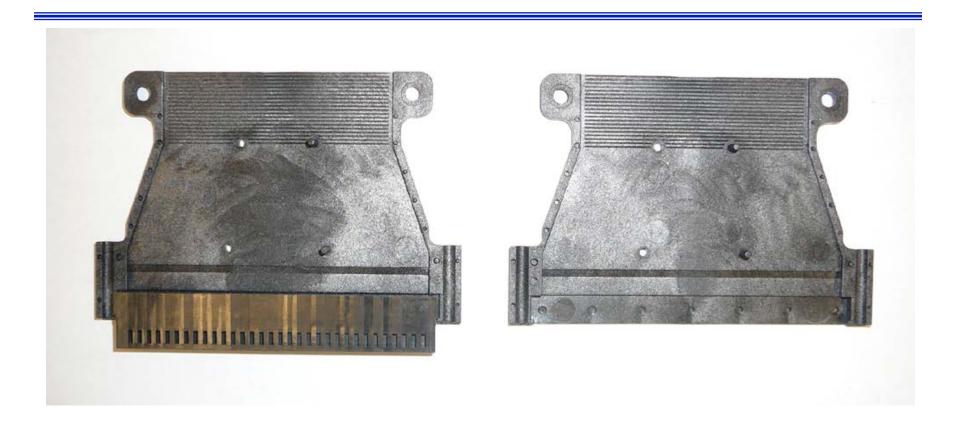




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Cold Cable Shells



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



NNS®

FEE test stand



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

S. Pordes Institutional Review



