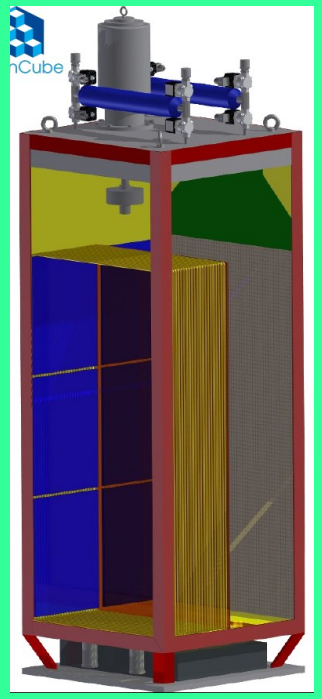
Detector-Scale Pixel System Needs



Pixel LArTPC Autumn Workshop, Fermilab, 29.09.18

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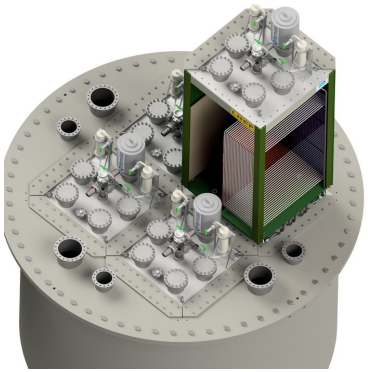
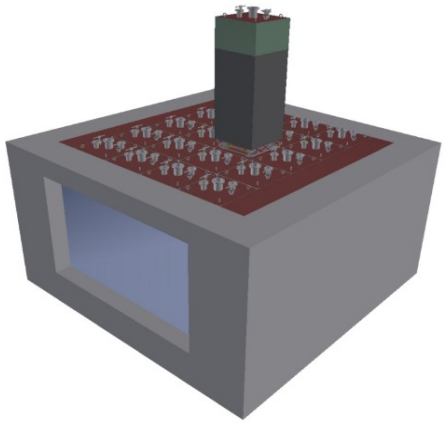
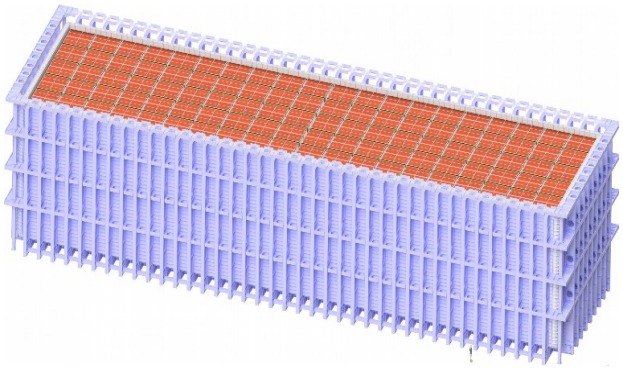
Three principal scopes

	2x2 (proto-ND)	ND	FD
Modules	2x2	4x5 (7x5?)	10x20
Module size	0.67 x 0.67 x 1.8 m	1.0 x 1.0 x 3.5 m	1.5 x 3.0 x 13.4 m
Total LAr mass	9 t	100 t	20'000 t
Active LAr mass	3 t	80 t	17'000 kt
			

Charge readout system parameters

	2x2	ND	FD
ASIC version	V2 (8 bits)	V3 (10 bits)	V3 (10 bits)
R/O area per module	1.6 m2	6 m2	80.4 m2
Total R/O area	6.4 m2	120 m2	16080 m2
Pixel density	62'500 pix/m2 (4x4 mm)		
Pix/mod	100'000	375'000	5'025'000
Tot pix	400'000	7'500'000	1e9
ASICs /module	1563	5859	78'515
Total asics	6250	~117'200	15.7e6
Data rate /mod	0.64 Mbps	0.24 Mbps	3.2 Mbps
Data rate Total	2.6 Mbps	4.8 Mbps	650 Mbps
Drift time	160 us	240 us	720 us

Charge readout system tasks

	2x2	ND	FD
ASICs design	LARPIX (LBNL)		
ASIC tests			
Tiles (pixel anode boards)	LBNL	LBNL	
APA-level interconnections	ANL?	ANL?	
APA support structures	?	?	
Signal FT (CF)	?	?	
Warm electronics	BERN+?	BERN+?	
Pixel DAQ soft	LBNL+BERN+?	LBNL+BERN+?	
DQM, Online			
Reconstruction			
Simulation			

Photon detection system parameters, tasks

	2x2	ND	FD
Average PDE	0.1%	0.1%	
Trigger threshold	70 keV	70 keV	
Technology(ies)	LCM + ArCLight	LCM/ ArCLight / UVSiPMs	
Possible aux. tests	UV SiPMs		
PDS cold part	Dubna/BERN		
PDS DAQ electronics	Dubna/BERN		
PDS DAQ software	Dubna/BERN		
DQM, Online	Dubna/BERN		
Reconstruction	Dubna/BERN		
Simulation			

Caution: UV SiPMs option interferes with pixel tile design !

Event level data processing

	2x2	ND	FD
DAQ computers			
Event assembly (charge+scintillation +triggers)			
Run parameters/configurations book keeping	Run DB, MIDAS?	Run DB, MIDAS?	Run DB, MIDAS?
Persistent storage	Local RAID	Local RAID, Grid	
Online processing / Data analysis			

Slow control			
	2x2	ND	FD
Cryogenics : purity, temperatures, pressures levels, flows	BERN		
Power: consumption currents per subsystem	BERN		
Online DQM (plots)			
Online Event Display			

Cryogenic system parameters, tasks

	2x2	ND	FD
Dissipated heat /module	10+10 W	40+40 W	500 W
Total dissipated heat	80 W	320 W	~100 kW
Recirculation rate /module	300 l/h	300 l/h	1 m3/h
Recirc. rate total	1200 l/h	6000 l/h	200 m3/h
Recirc. loop	Internal/External	TBD	TBD
Cooling	LN	TBD	TBD
External Loop design/production	FNAL	FNAL+?	
Internal Loop design/production	BERN+FNAL		

Infractructure (other)			
	2x2	ND	FD
Drift voltage	33kV (x4) 1 mA	HV: 50 kV (x20) 1 mA	HV: 150 kV (x200) 1 mA
HV FT	Custom (BERN)		
LV Power (R/O only)	5V, ~15-20A	5V, ~70-100A	~ 10 kW
Common Clock	10 MHz, latched to GPS		
Trigger / Time	NuMi / GPS-PPS	Beam / GPS-PPS	Beam / GPS-PPS
Cabling warm	B		
Cabling cold			
Module Building			
Module Testing			
Modules / components storage	~5x2 m (TBD)	15x30 m	
ES&H (ODH, procedures)			

Timeline

	2x2	ND	FD
Module 0 operative	Q2 2019 (Bern)		
Module design signoff	June 2019		
Modules production complete	Q4 2019		
Detector operative-1	Q4 2019 (Bern)		
Detector operative-2	Q2 2020 (FNAL)		

Backup Slides

ARGONCUBE 2x2 Module-0 progress