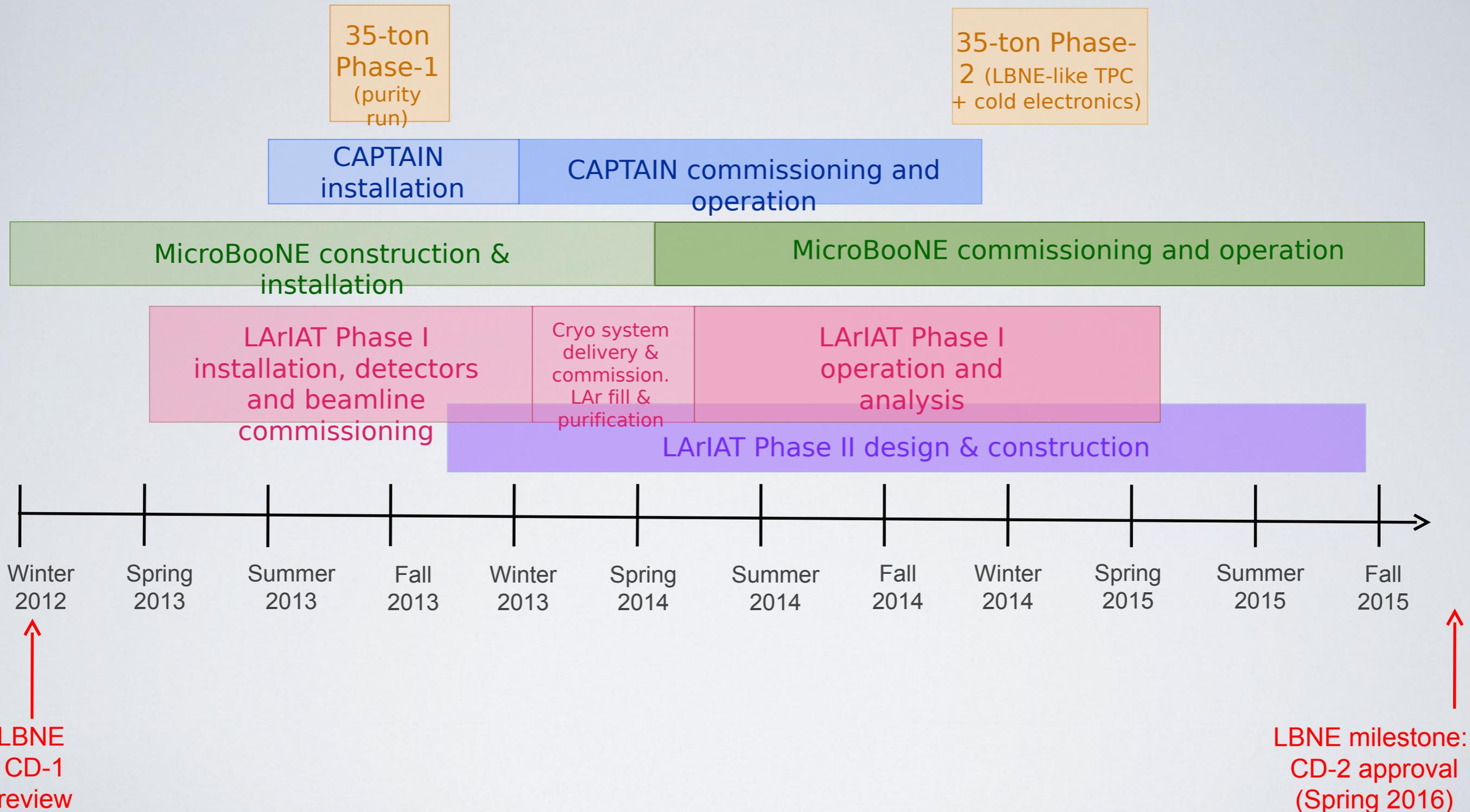


Items from the DOE visit I'm uncertain about
or which may need updating

Mike Kordosky

LArIAT Phased Program



Properties We Would Like to Measure (partial list of course)

- Ionization and light production properties
- Photon/electron differentiation
- Pi-zero identification
- Non-magnetic muon sign determination
- Nuclear effects in argon

Particle Identification

π^0 s

Picture of a pizero event?

- Test beam is right in resonance region
- Will make N^* , π^0 s
- Test algorithms for π^0 identification
- Measure cross section for N^* production and decay in Ar

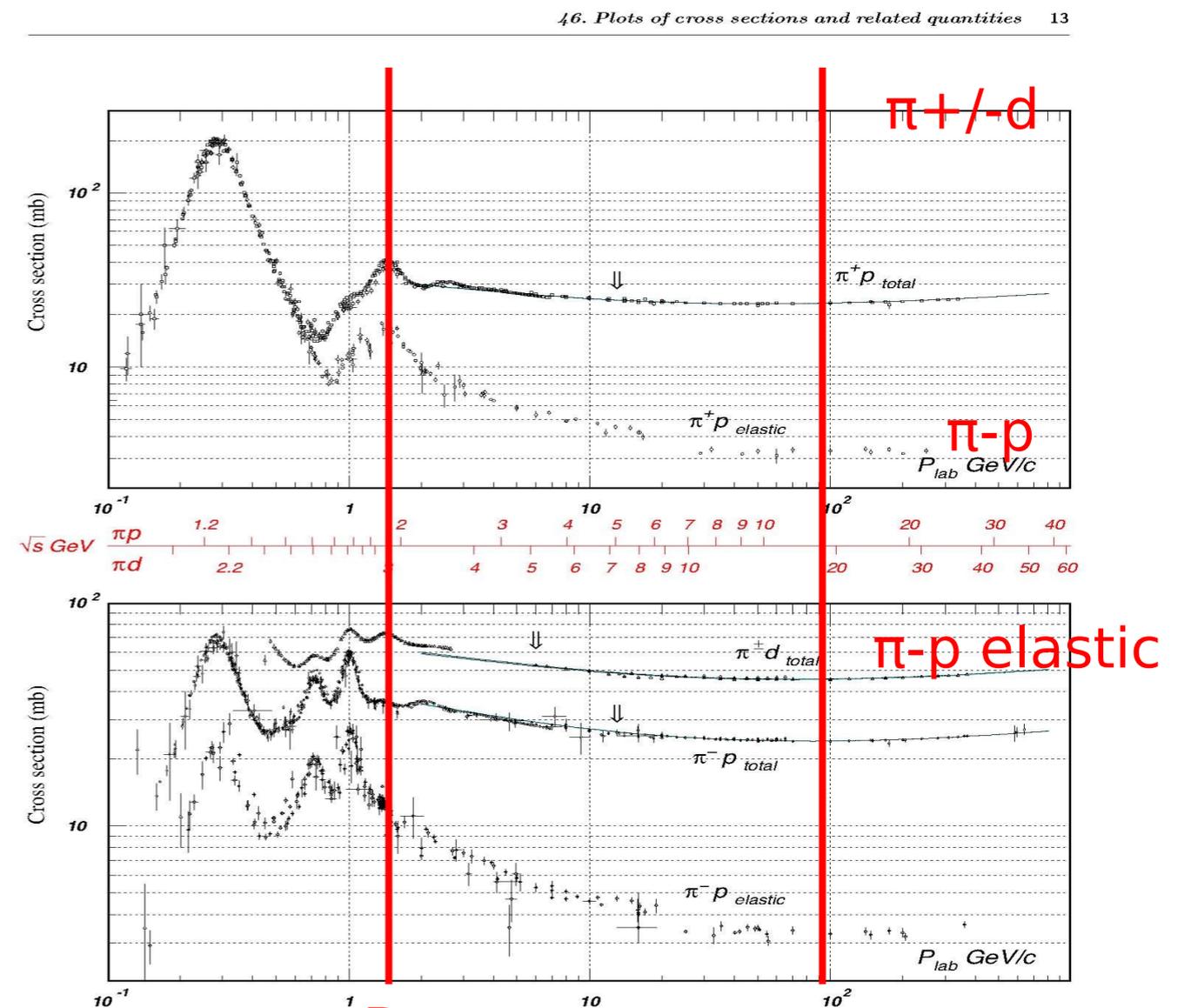


Figure 46.12: Total and elastic cross sections for $\pi^+ p$ and $\pi^+ d$ (total only) collisions as a function of laboratory beam momentum and total center-of-mass energy. Corresponding computer-readable data files may be found at <http://pdg.lbl.gov/current/xsect/>. (Courtesy of the COMPAS Group, IHEP, Protvino, April 2012)

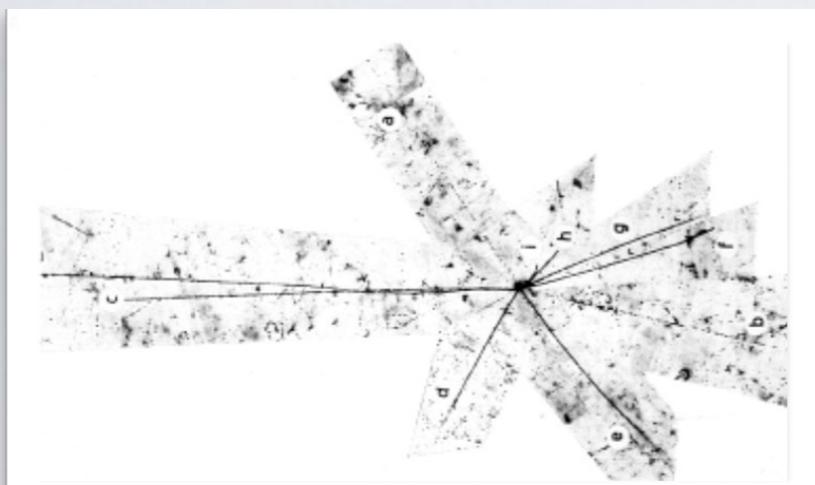
Study Nuclear Effects

- Nuclear effects are always an unknown for neutrino experiments

- Study fixed q^2 (t) transfer to nucleus by:

- Elastic scattering
- Quasielastic scattering
- Antiproton annihilation

**Further discussion of these items.
Pi and p reaction cross-sections?
GENIE & Minerva systematics motivation.**



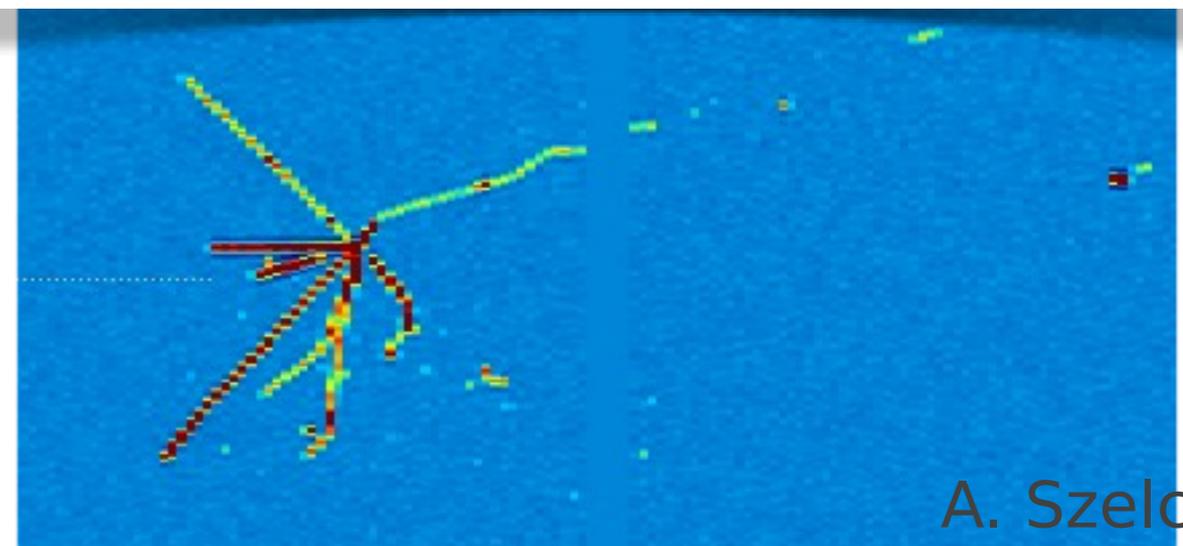
Antiproton Star Observed in Emulsion*

O. CHAMBERLAIN, W. W. CHUPP, G. GOLDBERGER, E. SEGRÈ, AND
C. WIEGAND, *Radiation Laboratory, Department of Physics,
University of California, Berkeley, California*

AND

E. AMALDI, G. BARONI, C. CASTAGNOLI, C. FRANZINETTI, AND
A. MANFREDINI, *Istituto di Fisica della Università, Roma
Istituto Nazionale di Fisica Nucleare,
Sezione di Roma, Italy*

Simulation of Antiproton Star in LAr



A. Szec

Don't know physics importance of this

procurement status and funding status

Modification of existing components

New components

Cryostat

TPC detector

(A) Scintillation detection and readout system

① Bottom Side - connection to Cooling/Purification system

④ Wire frame sustaining supports

(B)1 Beam trigger system
(B)2 Cosmic Muon trigger system

② Front Side Window

⑤ DAQ Board

(C) Argon cooling and purification system

③ Back Side - housing and connection to scintillation light readout system

(D) Cold Electronics

Completed

in progress

about starting

on hold

Still current? Needs Updating?

Beam counters (w/ r/o electronics) available

for beam monitor, halo veto/anticoincidence and trigger:

- * by FTBF - via TSW agreement T-1034 (MWPC, ToF)
- * by FNAL - via LArIAT FNAL grp. (Fenker Wire Ch.'s, Cerenkov)
- * by FNAL/CDF - via LArIAT FNAL grp. (Scint. Paddles)

Status (*see next slides*):

- Simulations/Selection/Design ~completed (use of Cerenkov counter to be decided)
- Individual components:
 - * Fenker Ch's and ToF: Test under way
 - * Scint. Paddles: test near to start
- Installation at MC7 currently under way (stands under construction)

ToDo list:

- Installation at MC7
- survey (positioning of elements)
- synchronization and on-line monitor/display
- include in LArTPC DAQ

Needs updating?

Labor and Installation Costs to complete:

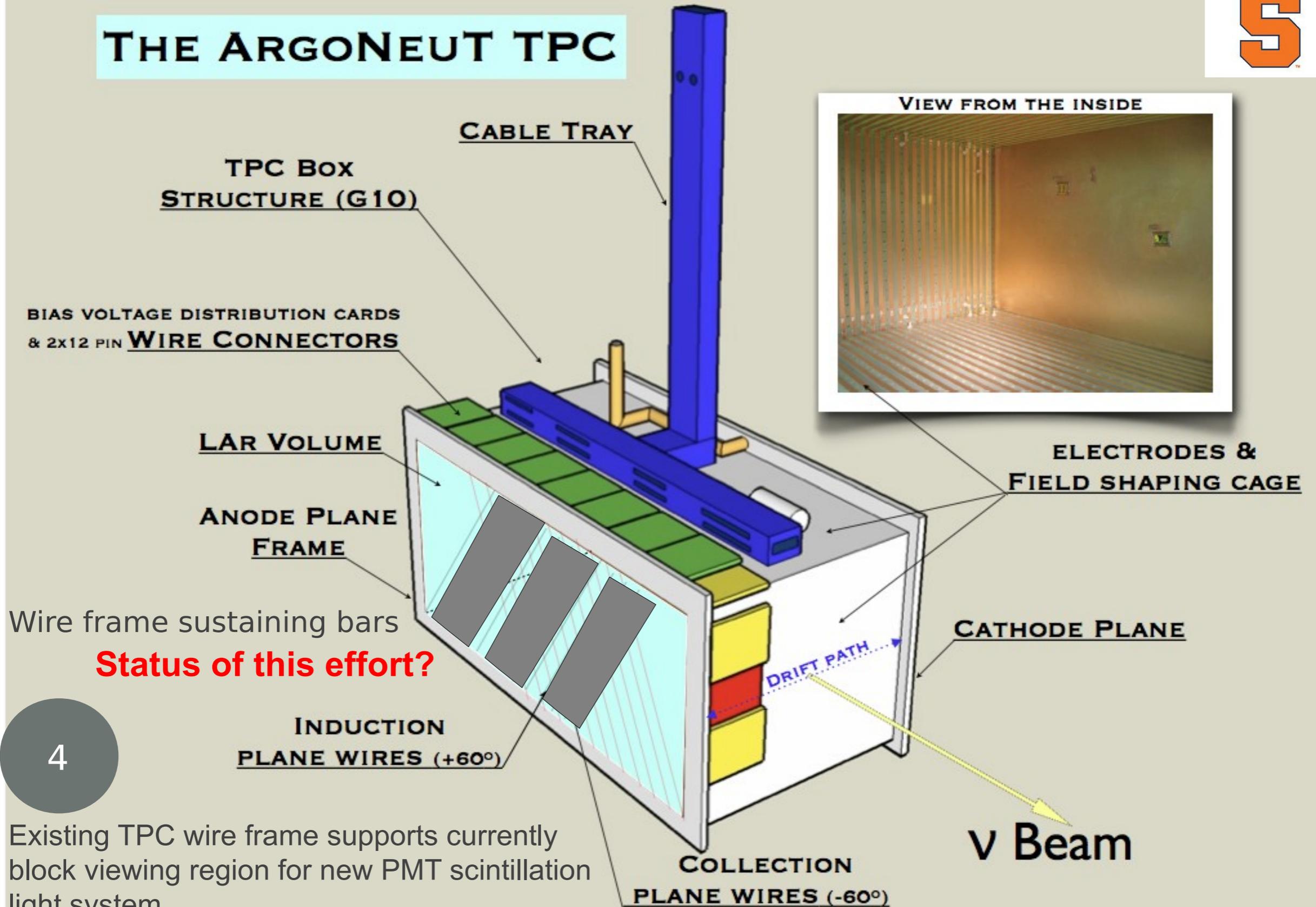
- partly by FNAL FTBF (through TSW agreement T-1034, signed Mar.13)
- partly by LArIAT collab.
(costs for installation)



Modification of Existing Components: TPC



THE ARGONEUT TPC



Wire frame sustaining bars
Status of this effort?

4

Existing TPC wire frame supports currently block viewing region for new PMT scintillation light system



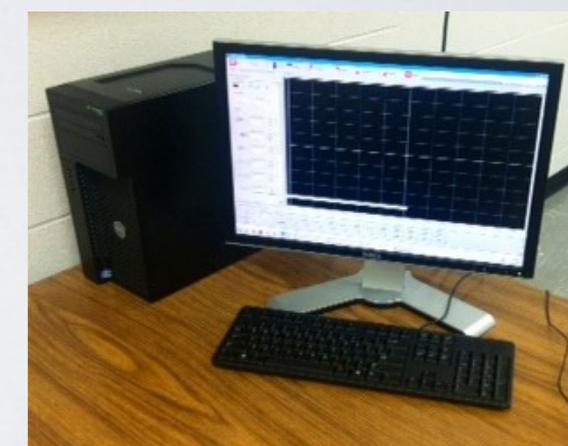
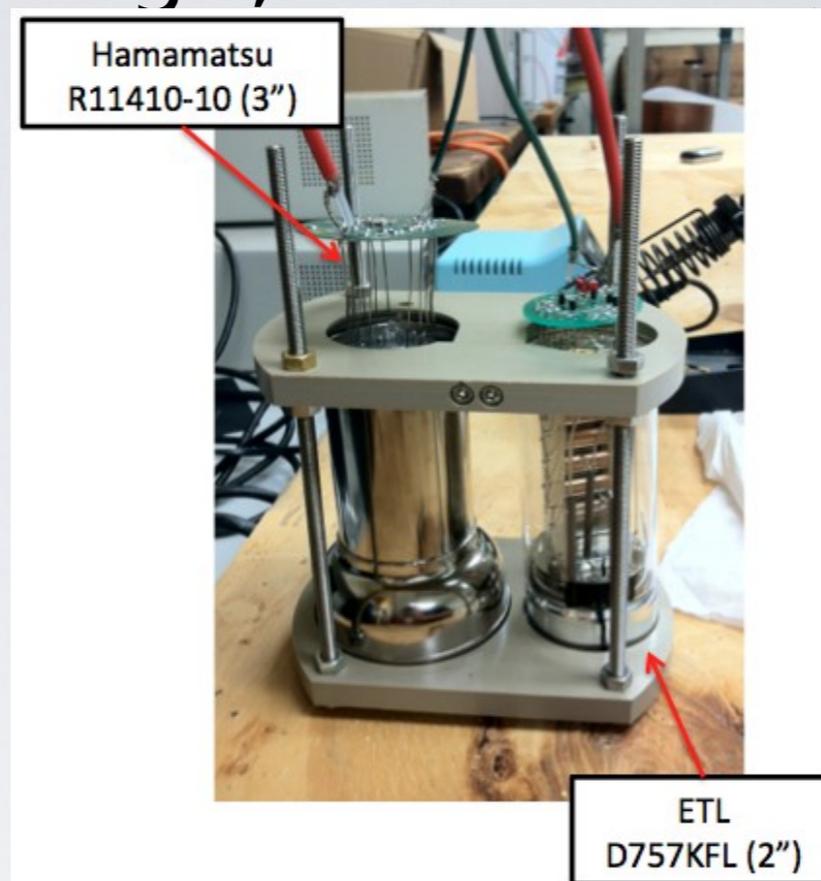
Testing the LArIAT Light Readout System



Still need to get a common code base going.

Chicago, Yale

- PMTs to be tested in LAr
- $\text{\O}2''$ ETL and 3" Hamamatsu
- Preparing box to be submerged in liquid argon to hold PMTs and SiPMs
- CAEN Fast Waveform Digitizer will be used to process signal from PMTs
- Currently setting up data acquisition software on PC to test full readout system in the coming months
- \O Observe cosmic rays and signal from a fast LED pulser



Modification of Existing Components: DAQ

⑤ Non-trivial change: Improve DAQ rate by factor of >10

- Existing ArgoNeuT readout system DAQ rate: ~ 1 Hz
- **Expected good trigger rate at FTBF: $\sim 5-10$ Hz**
 - ($\sim 20-40$ particles/spill in 4 second spill once per minute)

Speed increase 1:

Still current?

Implement block data transfers for ADF2 readout
x2-4 speed increase.

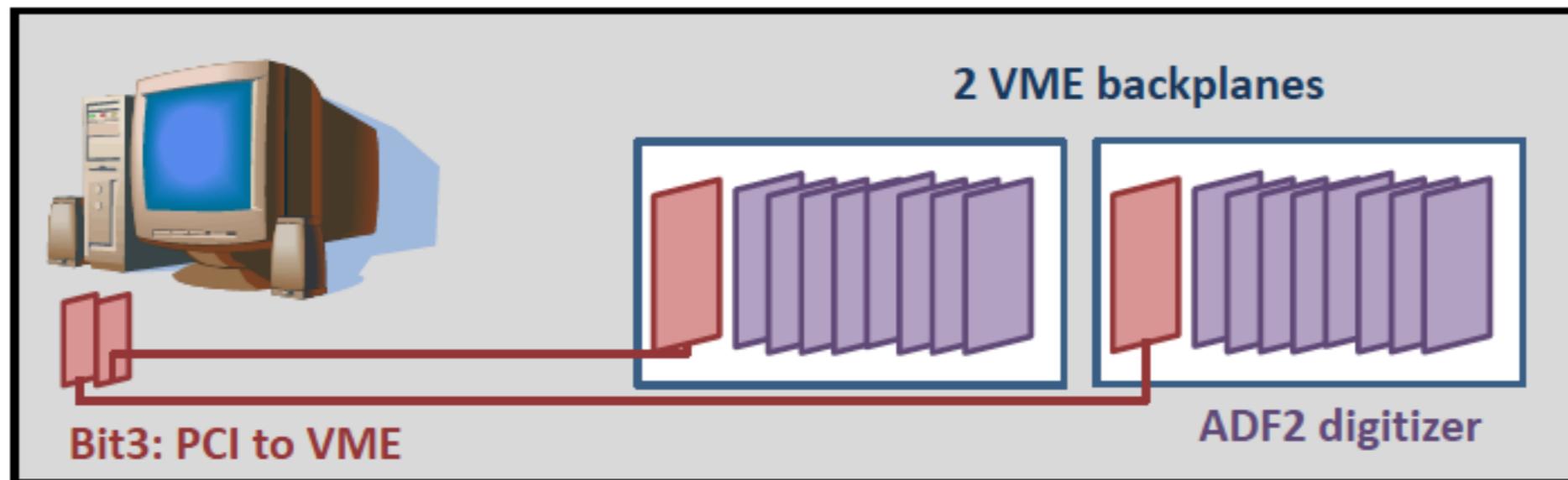
Carl will discuss more later

Speed increase 2:

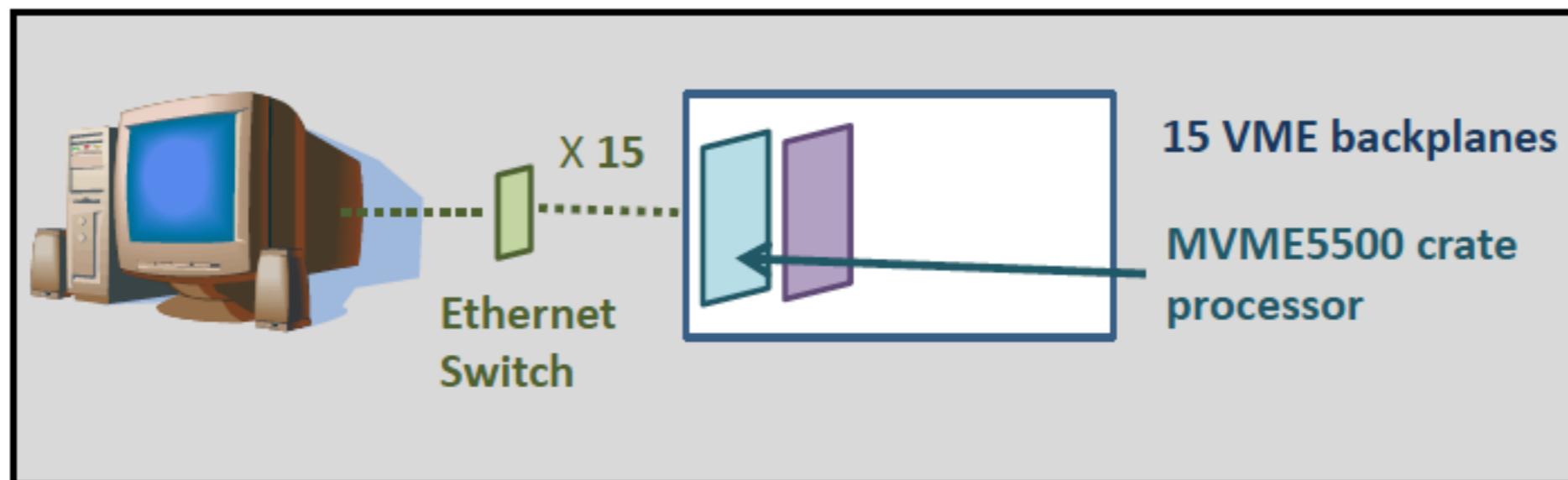
Move from serial to parallel readout of ADF2 cards
x8 speed increase

Details on next slide

DAQ upgrade



ArgoNeuT: 1.0(0.5) sec to readout 1 event at 200(400) ns/sample

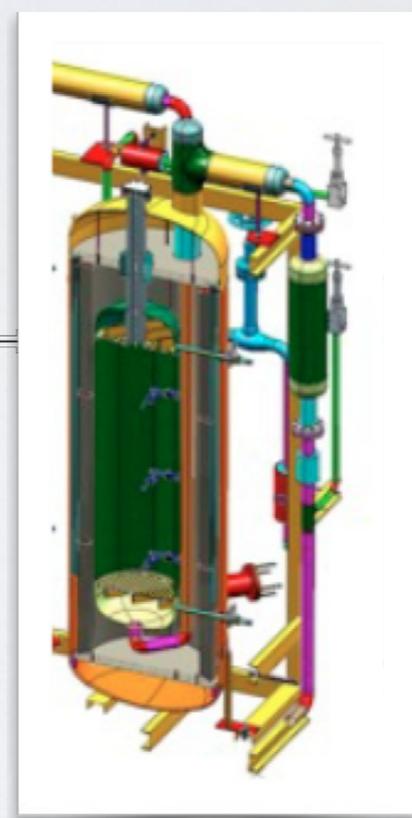
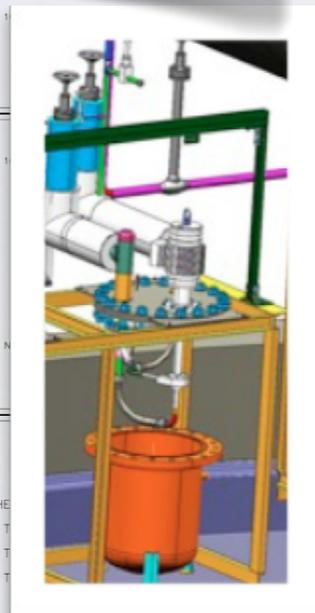
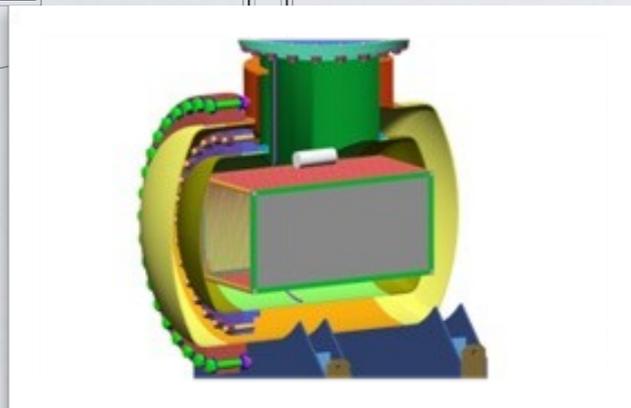
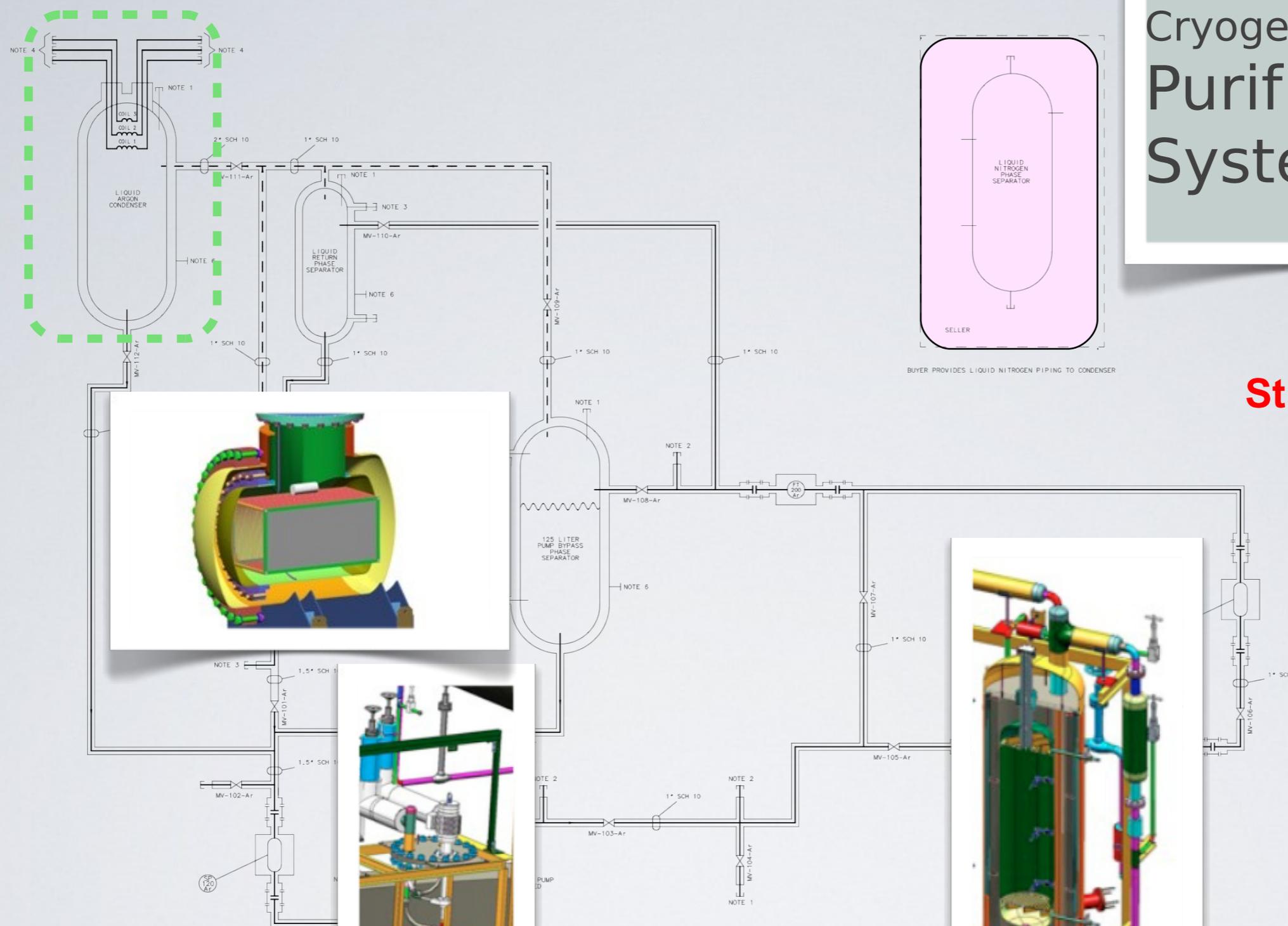
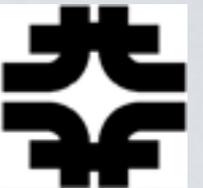


LArIAT: <0.06 sec to readout 1 event at 400 ns/sample

4/5/2013

Cryogenic & Purification System

Still current?



- NOTE 1 PIPING TERMINATES IN A 1 INCH MALE SWAGELOK VCR FITTING OUTSIDE THE
- NOTE 2 PIPING TERMINATES IN A 1/2 INCH MALE SWAGELOK VCR FITTING OUTSIDE THE
- NOTE 3 PIPING TERMINATES IN A 1/4 INCH MALE SWAGELOK VCR FITTING OUTSIDE THE
- NOTE 4 PIPING TERMINATES IN A 3/4 INCH MALE SWAGELOK VCR FITTING OUTSIDE THE
- NOTE 5 DIELECTRIC BREAK FLANGES ON BOTH ARGON PIPING AND VACUUM JACKET.
- NOTE 6 KF40 FITTING ATTACHED TO VACUUM JACKET.

UNLESS OTHERWISE SPECIFIED		ORIGINATOR	T. TOPE	03-APR-2013
		DRAWN	J. CATALANELLO	03-APR-2013
		CHECKED		
1. BREAK ALL SHARP EDGES MAX.		APPROVED		
2. DO NOT SCALE DRAWING.		USED ON		
3. DIMENSIONS BASED UPON				
4. MAX. ALL MACH. SURFACES		MATERIAL		
5. DRAWING UNITS:				
FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY				
MECHANICAL/COOLING SYSTEMS LIQUID ARGON TEST BEAM FLOW SCHEMATIC				
SCALE	DRAWING NUMBER	SHEET	REV	
NONE	9212.100-MD-493666	1 OF 1		
CREATED WITH: Ideas12NXSeries		GROUP: PPD/MECHANICAL DEPARTMENT		

Created: 13:28:48 on 12-04-13 (D-M-Y) By: catalan State: 1-INITIAL

Component

purchased or fabricated for LArIAT

already available

on loan

- Specifications for the system were carefully analyzed and defined (FNAL- Mar.13)
 - ∅ Bid package (30 pages) is now complete (not yet public though), to go out during this week.
- FNAL purchasing department will ask for bids to come back in 2 weeks (with extension up to 4 weeks if companies request)
 - ∅ Bid cycle is expected to be finished and PO placed within the second half of May
- Lead time for delivery expected in the range of 6 to 8 months.

Cryogenics/purification system is therefore the main critical task on the path.

timeline

2013

2014

New Cryogenics/Purif. System **Design**

New Cryogenics/Purif. System **Fabrication**

New Cryogenics/Purif. Sys. **Commissioning**

Tertiary Beam Configuration **Design**

Tertiary Beam **Installation** (MC7)

Tertiary Beam **Commissioning**

Beam Line Instrum. **Procurement & Test**

Beam Line Instrum. **Installation** (MC7)

Beam Trigger (and c.r. trigger)

Cryostat Modifications **Design**

Cryostat **Modifications**

TPC **Design and Modification**

Scint. Light Detector **Fabrication & Test**

Scint. Light Detector **Installation**

Cold Electronics **Procur/Assembl/Install**

LArDetector **Assembly** (Cryostat/TPC/S cintL)

DAQ Upgrade

Detectors Synchronization, Online Monitoring

Commissioning (LAr)

Critical Task

Needs updating

Critical Task

Summer Activity

we are here



Can this Gap be filled by a temporary alternative Option?

Costs to complete

New Cryogenics/Purif. System Design	
New Cryogenics/Purif. System Fabrication	FNAL PPD responsibility 
New Cryogenics/Purif. Sys. Commissioning	under FNAL PPD responsibility 
Tertiary Beam Configuration Design	
Tertiary Beam Installation (MC7)	under FNAL FTBF 
Tertiary Beam Commissioning	under FNAL FTBF 
Beam Line Instrum. Procurement & Test	under FNAL FTBF  and LArIAT - funding needed for final assembly 
Beam Line Instrum. Installation (MC7)	
Beam Trigger and C.R. trigger	funded by DoE/Yale  and by FNAL/LArIAT - funding needed 
Cryostat Modifications Design	
Cryostat Modifications	funded by DoE/Yale  Needs updating
TPC Design and Modification	funded by DoE/Yale  Still correct?
Scint. Light Detector Fabrication & Test	in kind (L'Aquila U. /LArIAT) 
Scint. Light Detector Installation	need to purchase feedthroughs 
Cold Electronics Procur/Assembl/Install	proposed for funding 
LArDetector Assemby (Cryostat/TPC/ScintL)	need support 
DAQ Upgrade	need support  
Detectors Synchronization, Online Monitoring	  Collaboration expense
Commissioning (LAr Filling/Purification)	to be defined

I suggest this as a separate talk given by Carl.

I strongly suggest we remove the cost & schedule table to backup.

This follows conversations with Randy. Let them ask if they want.

Also, we should be careful this doesn't sound too much like a sales pitch.

Cold Electronics for LArIAT

Carl Bromberg

Michigan State University

Cold Electronics: Cost and Schedule

- Costs including MSU indirect costs (53%)

Table - Cold Preamplifier Cost Breakdown

<u>Item</u>	<u>Cost</u>
480-ch of cold preamps, internal cabling & external cable drivers	\$66.0k
Preamp Engineering, testing/installation (2 months, D. Shooltz)	\$44.0k
ADF2 firmware (2 months, D. Edmunds)	<u>\$52.0k</u>
	Total \$162.0k
Less an MSU contribution (1 month D. Edmunds)	<u>-\$26.0k</u>
	Total \$136.0k

- Schedule (assuming start May 1, 2013)

- Complete ASIC preamp motherboard & control June 15, 2013
- Complete acquisition of components and QA July 15, 2013
- Complete assembly of boards, chassis, cables Sept. 15, 2013
- Complete installation and checkout
(requires cryostat/purifier/TPC ready) Sept. 30, 2013

- Additional manpower for installation:

- U. Cincinnati (PD) and U. Texas, Arlington (PD at FNAL, 2 months: \$15k)