MicroBooNE Operations

Michael Mooney

BNL

Outline

♦ Operations at MicroBooNE

- Operations Organization/Communication

- Safety

- Shift Taking and Detector Monitoring

- Reporting POT and Beam Performance

- Calibration Run Plan
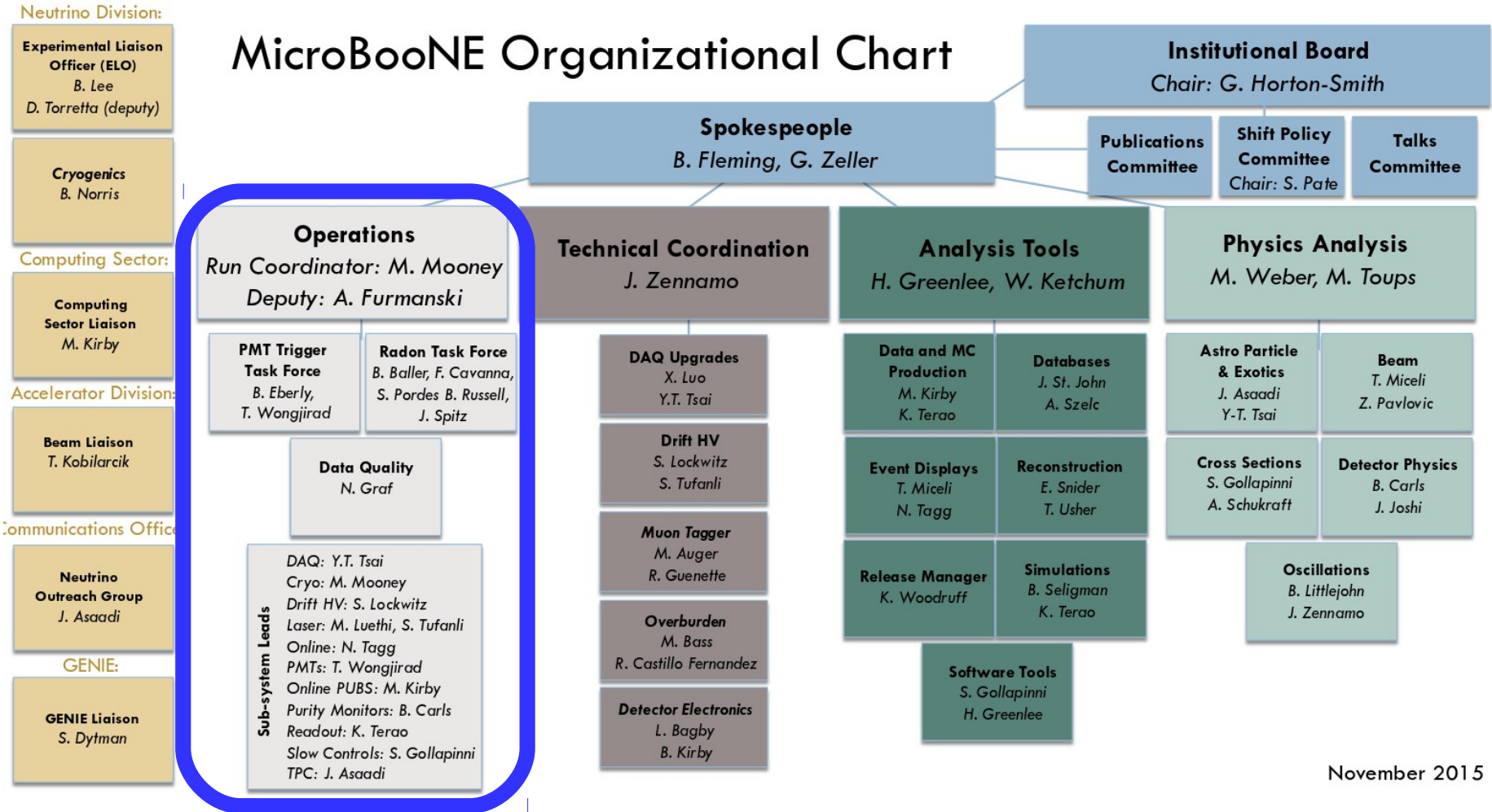
- Spares

ORR Charge Questions

♦ Addressing two ORR charge questions in this talk:

- **ORR Charge Question #2**: "Has it been demonstrated that the detector is ready for physics-quality data taking? If not, what actions are required to make the detector ready? Is there a clear plan for monitoring the data quality and has the associated infrastructure been tested? If not, what actions are required to adequately monitor the data quality?"

- **ORR Charge Question #3**: "Is there a well-understood run plan for FY16, consistent with accelerator schedule and performance? Have adequate resources from the laboratory and the collaboration been identified for an efficient and safe running of the experiment and for maintenance of the detector, and is it clear who is responsible for what?"

Start of Operations
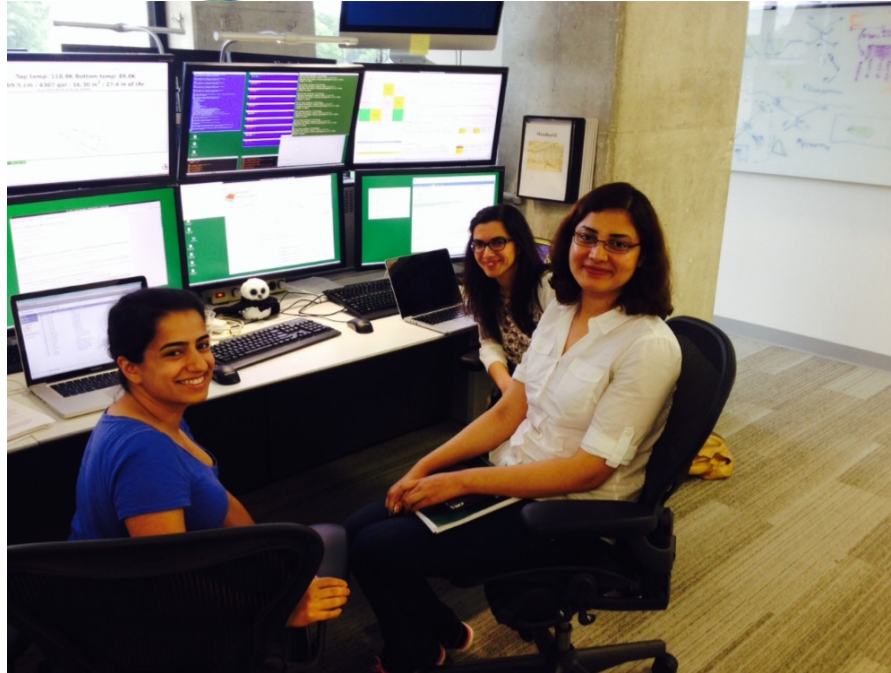
♦ First began **shifting** in ROC West on **June 1ˢᵗ**

- Two shifters, Mon-Thurs/Fri-Sun blocks, Owl/Day/Evening shifts
- Beginning trial runs of one local, one remote shifter

♦ **Operations and DAQ in stable state for first beam**

- Taking data (noise/cosmic runs) since June

MicroBooNE Organization

MicroBooNE Organizational Chart

Neutrino Division:

Experimental Liaison Officer (ELO)
B. Lee
D. Torretta (deputy)

Cryogenics
B. Norris

Computing Sector:

Computing Sector Liaison
M. Kirby

Accelerator Division:

Beam Liaison
T. Kobilarcik

Communications Office:

Neutrino Outreach Group
J. Asaadi

GENIE:

GENIE Liaison
S. Dytman

Institutional Board
Chair: G. Horton-Smith

Spokespeople
B. Fleming, G. Zeller

Publications Committee

Shift Policy Committee
Chair: S. Pate

Talks Committee

Operations
Run Coordinator: M. Mooney
Deputy: A. Furmanski

PMT Trigger Task Force
B. Eberly,
T. Wongjirad

Radon Task Force
B. Baller, F. Cavanna,
S. Pordes B. Russell,
J. Spitz

Data Quality
N. Graf

Sub-system Leads
DAQ: Y.T. Tsai
Cryo: M. Mooney
Drift HV: S. Lockwitz
Laser: M. Luethi, S. Tufanli
Online: N. Tagg
PMTs: T. Wongjirad
Online PUBS: M. Kirby
Purity Monitors: B. Carls
Readout: K. Terao
Slow Controls: S. Gollapinni
TPC: J. Asaadi

Technical Coordination
J. Zennamo

DAQ Upgrades
X. Luo
Y.T. Tsai

Drift HV
S. Lockwitz
S. Tufanli

Muon Tagger
M. Auger
R. Guenette

Overburden
M. Bass
R. Castillo Fernandez

Detector Electronics
L. Bagby
B. Kirby

Analysis Tools
H. Greenlee, W. Ketchum

Data and MC Production
M. Kirby
K. Terao

Databases
J. St. John
A. Szelc

Event Displays
T. Miceli
N. Tagg

Reconstruction
E. Snider
T. Usher

Release Manager
K. Woodruff

Simulations
B. Seligman
K. Terao

Software Tools
S. Gollapinni
H. Greenlee

Physics Analysis
M. Weber, M. Toups

Astro Particle & Exotics
J. Asaadi
Y-T. Tsai

Beam
T. Miceli
Z. Pavlovic

Cross Sections
S. Gollapinni
A. Schukraft

Detector Physics
B. Carls
J. Joshi

Oscillations
B. Littlejohn
J. Zennamo

November 2015

♦ Operations at MicroBooNE has significant (wo)manpower!

Org. Chart for Operations

Operations
Run Coordinator: M. Mooney
Deputy: A. Furmanski

PMT Trigger Task Force
B. Eberly,
T. Wongjirad

Radon Task Force
B. Baller, F. Cavanna,
S. Pordes B. Russell,
J. Spitz

Data Quality
N. Graf

# of Experts

Sub-system Leads:

	# of Experts
DAQ: Y.T. Tsai	3+2
Cryo: M. Mooney	2+1
Drift HV: S. Lockwitz	2+1
Laser: M. Luethi, S. Tufanli	2+1
Online: N. Tagg	1+0
PMTs: T. Wongjirad	3+0
Online PUBS: M. Kirby	3+0
Purity Monitors: B. Carls	1+1
Readout: K. Terao	4+0
Slow Controls: S. Gollapinni	2+0
TPC: J. Asaadi	3+0

(Current+Training)

♦ Three working groups under operations umbrella:
  • PMT Trigger Efficiency Task Force
  • Radon Task Force
  • Data Quality Monitoring (DQM)

♦ Also subsystem operations leads
  • Ensure on-call expert shifts filled
  • Help to organize subsystem maintenance
  • Communicate between Run Co. and other subsystem experts
  • Aid Run Co. in developing run plan
  • Ensure new experts are properly trained

Run Coordination

MicroBooNE
Run Coordinator
Schedule
2015-2016

Oct 2015	Nov 2015	Dec 2015
Run Coordinator: Mike Mooney (BNL) *Deputy Run Coordinator: Andy Furmanski (Manchester)* *Technical Coordinator: Joseph Zennamo (U Chicago)*		
Jan 2016	Feb 2016	Mar 2016
Run Coordinator: Mike Mooney (BNL) *Deputy Run Coordinator: Andy Furmanski (Manchester)* *Technical Coordinator: Joseph Zennamo (U Chicago)*		
Apr 2016	May 2016	June 2016
Run Coordinator: Andy Furmanski (BNL) *Deputy Run Coordinator: Matt Bass (Oxford)* *Technical Coordinator: Joseph Zennamo (U Chicago)*		
Jul 2016	Aug 2016	Sept 2016
Run Coordinator: Matt Bass (Oxford) *Deputy Run Coordinator: Person X (TBD)* *Technical Coordinator: Joseph Zennamo (U Chicago)*		
Oct 2016	Nov 2016	Dec 2016
Run Coordinator: Person X (TBD) *Deputy Run Coordinator: Person Y (TBD)* *Technical Coordinator: Person Z (TBD)*		

Run Coordinator prior to October:

Matt Toups (MIT/Fermilab)

<u>Terms:</u>

• Run Coordinator: 6 months
  (3 months as Deputy Run Coordinator,
  followed by 3 months as Run Coordinator)

• Technical Coordinator: 1 year

♦ Run coordinators (RC) oversee operations/maintenance as well as communicate state of operations to MicroBooNE and Fermilab

♦ Also responsible for organizing shifts and training shifters

♦ Tenure: three months as deputy RC, three months as full RC

Operations Task Forces
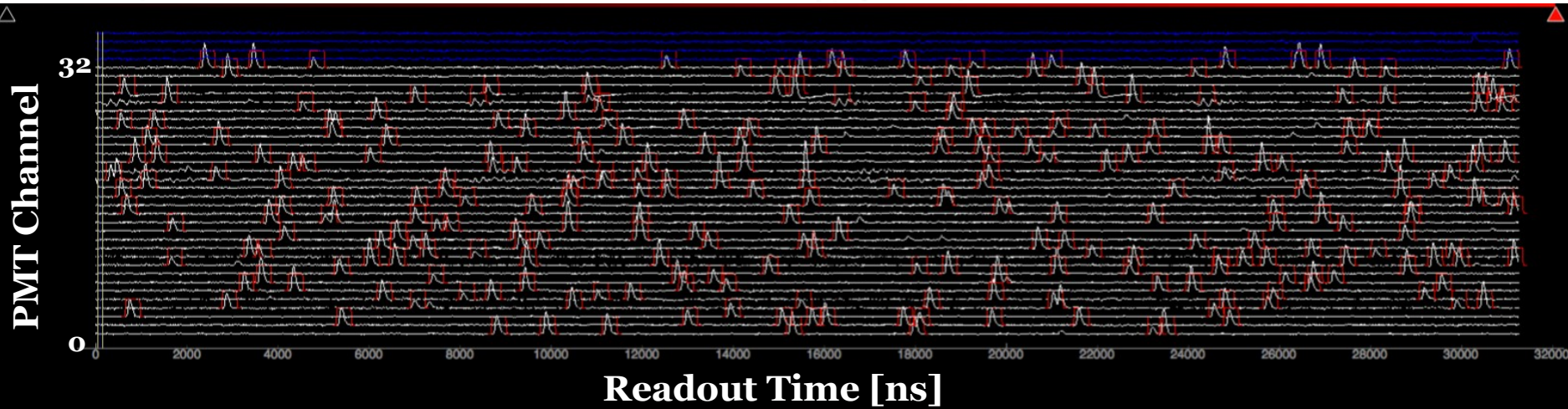
- ♦ Single photo-electron rate higher than expected; in part due to radon

- ♦ Two **operations task forces** related to this and PMT trigger:
    - PMT Trigger Efficiency Task Force: charged with measuring efficiency of PMT trigger, to be used to set PMT trigger thresholds
    - Radon Task Force: charged with determining radon source in detector and finding/implementing solution to reduce radioactivity levels

- ♦ Both very active groups – see Taritree's PMT Trigger talk

Ops Communication

MicroBooNE Organizational Chart

Neutrino Division:

Experimental Liaison Officer (ELO)
B. Lee
D. Torretta (deputy)

Coordinates Fermilab's resources to building-related problems encountered by the experiment, as requested by Run Co.

Cryogenics
B. Norris

Computing Sector:

Computing Sector Liaison
M. Kirby

Communicates cryogenics-related maintenance/operations issues to Run Co.

Accelerator Division:

Beam Liaison
T. Kobilarcik

Helps Run Co. to schedule and coordinate maintenance of DAQ and control room machines

Communications Office:

Neutrino Outreach Group
J. Asaadi

GENIE:

GENIE Liaison
S. Dytman

Informs Run Co. of beam downtime and helps communicate with AD

Institutional Board
Chair: G. Horton-Smith

Operations
Run Coordinator: M. Mooney
Deputy: A. Furmanski

Technical Coordination

Analysis Tools

M. Weber, M. Toups

PMT Trigger Task Force
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Radon Task Force
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Software Tools
S. Gollapinni
H. Greenlee

Slow Controls: S. Gollapinni
TPC: J. Asaadi

B. Kirby

November 2015

Safety

♦ Ensure that all shifters, experts, and those accessing LArTF pit/platform know procedures and have proper training

♦ Shifters:

- Run Co. ensures all shifters have Fermilab training up to date (including LArTF Hazard Awareness Training)
- Run Co. schedules training session with shifters before first shift

♦ Experts:

- Subsystem operations lead ensures experts are trained to operate subsystem equipment safely and know all procedures

♦ Experimental liaison officer (ELO) updates Run Co. on building-related safety issues

- Run Co. forwards this information to collaboration
- ELO also manages list of people who can access LArTF

Safety (cont.)

♦ For accessing pit/platform at LArTF (ODH-1 areas), Run Co. enforces following procedure:

- Those requesting access **first** contact MicroBooNE shifters

- If Run Coordinator not already aware of work to be done, Run Co. is contacted by shifters or person requesting access

- Run Co. dictates interlock system (keytree with passcode) to ensure those accessing ODH-1 areas have proper training:

  - LArTF Hazard Awareness Training (checked against ELO's access list)

  - ODH Training (including medical evaluation)

- Those accessing platform leave ID in keytree, take a key, wait 60 seconds to see if there is an alarm, and take safety equipment

  - If no alarm, take only hard hat and oxygen monitor

  - If alarm in pit after 60 seconds, also take oxygen rescue pack

- When leaving pit/platform, must call MicroBooNE shifters and inform them they are leaving

Operations Wiki

uBoone Operations

Overview | Activity | Issues | New issue | **Wiki** | Repository | Settings

Before you start your shift

🖉 Edit ⭐ Watch 🔒 Lock ↪ Rename 🗑 Delete ◀ History

- Make sure you have a current Fermilab ID, Fermilab Kerberos account, and ⧉ Fermilab Services account (and go to "Request New/Renew Accounts" or call 630-840-2345 - 24 hours a day).

- Make sure your Fermilab ⧉ training is up to date and that you have ⧉ LArTF Hazard Awareness training.

- Ask a control room expert or the Run Coordinator to add your Kerberos principal to the .k5login files for the uboonedaq and ubooneshift users on uboone-cr-01, uboone-cr-02, uboone-cr-03, and uboone-cr04.

- Arrange for shift training with a control room expert or the Run Coordinator.

Shift Procedure 🖉

Review Operations Wiki Updates page 🖉

- Changes in shift procedure and important notices for shifters are listed by date in the **Operations Wiki Updates** page. Please review this list at the **beginning of every shift** and contact the relevant subsystem expert or Run Coordinator if you are not clear on new procedures.

- Be sure to reread parts of the Operations Wiki that have been updated (or are new) since the last shift you took. The Operations Wiki Updates page should make it very simple to determine which material should be reviewed.

- If your last shift was before October 14th, 2015 (the date the Operations Wiki Update page was created), please read the entire Operations Wiki. Ideally this should be done before the beginning of your shift.

Log on to the control room computers 🖉

Before you start your shift
Shift Procedure
    Review Operations Wiki Updates page
    Log on to the control room computers
    REFRESH ALL OPEN BROWSERS and sign in to E-log, Google+
    Check for special run plans, else follow the routine shift procedure
Run Control
Slow Controls/Monitoring
Online Monitoring Lizard
Data Management and PUBS
Laser System
Light Collection/PMT System
Beam Monitoring
Raspberry Pi Webcam
Cathode High Voltage
Readout Electronics
Time Projection Chamber (TPC)
Purity Monitors
MiniBooNE
Online Event Display (Mac Event Display)
Off-Site Shifts
Example System
Call Lists
    Expert call list (password-protected)
    Collaboration contact list (password-protected)
Useful Links
Expert actions

♦ **Operations Wiki**: stores special run plans, shift procedures, and monitoring tool instructions for shifters/experts

A Day in the Life of a Shifter

♦ Shifter shows up for shift **10 minutes early**, communicates with previous shifters about recent events, logs into E-log (all posts go there)

- **FORM: Beginning of Shift**

♦ Shifter actively monitors slow monitoring system, run control, BNB beam monitor, channel health monitor, event display, DAQ Ganglia metrics, etc.

- **FORM: Checklist** (<u>two hours</u> and <u>six hours</u> into shift)

♦ Shifter addresses alarms if any are seen in slow monitoring system

- **FORM: Alarm Acknowledged**

♦ If someone requests access to pit/platform shifter follows detector access procedure (see slides on "Safety")

- **FORM: Start of Detector Access**
- **FORM: End of Detector Access**

♦ If in short-term run plan, shifter posts reports about special monitoring

- **FORM: End of Shift**

Detector Monitoring

Minor Alarm

♦ Detector monitored by shifters via slow monitoring system

  • Many variables (4000+) monitored, archived, and alarmed on

Detector Monitoring (cont.)

What we like to see!

Example: Monitoring ASIC LV

♦ Detector monitored by shifters via slow monitoring system

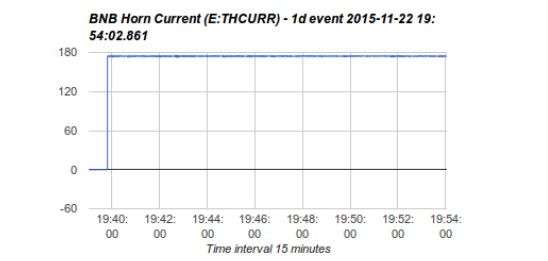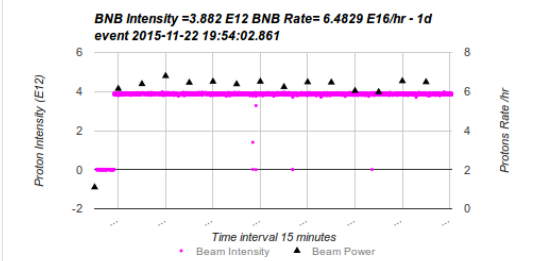- Many variables (4000+) monitored, archived, and alarmed on

Beam Monitoring

Booster Neutrino Beamline Status Display (e,1d events)
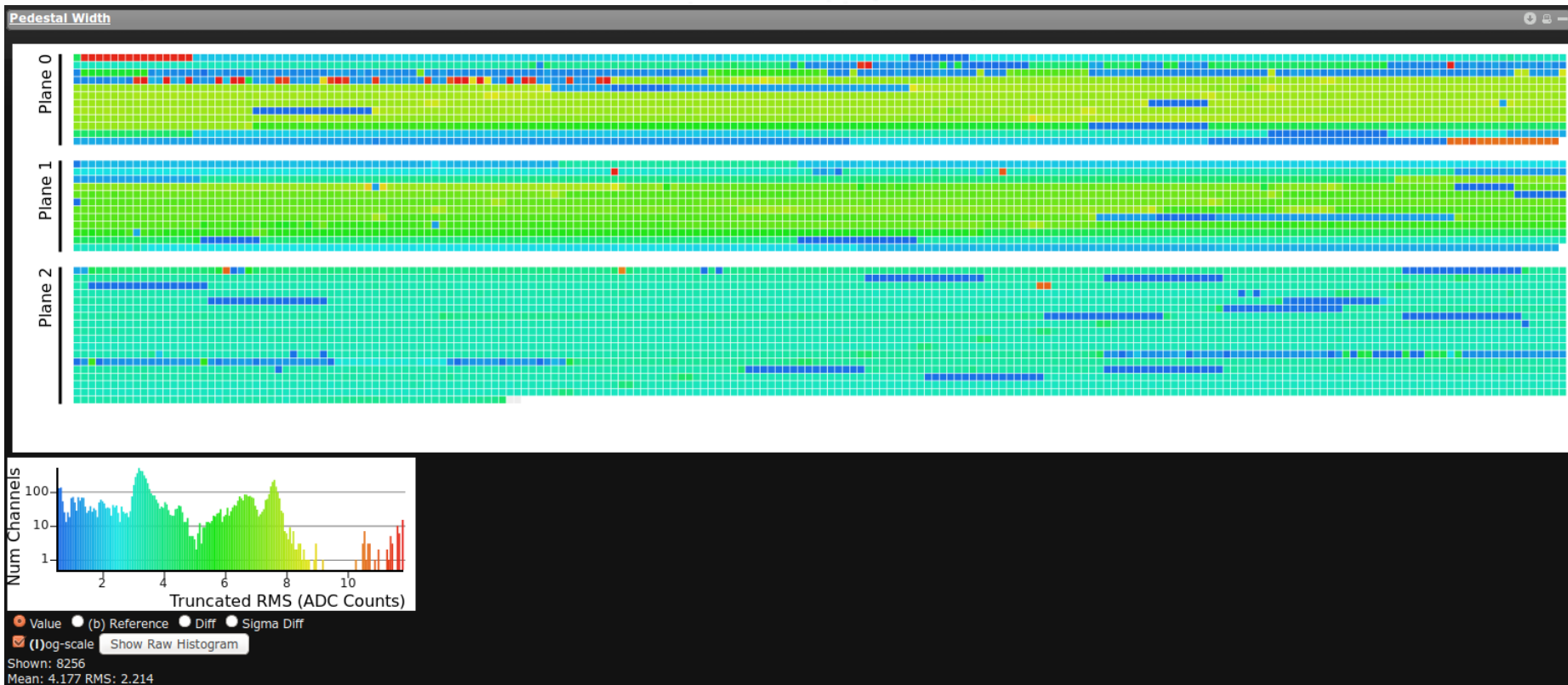Sun Nov 22 2015 19:54:32 GMT-0600 (CST) Last 1d time:Sun Nov 22 2015 19:54:08 GMT-0600 (CST)

Real Time   Historical search Enter Time : 2015-11-22 19:52:41   Get Plot   < prev spill   > next spill

BNB Protons on Target
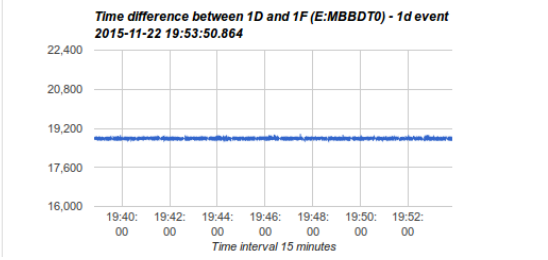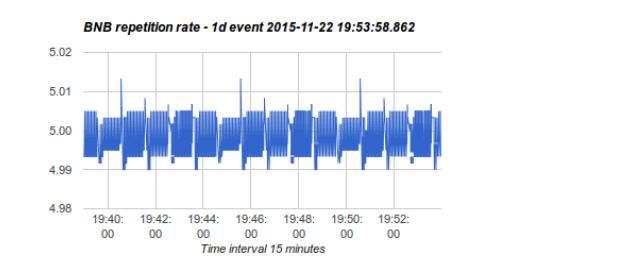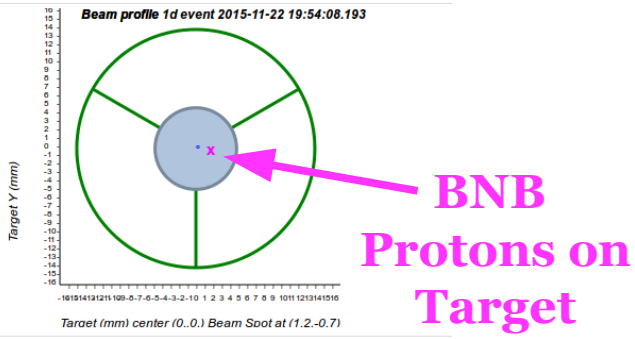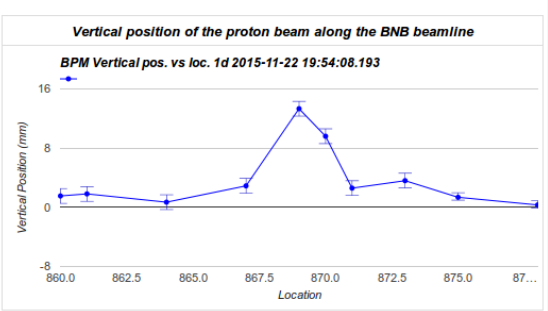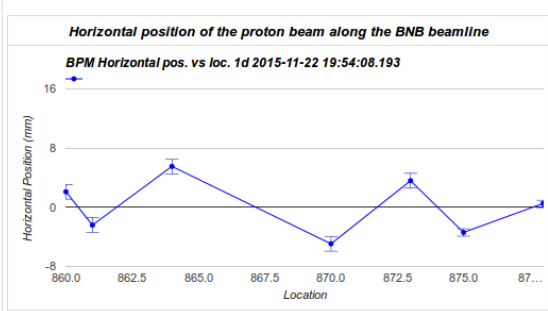
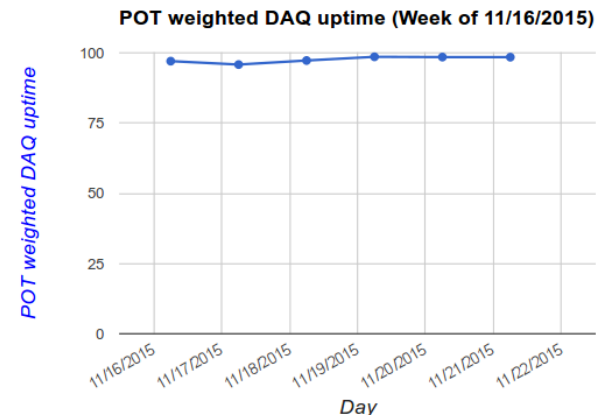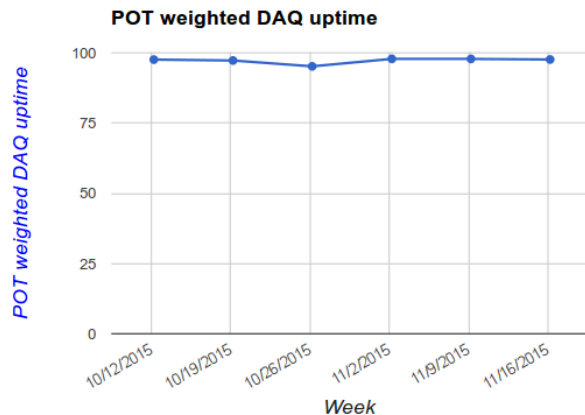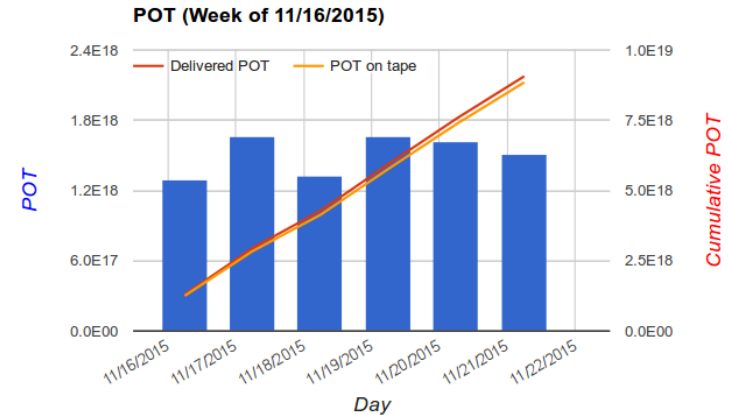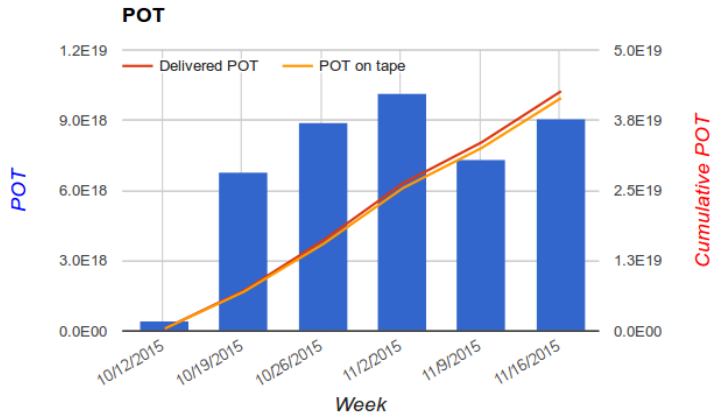♦ Shifters also actively monitor state of **BNB**

Shifter Checklist

- ♦ Twice a shift, shifter fills out **checklist** on E-log
  - Includes monitoring of bad channels, LV/HV, DAQ, beam status, etc.
  - Has already been useful in helping us learn about our detector

Beam Performance

♦ Recording/monitoring POT to tape for BNB and NuMI

♦ Independent set of monitoring plots for MiniBooNE

Beam Performance (cont.)

Triggers vs Spills

Triggers vs Spills (Week of 11/16/2015)

Trigger efficiency (Week of 11/16/2015)
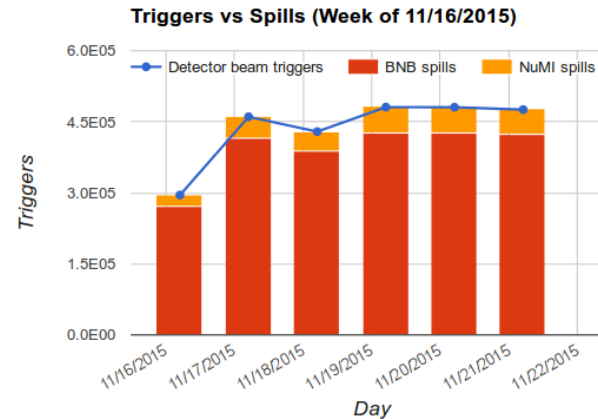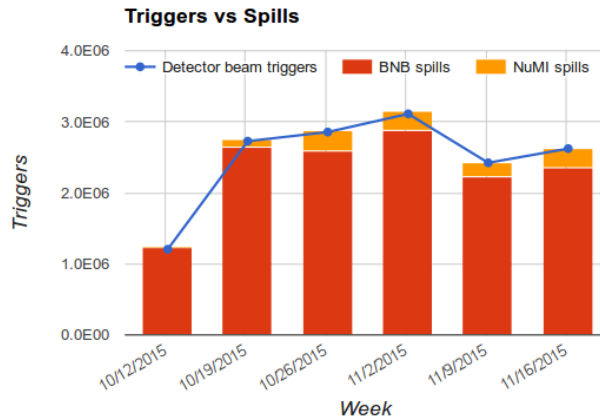
Triggering Efficiently on BNB _and_ NuMI Beam Spills
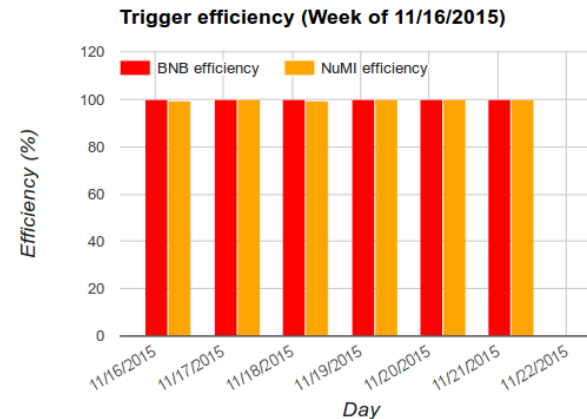
- ♦ Recording/monitoring POT to tape for BNB and NuMI
- ♦ Independent set of monitoring plots for MiniBooNE

Calibration Run Plan
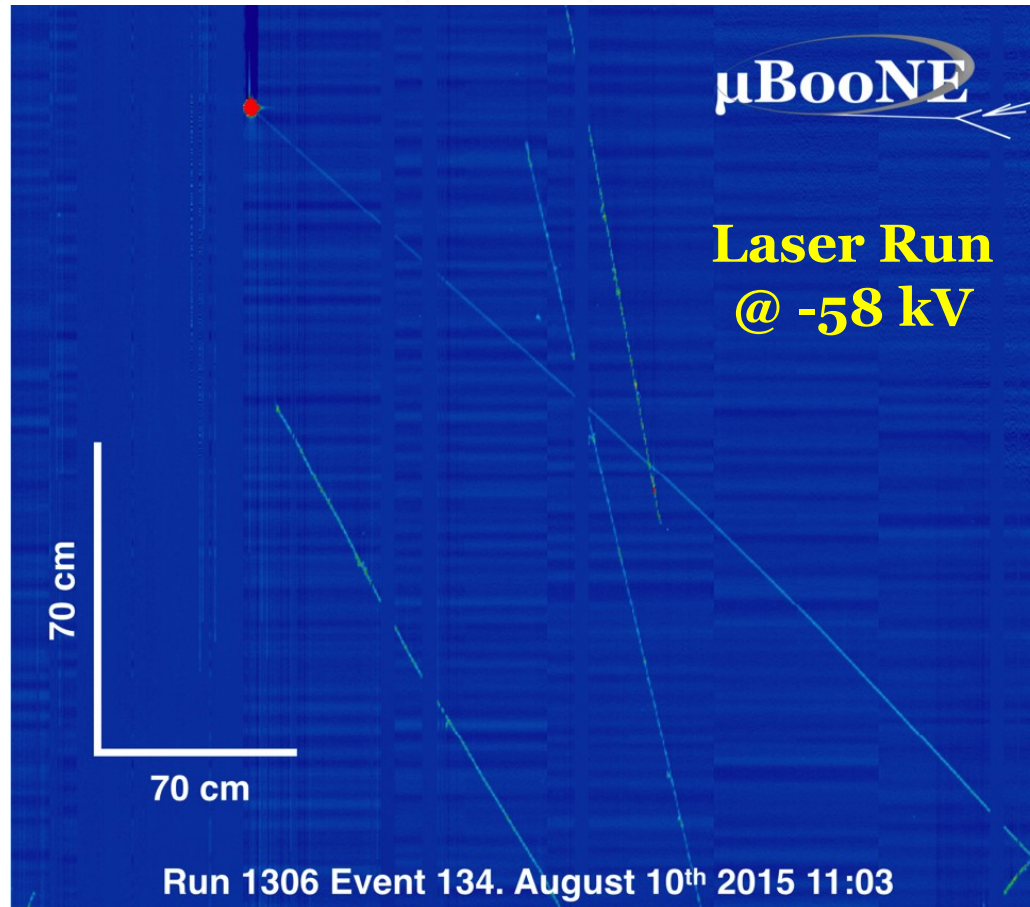
µBooNE

Laser Run
@ -58 kV

70 cm

70 cm

Run 1306 Event 134. August 10th 2015 11:03

♦ Take special runs as needed for calibrations and detector physics – laser, cosmic, special ASIC settings, etc.

Calibration Run Plan

Cathode Hit

μBooNE

Laser Run @ -58 kV

70 cm

70 cm

Space Charge Effect Not Large

Run 1306 Event 134. August 10th 2015 11:03

♦ Take special runs as needed for calibrations and detector physics – laser, cosmic, special ASIC settings, etc.

Calibration Run Plan (cont.)

♦ LArTPC technology requires infrequent calibration

♦ Nominal run plan is to **take data continuously** when beam up

- Laser runs: currently determining calib. frequency (weekly or monthly)

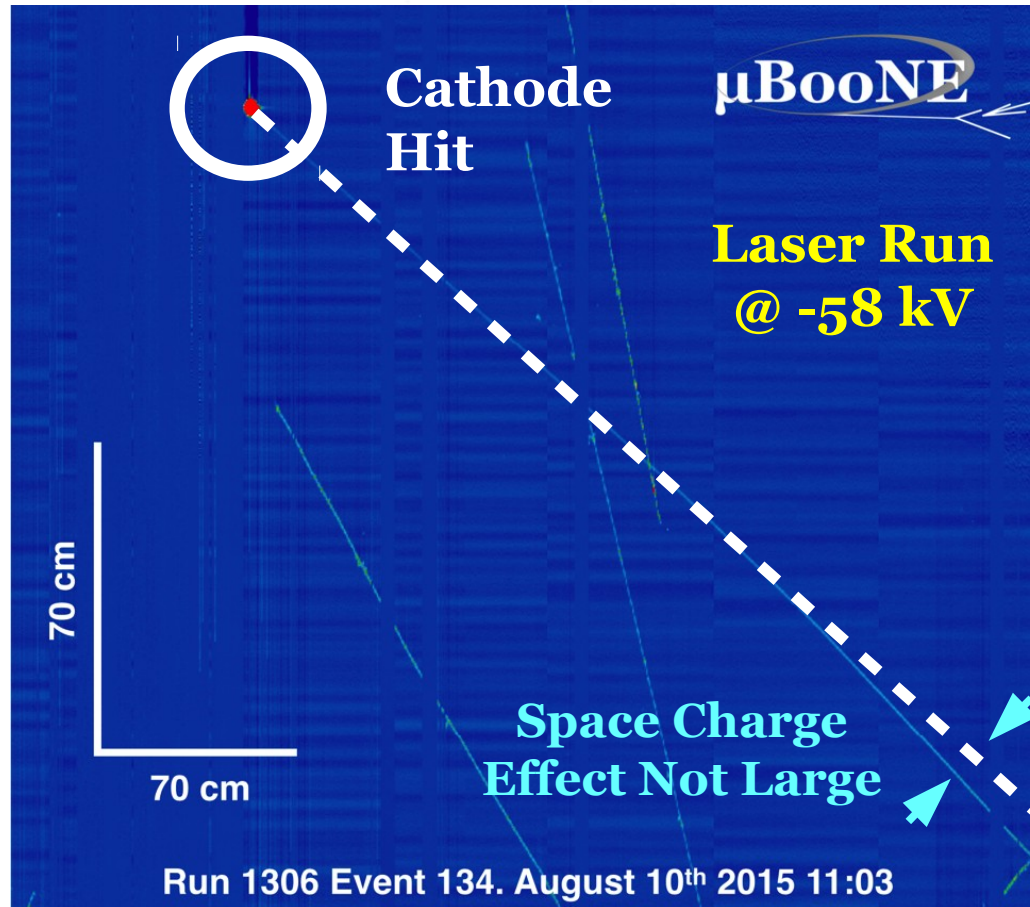- Muon paddle runs: typically taking when beam off – soon will also have muon paddle triggers with beam up

- Flasher runs: take as needed to calibrate PMT gain (when beam off)

- Pulser runs: take very infrequently (ASIC settings very stable)

♦ Procedure for collaborators requesting special runs:

- Contact Run Coordinators and come to operations toolbox meeting

- Prepare **detailed plan of action**: people involved, actions to perform, if DAQ is needed at each step, if platform access needed at each step, estimated time of completion for each step

♦ Preparing system for handling shelved requests for unexpected downtime (forms on our Operations Wiki)

MicroBooNE Spares

Subsystem	Part Name / Description	Manufacturer	Model Number	Quantity	Current Location	Expected Final Location
PMT	HV module	BiRA		1	Wilson Hall	DAB
Laser	Steerable Mirror	Zaber	T-OMG	1	Wilson Hall	DAB
Laser	Dichroic Mirror	Continuum	266nm Dichroic Mirrors	4	Wilson Hall	DAB
Laser	Water Filters	Continuum	Flow XF6 3/8	4	Wilson Hall	DAB
Laser	Flash Lamps	Continuum	Flashlamps	2	Wilson Hall	DAB
Laser	Brewster Polarizer	Altechna	2-BFP-0266-2040	4	Wilson Hall	DAB
Laser	Waveplate	Altechna	2-CPW-ZO-L/2-0266	2	Wilson Hall	DAB
Cabling	warm cabling, HV bias, LV, config, calib			Varies	LArTF	LArTF
DAQ	uboonedaq-evb			1	LArTF	LArTF
DAQ	uboonedaq-seb01			1	LArTF	LArTF
DAQ	uboonedaq-seb10			1	LArTF	LArTF
DAQ	10 Gigabit Network Interface Card	Intel		2	LArTF	LArTF
DAQ	PCIe Card w/ fuse			1	LArTF	LArTF
Slowmon	Slow controls rack monitor	FNAL		1	DAB	DAB
Racks	Rack protection system	FNAL		4	DAB	DAB
Electronics	Calibration fanout	FNAL		1	DAB	DAB
Racks	AC switch box	FNAL		3	DAB	DAB
Purity Monitor	LAr PM Electronics Module	FNAL	Type 2, Jan 2013, Ser #15	1	Wilson Hall	DAB
Purity Monitor	LAr PM Automation Module	FNAL		1	LArTF	LArTF
Purity Monitor	Flash Lamp Bulb	Newport	6427, 5J Large Bulb Xe	3	Wilson Hall	DAB
Purity Monitor	Flash Lamp Housing	Oriel		1	Wilson Hall	DAB
Purity Monitor	Flash Lamp Power Supply	Newport	68826	1	LArTF	LArTF
Purity Monitor	HV Feedthrough	FNAL		2	Wilson Hall	DAB
Shift	Shift workstation			1	ROC West	ROC West

- ♦ Spares for most run-critical components
  - • Working on preparing spare interlock chassis, Lambda PS (PMT)
- ♦ Currently collecting spares at permanent storage locations

MicroBooNE Spares (cont.)

Subsystem	Part Name / Description	Manufacturer	Model Number	Quantity	Current Location	Expected Final Location
Readout Electronics	PMT XMIT Board			1	LArTF	LArTF
Readout Electronics	PMT Shaper Board			1	LArTF	LArTF
Readout Electronics	PMT Shaper Board			1	LArTF	LArTF
Readout Electronics	PMT FEM Board			1	LArTF	LArTF
Readout Electronics	PMT CTRL Board			1	LArTF	LArTF
Readout Electronics	TPC Trigger Board			1	LArTF	LArTF
Readout Electronics	PMT FEM Board			1	LArTF	LArTF
Readout Electronics	TPC XMIT Board			1	LArTF	LArTF
Readout Electronics	TPC CTRL Board			1	LArTF	LArTF
Readout Electronics	TPC FEM Board			12	LArTF	LArTF
Readout Electronics	NIM module	FNAL	688AL (level adapter)	2	LArTF	LArTF
Readout Electronics	NIM module	FNAL	623 (discriminator)	3	LArTF	LArTF
Readout Electronics	NIM module	FNAL	365AL (coincidence)	1	LArTF	LArTF
Readout Electronics	NIM module	FNAL	365ALP (coincidence)	1	LArTF	LArTF
Readout Electronics	NIM module	FNAL	375L (coincidence)	1	LArTF	LArTF
Readout Electronics	NIM module	FNAL	222 (gate generator)	2	LArTF	LArTF
Readout Electronics	NIM module	FNAL	428 (fan-in-fan-out)	1	LArTF	LArTF
Readout Electronics	NIM module	FNAL	620AL (discriminator)	2	LArTF	LArTF
Readout Electronics	NIM module	FNAL	1880 scaler	3	LArTF	LArTF
Readout Electronics	NIM module	FNAL	622 (coincidence)	1	LArTF	LArTF
Readout Electronics	NIM module	FNAL	429A (fan-in-fan-out)	1	LArTF	LArTF
HV	Glassman power supply	Glassman	LX150N12	1	PAB	PAB
HV	Cable	Glassman		1	PAB	PAB
HV	Filter Pot	Jostlein Industries		1	PAB	PAB
HV	Cable	Dielectric Sciences		1	PAB	PAB
HV	Feedthrough	Jostlein Industries		1	MiniBooNE	MiniBooNE
HV	Spring tip	Jostlein Industries		1	PAB	PAB

♦ Spares for most run-critical components

- Working on preparing spare interlock chassis, Lambda PS (PMT)

♦ Currently collecting spares at permanent storage locations

Summary

♦ MicroBooNE has been in stable state of operations since first beam on October 15th

- DAQ uptime consistently above **97%**

♦ Operations team established to ensure constant monitoring of detector, safety procedures followed

♦ Shifters making use of wide array of well-documented monitoring tools

- Shifter **checklist** ensuring detector health scrutinized

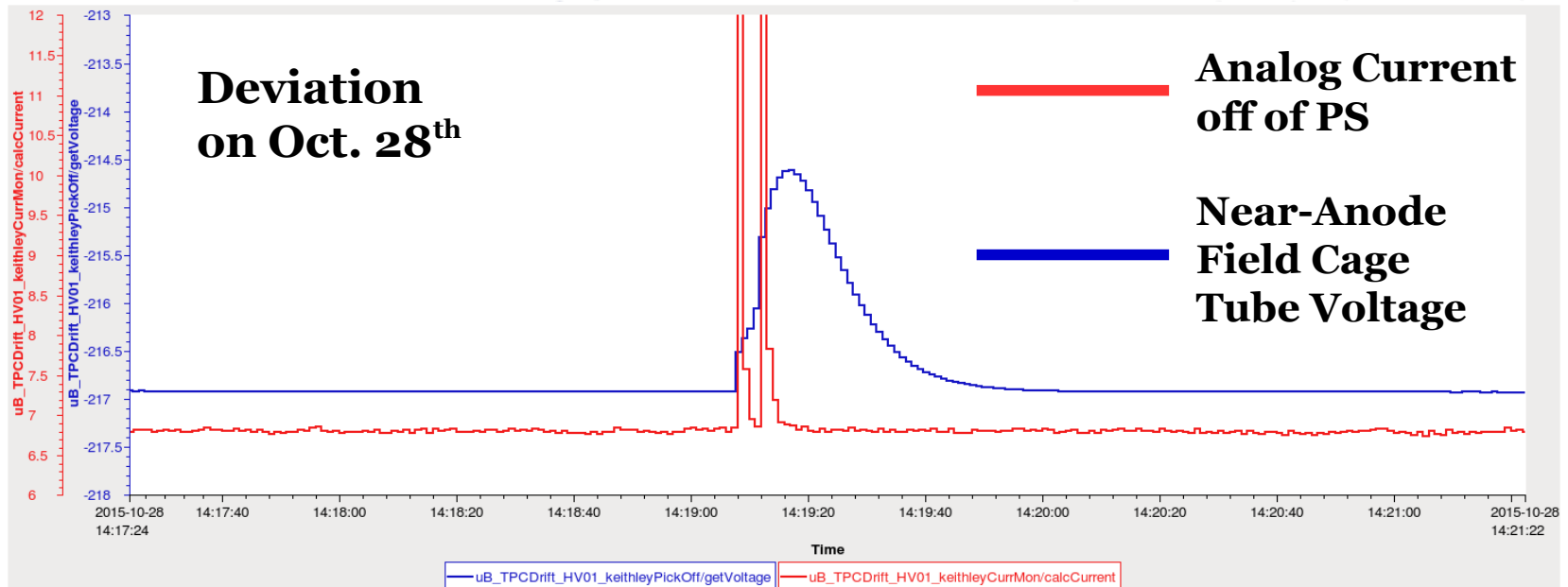♦ Run plan and spares list established

BACKUP SLIDES

Drift HV Trips
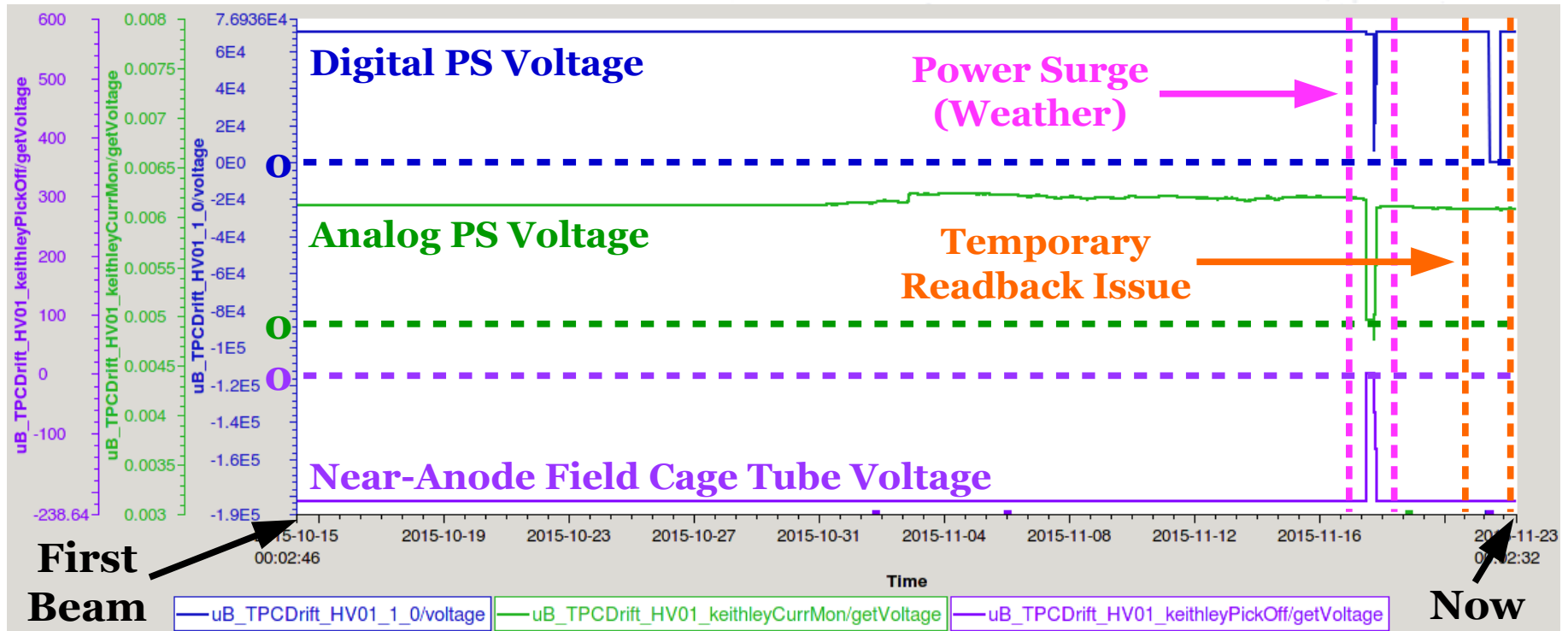
- **No cathode HV trips** ever observed while operating at **-70 kV**
  - One exception: power surge due to severe weather (Nov. 18th)

Drift HV Fluctuations

Deviation on Oct. 28th

- ♦ Shifters observed small deviations in cathode HV level
  - Pick-off point + analog current at PS (sometimes)

- ♦ Happening **roughly once per day** – less than 1% deviation
  - Observation of light with paddle PMT's suggest these are real discharges
  - Thanks to varistors do not expect there to be damage occurring to TPC

Locations of Spares

- ♦ **LArTF**
  - **Minimizes time taken** to locate, and minimizes chance of part being lost, misplaced, or taken
  - **Limited space**, only some components can be stored here
  - Spare DAQ machines, readout electronics **part of test-stand**

- ♦ **DAB**
  - Plenty of space for **larger components**
  - Takes **~30 minutes** to drive to DAB, fetch spare, and drive back
  - A spares rack will hold rack-based spares that don't fit in LArTF
  - A cabinet will hold **labeled** spares **sorted** by subsystem

- ♦ **PAB**
  - Used for many HV tests in the past
  - Some HV spares are **still in use** in this building by test experiments

Replacement Time of Spares

Component	Estimated Replacement Time
NIM module	1 hour
Control room workstation	30 minutes
NIM crate	2-4 hours (depending on cabling complexity, possibly more)
Rack Protection System, Slow Controls Hardware	1-2 hours
DAQ machine	4 hours
HV component	1 day

- Replacement time depends greatly on component
- Estimate is **after diagnosing problem** and experts arriving