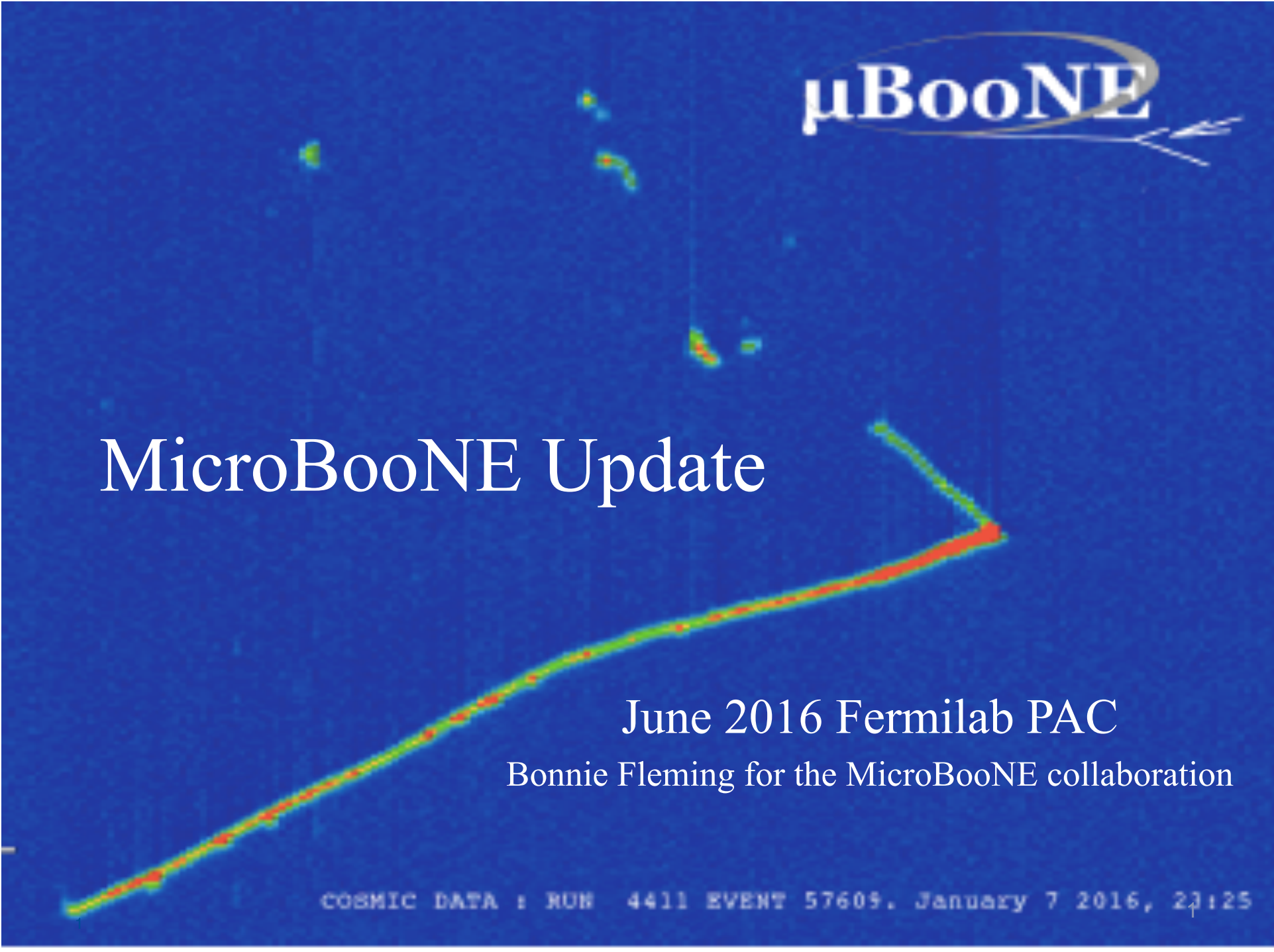


The background of the slide is a visualization of the MicroBooNE detector. It shows a blue grid representing the detector's structure. Several bright, multi-colored spots (yellow, green, red) are scattered across the grid, representing particle interactions or events. A prominent, curved line of red and yellow points starts from the bottom left and extends towards the center right, possibly indicating a specific event or a track.

μ BooNE

MicroBooNE Update

June 2016 Fermilab PAC

Bonnie Fleming for the MicroBooNE collaboration

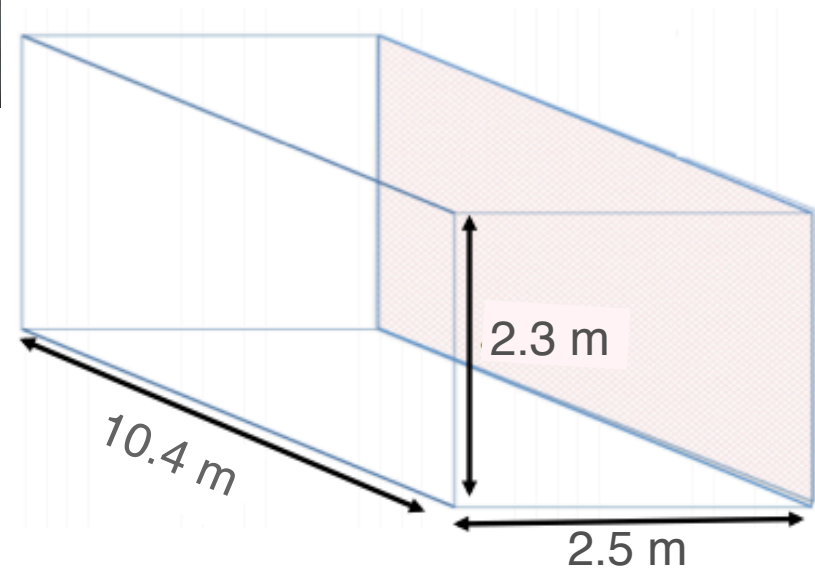
COSMIC DATA : RUN 4411 EVENT 57609. January 7 2016, 23:25

MicroBooNE

- LAr TPC (170 tons)
 - non-evacuated argon fill
 - cold (in argon) front-end electronics
 - long drift distance (2.5 m)
 - near surface operation
 - UV laser calibration system



- Goals:
 - address MiniBooNE excess
 - measure the first low energy neutrino-argon cross sections
 - R&D for future detectors (SBN and DUNE)
 - First phase in SBN program



DOE Achievement Award

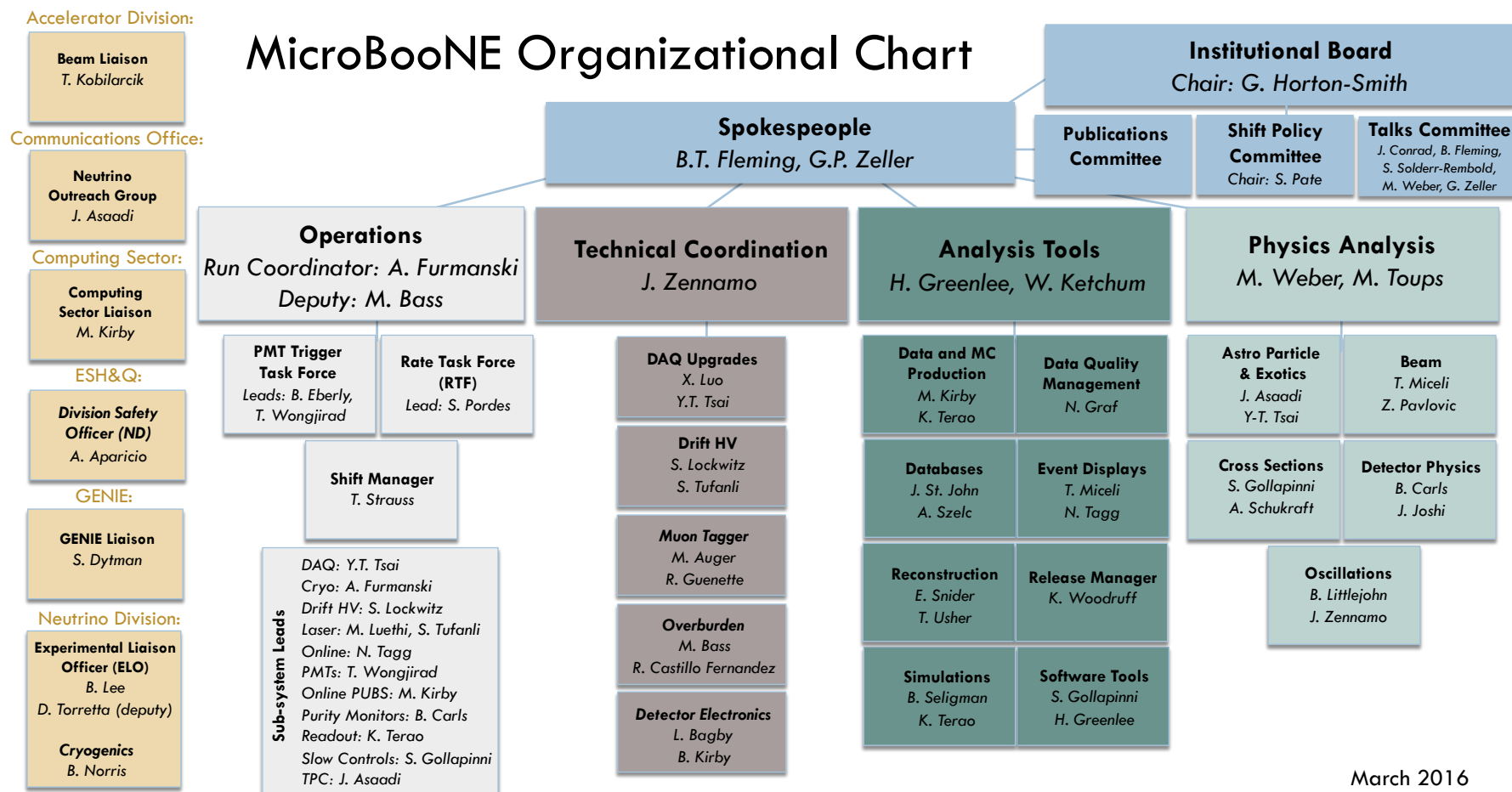
Paul Philp (Federal Project Director, Fermilab Site Office) was awarded a DOE Achievement Award for the successful completion of the MicroBooNE project. Congratulations to Paul and the MicroBooNE project team!



The plaque reads: "The MicroBooNE project team successfully fabricated a unique, first-of-its-kind 100 ton neutrino detector for the high energy physics program of discovery in neutrino science..."

MicroBooNE year 1 is nearing completion.....

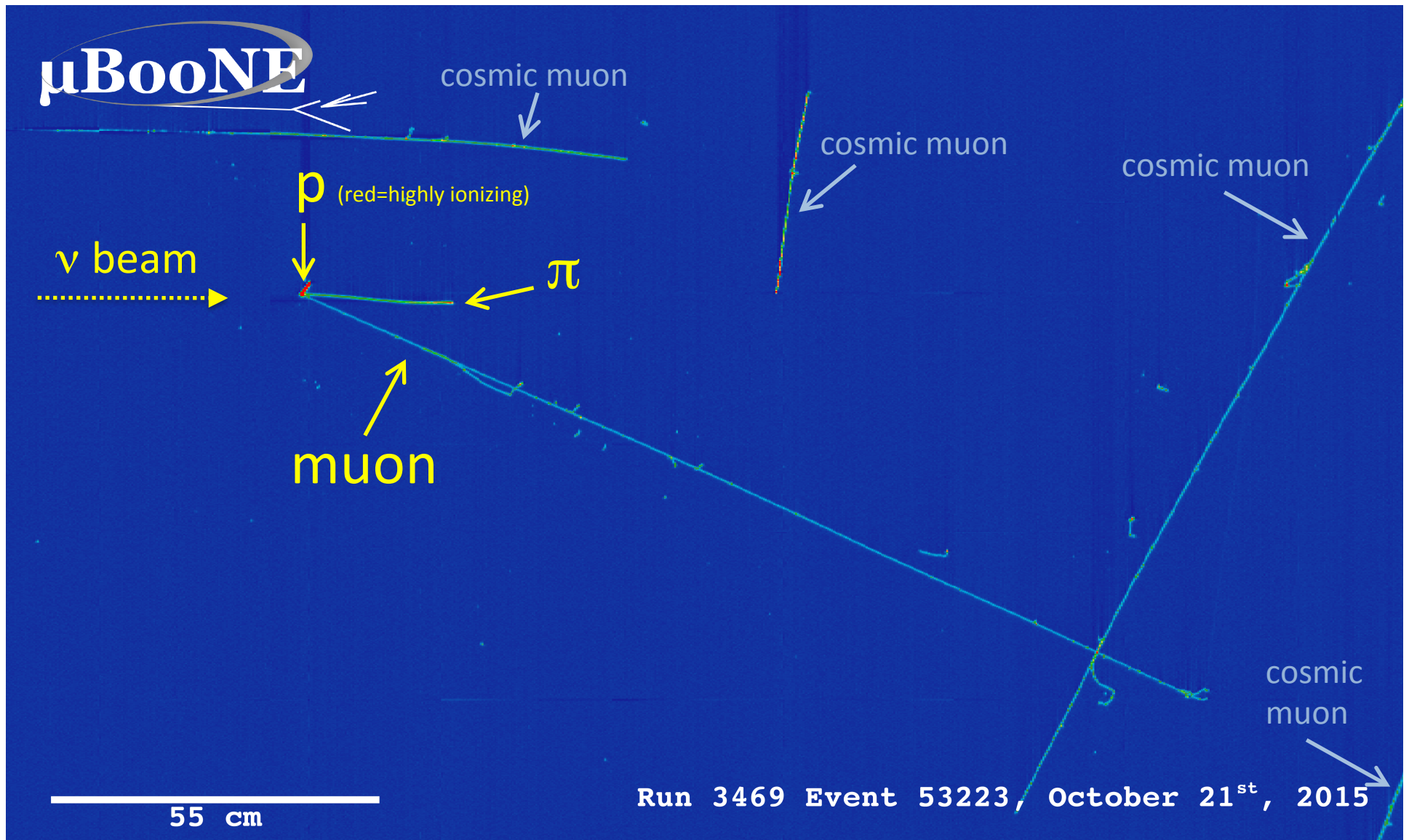
- Operations
- Analysis
- Technical upgrades
- Collaboration



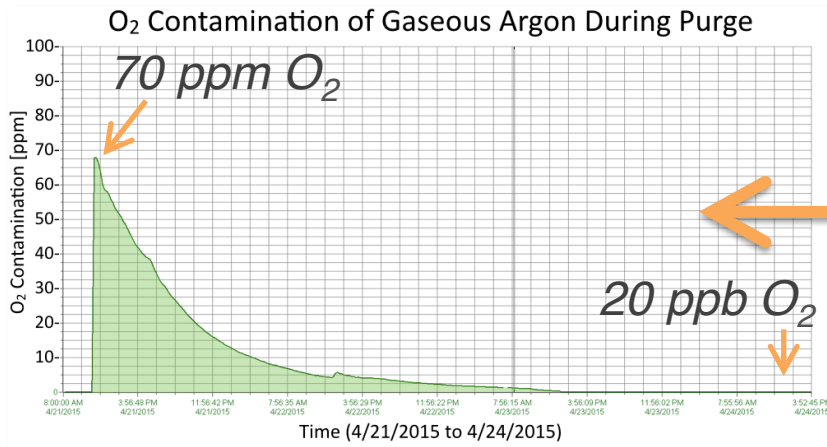
March 2016

MicroBooNE within the SBN program

Start of Operations → First Neutrinos: October 15, 2015

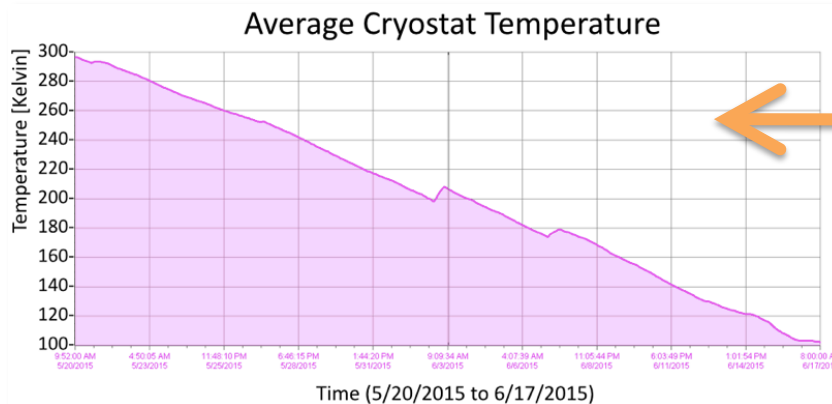


Cryogenics Cool Down and Operations



- step 1: purge with gaseous argon

- *first demonstration of this technique in a fully instrumented physics experiment*
 → *vessel evacuation not necessary*

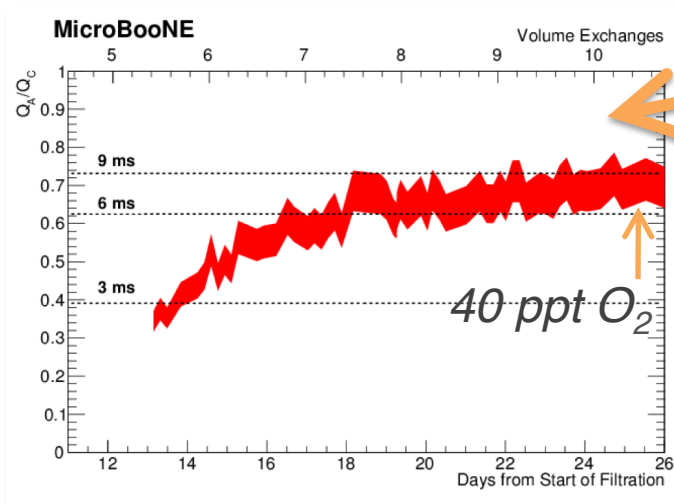


- step 2: cool to LAr temperatures

- *slowly cooldown (~8K/day) for a month*

- step 3: liquid argon fill (170 tons)

- *9 tanker truck loads, 22 days*



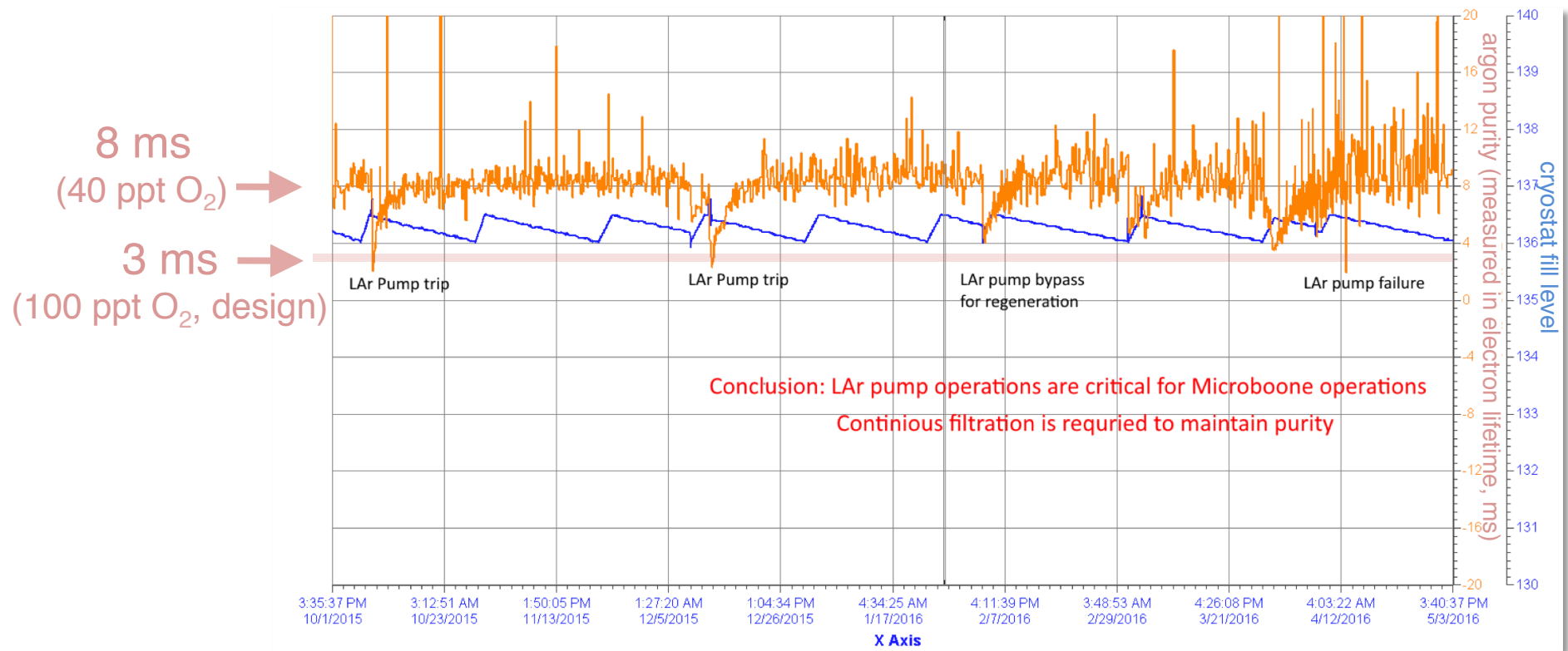
- step 4: recirculation and purification

- *MicroBooNE has been operating stably at > 2-3x design purity*

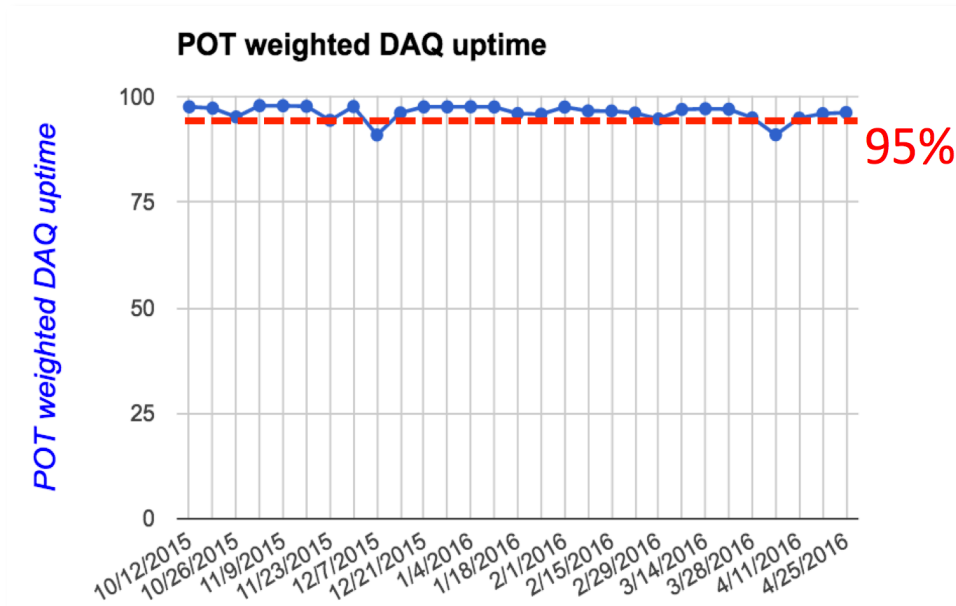
- *FNAL cryo staff were critical to this success*

Cryogenics Stability over time

- The performance of the MicroBooNE cryogenics system has been excellent – we maintain an average argon purity that is consistently above design (design = 3 ms electron lifetime = 100 ppt O₂)



MicroBooNE Data Acquisition and storage to tape

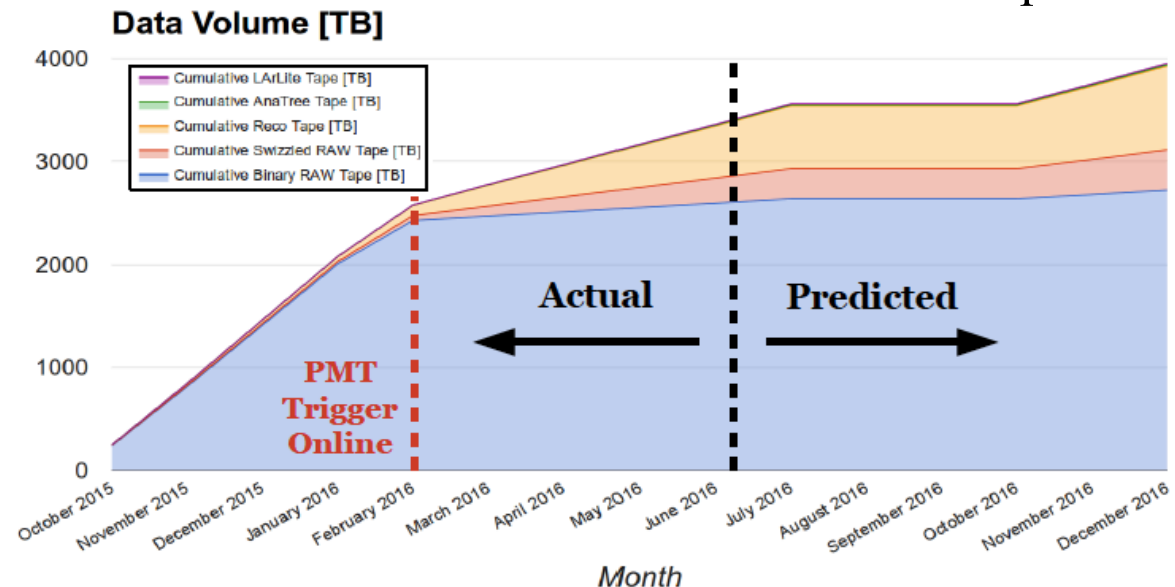


- DAQ performed well on day one with high reliability ($> 95\%$)
- Very stable despite receiving > 3 times expected data rate
- Computing Model Task force underway

Many thanks to SCD
for all their help!

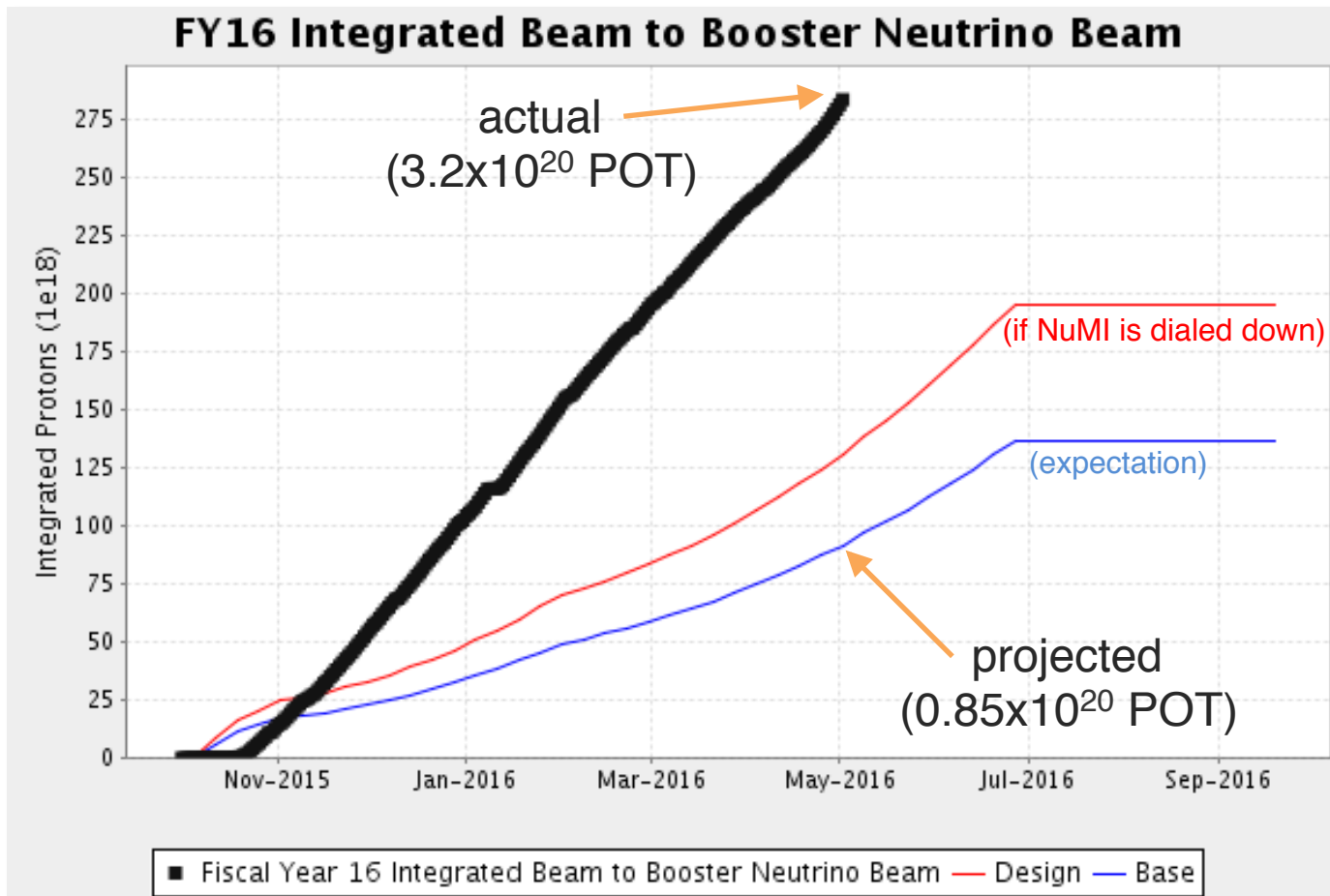
Data volume
before and after
PMT trigger
implementation.

High single PE rate
still not
understood...



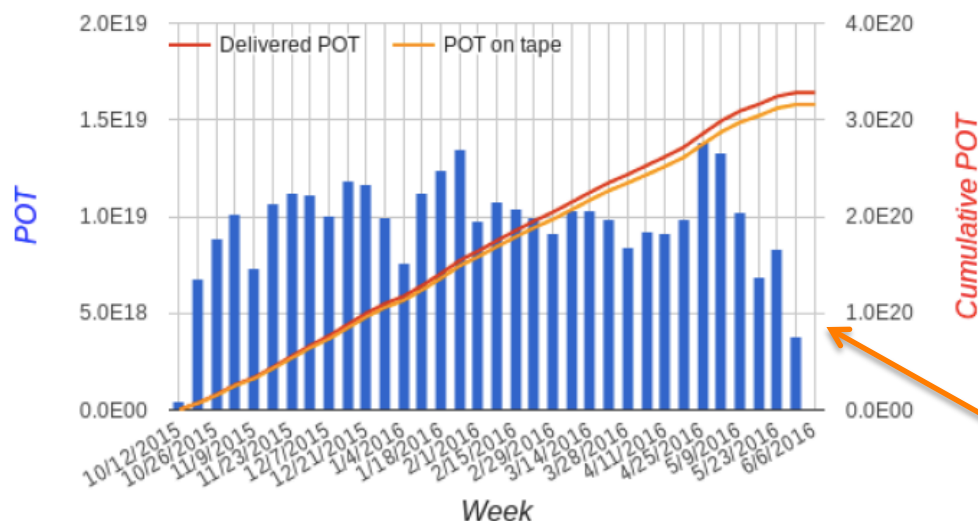
Beam to MicroBooNE

- FY16 saw the start of sustained 15 Hz Booster running with MicroBooNE as a direct benefactor. Many thanks to Accelerator Division!!!



- MicroBooNE has collected more than 3x the amount of neutrino beam expected from the BNB
- Horn #4 under construction
- Gates are being installed to allow BNB running when MI is down

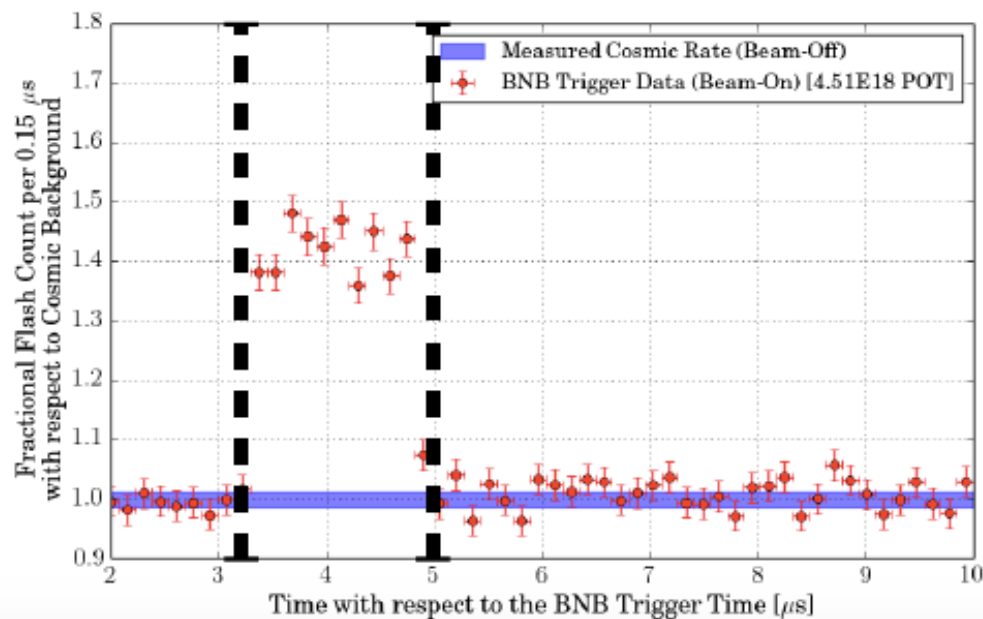
Neutrinos to MicroBooNE



Since October, MicroBooNE has collected 3.2×10^{20} POT

*45% of Run-I data set (pre-SBN)
97% written to tape
(combination of detector and DAQ uptime)*

Recent downtime due to horn ground fault → now fixed...

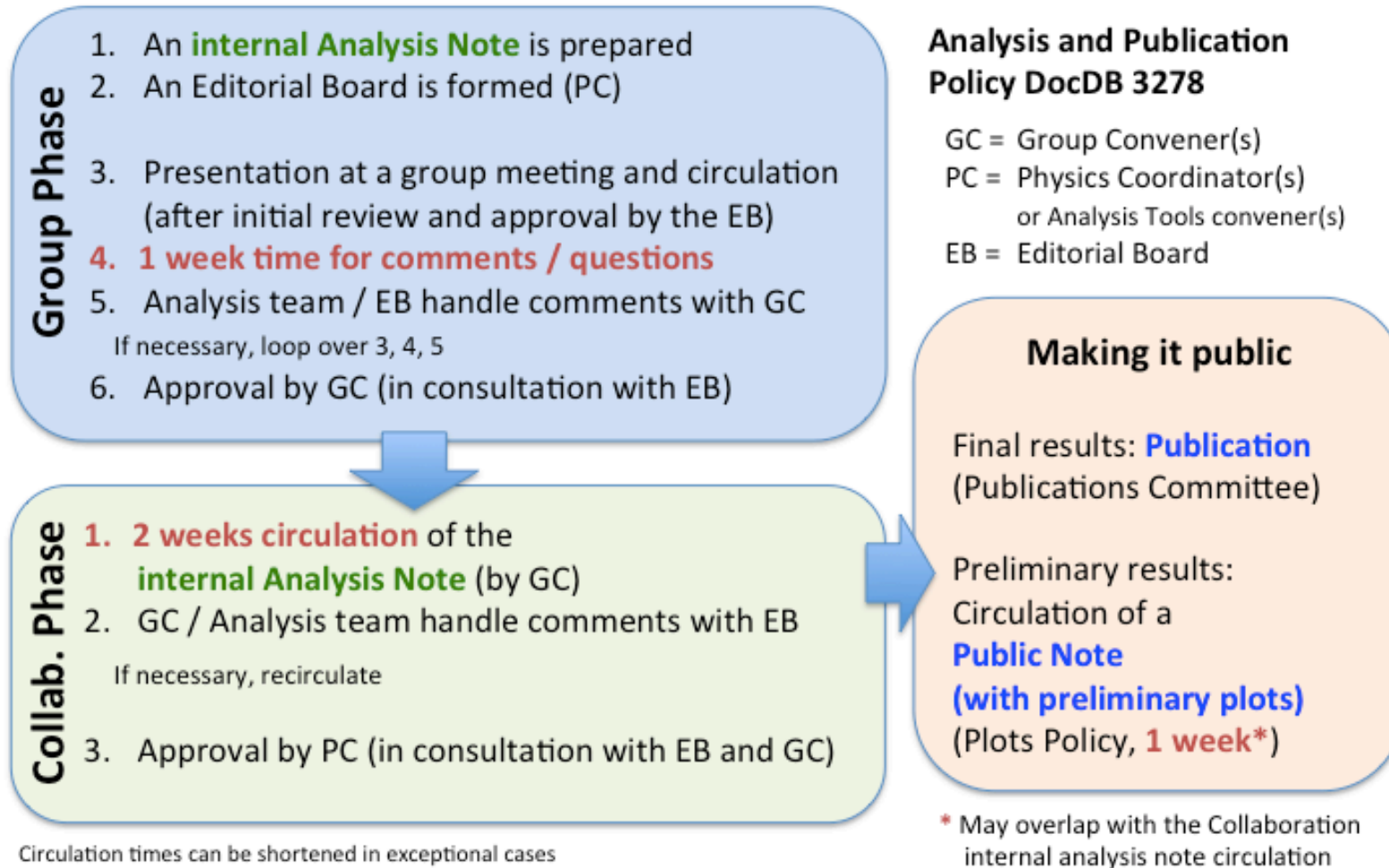


Observe neutrinos in the beam window. Neutrino ID through fully automated event selection

- *MicroBooNE has had a very successful first 7 months of operations!*

First Analyses:

- Understand the detector
- Characterization of event classes (eg: π^0 's towards xsecs and oscillation analysis)
- Cross section analyses



Rigorous analysis process...

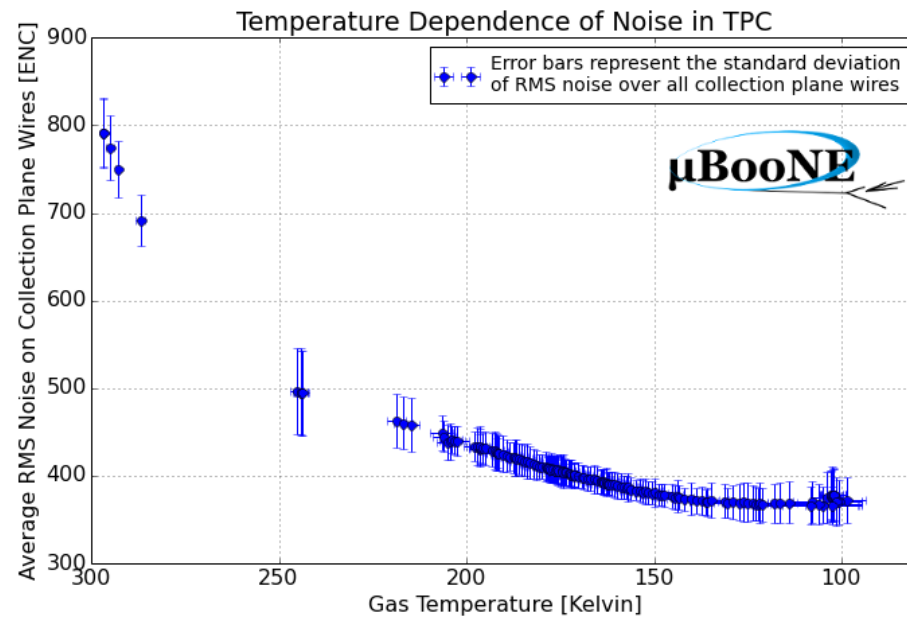
Completed Analyses with accompanying Public Notes:

Active	Analysis	Group	Analysis Contact	EB	Date created	Internal note	Public Note / Publication
	Drift speed measurement with UV laser data (for APS)	Det. Phys.	Joseph Z.	Bruce B., Mike M.	Mar 2016	DocDB-5509	1009 / DocDB-5509
	Michel electron spectrum (for APS)	Det. Phys.	David C.	Gerry G., Roxanne G.	Feb 2016	DocDB-5486	1008 / DocDB-5579
	NC Pi0 event selection study (for APS 2016)	Xsec	Ryan G.	Leslie C., Jonathan A.	Feb 2016	DocDB-5510	1006 / DocDB-5580
	Cosmic ray studies in MicroBooNE	"Overburden" task force	Sowjanya G.	Georgia K., Donna N.	Dec 2015	DocDB-4231	1005 / DocDB-5211
	NumuCC inclusive cross section study based on simulation	Xsec	Anne S.	Xin Q., Mike S.	Oct 2015		1004 / DocDB-4994
	Electronegative concentration and electron lifetime		Ben C., M. Zuckerbrot	Josh S, Brian R.	Sept 2015	DocDB-4823	1003 / DocDB-4928
	First neutrino events	Reco	Anne S., Andy F.	Dave S., Andrzej	Sept 2015	DocDB-4874	1002 / DocDB-4903
	Nucleon Decay	APE	Elena G.	Jen R., Eric C.	Aug 2015		DocDB-4765
	Noise vs. Fill Level	Commissioning	David C.	Bryce L., Vittorio P.	July 2015		1001 / DocDB-4717

Excellent performance of cold electronics!

Exhaustive investigation and mitigation of noise sources

Software noise filtering further reduces noise effects



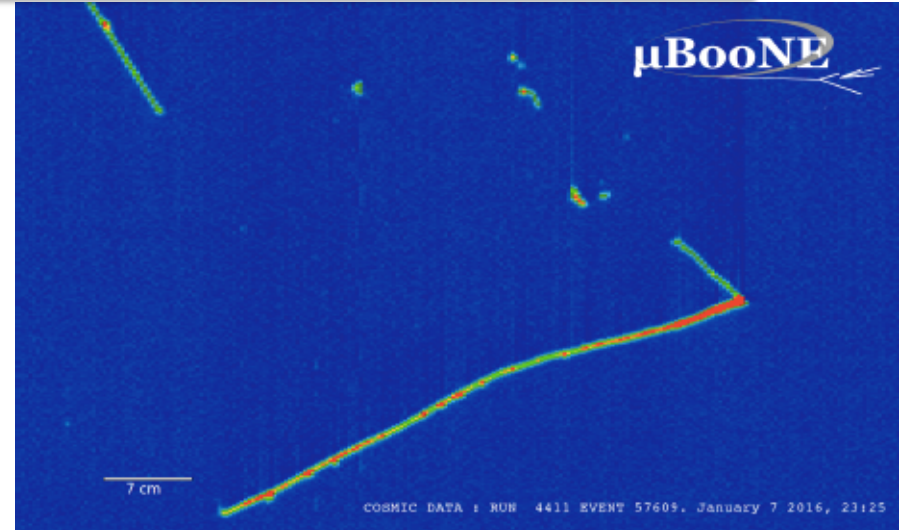
Without software noise filtering



With software noise filtering



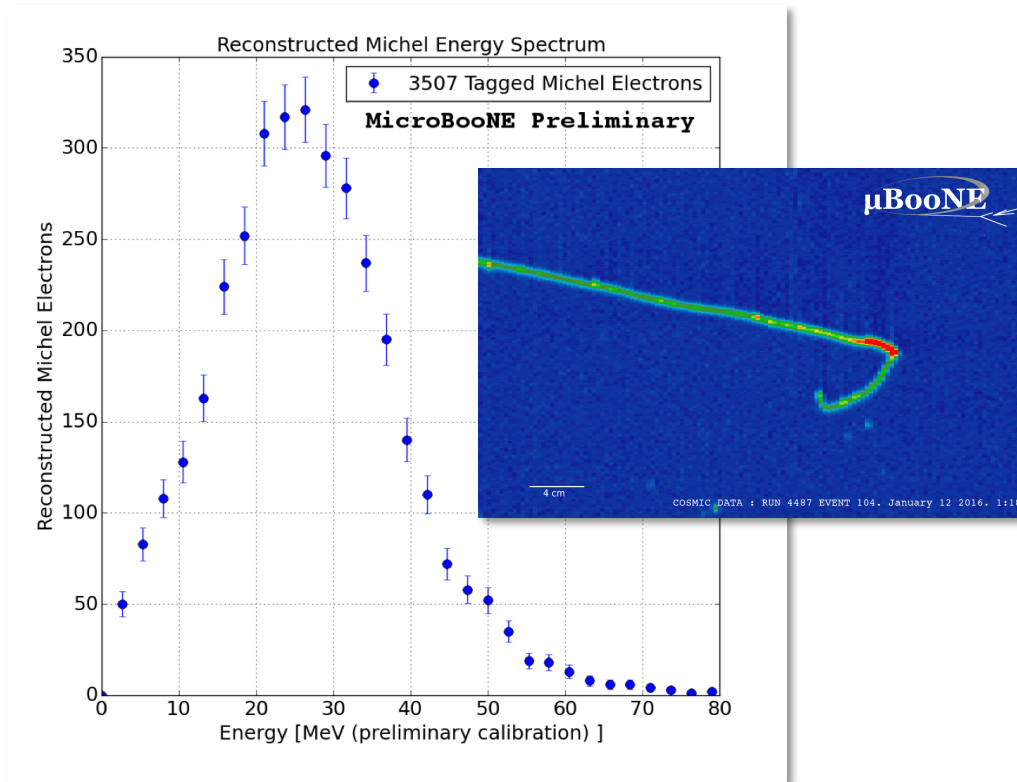
6/20/16



Fermilab PAC

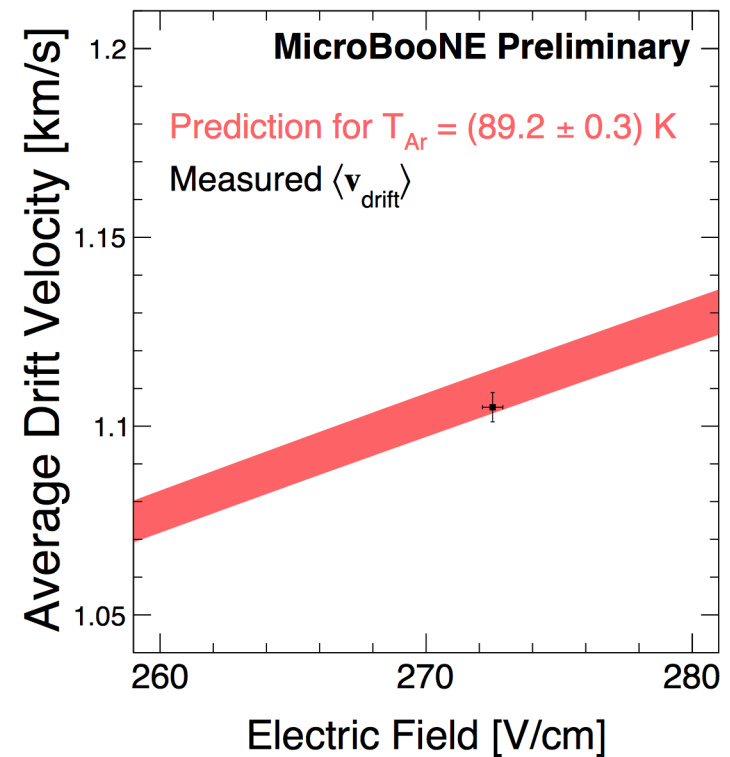
13

First Results from MicroBooNE

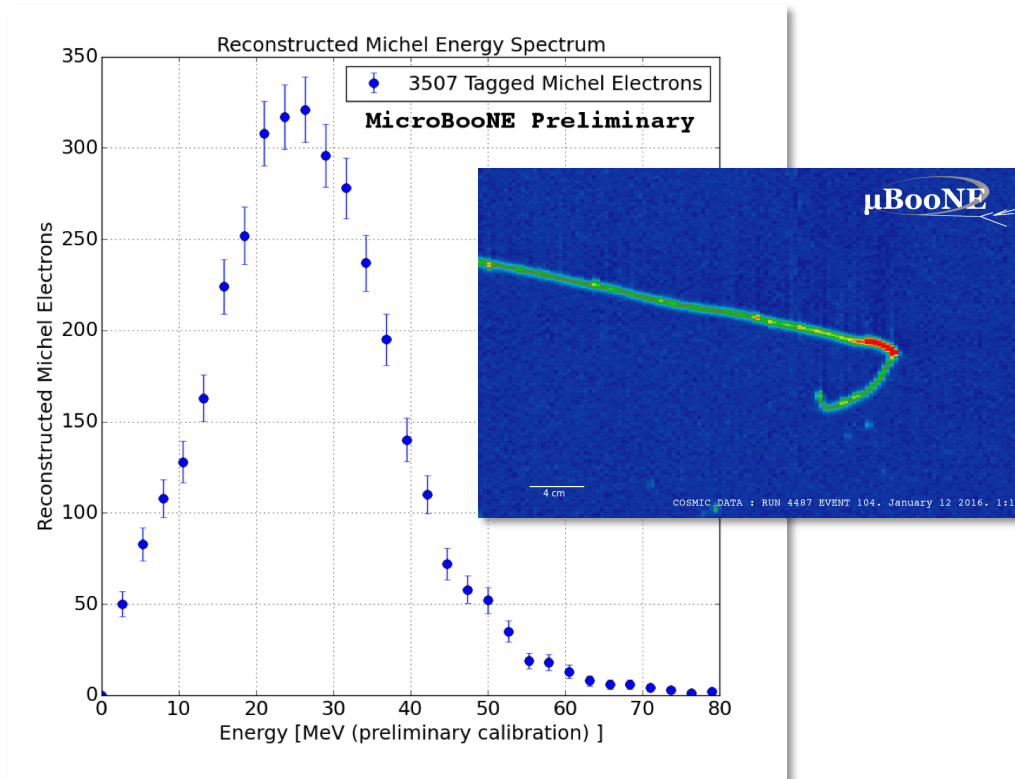


- Largest sample of Michel electrons ever collected in a LAr TPC
- Fully automated reconstruction

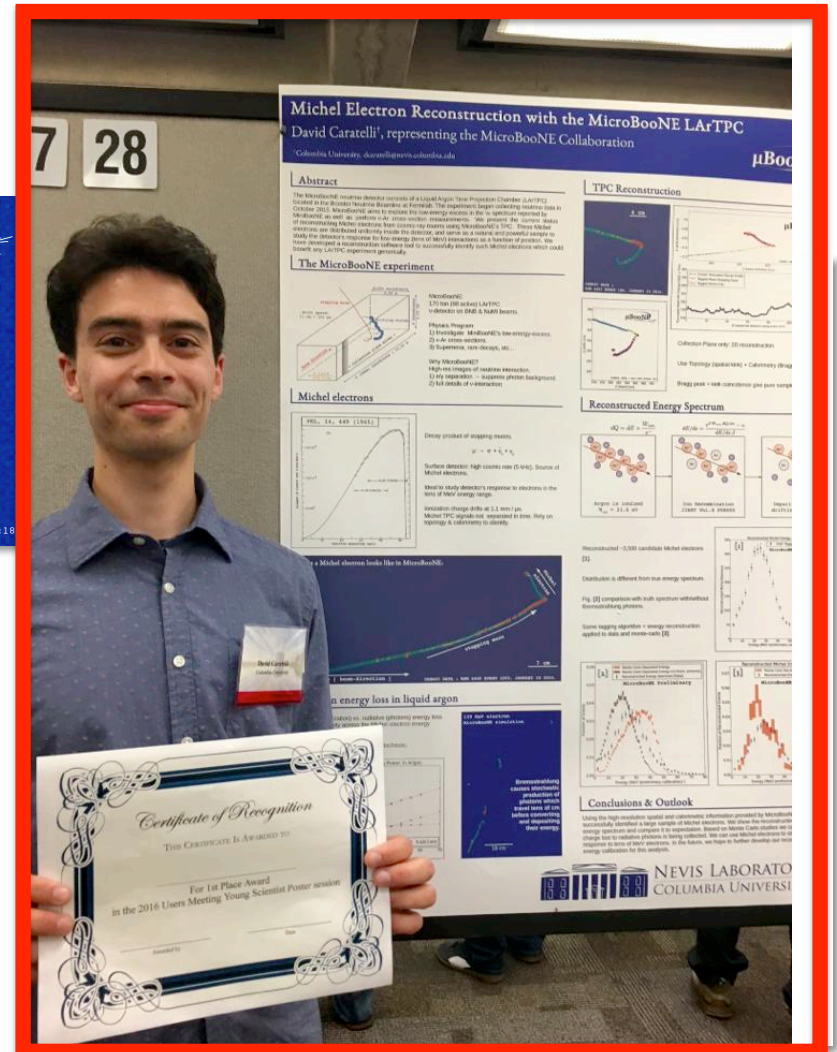
- Drift velocity measurement from UV laser data



First Results from MicroBooNE



MicroBooNE's David Caratelli wins first prize at the User's meeting poster contest for "Michel Electron Reconstruction with MicroBooNE"!



Reconstruction

- Reconstruction: pushing on all aspects of reconstruction with different approaches at each stage:
 - Tracking, vertexing, showering, calorimetry, particle ID, ...
 - Folding in calibrations: field response, space charge effects, electronics noise, non-responsive channels
 - Challenges: 2D $\rightarrow$ 3D, showering, ...
- Yearly Reconstruction workshop held this spring at UofM



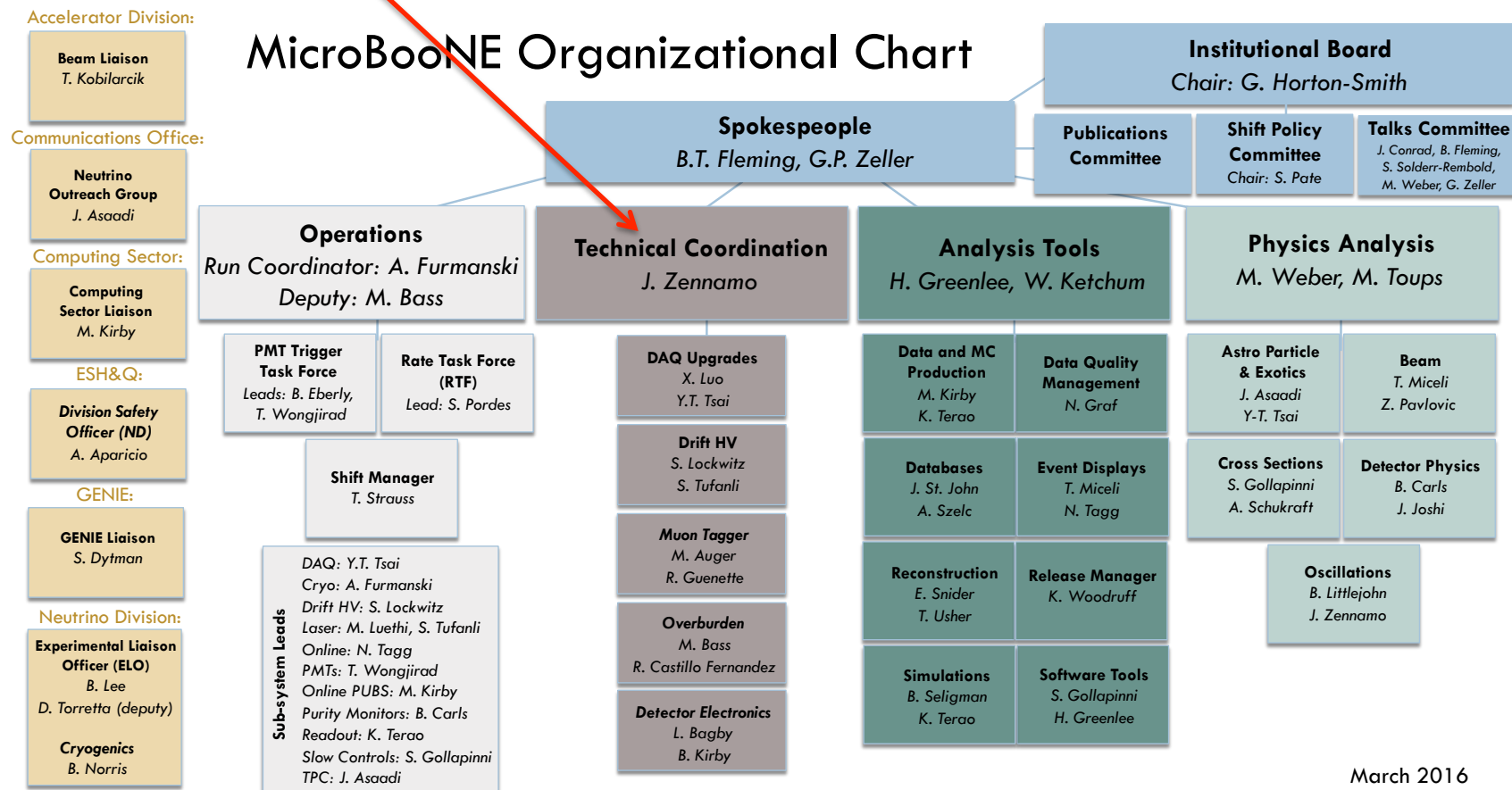
Analyses in preparation for summer conferences → Neutrino 2016 (using 0.5E20 POT)

Active	Analysis	Group	Analysis Contact	EB	Date created	Internal note	Public Note / Publication
*	Particle ID and neutrino identification with Deep Learning	Osc	Kazu, Taritree	Brett, Panagiotis	May 2016	Notes #1019	
*	Space charge measurement from cosmic muons	Det. Phys.	Mike M	Kirk, Craig, Nathaniel	May 2016	Notes #1018	
*	TPC signal processing	Det. Phys.	Xin	Igor, Richard	May 2016	Notes #1017	
*	TPC noise filtering	Det. Phys.	Jyoti	Mark C, Byron	May 2016	Notes #1016	
*	Pandora reconstruction in uB	Reco	John M	Bruce, Leon	May 2016	Notes #1015	
*	Reconstructed cosmic data/MC comparison	Reco	Adam L, Danny D	Eric, Cat	May 2016	Notes #1014	
*	Detector stability for 5E19 POT	Analysis Tools	Aleena	Steve W, Stephen P	May 2016	Notes #1013	
*	Reconstructing golden Pi0	Osc	Joseph Z	Leslie, Jonathan, Randy	May 2016	Notes #1012	
*	Beam timing	Beam	Tia, Zarko et al.	Alberto M, Mary B.	Mar 2016	Notes #1011	
*	First Numu CC distributions on data	Xsec	Anne S.	Xin Q., Mike S.	Feb 2016	Notes #1010	

Technical Coordination:

- CRT installation
- Noise mitigation: Service Board replacement, HV filtering
- Raising Drift HV...

- Supernova Trigger implementation
- Purity Monitor replacement

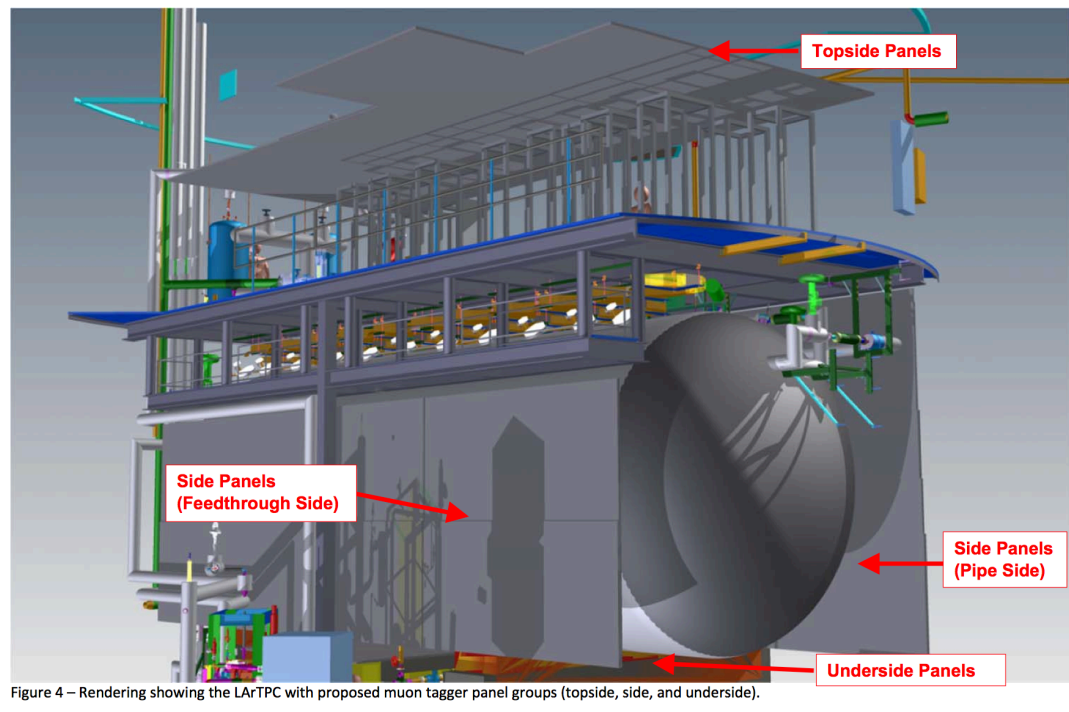


March 2016

MicroBooNE Technical Board chaired by Tim Bolton reviewing proposed shutdown activities

Cosmic Ray Tagger

- Reviewed by FNAL Neutrino Division
- Cost reduced substantially to <100k to lab for infrastructure (CRT detector: contribution from BERN)
- CRT panels under test at DAB
- Installation of bottom and side panels this shutdown
- Top panels in FY17



Elena Gramellini and Rui An testing the CRT panels at DAB

MicroBooNE Collaboration

- 143 collaborators
 - 1/2 of the collaboration is students & postdocs (37 grad students, 36 Post-docs!)
- 28 institutions in 3 countries
- New institutions from cell division...



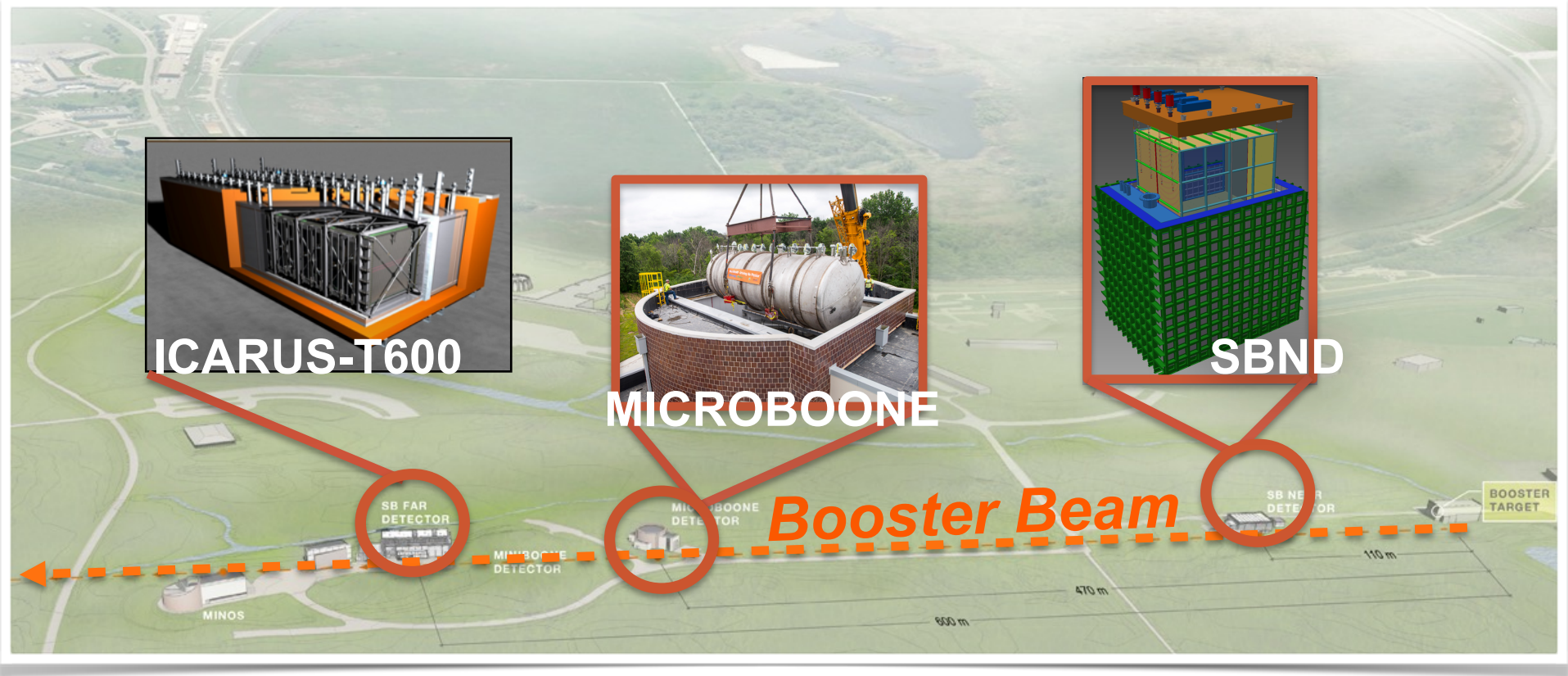
Postdoc Placement

- 20 of our postdocs have landed their next position;
- majority have remained on MicroBooNE (15/20)

- (1) *Roxanne Guenette, Oxford, STFC Rutherford Fellow*
- (2) *David McKee, Missouri Southern State University, Assistant Professor*
- (3) *Mike Cooke, DOE, AAAS Science & Technology Policy Fellow*
- (4) *Teppei Katori, Queen Mary University of London, Lecturer*
- (5) *Georgia Karagiorgi, Manchester, Lecturer*
- (6) *Bryce Littlejohn, IIT, Assistant Professor*
- (7) *Tingjun Yang, FNAL, Applications Physicist, ND*
- (8) *Zarko Pavlovic, FNAL, Applications Physicist, ND*
- (9) *Andrzej Szec, Manchester, Lecturer*
- (10) *Eric Church, PNNL, Scientist*
- (11) *Wes Ketchum, FNAL, Associate Scientist, SCD*
- (12) *Andy Blake, Lancaster, Lecturer*
- (13) *Josh Spitz, Michigan, Ann Arbor, Assistant Professor*
- (14) *Thomas Strauss, FNAL, Associate Scientist, TD*
- (15) *Matt Toups, Associate Scientist, ND*
- (16) *Jonathan Asaadi, UT Arlington, Assistant Professor*
- (17) *Leonidas Kalousis, Vrije Universiteit Brussel, Research Associate*
- (18) *Anne Schulkraft, Associate Scientist, ND*
- (19) *Sowjanya Gollapinni, University of Tennessee, Assistant Professor*
- (20) *Ben Carls, Fellowship, Insight Data Science*

- 10 University
(5 non-U.S., 5 U.S.)
- 7 U.S. lab
- 1 U.S. government
- 1 second postdoc
- 1 Data Science

MicroBooNE and SBN/DUNE



Coherency with SBN and DUNE....

- SBN
 - Software, workshops, shared systems, talks
 - Combined science analyses
- DUNE: uboone “Public notes” can be prioritized at DUNE request.

Summary

- MicroBooNE is completing a very successful first 7 months!
 - Detector running well
 - Data collection $\rightarrow 3.2 \times 10^{20}$ POT so far
 - Aggressive program of data analysis
 - Part of broader SBN/DUNE program

Backup

Path to Neutrino 2016

