SciBooNE (E-954) commissioning status

Masashi Yokoyama
(Kyoto University)

June 18, 2007
FNAL All Experimenters Meeting

http://www-sciboone.fnal.gov/

SciBooNE collaboration

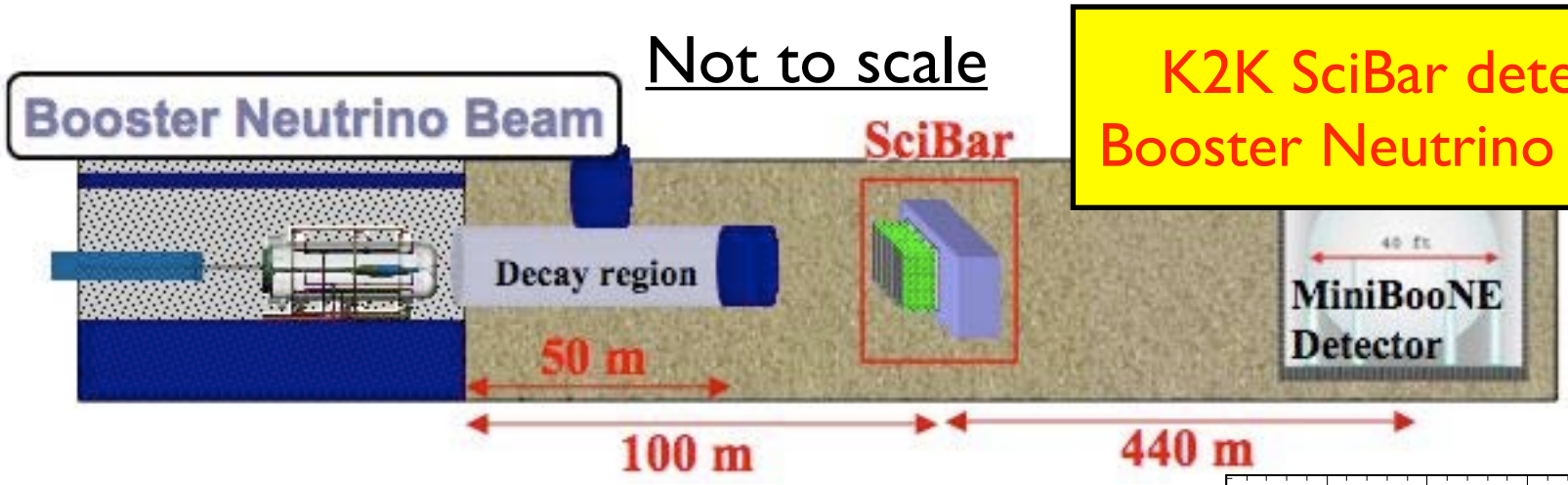
University of Barcelona ,IFAE
Chonnam National University
University of Cincinnati
University of Colorado
Columbia University
Dongshin University
Fermi National Accelerator Labortory
High Energy Accelerator Research Organization (KEK)
Imperial College London
Indiana University
ICRR, University of Tokyo
Kyoto University
Los Alamos National Laboratory
Louisiana State University
Purdue University Calumet
University of Rome "La Sapienza" and INFN
Seoul National University
Saint Mary's University of Minnesota
Tokyo Institute of Technology
University of Valencia, IFIC

Spokespeople: Tsuyoshi Nakaya (Kyoto) &
Morgan Wascko (Imperial College London)

6 countries
20 institutes
>70 people!

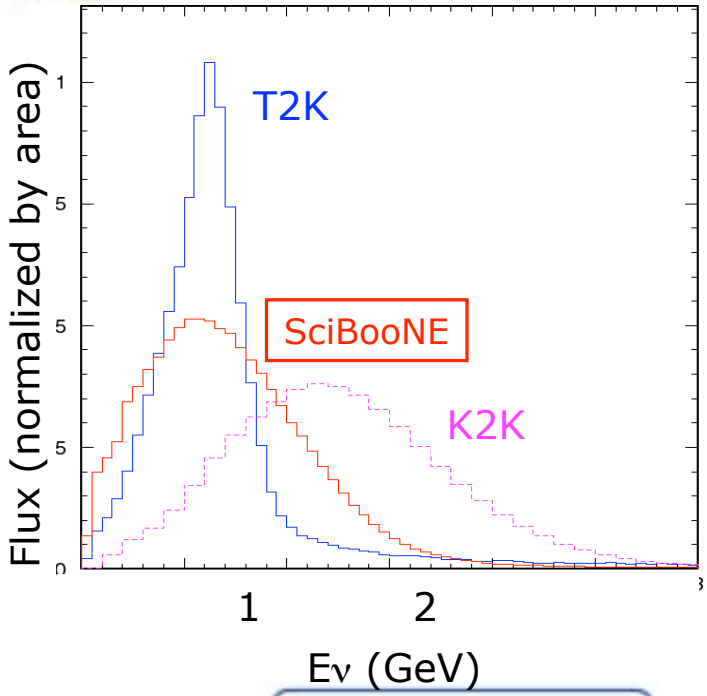
SciBooNE

SciBooNE motivations



K2K SciBar detector +
Booster Neutrino Beamline

- Precise neutrino-nucleus cross section measurements for T2K.
- Anti-neutrino cross sections.
- MiniBooNE near detector.

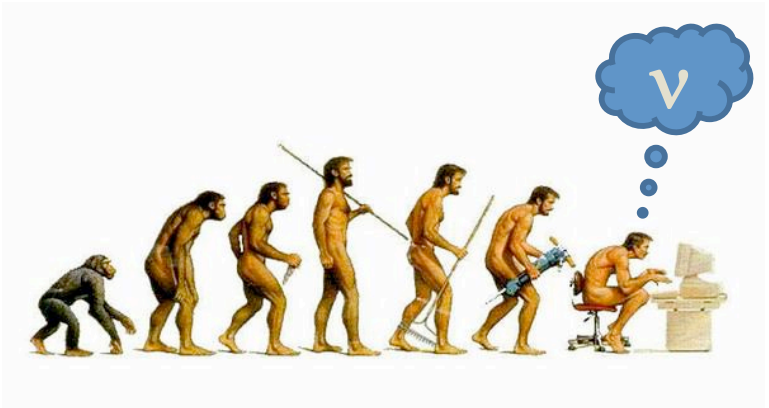


Plan: 1E20 POT ν,
1E20 POT $\bar{\nu}$

SciBooNE

SciBooNE "evolution" in two years

- Summer 05: Collaboration formed
- Nov. 05: Proposed to FNAL PAC
- Dec. 05: Approved
- Jul. 06: Detectors arrived from Japan
- Sep. 06: Civil construction started
- Sep.06-Mar.07: Detector assembly in CDF&Lab-F
- Mar. 07: Cosmic run in CDF&Lab-F
- Apr. 07: Detector installation to SciBooNE hall
- May 07: Cabling and commissioning
- May 30, 2007: First neutrino events with all detectors !



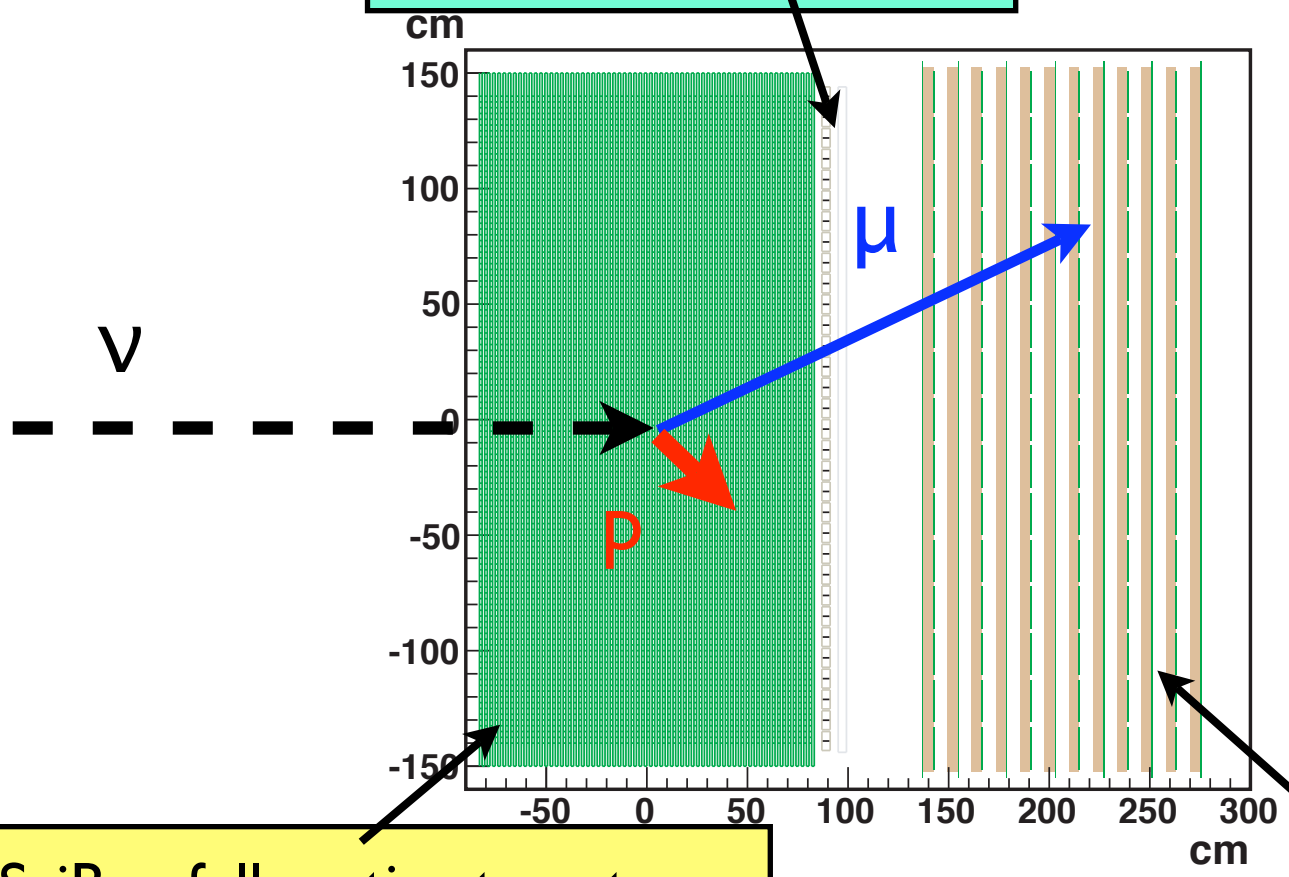
R.Napora, NuINT07

Recent progress

- May 26-June 1: commissioning w/ partial detector, w/ short running
- June 4-8: Channel-by-channel check of SciBar/MRD detectors, DAQ debugging
  - June 4: HVAC for SciBar turned on
  - June 6: ORC cleared
  - June 6-7: Overnight cosmic ray runs
- June 8, 10PM: Start commissioning w/ full detector!

SciBooNE detectors

EC: EM calorimeter
Lead+scinti. $11X_0$

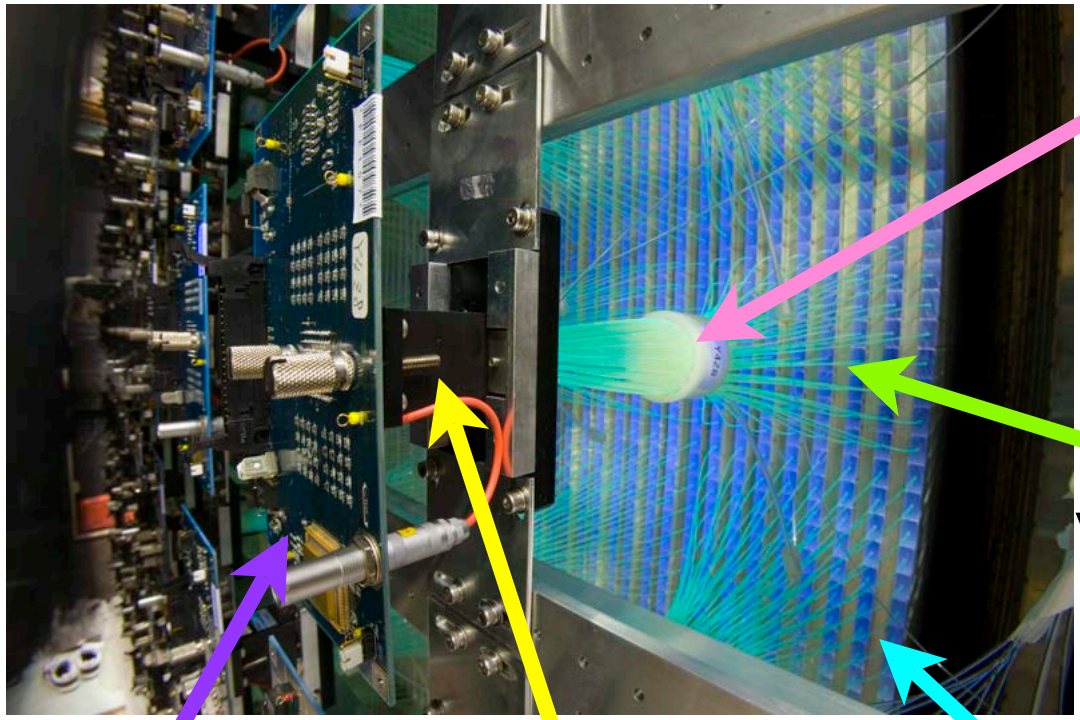


Schematic
charged-current
quasi-elastic (CCQE)
$\nu + n \rightarrow \mu + p$
interaction

SciBar: fully active target
total mass 15t, fiducial ~10t
14,336 channels
extruded scinti. + 64ch MA-PMT

Muon Range Detector (MRD)
12 x 2"-thick Fe plates + scinti.

SciBar detector



Optical fanout
for LED calibration
light distribution

Wavelength shifting fiber
(Kuraray Y11)

Front-end electronics
VA/TA chipset
64ch charge + 2ch timing
information / PMT

64ch MAPMT
(Hamamatsu)

Scintillator bars
(FNAL product)
X-Y 64 layers

224 PMTs = 14,336 ch

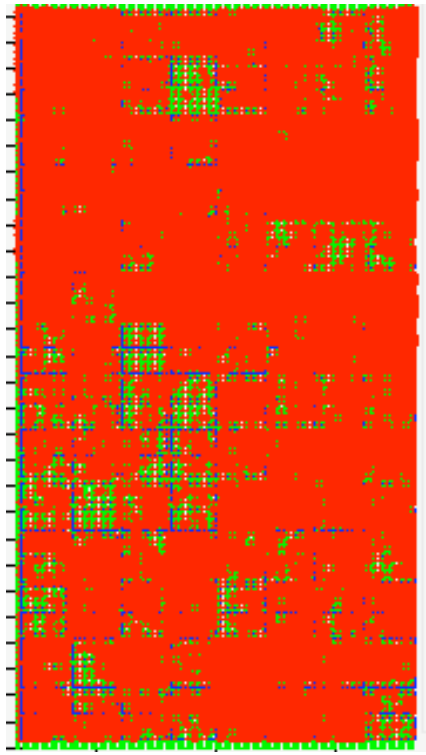
SciBooNE

SciBar calibration

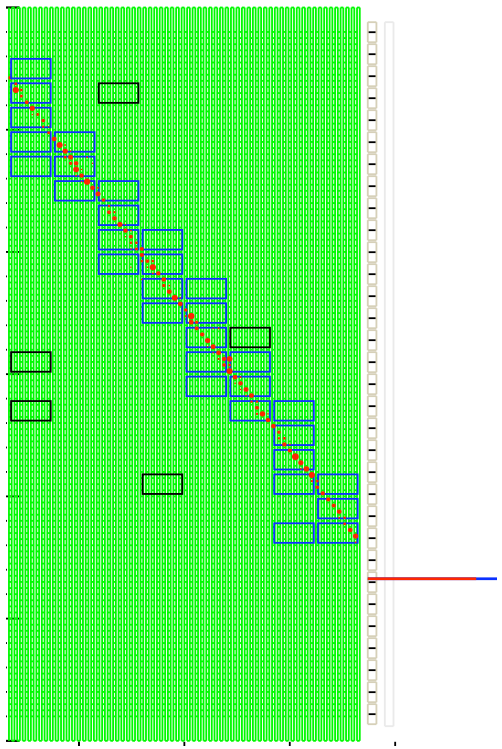
- Two sources: LED and cosmics
  - Taken between beams

Red points: ADC hits
(Area ∝ charge)

Box: TDC hits
(32ch OR-ed)



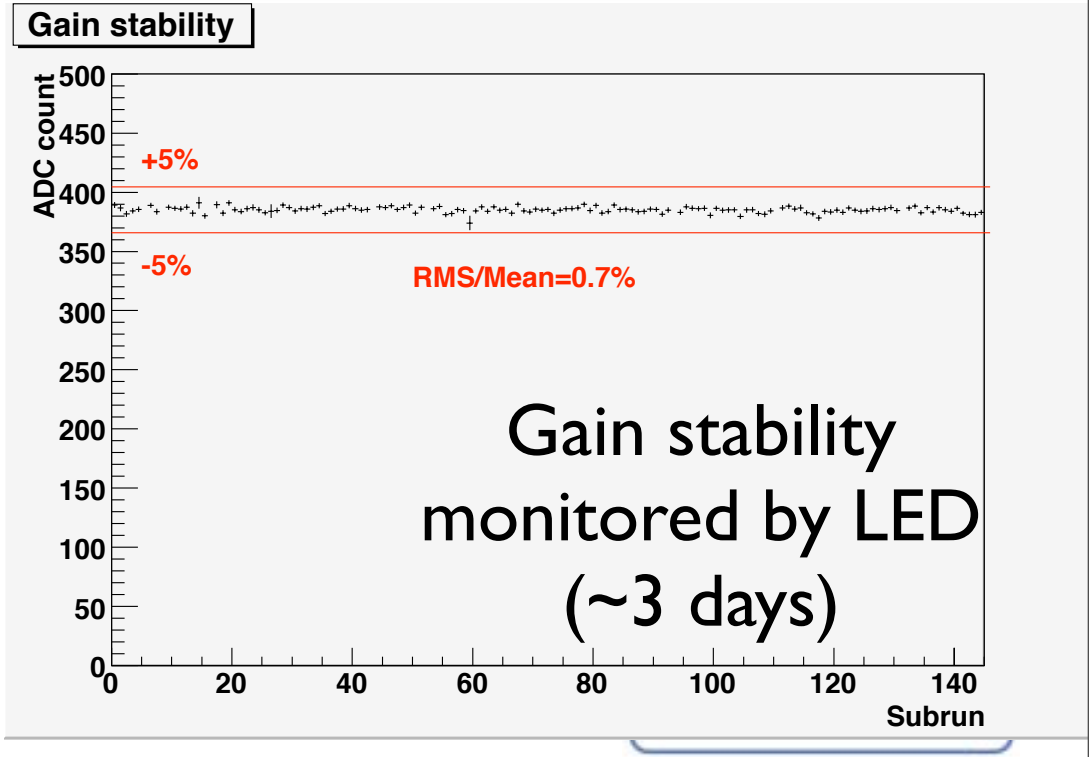
LED event display



cosmic

SciBar status

- PMT gain, Scintillator photo yield consistent w/ K2K&pre-installation.
- Stability continuously monitored.
  So far, gain/pedestal/noise stable.
- Dead channel:
  4 (out of 14,336)
- Layer hit efficiency: >99%
  (confirmed with
  cosmic-ray data)

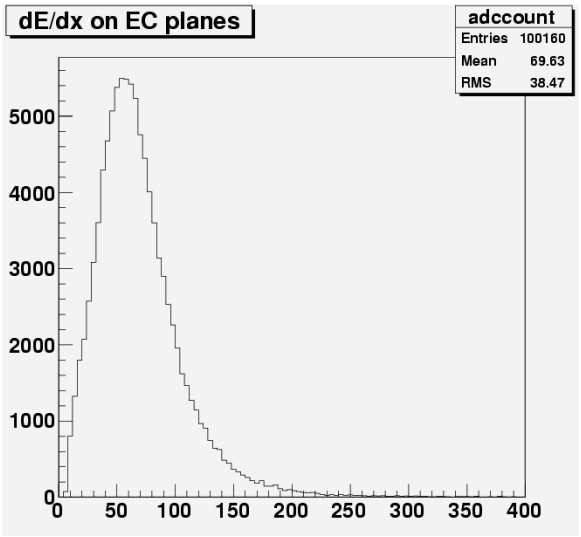


Electron Catcher (EC)

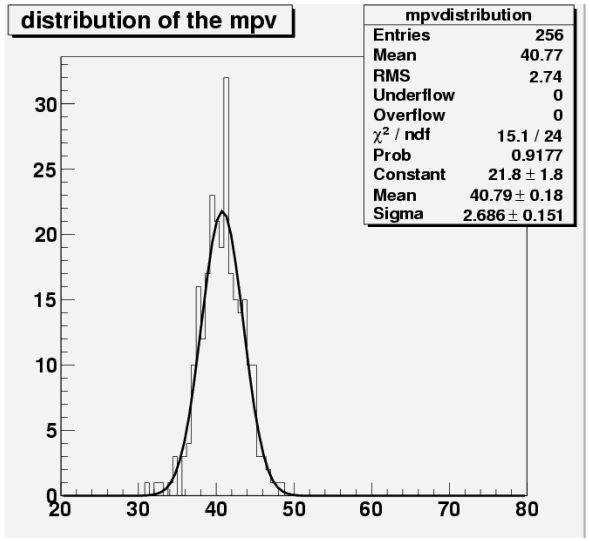
- "Spaghetti" calorimeter originally for CHORUS (→K2K→SciBooNE)
- 1mm scinti. fibers in grooves b/w lead foils, 4x4cm^2 readout from both ends
- 2 planes (Vert./Horiz.), 32 modules each
- 256 channels (ADC)
- 11X_0 total

EC status

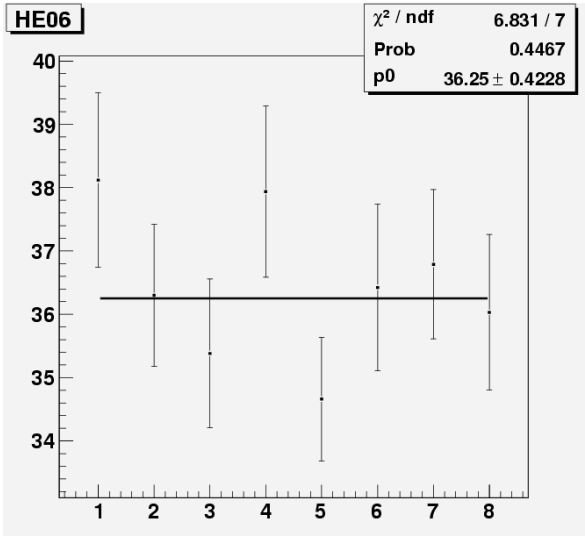
Calibration with cosmic ray



dE/dx
(arbitrary unit)



Most probable value
for all channels
→ gain is uniform



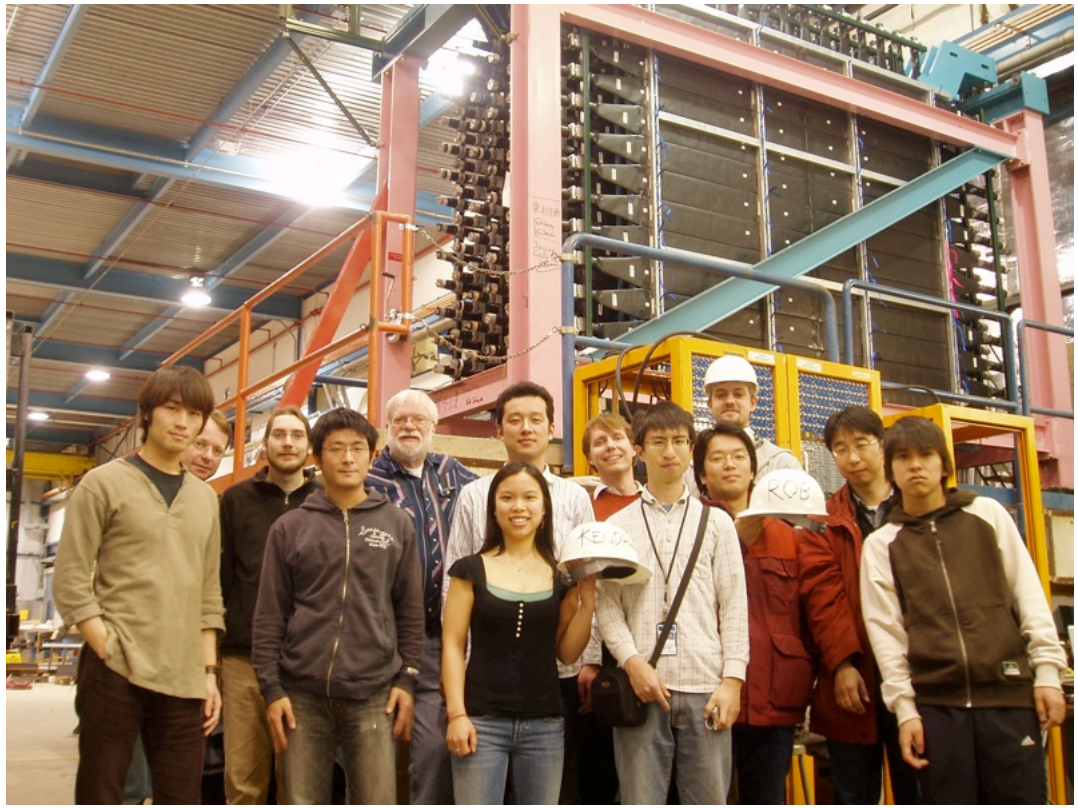
Gain stability
for ~3 days

- All channels (256) are working
- No noisy/dead channel

SciBooNE

Muon Range Detector (MRD)

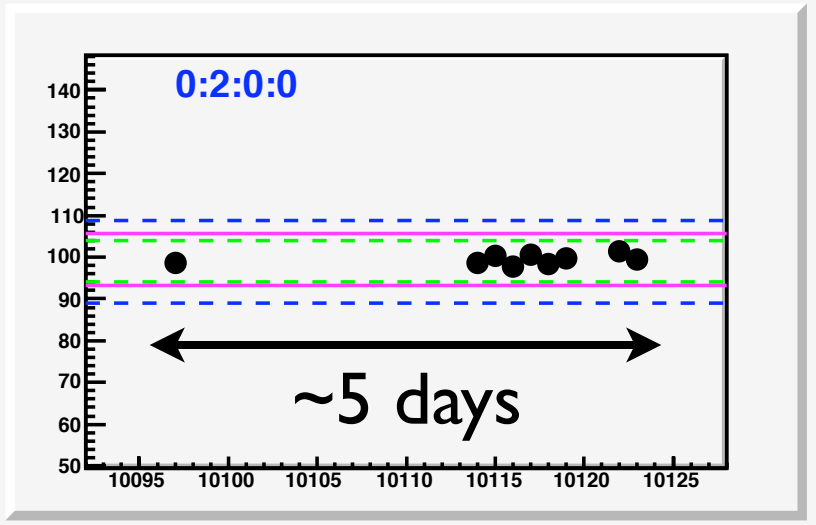
- Identify muons from charged current interaction
- Measure momentum with range
- 2”-thick steel x12
  - Stop <~1GeV μ
- Plastic scintillator paddles (362 ch total)
  - ADC/TDC information for each channel



SciBooNE

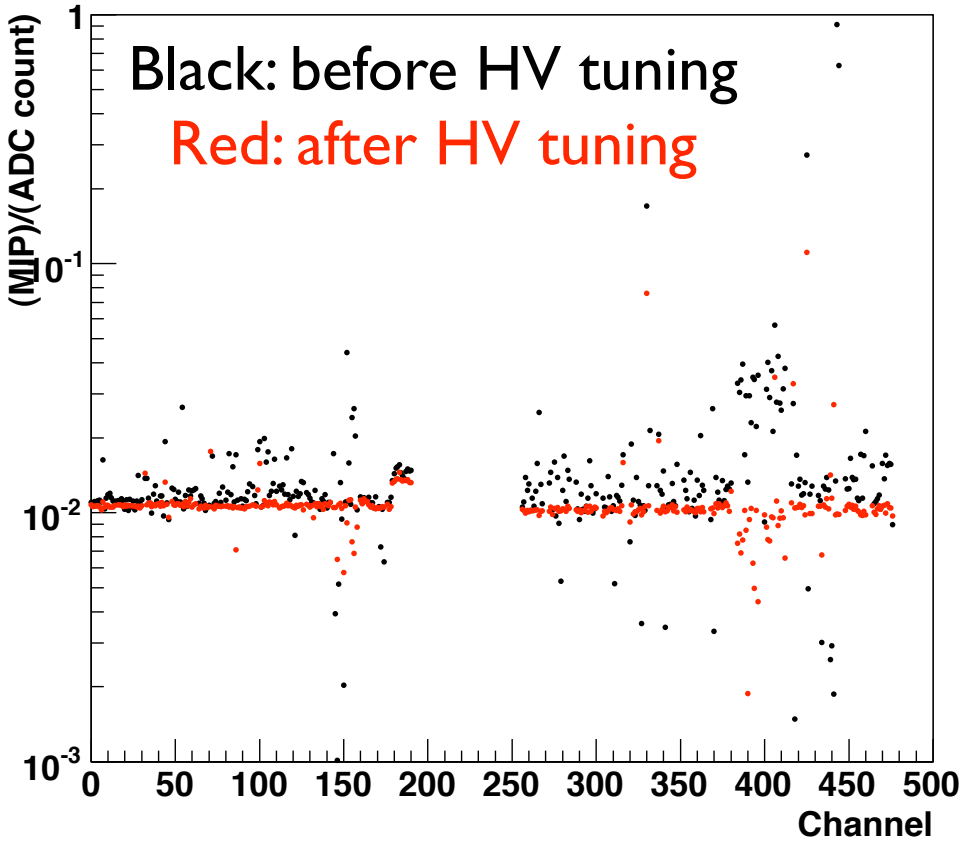
MRD status

- Calibrated with cosmic ray
- 4 dead channels (out of 362)



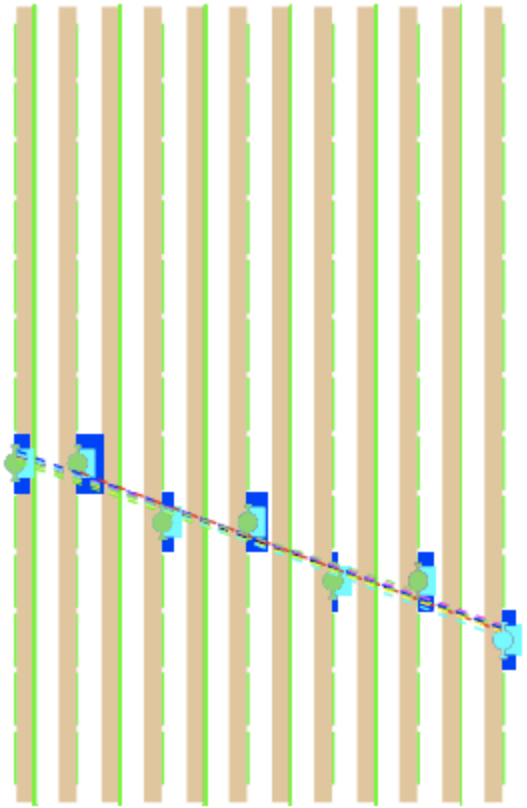
Gain stability w/ cosmic

Average ADC for cosmic ray

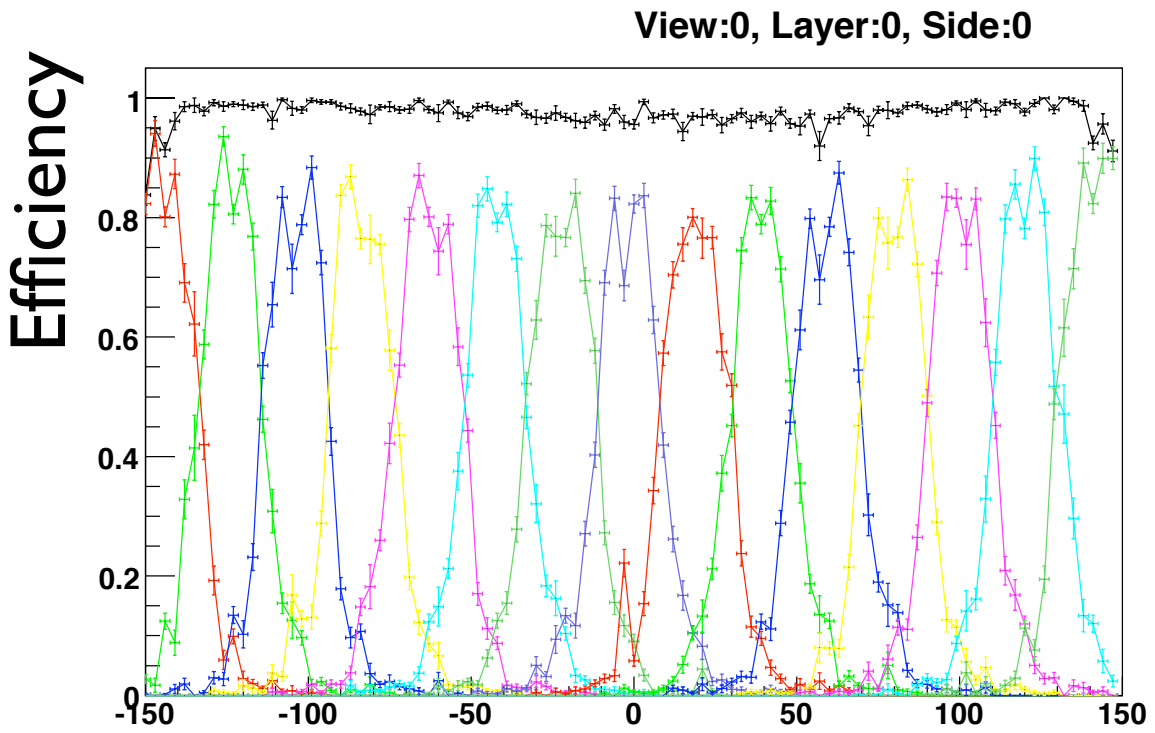


MRD status

- Efficiency estimated from cosmic ray

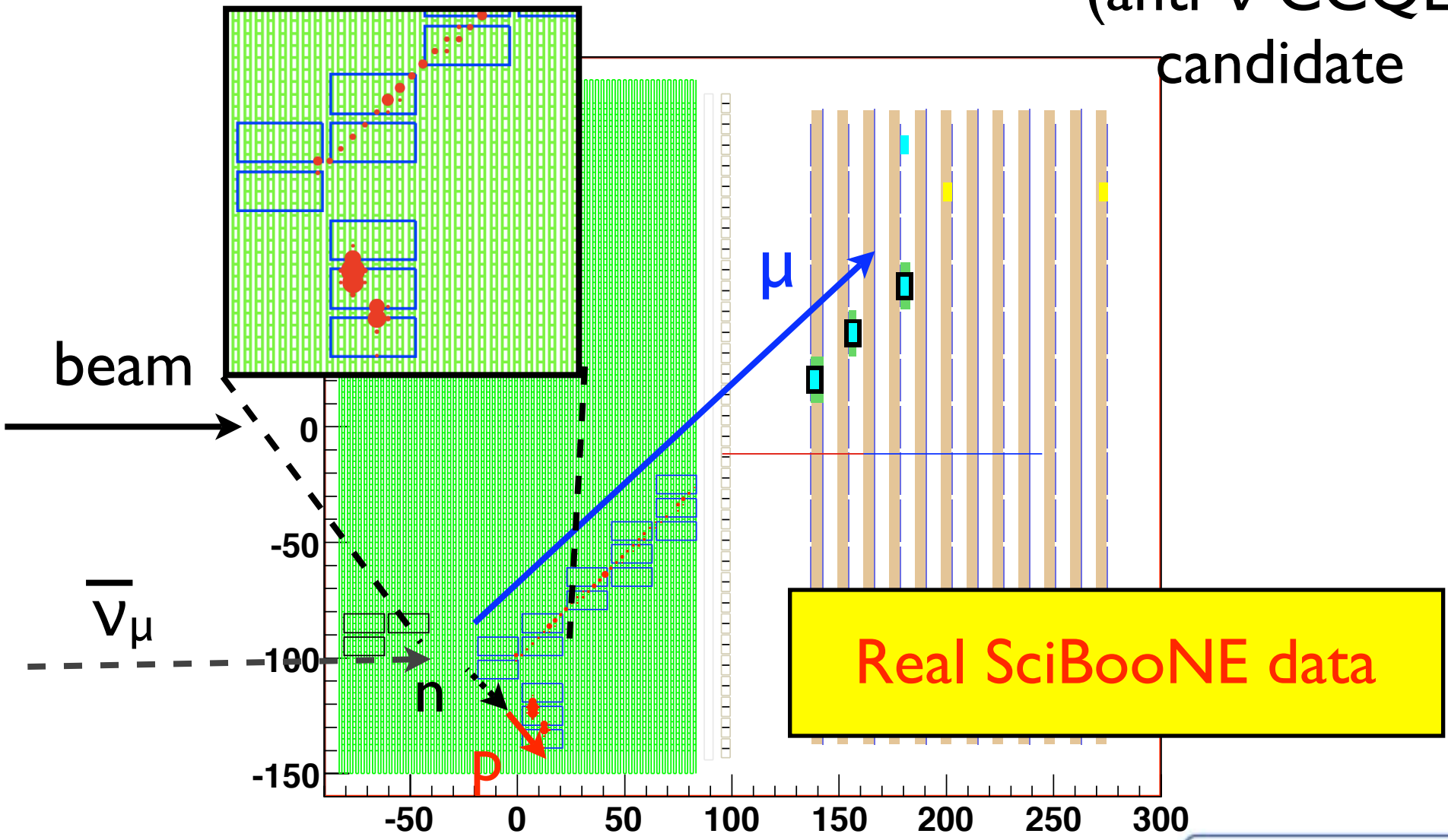


MRD cosmicray
taken b/w beam spills



Then...

$\bar{\nu}_\mu + p \rightarrow \mu^+ + n$
(anti-ν CCQE)
candidate

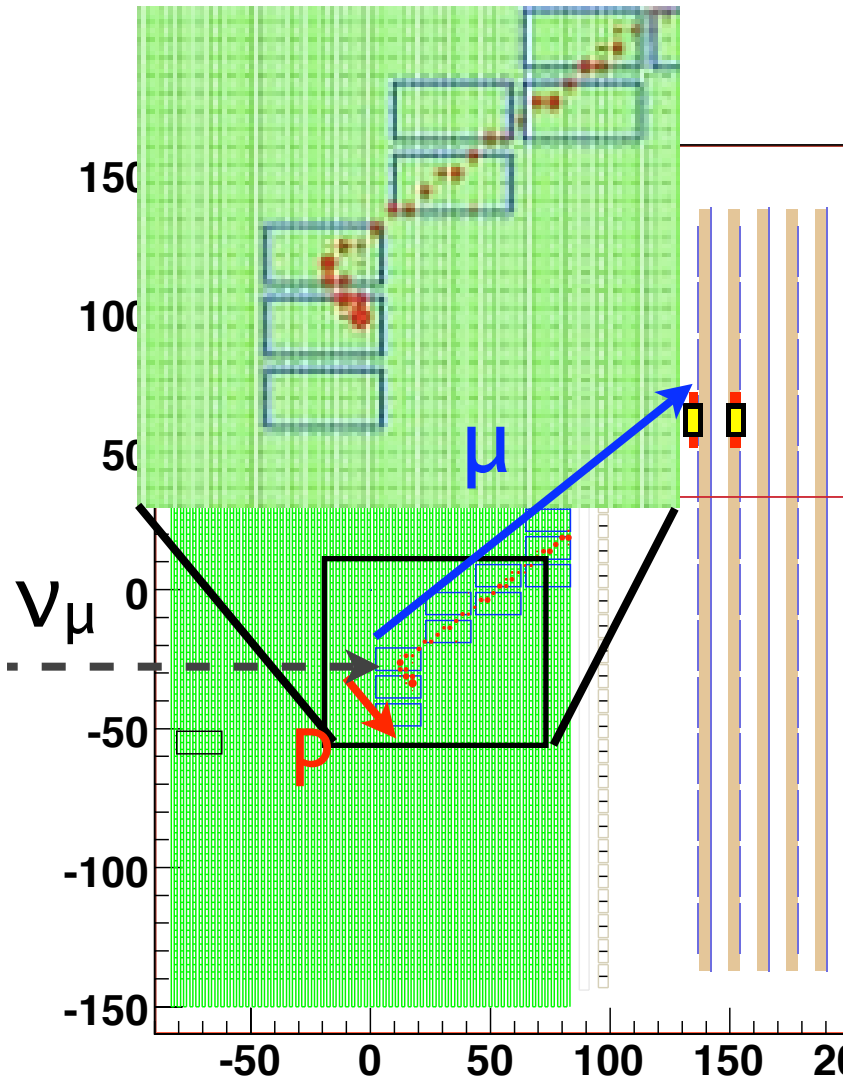


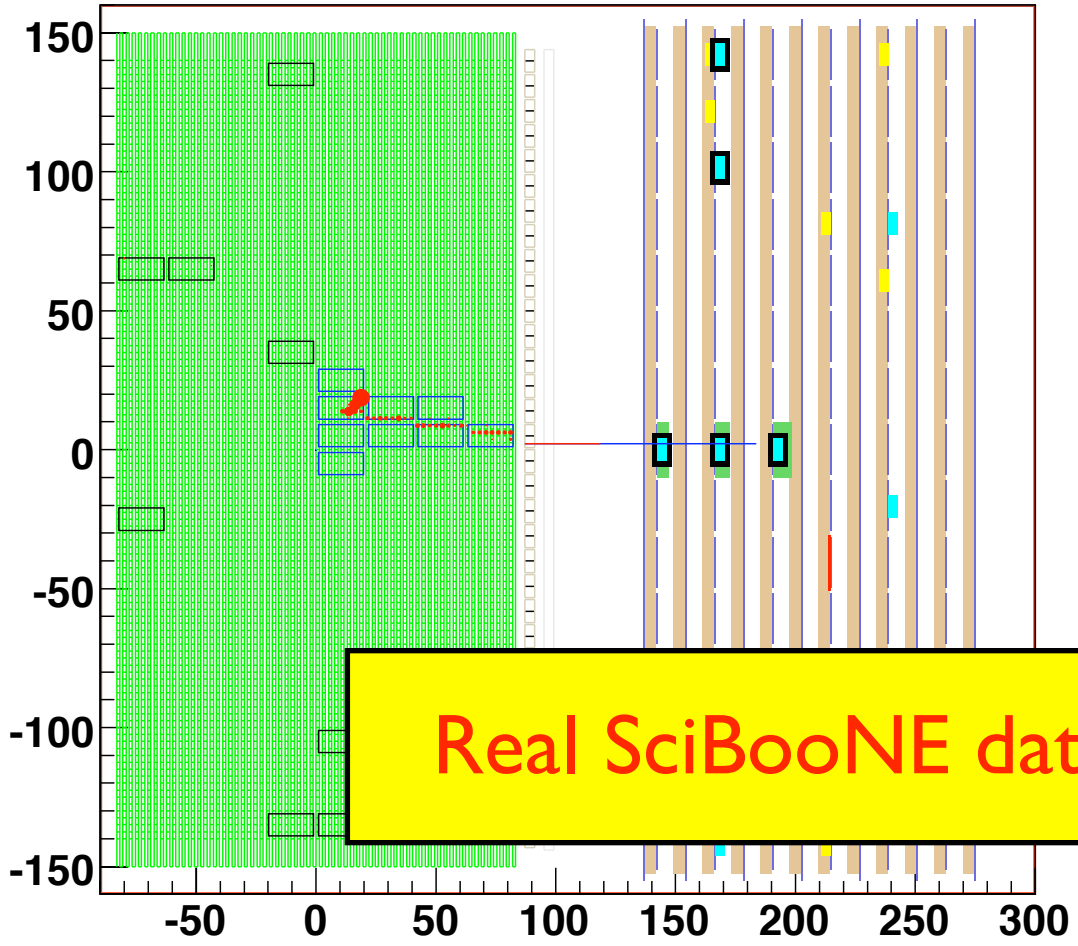
SciBooNE

And more...

$\nu_\mu + p \rightarrow \mu^- + p$
(ν CCQE)
candidate

Top view

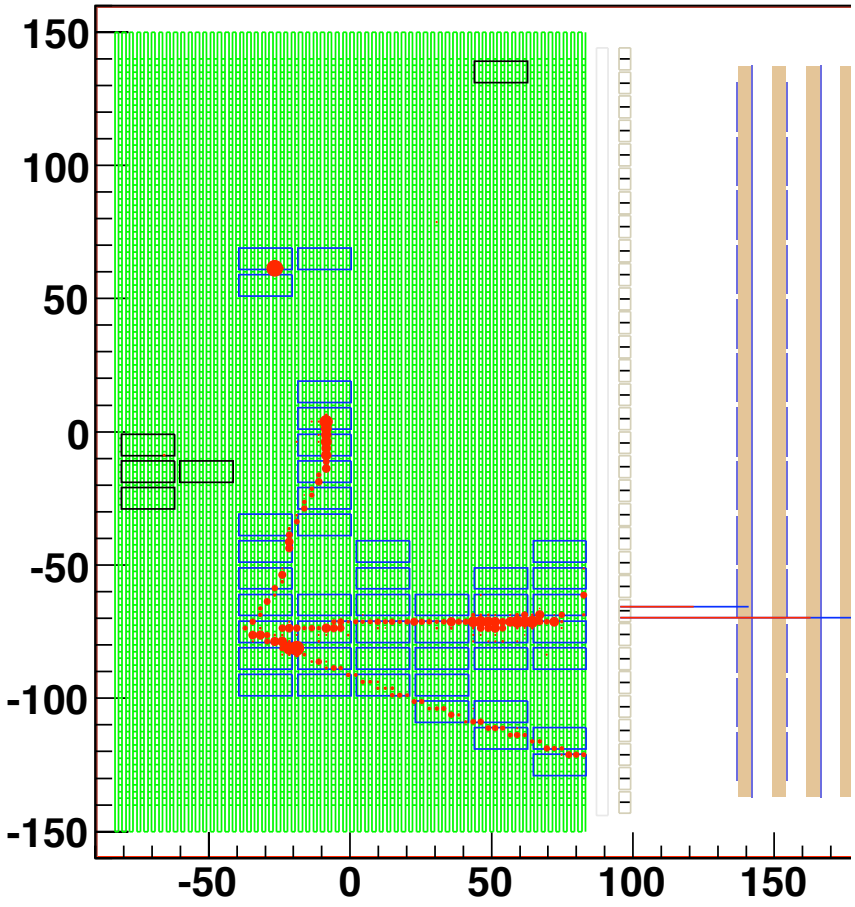




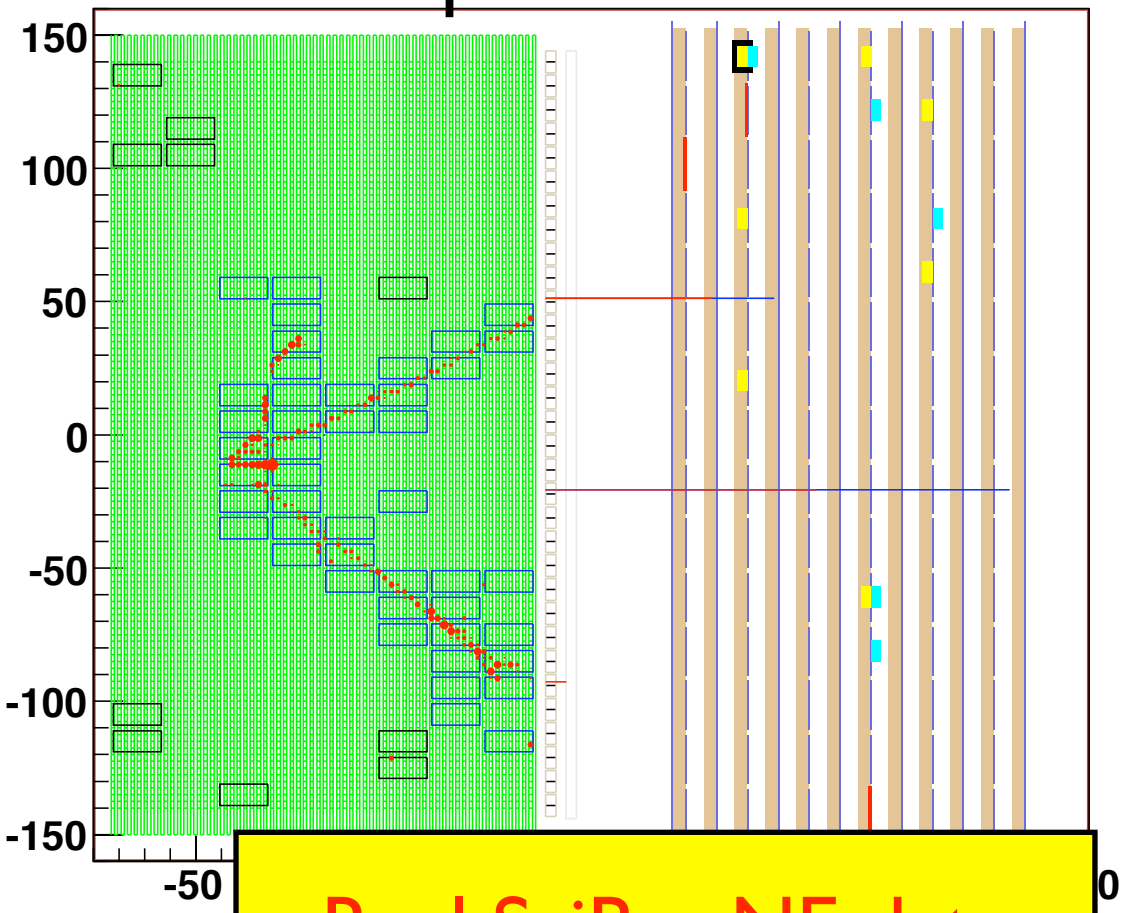
Real SciBooNE data

And more...

Side view



Top view



Real SciBooNE data

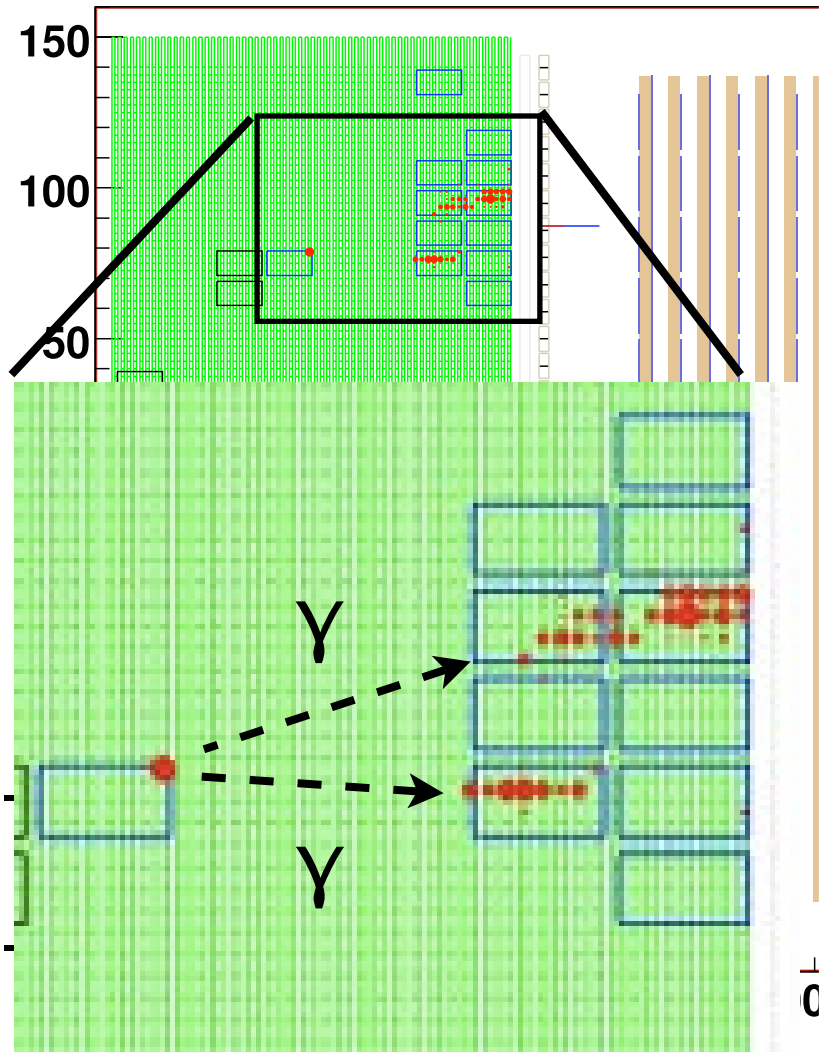
Red points: ADC hits (Area ∝ charge)

Box: TDC hits (32ch OR-ed)

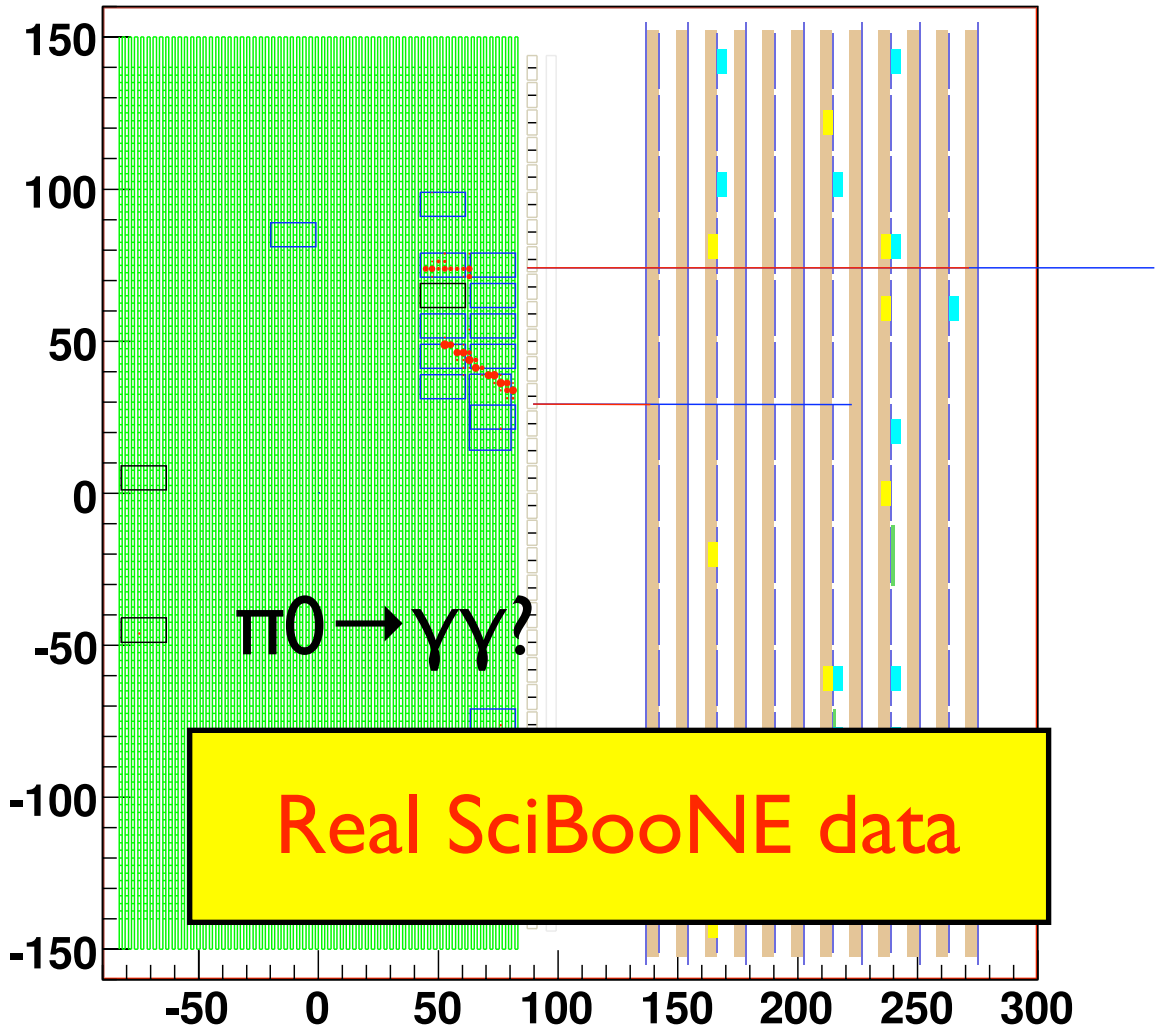
SciBooNE

And more...

Side view



Top view



Data taking status

- Detector live fraction (for periods with beam) from 6/9 midnight to 6/18 morning: ~83%
  - Detector maintenance/tuning at the beginning
  - MRD ADC problem 6/11 night
  - EC HV hardware problem 6/17 night
- Live time fraction for 6/12-18: 97%
  - Run change (2~5min. / shift)
  - Frontend initialization failure (~10min x 5)
  - Update of run control program (~10min x 2)
  - EC HV fix (~2 hours)

Data taking status (cont.)

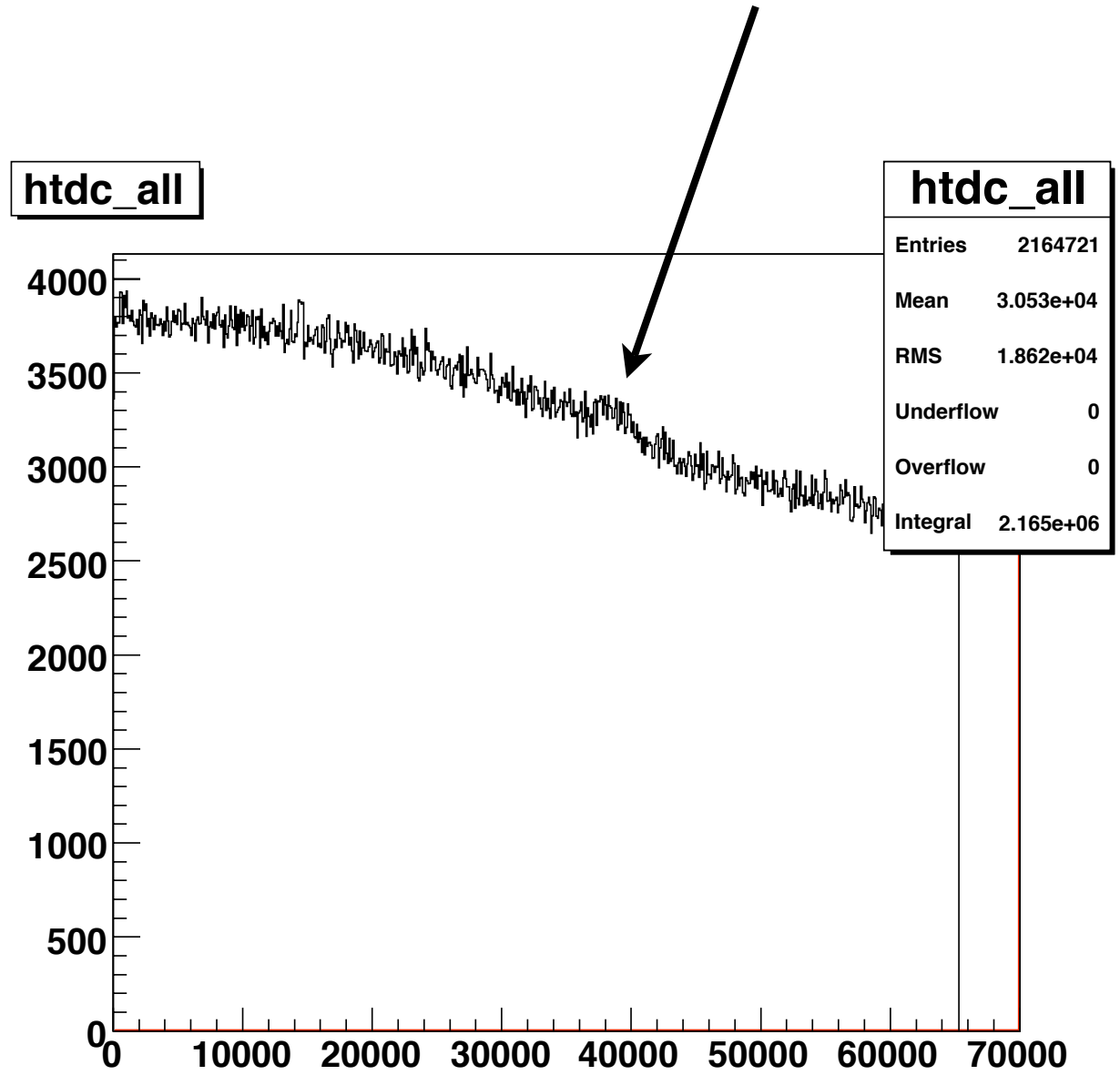
- Total live time by 6/18 morning: ~180 hours
  - >7E18 POT (Assuming average POT of ~4E16/hour)
- Already started monitoring by shifters.
  - Joint shift with MiniBooNE (single person to monitor both detectors & beam)
  - Supported by on-site "expert" team
- Need continuous improvement, but working fine.

SciBooNE

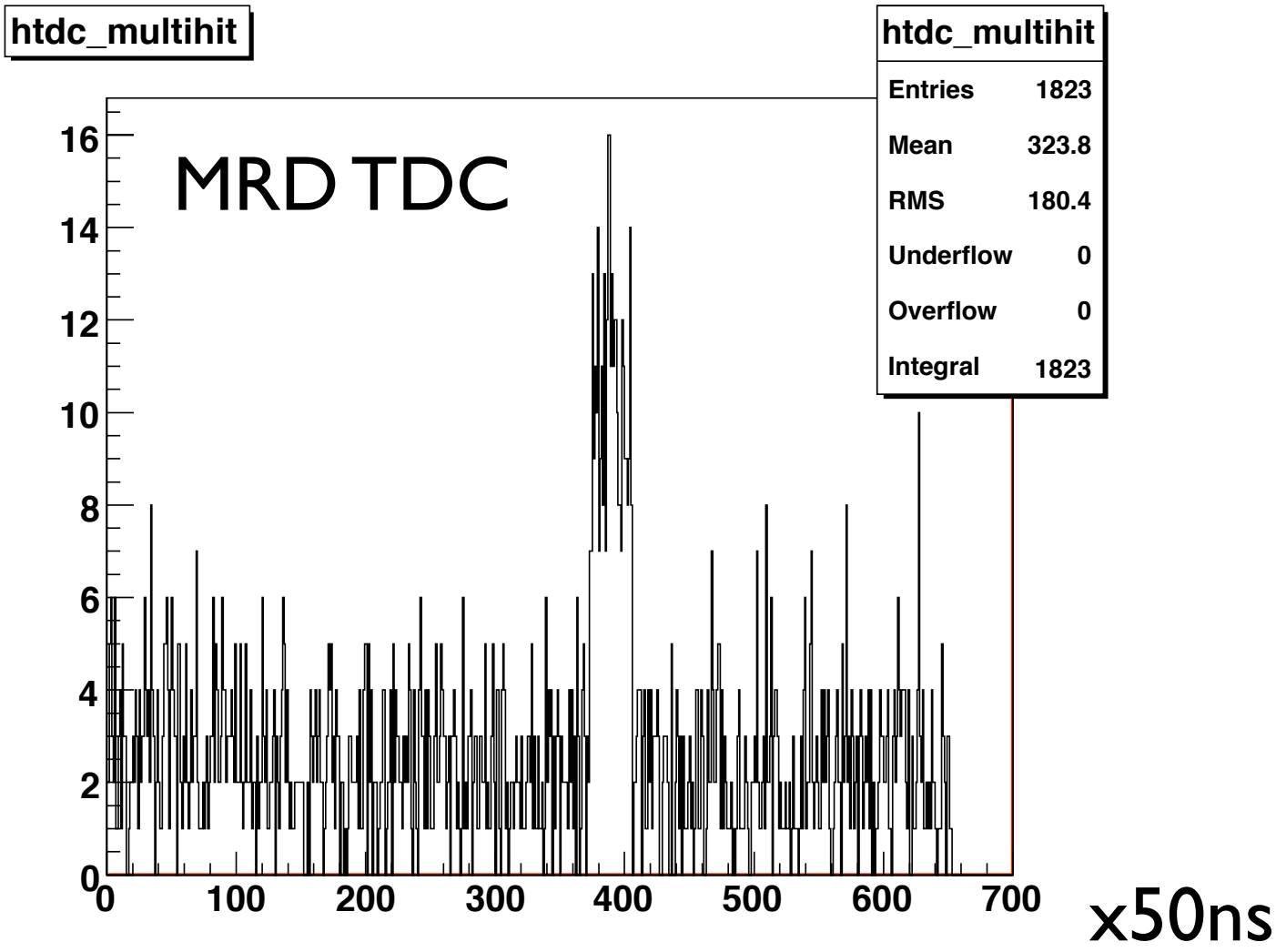
Summary

- SciBooNE started taking data.
  - Thanks to hardworking, young people.
    - I am the oldest of detector ops group..
- All detectors working well at first look.
  - Continue commissioning of experiment (more detail checking/monitoring).
  - Start weekly report at AEM from next week.
- Thanks for great help/support from Fermilab divisions/sections/experiments.

Backup

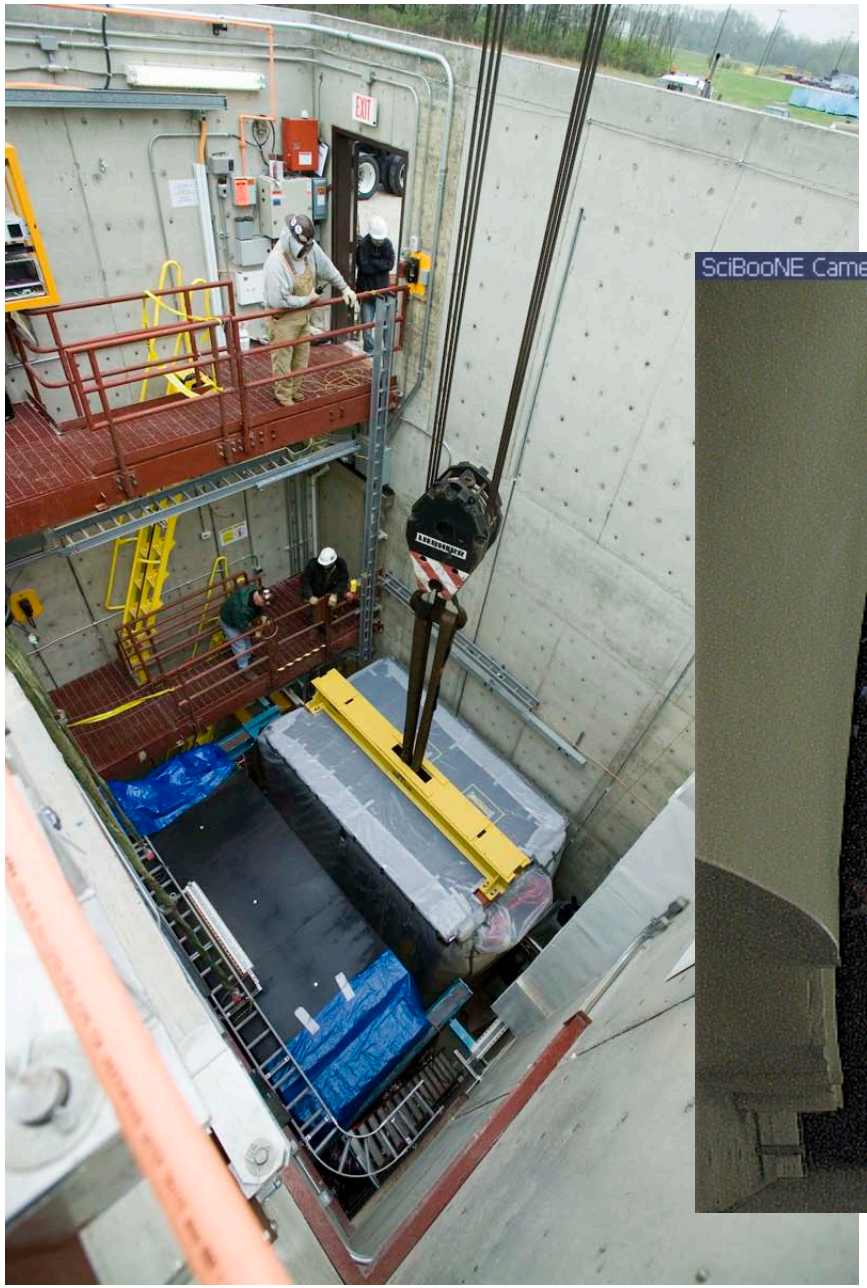


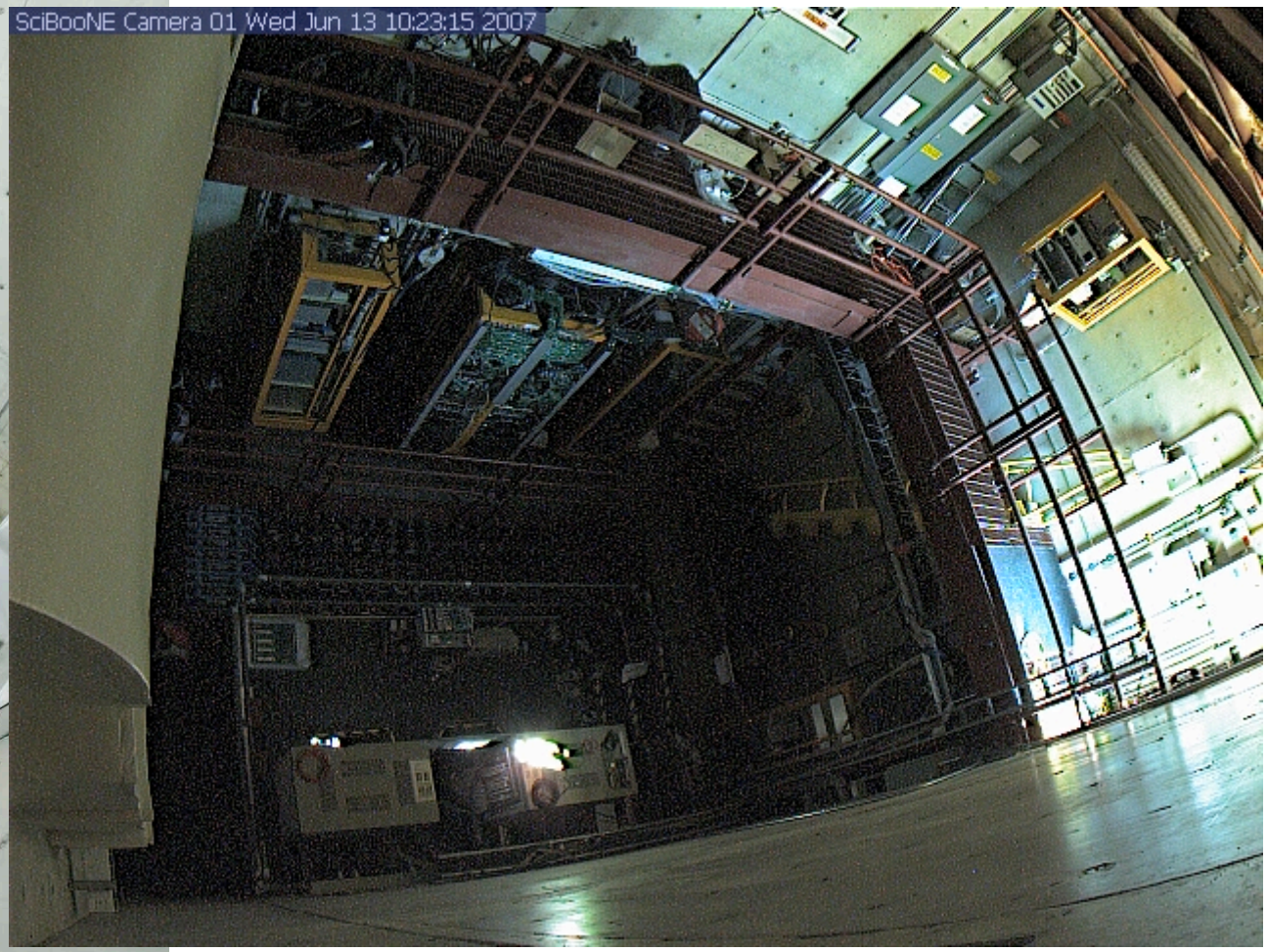
OR of all MRD TDC



Requiring ≥4 hits in 50ns window

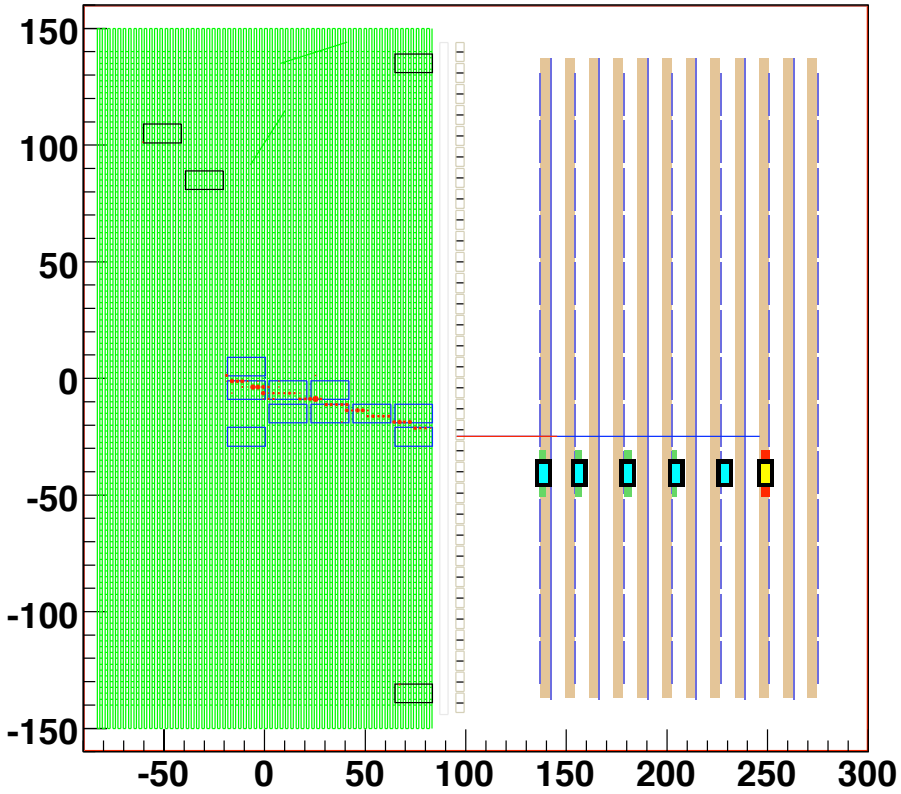
SciBooNE detector hall





And more...

Side view



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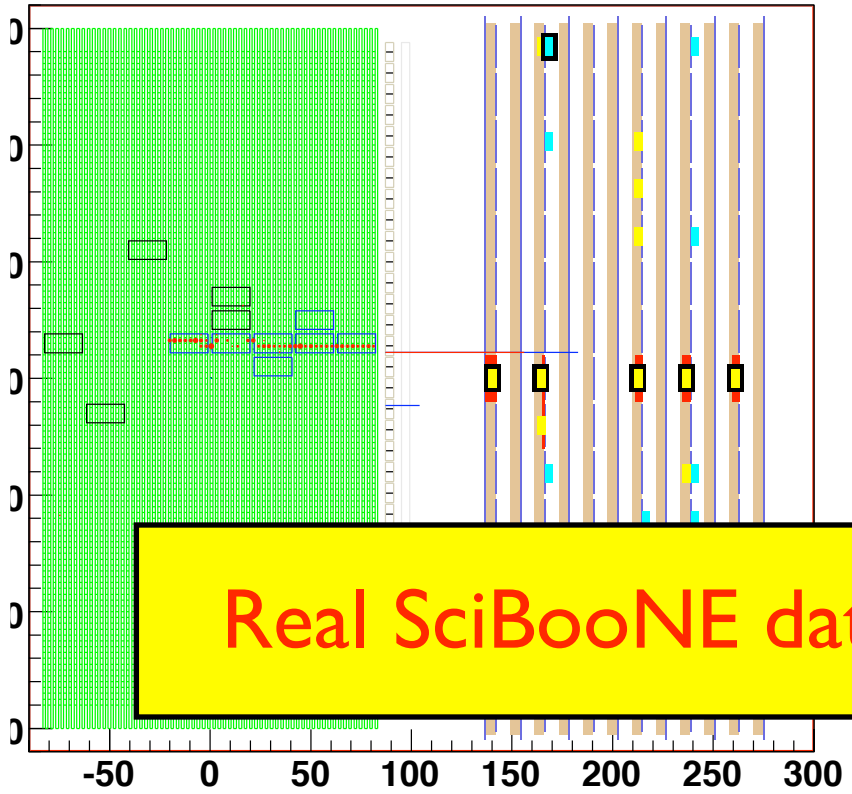

Real SciBooNE data

Red points: ADC hits
(Area ∝ charge)

Box: TDC hits
(32ch OR-ed)

Charged current
single track events
with track in MRD

SciBooNE