



Status of the Daya Bay Neutrino Oscillation Experiment

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(On Behalf of the Daya Bay Collaboration)

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The Daya Bay Nuclear Power Complex

- 12th most powerful in the world ($11.6 \text{ GW}_{\text{th}}$)
- One of the top five most powerful by 2011 ($17.4 \text{ GW}_{\text{th}}$)
- Adjacent to mountain, easy to construct tunnels to reach underground labs with sufficient overburden to suppress cosmic rays

Ling Ao NPP: $2 \times 2.9 \text{ GW}_{\text{th}}$



Ling Ao II NPP: $2 \times 2.9 \text{ GW}_{\text{th}}$

Ready by 2010-11



Daya Bay NPP:
 $2 \times 2.9 \text{ GW}_{\text{th}}$



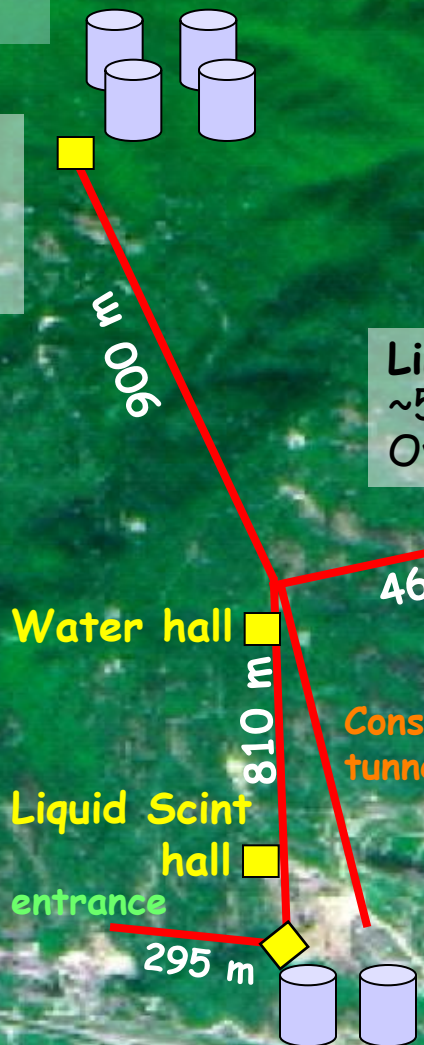
Daya Bay Experimental Site

4 x 20 tons target mass at far site

Far site
1615 m from Ling Ao
1985 m from Daya Bay
Overburden: 350 m

Ling Ao Near site
~500 m from Ling Ao
Overburden: 112 m

Daya Bay Near site
363 m from Daya Bay
Overburden: 98 m



Ling Ao-II NPP
(under construction)
2x2.9 GW in 2010-11

Ling Ao NPP, 2x2.9 GW

Daya Bay NPP, 2x2.9 GW

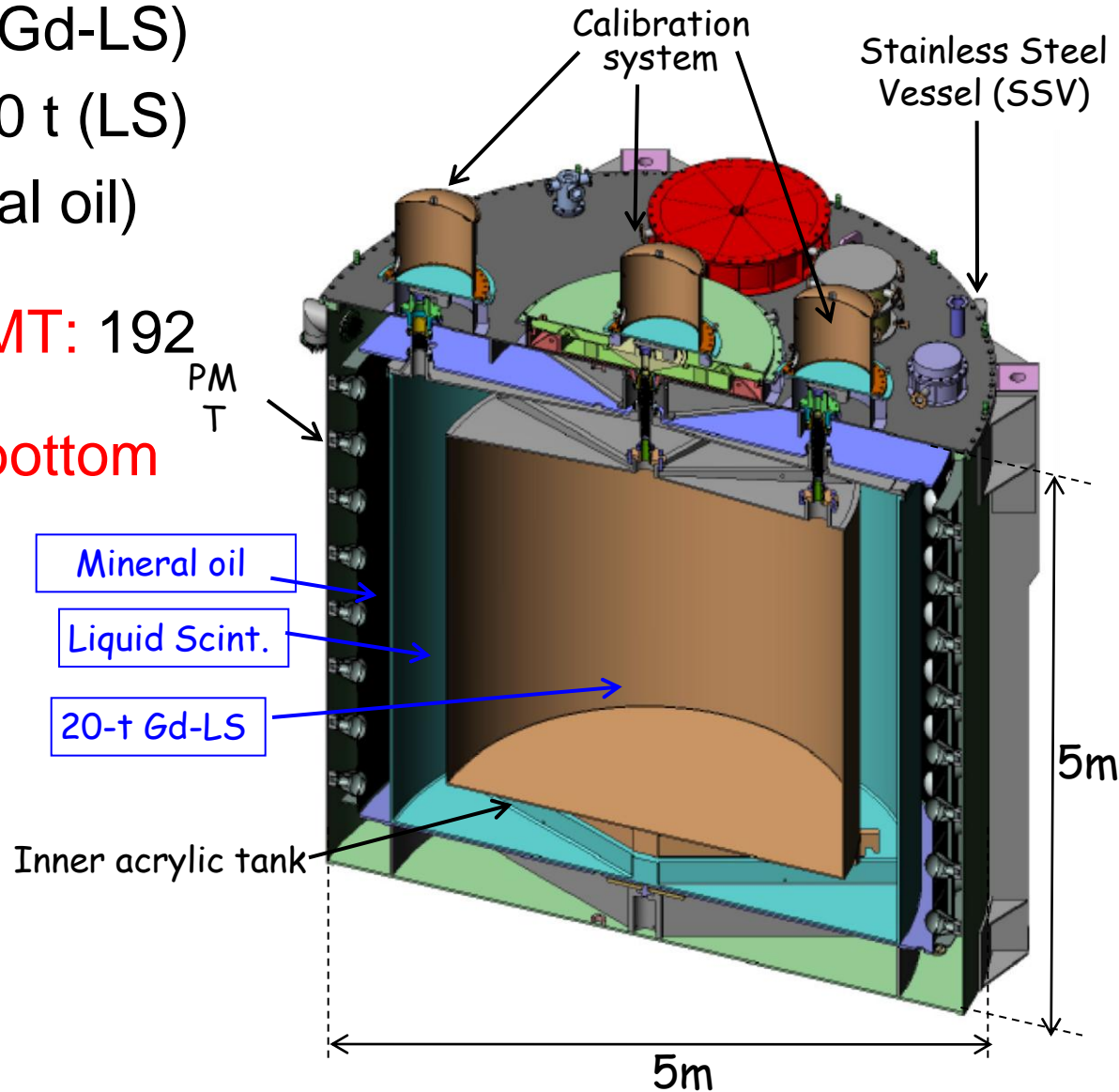
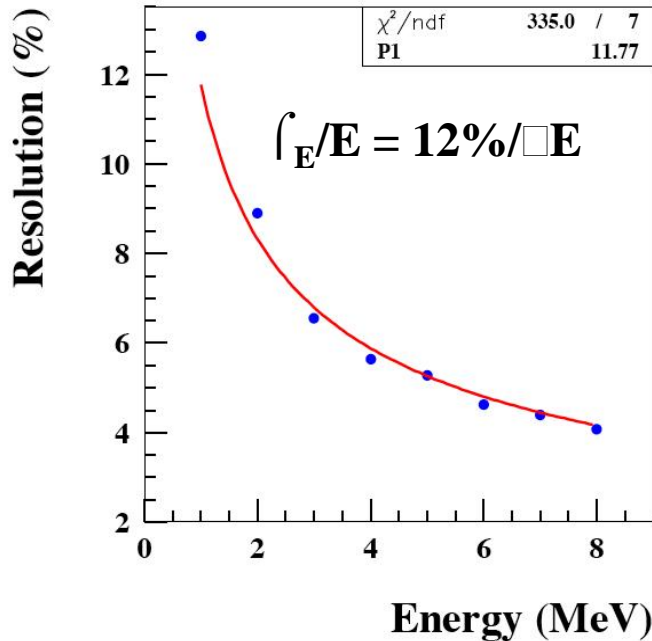
Antineutrino Detectors (AD)

- Three-zone cylindrical detector design

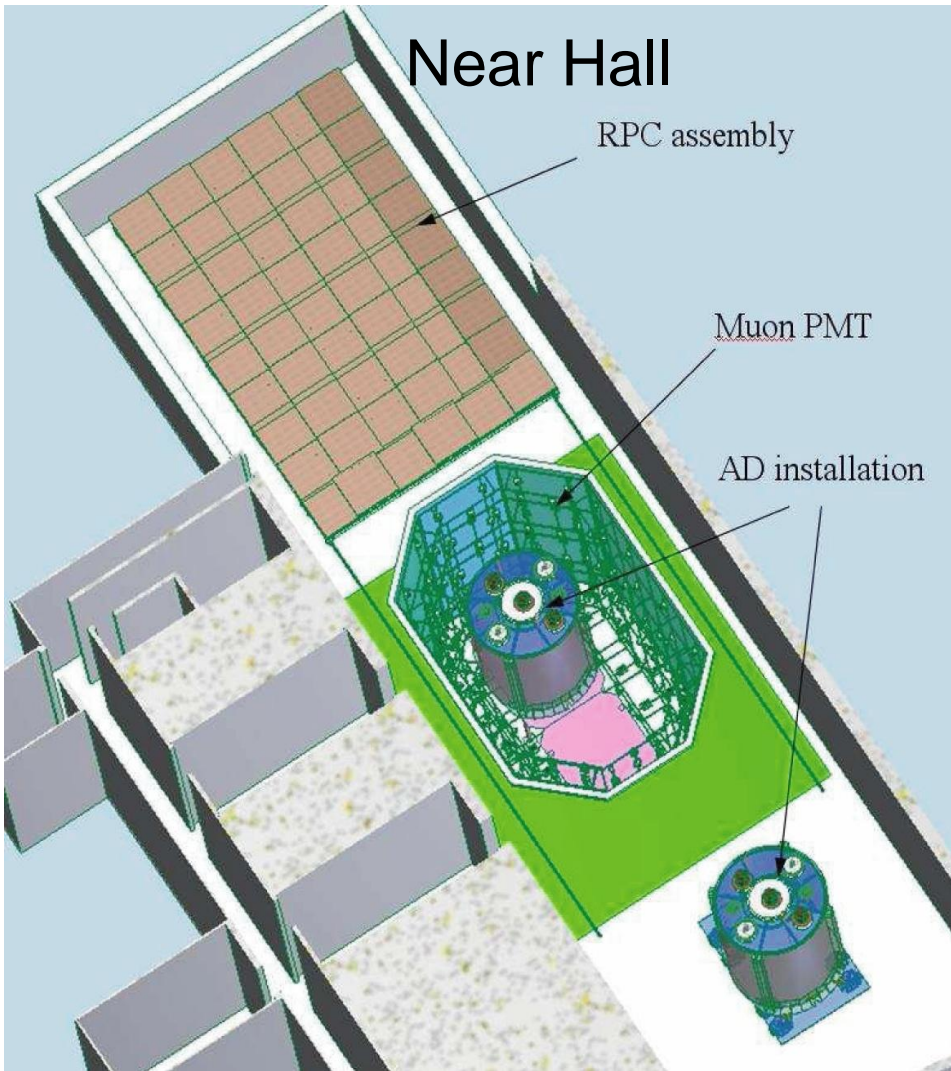
- Target: 20 t (0.1% Gd-LS)
- Gamma catcher: 20 t (LS)
- Buffer : 40 t (mineral oil)

- Low-background 8" PMT: 192

- Reflectors at top and bottom



Muon Veto Systems



- 2.5m of H₂O surrounds the ADs to suppress radioactive backgrounds from rock
- Water pool instrumented with PMTs to tag Cherenkov light:
 - $\epsilon_{\text{water}}(\mu) > 98\%$
 - LED flashers to calibrate and monitor performance
- RPC on top of the water pool:
 - 4 layers of Bakelite RPCs
 - Hits in 3 out of 4 layers \rightarrow
 $\epsilon_{\text{RPC}}(\mu) = 97.9\%$

The Daya Bay Collaboration

Europe (3) (9)

JINR, Dubna, Russia

Kurchatov Institute, Russia

Charles University, Czech Republic

Asia (19) (~130)

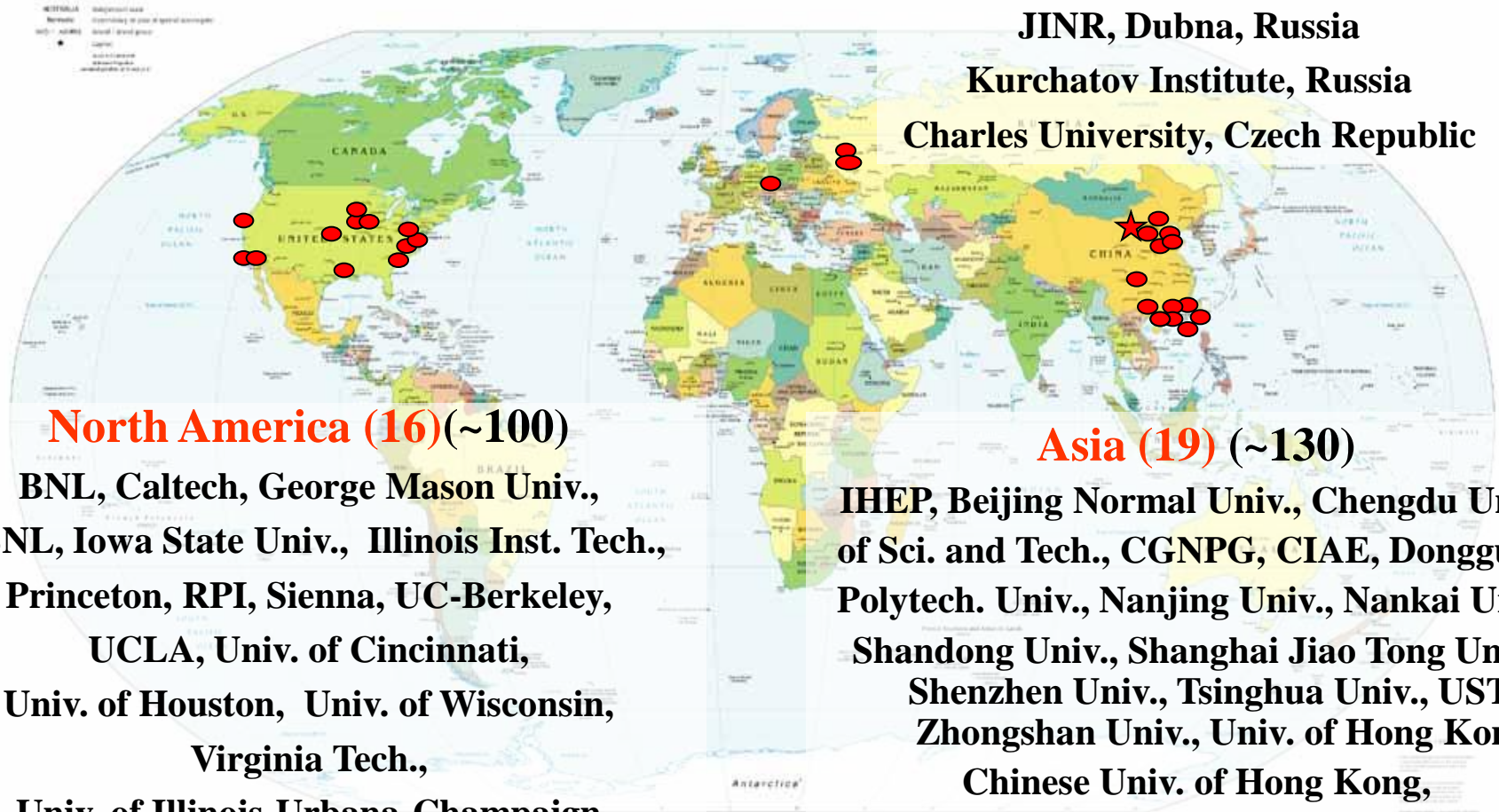
IHEP, Beijing Normal Univ., Chengdu Univ. of Sci. and Tech., CGNPG, CIAE, Dongguan Polytech. Univ., Nanjing Univ., Nankai Univ., Shandong Univ., Shanghai Jiao Tong Univ., Shenzhen Univ., Tsinghua Univ., USTC, Zhongshan Univ., Univ. of Hong Kong, Chinese Univ. of Hong Kong, National Taiwan Univ., National Chiao Tung Univ., National United Univ.

North America (16) (~100)

BNL, Caltech, George Mason Univ., LBNL, Iowa State Univ., Illinois Inst. Tech., Princeton, RPI, Sienna, UC-Berkeley, UCLA, Univ. of Cincinnati, Univ. of Houston, Univ. of Wisconsin, Virginia Tech., Univ. of Illinois-Urbana-Champaign

~ 240 collaborators

Political Map of the World, June 1999



Status of Civil Construction

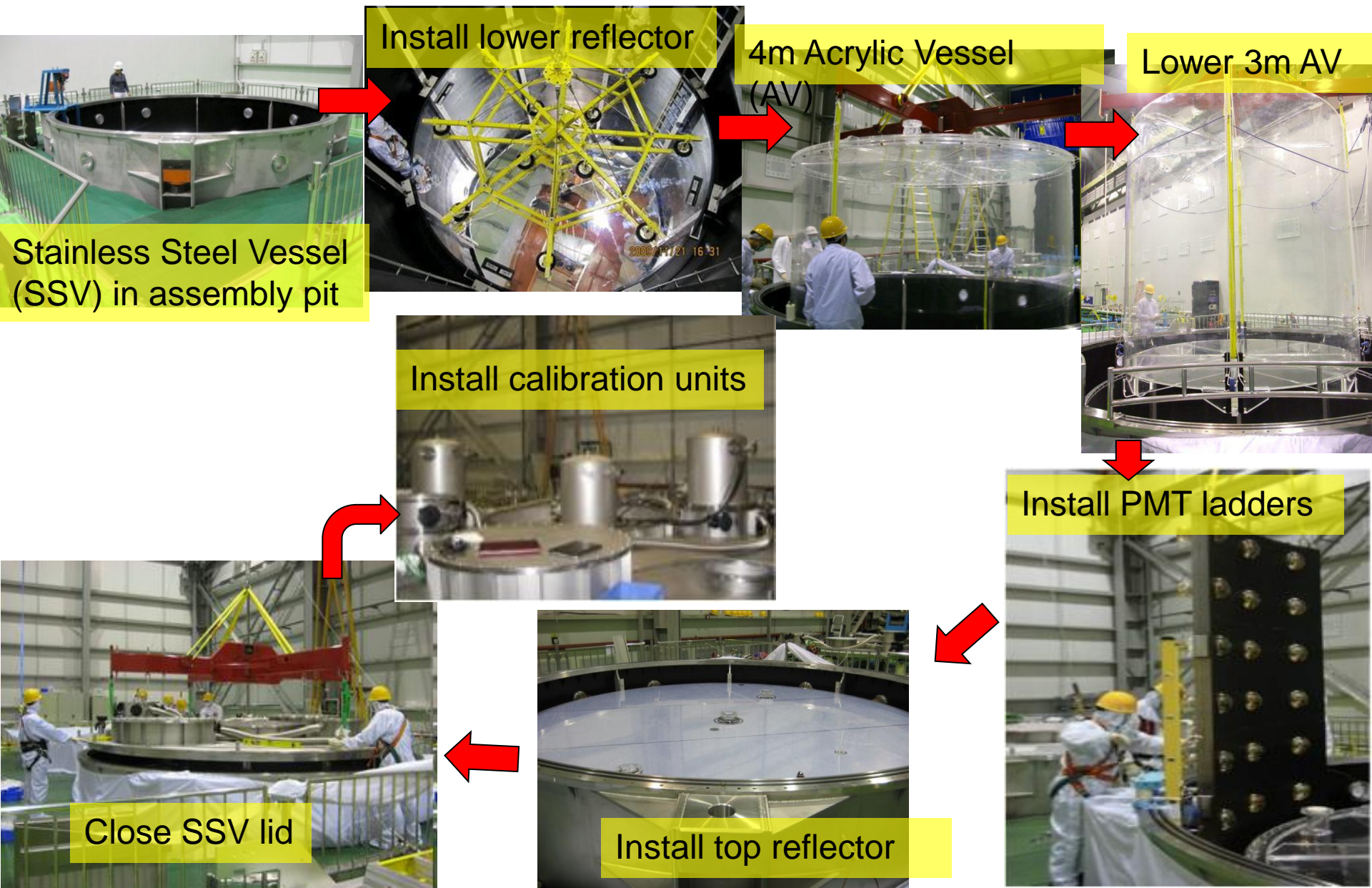


SAB in use since Mar 2009



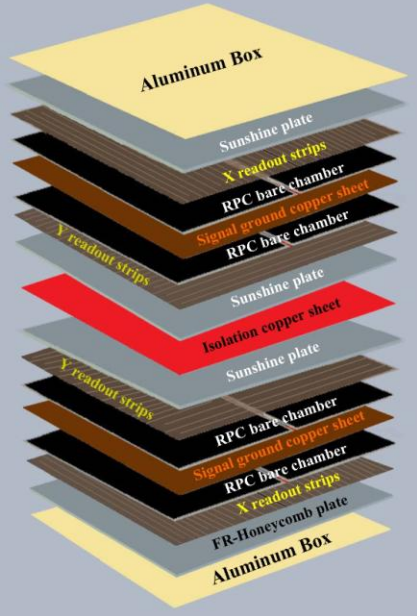
Status of Anti-Neutrino Detector

First production AD is assembled, second one is in progress!!!!

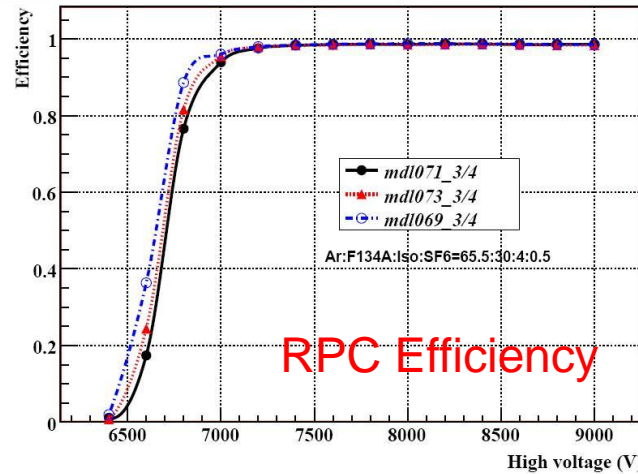


Status of Muon Veto Detectors

RPC Chamber Design



Module efficiency plateau @ 30mV



- 128 completed RPC modules just recently delivered to Daya Bay



- Onsite RPC testing completed. Results meet or exceed expectations
- ~400/1000 muon PMTs recycled from MACRO exp. Potting completed

Potting of PMT Bases



- All PMTs (R5912 and MACRO) have been tested and burned-in
- Support frames for muon PMTs onsite
- Installation will start soon

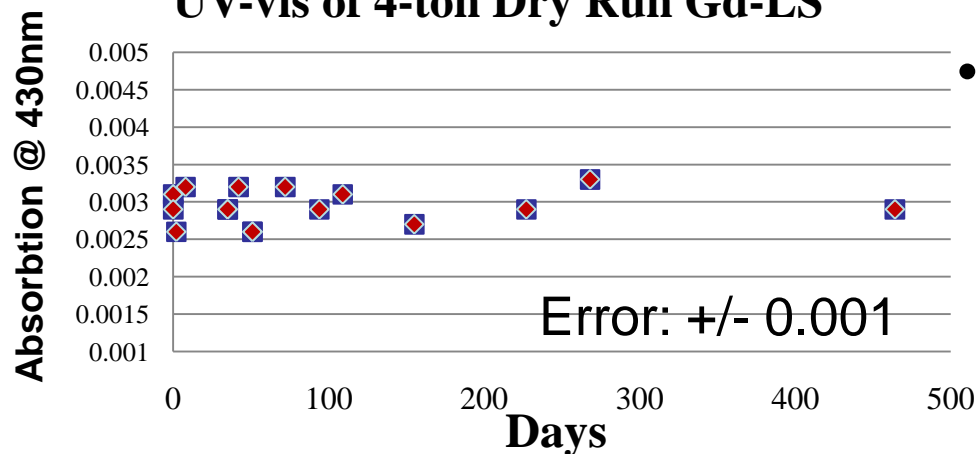
Production of Gd-Liquid Scintillator

LS Mixing Hall



- Daya Bay requires 185 ton 0.1% Gd-doped LS:
Gd-TMHA + LAB + 3g/L PPO + 15mg/L bis-MSB
- Properties of Gd-LS has been stable in the prototype detector since 2007
- Mixing equipment for mass production has been tested. 4-ton test batch was produced and monitored (Mar. 2009)

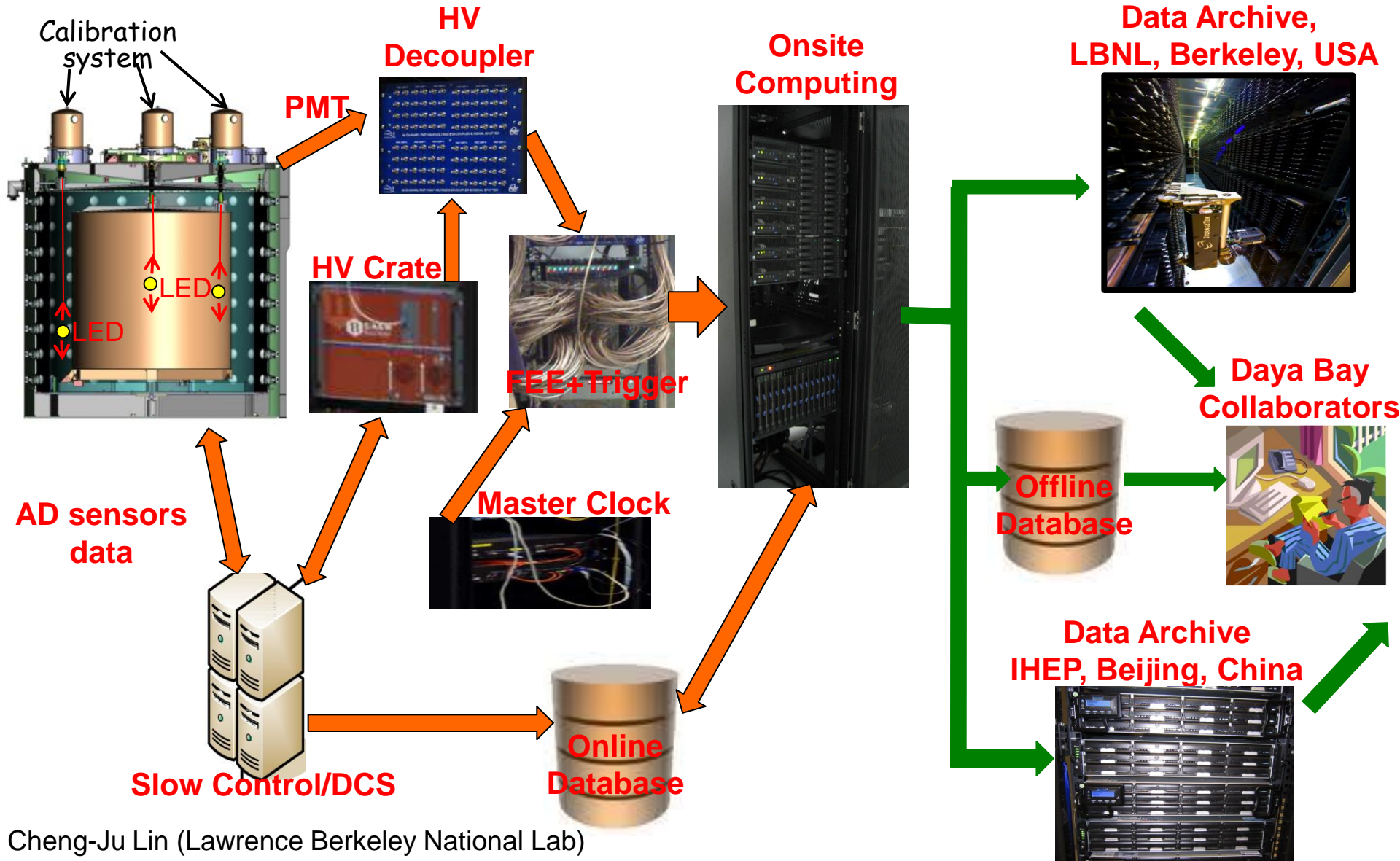
UV-vis of 4-ton Dry Run Gd-LS



- Gd-LS will be produced in 4-ton batches and stored in common reservoirs to ensure uniform sample for all 8 ADs

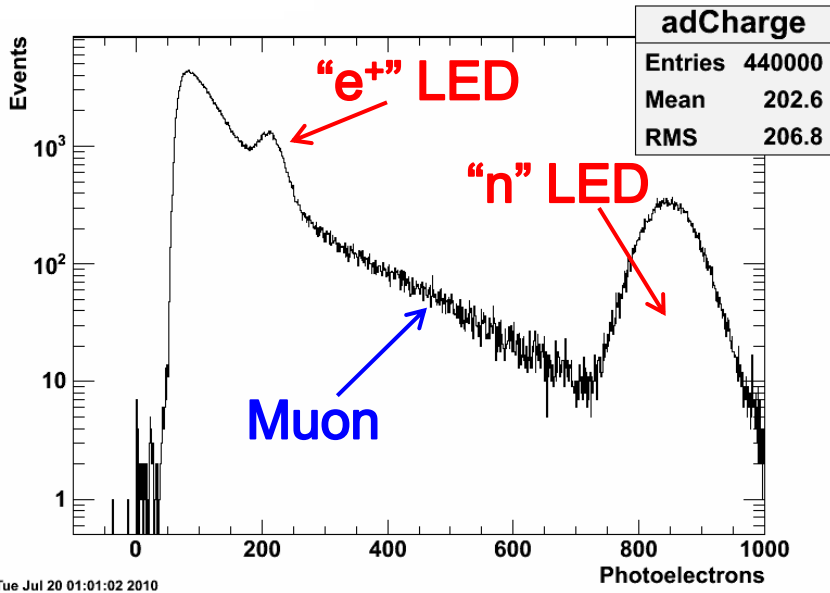
AD Dry Run (June 2010)

- Exercised the entire chain of online → offline framework
- Took calibration LED data using fully assembled AD

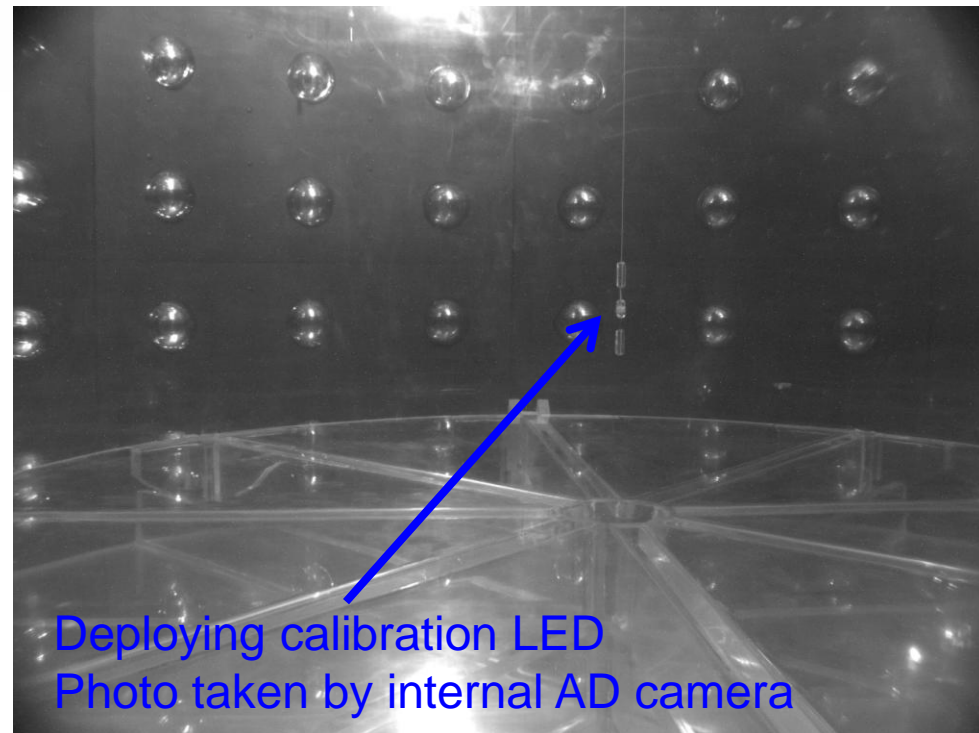
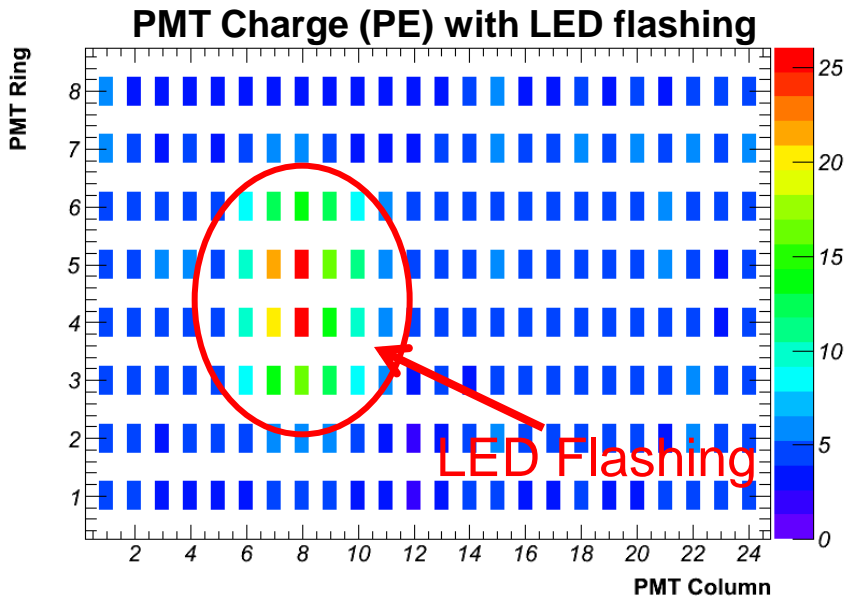


AD Dry Run Data Analysis (I)

Data analysis is still ongoing, showing some highlights today

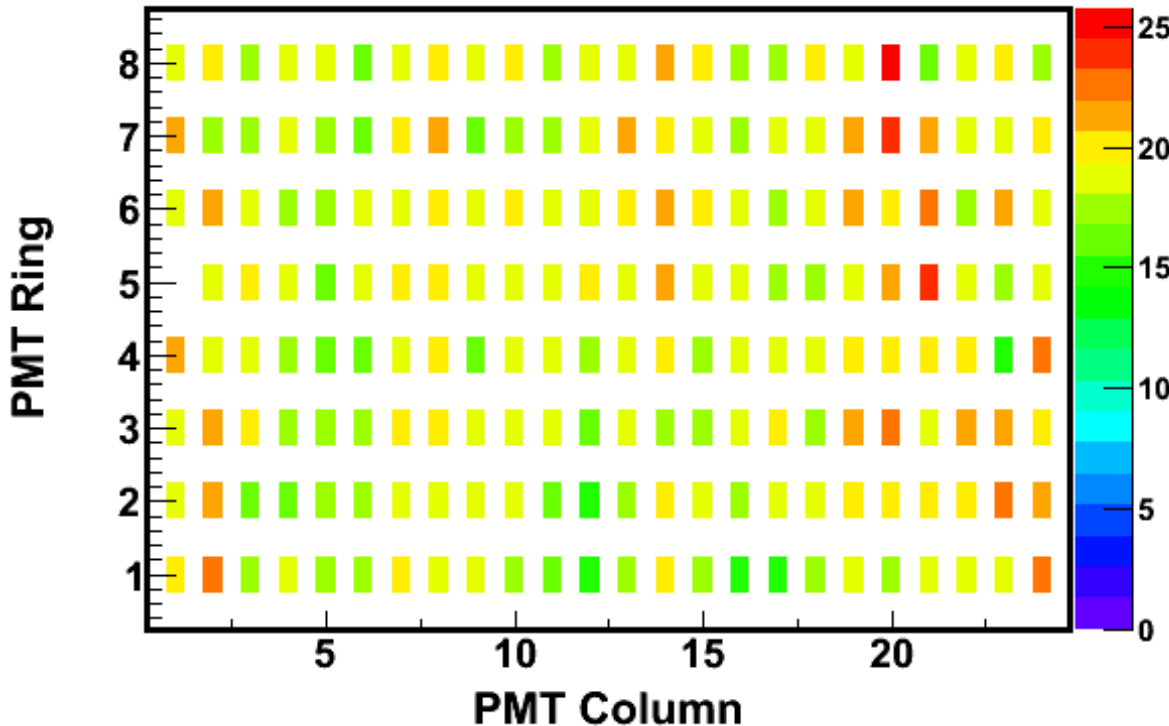


- Double-pulse LED to mimic $\bar{\nu}$ interaction
- AD Dry Run took place in SAB (above ground). Can clearly see muon events



AD Dry Run Data Analysis (II)

SPE Calibration Constants



- All 192 PMTs in AD#1 are operational
- PMT gain and FEE ADC calibrations ongoing
- Single photo-electron peak = ~ 20 ADC counts

Other ongoing Dry Run studies:

Trigger efficiency, vertex reconstruction, TDC time slew + offset corrections, pedestal stability, detector uniformity, etc.

Many other interesting results from the Dry Run not able to show today due to time constraints !!!

Signal, Background, and Systematic

- Summary of signal and background (per AD):

	Daya Bay Near	Ling Ao Near	Far Hall
Baseline (m)	363	481 from Ling Ao 526 from Ling Ao II	1985 from Daya Bay 1615 from Ling Ao
Overburden (m)	98	112	350
Radioactivity (Hz)	<50	<50	<50
Muon rate (Hz)	36	22	1.2
Antineutrino Signal (events/day)	840	740	90
Accidental Background/Signal (%)	<0.2	<0.2	<0.1
Fast neutron Background/Signal (%)	0.1	0.1	0.1
$^8\text{He}+^9\text{Li}$ Background/Signal (%)	0.3	0.2	0.2

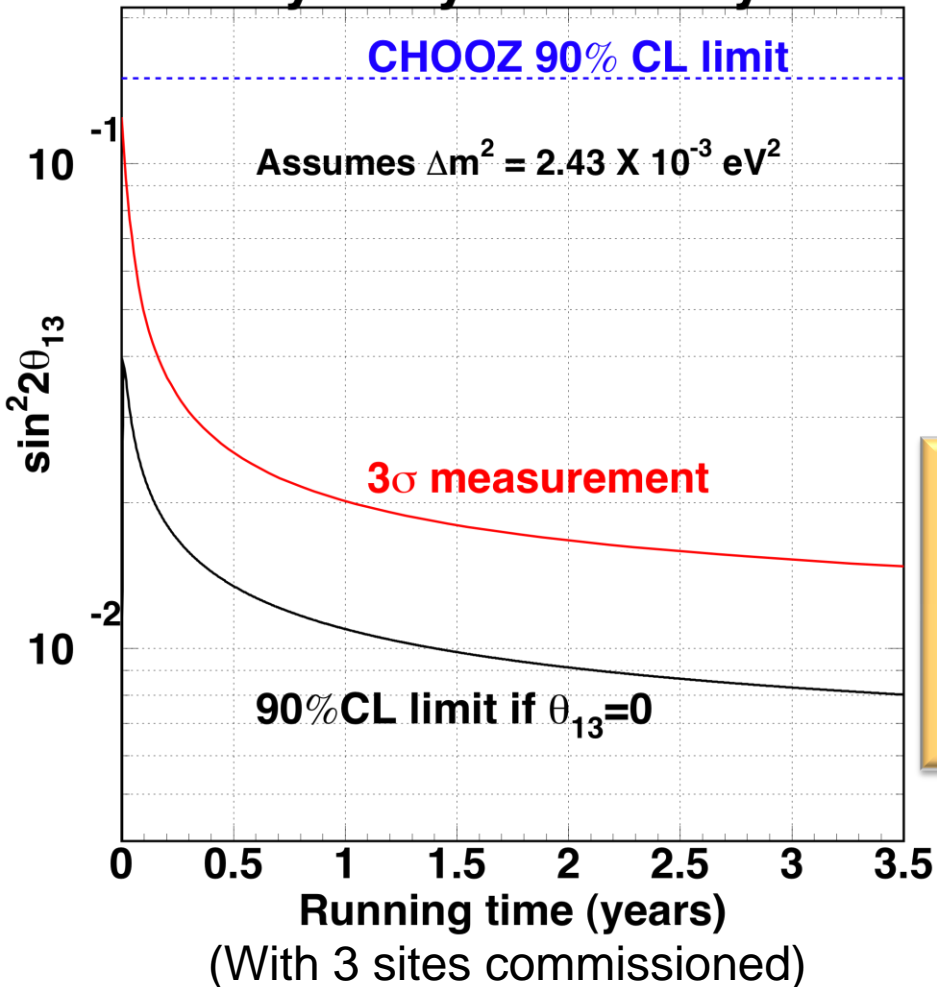
- Summary of statistical and systematic budgets:

Source	Uncertainty
Reactor power	0.13%
Detector (per module)	0.38% (baseline) 0.18% (goal)
Signal statistics	0.2%

Sensitivity and Schedule

Goal: sensitivity to $\sin^2 2\theta_{13} < 0.01$

Daya Bay sensitivity



Experimental Hall	Physics Ready
Daya Bay Near	Spring 2011
LingAo Near	Winter 2011/12
Far Hall	Fall 2012

Daya Bay design sensitivity after ~6 months is greater than the sensitivity of any experiments currently under construction !