Daya Bay Antineutrino Detector Assembly and Installation

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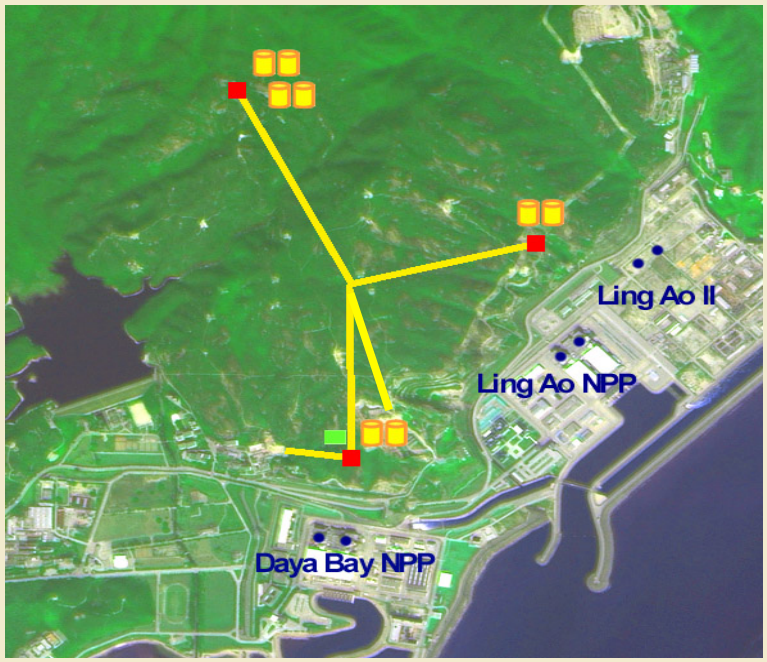
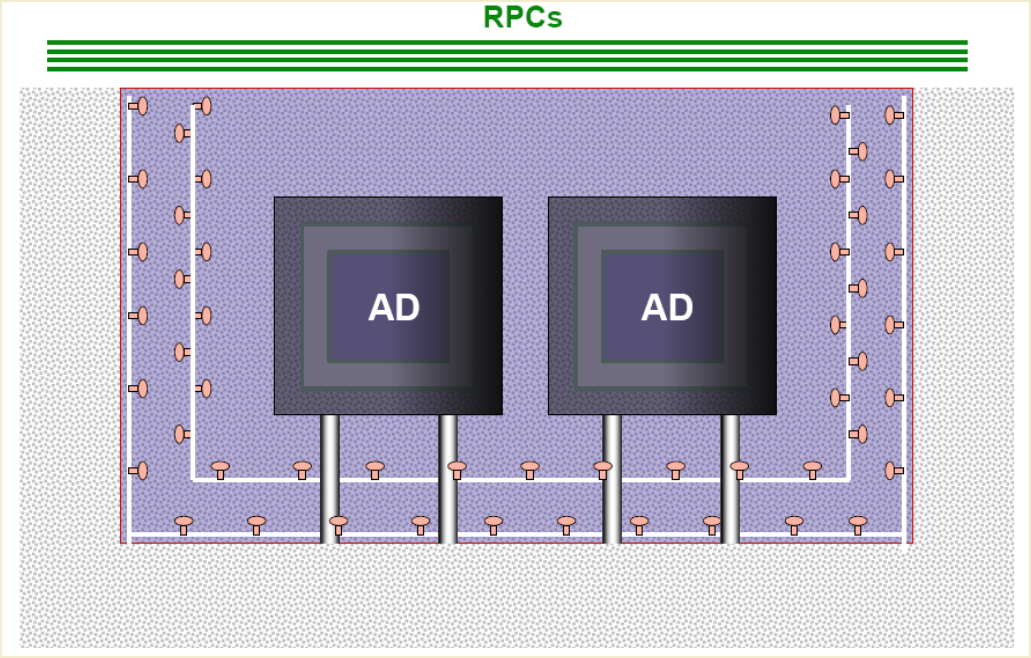
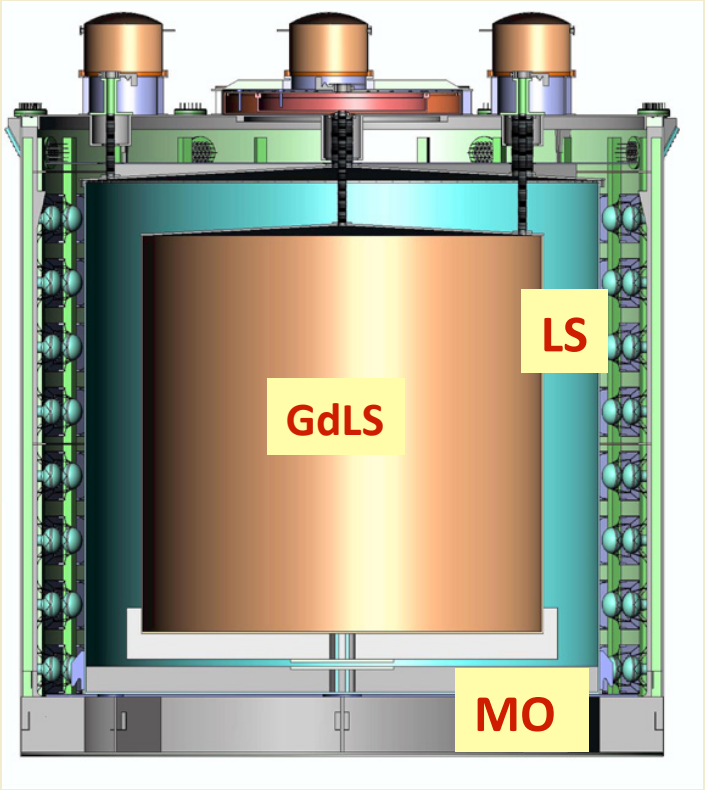
Daya Bay Antineutrino Experiment





- *Precision measurement of θ_{13} using antineutrinos from the Daya Bay Nuclear Power plant six cores ~17GW$_{th}$*
- *Measure ratio of observed events in "identical" detector pairs near/far to cancel correlated systematic errors*
- *Multiple detectors at each site in water pools*
- *Multiple muon detectors*
  - *4-layers of RPC*
  - *2-layers of water Cerenkov detector*

Antineutrino detector(AD)



GdLS -Target: 20 t
LS γ-catcher: 20t
MO Buffer: 40t
SS outer vessel : 20t

- 3 zone concept does not require position reconstruction
- Liquids contained in nested acrylic vessels
- Monitored by 192 8" PMTs
- Reflectors at top and bottom to increase PMT coverage
- Three calibration stations can deploy both sources & LEDs
- Level sensors in overflow tanks monitor changes in the target mass

Detector Components

Stainless steel vessel

4m Acrylic vessel

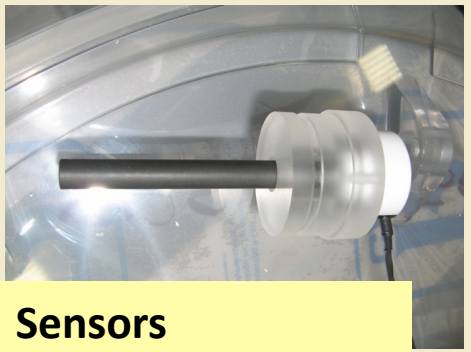
Calibration tubes

PMT Ladders
Reflector

3m acrylic vessel

Overflow tanks

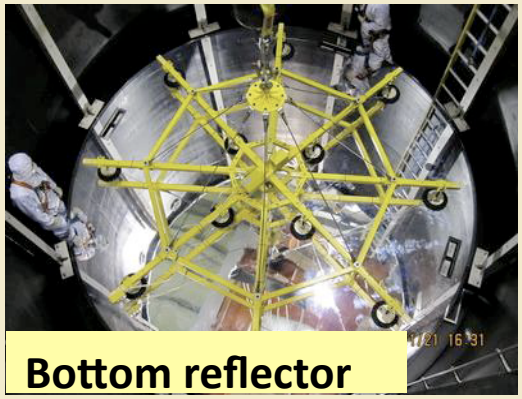
PMT

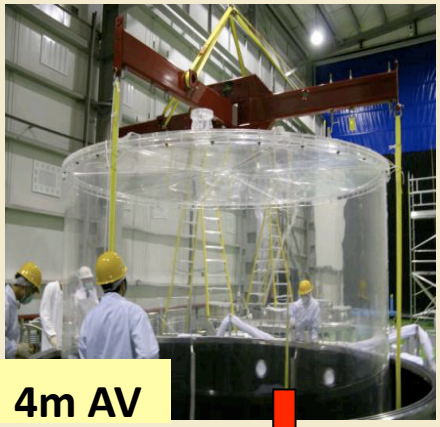


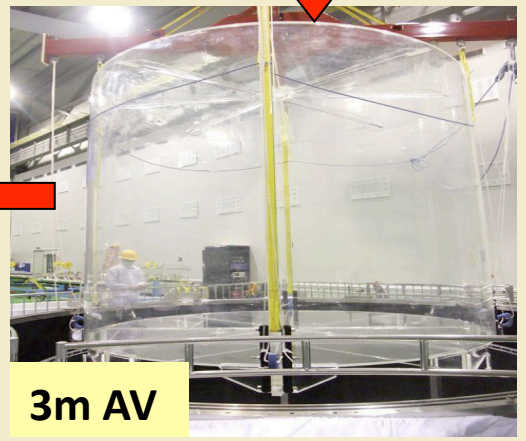
Sensors

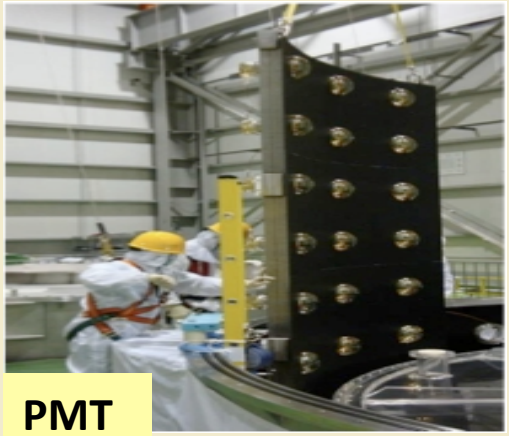
AD assembly

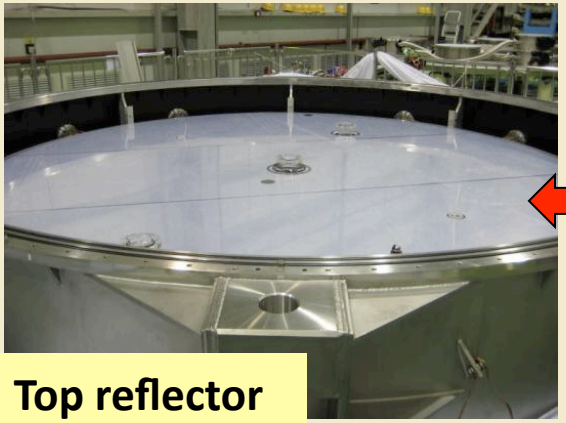

SSV


Bottom reflector

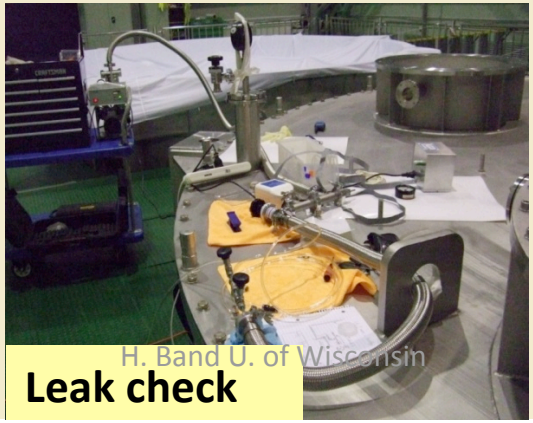

4m AV


3m AV


PMT

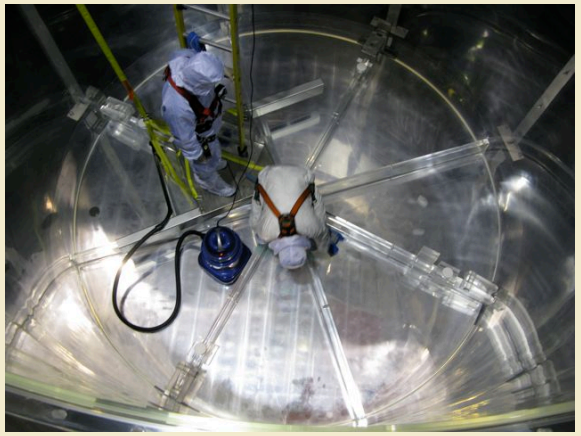

Top reflector

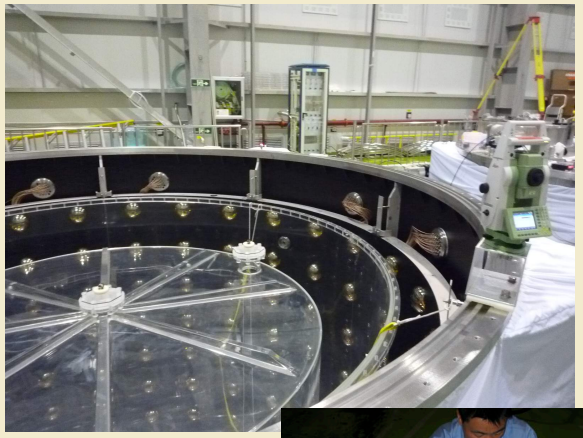

SSV lid

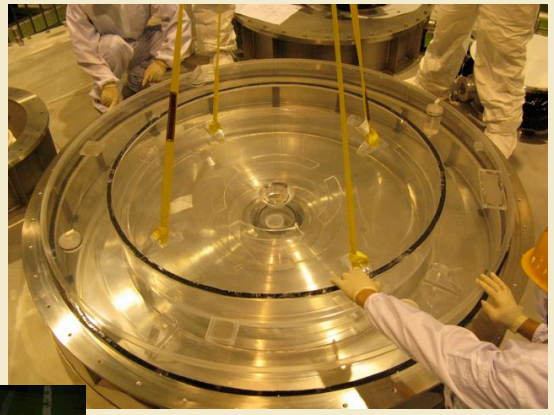

Leak check

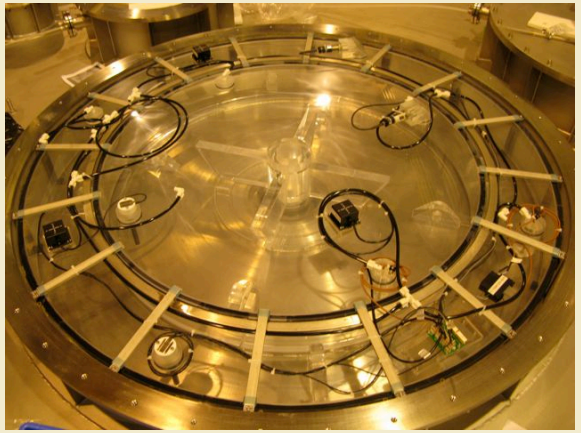

ACU

AD Assembly -2



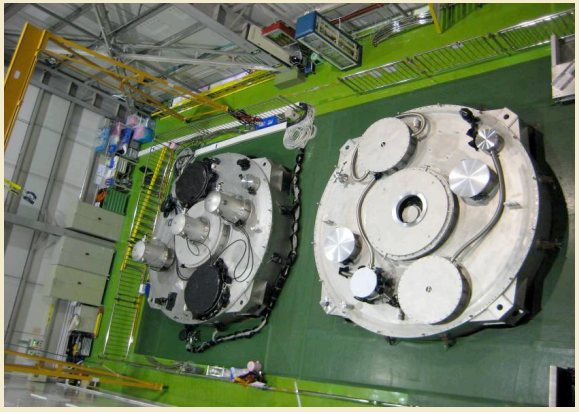






AD Assembly -3

- *Pairwise- the inner and outer acrylic vessels are constructed in pairs. The ADs are assembled and filled as pairs to make them as similar as possible.*

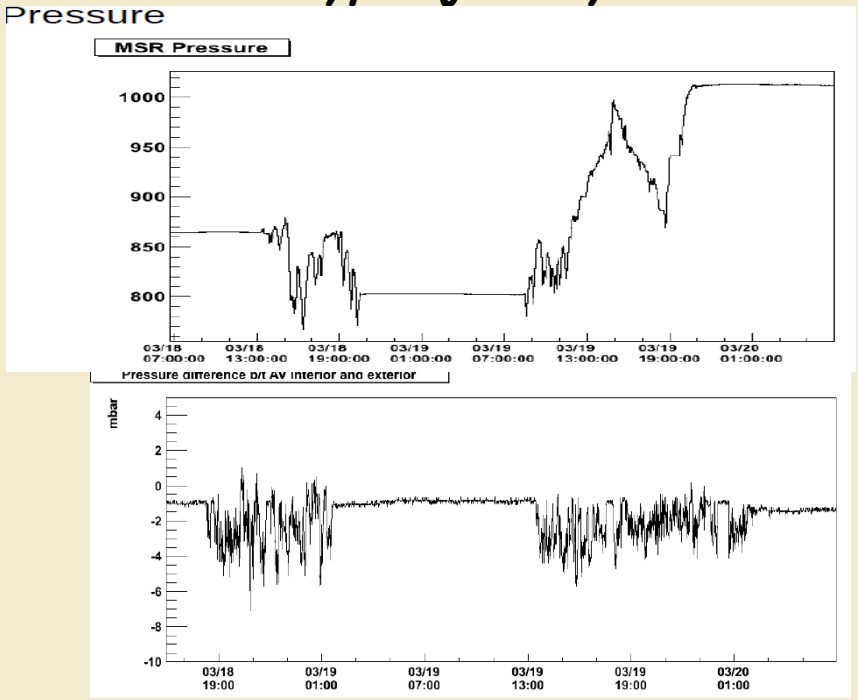


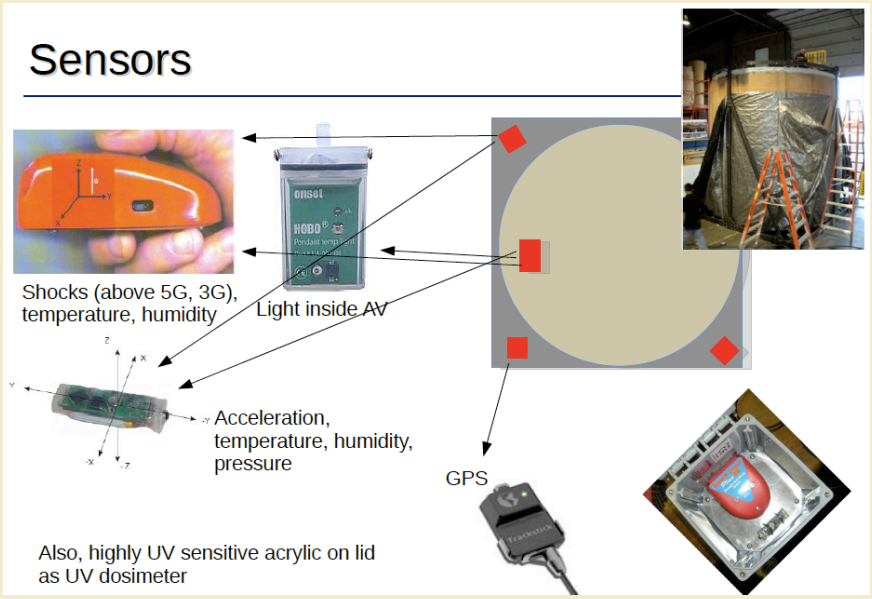
AD 1&2 stored before filling

- *The ADs are assembled in the surface assembly building, are <u>moved</u> underground while dry, and filled with liquids back to back. The filled AD is then <u>moved</u> to the experimental hall while full and lowered into the water pool. Requires highly maneuverable, robust & clean transport, the AGV.*

Shipping OAV

- *OAV shipped from Colorado to DB*
- *Instrumented each AD with multiple shock, acceleration. temperature, humidity, light, and position sensors*
- *Prototype journey*





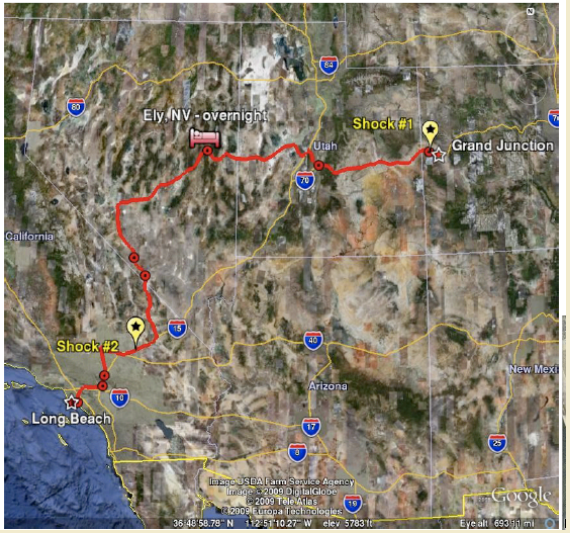
- *Unpleasant surprise when prototype reached port*

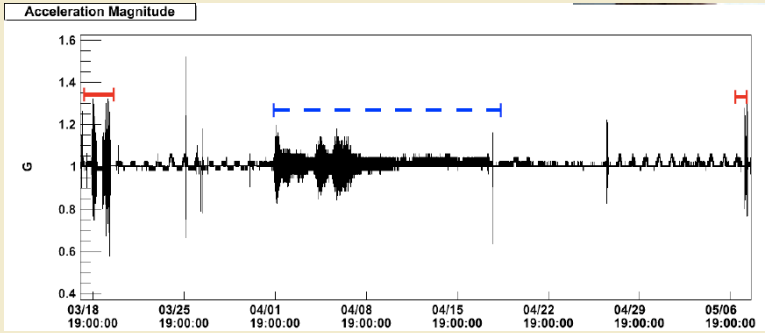
Bent lifting eye on frame

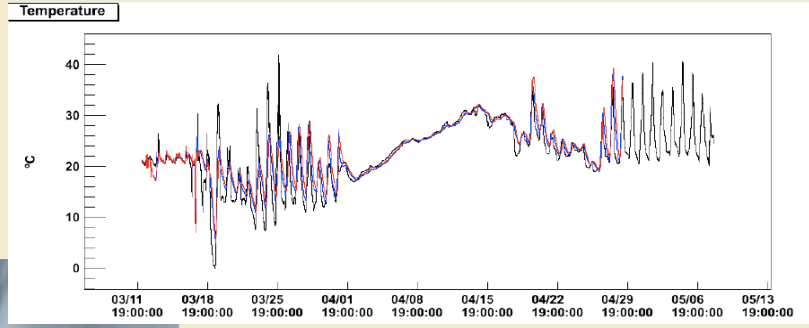
Shipping OAV -2

- *However, only a few shocks > 5G at the base, none at top*

US route 3/18 - 3/20







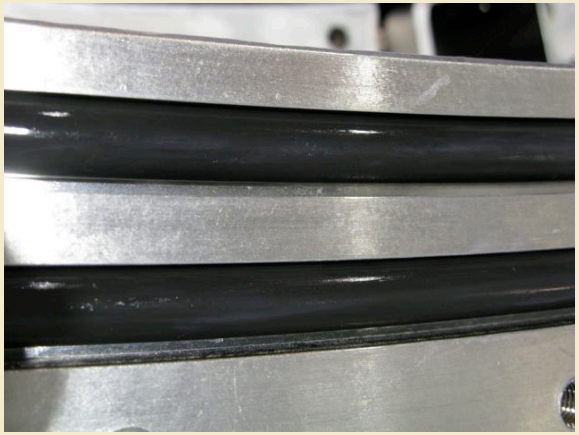
- *Identified biggest shock as this overpass outside of Grand Junction*

Only damage possibly related was a small craze on a lifting hook.
Made more compliant hold-downs
Insulated top of the packing crate

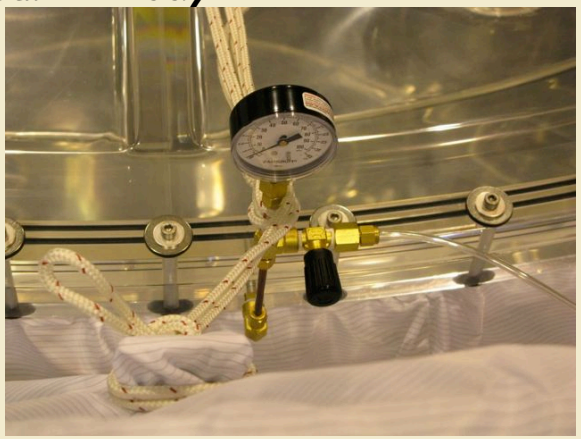
Leak Checking

- *Each AD has over 1600 o-rings and gaskets separating the 3 liquids, cover gas, and water pool*
- *Significant leaks could short an entire ladder of PMTs or could introduce systematic errors in the calculation of the target mass or change energy calibration.*
- *After the AD is fully assembled it will be difficult to locate the source of a leak and would require a major intervention (draining the water pool) to repair.*
- *Leak check at every assembly step*
- *Goals are typically < 2-4 l in 5 yr*
- *We test with air, Argon, or Freon at higher pressure differentials and scale for viscosity to reach the desired sensitivity*

- *For major seals we have double o-rings and do a vacuum rate of rise*

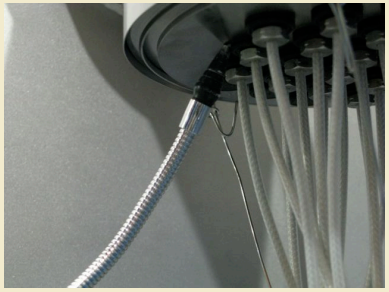


- *or pressure decay*

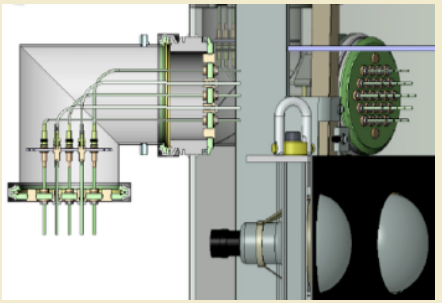


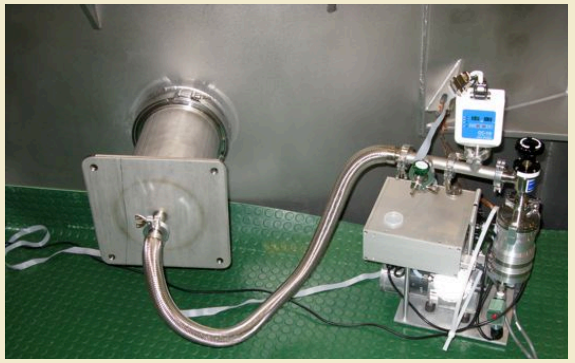
Leak Checking -2

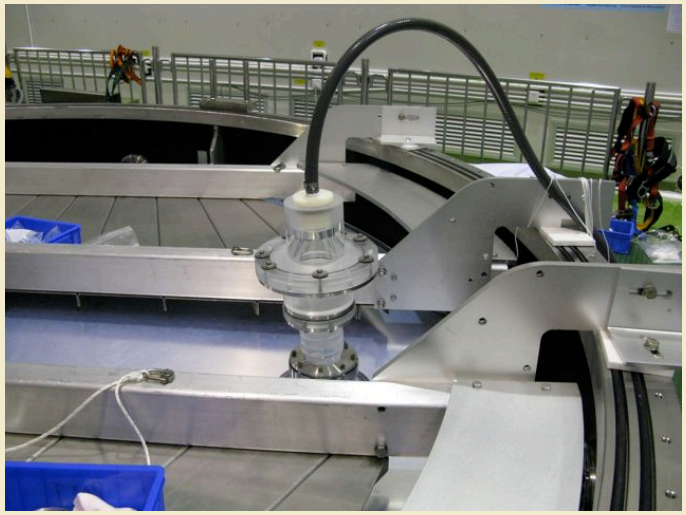
- *The acrylic vessels cannot be pressurized above 15 mbar*
- *To check calibration tube o-rings we pressurize with argon to 12 mbar and sniff the joints with an argon leak detector*



- *The dry box plugs/cables are tested both with vacuum and freon at low pressure*

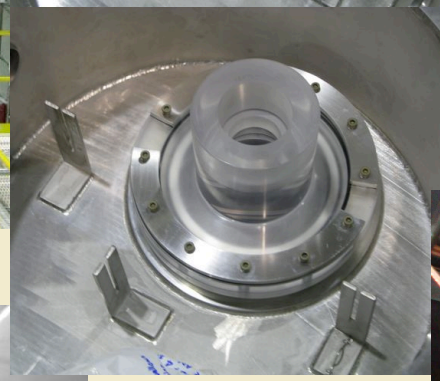


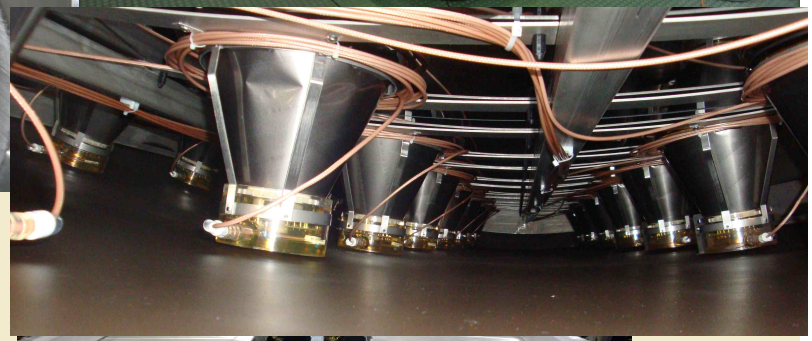


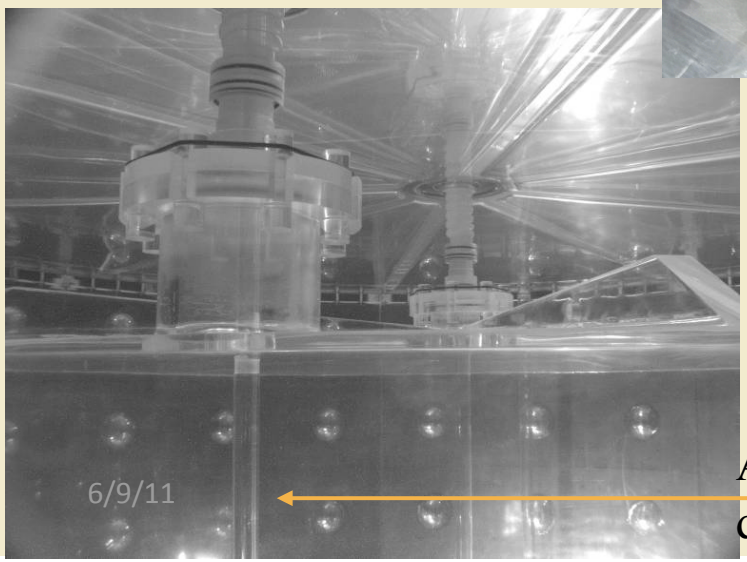


- *The last leak check looks for freon leaks from the LS volume to either the GdLS or MO volumes*

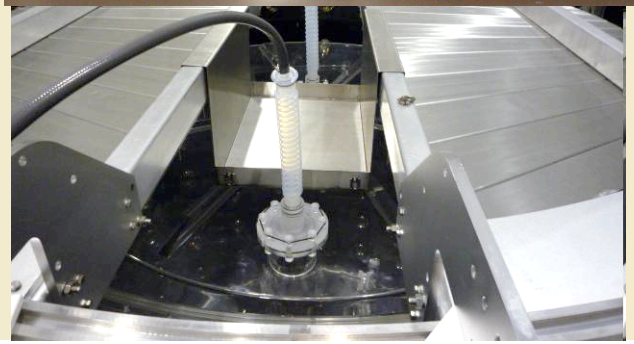
Recent AD Assembly Progress





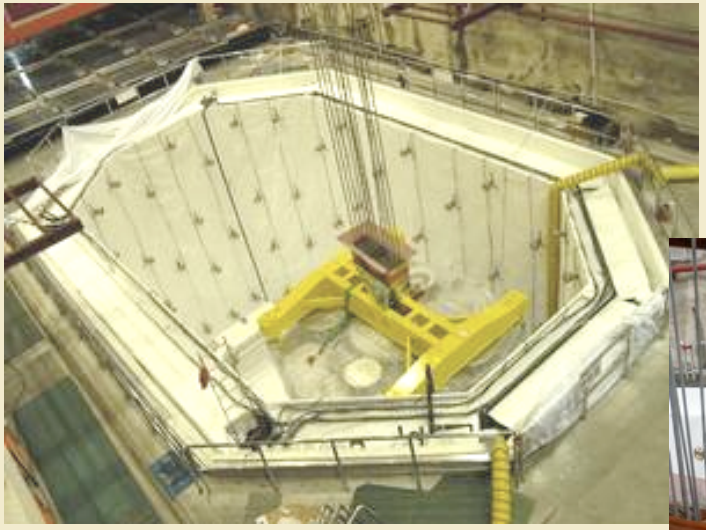


AD1 fill probes during filling



Hall 1 Installation

AD1 test install (Apr 11)



AD1 installed today!

Dry Pipe test installation

AD1 Dry box

ACU-C installed on AD1

Status

- AD1 & AD2 are filled. AD1 installed into EH1 water pool, AD2 next week
- Commissioning starts in July
- AD3 & AD4 undergoing dryrun tests (PMT checkout), will be completed this month
- All parts of AD 5&6 are built & on the way to DB, complete before Dec
- OAVs for AD7&8 have started fabrication, AD7&8 complete in spring 2012
- Daya Bay starts full 8 AD running in summer 2012

More Daya Bay

- *Antineutrino Detectors for a High-Precision Measurement of theta13 at Daya Bay. - K. Heeger Sat. 12:00*
- *High Precision Measurement of the Target Mass of the Daya Bay Detectors. T. Wise Sat 14:40*
- *The DAQ and Trigger Systems for the Daya Bay Reactor Neutrino Experiment. - C. White Sat 15:00*
- *The Front-end Electronics for the Daya Bay Reactor Neutrino Experiment. Z. Wang Sat 14:00*
- *Development and Characterization of the Acrylic Target Vessels for the Daya Bay ν Detectors. –B. Littlejohn -poster*
- *Detector Control System Design of Daya Bay Neutrino Experiment M. YE -poster*