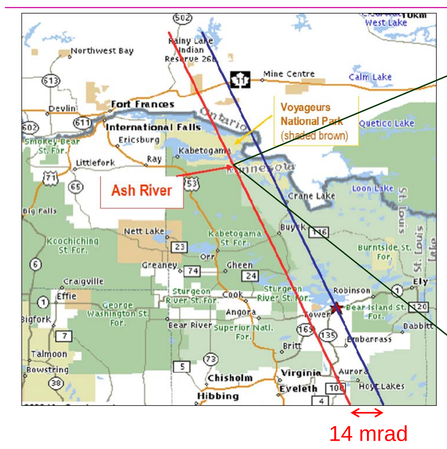
The NOνA Detectors

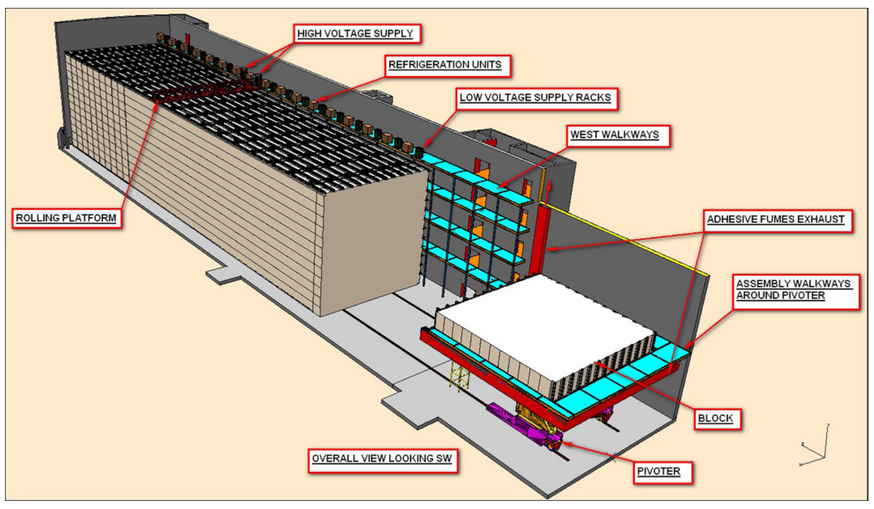
A.Habig, UMD, for the NOνA Collaboration



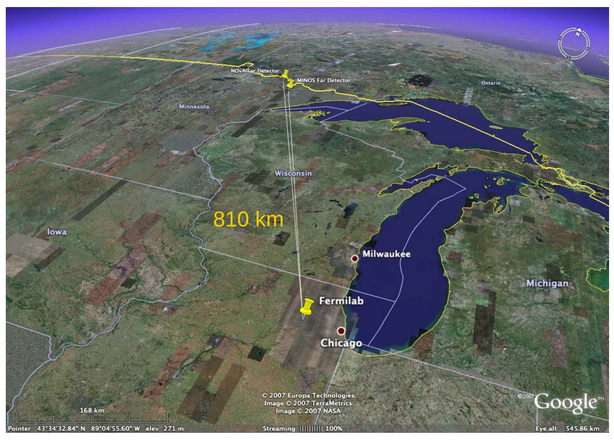
Civil construction at Ash River well underway, the building will be finished in March 2011.

Detector construction will finish in 2013.

An upgraded 700kW NuMI beam will provide ν from late 2012 onwards.



Planes will be assembled flat on a pivoting platform, when finished the whole platform pivots vertically and places the completed plane in the detector.



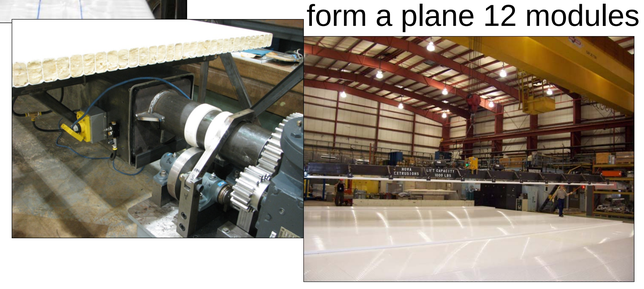
NOνA is an off-axis (14 mrad), long-baseline (810km), neutrino experiment using the NuMI ν_μ beam to look for ν_e appearance (and thus θ_{13}).

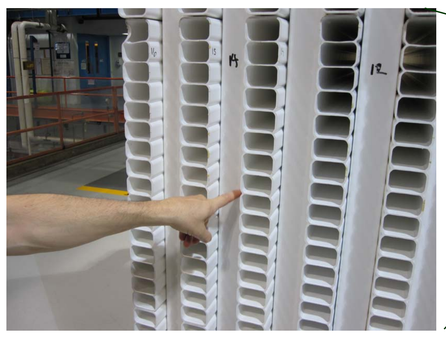
The Far Detector site near Ash River Falls, MN, is on the last road north the beam crosses in the USA.

See Greg Pawloski's poster for NOνA's Physics reach.

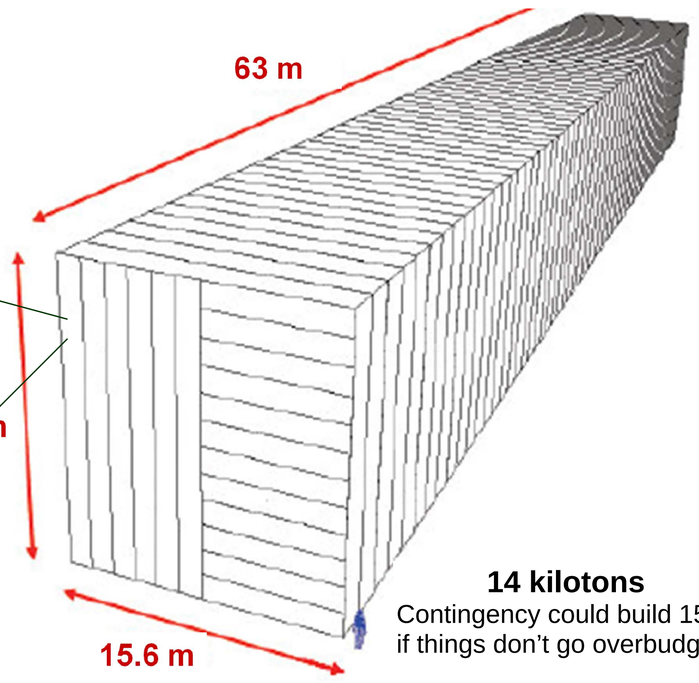
16-cell wide extrusions are glued into 32-cell wide modules, outfitted with fibers, endcaps, and manifolds, and leak tested.

Glue is put on the modules, they are flipped over, and laid down on the previous layer to form a plane 12 modules thick.



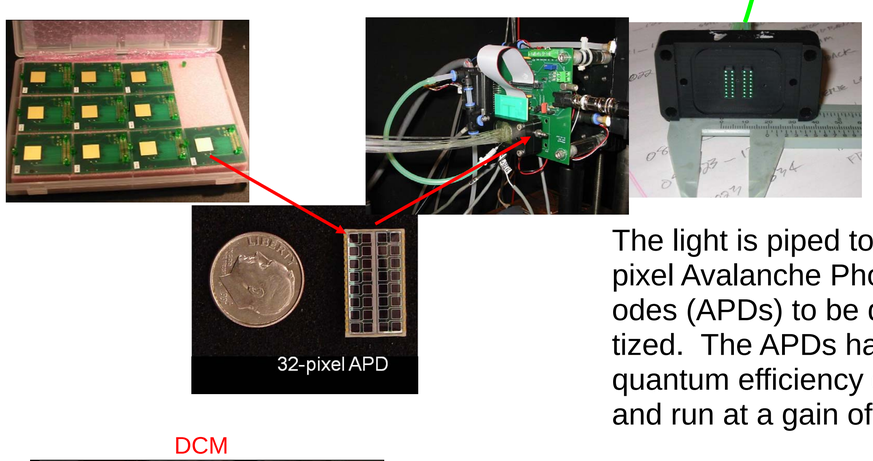


NOνA is composed of highly reflective (15% TiO_2) extruded PVC cells filled with liquid scintillator. A loop of wavelength shifting fiber is placed in each cell to pipe the scintillation light out to the readout. Alternating horizontal and vertical layers provide stereo views.

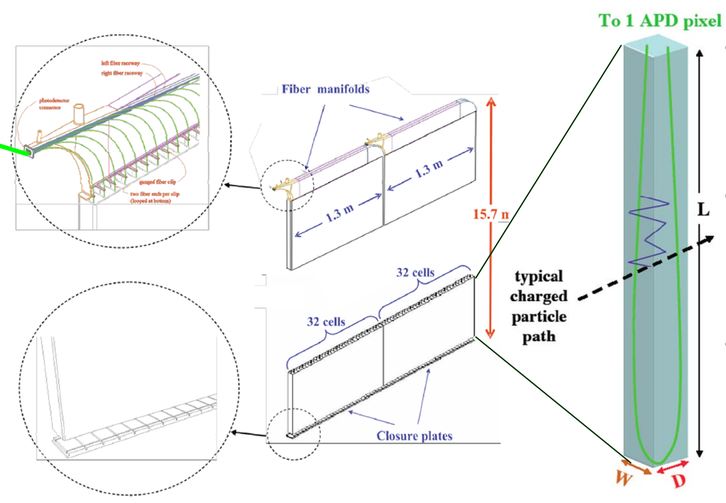


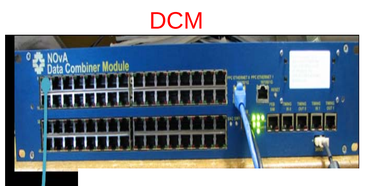
14 kilotons
Contingency could build 15kt if things don't go overbudget

- Liquid Scintillator - 11,280 kiloliters
  - 5.5% pseudocumene as scintillant
  - Mineral oil and waveshifters (PPO, bis-MSB)
  - ~475 tanker trucks
- PVC cells for primary containment
  - 11,160 modules, 370 truck loads of modules
  - Horizontals:3.87 cm x 6.0 cm x 15.7 m long
  - Verticals: 3.76 cm x 5.7 cm x 15.7 m long
- Looped wavelength shifting fiber to collect light
  - 12,050 km of fiber
  - 0.7 mm diameter, double clad, K27 wave-shifter
  - Almost perfect mirror, 3.6×light compared to 1 fiber
- Avalanche Photodiode readout
  - 357,120 channels of electronics
  - APD must operate at -15°C



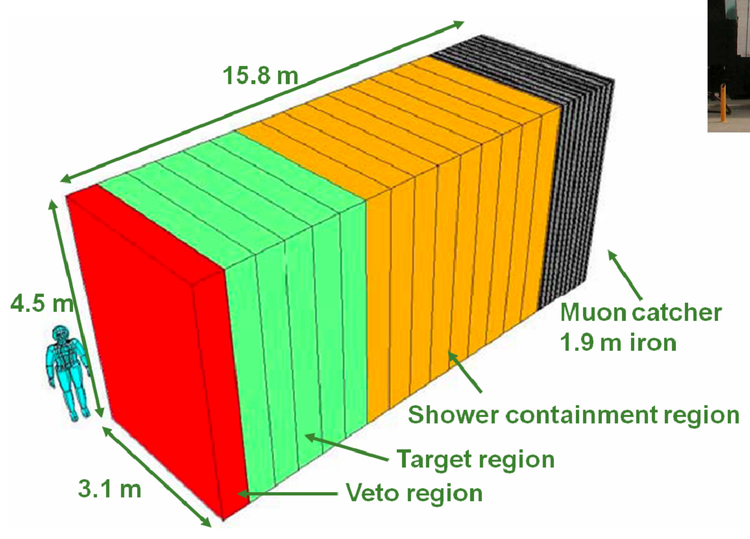
The light is piped to 32-pixel Avalanche Photo Diodes (APDs) to be digitized. The APDs have a quantum efficiency of 85% and run at a gain of 100.





Low-noise amplifiers digitize the APD signals, and the Front-End Board data is piped to Data Concentrator Modules, Power-PC based computers placed on the detector itself.

Data from the DCMs flows to several dozen commodity PCs acting as a circular buffer - holding ~30s worth of the 700MB/s data flow caused by having such a large detector in the surface cosmic ray flux.



The Near Detector will watch the NuMI beam at Fermilab from 100m underground, off-axis near the MINOS Near Detector. It is being built this summer on the surface to function as a prototype and beam test - the NDOS (Near Detector On the Surface) through 2011, then moved underground. It is 225 tons (130t totally active, 24t fiducial)

The NOνA collaboration with the first block of the Near Detector

GPS timestamps of the NuMI beam spills (12μs every 1.3s) are sent from Fermilab to the Far Detector. Data from those time windows are saved from the buffer nodes.

The NuMI Off-axis ν_e Appearance collaboration is
180 Scientists and Engineers from 26 Institutions .

Argonne National Laboratory - University of Athens - California Institute of Technology
University of California, Los Angeles - Fermi National Accelerator Laboratory - Harvard University
Indiana University - Lebedev Physical Institute - Michigan State University - University of Minnesota, Duluth
University of Minnesota, Minneapolis - The Institute for Nuclear Research, Moscow
Technische Universität München, Munich - State University of New York, Stony Brook - Northwestern University
University of South Carolina, Columbia - Southern Methodist University - Stanford University
University of Tennessee - Texas A&M University - University of Texas, Austin - University of Texas, Dallas
Tufts University - University of Virginia, Charlottesville - The College of William and Mary - Wichita State University

http://www-nova.fnal.gov

This Poster supported by NSF RUI grant #0970111. NOνA is funded by the U.S. Department of Energy and National Science Foundation, and the State and University of Minnesota.