NuMI
Neutrinos at the Main Injector

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Fermilab ILC Community Task Force Tour of the NuMI Underground Facilities

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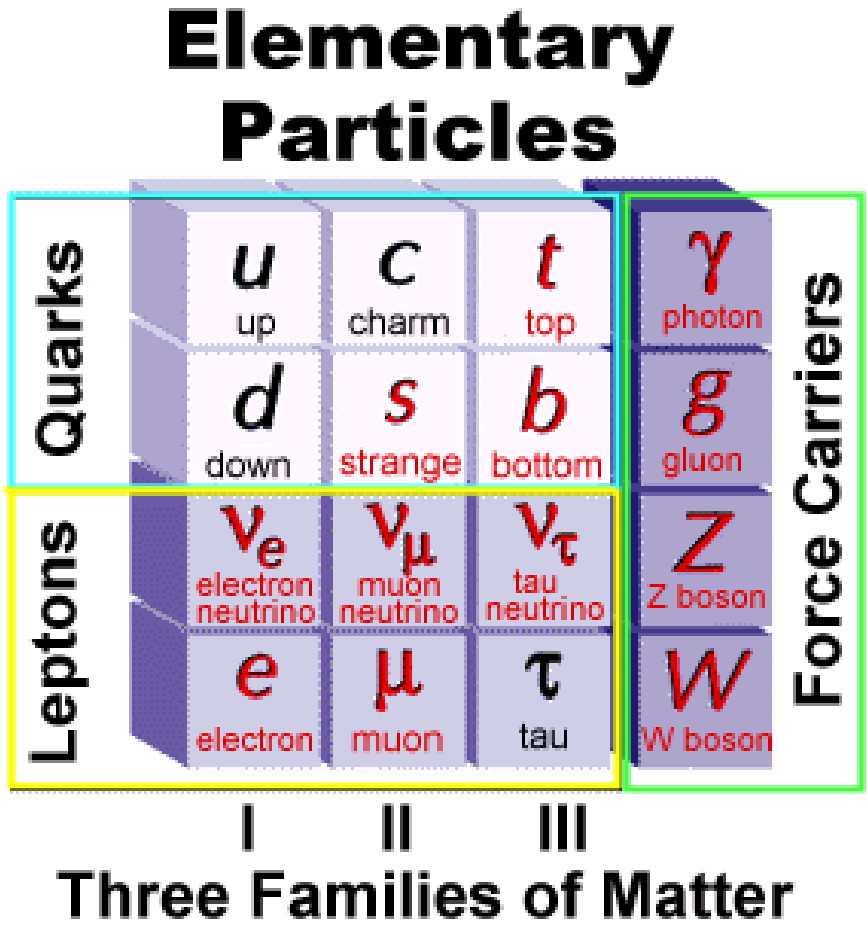
Today

- Take advantage of the maintenance shutdown period of the accelerator complex to tour the underground neutrino facility, which has some similarities to the facilities at an ILC
- 10 minute introductory talk, then a safety briefing, then board vans for tour of two sites
- Return to Wilson Hall. Some NuMI folks available for questions
- Done by noon

Neutrinos are Elementary Particles



Neutrinos are especially interesting

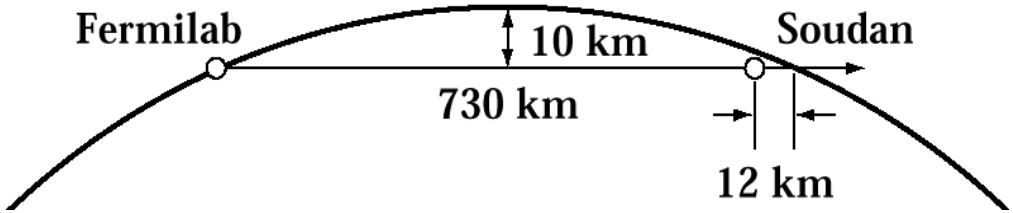
Neutrinos help shape our universe, but much about them remains a mystery.

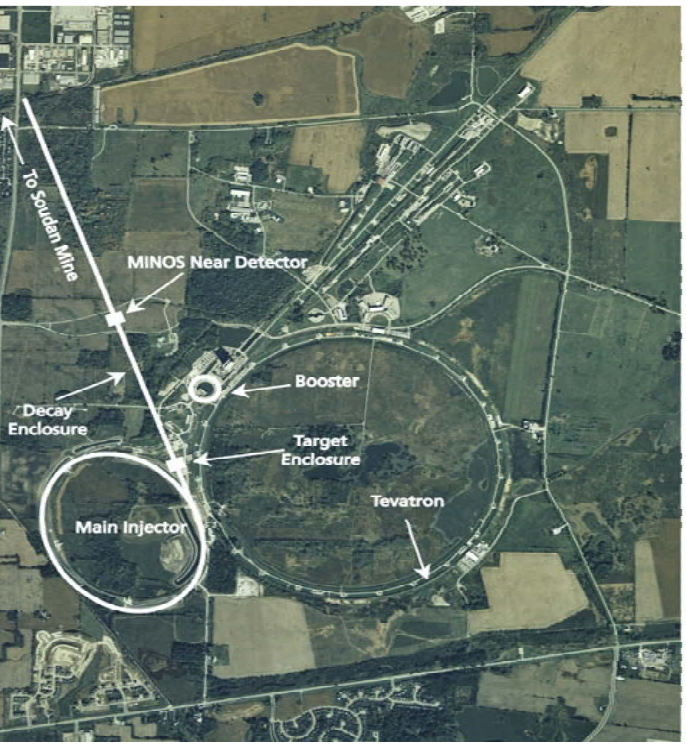
- Lightest particles, yet there is about as much neutrino mass in the universe as star mass. Different neutrinos have different masses.
- Change from one to another
- Abundant: remnants from the big bang, the sun, accelerators, and natural radioactivity.
- Extremely tough to observe. They don't interact much. This makes them safe to be around (we can stand in a beam of neutrinos), but hard to observe (neutrino detectors are very massive).

How do we study the neutrinos?

- At Fermilab we learn about the neutrino by studying how one type changes into another. (3 kinds: electron, muon, tau)
- We make muon neutrinos here at Fermilab and wait a few thousandths of a second to observe any change. At a speed of just under 186,000 miles per second that puts them in northern Minnesota.
- Local Jargon
  - NuMI is the source of the muon neutrinos
  - MINOS-- detects muon neutrinos
  - NOVA-- New experiment to detect electron neutrinos
- Here's how NuMI/MINOS works…..

The MINOS Experiment



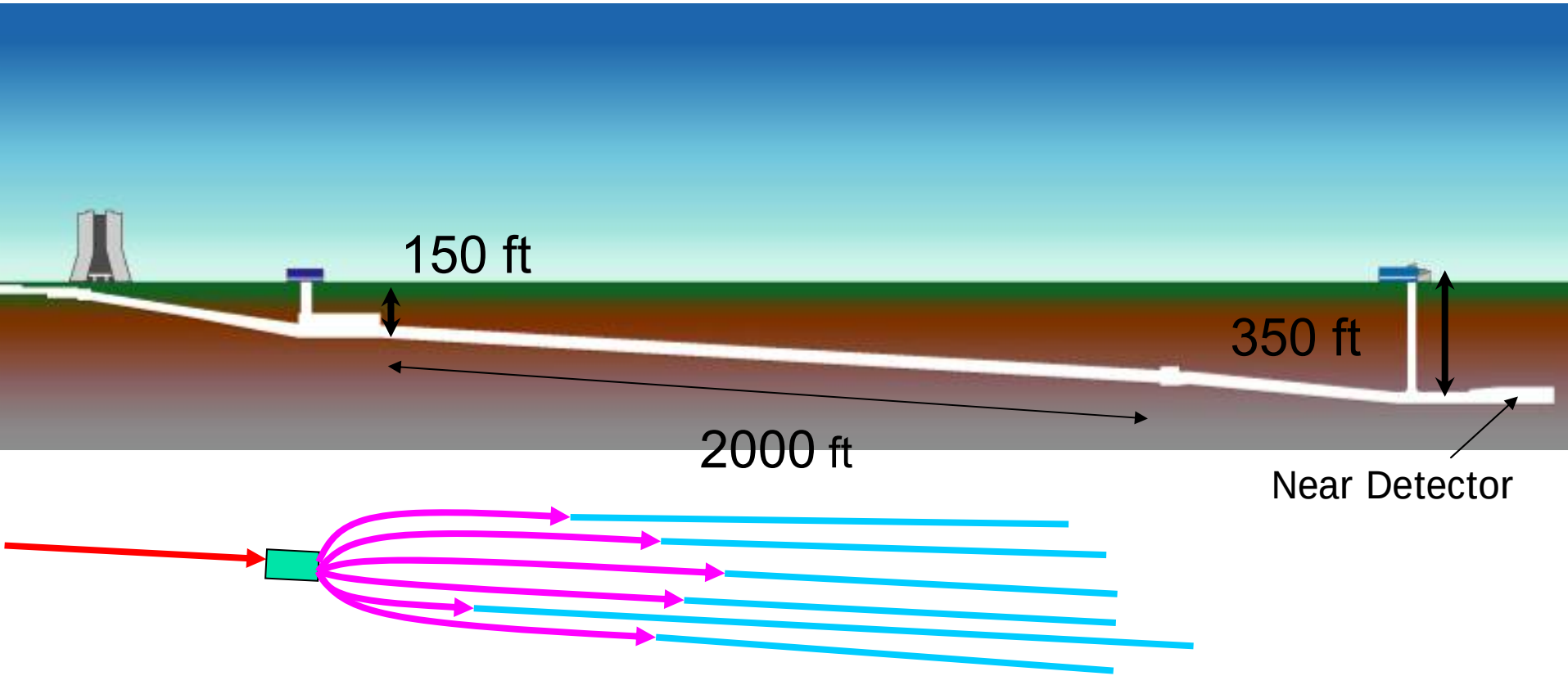


1. Produce neutrinos at NuMI
2. Measure them with the ‘Near Detector’
3. Wait a few thousandths of a second
4. Measure them with the ‘Far Detector’
5. Compare the results.

1st MINOS Collaboration Meeting : August 1994
MINOS Proposal Submitted : April 1995
Stage 1 Approval : June 1995
R&D & Conceptual Design : FY97-98
Construction : FY99-05
Data Taking: 2005-2011
NOVA Experiment: 2012-2018?

NuMI Facilities at Fermilab

Production of Muon Neutrinos and Measurement in a Near Detector



protons→target→unstable particles→neutrinos

Burst of protons for 0.00001 seconds every 2 seconds

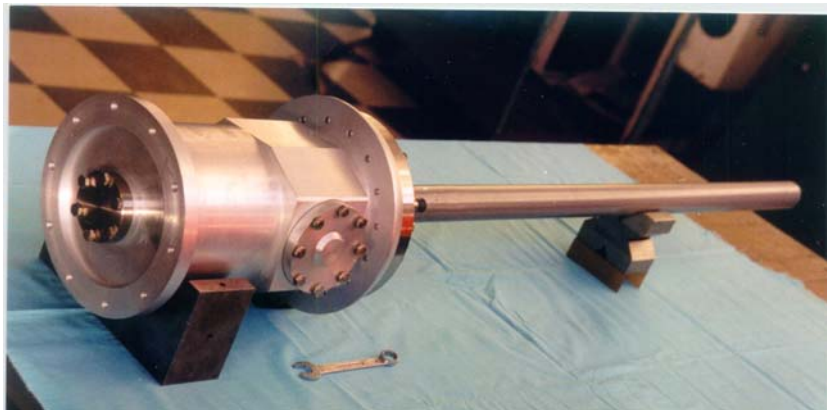
Construction

Construction

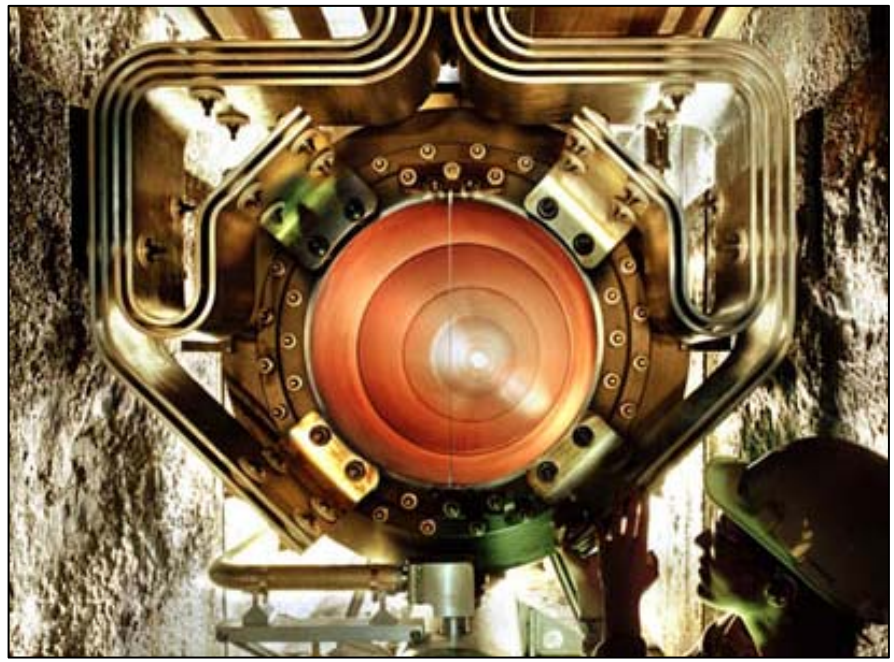
Civil Construction

Protons from the Main Injector

Neutrino Beam Devices



NuMI target assembly (upper)
Graphite target (lower)



DS end of Horn 1 in Target Chase

Near Detector

Located at FNAL
1040m from target
103m underground
980 ton mass
3.8m x 4.8m x 16m
282 steel + 153 scintillator planes

MINOS Far Detector in MN

1/2 mile underground

magnetized Fe-scintillator calorimeter

485 planes, 8m diam, 5400 tons

Scale of Proposed 'NOvA' Detector