R&D at SDDL

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ANNA PLA  FERMILAB
SDDL R&D, directions

1. MINERVA R&D:

   Triangle profile - current
   Rectangle profile - future

2. Current status R&D for MINERVA, plans.

3. CALTEC strands R&D: PAST

4. R&D plans for CALTEC.
STATUS-approved PAC (Physics Advisory Committee) April 15 2004

What is MINERVA

Main INjector Expe R iment ν-A

NICADD NIU has signed a MOU and SOW for 2006

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Neutrino Scattering Uncertainties and their Role in Long Baseline Oscillation Experiments


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ABSTRACT

The field of oscillation physics is about to make an enormous leap forward in material precision: first through the MINOS experiment in the coming year, and later through the NOvA and T2K experiments. Because of the relatively poor understanding of neutrino interactions in the energy range of these experiments, there are systematic effects that can arise in interpreting reactor detector data that can be as large as or even larger than the expected neutrino oscillations. We describe how these systematic errors arise, and how specific measurements in a dedicated neutrino scattering experiment, like MINERVA, can reduce the cross section systematic errors to well below the statistical errors.

1. Introduction

Over the past 20 years the field of neutrino oscillations has moved from seeing decade-long anomalies in cosmic-ray 1 and solar 2 neutrino data to cross checks of these anomalies (SNO data 3) and angular distributions in atmospheric neutrino
The fully active scintillator target is surrounded by nuclear targets and calorimeters. Interactions in the scintillator (CHₙ) can be compared with interactions in the upstream Pb and Fe targets to probe nuclear effects.

The MINERvA detector takes advantage of the unprecedented high intensity of the NuMI neutrino beam to build a detector capable of full reconstruction of exclusive final states.
Detector Elements

Sample quasi-elastic event:

\[ \nu_\mu n \rightarrow p \mu^- \]

Proton and muon tracks resolved and energy deposited shown as size of hit.

11/30/2005
Mech. measurements

MINERVA RUN (8.20 cm/s; 75 kg/h; 2.5 in)

Base (mm)

Strip No.

Ave: 30.2 mm
St. Dev: 0.37

base (33mm +0.5/-0.5)

MINERVA RUN (8.20 cm/s; 75 kg/h; 2.5 in)

Hole size (mm)

Strip No.

Vert.size
Horz.size (1.4mm +0.2/-0.0)
Cosmic test results, absolute LY, final. The results presented at IEEE NSS 2005.

Scaling to the first electron
Npe ~ 28
Gauss fit (left edge)~24
Correction to the scintillator thickness (1.7 cm)
gives ~22 PE,
~ 18 PE.
H3178-61 was used
Y11, 1.2 mm, 1.5 m (1m trigger-PMT)

\[ N = \left( \frac{A}{\sigma} \right)^2 \]

The fibers without reflective end where used!
PROCESSING RATE EFFECTS on LAL.
Co-extruded strips, LAL is being measured.
Necessity of the next step
R&D for MINERVA

- Currently we produce a new type of scintillator – co-extruded scintillator.
- There is some dead area in that new guy.
- No test beam so far.
- The tests were only carried out with cosmic rays.
- Lack of information about uniformity of the response.

Besides QC (after extrusion process) test beam is a must!
Possible test beam at FNAL

Where? FNAL, 120 Gev protons
What? 8 – 9 strips (co-extruded, MINERVA triangle type, 8-9 MRS as readout sensors)
When? Before shutdown, two-three days (during CMS assigned time)
Who? Me and Sasha? Kurt? Mike? At least 2 persons are to participate.

DAQ CAMAC based available, VME based (CALICE HCAL type) is an option.

Sensors, strips, fibers Available.

Training RAD worker, Controlled Access.

Mech support, Moving table Available.

Burocracy Writing MOU. Discussed with Eric Ramberg.

11/30/2005
Detector to be tested

Particles – pions 120 Gev

11/30/2005
- Co-extruder R&D (installation)
  - 1 month – October – November 2005
  - Run triangle die with capstocking
- ID tuning and prototyping
  - 2 months – November and December 2005
- OD tuning and prototyping
  - 2 months – January and February 2006
  - Final size – TBD

19mm*15mm
Customer – California Institute of Technology.

Neutrino Detector Prototype.

Extrusion of scintillator fibers $d=1.5$ (\sim 3\% size variation) mm, $L=110$ cm. Done.


Possible application-beam profile measurements.

Is it possible to perform an absolute LY measurements for the scintillator fibers?
Propose for the absolute LY measurements

Extruded scintillator fibers with d=1.5 mm

RU106 (2.5 MeV max energy)

Bunch of extruded fibers

Trigger

As a result we will get very close approximation of the LY from a MIP
Summary

- Status of the R&D at SDDL was discussed.
- Proposal for extruded triangle profile + MRS has been outlined.
- Proposal for the scintillator fibers absolute LY measurements has been outlined.
- http://nicadd.niu.edu/research/extruder/