

Next Steps and R&D Plans

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Context for US Planning



Snowmass on the Mississippi a.k.a CSS 2013

HEP Community Planning Exercise

- broad planning for all frontiers
- involves DOE HEP and NSF HEP

Community Planning Meetings

- instrumentation meeting, ANL, Jan 9-11, 2013
- neutrino and intensity groups, SLAC, March 6-8, 2012

→ several of us are involved in neutrino, instrumentation, and facilities groups as conveners (Yeh, Huber, Bernstein, KMH)

US Research Reactors

Reactor neutrinos can be used for a number of experiments and studies. **A US research reactor might serve a broader community with a diverse set of interest**

- short-baseline oscillation searches
- coherent scattering search
- reactor antineutrino flux studies
- liquid scintillator studies and R&D
- R&D on near-surface detectors
- reactor monitoring and safe-guard studies
- etc

Above research interests are supported by several funding agencies

- DOE HEP
- DOE NP
- NSF
- NA-22? DOD?

US Research Reactors

Identifying synergies at research reactor sites might help with

- programmatic support
- facility and site-specific support
- generate broader awareness and interest in the community

US research reactor sites are known for their main missions but not necessarily known in the broader neutrino community.

Proposal:

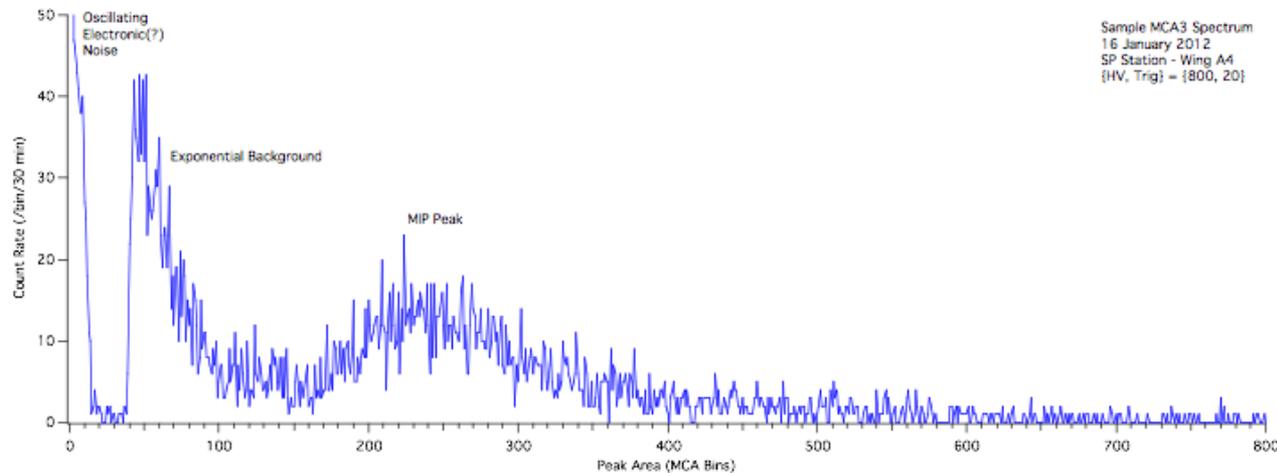
- Write white paper with the technical information on the possible reactor sites in the US for as reference materials for Snowmass and HEP planning discussions.
- Includes site-specific information that can be released to public. Focuses mainly on the facility aspect, and not on the details of the experiments.

Communication amongst US Interest Group

- **Indico site**
 - <http://agenda.hep.wisc.edu//conferenceDisplay.py?confId=704>
- **US email list**
 - have email list server at UW we can use for this purpose
 - <http://mail.physics.wisc.edu/mailman/listinfo/reactor-us>
- **DocDB**
 - have document server at UW we can use for this purpose
 - <http://docdb.physics.wisc.edu>

Portable Muon Detector

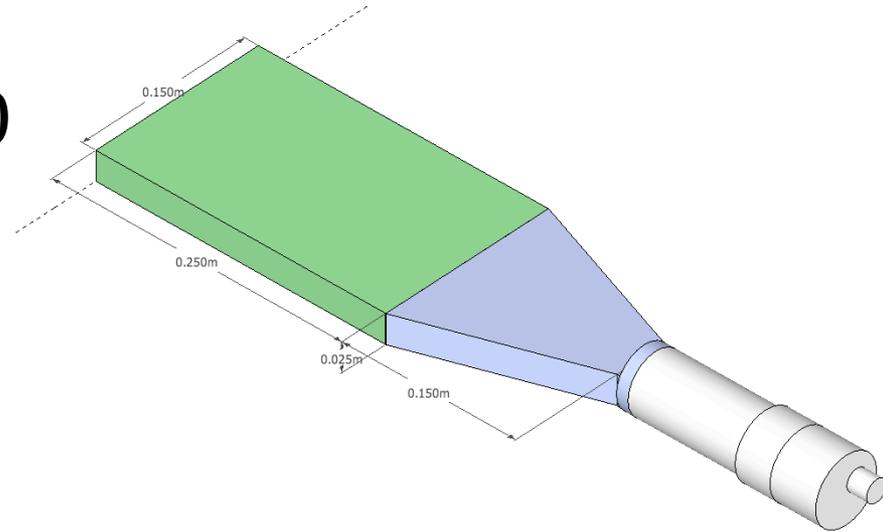
- Self-contained muon detector
 - Can run off internal (~8 hr) or external power
- Collects energy spectra (default)
 - Waveform collection capability



- 3 active channels (MCA1, MCA2, MCA3)
 - Fourth channel (MCA0) is non-responsive

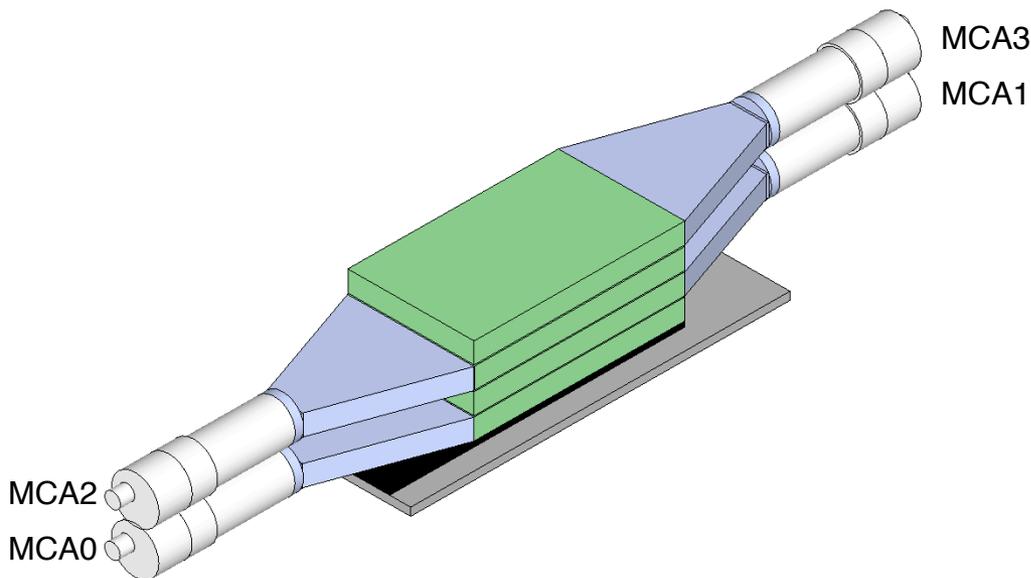
Portable Muon Detector - Scintillator Paddle

- **Scintillator: Eljen EJ-200**
 - 2.5 cm x 15 cm x 25 cm
- **Lightguide: cast acrylic**
- **PMT: ADIT B51D01**
 - 2" diameter
- **HV Base: Bridgeport hvBase-P-B14D10**
 - Signal out on BNC, control on 8-pin connector
- **Optical coupling:**
 - Eljen EJ-500 (optical cement)
 - EJ-560 (silicone rubber)



Portable Muon Detector - Detector Configuration

- 4 scintillator paddles in stack
- DAQ: Bridgeport qMorpho-2010
 - Controls HV bases, coincidence, data readout
 - 10 bit, 20 MHz ADC, 11 bit energy spectrum

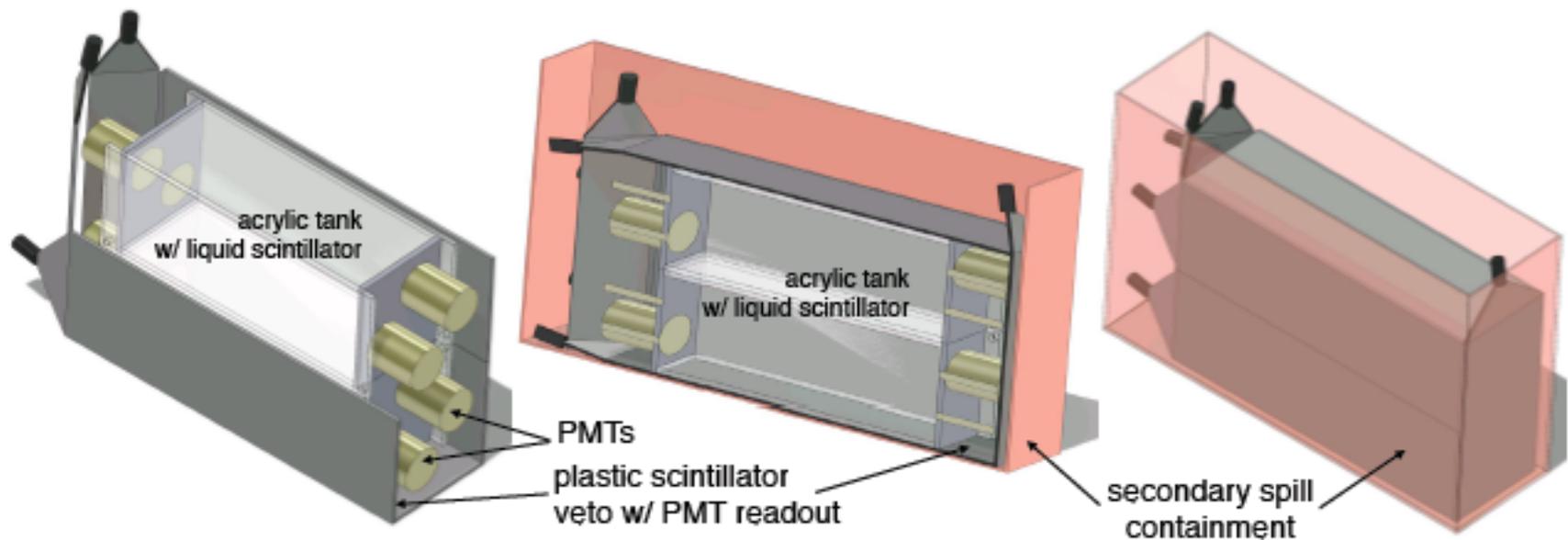


R&D Plans/Goals

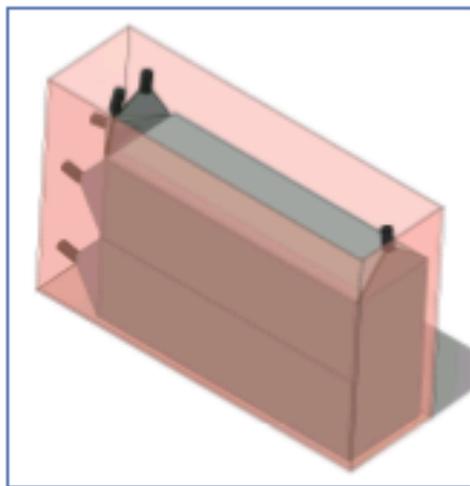
submitted 1-year R&D proposal to NSF to get started on some studies

Objective	Description
#1	Reactor Site Investigations
	Study the feasibility of a short-baseline reactor antineutrino experiment at one of the high-powered US research reactors. Investigate site-specific logistical and technical considerations and develop a conceptual plan for the deployment of an antineutrino detector at the three potential research reactor sites: NIST, HFIR, and ATR.
#2	Conceptual Detector Design and Performance Requirements
	Develop a conceptual design for a segmented antineutrino detector capable of making a precision measurement of the reactor neutrino flux and spectrum and searching for the energy and baseline dependent signature of short baseline neutrino oscillations.
#3	Prototype Detector Module
	Design and construct a prototype detector module, characterize its performance <i>in situ</i> near the NIST reactor, validate shielding and test with both Gd-LS and Li-based scintillators.

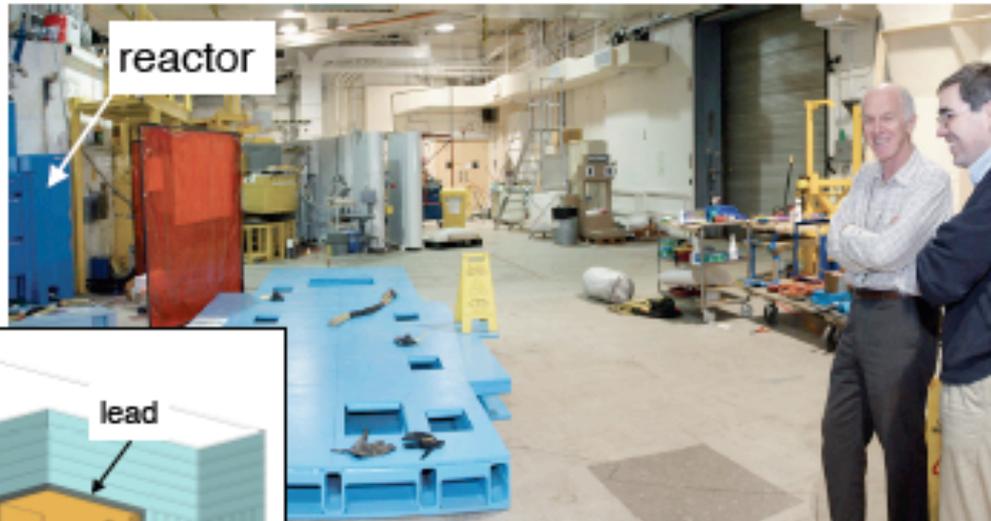
Prototype of Segmented Detector



Prototype Detector Module - Characterization

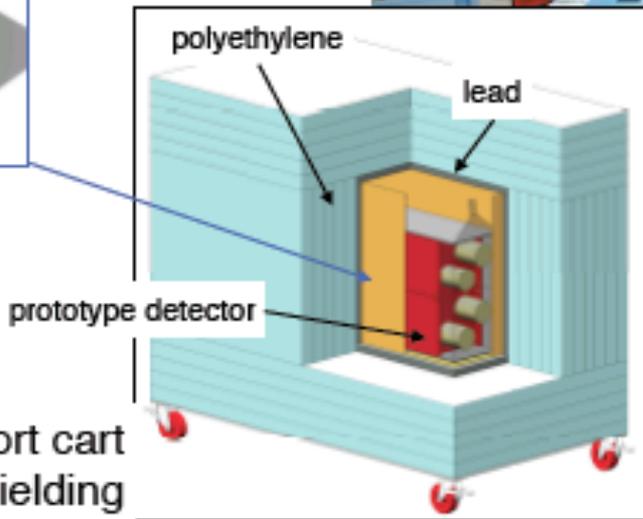


prototype detector module



reactor

experimental area at NIST



polyethylene

lead

prototype detector

transport cart with passive shielding

Prototype detector could be deployed at various reactor sites

Reactor Site Explorations - I

Continue site investigations at multiple sites, develop understanding of capabilities of various sites, understand constraints that will affect experimental design

1. What materials are allowed or NOT allowed in the areas being considered? Are there constraints on amounts? Are there mitigations required.
 - a. Oil based liquid scintillator – Combustible liquid with flashpoint ~170 C (340 F)
 - b. Plastic Scintillator – Combustible Solid
 - c. Acrylic Tank Material – Combustible Solid
 - d. Polyethylene Shielding – Combustible Solid
 - e. Metals – 304 or 316 SS, Lead, Copper
 - f. Glass (PMTs)
 - g. Water

Reactor Site Explorations - II

Continue site investigations at multiple sites, develop understanding of capabilities of various sites, understand constraints that will affect experimental design

1. What is the background at the places being considered
 - a. Cosmic Rays – measurement?
 - b. Fast Neutron Flux – measurement or model?
 - c. Thermal Neutron Flux – measurement or model?
2. What is the allowable floor loading?
3. What is the largest piece size we can move from outside to the areas being considered (weight (kg), dimensions (m))
4. What is the electrical noise environment? Large motors? Variable frequency motors? RF noise?

