Neutrino Division	Technical Scope of Work		
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MicroBooNE Cosmic Ray Tagger Bottom Panel Installation

6/30/2016

Prepared by:
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History of Changes

Date	Version	Changes/Comments	Authors
6/30	1		RG, JZ
7/19	2		DM
7/20	3		RP, JZ, DM
7/20	4		SZ, JZ
7/26	5		AS

I. INTRODUCTION

This is a technical scope of work between the Fermi National Accelerator Laboratory (Fermilab) and the MicroBooNE Collaboration, who have committed to installing scintillator panels provided by the University of Bern. These panels will allow us to tag cosmic ray particles that are passing through the MicroBooNE cryostat.

The memorandum is intended solely for the purpose of recording expectations for budget estimates and work allocations for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to modify this memorandum to reflect such required adjustments. Actual contractual obligations will be set forth in separate documents.

I.1. DESCRIPTION OF COSMIC RAY TAGGER SYSTEM:

This cosmic ray tagger system will be composed of two layers of scintillator where the light is directed to a pair of SiPM readout devices by two wavelength shift fibers. This system is intended to record location and timing of when charged particles pass through the scintillator with precise timing resolution. This will augment the existing MicroBooNE liquid argon time projection chamber and allow for us to tag activity as cosmic induced. This will reduce cosmic backgrounds and allow for the use of precise timing of cosmic particles as a calibration source.

The bottom panels are the first stage of a larger system whose testing and further installation will be documented in additional TSWs.

For the installation proposed here, the experimenters are requesting the following support from Fermilab:

Labor and expertise for installation.

Technical support to help with moving the equipment on site.

Engineering help with the design of the support structure and lifting procedure.

Material to build the mechanical support structure.

II. PERSONNEL AND INSTITUTIONS:

The physicists in charge of the installation will be Roxanne Guenette, professor, Oxford, and Martin Auger, postdoc, Bern, with David Martinez, postdoc, IIT and David Lorca, postdoc, University of BERN, acting as installation managers. Joseph Zennamo, MicroBooNE Technical Coordinator, is coordinating activities along with Matt Bass, MicroBooNE Run Coordinator. These physicists will work closely together on this effort.

The group members on this project at present are:

Institution	Collaborator	Rank/Position
Bern	Martin Auger	Postdoc
	David Lorca	Postdoc
	Michele Weber	Professor
U. Chicago	Joseph Zennamo	Postdoc
Yale	Elena Gramellini	Graduate student
	Rui An	Graduate student
IIT	David Martinez	Postdoc
	Bryce Littlejohn	Professor
Oxford	Matt Bass	Postdoc
	Roxanne Guenette	Professor

III. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS:

III.1. LOCATION

III.1.1. The support structure will need to be prefabricated in the Lab F facility.

III.1.2. The modules and support structures will need to be prepped for installation in LArTF at ground level.

III.1.3. The actual modules, along with support structure, will sit below the MicroBooNE cryostat in the LArTF "pit".

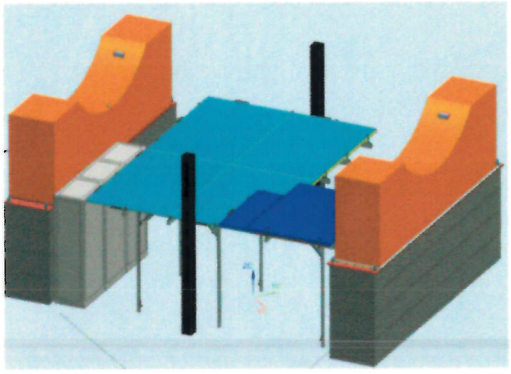

Figure 1: Schematic view of the MicroBooNE CRT bottom panels situated between the cryostat saddles.

III.2. EXPERIMENTAL CONDITIONS

III.2.1. AREA INFRASTRUCTURE

The proposed location of the CRT system bottom panel is shown if Figure 1.

The experiment will need help manipulating this structure in LArTF, specifically:

Help with prepping of the support structure.

Use of crane and riggers for moving and positioning the scintillator panels and support structure.

Rigging and lifting the support structure into place.

III.2.2. Description of CRT Bottom

The first stage will be the installation of the bottom panels in the pit under the cryostat. The first step will be to build and assemble the support structure shown in Figure 5.

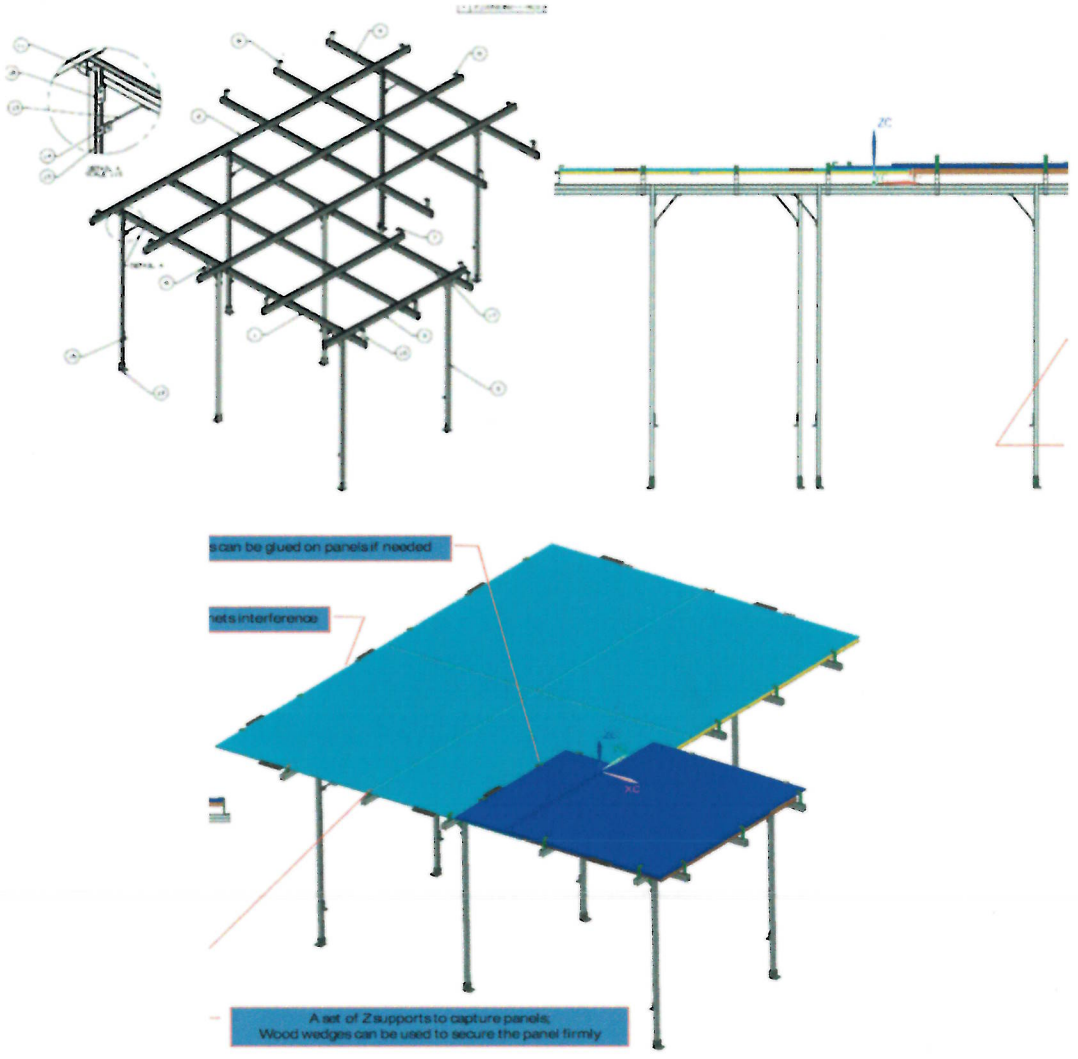

FIG 5: Example Schematic of the support structure for the bottom panel installation in the pit below the MicroBooNE cryostat.

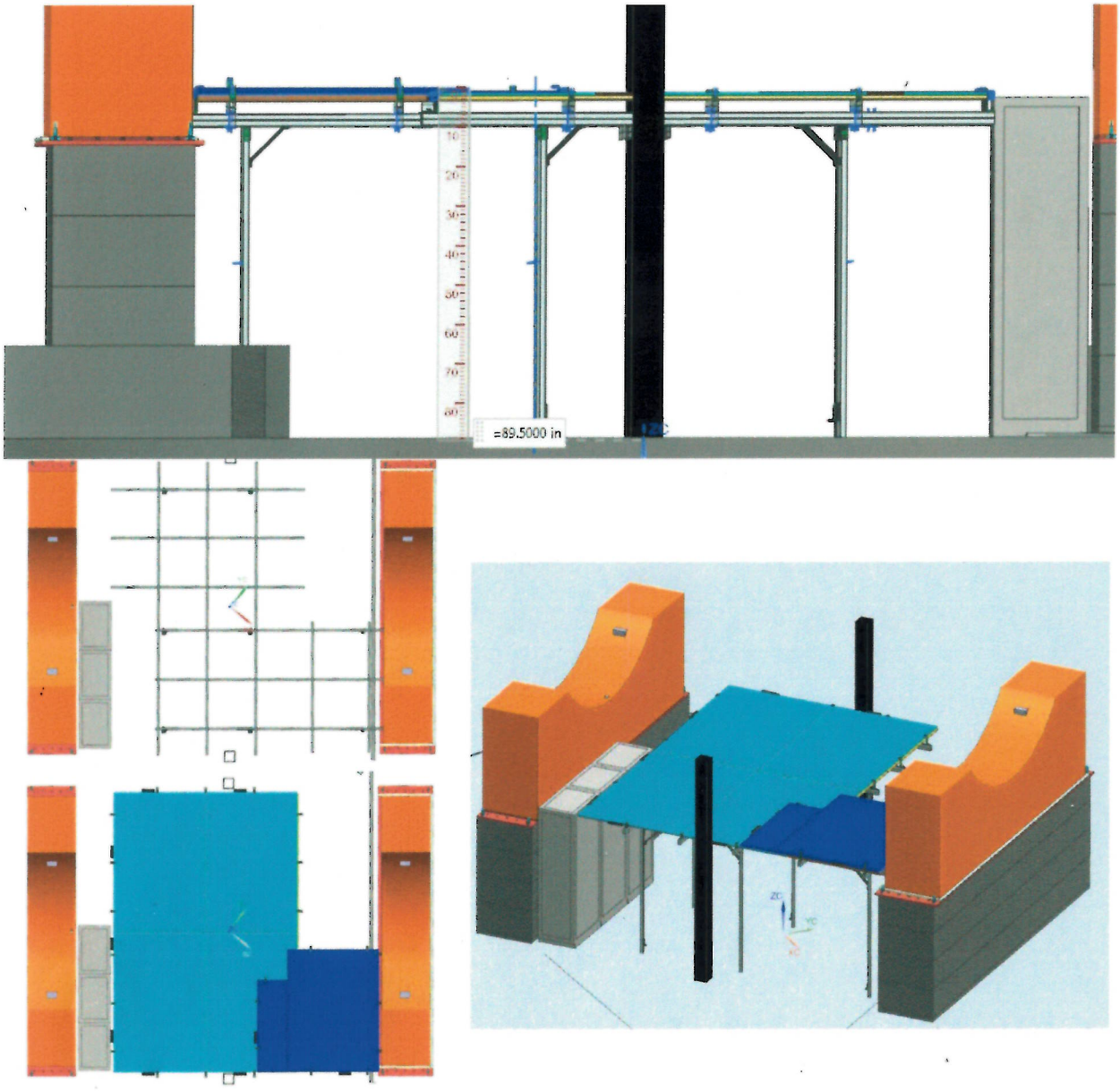

FIG 6: Example schematic of the support structure for the bottom panel installation in the pit below the MicroBooNE cryostat with cryogenic boxes and cryostat supports.

The panels will be lowered in the pit using the roof crane and a rigging system. This structure is composed of two parts. The "table top" which physically holds the panels and the legs which support the "table top".

The dimensions and specifications of the panels to be installed can be found in the following tables. The green columns represent the actual plan for the final structure.

As designed in metric:

Section	Under			
Orientation	Along Axis		Across Axis	
Nb. of bars	48.00	16.00	64.00	16.00
Nb. modules	3.00	1.00	4.00	1.00
Length (mm)	3,505.00	2,315.00	2,641.00	2,315.00
Weight of Front end modules (kg)	0.81	0.27	1.08	0.27
Weight of face plates (kg)	261.19	57.50	262.41	57.50
Weight of contour C-profiles (kg)	9.70	2.49	10.78	2.49
Weight of plastic (kg)	181.70	40.00	182.55	40.00
Weight per module (kg)	151.13	100.27	114.20	100.27
Weight of all modules (kg)	453.40	100.27	456.81	100.27

Converted into US units:

Section	Under			
Orientation	Along Axis		Across Axis	
Nb. of bars	48.00	16.00	64.00	16.00
Nb. modules	3.00	1.00	4.00	1.00
Length (inches)	137.992	91.142	103.976	91.142
Weight of Front end modules (lb)	1.79	0.60	2.38	0.60
Weight of face plates (lb)	575.8	126.8	578.5	126.8
Weight of contour C-profiles (lb)	21.4	5.5	23.8	5.5
Weight of plastic (lb)	400.6	88.2	402.5	88.2
Weight per module (lb)	333.2	221.1	251.8	221.1
Weight of all modules (lb)	999.6	221.1	1007.1	221.1

III.3. SCHEDULE

The experimenters are proposing the installation of this bottom before the start of the summer shutdown. Specifically in the weeks of July 18th after an engineering note can be complete that shows the installation hoists can support the weight of the panels and support structure without deforming.

Step 1: Target June 31 – July 19: Engineering review of mechanical installation, verifying the weight of the panels, and reviewing the current structure.

- This work will need the interface between the experimentalists with knowledge of the panels, the staff involved in positioning the panels, and engineering support to do the engineering analysis.

Step 2: Target July 20 – July 29: Aim to lift the assembled "table top" with the panels in place from the floor of the pit level to its nominal position.

This work will require:

- The placing of steel beams (type to be determined by the engineering analysis, probably I-beams) underneath the support structure.
- These I-beams will be attached to the I-beams that support the platform via chain hoists.
- These hoists will be used to lift the support structure to its nominal position underneath the MicroBooNE cryostat
    - This can be augmented with a central lifting device (like a large flat top jack) to provide central support.
- Finally the legs will be attached to hold the "table top" in its nominal position.
    - Will need to alert Fermilab fire department during these activities so they are aware of safety situation.

Example full bottom structure installation procedure (by J. Voirin) :

The following is an example step-by-step procedure delineating the steps taken to raise the CRT panels. This document does NOT supersede the HA for the task.

- Lower the lifting fixture down to the lower level of LArTF.
- Insert it alongside the existing channel on the south end.
- Connect the hoists to the vertical channel. Take up some load to release the horizontal channel.
- Move this channel next to the North Channel in a vertical orientation. This is sitting on a die cart which we will use for moving this item.
- Use hoists and stands to position channels in the correct lifting position.
- Raise and level load to position stands beneath load until ready to make lift.
- Prepare tools, posts and hardware for installation.
- Using spotters and levels uniformly raise the load.
- Continue raising the load until arriving at final position.
- Place temporary post next to final post position.
- Install perimeter posts. Repeat.
- Install bracing on perimeter posts.
- Using temporary posts enter area beneath panels and install final posts and bracing.
- Apply safety tape to all posts.
- Install aluminum covers over floor penetrations.
- Lower lifting fixtures uniformly. Remove all installation equipment from area.

Installation complete except for wiring.

All final HAs and procedures will be approved by the MicroBooNE CRT Mechanical Installation Committee.

IV. RESPONSIBILITIES BY INSTITUTION – NON FERMILAB

Cosmic Tagger Modules (Bern University)

Operational organization, including reviews, operation reports, and interactions with MicroBooNE collaboration (Bern, IIT, Oxford, Yale, U. Chicago)

Labor for installation (Bern, IIT, Yale)

V. RESPONSIBILITIES BY INSTITUTION – FERMILAB

V.1. FERMILAB PARTICLE PHYSICS DIVISION:

5.1.1 Technical support for the construction of the structure.
5.1.2 Technical support for the movement of the panels and structures into the pit.
5.1.3 Technical support for the installation of the fixture.
5.1.4 Engineering support for determining the installation procedure and verification of the structural supports.

V.2. FERMILAB NEUTRINO DIVISION

5.2.1 Funding for the M&S of the structure for the bottom panels
5.2.2 Technical oversite of the installation
5.2.3 Engineering review of the installation fixtures and procedures

V.3. FERMILAB ESH&Q SECTION

5.5.1 Assistance with safety reviews.
5.5.2 Provide necessary training for experimenters.

VI. SUMMARY OF COSTS

Source of Funds	**Materials & Services (For Bottom Installation)**	**Planning (For the bottom panel)** (person-weeks)	**Labor for Installation (For the bottom panel)** (person-weeks)
Neutrino Division	$2.0K	3 weeks for John V. + CM L. + Erik V.	1 weeks for John V. + 3 Technicians
Non-Fermilab		3 weeks for 2 collaborators (Martin and David)	1 week for 3 collaborators (David and 2 more)
Totals Fermilab	$2.0K	9	4
Totals Non-Fermilab	$450K	6	3

VII. MILESTONES

1. Engineering notes for the bottom installation process at the pit of LArTF approved.
2. Engineering note for the lifting fixture to put the panels on the nominal position (below the MicroBooNE cryostat)
3. Engineering Technical Review of the installation process, lifting fixture, and support structure, culminating in a recommendation to PPD and ND division heads to proceed with work.
4. Installation of the unistrut frame in the pit of LArTF.
5. Nine modules located over the unistrut frame in the pit of LArTF.
6. Installation of the bottom panels under the cryostat fulfilling the ES&H requirements bringing them from the floor to the nominal position (under the MicroBooNE cryostat) following the lifting fixture approved in the engineering note (Number: PPD-doc-2181).
7. Safety access under the panels to the cryogenic boxes.

VIII. SPECIAL CONSIDERATIONS

1. The responsibilities of the Spokesperson and the procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Researchers": (http://www.fnal.gov/directorate/PFX/PFX.pdf). The Spokesperson agrees to those responsibilities and to follow the described procedures.
2. To carry out the work a number of Environmental, Safety and Health (ES&H) maybe required. This includes creating any necessary Operational Readiness Clearance documents. The Technical Coordinator will follow those procedures in a timely manner, as well as any other requirements put forth by the Division's Safety Officer.
3. The Technical Coordinator will ensure one person is available at LArTF whenever work is being performed and that this person is knowledgeable about the experiment's hazards.
4. All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.
5. All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).
6. The experimenters will be responsible for maintaining both the electronics and the computing hardware supplied by them for the experiment. Fermilab will be responsible for repair and maintenance of the Fermilab-supplied electronics. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

VIII. THE FOLLOWING PEOPLE HAVE READ THIS TSW:

28/ 7/ 2016
MicroBooNE Technical Coordinator

/ / 2016
MicroBooNE Spokesperson

28/ 7/ 2016
Neutrino Division Representative

29 July 2016
Particle Physics Division Representative

APPENDIX I: - HAZARD IDENTIFICATION CHECKLIST

Items for which there is anticipated need have been checked. See next page for detailed descriptions of categories.

Flammable Gases or Liquids		**Other Gas Emissions**		**Hazardous Chemicals**		**Other Hazardous /Toxic Materials**
Type:		Type:			Cyanide plating materials	List hazardous/toxic materials planned for use in a beam line or an experimental enclosure:
Flow rate:		Flow rate:			Hydrofluoric Acid	
Capacity:		Capacity:			Methane	
Radioactive Sources		**Target Materials**			photographic developers	
	Permanent Installation		Beryllium (Be)		PolyChlorinatedBiphenyls	
	Temporary Use		Lithium (Li)		Scintillation Oil	
Type:			Mercury (Hg)		TEA	
Strength:			Lead (Pb)		TMAE	
Lasers			Tungsten (W)		Other: Activated Water?	
	Permanent installation		Uranium (U)			
	Temporary installation		Other:	**Nuclear Materials**		
	Calibration	**Electrical Equipment**		Name:		
	Alignment		Cryo/Electrical devices	Weight:		
Type:			Capacitor Banks	**Mechanical Structures**		
Wattage:			High Voltage (50V)	X	Lifting Devices	
Class:			Exposed Equipment over 50 V		Motion Controllers	

			Non-commercial/Non-PREP	X	Scaffolding/ Elevated Platforms	
			Modified Commercial/PREP		Other:	
Vacuum Vessels		**Pressure Vessels**		**Cryogenics**		
Inside Diameter:		Inside Diameter:			Beam line magnets	
Operating Pressure:		Operating Pressure:			Analysis magnets	
Window Material:		Window Material:			Target	
Thickness:		Window Thickness:			Bubble chamber	