Fermilab

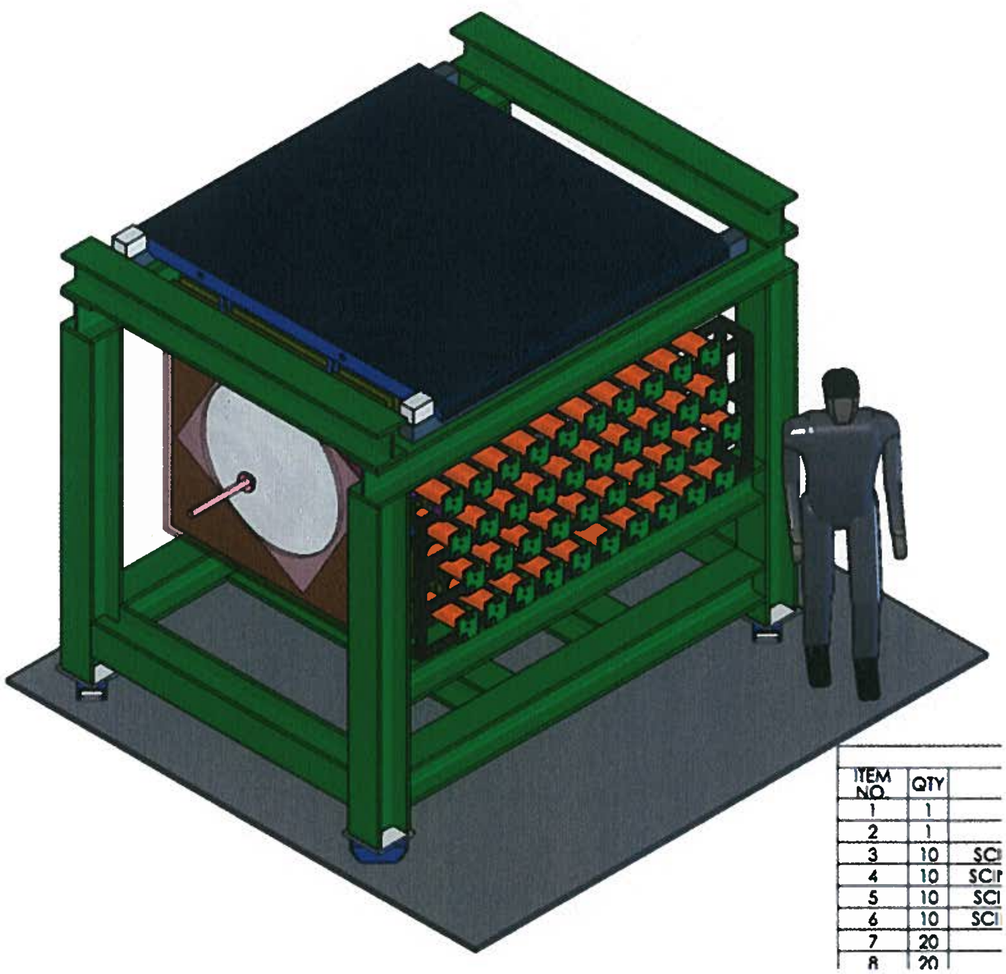
Directorate

TECHNICAL SCOPE OF WORK
FOR THE 2015 FERMILAB TEST BEAM FACILITY PROGRAM

T-977

Test beam calibration of the MINERvA detector components

Oct 16, 2008 / Update Oct 21, 2014



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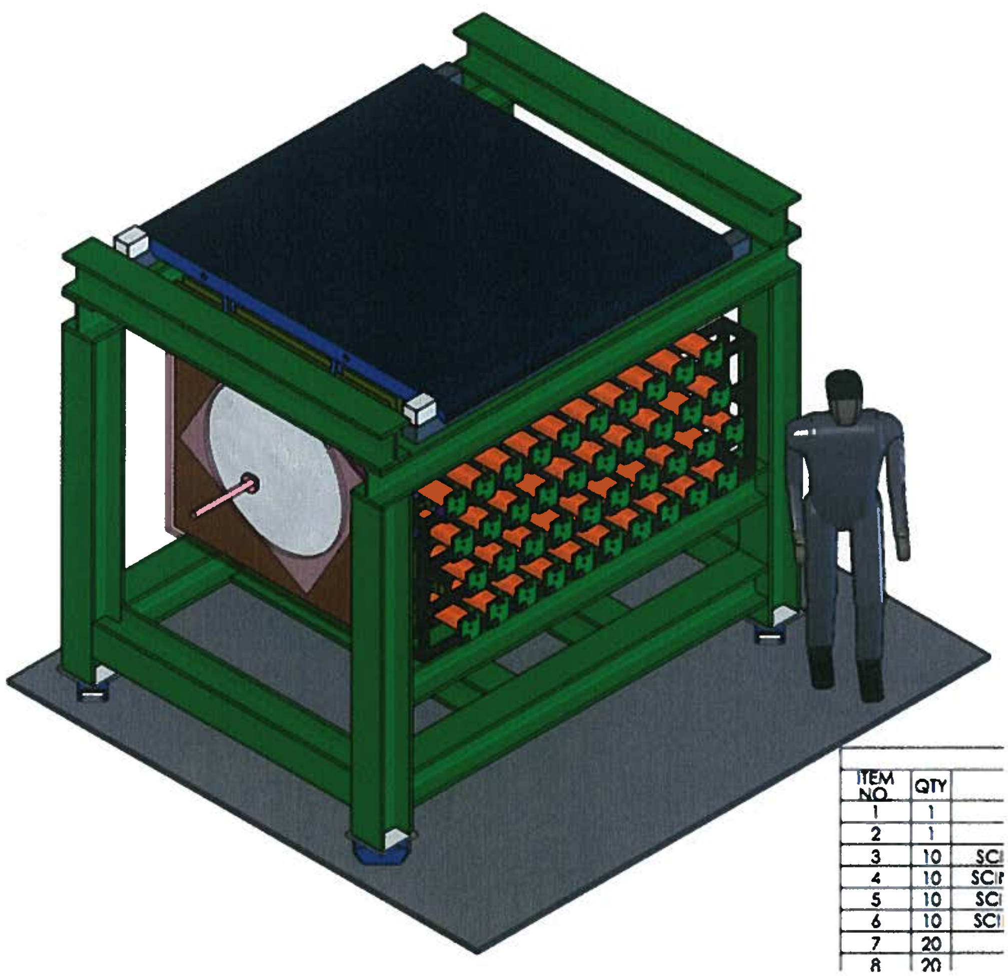

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INTRODUCTION

This is a technical scope of work (TSW) between the Fermi National Accelerator Laboratory (Fermilab) and the experimenters of University of Geneva, University of Rochester and the College of William and Mary who have committed to participate in beam tests to be carried out during the 2015 Fermilab Test Beam Facility program.

The TSW is intended primarily 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 scope of work to reflect such required adjustments. Actual contractual obligations will be set forth in separate documents.

This TSW fulfills Article 1 (facilities and scope of work) of the User Agreements signed (or still to be signed) by an authorized representative of each institution collaborating on this experiment.

Description of Detector and Tests:

The experimenters' primary need is to calibrate the MINERvA scintillator response (reconstructed energy) to pions and electrons, to measure the resolution in the response, and to reduce and then estimate the bias on the calorimetric shower energy reconstruction for these particles. This TSW describes the details involved in achieving that, as well as other, secondary goals of the beam test. The detector itself consists of 41 planes of scintillator that are arranged in different configurations, described below, and instrumented with 41 multi-anode phototubes. The detector schematic is shown in Figure 1.

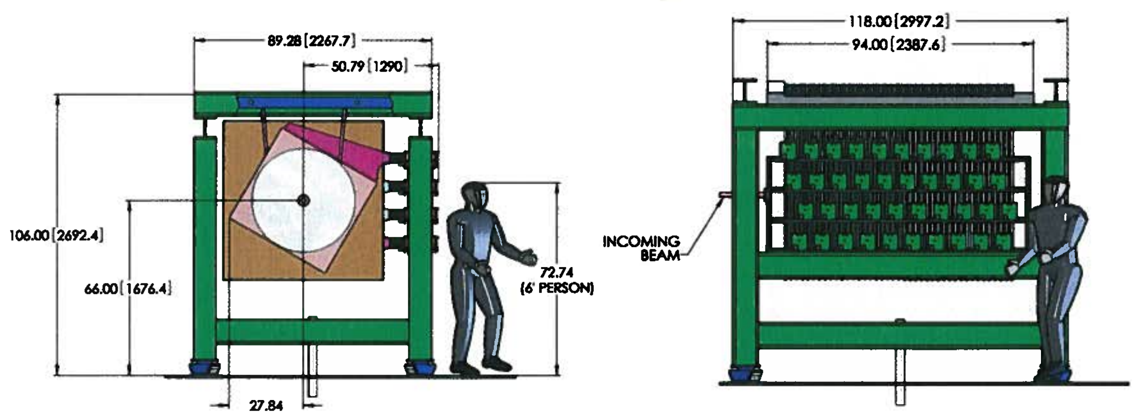


Figure 1 shows the MINERvA test beam detector, with dimensions of the stand in inches [mm]. The detector dimensions along the beam axis will depend on how many plates of absorber are used: the stand itself does not get longer just the extent to which the stand is filled with active elements.

The run plan involves taking data in three detector configurations, which will each require a downtime period of one week (based on previous run experience) to complete the change from one configuration to the next. MINERvA proposes to take data in a 20 ECAL + 21 HCAL configuration, the same as the MINERvA detector installed in the NUMI hall. This configuration is what was used for the data shown in Figure 2 and the plot in Figure 2 will be extended by taking data with additional high energy pions. This is also the ideal configuration for calorimetry with the electron sample. MINERvA will also take data in an HCAL heavy configuration with 32 planes of steel (MINERvA has 20 planes in its HCAL) which will provide for a more uniform measurement of the calorimetric response for pions at the highest momenta. Tracking (scintillator only) planes will be in front of the steel planes. Finally, MINERvA would take data in a configuration with 20 Tracker + 21 ECAL planes, which is also MINERvA-like, which can be used for tracking studies and possibly some interaction rate tests. This running order is proposed based on physics needs; mechanical assembly constraint in changing configurations are expected to be negligible.. All these configurations are supported by the existing detector elements from the 2010 test beam run.

This work follows upon the successful operation of and analysis of data from the first MINERvA test beam run T-977 in June and July of 2010. In that run, MINERvA used a new tertiary beam designed and assembled for T-977 to get a sample of protons and pion in the momentum range of 400 to 2000 MeV/c. Preliminary results have been approved and shown since 2012 in MINERvA talks and posters. Final results with essentially unchanged core conclusions were summarized in NIM A743 (2014) 130-59.

The 2010 data was used successfully to measure the calorimetric response of the MINERvA detector to protons and pions, as well as produce a calibration of the Birks' law parameter for the scintillator response and check proton momentum vs. range, the latter a test of the MINERvA detector mass model and/or Geant4. The total uncertainty in the analysis is due to several beam, detector, and calibration uncertainties that are between 1% and 2% each, such that the overall uncertainty on the calorimetry was around 4%. In addition, MINERvA has some preliminary results for a few stretch goals such as validating detector response issues that affect tracking and proton/pion PID within MINERvA, low momentum e/pi calorimetry ratio, and an exploration of how to extract information about the accuracy of individual processes within Geant4.

In this proposed second phase, MINERvA requests use of the FTBF MTest secondary beam in its low energy pion/electron mode. This will allow for calorimetry results for pions up to about 4 GeV, which is the range of primary interest for the MINERvA data in the NuMI NOvA-era medium energy beam which is dominated by DIS interactions. There is interest in higher energy pions, up to about 20GeV, but our ability to study these energies will be limited by our time of flight (ToF) system. The following figure illustrates an estimate of the spectrum of leading pions from two neutrino interaction modes (left) and how the new data extends the current results (right). The new program is the complement to the phase one T-977 program which achieved the low momentum sample important to the quasi-elastic and resonance interactions that make up the most important parts of the NuMI MINOS-era low energy MINERvA neutrino data. This proposal was envisioned even in the original T-977 MOU, but was not possible to accomplish in 2010.

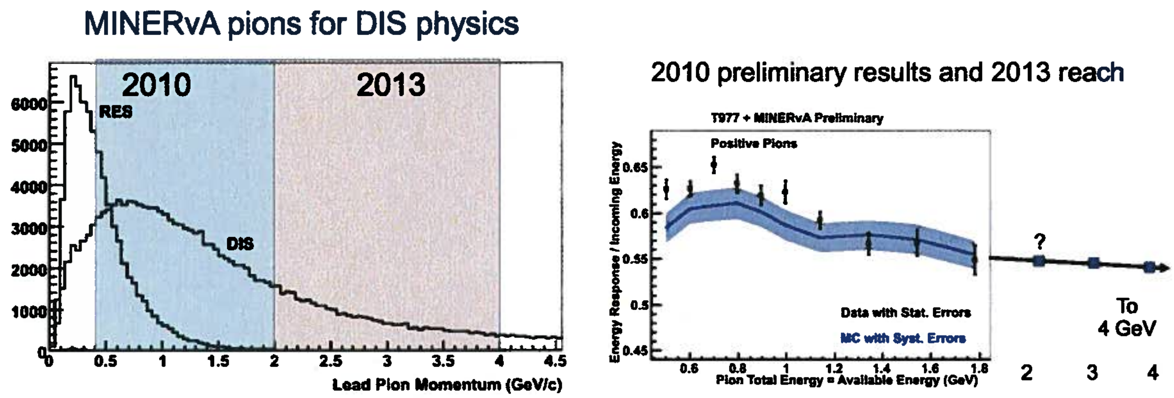


Figure 2: The anticipated DIS pion spectrum from neutrino interactions predicted by the GENIE neutrino event generator (left), and the 2012 preliminary results for pion calorimetry with an illustration of the extension to 4 GeV.

In addition to the pion sample, the secondary beam delivers a large sample of electrons, such that at 1 GeV the sample has pion content on the order of a few percent. In the 2010 data, the electron component was small and limited to very momenta below about 500 MeV/c. This new electron sample covers the other significant response calibration need for the MINERvA neutrino analyses.

The MINERvA experiment is funded by the DOE and the NSF. The test beam detector was built in 2010 primarily with a large contribution an NSF-MRI plus the use and re-use (pre-use) of MINERvA detector components funded by the DOE and some modification and fabrication work done at Fermilab.

I. Personnel and Institutions

Spokesperson: Leo Bellantoni

Lead Experimenter in charge of beam test: Sandro Bravar

Fermilab Experiment Liaison Officer: Eugene "JJ" Schmidt

Other MINERvA students, staff, and faculty may participate as shift takers for this experiment, and as technical experts on the detector subsystems MINERvA will install and operate.

	Institution	Country	Collaborator	Rank/Position	Other Commitments
1.1	University of Geneva	Switzerland	Sandro Bravar	Professor	NA61
			Yordan Karadzhov	Postdoc	NA61
1.2	Rochester	USA	Howard Budd	Scientist	
			Rob Fine	Graduate Student	
			Aaron Bercelli	Graduate Student	
			Jeffery Kleykamp	Graduate Student	
1.3	William and Mary	USA	Anne Norrick	Graduate Student	
			Jeff Nelson	Professor	MINOS+, NOvA
1.4	U. Pittsburgh	USA	Carrie McGivern	Postdoc	
			Lu Ren	Graduate Student	
			Steve Dytman	Professor	T2K,CAPTAIN
1.5	Centro Brasileiro de Pesquisas Físicas	Brazil	Mateus Carniero	Graduate Student	
1.6	Fermilab	USA	Leo Bellantoni	Scientist	D0
			Linda Bagby	Engineering Physicist	MicroBoone, LBNE
			Geoff Savage	Computing Services Specialist	FTBF
			Paul Rubinov	Engineering Physicist	
			Christinel Gingu	Engineer III	CMS
			Jim Kilmer	Sr. Engineering Physicist	MicroBoone, Super CDMS
			Michael Backfish	Engineering Physicist	SY120
1.7	U. Guanajuato	Mexico	Gerardo Zavala	Professor	
			Manuel Ramirez	Graduate Student	
1.8	U. Nacional Ingenieria	Peru	Gerald Salazar	Professor	
			Antonio Zegarra	Graduate Student	
1.9	U. Técnica Federico Santa Maria	Chile	Roger Galindo	Graduate Student	

II. Experimental Area, Beams, and Schedule Considerations

2.1 Location

2.1.1 All beam tests will take place in MT6.2D as shown in Appendix I.

2.1.2 Two desks and network connectivity are needed for the duration of T-977, including pre-beam setup and commissioning time during the 2014 shutdown. A third desk near the DAQ rack at the northeast corner of the enclosure is also helpful.

2.1.3 Space is needed in or nearby the beam location, prior to assembly in 2D, to stage the components of the detector. This space will also be used for light leak checks and source tests on scintillator planes; an area of about 20 x 20 sq. ft., with some table top space will suffice.

2.2 Beam

2.2.1 Beam Types and Intensities

Energy of beam: from 1.5 to 4 GeV is the primary region of interest, but MINERvA wishes to investigate energies up to 20GeV. Our ability to study these higher energies will be limited by the ultimate performance of our ToF system.

Particles: protons and pions, but electrons and muons will be needed for calibration purposes. The HCAL configuration will stop 1.2 GeV/c muons.

Intensity: will be less than the maximum normal rate in the pion configuration, which is 400,000 counts per spill in MT6SW1.

Beam spot size: about $10cm^2$

Regarding the secondary pion beam tunes the experimenters need the accuracy (absolute bias) of the momentum tune at the 2% level, and need to know with accuracy what the momentum bite is. Provisions may need to be made to revalidate or remeasure the momentum tune of the secondary beamline.

The experimenters are assuming a 4.2 second spill duration, arriving every one minute, for 24 hours per day (1440 spills per day, not including down time).

The MINERvA detector will be positioned, for reasons involving space constraints in the hall, such that the beam impacts the detector slightly off center and at normal incidence.

2.2.2 Beam Sharing

The experiment could tolerate up to a fraction of a radiation length of material upstream of the detector, provided that fraction was known to the 5% level or better.

In the HCAL configuration, the radiation length of the entire apparatus will be 40cm of scintillator (1.3 radiation lengths) plus 76cm of steel (30 radiation lengths).

2.2.3 Running Time

The experimenters are requesting to take data for at least 17 days in each of three configurations, and it is assumed that 1 week or less is needed between sequential configurations in order to reconfigure, for a total beam-dwell time of 15 weeks.

If there are 1000 recorded particles per 4 second spill, per minute, and 24 hours of beam per day, this would correspond to 24 million particles per detector configuration, which would be split in positives and negatives, and also split into several different beam energies.

The experimenters may need to access the detector area a few times per day if problems arise; if no problems arise the expectation is that the experiment will only need to access the detector when switching between configurations.

Installing and commissioning the detector to the level required for an ORC to take place is expected to take two months.

See section 2.4 for total run time and long-term schedule.

2.3 Experimental Conditions

2.3.1 Area Infrastructure

The experiment requests the use of the MT6.2D area, and installation of the detector will necessitate the overhead hatch. The steel absorbers will weigh 600 pounds. This will require an overhead crane or gantry crane for configuration changes.

The experimenters request the use of the downstream Cherenkov counter to tag electrons, in order to separate electrons from hadrons, and assistance to maximize and estimate the purity obtained with the system.

Experimenters will need some simple trigger panels, crates and NIM modules for triggering on the beamline and appropriate electronics to make that trigger available to the MINERvA DAQ.

The experimenters plan to use the scintillator wall that was used last time (which was obtained from the SciBooNE Muon Range Detector), and NIM triggering modules for cosmic ray and muon triggering.

The experimenters will need temperature monitor readout in the MT6.2 hall, which is an essential component of the calibration. (The system installed in 2010 is known to be adequate, and a better system has been installed since then.) The temperature of the hall will need to be stable within ±5 degrees C.

The experimenters have evaluated several possible ToF systems and found the capabilities of existing systems to be inadequate. The experimenters are, in conjunction with the AD Switchyard 120 group, developing a scintillator based ToF system. The upstream station will be in MT5, and the downstream station will go in MT6. Readout via CAMAC in MT6 is planned. Appendix IV describes the MT5 location in more detail.

High resolution, high speed tracking chambers will be needed in the beamline. The experimenters are planning to use the "Fenker" MWPC chambers already available at FTBF. To reduce material before the apparatus, which might introduce a significant effect at the lower beam energies, the experiment will not use more than 3 Fenker chambers. Because some MI buckets more than one particle will occur, and because considerable beam spreading at lower energies is expected, a veto system with 4 scintillator paddles will be needed near the Fenker closest to the detector; some material upstream of that might be needed as well to increase the efficiency of particle detection by causing showers.

2.3.2 Electronics and Computing Needs:

The beam and environmental variables from ACNET will need to be inserted into the data stream; in the previous running, this was done by the experimenters and we expect to do the same again.

The experimenters will require suitable electronics to form a trigger; it is anticipated that existing components in the FTBF, plus the NIM modules and crates mentioned in 2.3.1 or Appendix II will suffice.

The MINERvA electronics will open a gate, and can take a trigger input which will decide between reading out the contents of that gate or clearing the contents and starting a new gate.

The conditions that generate a trigger, as well as beam quantities such as the Cherenkov detector will need to be synchronized with the MINERvA DAQ while reading out hundreds or thousands of triggers per spill. This is best done via a counter/timestamp system latched into the MINERvA data stream. The experimenters will work with FTBF personnel to provide a suitable interface between all the components involved. It is anticipated that only a modest modification of the system used previously.

The experimenters will use the same custom front end electronics and DAQ system as was developed for the MINERvA experiment. The front end electronics are mounted on the PMT boxes in a frame right next to the scintillator, and are read out through VME and a PC. A low voltage system provides 48 V to Cockroft-Walton bases on the PMTs, so no exposed HV parts are present. All these components will be provided by the experimenters.

The experimenters will provide the computers needed for DAQ, data analysis, and disks for on-location data storage.

Fermilab will provide 600 Gigabytes of space on backed-up managed disk server that will be used for long term access to the test beam data. The experimenters require network access to transfer these data, preferably continuously, or at a minimum after every run.

2.3.3 Description of Tests

The experiment will take beam data for 24 hours a day, concurrently taking cosmic ray data for calibration purposes. The experiment will take several energies and will need to take data in both positive and negative polarities. The experiment will change detector configurations at two different points in time and 17 days of running in each of the three configurations (ECAL+HCAL, HCAL heavy and TRAK+ECAL) is requested. The run plan will seek to minimize and optimize the timing of these changes.

The experiment will need to run the beams with the opposite polarities.

The experimenters plan some special runs with through-going muons from the beamline, which FTBF accomplishes by selecting a pion tune and dropping a beam stop upstream from the MT6 hall. In the

2010 run, the experimenters found the data with this configuration to be not as good as cosmics samples, primarily because they did not take it daily. The experimenters are expecting to use cosmics primarily in this run, but believe that having some straight-through muons to compare against cosmics to be a prudent run plan.

2.4 SCHEDULE

The schedule proposed is to install during the Summer 2014 shutdown and begin operation as the facility comes out of shutdown in November 2014. A lengthy period for setup, commissioning and DAQ validation in the beamline is in the plan. This allows for sharing the beam with other users in addition to providing some schedule contingency.

Experimental Planning Milestones

Begin Installation: Main structural frame was installed on the week of 15 Sept. First 4 plane installation was done by 22 Sept. Remaining planes installation began 14 Oct.

Begin DAQ commissioning: Basic DAQ was operating by 13 Oct.

Complete Installation would have to be 24 Oct, to permit 1 week cosmics & debugging prior to beam. Progress to date suggests that installation will continue into November.

Complete DAQ commissioning: Final DAQ commissioning and validation occurs with beam

Begin ORC approval process Two ORCs are needed; the first was done on 7 October. The final ORC should be done in November.

Commissioning in HCAL+ECAL Configuration is now planned to run concurrently with other FTBF experiments in a split schedule. Other users have requested 12 hours of beam a day and are willing for those 12 hours to be between noon and midnight; this allows access to the hall in the morning hours. Commissioning of the readout and beam-related components of the MINERvA testbeam detector can be done parasitically to these other users.

Data taking in HCAL+ECAL configuration 26 Dec – 11 Jan 2015

Reconfigure to HCAL-only configuration, recommission 12-15 Jan

Data taking in HCAL-only configuration 16 Jan – 1 Feb

Reconfigure to TRAK+ECAL configuration, recommission 2 – 5 Feb

Data Taking in in TRAK+ECAL configuration 6 – 22 Jan 2015

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB

3.1 The experimenters will take care of and monitor their detector when it is on, including times when it is collecting cosmic ray data or when other users in MT6 are collecting data. MINERvA experts are responsible for coordinating with FTBF to access the FTBF data stream.

3.2 NAME OF INSTITUTION:

- University of Geneva: manpower as described above
- University of Rochester: manpower as described above
- College of William and Mary: manpower as described above
- Centro Brasileiro de Pesquisas Físicas: manpower as described above
- Caltech: manpower as described above
- University of Pittsburg: manpower as described above, and will provide a Light Injection system.

IV. RESPONSIBILITIES BY INSTITUTION – FERMILAB

4.1 FERMILAB ACCELERATOR DIVISION:

4.1.1 Use of MTest beamline as outlined in Section II. [0.25 FTE/week]

4.1.2 A better understanding of the MTest beamline than is currently available will be needed. The Switchyard 120 group will produce a MARS/TURTLE based MC to help understand the properties of the beamline, and support the installation of a ToF system as described in Section 2.3.1 and Appendix IV for measurement of the particle composition of the beam.

4.1.3 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.

4.1.4 Scalers and beam counter readouts will be made available via ACNET in the MTest control room.

4.1.5 Reasonable access to the equipment in the MTest beamline.

4.1.6 Connection to ACNET console and remote logging should be made available.

4.1.7 The test beam energy and beam line elements will be under the control of the AD Operations Department Main Control Room (MCR). [0.25 FTE/week]

4.1.8 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.

4.1.9 The integrated effect of running this and other SY120 beams will not reduce the neutrino flux by more than an amount set by the office of Program Planning, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.2 FERMILAB PARTICLE PHYSICS DIVISION:

4.2.1 The test-beam efforts in this TSW will make use of the Fermilab Test Beam Facility. Requirements for the beam and user facilities are given in Section II. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and FTBF computers. [6.5 FTE/week]

4.2.2 Use of the downstream Cherenkov counter to tag electrons.

4.2.3 Development, installation, and operation of a time-of-flight system as specified in section 2.3.1.

4.2.4 Use of the MWPC tracking stations Development, Installation, and operation of a time-of-flight system as specified in section 2.3.1.

4.2.5 Crane operation and adequate clearance to insert the detector frame is needed to install, remove, and reconfigure the detector. No upgrade of facility requirements over what was available in 2010 is needed.

4.2.6 Conduct a NEPA review of the experiment.

4.2.7 Provide day-to-day ESH&Q support/oversight/review of work and documents as necessary.

4.2.8 Provide safety training as necessary, with assistance from the ESH&Q Section.

4.2.9 Update/create ITNA's for users on the experiment.

4.2.10 Initiate the ESH&Q Operational Readiness Clearance Review and any other required safety reviews.

4.2.11 Fermilab collaborators in PPD will be needed to engineer, construct and install the mechanical frame supporting the detector (Jim Kilmer) [25.7 person-weeks]

4.2.12 Fermilab collaborators in PPD will be needed to modify CRIM and FEB firmware for better duty factor in the DAQ (Christianel Gingu) [4 person-weeks]

4.2.13 Fermilab collaborators in PPD will be needed to provide support on the DAQ hardware (Paul Rubinov).

4.2.14 A limited amount of PPD labor (Anatoli Ronzhin) will be requested to support the development of the ToF system.

4.2.15 Surveyors will be needed at the end of the installation process. [1 person-week]

4.3 FERMILAB SCIENTIFIC COMPUTING DIVISION

4.3.1 Internet access should be continuously available in the MTest control room.

4.3.2 See Appendix II for summary of PREP equipment pool needs.

4.3.3 600 Gigabytes of space on backed-up managed disk server (Section 6.3.2).

4.4 FERMILAB ESH&Q SECTION

4.4.1 Assistance with safety reviews.

4.4.2 Beta gun sources as now existing in the FTBF facility will be needed to commission detector components for about 1 month.

4.4.3 Provide safety training, with assistance from PPD, as necessary for experimenters. [0.2 FTE]

4.5 FERMILAB NEUTRINO DIVISION

4.5.1 Fermilab collaborators in ND will be needed to oversee commissioning of electronics racks, installation of the cable plant and production of ORC documentation (Linda Bagby). [3 person-weeks]

4.5.2 A DAQ specialist will be needed to oversee and participate in the installation and commissioning of the DAQ system (Geoff Savage), and to modify the DAQ to include the needs of the ToF system. [8 person-weeks]

4.5.3 The Spokesman, Leo Bellantoni, is in ND and he will also oversee and participate in the development of the ToF system. [1 FTE]

V. SUMMARY OF COSTS

Numbers formatted **(x.x)** are estimated outstanding needs as of this writing.

Source of Funds [$K]	**Materials & Services**	**Labor** (person-weeks)
Accelerator Division	0	1.0 **(1.0)**
Particle Physics Division	$10.0K	30.5 **(8.2)**
Neutrino Division	0	9.0 **(5.0)**
Scientific Computing Division	0	0
ESH&Q Section	0	0.2 **(0.2)**
Totals Fermilab	$10.0K	40.7 **(14.4)**
Totals Non-Fermilab	0	students / postdocs

5.1 PPD LABOR BREAKDOWN BY TASK

Task	**Duration (day)**	**Techs/ Spec.**	**Engineer**	**Drafter**	**Welder**	**total person-days**
Construct new detector stand	20	2	0.5	1	0.5	80
Install detector stand in MT6	1.5	3				4.5
Install detector and absorber planes in MT6	5	3				15
Modify detector plane setup	3	3				9 **(2)**
Change Detector Configurations (2 times)	10	2				20 **(20)**
SubTotal		13	0.5	1	0.5	128.5 **(22)**
Firmware modifications	20		1			20 **(15)**
Survey	2	2				4 **(4)**
Total		13	1.5	1	0.5	152.5 **(41)**

5.2 ND LABOR BREAKDOWN BY TASK

Task	**Duration (day)**	**Engineering Physicist DAQ Specialist**	**total person-days**
Installation, commissioning of the DAQ system, and modifications thereto; integration with FTBF infrastructure	40	1	40 **(30)**
Oversee commissioning of electronics racks, installation of the cable plant and production of ORC documentation	15	1	15 **(5)**
Total			45 **(25)**

VI. General Considerations

6.1 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 ensure that the experimenters all follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ESH&Q) reviews are necessary. This includes creating an Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The Spokesperson will follow those procedures in a timely manner, as well as any other requirements put forth by the Division's Safety Officer.

6.3 The Spokesperson will ensure at least one person is present at the Fermilab Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 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 ESH&Q section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).

6.6 The Spokesperson will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Scientific Computing Division management. The Spokesperson also undertakes to ensure no modifications of PREP equipment take place without the knowledge and written consent of the Computing Sector management.

6.7 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 listed in Appendix II. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

At the completion of the experiment:

6.8 The Spokesperson is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the Spokesperson will be required to furnish, in writing, an explanation for any non-return.

6.9 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ESH&Q requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters unless removal requires facilities and personnel not able to be supplied by them, such a rigging, crane operation, etc.

6.10 The experimenters will assist Fermilab with the disposition of any articles left in the offices they occupied.

6.11 An experimenter will be available to report on the test beam effort at a Fermilab All Experimenters' Meeting.

SIGNATURES:

The spokesperson is the official contact and is responsible for forwarding all pertinent information to the rest of the group, arranging for their training, and requesting ORC or any other necessary approvals for the experiment to run.
The spokesperson should also make sure the appropriate people (which might be everyone on the experiment) sign up for the test beam emailing list.

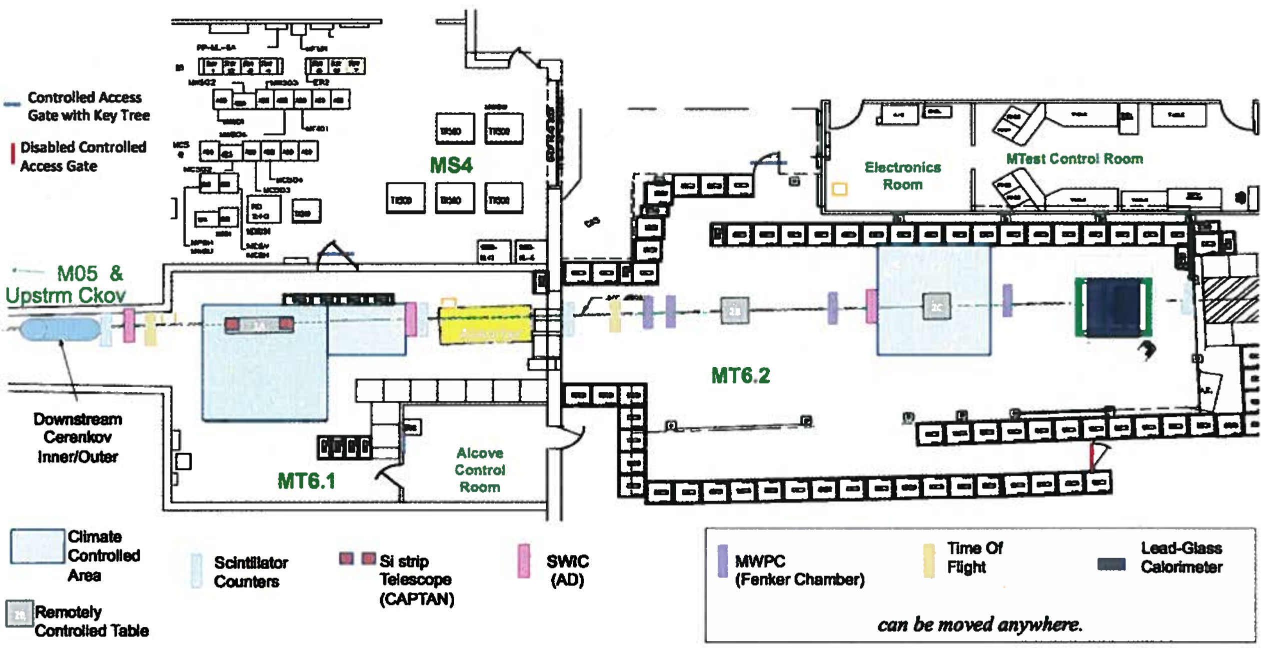
17 Oct 2014

Leo Bellantoni, Experiment Spokesperson

Appendix I: MT6 Area Layout

MTest Areas

The MINERvA Testbeam detector will be placed in MT6.2. One or two Fenker wire chambers will be placed directly up stream of it; a third will be placed at a convenient location in MT6.2 Fenker chambers must be fixed and immovable from time of survey onwards.



Appendix II: Equipment Needs

Provided by experimenters:

Equipment Pool and PPD items needed for Fermilab test beam, on the first day of setup.

PREP Equipment Pool:

Quantity	Description
	A two digit number of NIM modules will be needed to form the trigger and tracking system veto. This is in addition to NIM modules already issued from PREP to MINERvA for earlier testbeam efforts.

PPD FTBF:

Quantity	Description
3	MWPC Stations
0	Scintillator Counters (not necessary to include MT6SC1 - 3)

Appendix III: - Hazard Identification Checklist

Items for which there is anticipated need should be checked.
See ORC Guidelines for detailed descriptions of categories.
There is NO need to list existing Facility infrastructure you might be using.
(Do Not list FTBF Lasers or Motion Tables, unless you are bringing them)

Flammables (Gases or Liquids)		**Gasses**		**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:		X	Lead (Pb) (plates in detector)		TMAE	
Lasers			Tungsten (W)		Other: Activated Water?	
	Permanent installation		Uranium (U)			
	Temporary installation	X	Other: Steel plates in detector	**Nuclear Materials**		
	Calibration	**Electrical Equipment**		Name:		
	Alignment		Cryo/Electrical devices	Weight:		
Type:			Capacitor Banks	**Mechanical Structures**		
Wattage:		X	High Voltage (50V)		Lifting Devices	
MFR Class:			Exposed Equipment over 50 V		Motion Controllers	
		X	Non-commercial/Non-PREP	X	Scaffolding/ Elevated Platforms	
		X	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	
Window Thickness:		Window Thickness:			Bubble chamber	

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APPENDIX IV: RE-INTRODUCTION OF A SCINTILLATOR STATION IN MT5

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3 OCT 2014

In order to measure the beam composition of the "pion mode" secondary beam in the Fermilab Test Beam Facility, we wish to introduce a scintillator based time-of-flight (ToF) station at the same location as the old MT5SC scintillator. We believe that manpower is available to do this relatively simple task during this shutdown.

The MINERvA collaboration needs to determine the response of its detector to different hadrons of different energies. At this time, the expectation is that the beam, particularly at lower energies like 1GeV, will have a large p/π ratio. There isn't a good way to distinguish the species of hadron from shower shape or other detector variables, but different hadrons will, as a result of having different cross-sections for different processes, produce different detector responses. MINERvA seeks to determine detector response to the level of a few percent.

This information will also be used in validation of a MARS / TURTLE simulation of the beamline that will be of great value in predicting the properties of the beam under a variety of usage scenarios.

The scintillator station is under development, but will be very like the ToF stations developed earlier by Anatoli Ronzhin for use in MTBF. It will have either 2 or 4 opposed photomultiplier tubes. At this time, 1 HV and one BNC/RG58 signal cable are run to the location; we plan to run 4 more HV and 4 more signal cables, providing the capability of running a 4 tube station and having 1 spare cable.

Location: MT5SC was about 76 m upstream of MT6.1; it immediately proceeds MT5V1 which is before the final bend magnets, MT5E1-5. At that time, MT5CON, a rotating target wheel, was also installed between MT5SC and MT5VT1, and MT5PWC1, a proportional wire chamber, was just upstream of MT5SC.

This is the only location downstream of the target where there is a vacuum by-pass already installed. Without this, we would either need to introduce new vacuum pumps for the downstream section, or install a new by-pass.

With 1nsec time resolution in any given station, which is typical or even a little pessimistic for a scintillator based device, and an additional 30m of travel before a second station in MT6.2, we should have 3σ separation or better between p and π up to about 5.5GeV.

The scintillator will be supported with Unistrut, and can be rapidly removed, but is otherwise fixed. The time required to install the break is about 1 day.

Additional material: Less than 2m of air, and a few mm of scintillator.

Responsibility: Development of the ToF station will be done by the MINERvA collaboration. Creating the vacuum break will be done by the SY120 group of AD. Installation will be a collaboration between these two. Operational maintenance during the MINERvA run will be supported by the experiment, except for work that requires 2 person access to the AD owned enclosures; that will be done collaboratively.

Responsibility following the MINERvA use remains to be decided. The FTBF group may well desire to retain the device for possible use by later experiments.

The following people have read this TSW:

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