Fermilab

Directorate

Technical Scope of Work

FOR THE 2016 fermilab TEST BEAM FACILITY PROGRAM

T-1072

Beam test for muon strips

May 20, 2016

Introduction

This is a technical scope of work (TSW) between the Fermi National Accelerator Laboratory (Fermilab) and the experimenters of Fermilab, IHEP Protvino and Vinča Belgrade who have committed to participate in beam tests to be carried out during the 2016 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:

Beam test for muon strips is an experiment to measure the efficiency, time resolution and longitudinal position resolution of scintillator strips for a muon system at future colliders.

The muon system at future colliders is envisioned as several layers of position-sensitive detectors embedded in the iron flux-return yoke of the solenoidal magnet. The role of the muon system is primarily the identification of muons and track matching to the central tracker, besides serving as the tail catcher for the hadronic showers that penetrate beyond the hadron calorimetry. Previous tests performed at Fermilab with cosmic muons have shown that scintillators with wavelength-shifting (WLS) fibers and a SiPM readout offer promising performance (NIM A 823, 2016, pp.120-125). The purpose of the present beam tests is to determine the performance parameters with better accuracy.

The measurement setup is schematically presented in Fig. 1. The length of the tested strips will vary between 1 m and 2 m. The scintillator strip to be tested will be placed horizontally perpendicular to the beam on a platform in the area behind the beam dump of MT6.2. Two fast scintillators S1 and S2 with vacuum PMT readout will be placed in front and after the tested strip in the beam. The distance between S1 and S2 is 1 m. One fast scintillator strip S3 will be placed in beam immediately in front of the tested strip, perpendicular to the tested strip.

A rack with a CAMAC crate and two NIM crates will be used for the data acquisition. The data collection will be performed and monitored from a PC with USB connection to the CAMAC Crate controller.

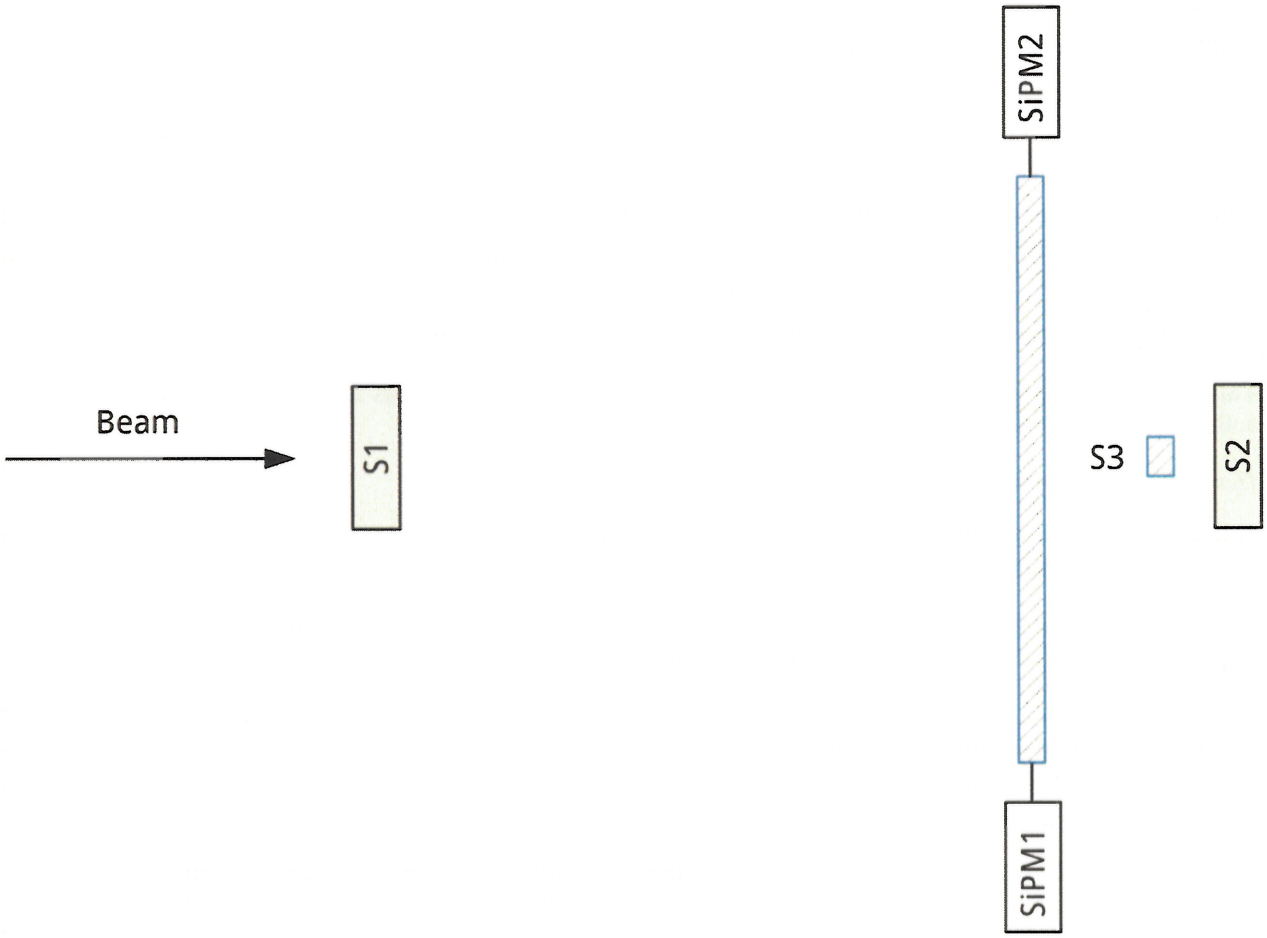

Figure 1: Sketch of the test beam setup

I. PERSONNEL AND INSTITUTIONS:

Spokesperson and lead Experimenter in charge of beam tests: Dmitri Denisov

Fermilab Experiment Liaison Officer: Mandy Rominsky

The group members at present are:

	Institution	Country	User	Rank/Position	Other Commitments
1.1	Fermilab	USA	Dmitri Denisov	Senior Researcher	D0, Part. Phys. initiatives
1.2	IHEP Protvino	Russia	Valery Evdokimov	Senior Researcher	Various
1.3	Vinča Belgrade	Serbia	Strahinja Lukić	Research Associate	FCAL, ILD, CLICdp
			Predrag Ujić	Research Associate	Research project OI171018 Serbia

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS:

I.1 LOCATION

I.1.1 The beam test(s) will take place in the area behind the beam dump of MT6.2, as shown in Appendix I. This area has been selected for ease of access and the expected purity of muon beam.

I.1.2 No additional space is needed.

I.2 BEAM

I.2.1 BEAM TYPES AND INTENSITIES

Energy of beam: broad band as available
Particles: muons (remaining from the secondary pion beam in MT6.2)
Intensity: as available
Beam spot size: as available

I.2.2 BEAM SHARING

The experiment shares beam with other users. As it is located behind the beam dump, it uses the beam as available according to the schedule of the experiments in MT6.2. Whenever other experiments do not put a requirements on the beam, the experimenters will request a 28 GeV pion beam in the "Non-muon mode", i.e. with MT6 beam absorbers open. This request will be communicated to the other experimenters in advance to allow them to move their equipment as desired.

I.3 EXPERIMENTAL CONDITIONS

I.3.1 AREA INFRASTRUCTURE

The experimental setup comprises three scintillators laid on a platform, a rack with one CAMAC crate and two NIM crates and a desk with the data-taking computer. The dimensions of the platform with scintillators is approximately 2 m by 1 m. The height of the platform is adjusted so that the beam intersects the scintillators. The table with the computer is approximately 1 m by 1 m.

The experiment does not use any gases.

I.3.2 ELECTRONICS AND COMPUTING NEEDS

No non-commercial electronics will be needed.

See Appendix II for summary of PREP equipment pool needs.

Fermilab computer will be brought to the area and used for DAQ.

I.3.3 DESCRIPTION OF TESTS

The measurements will be performed depending on the available beams, according to the beam schedule of experiments running in MT6.2. The data taking will focus on the periods when muons are available in the secondary beam.

The experimenters will need a beam-synchronization cable.

Two working days are needed to install before ORC inspection.

The experimenters will frequently access the setup. However as the setup is located behind the beam dump, the beam does not need to be stopped.

I.4 SCHEDULE

The experiment requests four weeks, with a return date to be specified later, for two more weeks.

Experimental Planning Milestones

Tentative date for beginning the installation: May 16th 2016

Tentative date for beginning data taking: May 17th 2016

III. RESPONSIBILITIES BY INSTITUTION – NON FERMILAB

I.1 IHEP PROTVINO:

- Design, assembly and commissioning of the scintillation counters.
- Data collection and analysis.

I.2 VINČA BELGRADE:

II. Design, assembly and commissioning of the beam telescope.

III. Data collection and analysis.

IV. RESPONSIBILITIES BY INSTITUTION – FERMILAB

IV.1 FERMILAB ACCELERATOR DIVISION:

4.1.1 Use of MTest beamline as outlined in Section II. [0.25 FTE/week]
4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.
4.1.3 Scalers and beam counter readouts will be made available via ACNET in the MTest control room.
4.1.4 Reasonable access to the equipment in the MTest beamline.
4.1.5 Connection to ACNET console and remote logging should be made available.
4.1.6 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]
4.1.7 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.
4.1.8 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.

IV.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 PPD DDOD Test Beam Group 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 Provide required space in the area behind the beam dump. Cabinets stored in the area may need to be moved.
4.2.3 Provide a beam synchronization cable.
4.2.4 Conduct a NEPA review of the experiment.
4.2.5 Provide day-to-day ESH&Q support/oversight/review of work and documents as necessary.
4.2.6 Provide safety training as necessary, with assistance from the ESH&Q Section.
4.2.7 Update/create ITNA's for users on the experiment.
4.2.8 Initiate the ESH&Q Operational Readiness Clearance Review and any other required safety reviews.

IV.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.

IV.4 FERMILAB ESH&Q SECTION

4.4.1 Assistance with safety reviews.
4.4.2 Provide safety training, with assistance from PPD, as necessary for experimenters. [0.2 FTE]

IV.5 FERMILAB COLLABORATORS

IV.5.1 Coordination of efforts at 0.5 FTE.

V. SUMMARY OF COSTS

Source of Funds [$K]	**Materials & Services**	**Labor** (person-weeks)
Accelerator Division	0	
Particle Physics Division	0.0	
Scientific Computing Division	0	0
ESH&Q Section	0	0.2
Totals Fermilab	$0.0K	
Totals Non-Fermilab	$0.0	3 FTE during 2 months

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.

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

6.9 The co-spokespersons are the official contact and are 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.

6.10 The co-spokesperson should ensure the appropriate people (which might be everyone on the experiment) sign up for the test beam emailing list.

6.11 The spokesperson, or designee, will generate a one-page summary of the experiment's use of the Test Beam facility during the fiscal year, to be included in the annual Test Beam Report Fermilab submits to the DOE.

At the completion of the experiment:

6.12 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.

6.13 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.

Signatures:

S. Lukic 20 / May / 2016

Strahijna Lukic, Experiment Spokesperson

Appendix I: MT6 Area Layout

The test setup would be installed in the area behind the beam dump of MT6.2 (see Fig. 2). The platform with the counters would be placed in beam (red rectangle in Fig. 2), the rack with electronics in the corner beside it (blue square in Fig. 2) and the computer desk along the wall beside the rack (green square in Fig. 2).

MTest Areas

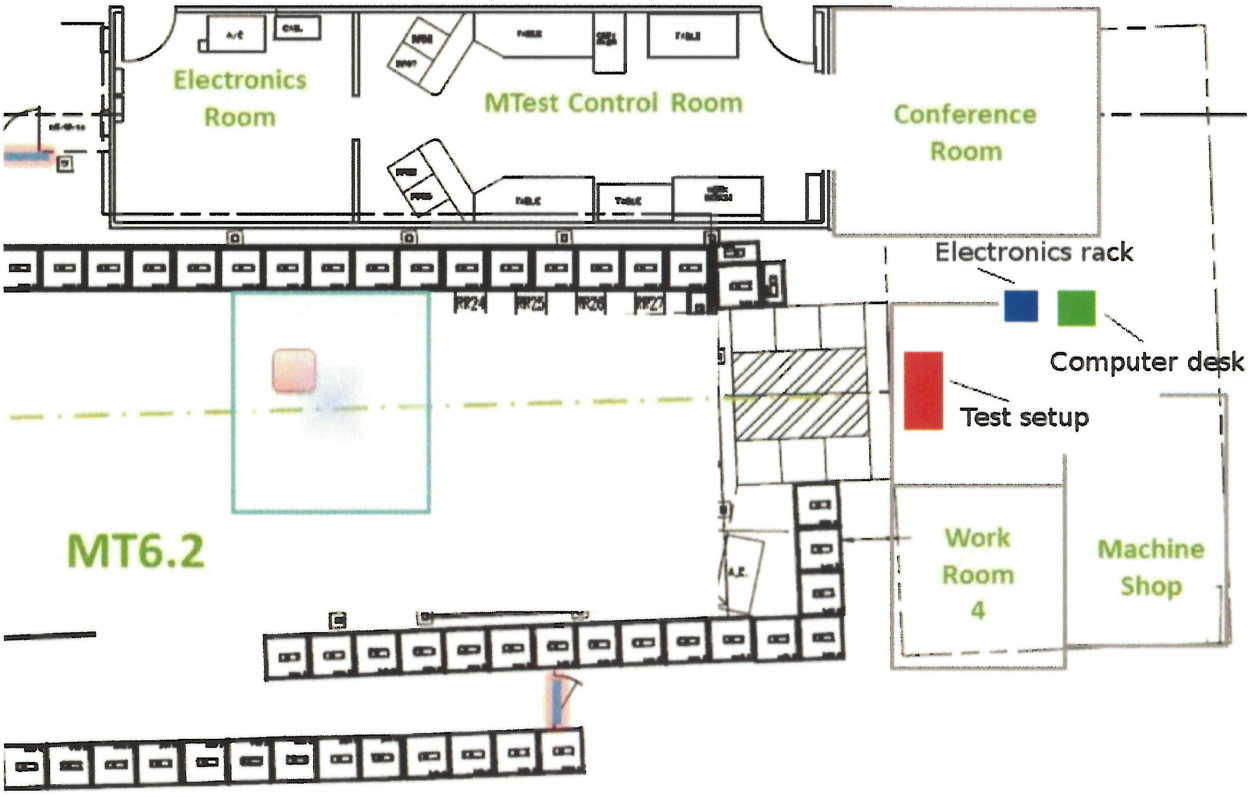

Figure 2: Layout of the test setup. The platform with the counters is represented by the red rectangle, the electronics rack by the blue square and the computer desk by the green square.

Appendix II: Equipment Needs

Provided by experimenters:

Scintillators

Rack with electronics: 1xCAMAC crate, 2xNIM crates, modules

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

PREP EQUIPMENT POOL:

Quantity	Description
1	Rack
2	HV supplies Fluke 415B

PPD FTBF:

Quantity	Description

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:			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:		X	High Voltage (50V)		Lifting Devices	
MFR Class:			Exposed Equipment over 50 V		Motion Controllers	
			Non-commercial/Non-PREP		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	
Window Thickness:		Window Thickness:			Bubble chamber	

The following people have read this TSW:

on separate sheet / / 2016
Patty McBride, Particle Physics Division, Fermilab

on separate sheet / / 2016
Sergei Nagaitsev, Accelerator Division, Fermilab

on separate sheet / / 2016
Martha Michels, ESH&Q Section, Fermilab

on separate sheet / / 2016
Robert Roser, Chief Information Officer, Fermilab

on separate sheet / / 2016
Joe Lykken, Chief Research Officer, Fermilab

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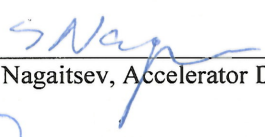
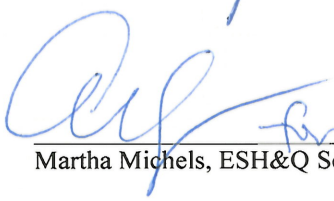


Sergei Nagaitsev, Accelerator Division, Fermilab / 5/20/16 / 2016



Martha Michels, ESH&Q Section, Fermilab / 5/20/16 / 2016

Robert Roser, Chief Information Officer, Fermilab / 5/24/16 / 2016

Joe Lykken, Chief Research Officer, Fermilab 5/24/16 / / 2016