Fermilab

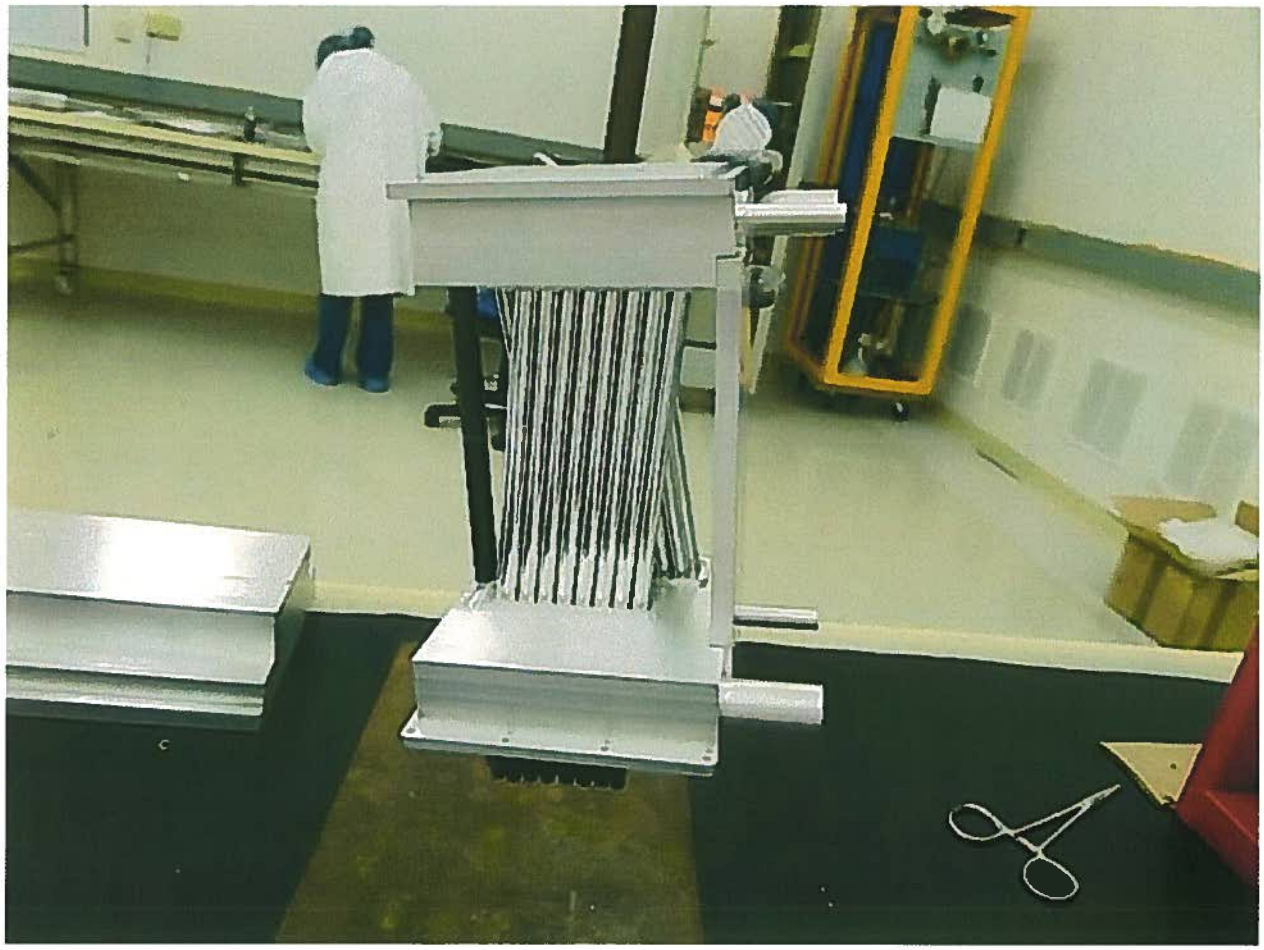
Directorate

TECHNICAL SCOPE OF WORK
FOR THE 2014 FERMILAB TEST BEAM FACILITY PROGRAM

T-1042

Muon g-2 Straw Tracker

January 13, 2014



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INTRODUCTION

This is a technical scope of work (TSW) between the Fermi National Accelerator Laboratory (Fermilab) and the experimenters of Fermilab, Boston University, Northern Illinois University, Northwestern University, Liverpool University, Oxford University and University College London, who have committed to participate in beam tests to be carried out during the 2014 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 new g-2 experiment is being constructed to improve on the current value measured at Brookhaven. One of the factors contributing to the improved understanding of systematic errors is a straw chamber that sits in the vacuum, close to the muon beam. These chambers can be used for a parasitic Electric dipole moment measurement, improved understanding of the beam dynamics and will improve the pile up library for the calorimeter. The chambers being built will consist of doublet U-V layers (with 15° between layers). The straws are made of wound mylar. One layer consists of 500 angstroms of aluminum on top of the mylar (the outside) and the other layer has 500 angstroms aluminum plus 200 angstroms of gold on the mylar. The two strips are wound together to make a straw. The straws will have a 25 micron gold plated tungsten wire in the middle at high voltage (~1400V) as the sense wire. A gas consisting of 80-20 Ar-CO_2 will be flowed through the straws. This will be a 32 channel prototype consisting of straws that are 9cm long.

There are several reasons for the beam test of this detector. While straws have been used in vacuum for a long time, these are very, very thin straws. One test will be to see how the outgassing holds up. Experimenters will need to test the electronics under running conditions, confirm the resolution of the straws and determine the gain.

I. PERSONNEL AND INSTITUTIONS:

Spokesperson: Mandy Rominsky

Fermilab Experiment Liaison Officer: Aria Soha

The group members at present are:

	Institution	Country	Collaborator	Rank/Position	Other Commitments
1.1	Fermilab	USA	Mandy Rominsky	Research Associate	D0
			Brendan Casey	Scientist	
1.2	Northwestern Univeristy	USA	Leah Welty-Rieger	Research associate	
			Heidi Schellman	professor	
1.3	Northern Ilinois Univeristy	USA	Mike Eads	professor	
			Nick Pohlman	professor	

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS:

2.1 LOCATION

2.1.1 The beam test(s) will take place in MT6.2B

2.1.2 The experimenters will need a few rack spaces in the control room and an SLF6 computer to run the DAQ system (Midas program).

2.2 BEAM

2.2.1 BEAM TYPES AND INTENSITIES

Energy of beam: 120 GeV
Particles: protons
Intensity: 10k – 100k particles/ 4 sec spill
Beam spot size: about $10cm^2$

2.2.2 BEAM SHARING

The experiment can share beam time with anyone using 120 GeV beam either upstream or downstream. The important thing for the experiment is to monitor the proton direction as it enters and exits the device and that the proton energy be high enough so that multiple scattering is not an issue.

The radiation length of the detector is approximately 1 radiation length.

2.2.3 RUNNING TIME

The experiment requests two weeks of run time, with 24 hours a day when possible. If sharing the beam, the experiment requests daytime hours, as shifters are expected to be Fermilab personnel. After the system is stable, frequent accesses are not expected and the experiment is mainly looking to acquire sufficient statistics.

See section 2.3.3 for total run time and long-term schedule.

2.3 EXPERIMENTAL CONDITIONS

2.3.1 AREA INFRASTRUCTURE

The apparatus to be tested is a 32 channel prototype straw tracking system. The straw system sits in a vacuum chamber. The vacuum chamber is a tube about 27 inches in diameter and about nine inches tall. The entire device is less than 1 cubic meter and will fit on the 2B motion table. The straws are filled with a gas (80:20 $Ar:CO_2$), so a non-flammable gas connection will be needed. At least 1 MWPC station will need to be provided by FTBF. The experiment will have a roughing pump that sits on the floor next to the device. The experiment will utilize the patch panels between the enclosure and the electronics room.

2.3.2 Electronics and Computing Needs

The experiment uses one custom board that is an amplifier using ASDQ chips very similar to the readout system of the FTBF Fenker wire chambers in the test beam area. The schematics will be provided to the ORC review committee. High and Low voltage from commercial supplies will be provided by the experiment.

The experiment will use one of the FTBF Linux computers to run the DAQ.

No additional PREP equipment will be needed.

2.3.3 Description of Tests

The experiment expects to use the first 4 days to get everything timed in correctly and then have 10 days of running. At least two shifters will be on hand at all times. The tests to be conducted on a day to day basis will evolve.

2.4 Schedule

The experiment requests 2 weeks in January 2014. A longer request with a larger system is expected in Fall of 2015.

III. RESPONSIBILITIES BY INSTITUTION – NON FERMILAB

3.1 BOSTON UNIVERSITY:

- Readout electronics

[$10k]

3.2 NORTHWESTERN UNIVERSITY:

- Software

[0k]

3.3 NORTHERN ILLINOIS UNIVERSITY:

- Human resources

[3 person weeks]

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 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.

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 Set up and maintenance of MWPC stations
4.2.3 Ar/CO_2 gas (80/20) for straws
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.

4.3 FERMILAB SCIENTIFIC COMPUTING DIVISION

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

4.4 FERMILAB ESH&Q SECTION

4.4.1 Assistance with safety reviews.

4.4.2 Loan of Fe(55) source for the duration of the test beam (2 weeks) to demonstrate that the chambers are working and the gain is calibrated and understood. There is a source at Lab 3 that may be used for this purpose.

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

4.5 FERMILAB COLLABORATORS

4.5.1 Straw Tracker [$100k]

V. SUMMARY OF COSTS

Source of Funds [$K]	Materials & Services	Labor (person-weeks)
Accelerator Division	0	0.5
Particle Physics Division	0.0	6.5
Scientific Computing Division	0	0
ESH&Q Section	0	0.2
Fermilab Collaborators	100K	10
Totals Fermilab	$100.0K	1.7
Totals Non-Fermilab	10K	14.7

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. 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:

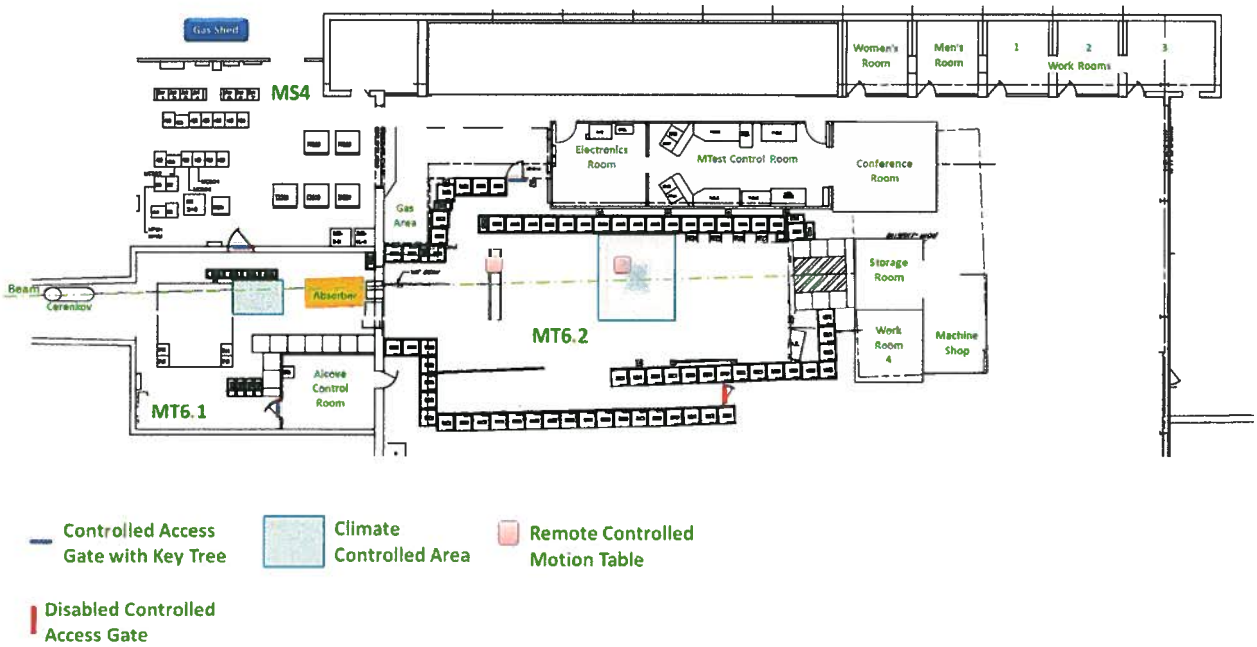
The spokesperson is the official contact and is responsible for forwarding all pertinent information to the rest of the group, arranging for their training, and requesting ORC or any other necessary approvals for the experiment to run.
The spokesperson should also make sure the appropriate people (which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

_____ 1 / 14/ 2014
Mandy Rominsky, Experiment Spokesperson

APPENDIX I: MT6 AREA LAYOUT

The experiment will sit on the motion table 2B

MTEST AREAS



APPENDIX II: EQUIPMENT NEEDS

Provided by experimenters:

Fermilab: tracker

Boston: electronics

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

PPD FTBF:

Quantity	Description
2	MWPC Stations
2	80:20 Ar:CO2 canister

APPENDIX III: - HAZARD IDENTIFICATION CHECKLIST

Items for which there is anticipated need have been checked.

Flammable Gases or Liquids		Other Gas Emissions*		Hazardous Chemicals		Other Hazardous /Toxic Materials
Type:		Type:	Ar-CO_2		Cyanide plating materials	List hazardous/toxic materials planned for use in a beam line or an experimental enclosure:
Flow rate:		Flow rate:	2 cc/min		Hydrofluoric Acid	
Capacity:		Capacity:			Methane	
Radioactive Sources		**Target Materials**			photographic developers	
	Permanent Installation		Beryllium (Be)		PolyChlorinatedBiphenyls	
X	Temporary Use		Lithium (Li)		Scintillation Oil	
Type:	Fe55		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	
		X	Non-commercial/Non-PREP		Scaffolding/ Elevated Platforms	
			Modified Commercial/PREP		Other:	
Vacuum Vessels		**Pressure Vessels**		**Cryogenics**		
Inside Diameter:	10inches (OD)	Inside Diameter:			Beam line magnets	
Operating Pressure:	10^{-4} Torr	Operating Pressure:			Analysis magnets	
Window Material:	Stainless steel	Window Material:			Target	
Window Thickness:	1/8"	Window Thickness:			Bubble chamber	

The following people have read this TSW:

_____ 1/15/2014
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Sergei Nagaitsev, Accelerator Division, Fermilab

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_____ 1/14/2014
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Stuart Henderson, Associate Director for Accelerators, Fermilab