Fermilab

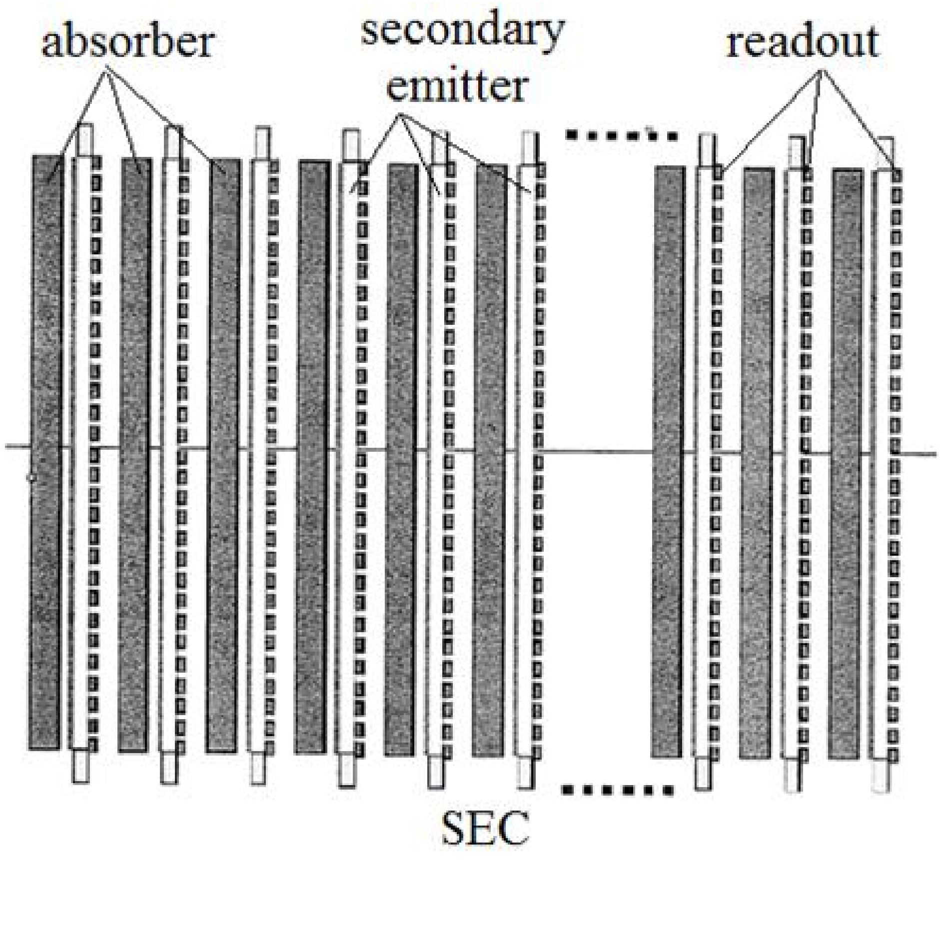
Directorate

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

T-1058

Secondary Emission Calorimeter (SEC)

25 June, 2014



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INTRODUCTION

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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:

One possibility to make a fast and radiation resistant shower maximum (SM) detector is to use a secondary emitter as an active element. Electron multipliers were first proposed as the active elements in calorimeters in 1990 [1]. The attractive properties of such calorimeters are: 1) a 2-dimensional map of energy at each sampling depth; 2) timing information at each depth; and 3) possible separation of electromagnetic and hadronic energy based on the differences in timing and spectrum of Cherenkov and scintillation light.

An electron-multiplier-based sampling calorimeter requires thin planar detectors at an affordable cost. Large-area photo detectors based on ALD-functionalized 20-cm-square borosilicate glass capillary micro-channel plates (MCPs), currently being developed by the LAPPD Collaboration [2], are candidates for the active elements.

The first results of the new shower maximum detector with the micro channel plate photomultiplier (MCP-PMT) as active elements are described in the references [3]. The current proposal is the next natural step in this direction.

The experimenters propose using large-area MCPs assembled without the usual bialkali photocathodes as the active element in sampling calorimeters, as described in Ref. [2]. LAPPD modules without photocathodes can be economically assembled in a glove box and then pumped and sealed using the process to construct photomultipliers, bypassing the slow and expensive vacuum-transfer process required by bialkali photocathodes.

The first use of electron multipliers, in this case MCPs (Fig. 1, left) as an active element in multi-layer sampling calorimeters is described in Ref. [1]. A chevron of two MCPs in vacuum, was located behind a tungsten plate on which 5 GeV and 26 GeV electrons were incident (Fig. 1, right). The amplitude of the MCP signal (Fig. 2) as a function of the tungsten thickness was measured. The primary electrons produce a shower of secondary particles, including positron-electron pairs and gammas; the response of the MCPs (Fig. 2, left) is proportional to the number of particles in the shower, which is dependent on the initial particle energy. The MCP signal shape is presented in the Fig. 2, right). The FWHM of the signal is 1 ns.

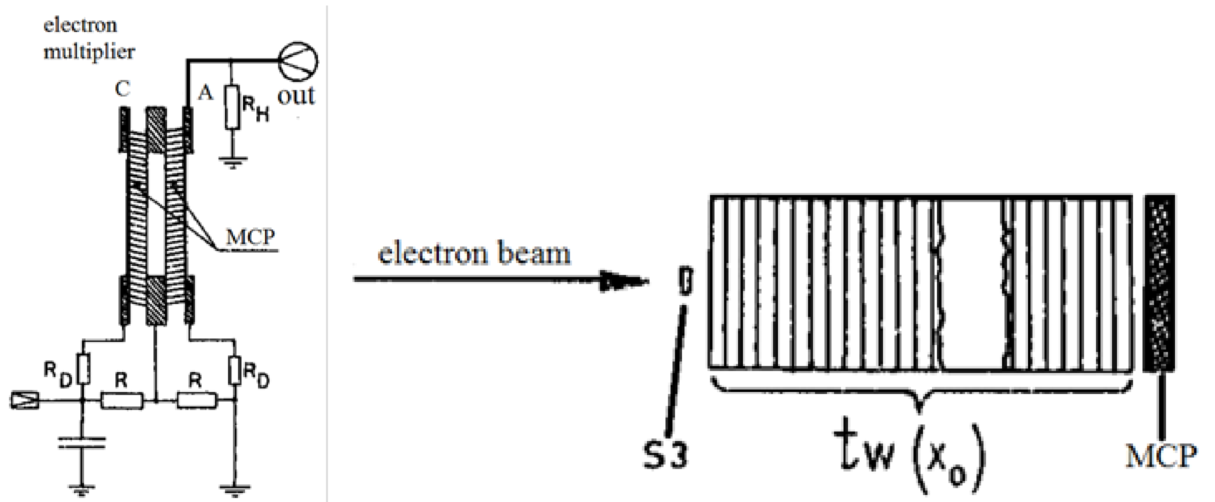


Fig. 1. The micro channel plate (MCP) schematics, left; and test beam setup, right. S3 - scintillation counter, tungsten thickness tw(X_0), MCP – micro channel plate.

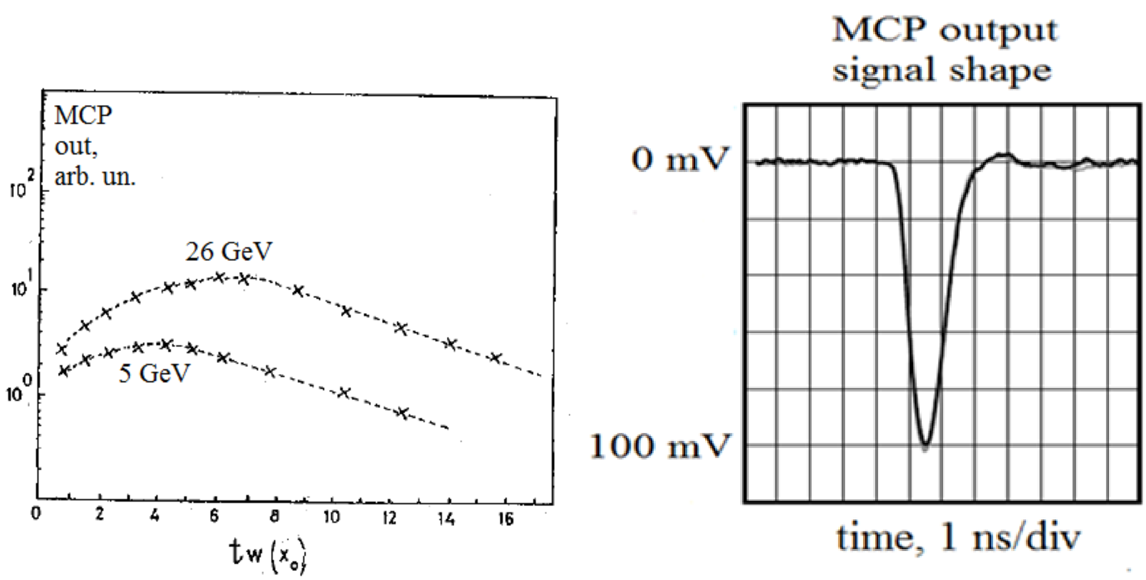


Fig. 2. The amplitude of the MCP signal as a function of the tungsten thickness tw(X_0), left; and the MCP signal shape, right.

The experimenters propose to investigate the possibility of producing an electromagnetic calorimeter based on W and Pb absorber plates sandwiched with LAPPD detectors (Fig. 3). Measurements can be made with bare plates and absorber inside of vacuum vessel. The LAPPD Collaboration has developed a thin, flat, system package that provides both 2D energy maps and correlated timing, including a vertical slice of a complete DAQ system (Fig. 4, right). Tests will be made with test beams at FTBF. If the results are promising the experimenters would like to construct and test a full-size electromagnetic calorimeter module large enough to contain high-energy showers, although this will require investment in additional chips, boards, and person-power.

The proposed detector for the FTBF test is pictured below (Fig. 3).

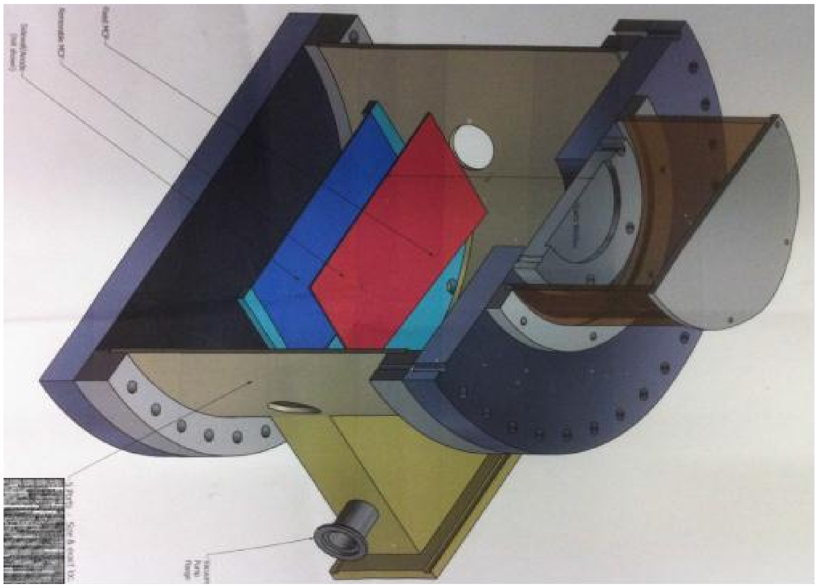


Fig. 3. Proposed SEC for the FTBF. Vacuum vessel with LAPPD MCP (blue) and absorber plate, W or Pb (red). (Single layer is shown in the figure for simplicity, like for shower maximum (SM) detector. Few layers will be installed when we will test the calorimeter).

The experimenteers plan to use different structure of the calorimeter in "final" version, Fig. 4 (left, in frame of possible another project)

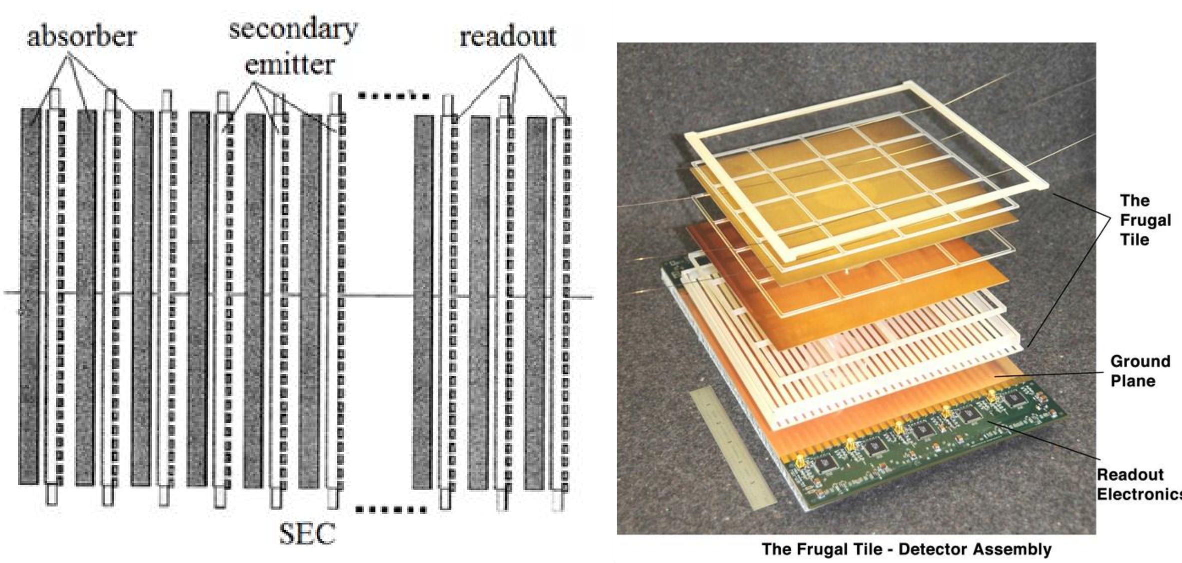


Fig. 4. Final design of the SEC. The calorimeter (left). Absorption layers are sandwiched by the MPC of LAPPD (right).

I. I. PERSONNEL AND INSTITUTIONS:

Co-spokespersons and lead experimenters in charge of beam tests: Henry Frisch, UC and Anatoly Ronzhin, Fermilab.

Fermilab Experiment Liaison Officer: JJ Schmidt

The group members at present are:

	Institution	Country	Collaborator	Rank/Position	Other Commitments
1.1	University of Chicago	USA	Richard Northrop	engineer	CMS
			Henry Frisch	Professor	CMS
			Andrey Elagin	Senior Researcher	CMS
1.2	Fermilab	USA	Anatoly Ronzhin	Physicist	CMS
			Erik Ramberg	Scientist	CDMS
1.3	Caltech	USA	Maria Spiropulu Artur Apresyan Si Xie	Professor Scientist Fellow	CMS CMS CMS

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS:

2.1 LOCATION

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

2.1.2 The experiment requests some storage space (2-3 cabinets next to MT6).

2.2 BEAM

2.2.1 BEAM TYPES AND INTENSITIES

Energy of beam in GeV: 120 – protons; 2, 4, 8, 16, 32 – electrons.
Particles: protons, electrons.
Intensity: 10k – 100k particles/ 4 sec spill
Beam spot size: about $10cm^2$

2.2.2 BEAM SHARING

Thin silicon telescope or gas detectors upstream of our detector are acceptable.

The radiation length of all the material intended to be in the beam is 27 rad. lengths as maximum.

2.3 EXPERIMENTAL CONDITIONS

2.3.1 AREA INFRASTRUCTURE

The main part of the apparatus is located inside of the dark box with the dimension of 38"x22"x11". The weight is about 20-30 lb. The experimenters place only single secondary emission layer in the box for the test. A standard rack with electronics will be located next to the box.

Another part of the equipment is a vacuum vessel with 12" diameter and height. This vessel is connected with our turbo pump. Both of these devices are positioned stationary on some support. The experimenters place many secondary emission layers in the vessel for this test. The weight of the vessel with part of the SEC inside is 40 lb as maximum.

The experimenters will make use of upstream Cherenkov counters, time of flight system (that the experimenters are responsible for) for particles ID, set of scintillation counters of different size (sensitive area 1x1mm2, 2x2mm2, 3x3mm2, proportional chambers for tracking,

The experiment needs moving tables with 1 mm of accuracy in X and Y, for the dark box placement, HV power with ~20 channels total. The expected range of motion of the table is about 7" in X and 3" in Y direction.

No gas used in the experiment.

2.3.2 ELECTRONICS AND COMPUTING NEEDS

The experiment does not use non-commercial electronics. The experiment uses commercial digital samplers (DRS4 readout) as well as PSEC4 digital samplers developed by UC.

No PREP electronics are requested.

The experimenters plan to bring a computer which should to be connected to the Fermilab Network.

2.3.3 Description of Tests

The experimenters need to have access to our detector as often as possible. The parts of the secondary emitter in the dark box are changed pretty often (say, every 1 hour). The experiment will have to change beam type for every set of the secondary emitters. This means that few sets of beam type preferable during the shift. The shift duration is about 8-12 hours (10am – 10pm are OK). The experimenters prefer day time. Overnight shifts are possible if working in parallel with other experiment. The experiementers need ~1 working day to install the equipment at the beam line before ORC inspection.

2.4 Schedule

The length of each beam test is 1-2 weeks. The experiment expects to have 3 beam test time during 1 year. The total duration of the experiment is about 3 years. The FTBF management will be informed if more beam time is needed in convenient time scale.

The experiment expects to start data taking by August 2014. The particular time is bounded by prototype detector readiness and the need to present these performance results to the DOE as part of the project approval process.

III. Responsibilities by Institution – Non Fermilab

3.1 University of Chicago

- The primary University of Chicago responsibility will be production of the vacuum vessel with absorber layers (lead or tungsten) and secondary emission layers (MCP, 8”x8”).
- Giga-sample waveform sampling electronics, PSEC4, for the SEC readout.
- Shifts and data analysis.

3.2 CALTECH

- Develop signals waveform processing algorithms to get best timing.
- Develop simulation programs for electromagnetic showers with special attention to the low energy component (1-10 KeV) of a secondary shower’s particles.
- Shifts and data analysis.

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 Main part of our equipment located inside of the dark box with the dimension of 38"x22"x11". The weight is about 20-30 lb. We place only single secondary emission layer in the box for our test. We locate standard rack with electronics next to the box. Another part of the equipment is vacuum vessel with 12" diameter and height of both. This vessel connected with our turbo pump Phyffer. Both these devices positioned stationary on some support. We place many secondary emission layers in the vessel for our test. The weight of the vessel with part of the SEC inside is 40 lb as maximum.

4.2.3 We need motion tables for the dark box placement, tracking or trigger systems (see above), HV power with ~20 channels total. The expected range of motion of the table is about 7" in X and 3" in Y direction.

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.

4.3.2 We plan to bring computer which should to be connected to the Fermilab Network.

4.4 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]

V. SUMMARY OF COSTS

Source of Funds [$K]	Materials & Services	Labor (person-weeks)
Accelerator Division	0	0.5
Particle Physics Division	0.0	2.2
Scientific Computing Division	0	0
ESH&Q Section	0	0.2
Totals Fermilab	$0.0K	1.7
Totals Non-Fermilab		6

VI. General Considerations

6.1 The responsibilities of the co-spokespersons 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 co-spokespersons agree 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 co-spokespersons 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 co-spokespersons 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 co-spokespersons 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 Spokespersons also undertake 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 co-spokespersons 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 Spokespersons 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 The experimenters will be available to report on the test beam effort at a Fermilab All Experimenters' Meeting.

VII. BIBLIOGRAPHY

1. A. A. Derevshchikov, V. Yu. Khodyrev, V.I. Kryshkin, V.E. Rakhmatov, A. I. Ronzhin, "On possibility to make a new type of calorimeter: radiation resistant and fast". Preprint IFVE 90-99, Protvino, Russia, 1990.
2. B. Adams, A. Elagin, H. Frisch, R. Obaid, E. Oberla, A. Vostrikov, R. Wagner, M. Wetstein. "Measurements of the gain, time resolution, and special resolution of a 20x20 cm2 MCP based picosecond detector". Nuclear Instruments and Methods. A 732 (2013) 392-396.
3. A. Ronzhin, S. Los, E. Ramberg, M. Spiropulu, A. Apresyan, S. Xie, H. Kim, A. Zatserklyaniy "Development of a new fast shower maximum detector based on micro channel plates photomultipliers (MCP-PMT) as an active element", submitted to NIM, NIMA-D-14-00186, 2014

VIII. SIGNATURES:

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

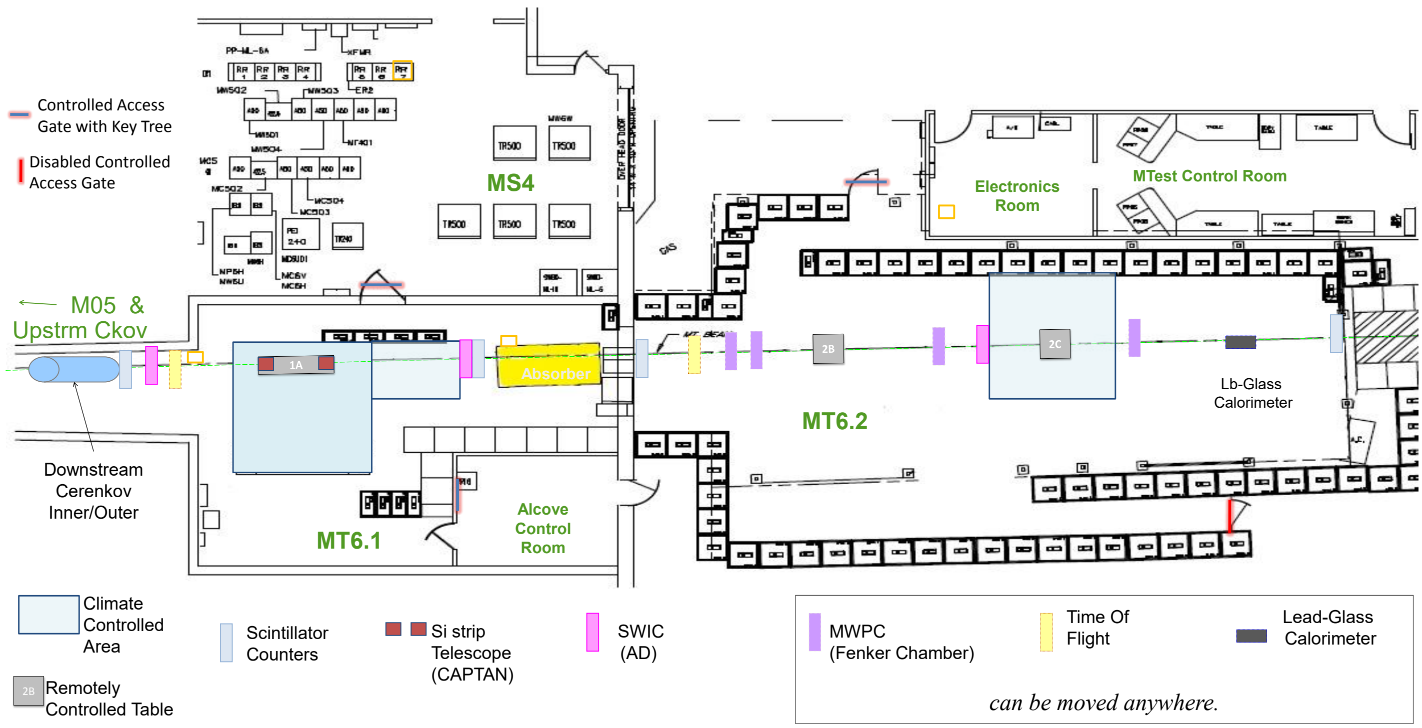
____ / /2014
Henry Frisch, Experiment co-spokesperson

____ / /2014
Anatoly Ronzhin, Experiment co-spokesperson

Appendix I: MT6 Area Layout

The apparatus will be in the MT6.2 area on the moving table with two MWPCs in front.

MTest Areas



Appendix II: Equipment Needs

Provided by experimenters:

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

PPD FTBF:

Quantity	Description
2	MWPC Stations
1	Time of Flight System
7	Scintillator counters (not necessary to include MT6SC1)

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:			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:

____ / / 2014
Michael Lindgren, Particle Physics Division, Fermilab

____ / / 2014
Sergei Nagaitsev, Accelerator Division, Fermilab

____ / / 2014
Robert Roser, Scientific Computing Division, Fermilab

____ / / 2014
Martha Michels, ESH&Q Section, Fermilab

____ / / 2014
Greg Bock, Associate Director for Research, Fermilab

____ / / 2014
Sergei Nagaitsev, Associate Director for Accelerators, Fermilab

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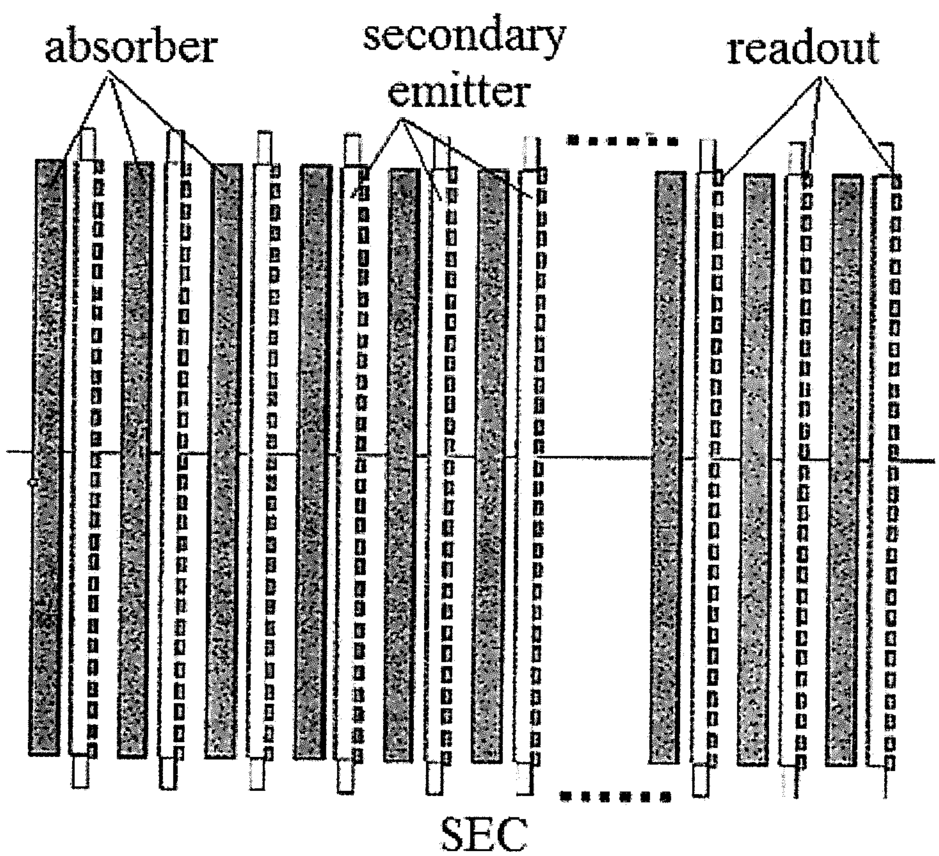

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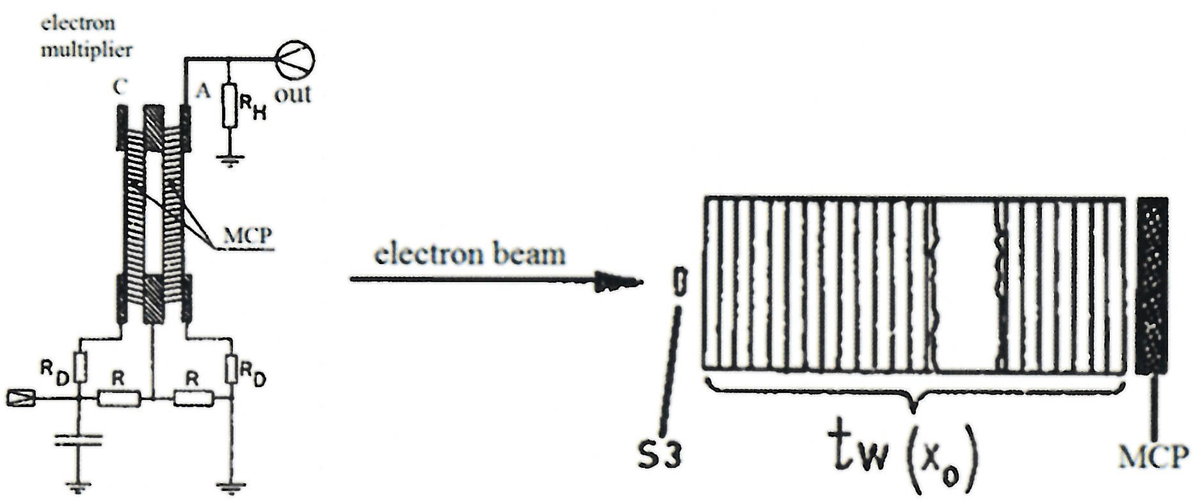

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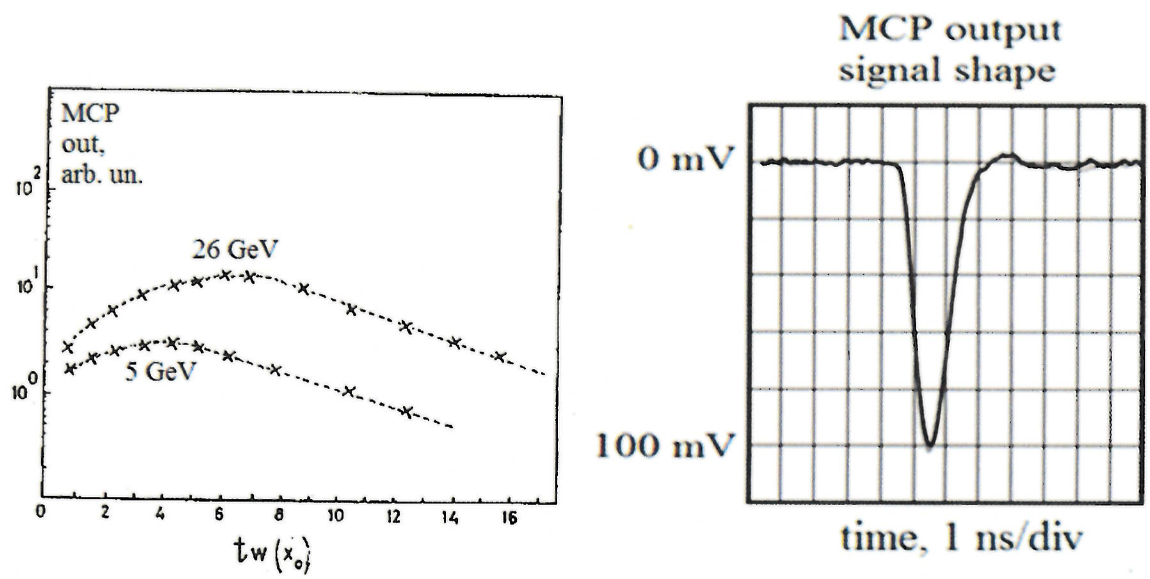

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If the results are promising the experimenters would like to construct and test a full-size electromagnetic calorimeter module large enough to contain high-energy showers, although this will require investment in additional chips, boards, and person-power. (See Figure 4).

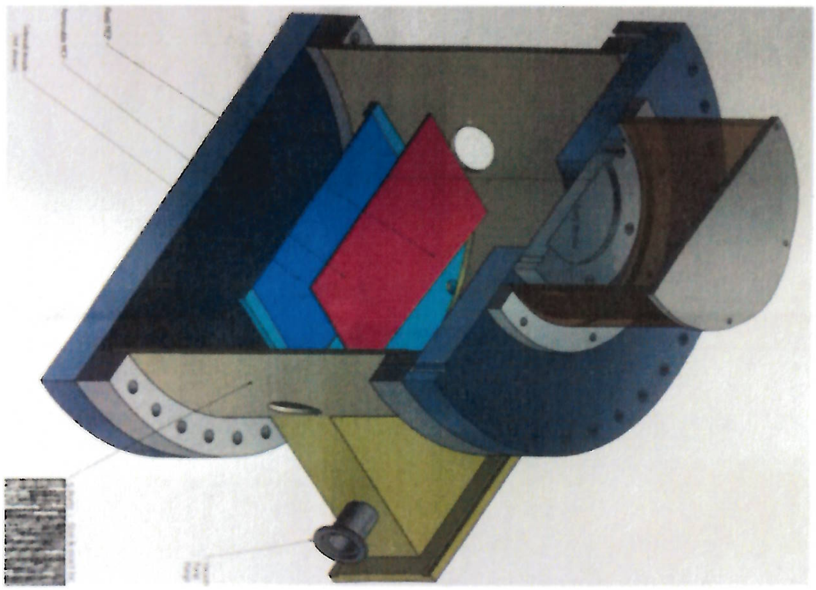


Fig. 3. Proposed SEC for the FTBF. Vacuum vessel with LAPPD MCP (blue) and absorber plate, W or Pb (red). (A single layer is shown in the figure for simplicity, much like for a shower maximum (SM) detector. Six layers will be installed for the initial beam test.

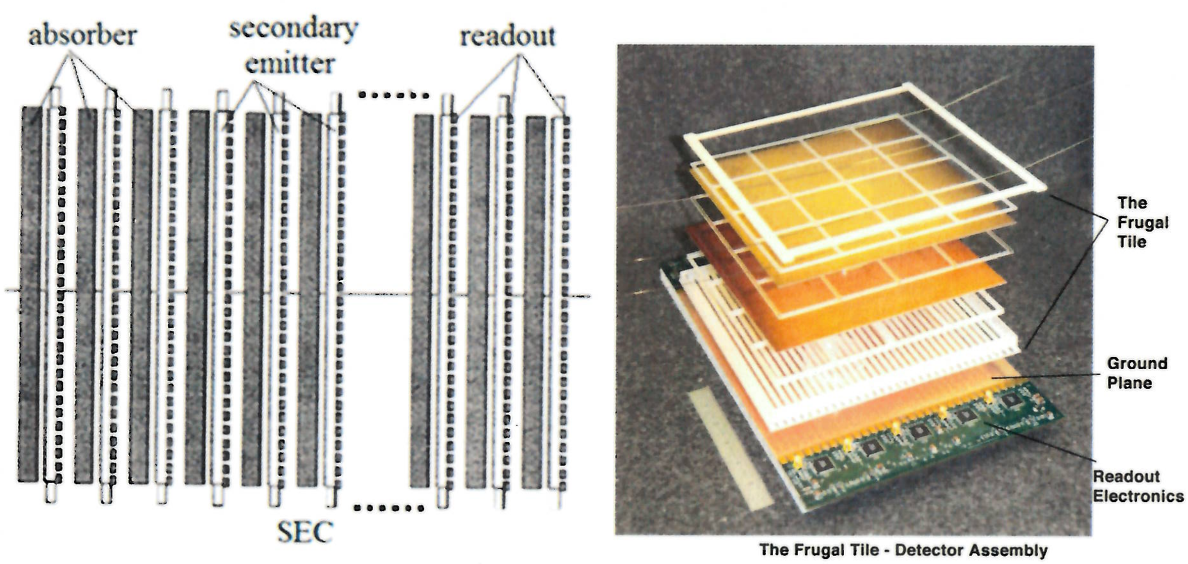


Fig. 4. Final design of the SEC calorimeter (left). Absorption layers are sandwiched by the large area MCP's, such as used in LAPPD (right).

I. I. PERSONNEL AND INSTITUTIONS:

Co-spokespersons and lead experimenters in charge of beam tests: Henry Frisch, UC and Anatoly Ronzhin, Fermilab.

Fermilab Experiment Liaison Officer: Eugene "JJ" Schmidt

The group members at present are:

	Institution	Country	Collaborator	Rank/Position	Other Commitments
1.1	University of Chicago	USA	Richard Northrop Henry Frisch Andrey Elagin Eric Spieglan Eric Oberla	engineer Professor Senior Researcher Student Student	LAPPD LAPPD LAPPD LAPPD LAPPD
1.2	Fermilab	USA	Anatoly Ronzhin Erik Ramberg	Physicist Scientist	CMS CDMS
1.3	Caltech	USA	Maria Spiropulu Artur Apresyan Si Xie	Professor Scientist Fellow	CMS CMS CMS

II. Experimental Area, Beams and Schedule Considerations:

2.1 Location

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

2.1.2 The experiment requests some storage space (cabinet next to MT6).

2.2 Beam

2.2.1 Beam Types and Intensities

Energy of beam in GeV: 120 – protons; 2, 4, 8, 16, 32 – electrons.
Particles: protons, electrons.
Intensity: 10k – 100k particles/ 4 sec spill
Beam spot size: about $10 cm^2$

2.2.2 Beam Sharing

Thin silicon telescope or gas detectors upstream of our detector are acceptable.

The radiation length of all the material intended to be in the beam is 8 radiation lengths maximum.

2.3 Experimental Conditions

2.3.1 Area Infrastructure

The part of the apparatus used for triggering and timing start is located inside of a dark box with the dimension of 38"x22"x11". The weight is about 20-30 lb. The experimenters place only a single MCP phototube in the box for the test, along with triggering counters. A standard rack with electronics will be located next to the box.

Another part of the equipment is a vacuum vessel with 16" diameter.. This vessel is connected with the experimenter's turbo pump. Both of these devices are positioned stationary on some support. The weight of the vessel with this partial SEC inside is 400 lb. maximum.

The experimenters will make use of upstream Cherenkov counters, time of flight system (that the experimenters are responsible for) for particle ID, a set of scintillation counters of different size (sensitive area 1x1mm2, 2x2mm2, 3x3mm2), and proportional chambers for tracking,

The experimenters request use of a moving table with 1 mm of accuracy in X and Y, for the dark box placement. The expected range of motion of the table is about 7" in X and 3" in Y direction.

No gas will be used in the experiment other than nitrogen for cleaning and drying.

2.3.2 Electronics and Computing Needs

The experiment uses commercial digital samplers (DRS4 readout) as well as PSEC4 digital samplers developed by UC.

No PREP electronics are requested.

The experimenters plan to bring a computer which should to be connected to the Fermilab Network.

2.3.3 Description of Tests

The experimenters need to have occasional access to the detector. The experimenters prefer day time shift, but overnight shifts are possible if working in parallel with other experiments. The experimenters need ~1 working day to install the equipment at the beam line before ORC inspection.

2.4 Schedule

The length of each beam test is 1-2 weeks. The experiment expects to have 3 beam tests during 1 year. The total duration of the experiment may be about 3 years. The FTBF management will be informed if more beam time is needed in convenient time scale.

The experiment expects to start data taking in August 2014.

III. Responsibilities by Institution – Non Fermilab

3.1 University of Chicago

- The primary University of Chicago responsibility will be production of the vacuum vessel with absorber layers (lead or tungsten) and secondary emission layers (MCP, 8"x8").
- Giga-sample waveform sampling electronics, PSEC4, for the SEC readout.
- Shifts and data analysis.

3.2 CALTECH

- Develop signals waveform processing algorithms to get best timing.
- Develop simulation programs for electromagnetic showers with special attention to the low energy component (1-10 KeV) of a secondary shower's particles.
- Shifts and data analysis.

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 Assistance in installation of equipment in the FTBF MTest beamline. Description of equipment is given in Section 2.3.1.

4.2.3 Maintenance of installation on motion table for the dark box placement, tracking or trigger systems (see above). The expected range of motion of the table is about 7" in X and 3" in Y direction.

4.2.4 HV power with ~20 channels total.

4.2.5 Conduct a NEPA review of the experiment.

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

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

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

4.2.9 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.

4.3.2 We plan to bring computer which should to be connected to the Fermilab Network.

4.4 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]

V. Summary of Costs

Source of Funds [$K]	**Materials & Services**	**Labor** (person-weeks)
Accelerator Division	0	0.5
Particle Physics Division	0.0	2.2
Scientific Computing Division	0	0
ESH&Q Section	0	0.2
Totals Fermilab	$0.0K	1.7
Totals Non-Fermilab		6

VI. General Considerations

6.1 The responsibilities of the co-spokespersons 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 co-spokespersons agree 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 co-spokespersons 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 co-spokespersons 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 co-spokespersons 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 Spokespersons also undertake 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 co-spokespersons are 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 Spokespersons 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 The experimenters will be available to report on the test beam effort at a Fermilab All Experimenters' Meeting.

VII. BIBLIOGRAPHY

1. A. A. Derevshchikov, V. Yu. Khodyrev, V.I. Kryshkin, V.E. Rakhmatov, A. I. Ronzhin, "On possibility to make a new type of calorimeter: radiation resistant and fast". Preprint IFVE 90-99, Protvino, Russia, 1990.
2. B. Adams, A. Elagin, H. Frisch, R. Obaid, E. Oberla, A. Vostrikov, R. Wagner, M. Wetstein. "Measurements of the gain, time resolution, and special resolution of a 20x20 cm2 MCP based picosecond detector". Nuclear Instruments and Methods. A 732 (2013) 392-396.
3. A. Ronzhin, S. Los, E. Ramberg, M. Spiropulu, A. Apresyan, S. Xie, H. Kim, A. Zatserklyaniy "Development of a new fast shower maximum detector based on micro channel plates photomultipliers (MCP-PMT) as an active element", submitted to NIM, NIMA-D-14-00186, 2014

VIII. SIGNATURES:

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

H Frisch ______________________________ July 22, 2014

Henry Frisch, Experiment co-spokesperson

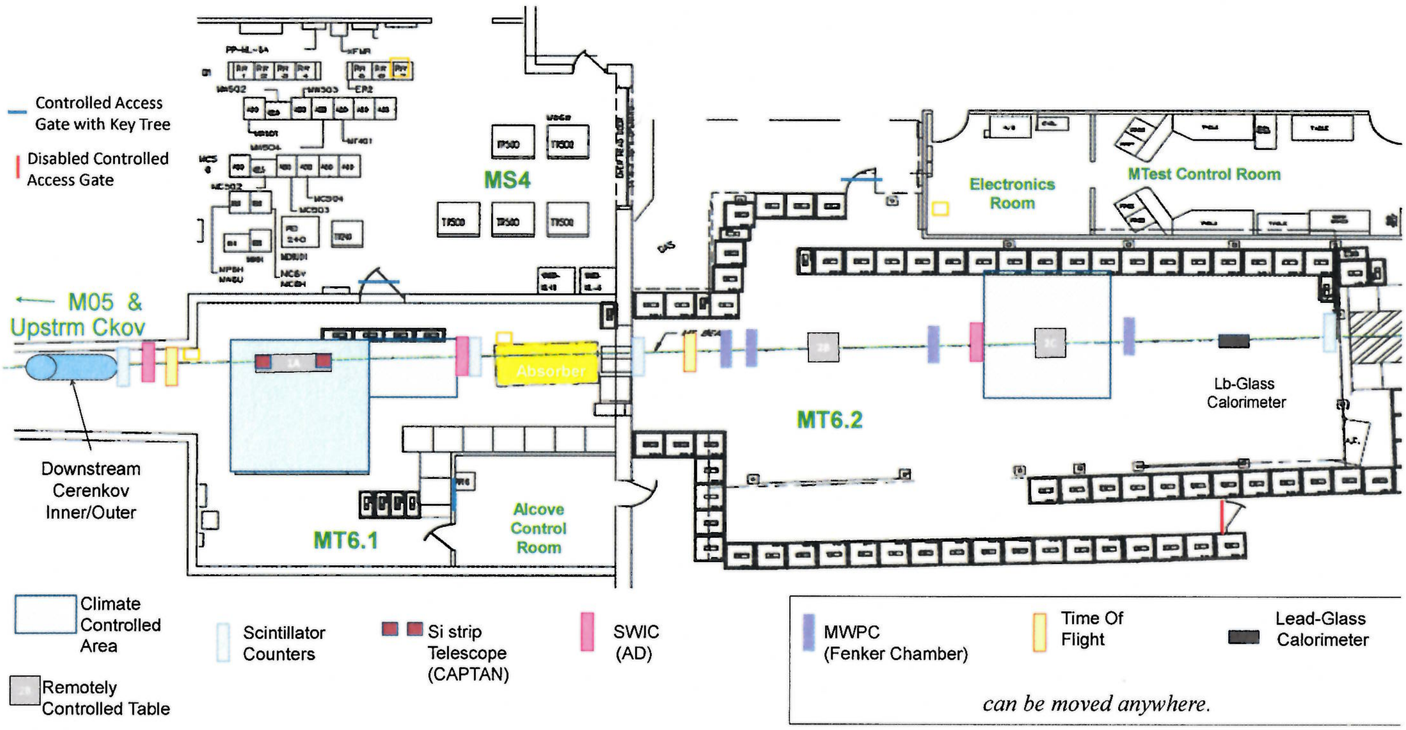
______________________________ / /2014

Anatoly Ronzhin, Experiment co-spokesperson

APPENDIX I: MT6 AREA LAYOUT

The apparatus will be in the MT6.2 area on the moving table with two MWPCs in front.

MTEST AREAS



Appendix II: Equipment Needs

Provided by experimenters:

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

PPD FTBF:

Quantity	Description
2	MWPC Stations
1	Time of Flight System
7	Scintillator counters (not necessary to include MT6SC1)

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)		TMAE	
Lasers		X	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	X	Motion Controllers	
			Non-commercial/Non-PREP		Scaffolding/ Elevated Platforms	
			Modified Commercial/PREP		Other:	
Vacuum Vessels		**Pressure Vessels**		**Cryogenics**		
Inside Diameter:	16”	Inside Diameter:			Beam line magnets	
Operating Pressure:	10^{-6} torr	Operating Pressure:			Analysis magnets	
Window Material:	Fused silica	Window Material:			Target	
Window Thickness:	¼”	Window Thickness:			Bubble chamber	

The Following people have read this TSW:

______________________________ 7 / 29 / 2014
Michael Lindgren, Particle Physics Division, Fermilab

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Sergei Nagaitsev, Accelerator Division, Fermilab

______________________________ 7 / 30 / 2014
Robert Roser, Scientific Computing Division, Fermilab

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Greg Bock, Deputy Chief Research Officer, Fermilab