Plans for the test beam

A collection of thoughts, considerations, pictures, (missing) information and possibilities

G.C.

Fermilab Test Beam Facility

Mario is coordinating the preparation of a memorandum of understanding with the FNAL test beam group

Fermilab   Directorate

MEMORANDUM OF UNDERSTANDING

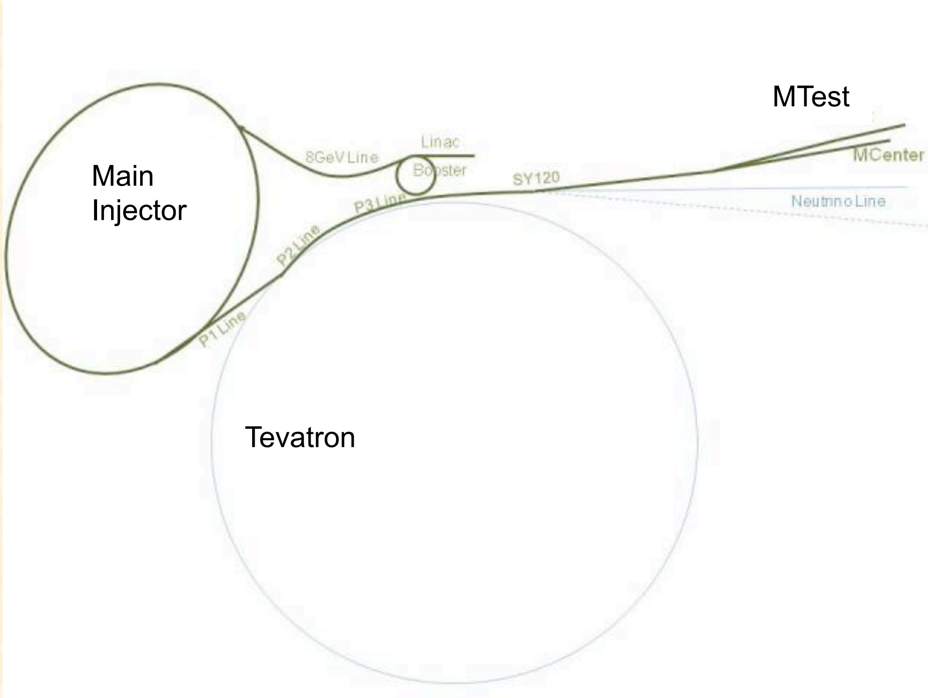
FOR THE 2010 FERMILAB TEST BEAM FACILITY PROGRAM

T-XXXX

SuperB Muon Detector Prototype

May 3, 2010

The beam



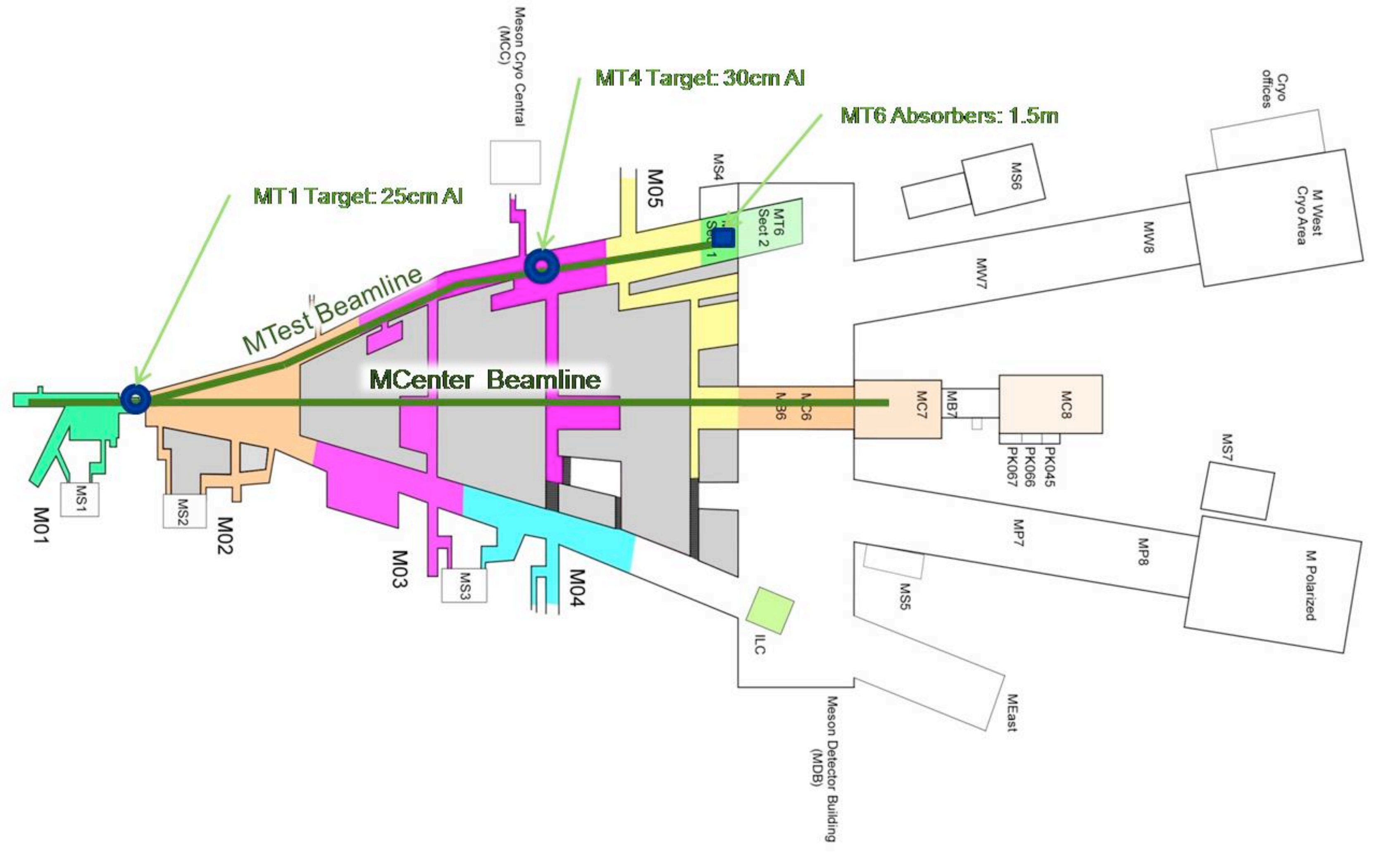
Extraction of beam from Main Injector:

• From 1 to 6 batches in the Main Injector
• Each batch from 0.2 to 1.6 μsec in length – Full batch equals 2E11 protons.
• A fraction of the beam is resonantly extracted in a slow spill for each Main Injector rotation

Three spill options exist:

* Single 4 sec spill/minute
* Two 1 sec spills/minute
* Several millisecond level bursts per minute

The MTest Beamline



The MTest Beamline

There are 2 movable targets in the MTest beamline:

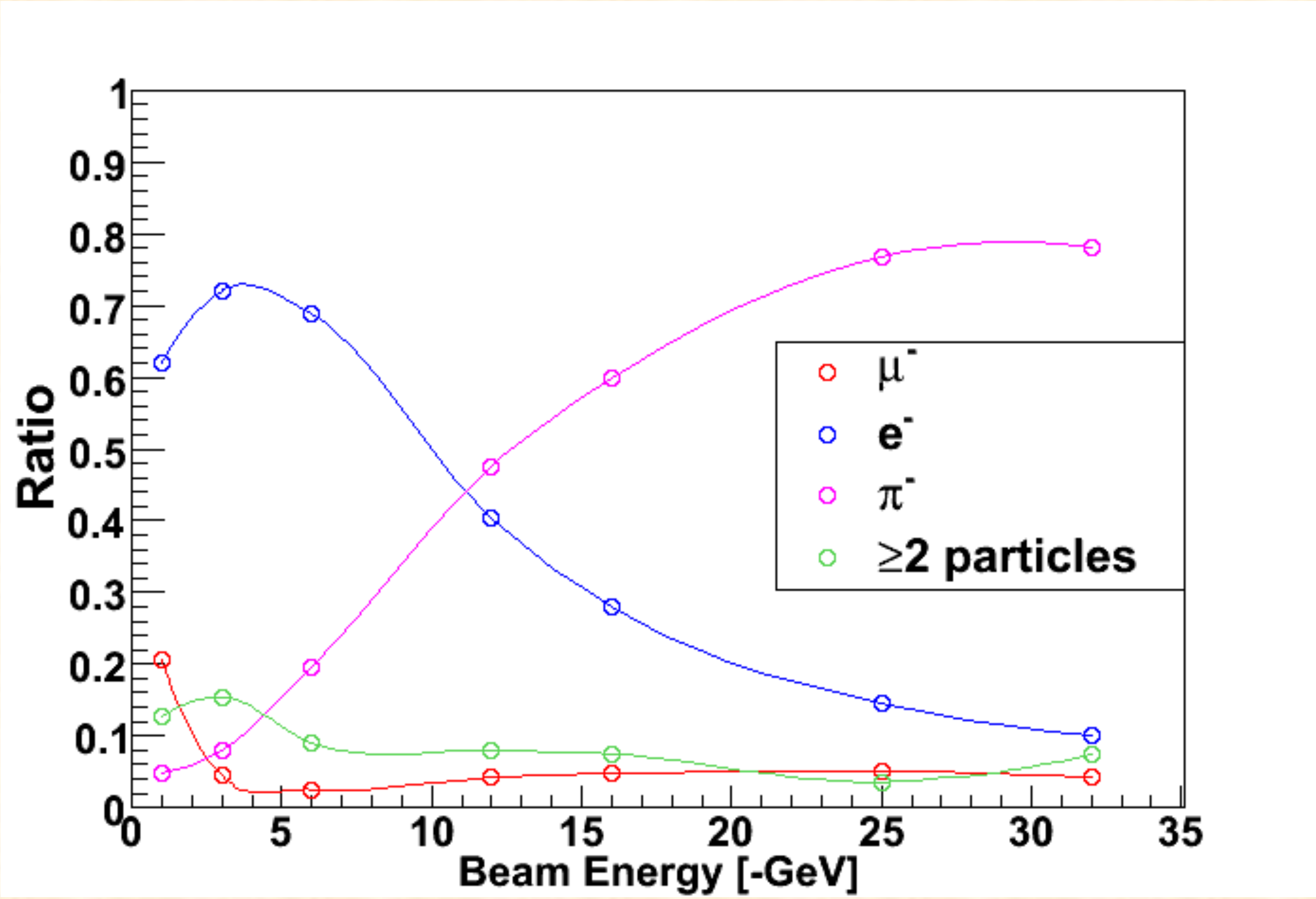
MT1 Target: 435 meters upstream of MT6; 25cm Aluminum
MT4 Target: 145 meters upstream or MT6; 30cm Aluminum

There is also a pinhole collimator (MT3CH) in MT3; two absorbers each 1.5 m long at the end of the MT6.2 enclosure (F:MT6AB1,2); and a Copper/Steel-Target/Collimator at the entrance to the MT6.2 enclosure.

These objects can be moved in various configurations to create the following beam modes:

* Primary Beam
  - o Proton Mode: 120 GeV protons - MT1 target plus MT3 pinhole collimator
* Secondary Beam
  - o Pion Mode: 8 - 66 GeV beam - MT1 target moved in, tuned for secondaries
  - o Low Energy Pion Mode: 1 - 32 GeV beam - MT4 target moved in, tuned for secondaries
  - o Muon mode: Any of above modes with MT6 beam absorbers closed.
* Tertiary Beam
  - o 200 MeV - Low E pion mode with MT4 target and the MT6.2 Target & Collimator moved into the beam

Beam composition from CALICE experiment



Rates from CALICE experiment

Measured rates* without lead scatterer

Beam Energy (GeV)	Rate at Entrance to Facility (per spill)	Rate at Exit of Facility (per spill)	%Pions, Muons**	% Electrons**
16	132,000	95,000	87%	13%
8	89,000	65,000	55%	45%
4	56,000	31,000	31%	67%
2	68,000	28,000	<30%	>70%
1	69,000	21,000	<30%	>70%

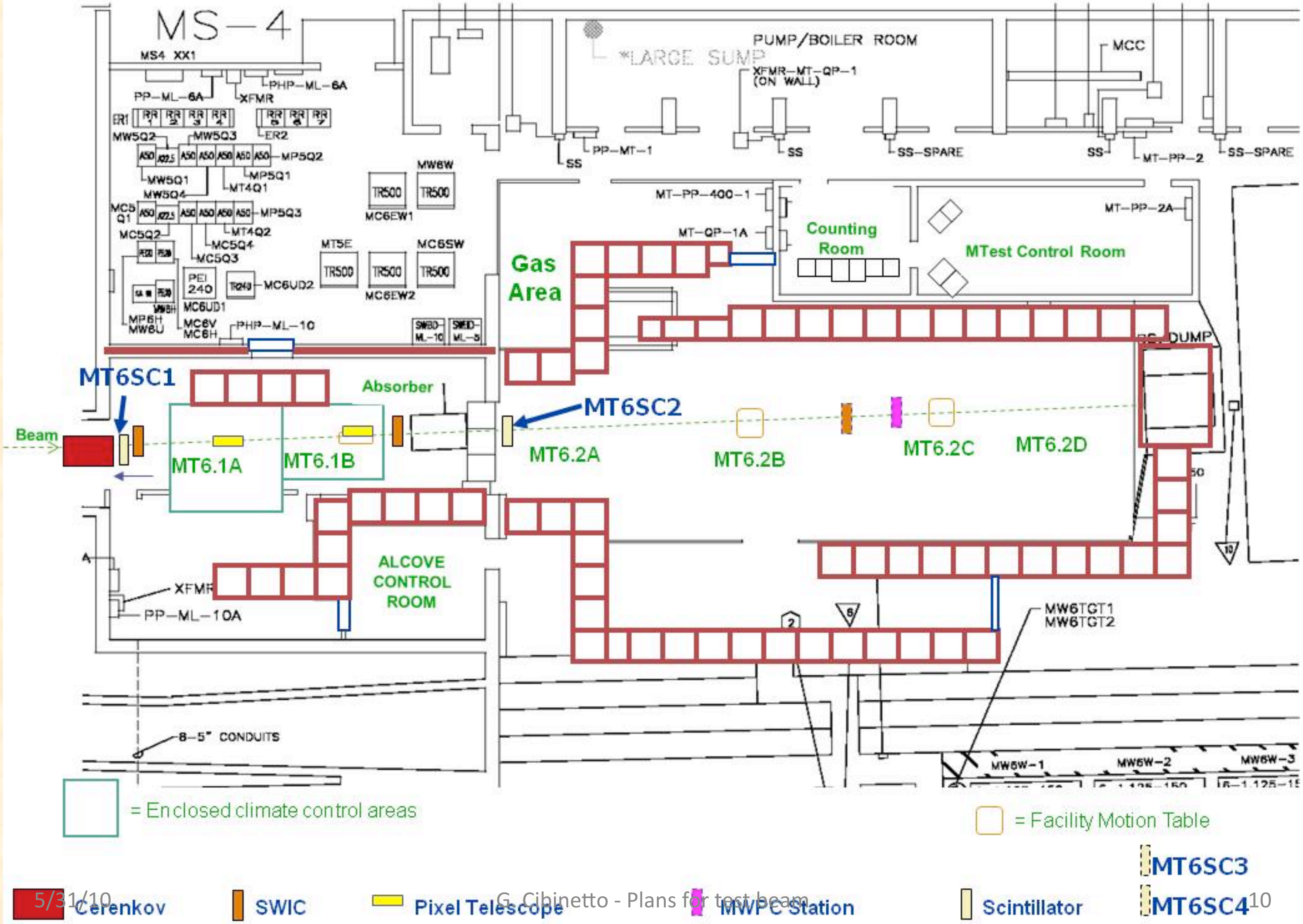
Measured rates* with 1/4” lead scatterer

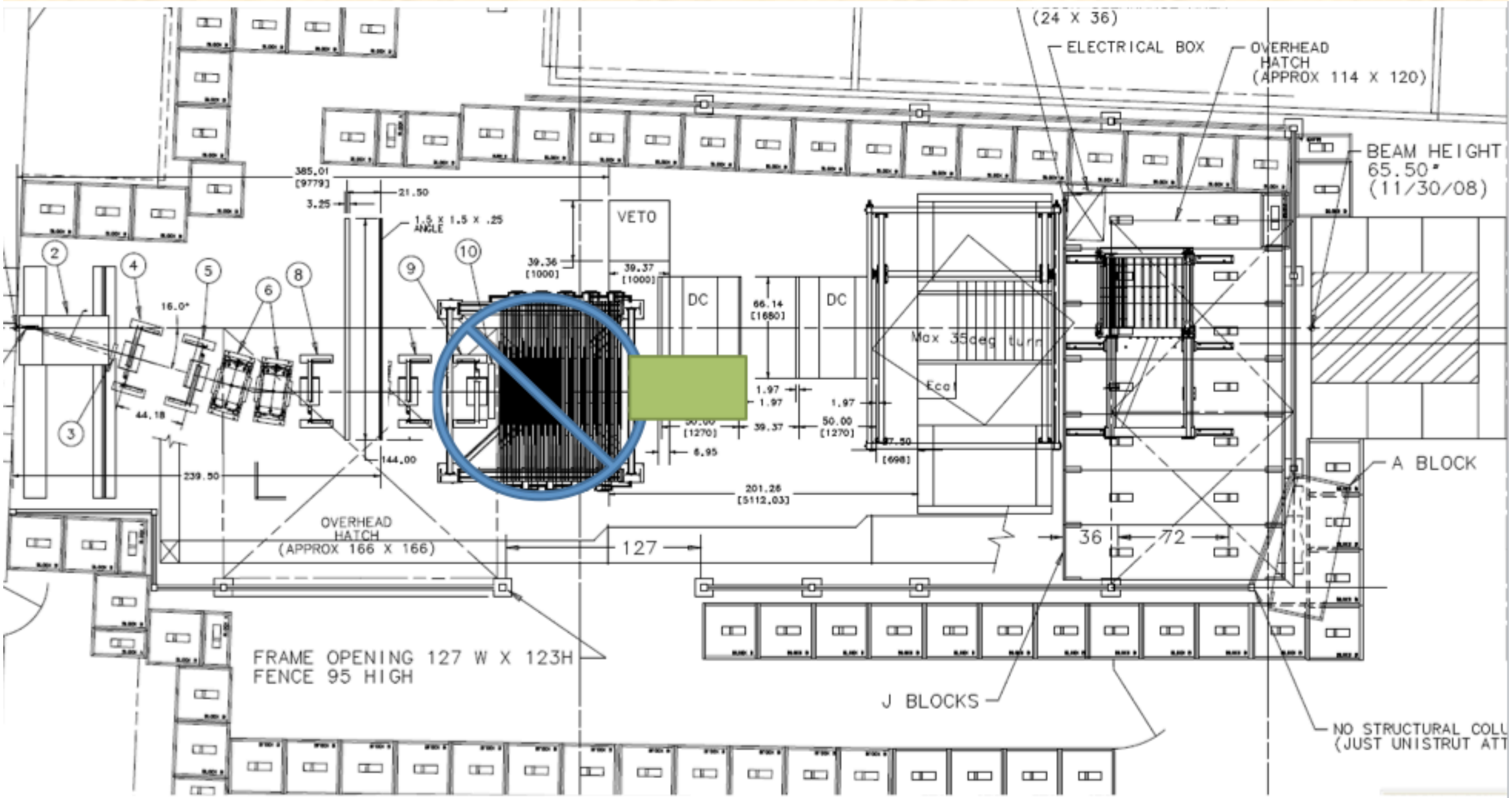
Beam Energy (GeV)	Rate at Entrance to Facility (per spill)	Rate at Exit of Facility (per spill)	%Pions, Muons**	% Electrons**
16	86,000	59,000	100%	0%
8	31,000	18,000	98%	2%
4	5,400	1,300	74%	15%
2	4,100	250	<30%	>70%
1	4,900	120	<30%	>70%

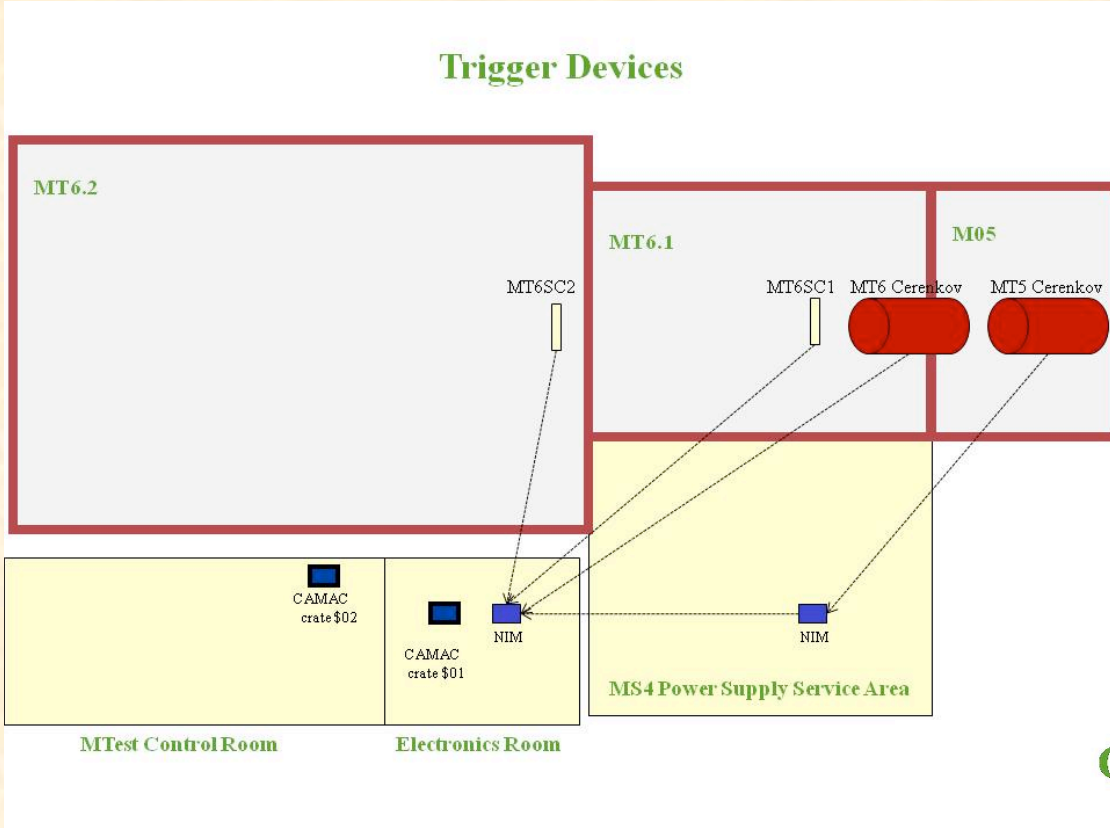
*Rates here are normalized to 1E11 at MW1SEM

The experimental setup

MTest Beamline Instrumentation



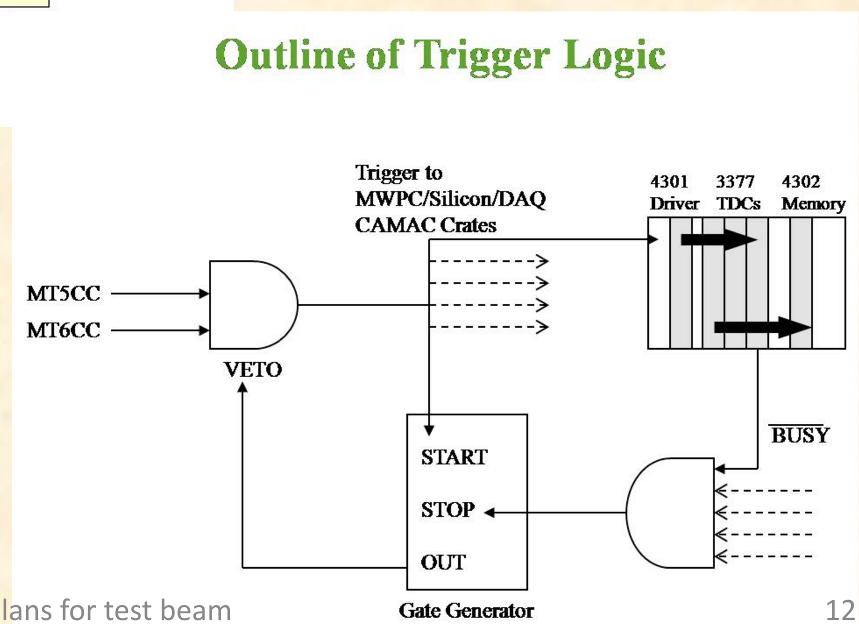

(24 X 36)
ELECTRICAL BOX
OVERHEAD HATCH (APPROX 114 X 120)
BEAM HEIGHT 65.50" (11/30/08)
VETO
DC
DC
Max 35deg turn
Ecal
A BLOCK
OVERHEAD HATCH (APPROX 166 X 166)
127
36
72
FRAME OPENING 127 W X 123H
FENCE 95 HIGH
J BLOCKS
NO STRUCTURAL COLU
(JUST UNISTRUT ATT
1.5 X 1.5 X .25 ANGLE
385.01 [9779]
239.50
201.28 [5112.03]
144.00
44.18
16.0°
66.14 [1680]
39.36 [1000]
39.37 [1000]

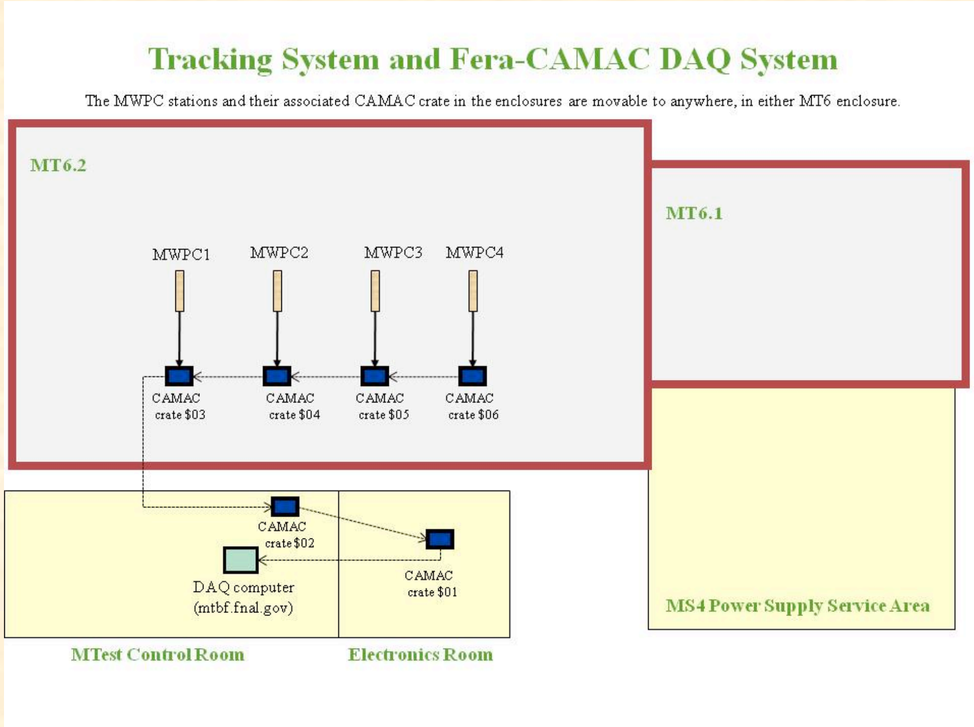


A trigger system is already present.
It combines signals from the two Cherenkov counters and a veto coming from the busy of each detector.

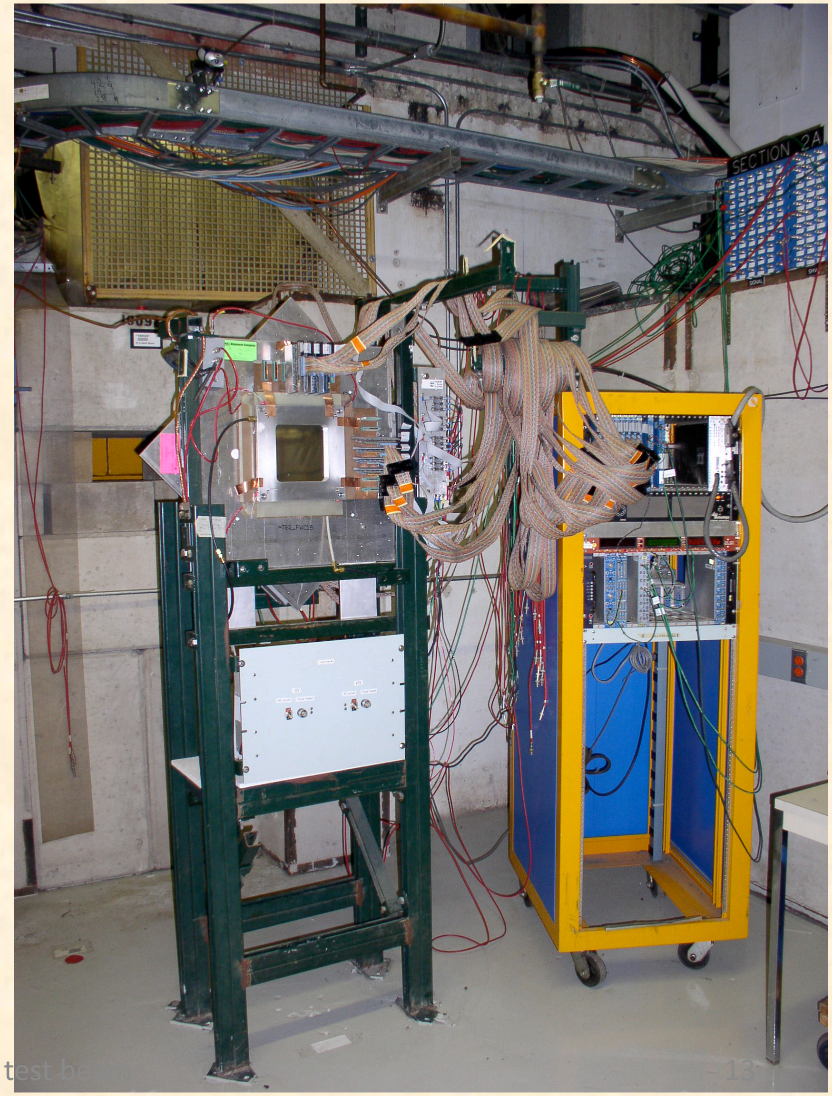
It should be easy to replace the Cherenkov signals with the ones from a couple of trigger scintillators placed in front of the prototype.

Is this the best choice for trigger?
Think about a "muon" trigger for efficiency measurement.





The MWPC Tracking System is made up of 4 stations, and an associated DAQ system. Each Station consists of 2 wire modules, set at a 45° angle from each other, and the necessary CAMAC hardware to support them.



How it works:

* Trigger system turns on a gate/latch
* controller gets gate
* The front end readout goes to a memory module
* The memory module gives a finish to the next TDC through a tolken readout
* The last tolken goes to the control room and clears the veto (The veto is a ECL to NIM converter.)
* When the memory is full it triggers off, which triggers the veto
* The computer reads out the memory, clears it, and resets the veto

Open questions about the experimental setup

How many MWPC do we need?

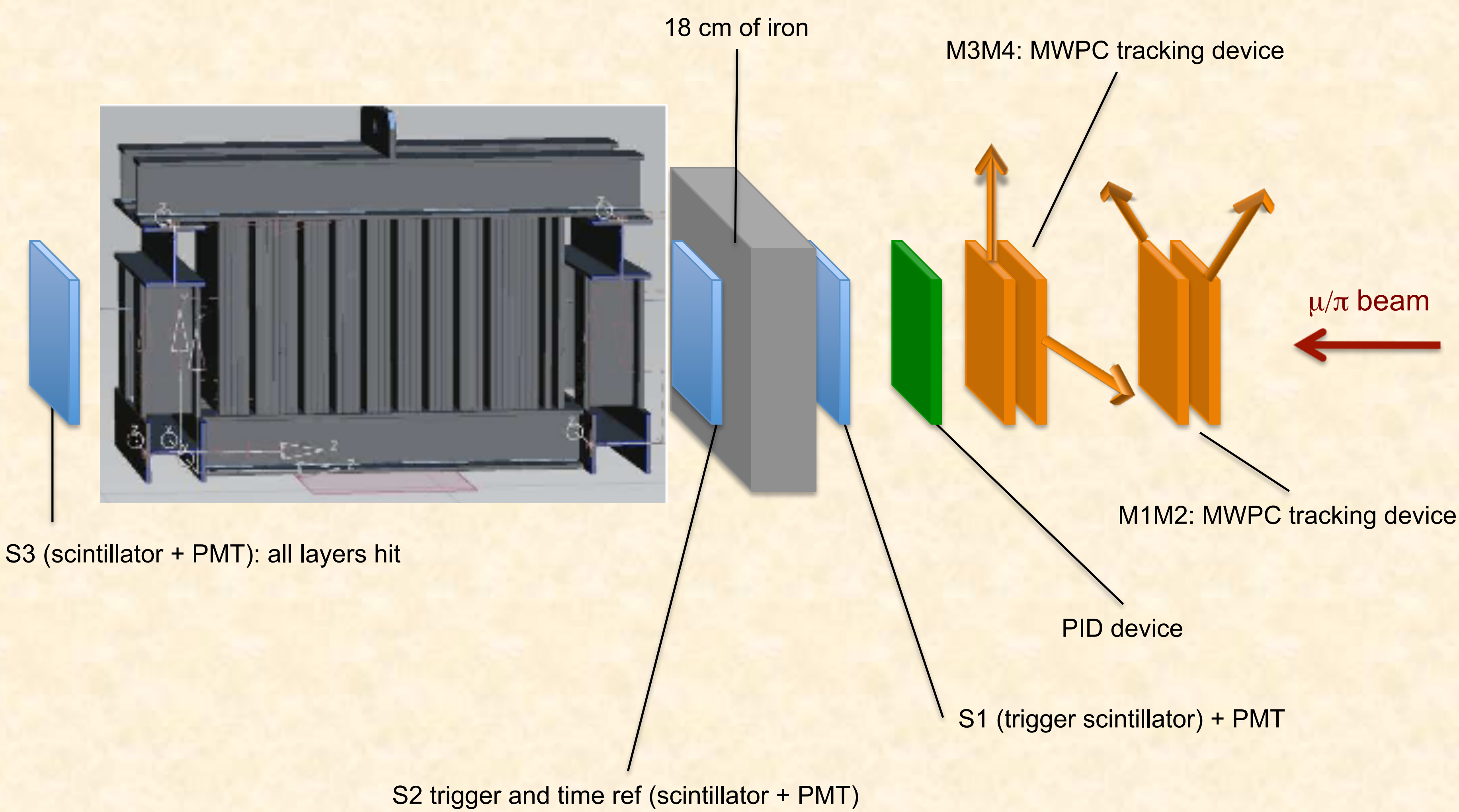
What will be the best choice for the trigger?

Do we have a PID device?

How do we handle the synchronization among all the detectors?

How do we handle data from all the detectors? Do we need all of them online or can we use them just for offline analysis?

The detectors



The test

Purpose of the prototype

- confirm R&D results on large
- validate/tune the optimization/simulation
- spot any problem/issue with this technology

Quantities to look at

efficiency
time resolution
noise rate and occupancy
track reconstruction
muon ID, pion rejection

Parameters to change

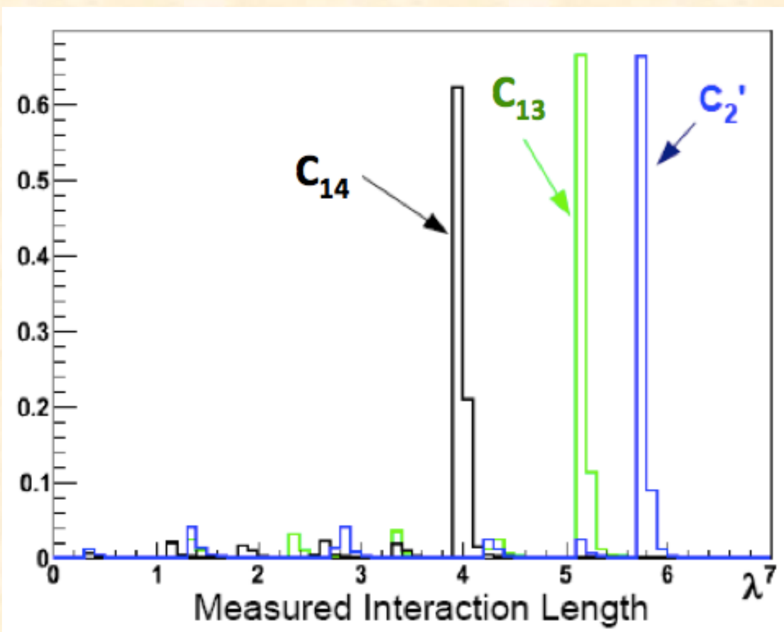
absorber configurations
(Different amount of material
8 or 9 active layers)
readout (special modules with
different SiPM or different fiber
size)
beam energy
SiPM gain (?)
SiPM threshold (?)

What configurations

```
|=|=|========|============|============|=======|=====|   C2' Fe 920mm
|2|2|   16   |     24     |     24     |  14   | 10  |

|=|=|========|========|========|========|=======|       C13 Fe 820mm
|2|2|   16   |   16   |   16   |   16   |  14   |

|=|=|======|======|======|======|=====|                 C14 Fe 620mm
|2|2|  12  |  12  |  12  |  12  | 10  |
```



Up to now in the simulation we tested 4 different configurations:

8 layers
- 920 cm iron
- 820 cm iron
- 620 cm iron

9layers
- 920 cm iron

It's impossible to test all the combinations of different parameters, perhaps is not needed, for instance:

We don't need to extract muon ID from special modules, we are interested only in efficiency/timing performances for them.

We don't need to change thresholds and to do the gain scan for all the configurations, maybe just one is enough and maybe not for all the momentum bins.

Do we need to test the configuration with 620 cm of iron? Maybe not.

How many momentum bins? 1, 2, 3, 4, 5 GeV? How long does it take to change among them? (probably not as much). How precise is the momentum selection?

How easy is to stop the beam and access the experimental area to change the setup?

Doing a schedule for the test, at this time, is not very meaningful: still too many things to know.

But assuming a (low) rate about 100Hz we can have enough data for muon ID measurements in about one or (better) two hours.

Day	Morning	Afternoon
1st	Beam and DAQ tuning	C2’
2nd	C2’	C2’
3rd	C2’	C2’ -> change conf
4th	9layers	9layers
5th	820cm	820cm
6th	special modules	special modules
7th	time for additional tests	dismount

Test Beam Schedule

Jul 19 - Aug 16	No Beam: SHUTDOWN				
Sep 15 - Sep 29	T992	SLHC sensor tests	Yun	1-B	Primary
Sep 30 - Oct 6	Facility Development				
Oct 7 - Nov 2	T978	CALICE	Repond	2-D	Primary
Nov 3 - Nov 9	T1004	Dual Readout Calorimetry	Para	2-B	Primary
Nov 10 - Nov 23	T992	SLHC sensor tests	Yun	1-B	Primary
Nov 10 - Nov 16	T979	Fast Timing Counters for PSEC	Albrow	2-B	Secondary
Dec 1 - Dec 7		SuperB prototype	Posocco	?	Primary
Dec 8 - Dec 23	T994	JASMIN	Nakashima	2	Primary
2011					
Jan 5 - Feb 1	T978	CALICE	Repond	2-D	Primary