Preparation for the CDC+TOP run

Alessandro Gaz,
University of Padova & INFN

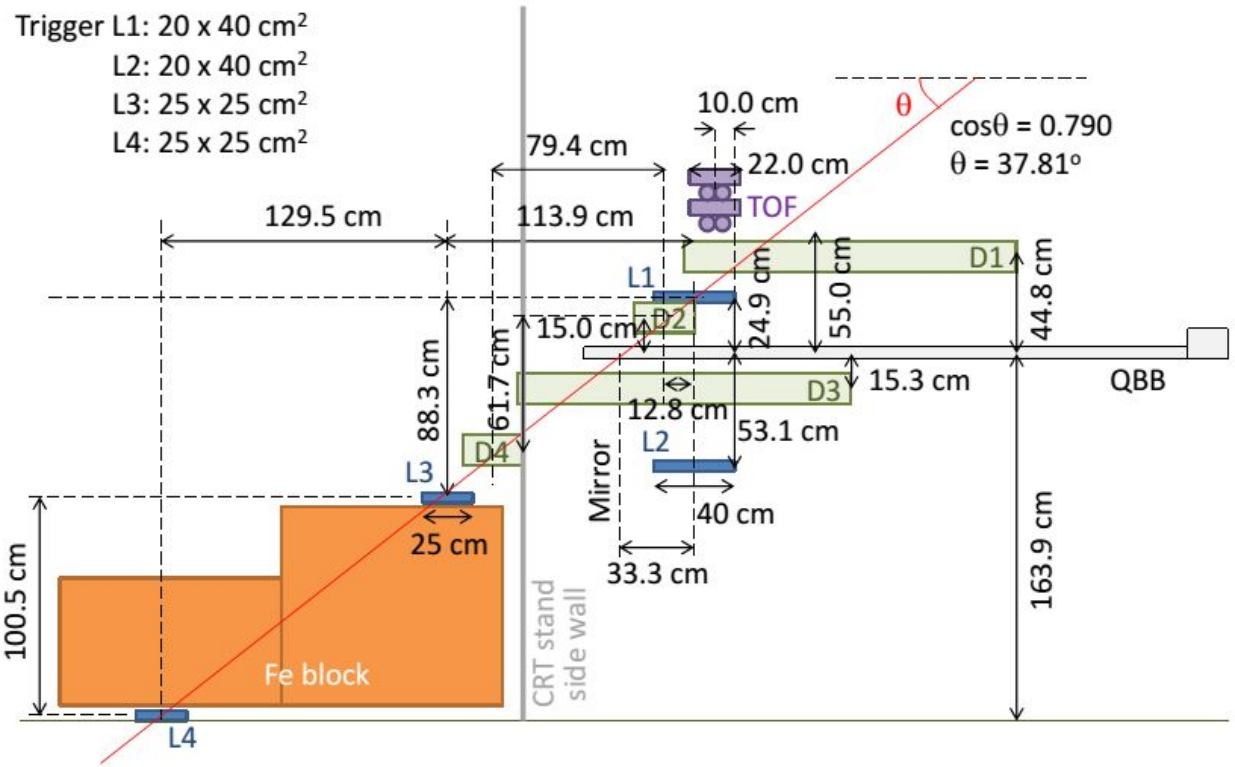
Belle II Italia PID meeting
Torino, October 1st 2015

Introduction

- After several months of struggle we are finally able to take laser and cosmic data with Module 1 in the CRT setup;
- We want to test the PID performance of a TOP module in a more realistic scenario than the CRT stand or the test beam;
- A combined run including (part of) the CDC and a TOP module has been proposed, also as a pilot run for the integration of all subdetectors in the BelleII DAQ;
- The combined CDC+TOP run was foreseen for October, but due to various delays (mostly on the TOP side) it has been postponed. As the priority is given to the CRT tests and installation exercises, we don't have a clear schedule yet;
- So what I'm presenting today is still very preliminary and subject to more discussion/changes.

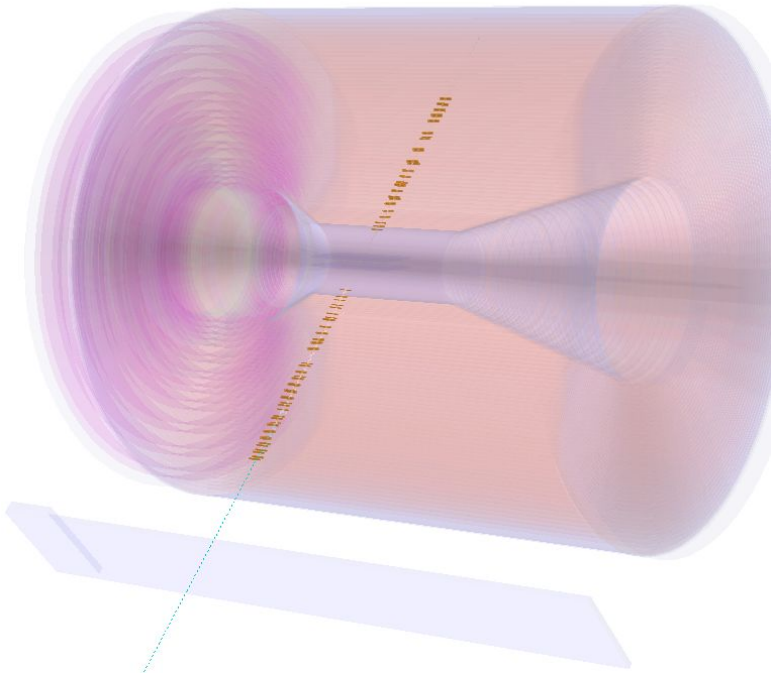
The CRT stand

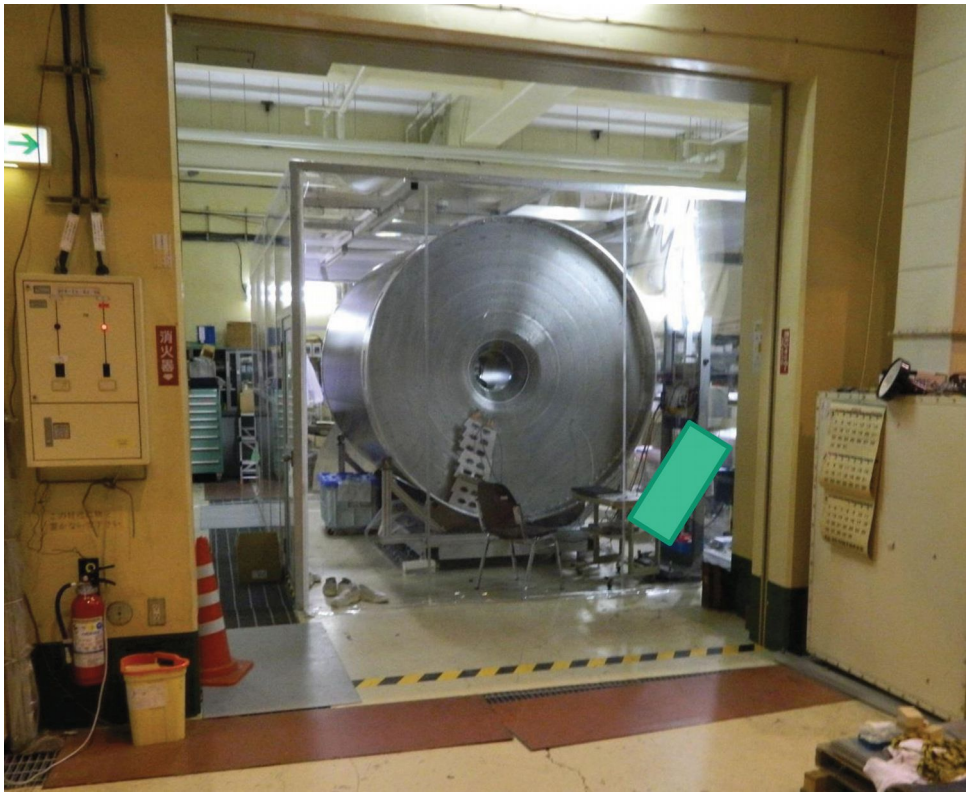
- The CRT stand has been used so far to test/debug the TOP prototypes and the TOP Module 1;
- The trigger setup and a ~1 m thick iron absorber allow to select high momentum muons;
- Sets of drift tubes provide some basic tracking;



- This setup is not adequate to test the PID capabilities of the detector mostly due to:
  - ➔ Limited acceptance (due to size of trigger pads);
  - ➔ Low tracking performance (angular resolution 5-10 mrads).

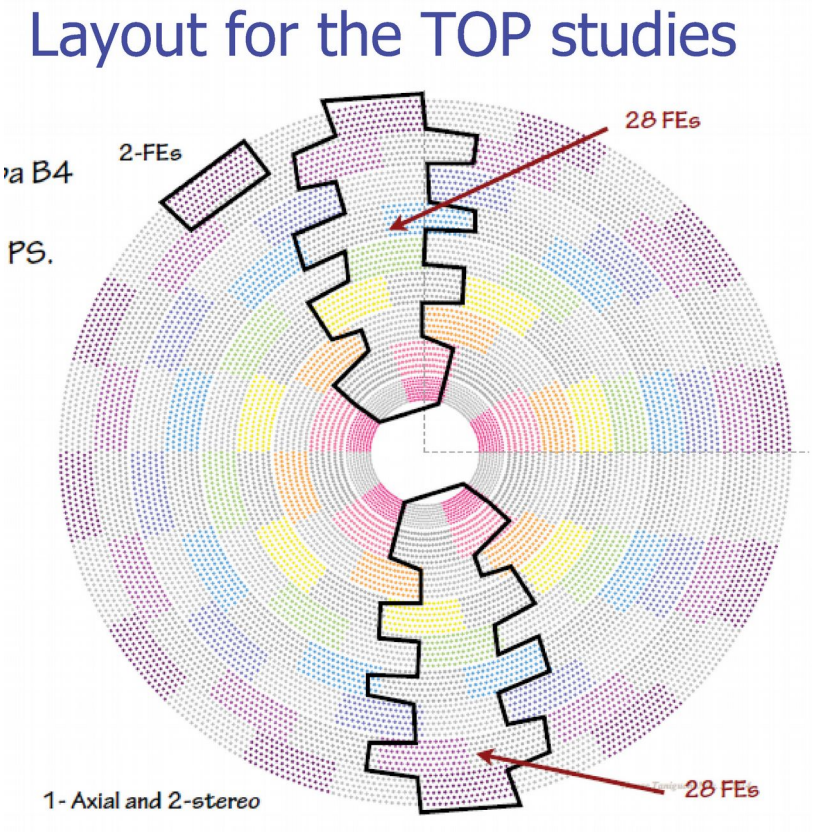
The CDC+TOP setup

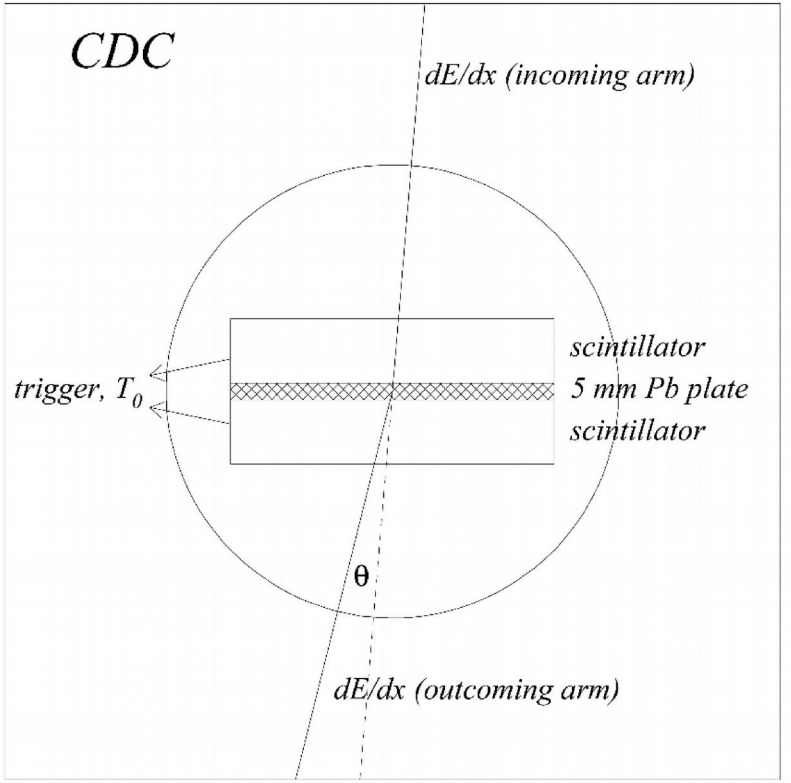




- Proposed setup: place a TOP module on the side of the CDC, so to exploit its tracking capabilities (angular resolution of 1-2 mrad seems to be achievable even in a provisional setup);
- No magnetic field (if you neglect that of the Earth).

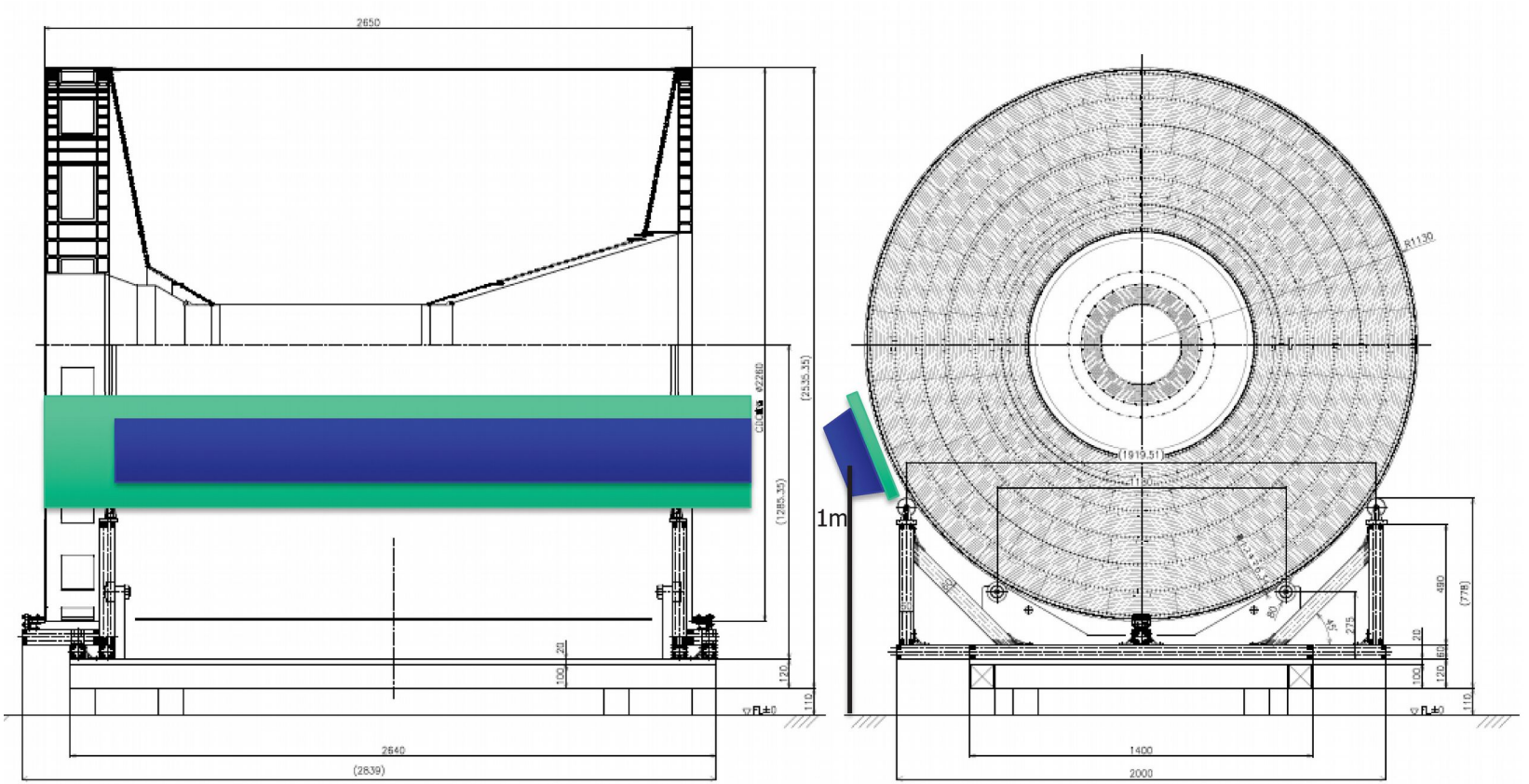
The CDC+TOP setup





- Just a narrow slice of the CDC is instrumented for this test;
- The trigger is provided by scintillator slabs in the empty area that would be occupied by the silicon detectors;
- A 5mm thick layer of lead provides a kink to the low momentum muons (that we want to veto).

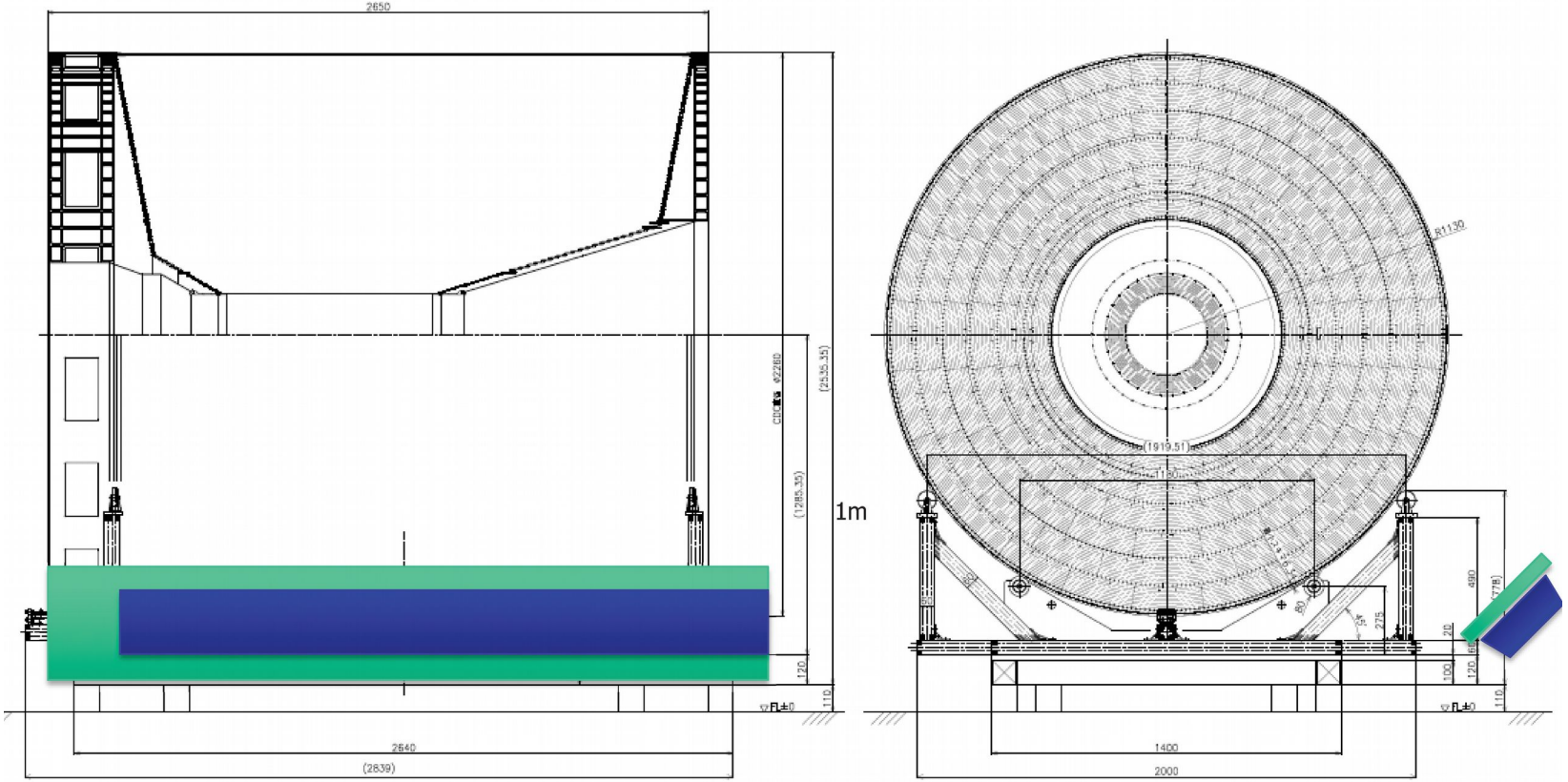
Position “1”



TOP box to the side, on the ground, at roughly 22 degrees

- ✔ The TOP module can be placed next to the CDC, so good impact point resolution;
- ✗ Muon rate in this position is relatively low, though.

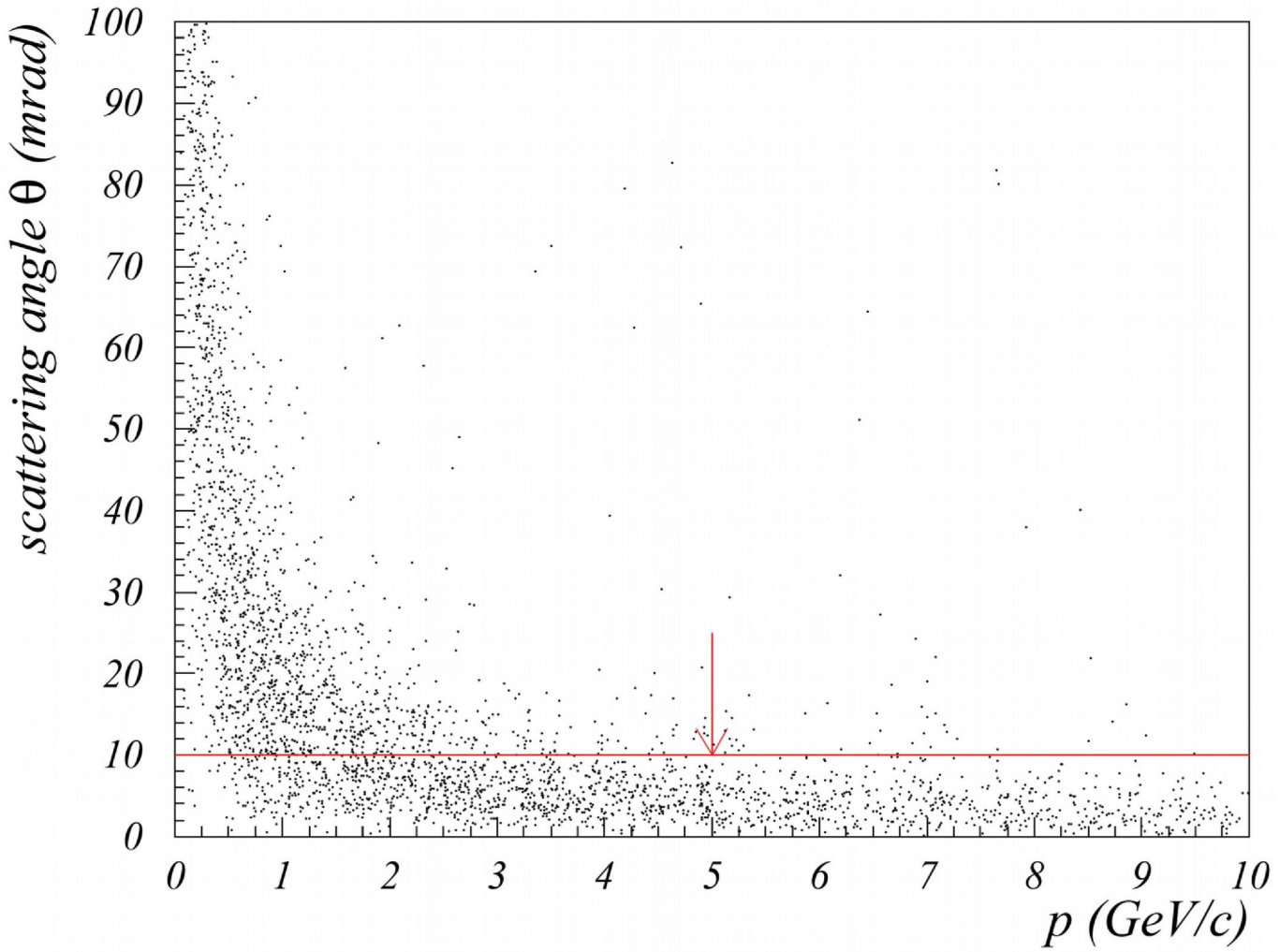
Position “2”



TOP box to the side, on the ground, at roughly 45 degrees

- ✔ Higher muon rate;
- ✗ Worst impact point resolution.

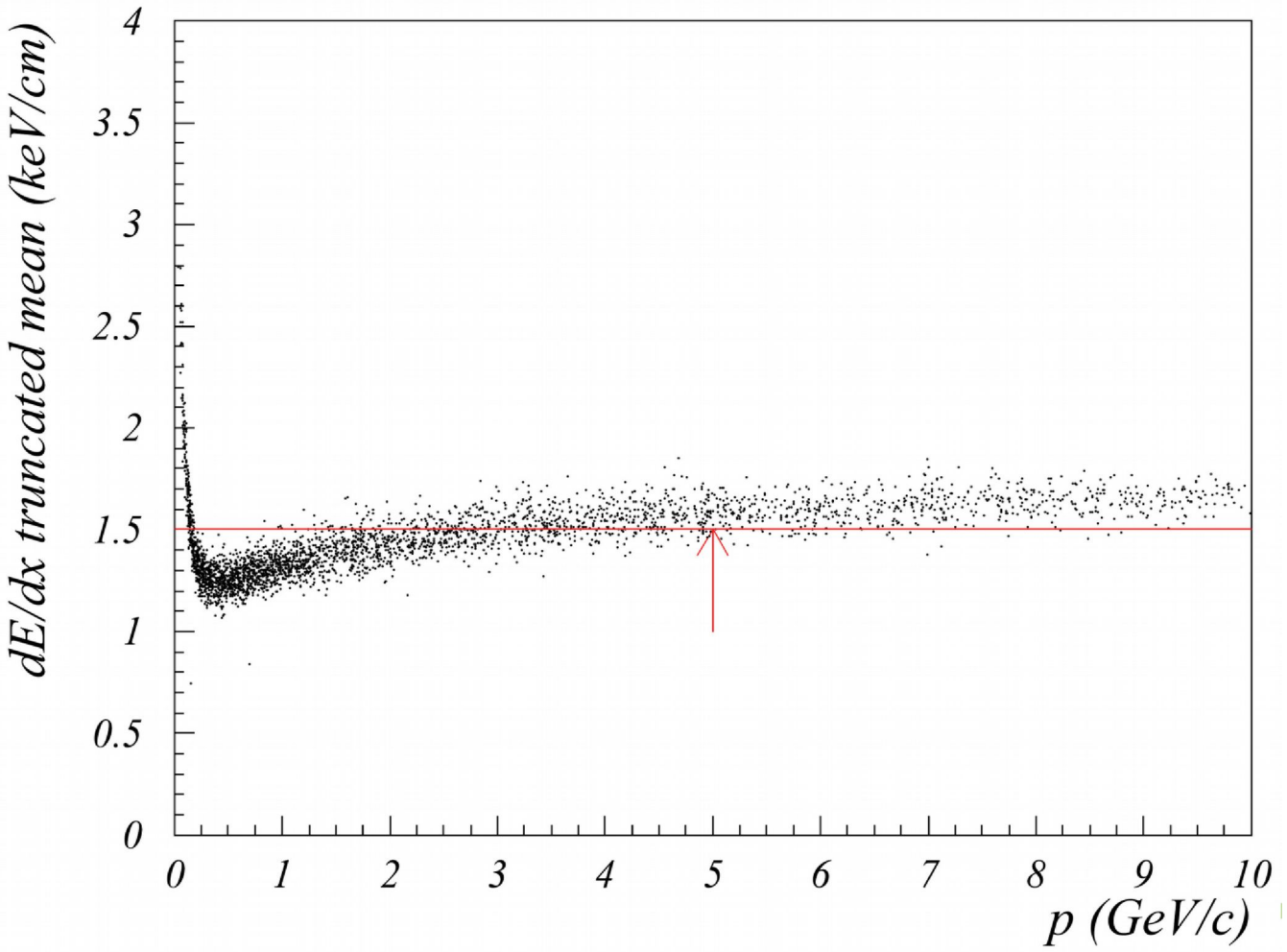
Muon selection



We plan to discard tracks with a scattering angle (between the two segments) > 10 mrads

This assumes a realistic hit resolution of 200 μm (nominal is 130 μm)

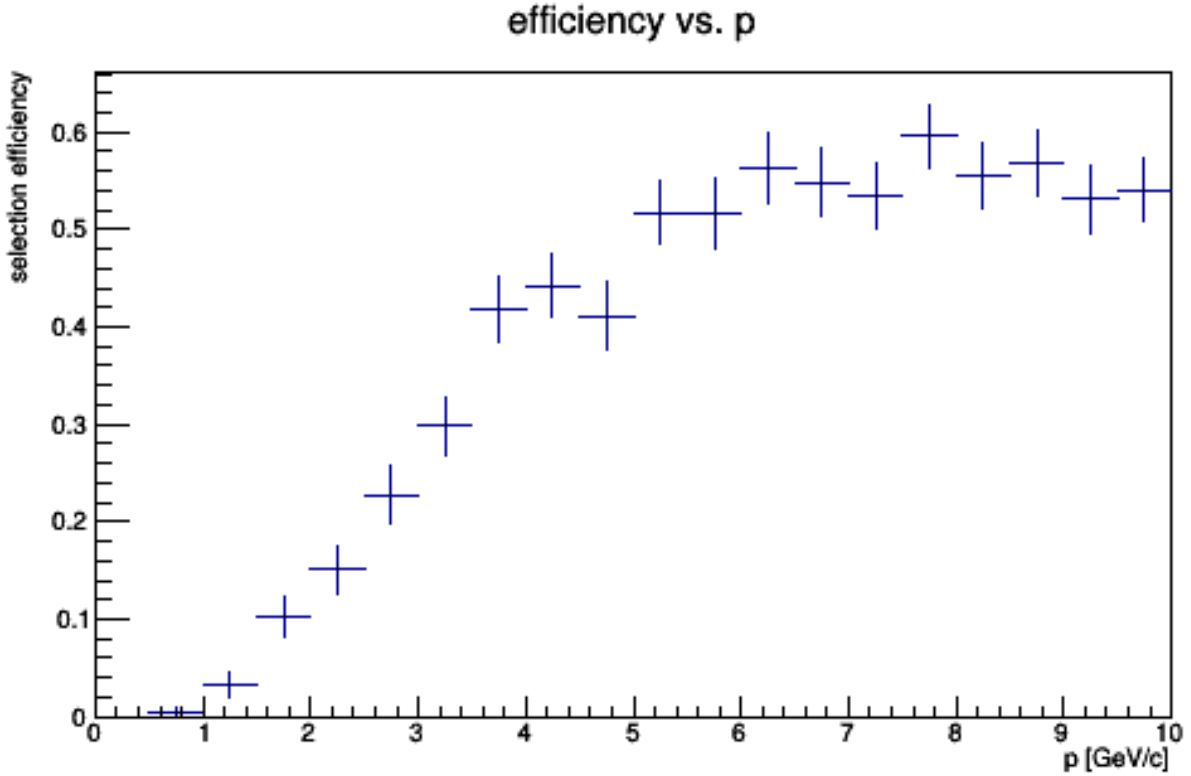
Muon selection



We plan to discard tracks with dE/dx < 1.5 keV/cm to suppress low momentum muons

This assumes a realistic dE/dx resolution of 7% (nominal is 6%)

Resulting muon spectrum



- Muon selection efficiency ~flat above 5 GeV;
- The expected event rate at position 2 (1) is ~0.7 (0.2) Hz;
- With a 30% data-taking efficiency, we plan to collect ~500k (150k) good tracks in a month.

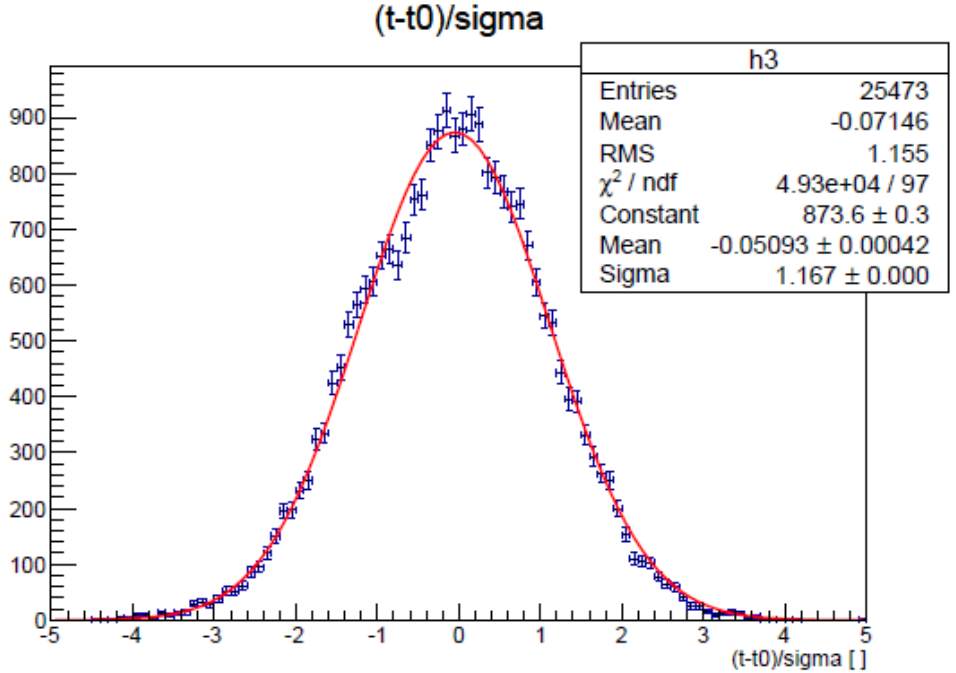
Analyzing the data

- Once we have collected the data, the goal of the test is to check that the distribution of the detected photons matches the expected pdf;
- Very different situation from a test beam scenario, where a monochromatic beam interacts at a fixed angle and position;
- In the CDC+TOP test, the photon distribution depends on the entry point of the track (two coordinates) and its direction (two angles);
- Each event would have its own pdf;
- A simplified approach is being considered: separately consider each photon for each event and assign it to the most likely peak;
- Each peak is characterized by a mean t_k and a width σ_k:

  compute the pull $(t - t_k)/\sigma_k$.

Analyzing the data

- Check the pull distributions in bins of impact point, angle, and separating direct and reflected photons;
- Preliminary studies on the MC show no systematic dependence on the geometry;
- Small correction to the width needs to be applied;
- This technique will be used also as a diagnostic tool for collision data.



Conclusions

- The combined CDC+TOP run is a necessary step to characterize the TOP performance in semi-realistic data taking conditions;
- It is also a good exercise to integrate the DAQ of the different subdetectors into a single working experiment;
- Right now the project is on hold as the TOP group deals with more urgent priorities;
- The final details on the test still need to be sorted out, but the path forward is reasonably settled.