SCREAM* at PS

6.12.2018

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on behalf of the SCREAM Common Project consortium**

RD51 mini-week, CERN, Dec. 6th 2018

(**)
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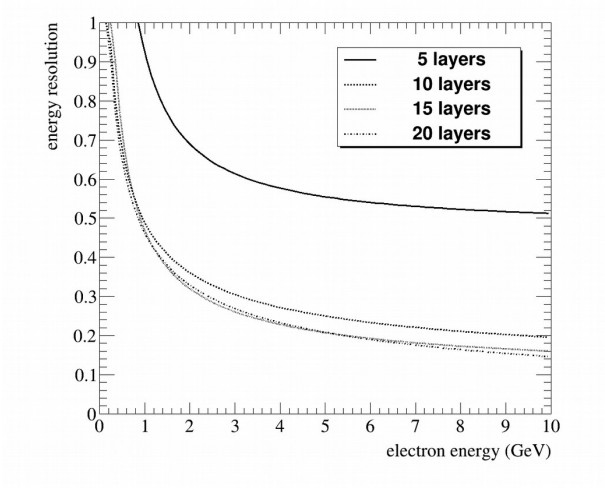
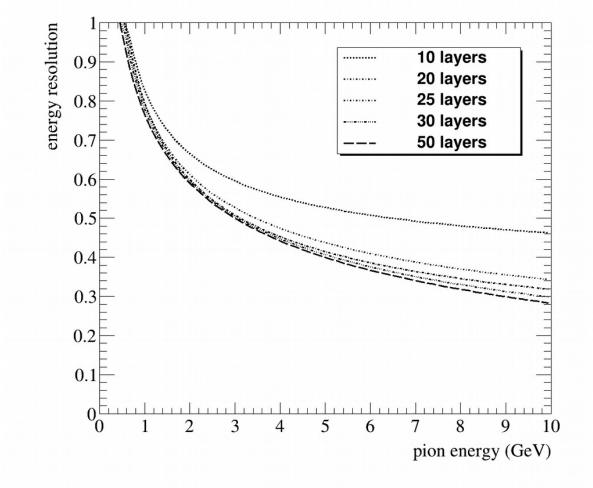
4. NCSR Demokritos/INP, T. Geralis
5. CEA/IRFU, M. Titov
6. University of Aveiro, J. Veloso
7. University of Coimbra, F. Amaro

* Sampling Calorimetry with Resistive Anode MPGDs

Introduction

- Goal: Test of an MPGD-based calorimeter prototype
  - Good containment of showers up to 10 GeV with ~10 layers
- Test beam 1-12.11.2018 at PS/T10.
  - Parasitically
    - 4 groups in total.
  - Low energy (E <7 GeV; p 1-6GeV/c) electrons and pions
    - Electron beam was not possible due to large material budget upstream and pressure from other users in T9 and T10.





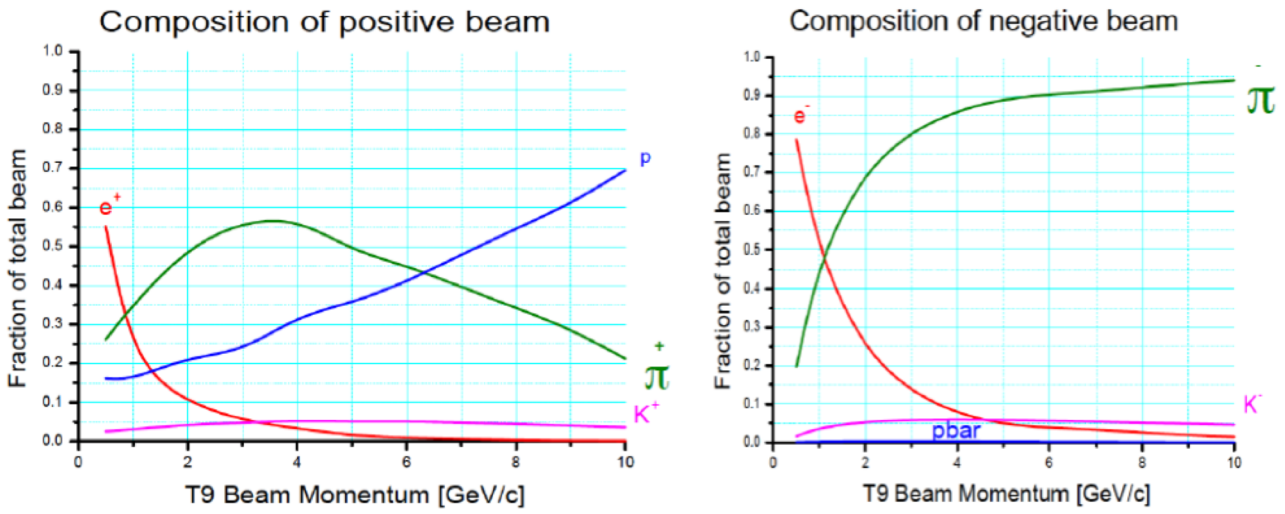
Experimental setup

- 12 Detectors
  - Active Sensor Unit (ASU): 28 MICROROC (x64 channels with 3 thr) → 1792 pads of 1x1 cm2 (with or w/o diodes)
    - 3 48x48 cm^2 resistive bulk-μM: embedded-R (~1 MΩ)
    - 5 48x48 cm^2 RPWELL: silicate glass (~10^{10} Ωcm)
  - 3 16x16 cm^2 bulk-μM with 4 MICROROC
  - 1 16x16 cm^2 resistive bulk-μM with 4 MICROROC
- 2 cm thick steel absorbers between the different layers
  - Calorimeter is between 1-1.5 interaction length thick.
- Hold onto a mechanical structure and read by a single DAQ system.
- Trigger: from ALICE ~1x1 cm^2
- Gas: Ar/ 7%CO_2, flushed in parallel in all chambers
  - thanks a lot to RD51
- HV mainframe and monitoring - supplied by RD51.

Experimental setup

T9 Beam Composition

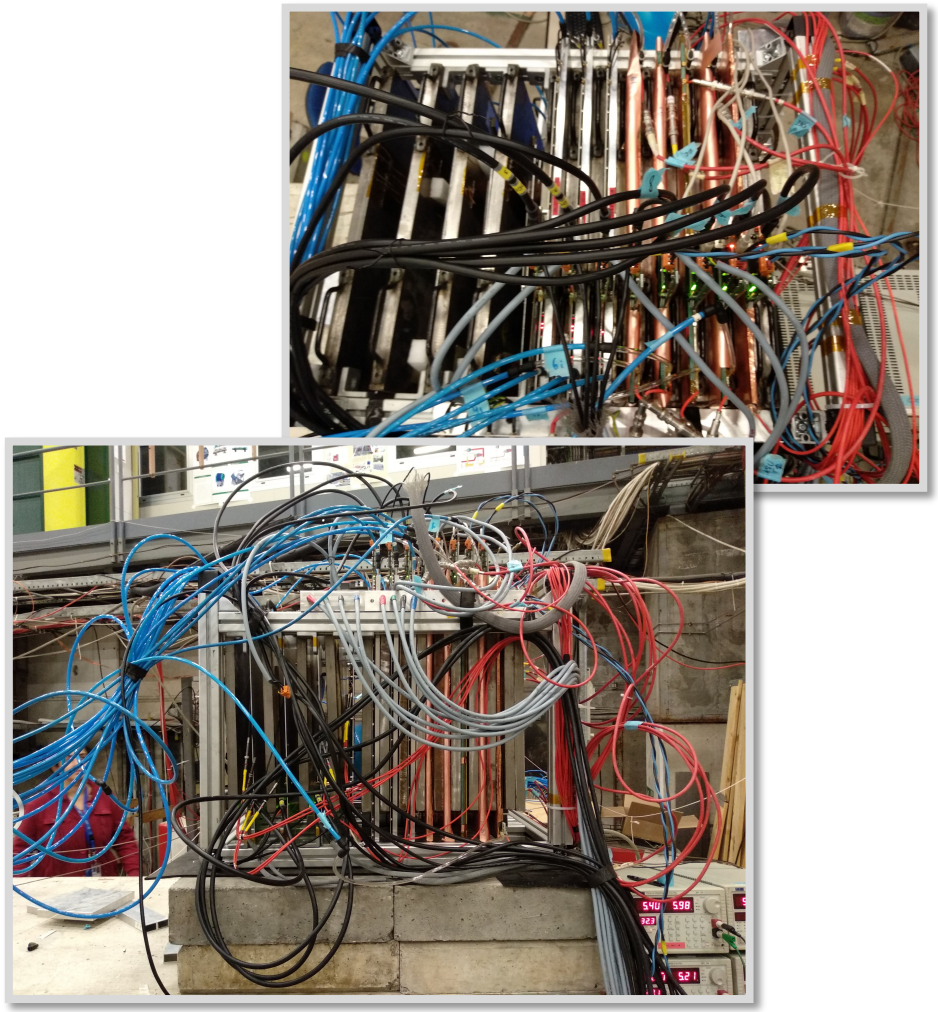
Open collimators and electron enriched target



- Used T10's Čerenkov counter as veto.
- In hadron enriched target, $e^{\pm}$ should be much smaller.

Experimental setup

- Single DAQ system
- Steel absorbers
- Two configurations:
  - 11 detectors
    - 3 16x16 cm^2 μM
    - 3 48x48 cm^2 μM
    - 5 48x48 cm^2 RPWELL
  - 8 detectors
    - 3 16x16 cm^2 μM
    - 3 48x48 cm^2 μM
    - 2 48x48 cm^2 RPWELL
  - Thus increasing DAQ efficiency by a factor of 5.

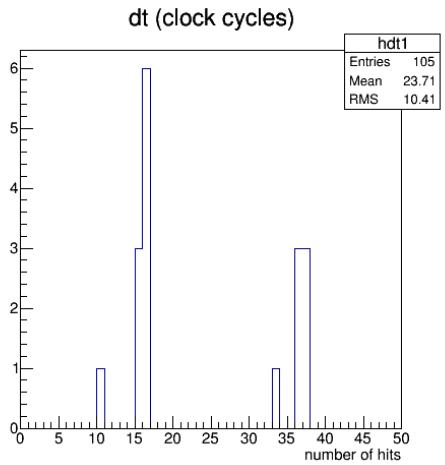


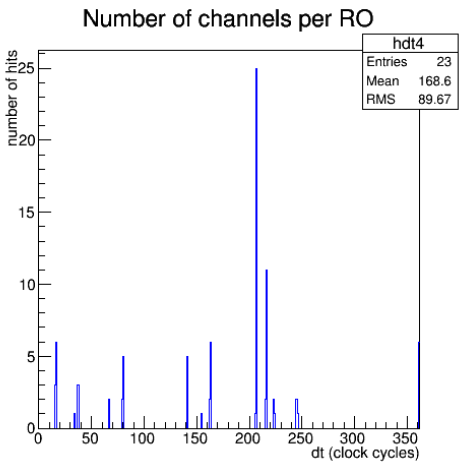
Test summary

- First run with so many sampling layers
- Lots of time-consuming debugging
  - Difficult to access the area
  - Detectors arrived after installation
  - 3 THGEM electrodes were of low quality
- Parasitic users:
  - Only two shifts as master
  - Difficult to change the energy – main user used 5 GeV/c
- Pions
  - Energy scan 2,3,4,5 (and 6 GeV for the 8 layers) @ ~6000/spill
    - 11 detectors: ~15k triggers for each energy value
    - 8 detectors: triggers > 25k for each energy value
  - Short voltage scan
  - Rate scan
- Many thanks to:
  - Paolo Martinengo and Crispin William (ALICE), for allowing our parasitic use
  - RD51 for the gas, HV, monitoring

Actual statistics larger than triggers

- The ASU records between triggers
  - writes more incidents than the triggering region
- Instead of hits synced with trigger → search for peaks in # of hits

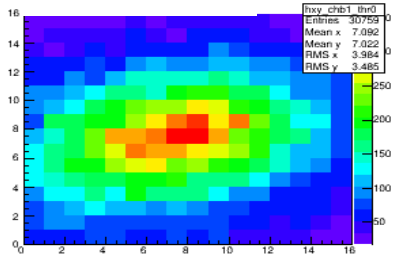




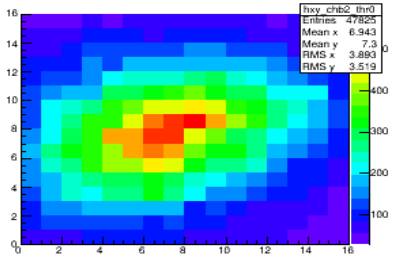
Typical beam profile

- Clear beam profile on all chambers

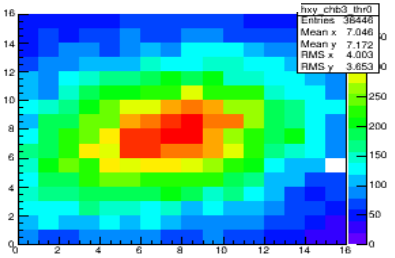
Chamber 1



Chamber 2



Chamber 3



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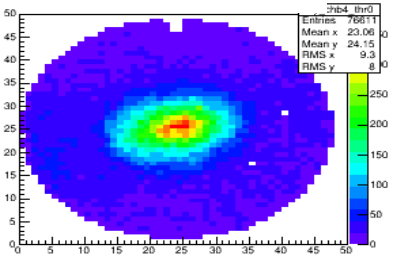
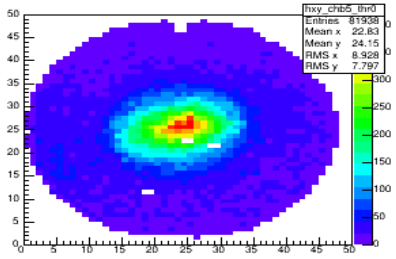
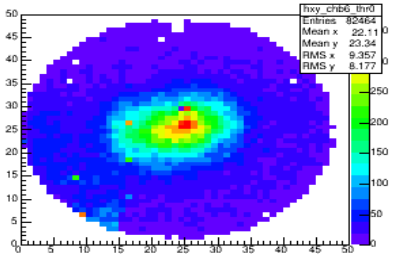


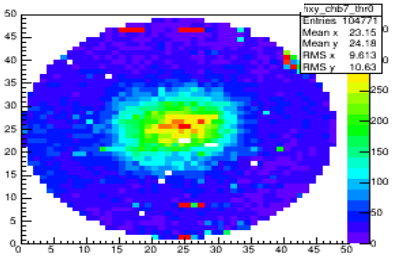
Chamber 5



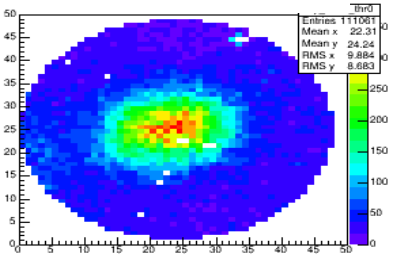
Chamber 6



Chamber 7



Chamber 8



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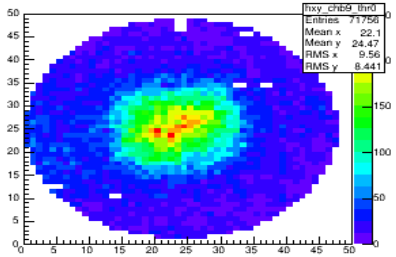
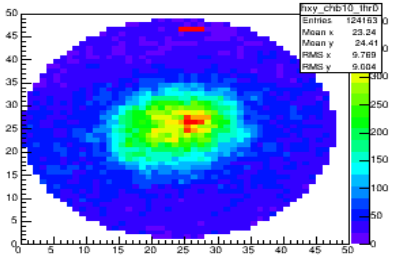
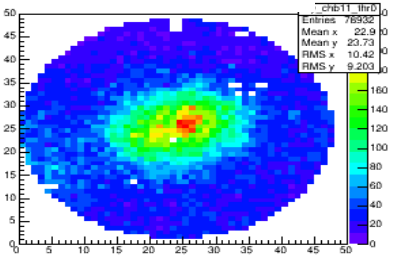


Chamber 10



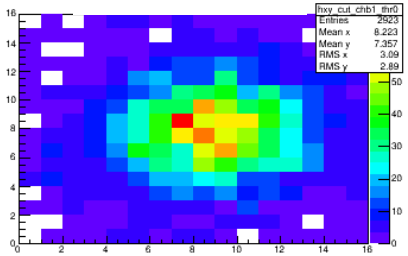
Chamber 11



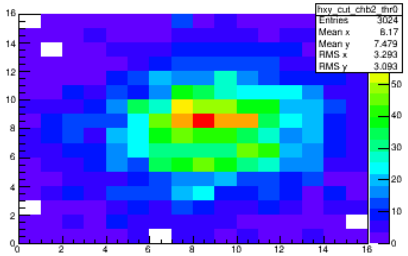
Typical beam profile – time cut

- Selection of events corelated with trigger time

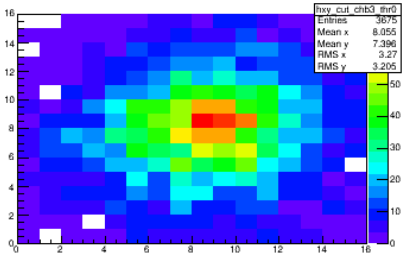
Chamber 1



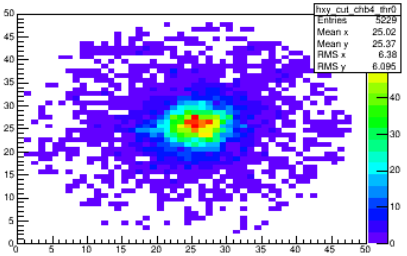
Chamber 2



Chamber 3



Chamber 4



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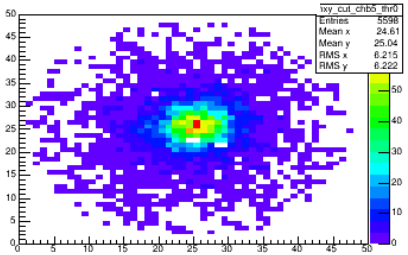

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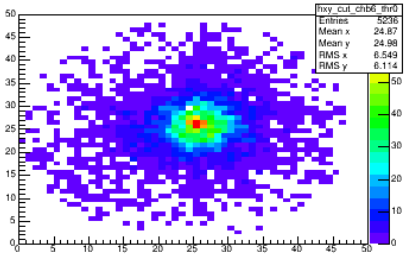
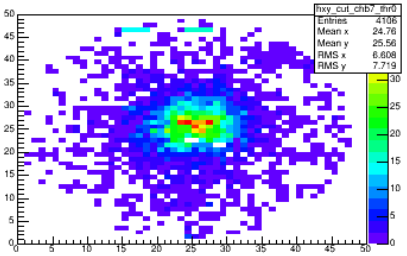


Chamber 7



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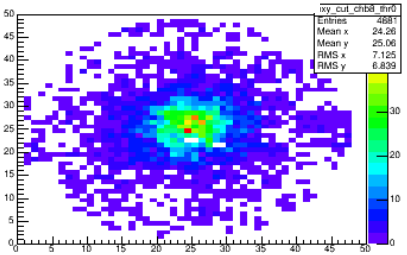
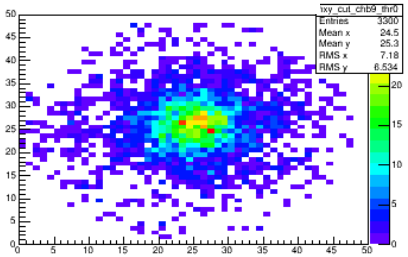


Chamber 9



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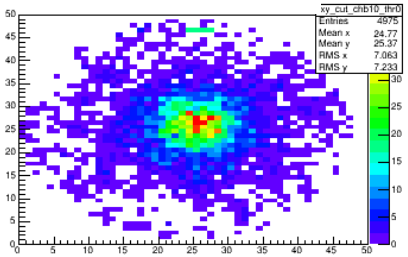

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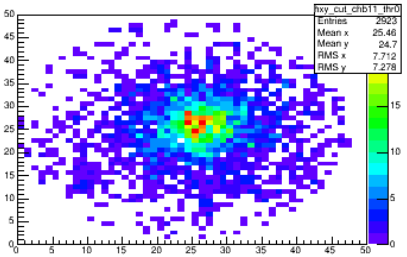
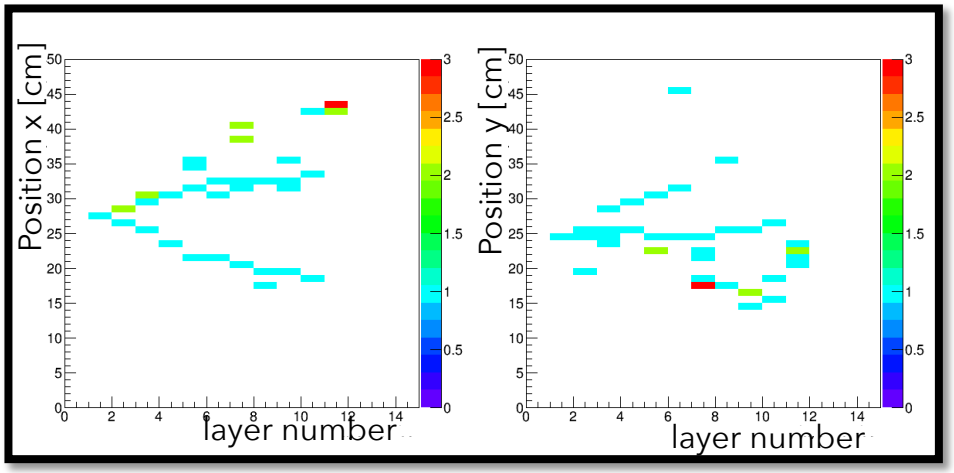
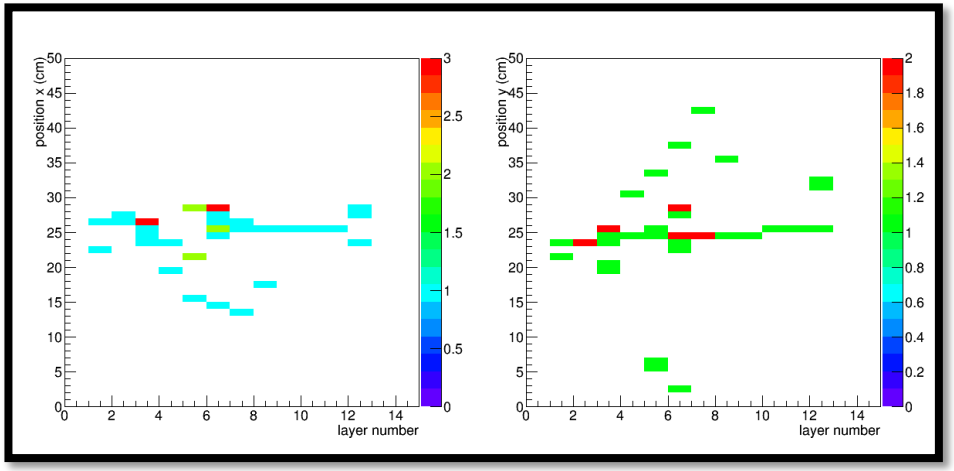


Event display

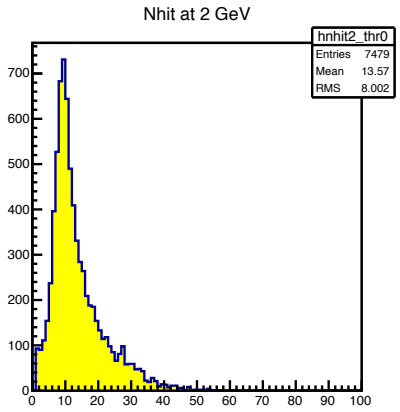
- Clear tracks
- Allows tagging
  - penetrating MIPS
  - Showers
  - to select showers starting at the beginning of the calorimeter

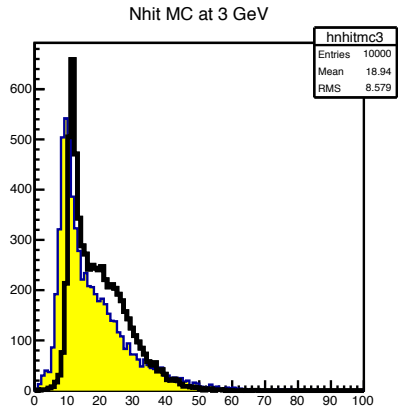


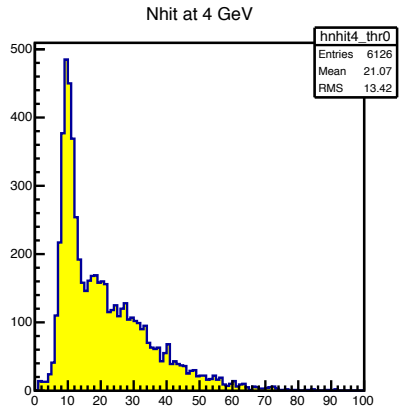


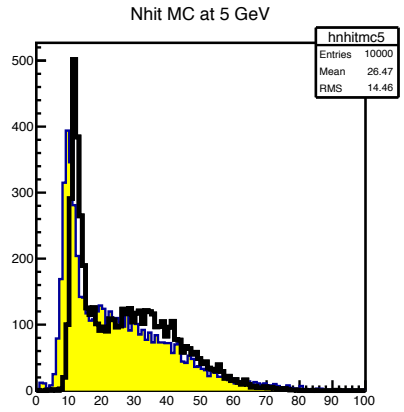
Preliminary results

- Number of hits distribution requires some refinement, but close to simulation prediction.









Summary

- First SDHCAL prototype with multiple RPWELL and μM detectors was tested at PS/T10
- Interesting data set to look at the performance of an MPGD-based SDHCAL

Next steps:

- Experimental data analysis is ongoing
- Geant4 simulation work will follow.

Thank you