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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Sampling Calorimetry with Resistive Anode MPGDs

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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 1-6 GeV/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 cm² resistive bulk-μM: embedded-R (~1 MΩ)
    - 5 48x48 cm² RPWELL: silicate glass (~10¹⁰ Ωcm)
  - 3 16x16 cm² bulk-μM with 4 MICROROC
  - 1 16x16 cm² 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 cm²

- **Gas:** Ar/ 7%CO₂, flushed in parallel in all chambers
  - thanks a lot to RD51

- **HV mainframe and monitoring** - supplied by RD51.
Experimental setup

• Used T10’s Čerenkov counter as veto.
• In hadron enriched target, $e^\pm$ should be much smaller.

Open collimators and electron enriched target
Experimental setup

• Single DAQ system
• Steel absorbers
• Two configurations:
  • 11 detectors
    • 3 16x16 cm² μM
    • 3 48x48 cm² μM
    • 5 48x48 cm² RPWELL
  • 8 detectors
    • 3 16x16 cm² μM
    • 3 48x48 cm² μM
    • 2 48x48 cm² 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

![Graphs showing distribution of hits and channel numbers per RO](image-url)
Typical beam profile

• Clear beam profile on all chambers
Typical beam profile – time cut

- Selection of events correlated with trigger time
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