Analysis plans 2013 - Publications m2 Micromegas

Chamber construction & commissioning
→ mechanical design, front-end ASIC, DAQ, software
→ ASIC calibration, Bulk cooking
→ Threshold equalisation, ASU X-ray test (Vmesh scan, thr. Scan)
→ power-pulsing with 4 chambers & RAMFULL

Performance standalone
→ Vmesh scan 1: efficiency, multiplicity, uniformity for 3 thresholds
→ Vmesh scan 2: Nhit distribution from pion showers
→ thresholds scan (comparison to ASIC calibration)
→ rate scan : spark rate with MIPs and pion showers
→ angle scan with MIPs and pion showers
→ analogue readout: landau (fC) at various mesh voltage, comparison with gain curve

Calorimetry study in SDHCAL
→ Choosing medium and high thresholds: software compensation (G4 sim)
→ Setting thresholds in MIP units: analogue readout
→ Longitudinal profile: shower start (G4 sim), fit (leakage, e/h)
→ Response: Nhit for 3 thresholds and reconstructed energy
→ Resolution: validate simulation and use it to calculate resolution with 1 and 3 thresholds

Analysis plans 2013 - Publications m2 Micromegas

PUBLICATION 1
Chamber construction & commissioning

PUBLICATION 2
Chamber performance in beam

PUBLICATION 3
Calorimetry study with Micromegas chambers

Publication 1: Chamber construction & commissioning

1. Overall description of Micromegas chambers

Mechanical design
Scalability, dead zone, drift gap, pad size, ASU size
Services: gas distribution, gas mixture, voltages, I/O signals

MICROROC
Low noise, 3 global thresholds, dynamic range, pedestal correction, analogue readout, variable shaping time, time-stamping and memory
Power pulsing and consumption
External/internal trigger

Active Sensor Units
Design: layers, Nasic, connectors, T probe
Spark protections
Bulk mesh: Bulk process, amplification gap, dead zone (pillars and edges), inter-pad

DAQ and software
Architecture front & back-end: daisy chain, ASU, interDIF, DIF (USB, HDMI) + DCC, SDCC
Chain test with 4 ASU
Software: Labview (calibration and testbeam) and Xdaq
Framework: detector classes, xml geometry files, event display, rootfiles etc...

2. Test prior chamber assembly

ASIC calibration
Purpose and method (setup, scurve, correction on PCB)
Noise, shaper gains, noisy channels, pedestal offset

HV training of Bulk mesh
Purpose and method
Results: Vmax and I(Vmax) for all ASUs

Threshold equalisation
Purpose and method
Low threshold distribution and uniformity before/after equalisation

ASU X-ray test
→ Vmesh scan at the lowest threshold
Counting plateau and effective detection threshold

→ Threshold scan (DAC0 & DAC2) at various mesh voltages
Inflexion point versus Vmesh, gain curve slope

→ Position scan (6 positions)
RMS of Nhit for all ASUs

Publication 1: Chamber construction & commissioning

3. Chamber assembly

Steps and photos, hardware tests

4. Cosmic tests (?)

Channel occupancy for 4 chambers at 350 V
Cosmic angular distribution
Power-pulsing & RAMFULL (?)

4. Functional tests in a beam

Noise condition → Channel occupancy, signal to noise ratio, masked channels
Uniformity → Nhit distribution over 6 ASU
Shaper → Efficiency @ 370 V versus shaping time
3 thr → Radial nhit profiles with showers
Ramfull → RAMFULL time & beam rate
Analogue readout → Landau distribution at 350 V
Power-pulsing

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Publication 2: Chamber performance in beam

1. Test beam set-up (RD51 nov 2012 & CALICE oct 2011)

CERN/SPS beam lines
Detector stack, iron block, dimension
Gas mixture and distribution
DAQ, trigger, rates

Publication 2: Chamber performance in beam

2. Response to MIPs

Method to measure efficiency and multiplicity
Test 1 chamber using 3 others as tracker

Voltage scan (*RD51*)
Efficiency & multiplicity for 3 thresholds versus Vmesh

Threshold scan (*RD51*)
Efficiency & multiplicity versus DAC0, DAC1 and DAC2 at various Vmesh

Angle scan (*RD51*)
Efficiency & multiplicity versus angle

Analogue readout (*RD51*)
Landau distribution at various mesh voltages for 4 chambers
Compare trend slope with gain curve

Uniformity (*CALICE*)
Efficiency and multiplicity in 8x8 cm2 regions inside SDHCAL

Comparison to Monte Carlo (*CALICE*)
Nhit at layer 49-50 inside SDHCAL

Publication 2: Chamber performance in beam

3. Response to pions

Voltage scan (*RD51*)
Nhit distribution at various Vmesh behind iron block for 4 chambers
→ Vmesh & gas gain for 95% of shower hits

Angle scan (*RD51*)
Nhit distribution versus angle

Analogue readout (*RD51*)
Signal distribution in shower core
Compare with MIP Landau

Comparison to Monte Carlo (*CALICE*)
Nhit at layer 49-50 inside SDHCAL

4. Sparking study

Rate scan (*RD51*)

Nhit distribution at various rates behind iron block for 4 chambers
→ Mean Nhit VS rate → no space charge

Method to identify and count sparks (HV slow control, hit pattern)
→ spark rate versus pion rate

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1. Motivations, set-up & statistics, analysis method, Monte Carlo

What is the response of a 50 layers Micromegas SDHCAL?
What improvement with a semi-digital readout compared to pure digital?

Experimental set-up & statistics
CALICE SDHCAL 46 RPC 4 uM
Energy scan: 20-150 GeV with 15-20 k pions / energy

Analysis method
Shower start, longitudinal profiles, response

Monte Carlo
Geant4 version, physics lists, geometry

2. Software compensation with a semi-digital readout
(or: what values for medium and high thresholds?)

Method to use the semi-digital information
Determine best values of medium and high thresholds

3. Setting of the thresholds in MIP units

Analogue readout
Landau distribution with cuts on DAC0, DAC1 and DAC2
→ calibration of the 3 thresholds in MIP units (DAC to ADC relation)

4. Longitudinal profiles

Shower start algorithm
Optimisation by Monte Carlo

Event selection
Time cut, fiducial cuts
→ Effective interaction length from real data at various energies VS MC

Longitudinal profiles
Fit function → leakage correction & e/h ratio
Comparison to MC for 3 thresholds (0-5-15 MIP)

5. Response to hadrons

Response for 3 thresholds
Nhit VS energy (Data/MC)

Response semi-digital
Erec VS energy (MC ONLY)

6. Improvement SDHCAL compared to DHCAL