More on geometrical response of 2021 TB module

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Introduction

Analysis on the 20 GeV data sample at SPS taken without preshower in front (run 695)

Found two different response regimes depending on whether the shower maximum is in a scintillator or a cerenkov row, requiring different intercalibration constants

Last meeting: study of dependence on impact point on simulation by Andreas, based on pencil beam, confirms on simulation the very strong dependence of response on impact point

Today: try to reproduce response distributions from run 695 by tuning angles and position of module with respect to the beam

Simulation handling

Inserted x and y position of beam in G4 output

For each test run 10k events of e+ beam with circular cross-section and 10 mm radius

Default configuration: beam centered to geometrical center of calo, calo inclined by 1 degree in x-z plane, no inclination in y-z plane.

Response calibrated in GeV using nphe/GeV numbers in Lorenzo's example analysis program (217.501 Sci, 54.1621 Cer)

Simulation output converted to ntuples in test beam format, run same analysis program on data and MC
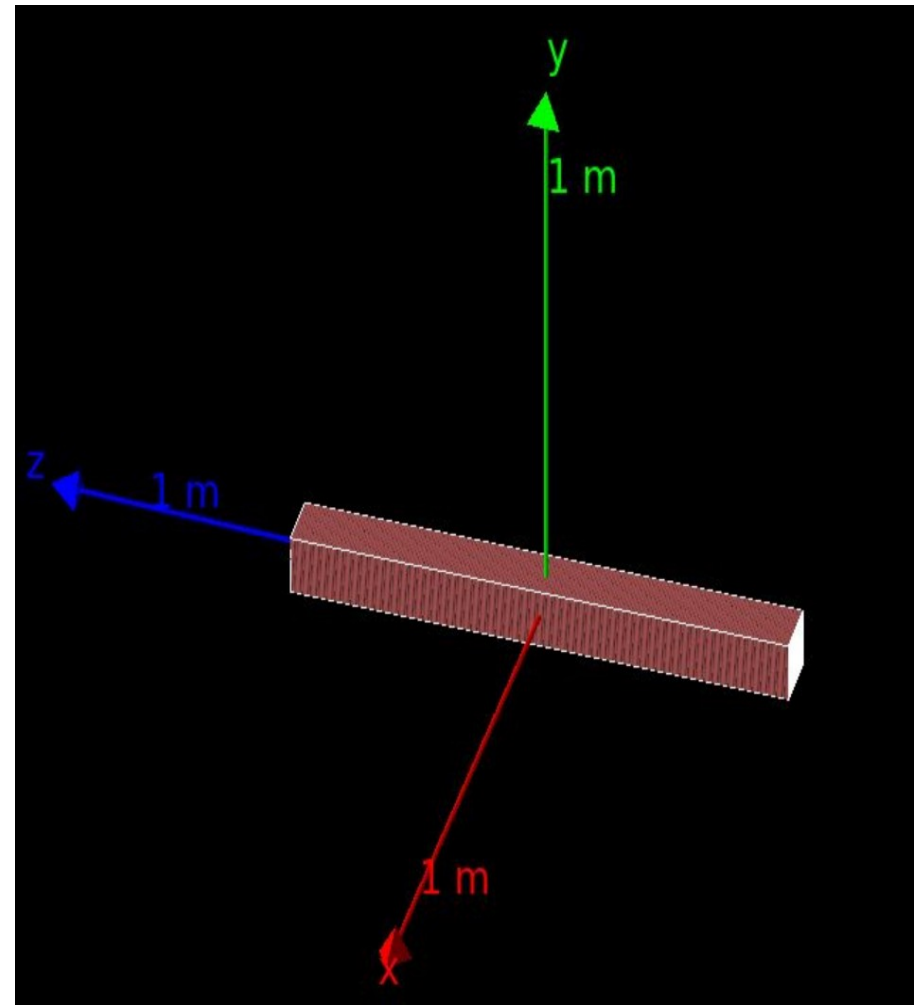

Beam in Z direction from the right

Data handling

Require:
- Beam:
  - Cerenkov1 10 counts above pedestal
  - Radius of beam in DWC2<10 mm
  - Beam collimated:
    |XDWC2-XDWC1|, |YDWC2-YDWC1|<3 mm
- Calo cleaning
  - Put to zero cerenkov cell 8
  - Require total cerenkov energy < 90 GeV
- SiPM containment
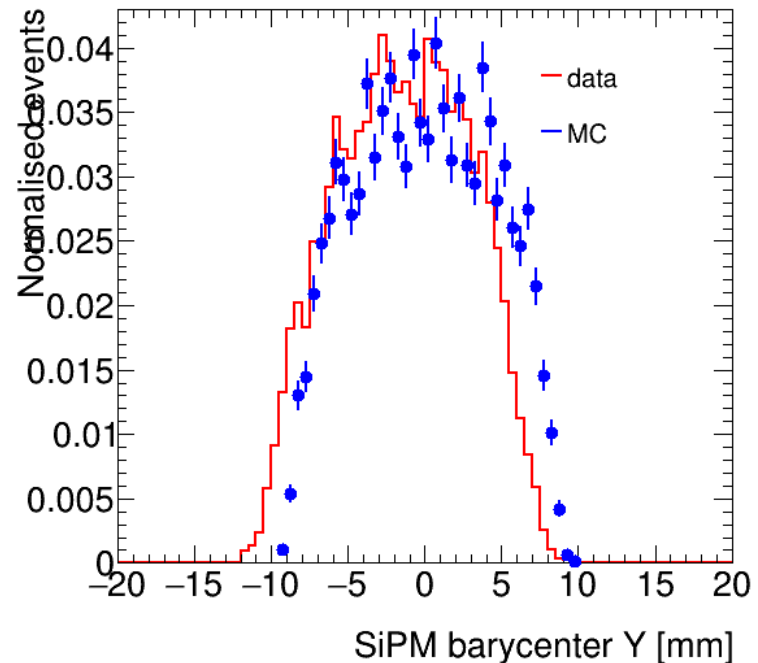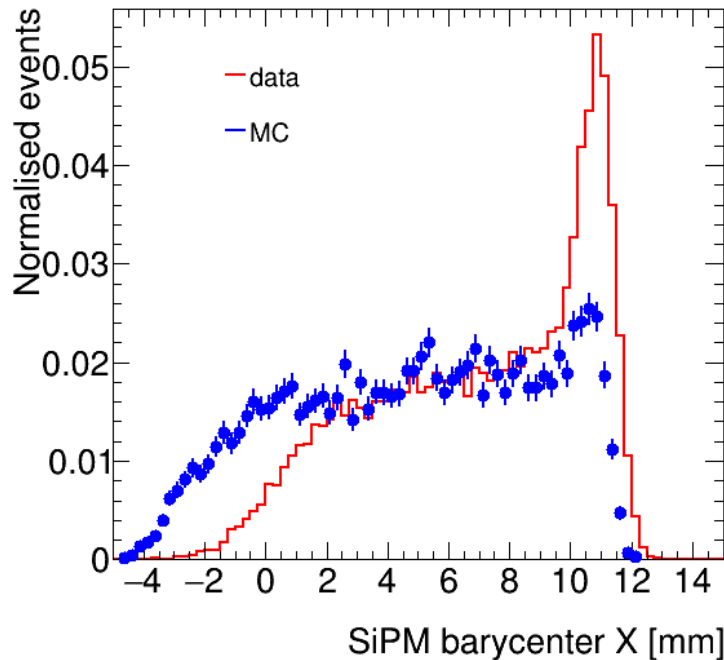 - For variables in y direction require barycenter in x<5 mm

Default configuration: raw energy response
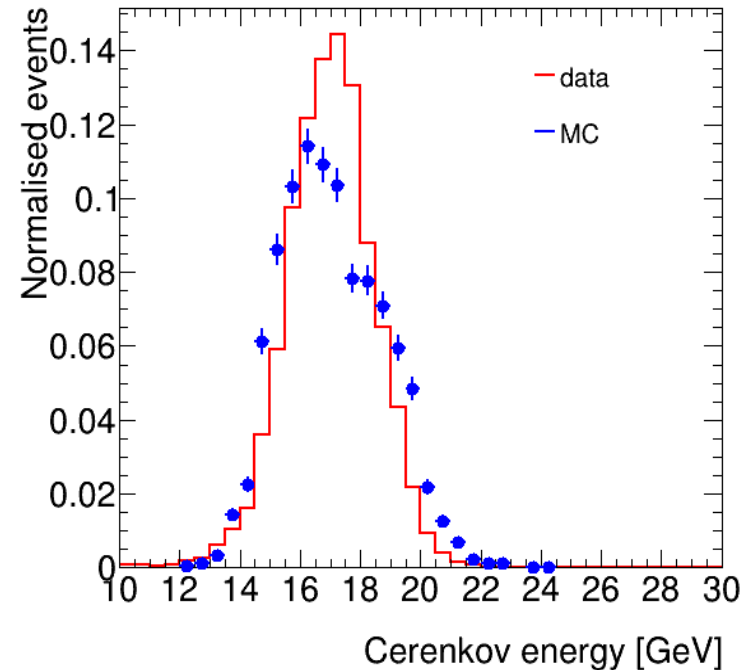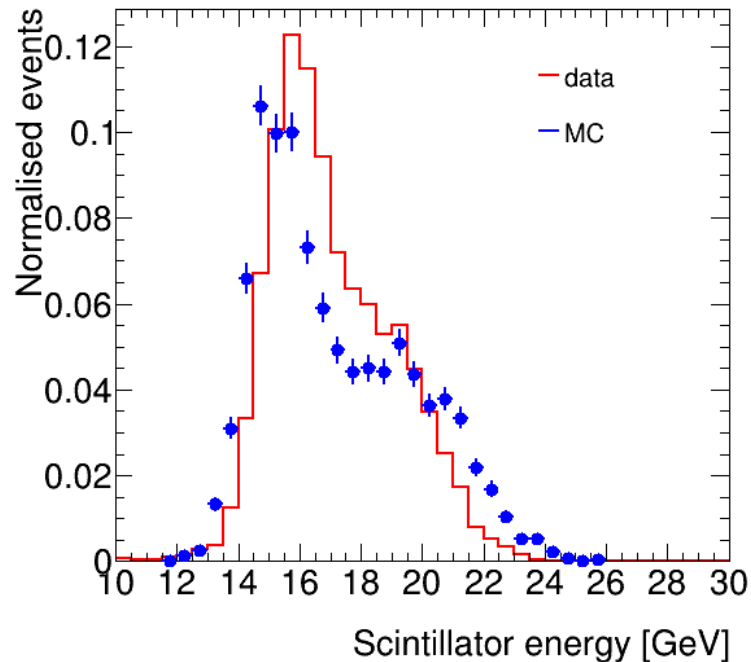
Distributions of energy sum in SiPMs (module 0)

Simulation scaled up by a factor 1.084 (1.071) for Scintillator (Cerenkov),
so that data and MC distributions have the same average value.

Default configuration: beam barycenter

In each direction barycenter is calculated by summing positions of center of each fiber weighted by the energy deposition in the fiber, normalised by total energy

Spike at ~10 in X is events where most of the energy is deposited in adjacent tower 5, sensitive to angle and impact position

Optimisation in x direction

Try to match x barycenter distribution: two handles:
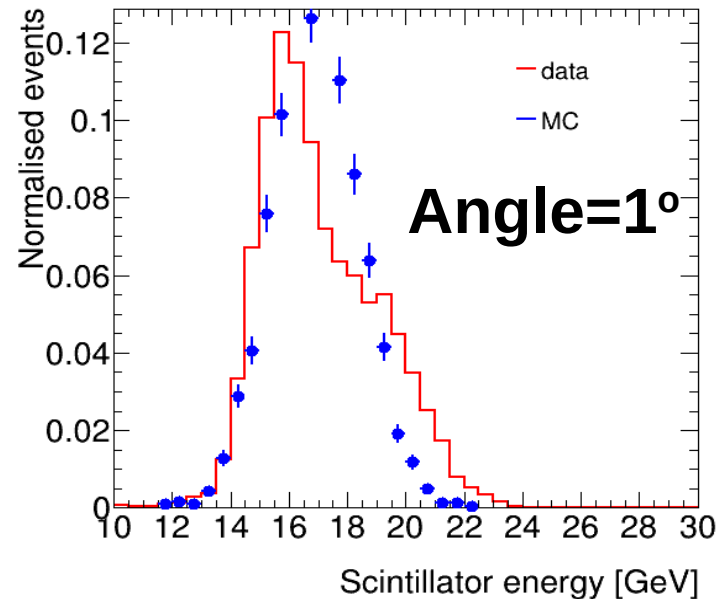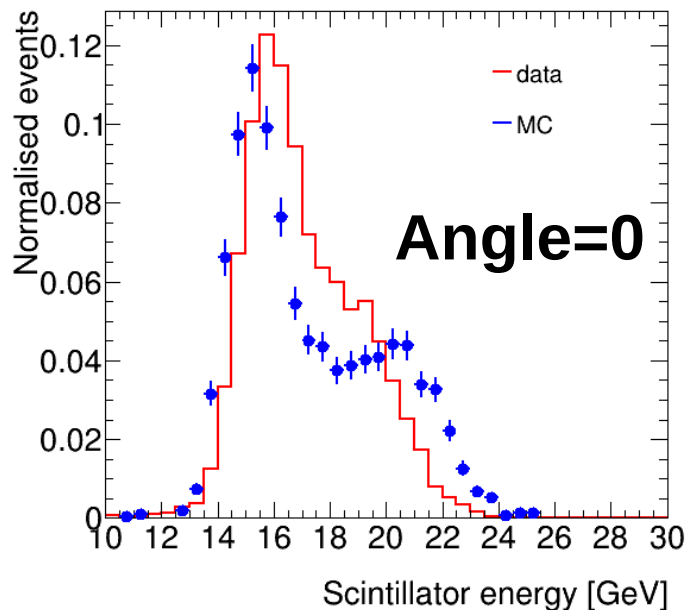- Change angle in x-z plane (rotation around x axis)
- Change x-position of calo
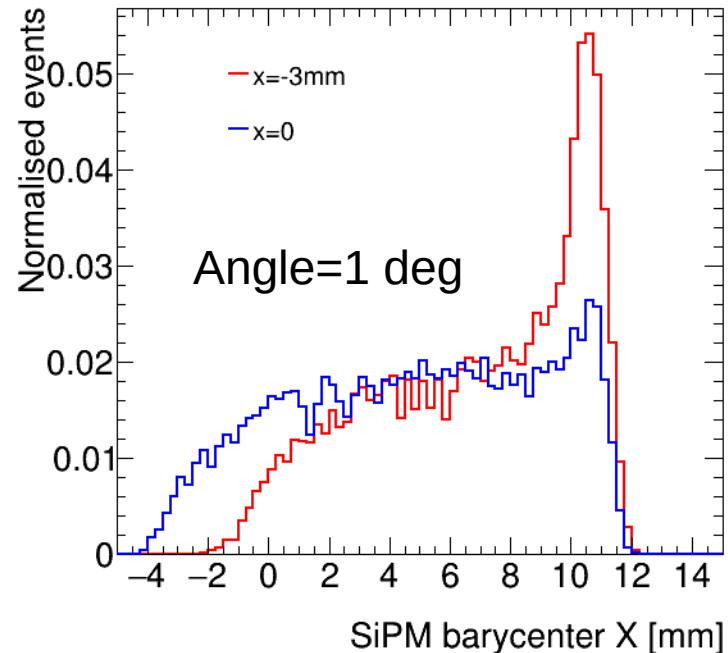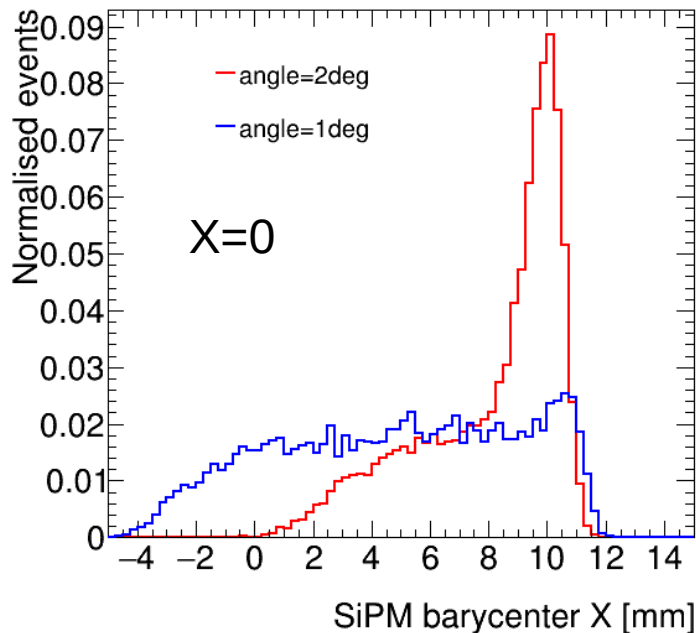
Similar effect by changing the angle or moving the beam in x
angle=1.5 deg && X=0 mm   similar to angle=1 deg && X=-3mm
Choose second for further studies

Optimisation in y direction
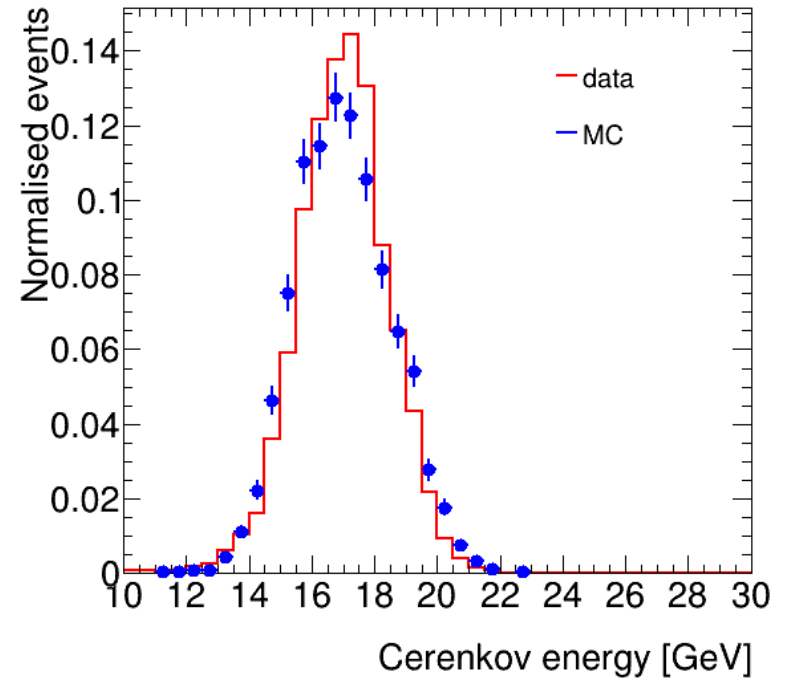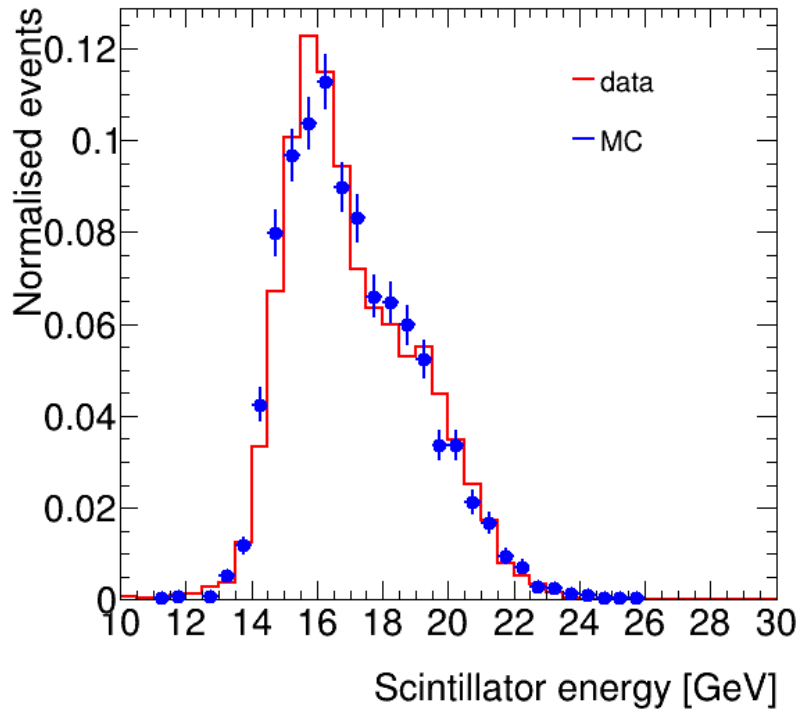
Match width of energy deposition in scintillator

Change inclination in y-z plane (rotation around x axis)

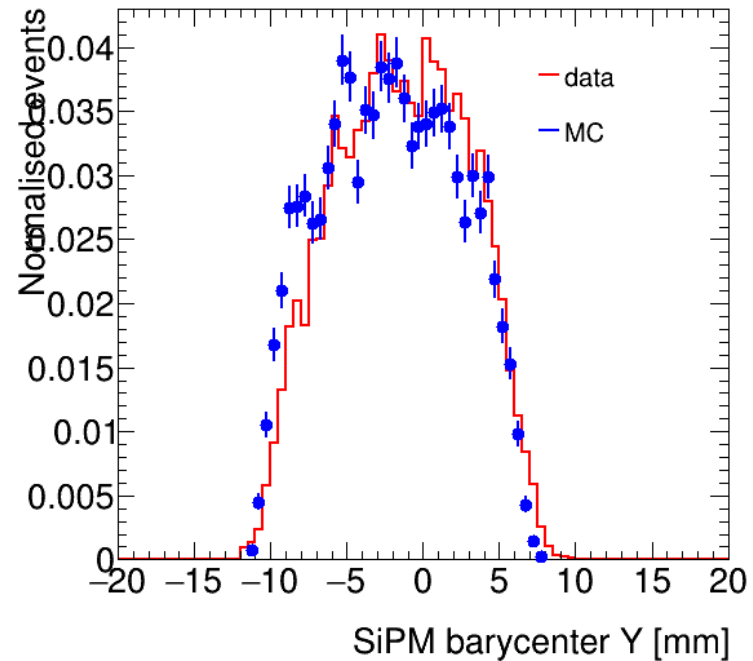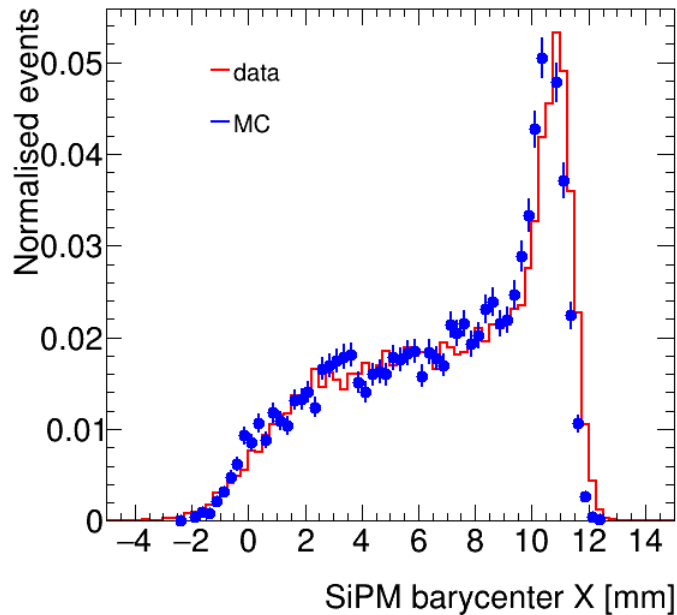Large change in shape with angle

Optimised value Angle=0.4 degrees

Optimized configuration: raw energy
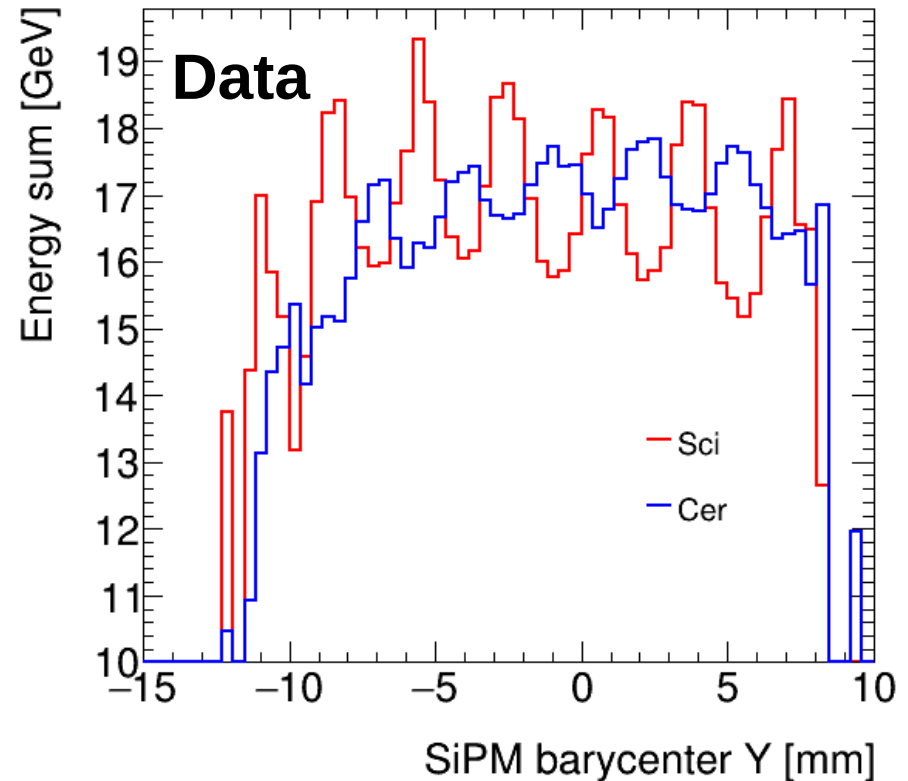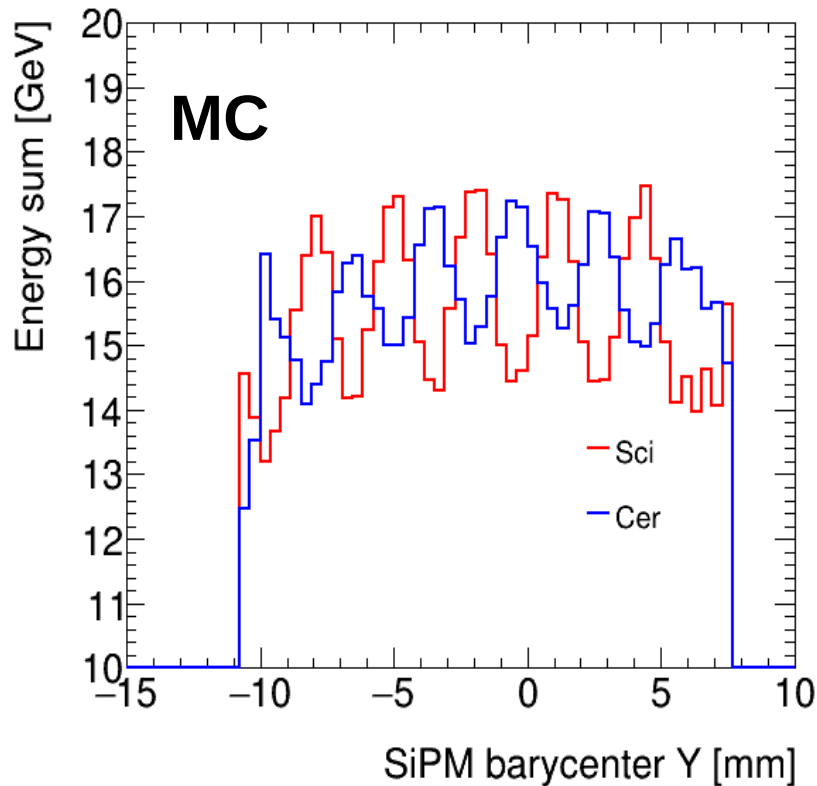

Agreement data-simulation much improved, still some difference

# Optimized configuration: beam barycenter

Agreement data-simulation much improved, still some difference

Energy as a function of y barycenter (prelim)

Profile plot of measured energy vs y barycenter for 'optimal' choice of geometry
Observe both in data and MC sinusoidal modulation for both scintillator
and cerenkov, with opposite phase
Amplitude in cerenkov smaller than in scintillator

Energy as a function of y barycenter (prelim)
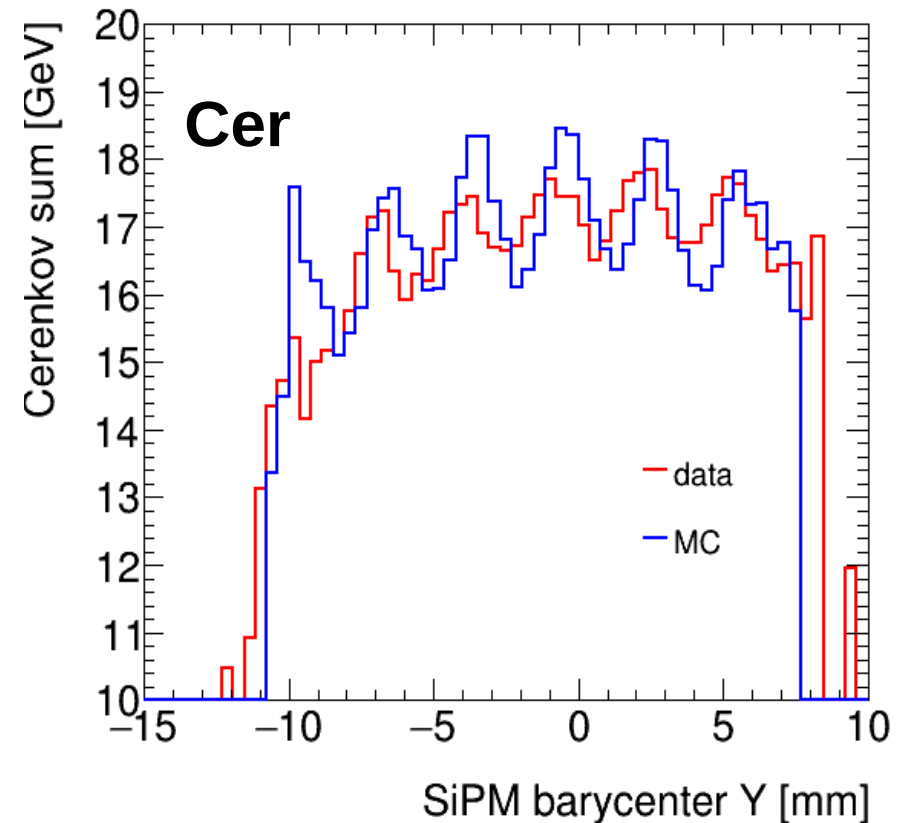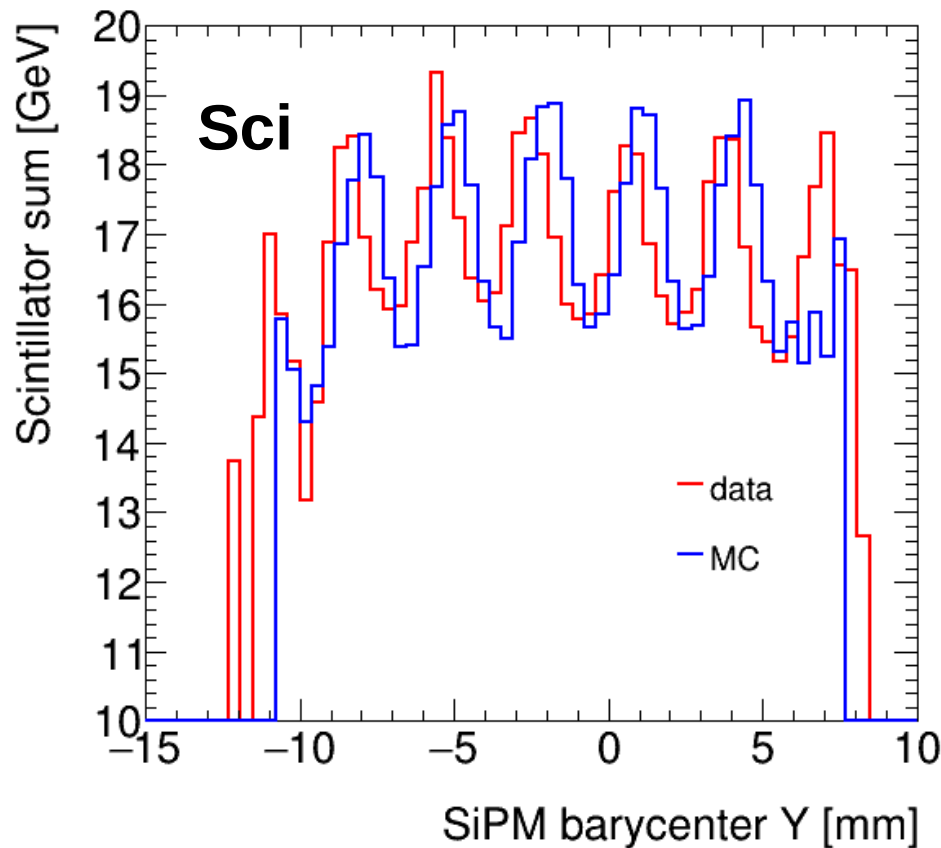
- Good agreement in period
- Reasonable agreement in amplitude for scintillator, large difference in cerenkov
- Phase off by somewhat less than 1mm
  Effects under investigation

Conclusions & outlook

- Analyse 20 GeV SPS data without preshower

- Try to see how well simulation reproduces data on basic variables

- After tuning position and angles of module with respect to beam achieve reasonable data-MC comparison

- Observe large dependence of distributions on impact angles on calorimeter

- Modulation as a function of barycenter in y observed both in data and simulation. Some differences observed, working on understanding them

Backup