Bar Shaped Scintillator Tiles

Test Beam Plans and First Analysis

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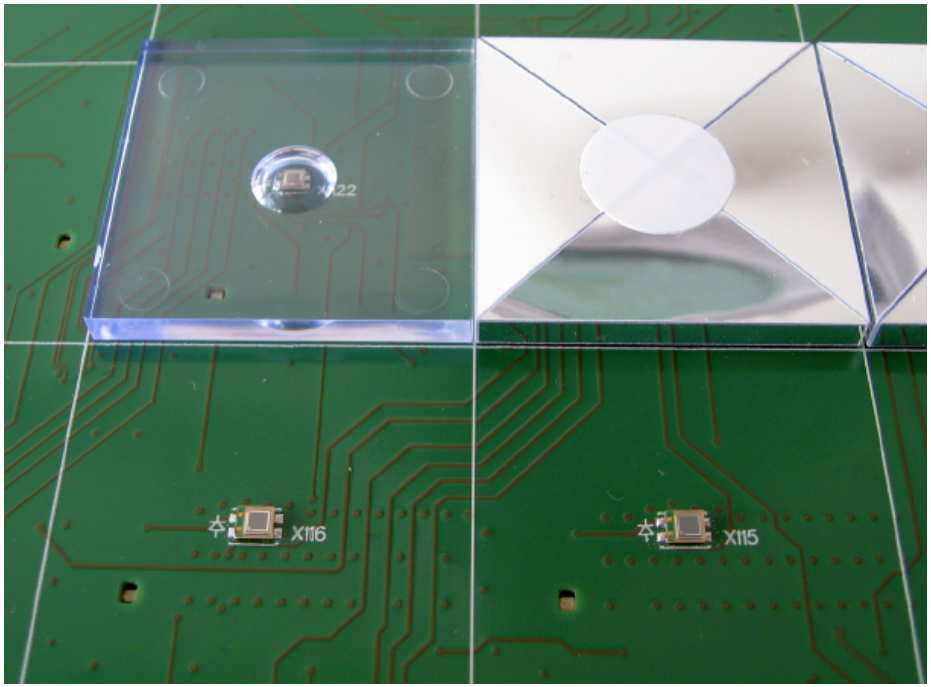
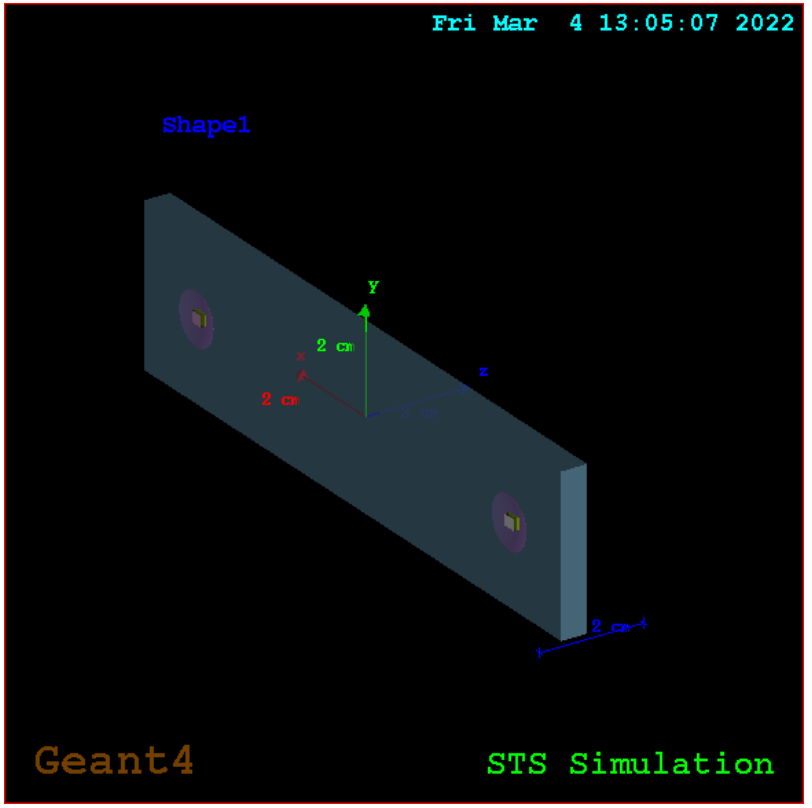
Current design

- Square shaped scintillator tile
- Dimple milled for SiPM
- Reflective wrapping
- SiPM in the middle of the tile
- In the order of 30 x 30 x 3 mm



Bar shaped design approach

- Differences in geometry:
  - Bar shaped instead of square shaped width = 30 mm, **height = 5 mm** and length between 120 and 500 mm
  - 2 dimples, located 15 mm from the edge of the tile (square tile dimples used for simplicity and easier analysis of differences)
  - 2 SiPMs corresponding to the dimples
- Similarities:
  - Same materials used (scintillator, wrapping etc.)
  - Dimples of same size, despite thicker tile



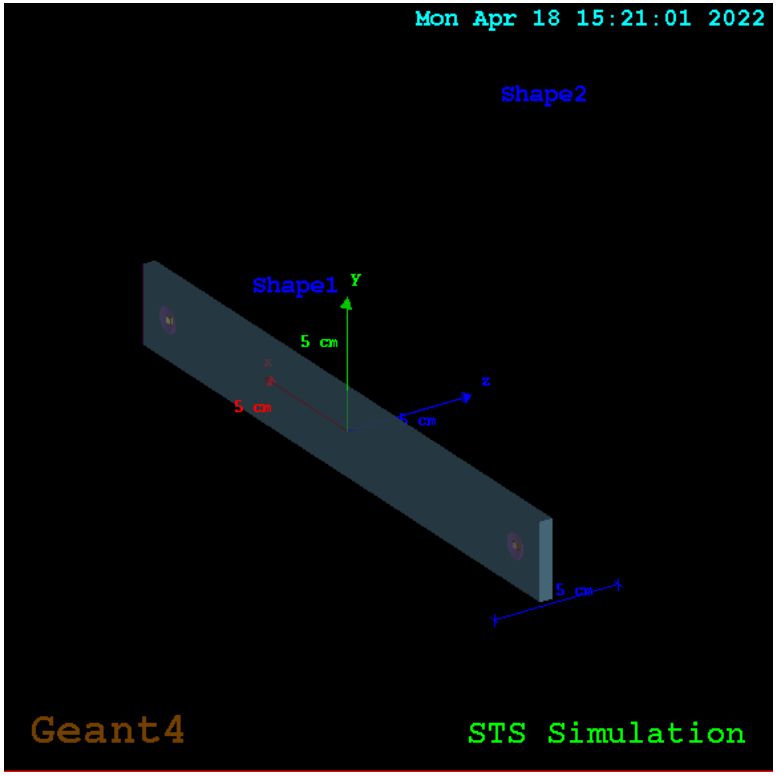
120 mm tile

Bar shaped design approach

General idea:

- Investigate lightyield for these geometries
- Get a feeling for the lightyield / length dependency
- Compare and verify Geant4 simulation for bar shaped structures
- Investigate dimple position and size further

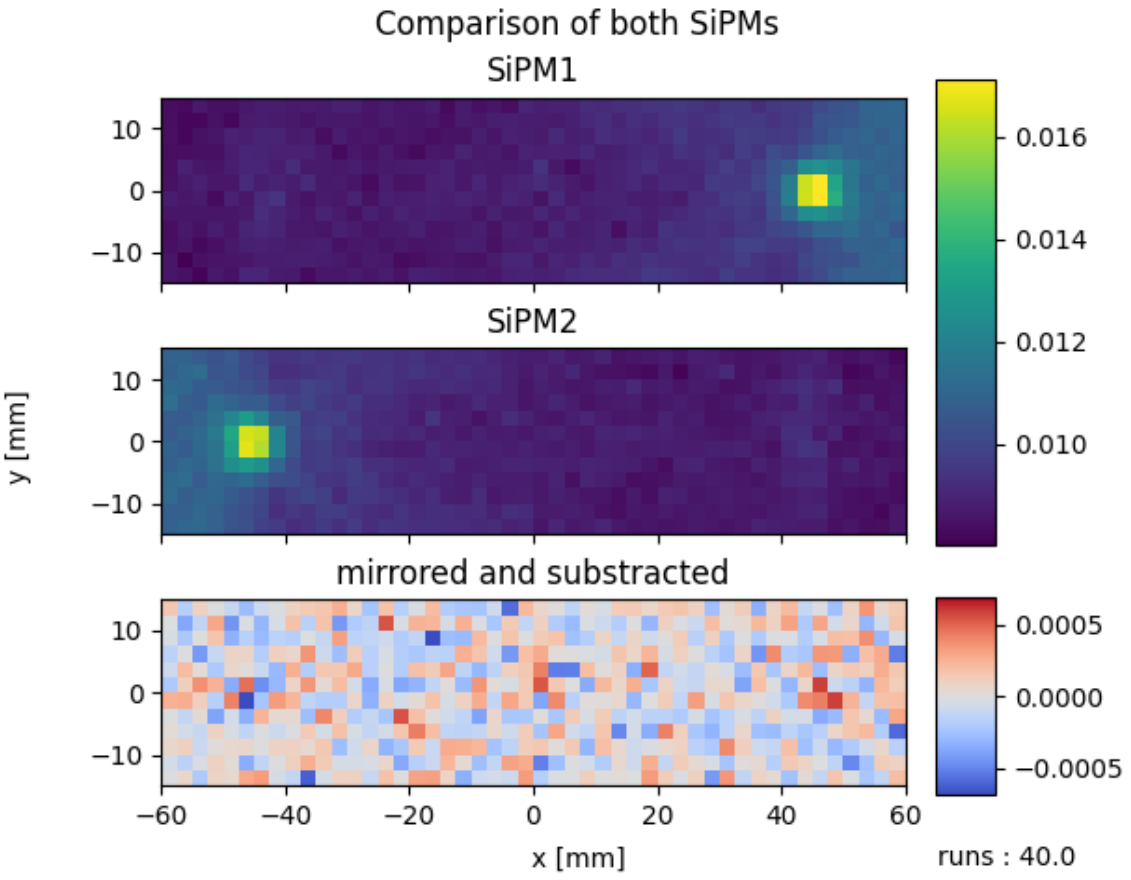
→ Test beam and simulations



240 mm tile

Simulation

- Seperate bar into grid to iterate over
- Track photons arriving at both SiPMs
- Scale by number of photons produced to remove effect of different energy depositions in the scintillator



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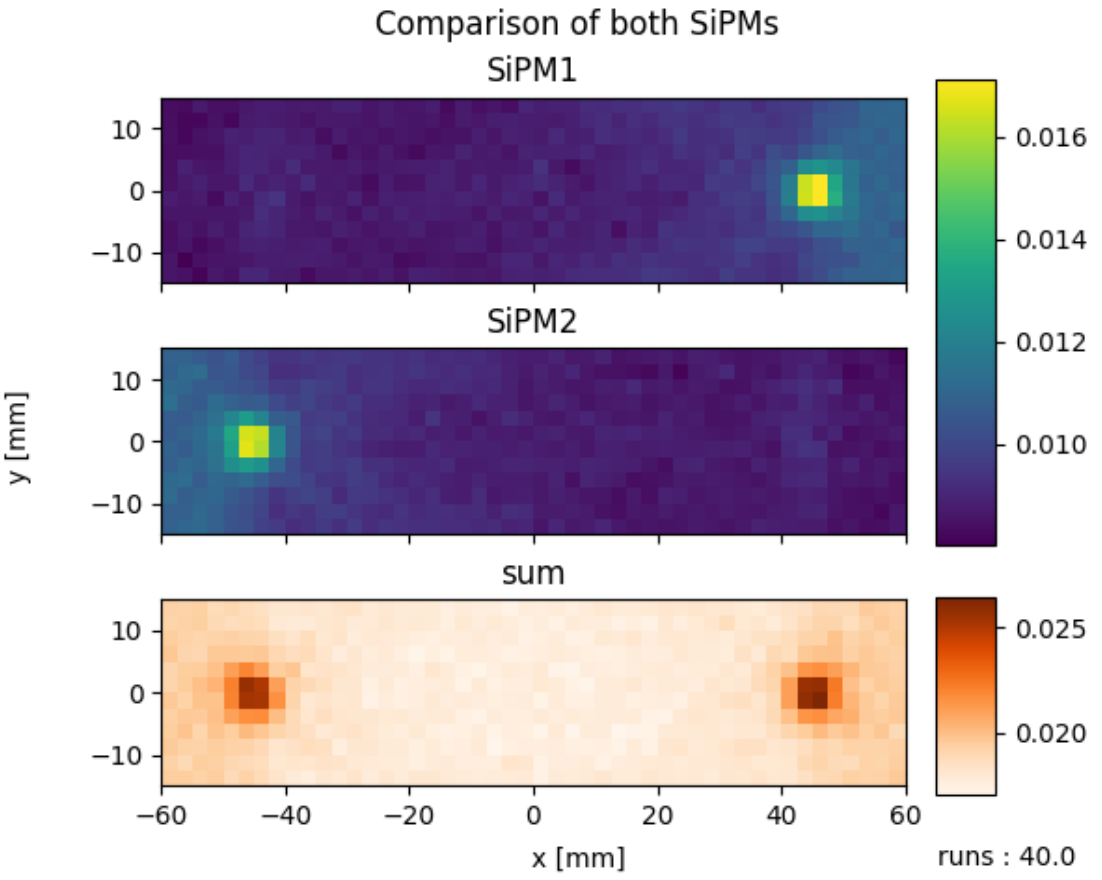
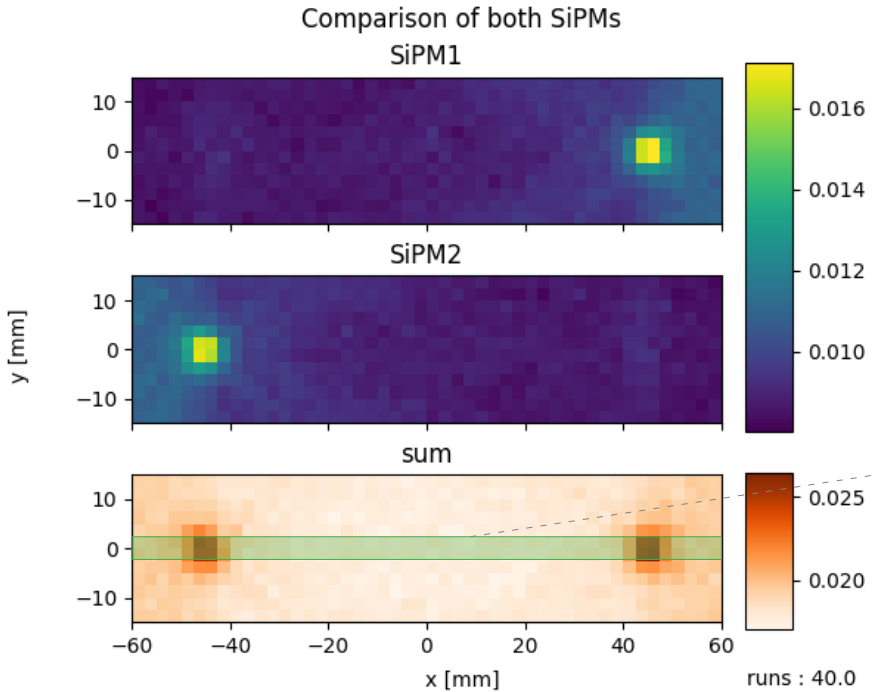
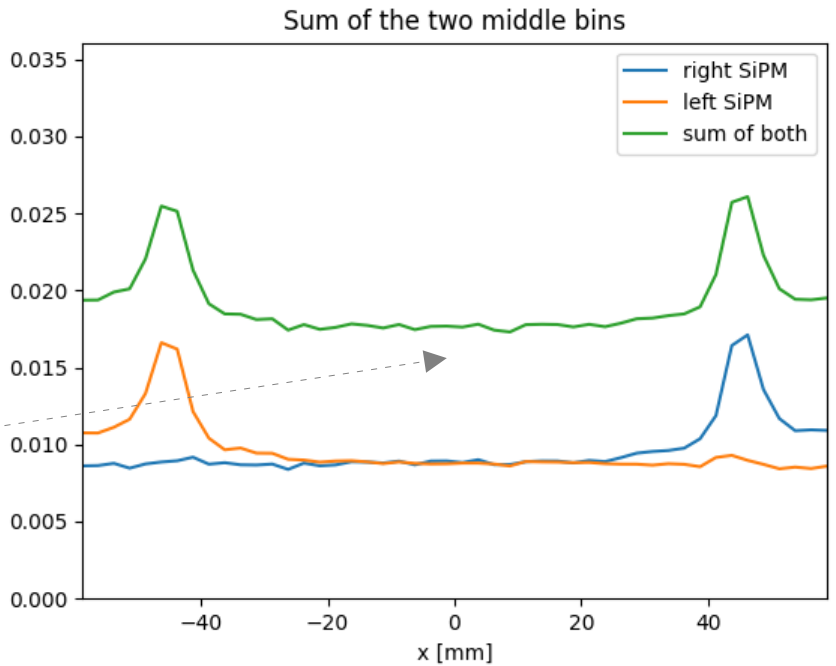


Lightyield from simulation

Sum of two middle bins gives fraction of photons that a SiPM see depending on x.

→ For 120 mm about 2 percent of produced photons get detected



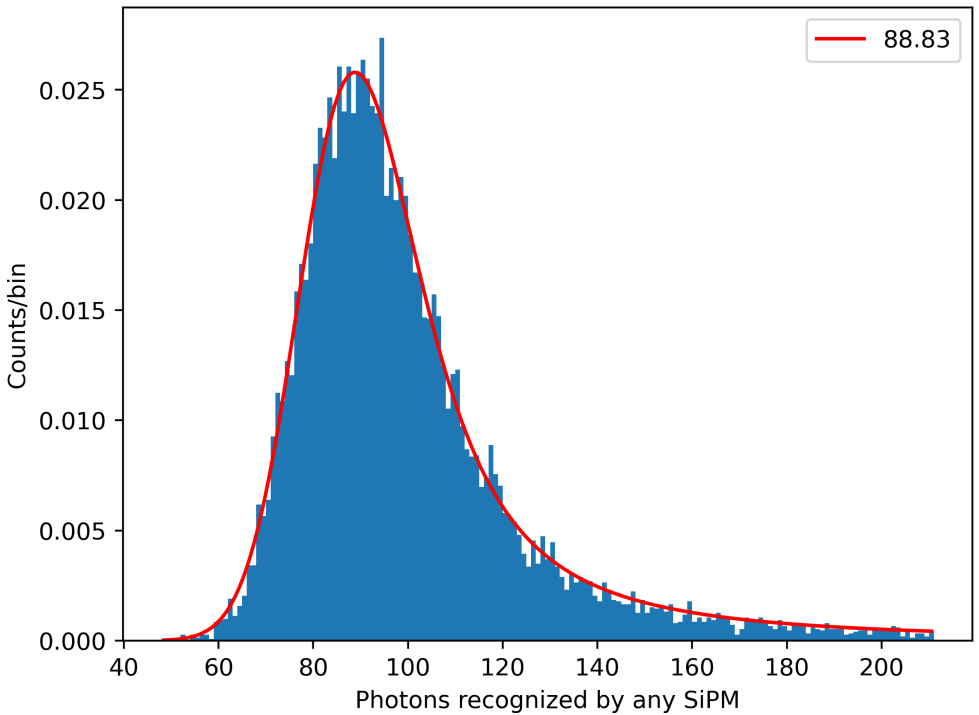


Lightyield from simulation

- 240 x 30 x 5 mm tile
  SiPMs 15 mm from the edge
- Approx. 89 photons recoginzed by any of the SiPMs (mode of the fit)

  → ca. 44 Photons detected per SiPM

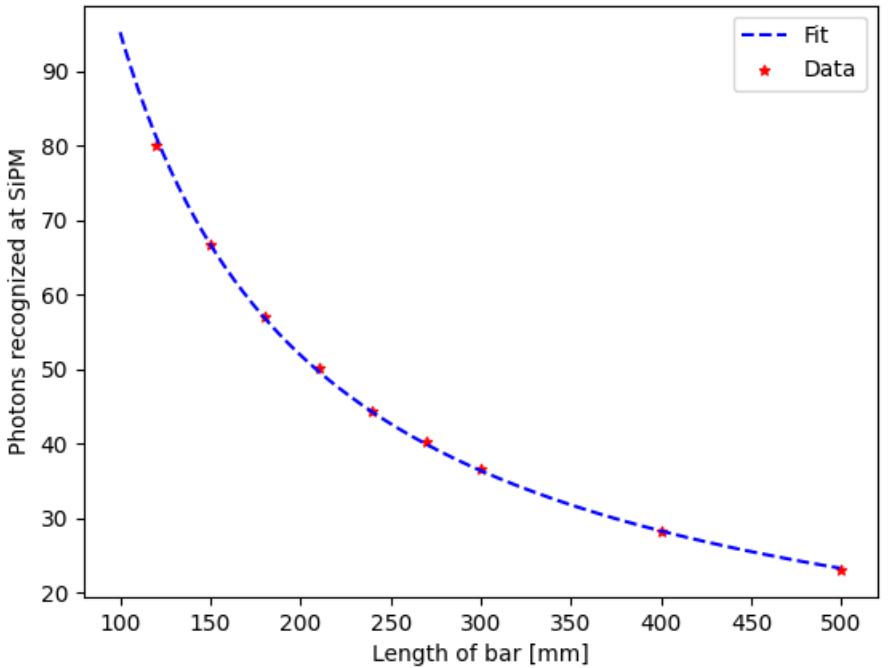
  Enough to be distinguished from background !



Lightyield by length

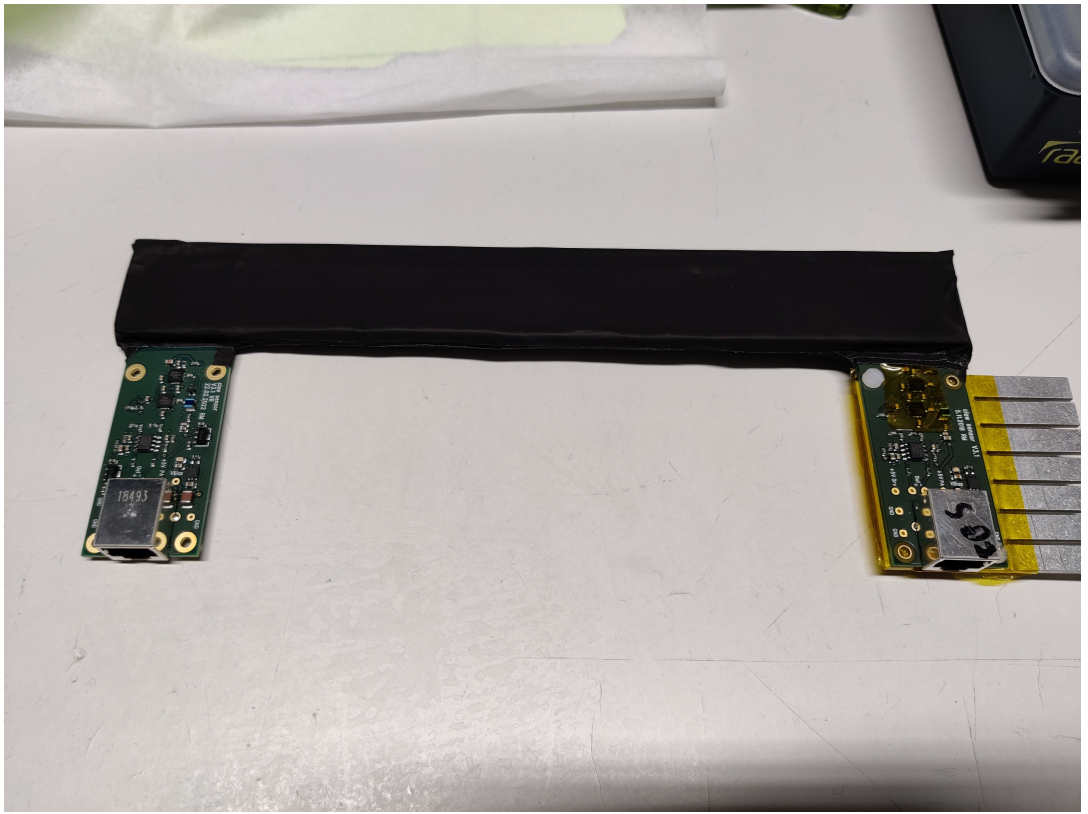
- Simulating nine different bar lengths results in:

- $f(x) = 5386 * x^{-0.88}$

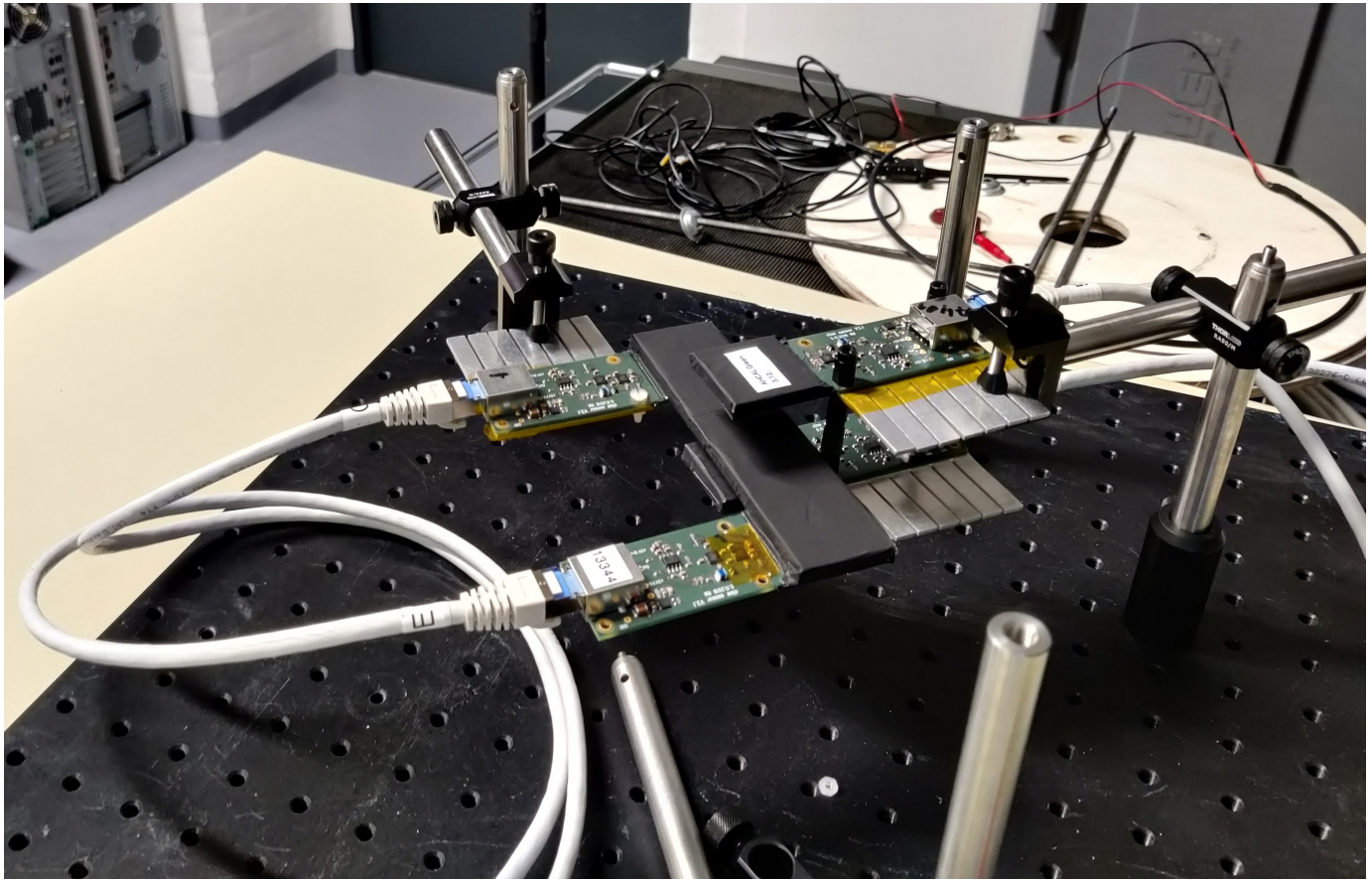


Experimental setup

- 2 Bars:
  - 120 x 30 x 5 mm
  - 240 x 30 x 5 mm
- 2 Trigger with different geometries dependings on the measurement
- Moveable stage for easier operation

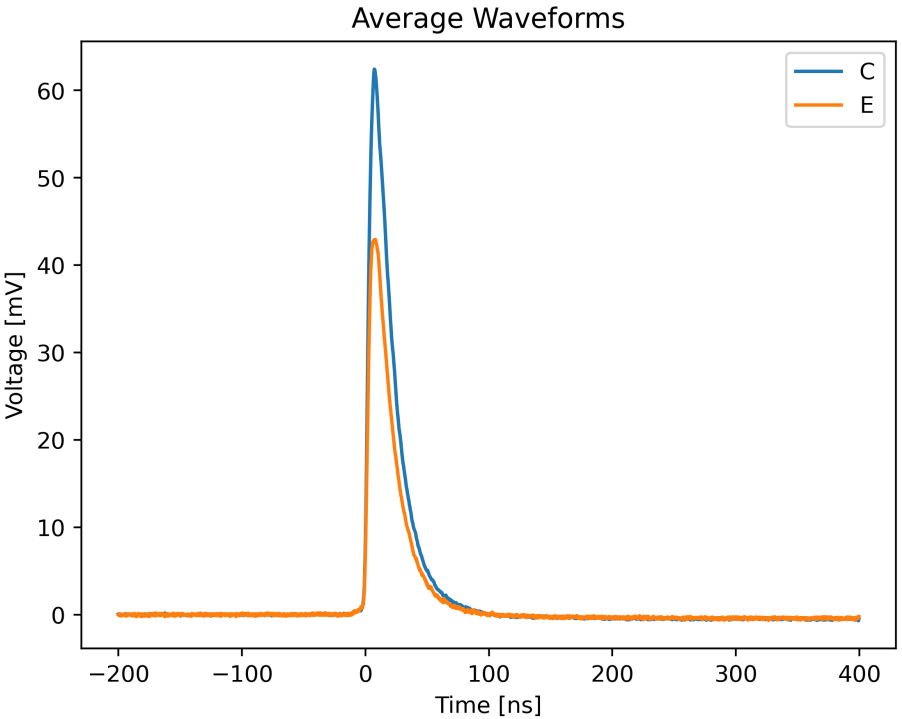


Experimental setup

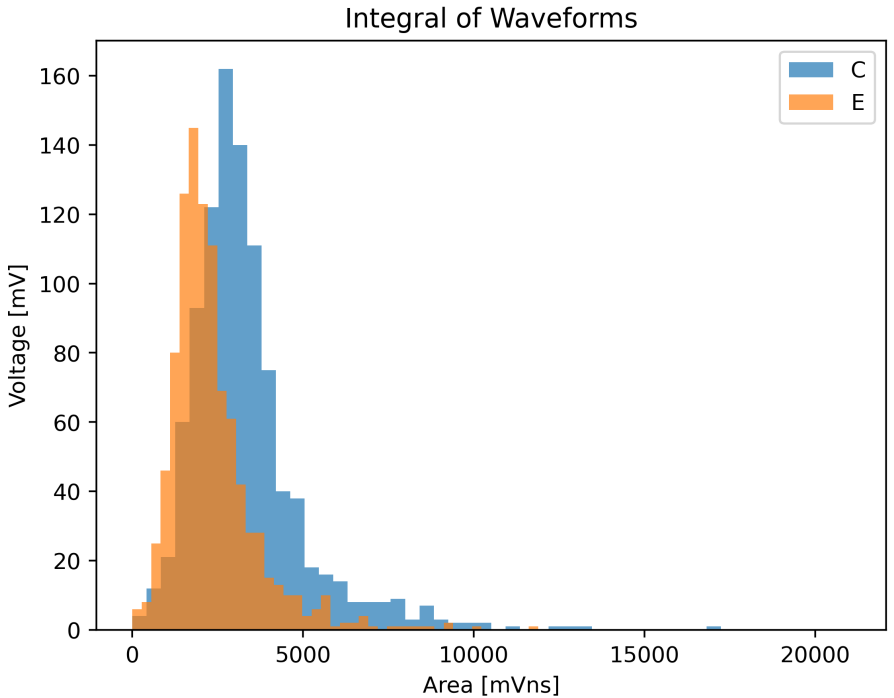


Results: Muon measurements

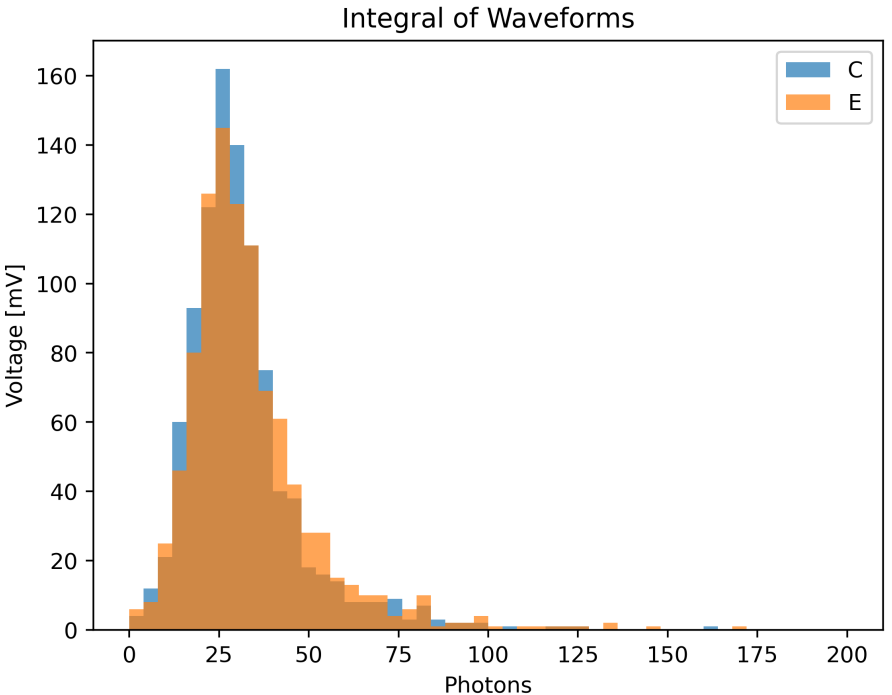
- All results are from the 240 x 30 x 5 mm bar
- Data taken from 1000 Muons measured over 4 days
- Different height of peaks due to different boards / slightly adapted electronics



Lightyield from experiment

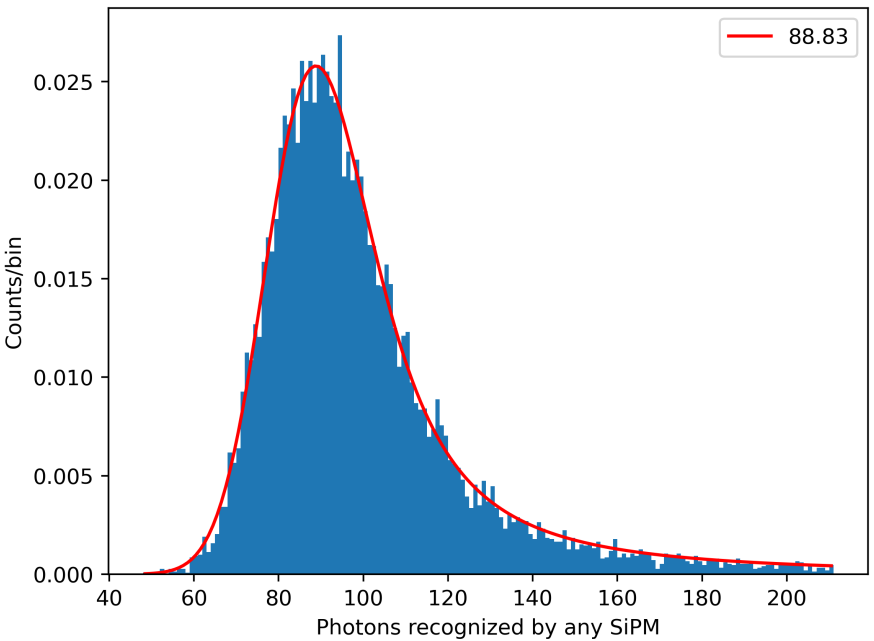


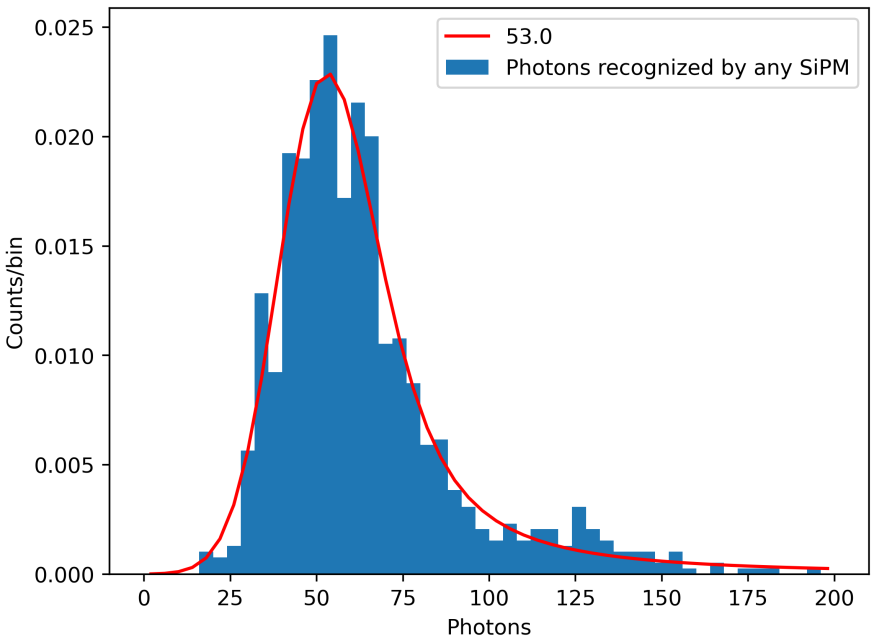
Before p.e. calibration



p.e. calibrated

Lightyield from experiment

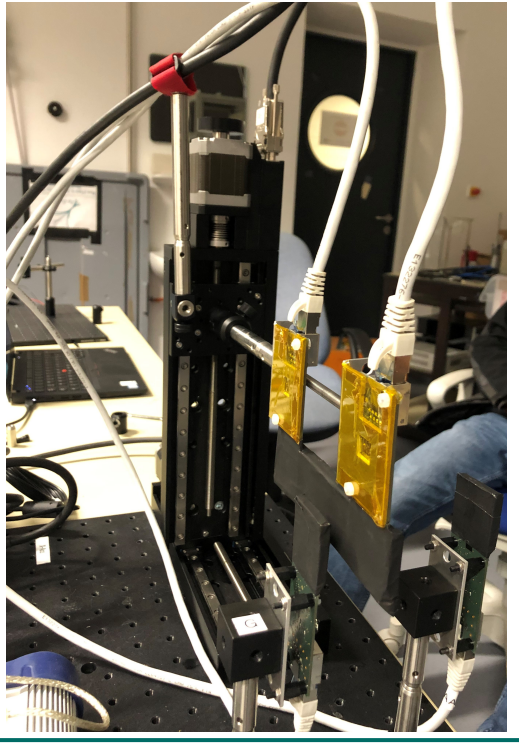




→First results yield smaller light yield, still high enough to be distinguished from background

Test beam plans

- Take data for small and long bar
- Understand general behaviour of bar for e.g. reconstruction of hit position from SiPM signals
- Increase position resolution with small trigger cube (5 x 5 mm)
- Time resolution measurements
- Automated scanning of the bar with movable stage



Outlook

- Analysis of test beam results from current setup
- Simulations with other dimple sizes, as this is a 5mm setup now
- Improvement / deeper consideration of dimple placement for 2 SiPM setup
- Hit detection with bar scintillators
- Timing studies for bar scintillators