

# First detector module test measurements of the forward endcap in the Bonn teststation

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PANDA LIII. Collaboration Meeting 2015-06-09

## Motivation

The Bonn  
teststation

Design of the  
teststation

Construction

Signal  
procession

Test setup

Measurements

First results

Analysis

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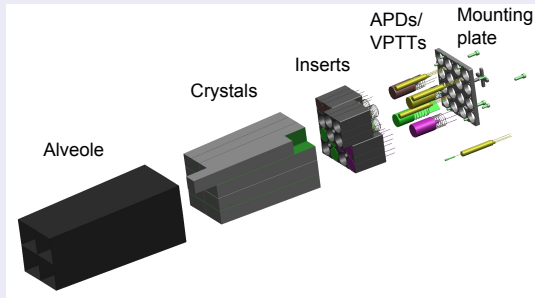
## Analysis

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## Detector Submodule Assembly



- Each detector submodule needs to be fully operational before being mounted into FW Endcap
- Development of a standardized testing procedure → Teststation needed
- Relative pre-calibration can be done

# Design of the teststation - trigger detector

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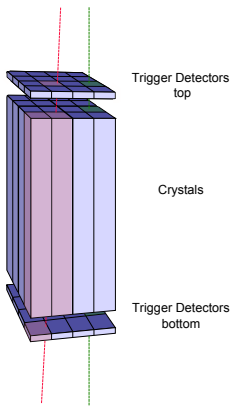
First results

## Analysis

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## Summary



- Compact and capable of generating a trigger signal  
→ SiPM readout
- Detector parts easily exchangeable

- Detection of cosmic particles, which are passing the crystal  
→ 16 squared organic scintillators (Eljen EJ-200)
- Spatial resolution corresponds to the front face of the PANDA crystals  
→ two different scintillator sizes
- Experimental conditions:  $-25^{\circ}\text{C}$   
→ climate chamber



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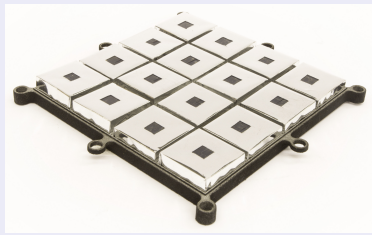
First results

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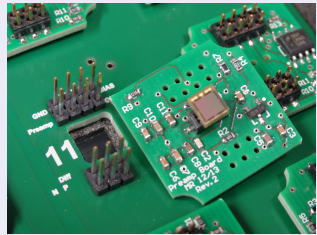
Approach I  
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## Array of 16 scintillators



## Preamplifier with SiPM



- Casing printed from aluminum-nylon composite material
- Scintillator wrapped in mylar foil
- SiPMs coupled to front face of the scintillator
- Preamplifier enhances signal and generates differential signal for further processing

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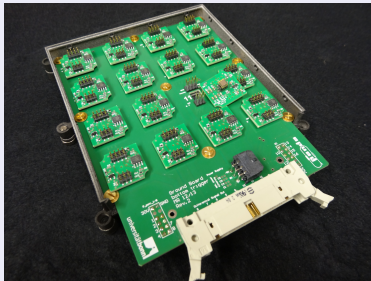
Analysis

Approach I

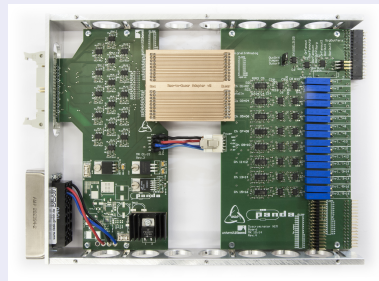
Approach II

Summary

## Ground board

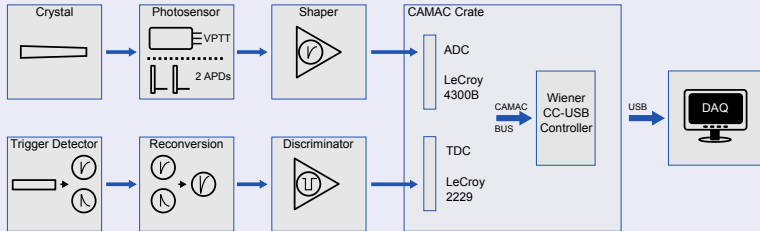


## NIM discriminator



- SiPMs receive individual supply voltage via ground board
- Signals transmitted via differential wires to reconversion board
- Low discriminator threshold adjustable

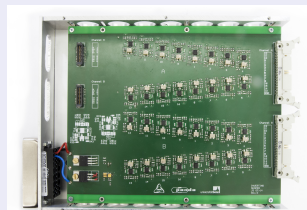
## Scheme of the test setup



## Crystal Signal processing

- Test of one submodule with 16 crystals
- Crystal signals shaped to fit ADC
- FERA-ADCs for readout

## NIM shaper





# Test setup

Motivation

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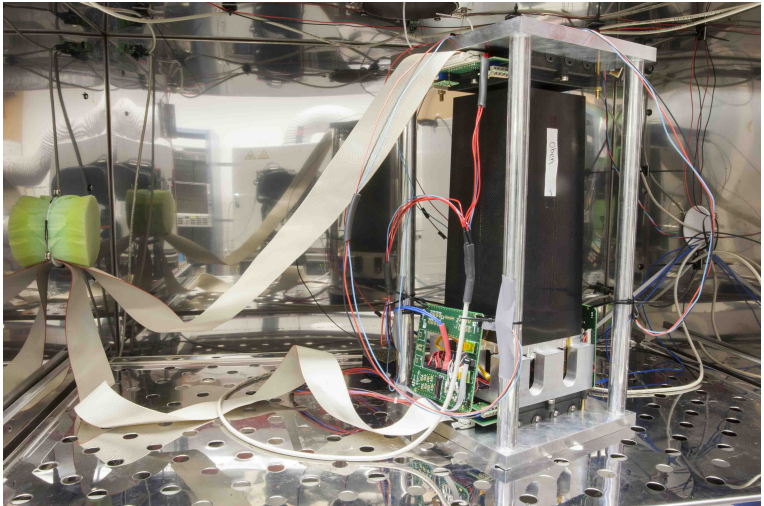
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**Measurements**

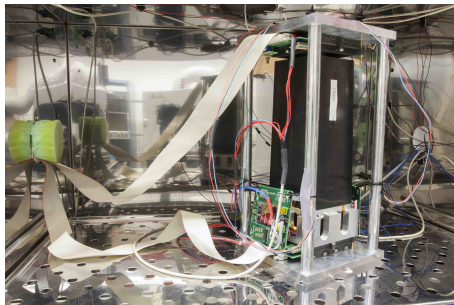
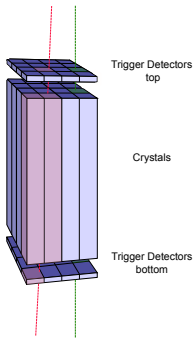
First results

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## Measurement procedure:

- 2 Setups per climate chamber are cooled down ( $\approx 4$  h), measured for 72 h and warmed up again ( $\approx 4$  h)
- Usage of two climate chambers in parallel
- All track types are recorded to have better statistics

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## The Bonn teststation

- Design of the teststation
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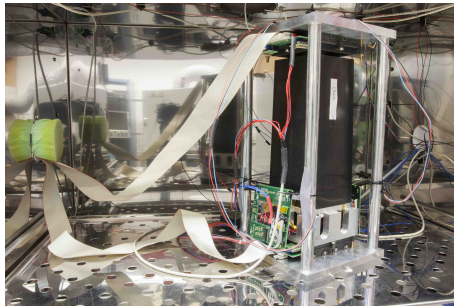
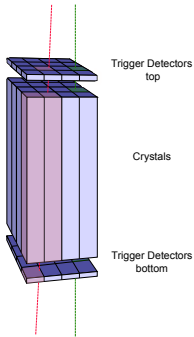
## Measurements

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## Aims of the Measurement

- Test of submodule functionality
- Do a relative pre-calibration



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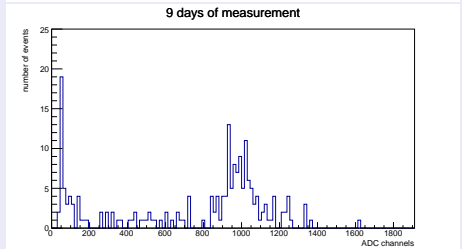
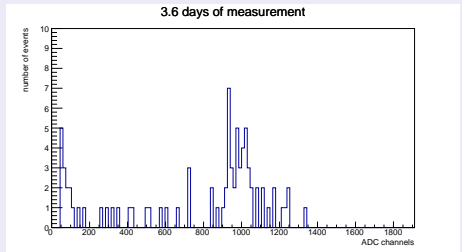
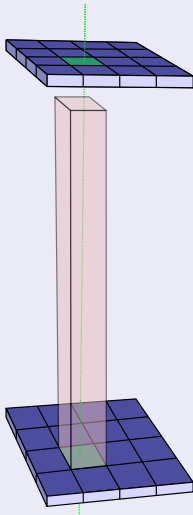
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## Track type 1



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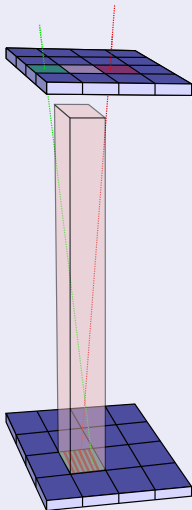
Analysis

Approach I

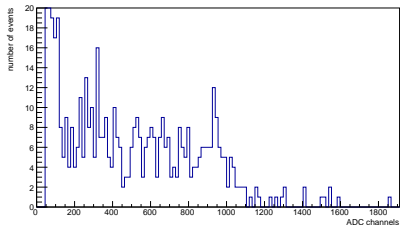
Approach II

Summary

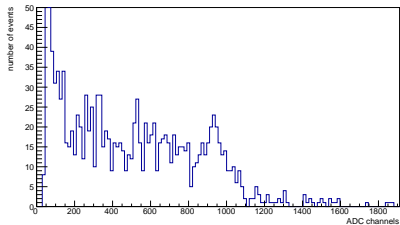
## Track type 2



3.6 days of measurement



9 days of measurement



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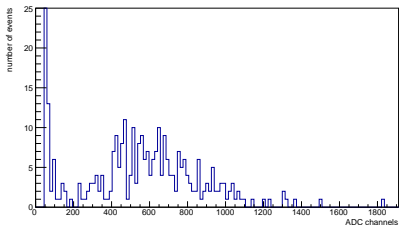
Approach II

Summary

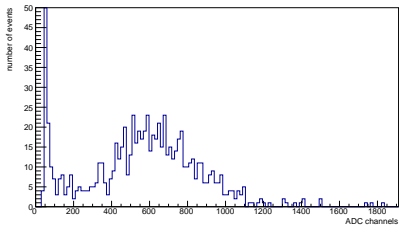
## Track type 3



3.6 days of measurement



9 days of measurement



Motivation

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Approach I

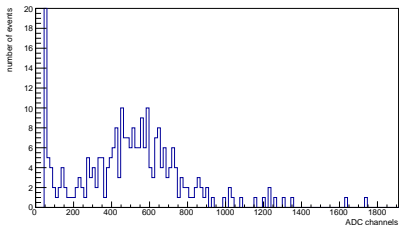
Approach II

Summary

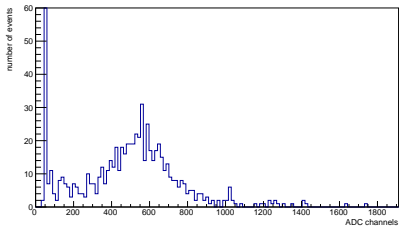
## Track type 4



3.6 days of measurement



9 days of measurement



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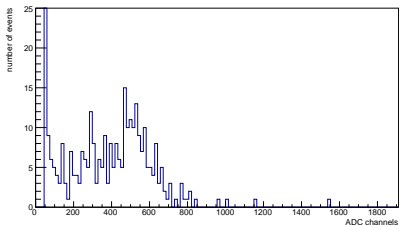
Approach II

Summary

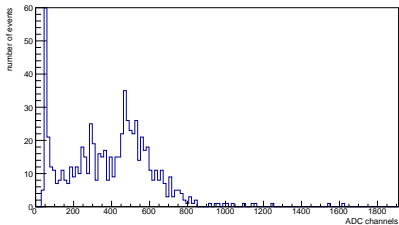
## Track type 5



3.6 days of measurement



9 days of measurement





Motivation

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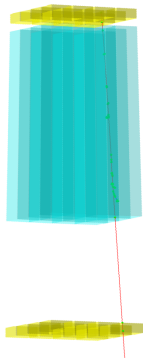
First results

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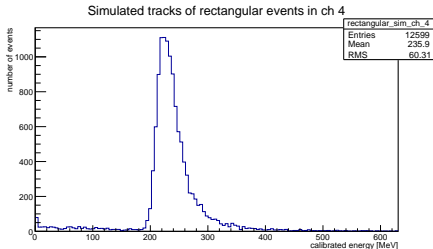
Summary



# Simulation

## Simulation

Simulated particles within geometry  
of teststation setup using Geant4  
with *Cosmic Ray Shower Generator*  
(CRY) library from LLNL



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## Goal of the analysis

Compare measured and simulated data to obtain pre-calibration for each of the crystal channels

### Approach I

- Fitting functions to measured and simulated data
- Compare peak values of different tracks
- Do linear regression through different points

### Approach II

- Fit simulated spectra directly to measured histograms
- Get mean of different calibration factors

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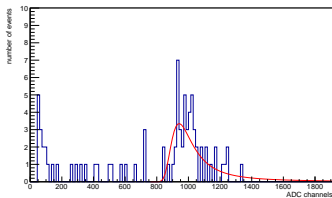
Approach I

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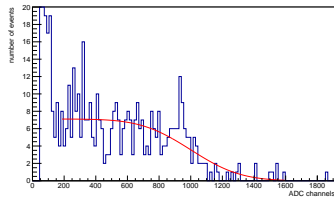
## Type 1 events:

3.6 days of measurement

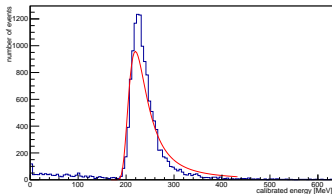


## Type 2 events:

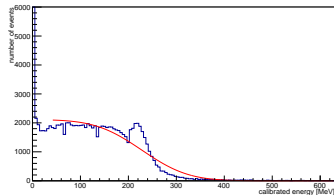
3.6 days of measurement



Simulated data



Simulated data





# Approach I

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- Design of the teststation
- Construction
- Signal procession
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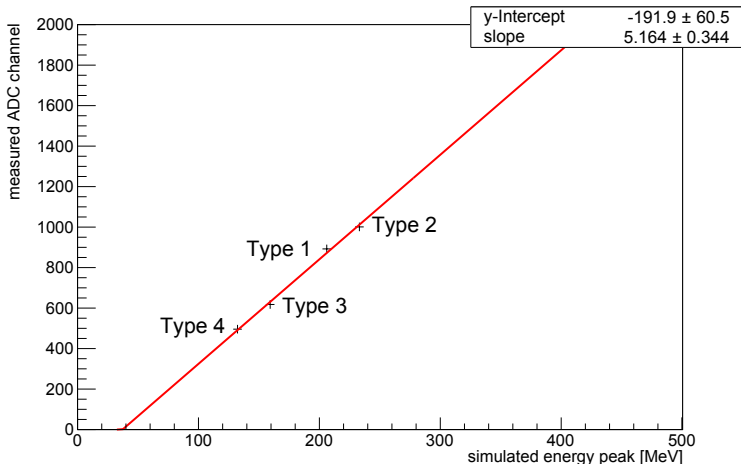
Measurements

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- Approach I**
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⇒ Obtain relation to calibrate Spectra.

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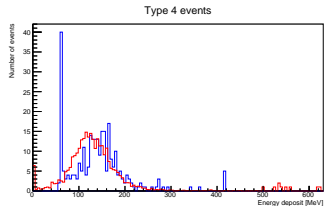
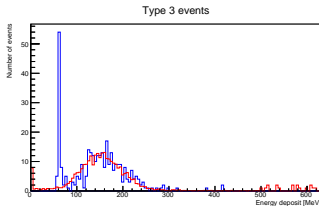
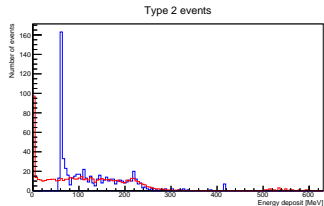
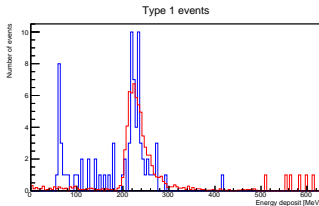
First results

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# Approach II - First results

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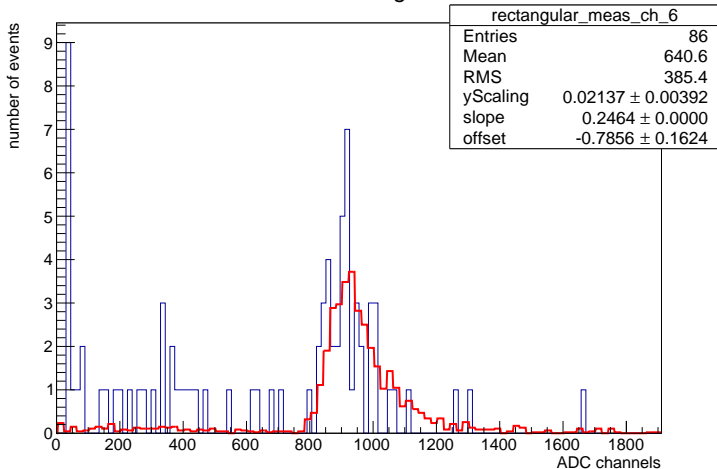
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Approach I

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Measured tracks of rectangular events in ch 6



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## Summary:

- First submodule teststation built up
- First Cosmic particle simulation looks promising
- Approach I: fundamentally working
- Approach II: work in progress

## Outlook:

- Both approaches need to be evaluated further and need to be compared
- Setup needs to be duplicated
- Test and pre-calibration of 268 detector submodules



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Thank you for your  
attention!