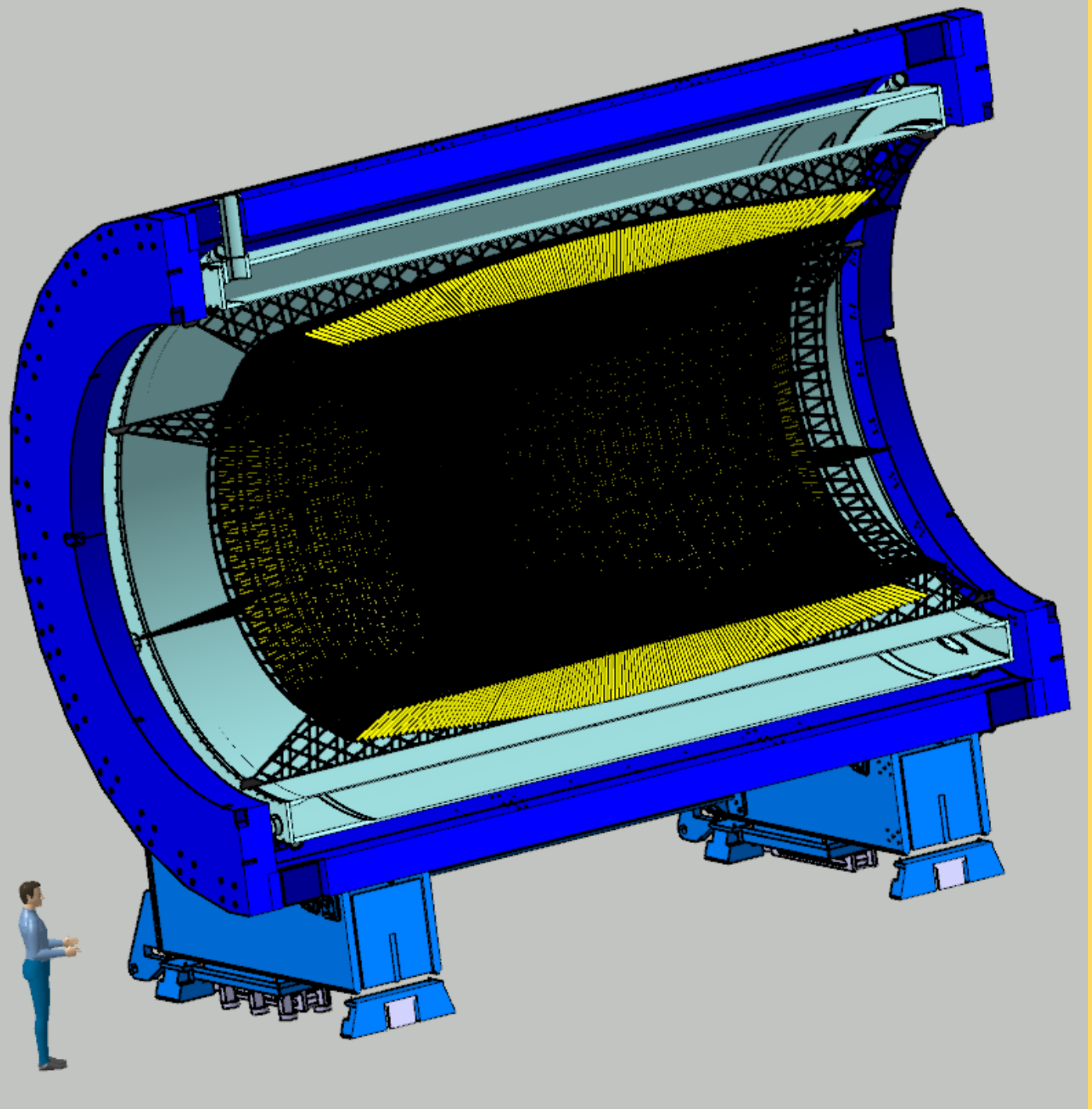
Ecal status

Construction

Tests

MC simulation

WARSAW
October 2019
Igor Tyapkin



38400 башен

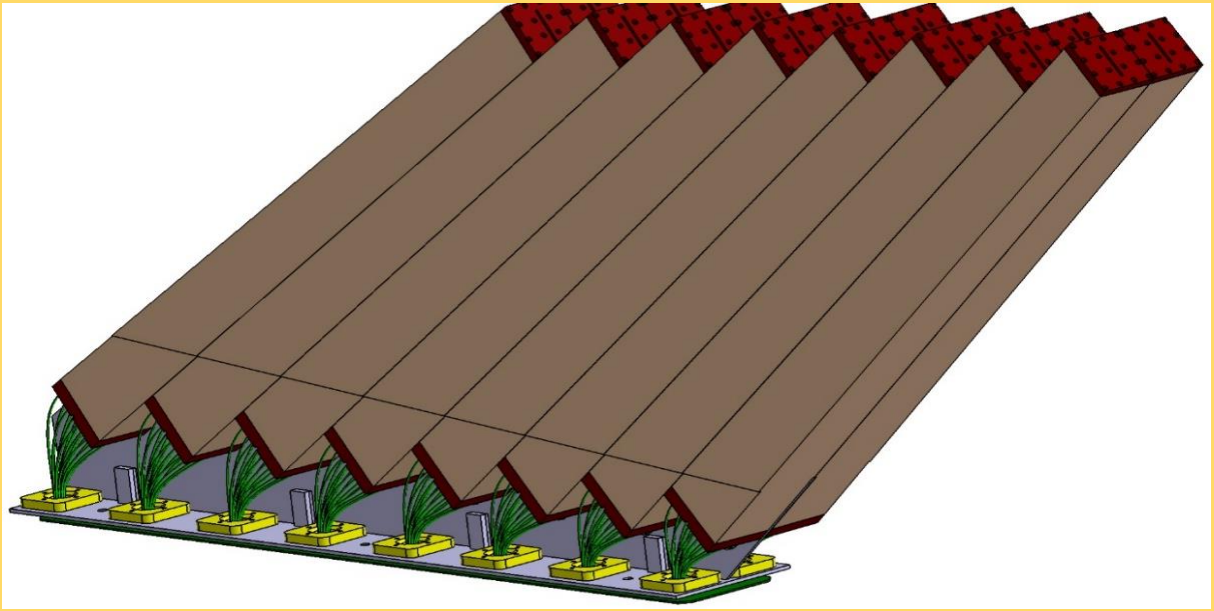
2400 модулей

50 half-sectors → 25 sectors

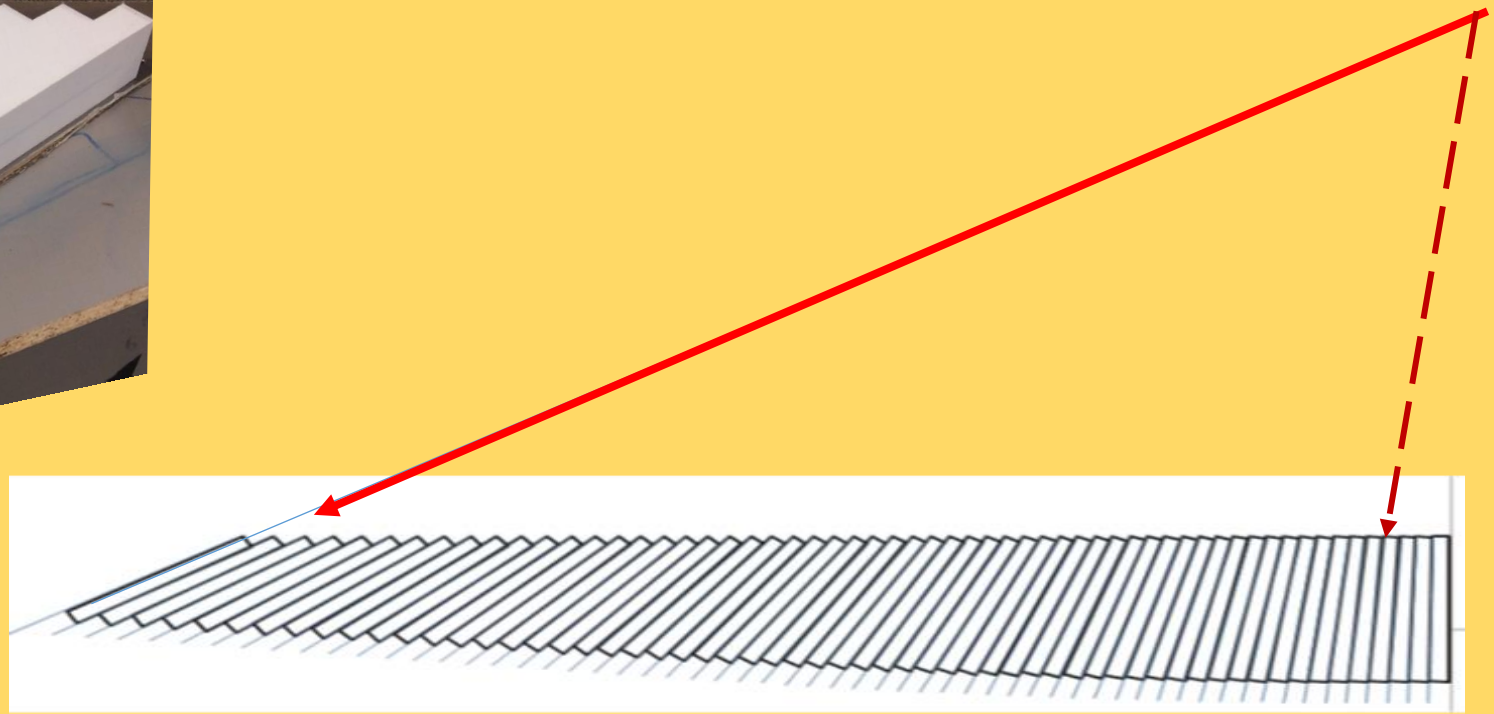
48 modules/half-sector

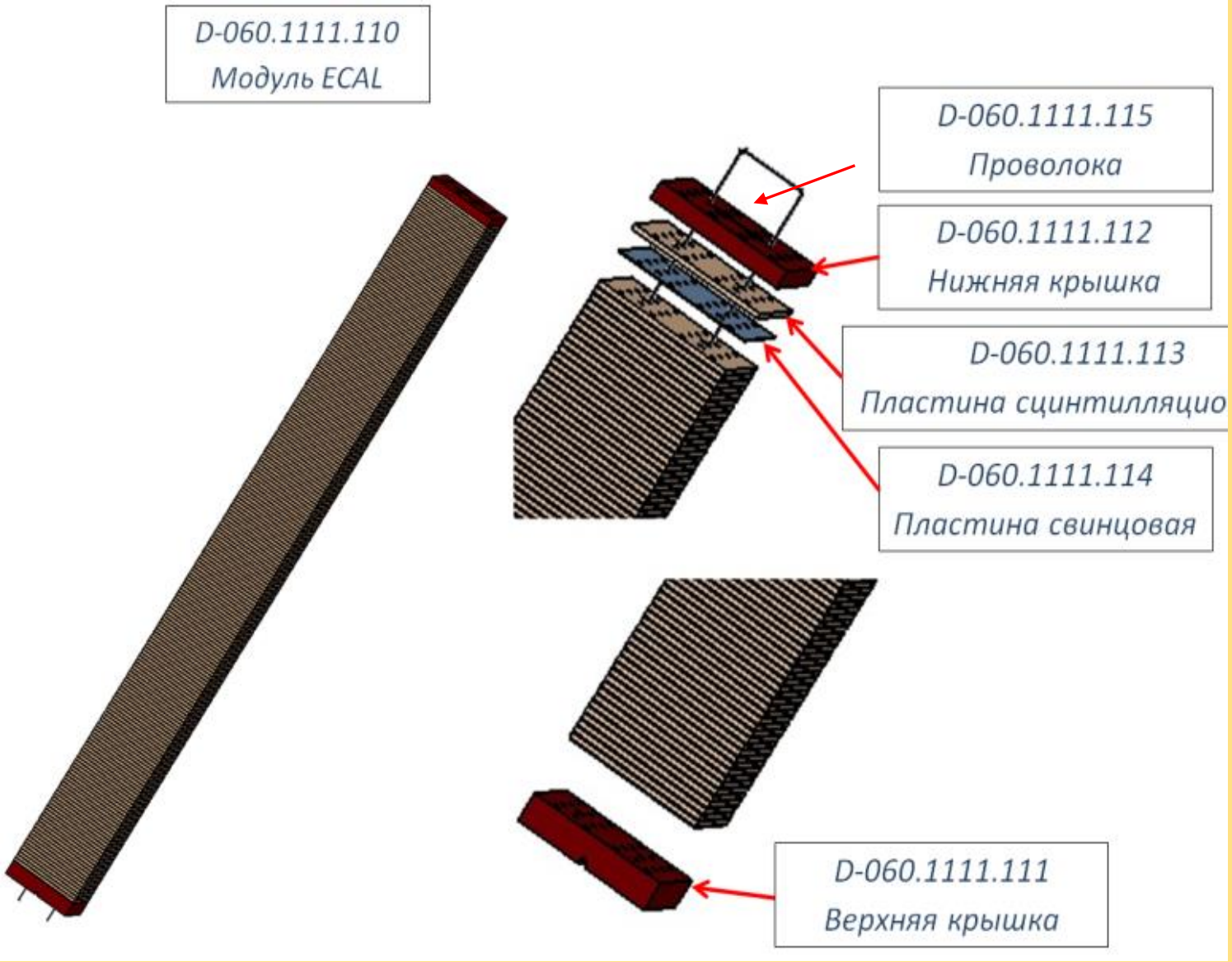
50 DAQ stations

Eight Module Types for Projective Geometry of ECAL



8th Module Type
Produced at JINR
Tested at DESY





- **Scintillator plates**

  Polypac company (Dubna) and Uniplast company (Vladimir)

  100% is done

- **Lead plates**

  Russia (25%) and China (75%)

  in progress under study

- **Pressure plates and fiber bonding plates**

  Polypac (Dubna) –

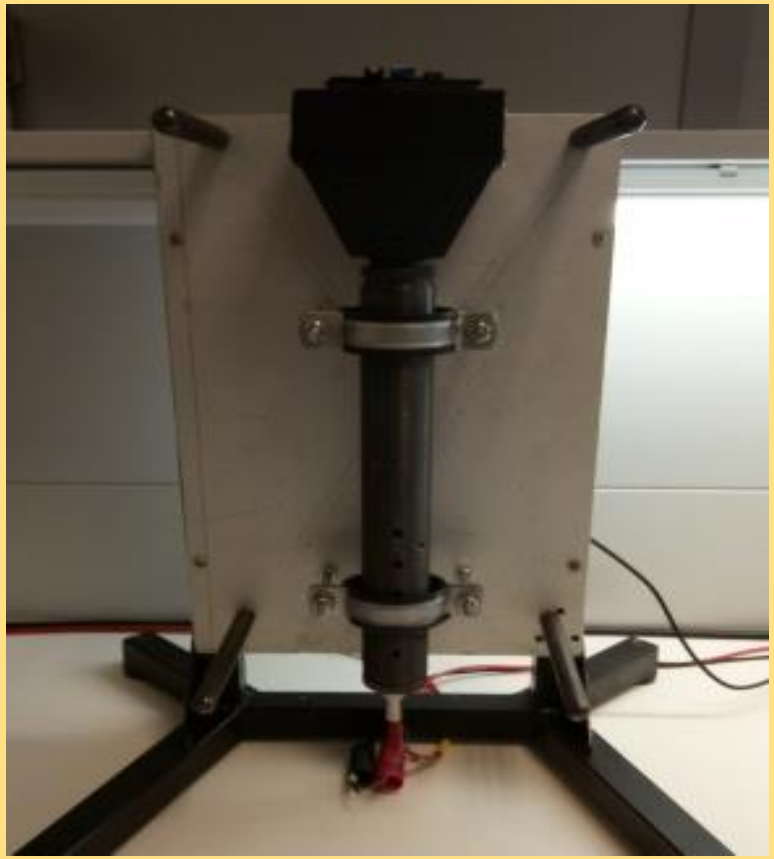
  100% is done

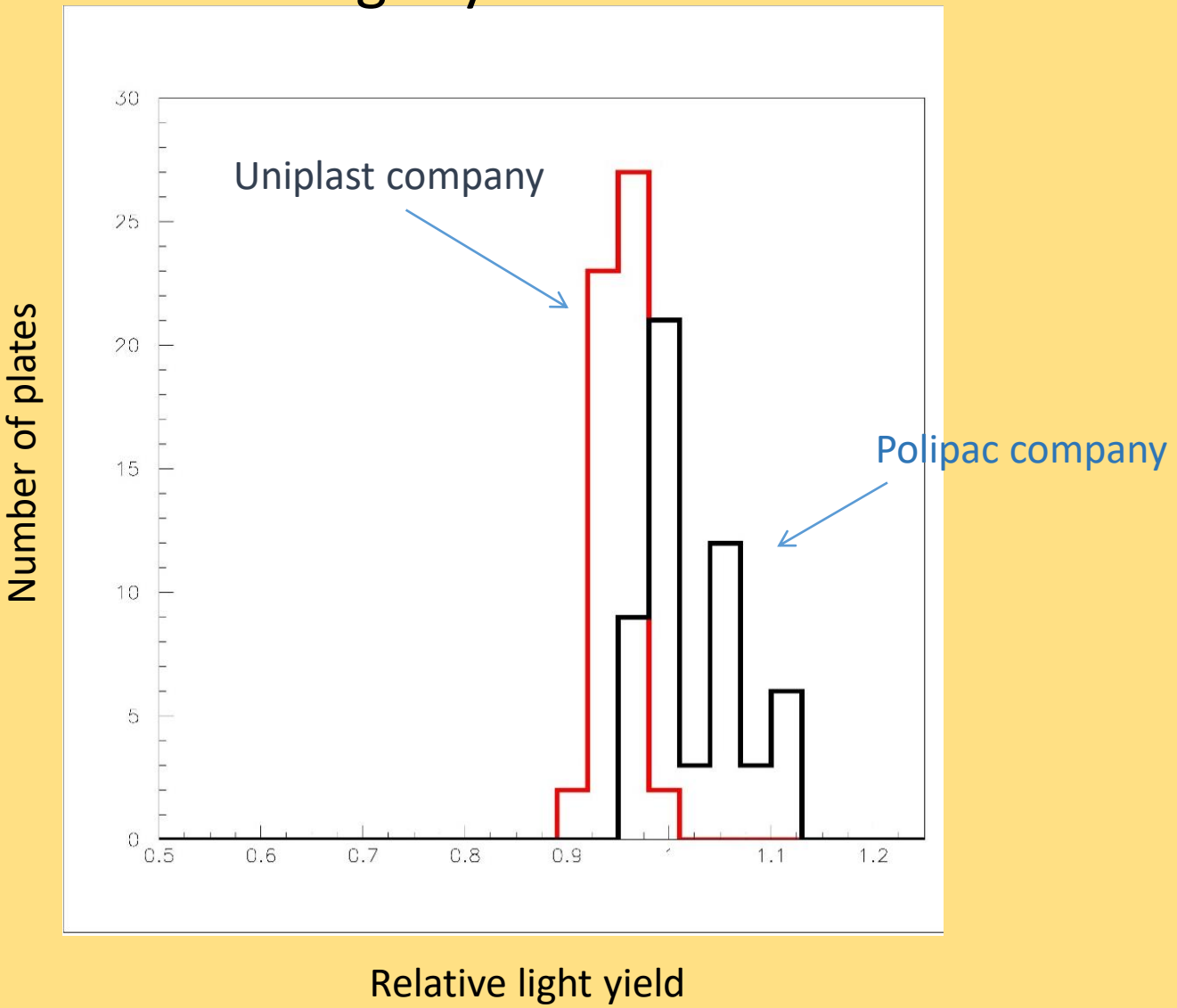
- **WLS fibers. Kuraray (Japan).**

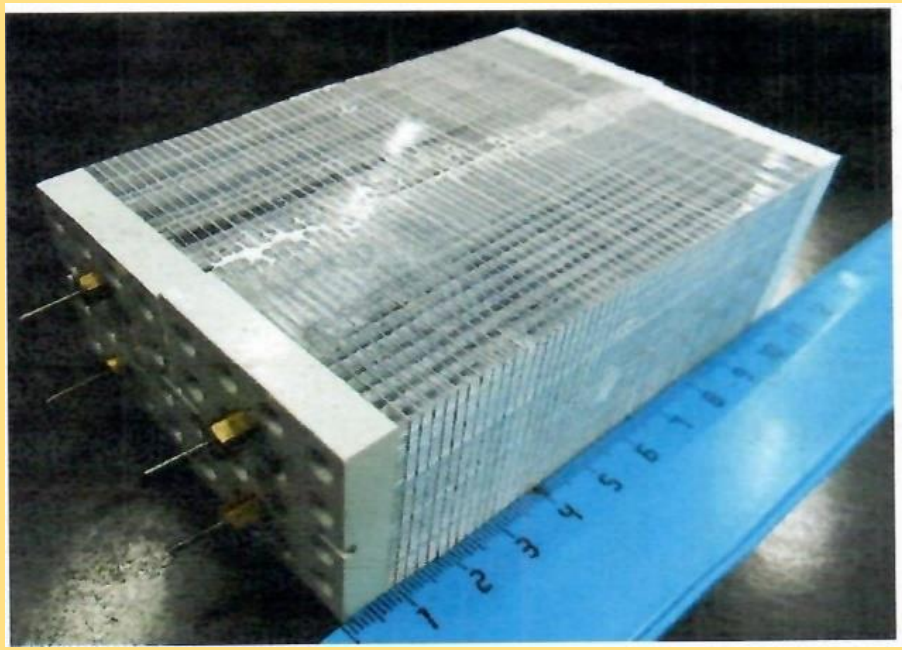
  Russia (25%) and China (75%)

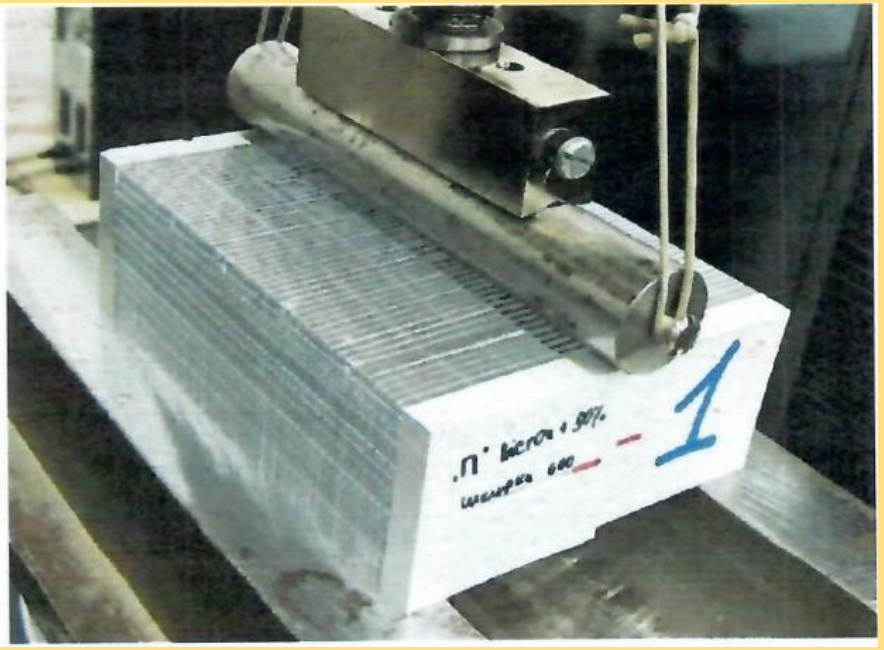
  100% delivered under study

Typical measurement results of relative light yield

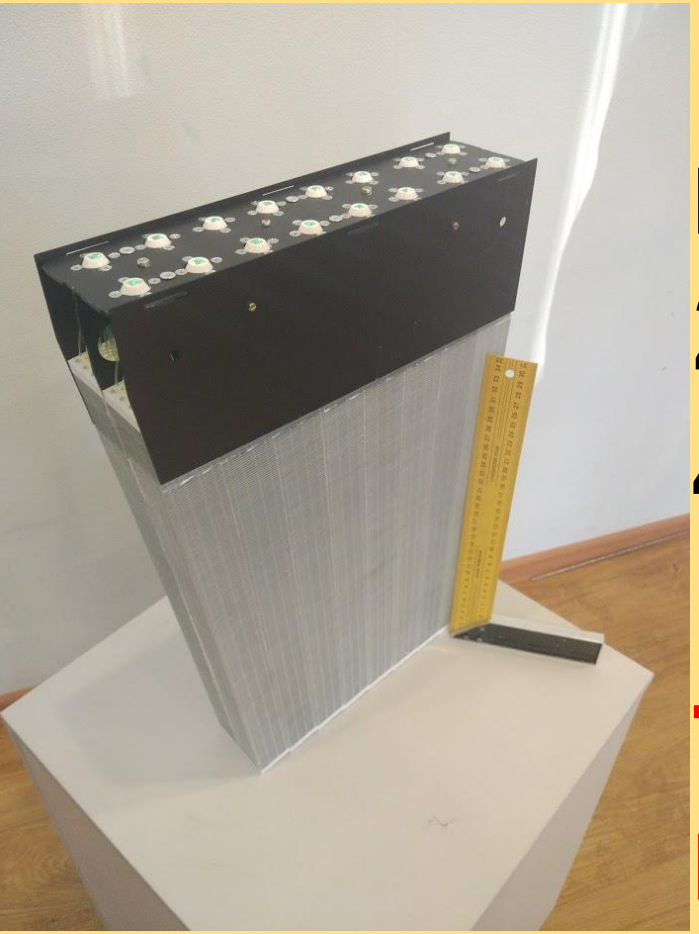








Example	2	1	3	4	5	6	7	8	9
Destructive load, [H]	3151	3884	3231	918	4400	3565	2763	2271	11094
Displacement **[мм]**	0,33	0,33	0,29	0,39	0,39	0,45	0,27	0,21	0,59



Protvino

Production started

2019-2020

440 modules

China

2016 mod

ТЕНЗОР

Production started

2019-2020

250 modules

China production site

Contribution of both sides:

China

Modules production
Electronics production analog part

Institutes：

Tsinghua University (60%)

Huzhou University

Shandong University (20%)

Fudan University (10%)

University of South China (10%)

To guarantee quality:

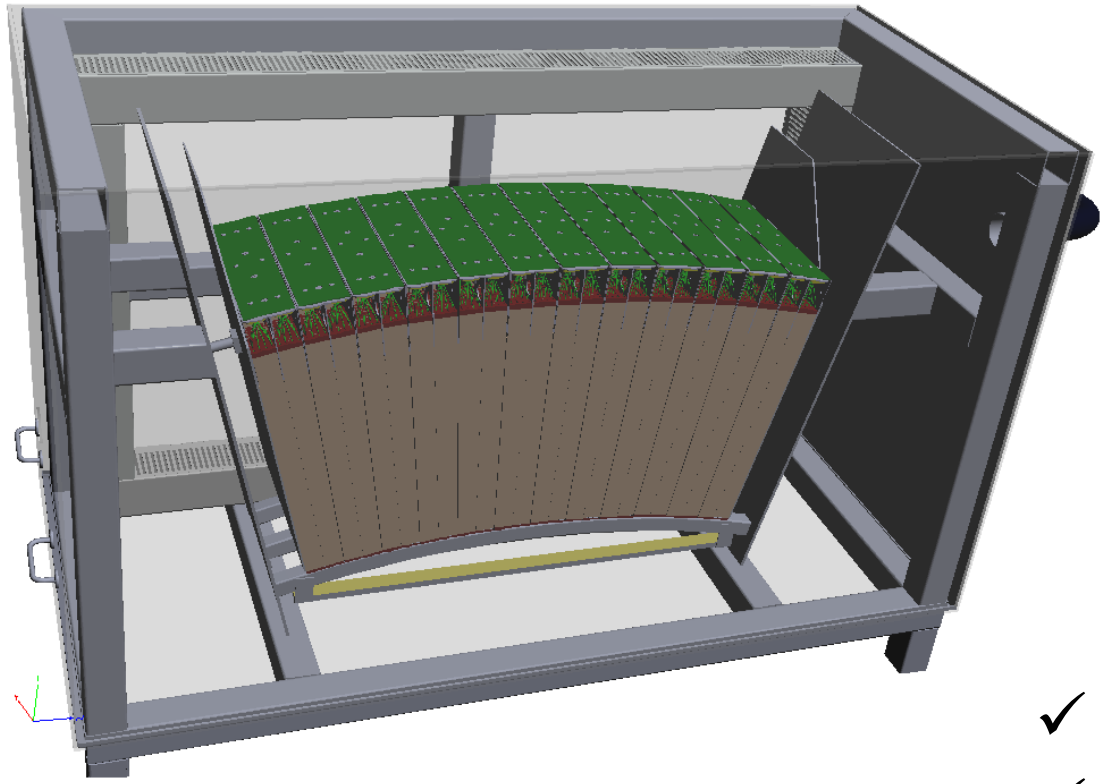
- same material
- same standard
- same procedure

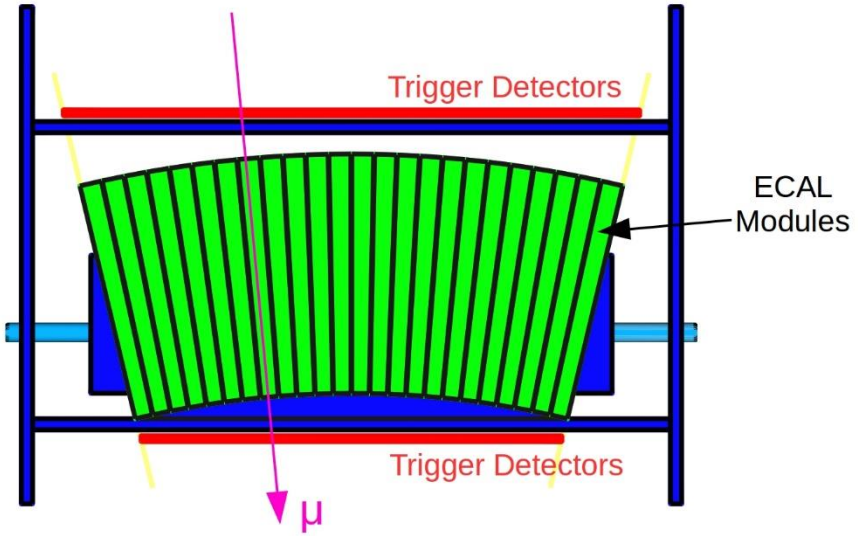
Time line (draft)

- ***2019.8-12*** – ***Preparation for production***
- ***2020.1-2020.6*** – *Preproduction, cosmic test*
- ***2020.7-2021.6*** – ***Finish production***
- ***2020.8*** – *Install on MPD*
- ***2021.10*** – ***Finish install and detector commission***
- ***2021.11*** – *Start commission*

Stand for ECAL Modules Calibration

A. Semenov

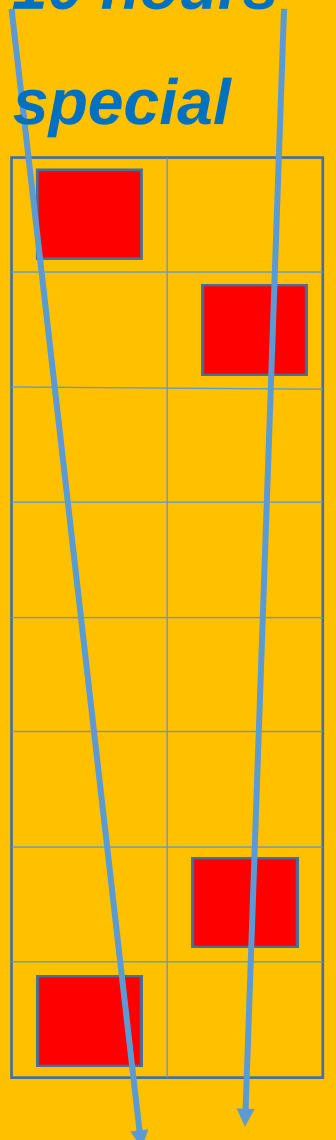


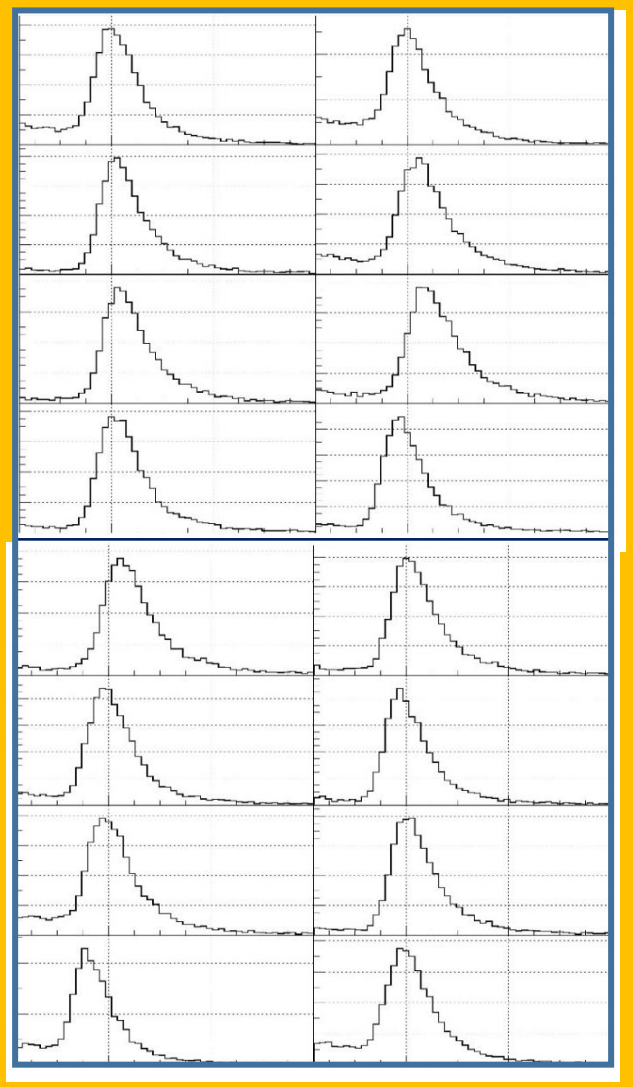


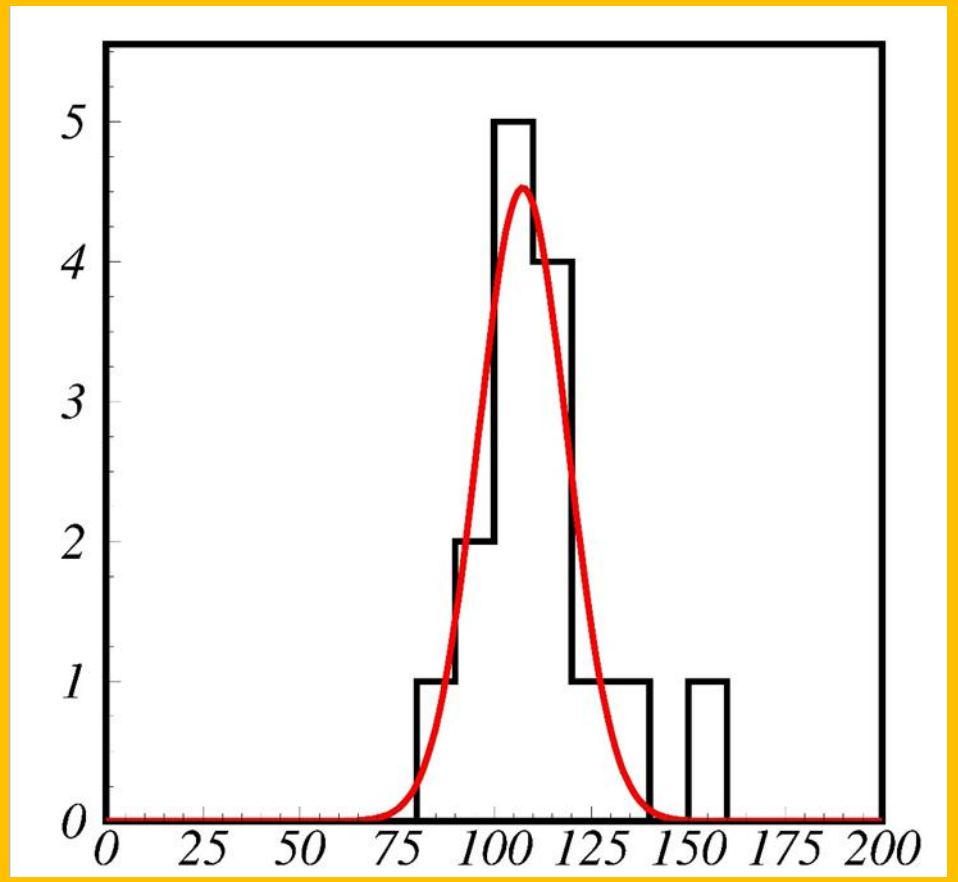
- ✓ *Cosmic rays*
- ✓ *Test one load (12 modules) in 10-14 days*
- ✓ *8 stands for 8 types of modules*
- ✓ *All modules test and calibration in about 1 year*

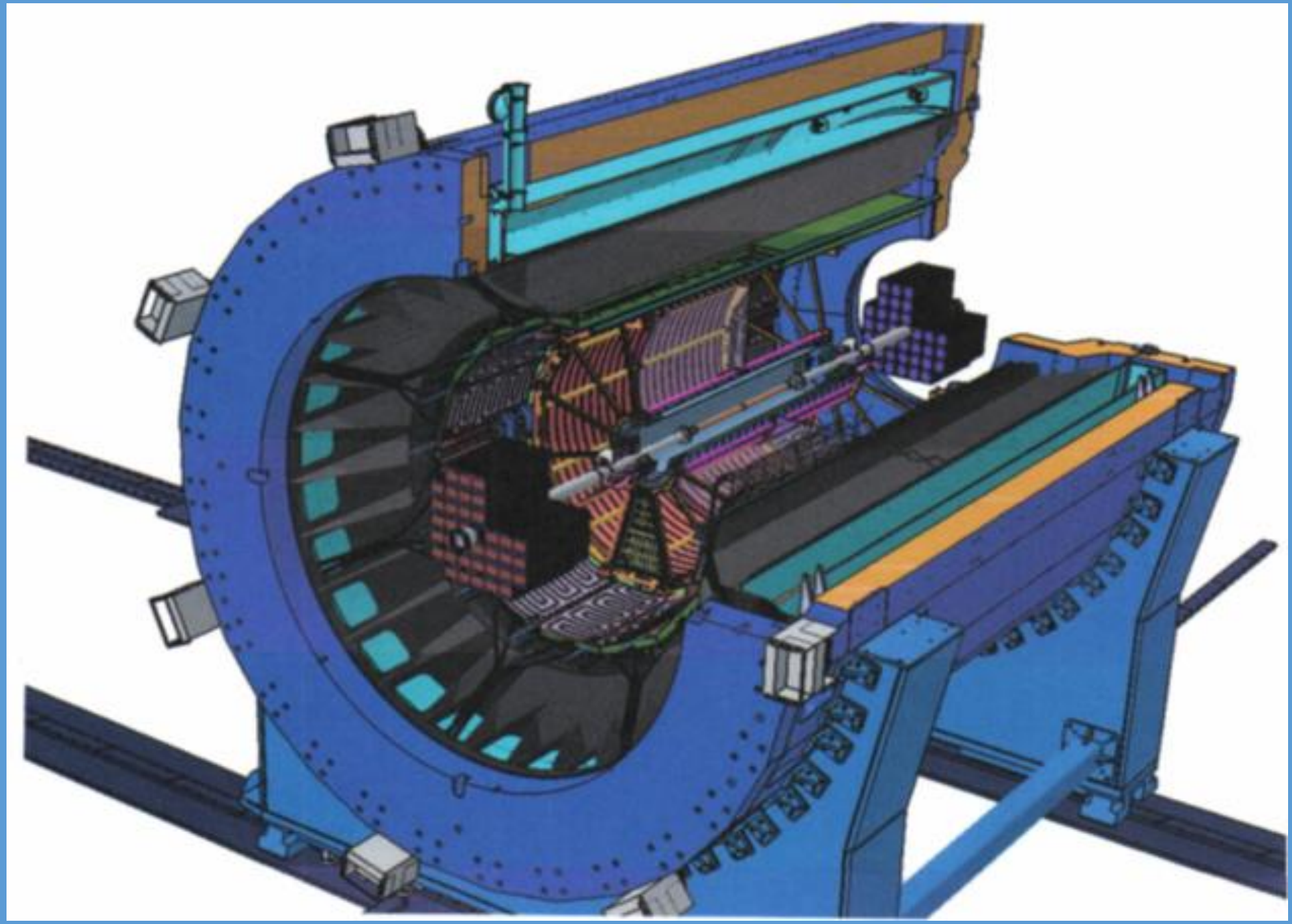
Simplified ECAL Modules Calibration

- ✓ *Cosmic rays*
- ✓ *Calibrates any number of modules in 10 hours*
- ✓ *Do not need special equipment*

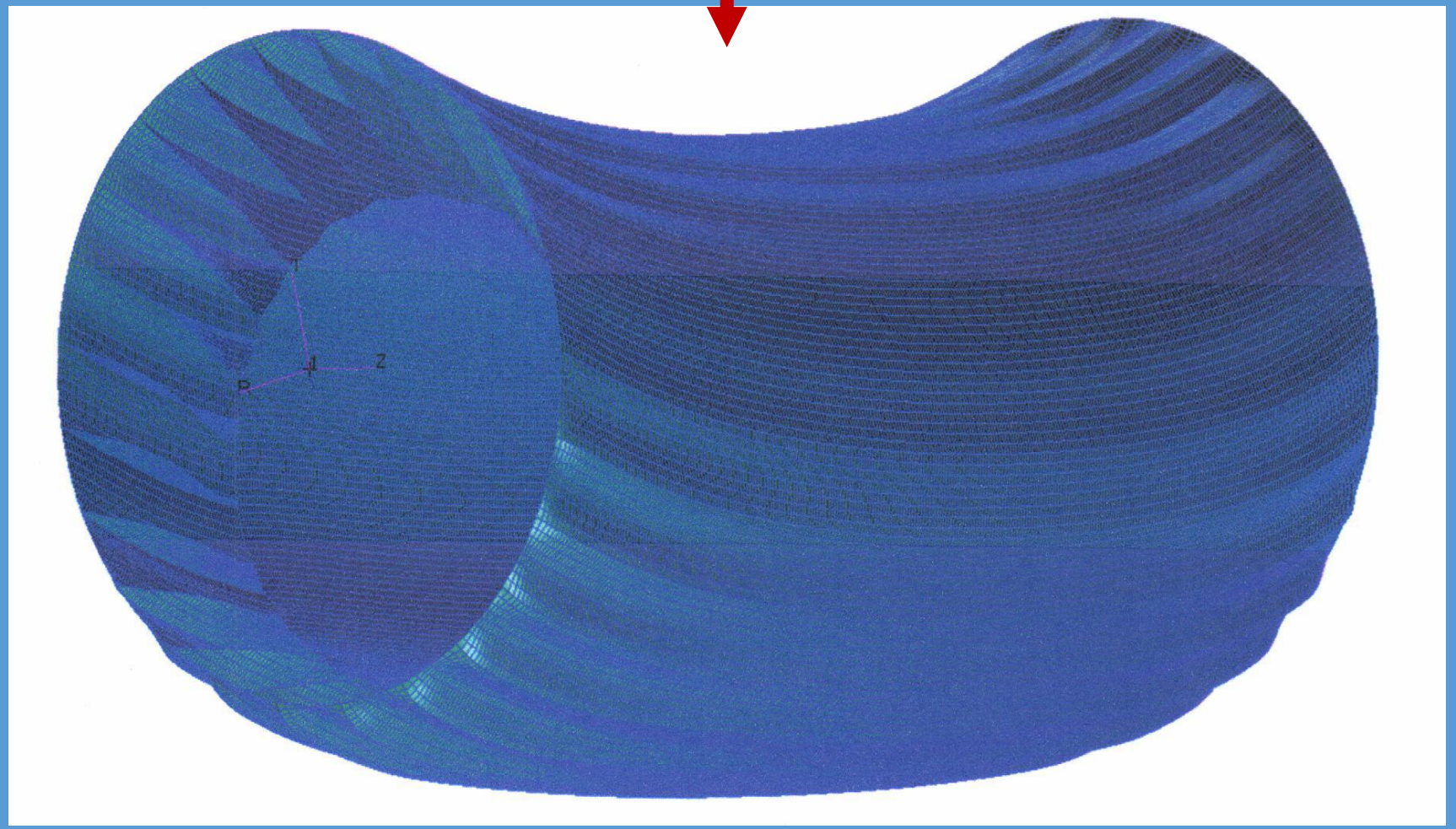




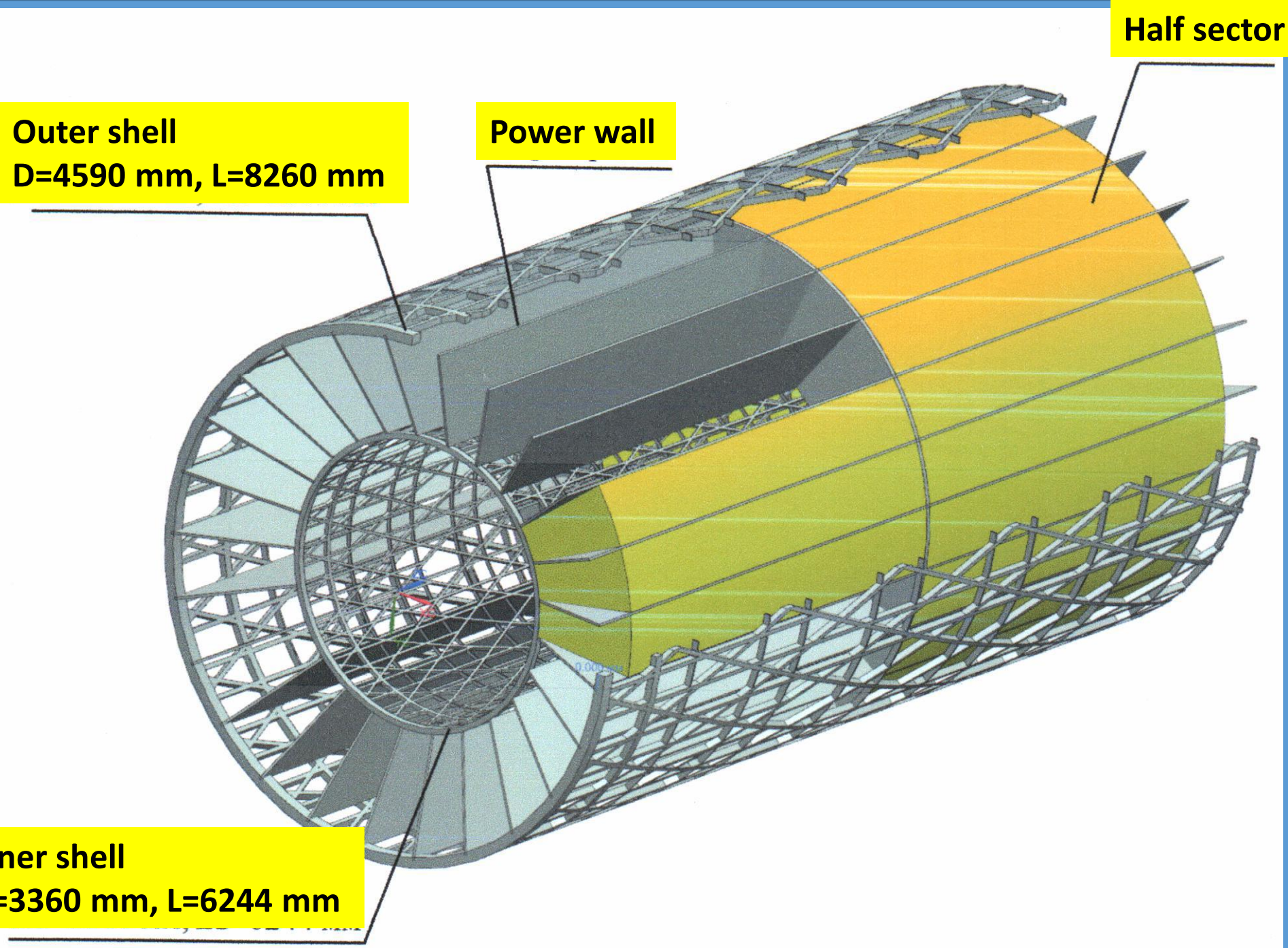




100 Tons **Up to 5 mm**

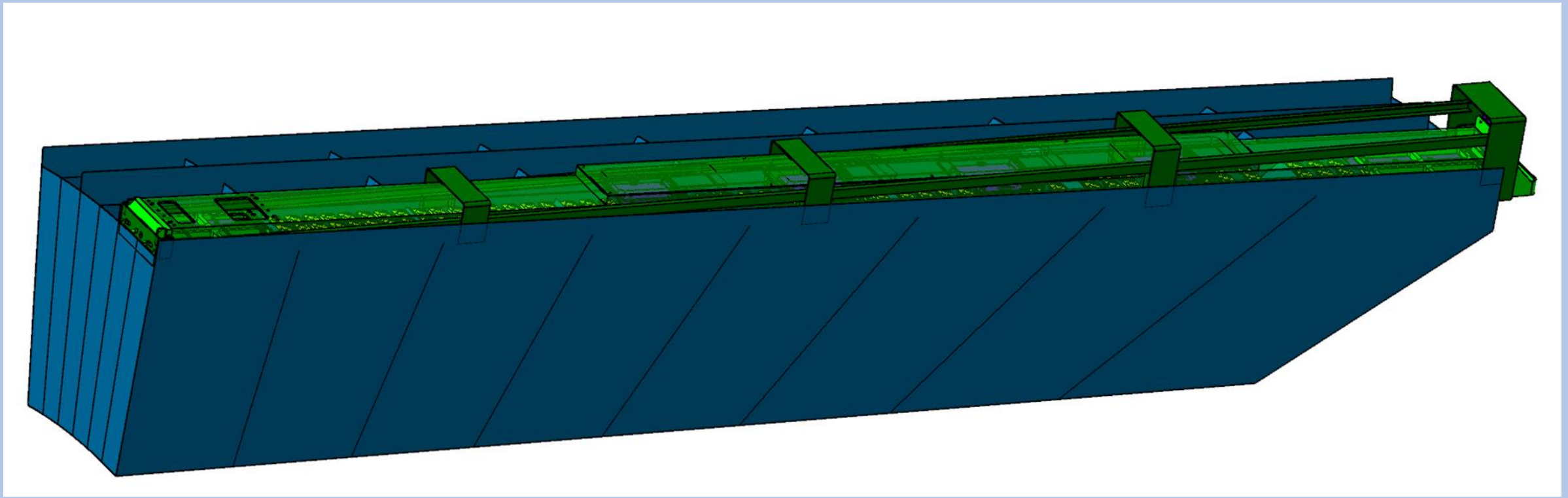


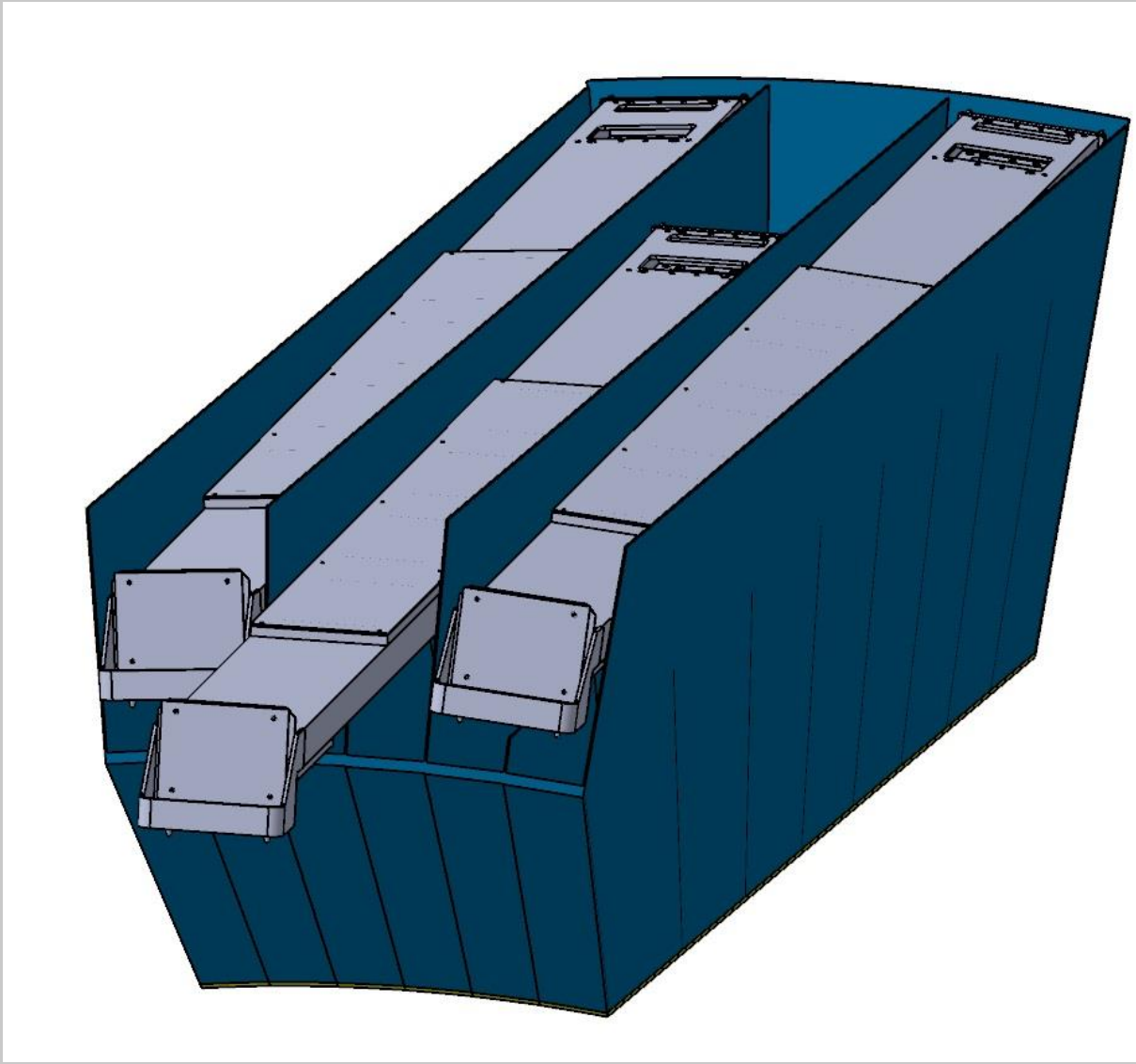
8,26 m !!!

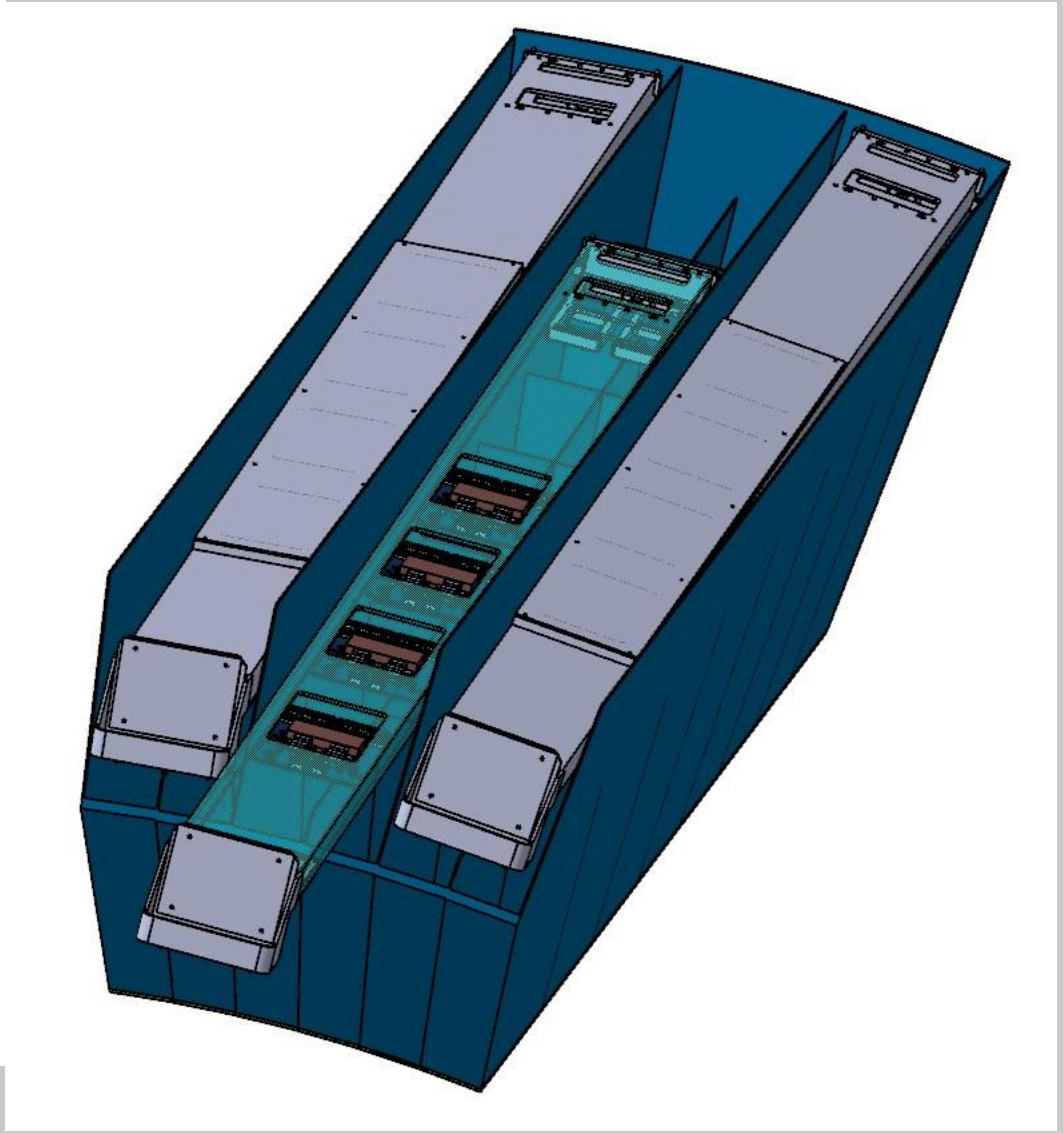

Half sector basket
Outer shell
D=4590 mm, L=8260 mm
Power wall
Inner shell
D=3360 mm, L=6244 mm

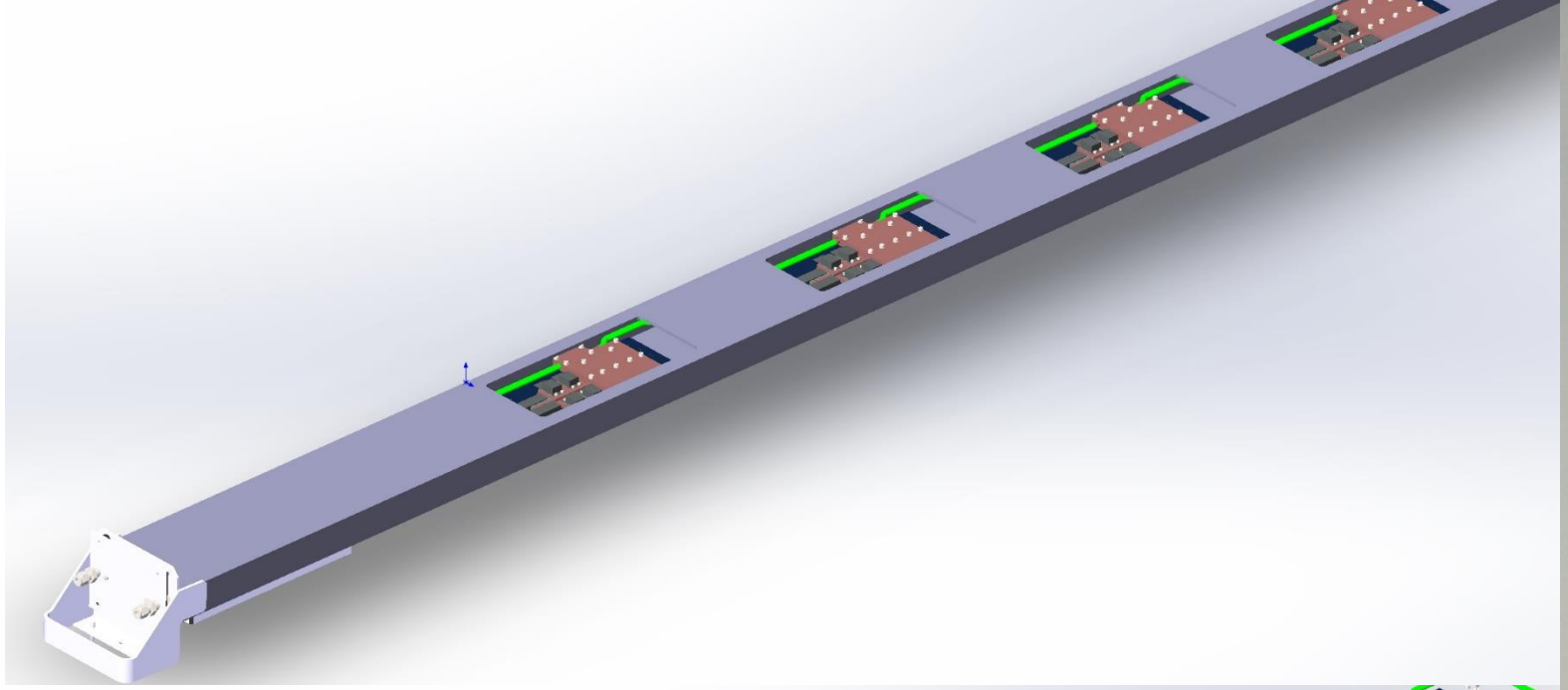
Container for the modules (half-sector)

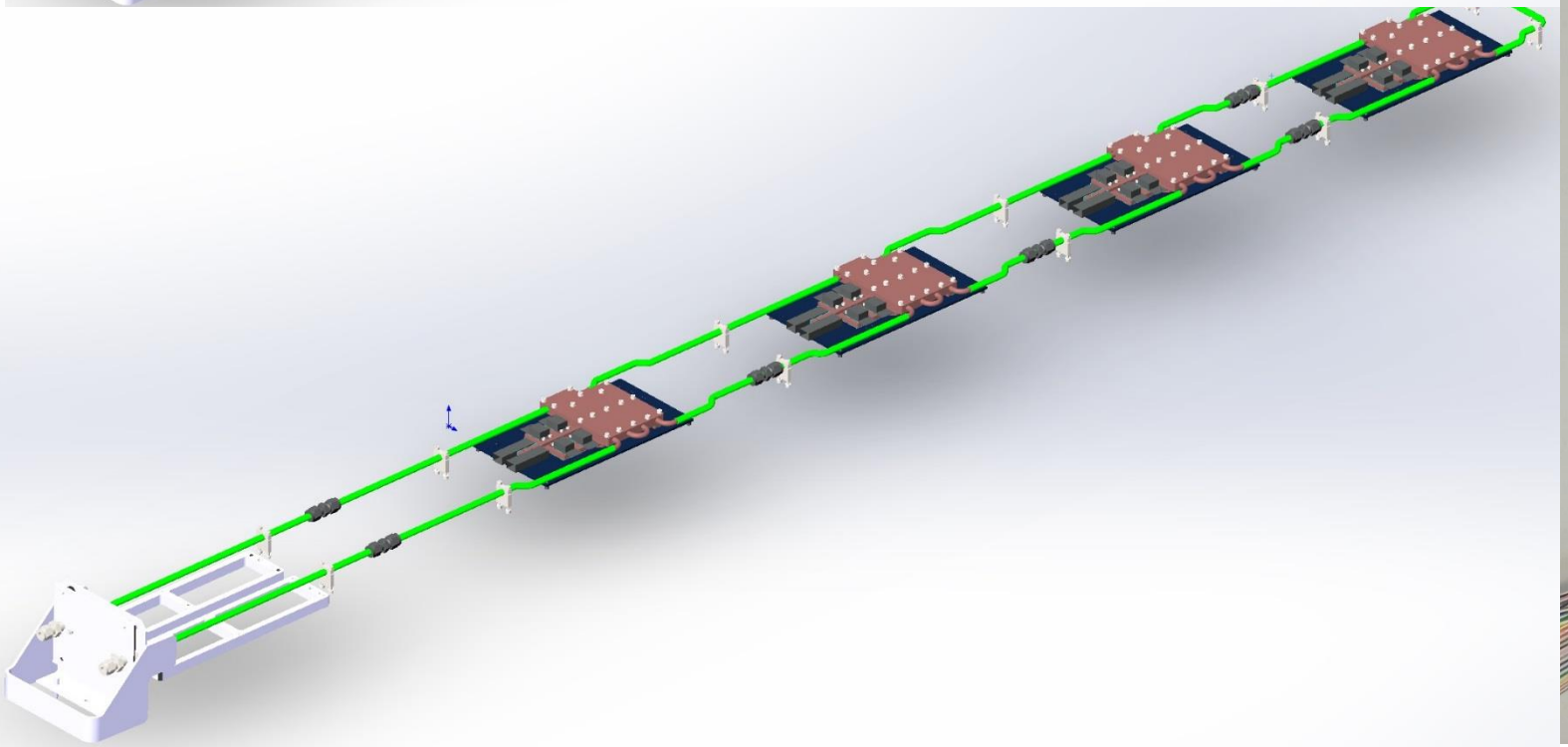
- ✓ *Total load of about 1.2 tons*
- ✓ *Made from carbon composite*

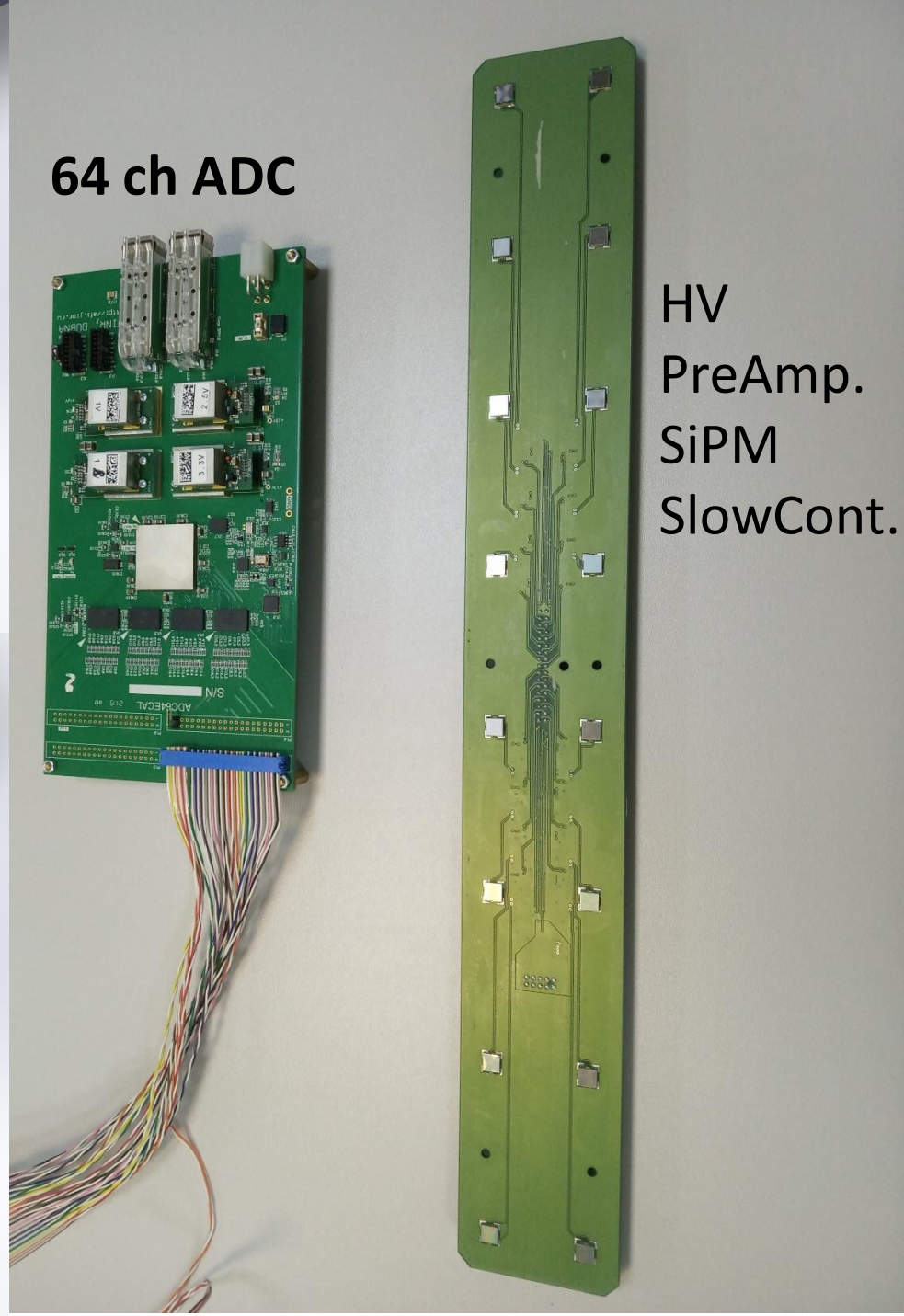




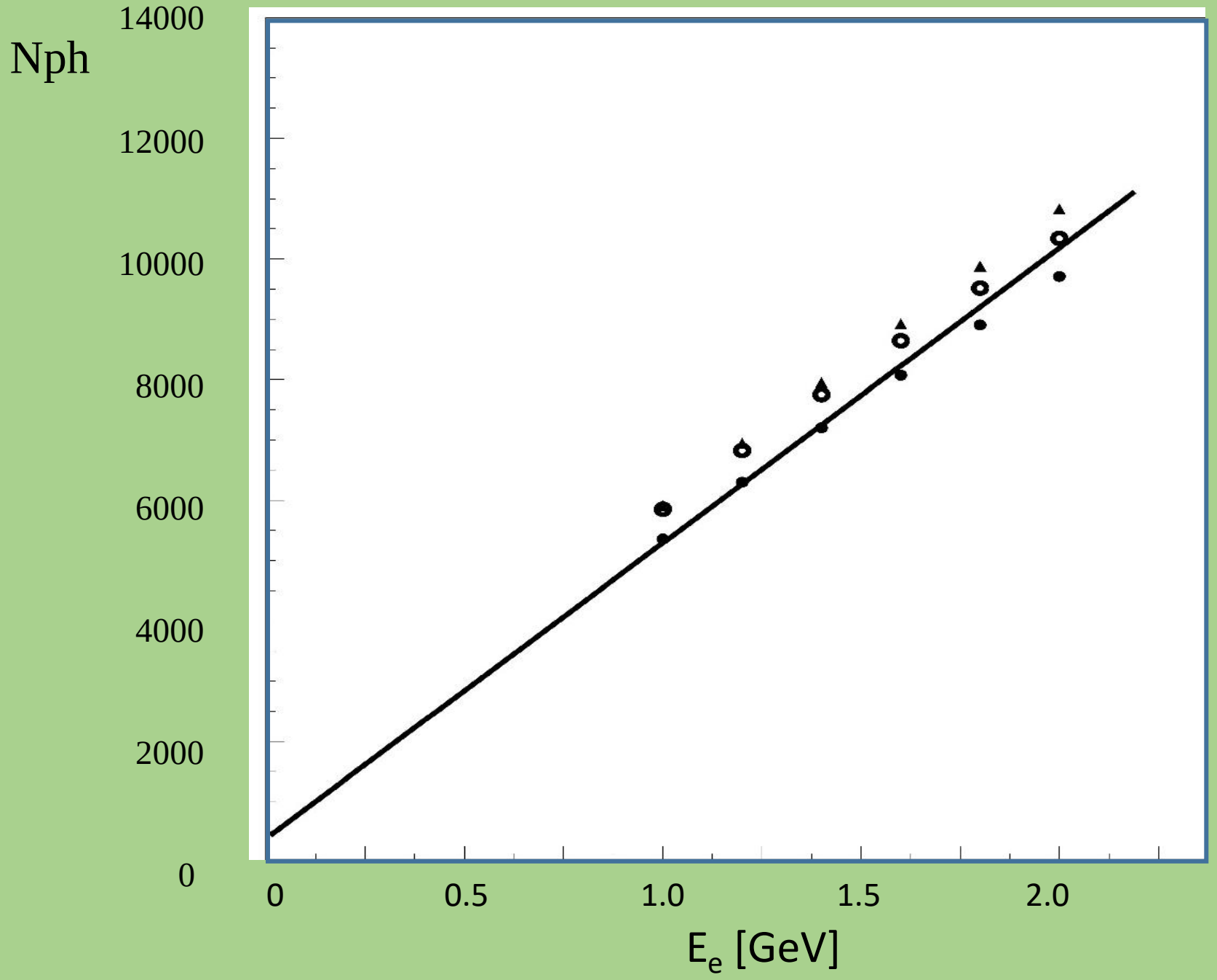


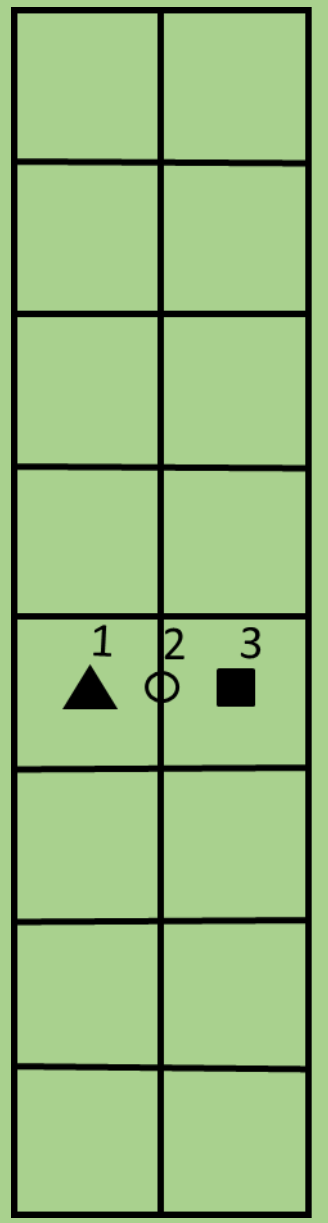




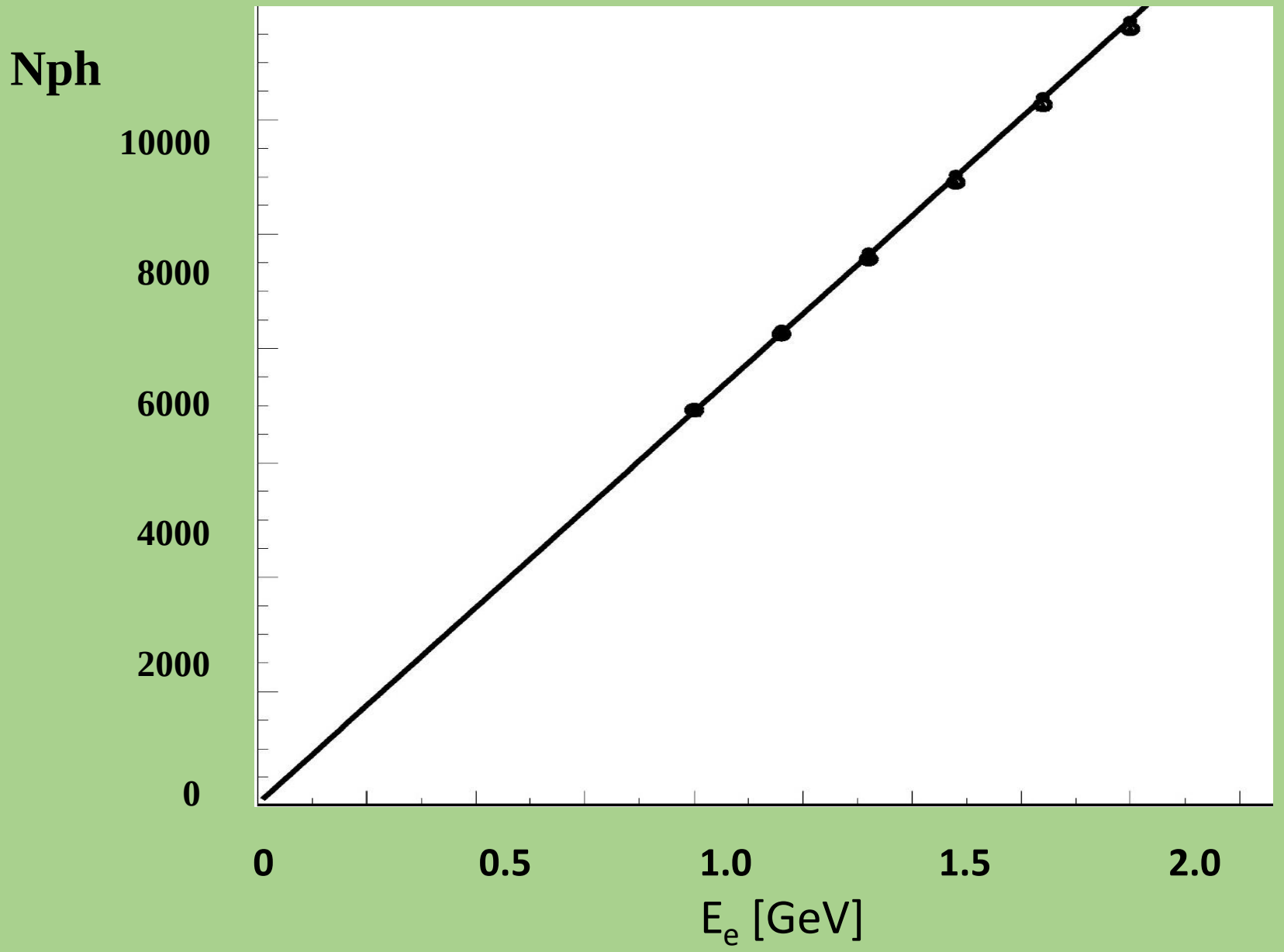

64 ch ADC
HV
PreAmp.
SiPM
SlowCont.

DESY electron beam



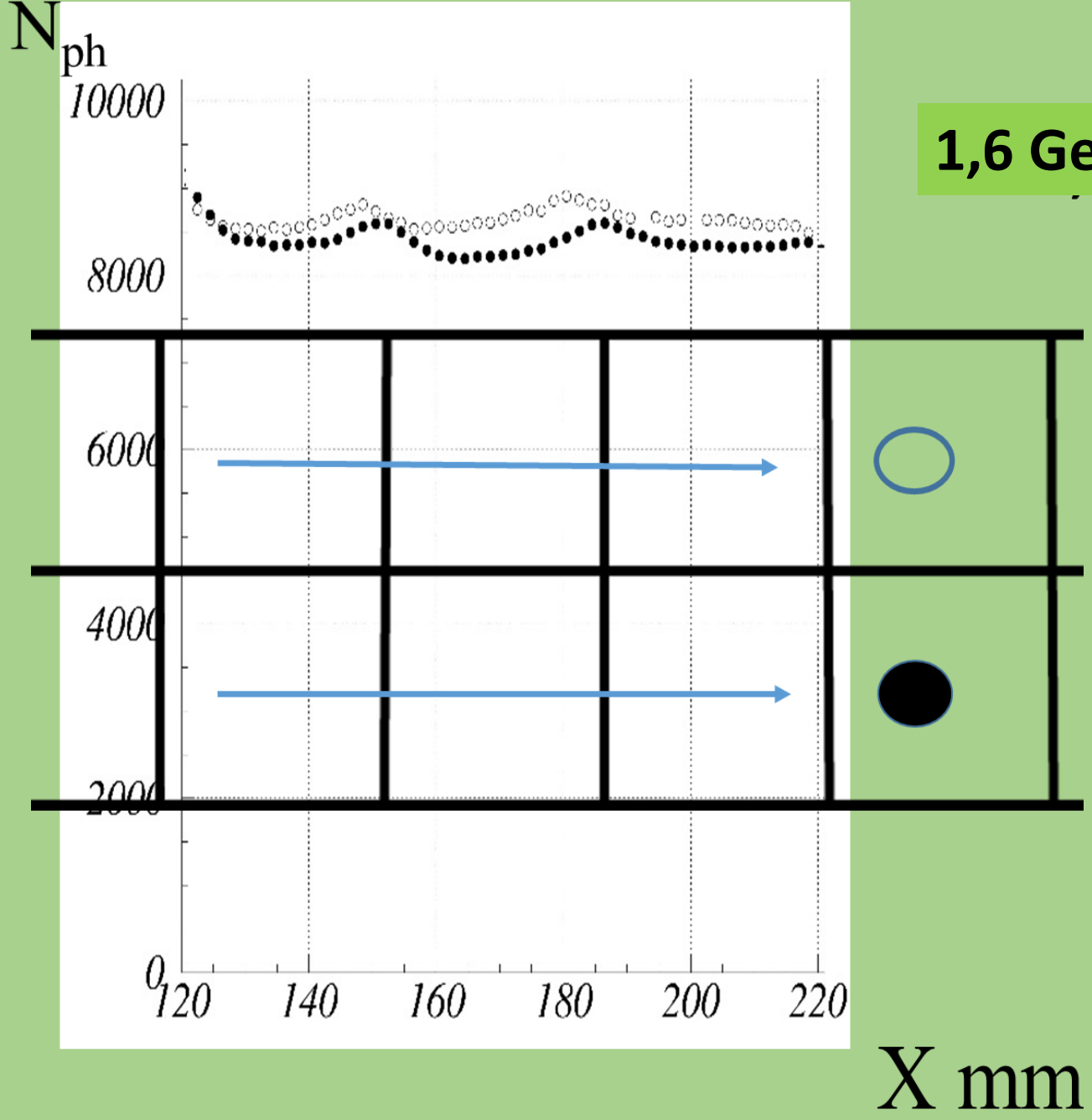


After corrections



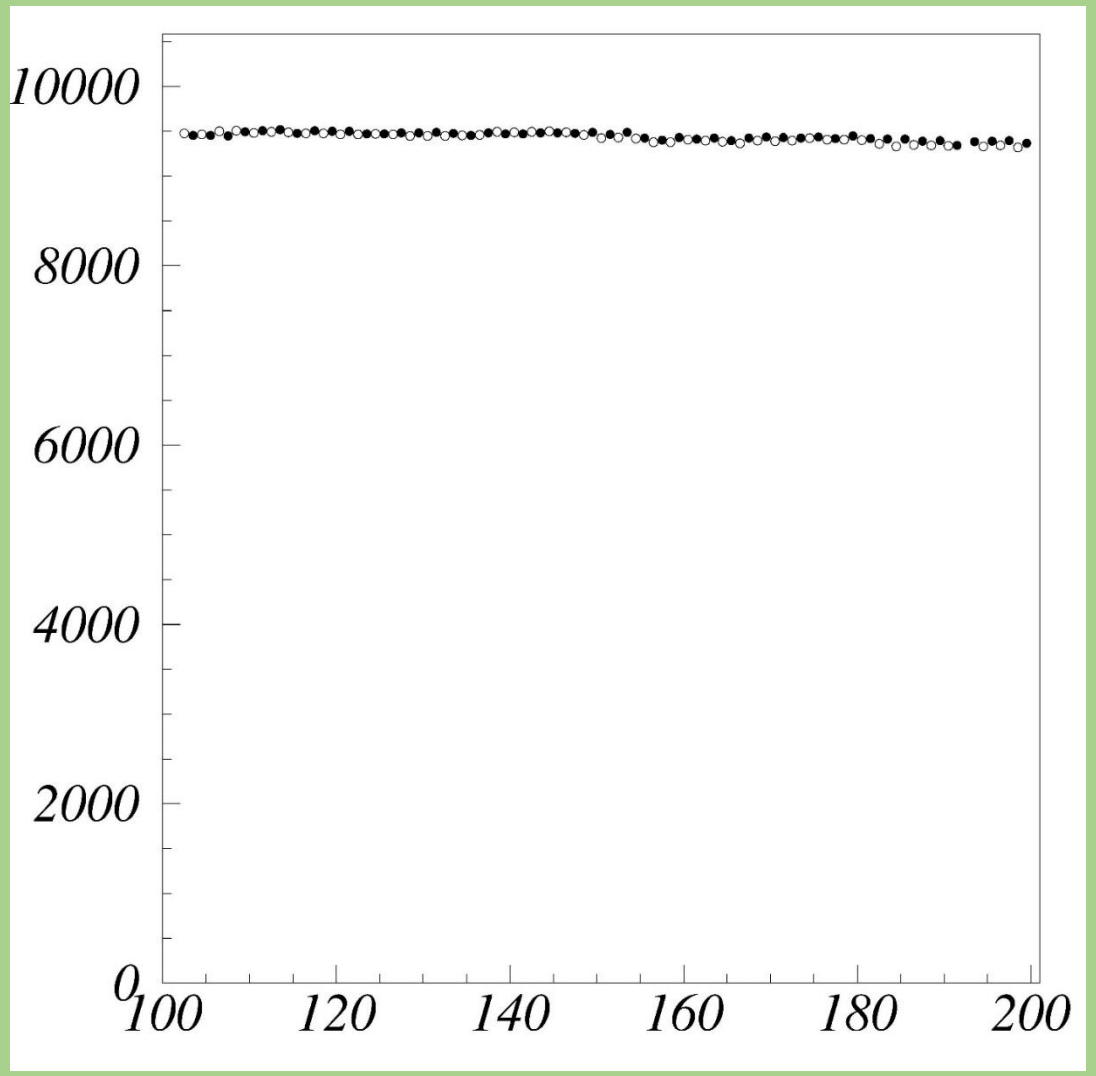
DESY test beam

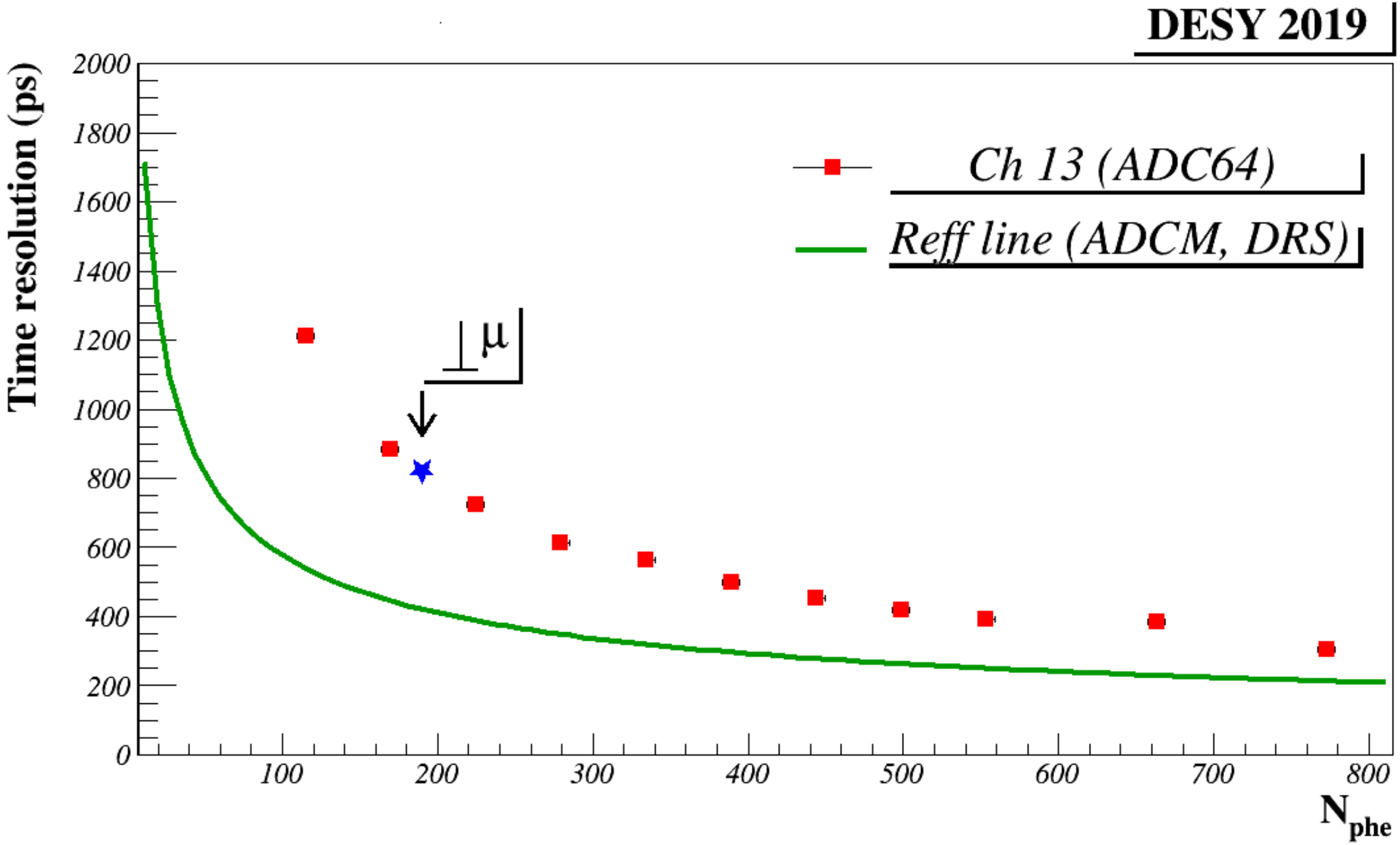
1,6 GeV



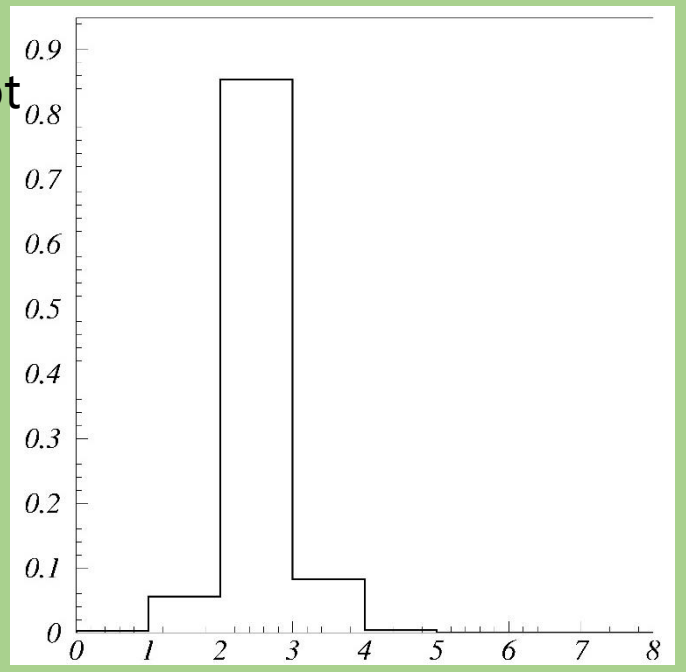
N ph

After corrections

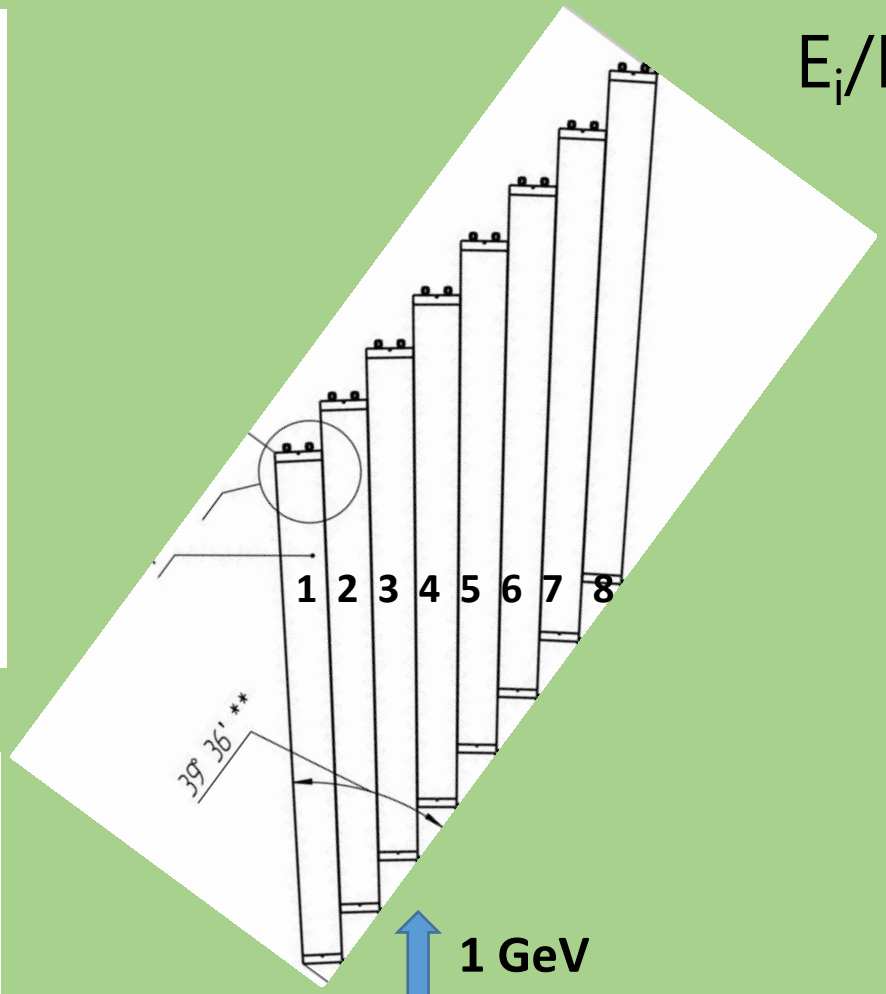



DESY 2019
Time resolution (ps)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
100
200
300
400
500
600
700
800
N phe
Ch 13 (ADC64)
Reff line (ADCM, DRS)
⊥ μ

E_i/E_{tot}



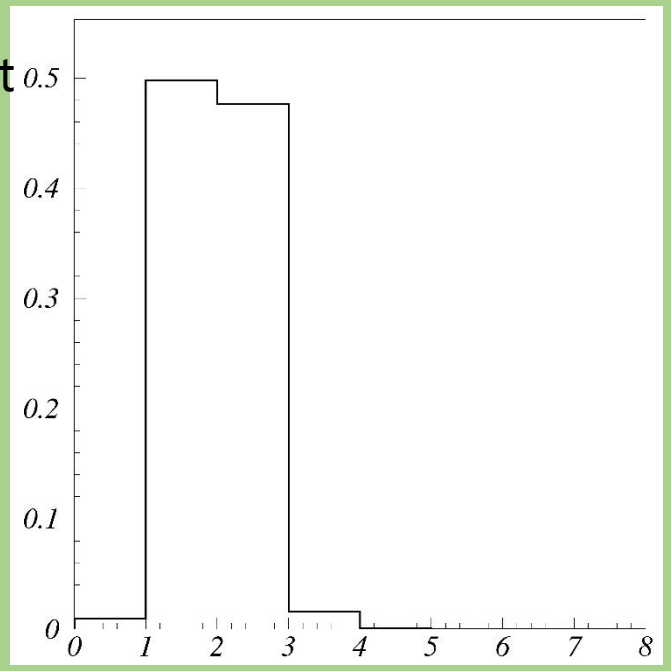
Tower



1 GeV electron beam

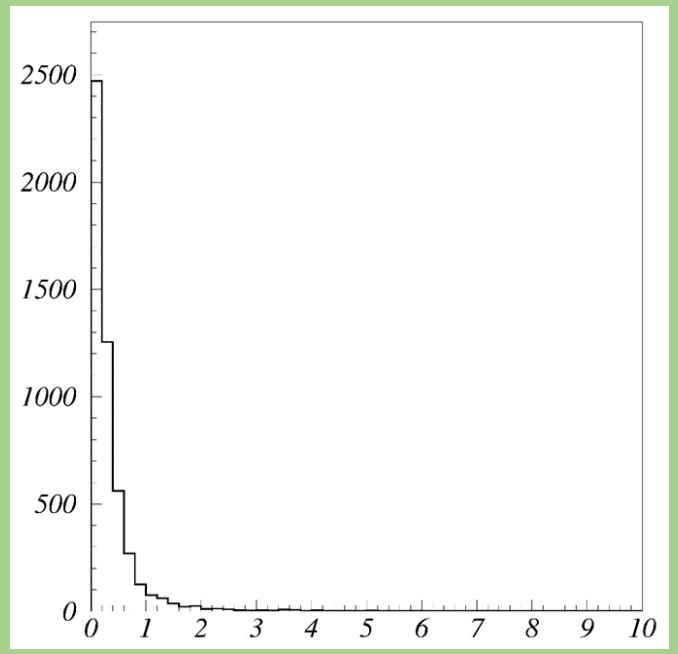
X scan

E_i/E_{tot}



Tower

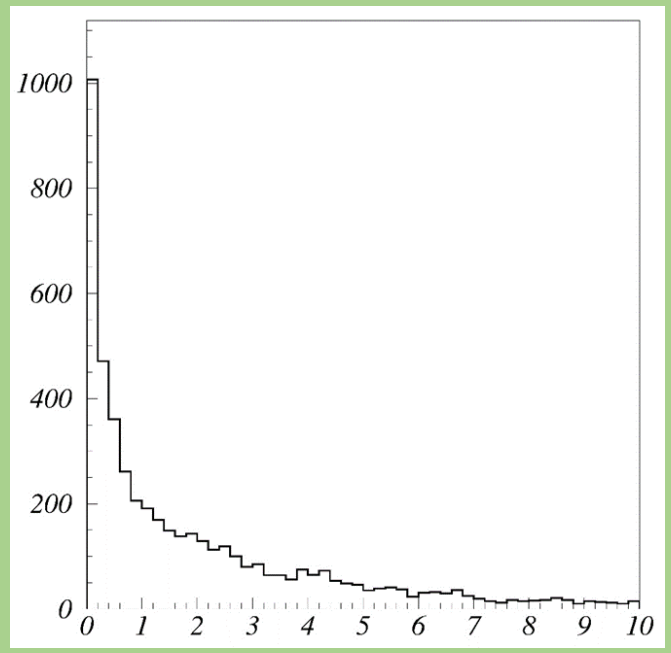
N



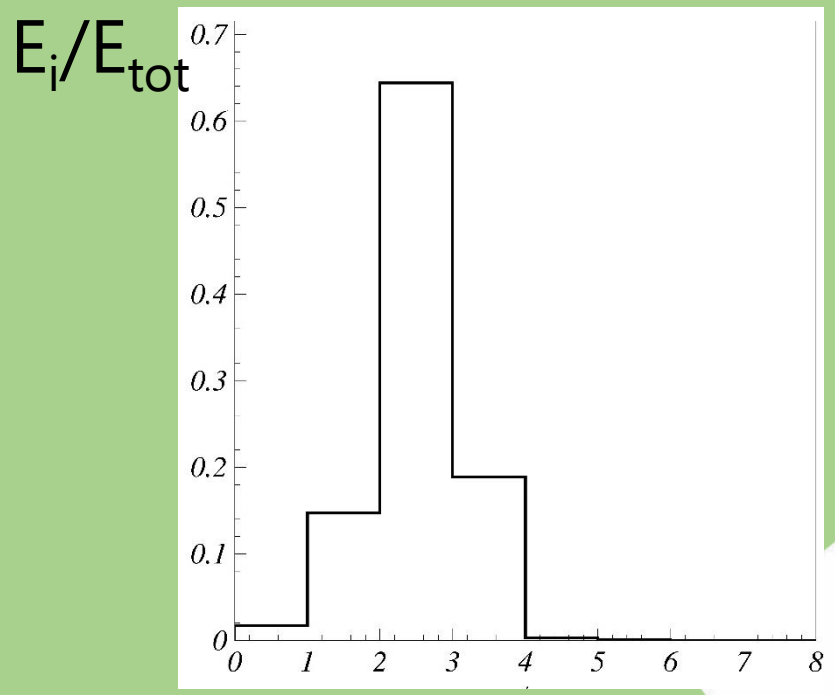
χ^2

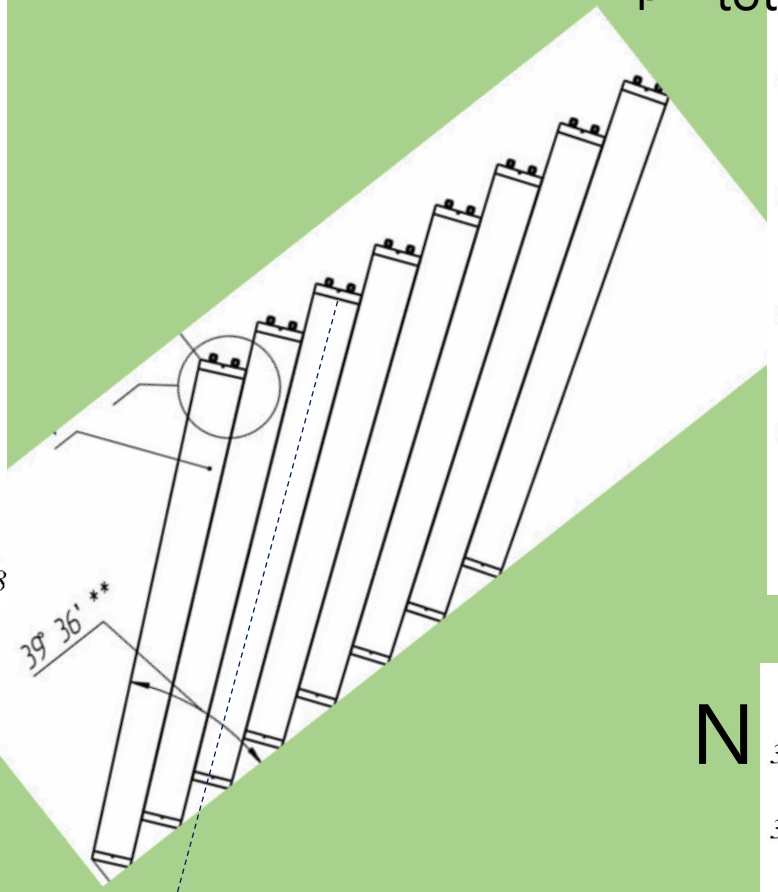
$$\text{Chi2} = \sum_i \frac{\left(E_i^{measured} - E_i^{expected}\right)^2}{\sigma_i^2}$$

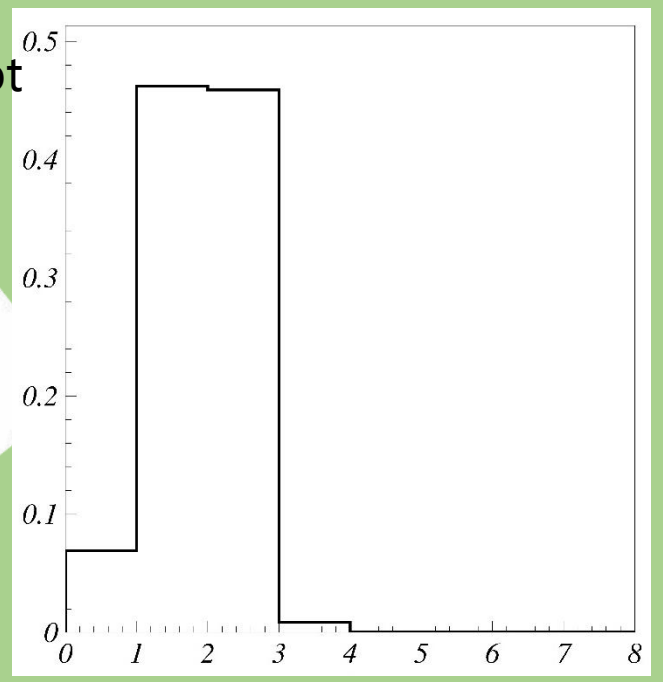
N

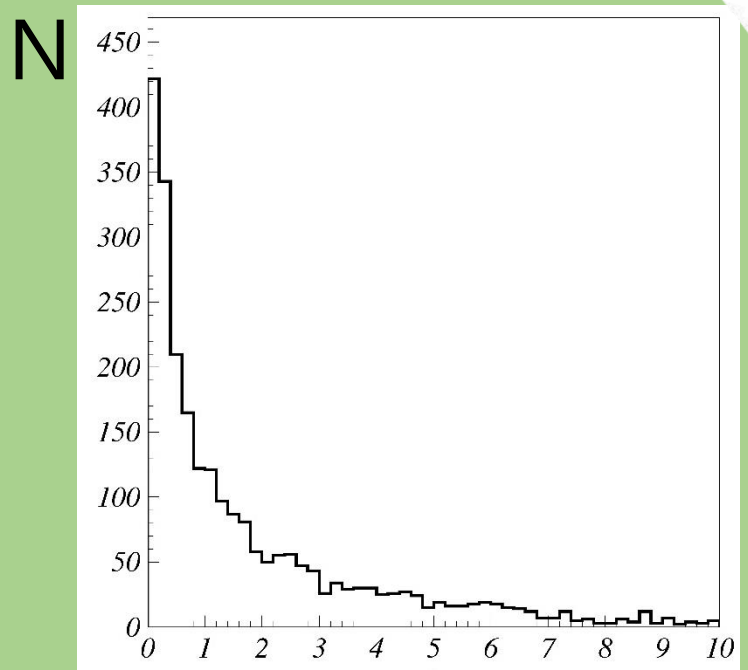


χ^2





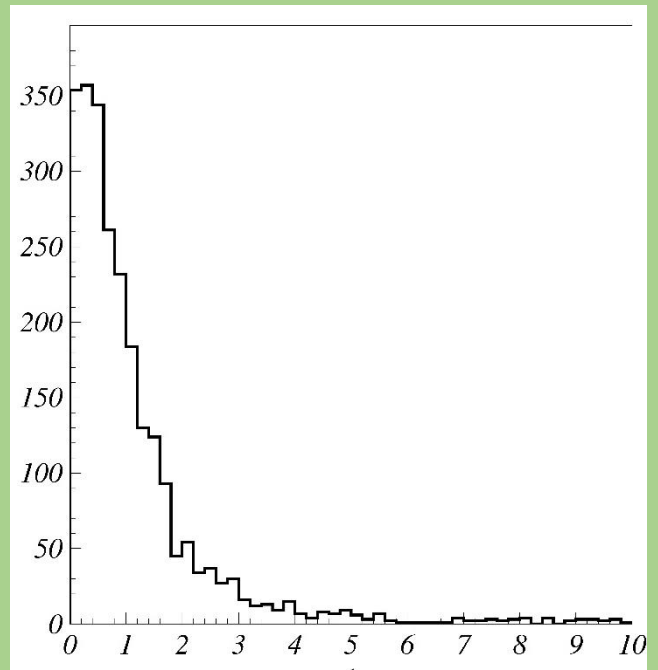


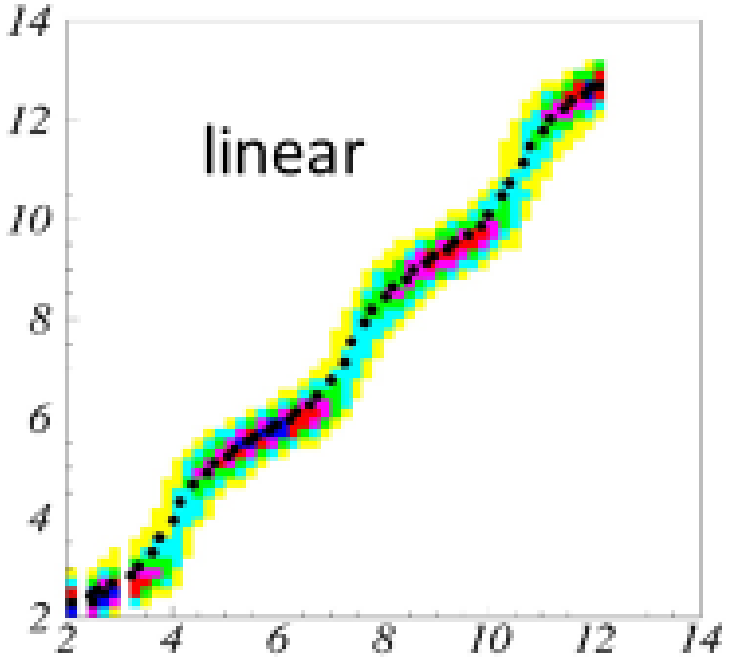


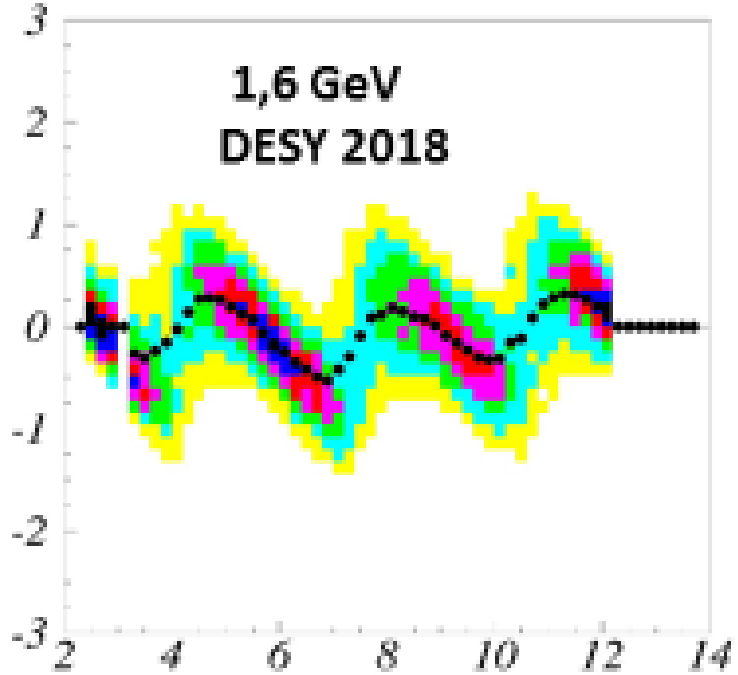
1 GeV
electron beam

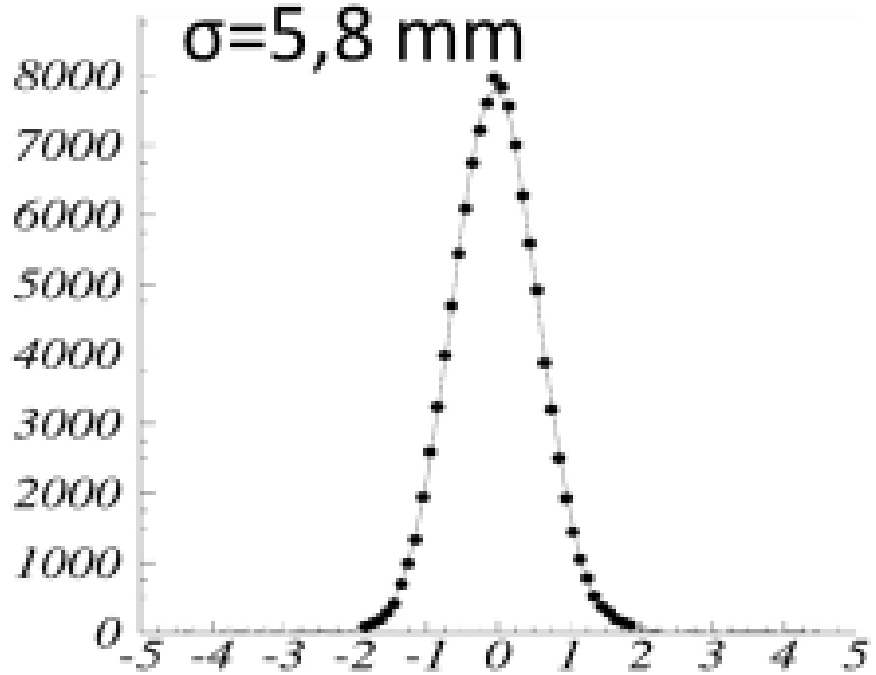
5°

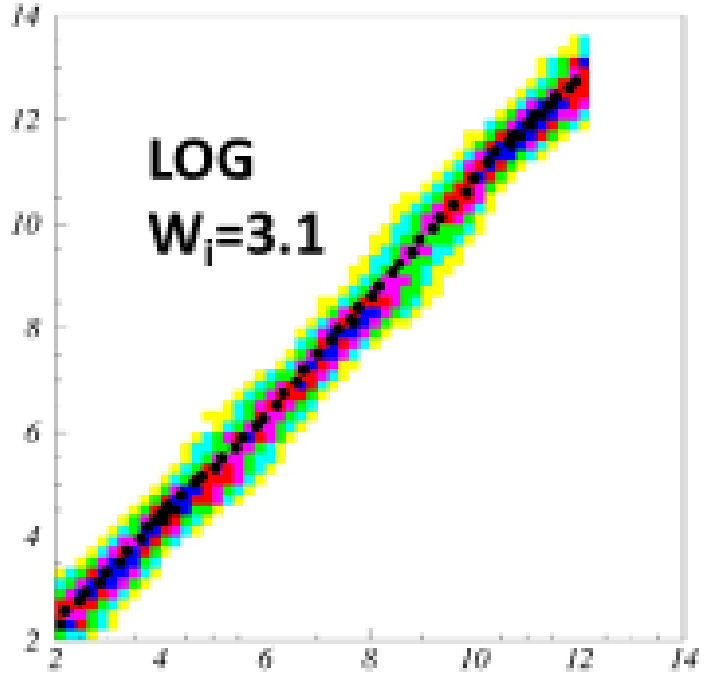
X scan

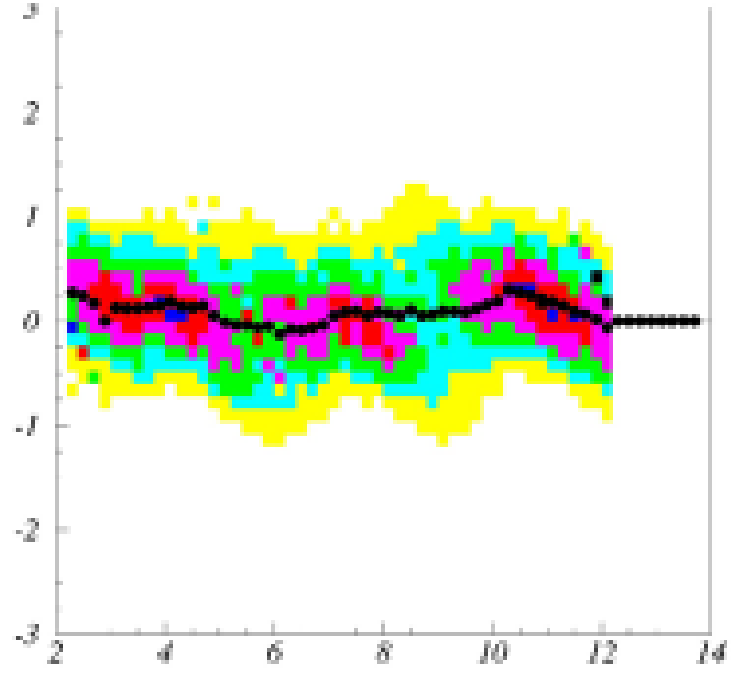


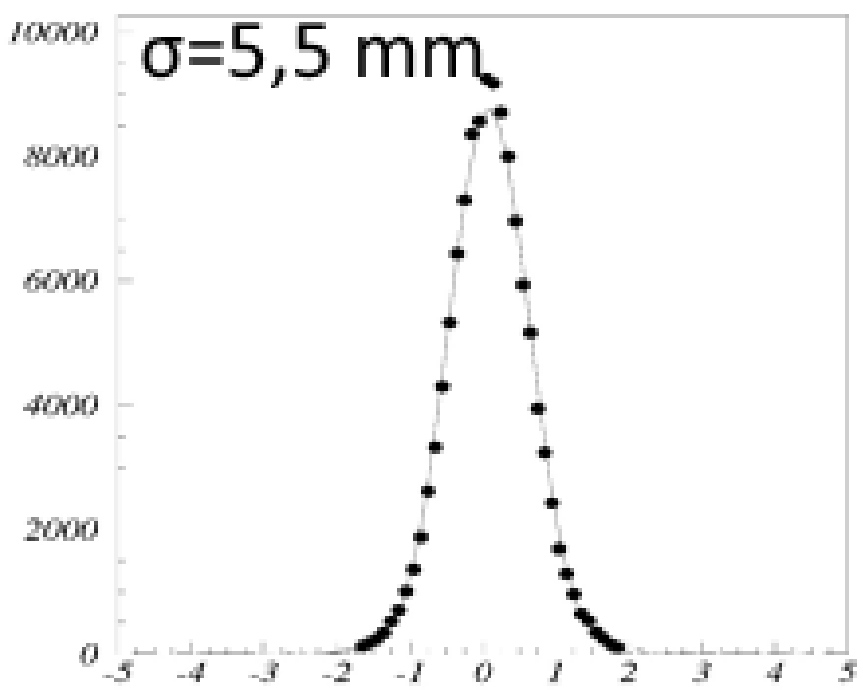

linear

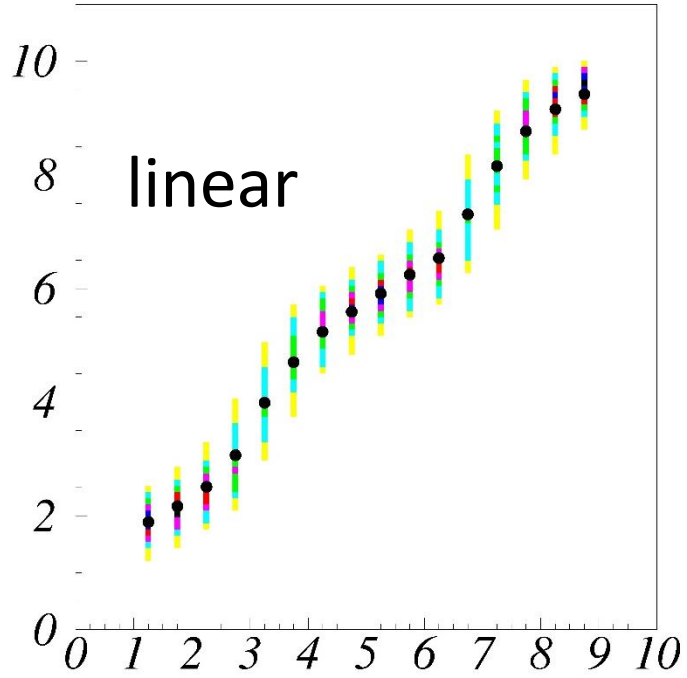

1,6 GeV
DESY 2018

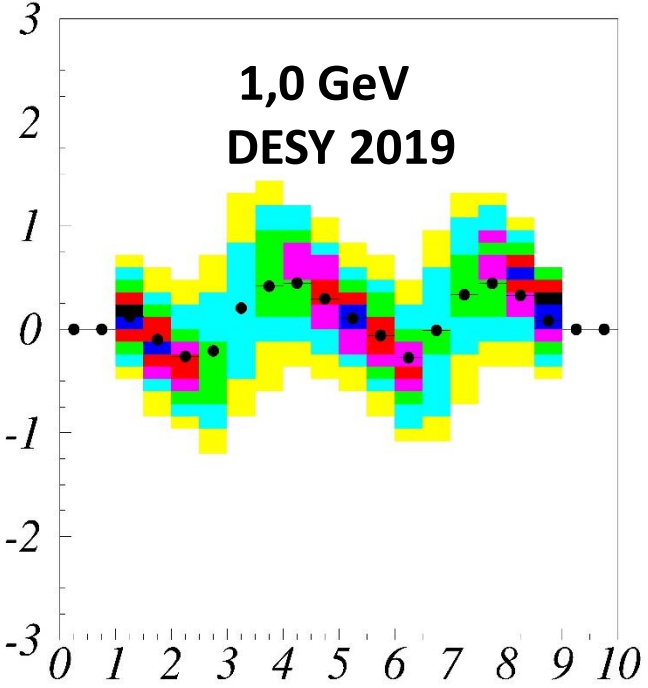

σ=5,8 mm

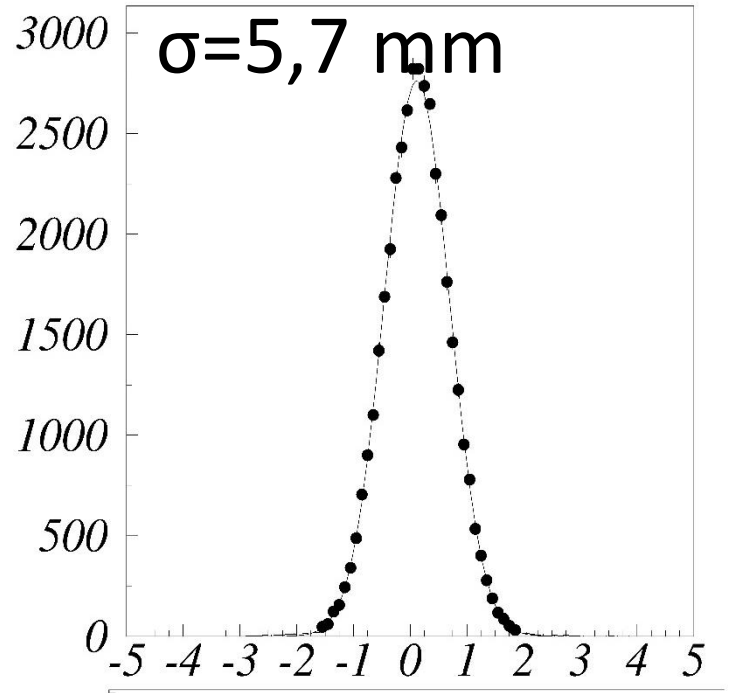

LOG
W_i=3.1

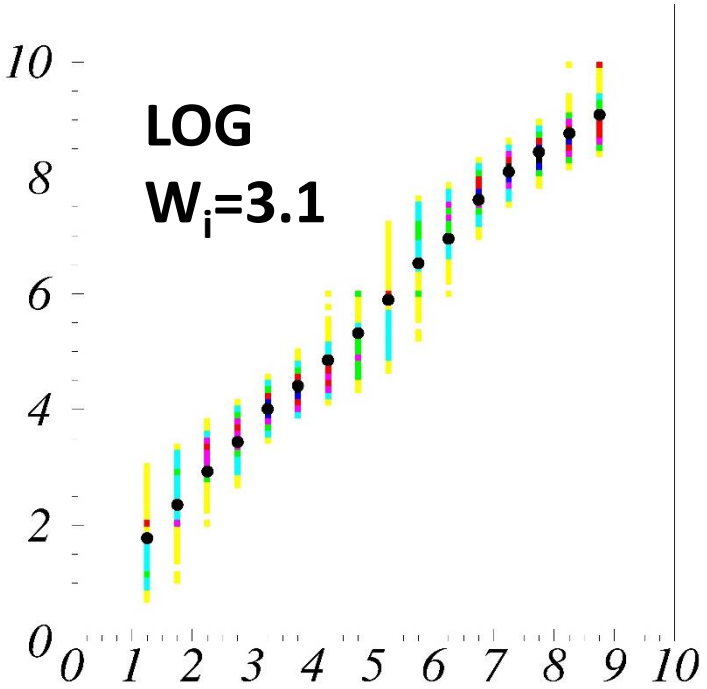


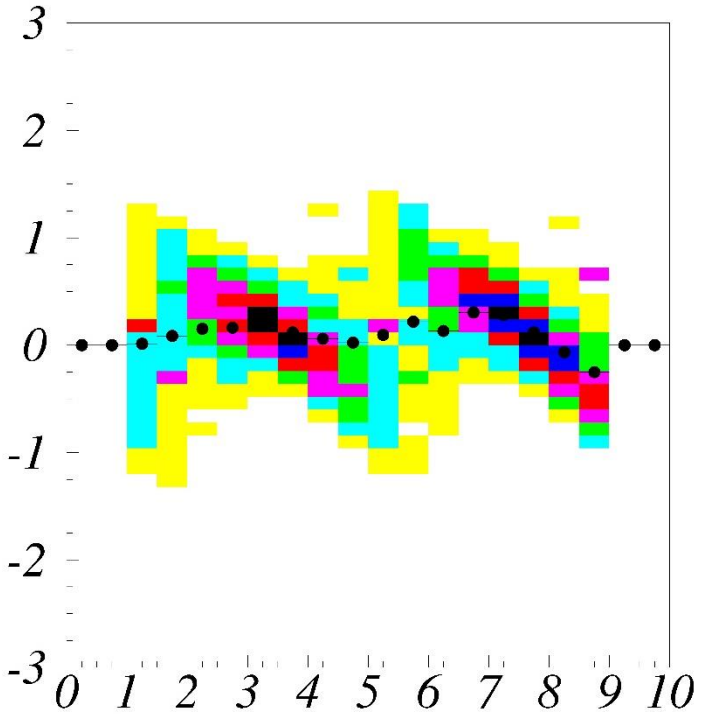

σ=5,5 mm

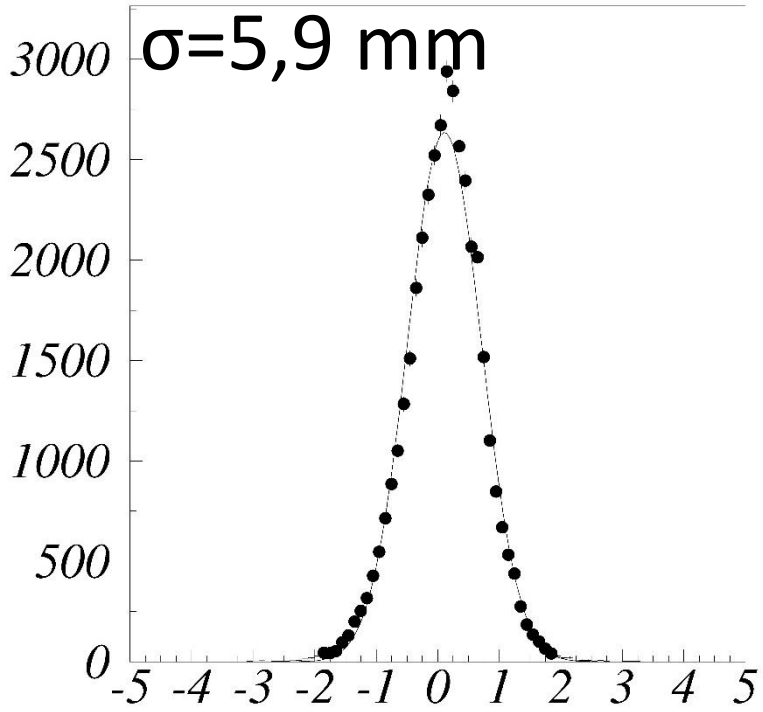

linear

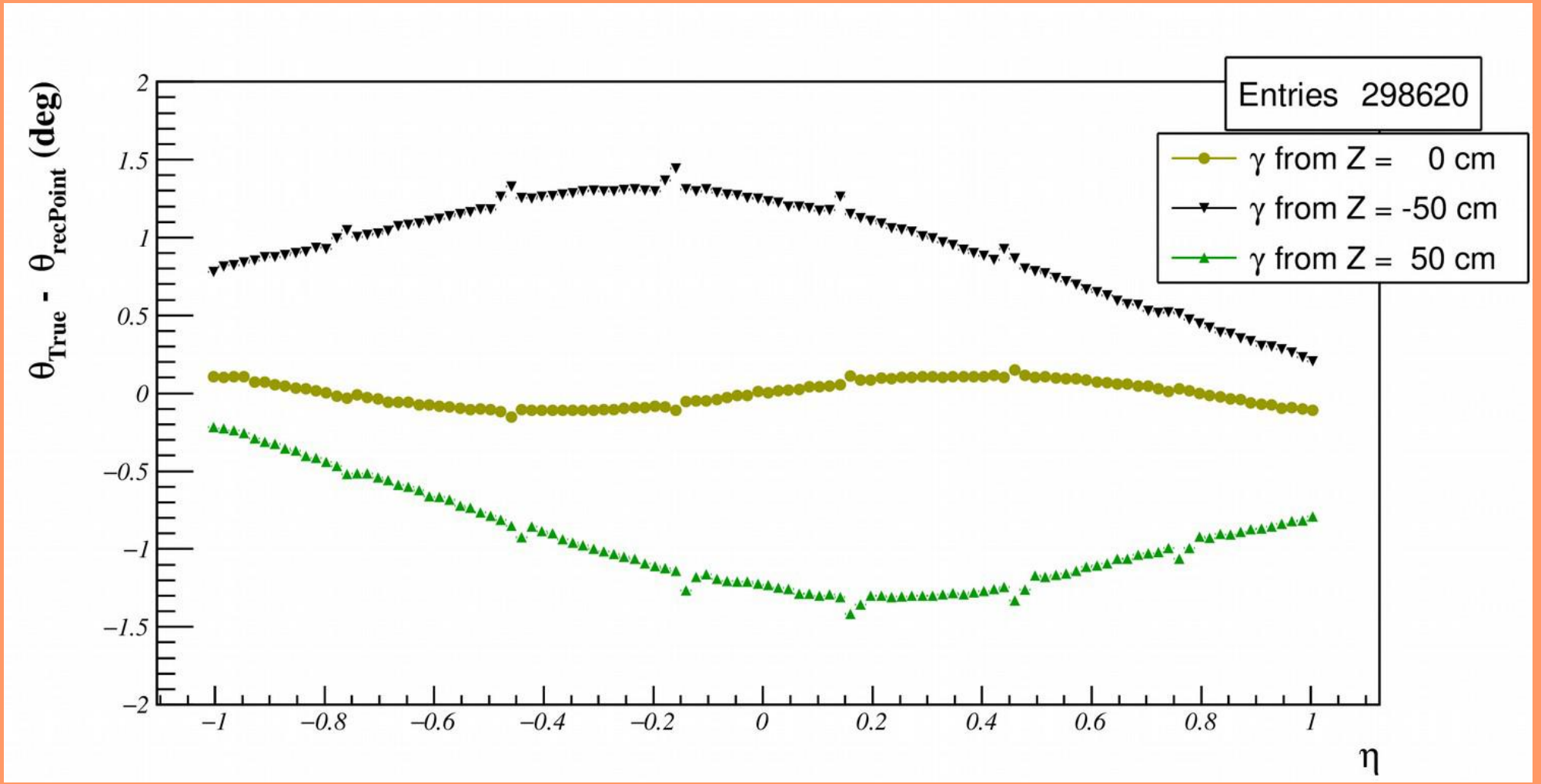

1,0 GeV
DESY 2019


σ=5,7 mm

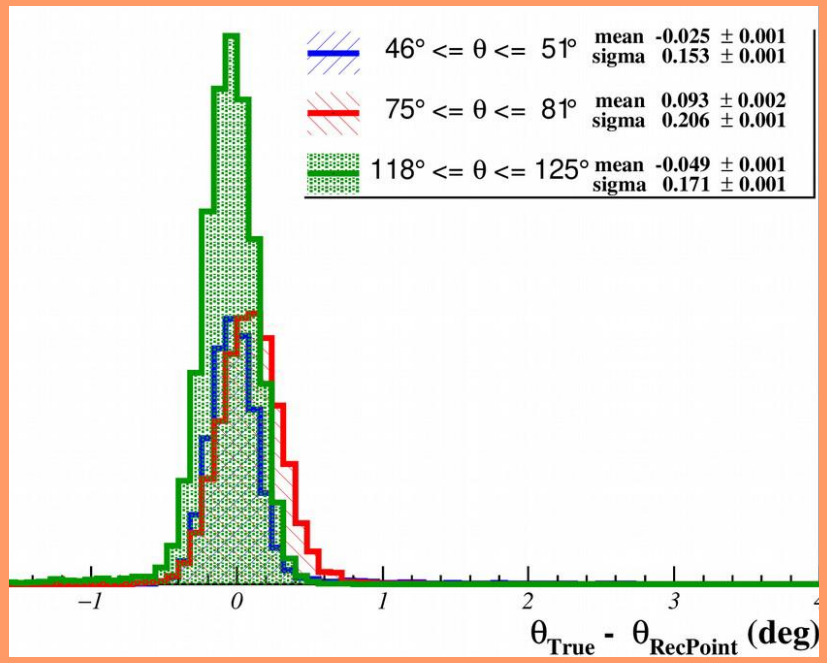

LOG
W_i=3.1

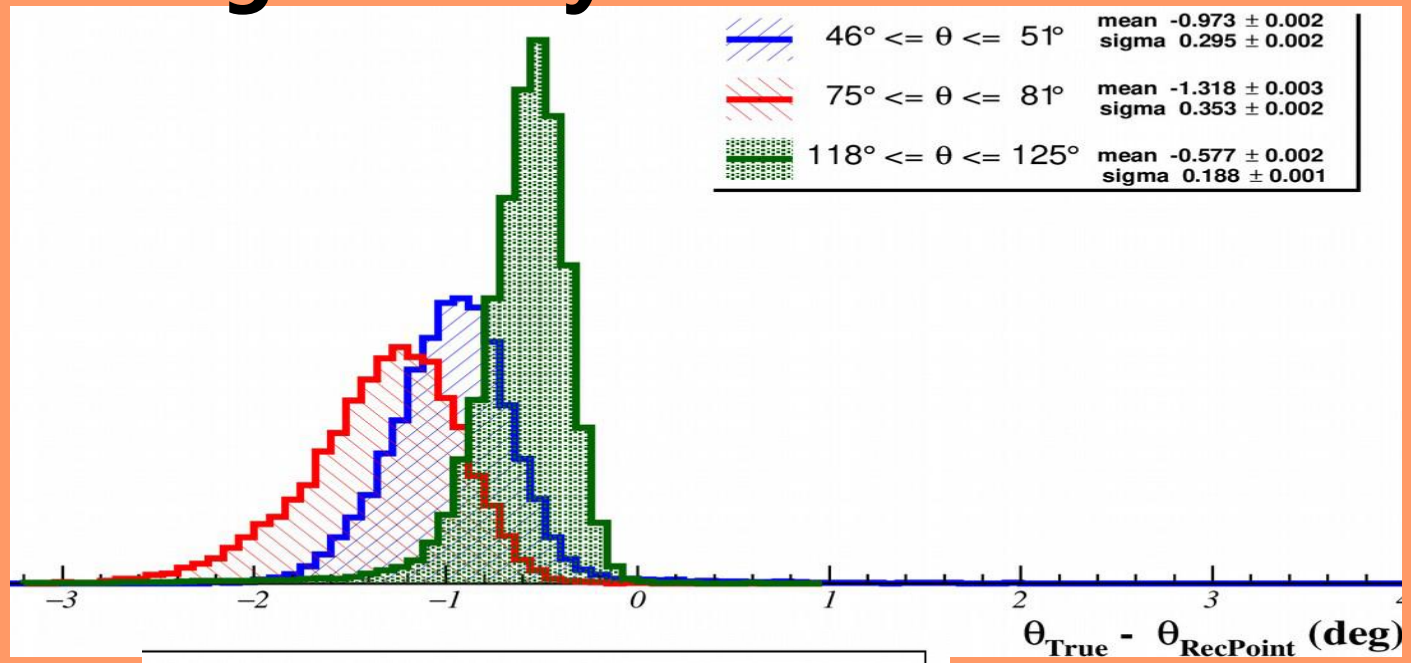


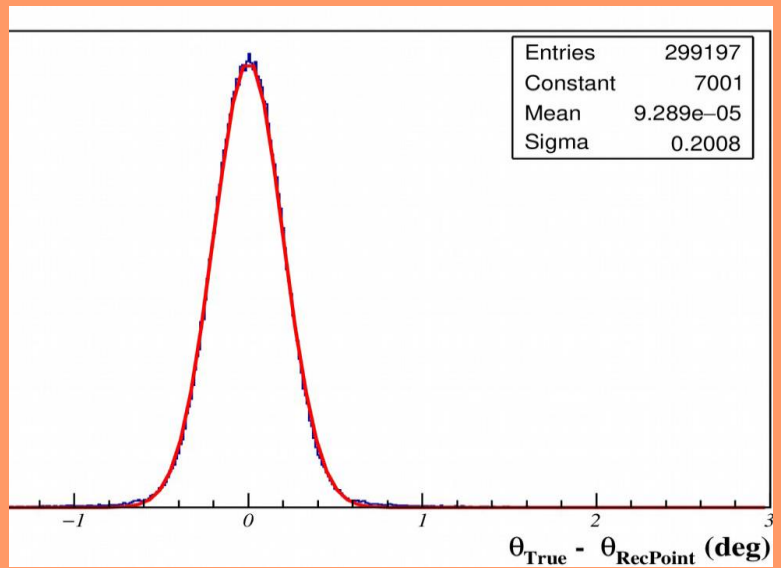

σ=5,9 mm

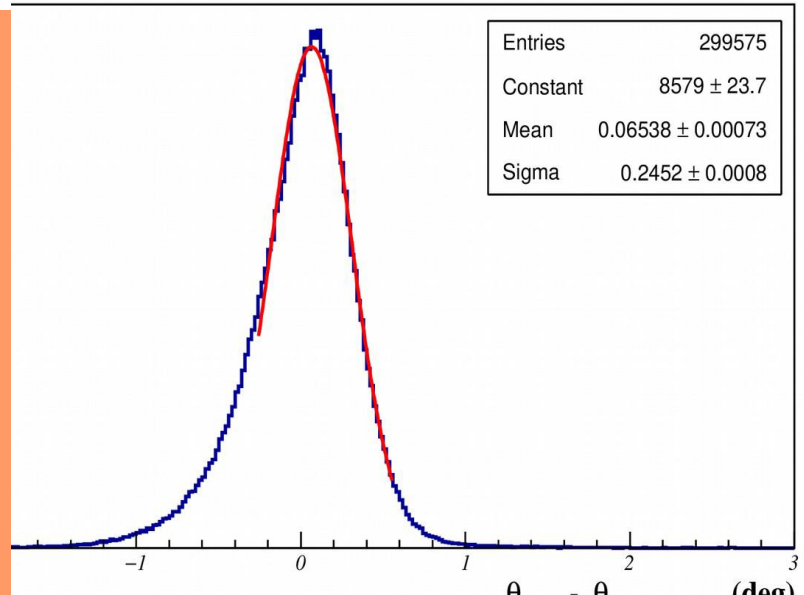

Entries 298620
γ from Z = 0 cm
γ from Z = -50 cm
γ from Z = 50 cm
θTrue - θrecPoint (deg)
η
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

Systematic error in the polar angle measurements due to the not fully projective geometry of ECal









Summary

- All materials are already produced and delivered. Quality of all materials is under careful control
- First modules are produced in all production areas and tested
- China will be ready to start production in the few production areas in beginning of 2020
- Carbon made supporting frame is under design and may be produced in the second half of 2020!
- Moving frame for the electronics is under development.
- Assembling can start not before autumn 2020 and completed in the second half of 2021
- First modules have been tested.
  Sensitivity to the electromagnetic shower is shown on the level of previously constructed devices
  Effect of numerical saturation of the SiPM was studied and found to be well in the agreement with expectations

2. Easy method of the channels calibration by means of cosmic muons have been tested
3. Systematic error in the polar angle measurements due to the not fully projective geometry of ECal was studied and solution proposed
4. More research is needed to study possibility of use in physical analysis the shower shape cuts .

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