

Ecal status

Design

Construction

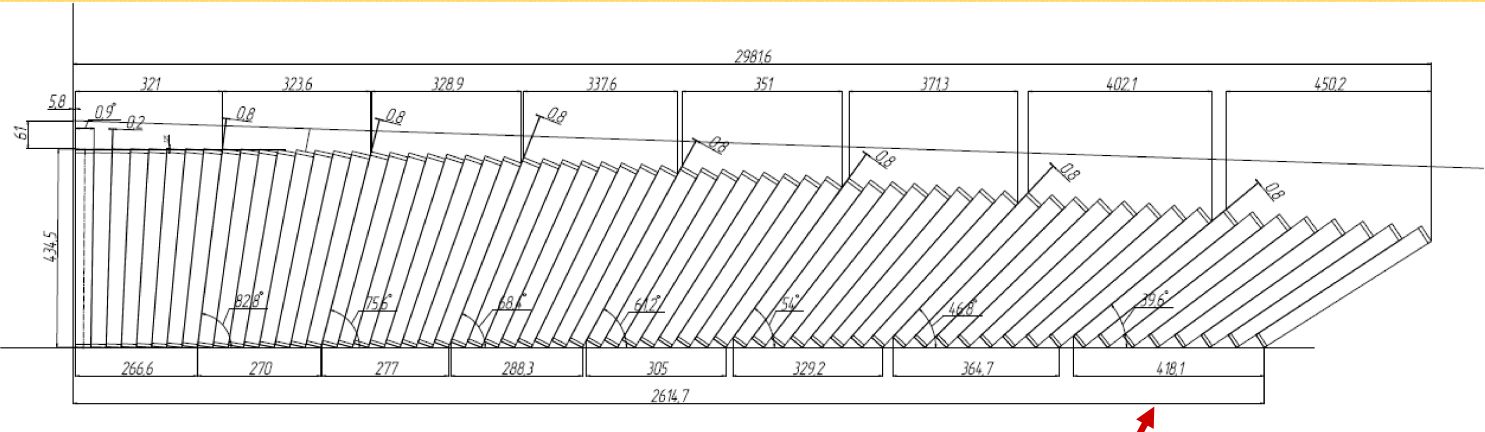
Tests

Dubna

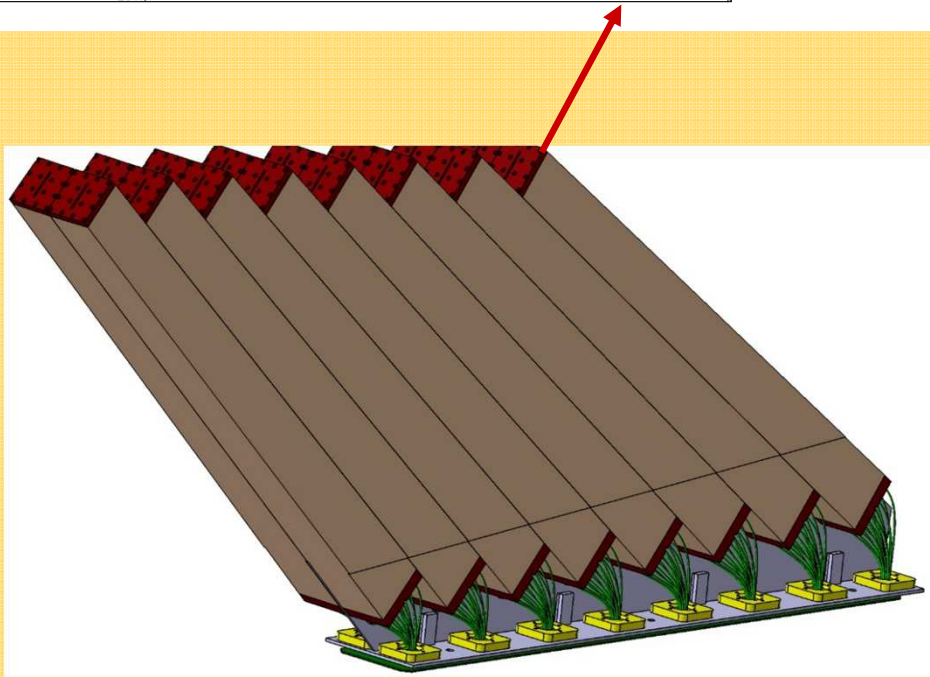
June 2019

Igor Tyapkin

Eight Module Types for Projective Geometry of ECAL



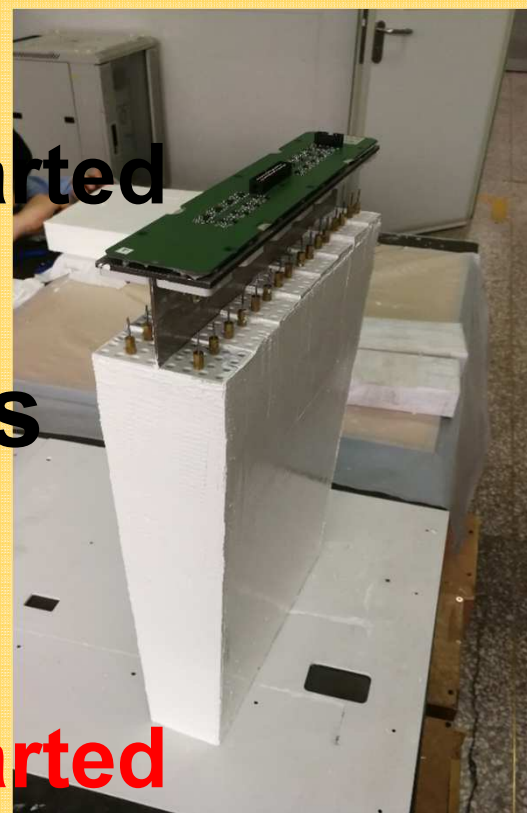
8th Module Type
Produced at JINR
Tested at DESY





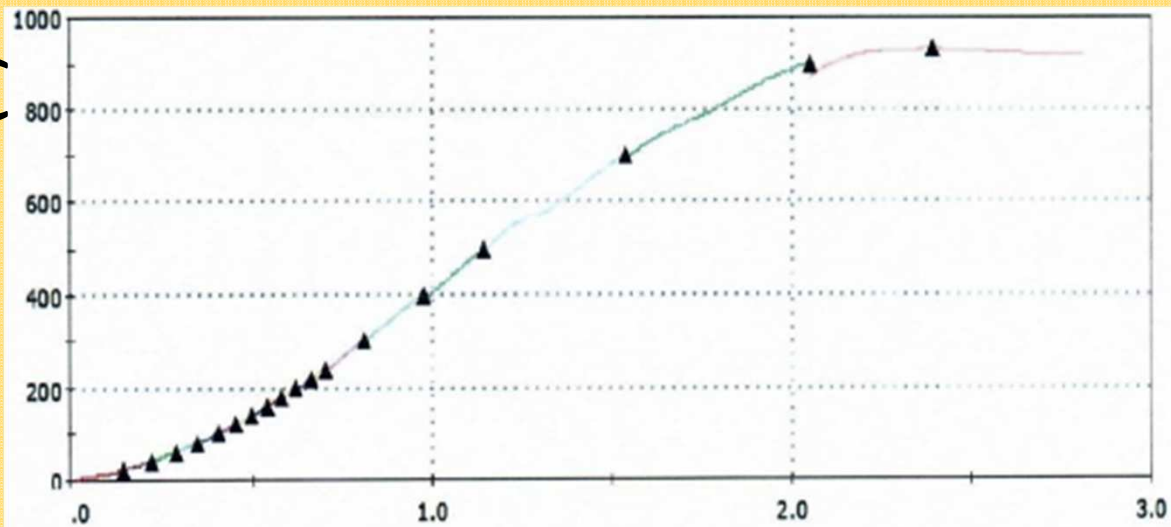
Protvino
Production started
2019-2020
440 modules

TEH30P
Production started
2019-2020
250 modules



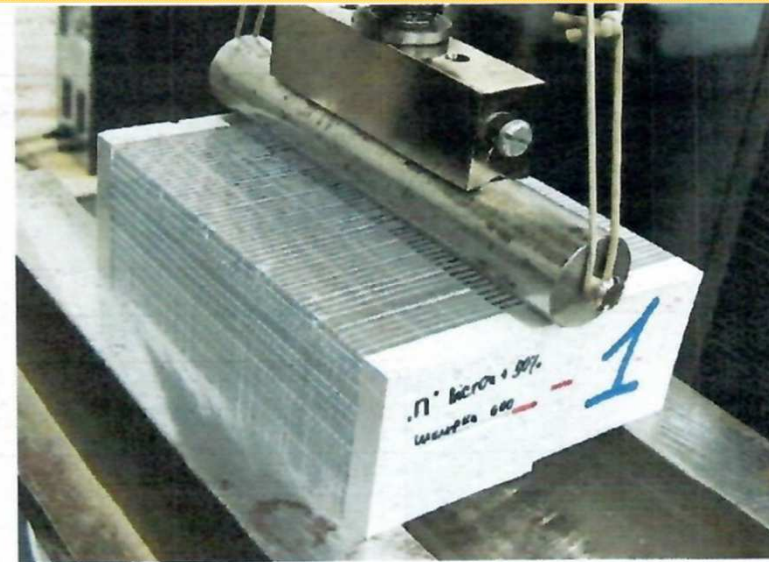
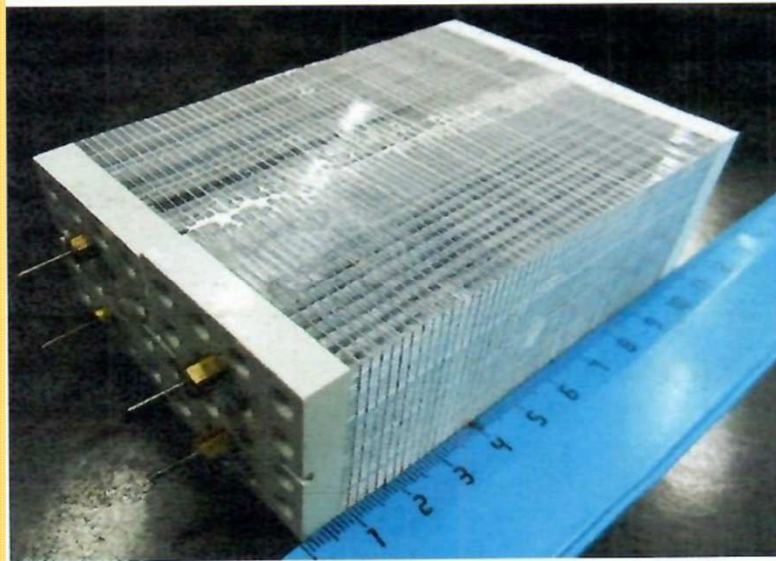
China
2016 mod

Load
(N)



Displacement (mm)

| | | | | | | | | | |
|----------------|------|------|------|------|------|------|------|------|------|
| Сила, Н | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
| Деформация, мм | 0,14 | 0,22 | 0,29 | 0,35 | 0,4 | 0,45 | 0,5 | 0,54 | 0,58 |
| Сила, Н | 200 | 220 | 240 | 300 | 400 | 500 | 700 | 900 | 930 |
| Деформация, мм | 0,62 | 0,66 | 0,7 | 0,81 | 0,98 | 1,14 | 1,54 | 2,05 | 2,39 |

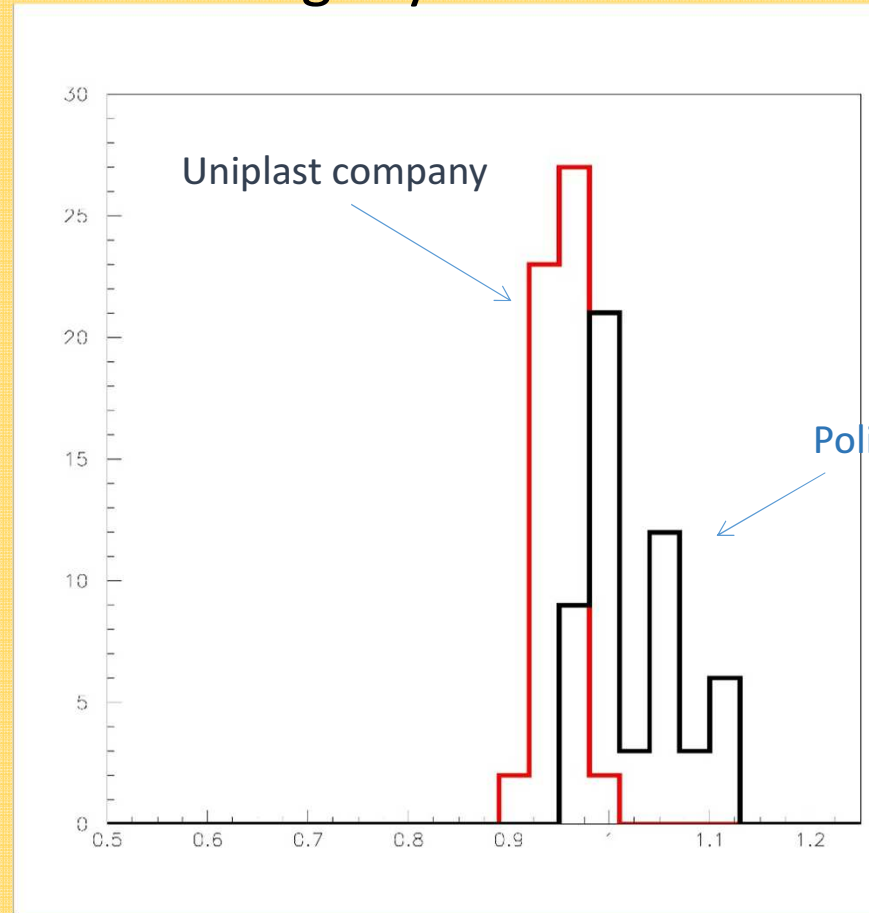


| Example | 2 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------------------|------|------|------|------|------|------|------|------|-------|
| Destructive load, [H] | 3151 | 3884 | 3231 | 918 | 4400 | 3565 | 2763 | 2271 | 11094 |
| Displacement [MM] | 0,33 | 0,33 | 0,29 | 0,39 | 0,39 | 0,45 | 0,27 |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

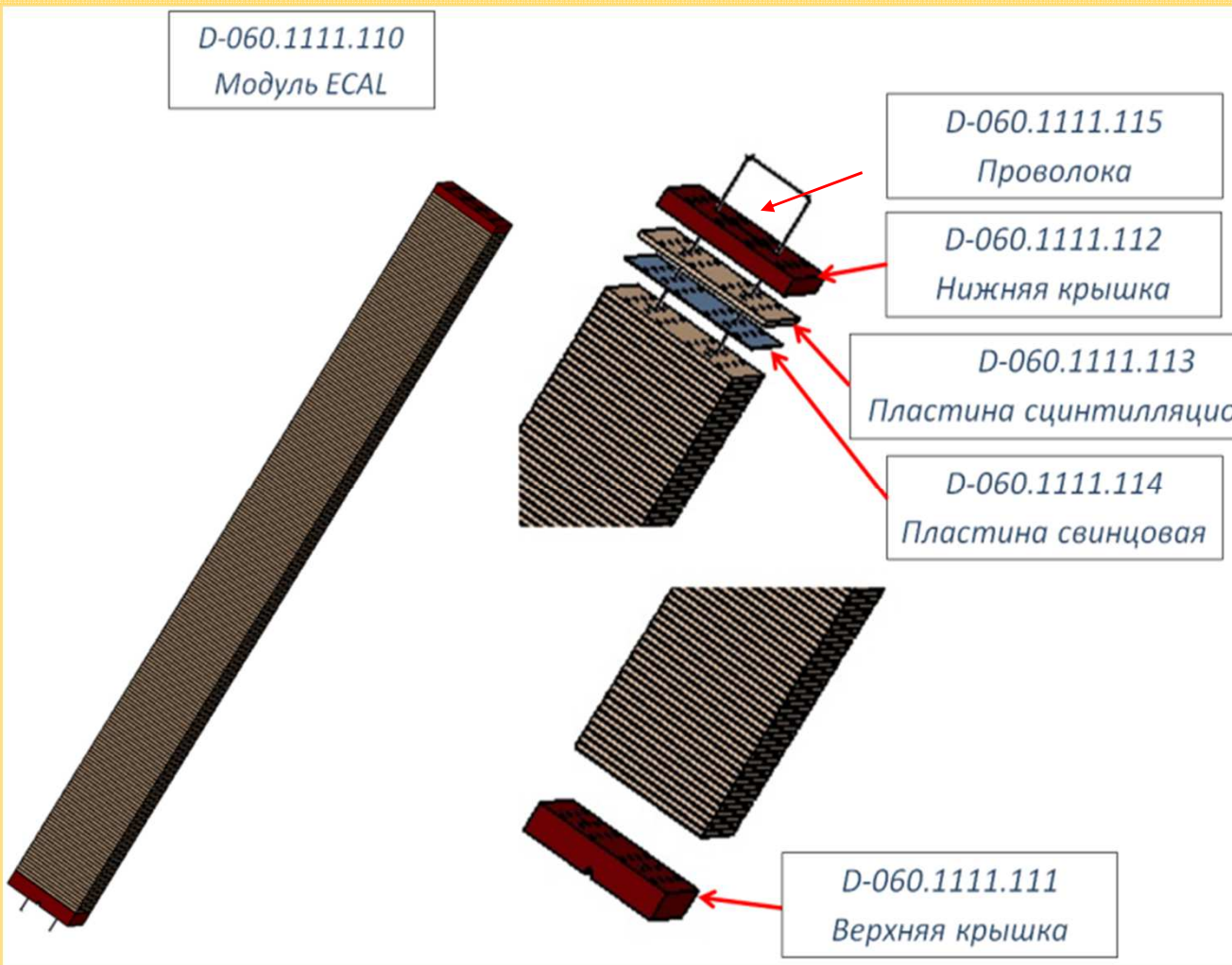
Typical measurement results of relative light yield



Number of plates



Relative light yield



- **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

China production site

CHINA Contribution:

| | |
|------------------------------------|------|
| Modules production | 9M\$ |
| Electronics production analog part | 4M\$ |

Institutes:

Tsinghua University (60%)

Huzhou University

Shandong University (20%)

Fudan University (10%)

University of South China (10%)

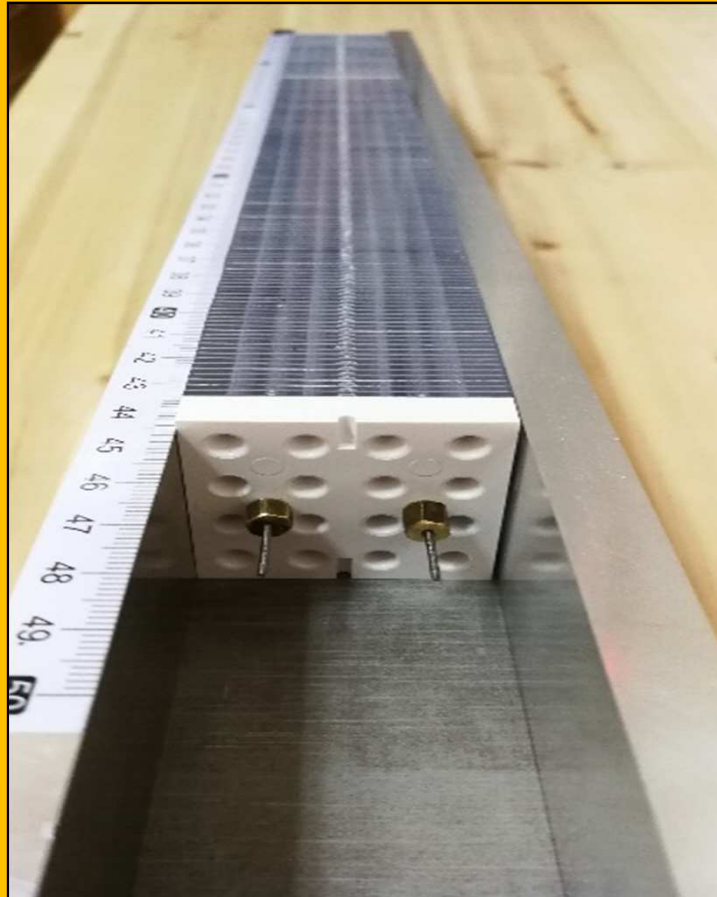
To guarantee quality:

- same material
- same standard
- same procedure

Time line (draft)

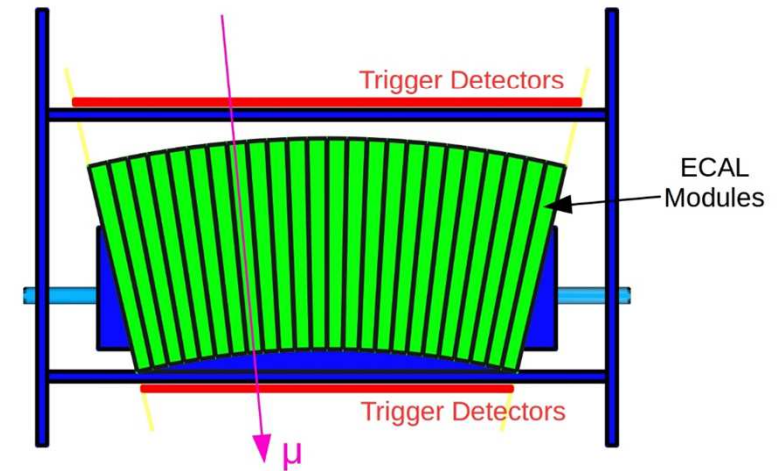
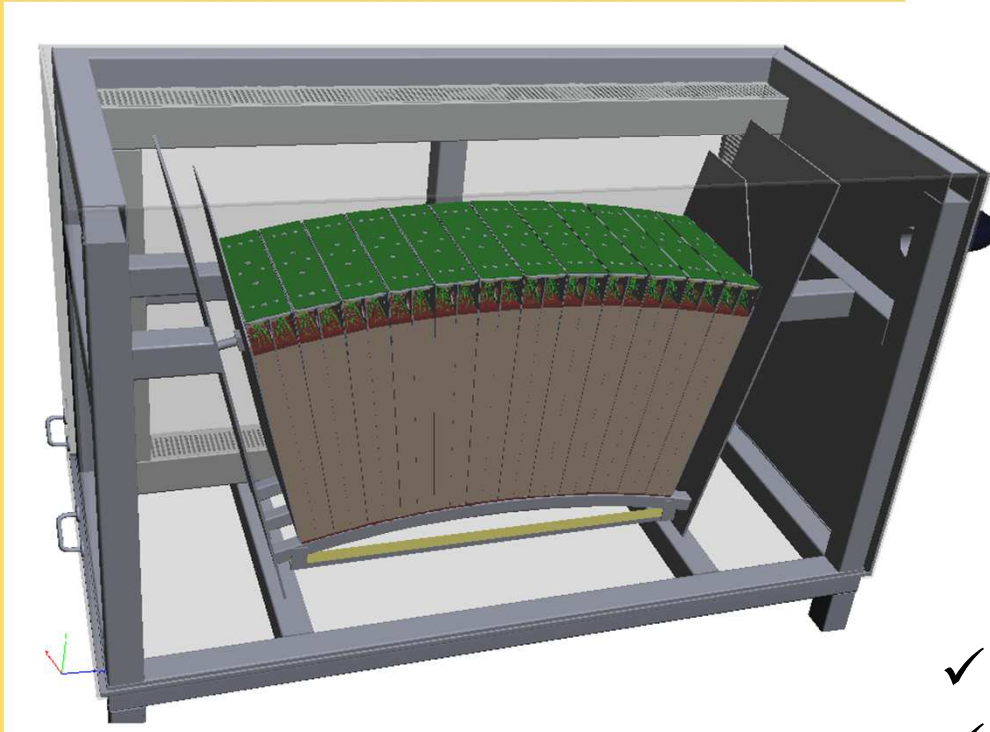
- **2019.7-8** – *Submit proposal, review*
- **2019.8-12** – ***Preparation for production***
- **2020.1-2020.6** – *Preproduction, cosmic test*
- **2020.7-2021.6** – ***Finish production***
- **2020.8** – *Install on MPD*
- **2021.10** – ***Finish install and detector commission***
- **2021.11** – *Start commission*

Assembling equipments



Stand for ECAL Modules Calibration

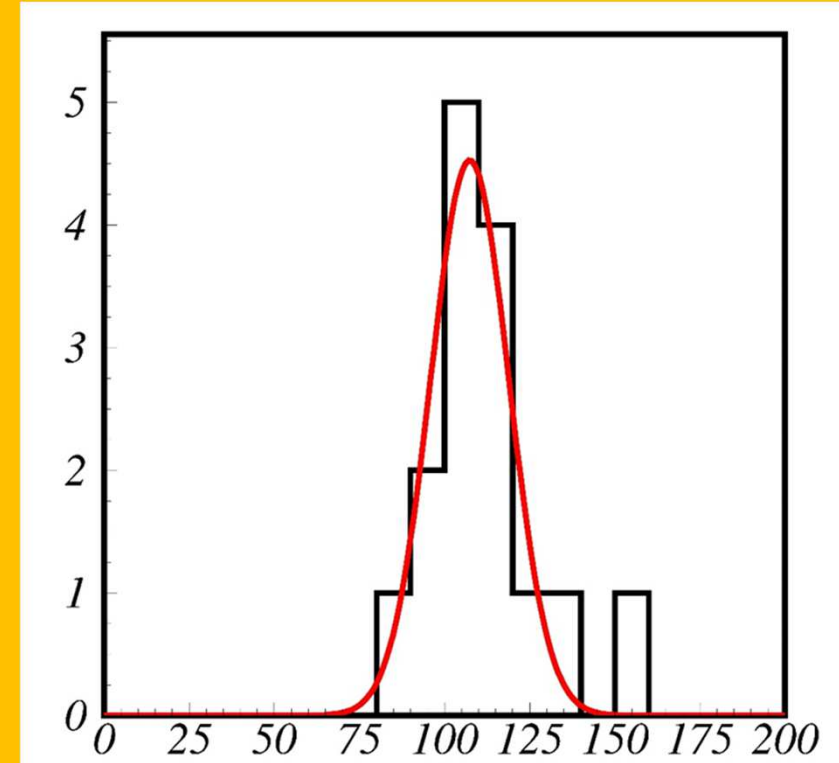
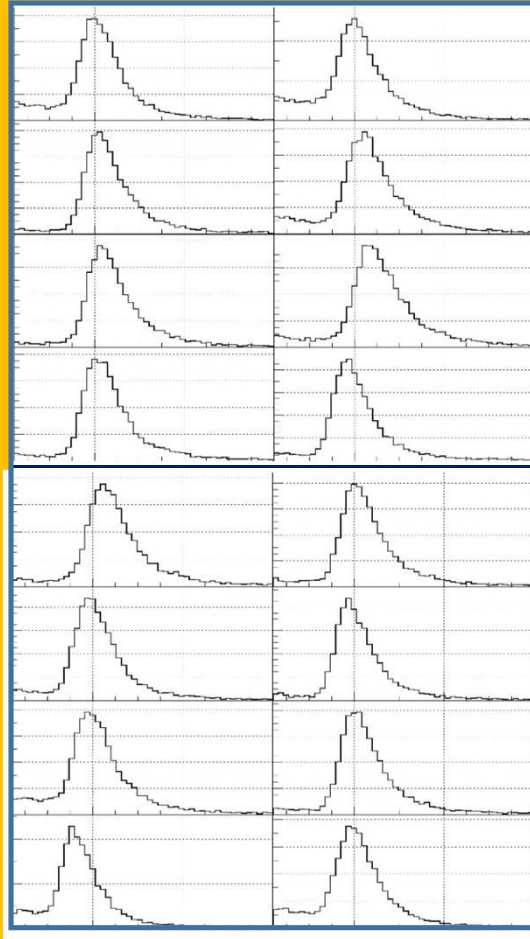
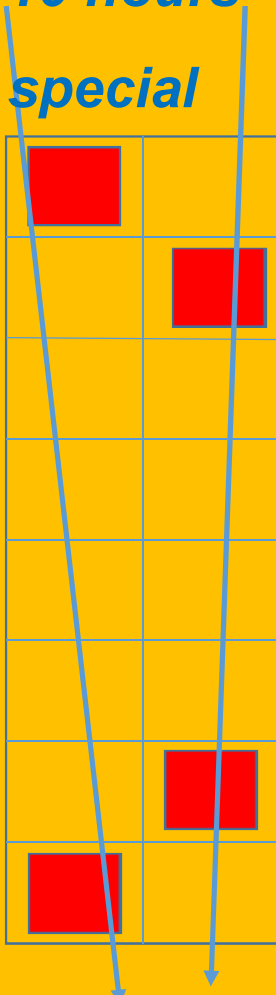
A. Semenov



- ✓ *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*

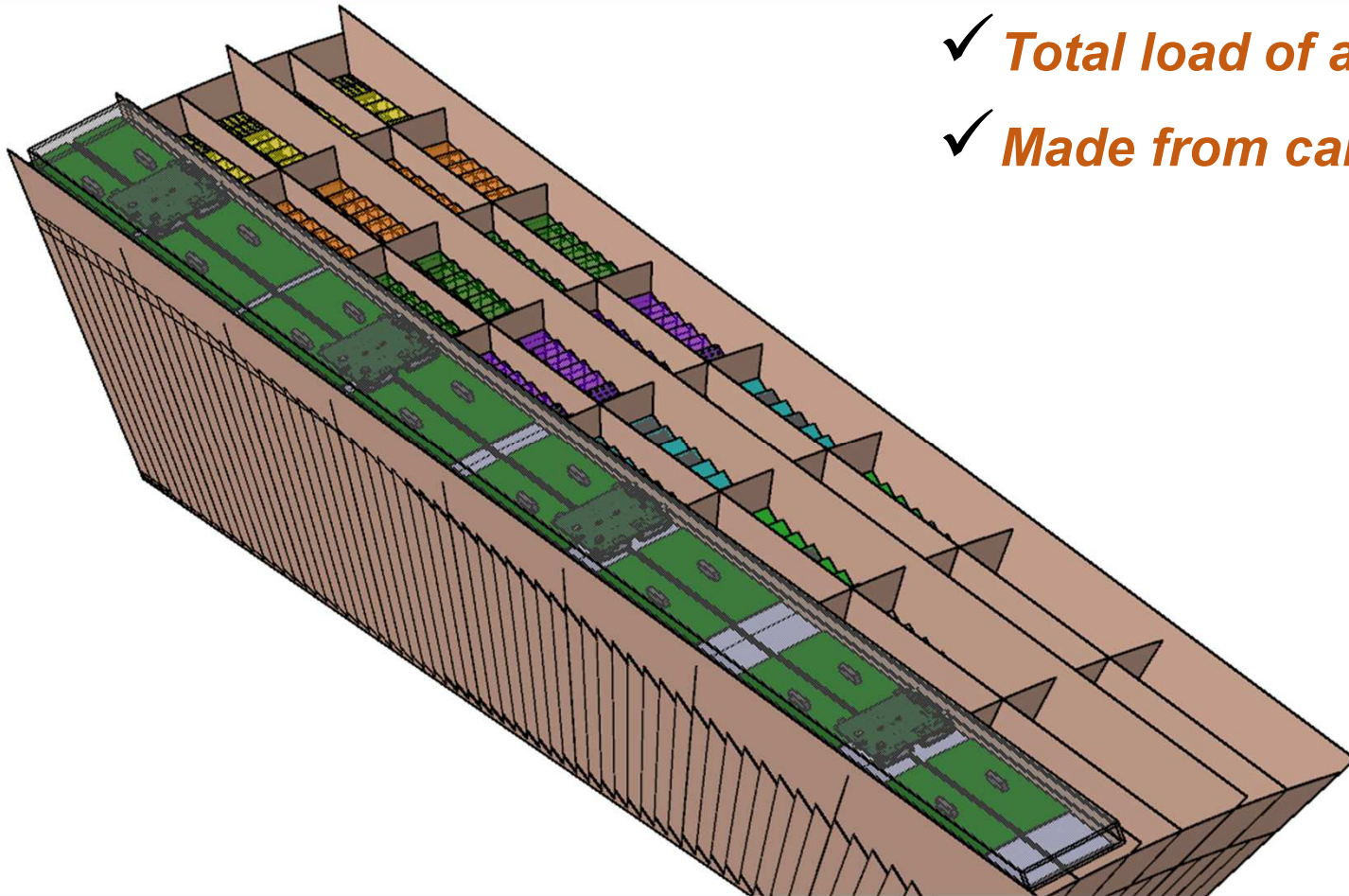
Simplified ECAL Modules Calibration

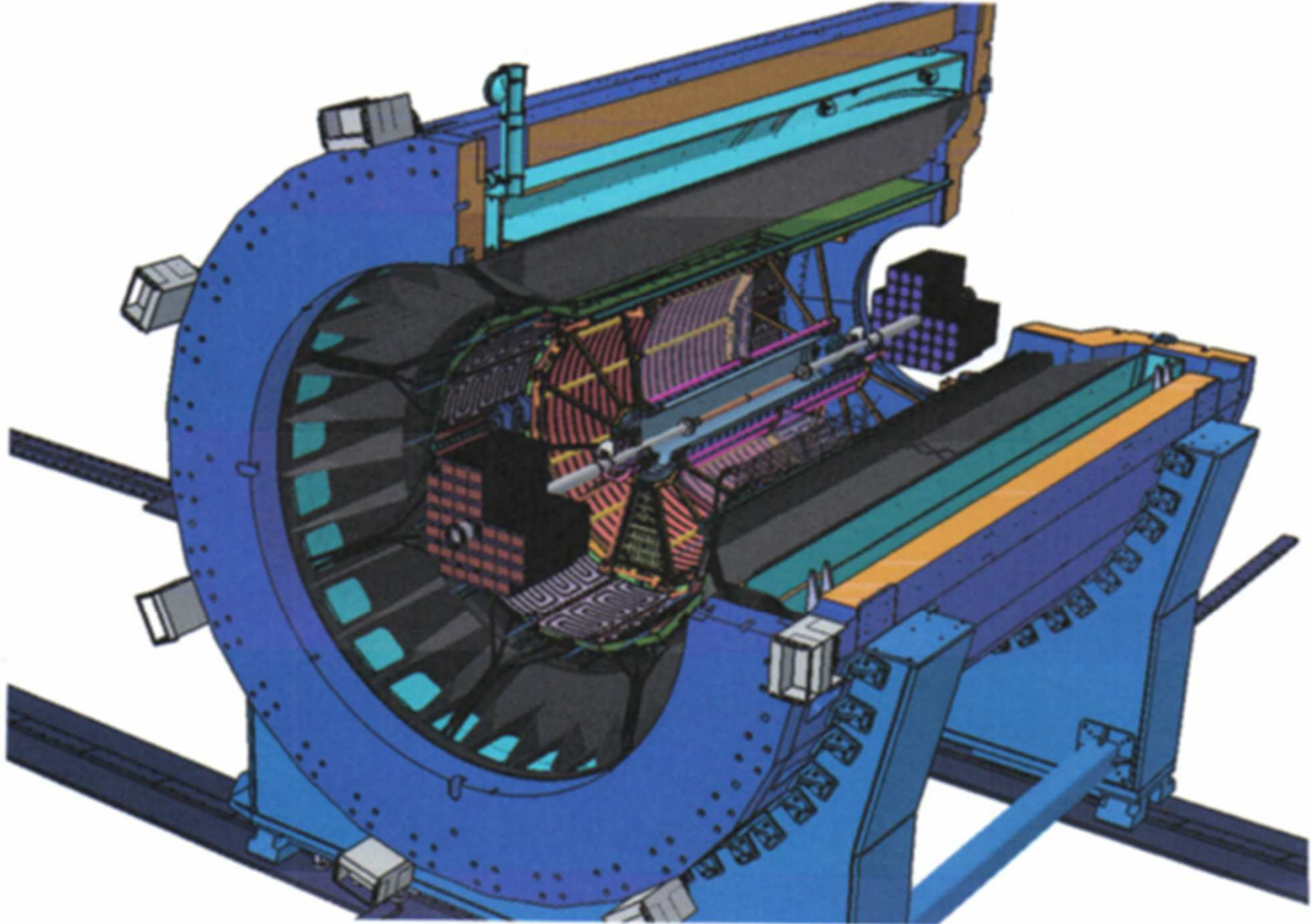
- ✓ *Cosmic rays*
- ✓ *Calibrates any number of modules in 10 hours*
- ✓ *Do not need special equipment*

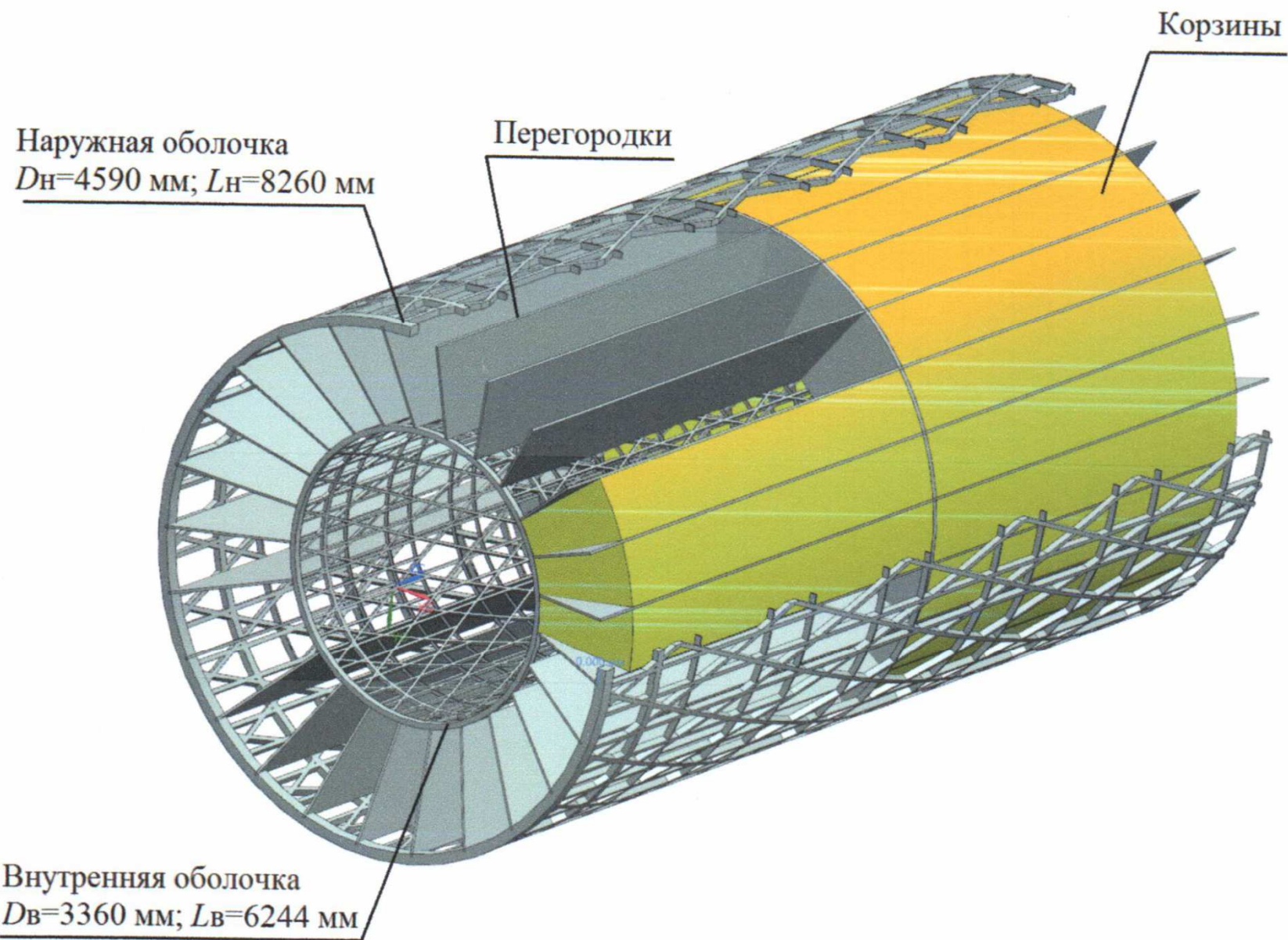


Container project for the modules (half-sector)

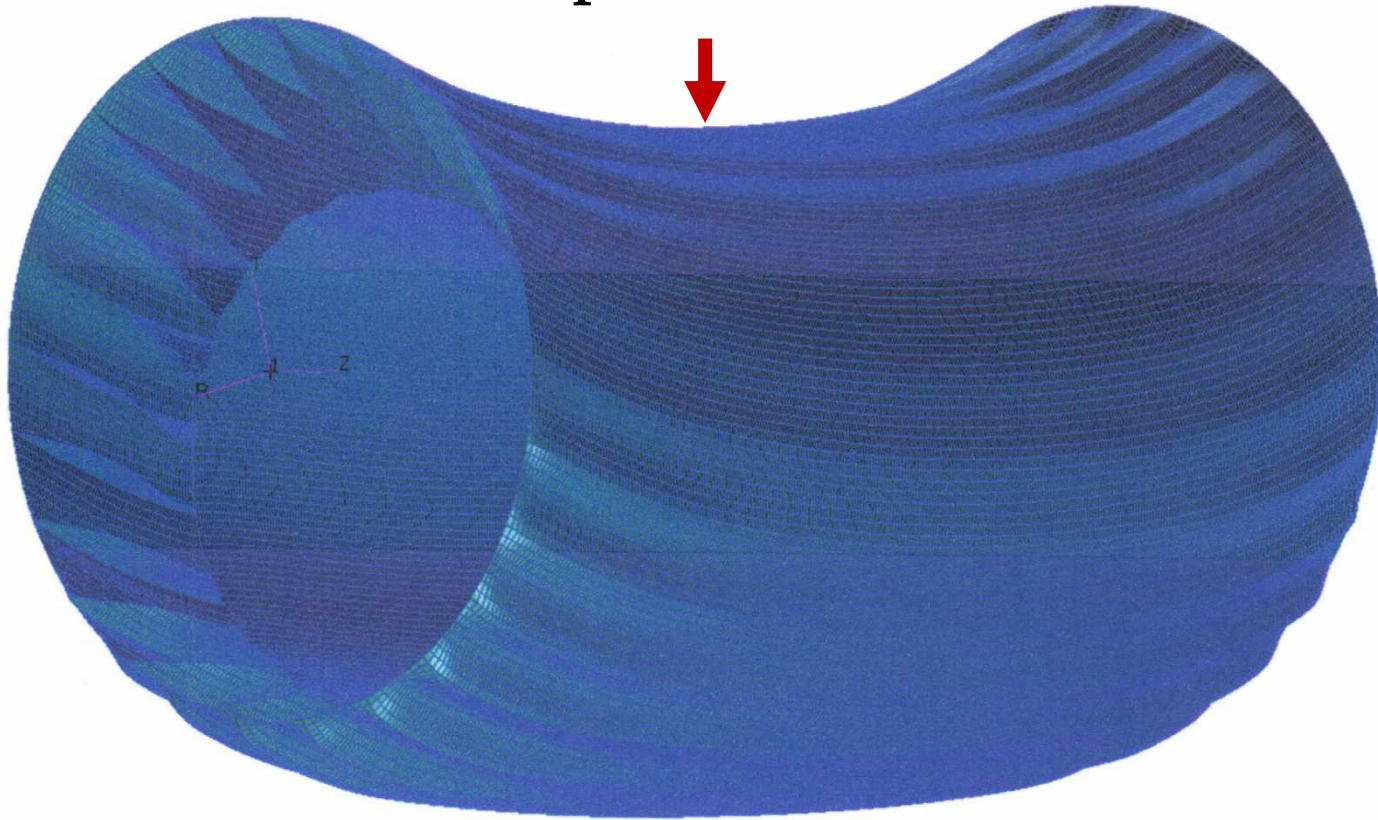
- ✓ ***Total load of about 1.2 tons***
- ✓ ***Made from carbon composite***



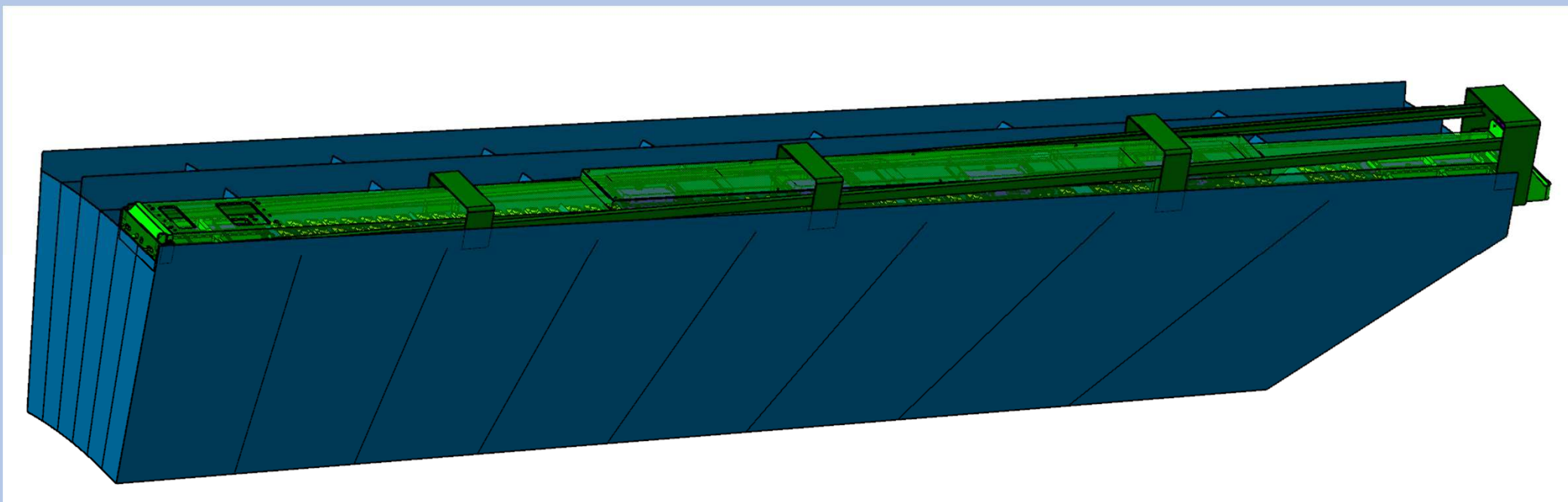




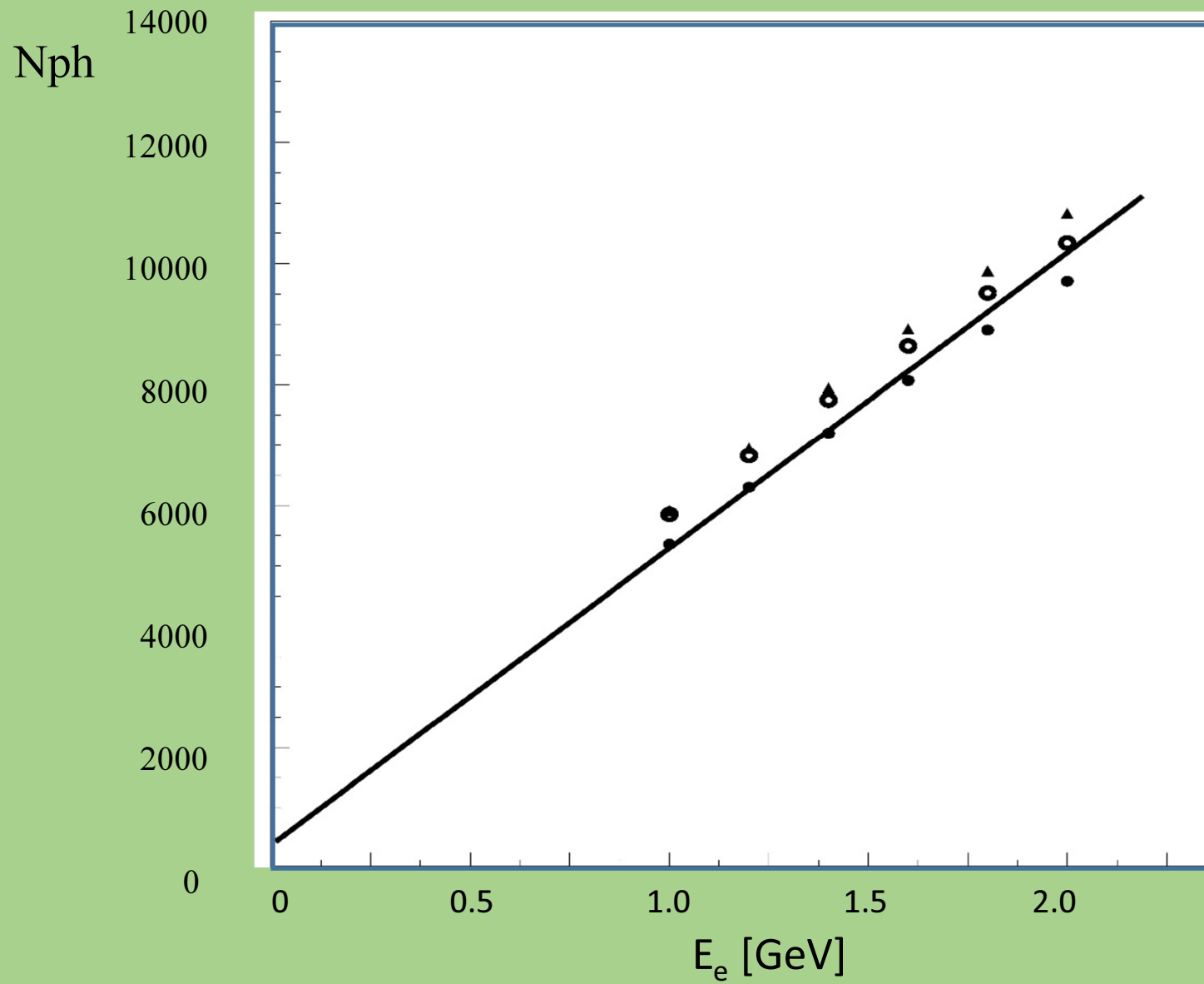
Up to 5 mm



A. Semenov

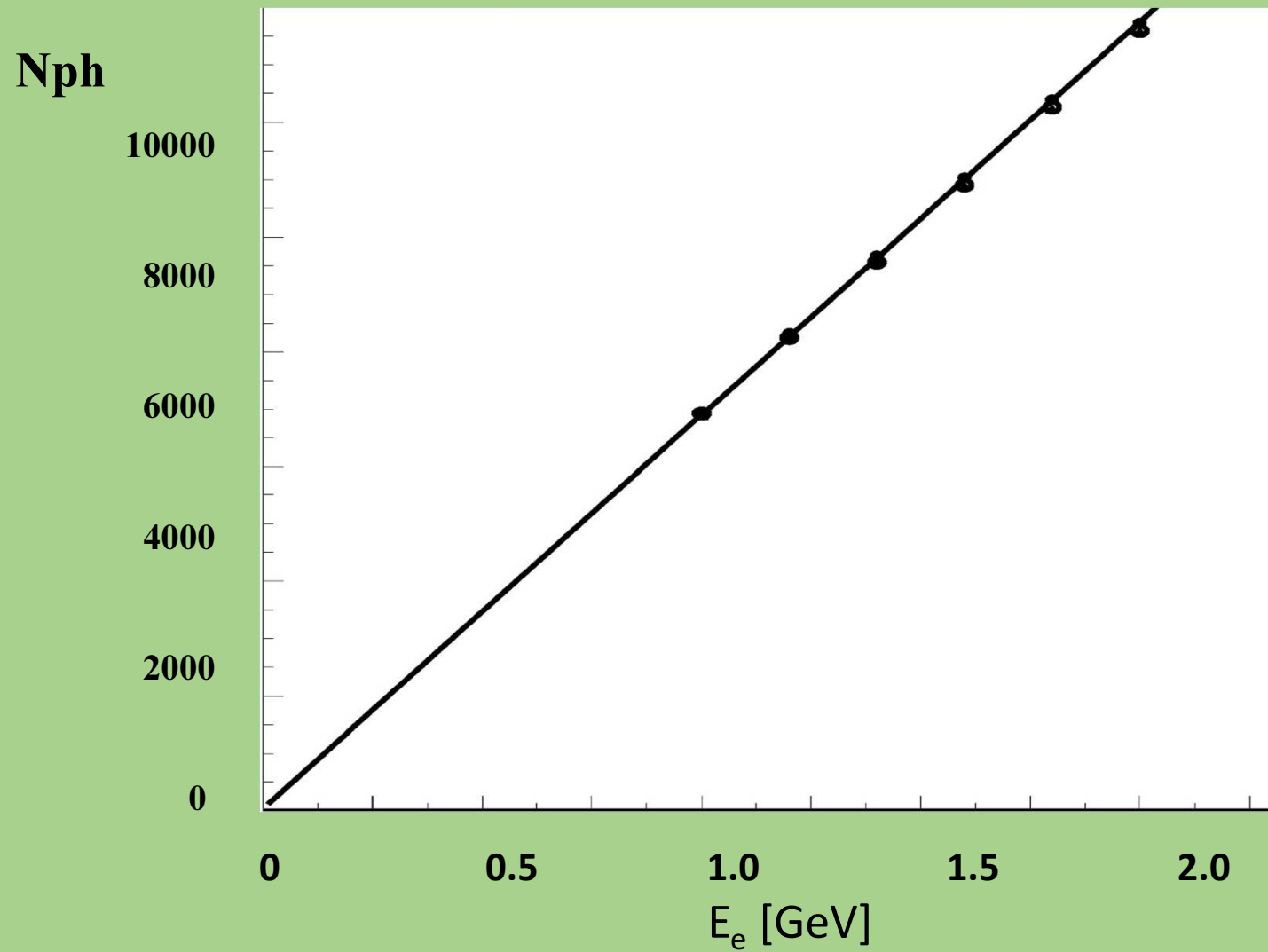


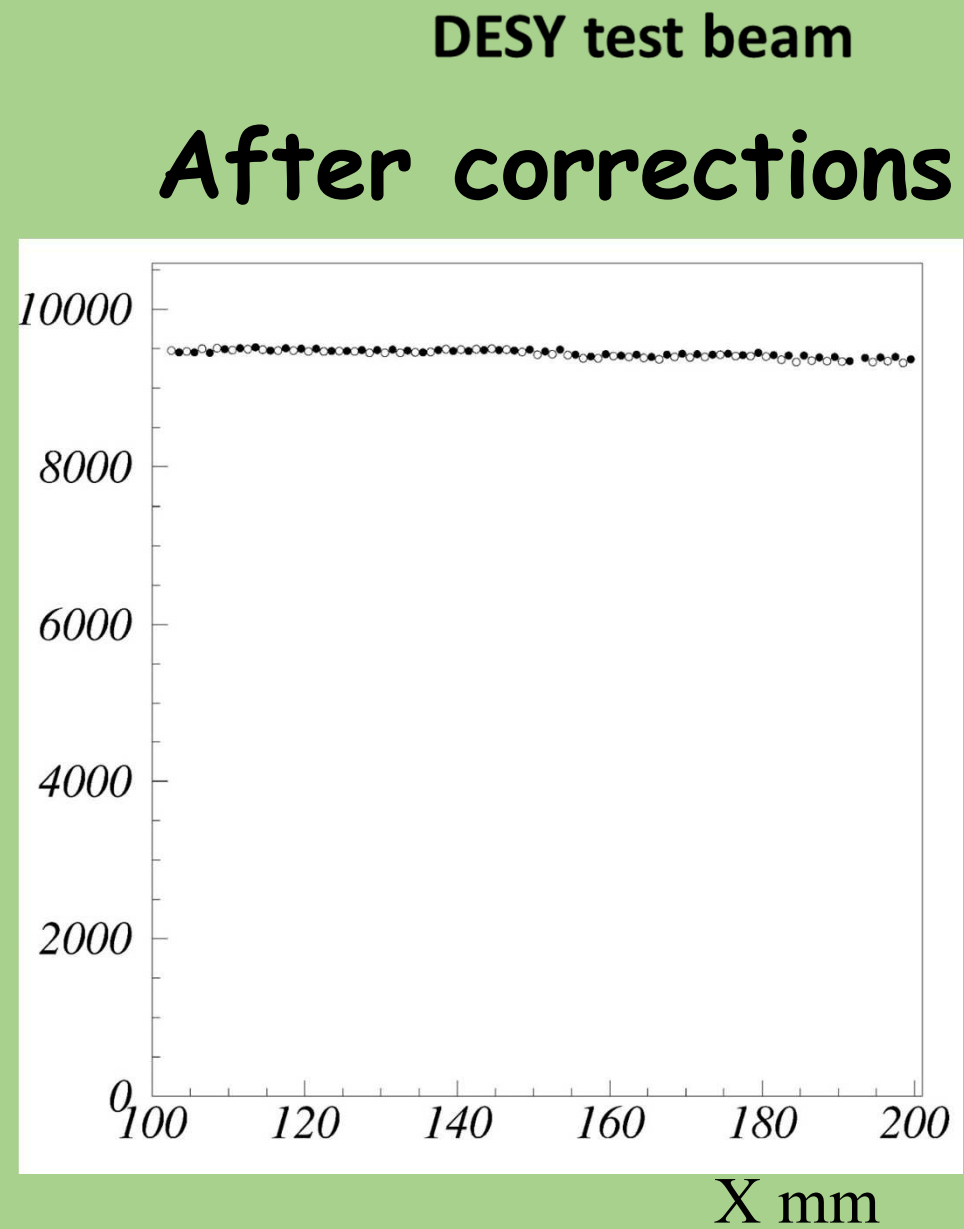
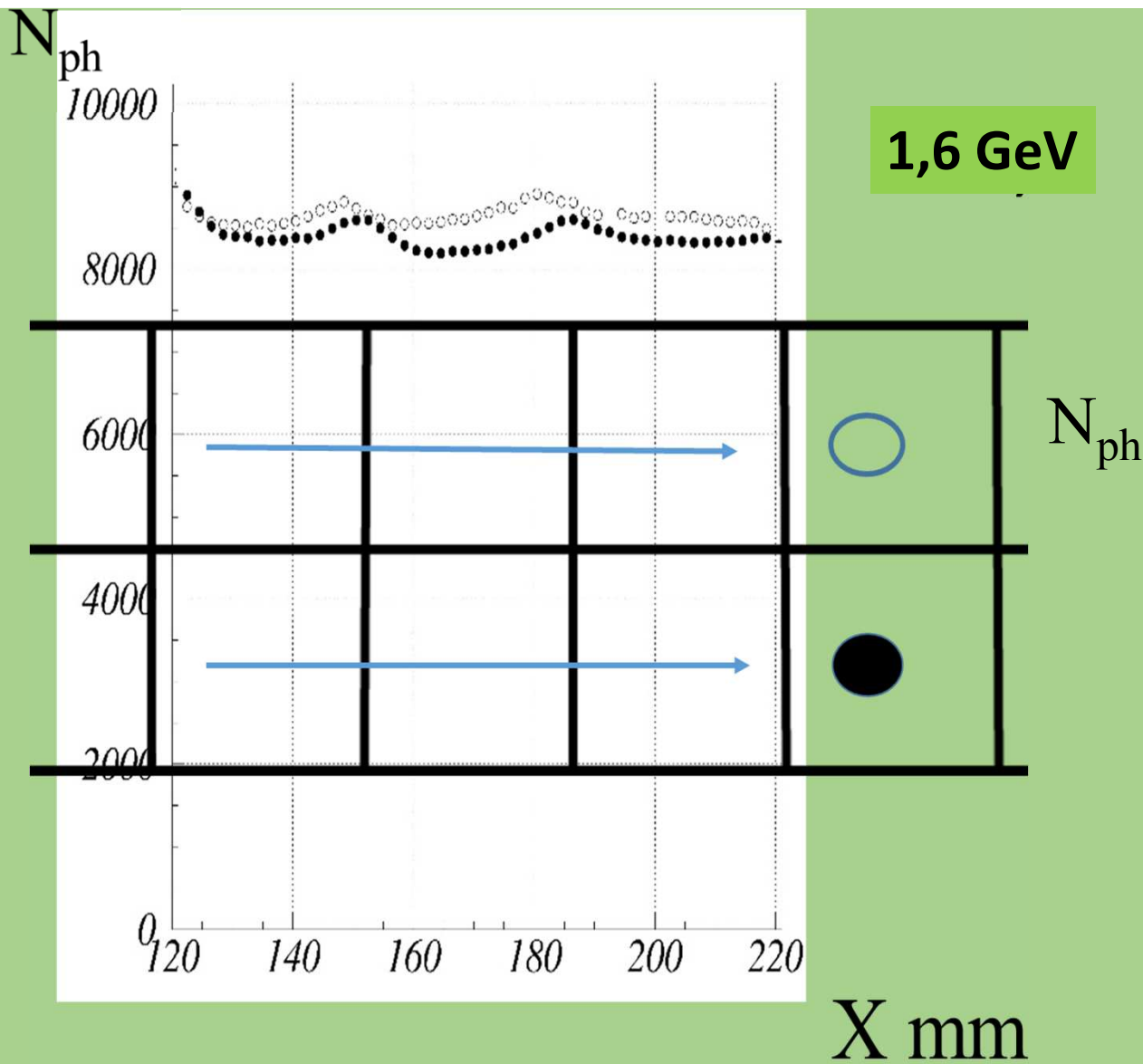
DESY electron beam



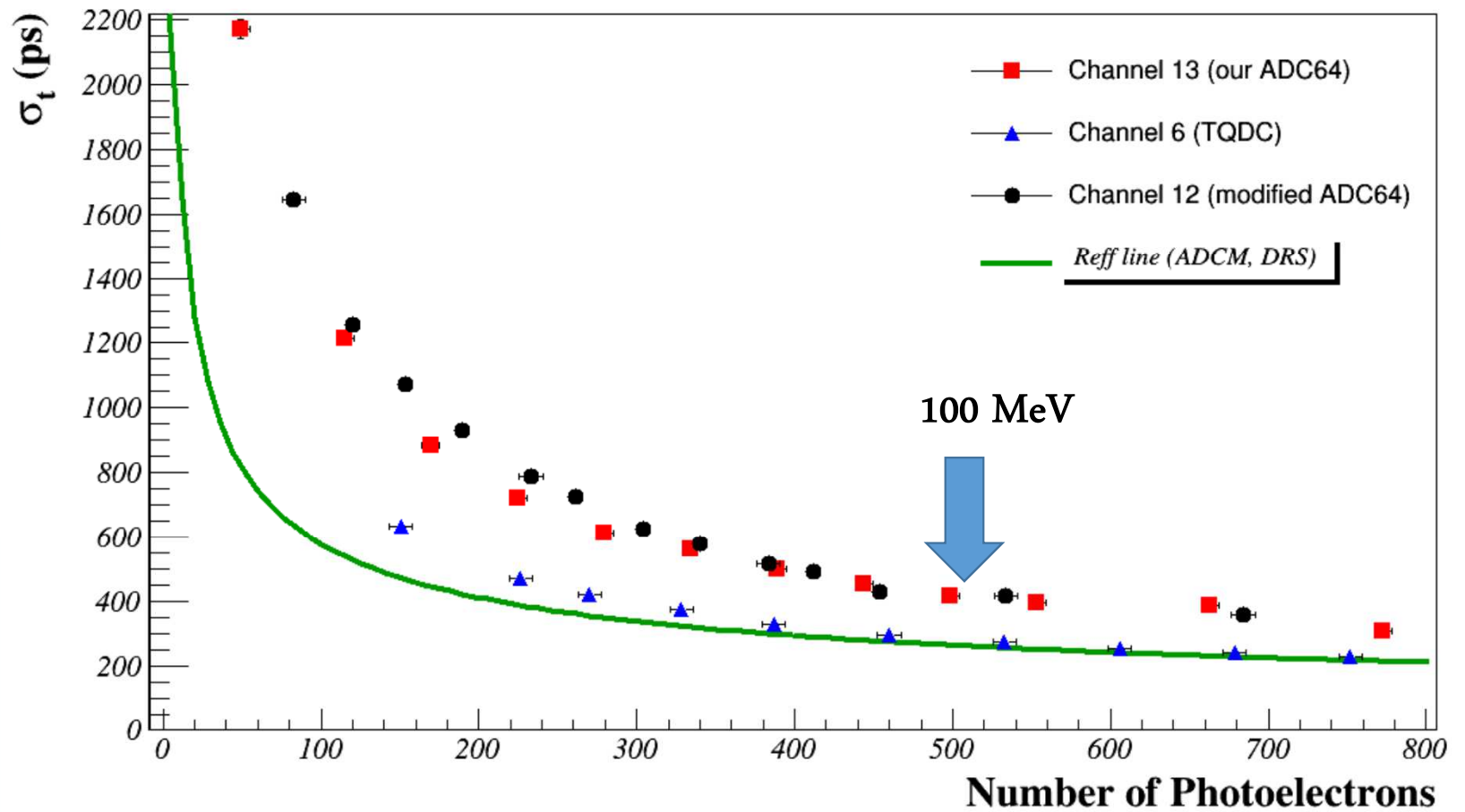
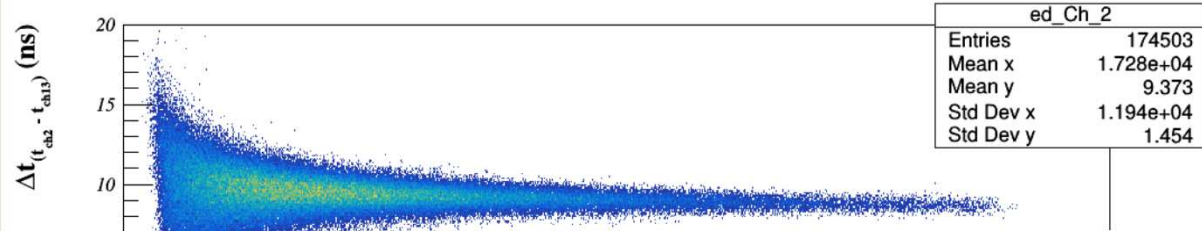
| | | |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| 1 | 2 | 3 |
| ▲ | ○ | ■ |
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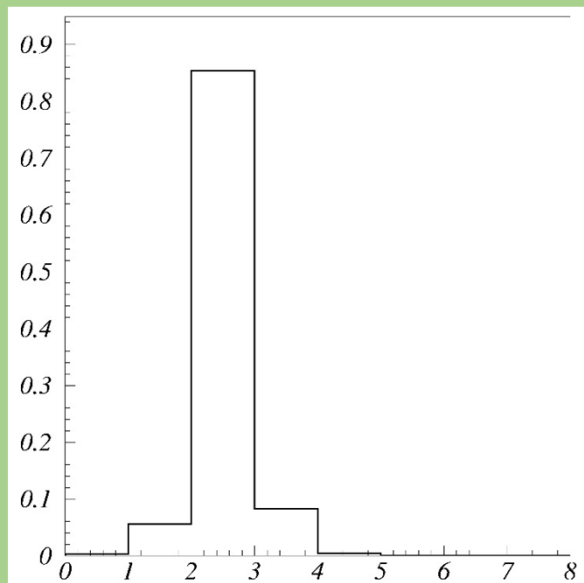
After corrections





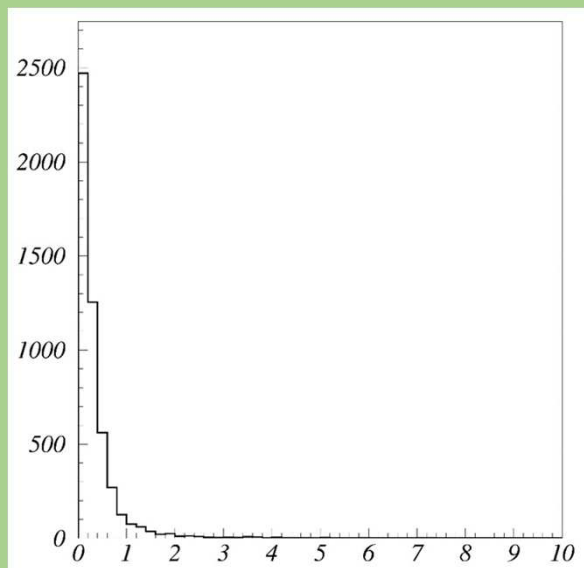
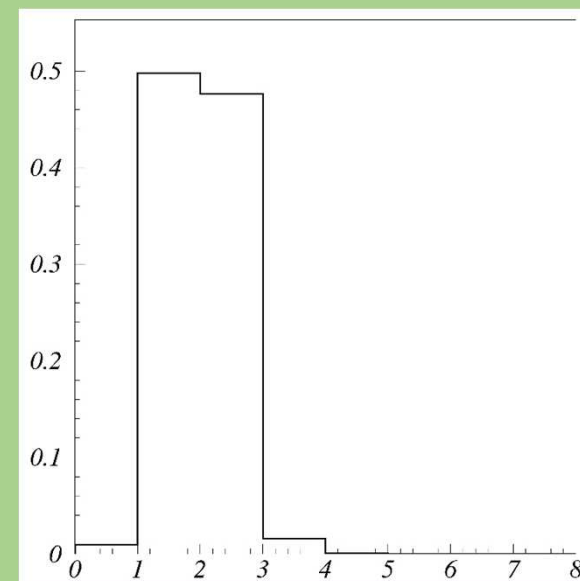
DESY test beam



E_i/E_{tot} 

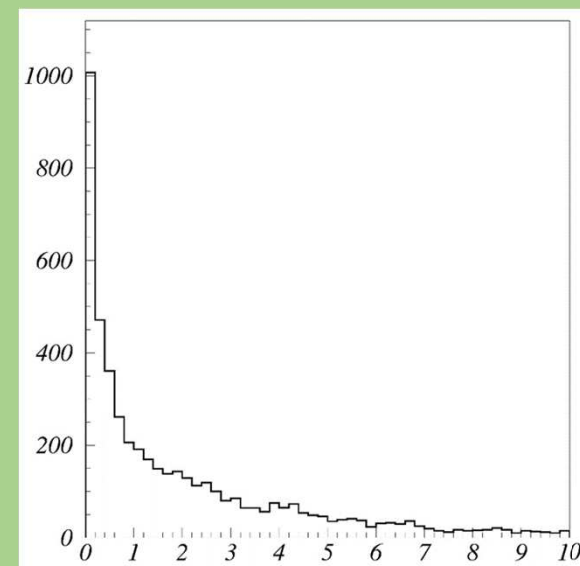
Tower

N

 χ^2 E_i/E_{tot} 

Tower

N

 χ^2

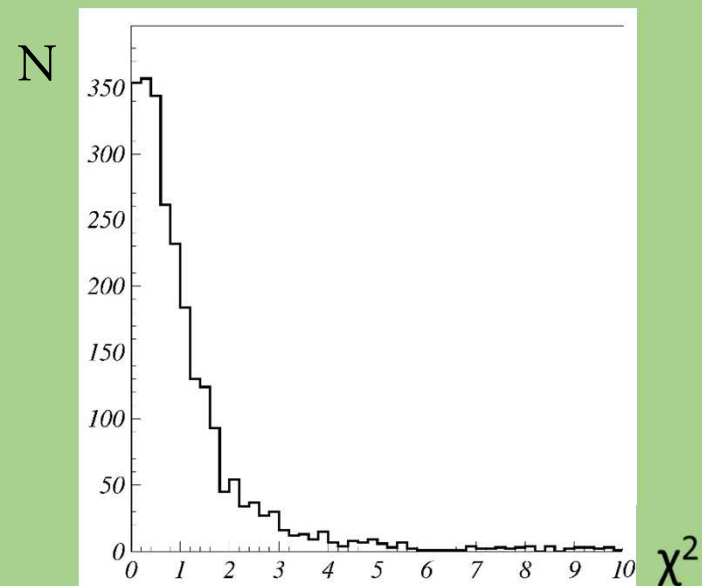
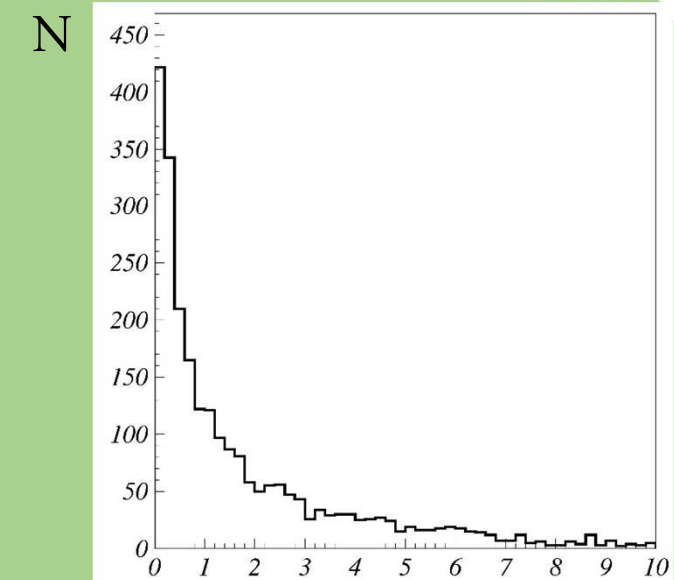
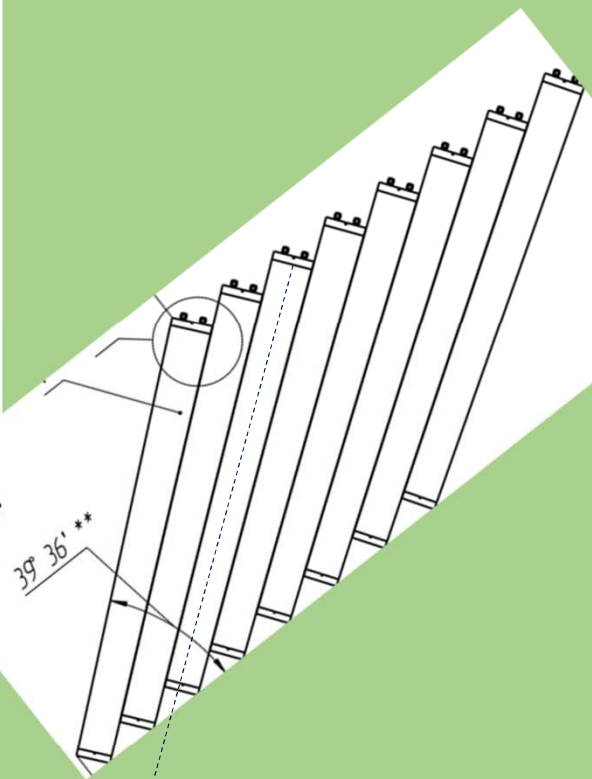
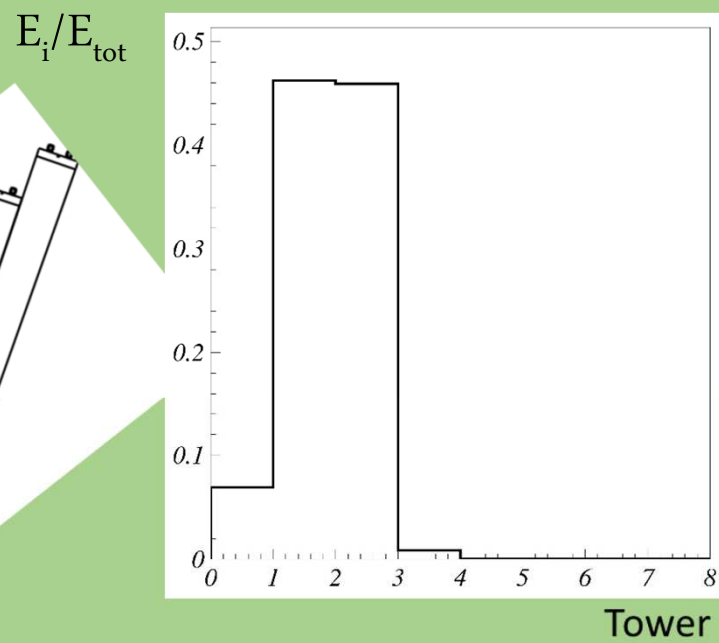
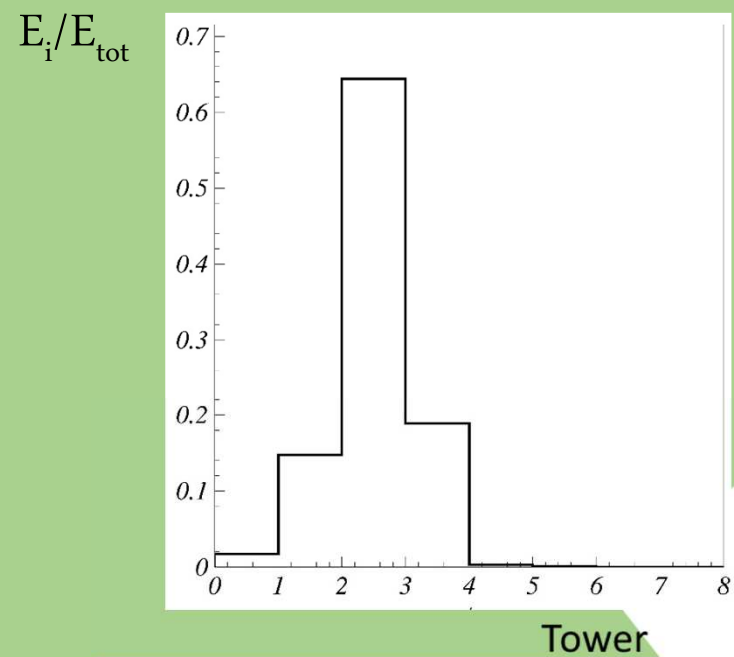
39 36' **

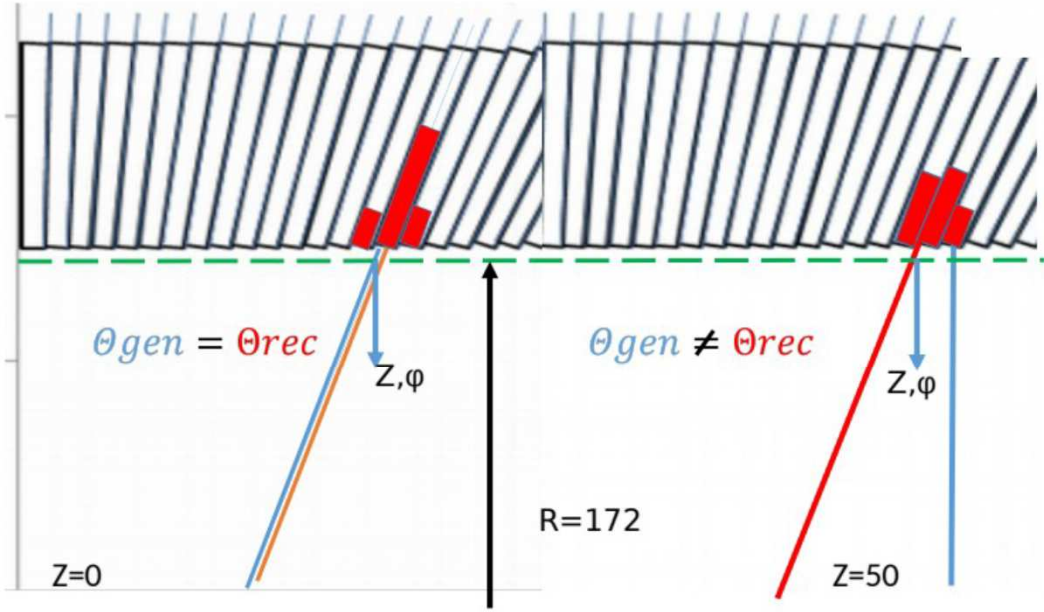
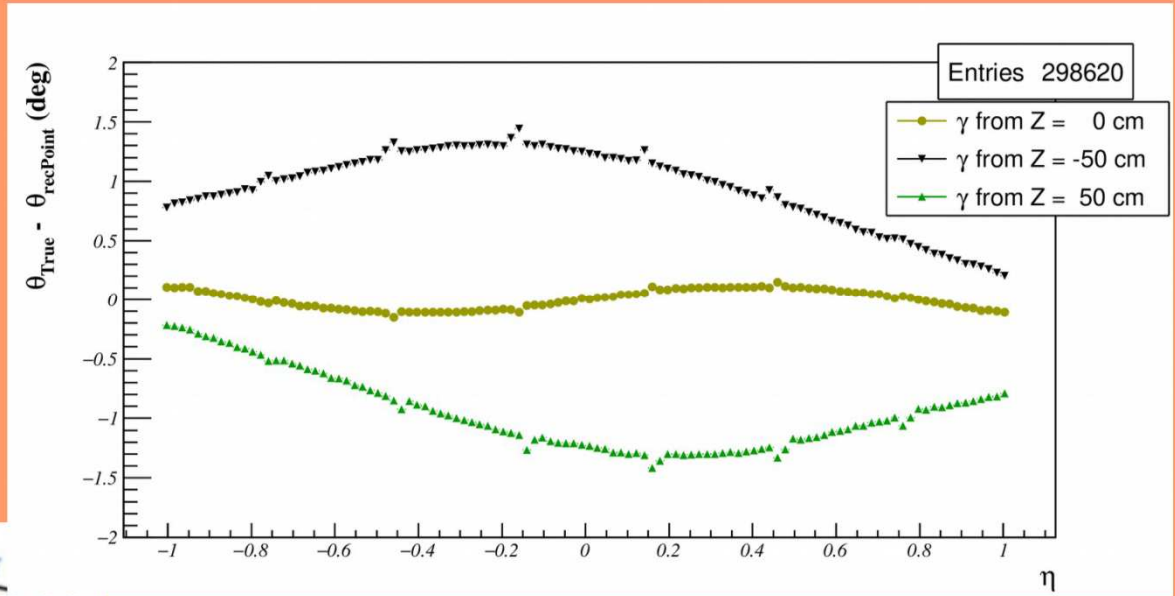
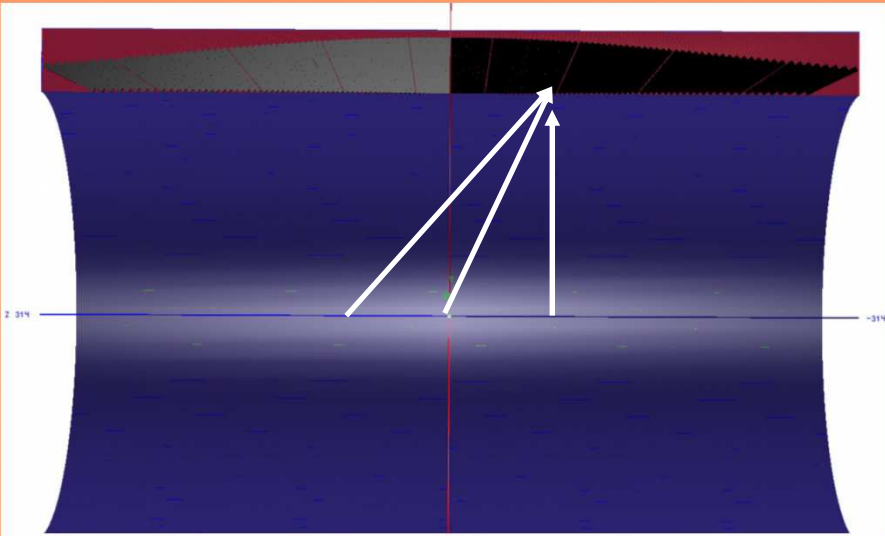
1 2 3 4 5 6 7 8

1 GeV
electron beam

X scan

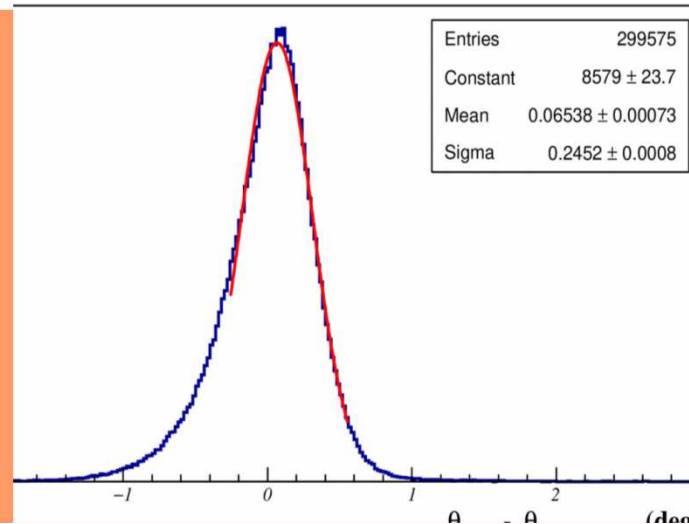
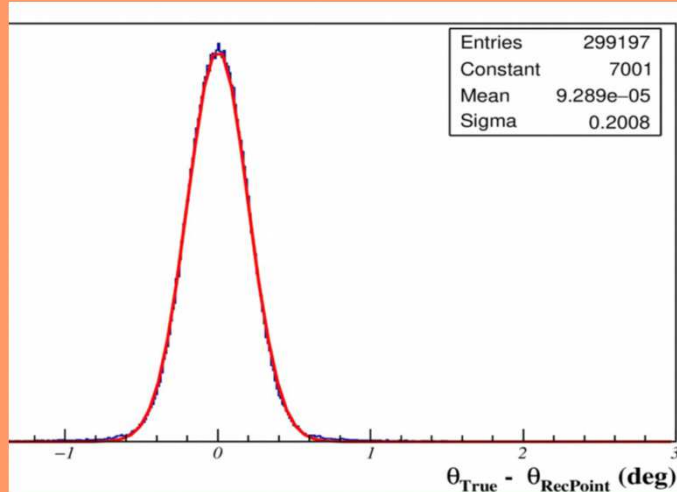
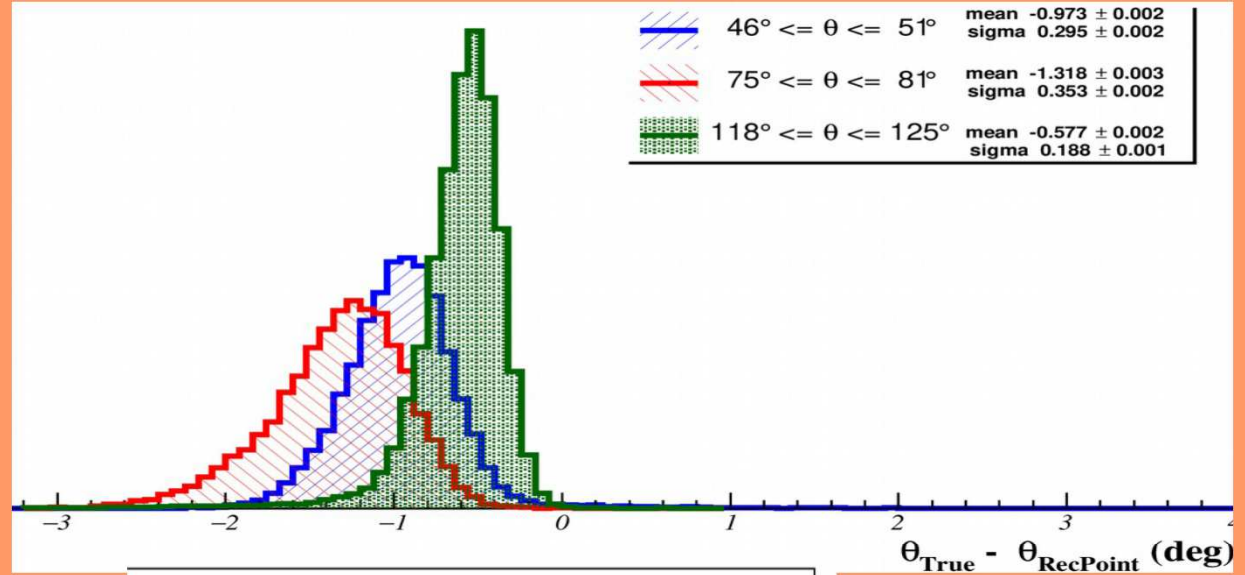
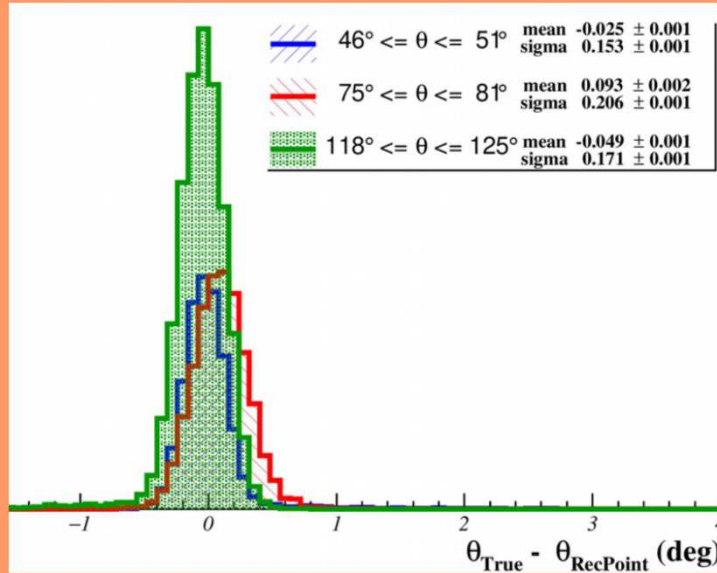
$$\chi^2 = \sum_i \frac{(E_i^{\text{measured}} - E_i^{\text{expected}})^2}{\sigma_i^2}$$





Systematic error in the polar angle measurements

due to the not fully projective geometry of ECal



Summary

1. Production

- All materials or already delivered, or will be delivered in nearest future
 - 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 soon
 - Carbon made supporting frame is under design and may be produced in the second half of 2020!
 - Assembling can start not before autumn 2020 and completed in the second half of 2021
 - First, most complicated, module have been constructed and 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 .