ECal status

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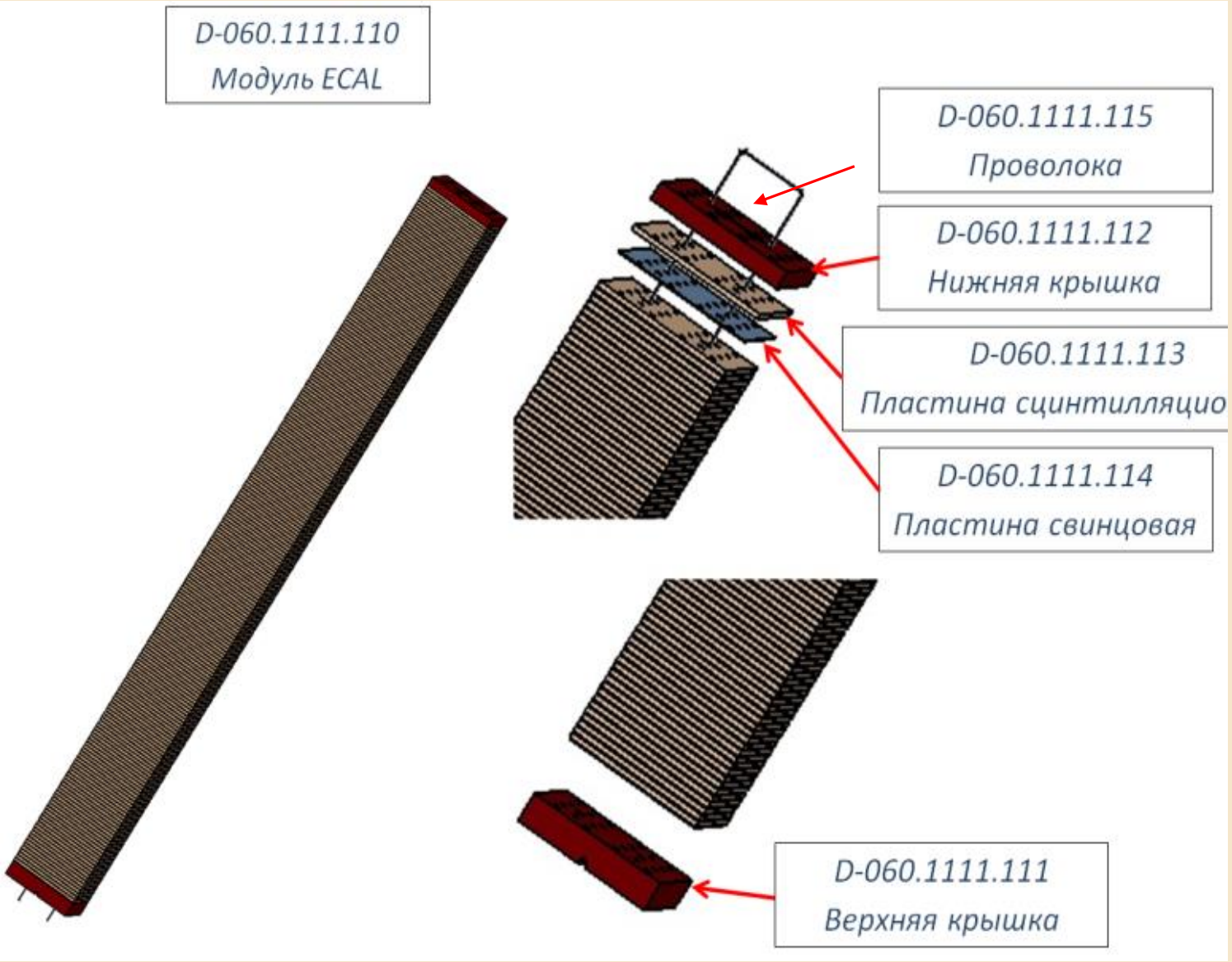
Dubna, February 2020

Protvino
Production started
2019-2020
440 modules

ТЕНЗОР
Production started
2019-2020
250 modules

China
2016 modules



- **Scintillator plates**
- *Polypac company (Dubna) and Uniplast company (Vladimir)*
  100% is done

- **Lead plates**
- *Russia (25%) and China (75%)*
  75% Done
- **Pressure plates and fiber bonding plates**
- *Polypac (Dubna) –*
- **100% is done**

- **WLS fibers. Kuraray (Japan)**
- *Russia (25%) and China (75%)*
- **100% delivered**

China production site

China Contribution

Modules production (75%)
Analog boards (HV + amp.) production (50%)

Institutes：

Tsinghua University (60%)

Huzhou University

Shandong University (20%)

Fudan University (10%)

University of South China (10%)

Calibration Method

Traditional calibration:

1) equalize the gain of all channels;
2) find one common calibration coefficient for ADC→(impact E) conversion (using electron beam or reconstructed π^0).

Problem: the method does not take into account the geometrical differences of the calorimeter cells and energy dependence of the shower development =>additional "phenomenological" corrections on E, p_T, cell location etc. are needed.

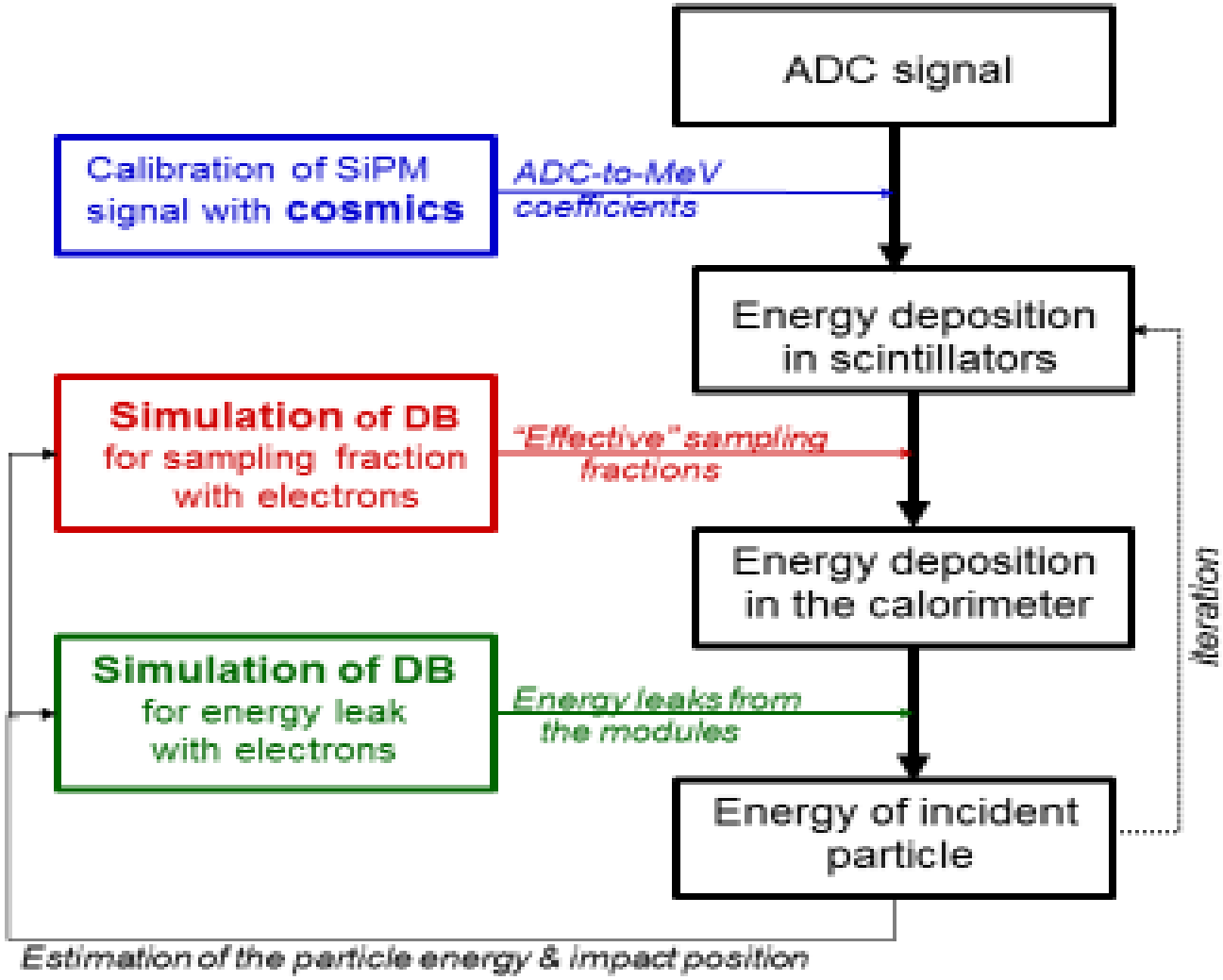
Our calibration:

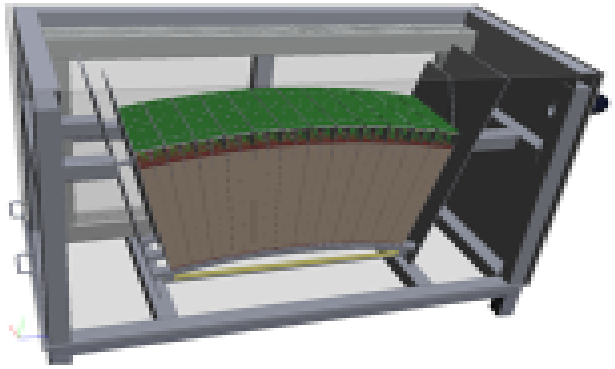
1) find ADC→(E in scintillators) coefficients for each cell (with cosmics);
2) simulate the Data Base for ECal parameters (sampling fraction, energy leak) as a function of impact energy, cell location in ECal, and the distance from the impact point.

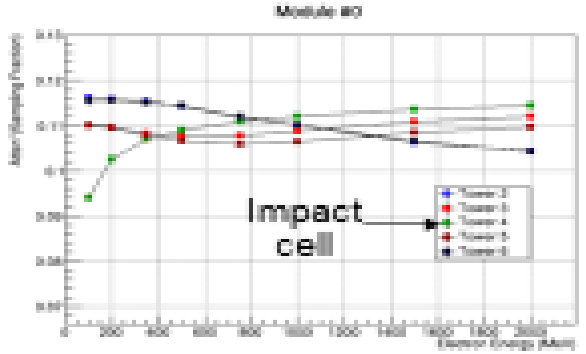
PRO: no "phenomenological" corrections are expected.

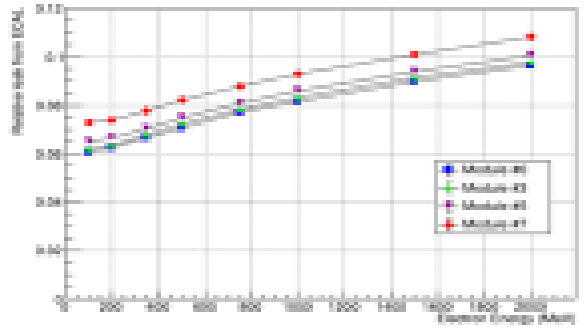
Caution: detailed computer model of ECal modules should be used for simulation.

Iterative Procedure of Event-by-Event Calibration









Conclusions

· We plan to perform ECal calibration procedure that relies on "energy scale" measurements with MIP (muons) and detailed simulation of the calorimeter parameters.

· Production of the calibration parameters requires massive simulations in 2020 and 2021.

· Calibration parameters are the functions of the incident particle energy, cell location & impact position
=> **No additional non-linear corrections are required!**

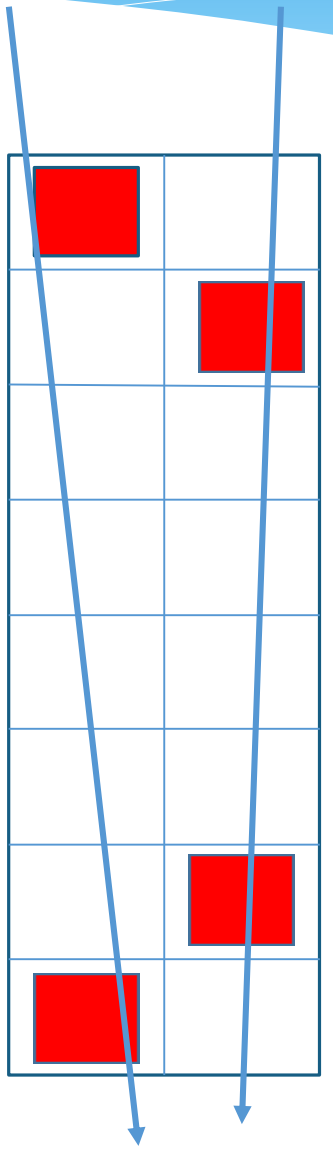
· We plan to perform calibration on muons for all ECal modules during 2020 and 2021 (together with the modules QA).

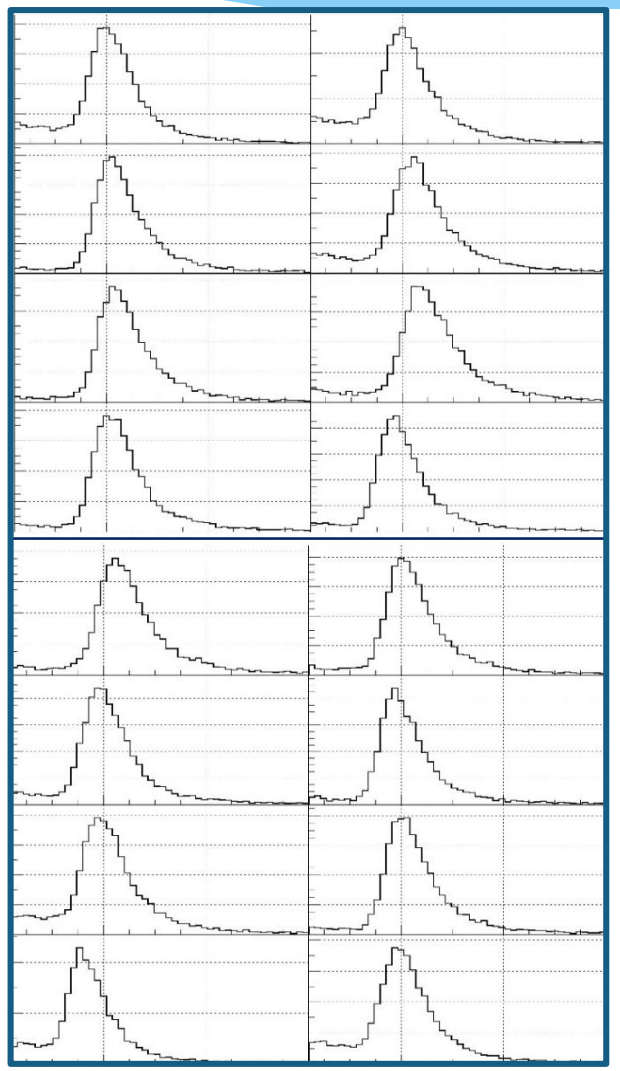
· Correction on signal saturation because of finite number of SiPM cells should be applied on the top of this calibration.

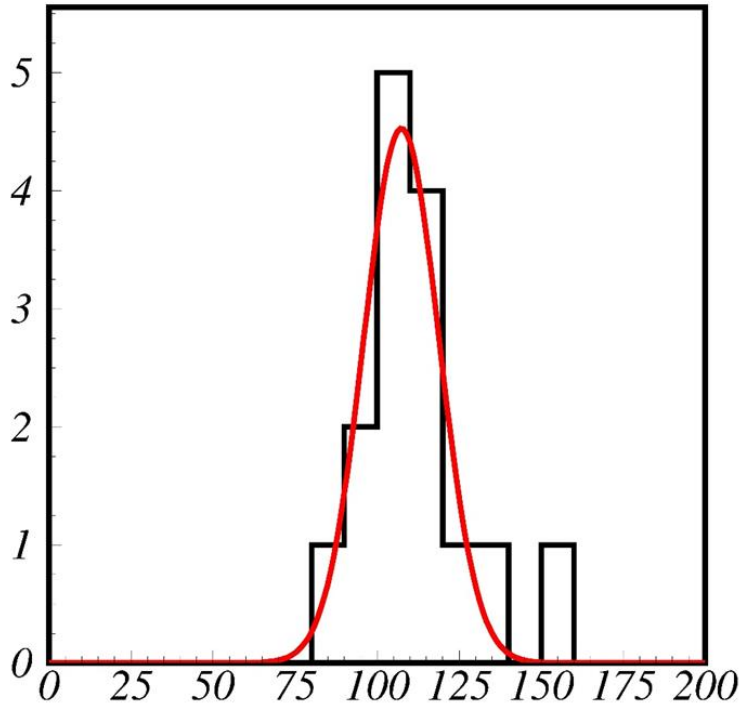
· Preliminary test was done with electron beam @ LPI RAS (Troitsk, Moscow reg., Russia). Data analysis is in progress.

Simplified ECAL Modules Calibration

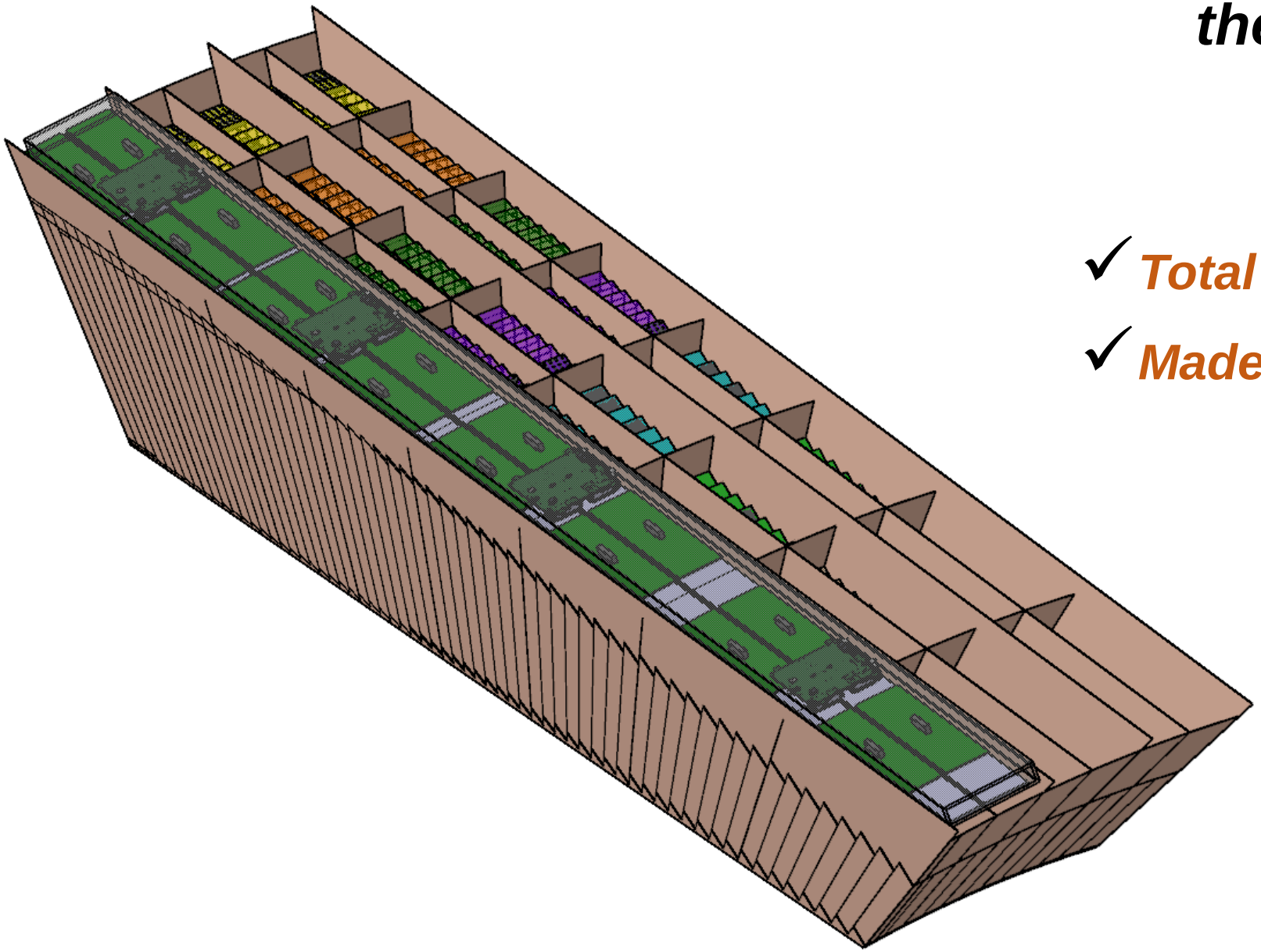
- ✓ *Cosmic rays*
- ✓ *Calibrates any number of modules in 10 hours*
- ✓ *Do not need special equipment*





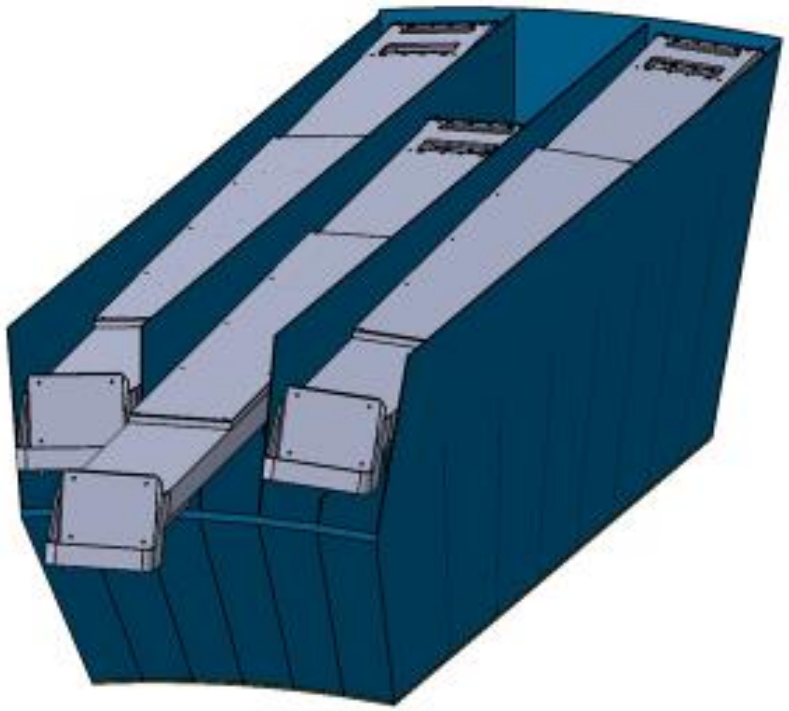


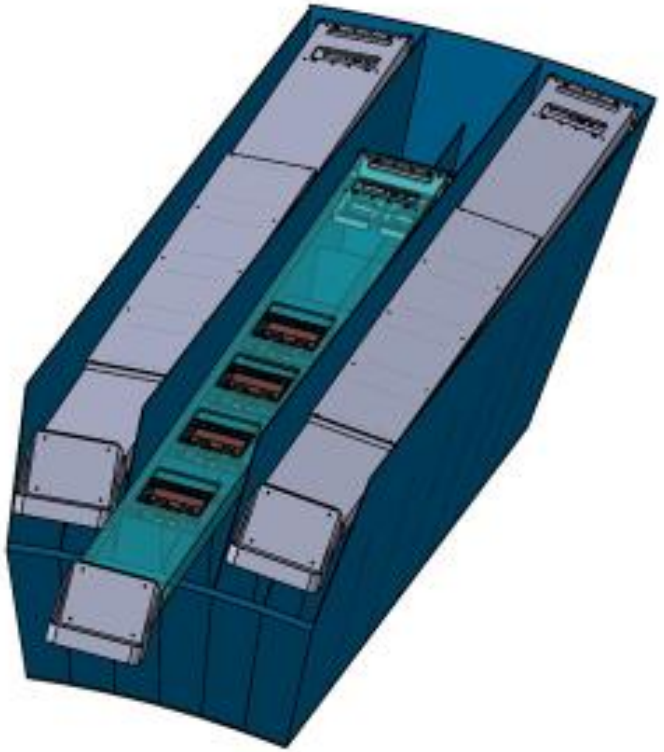
Container project for the modules (half-sector)

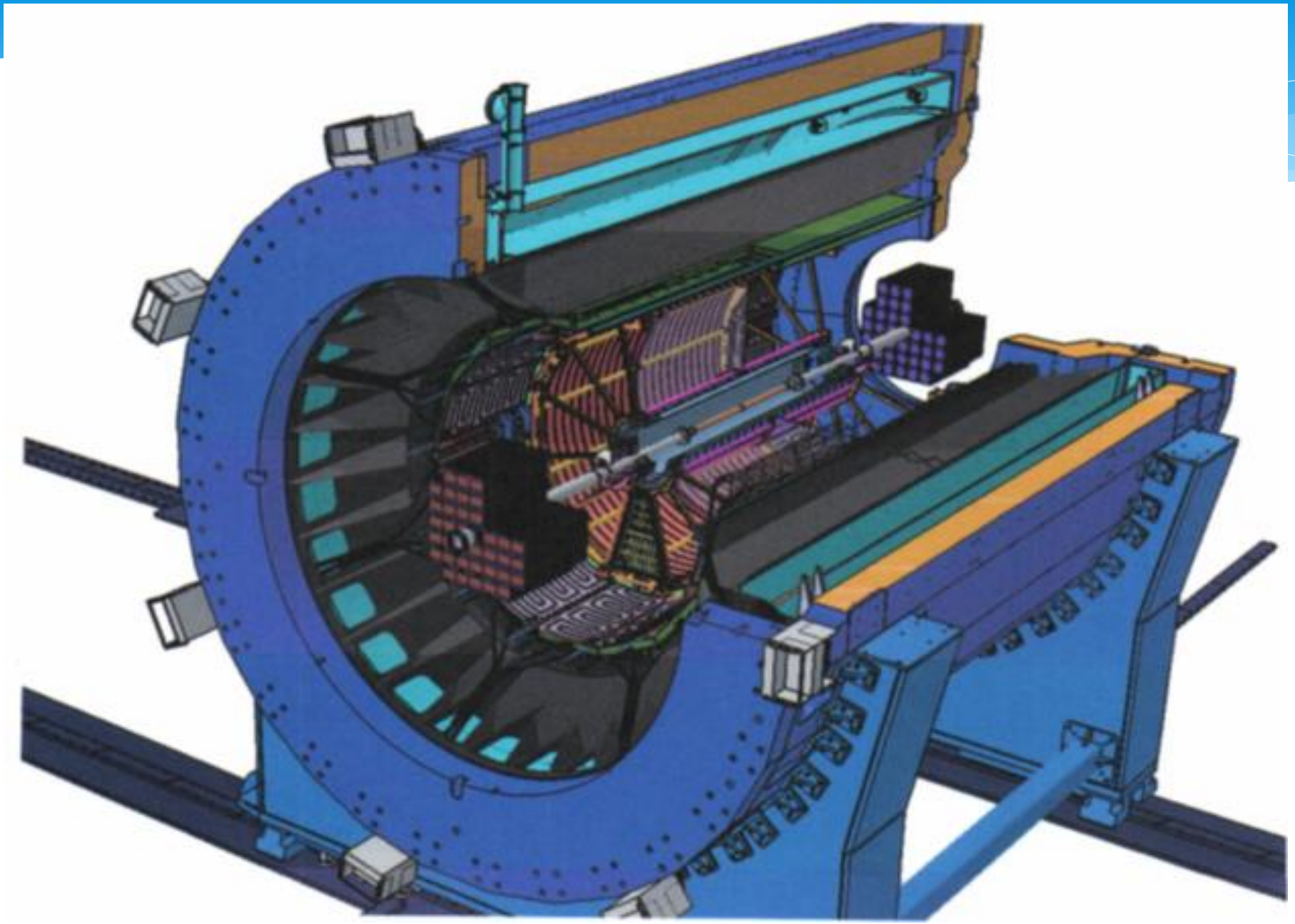


- ✓ *Total load of about 1.2 tons*
- ✓ *Made from carbon composite*

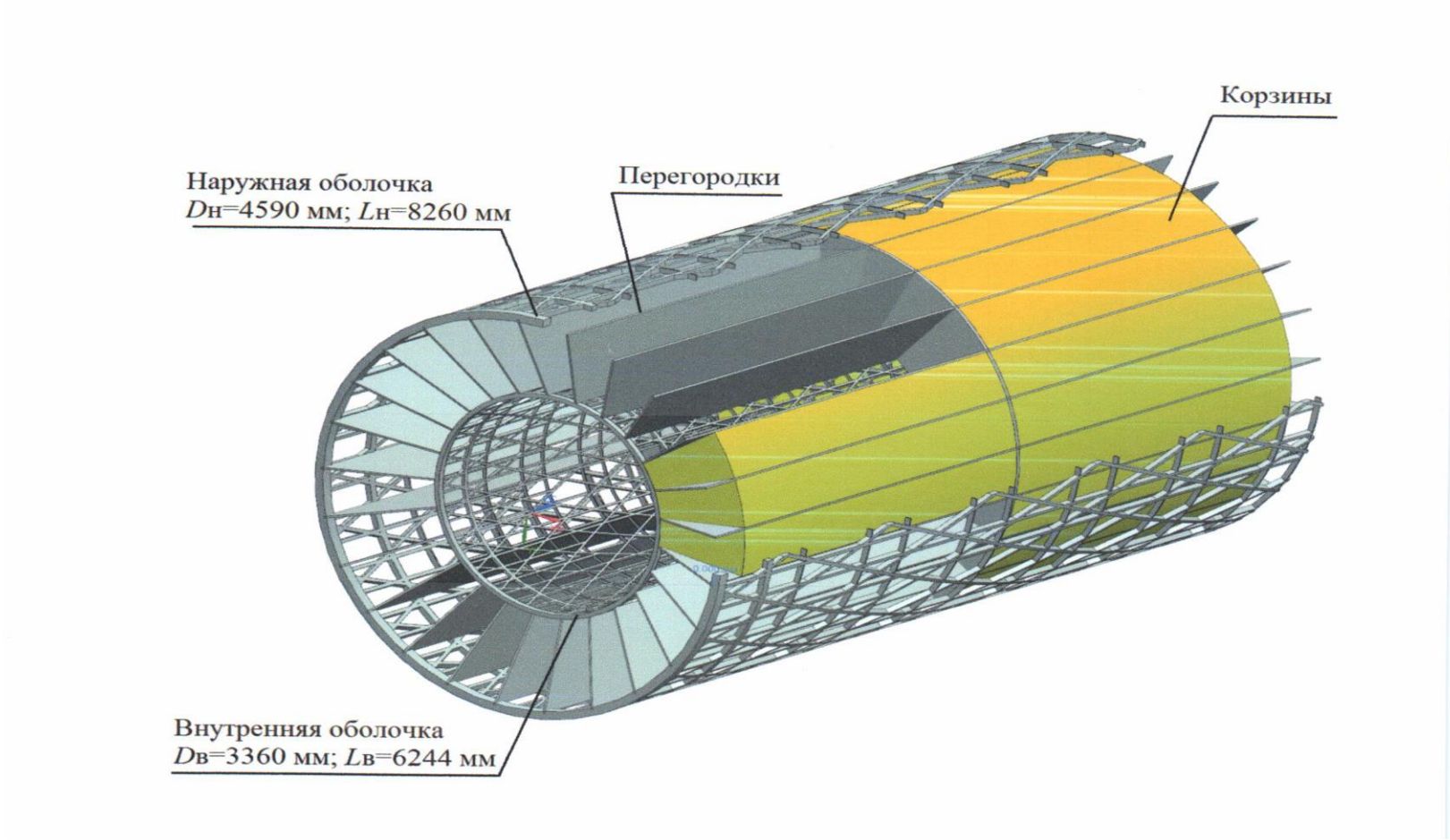
Removable electronics







Power frame


Корзины
Наружная оболочка
Dн=4590 мм; Lн=8260 мм
Перегородки
Внутренняя оболочка
Dв=3360 мм; Lв=6244 мм

Up to 5 mm

Power frame

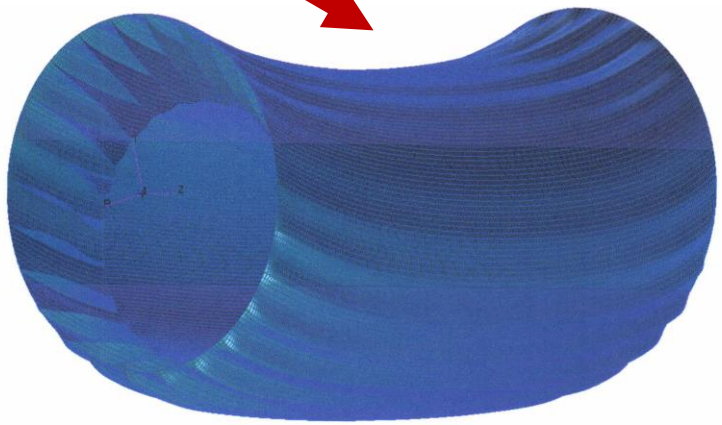
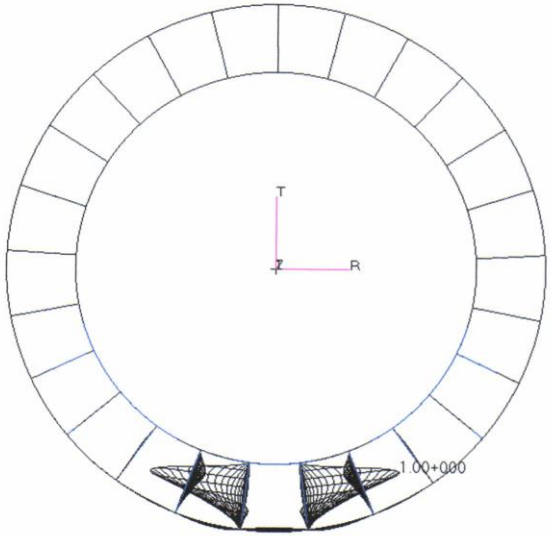
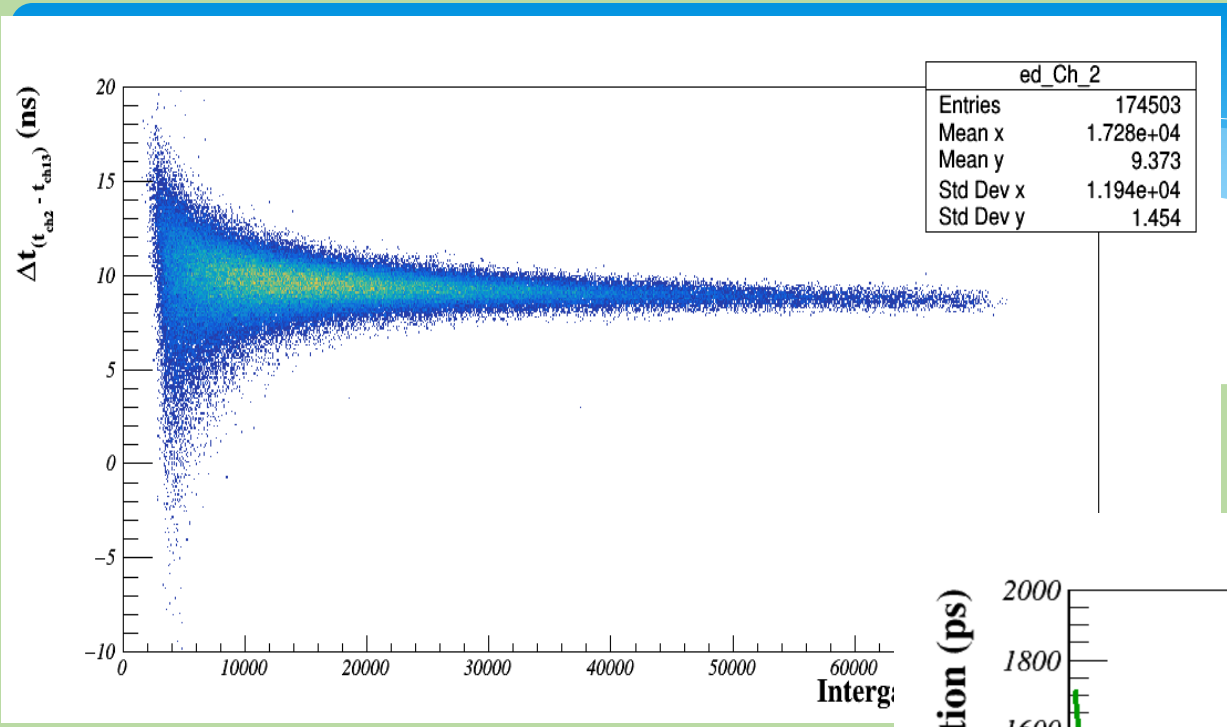
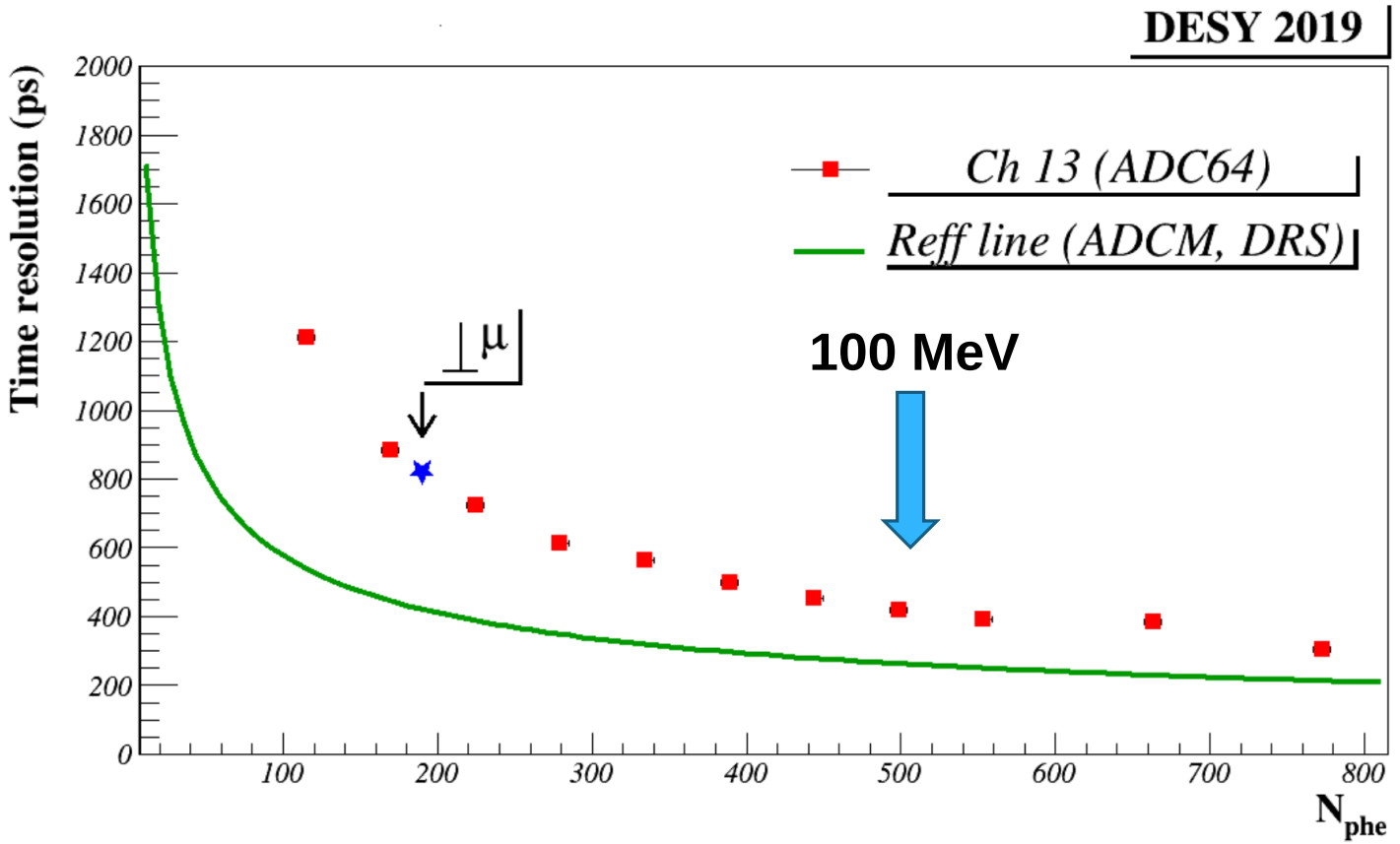


Рисунок 2.6. Деформированное состояние модели

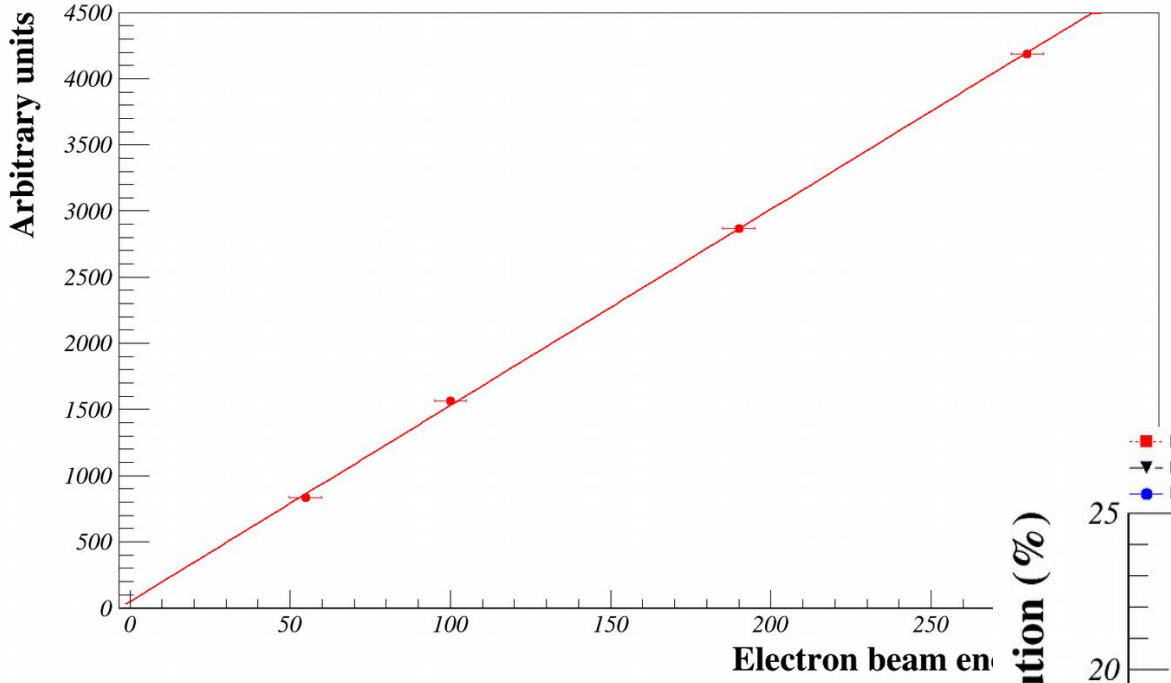


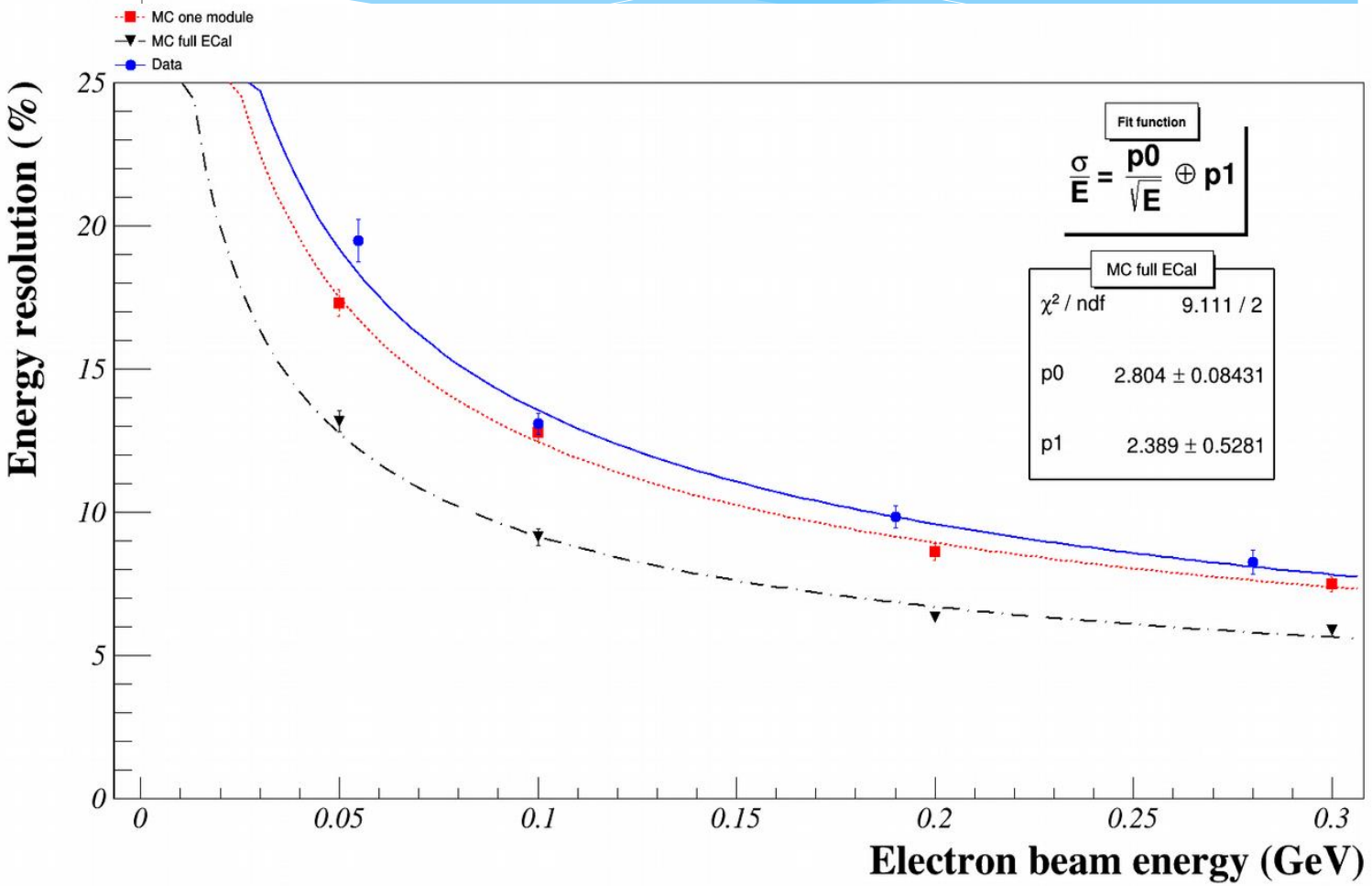
DESY test beam



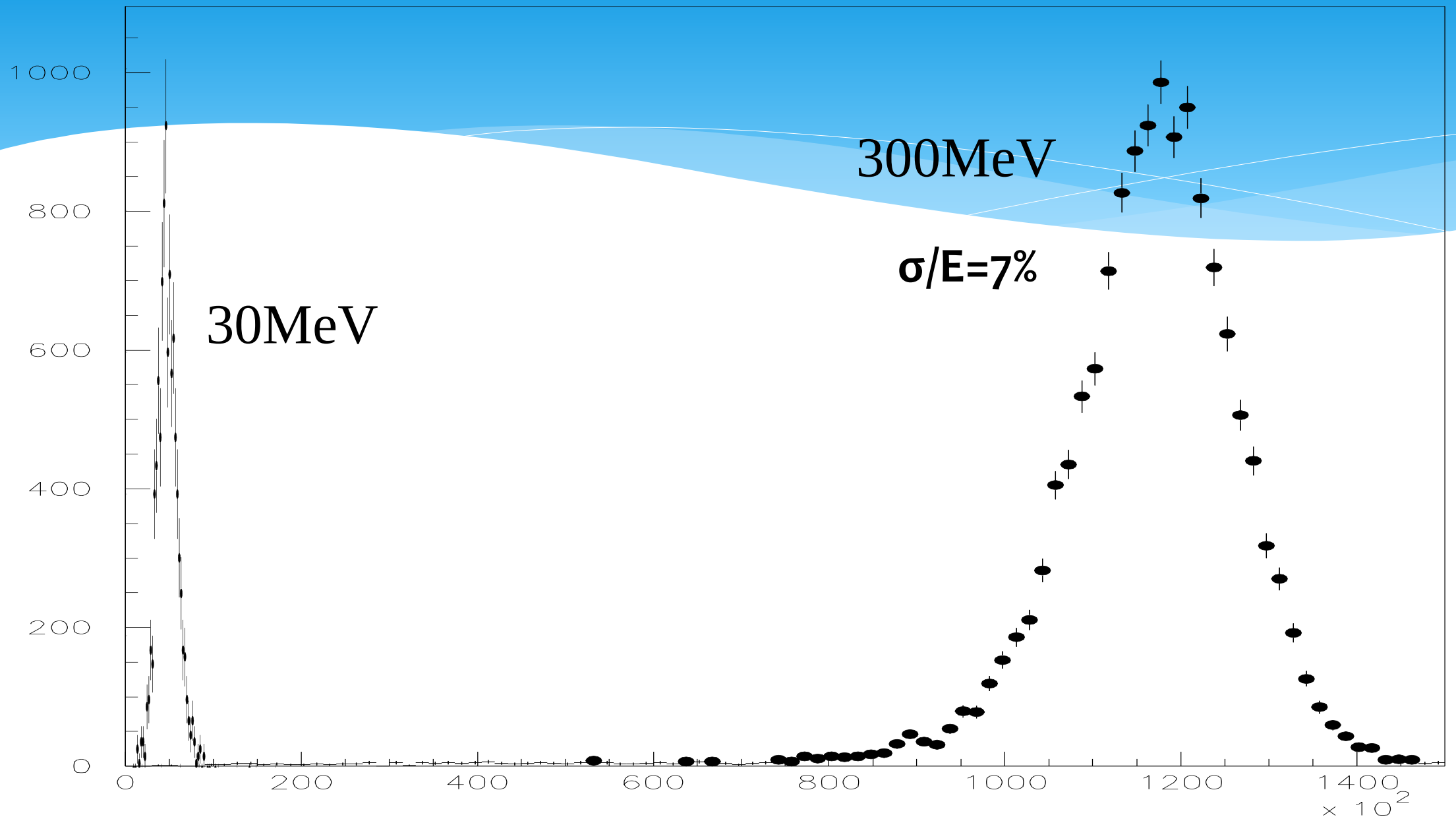


FIAN test beam

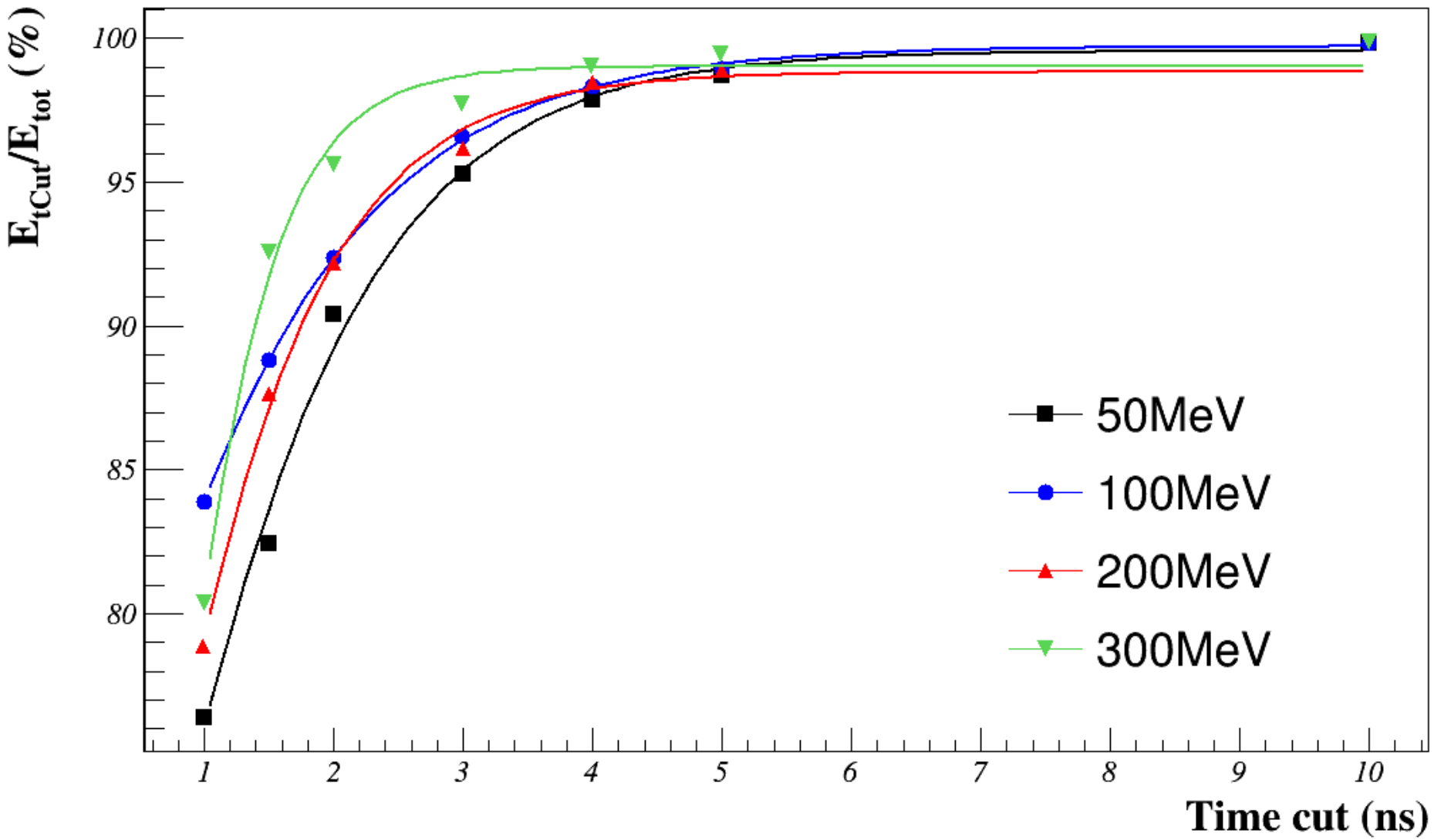




FIAN test beam



FIAN test beam



1. Production

- Materials or already delivered, or will be delivered in nearest future
- Quality of all materials is under careful control
- China will be ready to start production in the few production areas soon (but only 25% of their quota is cowered by the budget so far)
- Carbon made supporting frame is under design and may be produced in the second half of 2020!
- Assembling can start not before autumn 2020.

2. Tests

- First modules have been constructed and tested.
- Sensitivity to the electromagnetic shower is shown on the level of previously constructed devices and in reasonable agreement with MC prediction.
- Methods for calorimeter calibration by means of cosmic muons have been proposed and tested

3. MC study

- More research is needed to study possibility of use in physical analysis all specific detector property.