

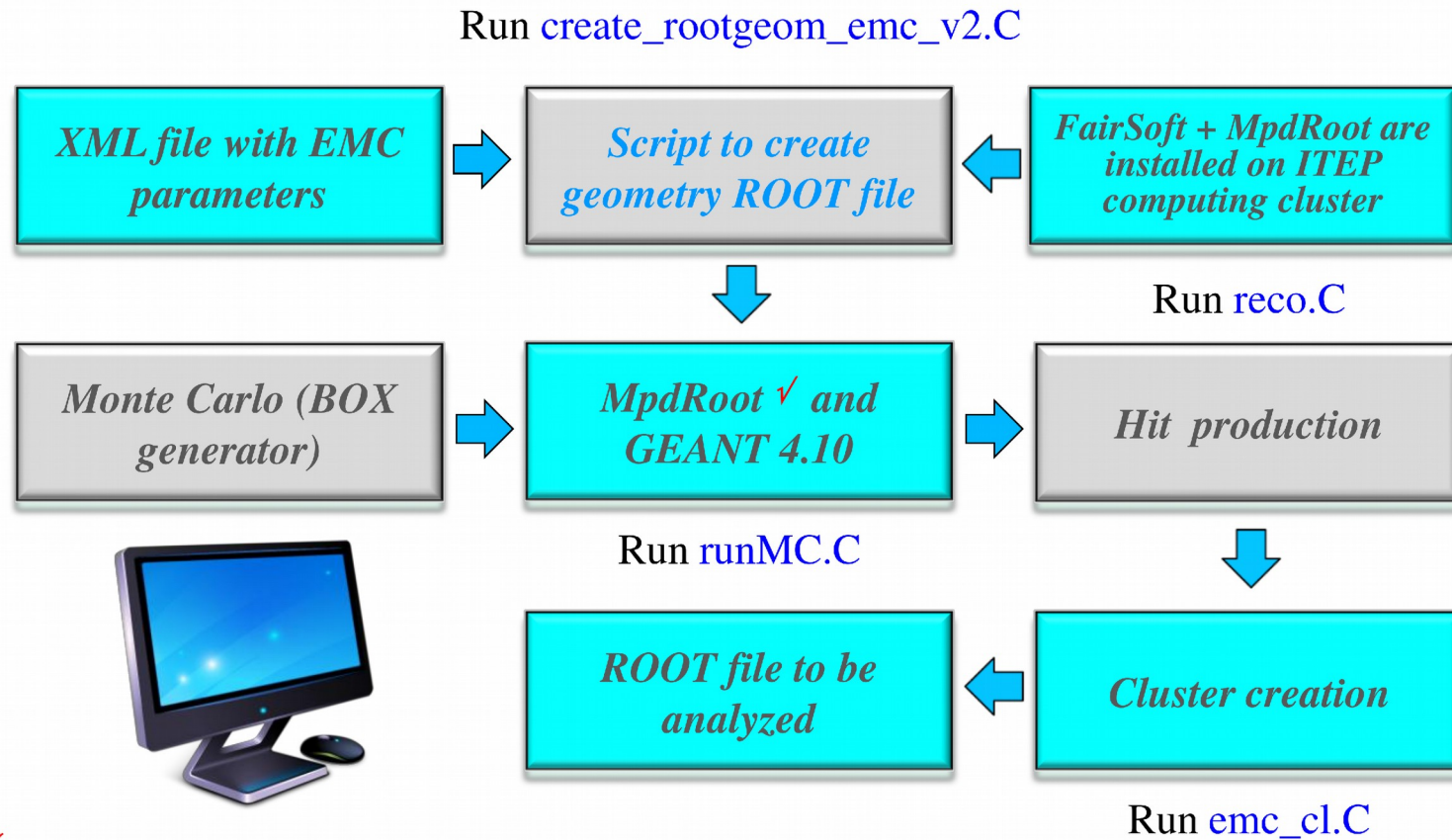
Update on Electromagnetic Calorimeter (ECAL)

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on behalf of ECAL group

June 20, 2018

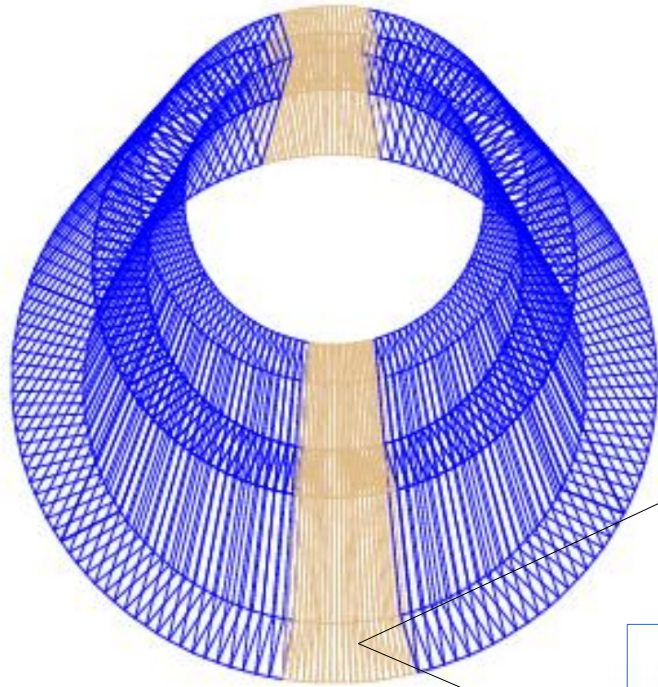
Outline

- ECAL geometry for simulations and data analysis from ITEP group.
- Test manufacturing of the calorimeter towers/modules.
- Two concepts of electronics installation into ECAL.



✓ Works with Root5.3x

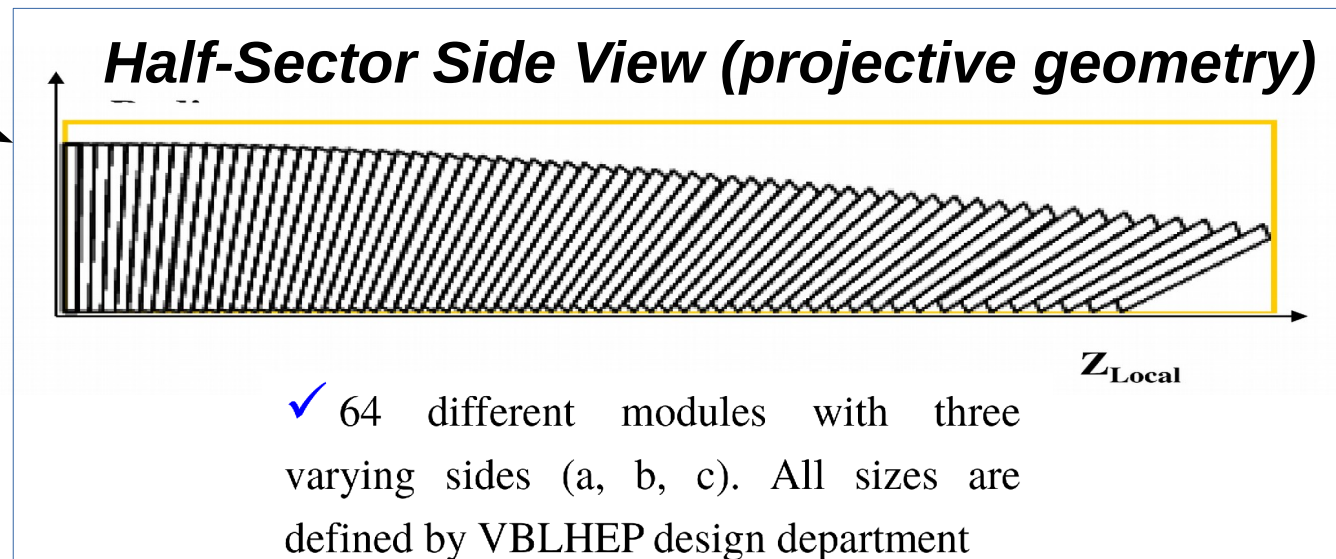
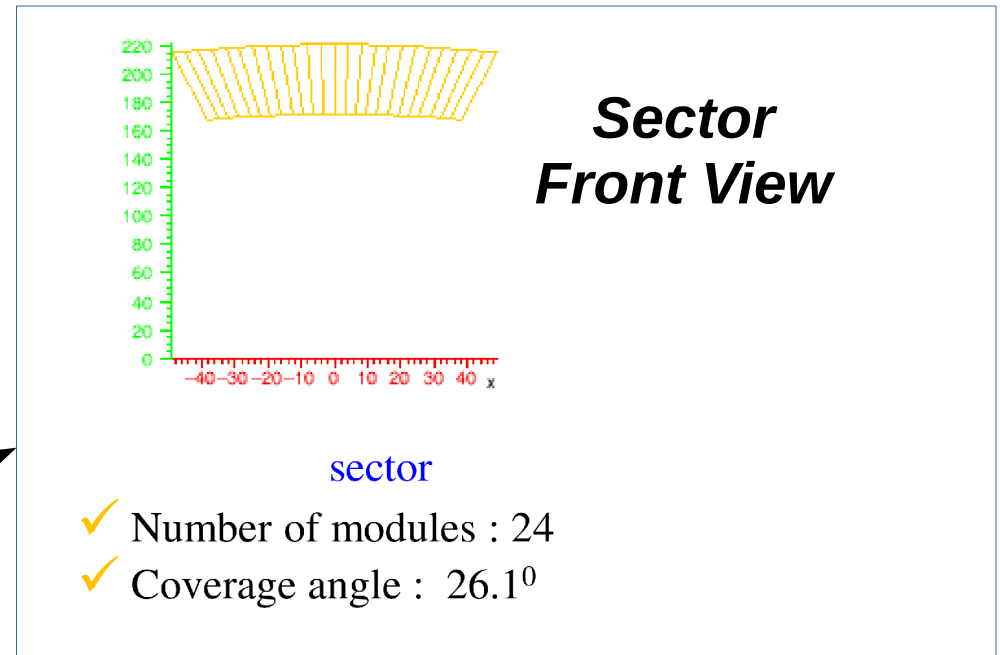
Software to create ECAL geometry was developed by the group from the Institute for Theoretical and Experimental Physics (ITEP).



EMC Barrel

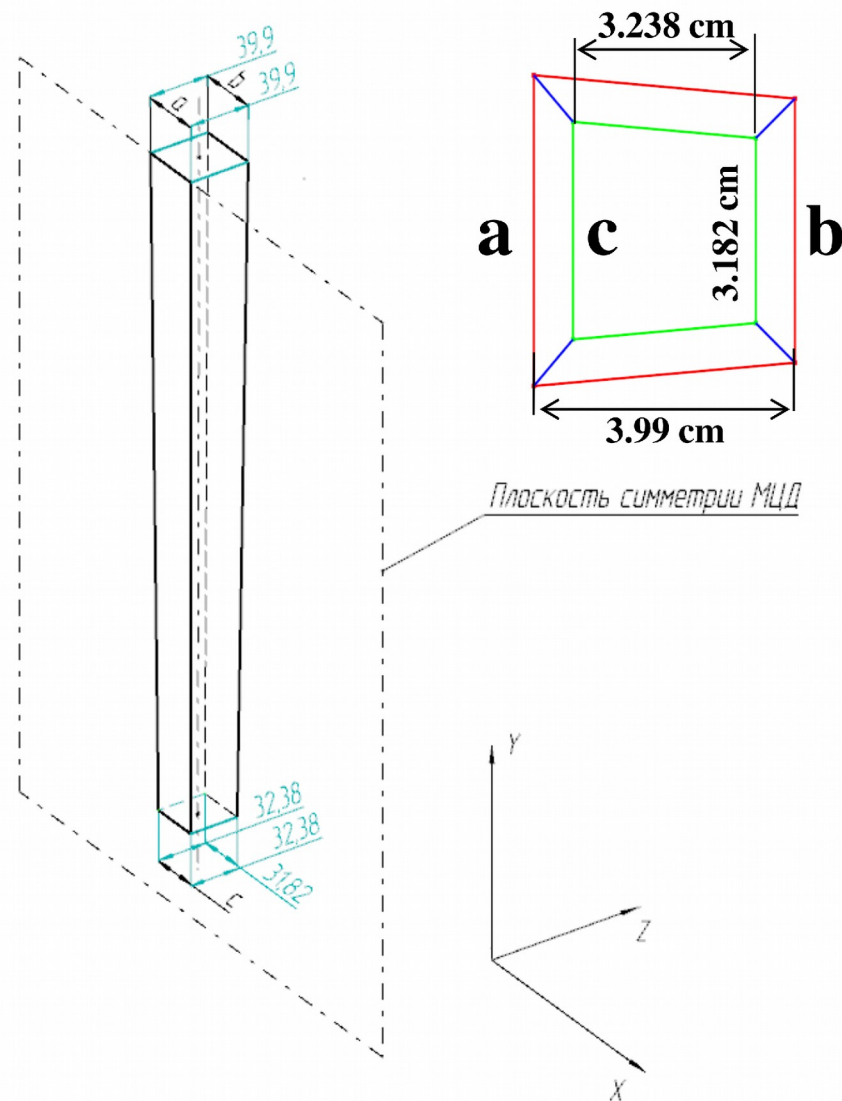
- $R_{in} = 172 \text{ cm}$, $R_{out} = 221 \text{ cm}$
- $L = 2 \times 314 \text{ cm}$

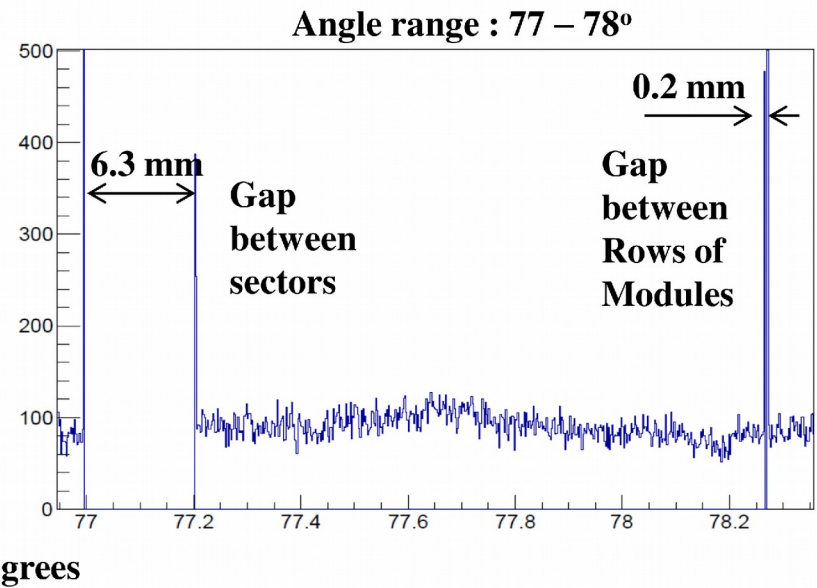
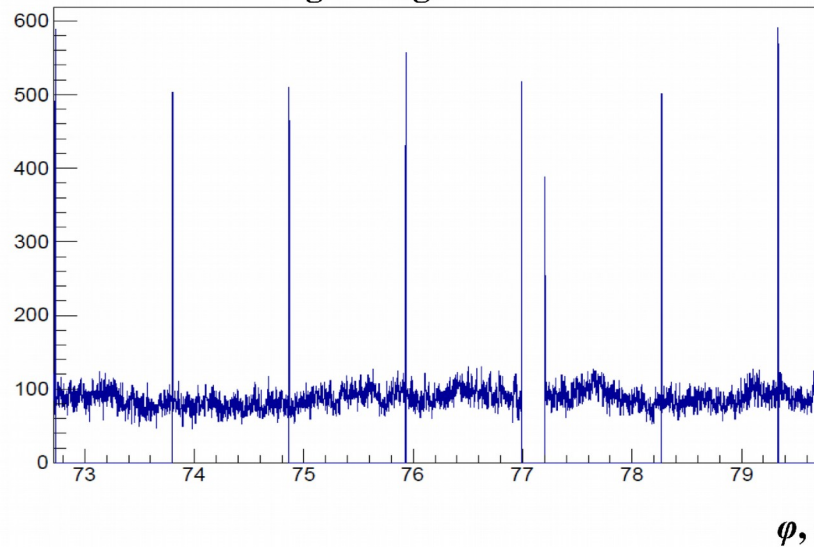
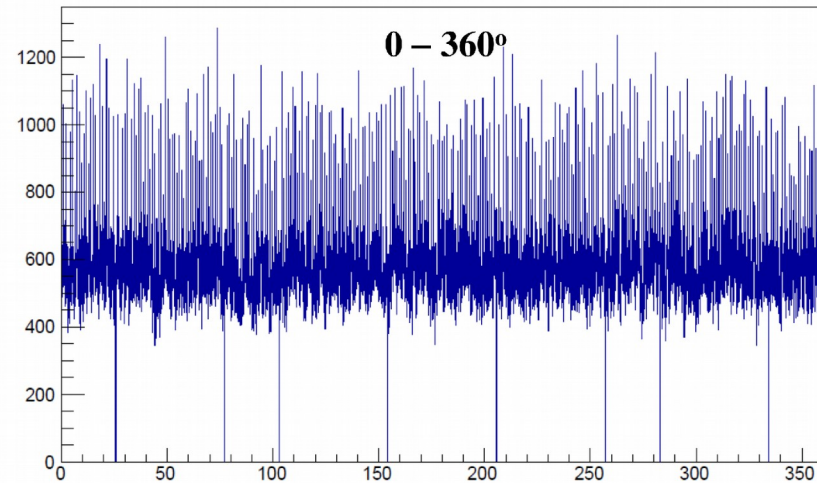
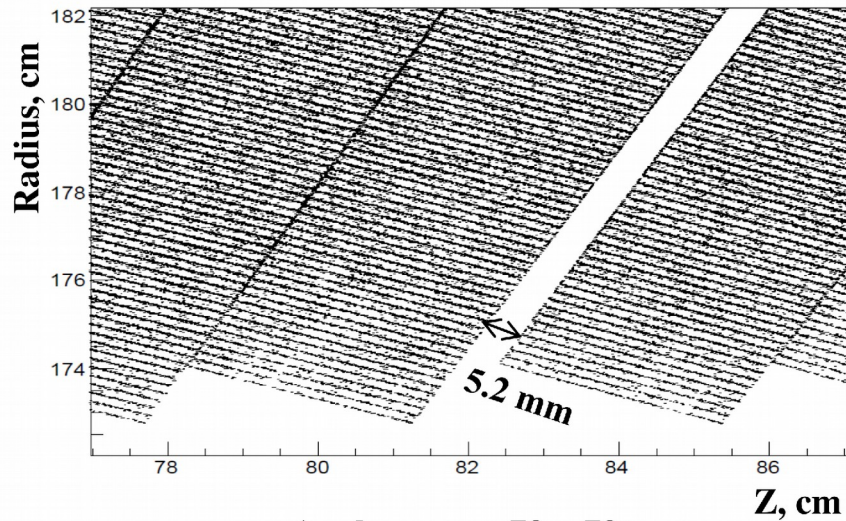
Divided into 14 sectors



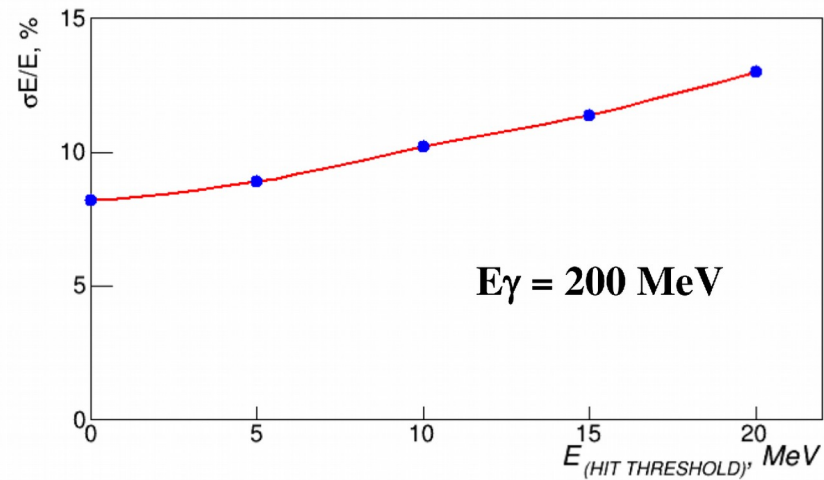
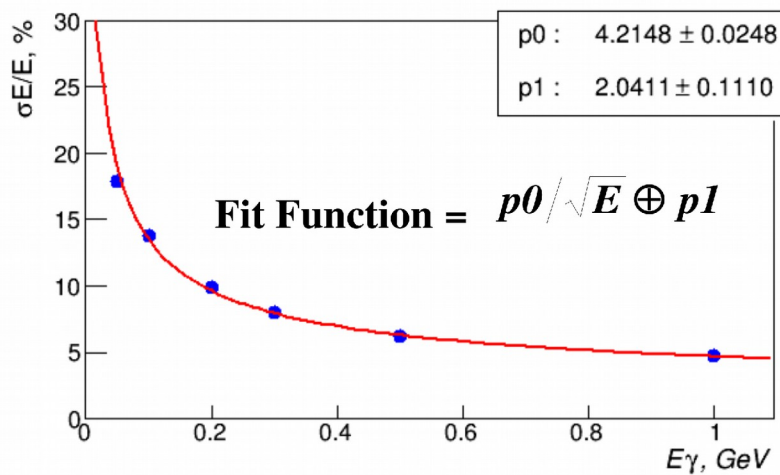
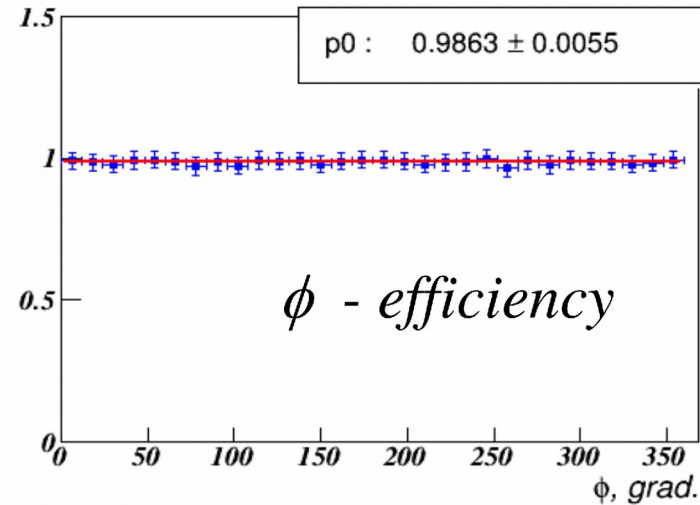
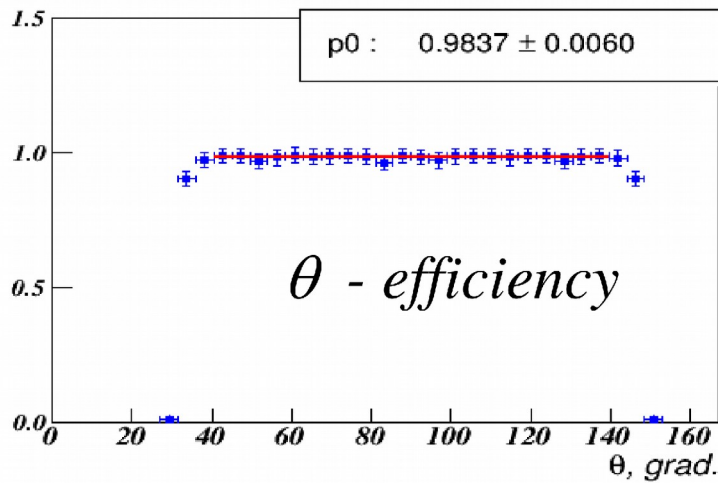
EMC module

- ✓ Total number of modules : 43008
- ✓ Longitudinal size : 43.095 cm
- ✓ Each module has 221 Pb ($h = 0.3$ mm) plates and 221 (FscScint – C_9H_{10} , $h = 1.5$ mm)
- ✓ Module is fixed by two plates on top and bottom (Kapton – $N_2C_{22}H_{10}O_5$, $h = 8$ mm)
- ✓ Correction in MpdEmc.cxx : sensitive volume is scintillation plate
- ✓ A huge number of nodes :
 $444 \times 43000 \sim 19 \times 10^6$
- ✓ EMC geometry is stored in ROOT – file ([emc_v2.root](#))





$E_\gamma = 200 \text{ MeV}$



Plans

ECAL geometry software has been tested and installed on JINR computers.

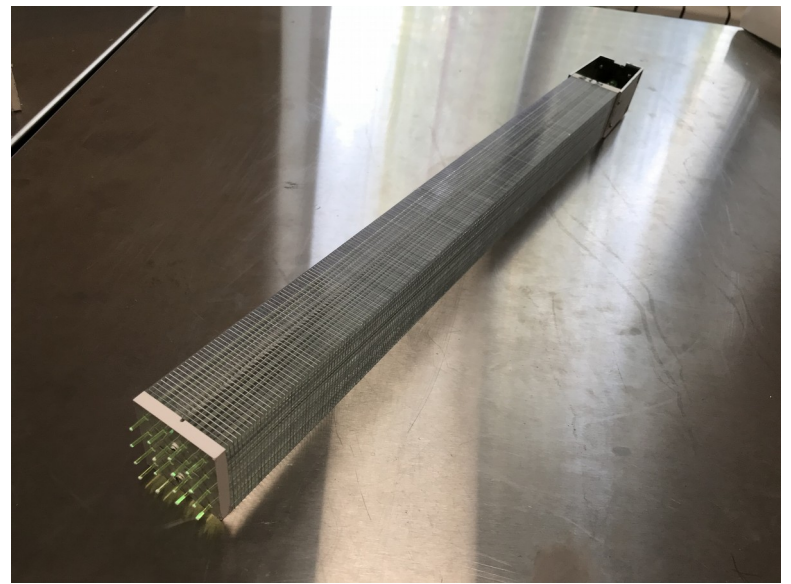
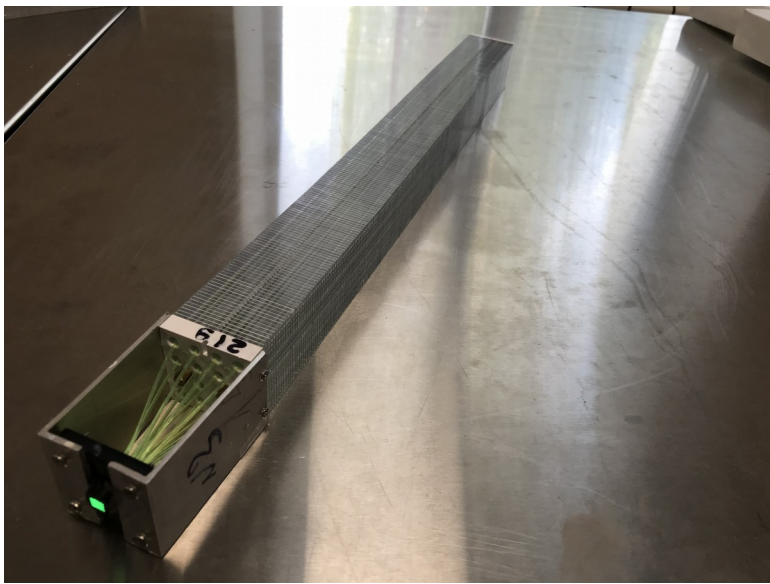
A dedicated group of experienced physicists and software developers has been established. It includes our collaborators from JINR (senior + 2 PhD students), ITEP (2 seniors), and China (postdoc + PhD student).

The urgent tasks of the group are:

- A) validation and crosschecking of the ECAL clusterization algorithms (2 of them are ready);
- B) tests of the matching between TPC tracks and ECAL clusters;
- C) feasibility study for several physics cases including π^0 reconstruction, dileptons, and measuring of the photon flux.

ECAL Manufacturing

- Three production sites are created in [Dubna](#), [Protvino](#) (Russia) and [Beijing](#) (China).
- Test assembling of ECAL towers and modules (2x8 towers each) is started.
- Cosmic ray tests of produced towers (uniformity, amount of light).
- The materials for towers assembling are identical for all 3 sites. At the moment, the major attention is on the identical technologies/tools to be used for ECAL towers/modules manufacturing.



ECAL towers.



Two half-modules before the gluing.



The Goal

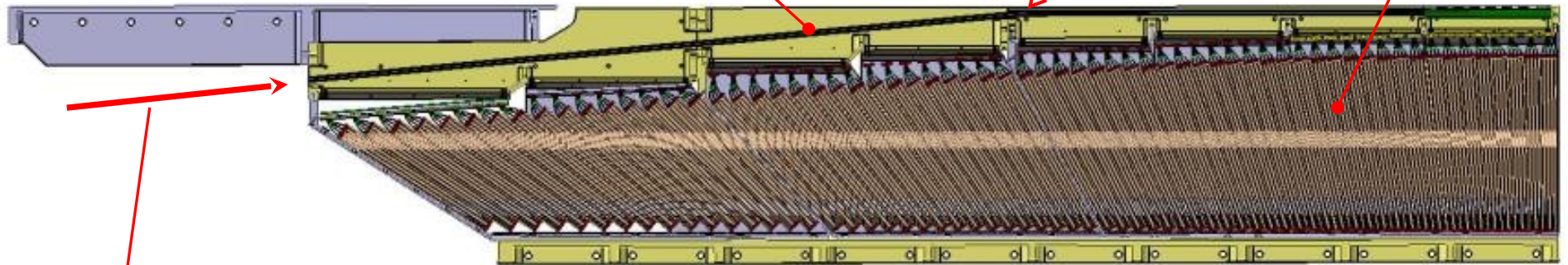
1. Provide possibility of installation of electronics and cables after ECAL assembling.
2. Locate ECAL electronics in the stand-alone module to allow the electronics assembly and service separately from ECAL carriage.
3. Provide possibility to extract any module with electronics for repair or service without major ECAL disassembling .

Directing Rails

directing rails

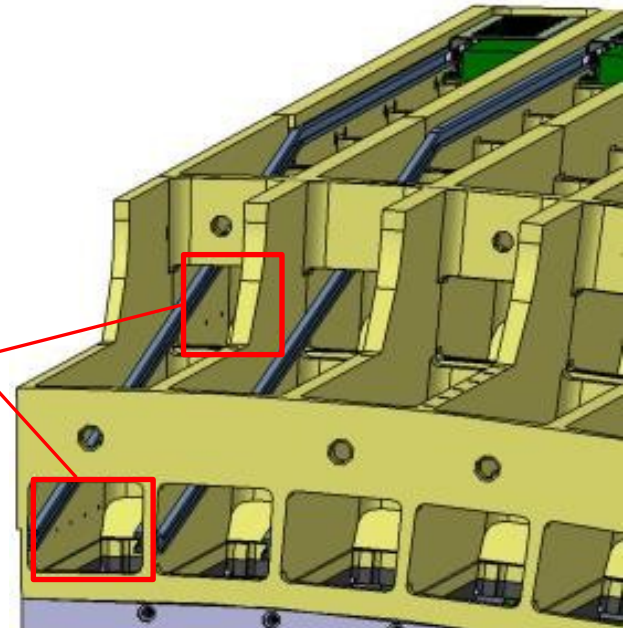
rails kink

ECAL towers (modules)



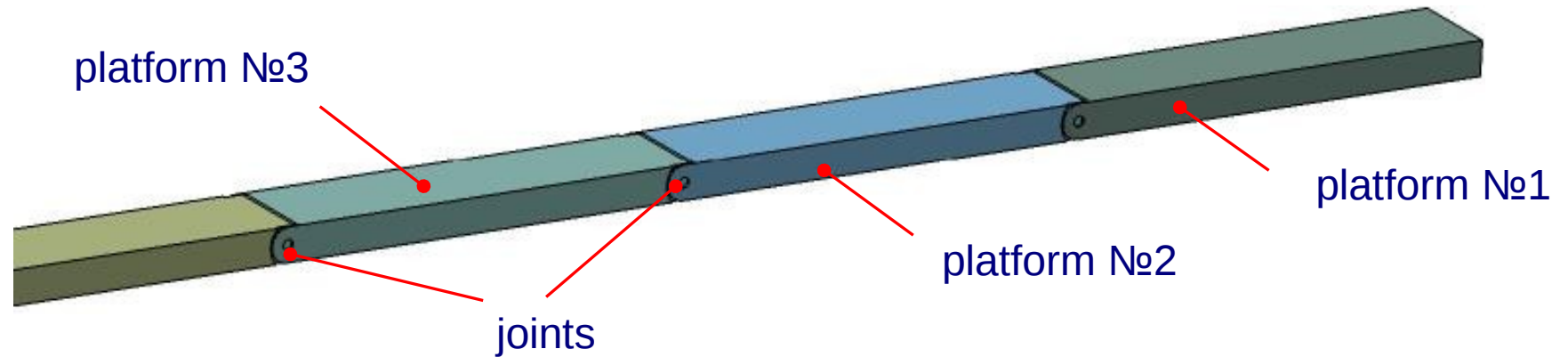
module movement trajectory is located apart of the ECAL carriage

windows to insert the module



Directing rails are mounted on ECAL frame

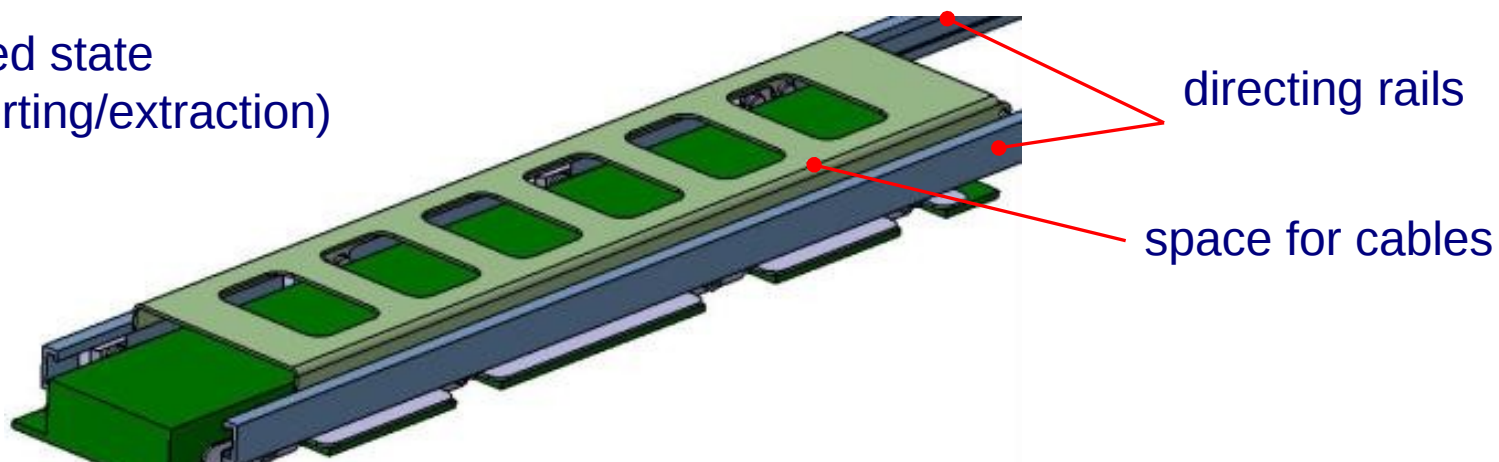
Module with electronics



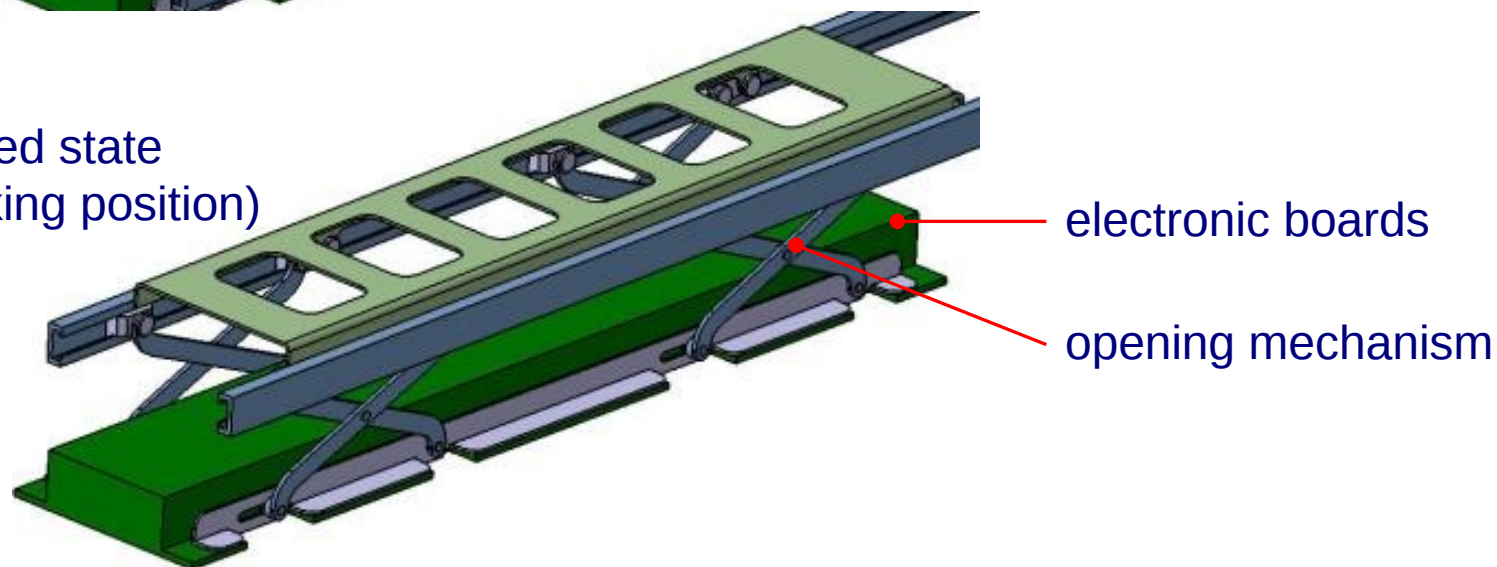
- 4 or 8 moving platforms are linked to the module that serves half-length of the ECAL (viz., about 3080 mm).
- Each module is assembled and tested separately from MPD; it could be inserted into ECAL using directing rails.
- If needed, the module with electronics could be extracted for repair or service without major ECAL disassembling

Platform

closed state
(inserting/extraction)



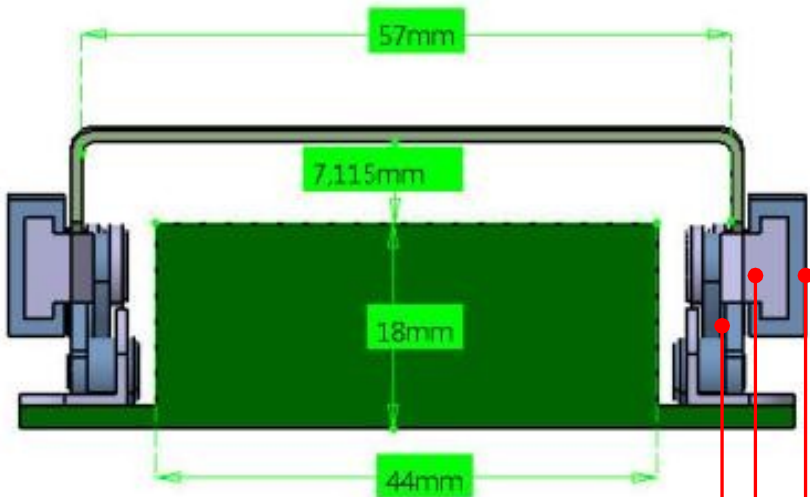
opened state
(working position)



1. Opening/closing with torsion bar.
2. After opening, photodetectors on the electronic board are pressed to the output optical fibers in the calorimeter.

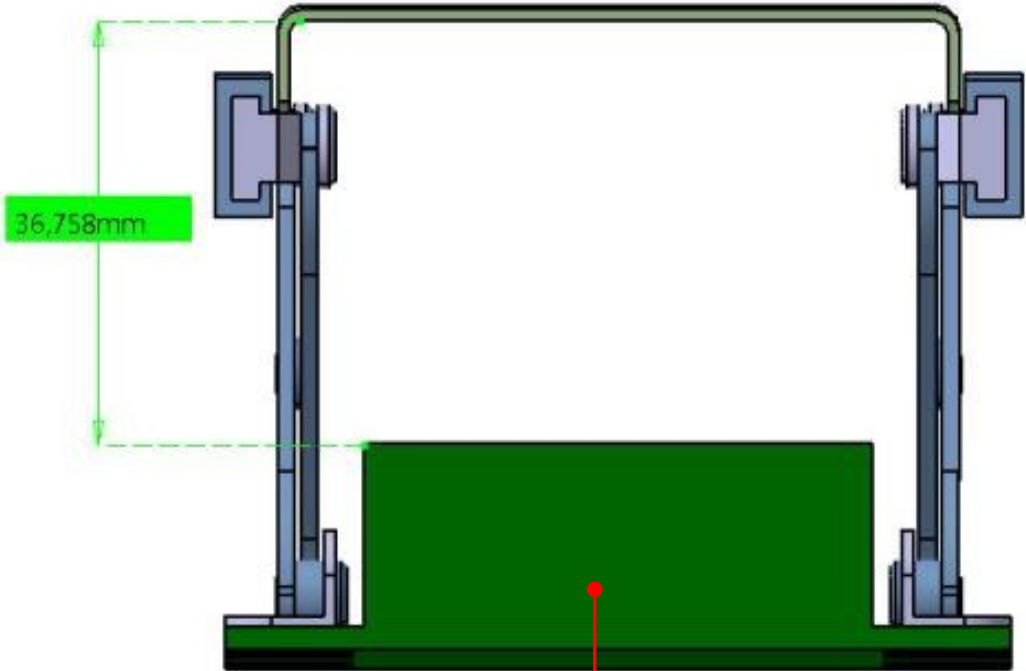
Platform Size

closed state



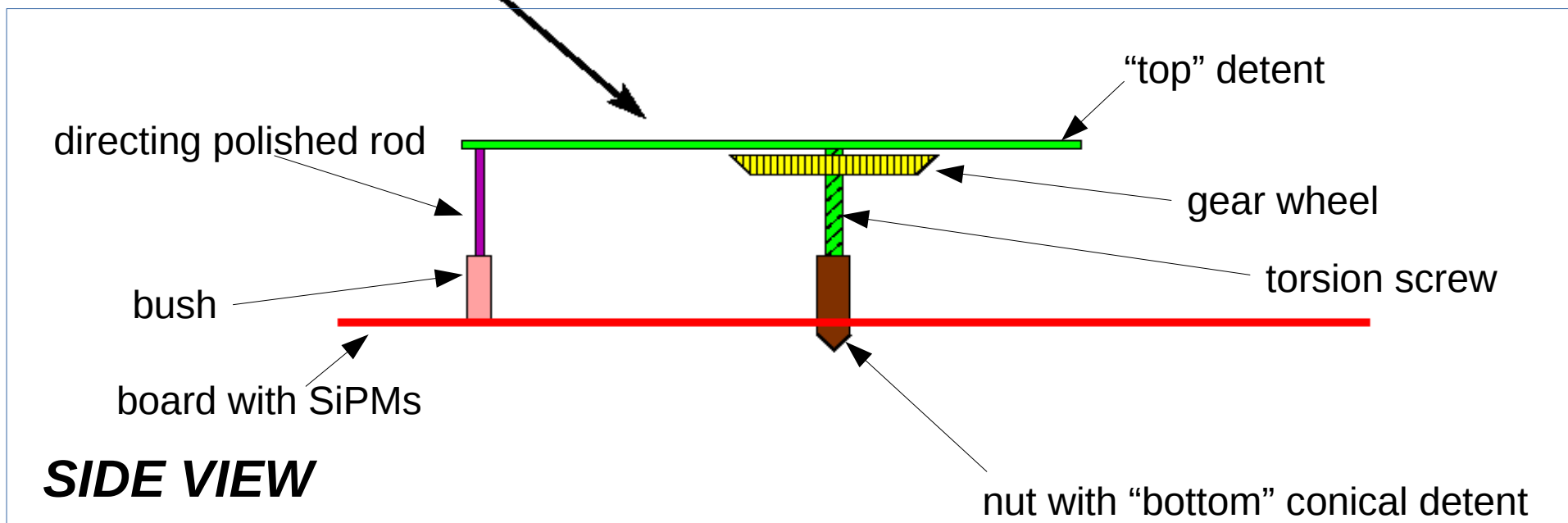
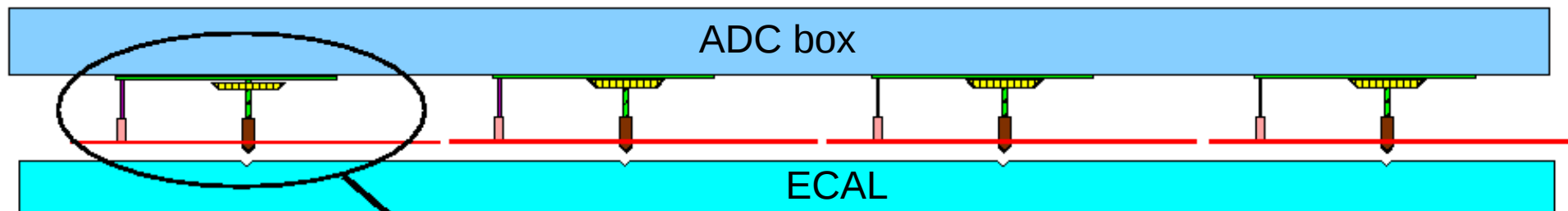
- opening mechanism
- directing wheels
- directing rails

opened state

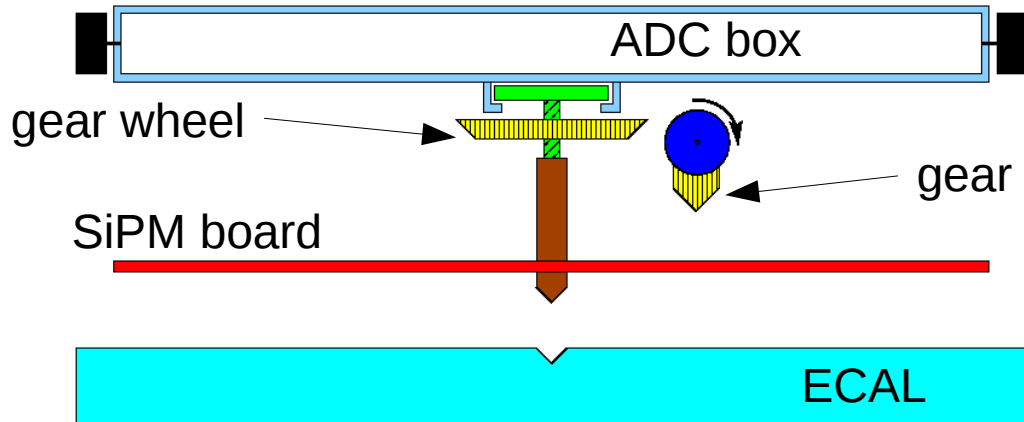


electronic boards

In the **second concept of electronics installation**, ADC boards for half-length of ECAL (with cables and water-cooling system) are located in the 3-m-long box that serves also as a frame for SiPM boards mounting. The SiPM boards are located between ADC box and ECAL. ADC box and SiPM boards can be inserted into MPD as one piece.

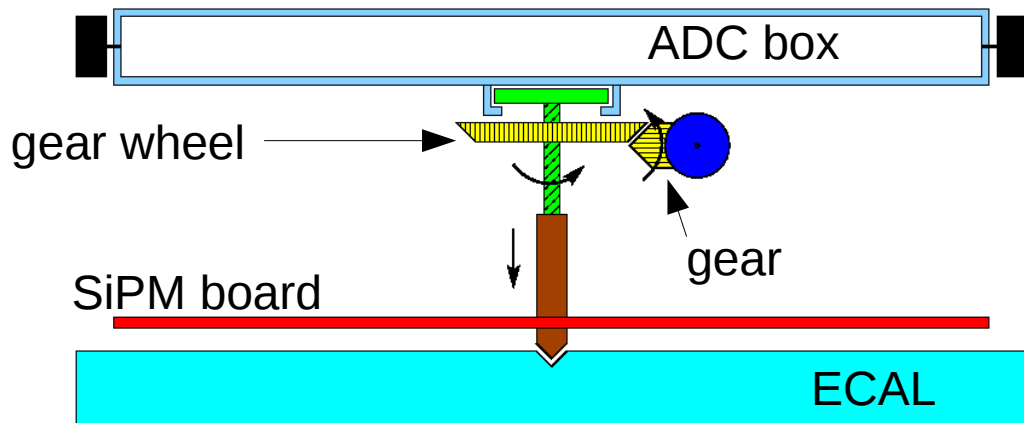


FRONT VIEW



Open state
(insert/extract)

Revolving the gear wheel and the torsion screw, we can install the SiPM board to the working position on ECAL. Conical detent on the nut and conical socket on ECAL guarantee correct location of photodetectors in respect to the readout fibers.



Closed state
(working position)

Conclusions

- Geometry software for ECAL in projective geometry is tested and installed on JINR computers.
- A dedicated group of experienced physicists and software developers is created to check and improve the reconstruction algorithms. We hope to start the production of the physics results from the simulation soon.
- Test manufacturing of the calorimeter towers/modules is started in three production sites using identical materials and techniques. The produced test towers are under study with cosmic rays.
- Two concepts of the installation of electronics into ECAL are under development. The major attention here is on the simplicity and reliability of the system to avoid accidental lock of the electronics in ECAL.