ECal status

Design

Construction

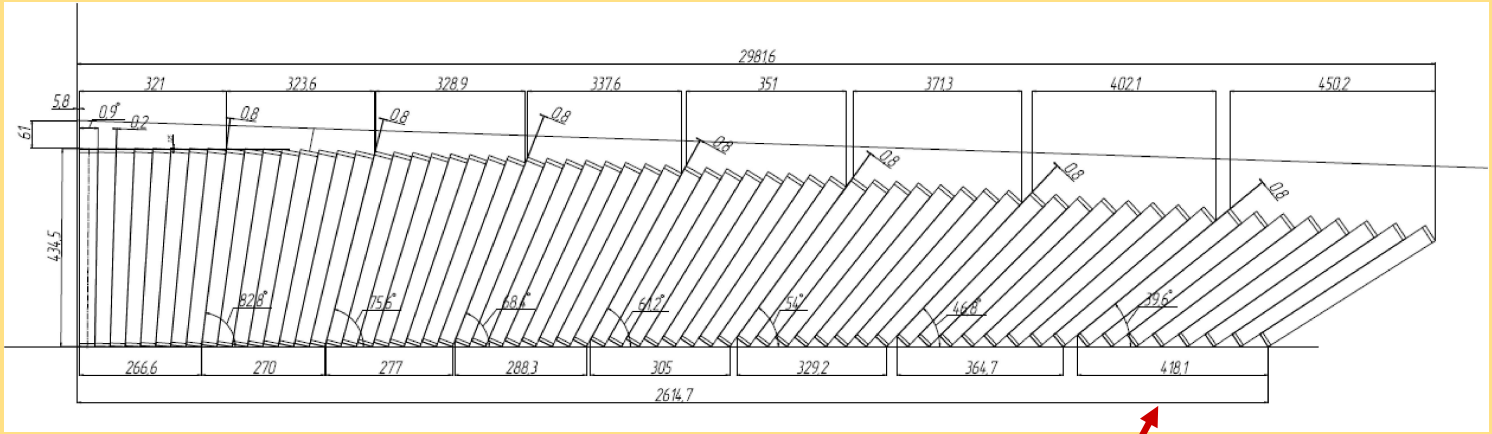
Simulation

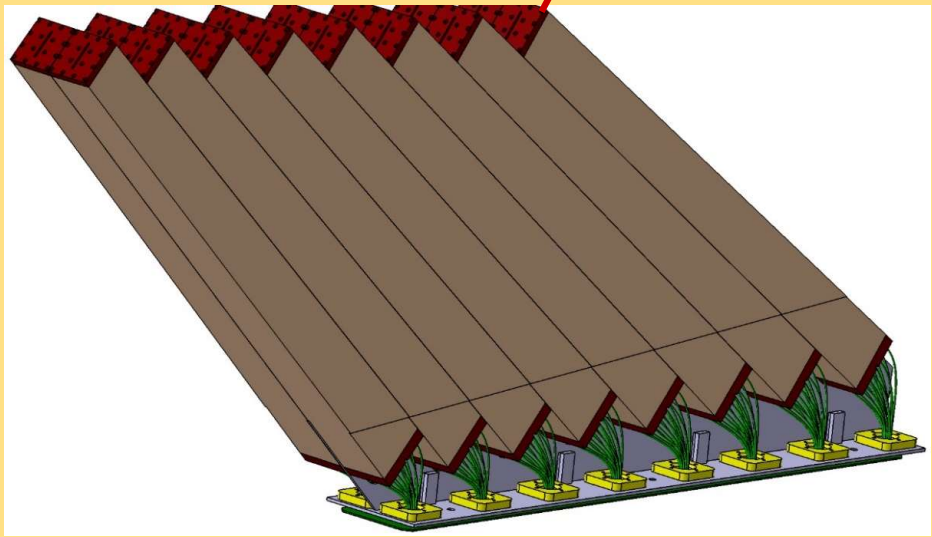
JINR, Dubna

April 2019

Igor Tyapkin

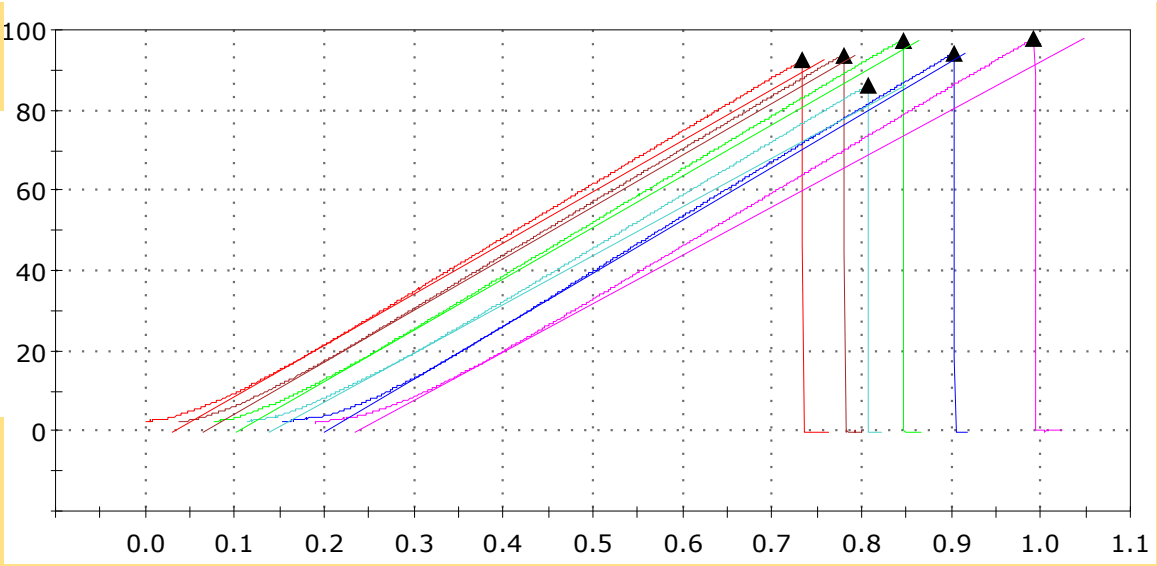
Eight Module Types for Projective Geometry of ECAL

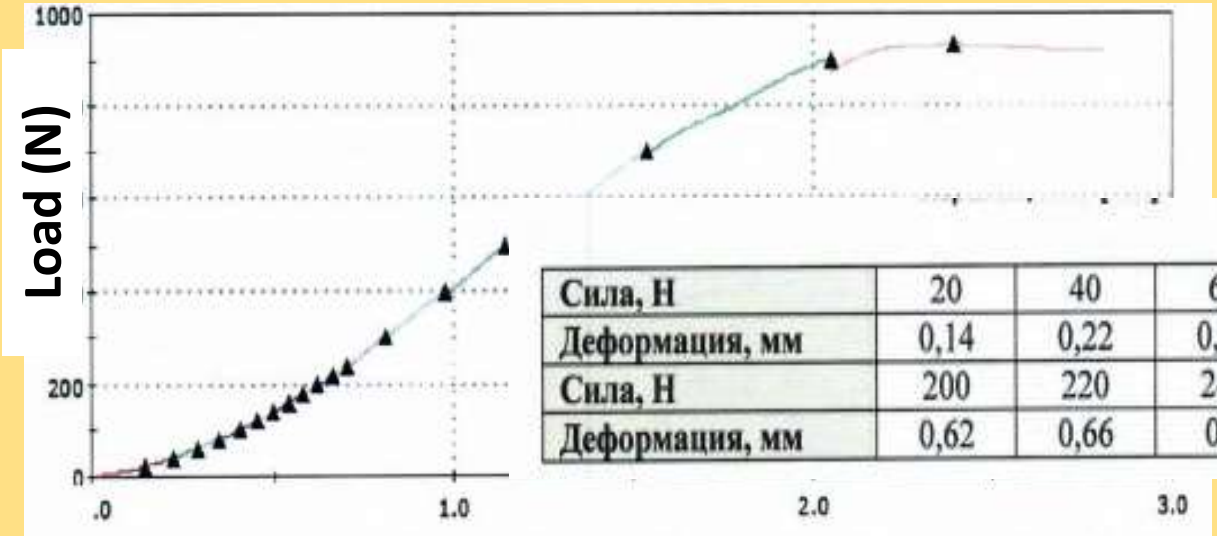




8th Module Type
Produced at JINR
Tested at DESY

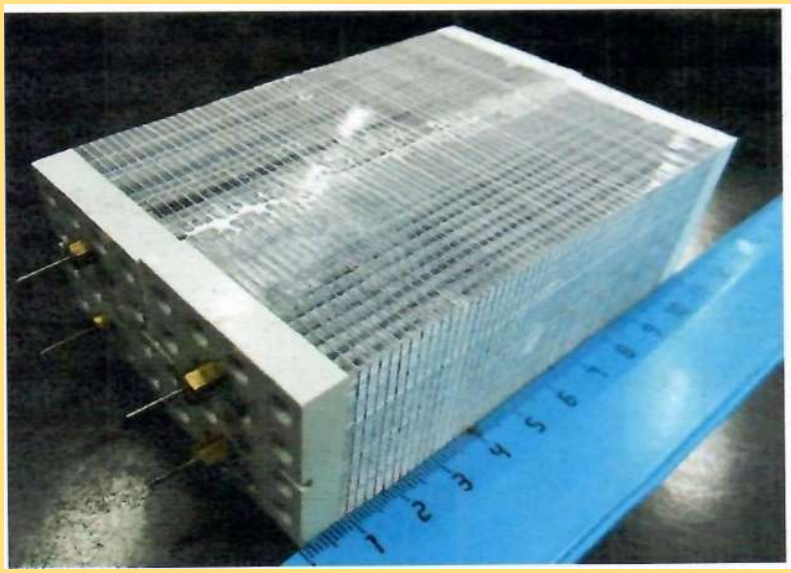
Yu. Krechetov

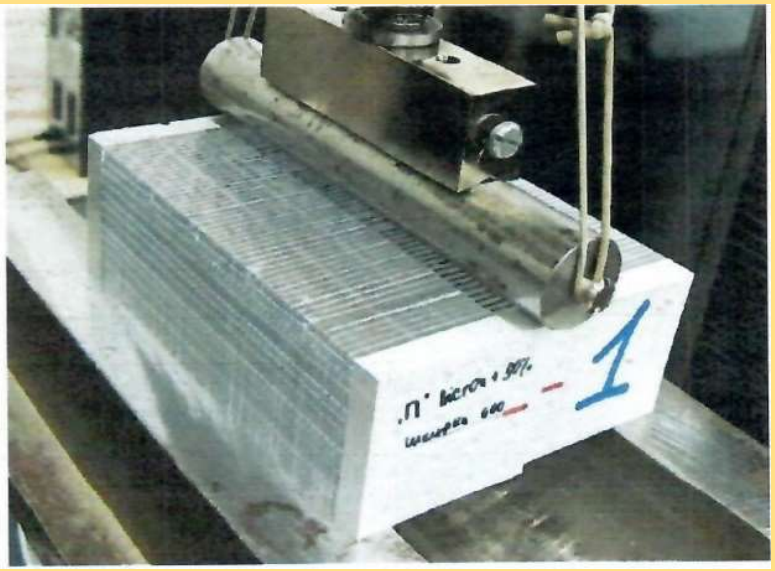




Сила, Н	20	40	60	80	100	120	140	160	180
Деформация, мм	0,14	0,22	0,29	0,35	0,4	0,45	0,5	0,54	0,58
Сила, Н	200	220	240	300	400	500	700	900	930
Деформация, мм	0,62	0,66	0,7	0,81	0,98	1,14	1,54	2,05	2,39

Yu. Krechetov

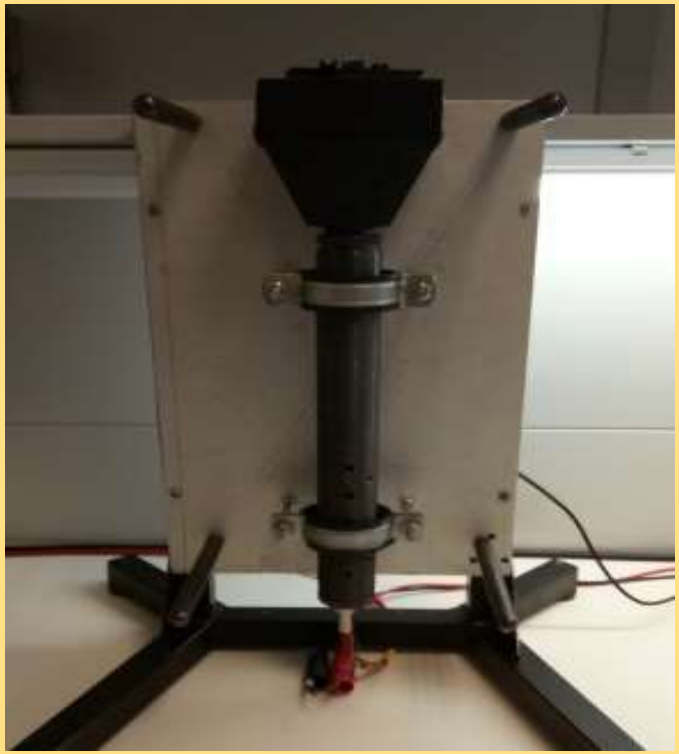


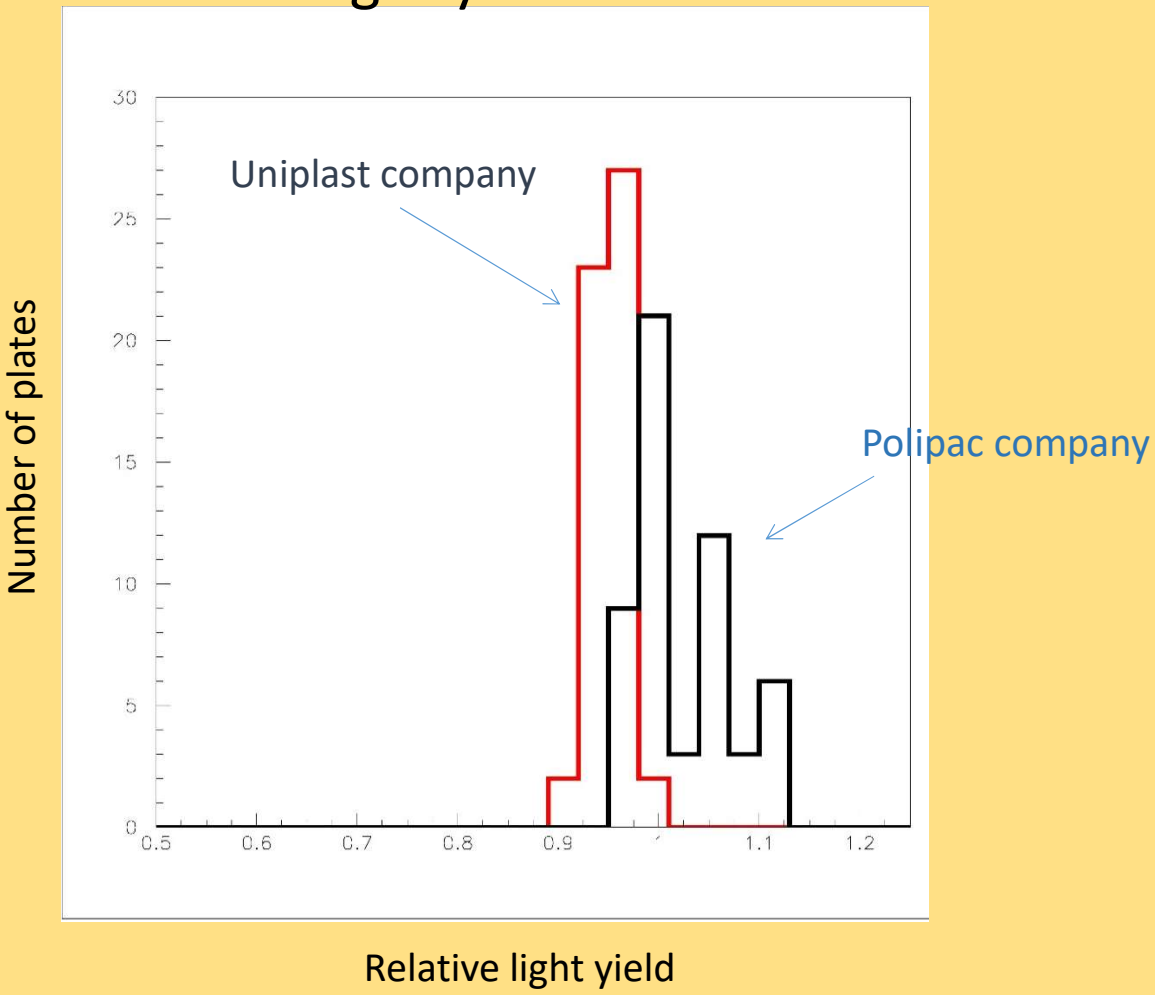


Example	2	1	3	4	5	6	7	8	9
Destructive load, [H]	3151	3884	3231	918	4400	3565	2763	2271	11094
Displacement **[мм]**	0,33	0,33	0,29	0,39	0,39	0,45	0,27	0,21	0,59

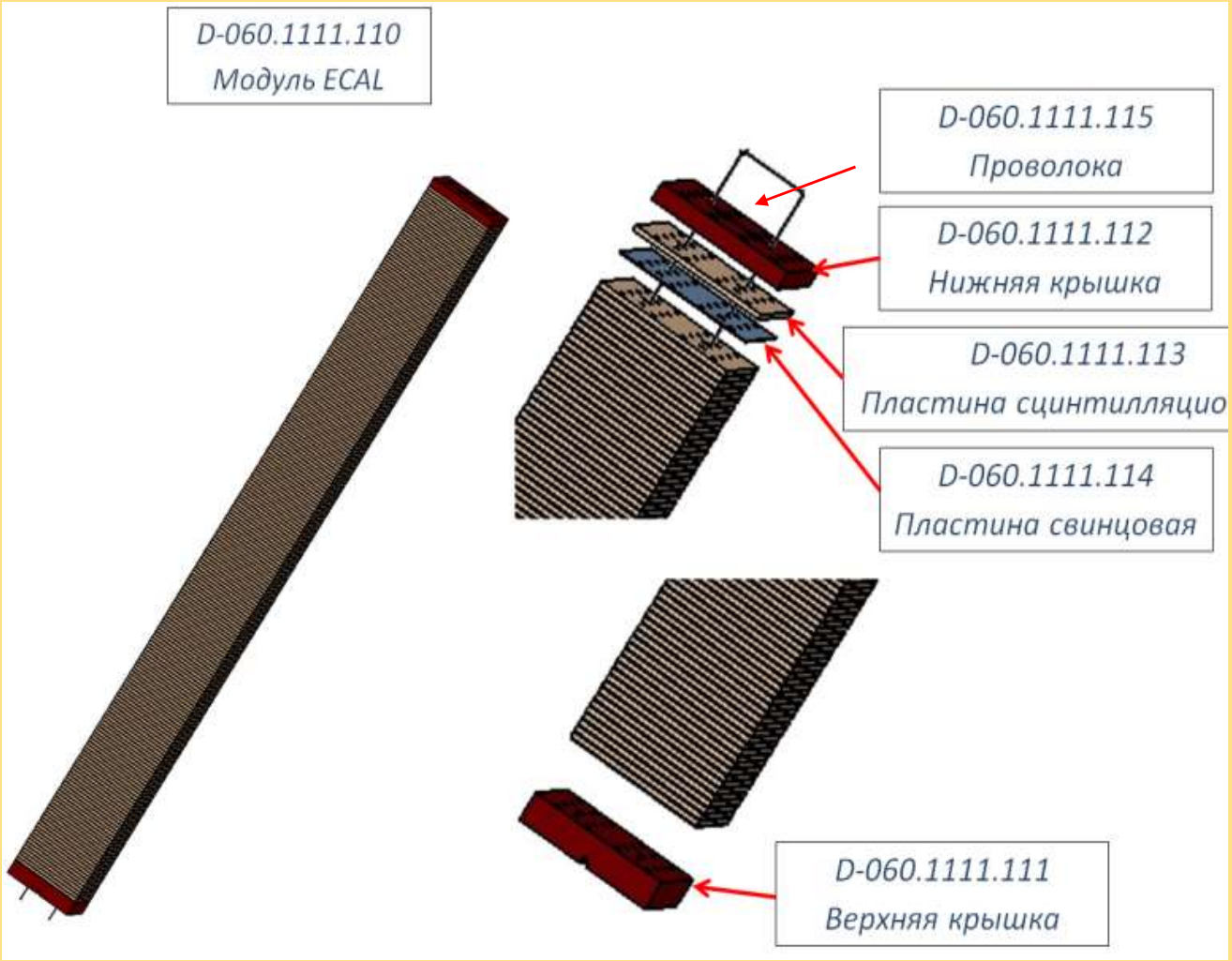
Typical measurement results of relative light yield

Larisa Stolypina





Yu. Krechetov



- **Scintillator plates**

  Polypac company (Dubna) and Uniplast company (Vladimir)

  70% 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

2688 modules in total

Protvino
Production started
2019-2020
440 modules

TEH3OP
Production started
2019-2020
250 modules

China
2016
modules

China production site

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

Contribution of both sides:

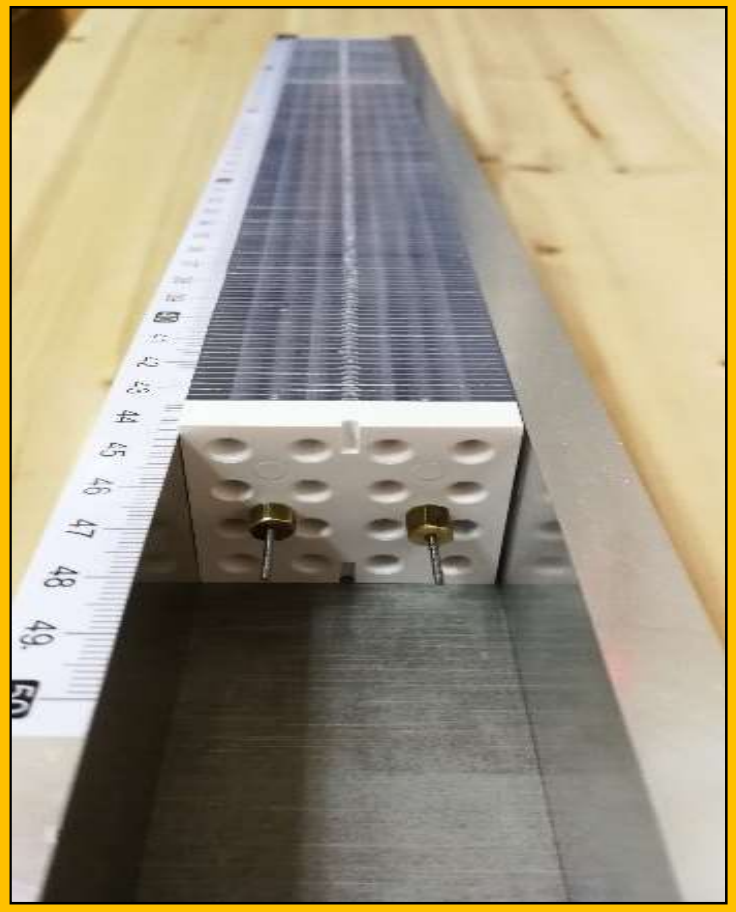
China

		M$
Modules production	**–**	**9.3 (Total)**
Electronics production 50%	**-**	**6.0**
	Total:	**15.3**

Time line (draft)

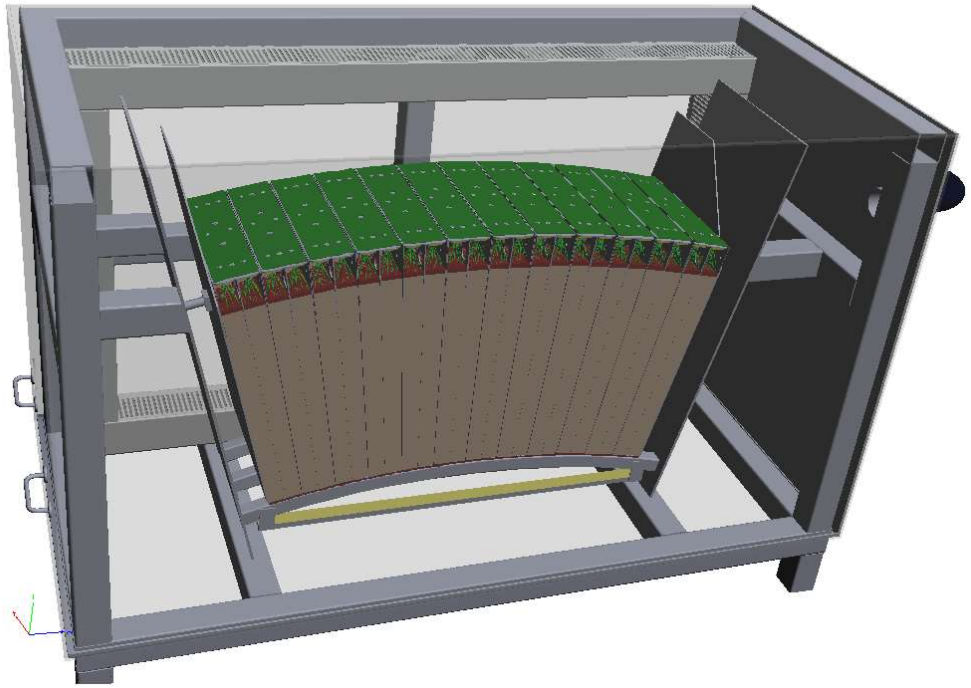
- ***2019.7-8*** – *Submit proposal, review*
- ***2019.8-12*** – ***Preparation for production***
- ***2020.1-2020.6*** – *Preproduction, cosmic test*
- ***2020.7-2021.6*** – ***Finish production***
- ***2020.8*** – *Install on MPD*
- ***2021.10*** – ***Finish install and detector commission***
- ***2021.11***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

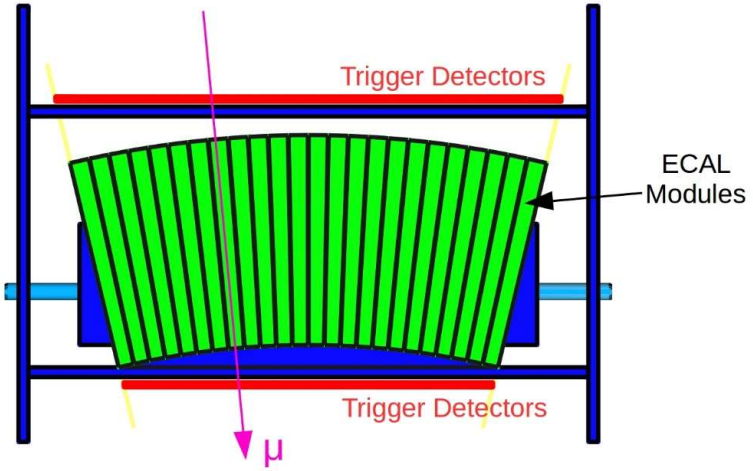
Assembling equipments



Stand for ECAL Modules Calibration

A. Semenov

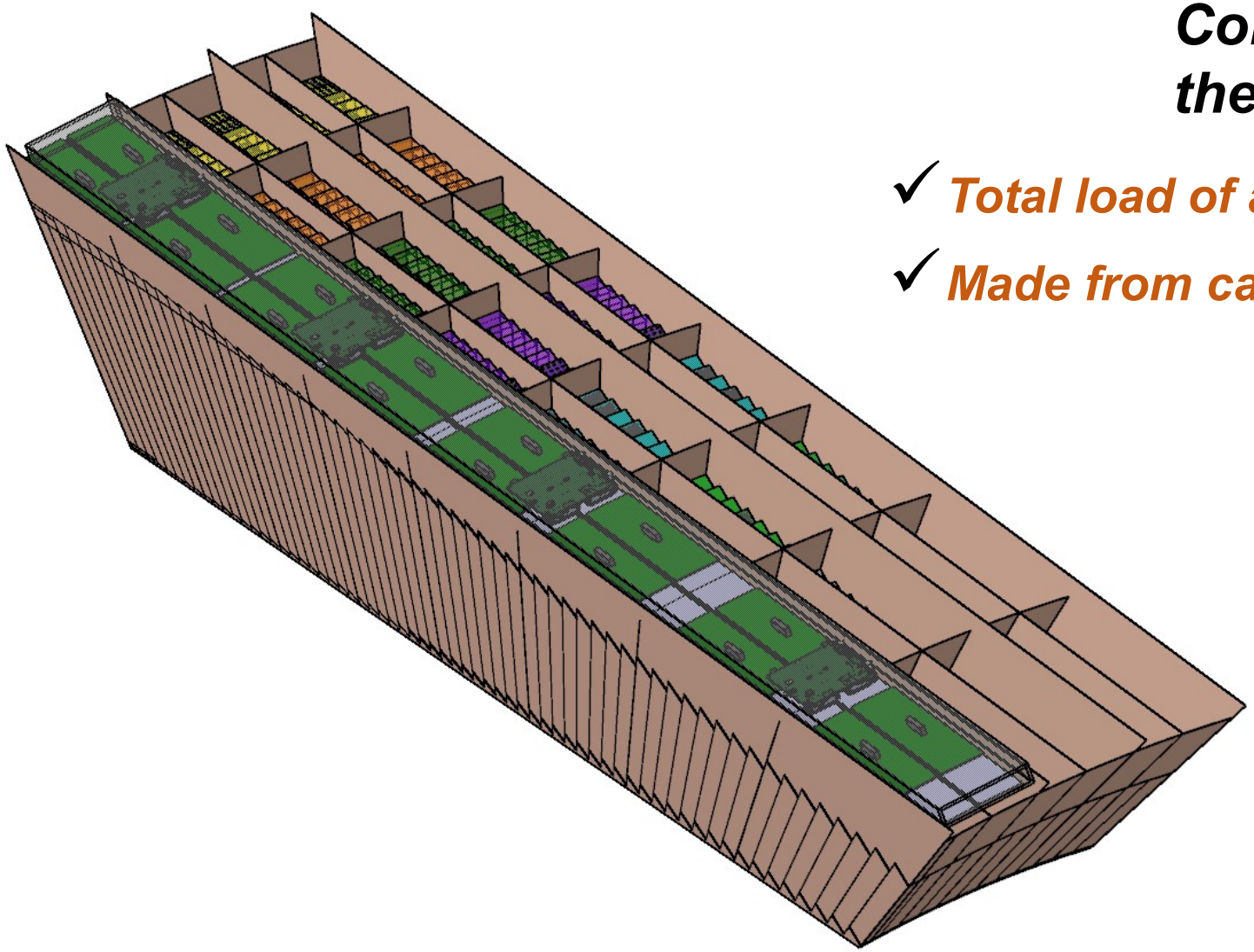




- ✓ *Cosmic rays*
- ✓ *Test one load (12 modules) in 10-14 days*
- ✓ *8 stands for 8 types of modules*
- ✓ *All modules test and calibration in about 1 year*

A. Semenov

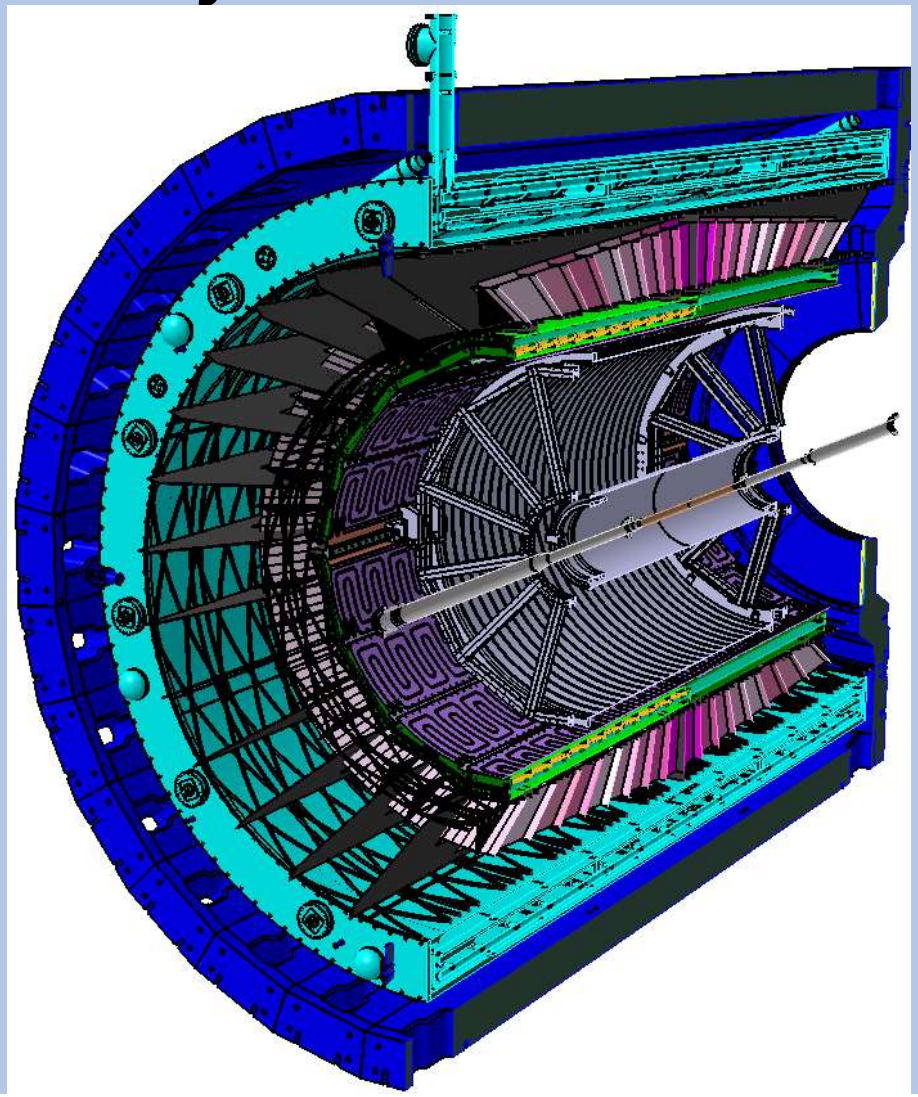
Container project for the modules (half-sector)

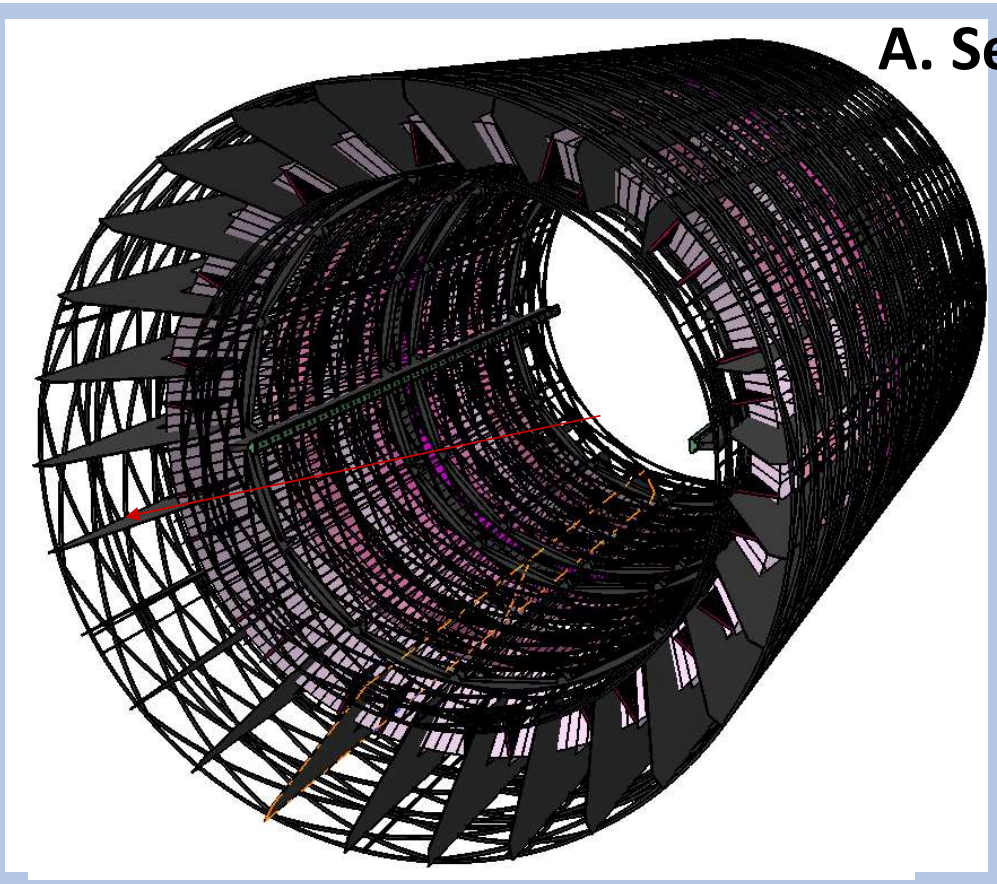


- ✓ *Total load of about 1.2 tons*
- ✓ *Made from carbon composite*

MPD Power Frame Ready - 09.2020

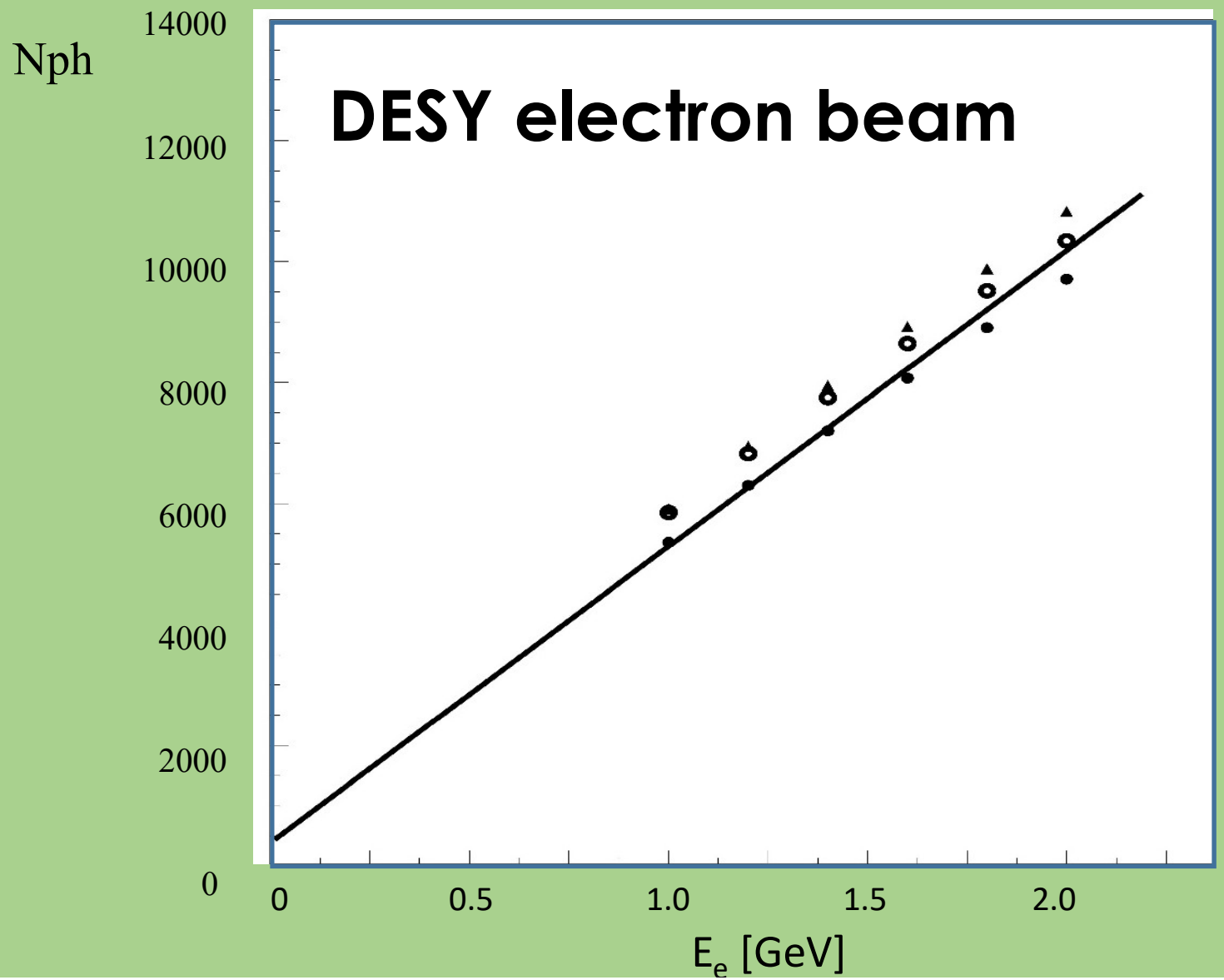
A. Semenov

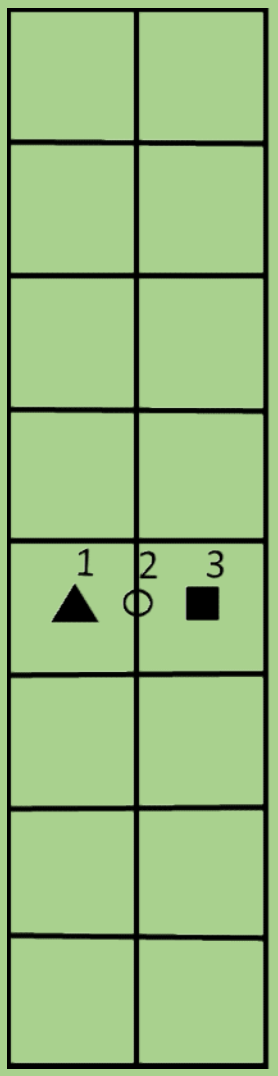




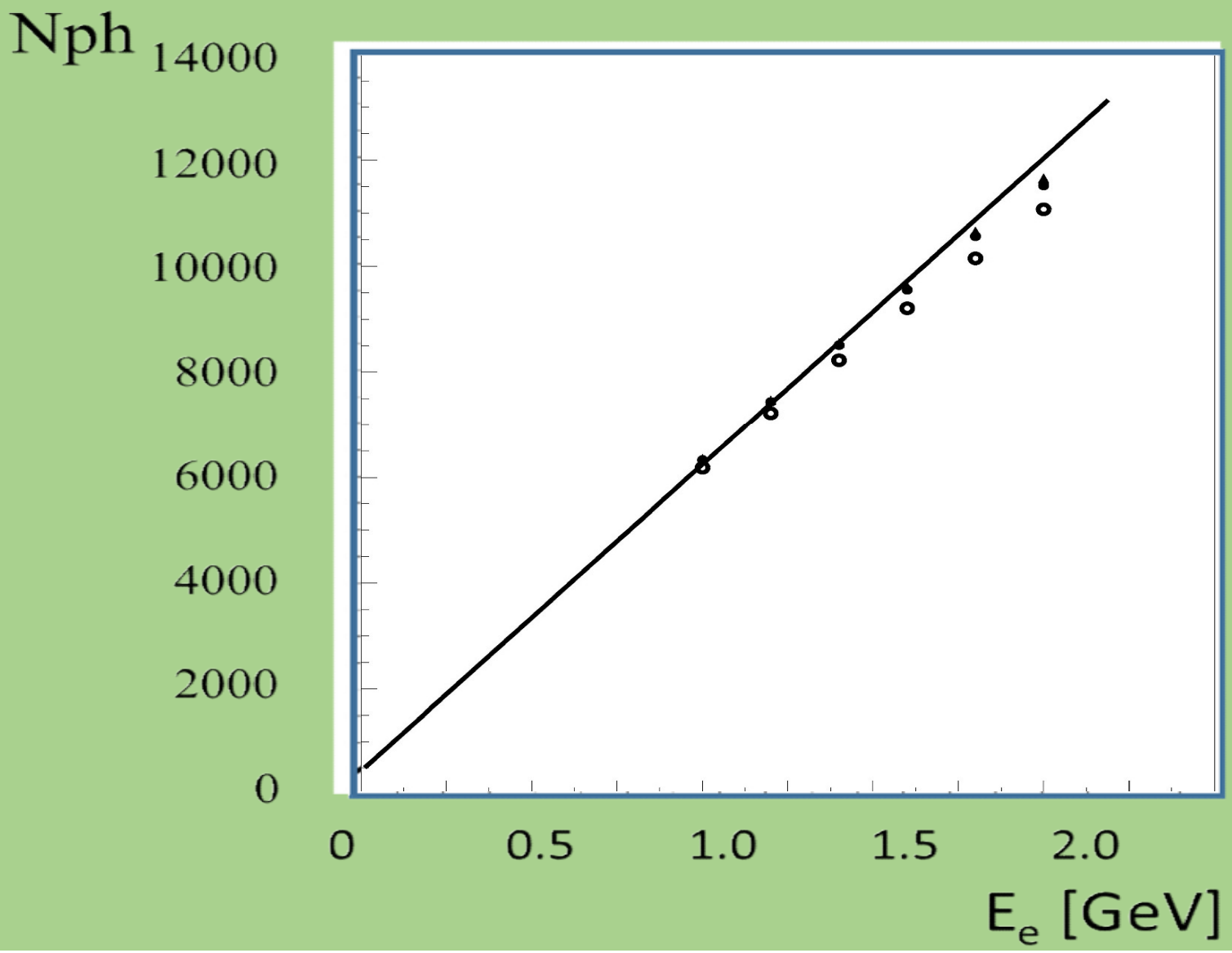
- ✓ *Carbon composite*
- ✓ *More than 6-m long and about 4.5 m in diameter*
- ✓ *25 compartments for 50 half-sectors*
- ✓ *Total load of about 100 tons*
- ✓ *Maximal frame sagging should be less than 0.5 mm*

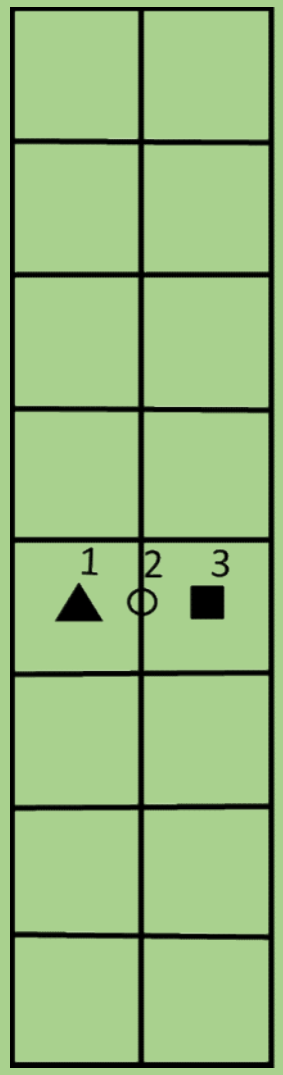
I. Tyapkin


DESY electron beam
Nph
14000
12000
10000
8000
6000
4000
2000
0
0
0.5
1.0
1.5
2.0
E_e [GeV]

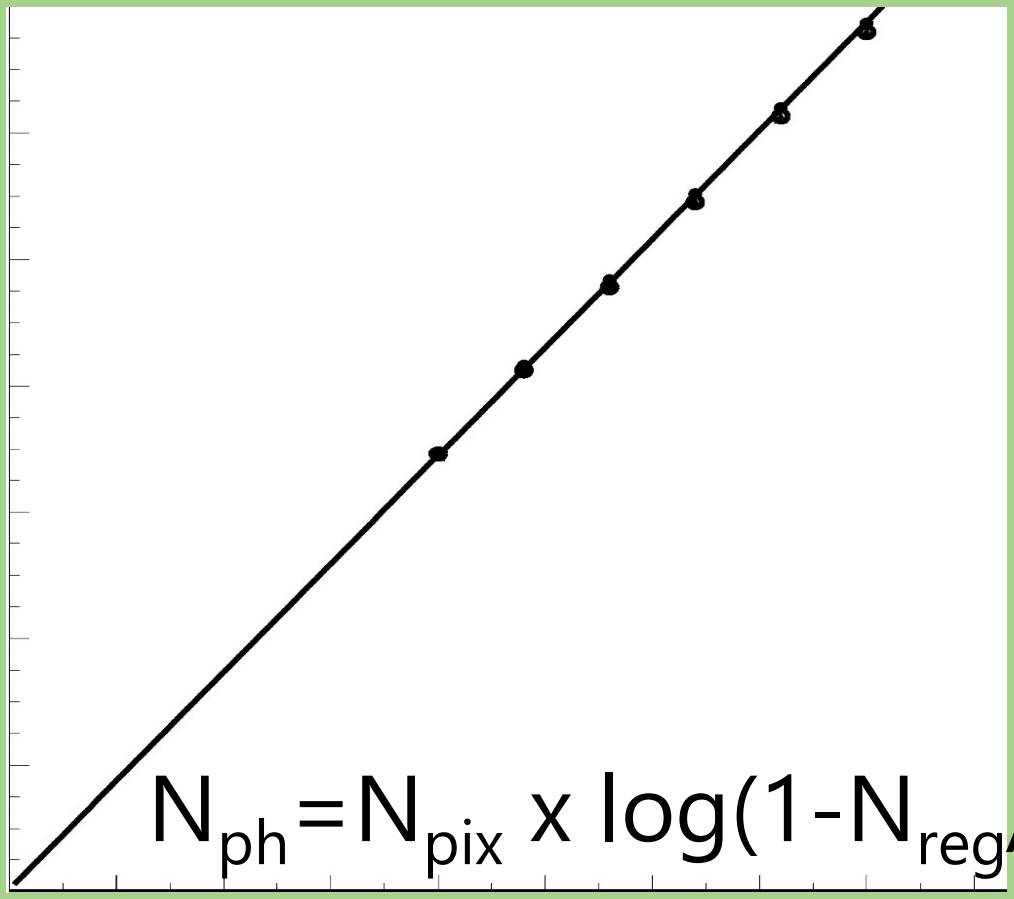

1
2
3

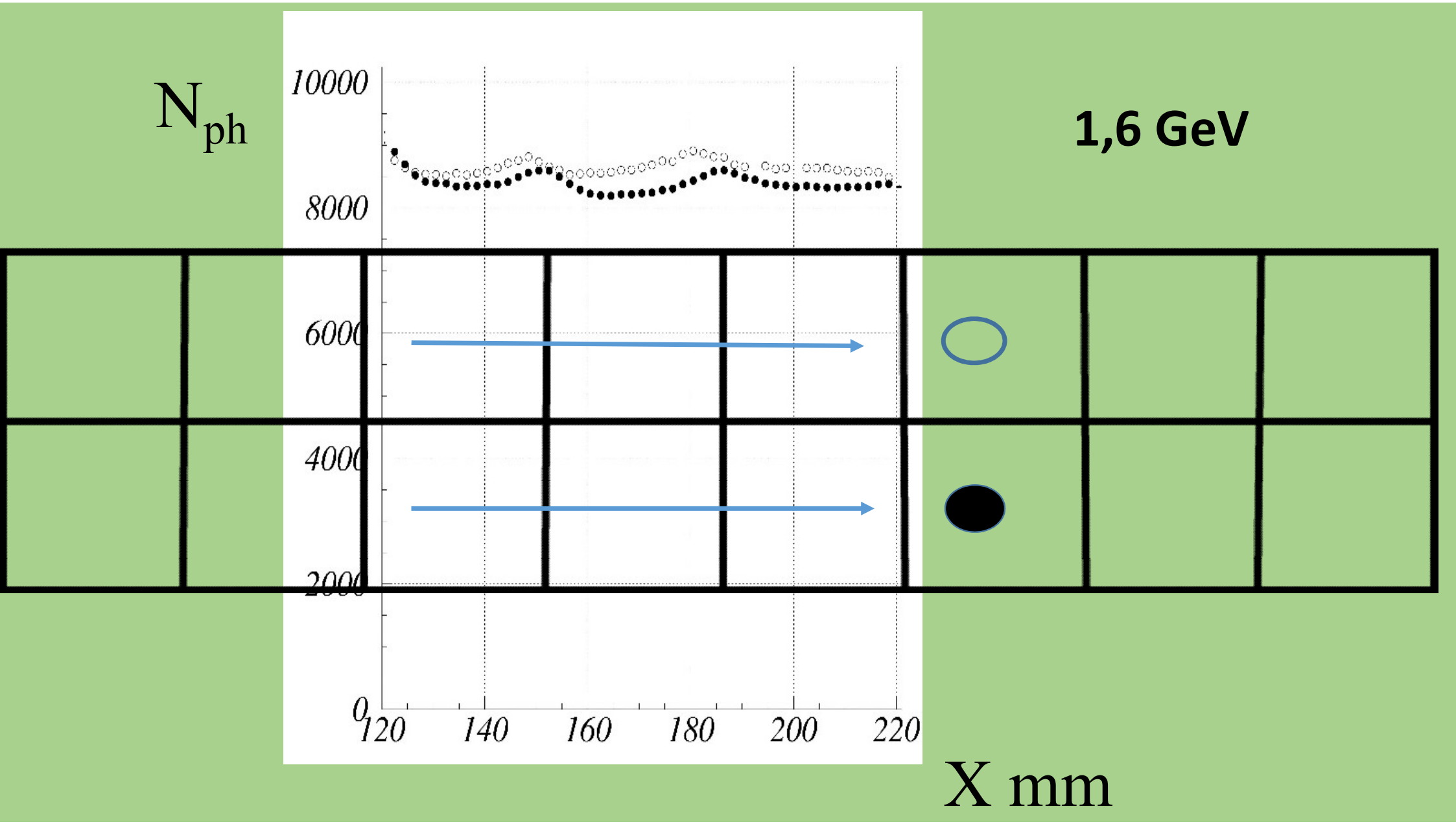
I. Tyapkin


Nph
14000
12000
10000
8000
6000
4000
2000
0
0
0.5
1.0
1.5
2.0
E_e [GeV]


1
2
3

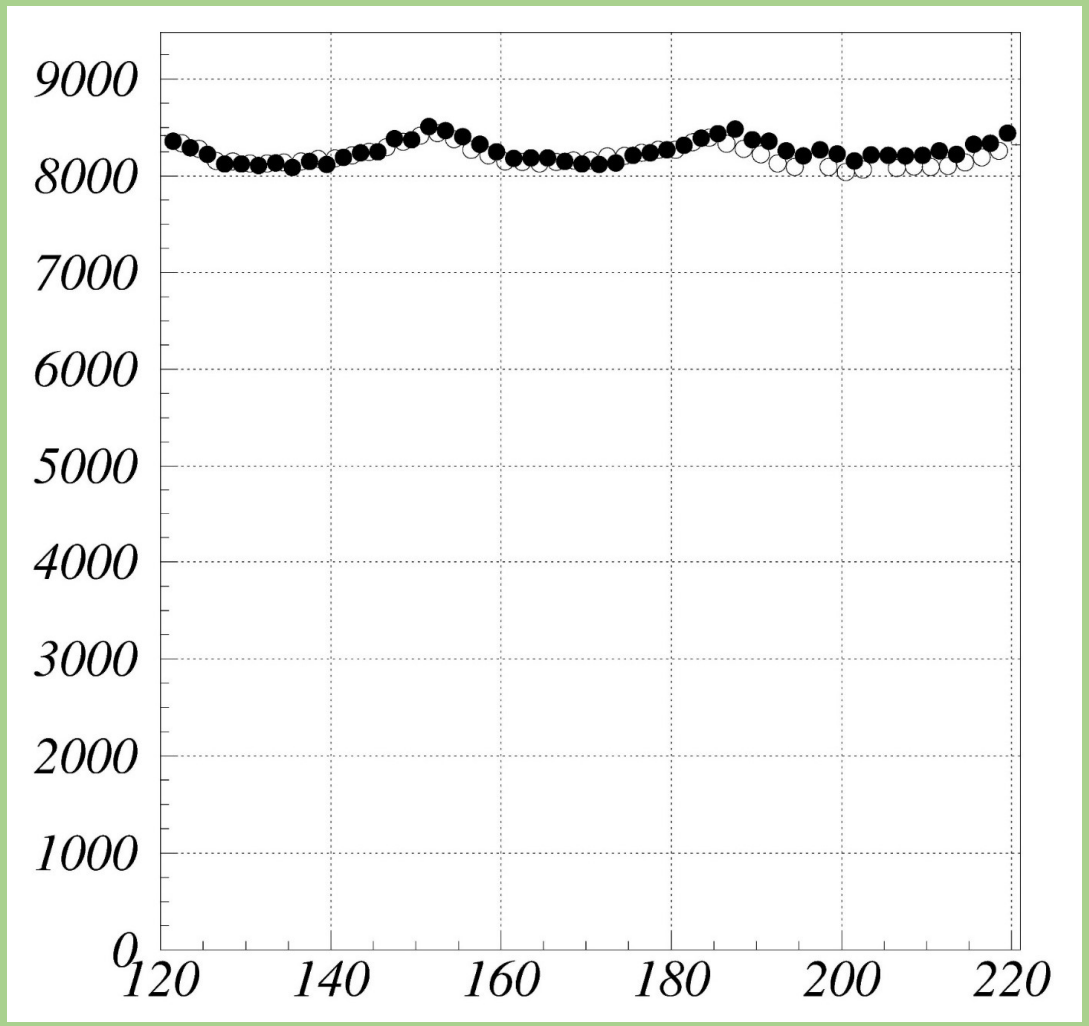
After pixels saturation corrected




N_{ph}
10000
8000
6000
4000
2000
0
120
140
160
180
200
220
1,6 GeV
X mm

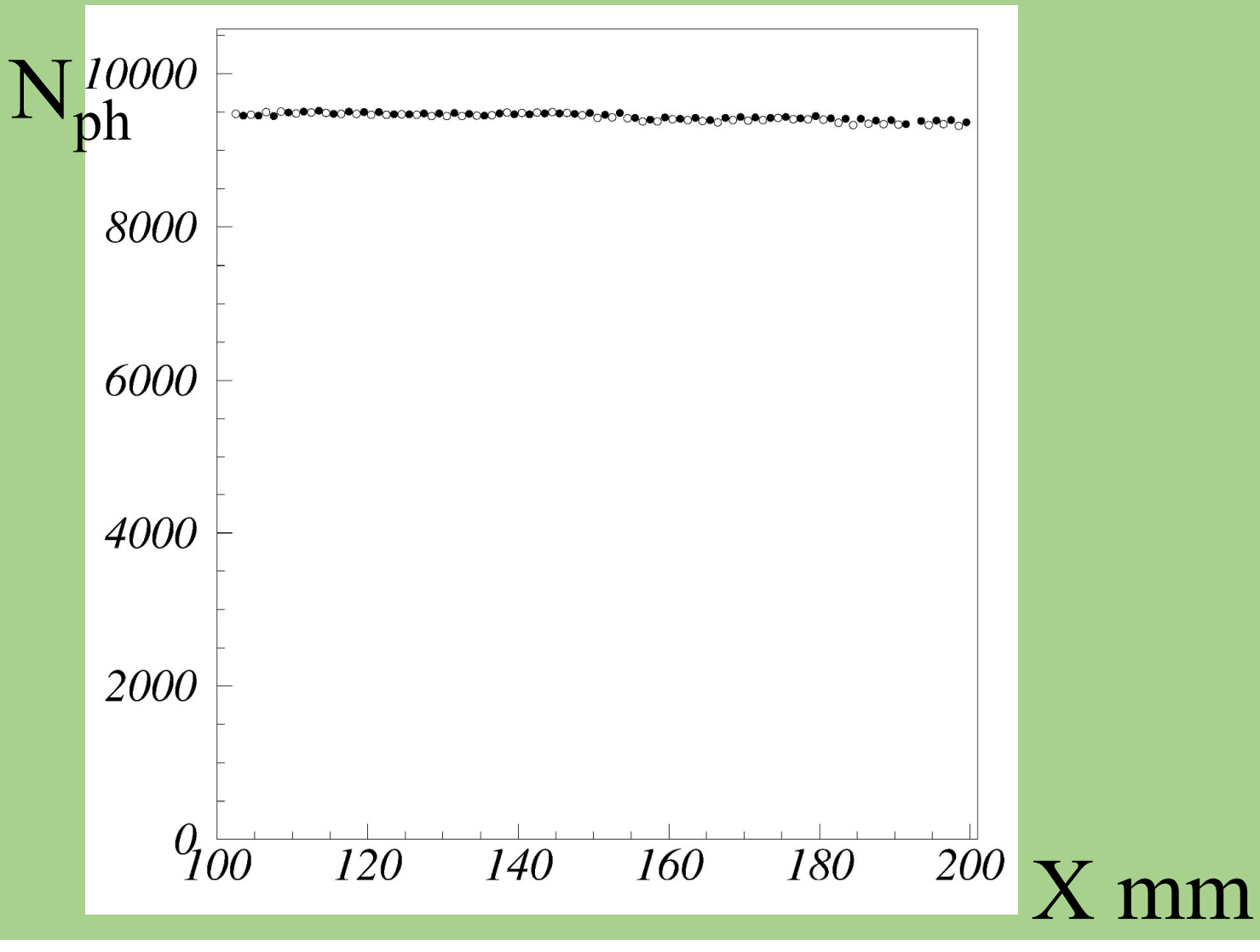
After calibration corrections applied

I. Tyapkin

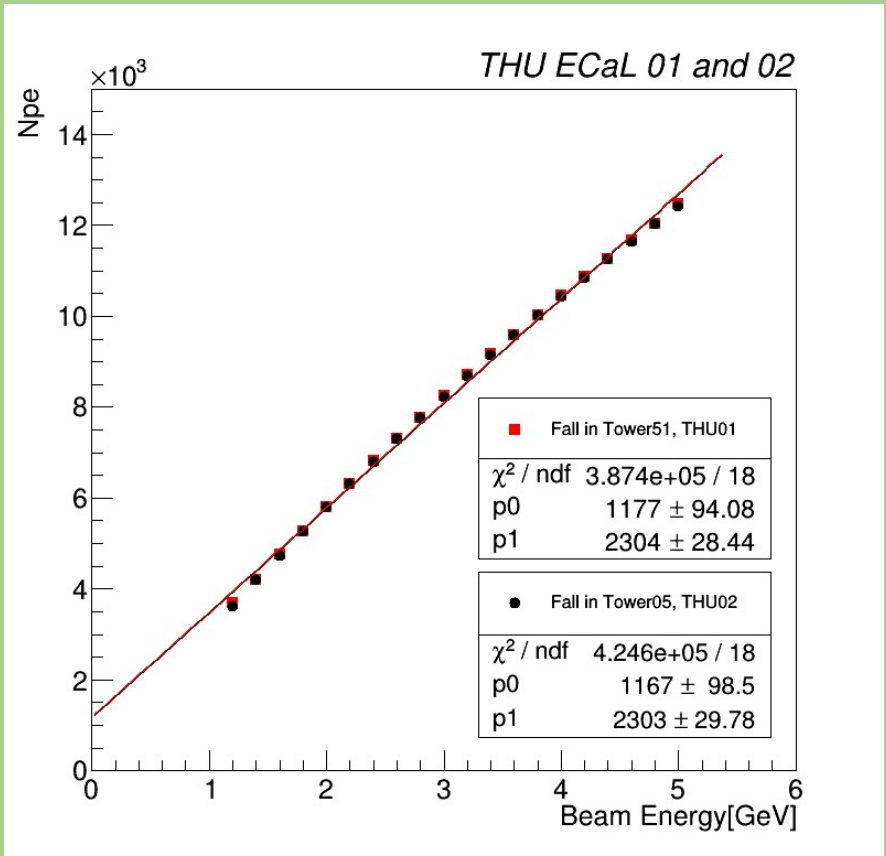


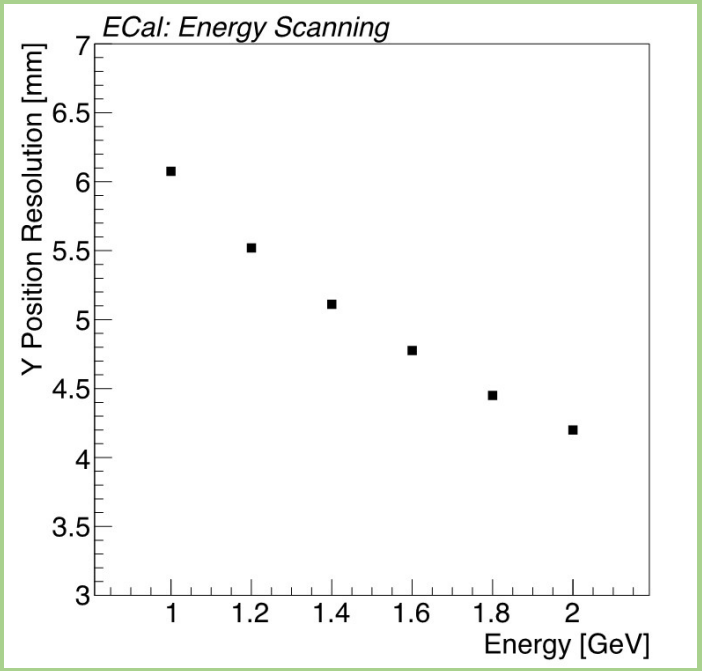
After pixels saturation corrected

I. Tyapkin



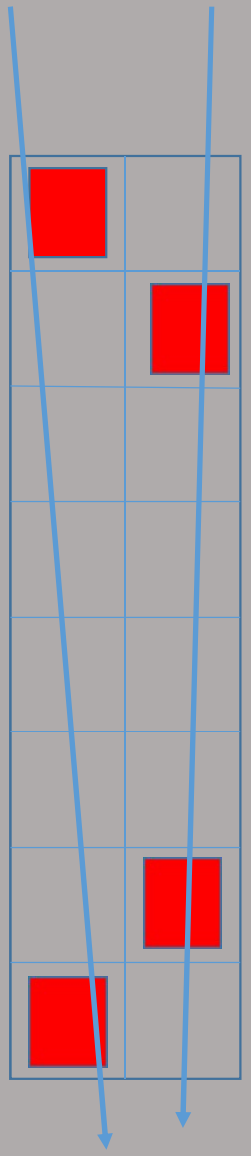
I. Tyapkin

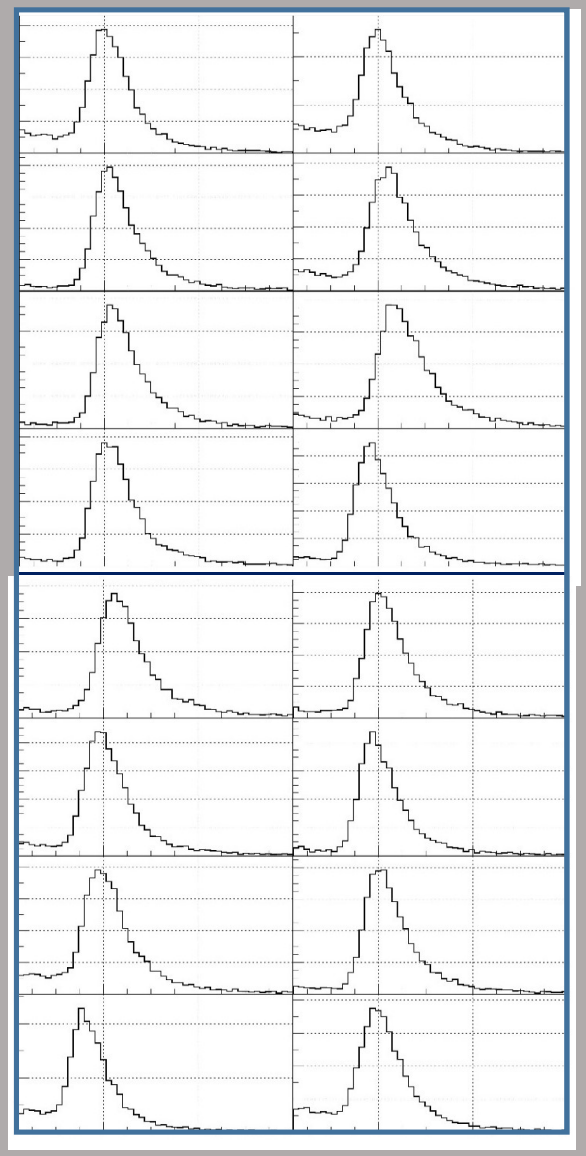

THU ECaL 01 and 02
Npe
×10^3
Beam Energy[GeV]
Fall in Tower51, THU01
χ² / ndf 3.874e+05 / 18
p0 1177 ± 94.08
p1 2304 ± 28.44
Fall in Tower05, THU02
χ² / ndf 4.246e+05 / 18
p0 1167 ± 98.5
p1 2303 ± 29.78

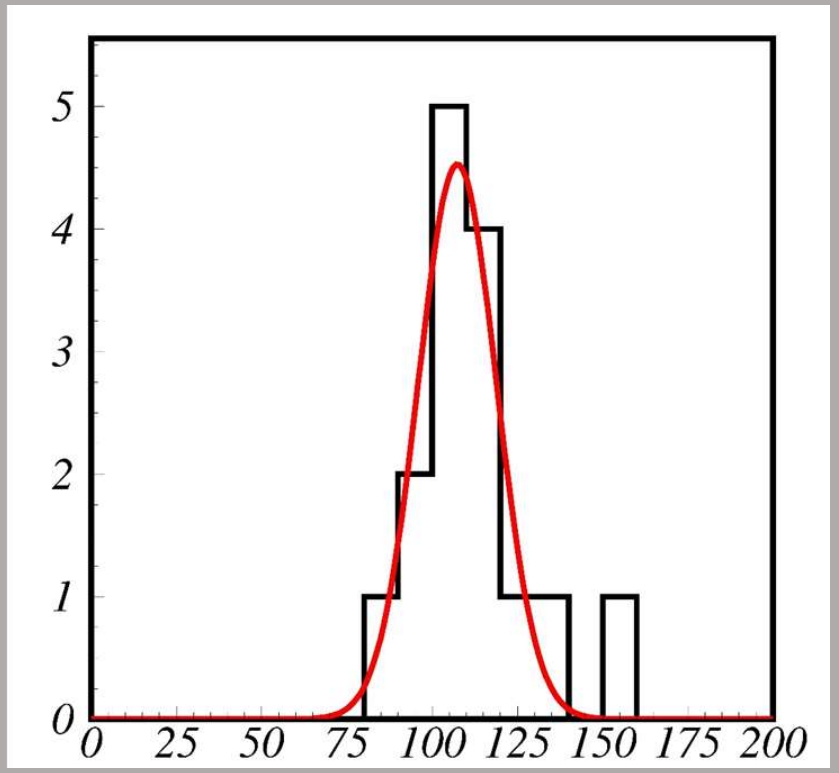

ECal: Energy Scanning
Y Position Resolution [mm]
Energy [GeV]

Macharab

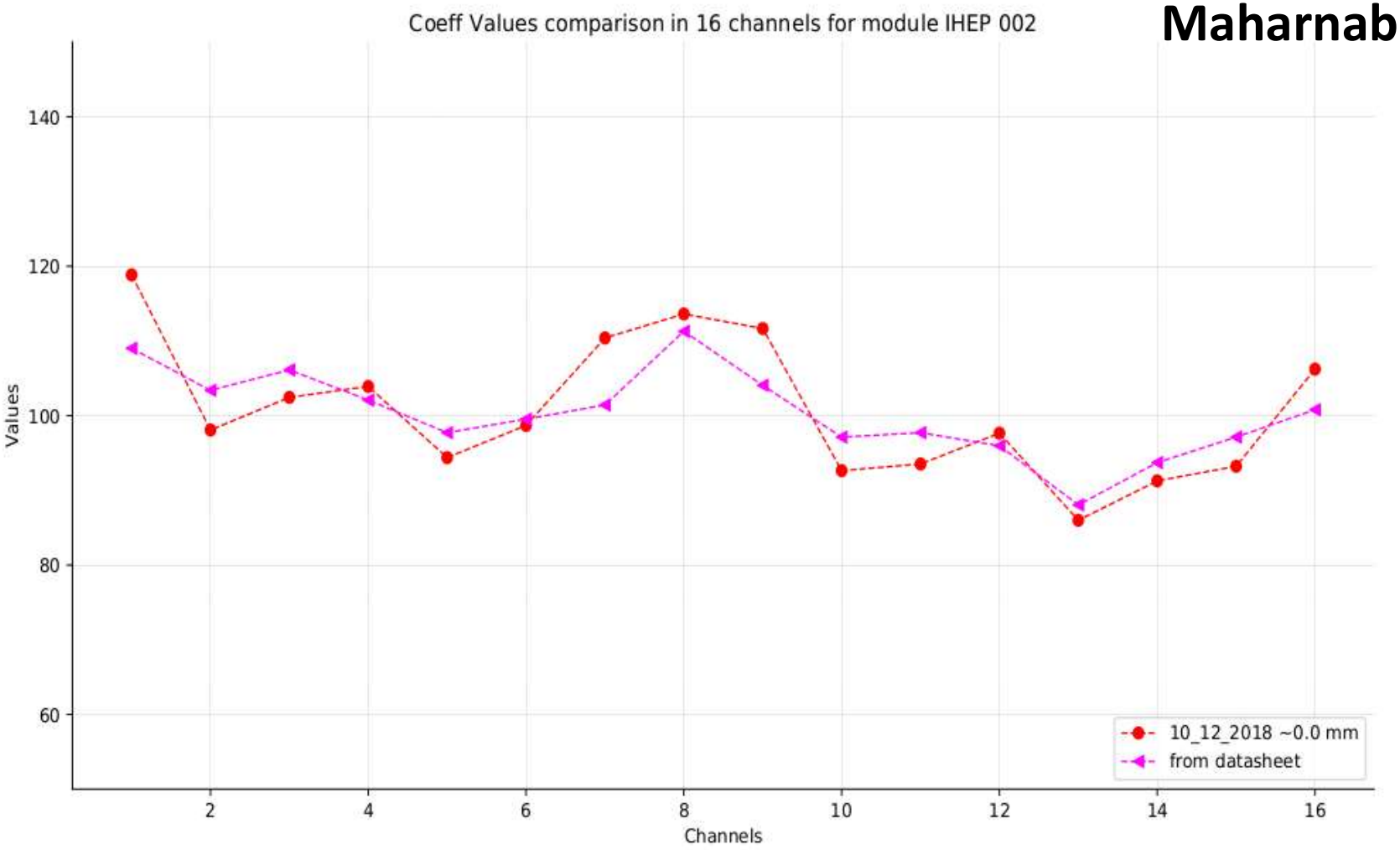
Cosmic calibration



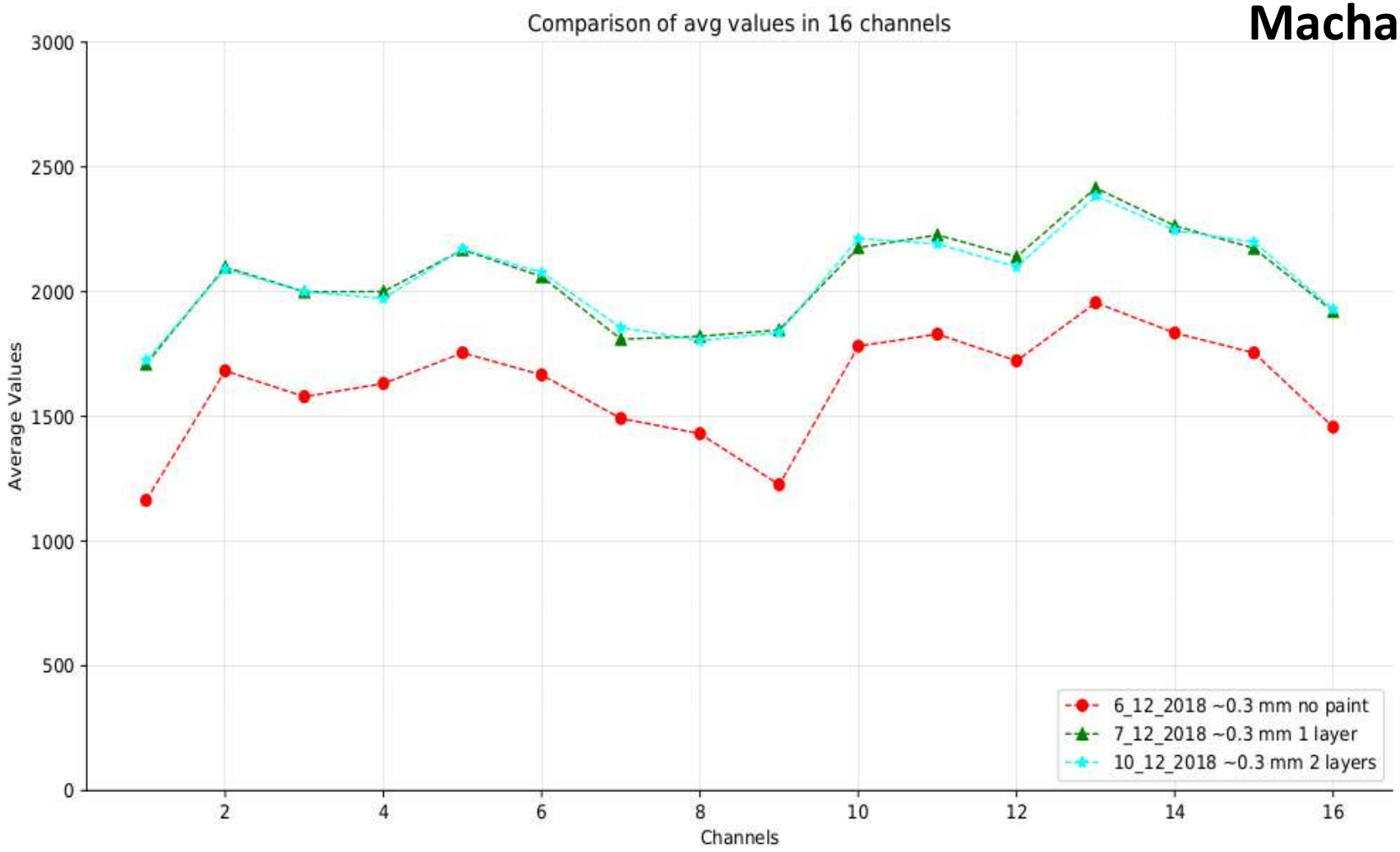




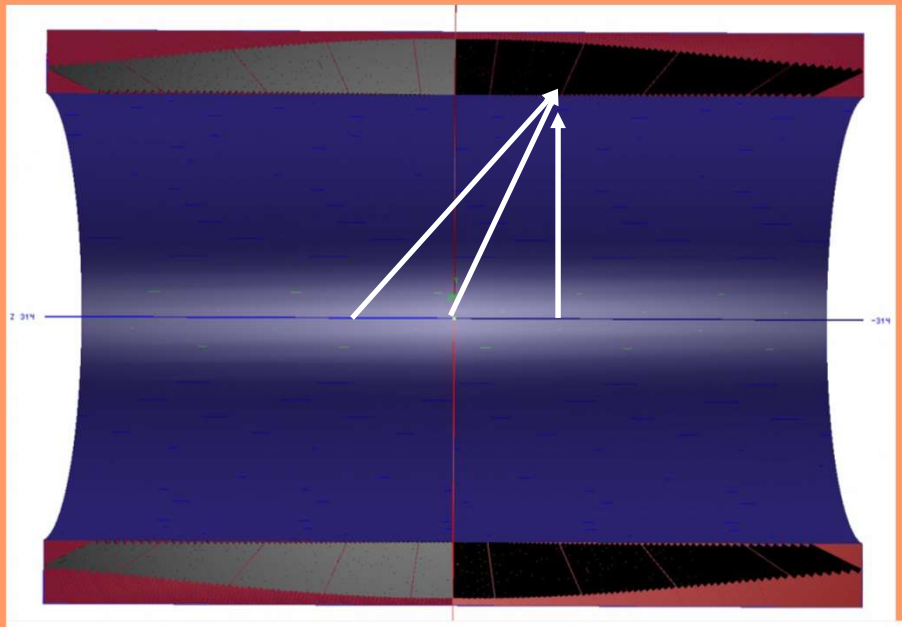
Maharnab

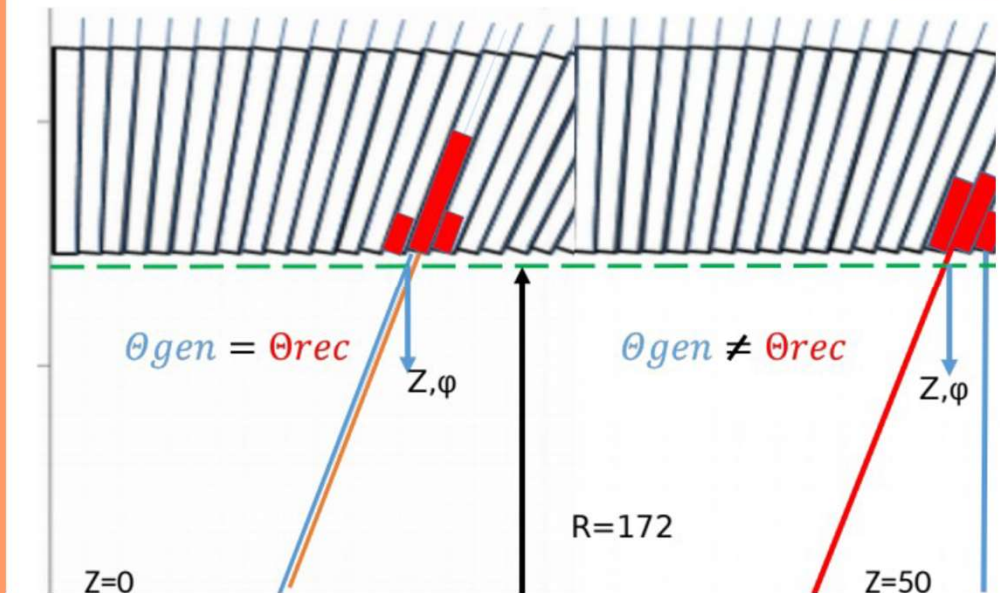

Coeff Values comparison in 16 channels for module IHEP 002
Values
Channels
140
120
100
80
60
2
4
6
8
10
12
14
16
10_12_2018 ~0.0 mm
from datasheet

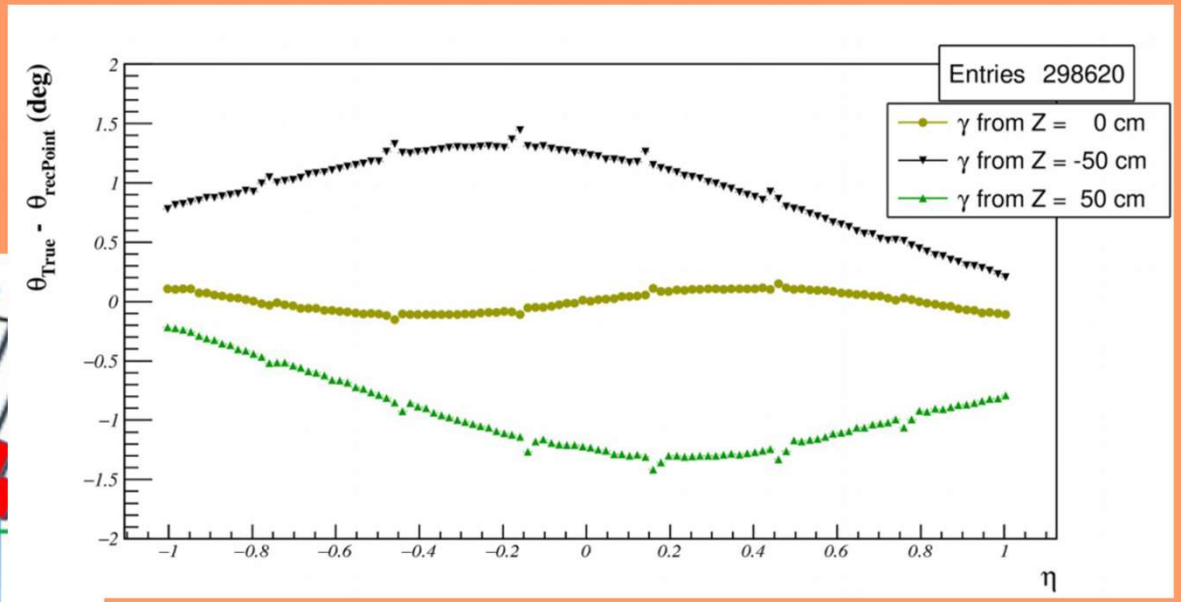
Macharab


Comparison of avg values in 16 channels
Average Values
Channels
3000
2500
2000
1500
1000
500
0
2
4
6
8
10
12
14
16
6_12_2018 ~0.3 mm no paint
7_12_2018 ~0.3 mm 1 layer
10_12_2018 ~0.3 mm 2 layers

Boyana Dabrowska and I. Tyapkin

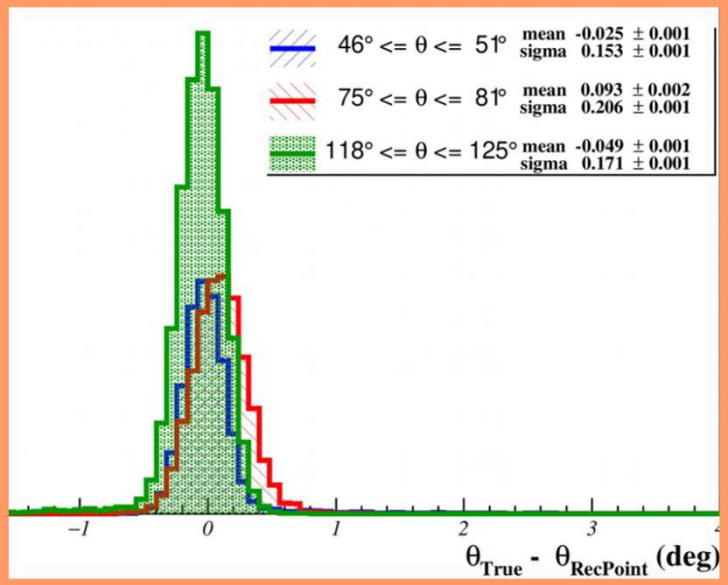


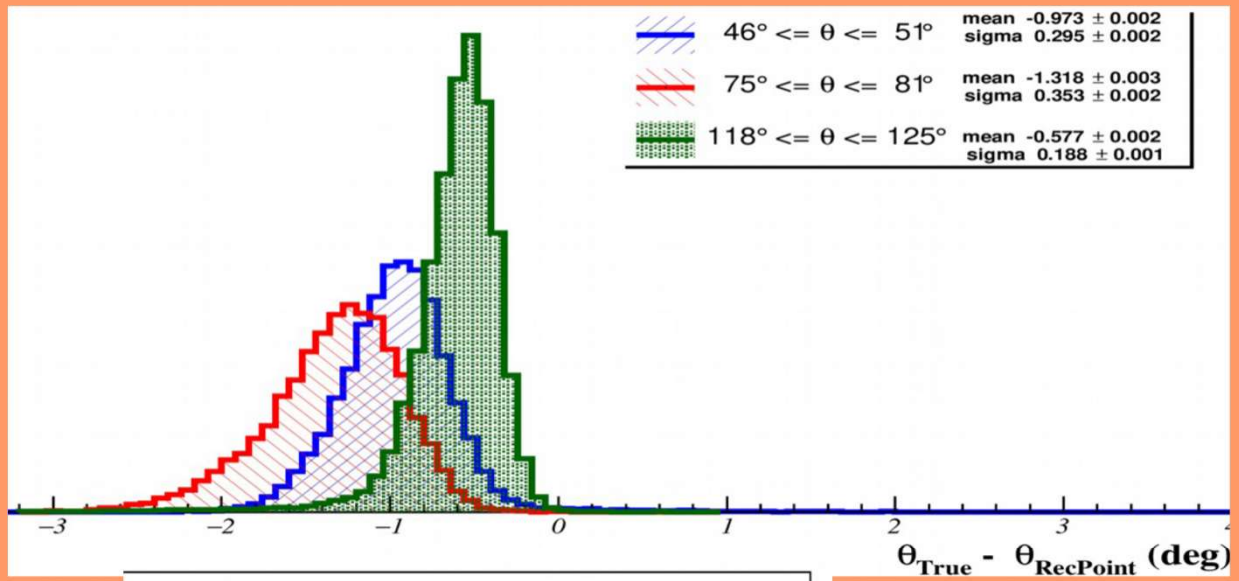


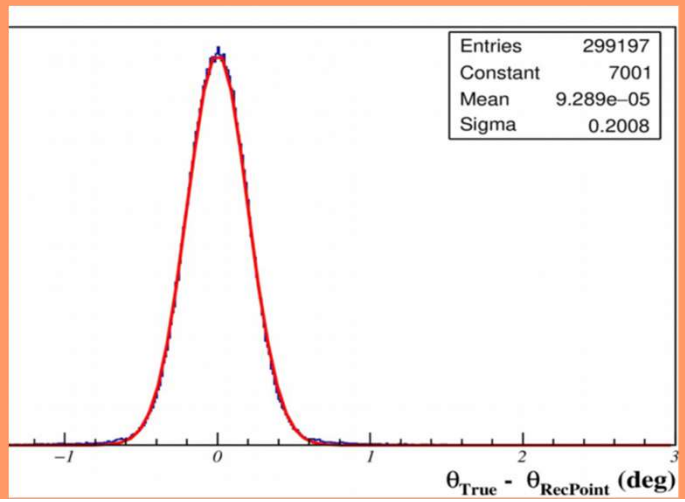


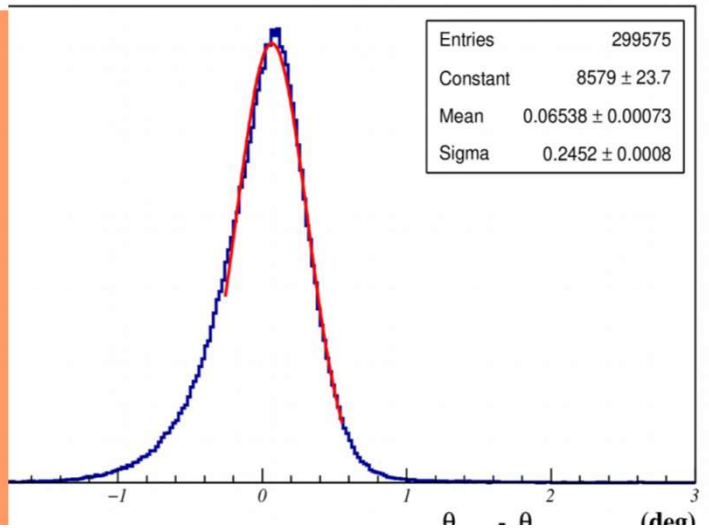
Systematic error in the polar angle measurements due to the not fully projective geometry of ECal

Boyana Dabrowska
I. Tyapkin





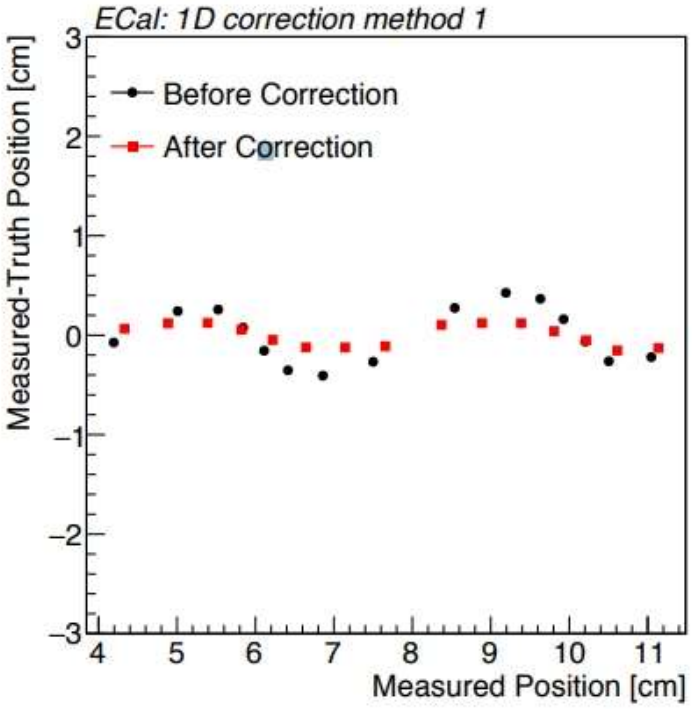


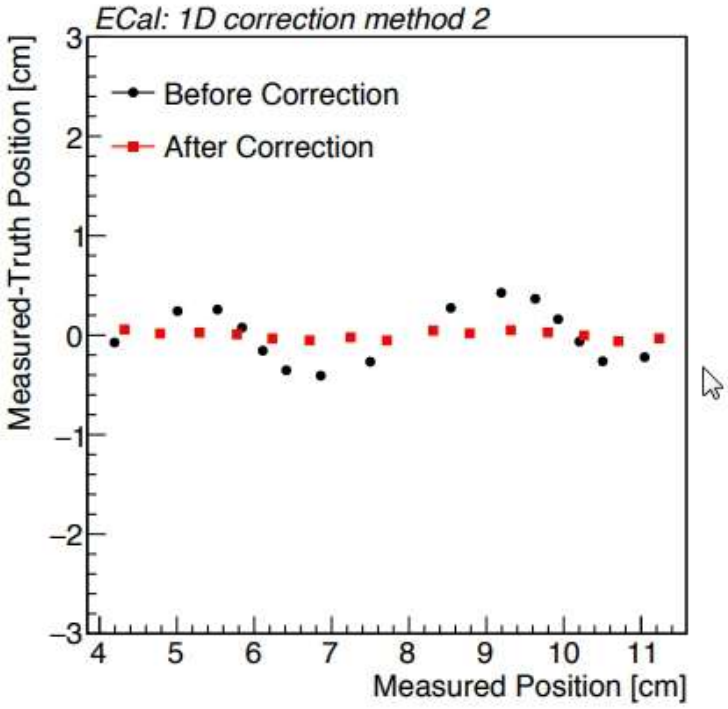


Position reconstruction with machine learning

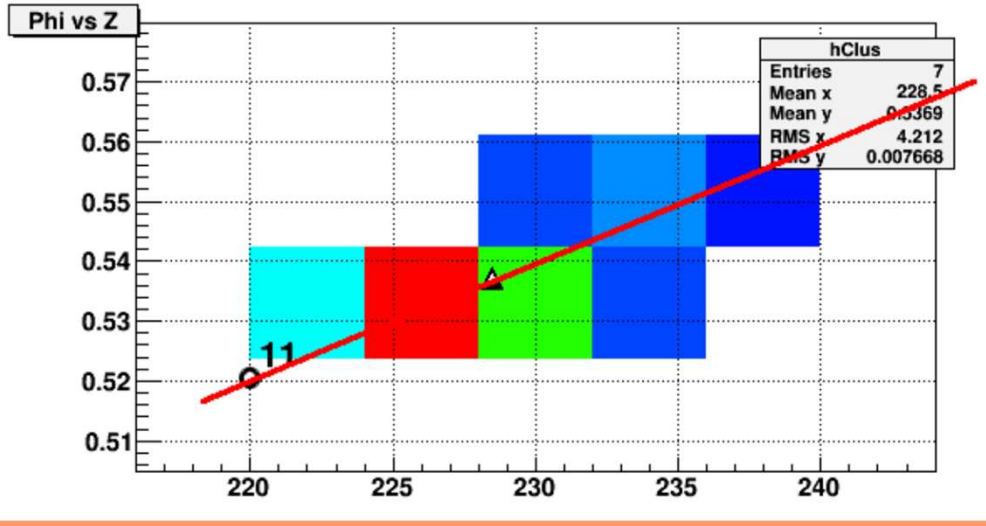
Fugue Wang

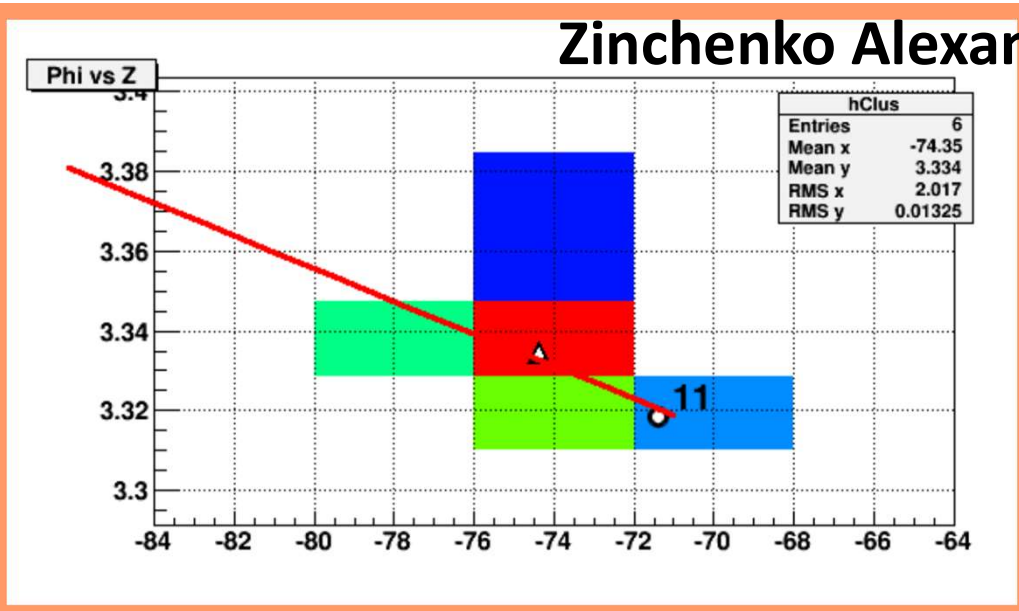
- Two 1D correction

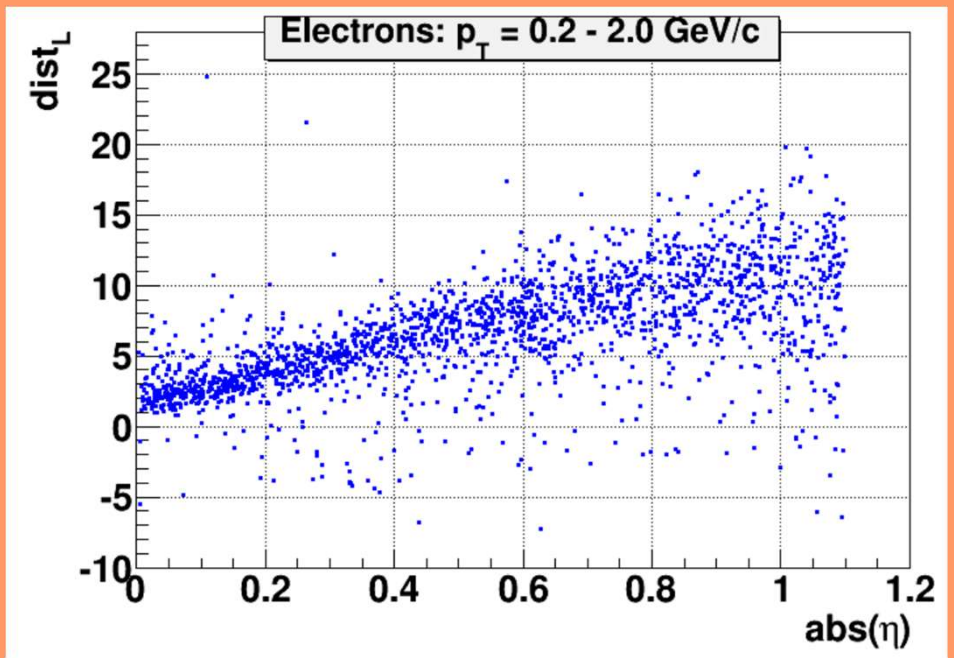


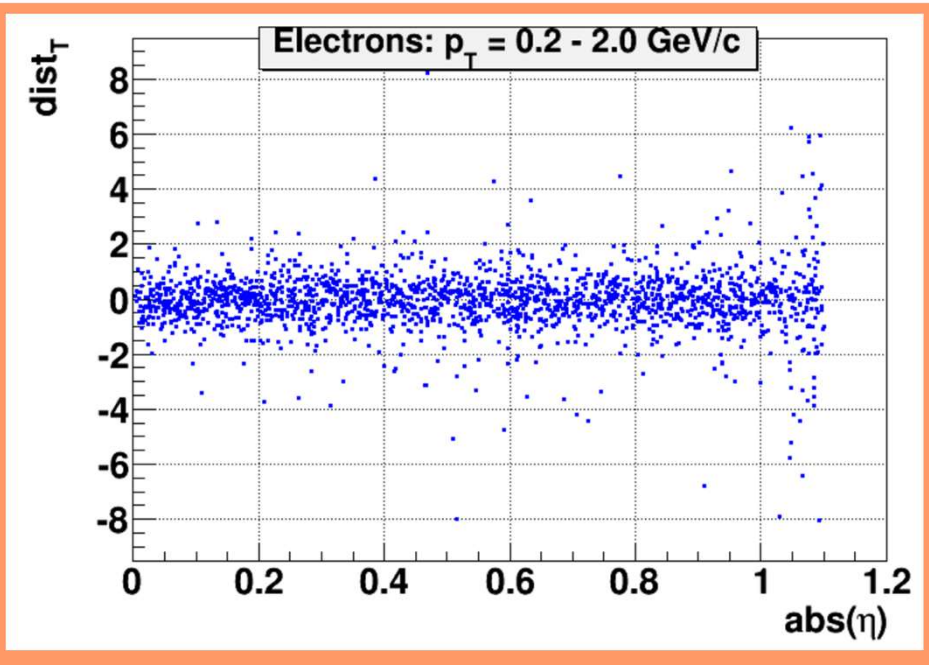


Zinchenko Alexandr

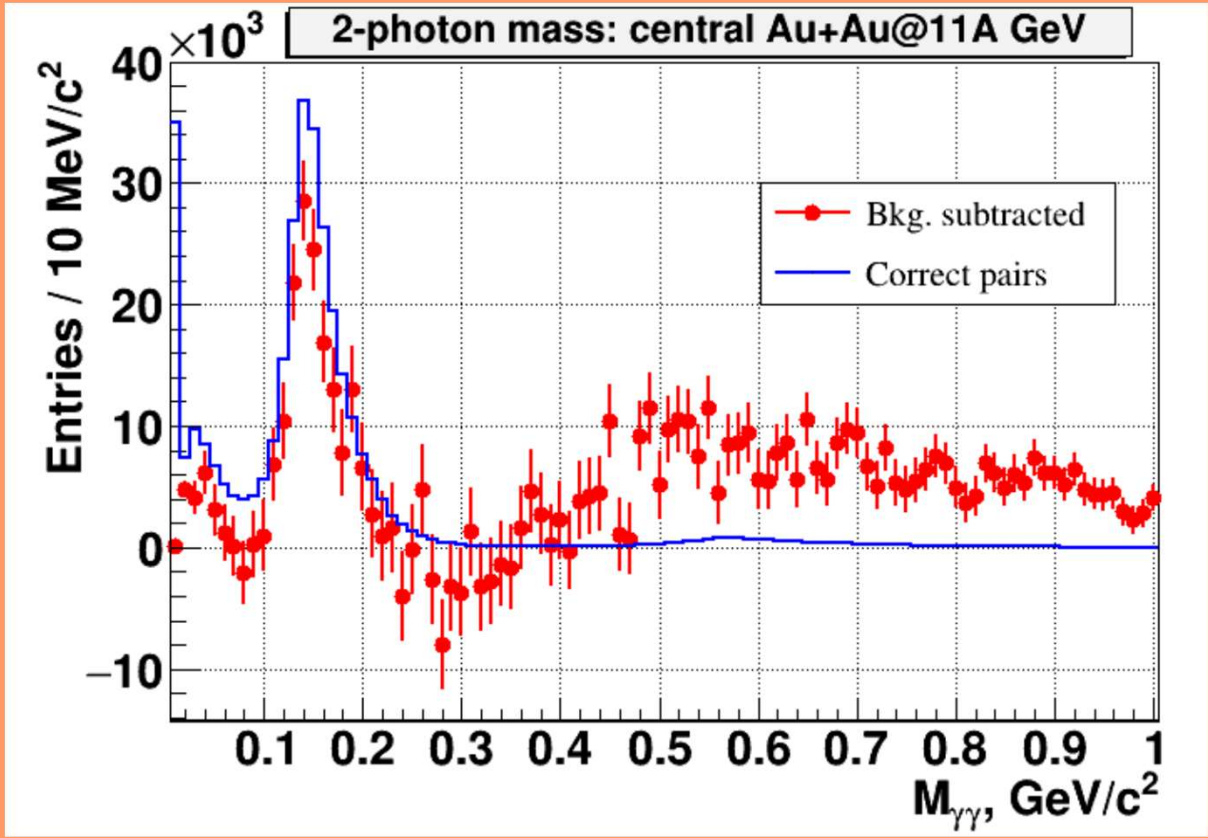






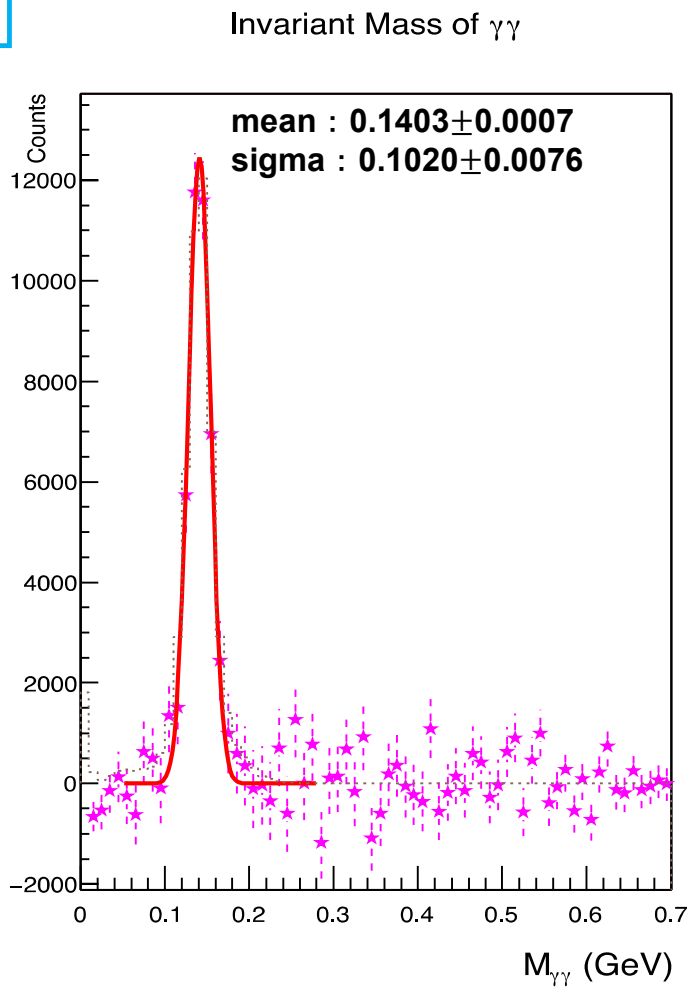


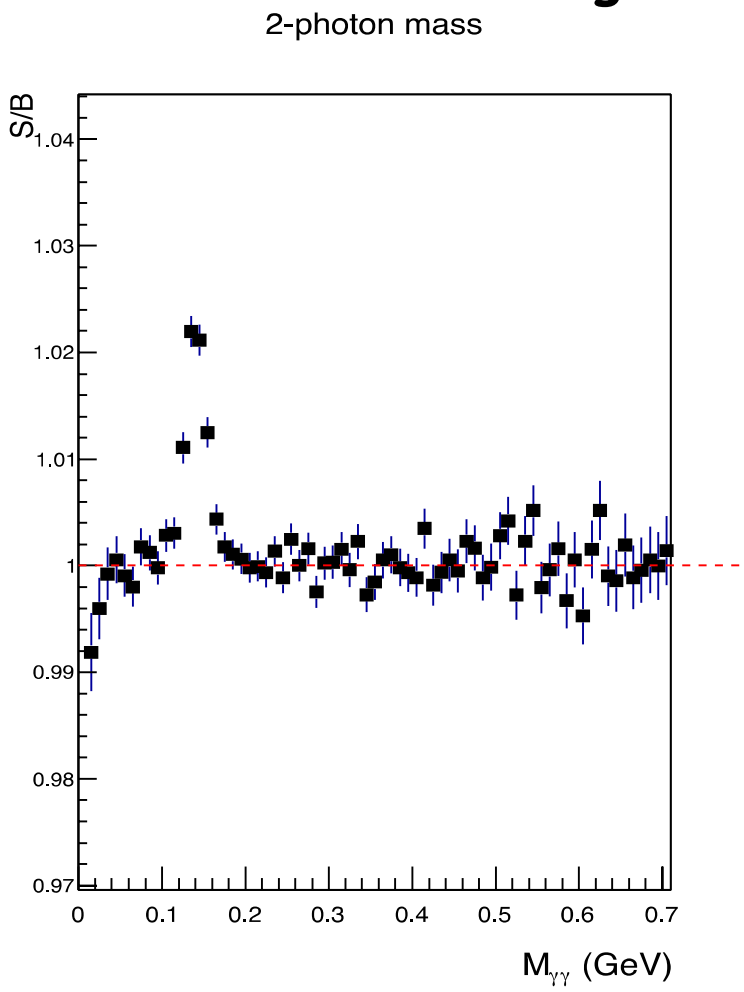
Zinchenko Alexandr



Yan Huang
Tsinghua University

- HypYpt Generator
- Multiplicity 197

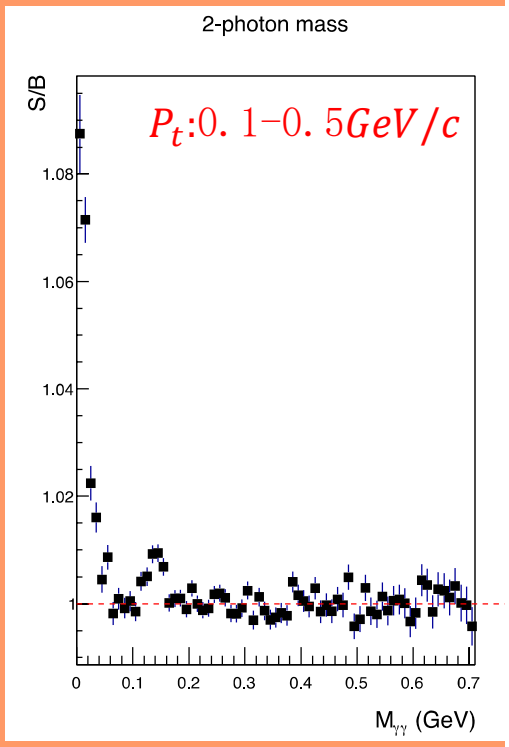


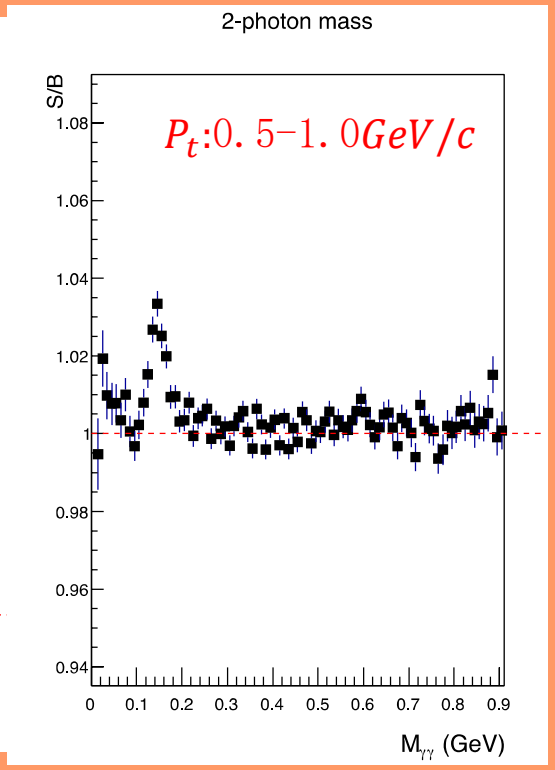


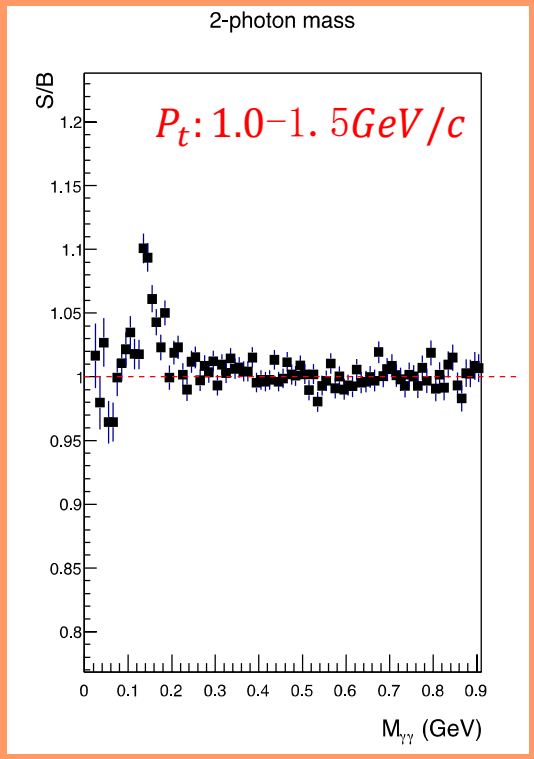
Reconstruction of two-photon invariant Mass and the S/B Ratio

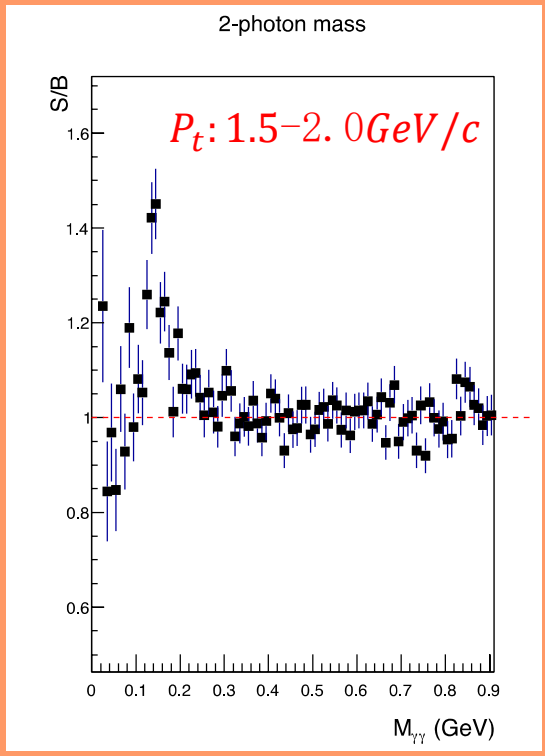
Yan Huang
Tsinghua University

- **UrQmd** $Au + Au$
- $\sqrt{s} = 11GeV$, b_{max}=-3







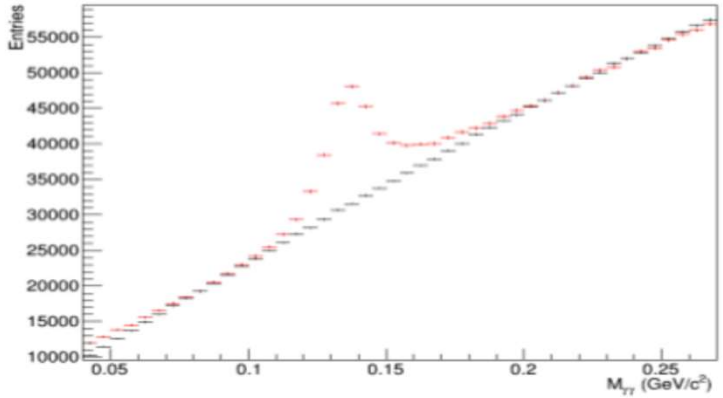


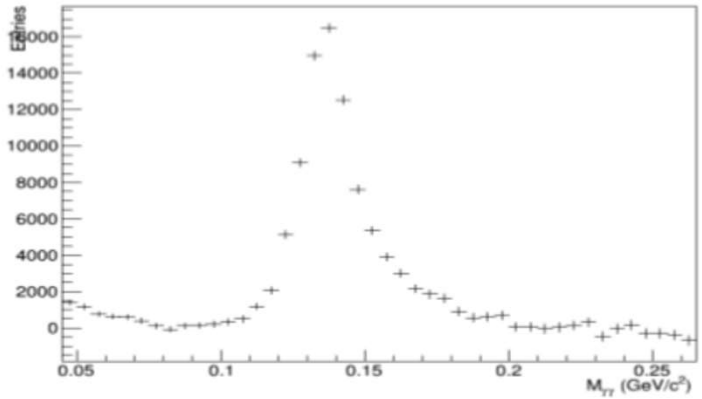
- Yield of π_0 get larger with P_t increases
- The background is large for low $M_{\gamma\gamma}$, especially for low P_t

Detector performance: π^0

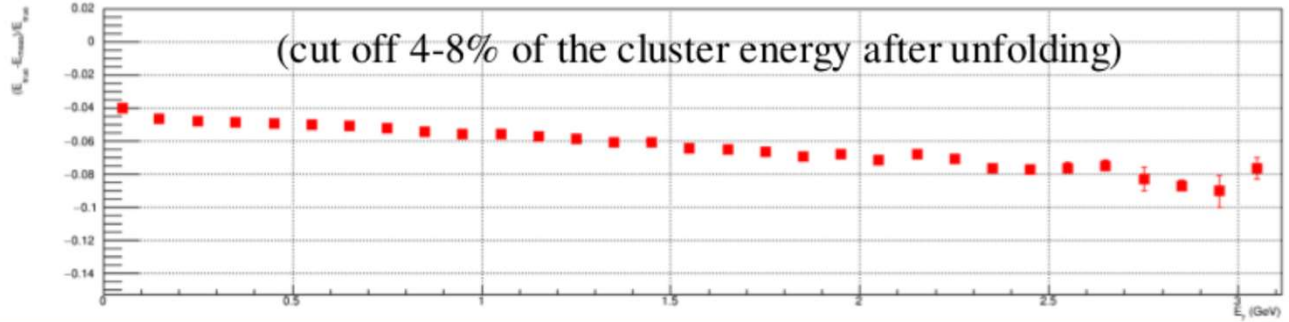
V.Riabov

- UrQMD, minbias AuAu@11, realistic vertex distribution
- $E\gamma > 0.1$ GeV, $|y| < 1.0$, $p_T > 2.0$ GeV/c, track veto
- Tested all methods of minimization. The best performance is achieved by limiting the cluster size after unfolding to 3x3 cells around the cluster center





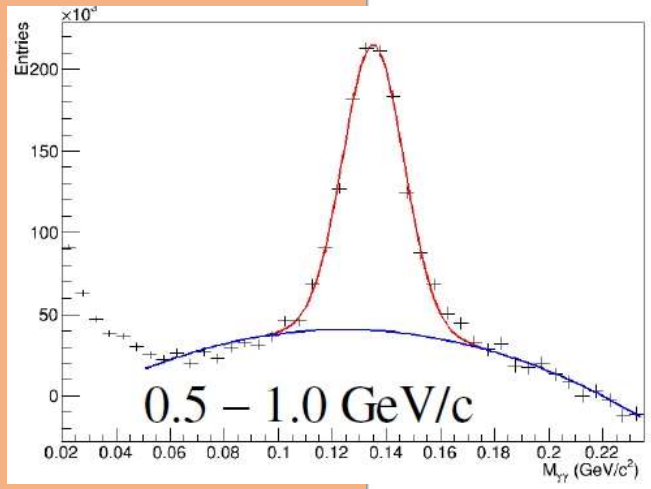
- Corresponding non-linearity correction should have been taken into account

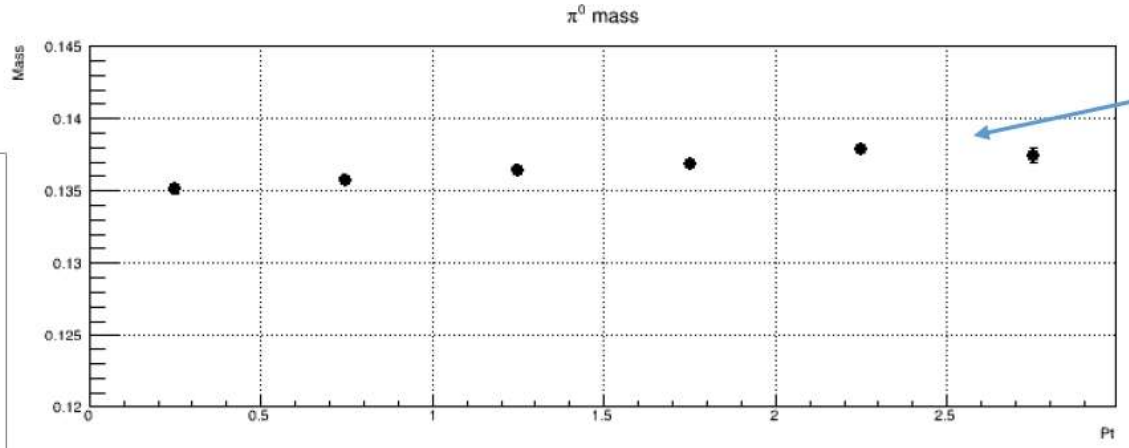


Detector performance: π^0

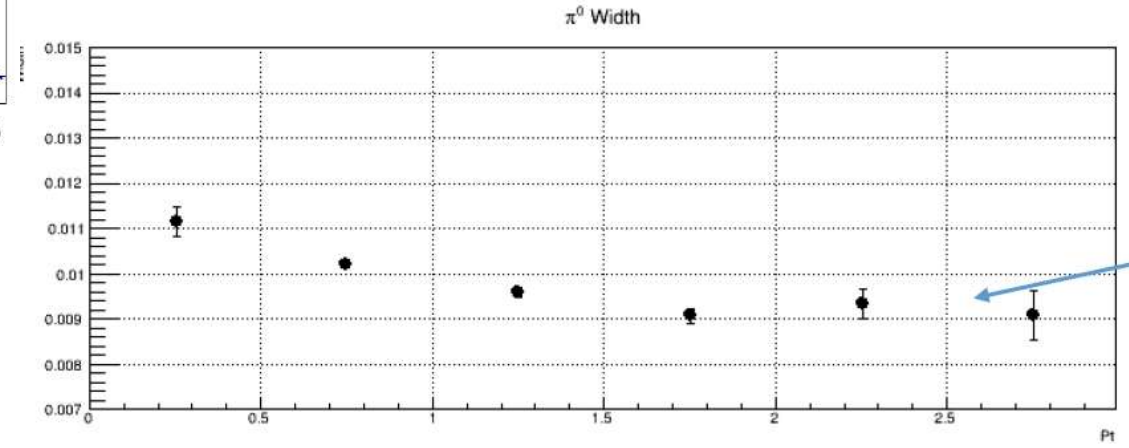
V.Riabov

- UrQMD, ***minbias*** AuAu@11, realistic vertex distribution
- Mass and width





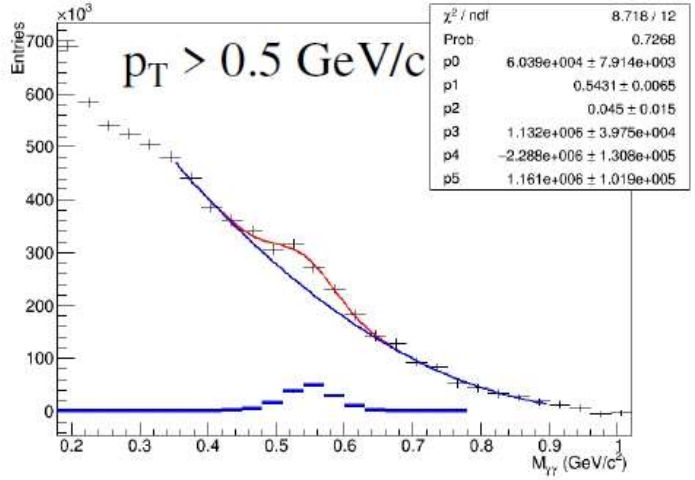
~ 137 MeV/c^2

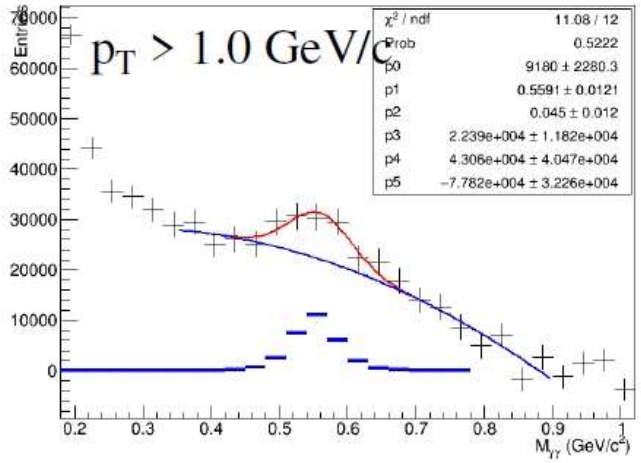


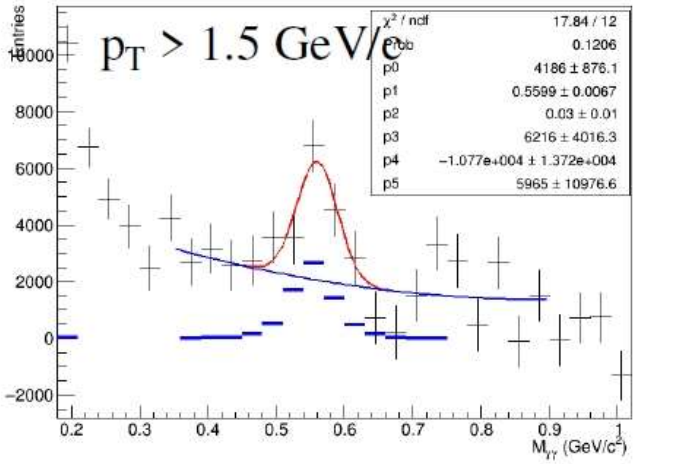
~ 9 MeV/c^2

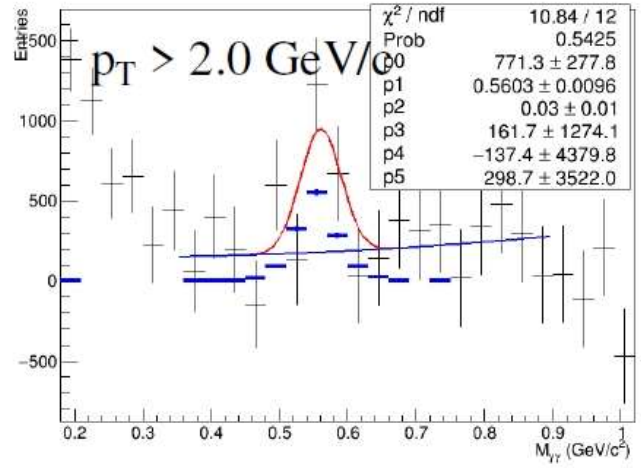
- UrQMD, minbias AuAu@11, realistic vertex distribution
- Observe with expected mass/width, numerical studies need more statistics

V.Riabov









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 mass 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

2. 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
3. Easy method of the channels calibration by means of cosmic muons have been tested
4. Systematic error in the polar angle measurements due to the not fully projective geometry of ECal was studied and solution proposed
5. Improvement of the position reconstruction accuracy with help of machine learning algorithm is demonstrated
6. Clasterization and track matching algorithms are developed and tested on the π^0 reconstruction