New results of ECAL test at electron beam at Troitsk

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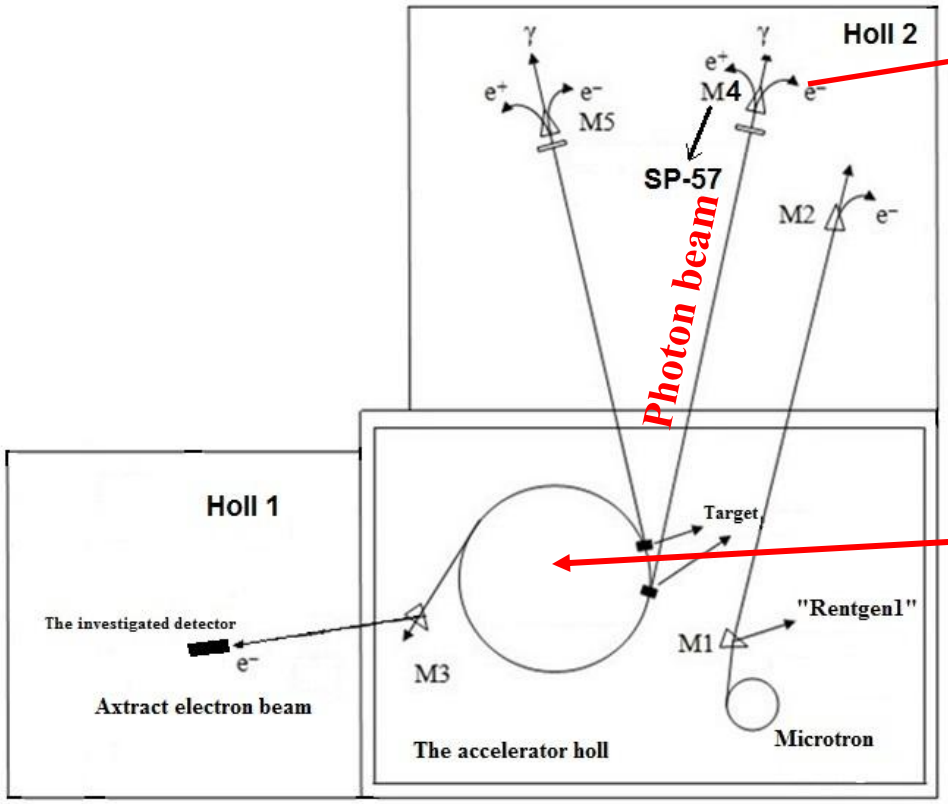
Introduction

Measurements on electron beam of Pahra accelerator and cosmic rays have been performed at 28-30 of January 2020 by JINR-group (I.Typkin) and FIAN-group (V.Baskov). Data analysis has been performed independently by JINR-group and ITEP-group (V.Kulikov, M.Martemianov.M.Matsyuk) .

Under test were 3 modules (48 towers) of central type. Two modules were produced at IHEP (Protvino)

Pahra accelerator complex

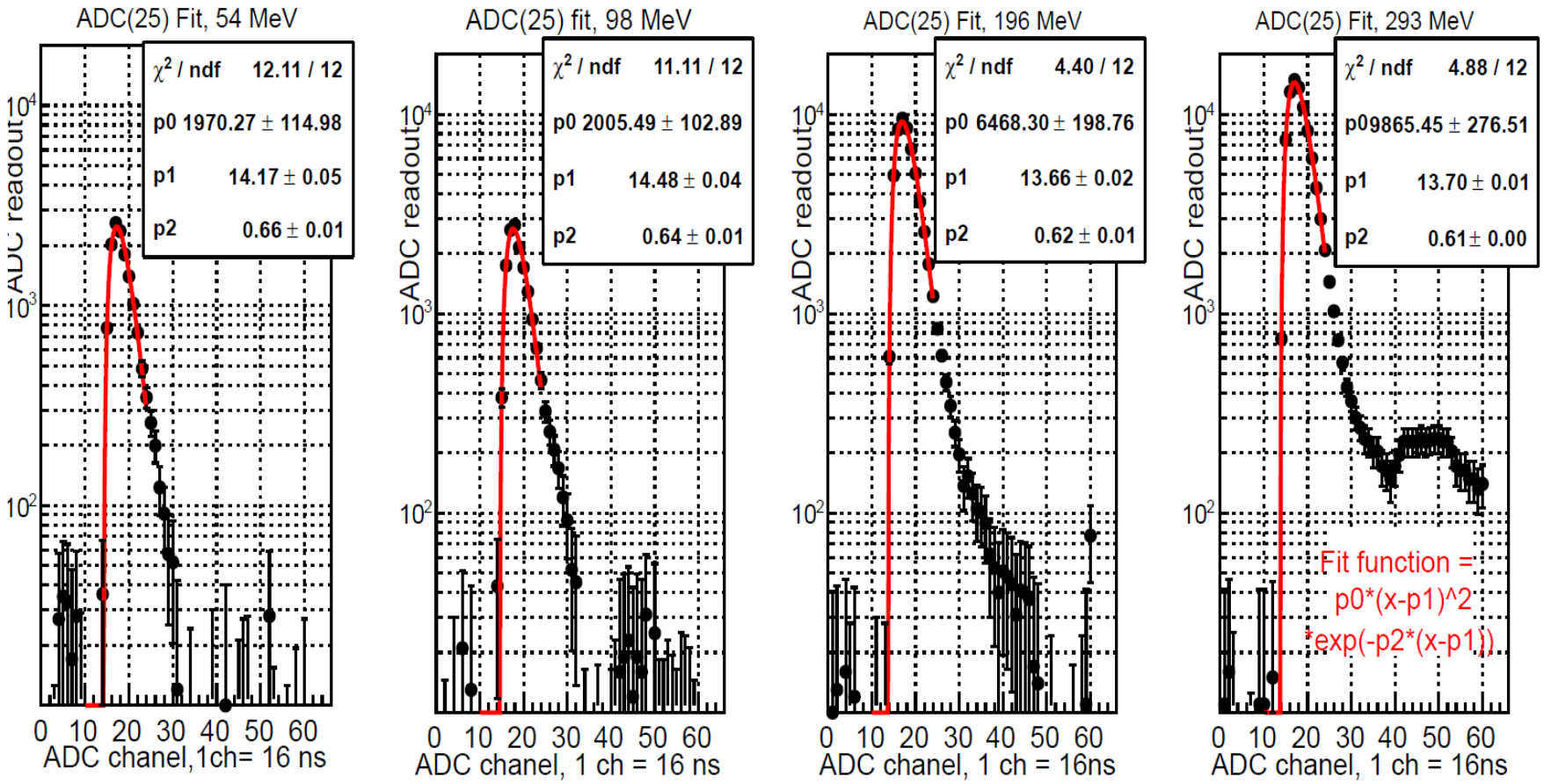


To ECAL

Electron beam up to 300 MeV and few hundreds of electrons per second

Pahra accelerator

MPPC signal measured by ADC



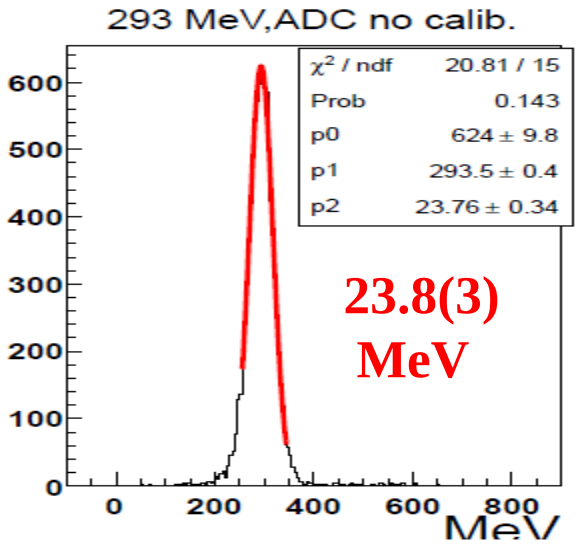
Very nice electronics: negligible pedestal, afterpulses only on 1% level. Deposit energy can be measured as a sum of counts in a range of ADC channels, as area under fit by p0*t*t*exp(t/p2),where t=x-p1 and x is ADC channel , and as maximal amplitude.

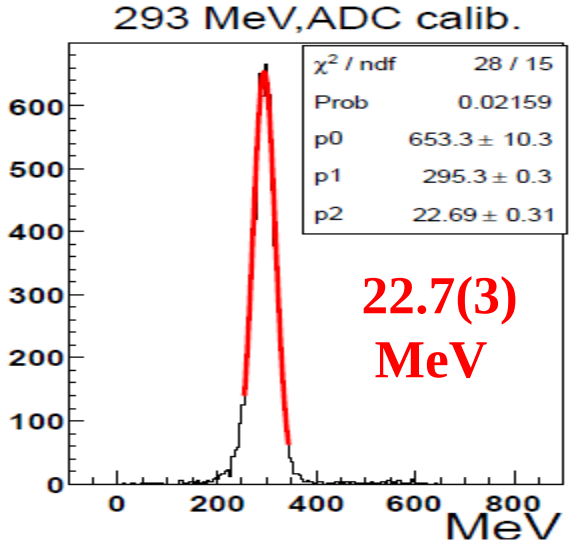
Towers non-identity correction

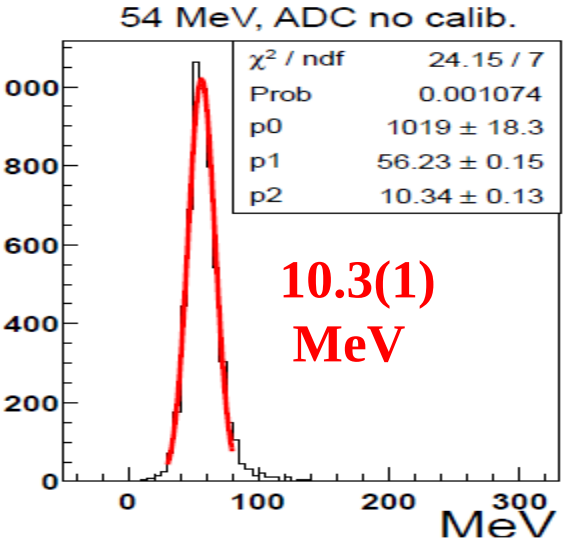
No correction

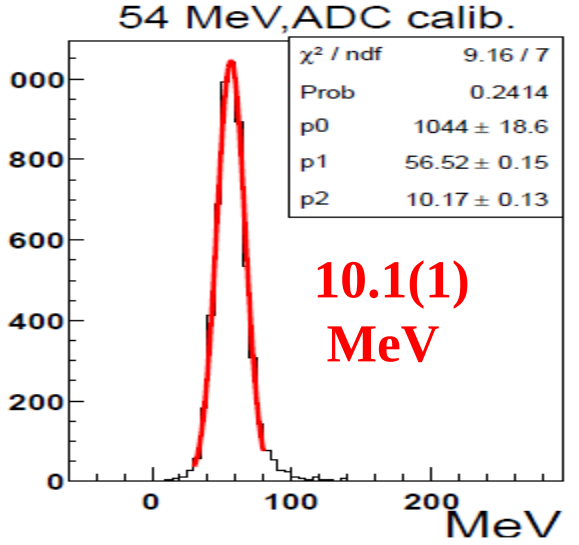
With correction

Using Cosmic Rays Maharnab Bhattacharjee obtained relative correction coefficients for each of 47 towers. These coefficients change from 1.37 to 0.78. This slide demonstrate the influence of this energy correction for 293 and 54 MeV beams. It reduces energy resolution by 5% at 293 MeV electrons and will be more important for different positions of the beam.



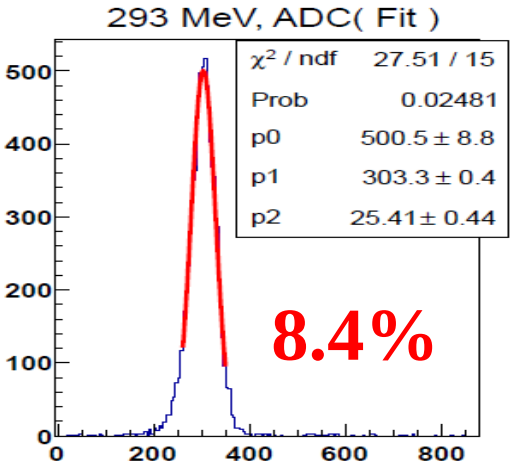


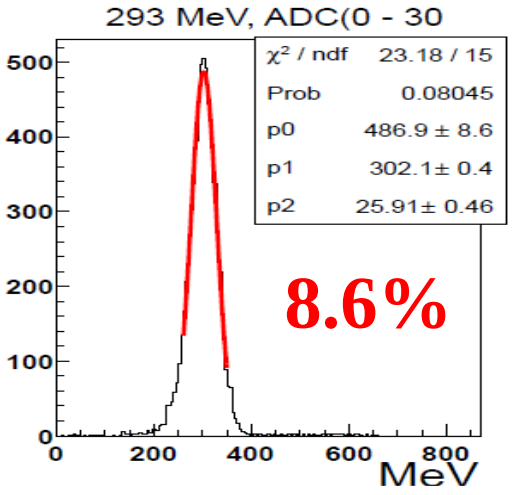


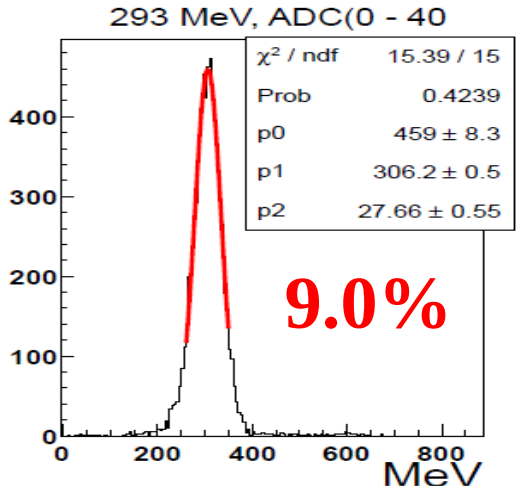


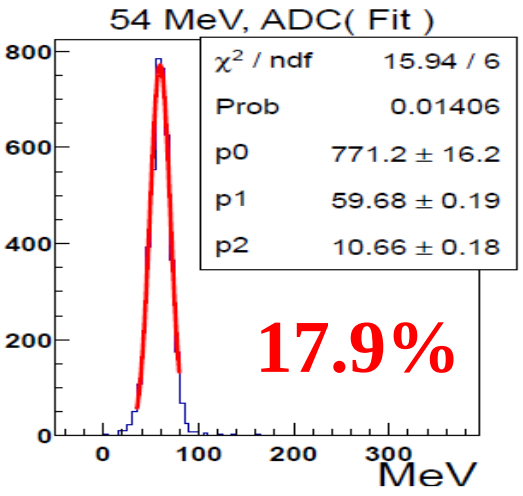
Energy resolution for 293 and 54 MeV

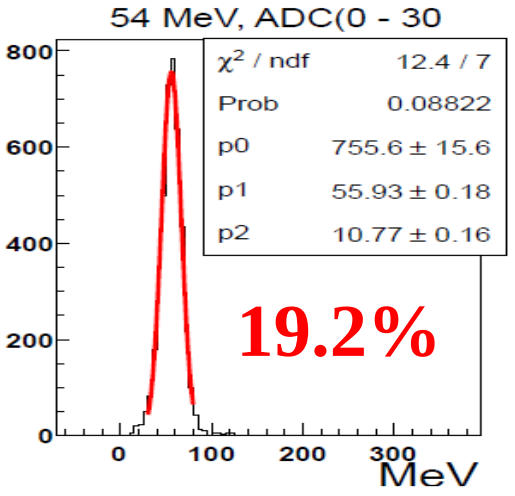
Fit **Sum over 30 ch.** **Sum over 40 ch.**

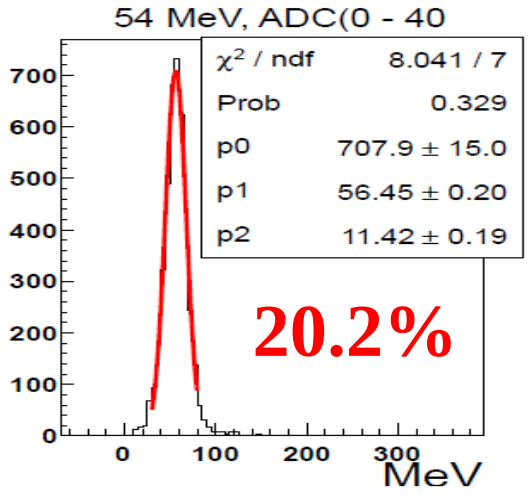






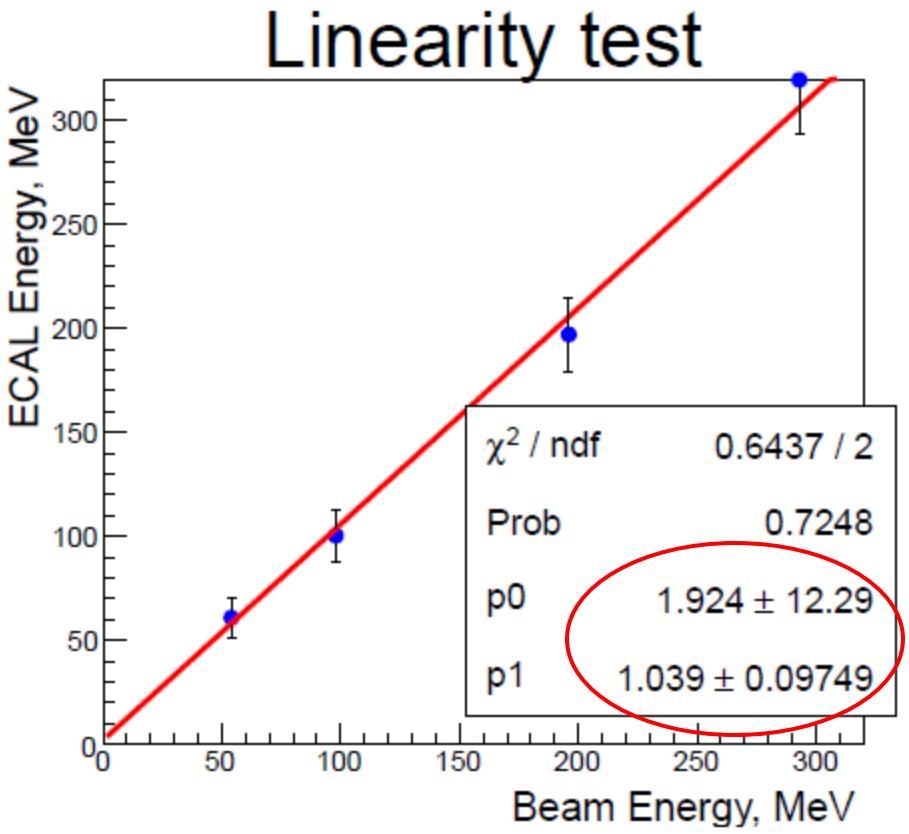


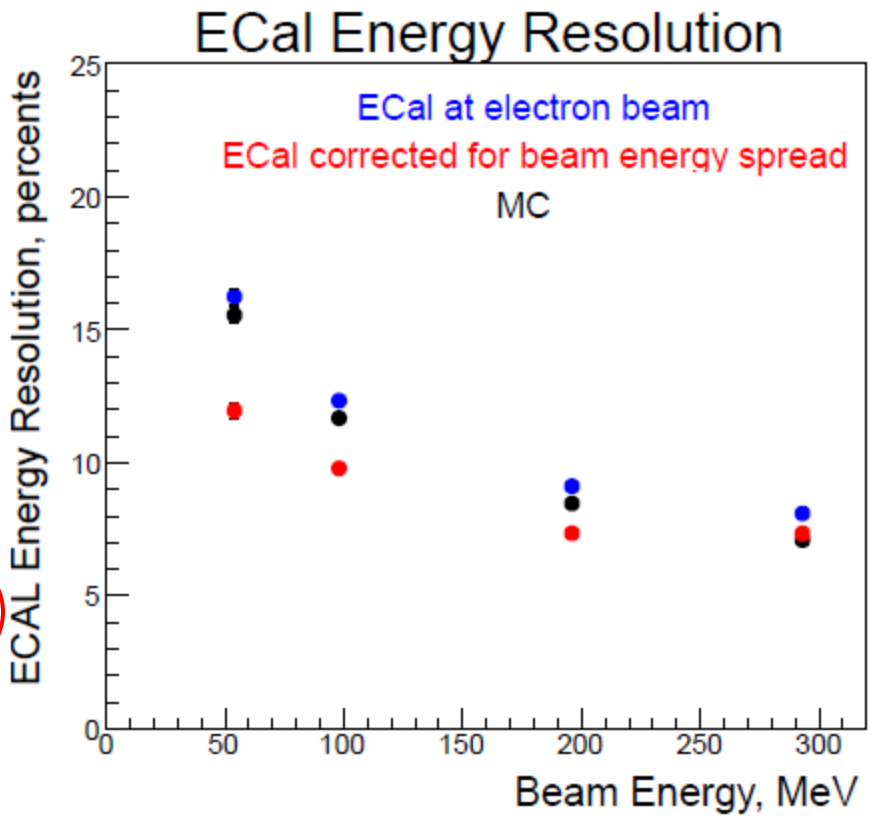




Fit works better but is slow and less reliable, sum over 30 ch. will be used

Linearity and resolution energy dependence





Linearity is reasonable but not perfect: +/- 12 MeV impact parameter

Good agreement between MC and data but correction for beam spread is questionable

Energy resolution tables

Beam Energy, MeV	293	196	98	54	
ECal measured, %	8.1	9.1	12.3	16.3	(accuracy 0.1-0.05)
e-beam spread	3.4	5.4	7.5	11.0 +/- 10%	given by V.Baskov
ECal corrected(*), %	7.4	7.4	9.8	12.0	
MC , %	7.1	8.5	11.7	15.6	
ECal to MC ratio	1.04	0.87	0.84	0.77	

Beam Energy, MeV	293	196	98	54	
ECal measured, %	8.1	9.1	12.3	16.3	(accuracy 0.1-0.05)
e-beam spread	3.4	3.4	3.4	3.4	// my guess
ECal corrected(*), %	7.4	8.5	11.9	15.9	
MC , %	7.1	8.5	11.7	15.6	
ECal to MC ratio	1.04	1.0	1.02	1.02	

My guess is based on independence of beam spread from energy in case of small multiple scattering/

Conclusion

1. **The beam test has shown a good performance of the first 3 ECAL modules and electronics.**
2. **Software is ready for data analysis**
3. **Energy resolution is in reasonable agreement with MC. For 300 MeV this agreement is better than 5%. At smaller momentum the beam spread problem has to be and will be solved at extracted electron beam.**
4. **Work on the optimization of time resolution, MC simulation of beam test set up and cosmic ray calibration of ECAL are in progress.**

Thank You