Виктор Дугинов, зам. нач. отдела

Отдел множественных адронных процессов ЛЯП

(Нач. отдела Ю.И.Давыдов)

Активности, связанные с эл.-магнитной калориметрией

- COMET

Электромагнитный калориметр, паспортизация кристаллов LYSO

- Mu2e

Исследование элементов калориметра на CsI на электронных пучках и с γ-источниками

Certification of the LYSO crystals for the COMET exprriment

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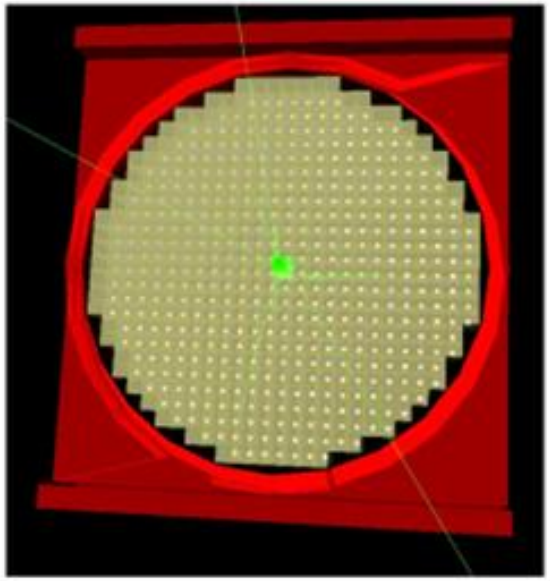
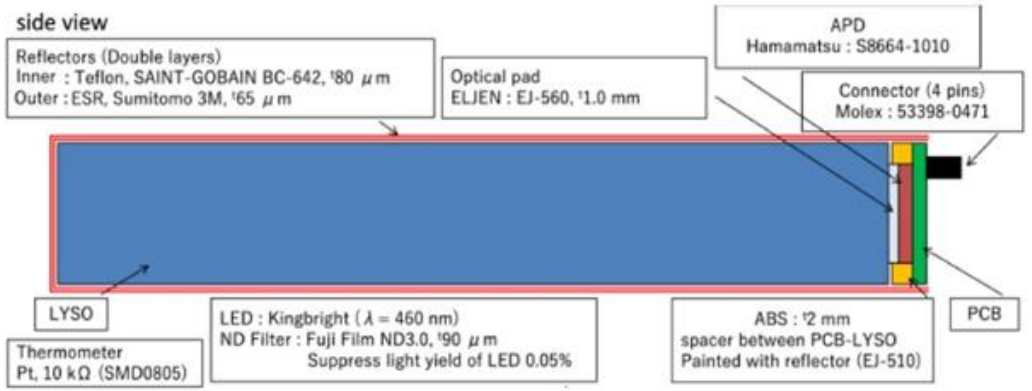
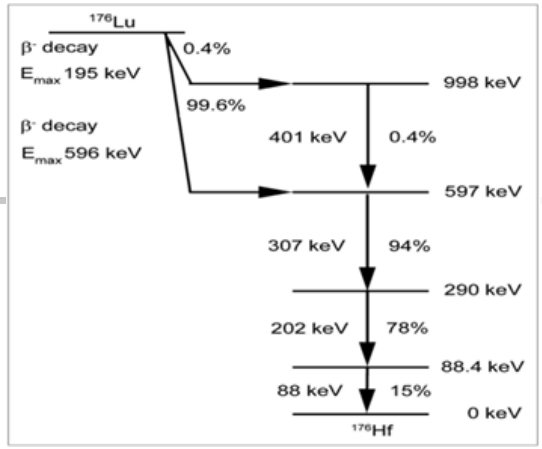
[1] *Department of multihadron processes, DLNP, JINR*
[2] *Sector of the rare processes , DLNP, JINR,*

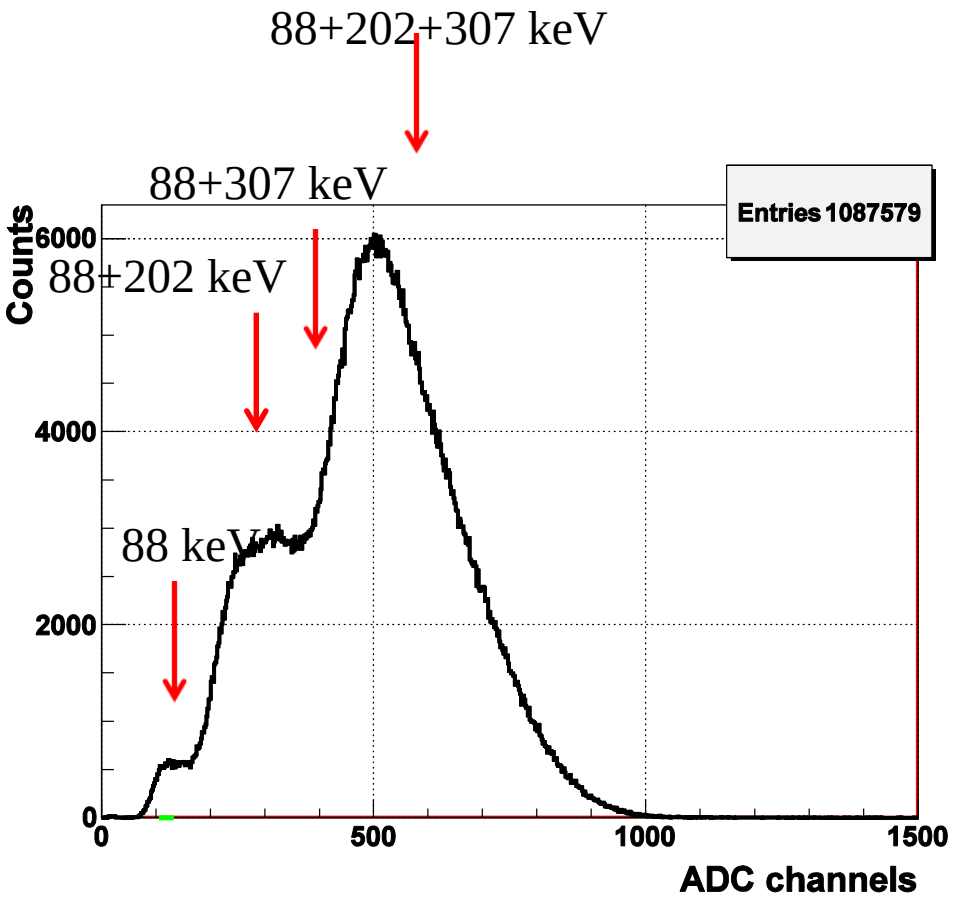
Э.-м. калориметр COMET
~2000 кристаллов 20x20x120 мм^3





LYSO intrinsic activity

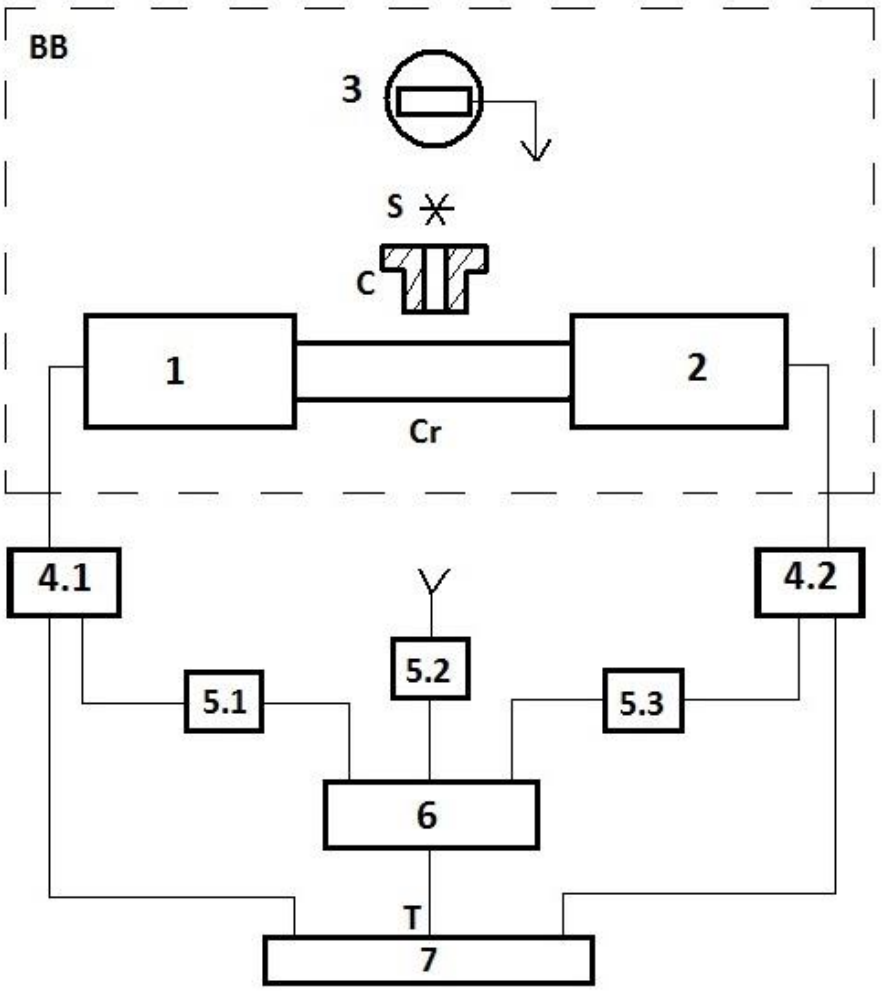




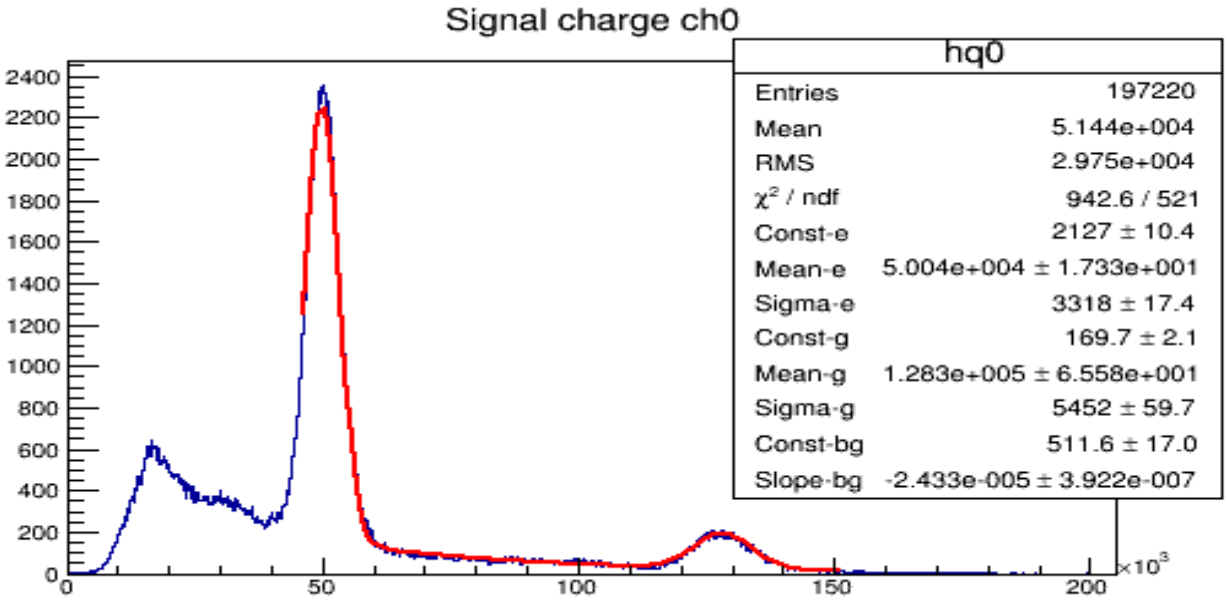
The measuring setup.

- The measuring setup consists of the PMT based optical measuring system, the precision mechanical bench for moving the radiation source, and DAQ electronics.
- The bench (produced by our shop) is in the black box (BB), the electronics from CAEN

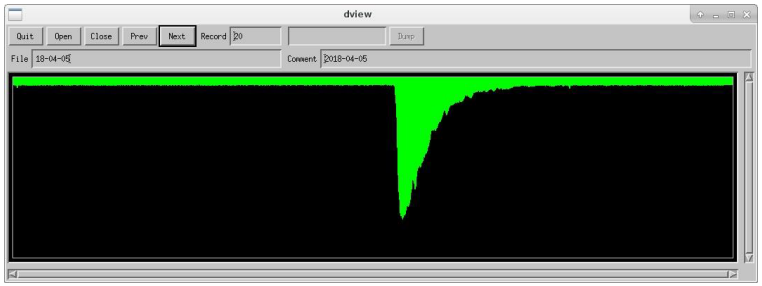
1,2 – PMT's H6410
3 – PMT FEU-85
4 – Linear FAN–IN-OUT N625
5 – Discriminator N840
6 - CC-AC N405
7 – Digitizer V1742
C – Collimator with Na-22 (S)

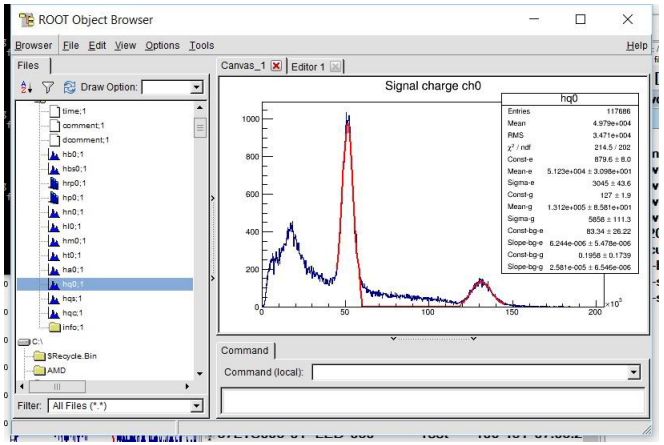


The spectrum from Na-22

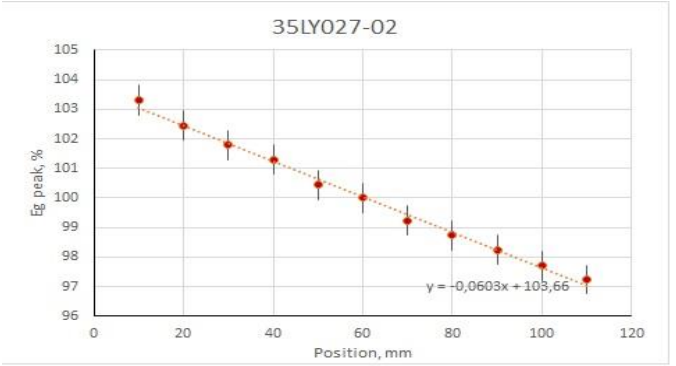


The light output and the losses of the light along the crystal length for each crystal are measured. The data for the crystals are stored in the paper and electronic formats.

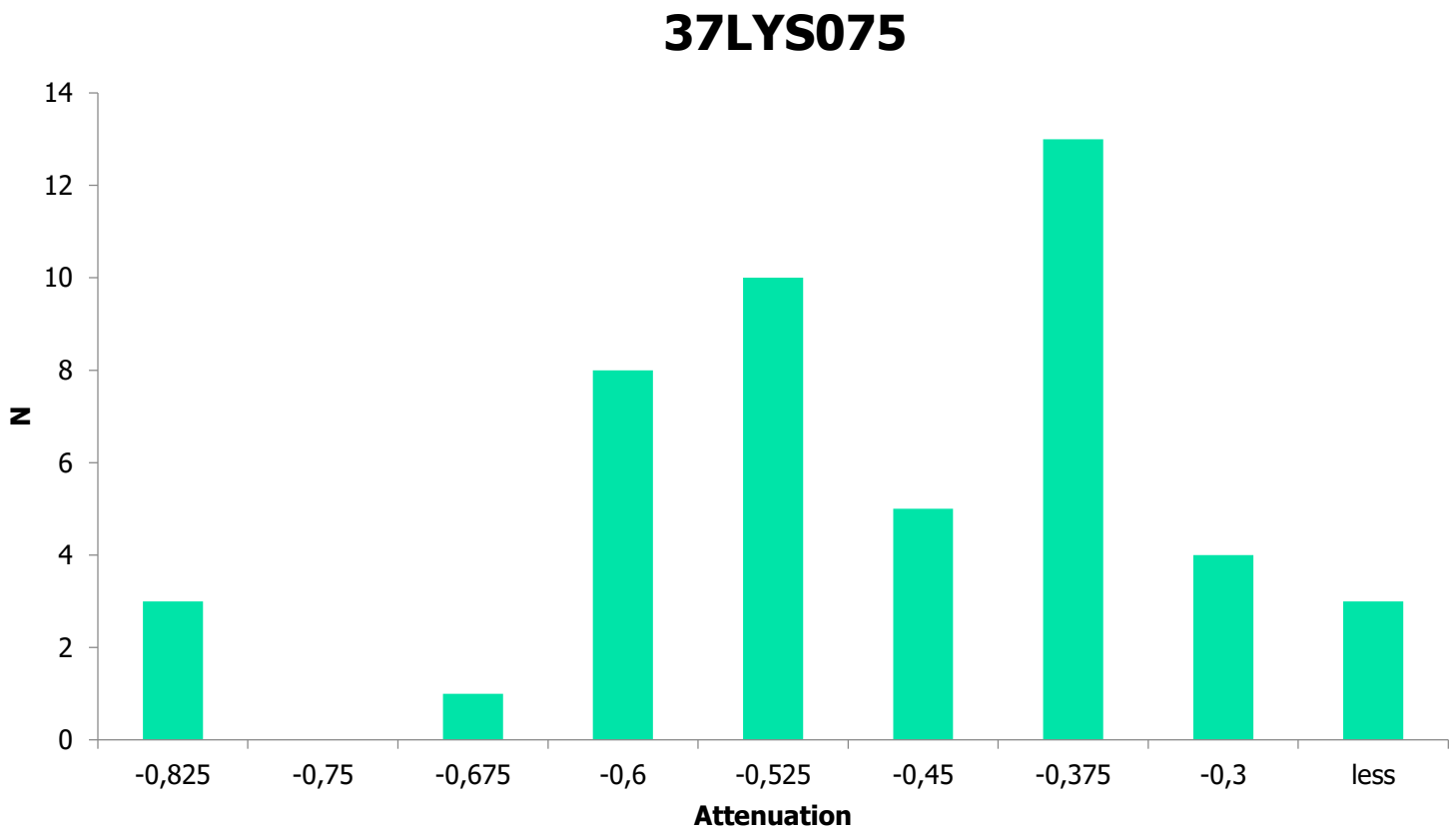




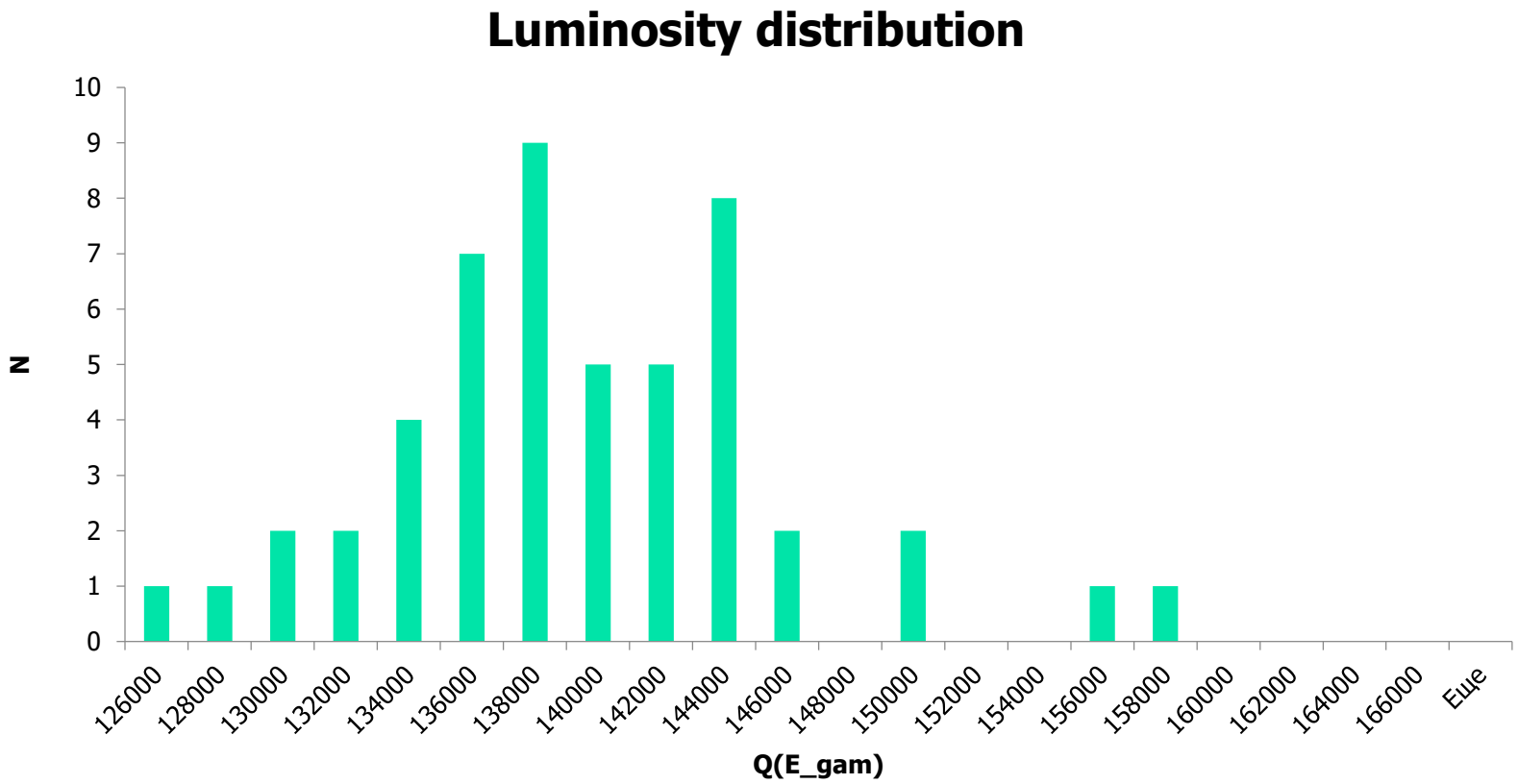
Data files



A histogram of the distribution of attenuation coefficients for one of the early batches.



A histogram of the brightness distribution.



Radiation test

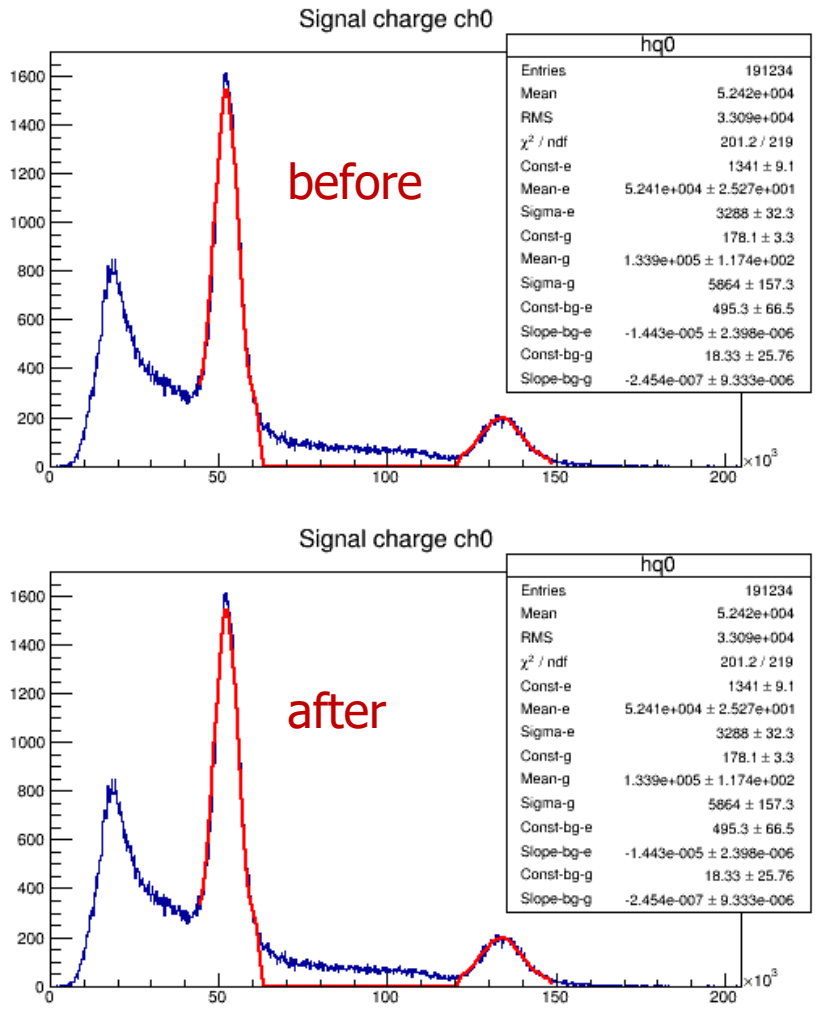
3 crystals

$6 \cdot 10^{11}$ n/cm^2

The middle crystal was cut because it had a defect in the form of the bubbles.

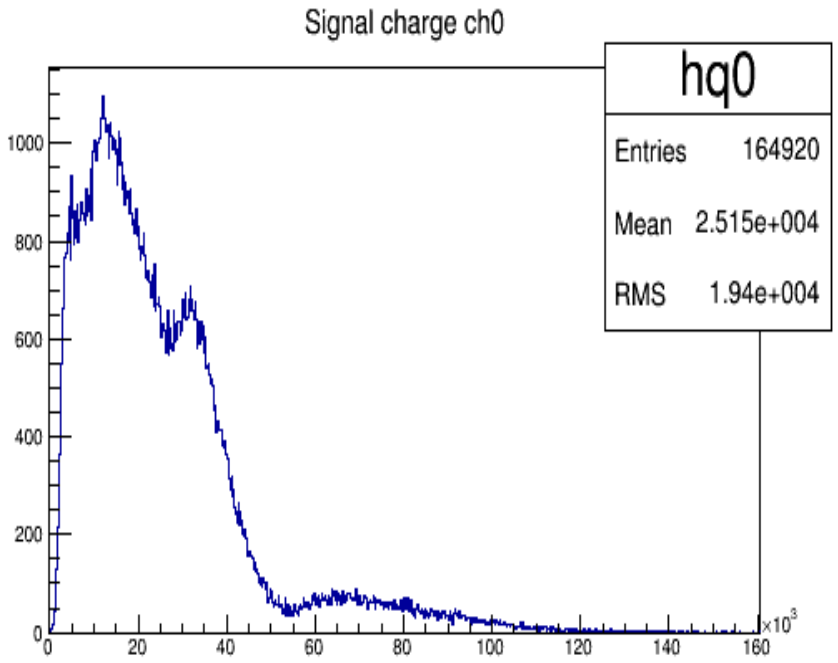
Radiation test

- Light output increased by about 1.1-1.2 times, but after 3 months returned to almost the initial value.
- Own radioactivity increased from 12 kHz to 30 kHz, but after 3 months fell to 15 kHz.



Radiation test

The increase in own activity was mainly due to low-energy particles and a small peak in the region of 0.7-0.8 MeV



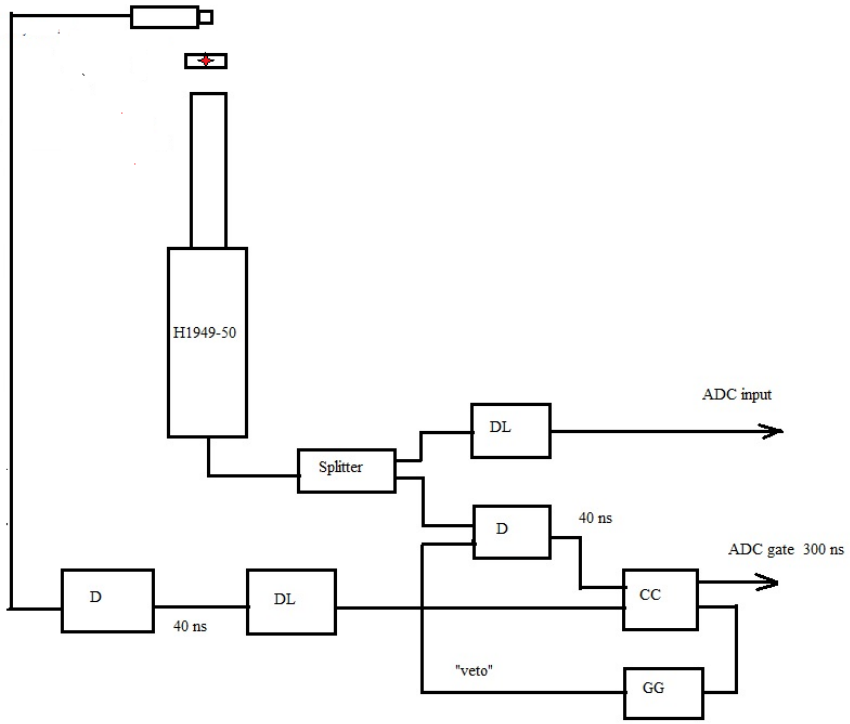
Tests of undoped CsI crystals and matrixes with an electron beam

*A. Artikov[1], N.Atanov, H. Ayvazyan[2], A. Babayan[2], V. Baranov[1], J. Budagov[1], D. Chokheli[1], **Yu.I. Davydov[1], D.Demin**, V. Glagolev[1], A. Hakobyan[2], H. Hakobyan[2], A. Simonenko[1], A. Sirunyan[2], A. Shalyugin[1], V. Tereschenko[1], H. Torosyan[1], Z. Usubov[1], H. Zohrabyan[2]*

[1] *Joint Institute for Nuclear Research, Dubna, Russia*

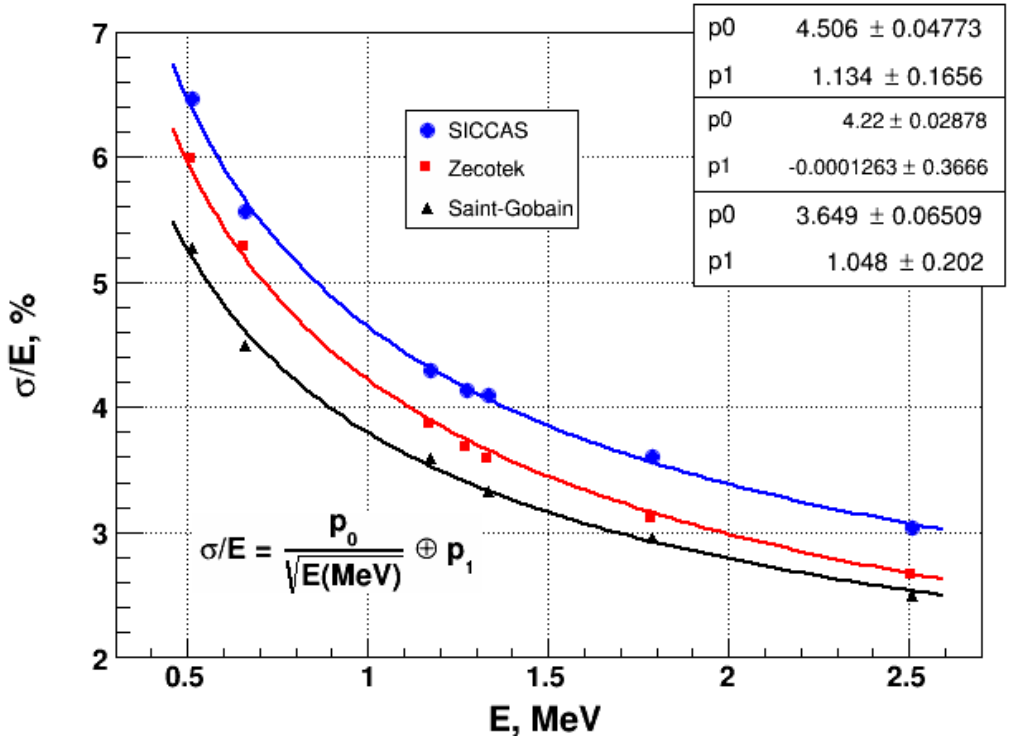
[2] *A.Alikhanyan National Laboratory, Yerevan, Armenia*

Mu2e -Energy resolution measurements



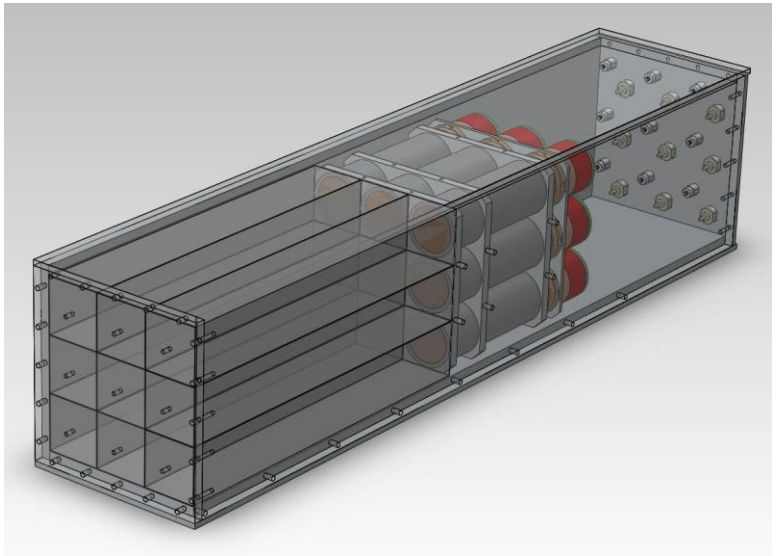
- Sources were placed over the crystals irradiating their far ends
- Data were taken in self triggering mode and in coincidence with 1 cm^3 LGSO crystal attached to Hamamatsu 5783 PMT (in the former case CC unit required a single input signal)
- ^{22}Na, ^{137}Cs and ^{60}Co gamma sources were used for all crystals irradiation

Mu2e - Energy resolution



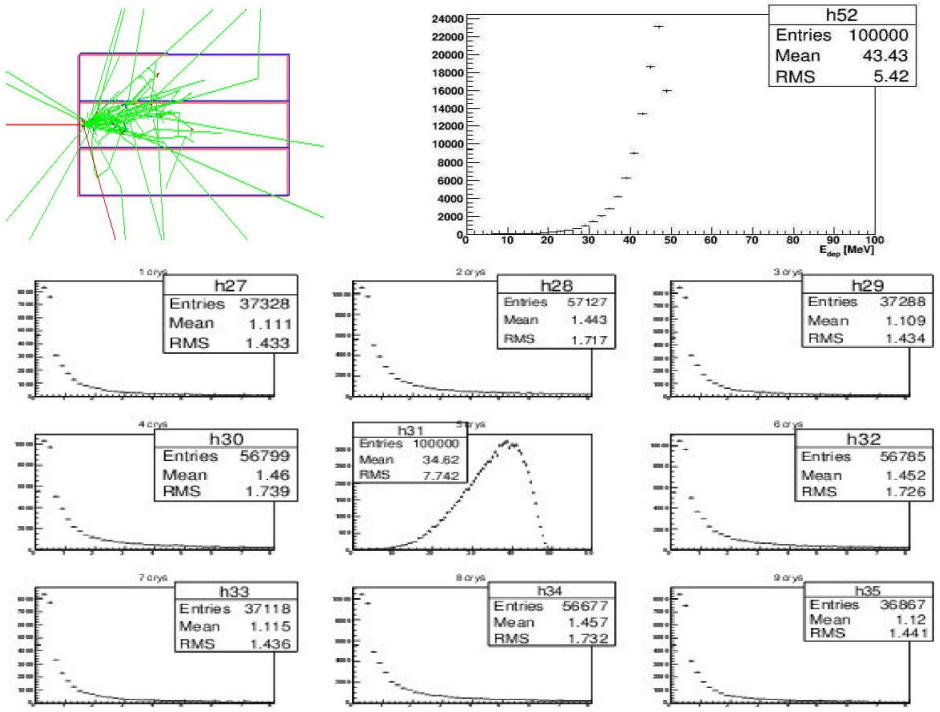
Mu2e - Test box

- 9 crystals of undoped CsI, 3x3x20 см
- Wrapped with Tywek
- Photo sensors: FEU-85



Simulated matrix response on 50 MeV e-beam

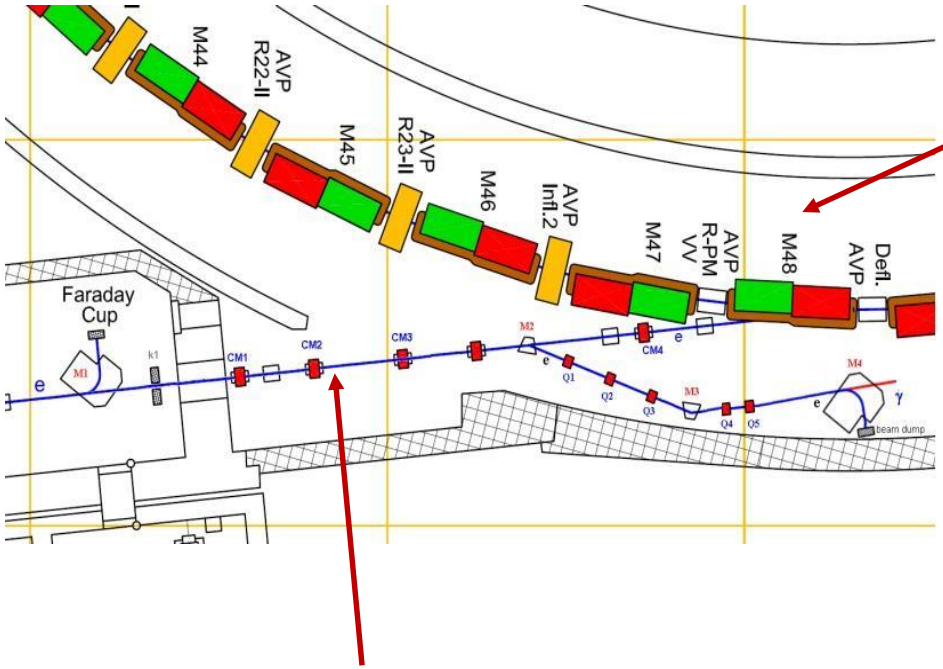
Электроны с E=50 МэВ в центр торца матрицы



Sum of all crystals

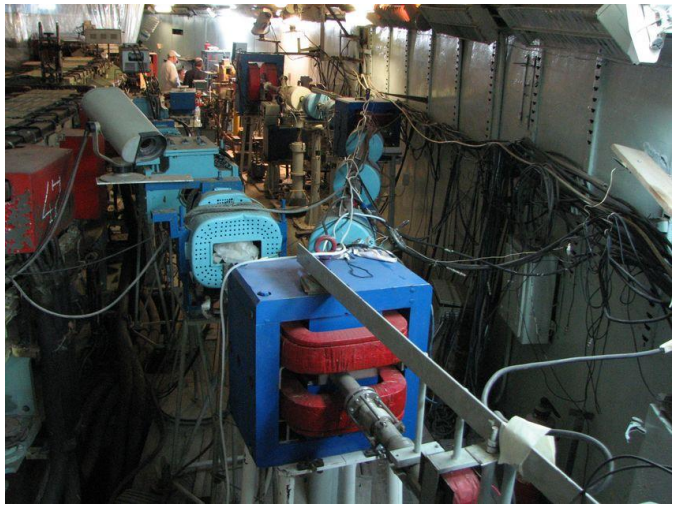
Response of each crystal on the 50 MeV electron beam pinging in the matrix center

LINAC of Yerevan Physics Institute (Armenia)
10 – 75 MeV, I<10 mkA



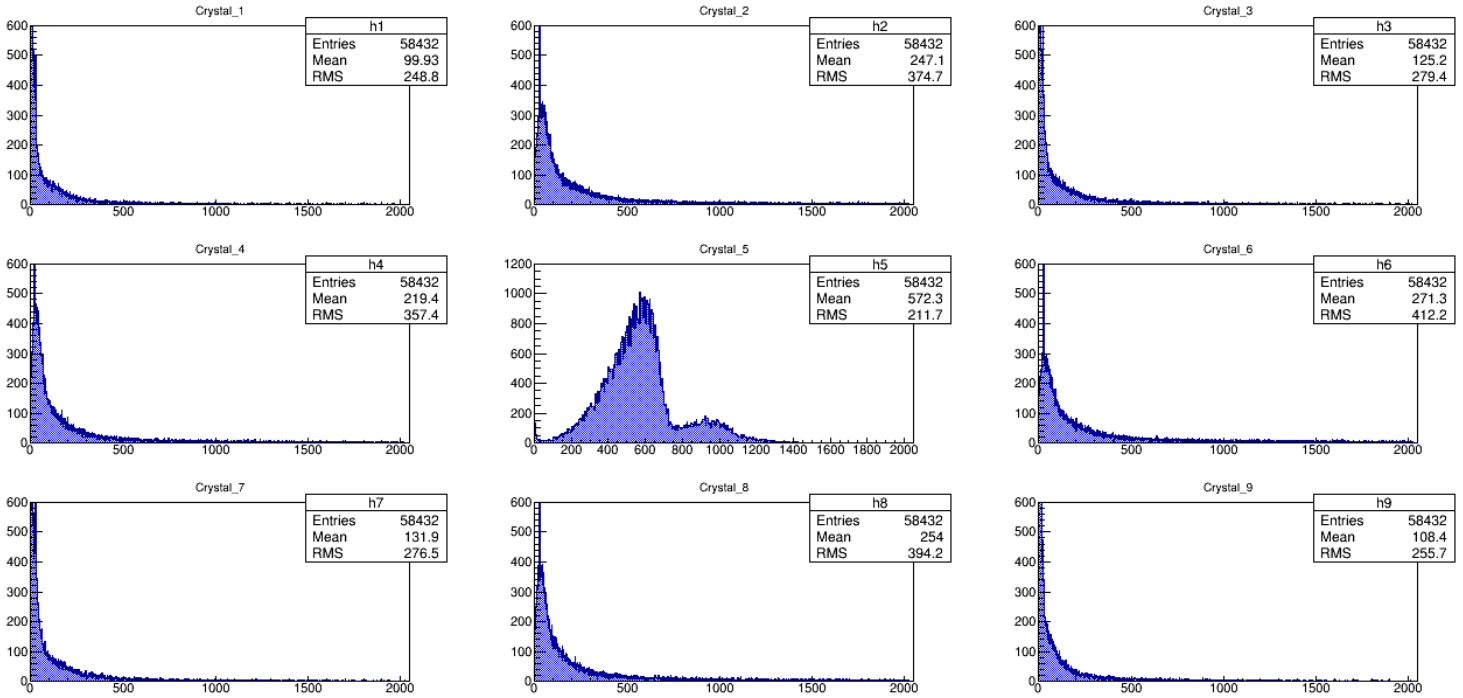
Electron synchrotron ARUS, up to 6 GeV

Linac LUE-75

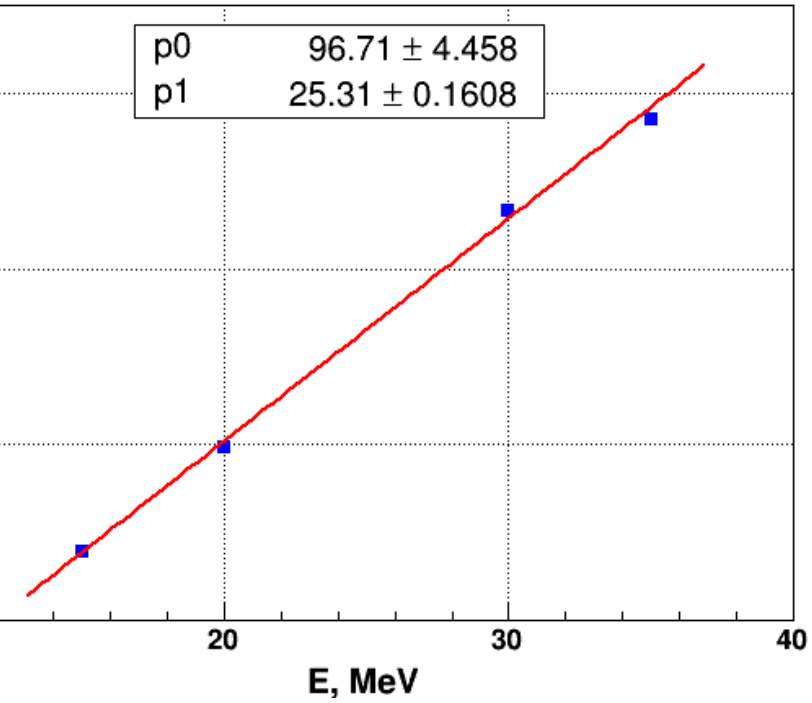


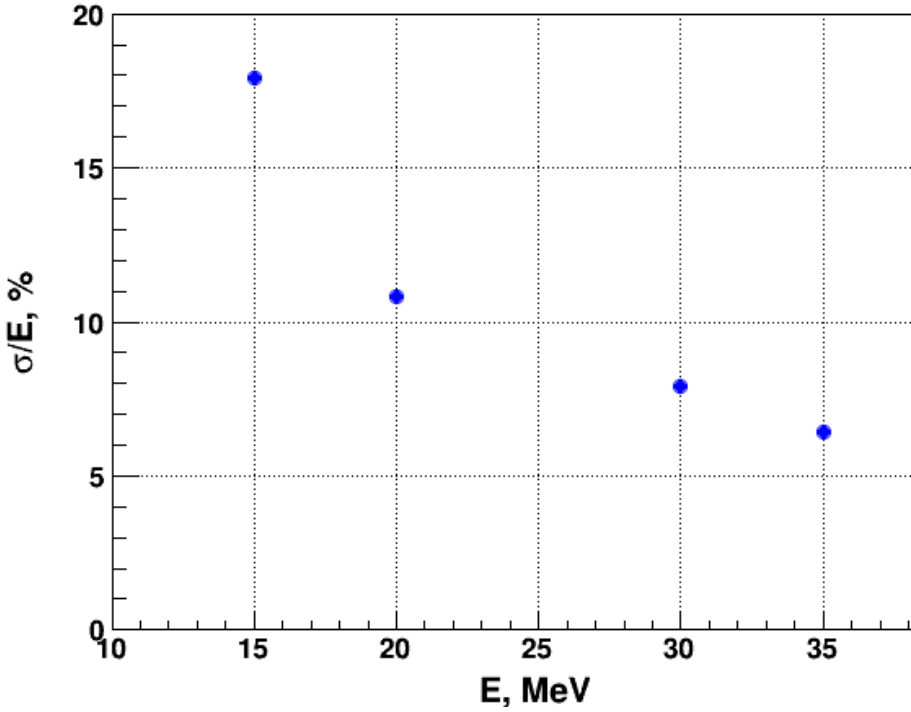
35 MeV beam

Individual crystals response on 35 MeV beam (raw data)

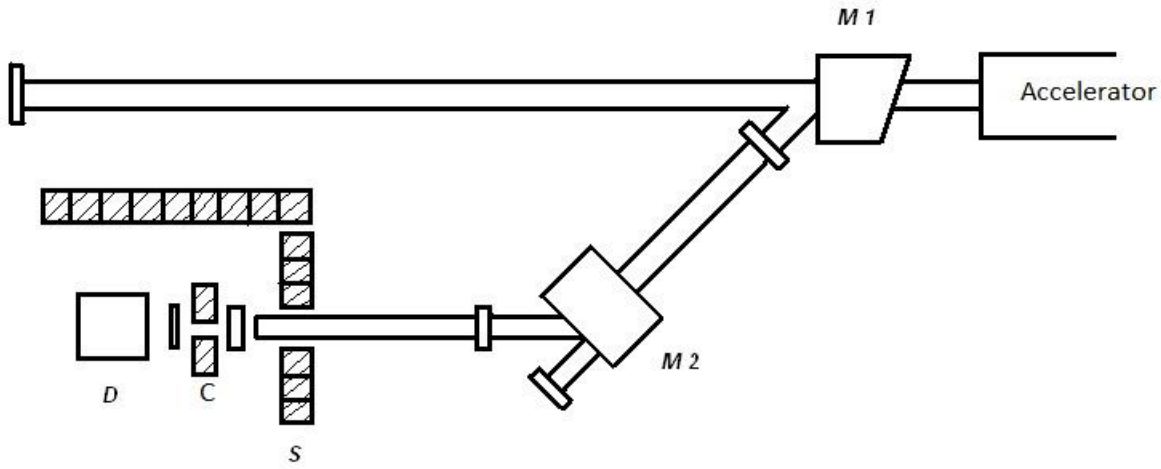


Linearity and energy resolution





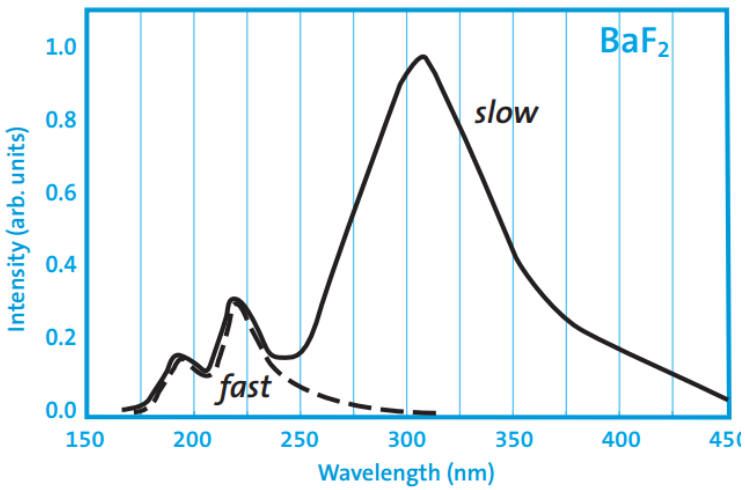
Электронный ускоритель ЛУЭ-800 (118 корп ЛЯП)



ЛУЭ-800

до 200 МэВ, ΔE/E≈10%, F ~ 10 Гц, I ~ 100 мкА

BaF_2 scintillators for the Mu2e electromagnetic calorimeter



Stage II. **BaF_2** scintillators

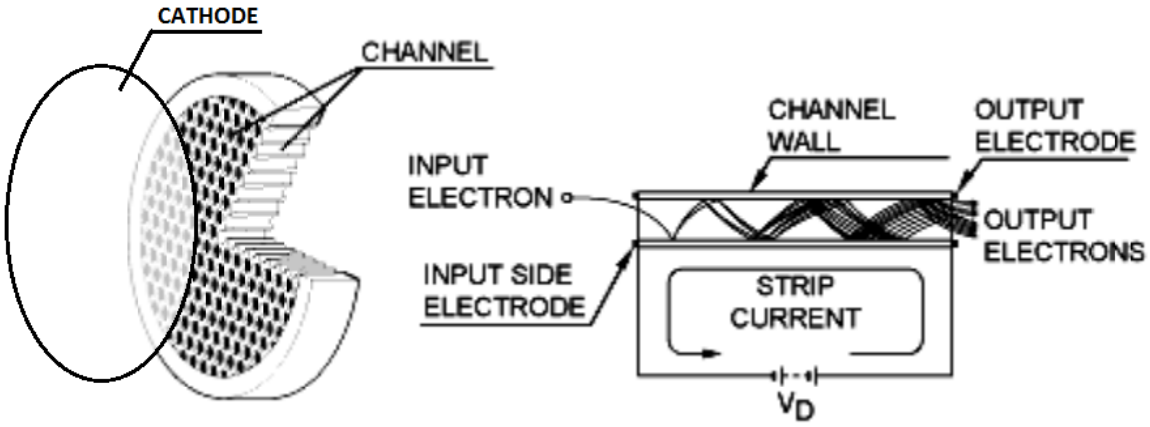
emission peaks fast ~220 nm, slow ~310 nm
decay time 0.8 ns (fast), 600 ns (slow)
radiation hardness up to 10 Mrad*

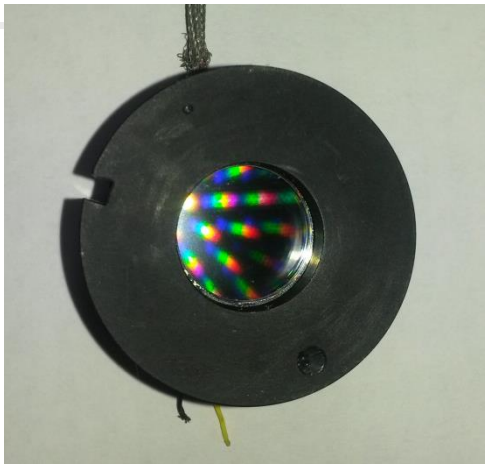
BaF2 scintillation crystalls for Mu2e calorimeter from different vendors. Sizes are 3x3x15 cm

*for Saint-Gobain BaF_2 crystals

Fast component of BaF_2 is emmited in UVC (< 280 nm) range. To achive greate time resolution one need to suppres slow component (250-400 nm) and select fast component (170-250 nm) → the challenge is to get suitable photodetector.

Photomultiplier based on microchannel plate (MCP) with AlGaN-based photocathodes with a negative electron affinity

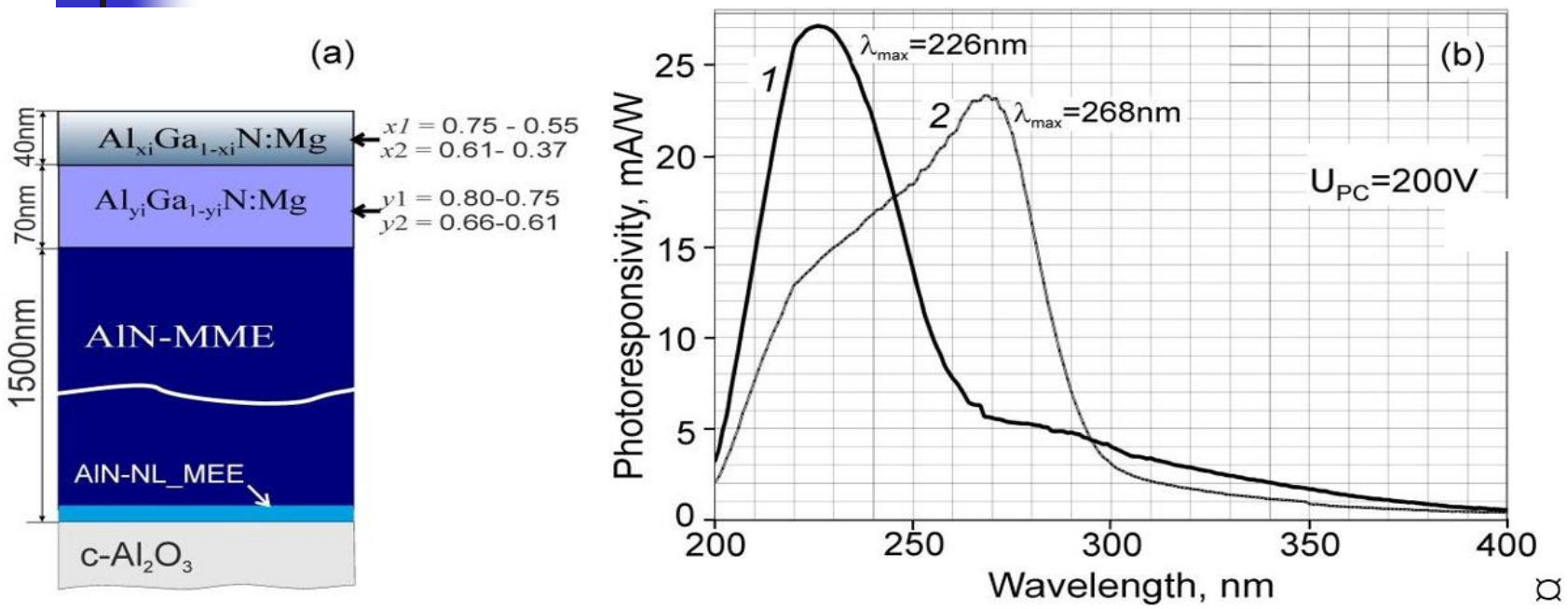




MCP consists of a two-dimensional periodic array of very-small diameter glass capillaries (channels) fused together and sliced in a thin plate. A single incident particle enters a channel and emits an electron from the channel wall.

AlGaN photocathodes with 320 & 260 nm long-wavelength edges were combined with MCP in a single device with 18 mm window diameter.

UV cathodes. MBE production method. MCP device spectrum sensivity



Good spectral range, but high dark noise at level 1 uA. **One need 2-3 more production iterations to eliminate noise and complete this device.**