Bortko Lucia Yurievna

Education :

2005–2012 National Research Nuclear University "MEPhI"
Department «The experimental nuclear and microparticle physics, and physics of near and far space»
Qualifications engineer-physicist

Main research topics :

- Experimental research of possibility of making Compton gamma camera for nuclear medicine (Presented at the Scientific Session of MEPhI February 2012)

- Assembling and adjustment of apparatus for “Analysis of the abilities of the gamma spectrum apparatus” laboratory work

- Work with different scintillation, Xe and CZT detectors, with NIM and CAMAC electronics, with radioactive sources

Additionally:

C++ programming language(acquainted)
Experience with OS : Linux, Windows
Experience with data processing :MS word processing and spreadsheets; analysis package Origin
Particular radionuclide diagnostics(acquainted)

Experience:

02.2008- to present Physico-Technical College

The teacher on mathematics and physics
- preparation for Uniform Graduation Examination, receipt in Institutes

The teacher of courses of development of memory and fast reading

Assistant Administrator
-assistance in the organization of work of the educational center, registration of the contracts, communication with clients

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Lucia Bortko

National Research Nuclear University "MEPhI"

Department of Theoretical and Experimental Physics

The subject of study:

«EXPERIMENTAL RESEARCH OF THE POSSIBILITY OF MAKING COMPTON GAMMA CAMERA FOR NUCLEAR MEDICINE»

Moscow 2012

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SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY(SPECT)

- SPECT– is a nuclear medicine tomographic technique using single gamma ray from the radioisotopes for imaging.

- This technique gives cross-sectional slices through the patient showing the distribution of a radiopharmaceutical in the tissues and blood flow.

- SPECT allows to examine anomalies in organ's functioning, to diagnose oncological diseases at an early stage and to analyze the heart's blood flow.

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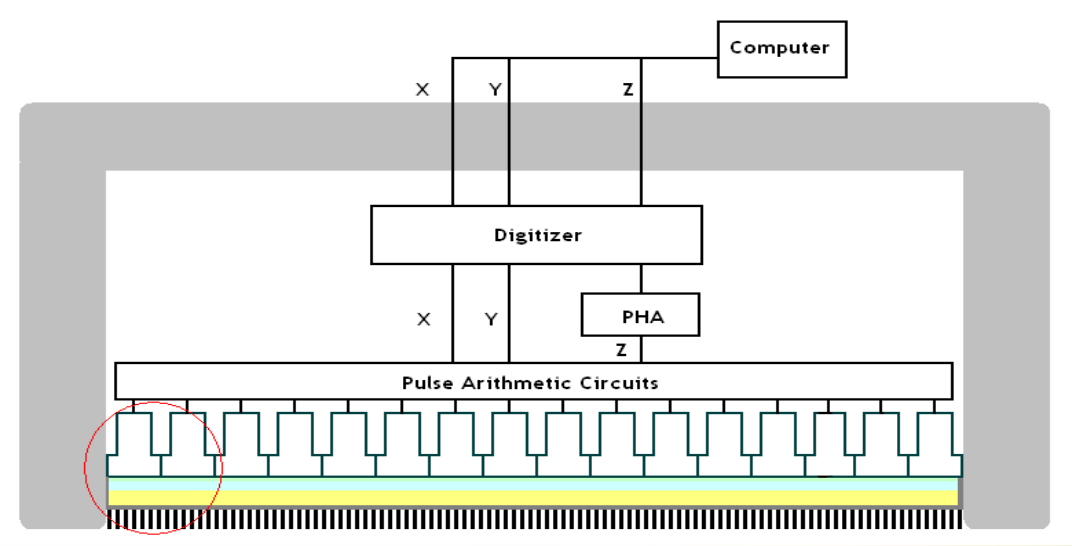
Gamma camera

- Gamma camera - one of the most widespread device for radionuclide diagnostics.



Includes collimators, plane scintillator, set of photoelectronic multipliers.

- To determine the direction of the detected gamma rays we have to use a collimation system
- Principal disadvantage – low light-gathering power.

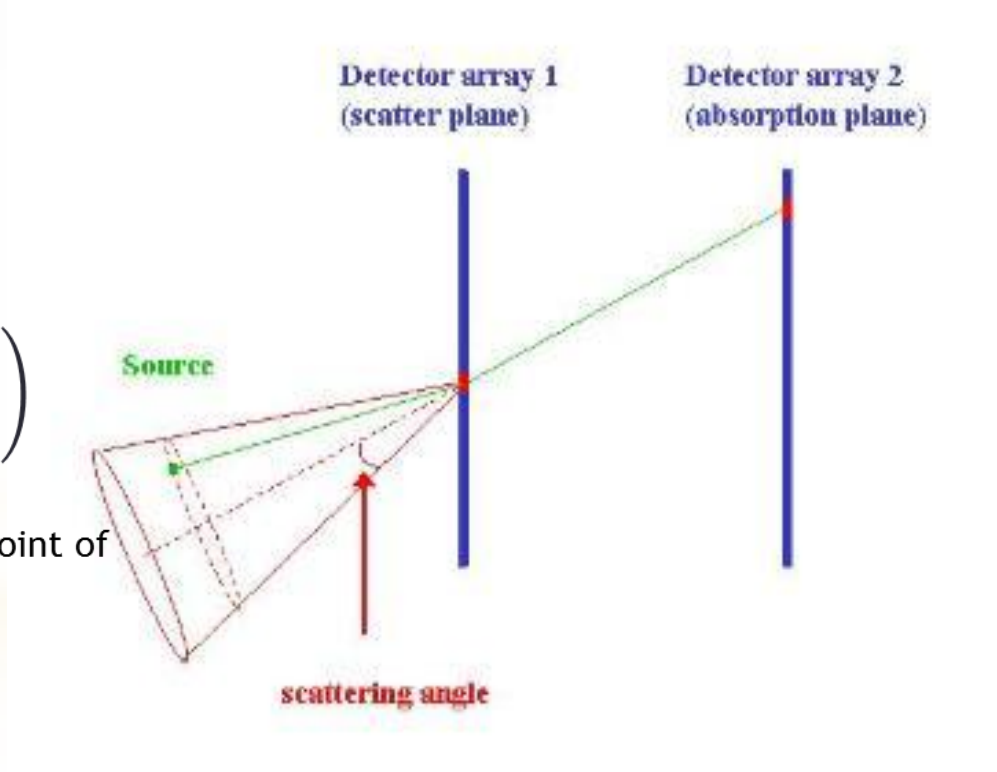
Compton gamma camera

- The proposal is to replace the mechanical collimator with the "electronic" one.
- The event is a pair of interactions– Compton scattering and photoabsorption recorded in coincidence.

The half-cone angle is determined from $E_a = \frac{E}{1+\frac{E}{m_e c^2}(1-\cos\theta)}$ by the following equation.

$$\Theta = arccos\left(1 - m_e c^2\left(\frac{1}{E_a} - \frac{1}{E_a+E_s}\right)\right)$$

there $E = E_s + E_a$, E_s - energy release in the point of compton scattering, E_a - energy released in the photoabsorption point



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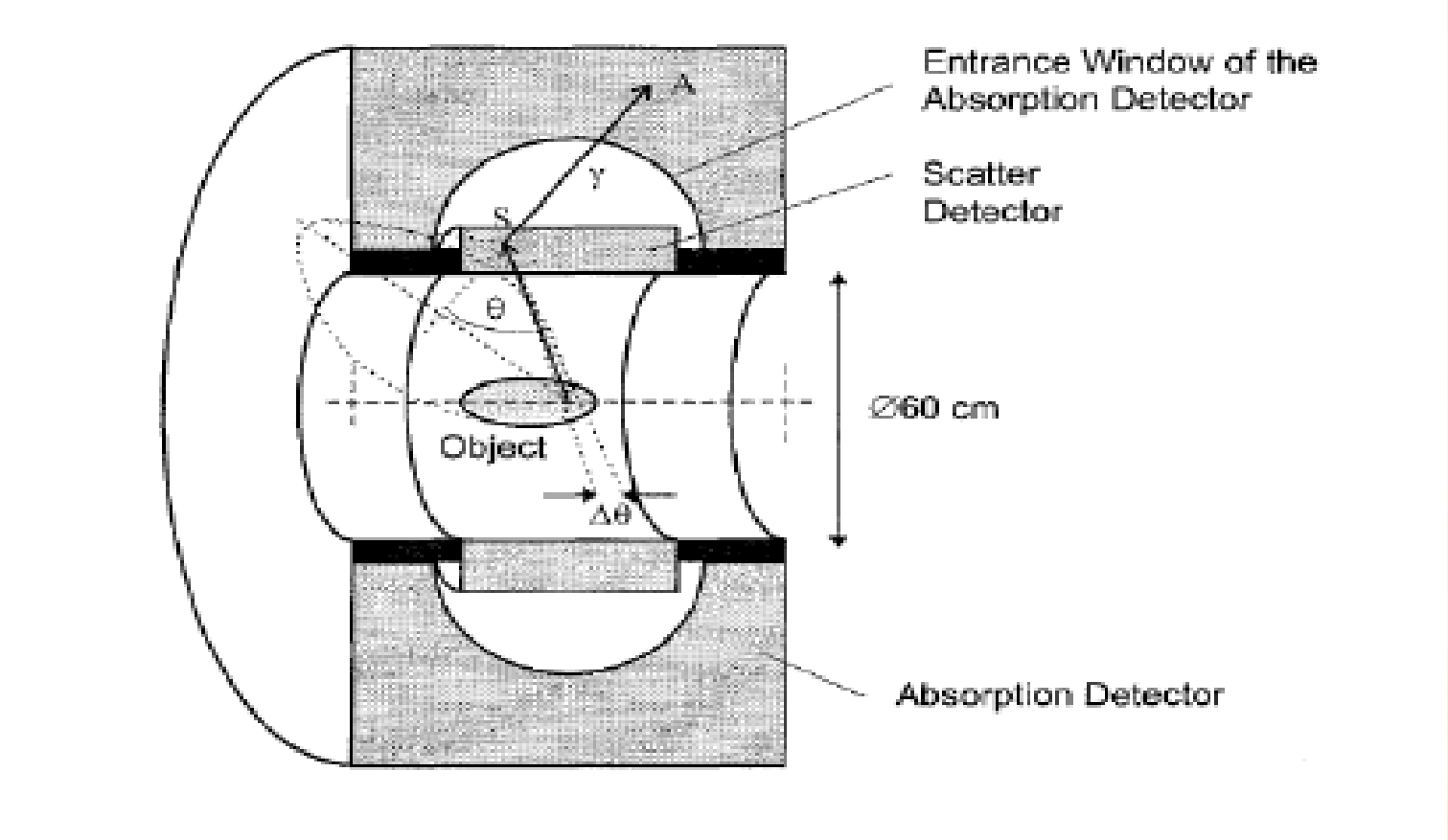
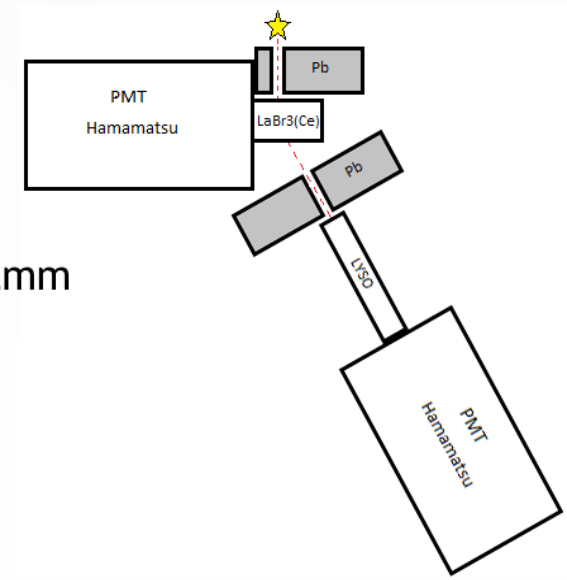
CONCEPT OF THE CYLINDIRAL GAMMA CAMERA FOR SPECT

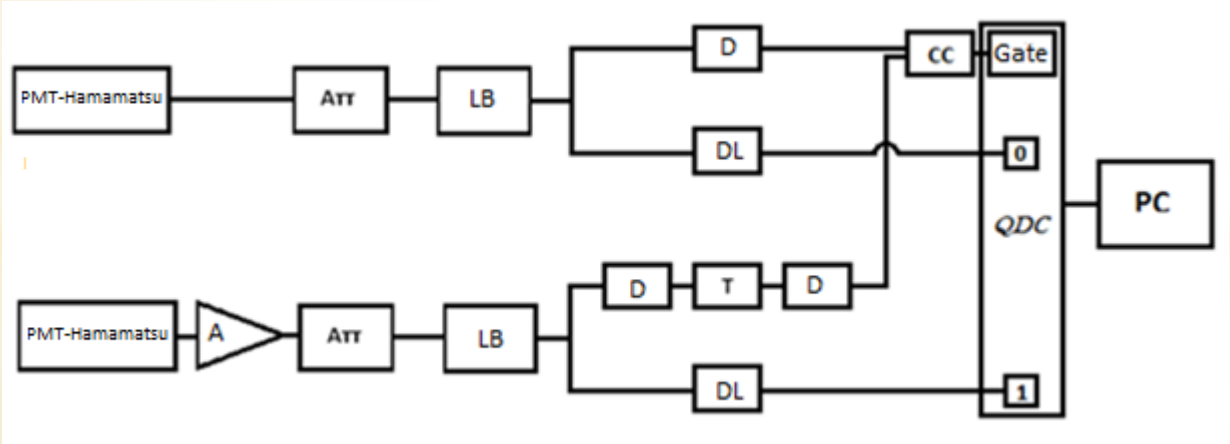


- To achieve the maximum luminosity, the ideal Compton camera should circle the patient, that is have form of a hollow cylinder.

Experimental apparatus

Source: Cs-137
Lead screens : thickness 8мм, holes Ø2mm
$LaBr_3$:(Ce): Ø5mm, length 6mm,
en.res. 8%(662keV)
LYSO: 4x4x20mm, en.res. 12% (662keV)





- <u>Coincidence circuit</u>

A-amplifier,
Att-attenuator,
LB-line branching,
D-discriminator,
DL-delay line,
T-timer,
CC-coincidence circuit,
0,1-analog input
Lecroy - 2246(QDC)

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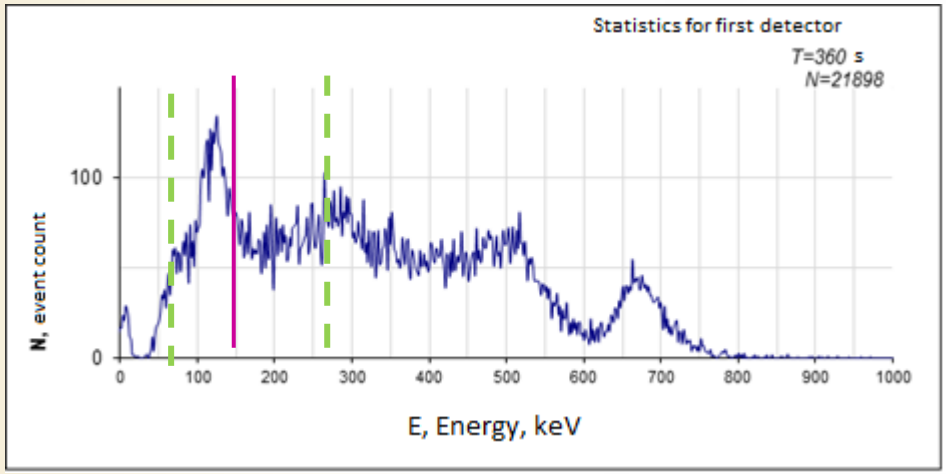
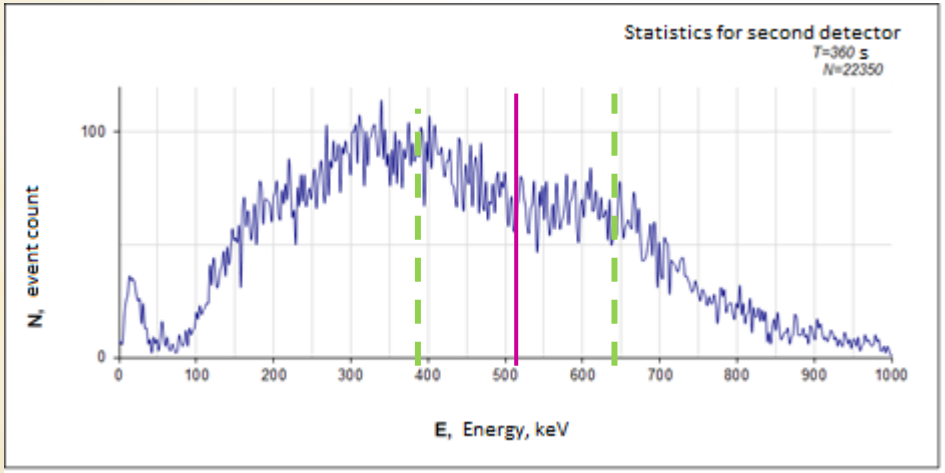
MEASUREMENT





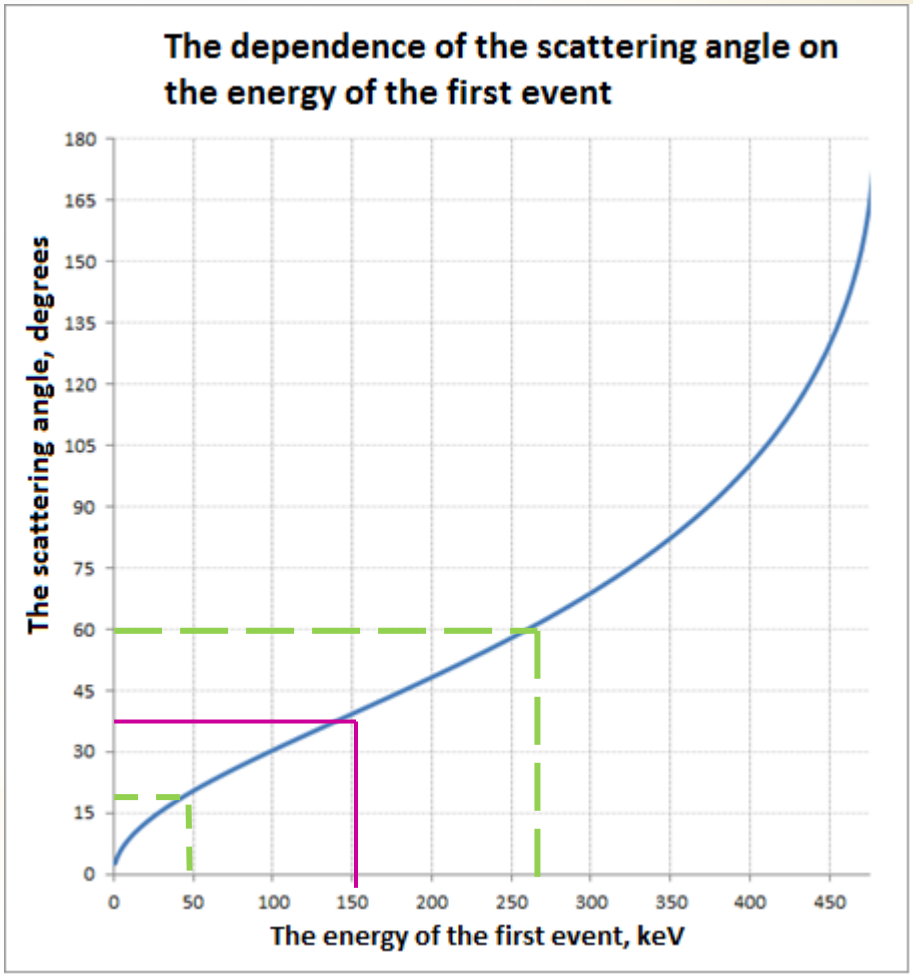


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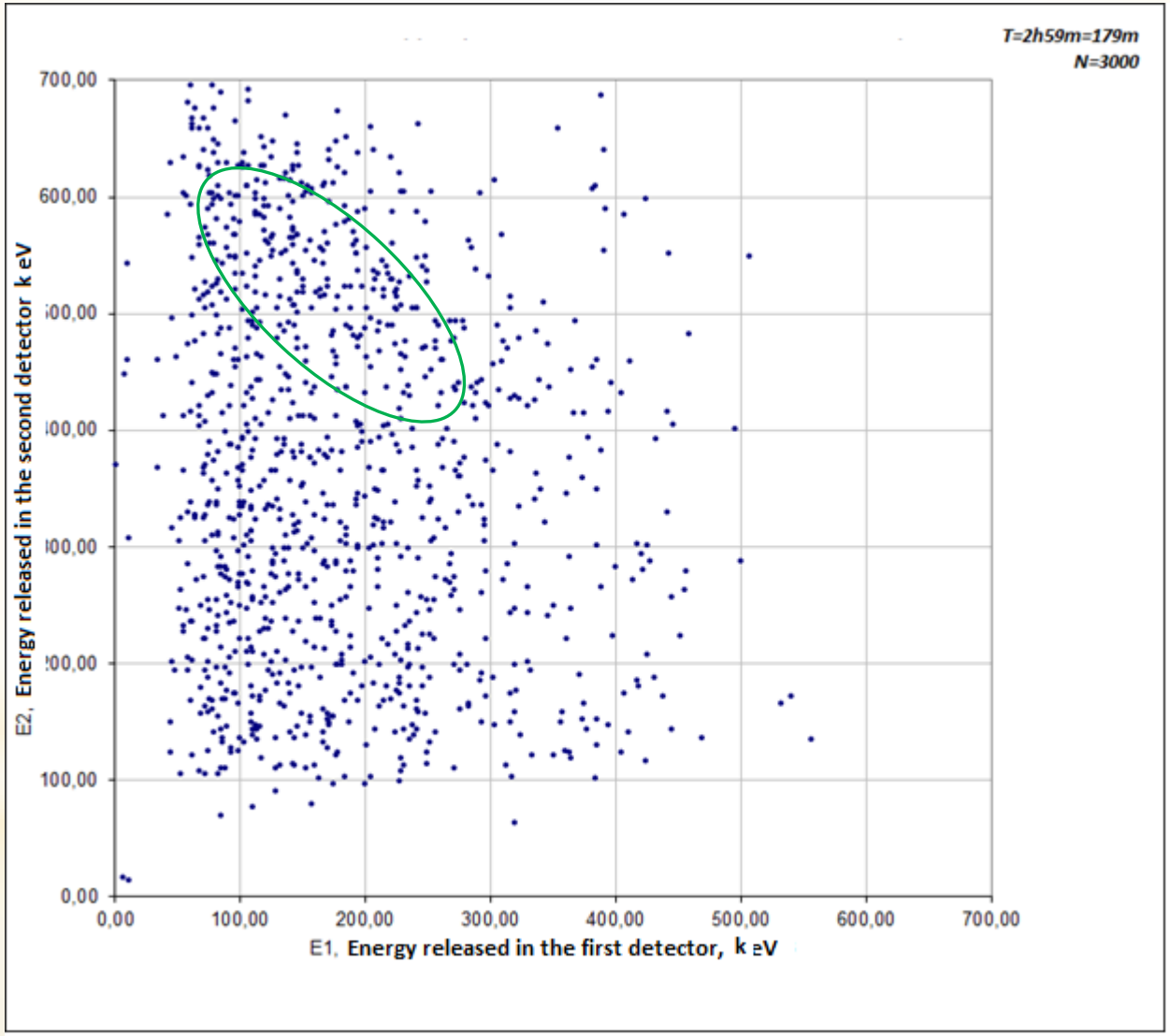
DIAGRAM OF THE COINCIDENCE



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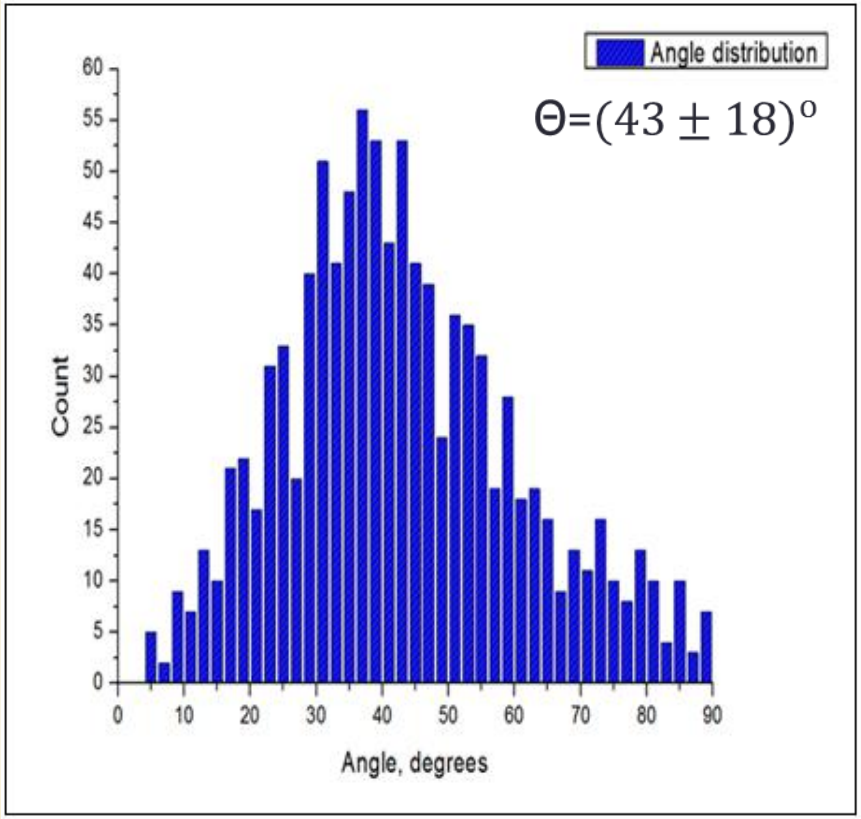
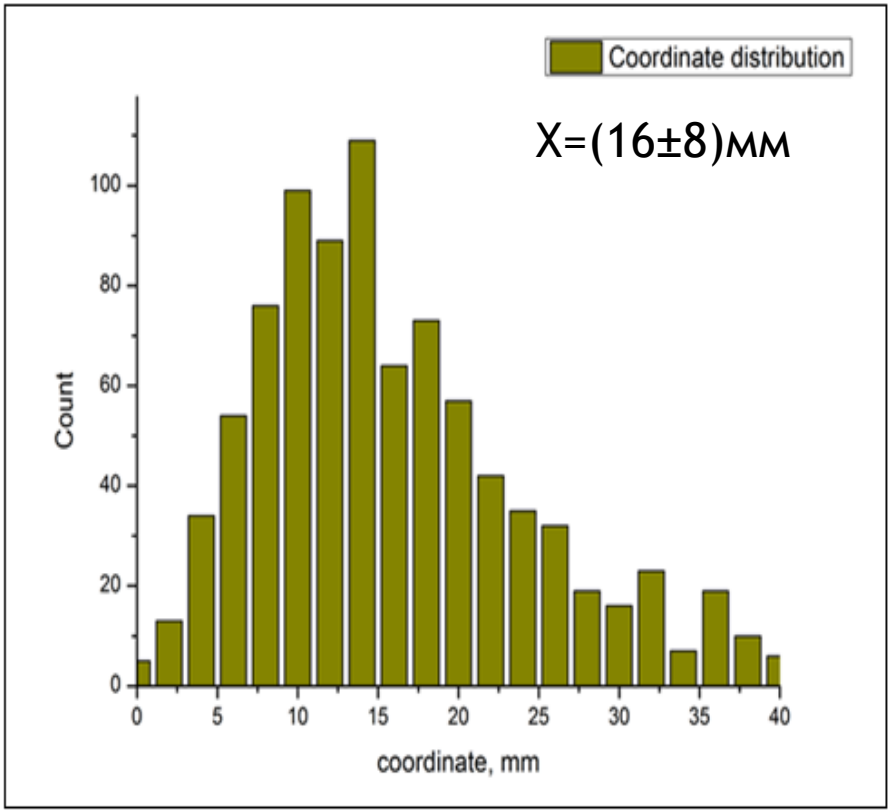
THE RESULTS OF MEASUREMENTS





<u>As a result of carrying out experiment the following tasks were solved:</u>

1. *The model of the stand and the electronics for future researches of creation the Compton detector on the basis of gas detectors and SiPM are worked out;*
2. *Skills of work are acquisitioned;*
3. *Comparison of experimental results with the mathematical modeling (which will be submitted further) is carried out.*
4. *For the given geometry the expected results were received.*

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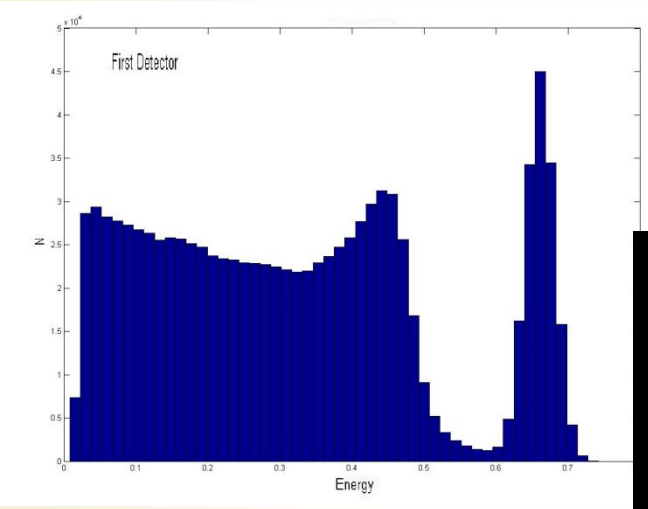
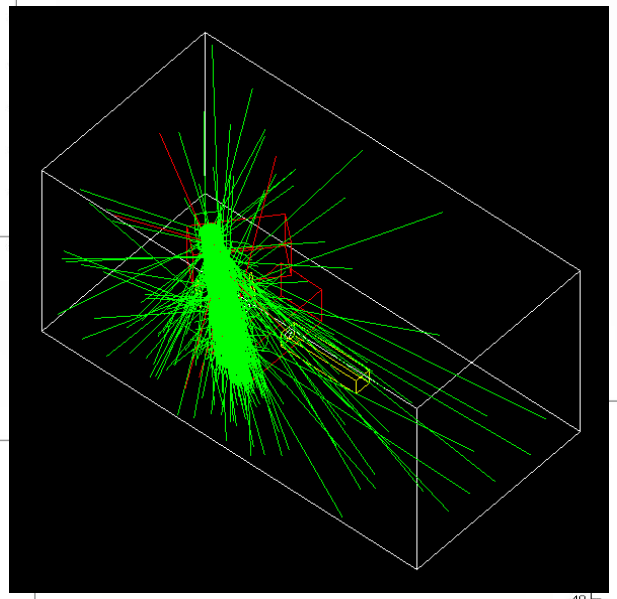
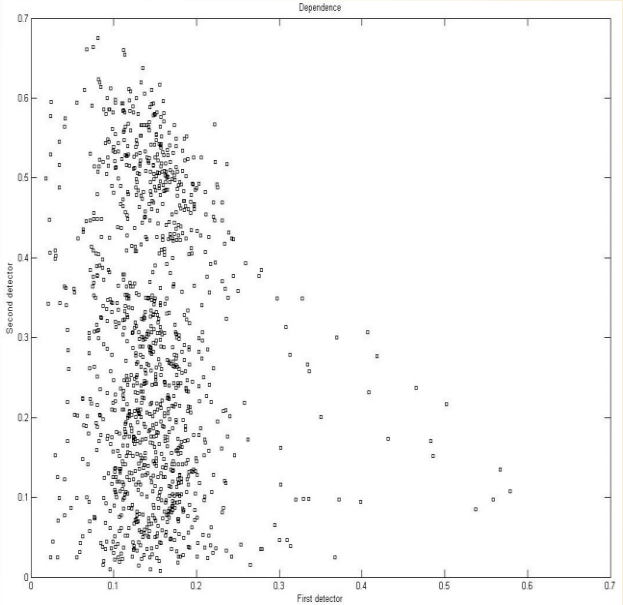
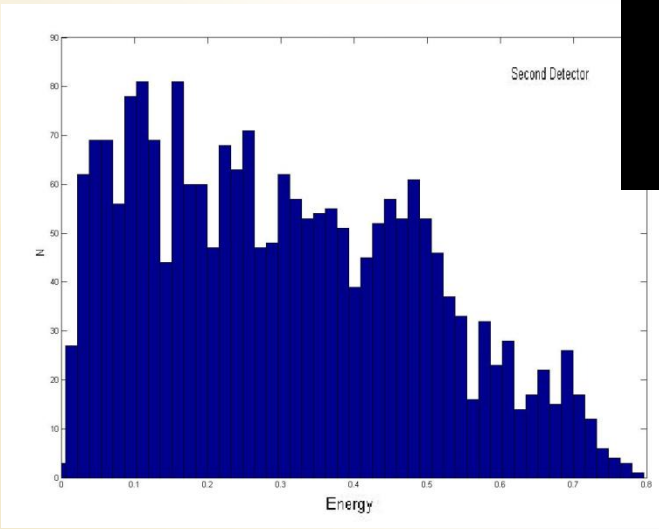
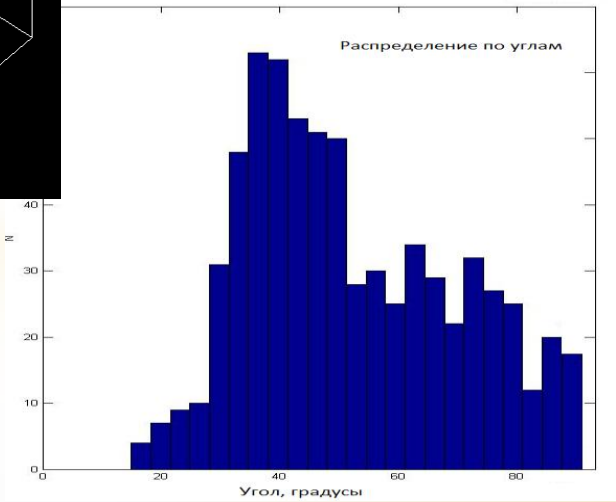
Modeling in Gate/Geant4











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CONCLUSION

- The principles of the operation of the Compton gamma camera was studied. The installation model for methodical studying of correlations of a Compton scattering and a photoabsorption was assembled. The scattering angle and source coordinate were calculated.

- The experimental data received on the model of the Compton detector are in agreement with the results of mathematical modeling.

- All the main results of the research paper were reported at the Scientific Session of Moscow Engineering Physics Institute NRNU.

Thank you for your attention!

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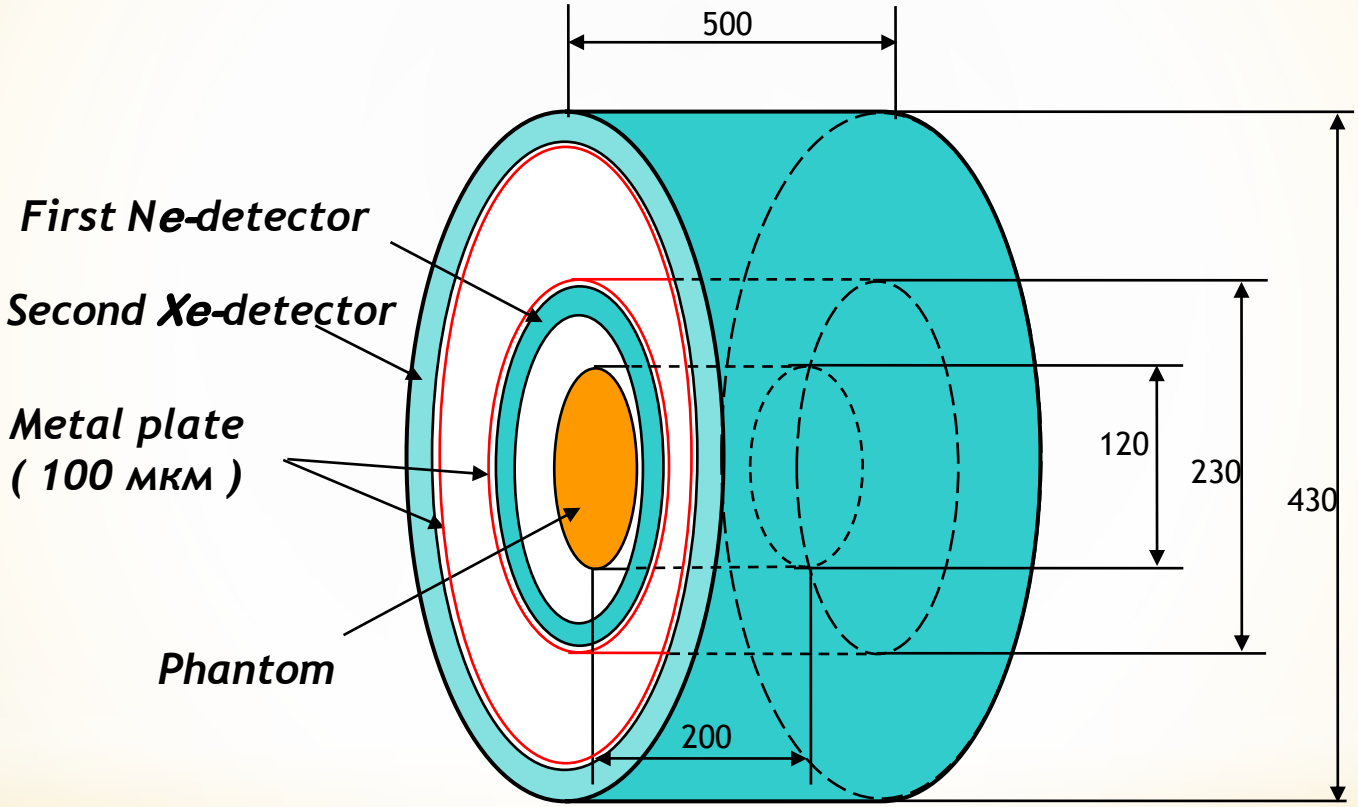
Modeling of the cylindrical gamma detector in Gate/Geant4



The model of the camera represents two concentric cylinders, filled with Ne and Xe gas under pressure. Inside there is a phantom consisting of water and in the center of it there is the monodirectional source of Tc-99 (140keV).

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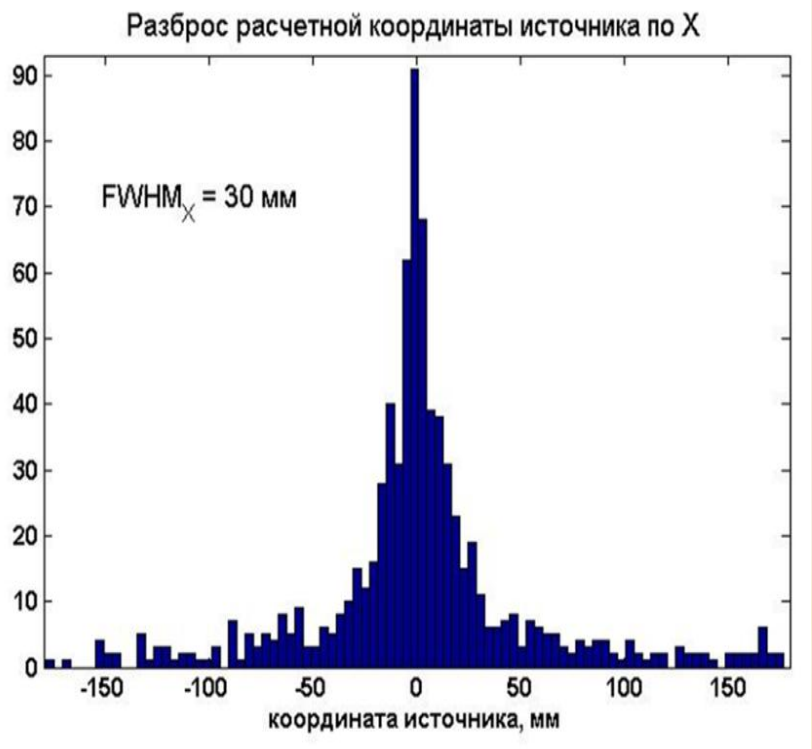
Modeling results



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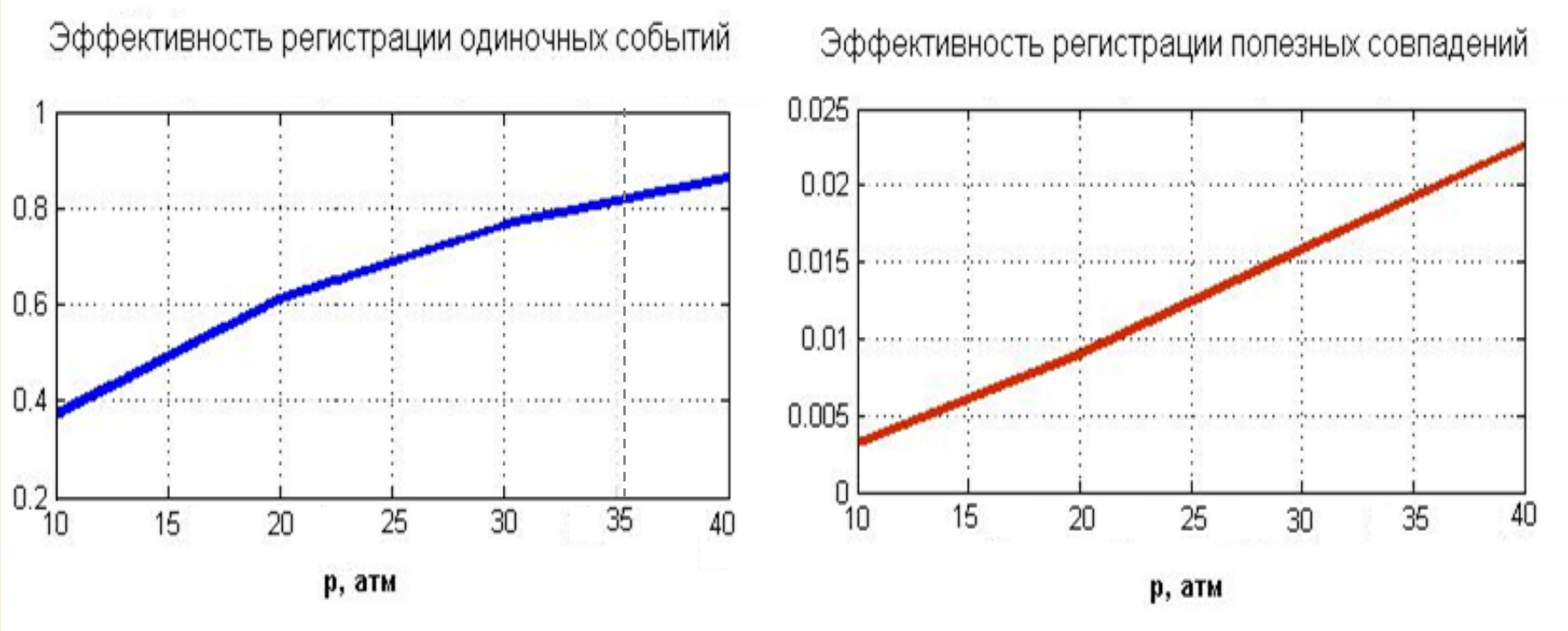
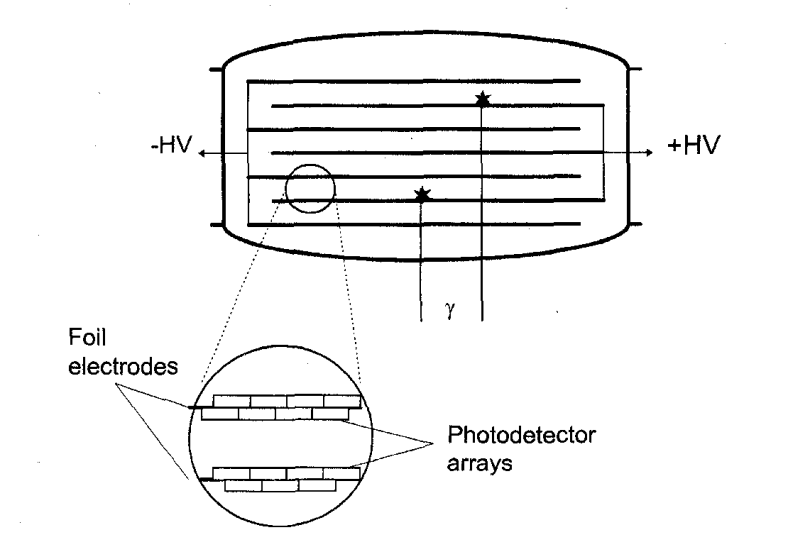
Efficiency of the compton detector

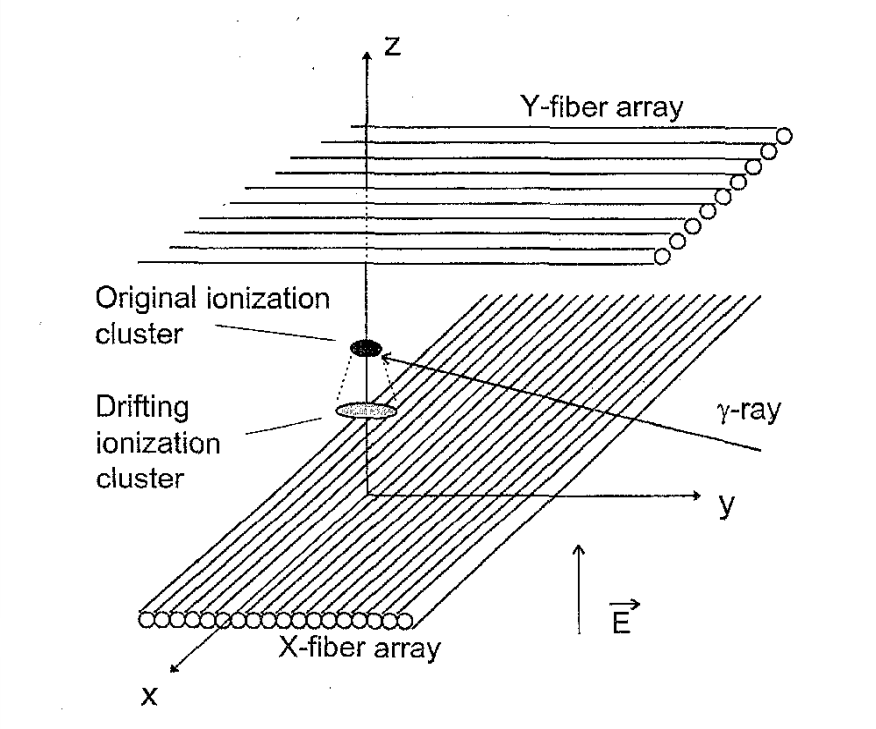


Common gamma camera's efficiency is about ten's in minus fourth order of magnitude. As it seen from this picture than the gas pressure about 20 atmospheres the efficiency is two orders higher.

Multilayer electroluminescence camera



Схематическая конструкция МЭЛК



Схематическое изображение одного слоя МЭЛК

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