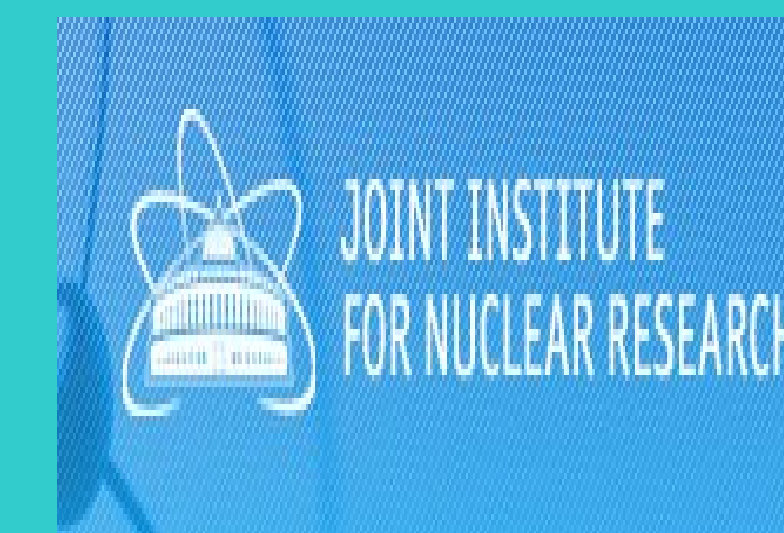




ISINN-20
International Seminar on Interaction of Neutron with Nuclear
Alushta, Ukraine, May 21-26, 2012

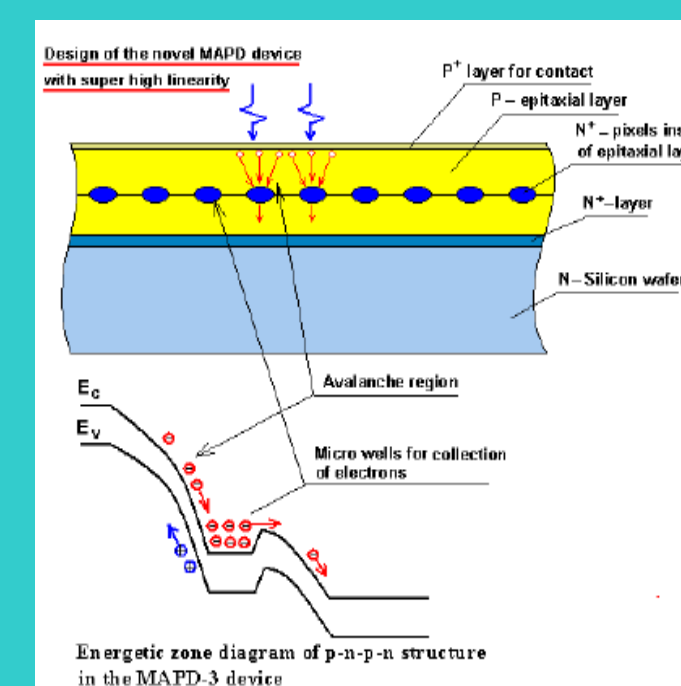


SILICON MICRO-PIXELS AVALANCHE PHOTODIODES AND SCINTILLATION
DETECTORS

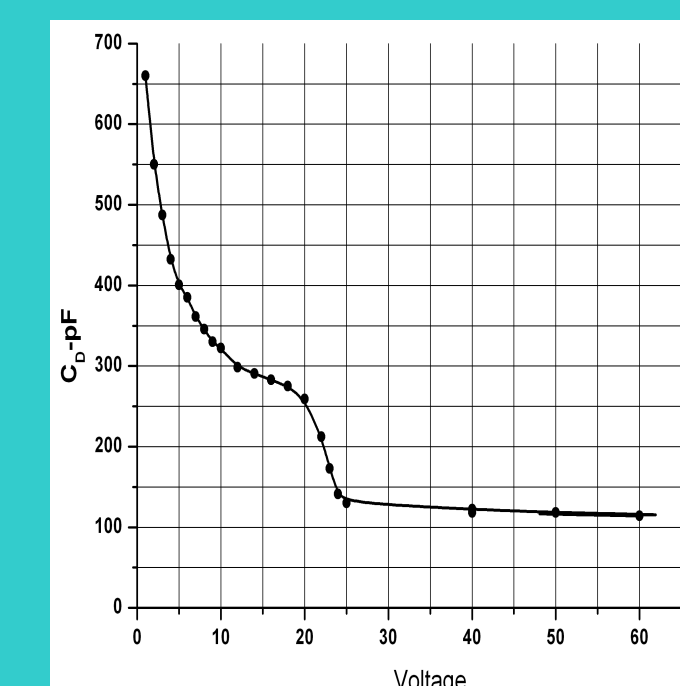
Ahmadov. F^{1,3}, Ahmadov. G^{1,3}, Kopatch. Yu¹, Madatov. R³, Sadygov. Z^{1,2}, Shvetsov. V¹, Tiutiunnikov. S¹, Titov. A⁴, Zhezher. V¹

¹ - Joint Institute for Nuclear Research, Joliot-Curie 6, 141980 Dubna, Russia, ² - Institute of Physics-ANAS, H. Javid 33, AZ-1143 Baku, Azerbaijan, ³ - Institute of Radiation Problems-ANAS, B. Vaxabzade 9, AZ-1143 Baku, Azerbaijan, ⁴ - The Federal State Unitary Enterprise All-Russia Research Institute of Automatics, ul. Sushchevskaya, Moscow 127055, Russia

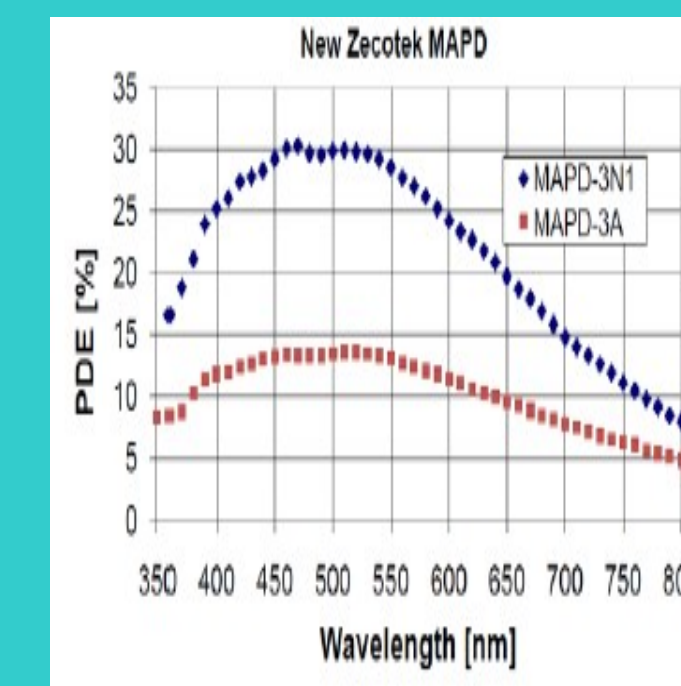
In this work the performance of new generation Micro-Pixel Avalanche Photodiode (MAPD) is described. Micro-pixel avalanche photodiode manufactured by Zecotek Photonics Inc. Micro-Pixel Avalanche Photodiode has the following features: gain can reach values of 10^5 , photon detection efficiency is 30-35 % in a wide wavelength range and pixels density is 15000pixels/mm². We report the results of gamma-rays and alpha particle detecting measurements performed using lutetium fine silicate (LFS) crystal by micro-pixel avalanche photodiode. In the experiment was used different size of LFS scintillators (3x3x0.5 mm³, 2x2x10 mm³ and 2x2x20 mm³) which were manufactured by Zecotek Photonics Inc. The following results are obtained energy resolution of 30% for 59.6 keV gamma rays from 241Am, 11% for 662 keV gamma rays from 137Cs, 6.25% for 1.3 MeV gamma rays from 60Co source and 8.6% for 4.5MeV alpha particle from 241Am source. Another new alpha particle detectors based on silicon manufactured by Russian acronym - FSUE VNIIA too. Energy resolution of this new detector was about 4.5% for 3.5 MeV alpha particles.



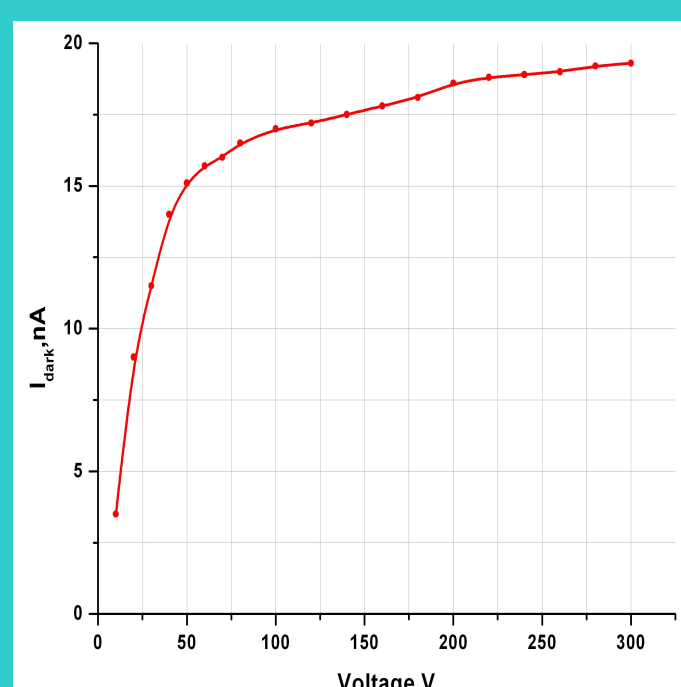
MAPD cross-section and energy zone diagram



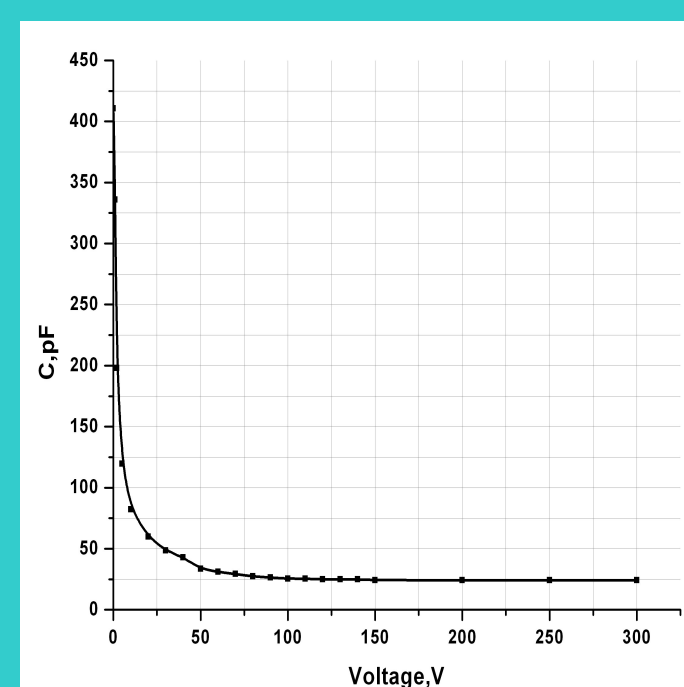
Capacitance-Voltage characteristics of MAPD



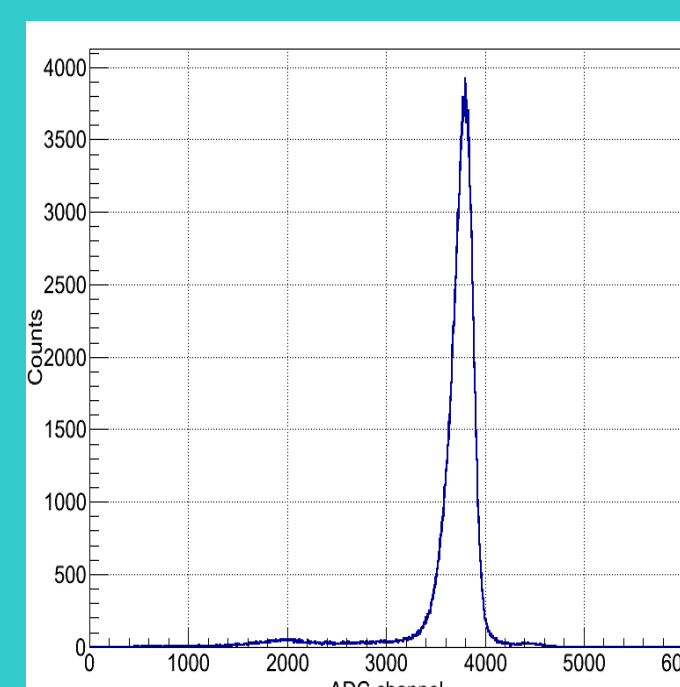
The PDE dependence on the wavelength of detected light
 $PDE(\lambda, U, T) = QE(\lambda, T) * G_r * P_b(\lambda, U, T)$



CV characteristics of the new alpha detector

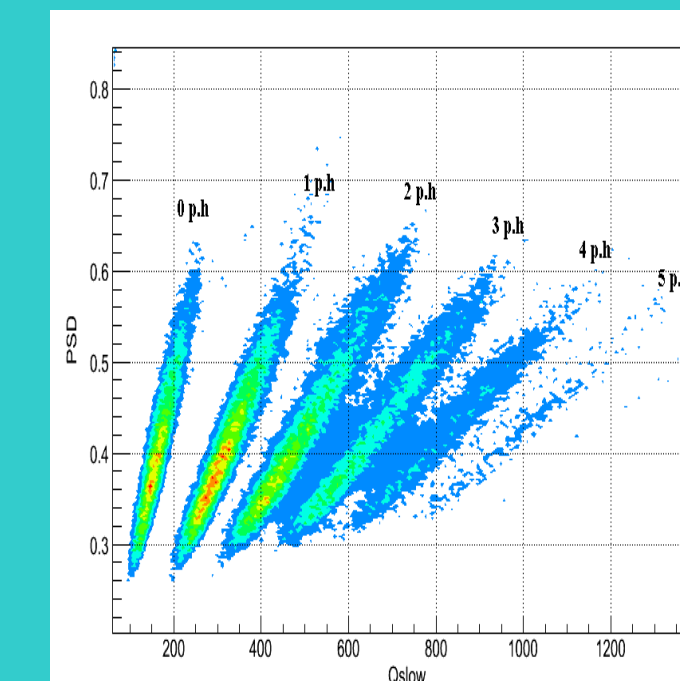


Capacitance-Voltage characteristics of the new alpha detector

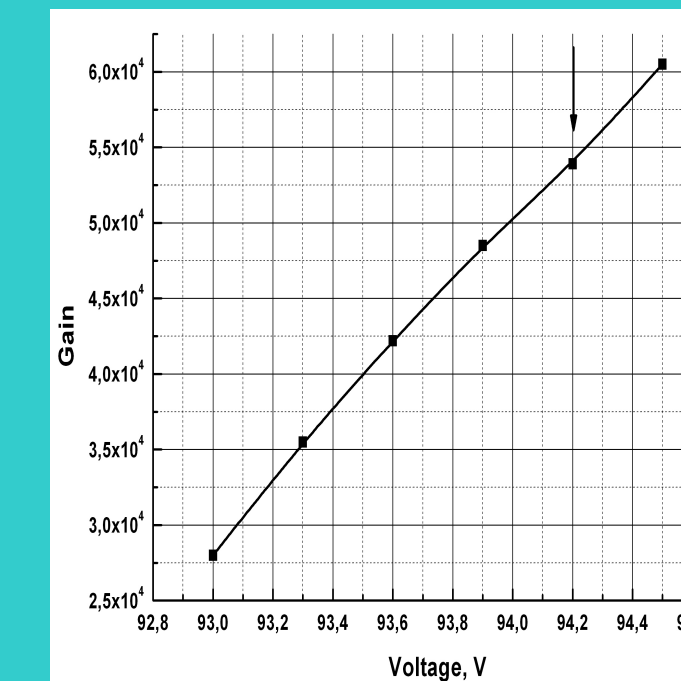


Amplitude spectra obtained with the new alpha particle detectors (size 1*1 cm²) for 3.5MeV energy of alpha particle at operation voltage

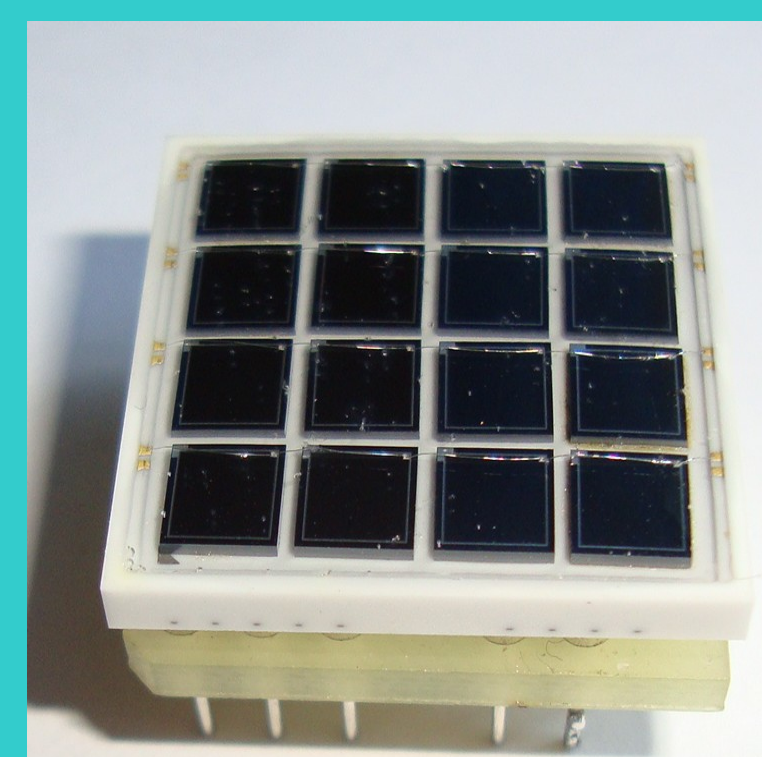
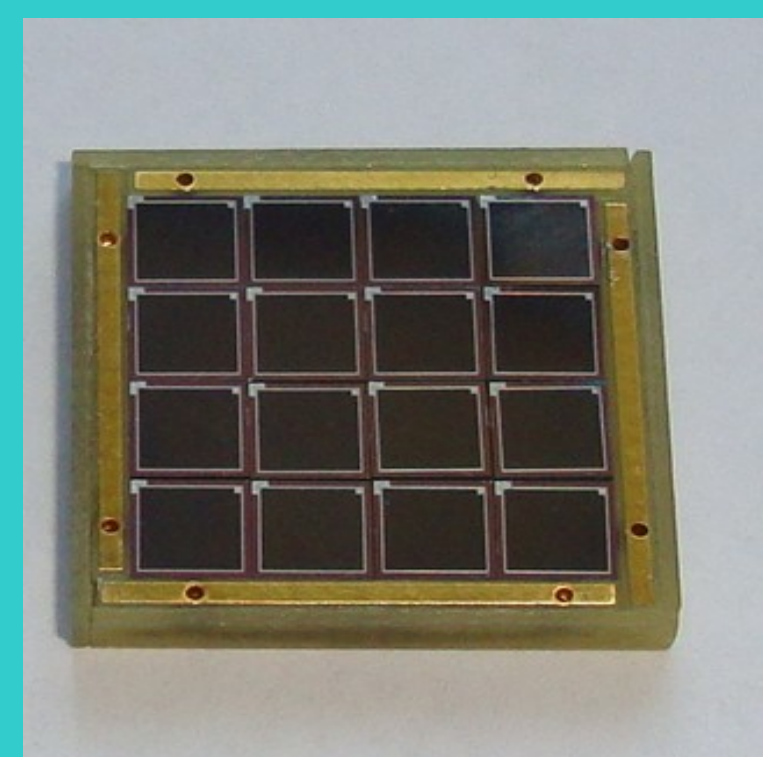
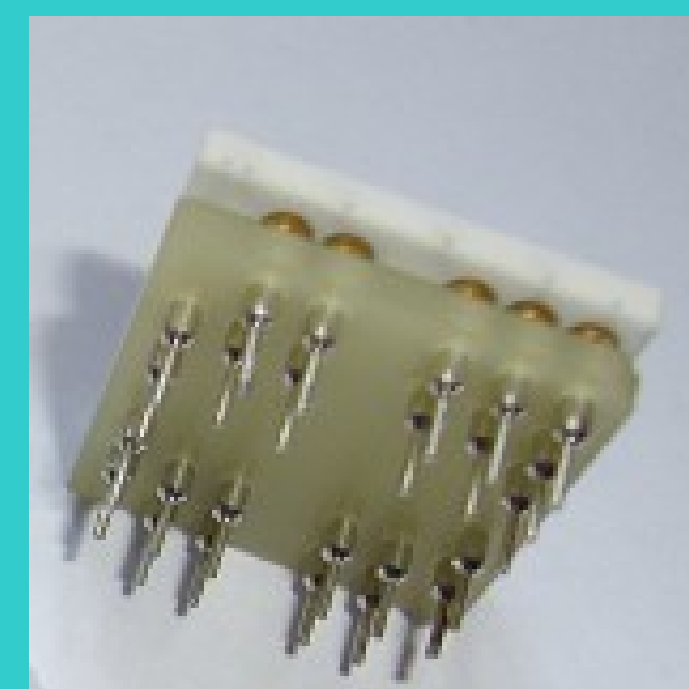
MAPD	3A	3N	3N1P
Density-pix/mm ²	15000	15000	15000
PDE	~13	~27	~30
Gain-10 ⁴	2	5	5
Sensitivity (nm)	450-550	450-550	450-550



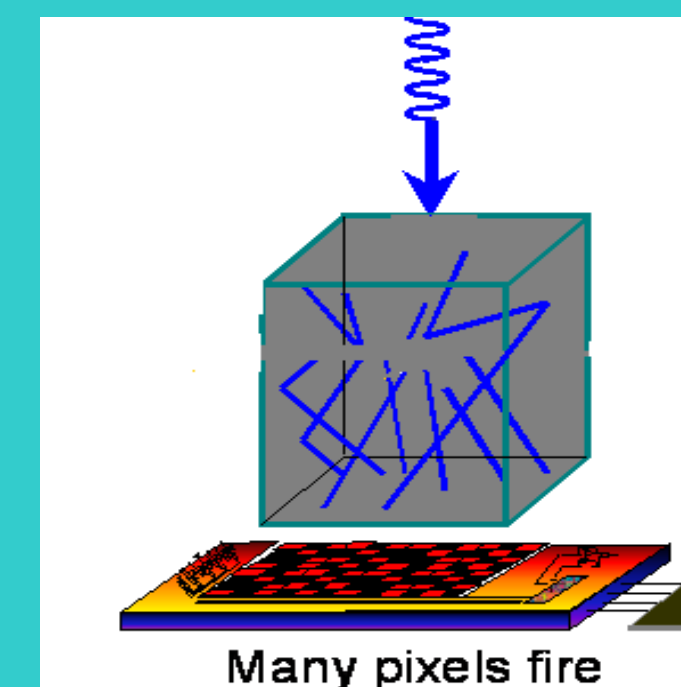
2D plot of MAPD-1P for low-intensity light pulses with number of 1.5ph.e.a.



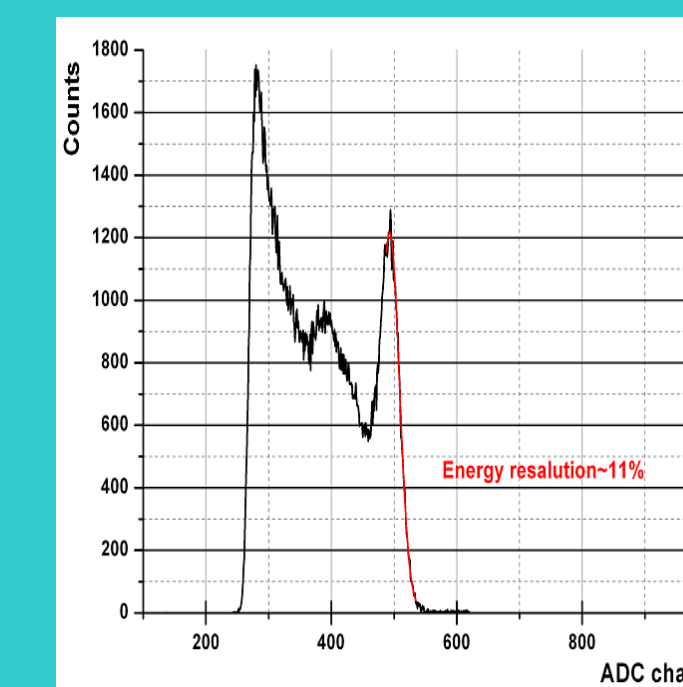
Gain characteristics' MAPD-1P
 $Gain = C_{pixel} * (V - V_b) * n_{ph.e}$



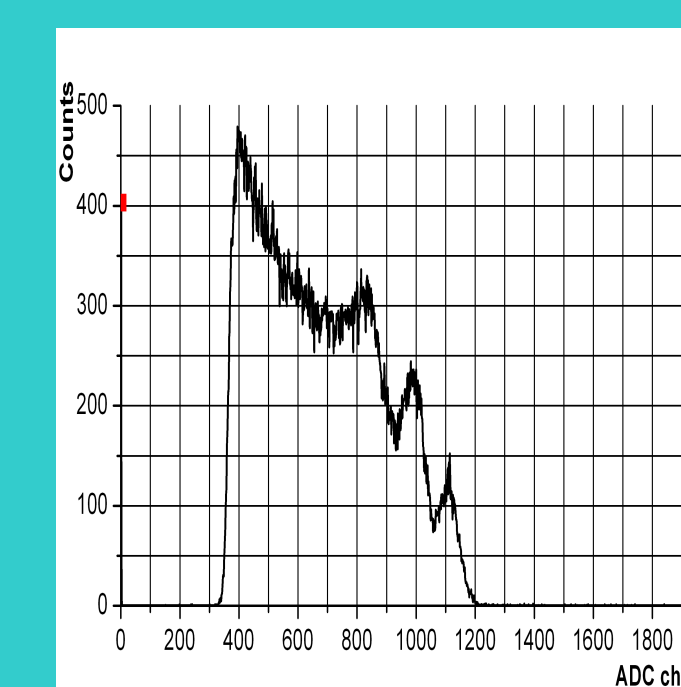
Development of Positron Emission Tomography and scintillation detectors



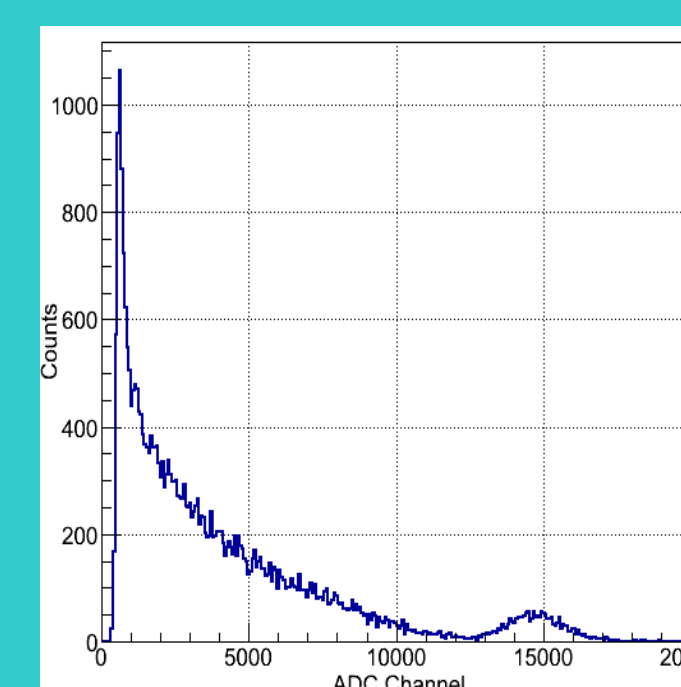
Many pixels fire



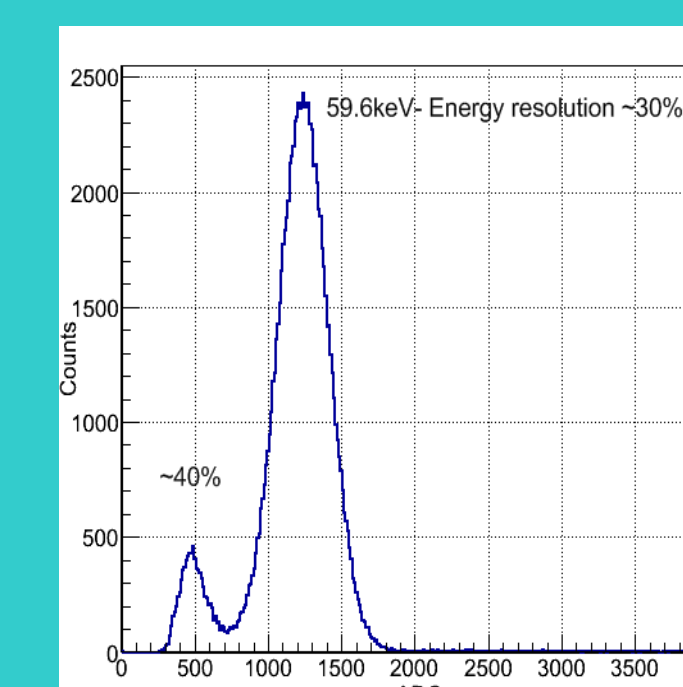
Amplitude spectra obtained with MAPD-3N at detection 137Cs g-ray with an LFS scintillation crystal of size 2*2*10mm³ at T=21C.



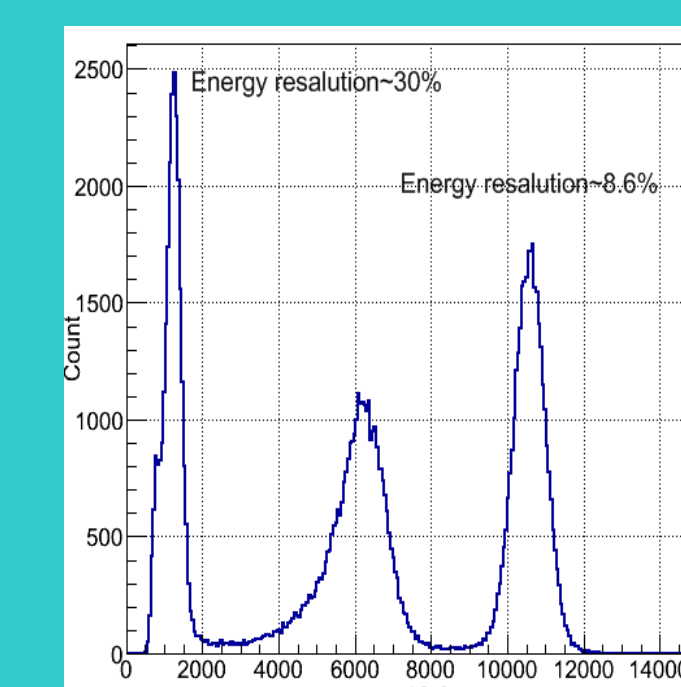
Amplitude spectra obtained with MAPD-3N at detection Co60 g-ray with an LFS scintillation crystal of size 2*2*20mm³ at T=21C.



Amplitude spectra obtained with MAPD-1P at detection Cs137 g-ray with an LFS scintillation crystal of size 3*3*0.5mm³



Amplitude spectra obtained with MAPD-1P at detection Am241 gamma rays (59.6keV, 23.4keV) with an LFS scintillation crystal of size 3*3*0.5mm³



Amplitude spectra obtained with MAPD-1P at detection Am241 alpha particle with an LFS scintillation crystal of size 3*3*0.5mm³ at operation voltage

Reference

1. Z. Sadygov, A. Olshevski, I. Chirikov, et al., Nucl. Instr. and Meth. A 567 (2006) 70.
2. 3. Я. Садыгов, Патент РФ №2102820, приоритет от 10.10.1996.
3. 3. Я. Садыгов, Патент РФ №2294035, приоритет от 24.03.2005
4. Ahmadov. F, Ahmadov. G, Sadygov Z, Madatov. R ISINN-19, 2011

Contact: ahmadovf@nf.jinr.ru , ahmedovg@nf.jinr.ru