Contribution ID : **18** Type : **talk**

Development of detectors with SiPM readout for nuclear medicine

Wednesday, 8 July 2015 17:40 (0:20)

Content

Russian domestic medicine is suffering from a crippling deficit of modern equipment for diagnostics. Almost all of this equipment was imported. Most of them are operated for more than 10 years and are now needed to be either modernized or completely replaced.
Proof-of-principle prototype of the gamma-camera module was assembled. The prototype consists of 64-channel matrix of 6×6 mm^2 KETEK SiPMs (*www.ketek.com*), assembled at Scientific-Production Enterprise "Pulsar", Moscow. Front-end analogue readout and digitazing of the signals from the matrix is performed by 64-channel ASIC MAROC, which is commercial available and produced by French company WeeRoc (*www.weeroc.com*). Further processing of digitized signal is made on PC. The experimental measurements with NaI(Tl) $\oslash$ 30 $mm \times 20$ mm scintillator were carried out. The aim of the researching was to check an obtaining of necessary energy resolution since the signal is a sum of the eight center signals from the individual channels that operating under common bias voltage and having dark count rate, also integration time of MAROC3 is 150 ns and this time is less than decay time of scintillator, and as a consequence it leads to integrating at least half of the light. As result, energy spectrum of sum signal from the detectors with Cs-137 source has been built and energy resolution of 23.8% (for the 31-35 keV lines) has been obtained. In fact, this result is equal to 25.2% resolution obtained with PMT XP2020 with the full integration of the signal (all light has been collected) on digital oscilloscope LeCroy WaveRunner 620Zi with the same scintillator. It is assumed to make a tests with scintillator from the real gamma camera. The Monte-Carlo simulating of the full-size gamma camera is performed using Geant4 libraries (transportation of the photons), MATLAB (simulating of SiPM characteristics) and ROOT (fitting and histogramming) to obtain required energy and spatial resolution.
In parallel, we are developing the detector for dose monitoring in neutron capture therapy (NCT). It was suggested to utilize a LaBr3(Ce) scintillation crystal, that have the best energy resolution, using SiPM matrix for readout. The usage of SiPM matrix allows to create a dose detector, that capable not only to estimate the dose in the region of interests but also to restore a dose distribution shape in the real time during radiation process. To decrease a contribution of a background events it is suggested to use an active protection surrounding LaBr3(Ce) and operate in anti-coincidence mode. To perform the measurements the test prototype was assembled. LaBr3(Ce) cylindrical crystal made in Chernogolovka is surrounded by LYSO crystals, 64-channel matrix of $6 \times 6 mm^2$ KETEK SiPMs and the test board with MAROC3 electronics. The measurements with Cs-137 source were performed, resolution of 4.5% (662 keV) was obtained and result of using of the active protection was demonstrated. Currently, we have improved LaBr3(Ce) crystal with higher light output. The protection geometry is being optimized as well.
Also in collaboration with "POSITOM-PRO" company is related to the development of TOF-PET (time-of-flight PET) module using SiPM with the following requires: 10-15% energy resolution on 511 keV line, spatial resolution of about 3-4 mm FWHM, maximum count rate no less than 100 kHz and time resolution of about 300-400 ps, which is state-of-art commercial TOF-PET. Simultaneously, a module with the time resolution on 100 ps level for the next generation TOF-PET is being developed. One reason for worsening the time resolution is a slope of the leading front of the detector signal. The slope is higher, the time jitter related to the obtaining of the cut-off time is less. Thus, it is necessary to amplify the signal and not to change the slope of the front (to transmit the high frequencies without distortion). To do this, the selection of different high frequency amplifiers is being studied.
The latest obtained results will be presented.

Author's Institution

NRNU MEPhI

Co-author's Institution

Primary author(s) : PHILIPPOV, Dmitry (NRNU MEPhI); Mr. BUZHAN, Pavel (NRNU MEPhI); Dr. POPOVA, Elena (NRNU MEPhI); Mr. STIFUTKIN, Alexei (NRNU MEPhI); Mr. ILYIN, Andrei (NRNU MEPhI); Prof. BELYAEV, Vladimir (NRNU MEPhI)

Presenter(s) : PHILIPPOV, Dmitry (NRNU MEPhI)

Session Classification : Afternoon Session 8 July/D