Large area UV SiPMs with extremely low cross-talk

Masahiro Teshima¹, Razmik Mirzoyan¹, Boris Dolgoshein², Pavel Buzhan², <u>Elena Popova²</u>, Alexey Stifutkin², Andrey Ilyin², Vladimir Kaplin², Andrey Zhukov³ ¹Max-Planck-Institute for Physics, Munich, Germany ²Moscow Engineering and Physics Institute, Moscow, Russia ³National Research University Moscow Institute of Electronic Technology

Memory of Boris Dolgoshein (1930-2010)



Professor MEPHI

Head of the particle-physics department of MEPHI

Inventor of streamer chamber (1962) Developer and pioneer of Transition Radiation Detector (TRD) Since 1993 Boris had developed a new photon detector which he called Silicon PhotoMultiplier (SiPM) in collaboration with DESY and then with Max Planck Institute fur Physics

First in the world large scale SiPM application in Hadron Calorimeter prototype had made by Boris and his team

Development of UV sensitive SiPM with extremely low crosstalk for application in MAGIC and EUSO experiments was the last Boris task

MEPhI - MPI for Physics R&D collaboration and cooperation with PerkinElmer Industries (now EXCELITAS)

Test batch have been produced in December 2010



SiPM Sizes	1x1 and 3x3 mm ²
µ-cell pitch	50 and 100 µm
Geom. Eff.	40-80%

18 different modifications



SiPM vs MPPC. Maximum PDE. LED 435nm 100x100 micron² (Geometrical Efficiency ~80%), 1x1mm² T=+25C



Crosstalk and Excess noise factor

For light distributed according to Poisson law





Timing with 3x3mm² 100B SiPM

40ps laser 405nm single photon mode T=-40C



Best value for 3x3mm² 100B SiPM is 205 ps

Efficiency measurements with calibrated PIN-diode

(Hamamatsu S1337-1010BQ)

100





PDE checking (pulsed mode LEDs) 100B 1x1mm² SiPM

Measurements at MEPHI and



•PDE measured with reference calibrated PIN-diodes is slightly lower then for reference calibrated PMT

•All results are equal within experimental errors

Spectral PDE comparison



E.Popova 04.07.2011 NDIP

Voltage stability SiPM 100B



Temperature stability SiPM 100B



PET Spectrometry with LYSO and Na²²

Preliminary. Setup is not optimized



Timing for PET with LYSO and Na²²

LYSO 3x3x5mm3 Without collimator Preliminary. Setup is not optimized



Summary

- MEPHI&MPI in cooperation with Excelitas Technologies have been produced SiPMs 1x1 and 3x3 mm² with extremely high PDE (above 50%) in UV-blue region
- ENF is very close to 1 due to complex crosstalk suppression
- Time jitter (FWHM) for 3x3mm² SiPM with 100 micron pitch is about 200-300ps and improvements are possible
- Such SiPMs are very promising for Astroparticle and PET applications
- During one year UV SiPMs will be commercial product of Excelitas Technologies

SiPM Noise



E.Popova 04.07.2011 NDIP

