ПРЕДУСИЛИТЕЛЬ СИГНАЛОВ С SIPM С ФУНКЦИЕЙ ТОТ ДЛЯ BBC

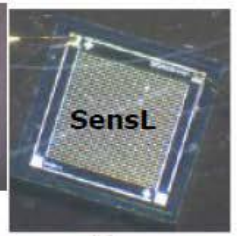
Дубна 16.12.2019

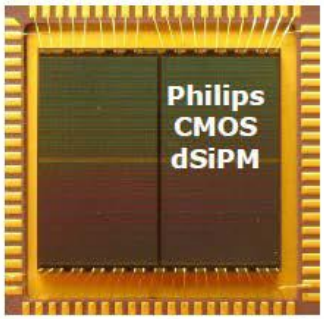
SIPM история

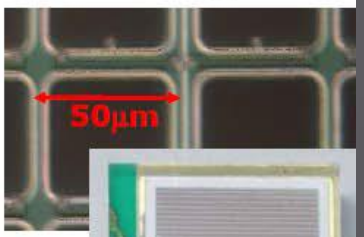
Today

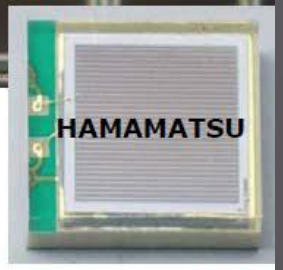
Many institutes/companies are involved in SiPM development/production:

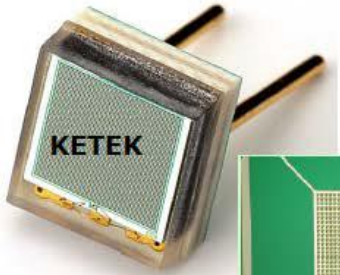
- **CPTA**, Moscow, Russia
- **MePhi/Pulsar** Enterprise, Moscow, Russia
- **Zecotek,** Vancouver, Canada
- **Hamamatsu HPK**, Hamamatsu, Japan
- **FBK-AdvanSiD**, Trento, Italy
- **ST Microelectronics**, Catania, Italy
- **Amplification Technologies** Orlando, USA
- **SensL**, Cork, Ireland
- **MPI-HLL**, Munich, Germany
- **RMD**, Boston, USA
- **Philips**, Aachen, Germany
- **Excelitas** tech. (formerly Perkin-Elmer)
- **KETEK**, Munich, Germany
- **National Nano Fab Center**, Korea
- **Novel Device Laboratory** (**NDL**), Bejing, China
- **E2V**
- **CSEM**

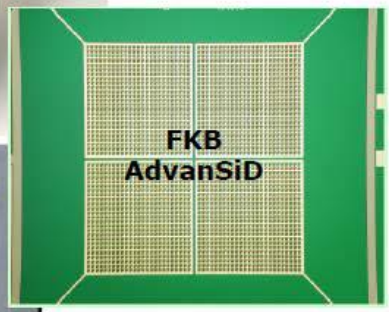


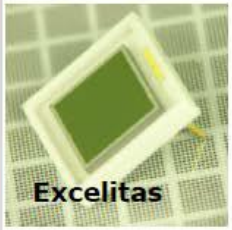


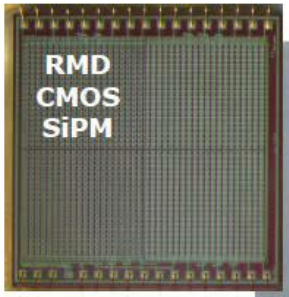


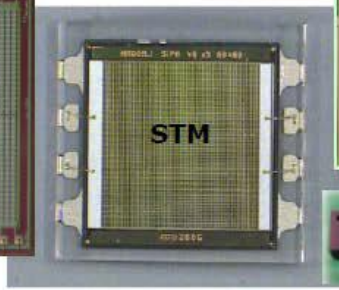






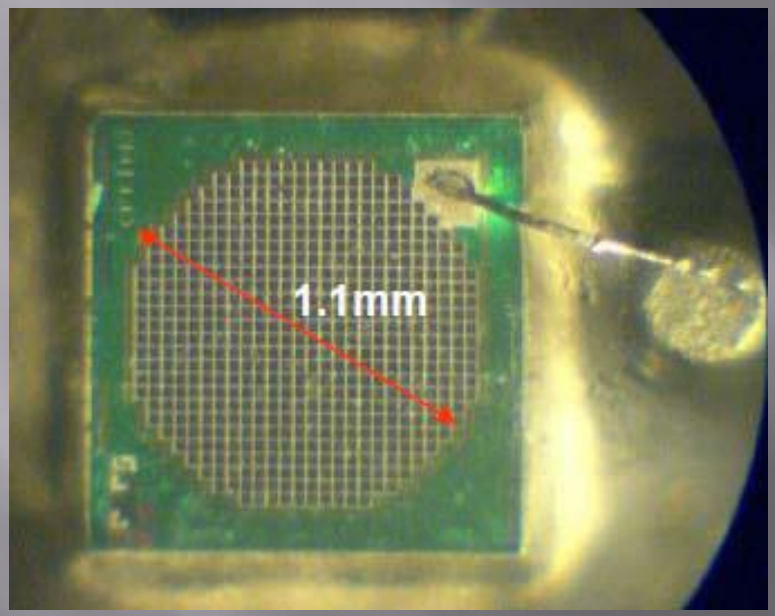


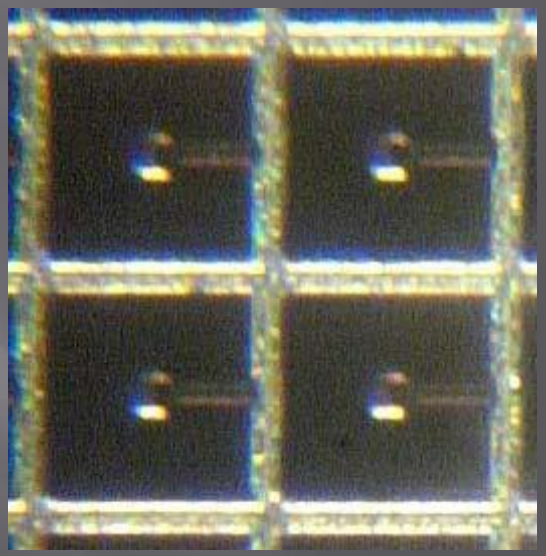




G.Collazuol - PhotoDet 2012

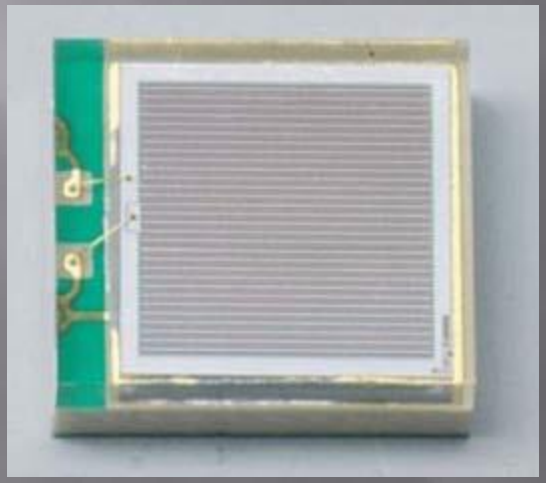
SIPM история

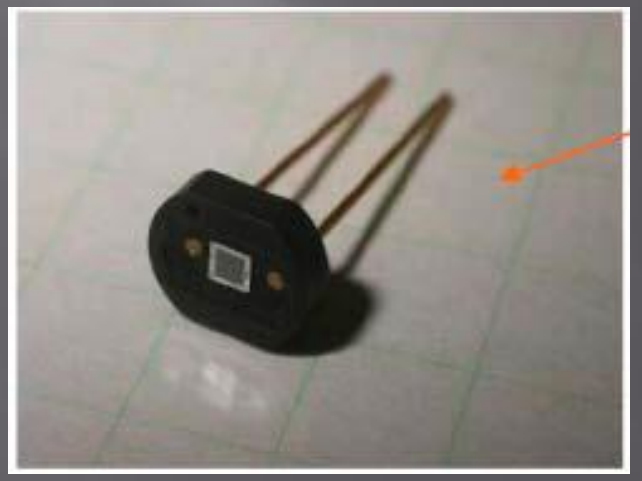




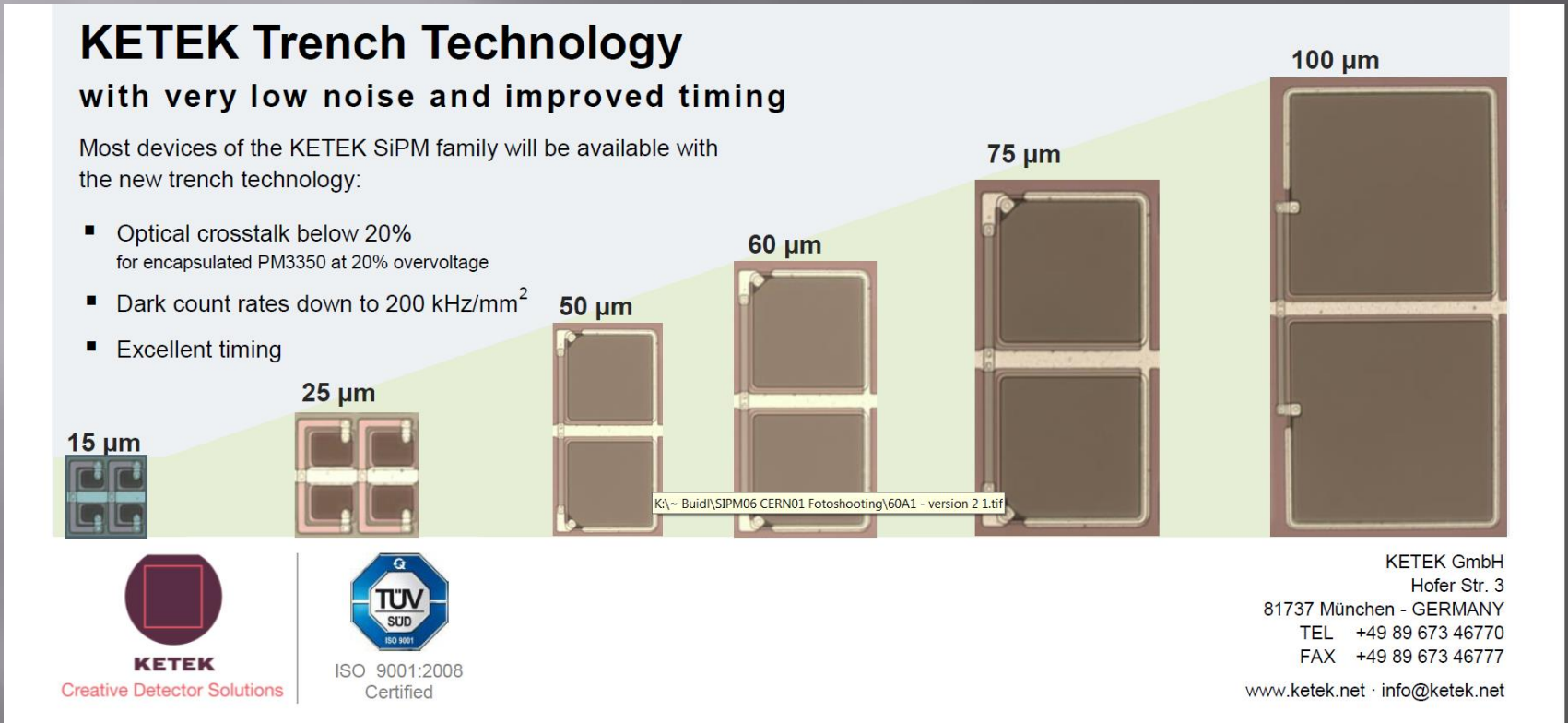
SIPM ЦПТА

SIPM история





SIPM реалии


KETEK Trench Technology
with very low noise and improved timing
Most devices of the KETEK SiPM family will be available with the new trench technology:
Optical crosstalk below 20%
for encapsulated PM3350 at 20% overvoltage
Dark count rates down to 200 kHz/mm2
Excellent timing
15 µm
25 µm
50 µm
60 µm
75 µm
100 µm
K:\~ Buidl\SIPM06 CERN01 Fotoshooting\60A1 - version 2 1.tif
KETEK
Creative Detector Solutions
TÜV SÜD ISO 9001
ISO 9001:2008
Certified
KETEK GmbH
Hofer Str. 3
81737 München - GERMANY
TEL +49 89 673 46770
FAX +49 89 673 46777
www.ketek.net · info@ketek.net

SIPM реалии

C-Series Low Noise, Fast, Blue-Sensitive Silicon Photomultipliers

DATASHEET

sensL
sense light

Low Noise, Fast, Blue-Sensitive Silicon Photomultipliers

SensL's C-Series low-light sensors feature an industry-leading low dark-count rate, combined with high PDE that extends much further into the blue part of the spectrum using a high-volume, P-on-N silicon process. For ultrafast timing applications select C-Series sensors have a fast output, previously introduced in SensL's M-Series & B-Series sensors. These fast signals can have rise times of 300ps and pulse widths of 600ps. The C-Series is available in different sensor sizes (1mm, 3mm and 6mm) and packaged in a variety of formats, including a 4-side tileable surface mount (SMT) package that is compatible with industry standard, lead-free, reflow soldering processes. C-Series sensors are pin-for-pin compatible with the B-Series.

The C-Series Silicon Photomultipliers (SiPM) form a range of high gain, single-photon sensitive, UV to visible light sensors. They have performance characteristics similar to a conventional PMT, while benefiting from the practical advantages of solid-state technology: low operating voltage, excellent temperature stability, robustness, compactness, output uniformity, and low cost. For more information on the C-Series devices please refer to the website, www.sensl.com.

SIPM реалии

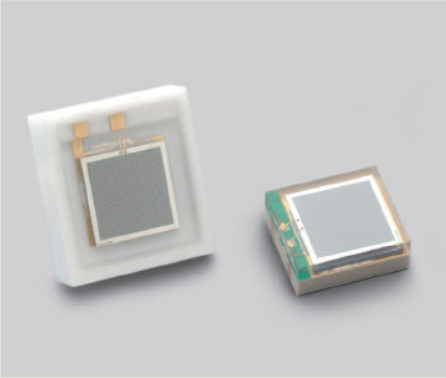
PERFORMANCE PARAMETERS

Sensor Size	Microcell Size	Parameter[1]	Overvoltage	Min.	Typ.	Max.	Units
1mm	10µ, 20µ, 35µ, 50µ	Breakdown Voltage (Vbr)[3]		24.2		24.7	V
3mm	20µ, 35µ, 50µ						
6mm	35µ						
1mm	10µ, 20µ, 35µ, 50µ	Recommended overvoltage Range (Voltage above Vbr)[2]		1.0		5.0	V
3mm	20µ, 35µ, 50µ						
6mm	35µ						
1mm	10µ, 20µ, 35µ, 50µ	Spectral Range[4]		300		800	nm
3mm	20µ, 35µ, 50µ						
6mm	35µ						
1mm	10µ, 20µ, 35µ, 50µ	Peak Wavelength (λp)			420		nm
3mm	20µ, 35µ, 50µ						
6mm	35µ						

[1] *All measurements made at 2.5V overvoltage and 21°C unless otherwise stated.*
[2] *Please consult the maximum current levels on page 6 when selecting the overvoltage to apply.*
[3] *The breakdown voltage (Vbr) is defined as the value of the voltage intercept of a parabolic line fit to the current vs. voltage characteristic curve.*
[4] *SMT package spectral range is limited from 320nm to 800nm. X13 package extends UV response to 300nm.*

SIPM реалии

HAMAMATSU
PHOTON IS OUR BUSINESS



MPPC® (multi-pixel photon counter)

S12572-010, -015C/P

Low afterpulse, wide dynamic range, for high-speed measurement
Photosensitive area: 3 × 3 mm

These MPPCs utilize very small pixels arrayed at high densities to achieve a high-speed recovery time and wide dynamic range. Hamamatsu currently produces MPPC with a pixel density up to 10000 pixels/mm² (pixel pitch: 10 µm). Utilizing advanced technology to enhance photon detection efficiency minimizes the drop in photon detection efficiency that usually occurs due to shrinking the pixel pitch.

Features

- Low afterpulse
- High fill factor
- High photon detection efficiency
- Wide operating voltage range
- Short recovery time
- High count rate

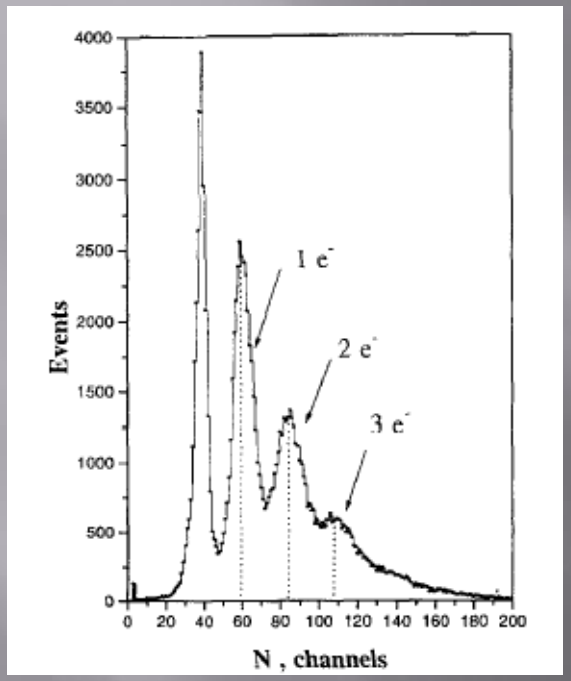
Applications

- Scintillation measurement
- Low-light-level detection
- Scattered light measurement

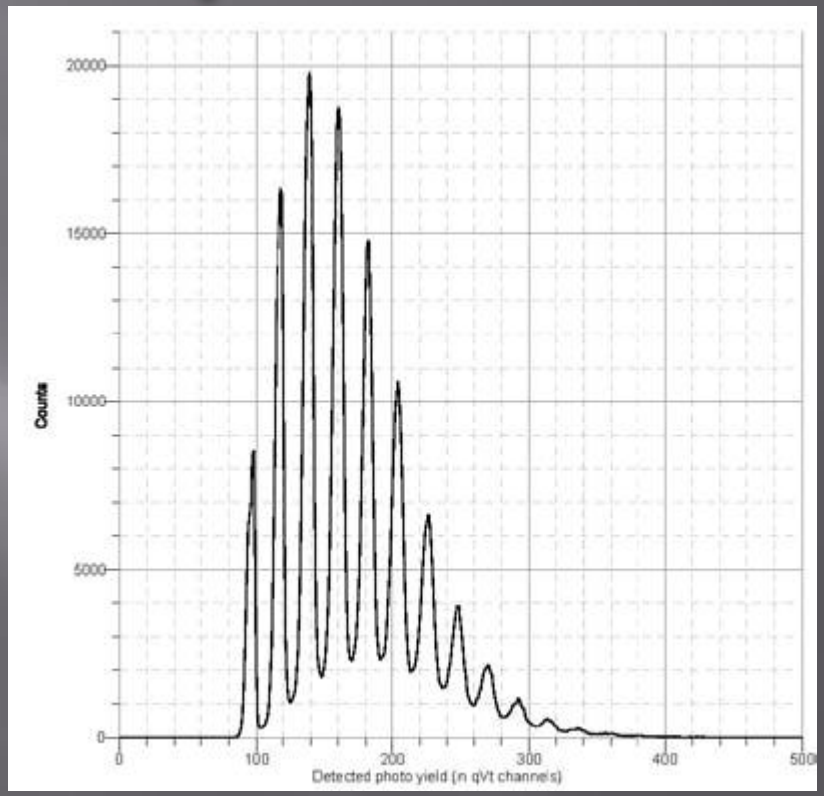
Related product (sold separately)

MPPC module	C11209-110

SIPM история

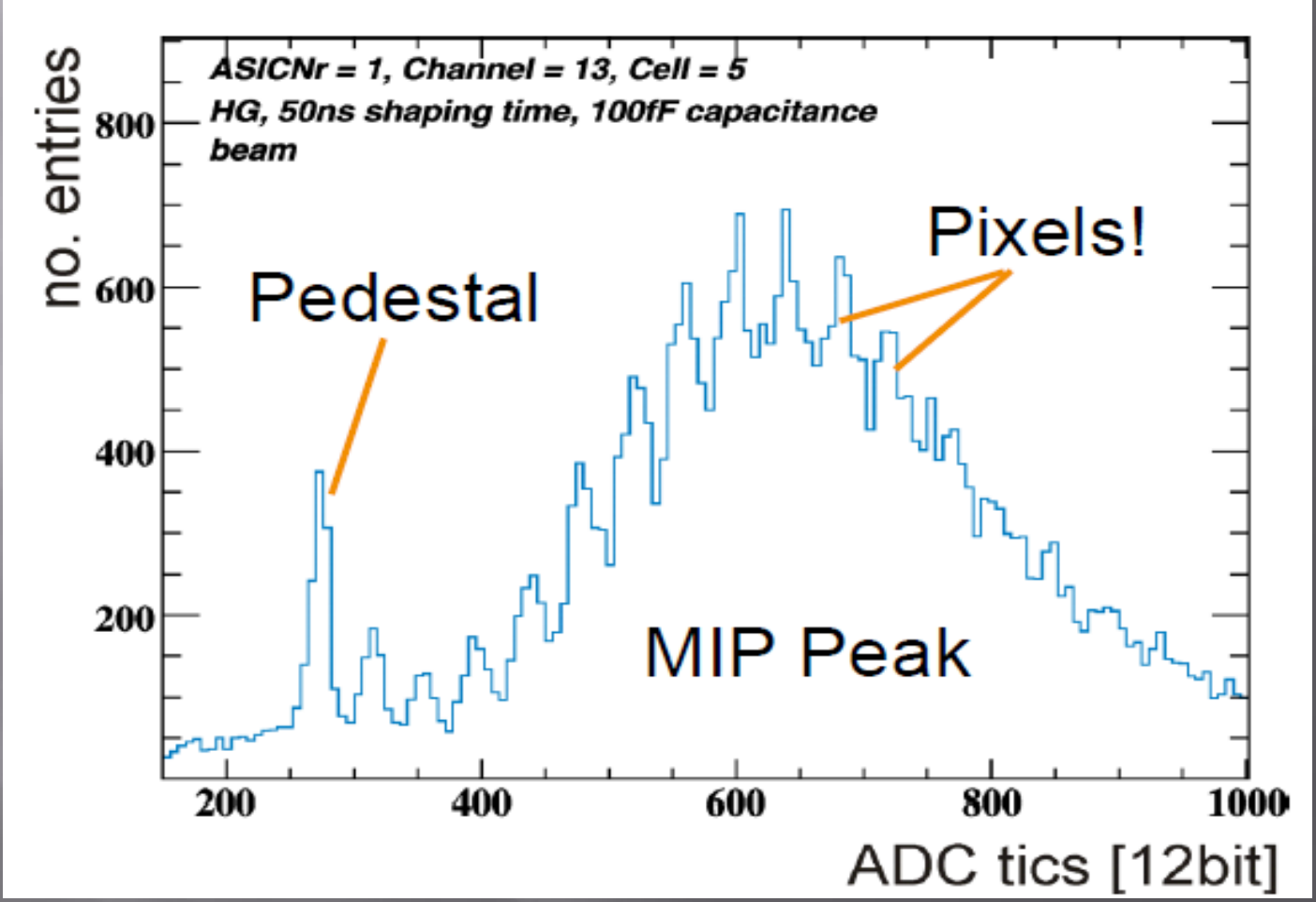


(A. Akindinov et al., NIM387 (1997) 231)

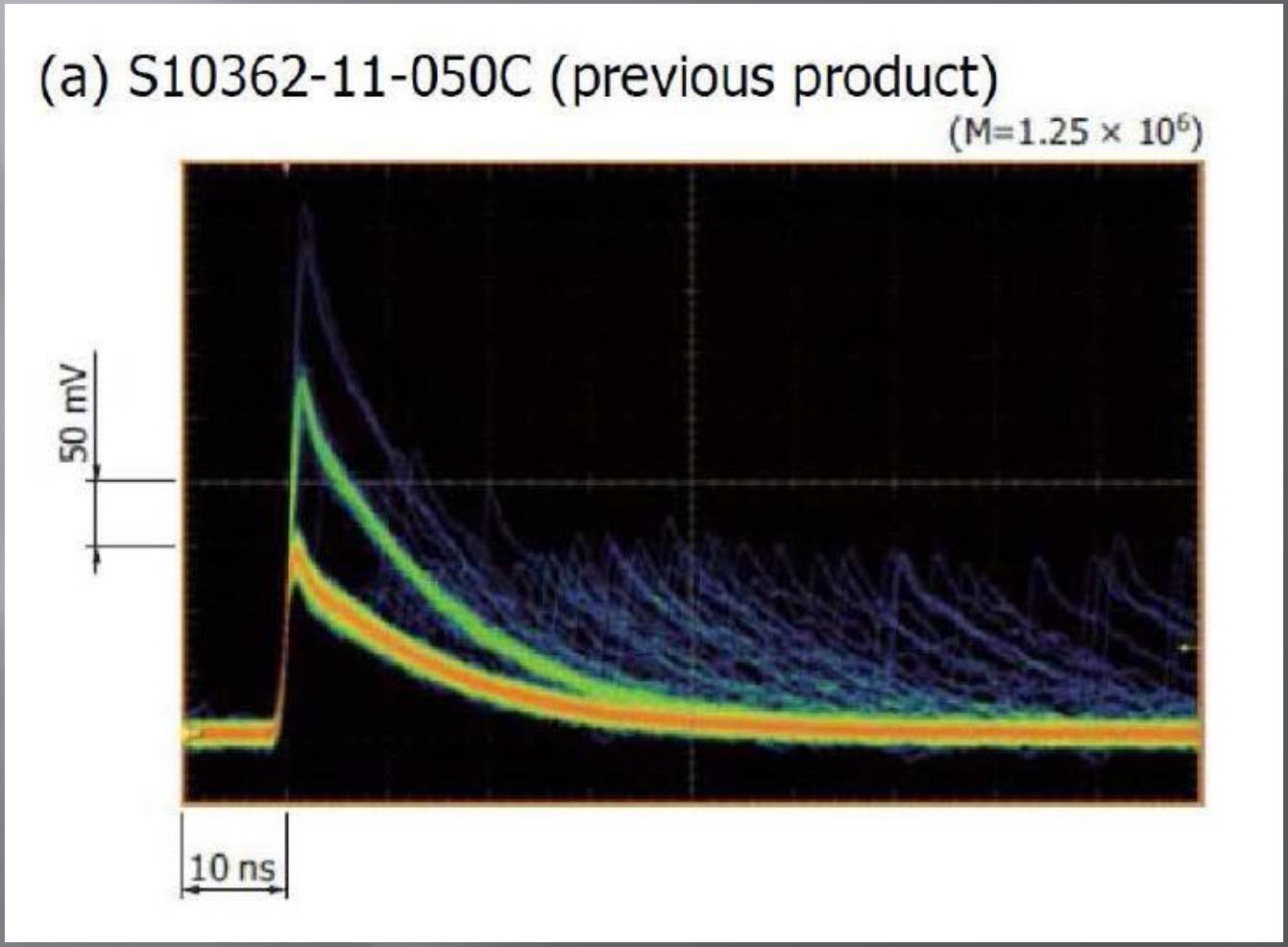


Barry W. Baumbaugh, et al. 2009 IEEE Nuclear Science Symposium Conference Record
(0.25pC/channel)

MIP response in DESY 6 GeV electron testbeam



SIPM сигналы



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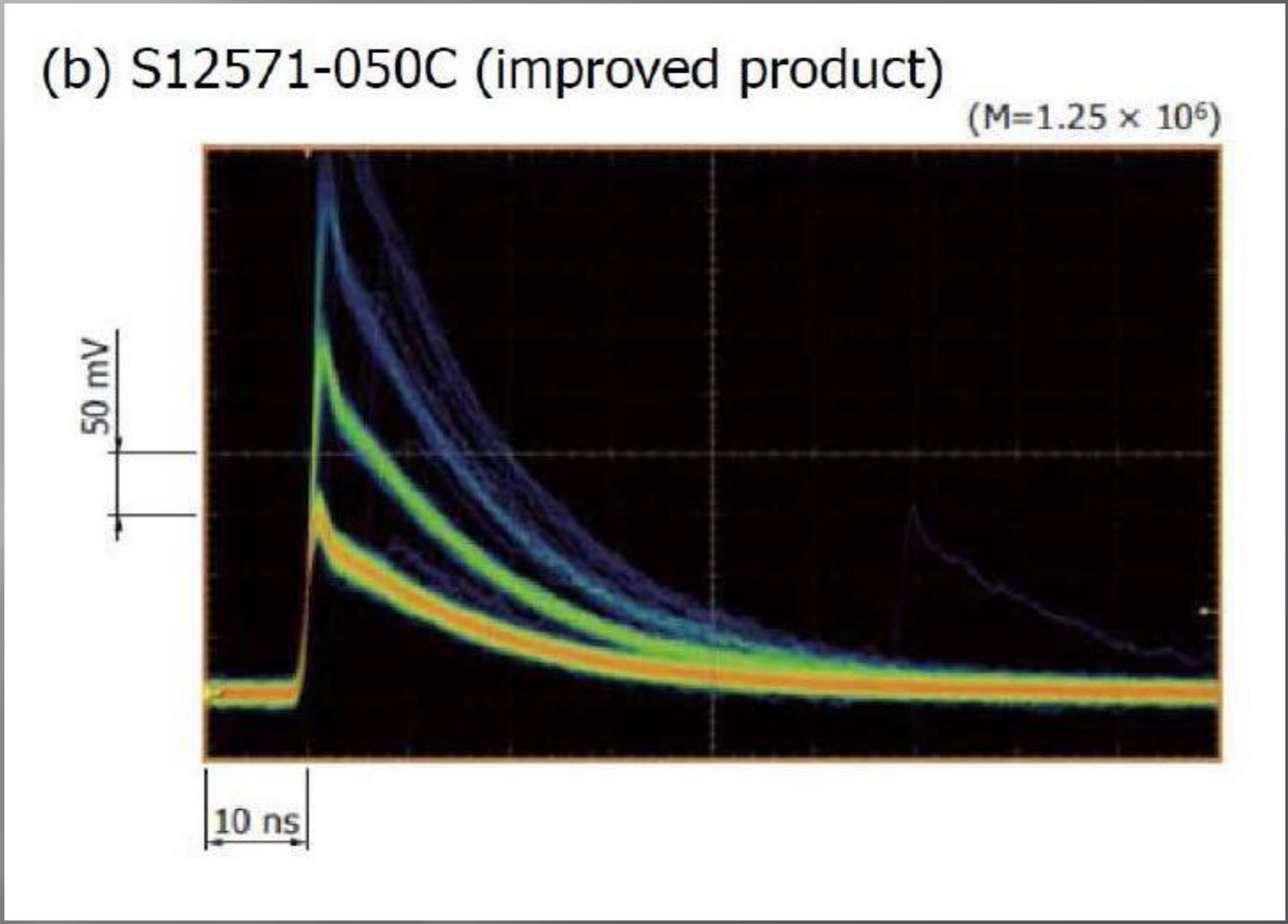

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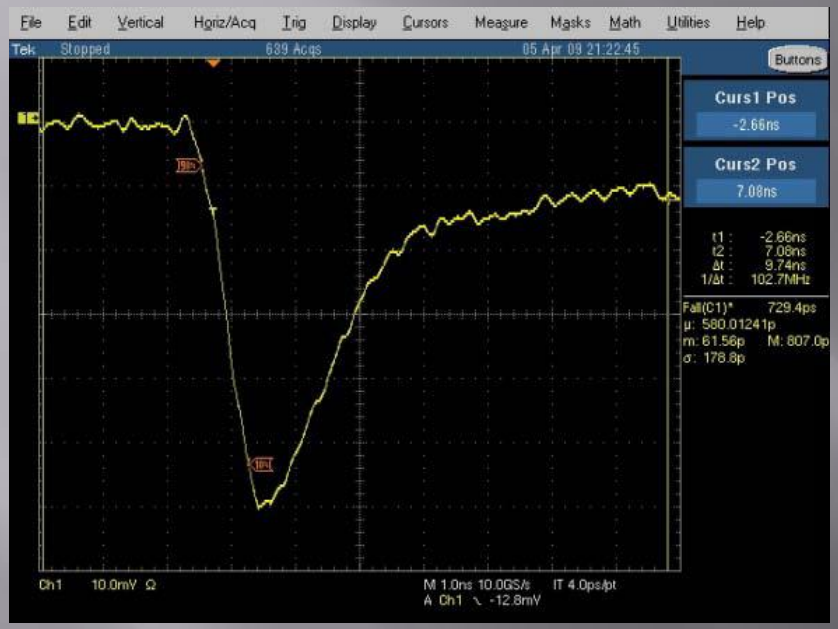
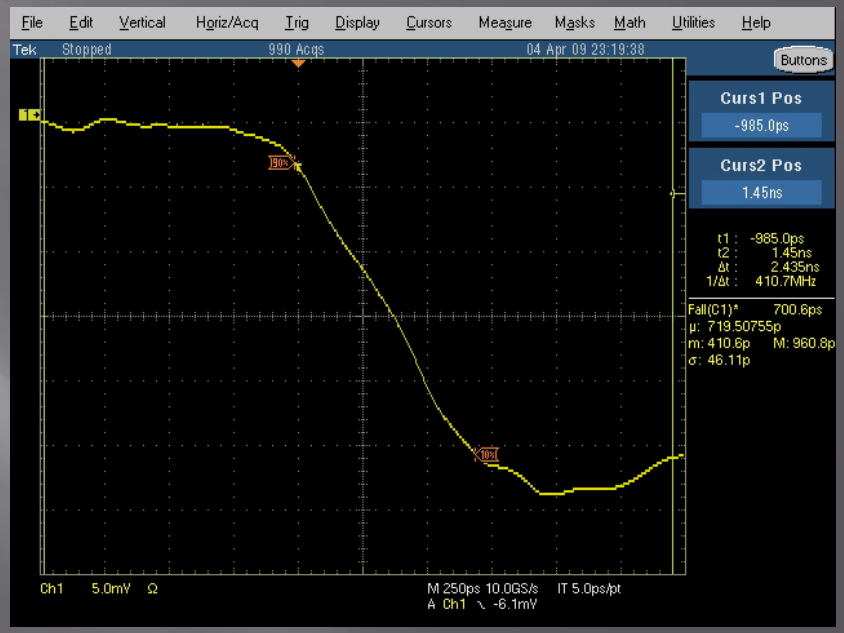


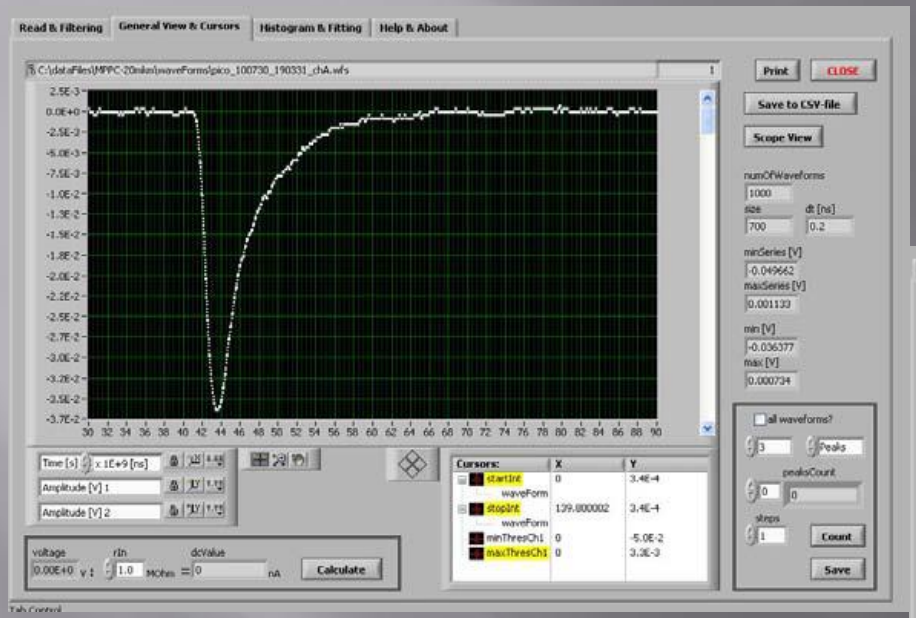


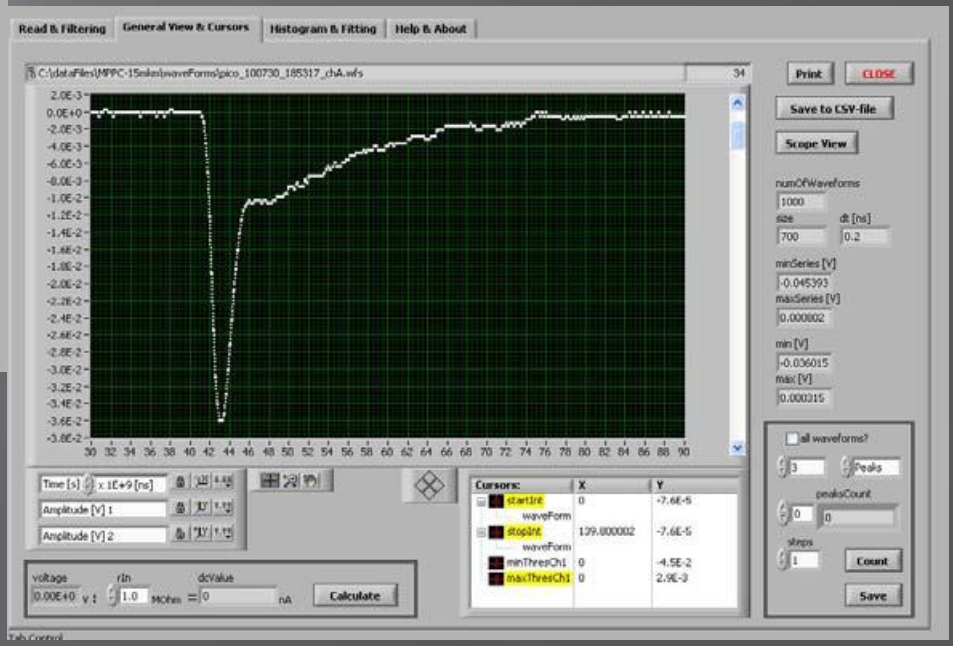
~700 psec rise time was measured (limited by circuitry)

CPTA/Photonique1 mm2SSPM response to a 35 psecFWHM laser pulse (λ=635 nm)

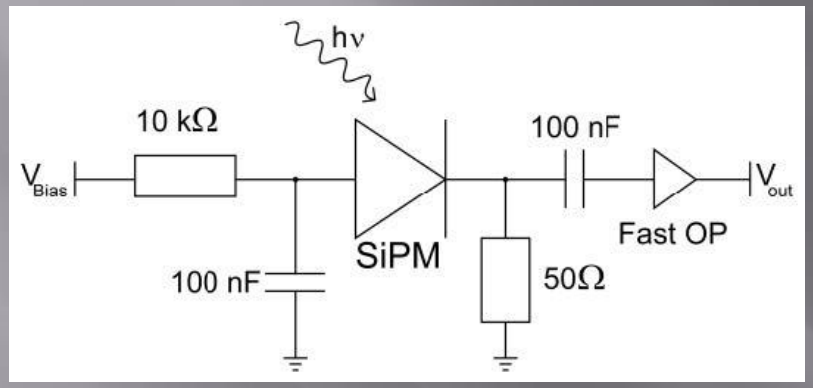
Zecotek3x3 mm2MAPD response to a 35 psecFWHM laser pulse (λ=635 nm)

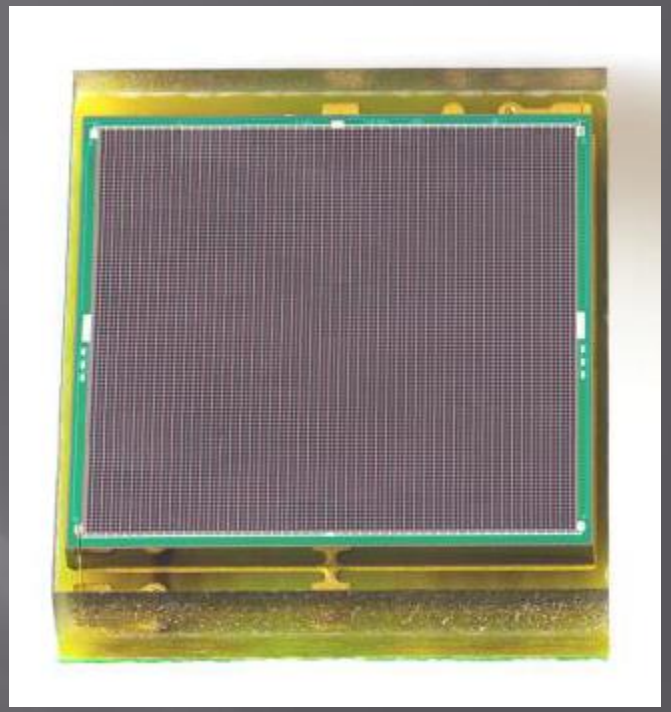
SIPM сигналы





SIPM включение

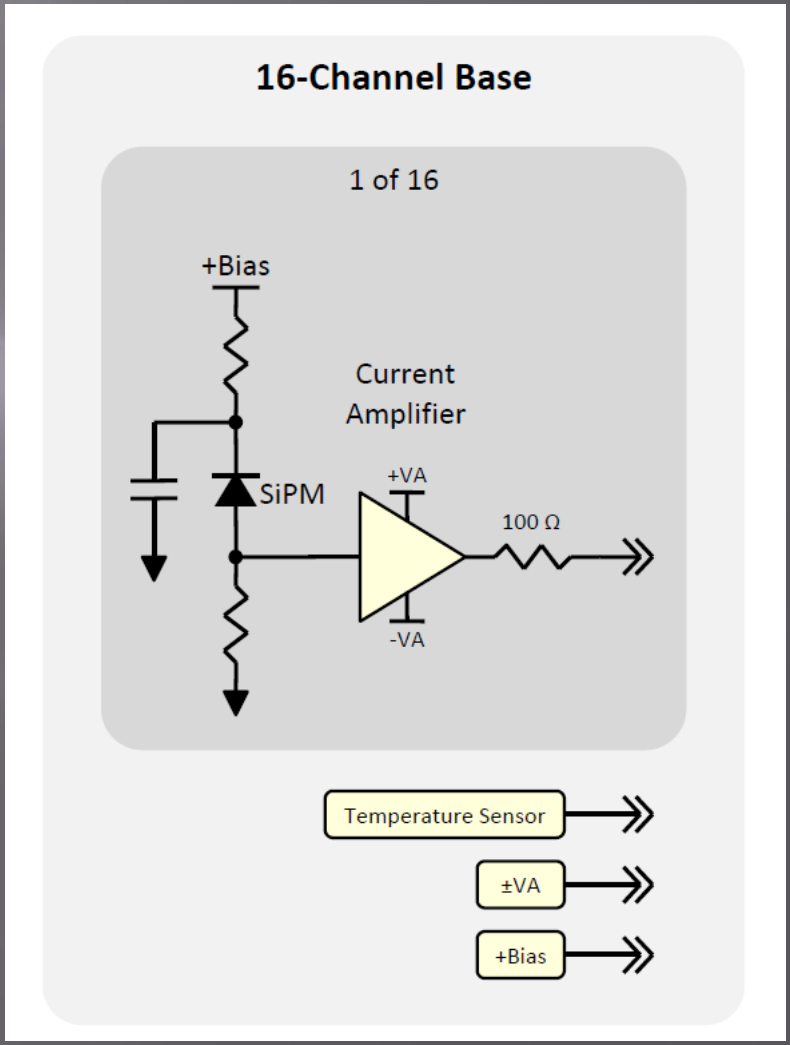




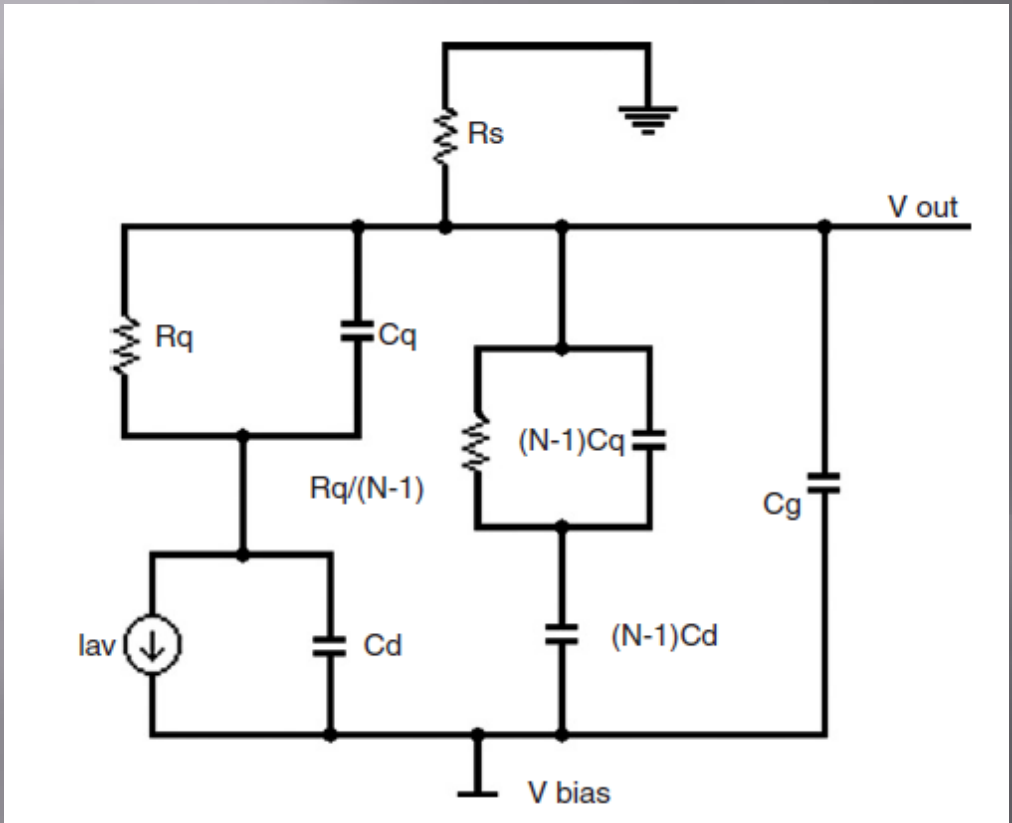
Example for Read Out Circuit
PM6660

SIPM включение

Example for Read Out Circuit
S11064



SIPM модель



Modelization by Corsi et al [NIM A572 2007]

SIPM модель

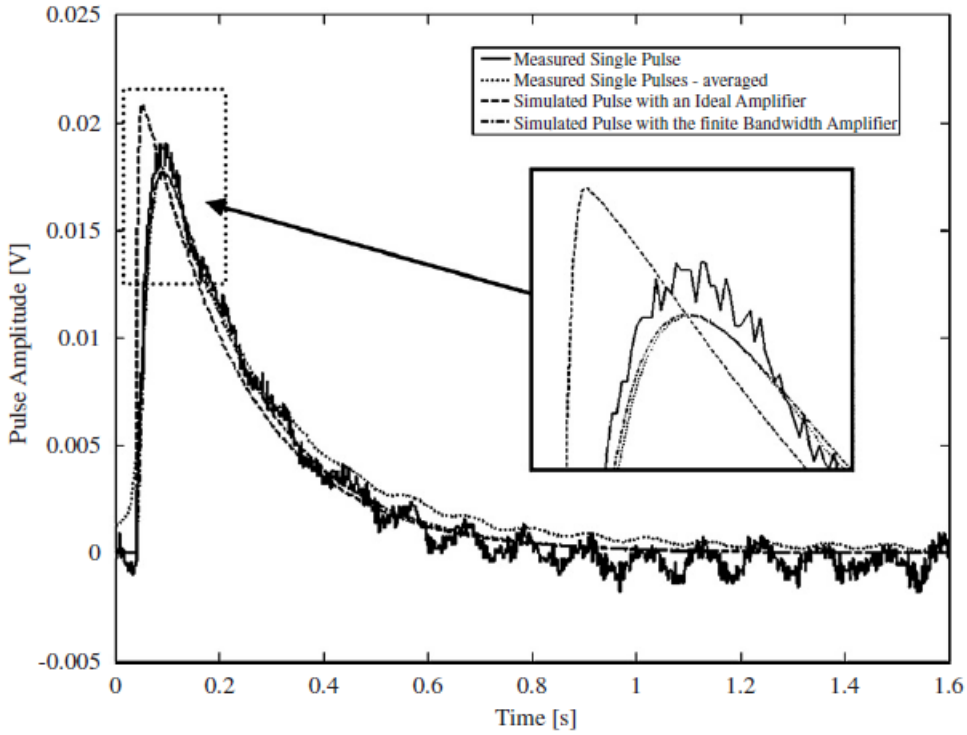
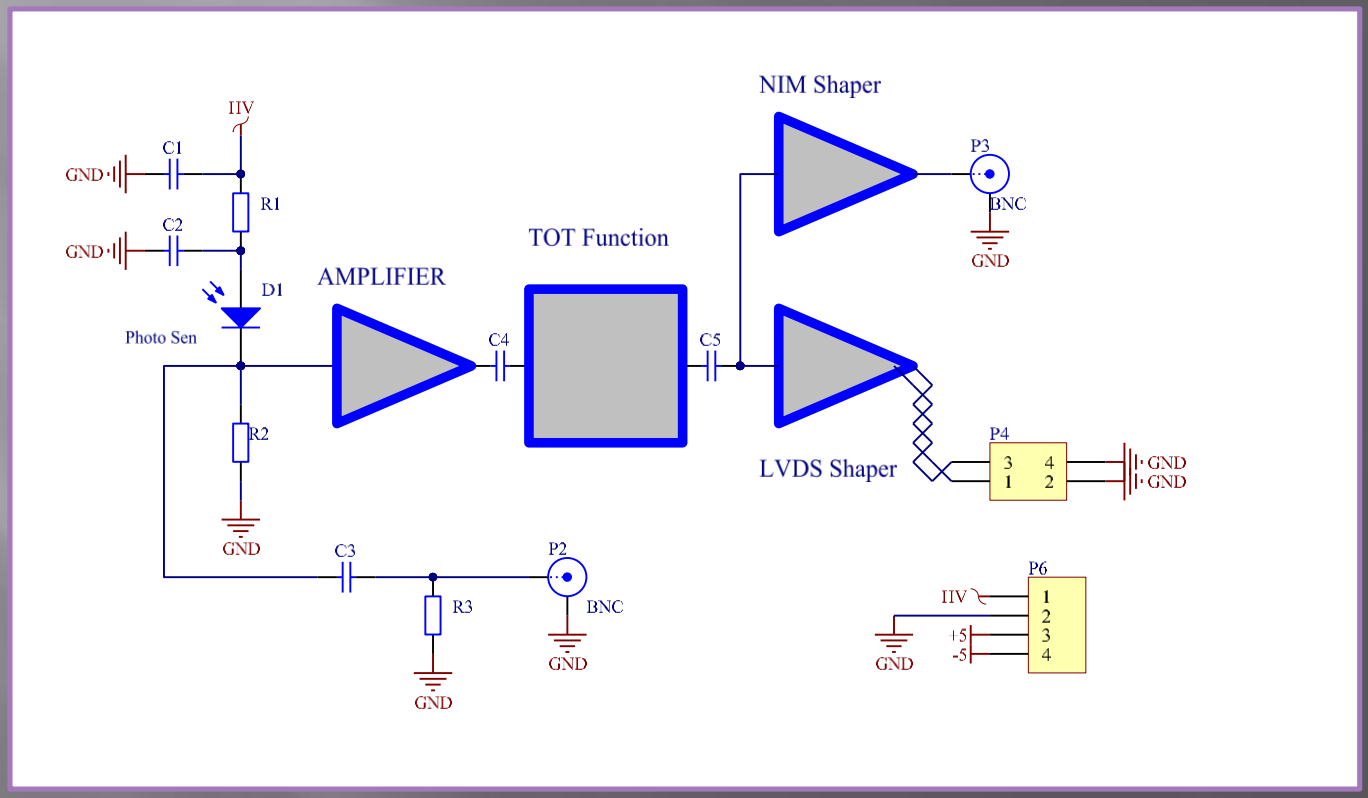
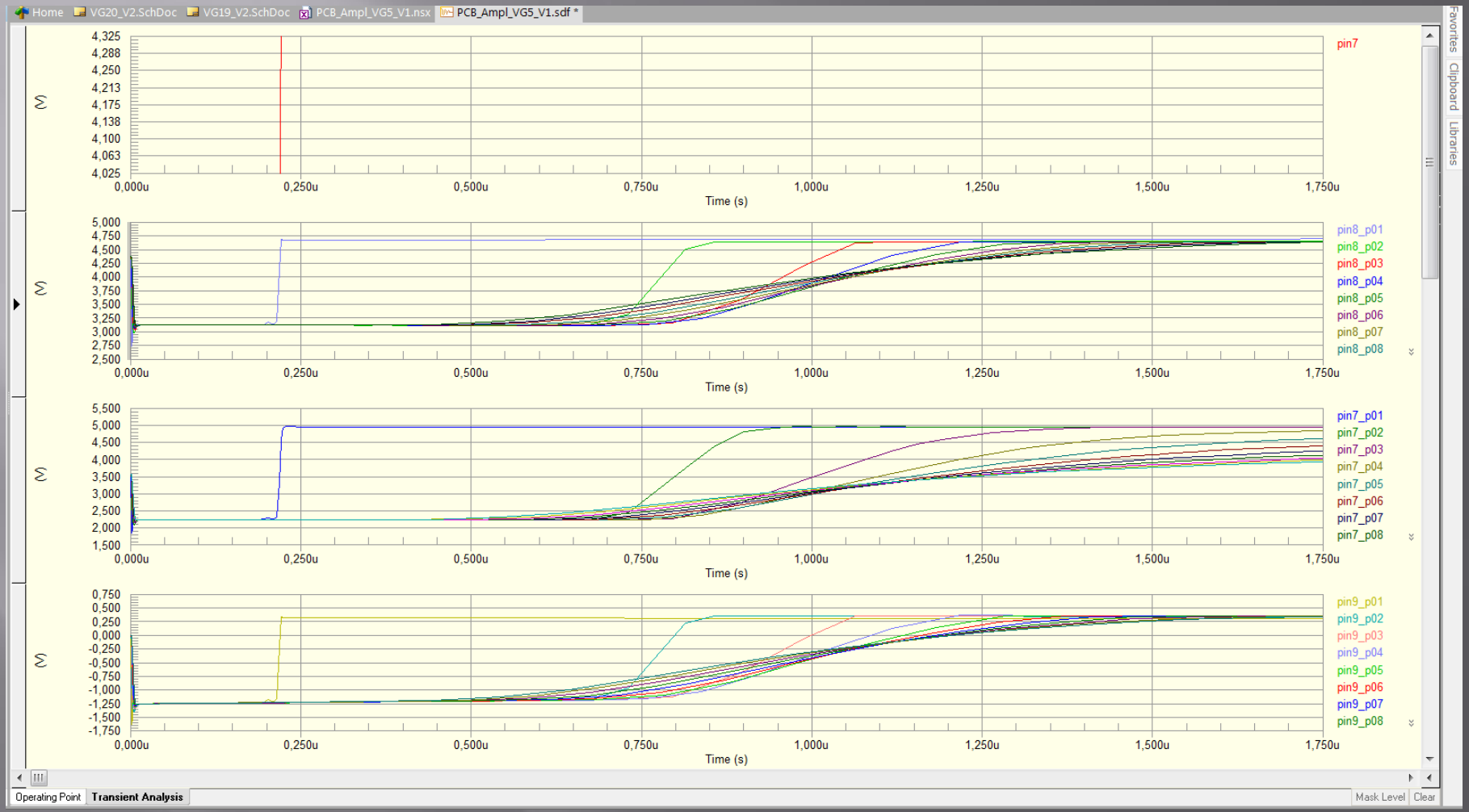


Fig. 2. Fitting of real data with the simulation results on the device model.

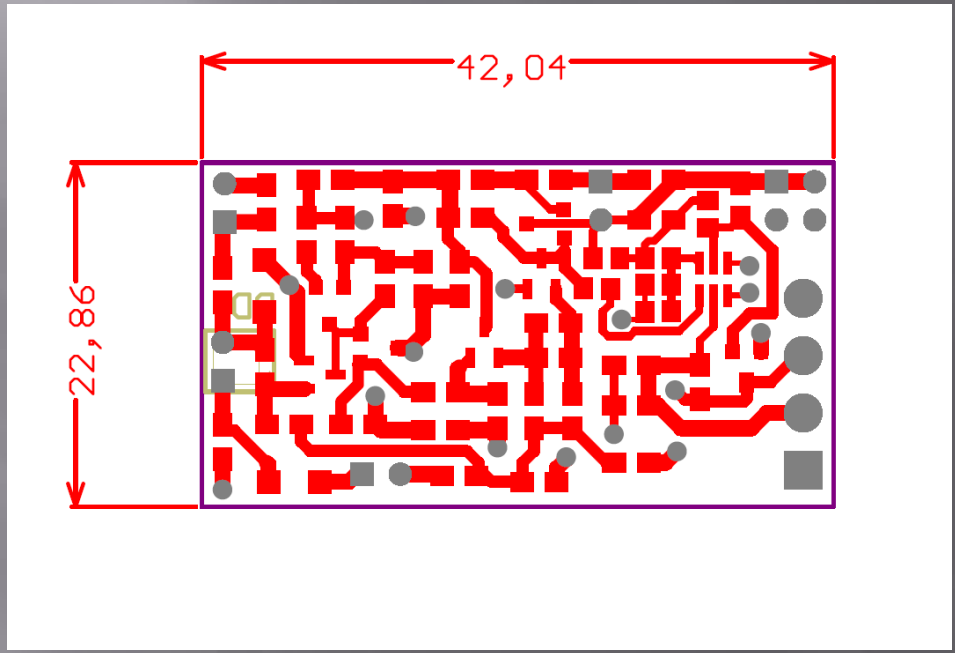
Схема предусилителя



Моделирование

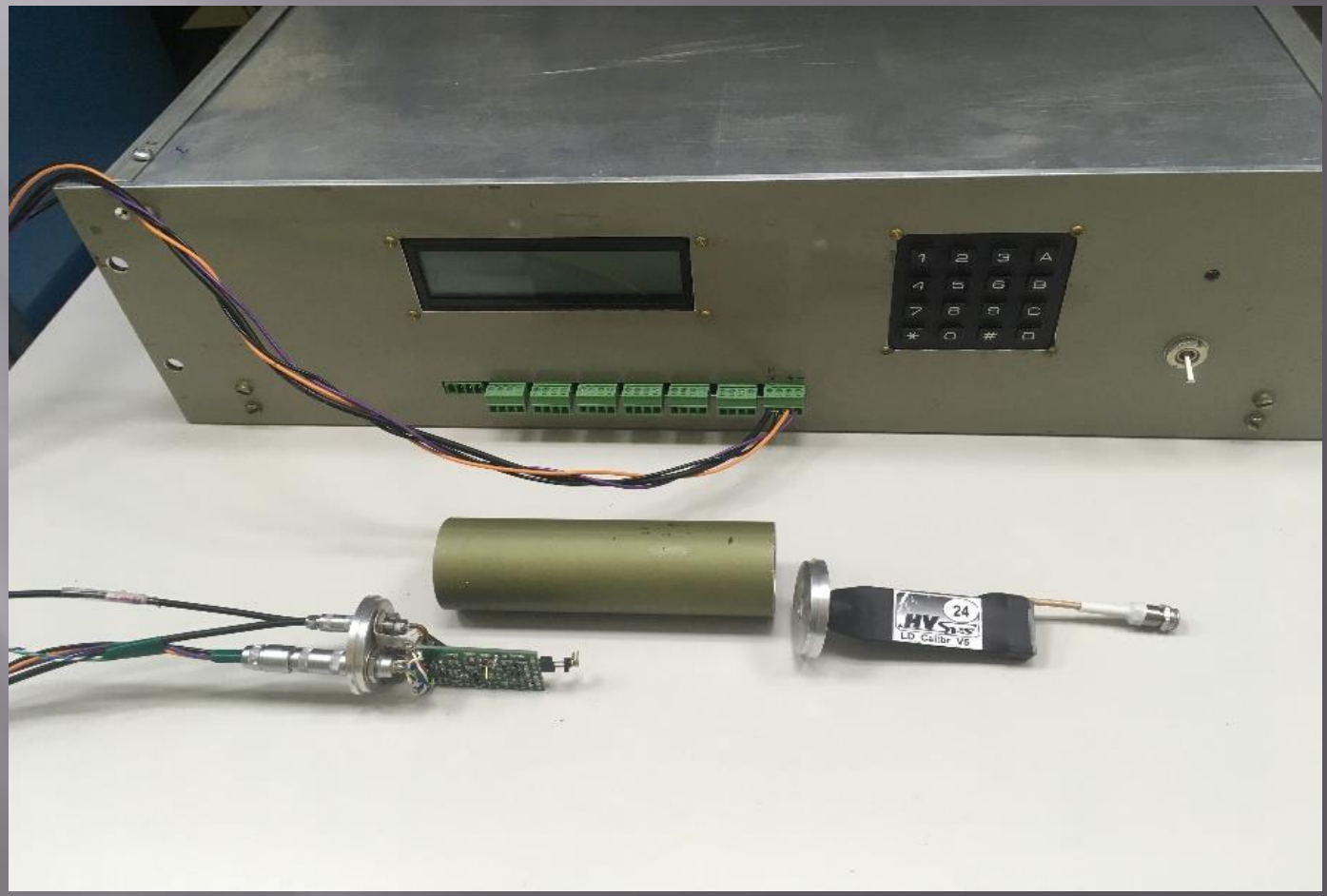


Плата Предусилителя

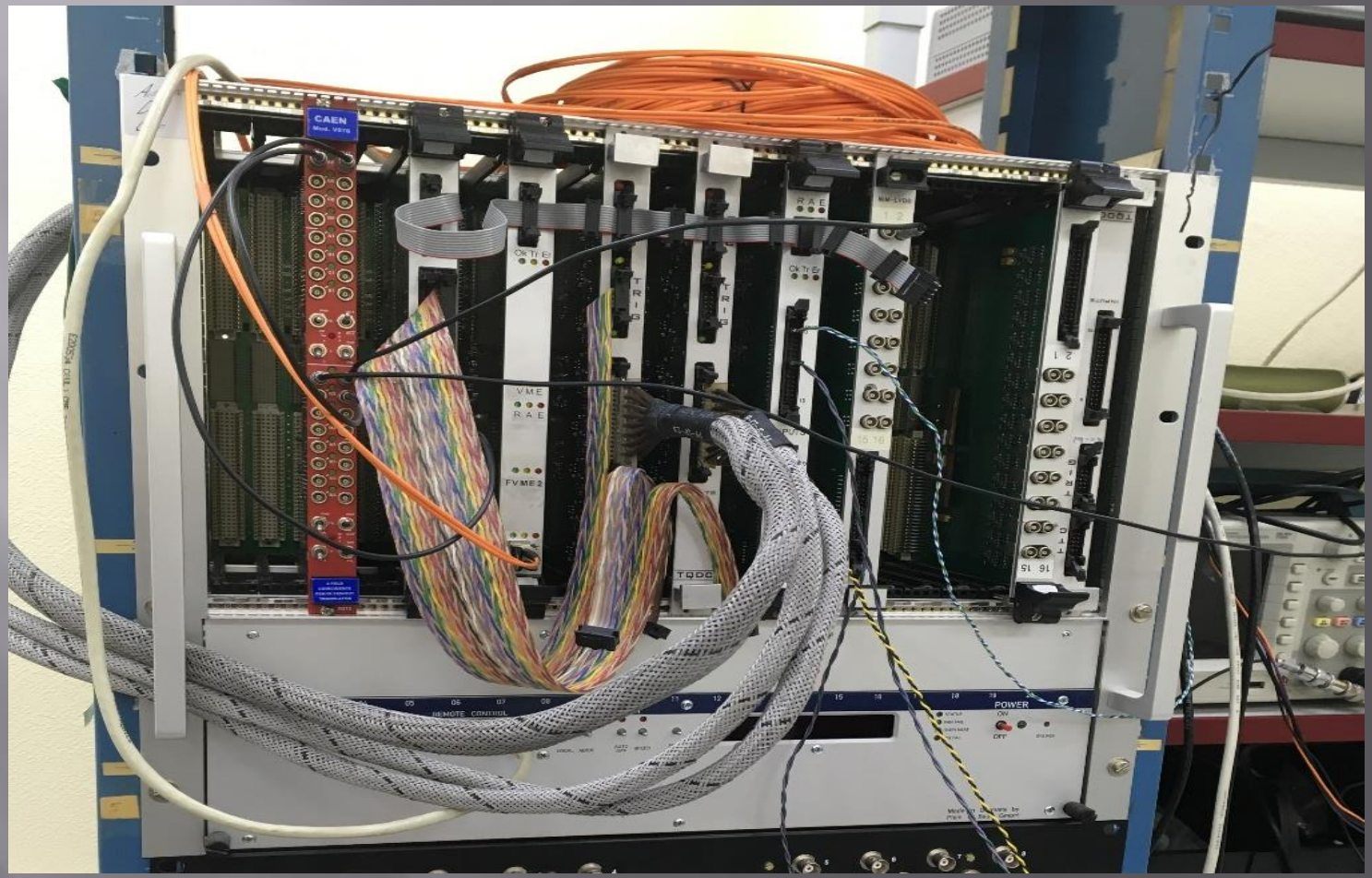


Размер в миллиметрах

Усилитель и сервис

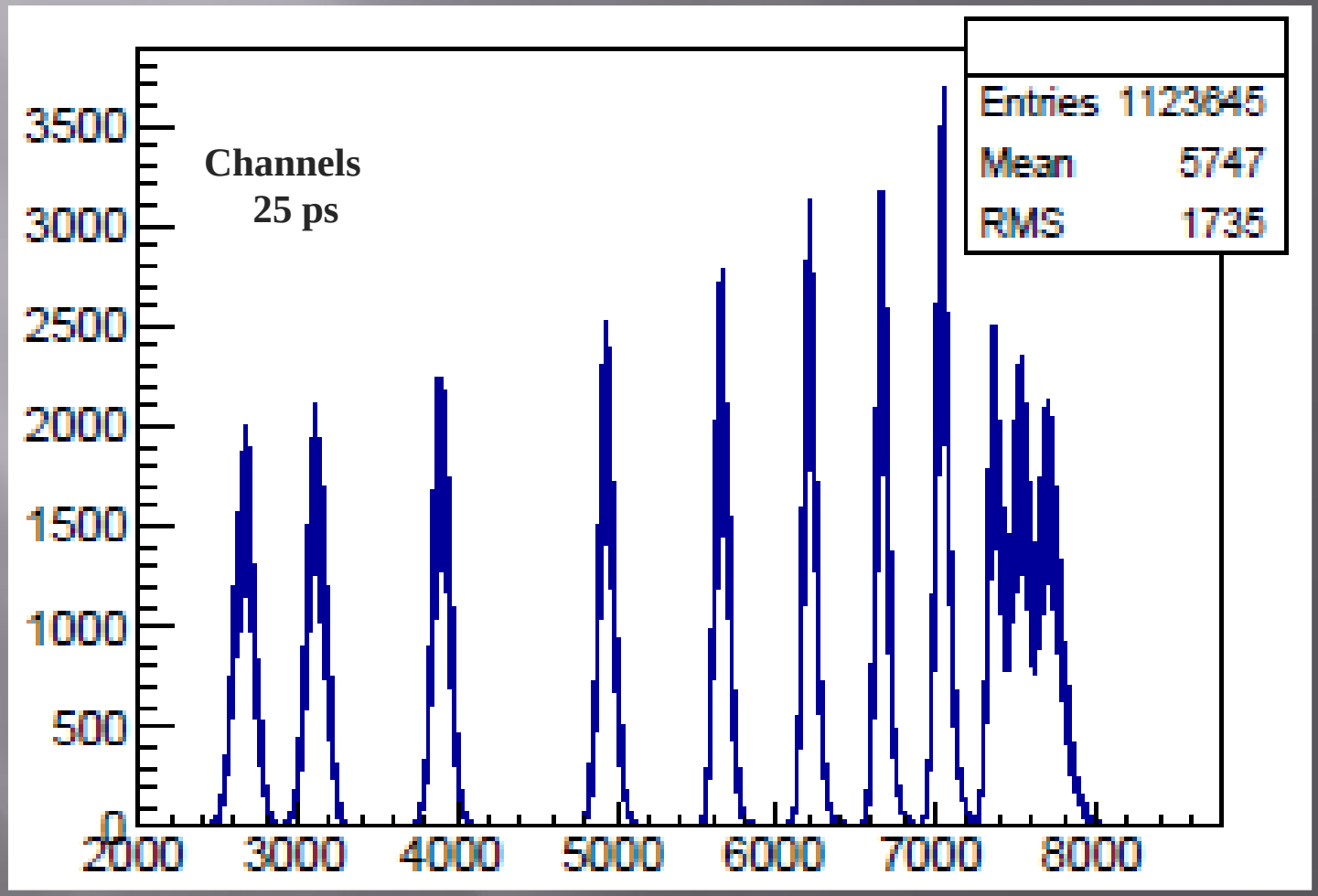


Тест стенд



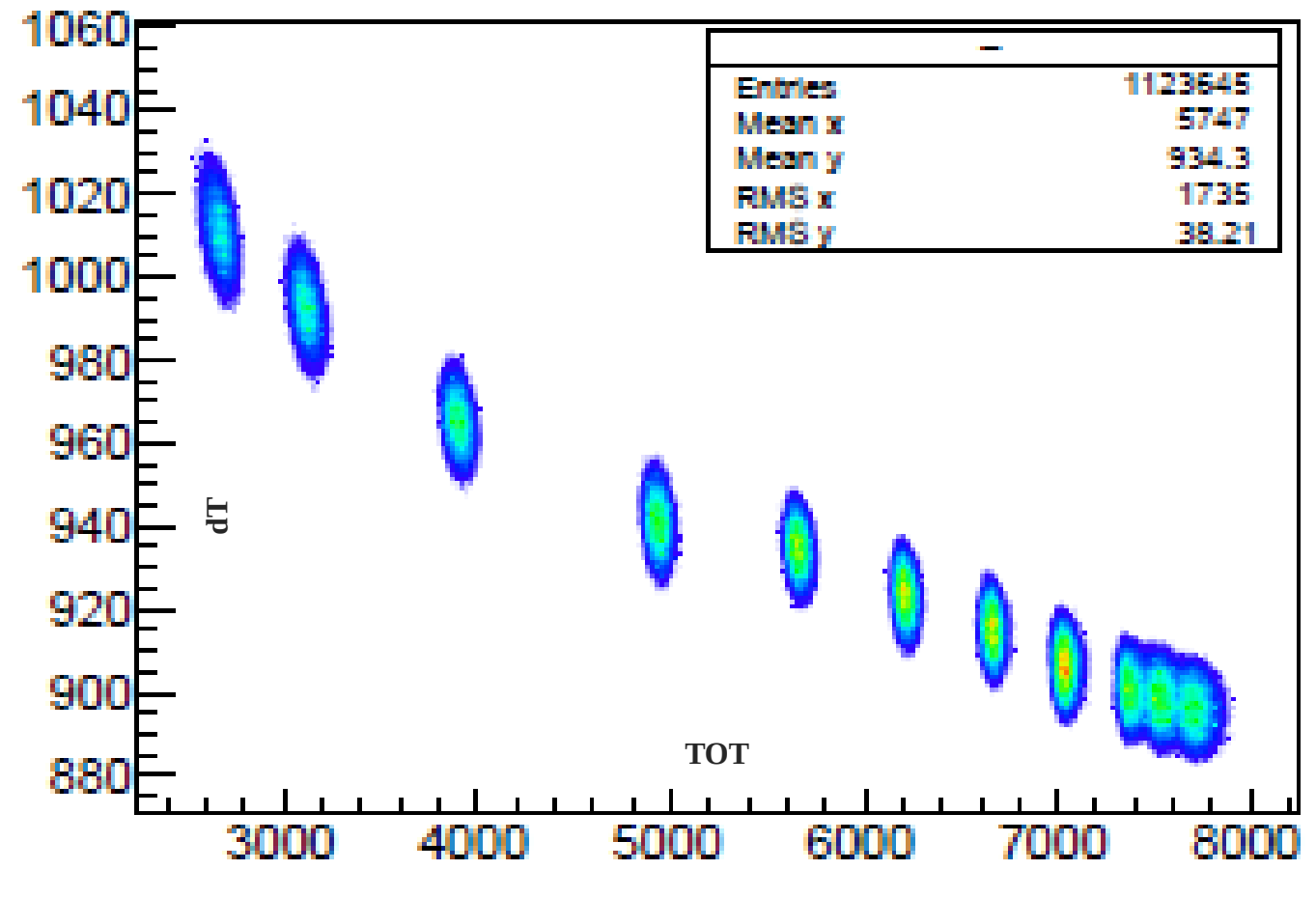
Результат

ТОТ



Результат

Correlation dT/TOT



Результат

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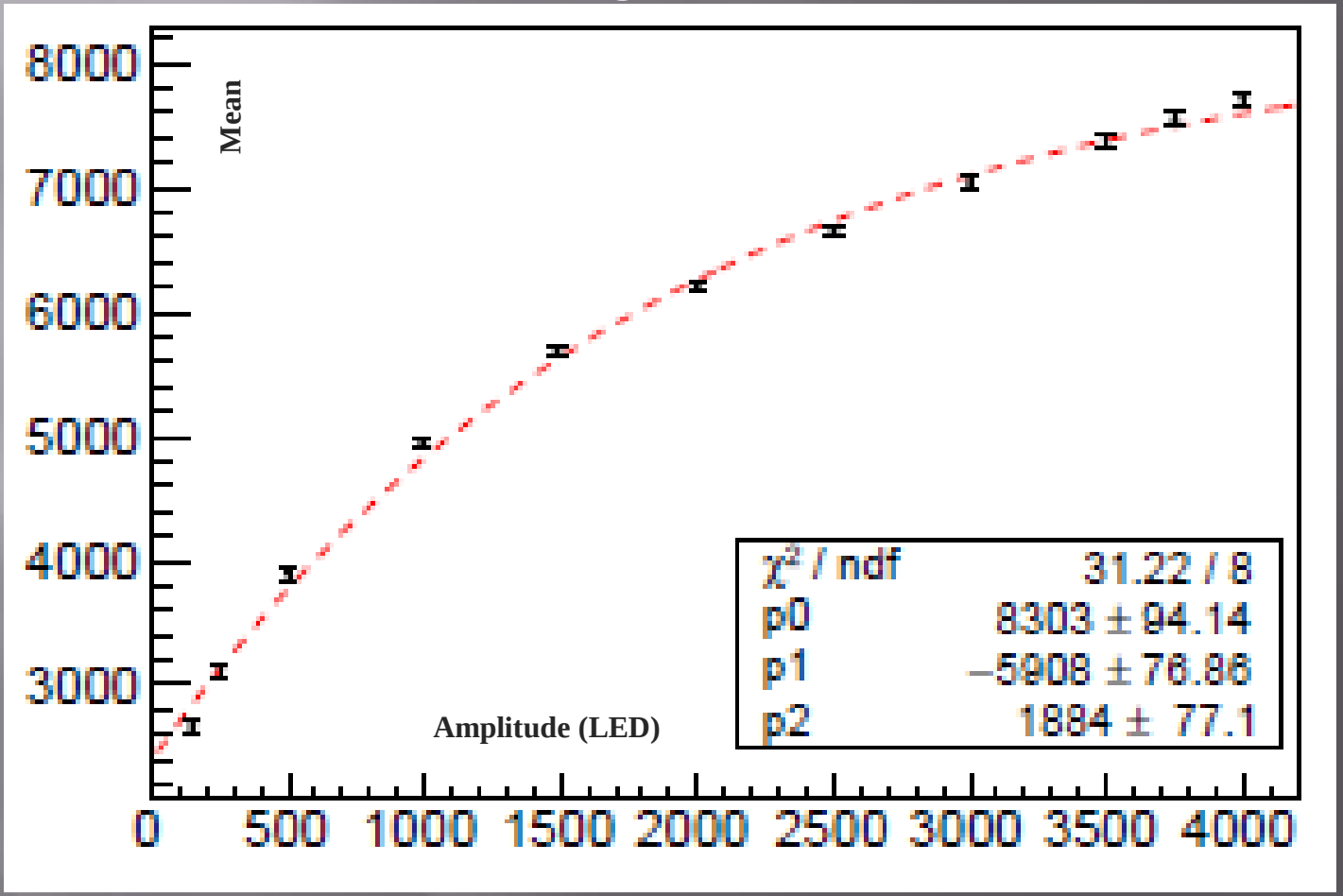

Результат

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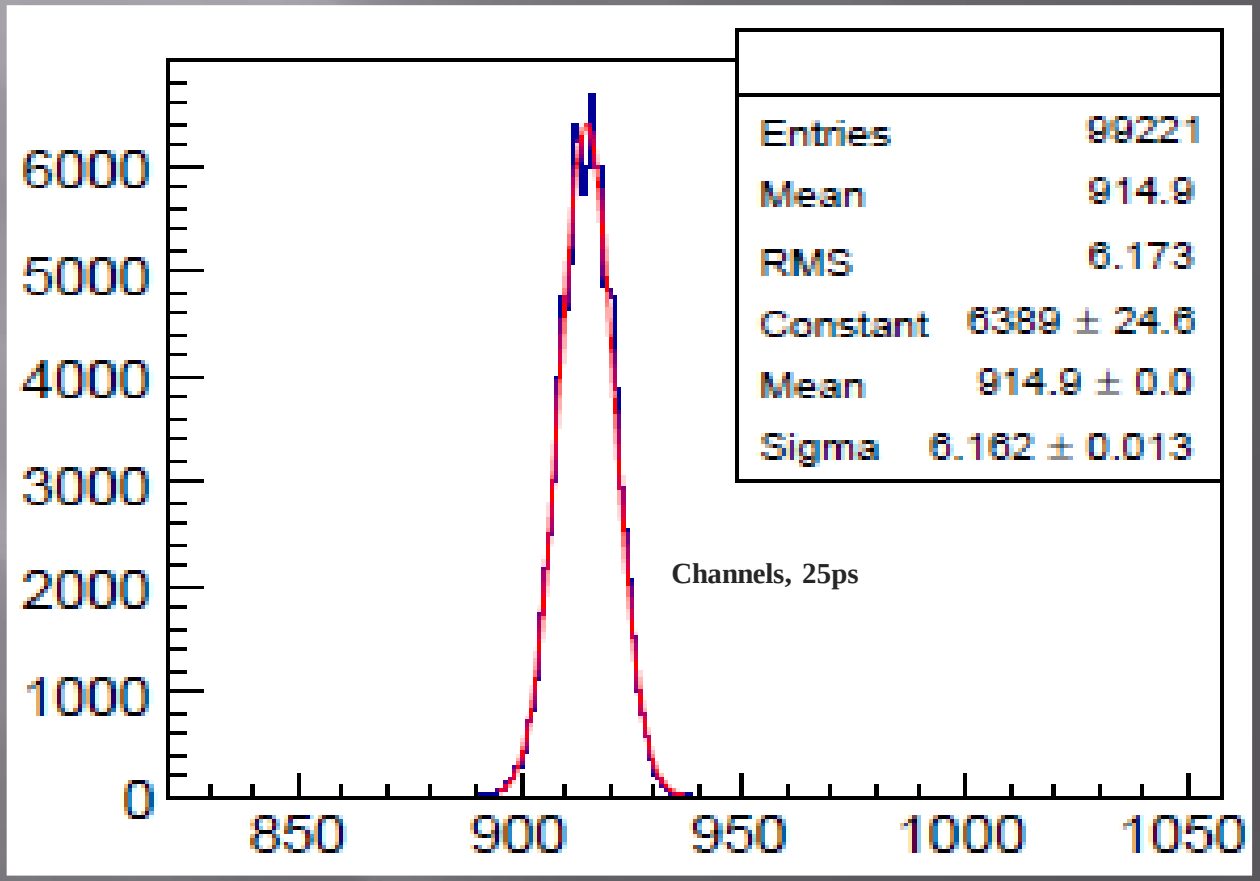

Заключение

- 1. Разработана схема предусилителя и изготовлены образцы.
- 2. Изготовлен модуль питания системы.
- 3. Проведены тесты.
- 4. Получена зависимость ТОТ.
- 6. Предварительно получено временное разрешение ~ 150ps.

СПАИБО ЗА ВНИМАНИЕ !

Дубна 16.12.2019