Status report of SiPM performance tests

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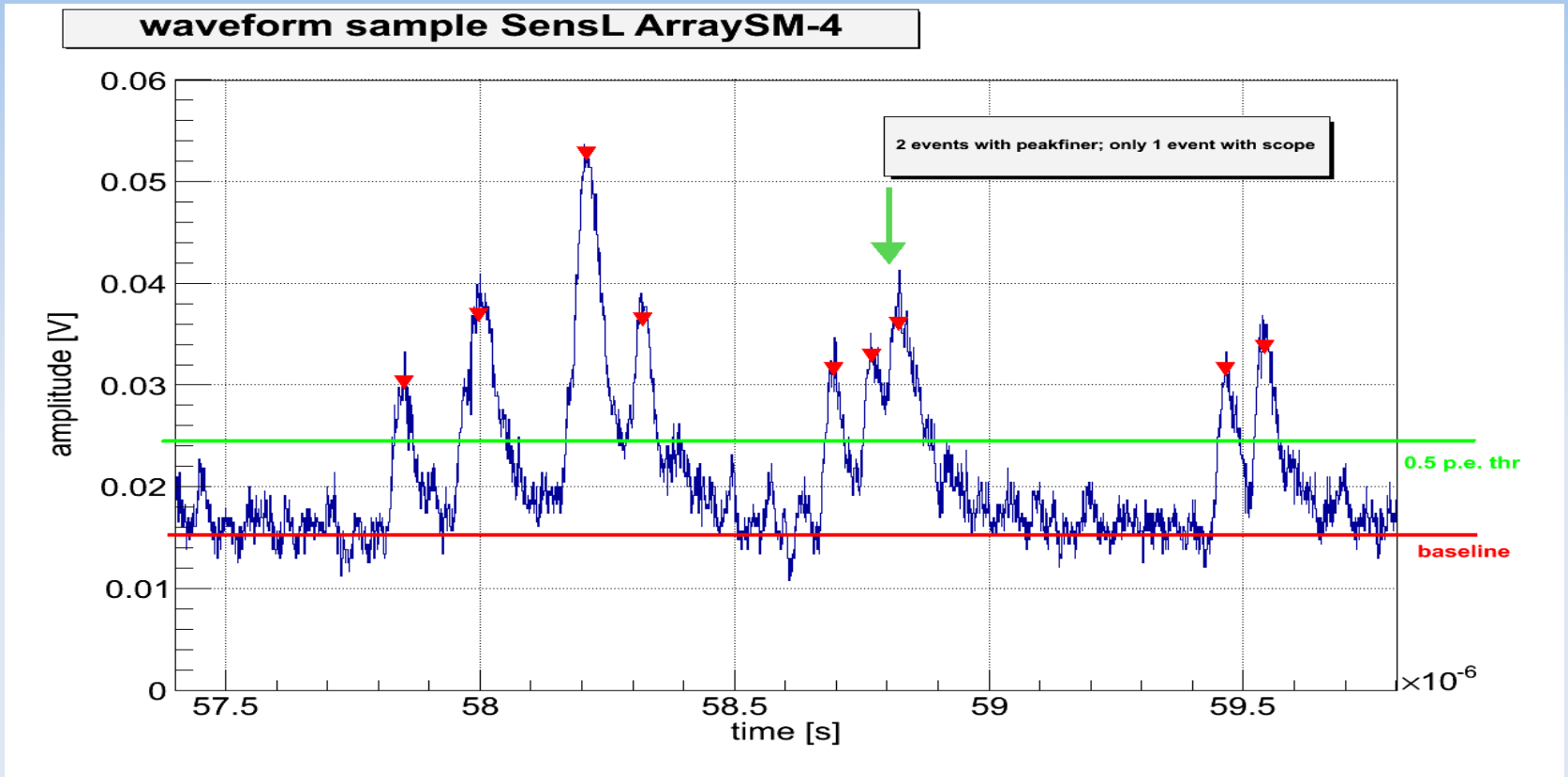
Investigated SiPMs

	SensL ArraySM-4	Hamamatsu S10362-11-100U
number of pixels	4x4	1
pixel active area (mm²)	3.05x3.05	1x1
microcells per pixel	4474	100
microcell area (µm²)	35x35	100x100
typ. Breakdown voltage	27.5V	70V
peak PDE	20% @ 500nm (VBr +2V, 21°C)	50% @ 440 nm
		

- Performance tests
  - dark count rate
  - time resolution
  - photo detection efficency (PDE)

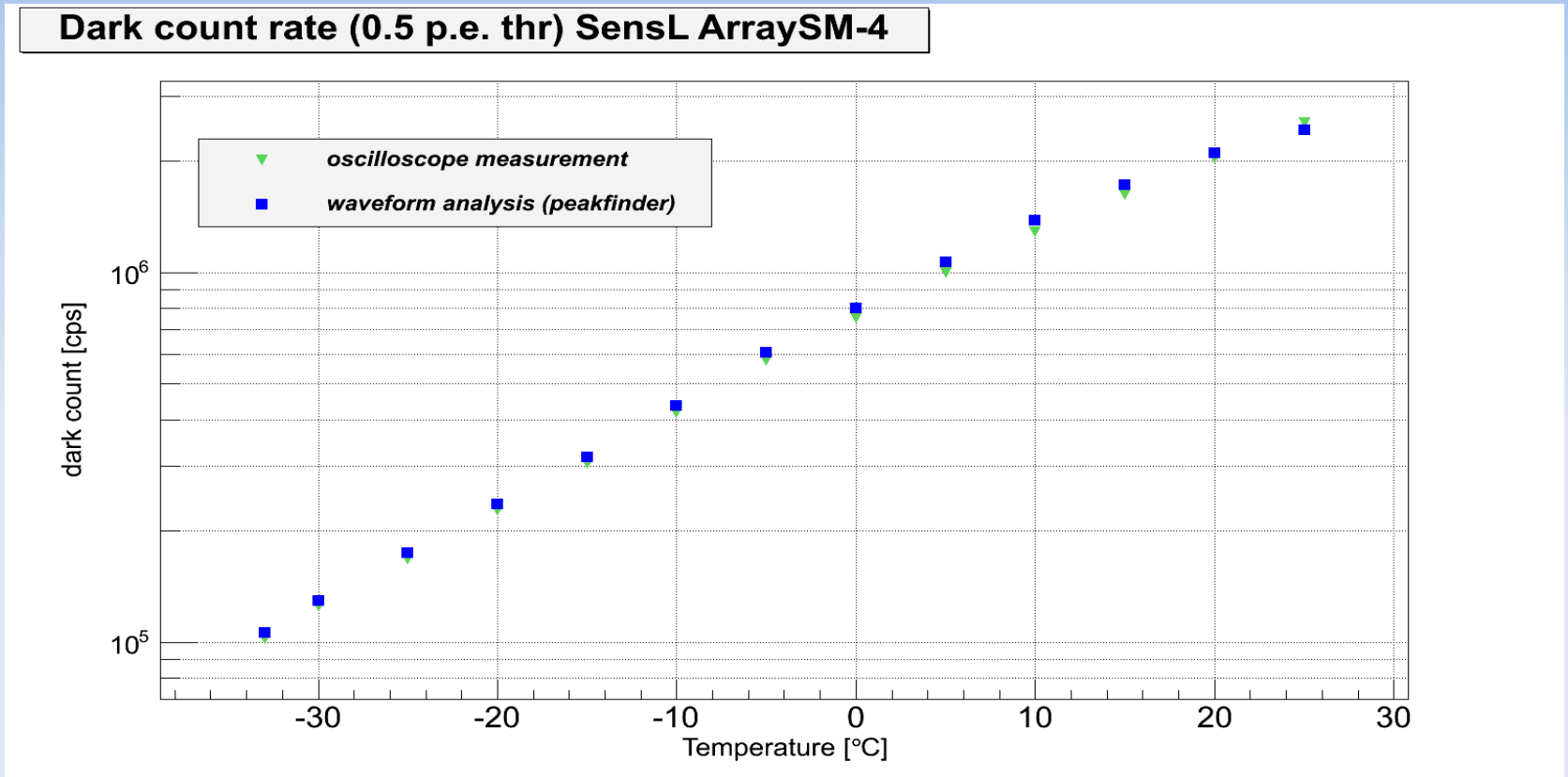
Methods to measure dark count rate



1. direct measurement with scope → may loose events from overlapping signals

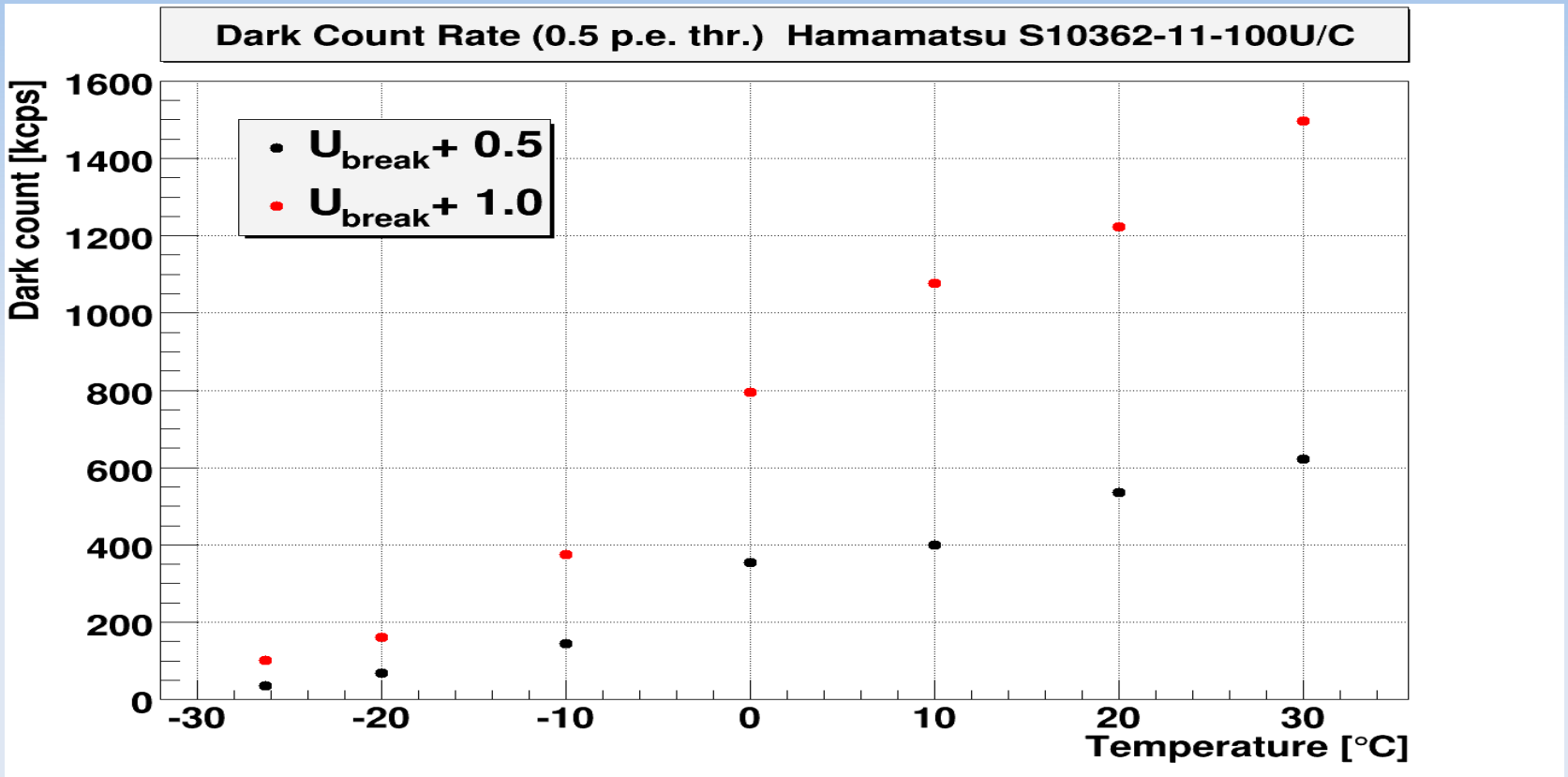
2. offline waveform analysis with peakfinder

Dark Count Rate vs Temperature of SensL SiPM



- maximum dark count rate of one pixel ~ 2.5 Mcps (at 30V, 25°C)
- dark count rate drops around factor ~ 15

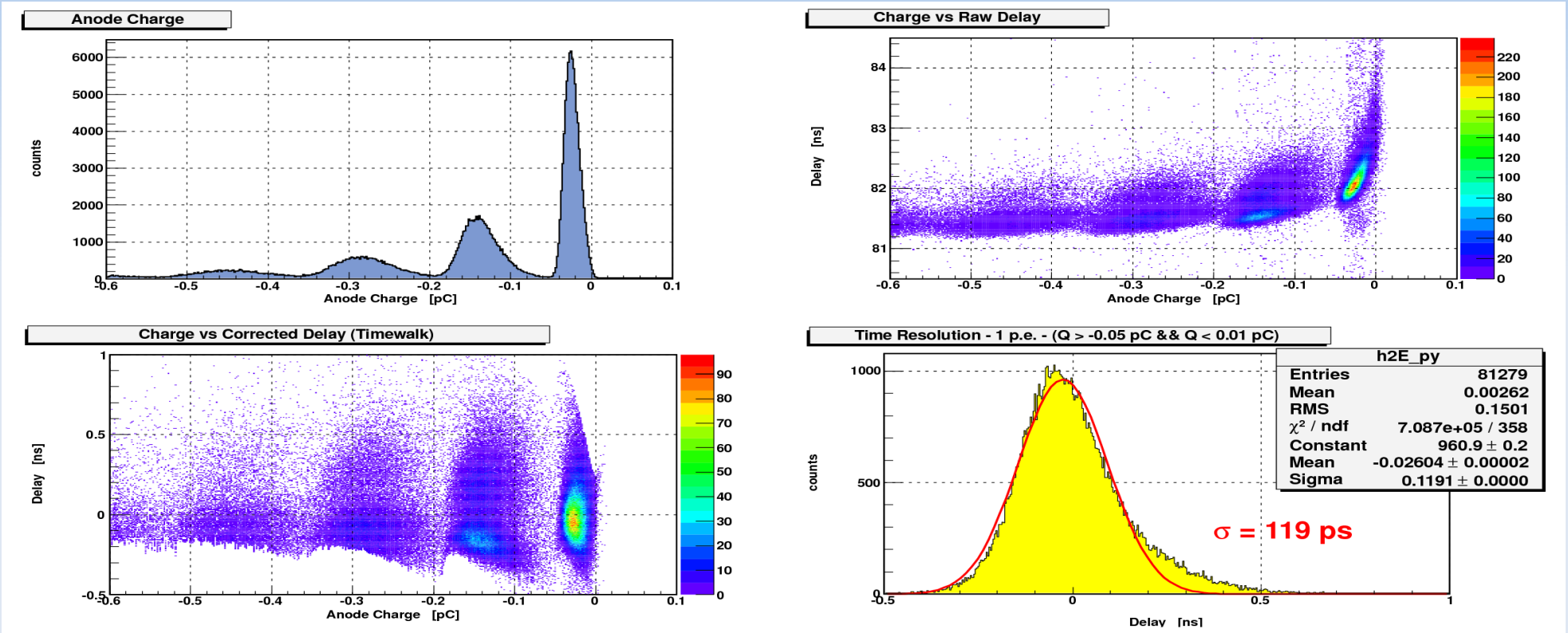
Dark Count Rate vs Temperature of Hamamatsu SiPM



- maximum dark count rates ~ 1.5 Mcps and ~ 600 kcps (at U_{br}+0.5/1, 30°C)
- dark count rate also drops around factor ~15 for both voltages

Time Resolution of Hamamatsu SiPM

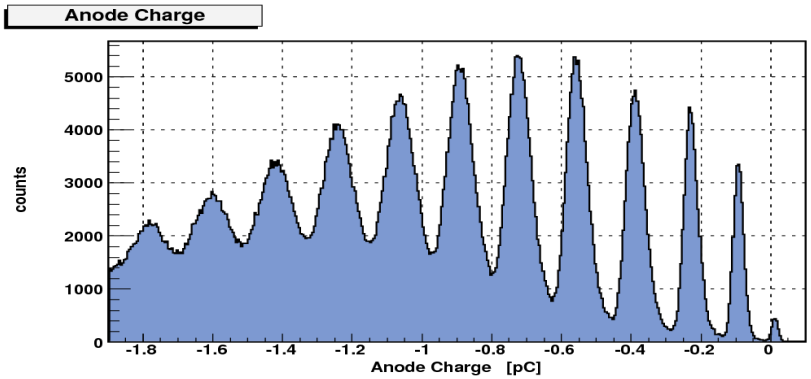
Amplifier Ortec FTA820 (x200; 350 MHz) --- Discriminator Philips Scientific 705

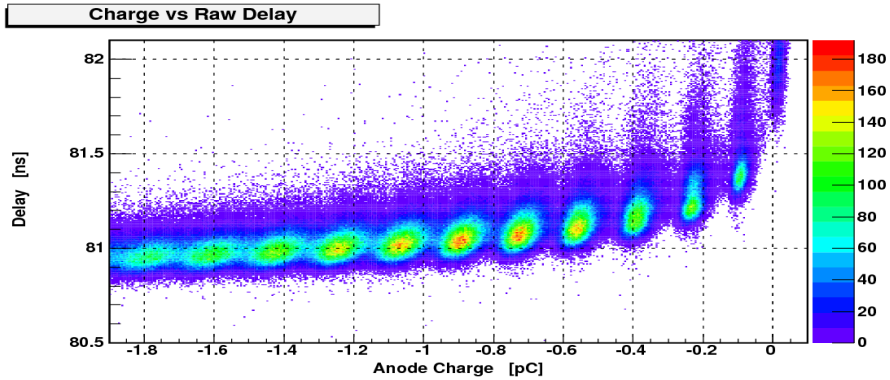


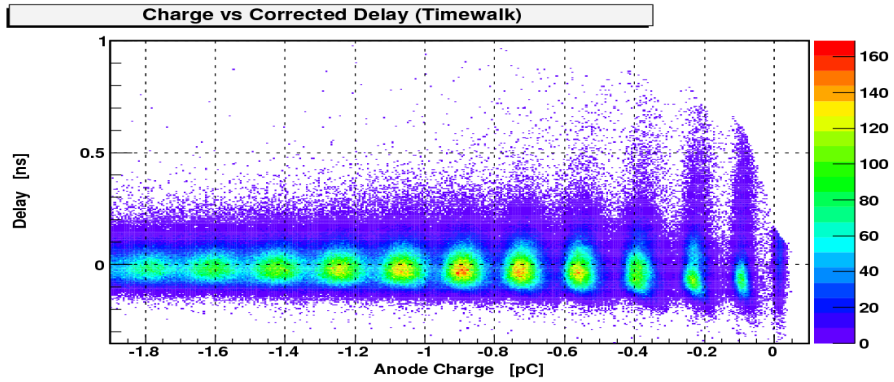
- measured with LeCroy WavePro 7300A oscilloscope at 25°C
- single photon time resolution σ = 119 ps

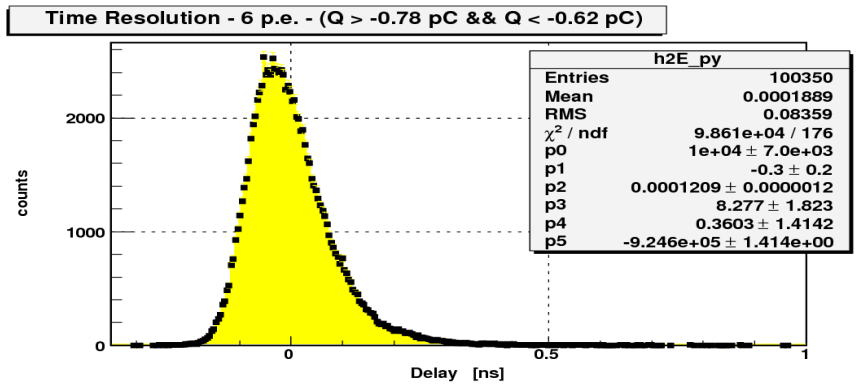
Time Resolution of Hamamatsu SiPM

Pulse height and timewalk spectra at -30°C



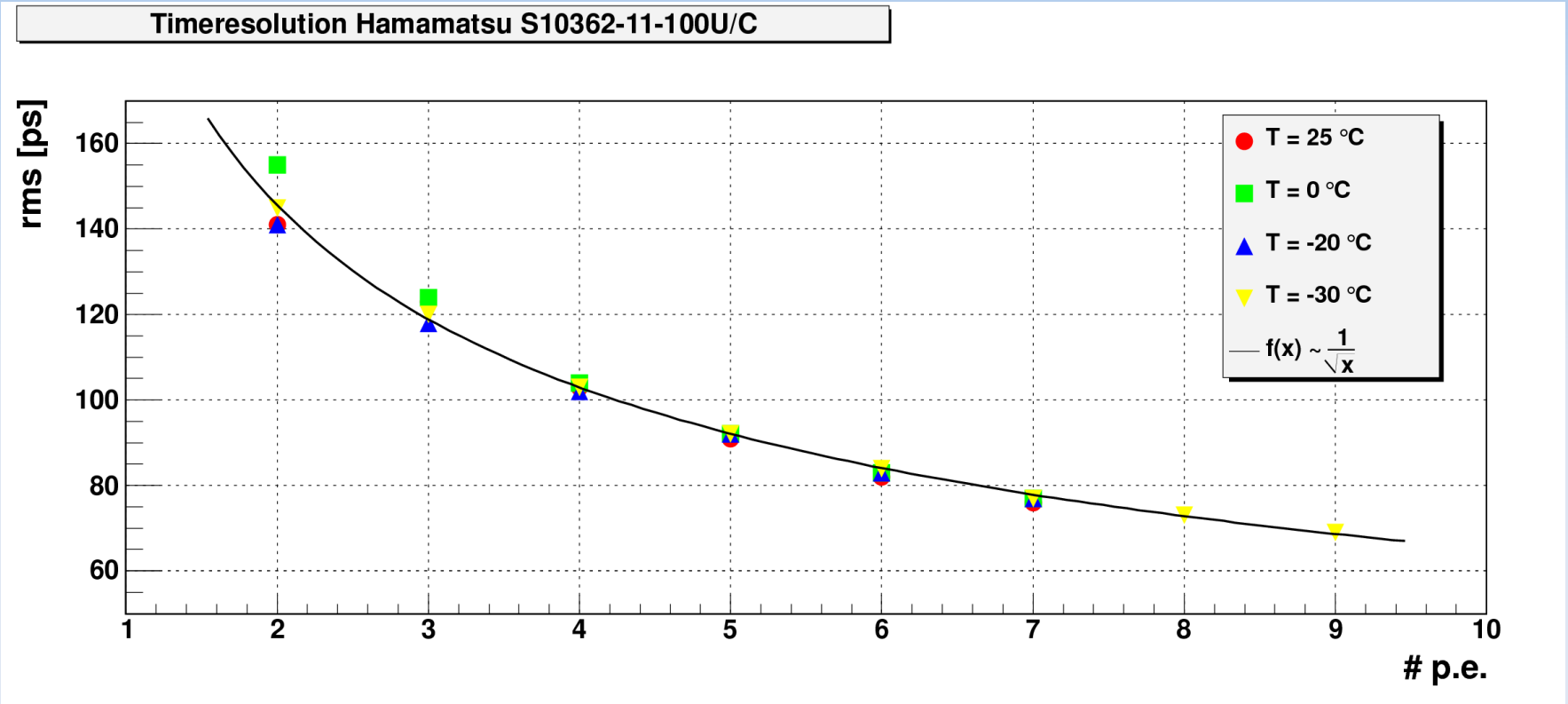






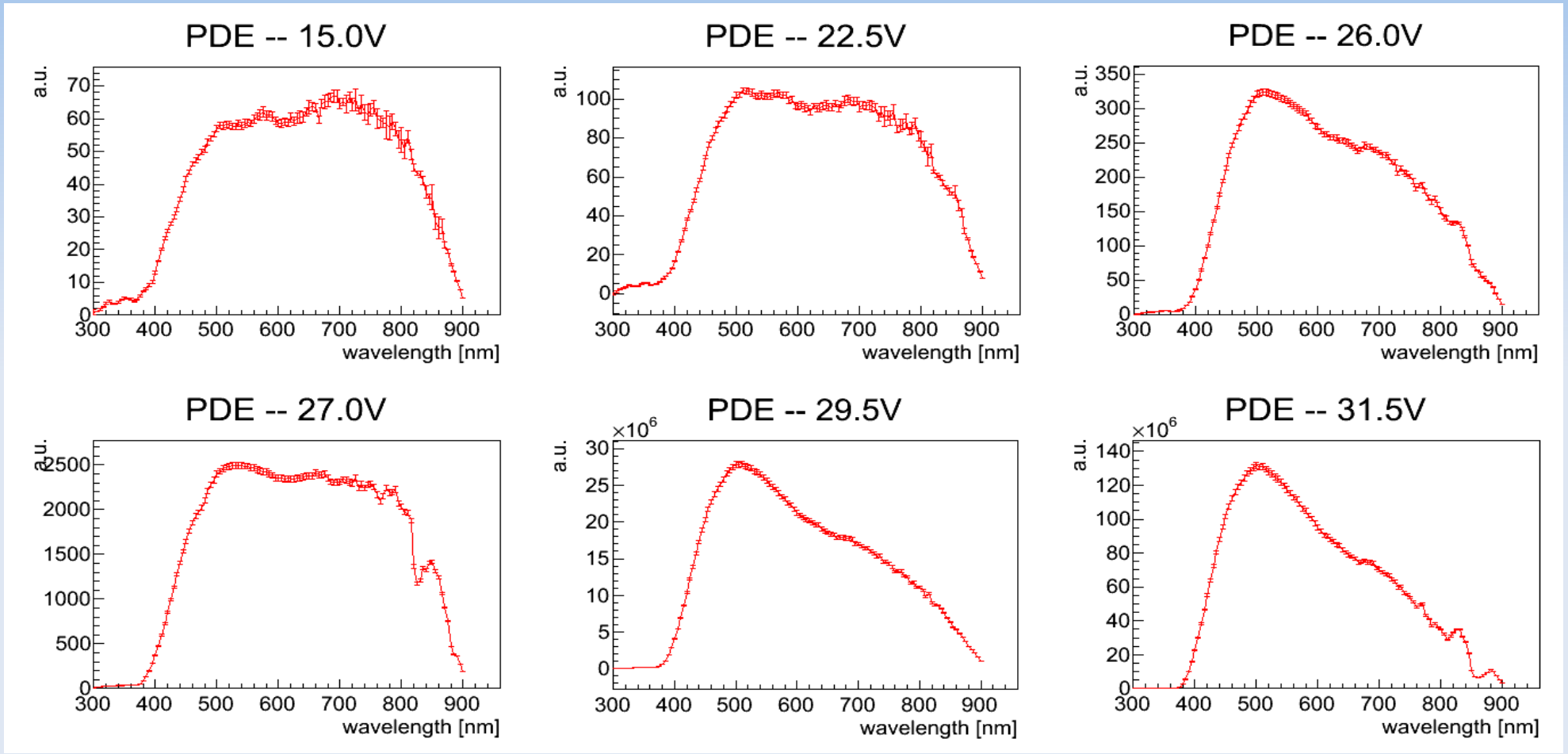
- multi-photon timing measurements down to -30°C

Time Resolution of Hamamatsu SiPM



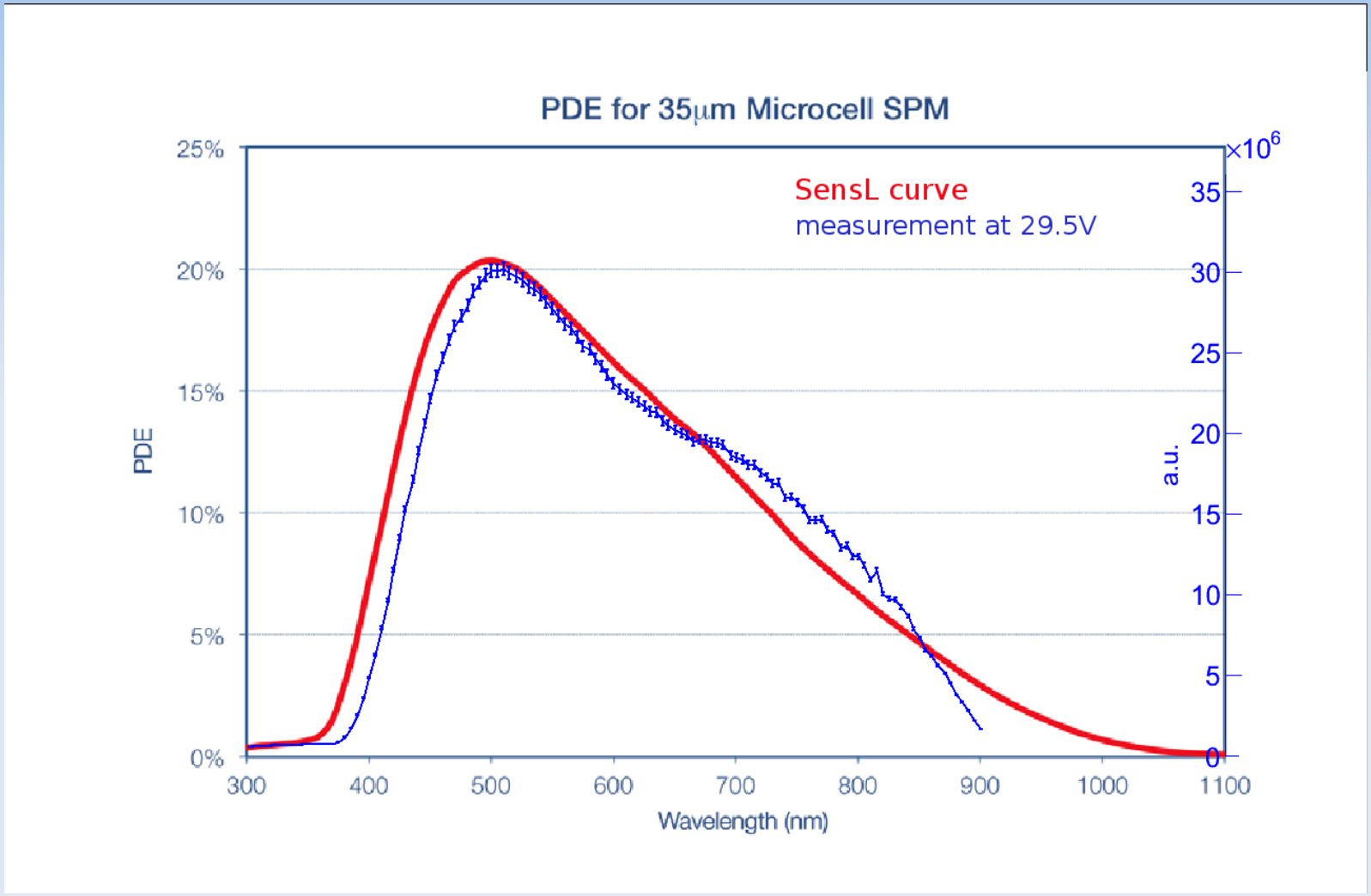
- slope of time resolution proportional to expected 1/sqrt(x)
- time resolution not dependent on temperature

PDE of SensL Array-4 SiPM (I)



- slope of PDE changes in specific voltages ranges (U_{br} at 27.5V ±0.5V)

PDE of SensL Array-4 SiPM (II)



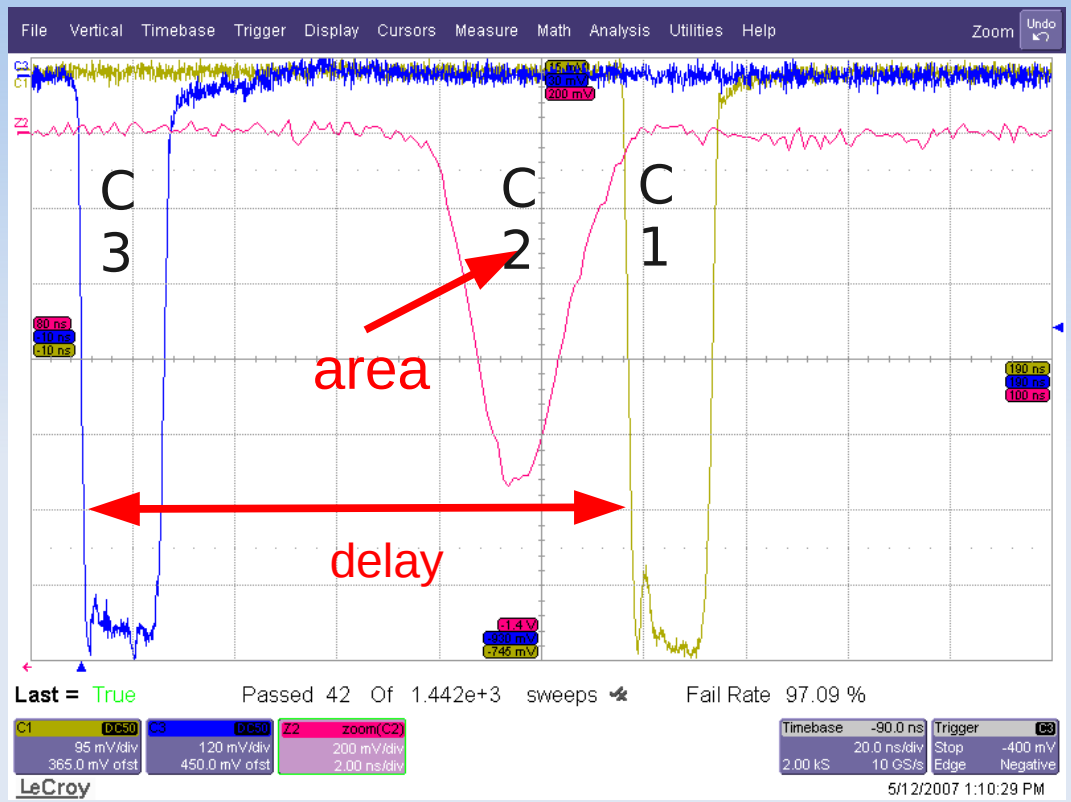
- measured PDE curve consistent with datasheet (exact gain measurement needed for absolute values)

Summary and Outlook

- dark count measurements down to -35°C
- time resolution of Hamamatsu S1063-11-50U SiPM not dependent on temperature
- first SiPM PDE measurements

- investigate Hamamatsu S10931-100P SiPM (one pixel, 3x3mm^2)
- build SciTil with improved version of 3x3mm^2 SiPM from Hamamatsu (lower dark count)

Time Resolution Measurements



- 3 GHz / 20 Gs oscilloscope
- measure area (C2)
- measure delay of PiLas reference pulse C3 to MCP pulse C1 ⇒ jitter ≡ time resolution

- timewalk to be corrected for
  - sampling noise of oszilloscope
  - longterm drifts in delay