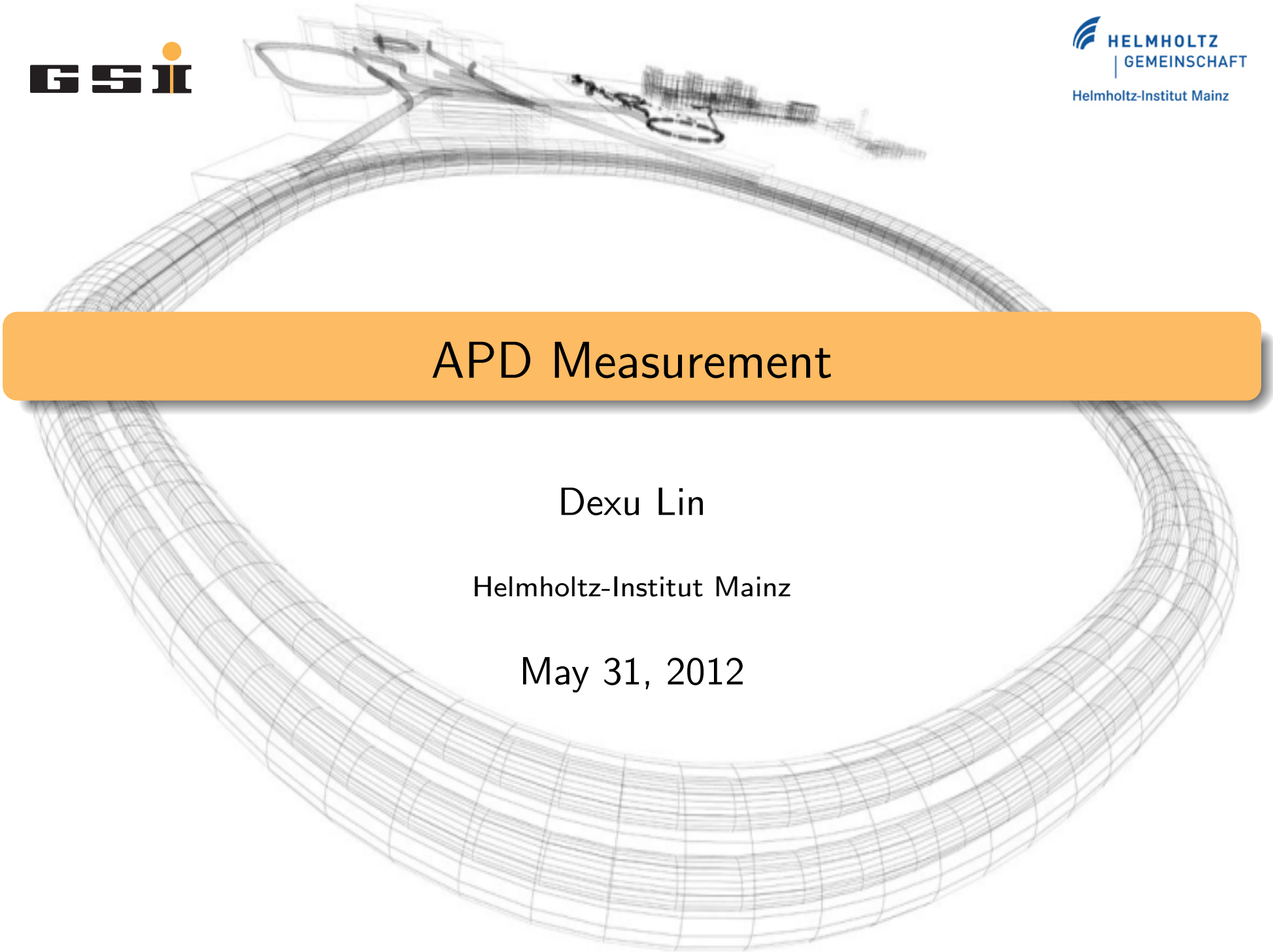

APD Measurement

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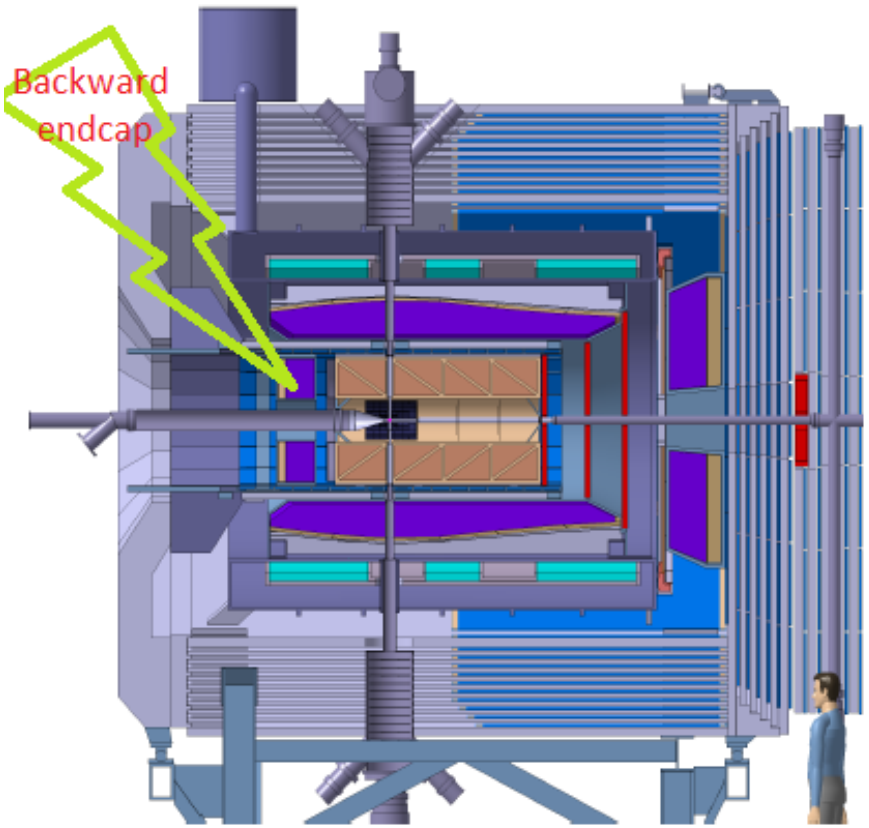
Outline

- 1. Introduction
- 2. Setup of the APD measurement
- 3. Results
- 4. Analysis
- 5. Summary and the future plan

Introduction

- EMC of $\bar{P}ANDA$
  - three components
  - scintillator: PWO II, $22X_0$
- Backward endcap
  - 0.8m in diameter;
  - located at 1m upstream from target;
  - angular coverage: $151.4^0 \sim 164.7^0$.
- Readout
  - two Large Area APDs (LAAPDs) per crystal;
  - active area: $7 \times 14mm^2$.



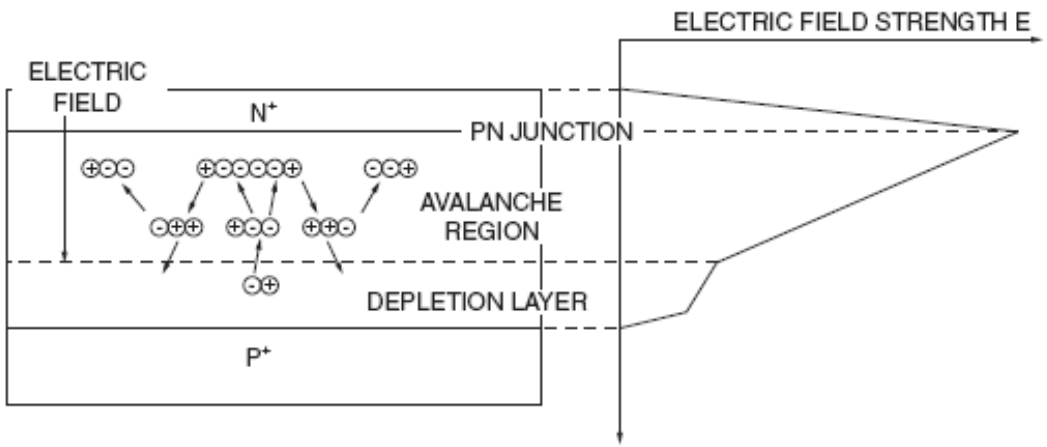
1

[1] TDR for $\bar{P}ANDA$ EMC(2008)

Introduction

- Avalanche Photodiode
  - thickness: $\sim 200\mu m$;
  - high quantum efficiency: $70 \sim 80\%$ at λ of maximum emission intensity of PWO.
- The avalanche process

Figure 1-1 Schematic diagram of avalanche process



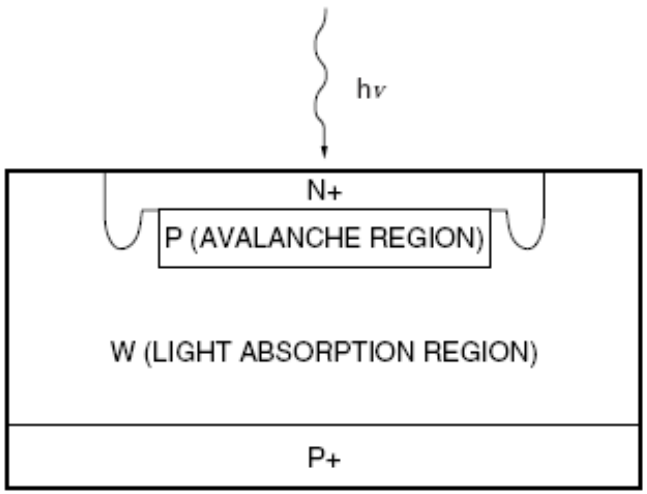
[2]

[2] Technical information SD-28 HAMAMATSU

Introduction

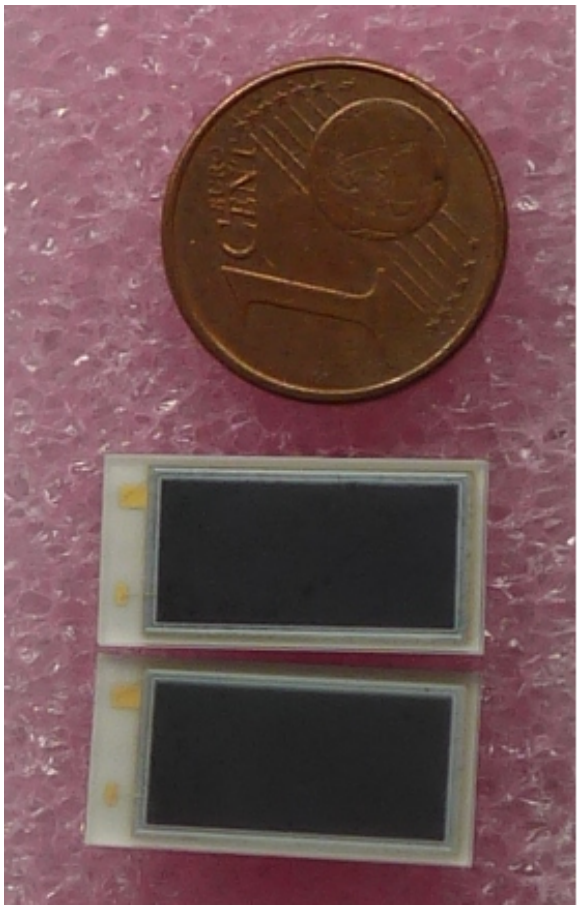
- Principle of operation of an APD

Figure 2-1 Cross section of near infrared APD



KAPDC0012EA [3]

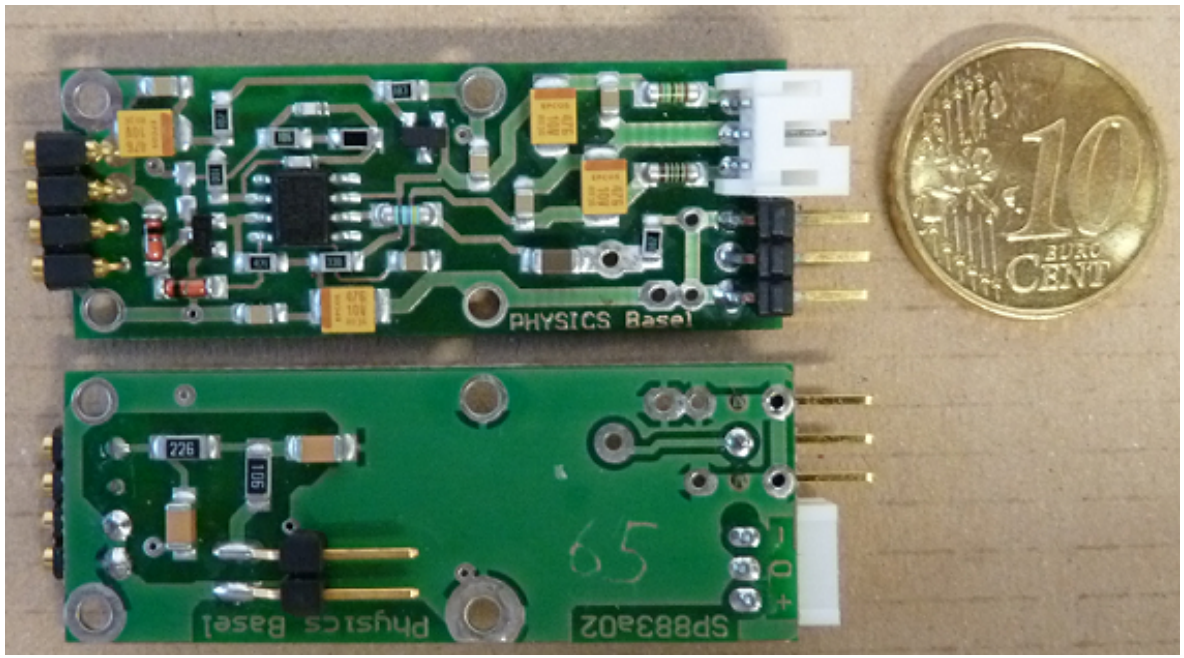
- Large Area APD (Avalanche Photodiode)



[3] Technical information SD-28 HAMAMATSU

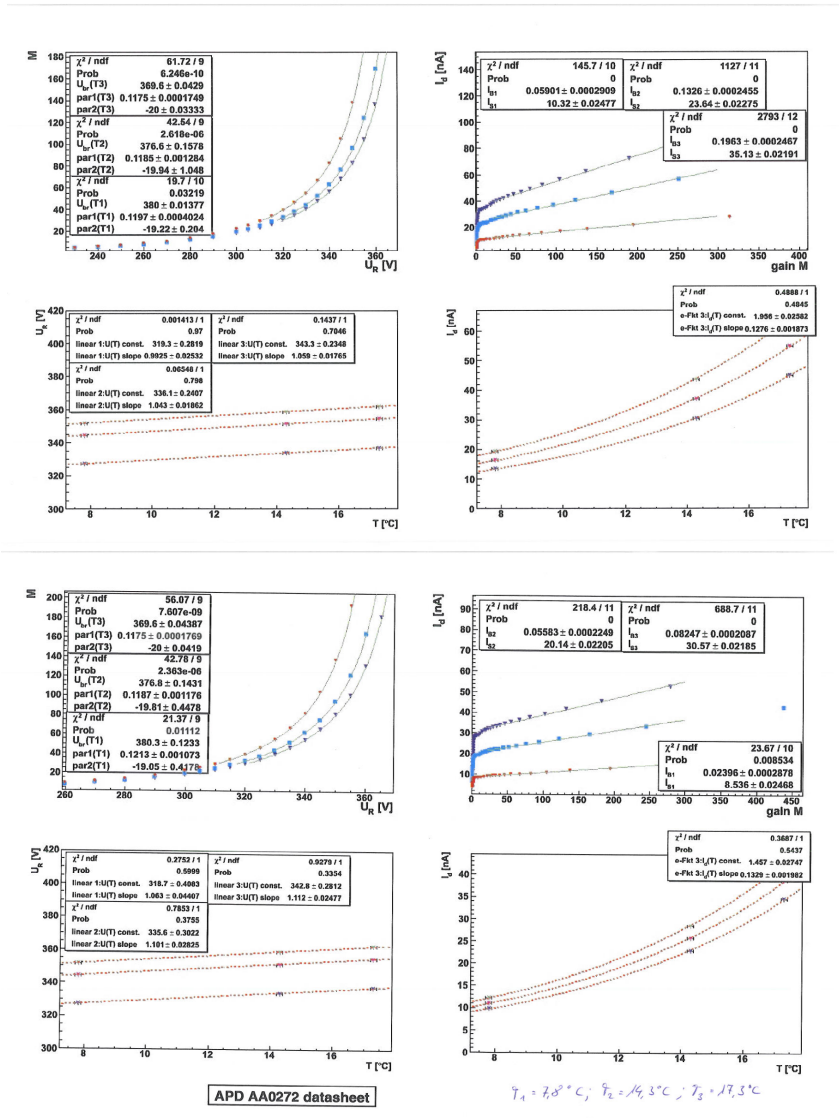
Introduction

- Low noise/low power(LNP) charge sensitive preamplifier
  - low energy threshold of EMC requires an extreme low noise;
  - low power consumption from the front-end electronics.



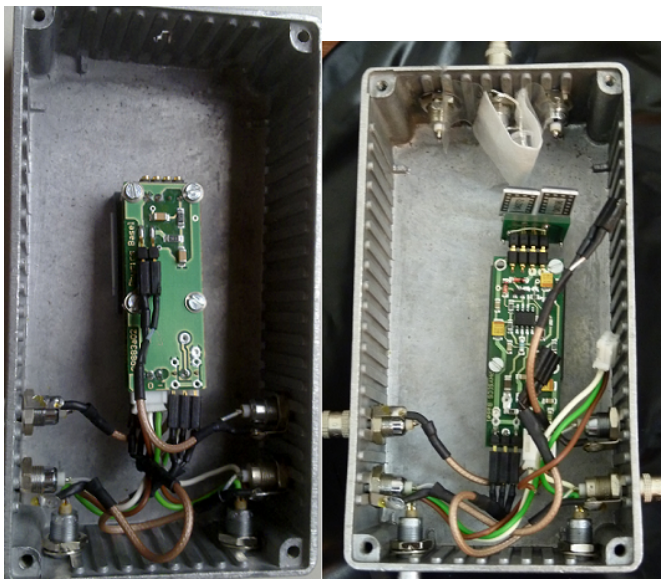
Introduction

- Three different cables from preamplifier;
- The space constraint in the backward endcap EMC;
- The signals from two APDs of one crystal will be summed up after ASIC;
- If we can find two APDs with the same Gain-Voltage characteristics, we can send the two signal from two APDs into one preamplifier

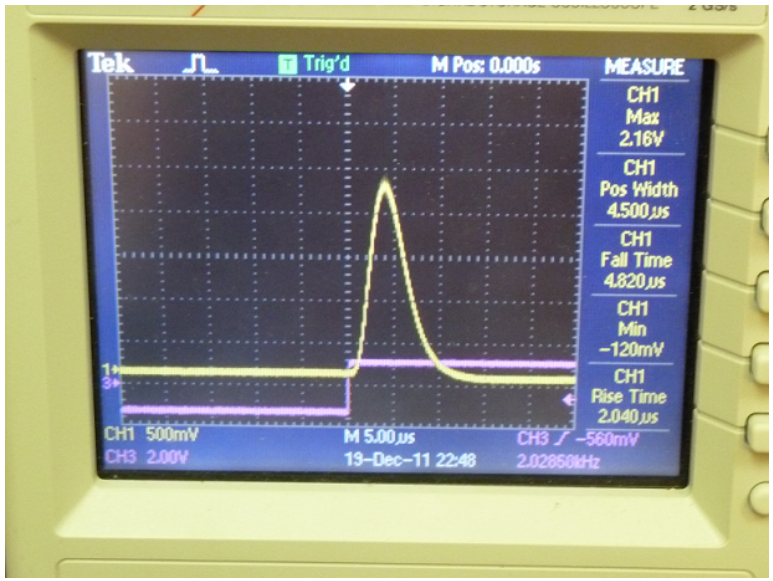


Setup of the APD Measurement

- The instrument for APD measurement
  - easy to mount the APD and preamplifier;
  - well ground and light tight;
  - fixed the LED pulser.



- Signal Measurement Oscilloscape and shaping amplifier

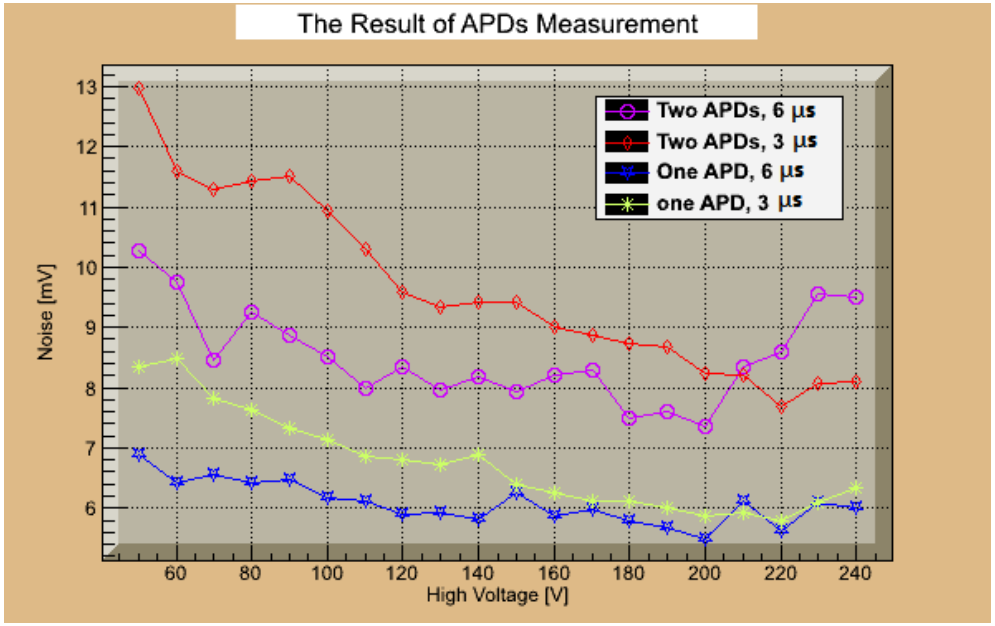


Setup of the APD Measurement

- Noise measurement: without LED pulser
- Signal measurement: with LED pulser
- One preamplifier for one APD
- One preamplifier for two APDs

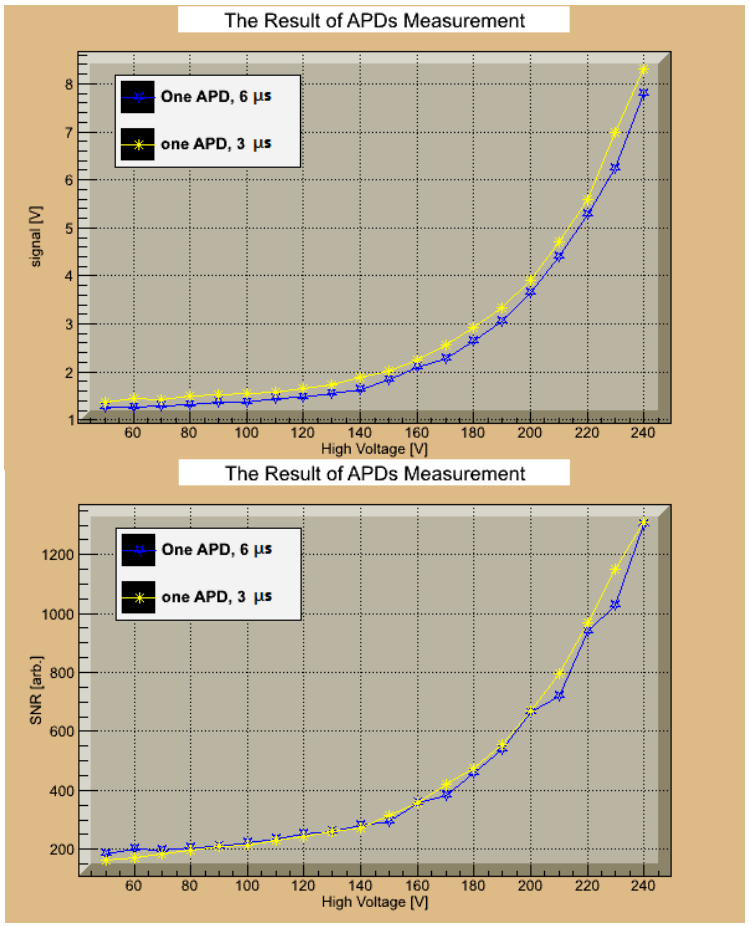
Results

- The noise measurement
  - without LED pulser;
  - the HV of APD is from 50V to 240V stepped by 10V.

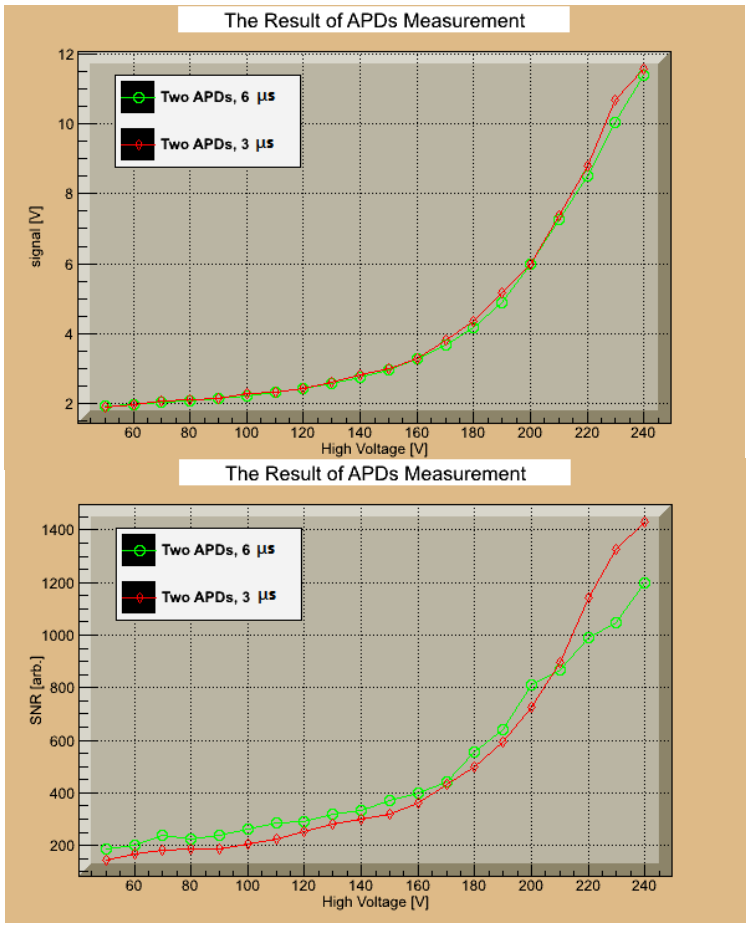


Results

- Signal-to-noise(SNR)
  - one preamplifier for one APD



- Signal-to-noise(SNR)
  - one preamplifier for two APDs

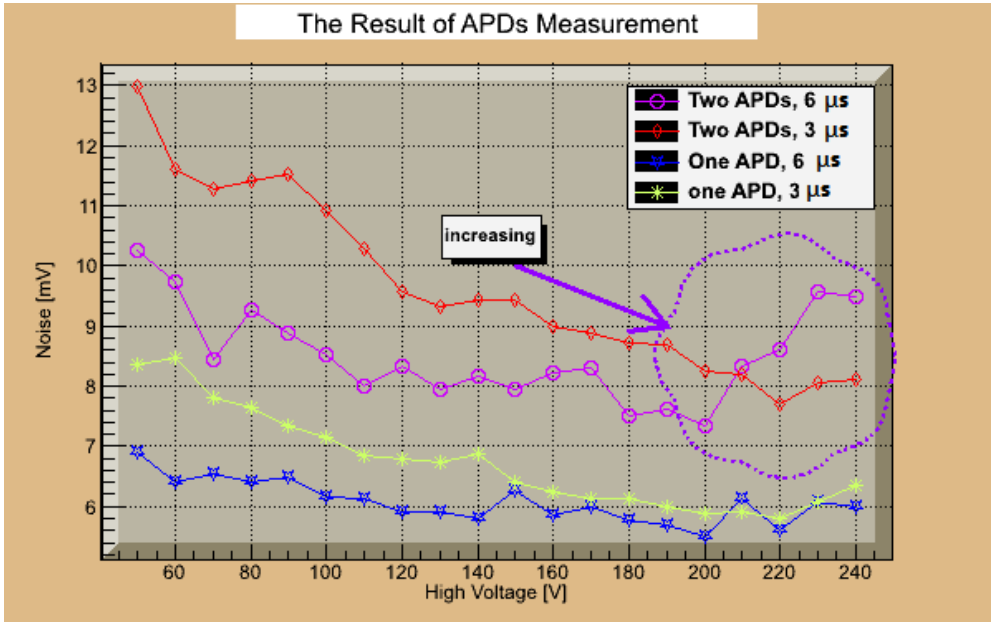


Analysis

- the noise is decreased with the high voltage;
- comparing the noise from one APD and two APDs:

$$N_{two} = \sqrt{2} \times N_{one}$$

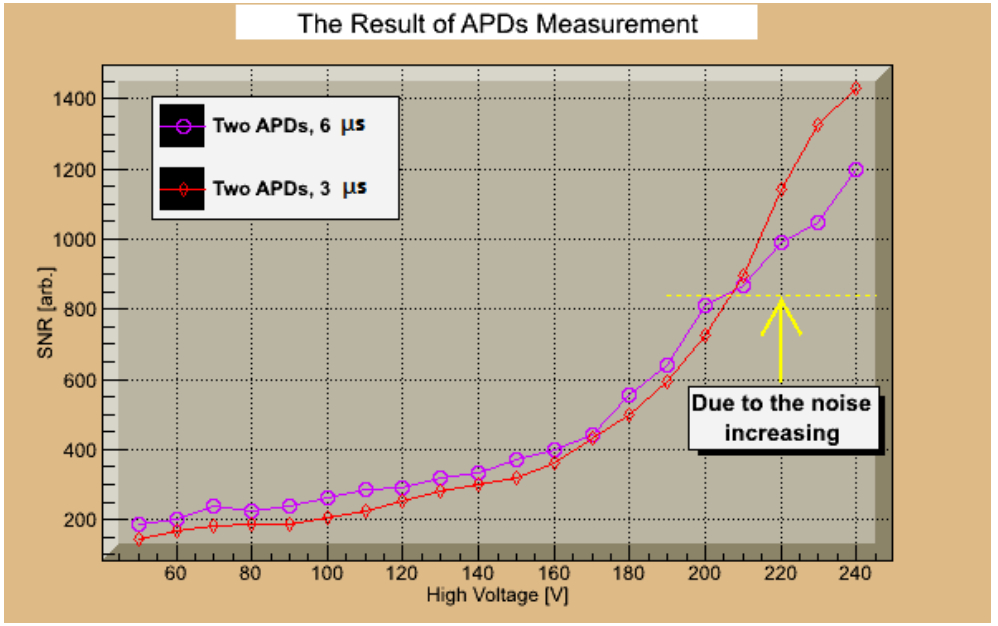
- for two APDs on 6 μs shaping time, when HV>200V, the noise is increased;



Analysis

- the SNRs are not so much different with different shaping time;

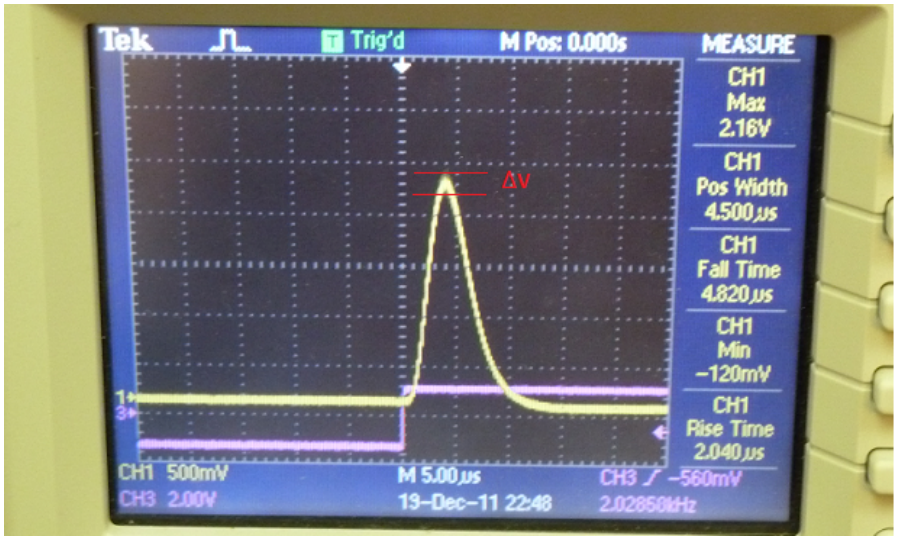
- the SNR of two APDs on 6μs is smaller than it on 3μs when the HV is bigger than 200V, which is due to the noise increasing.



Summary and the future plan

- the difference of nois from one APD and two APDs are measured;
- comparing the SNR of two measurement methods on different shaping time.

- measure FWHM with an ADC(MCA) and compare the energy resolution with one APD and two APDs;



- improve the measurement instrument.