Recent R&D at Nara

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for Tamaki Hirai / Tomoko Iwashita

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SuperBelle calorimeter meeting

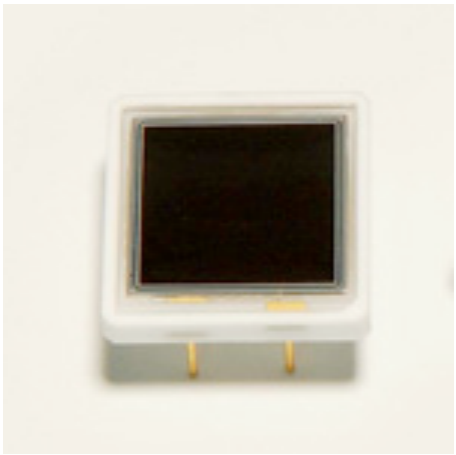
Outline

- S8664 series APD readout option
  - Attaching to PureCsI, cosmic signal seen.
  - Comments on ^{241}Am(60keV X-ray) usage.

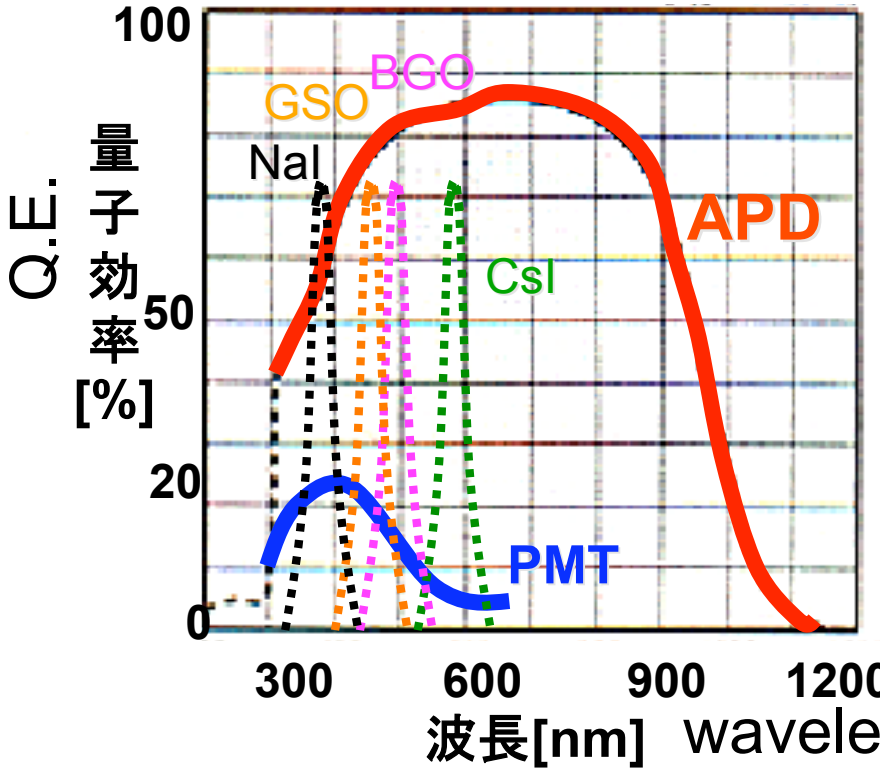
- Plans of Pr:LuAG
  - As soon as new ceramic sample gotten, radiation hardness will be tested.

Hamamatsu S8664-1010 APD

- Active area : 1cm×1cm.
- Quantum Efficiency 35~40% @300nm.
- Typical gain : 50.

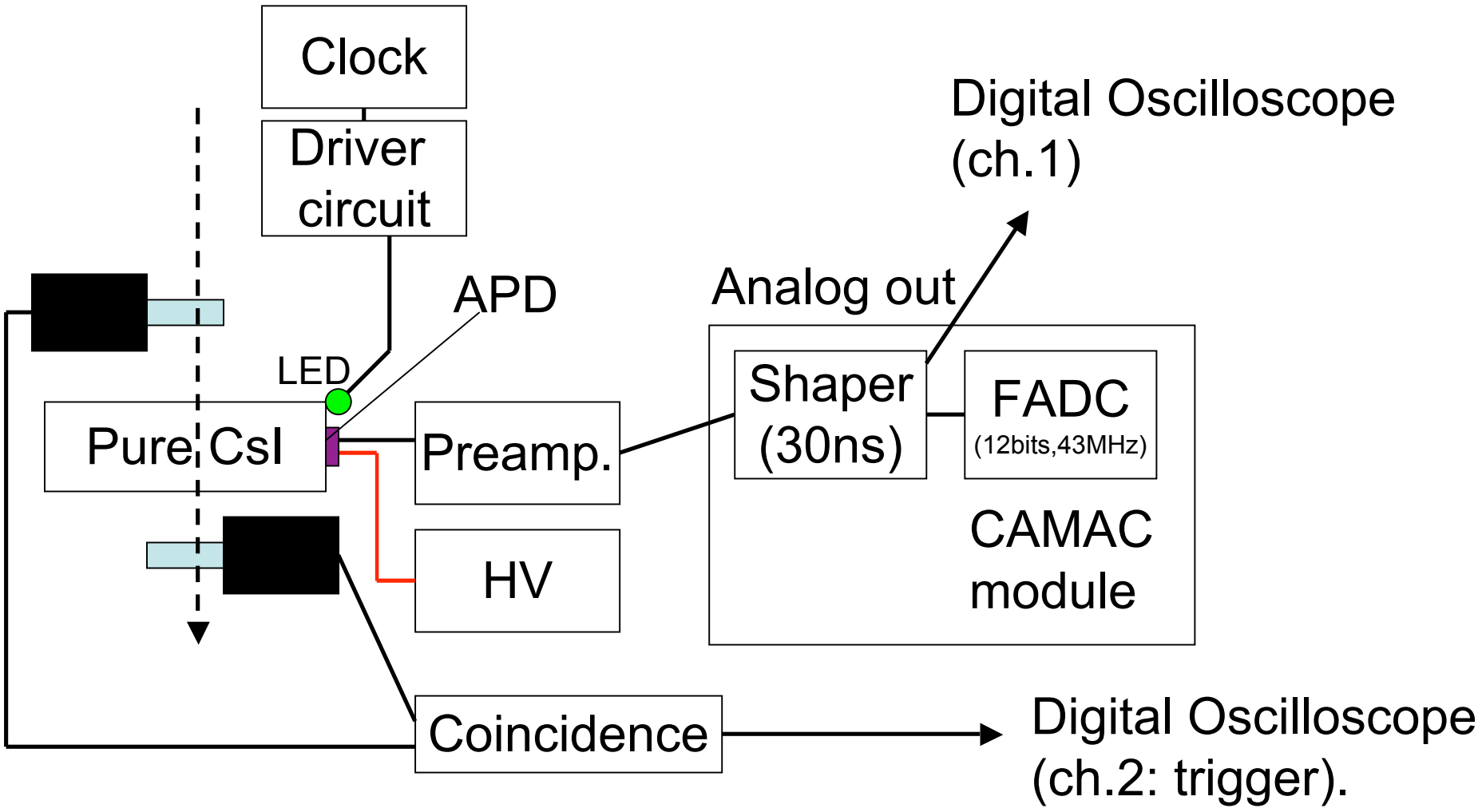


S8664-1010
(Taken from Hamamatsu web page)

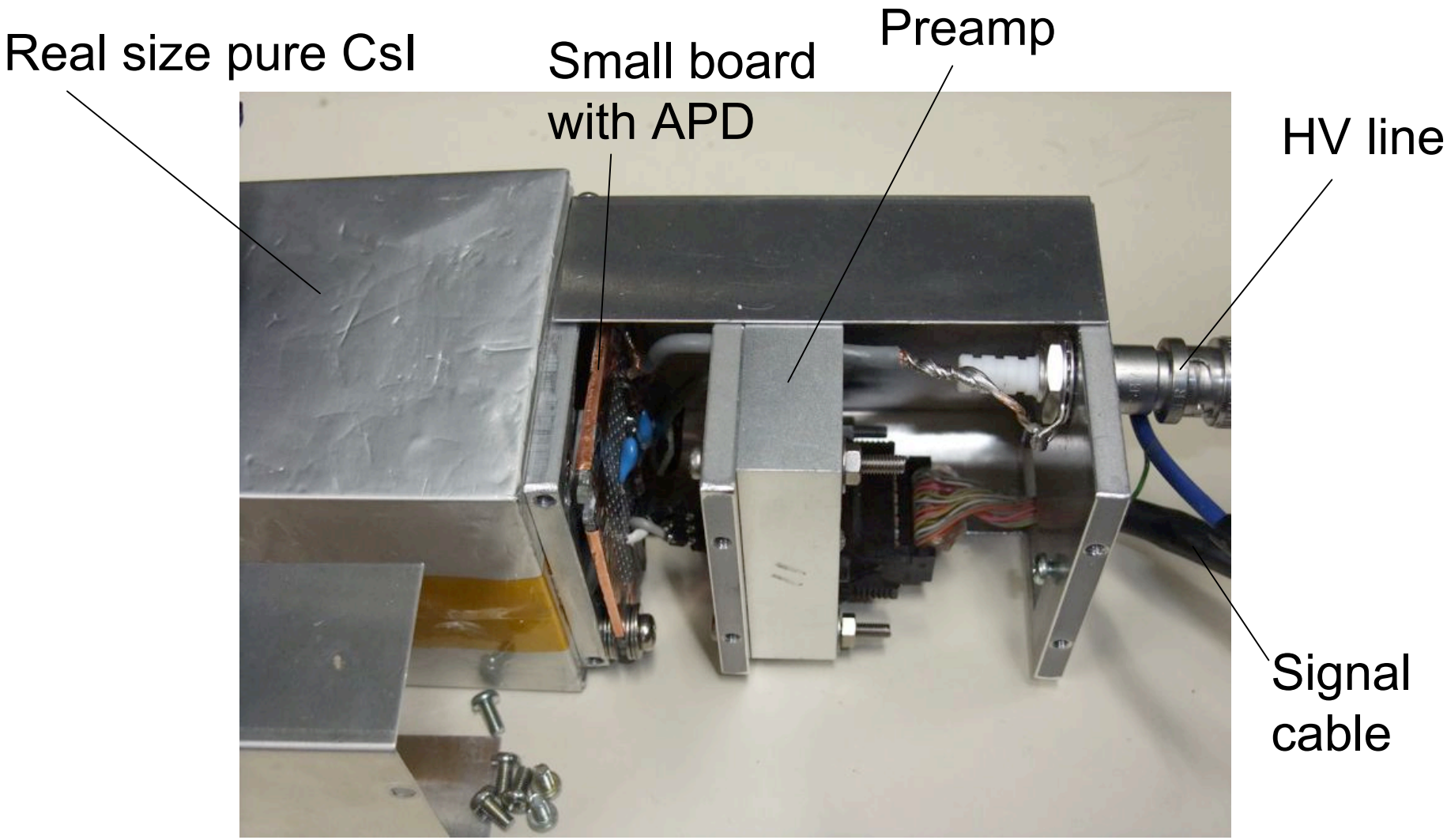


Taken from Dr. J.Kataoka's ppt

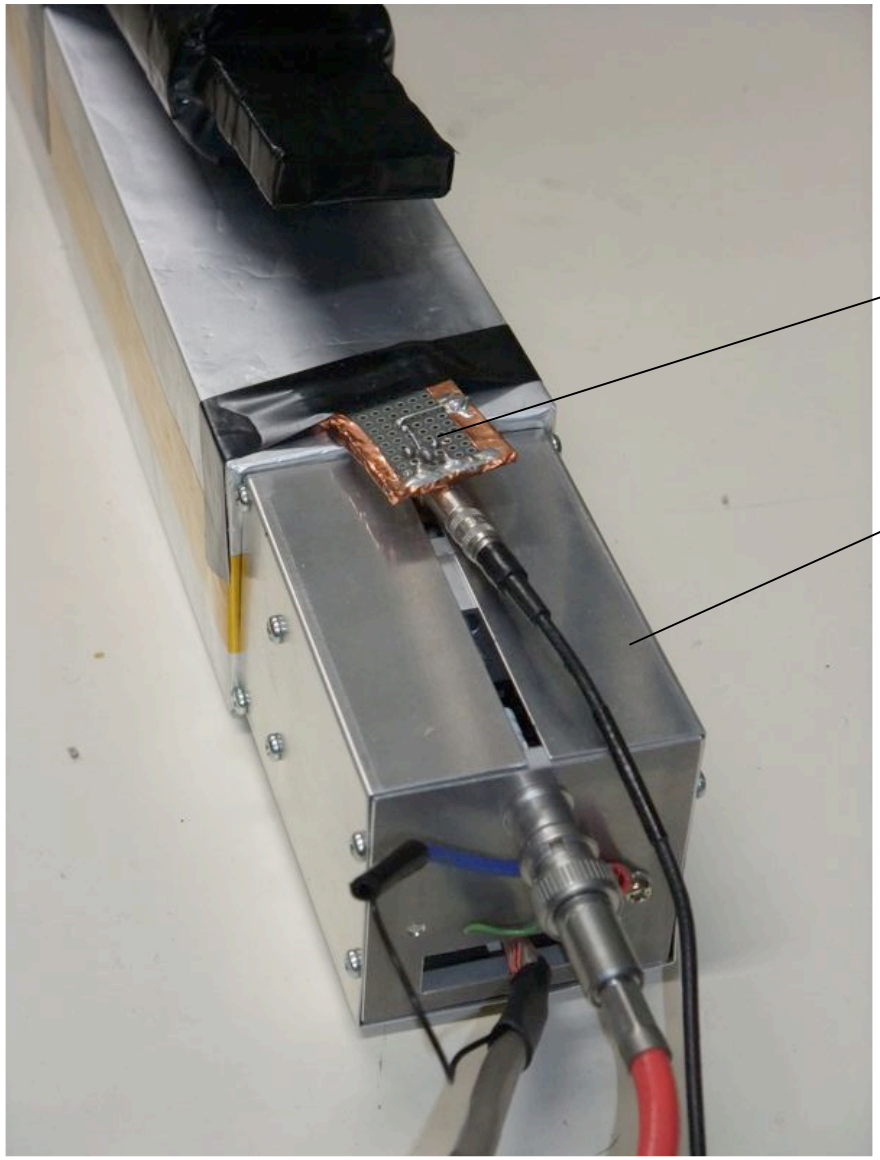
Test by attaching with PureCsI



Counter preparation



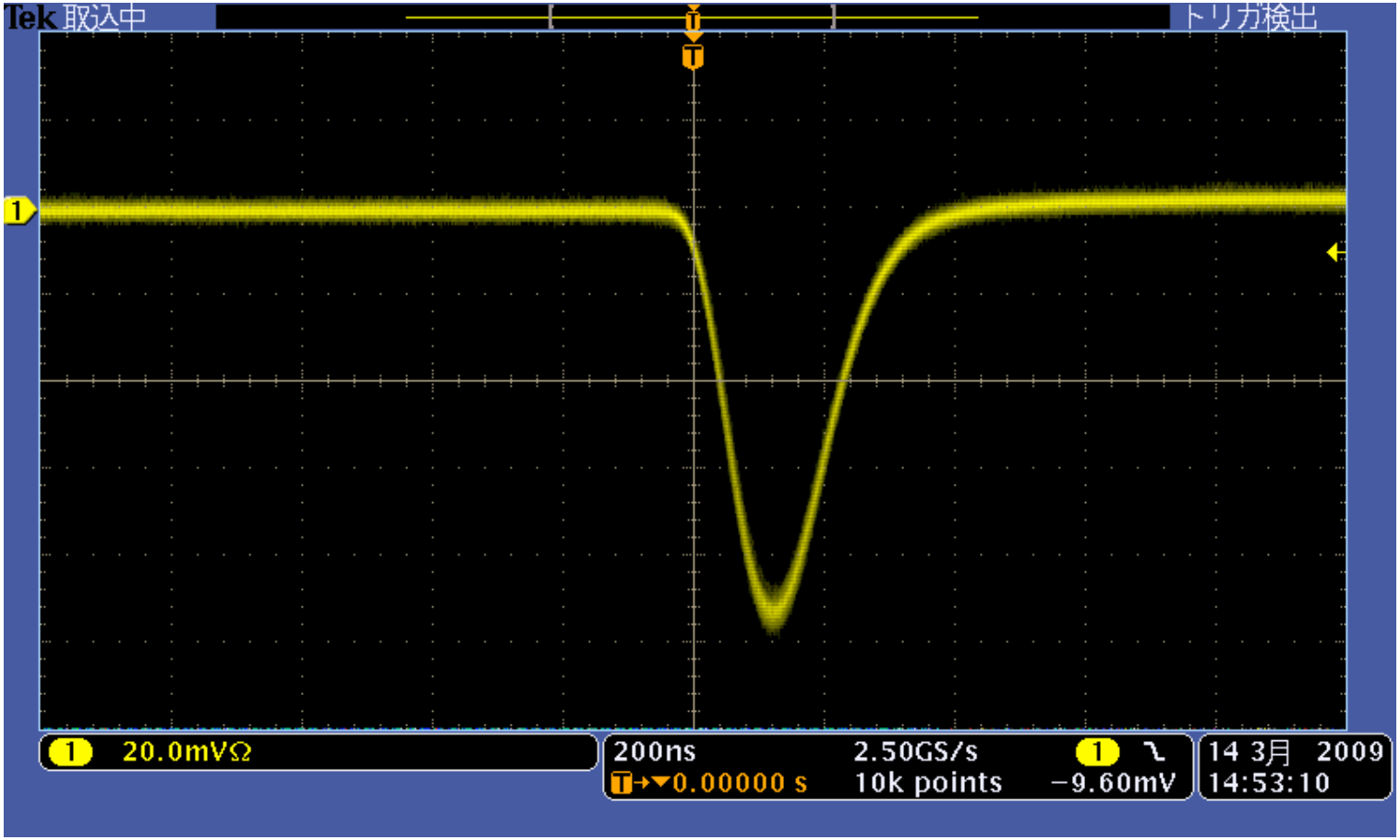
To see APD dead/alive



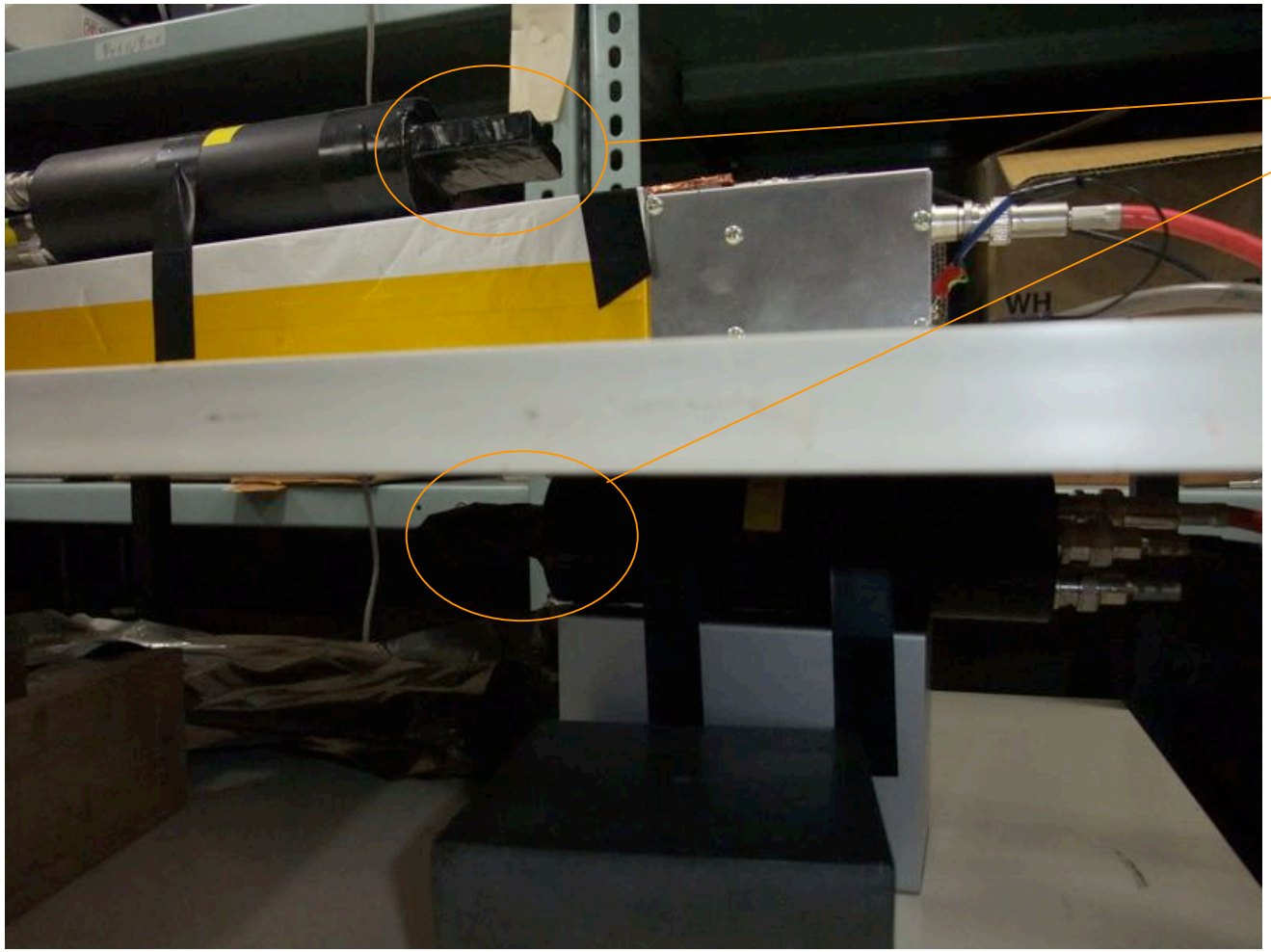
Put LED driven by clock
(pulse width ~ a few 10ns)

For electric shield, Al casing is assembled.

Response for LED seen



Two trigger counters to take coincidence

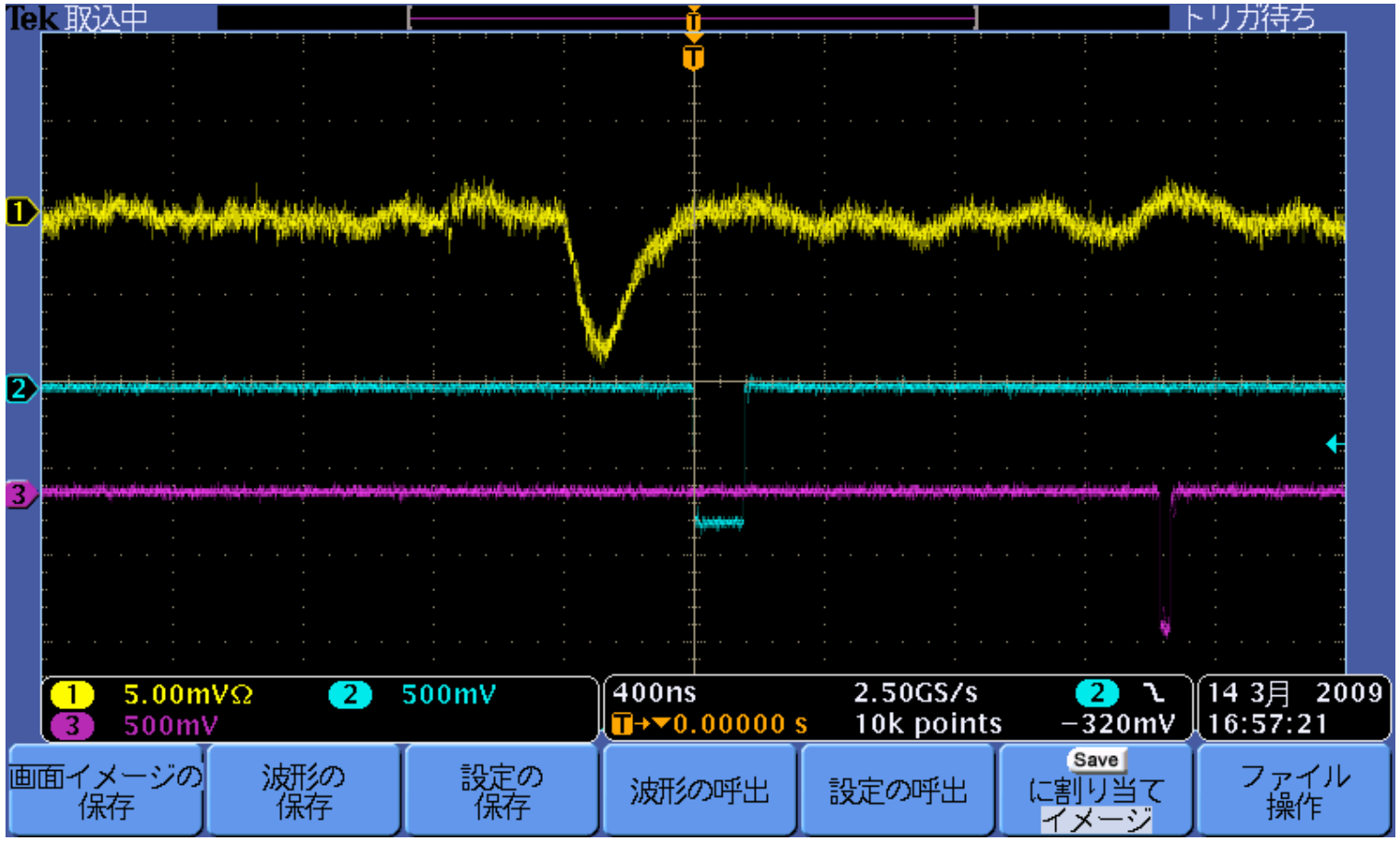


Each has
~ 4.5cm×4.5cm

Rate: 1/40~1/50 Hz

HV on APD:
increase up to
455V(475V is U.L.)

Signal seen!

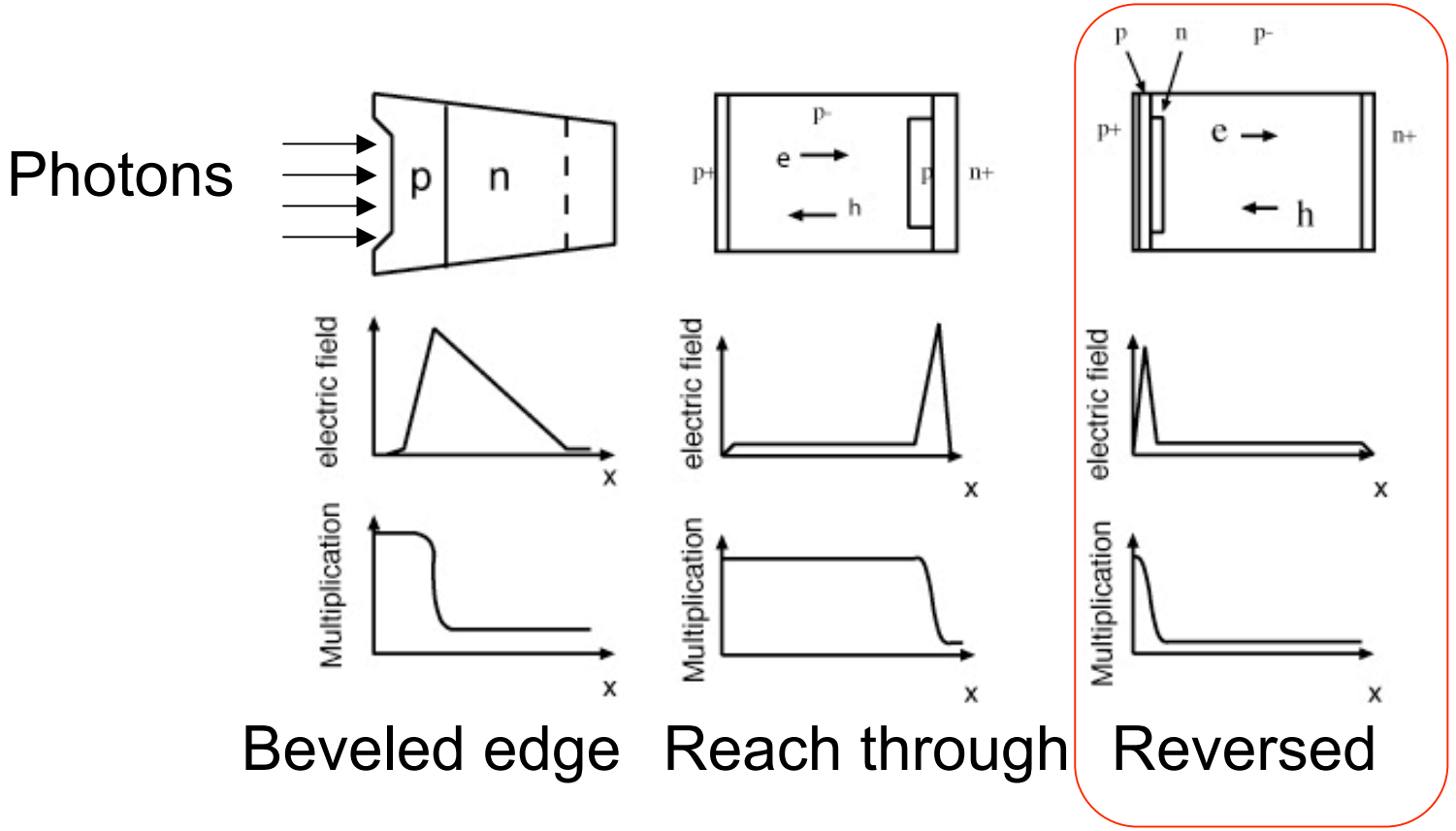


Waveform recorded by FADC is also read via CAMAC. Pulse height spectrum to discuss absolute energy scale as well as noise level will come next time.

A comment on ^{241}Am(60keV X-ray)

- To test PIN-PD readout for CsI(Tl), ^{241}Am was used as 60keV X-ray source.
- Photoelectric peak seen by direct irradiation to PIN-PD.
- $60\times10^{3}\div3.6 = 1.7\times10^{4}$ e-h pairs produced → was useful number to calibrate readout electronics chain.

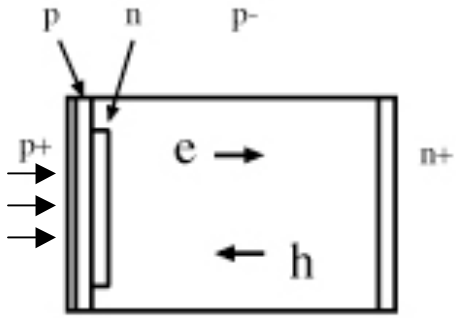
A comment on ^{241}Am(cont.)

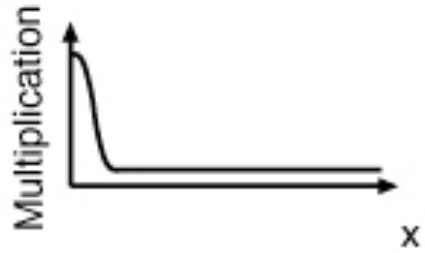


- APD structure is categorized in 3 types.
- Hamamatsu S8664-1010 is “Reversed” type.

Why “Reversed” structure?

Photons



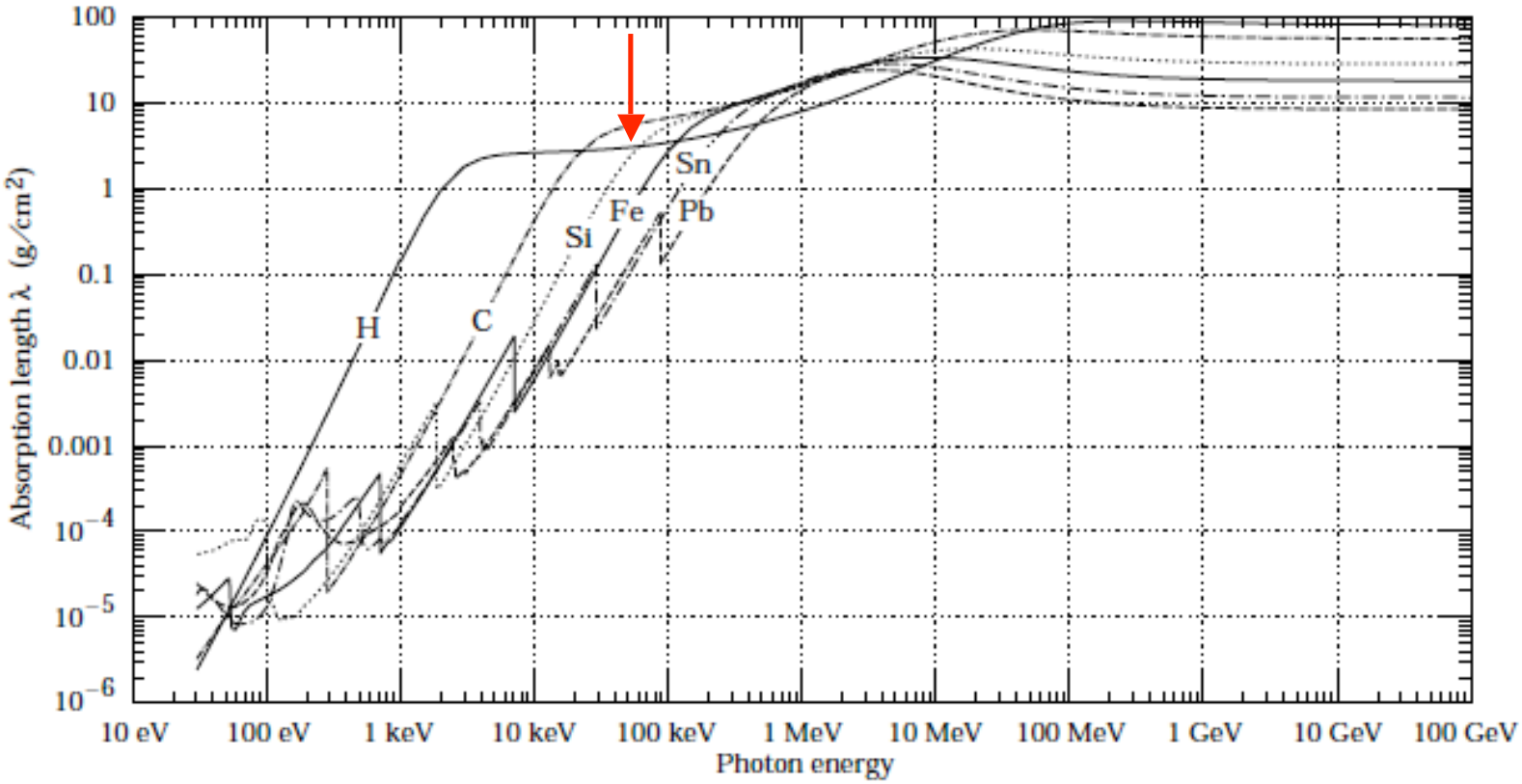


300~500nm photons encounter photoelectric absorption in the first a few μm of the depletion layer.

Liberated electros are immediately amplified by avalanche formation without significant drift.

Thermal excitation results in the holes drifting toward avalanche region → smaller avalanche, noise pulse becomes much smaller.

60keV X-ray case



Absorption length in Si ~ 4mm, interaction in the APD totally results in the holes drifting toward avalanche region.
The number of e-h pairs can NOT estimated properly at all.

Status of Pr:LuAG

- Ceramic samples not yet delivered.
  - I have to push Yoshikawa-group(Tohoku) and the company again.
  - Pr dope; 0%, 0.2%, 0.6% 1.0%, 2.0% are planned to be produced.
- Rad. hardness tests to be done in FY2009
  - Up to 10 ~ 100 Gy by γ-ray
  - Up to 10^{11} ~ 10^{12} neutrons/cm^2

Summary

- PureCsI+S8664-1010APD
  - Cosmic signal seen!
  - Pulse height spectrum comes next time.
  - PIN-PD experience=^{241}Am(60keV X-ray) is not valid any more for Reverse-type APD.
- Pr:LuAG
  - Push again relevant people to get ceramic sample.
  - Radiation hardness test to be done in FY2009.