Highlight: Report on the first LAPPD workshop

[on the applications of LAPPD in HEP and NP]

Deb Sankar Bhattacharya, on behalf of INFN, Trieste

Informal LAPPD Workshop on the Applications in HEP and NP has been organised

Organized on 21 March 2022 by:

Silvia Dalla Torre (INFN, Trieste),
Alexander Kiselev (BNL),
Deb Sankar Bhattacharya (INFN, Trieste),
Junqi Xie (ANL)

- **Participation has been overwhelming: peaked at 80**
- **Number of contributions is larger than expected**
- **Indication to create more synergies**

08:10 → 08:30 **LAPPD overview** 20m

Speaker: Shawn Shin (Incom Inc.)

LAPPD Overview_S...

08:30 → 08:40 **LAPPD Photocathode Development** 10m

Speaker: Alexey Lyashenko (Incom Inc.)

2022-03-21_BNL_w...

08:40 → 08:55 **HRPPD Development** 15m

Speaker: Michael Foley (Incom Inc.)

2022-03-21 Foley H...

INCOM

Geometry, Photocathode

08:55 → 09:15 **LAPPD R&D effort at INFN Bologna** 20m

Speaker: Vincenzo Vagnoni (INFN Bologna)

LAPPD Workshop 2...

INFN Bologna

Time resolution, LHCb/ECal.

09:15 → 09:30 **Brookhaven Lab R&D on capacitively coupled LAPPDs with 2D pixelated readout planes for Ring Imaging Cherenkov detectors** 15m

Speaker: Alexander Kiselev (BNL)

ayk-2022-03-21-lap...

BNL

R&D on EIC

09:30 → 09:50 **LAPPD R&D effort at IJS Ljubljana** — 20m

Speaker: Rok Pestotnik (IJS)

2022-03-21-LAPPD-...

IJS, Slovenia

RICH: LHCb, BELLE-II

10:00 → 10:20 **LAPPD R&D effort at Argonne** — 20m

Speaker: Junqi Xie (ANL)

LAPPD workshop-A...

ANL

R&D on EIC

10:20 → 10:35 **Cherenkov and scintillation separation in water-based liquid scintillator using LAPPDs** — 15m

Speaker: Ed Callaghan (UC Berkeley)

UC Berkeley

10:35 → 10:50 **LAPPDs in ANNIE: from test bench to a full experiment** — 15m

Speakers: Amanda Weinstein (Iowa State University) , Matthew Wetstein (Iowa State University)

wetstein.pdf

ANNIE col.

Neutron Detection

10:50 → 11:15 **LAPPD Readout Plane - Modelling and Optimization** — 25m

Speaker: Luca Macchiarulo (Nalu Scientific)

Nalu-Incom-HFAD-S...

11:15 → 11:30 **Digitizer ASIC options for LAPPD applications** — 15m

Speaker: Isar Mostafanezhad (Nalu Scientific)

2022- March - Nalu- ...

NALU

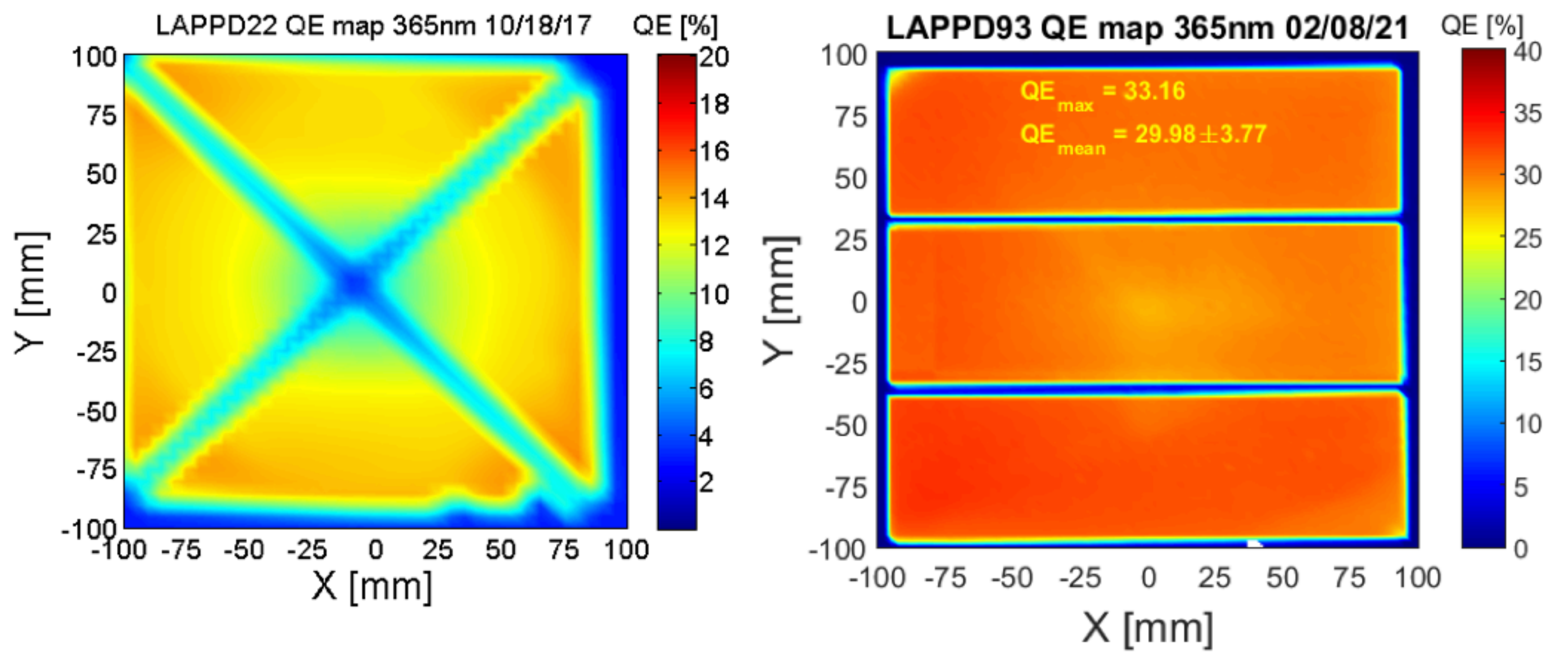
Signal Induction Analysis
New Readout/Electronics

Incom Talks

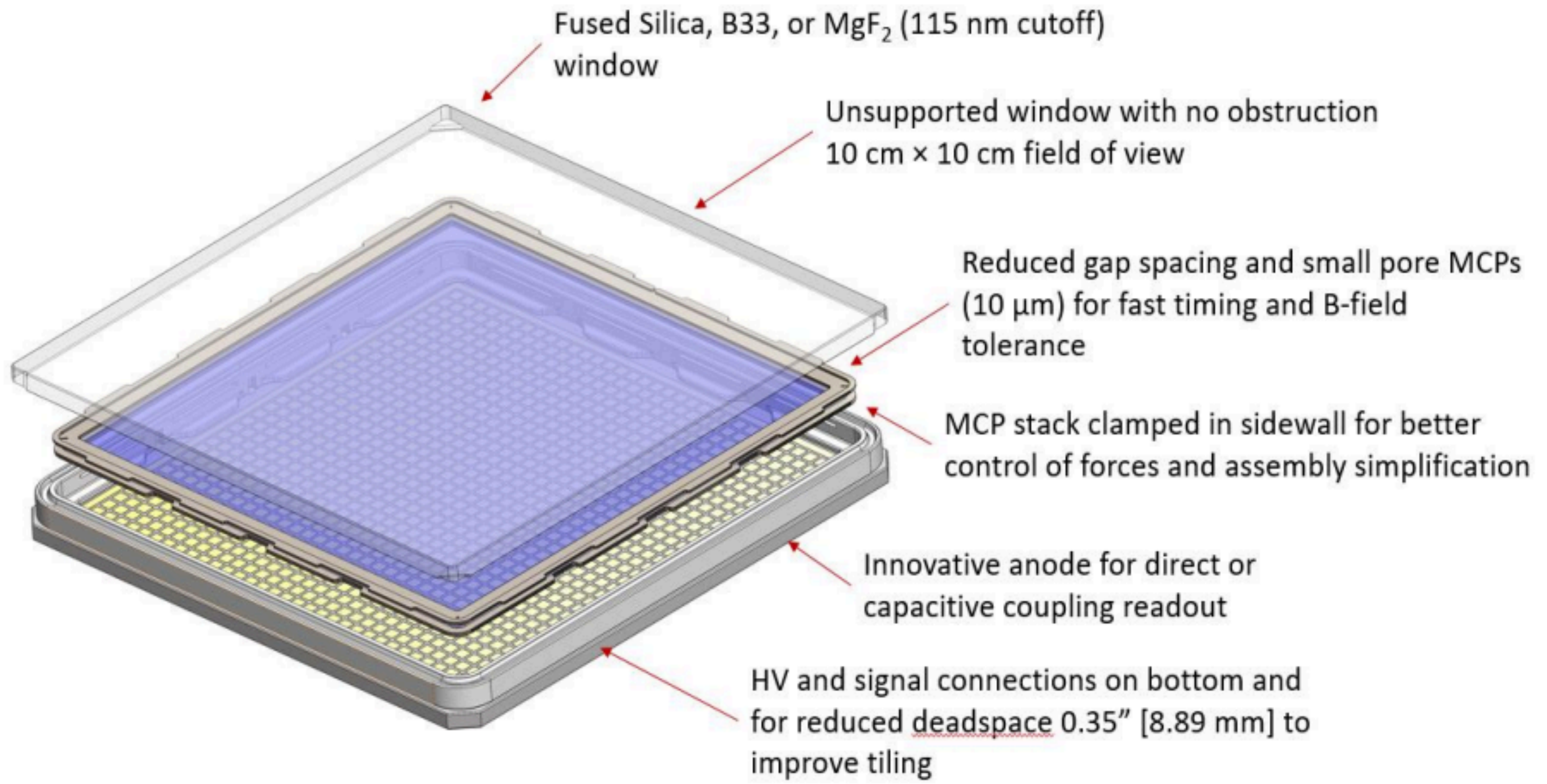
- A comparison between GEN-I and GEN-II type LAPPDs
  - GEN-1: Strip Line Anode
  - GEN-II: Capacitively Coupled Anode with External Pixelated Board

Progress in Na_2KSb photocathodes

- Improvement on the QE of Photocathode
- Improvised support structure



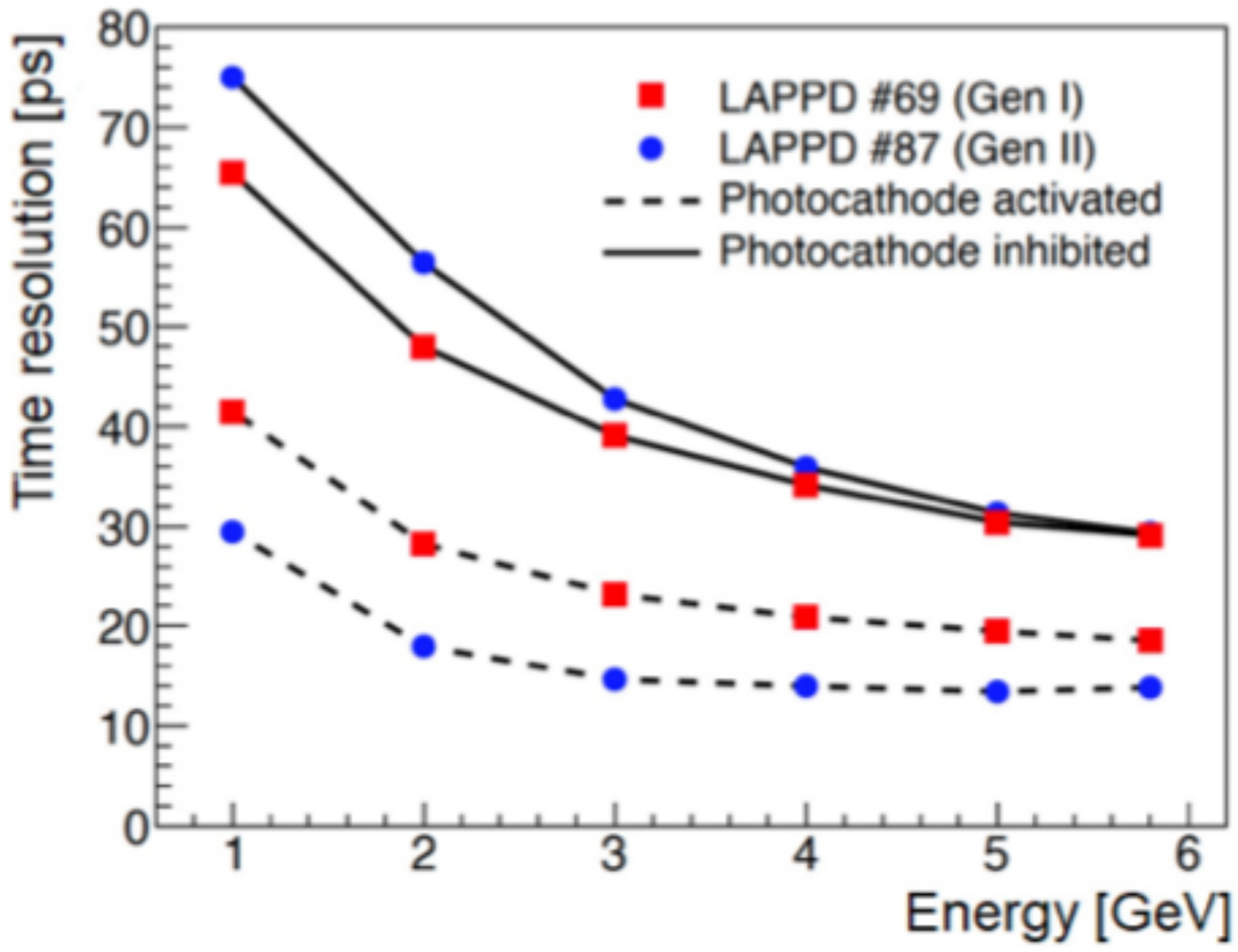
- High Rate PicoSec Photon Detector (HRPPD)
- Small pore MCP (10 μm) for fast timing and high B-field tolerance
- Novel anode for direct or capacitive-coupled readout



INFN Bologna: Vincenzo Vagnoni

A detailed presentation on the LHCb E.Cal Upgrade:

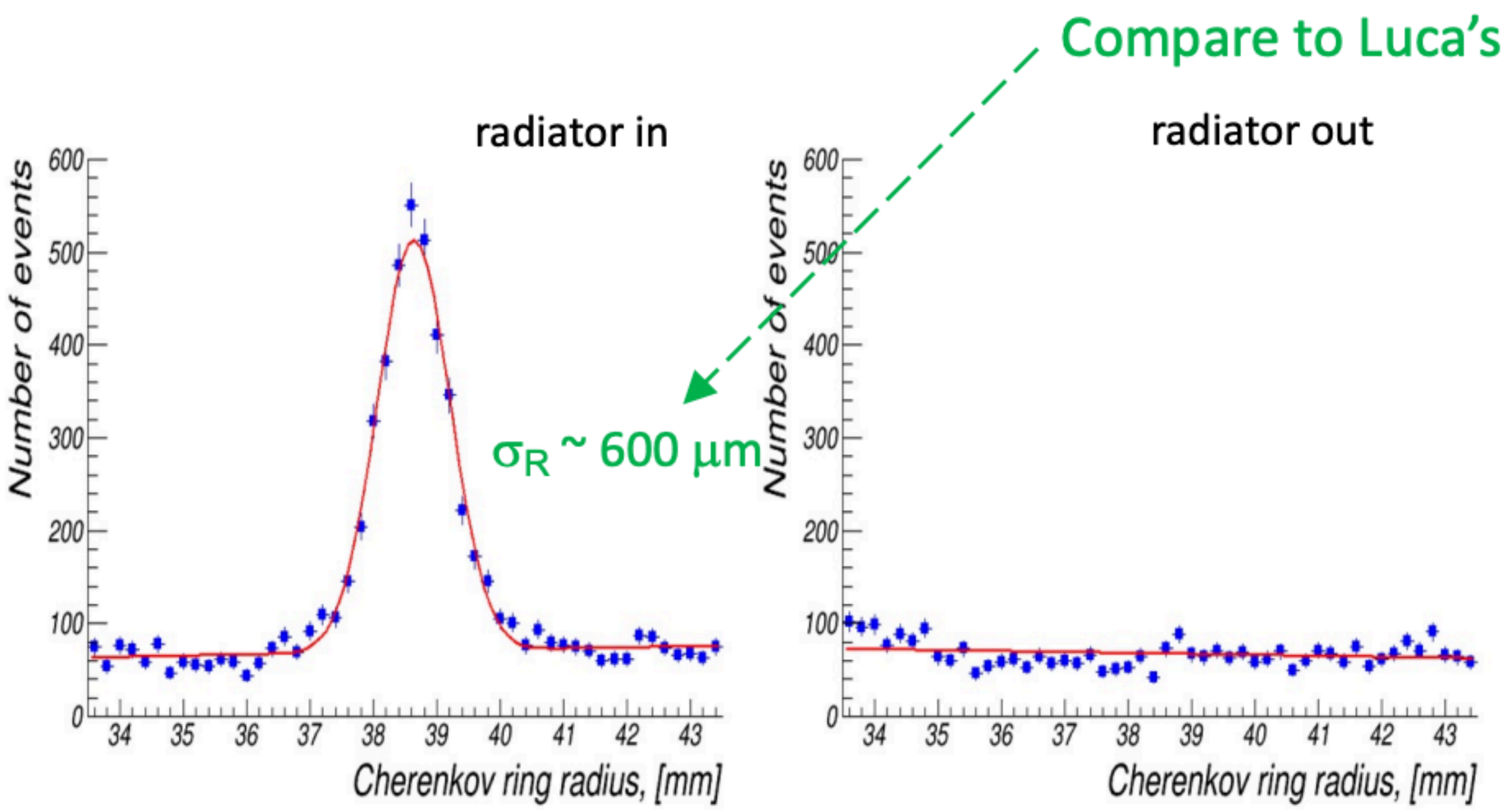
- **Timing with single photon**
- **Test Bench results with dual-LASER setup to mimic background**
- **Beam Tests at DESY and CERN**
- **Comparison of Time response with and without Photocathode activated.**



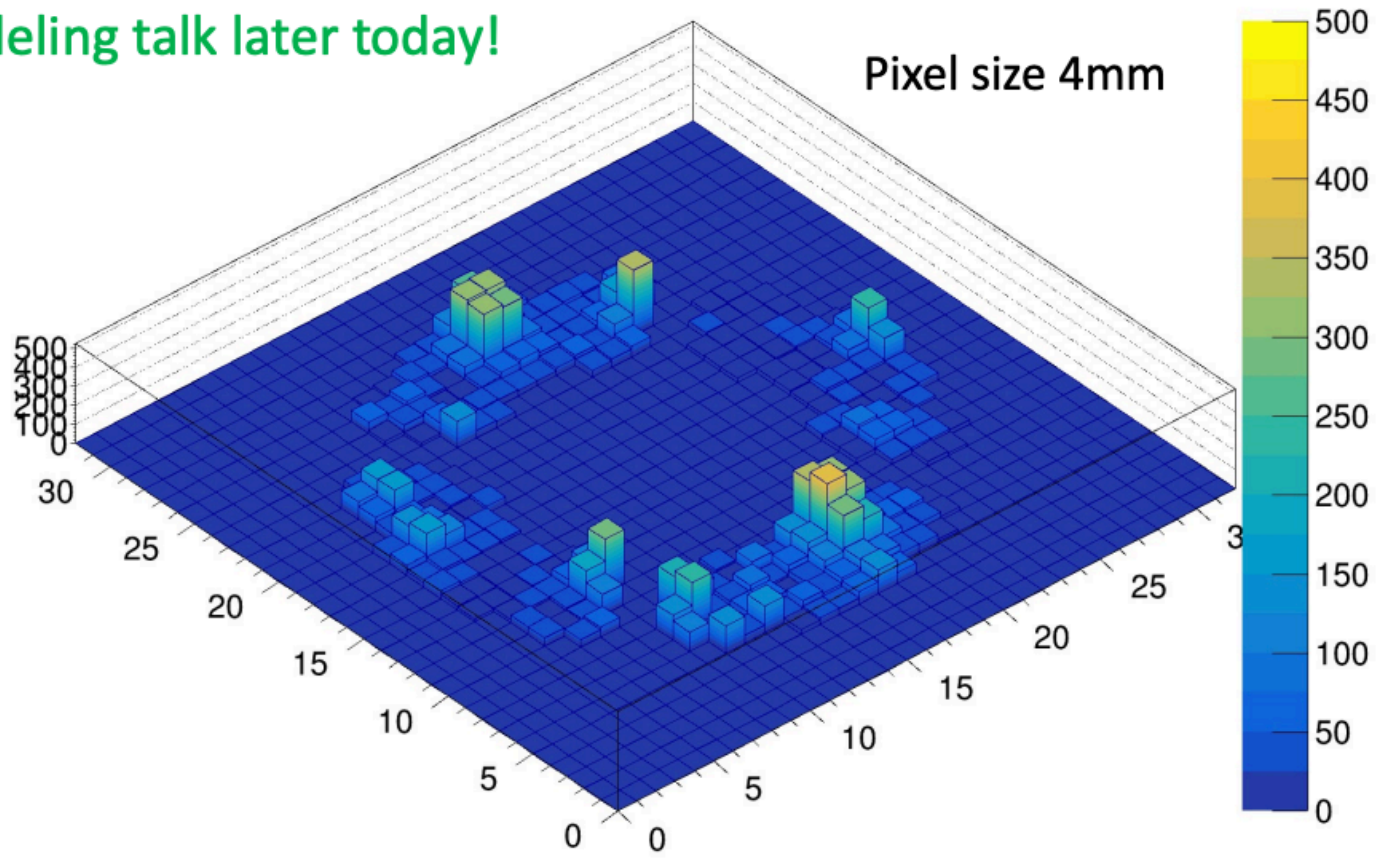
BNL: Alexander Kiselev

- **With GEN-II LAPPD, R&D for the EIC: Test Bench Results and Results from Beam Tests at Fermilab**
- **Optimisation of readout board for Spatial Resolution, Cross Talk suppression**

Cherenkov ring radius resolution



Single photon ring radius resolution



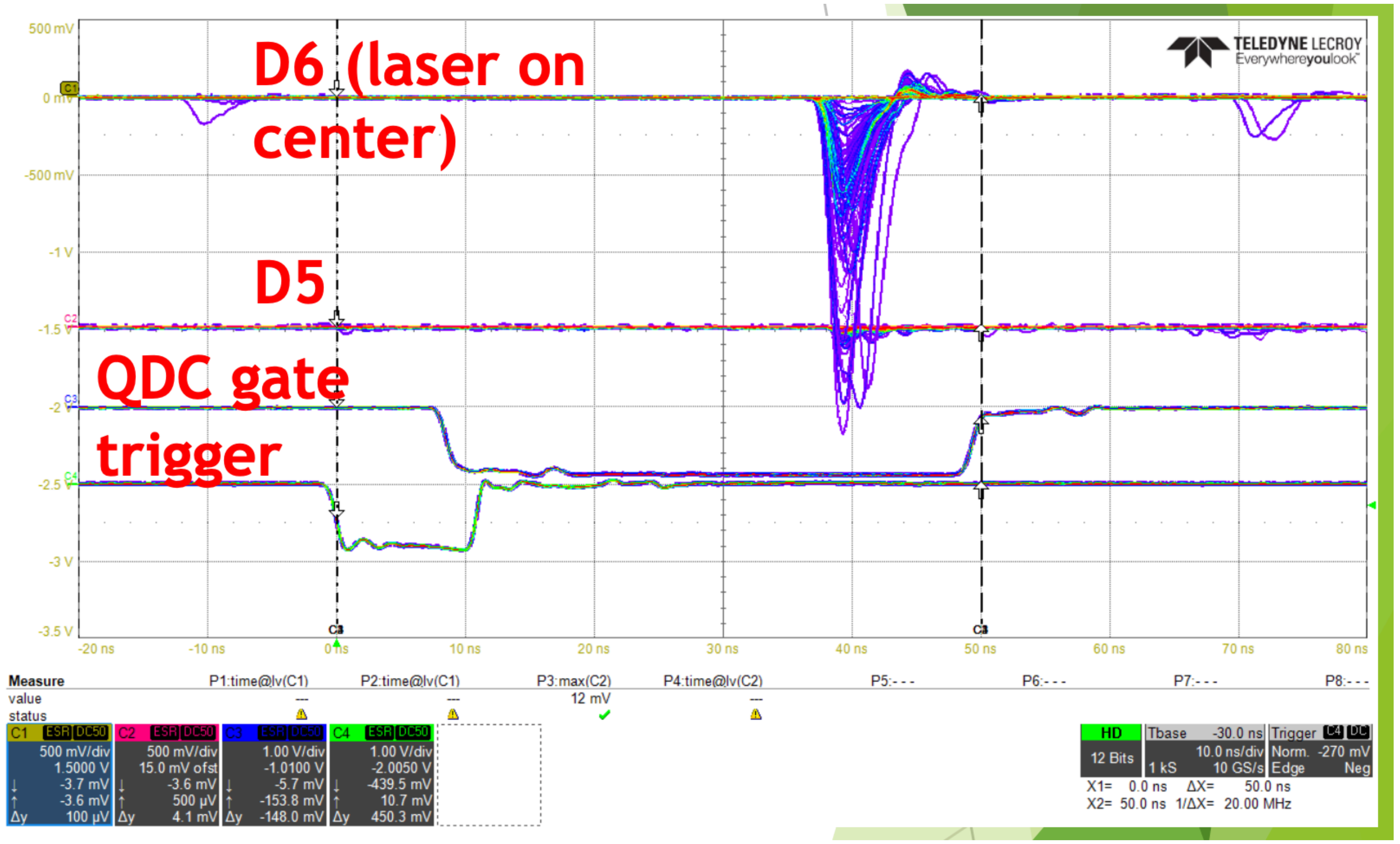
Single event with multiple photon clusters

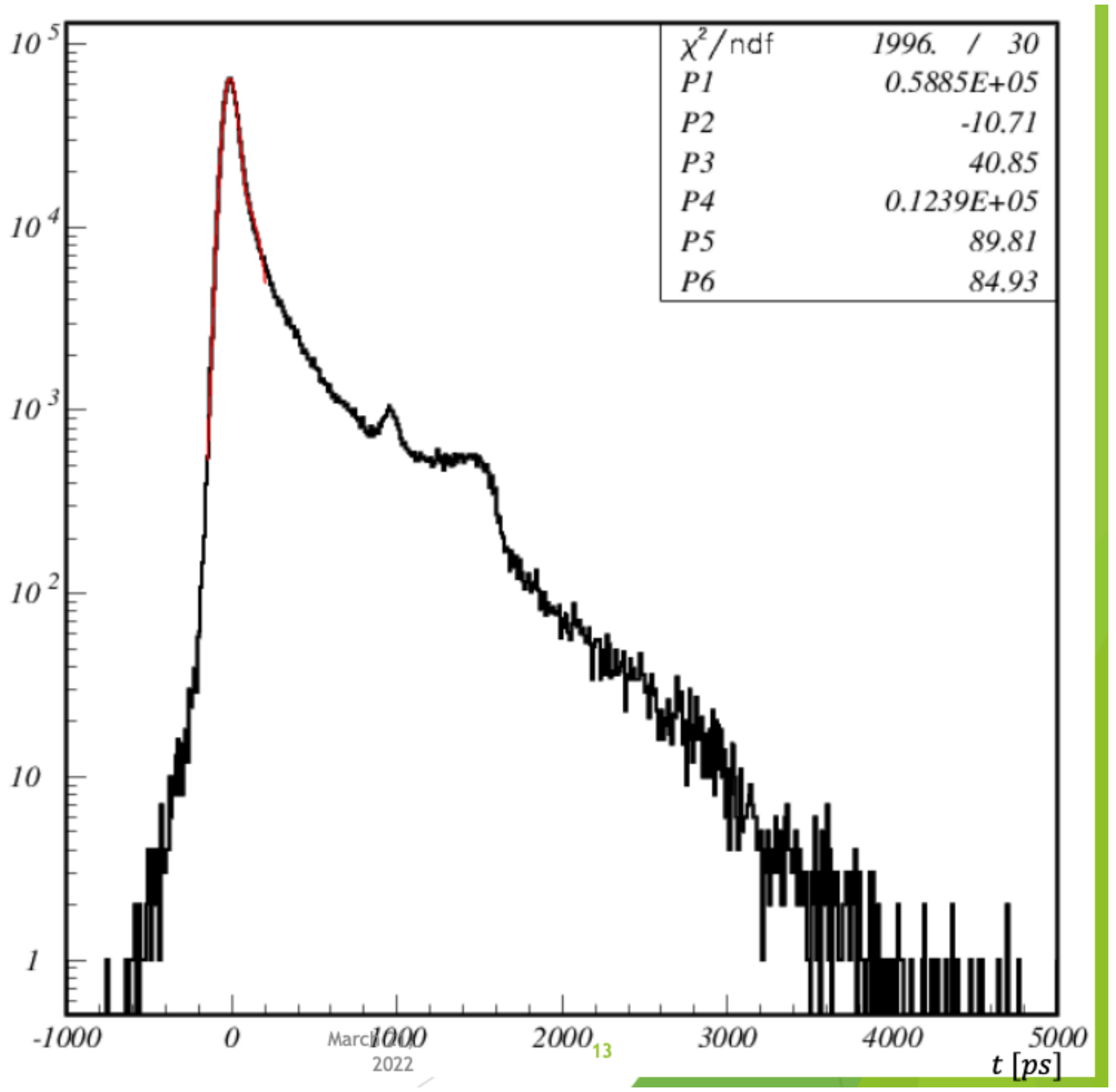
- Yes, one can measure single Cherenkov photons with sub-mm spatial resolution using pixelated Gen II LAPPDs!

Paradigm change in the Cherenkov ring imaging data analysis: overlapping clusters rather than single pixel hits

IJS: Rok Pestotnik

- R&D on the LAPPDs for the RICHs (in LHCb and BELLE-II)
- Using GEN-II, (LAPPD #109) : Results on Pulse shape and Time Response for the Single Photon

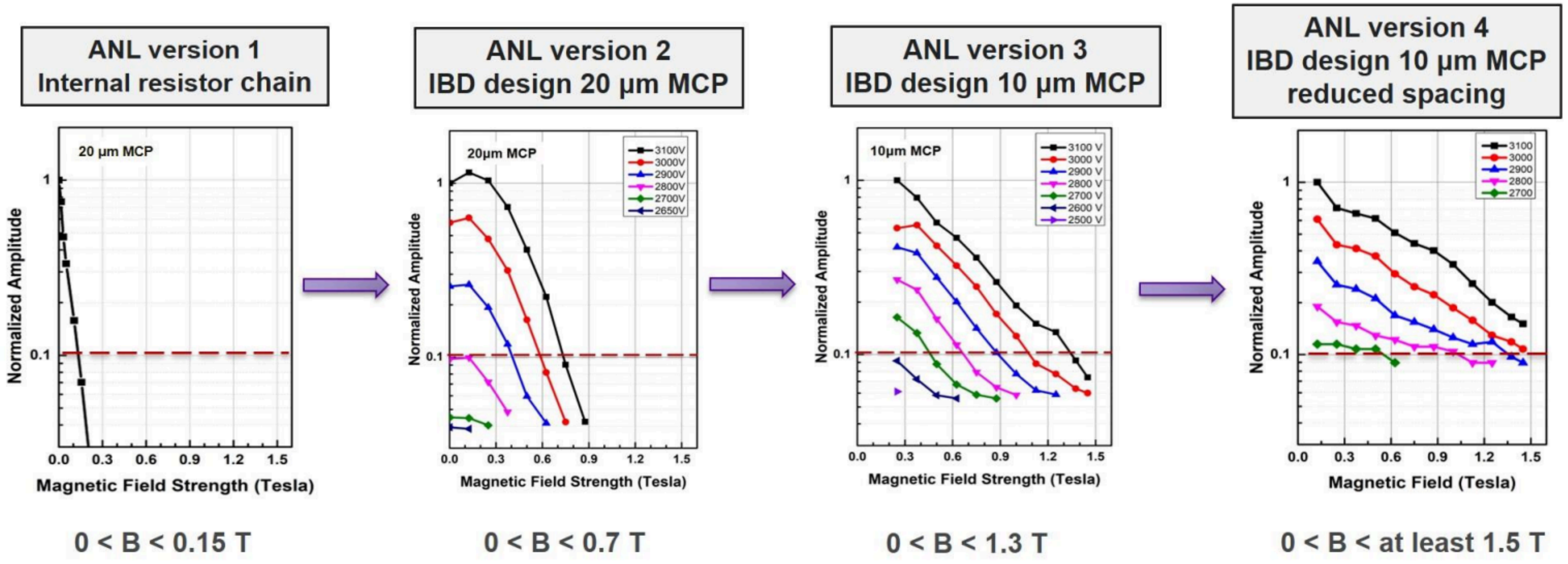




- *FastIC*: A highly configurable multi-channel ASIC.
- Fast-timing applications
- Designed in collaboration: CERN + University of Barcelona

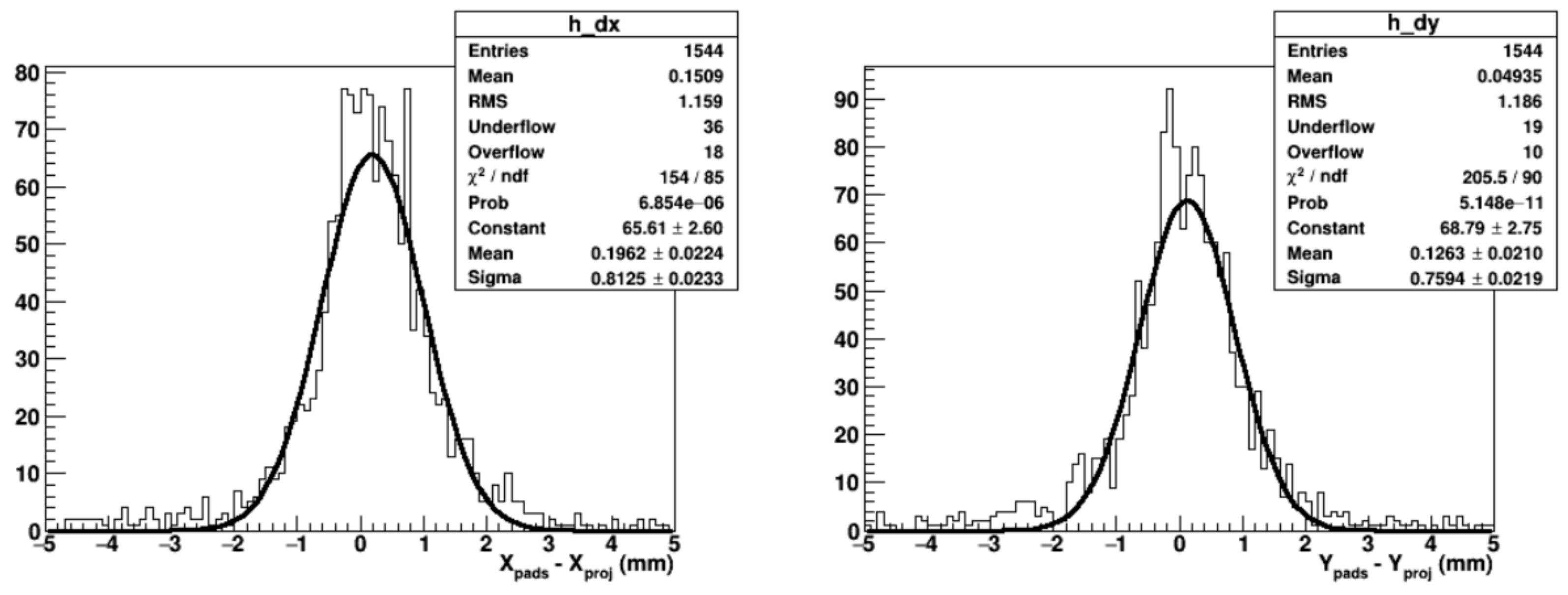
ANL: Junqi Xie

- **R&D on the LAPPDs focused on EIC and other Nuclear Physics Programme**



Babar and CLEO Magnets: 1.5T

4 mm x 4 mm pixel as example



	X res (mm)	Y res (mm)
2x2 mm	1.4	1.7
3x3 mm	0.94	0.95
4x4 mm	0.81	0.76
5x5 mm	1.1	0.97

- All resolutions ~1 mm with small pixels, reaching the requirements for EIC Cerenkov sub-systems.
- Potentially limited by track pointing resolution capability of MWPCs (1 mm pitch)
- 2x2 may be worse due to leakage of signals (poor containment since it is a smaller area)

JUNQI XIE

Argonne

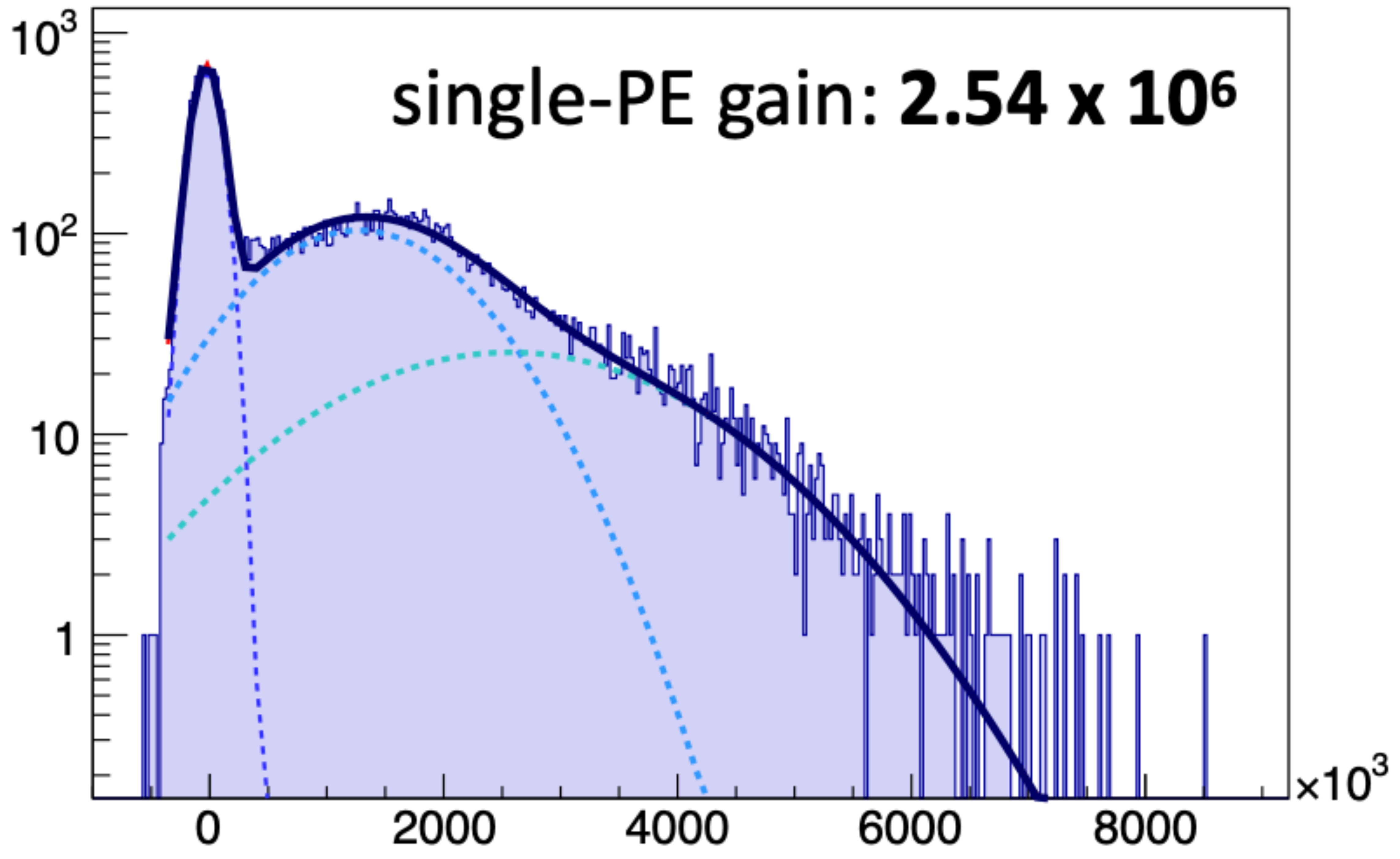
Improvement in B-field with varying pore size.

Spatial resolution with varying pixel size

ANNIE: Amanda Weinstein and Matthew Wetstein (ISU)

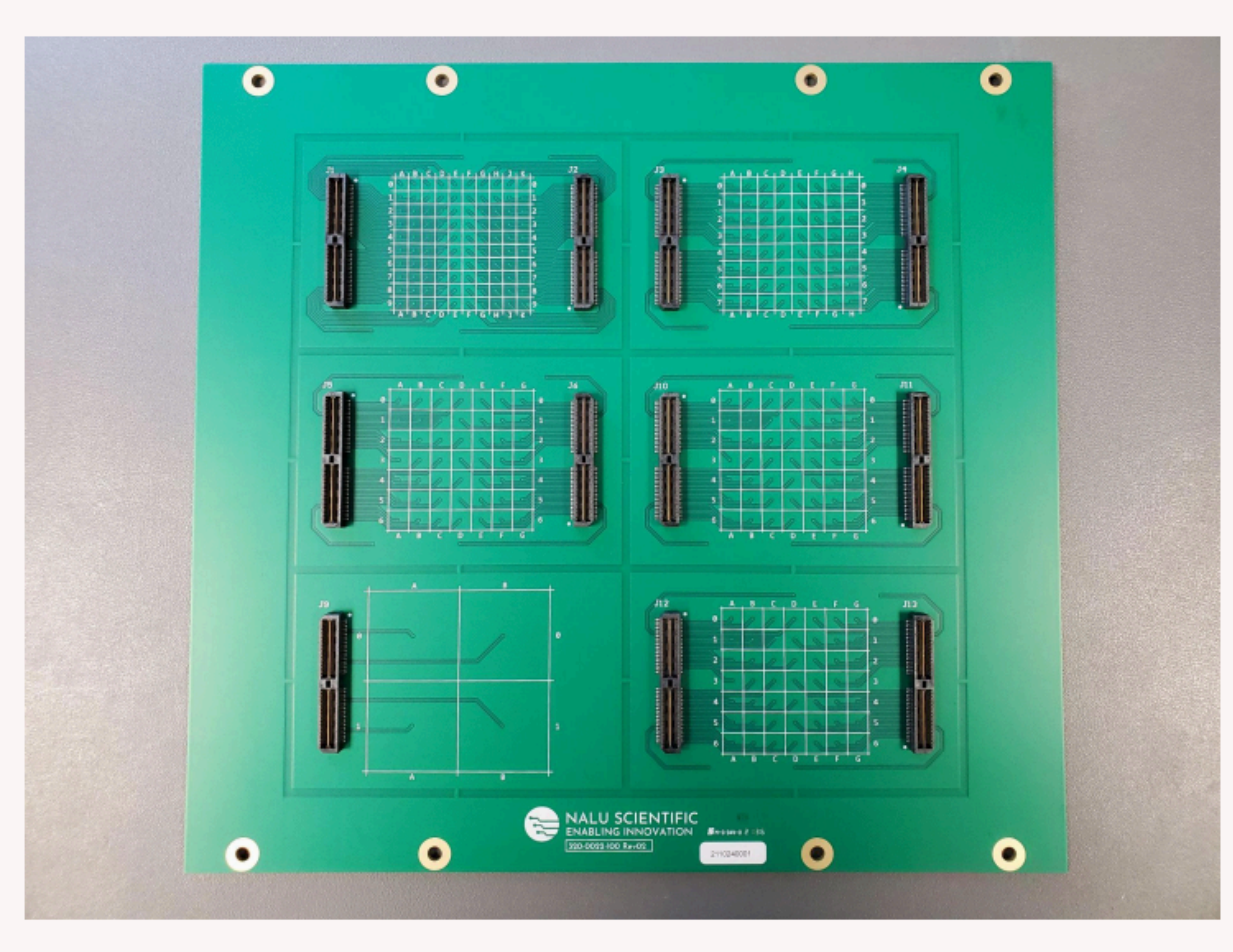
- LAPPD for Neutrino detection
- Using LAPPD under water
- First running HEP experiment to use LAPPD
- With a long term experience on the LAPPDs

- Charge spectrum of a Single Photo-Electron
- Clearly showing the Gain of the LAPPD

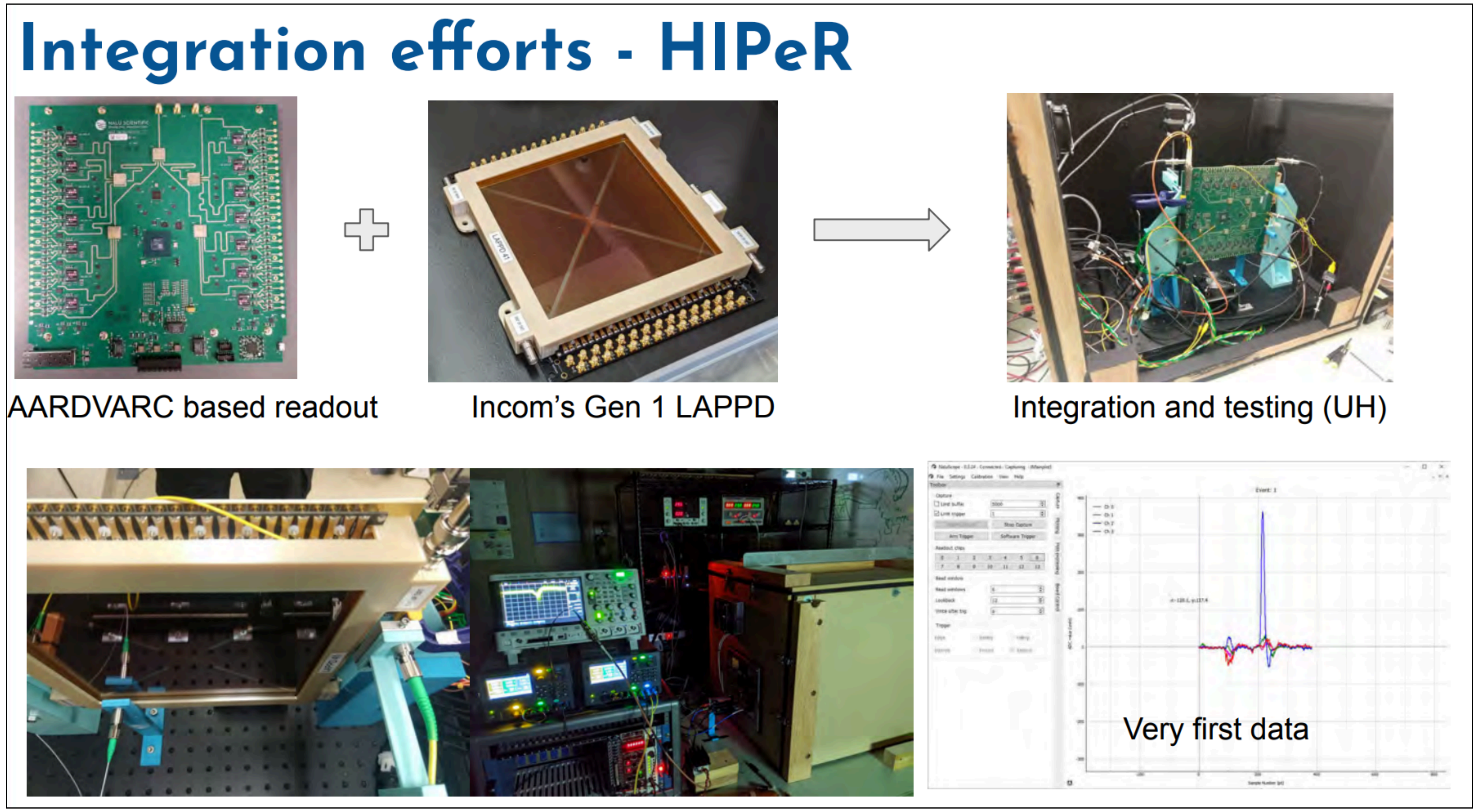


Nalu Scientific: Talks

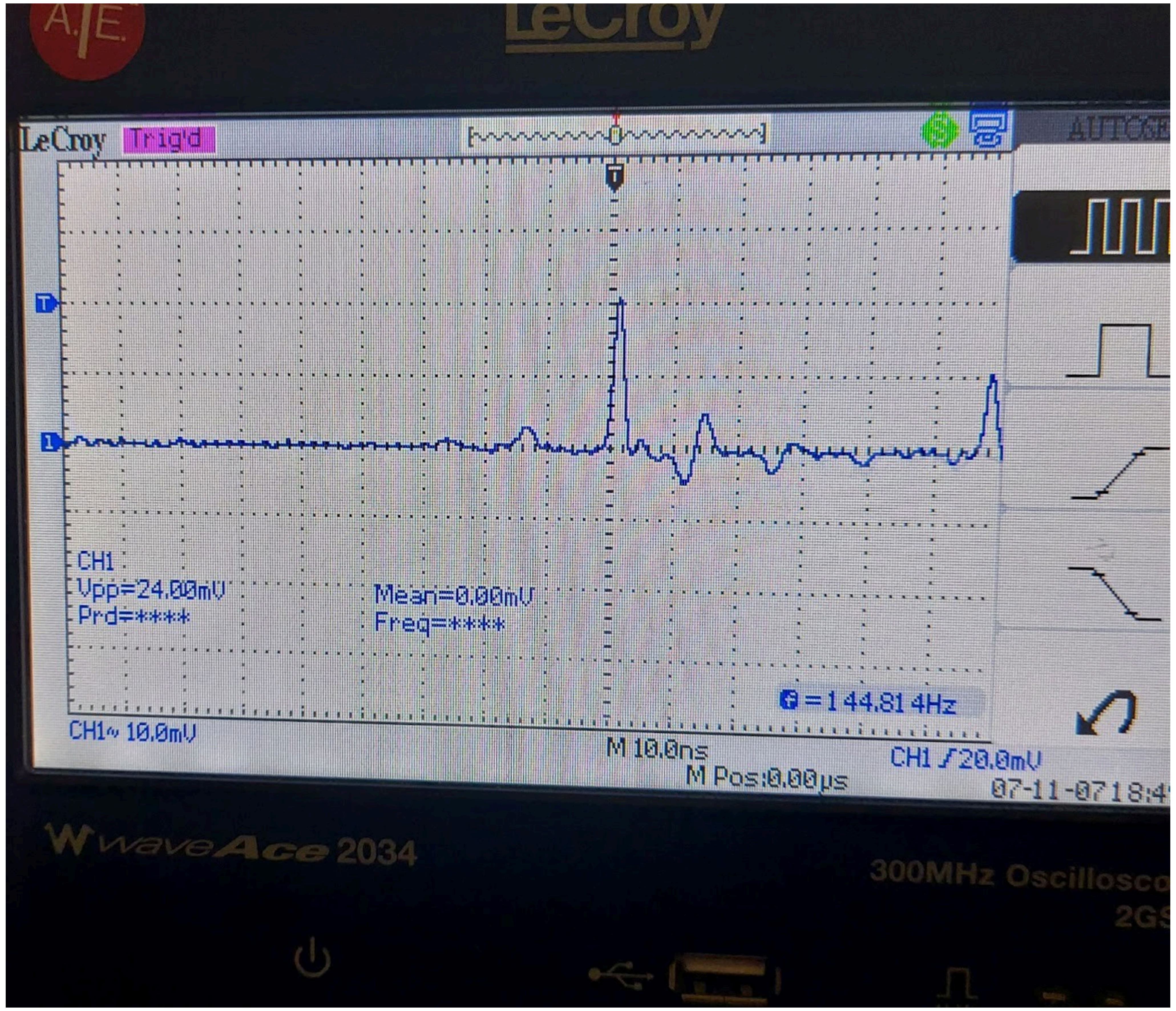
- **Conceptual studies on the response of the resistive anode of different geometries and with photon sources of different sizes**



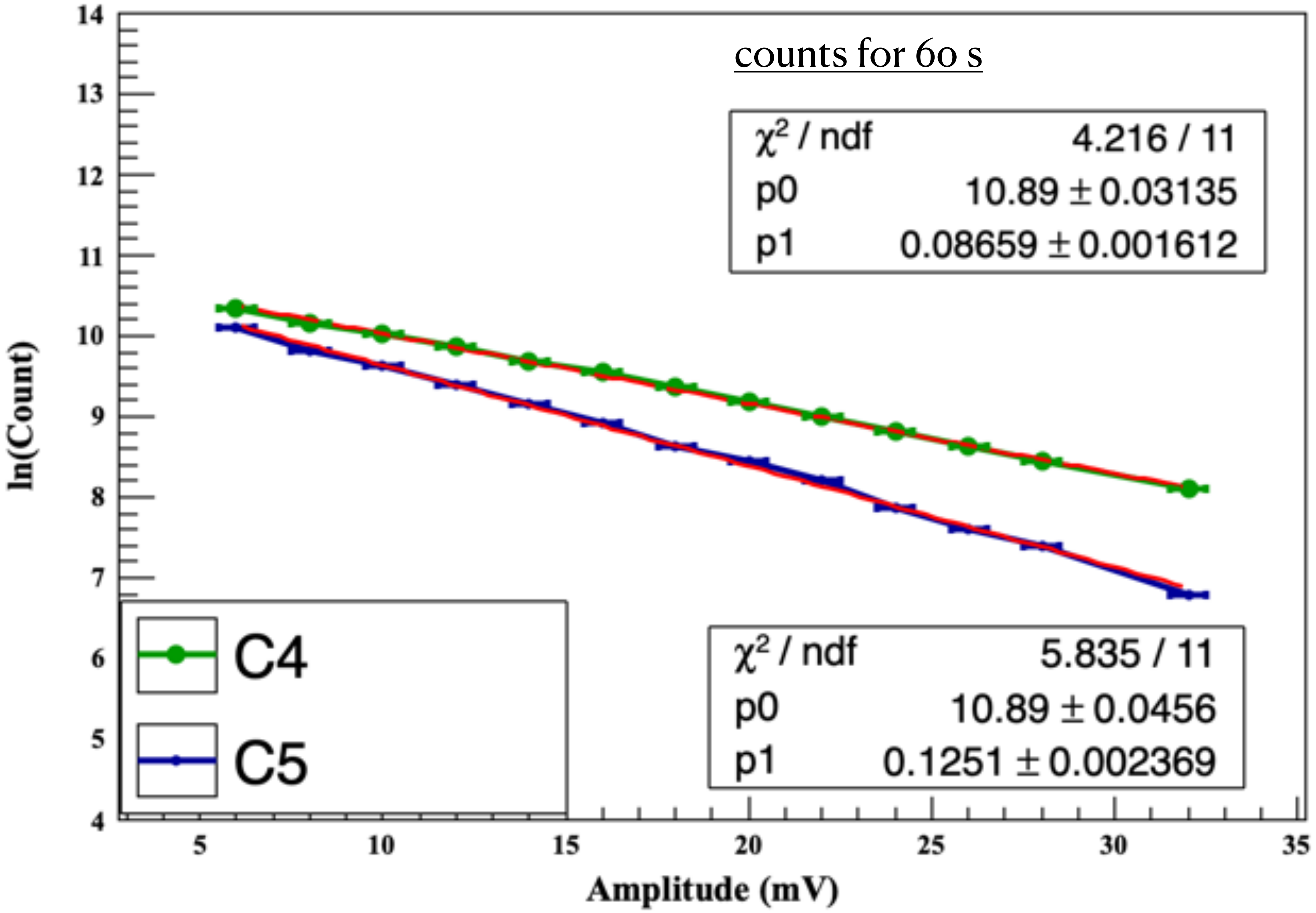
- **Electronics based on discrete components: (System on Chip).**
- **AARDVARC: Variable rate readout chip for fast timing and low dead-time.**



Trieste Activity - I:



voltages: 2160 V, 2150 V, 1275 V, 1075 V, 200 V
PC = -10V, MCP = 875 V

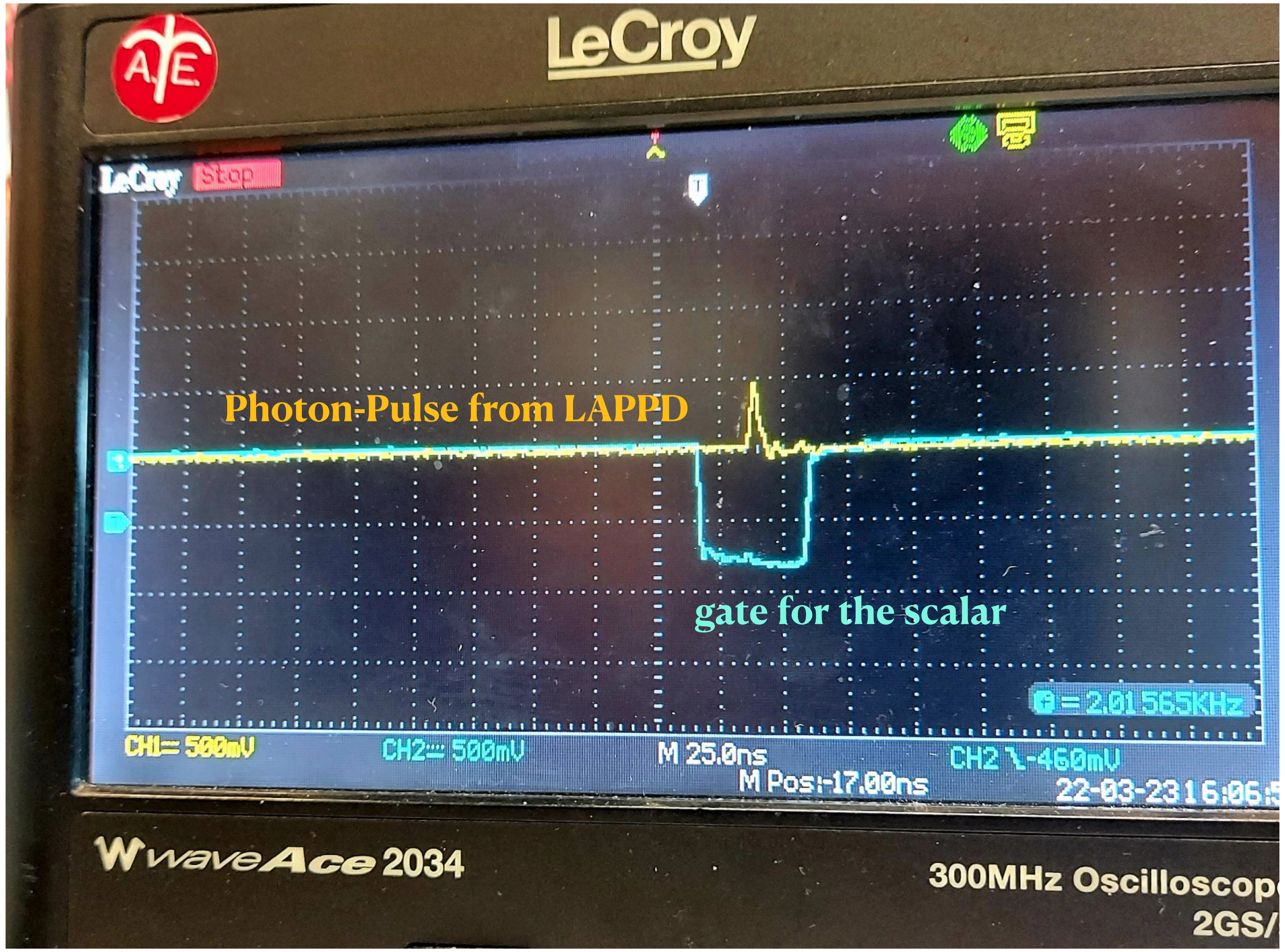


- **Dark Pulse (with the ion feedback Pulse)**

- **Intrinsic dark rate = 900 Hz/Pixel = 140 Hz/cm^2**
- **The rate is similar over a few pixels**

Trieste Activity - II:

Response from a Pulsed LED source



- Getting the first signals from a Pulsed LED source
- Pulse width is limited to 20 ns => Multi PE response
- A fast pico-LASER source is expected in May
- A study on the noise level comparison is ongoing

- The first joint venture between Trieste and Genova is organised during the week of 4 April at Trieste. [Mikhail and Saverio]

Conclusion:

- A great number of participants
- A great number of contributions
- Variety of topics have been discussed
- Yet, more topics can be discussed
- We need more of such events over the year

- At Trieste, Dark noise rate of the LAPPD is understood
- Uniformity study is ongoing
- Photon signal with a Pulsed-LED (20 ns) is ongoing
- Expecting the Pico-LASER in May
- Joint work between Trieste-Genova, next week

Thank you!