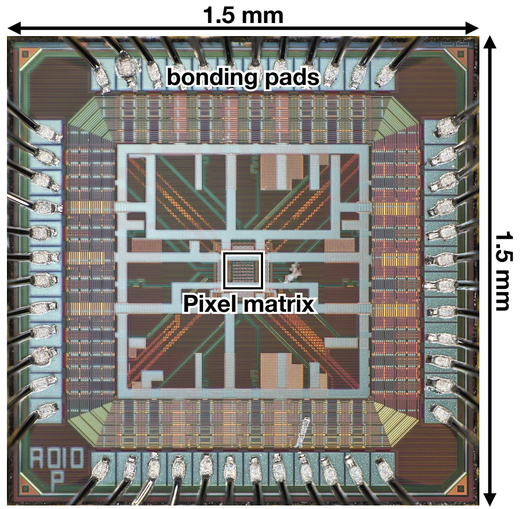
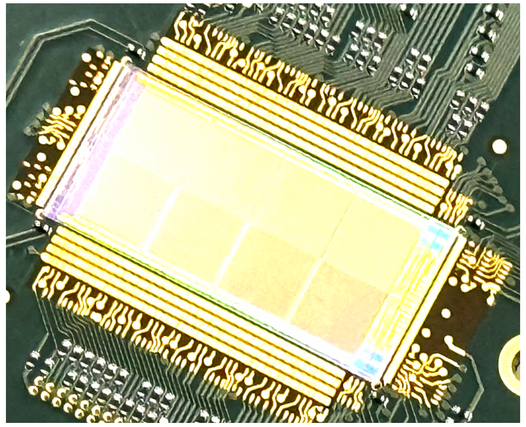
Summary:
ITS3 Activities in Torino

Bong-Hwi Lim
on behalf of INFN Torino ITS Team

Contents



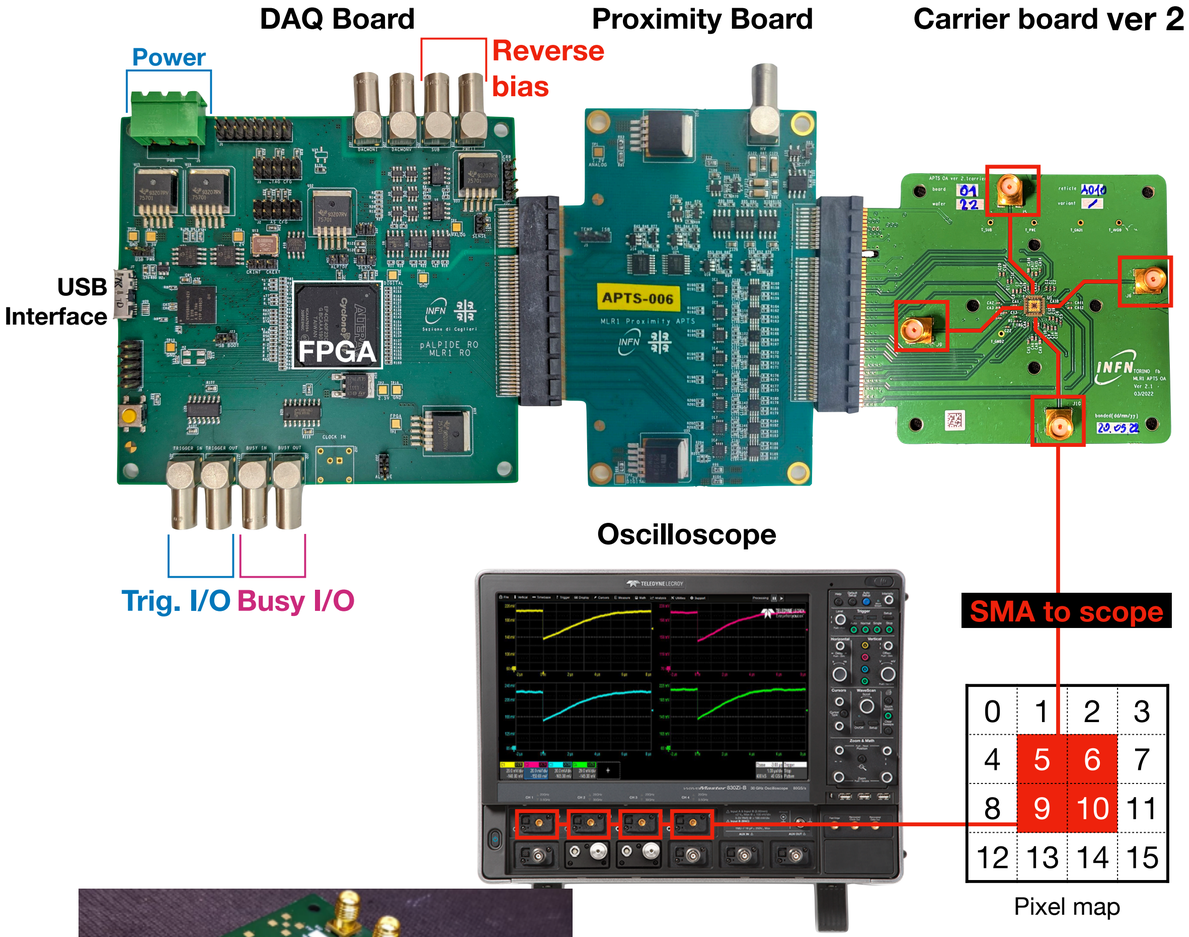
APTS-OA



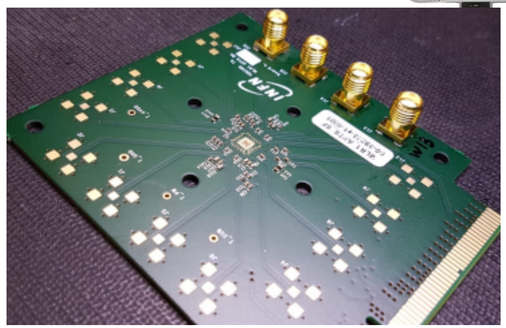
babyMOSS

- **MLR1 activity (APTS-OA)**
  - Development of the DAQ system
  - Parameter optimisation with Lab measurement
  - Performance measurement with Test beam
- **ER1 activity (babyMOSS)**
  - babyMOSS assembly
  - Plans and capabilities

Development of the DAQ system

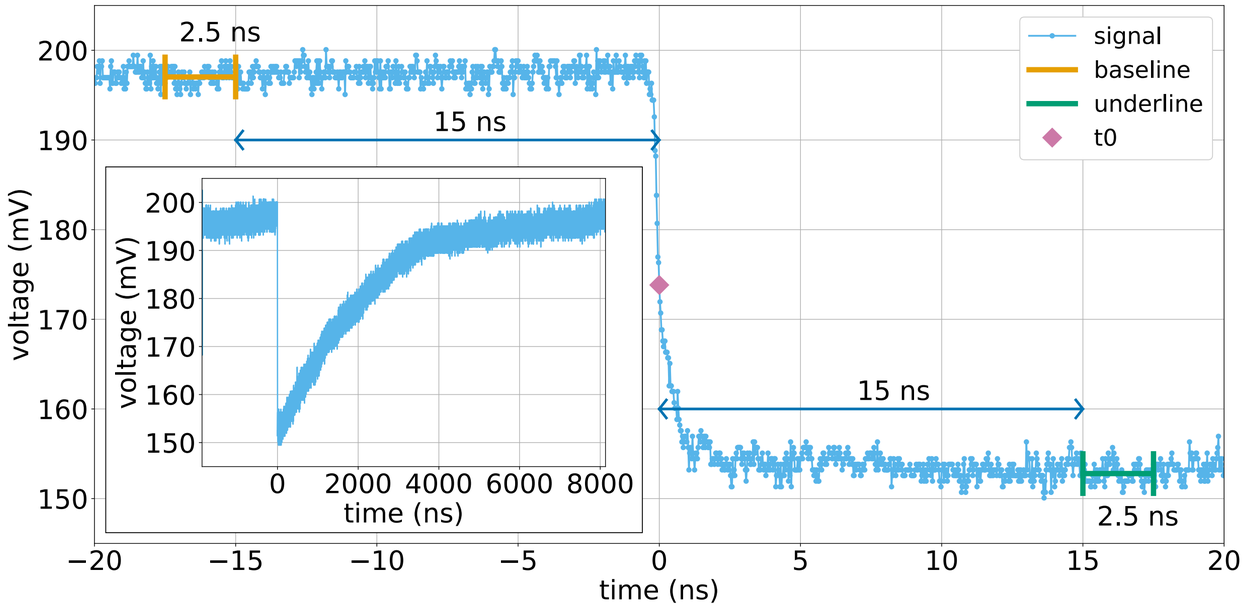


DAQ system



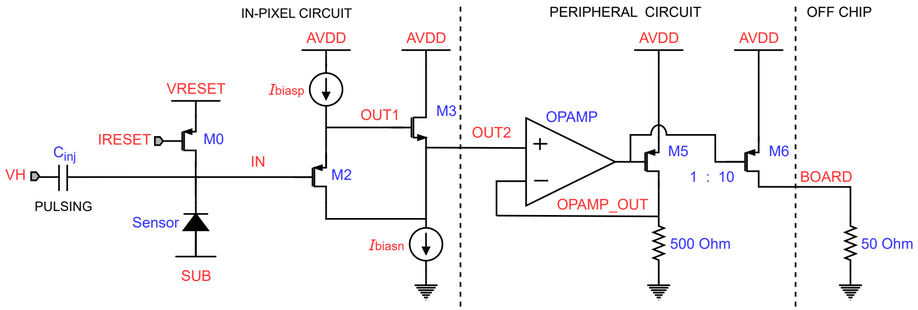
Carrier ver 1

- **Main object of APTS-OA characterisation**
  - Test the **intrinsic timing resolution** of 65 nm technology (TPSCo65)
  - Needs of measure the signal with fine time interval (~ps) **directly from the analogue buffer output**
    - Ultra-fast oscilloscope (~40GS/s) is utilised.



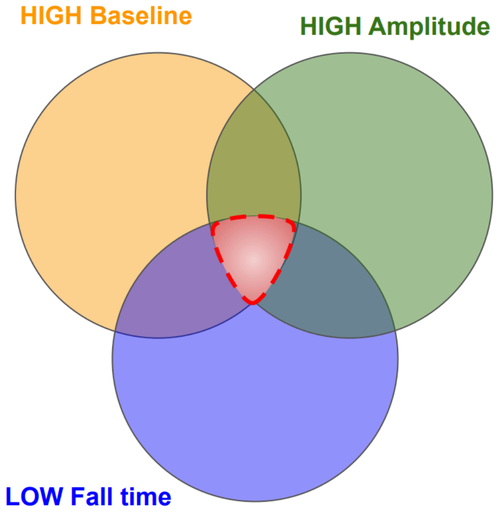
Analogue signal from the pixel

Lab Measurement - Parameter Optimisation

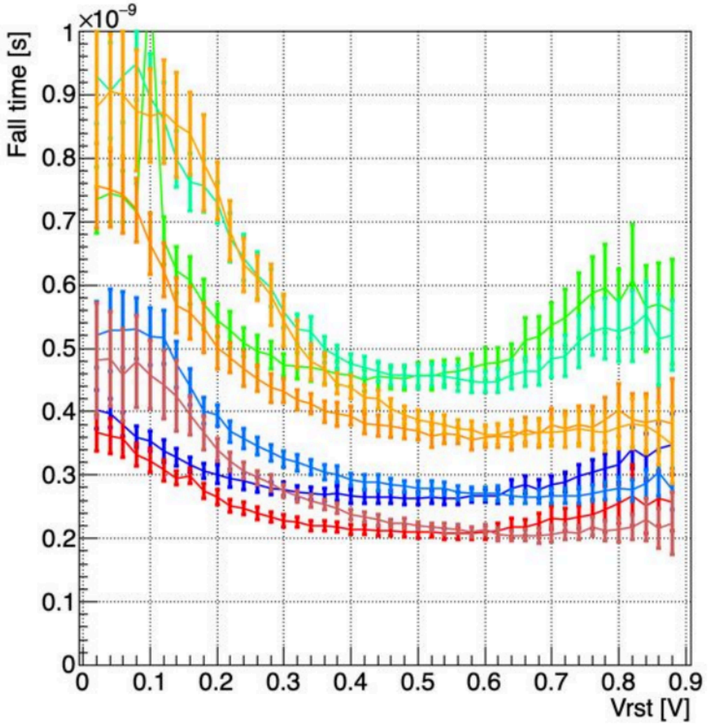


Param	A	B	C	D
IBIASN [uA]	250	500	750	800
IBIASP [uA]	45	70	80	95
IBIAS4 [mA]	1	1.8	2.5	2.6
IBIAS3 [uA]	100	400	600	850
VCASP [mV]	140	270	300	400
VCASN [mV]	560	630	750	900

Parameters scanned



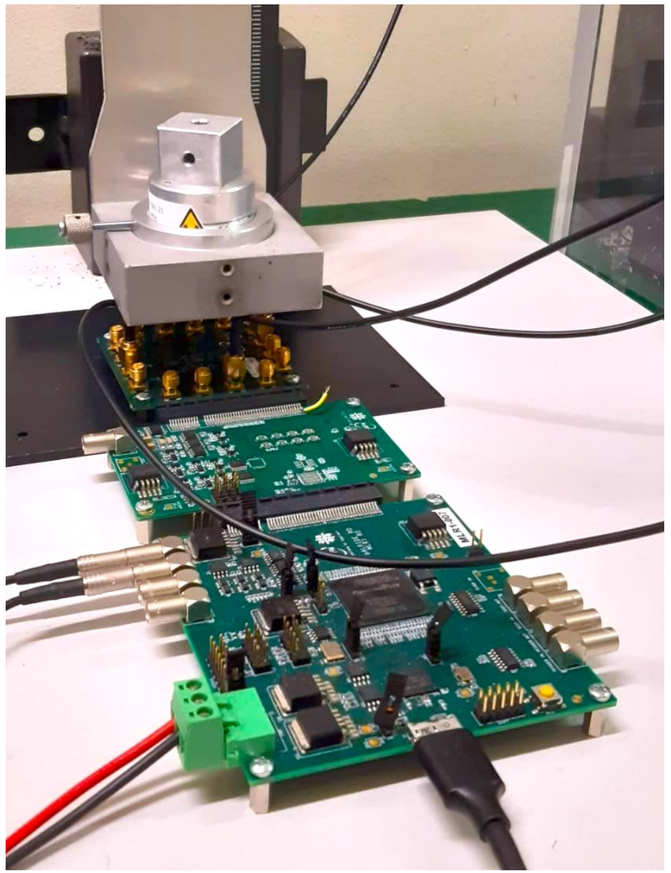
Target for the best timing performance



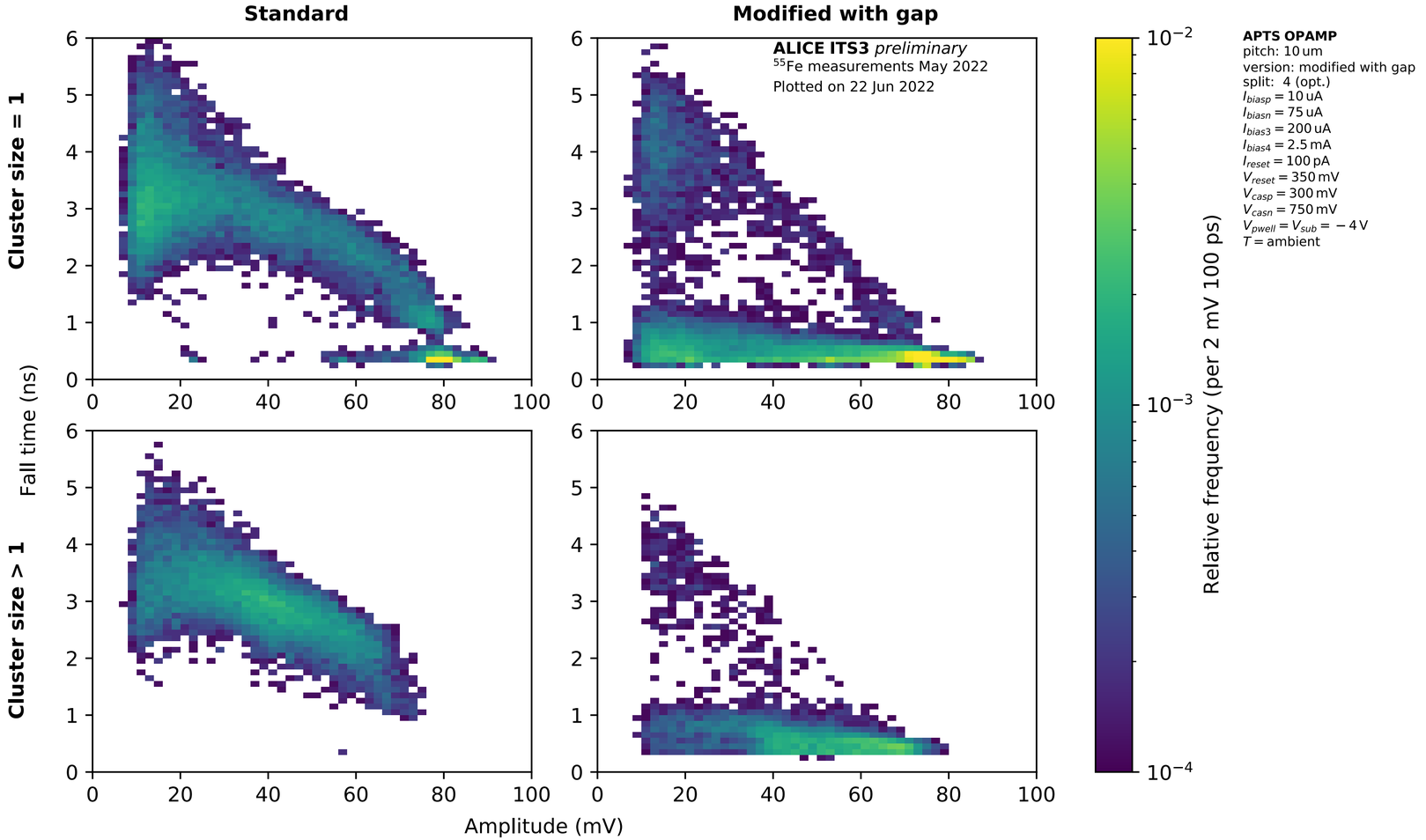
Example of parameter scan (Fall time)

- **Parameter scan:** Total **729** configurations tested
  VRESET scanned from 20 mV to 900 mV (20mV step)
  IRESET = 1 uA, **VH** = 1.2 V (fixed)
- Find the parameter combination that has **HIGH Baseline**, **HIGH Amplitude**, **LOW Fall time**

Lab Measurement - ^{55}Fe measurement

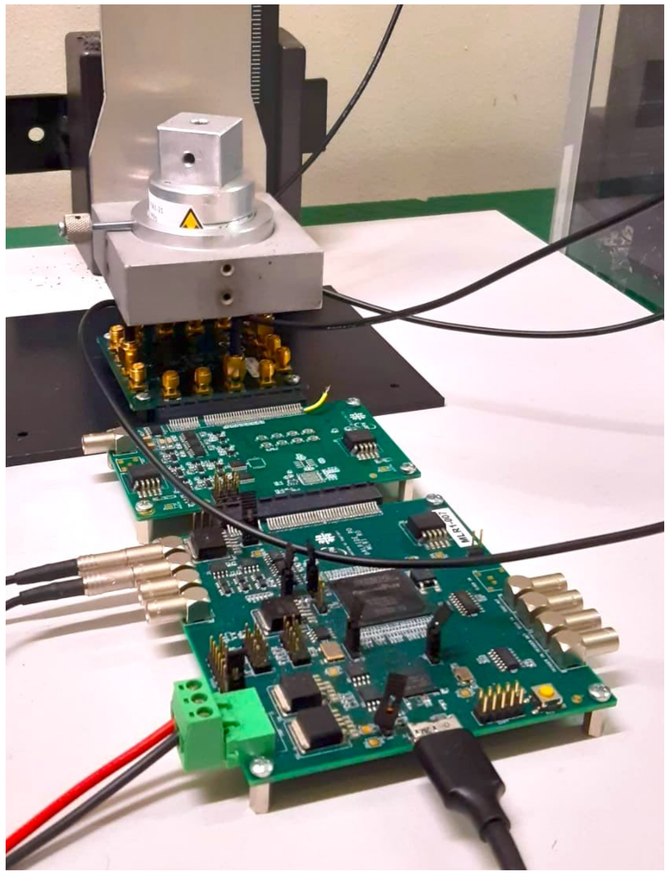


Lab measurement setup



- **Fall time vs amplitude distributions for different cluster size**
  - Evident difference in charge collection between different process versions
  - Modified with gap process shows more events with **high amplitude and low fall time**

Lab Measurement - ^{55}Fe measurement



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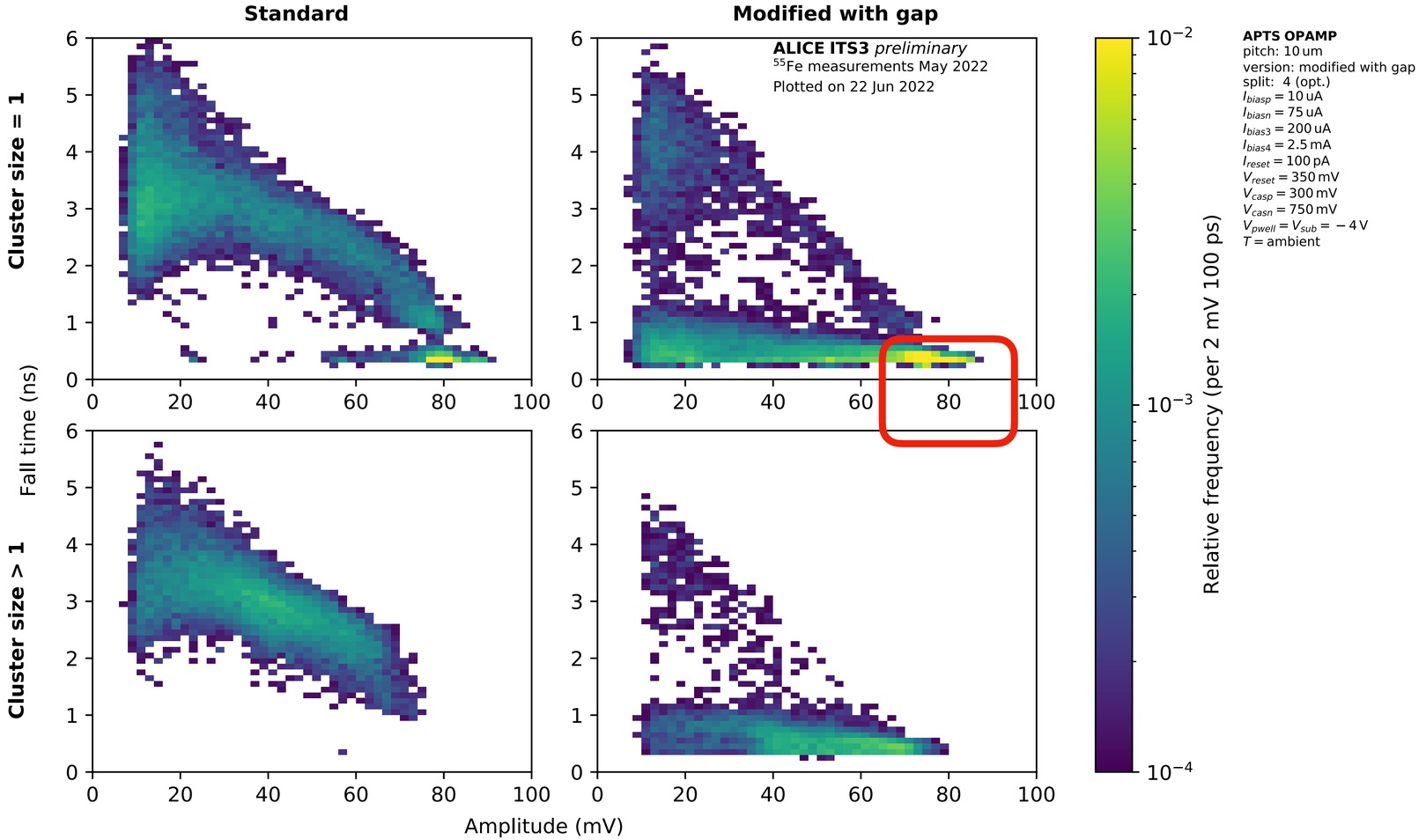

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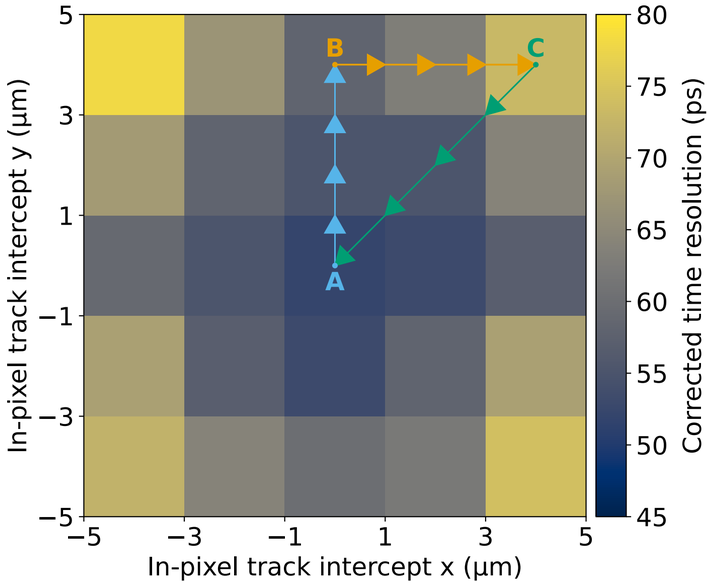
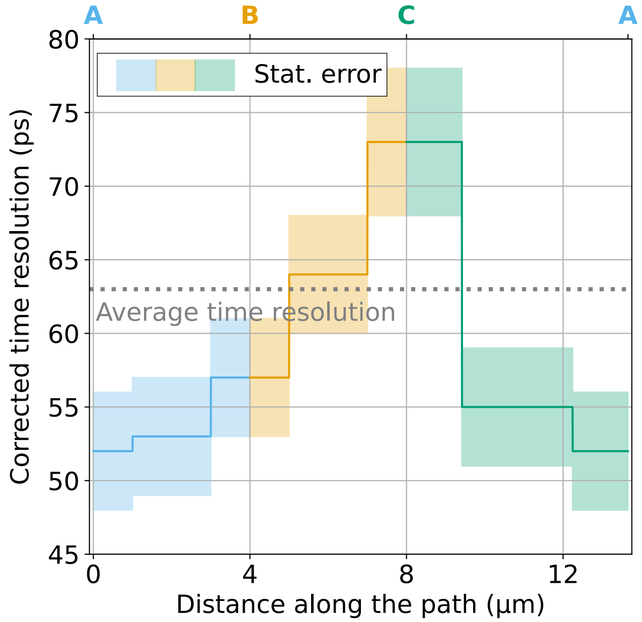
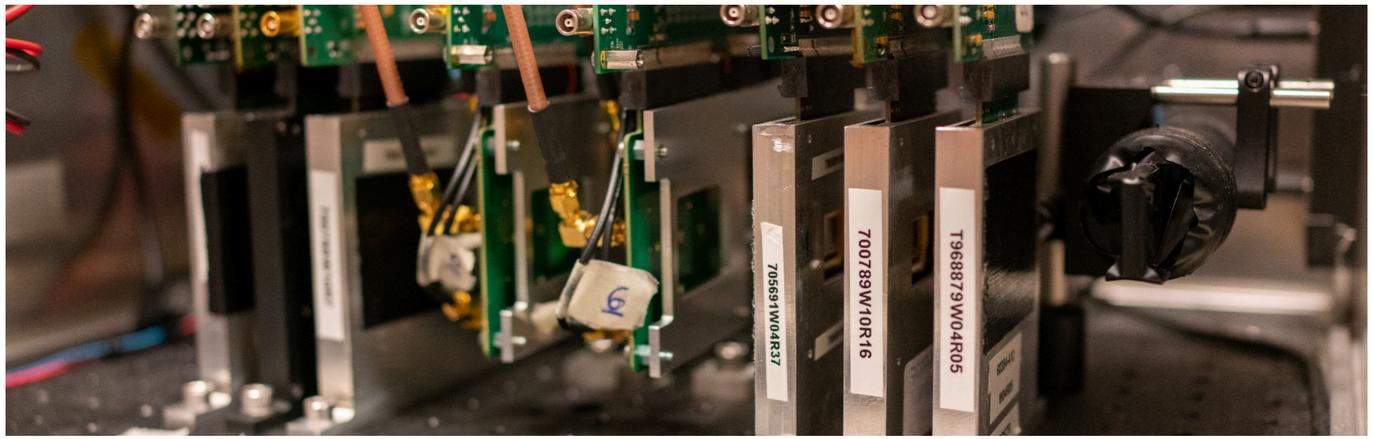
Beam Test - Performance measurement





In-pixel timing resolution



Test beam measurement setup (Telescope)

- **Measurement of timing resolution**
  - Performed at SPS@CERN
  - Two type of measurements:
    - Time residuals between APTS-OAs
    - Time residuals between APTS-OA and Reference timing detector (LGAD)
  - Analysed with both Corryvreckan and offline timing analysis and correction.
  - **Average resolution: 63 ps**
    - Down to **~50 ps at the centre of the pixel**
    - **with 99.5% efficiency**

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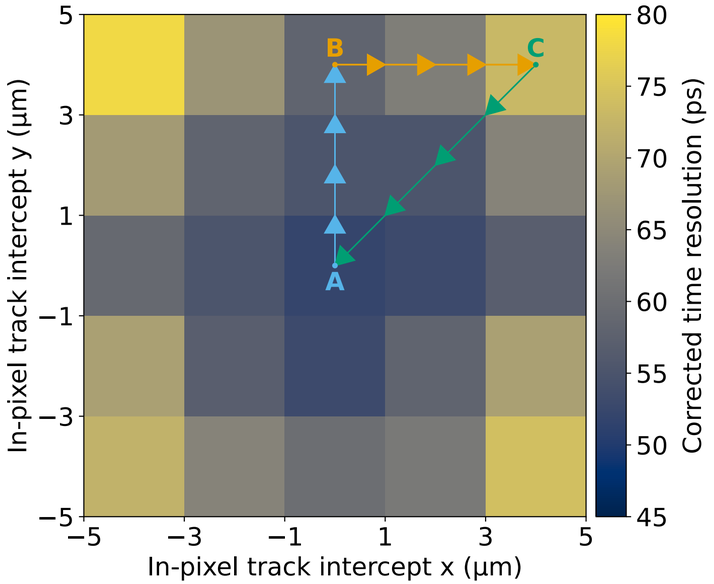

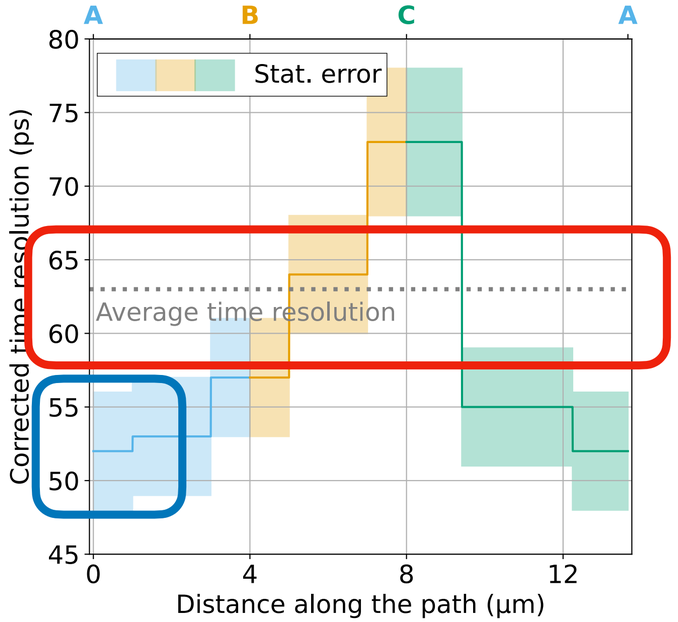

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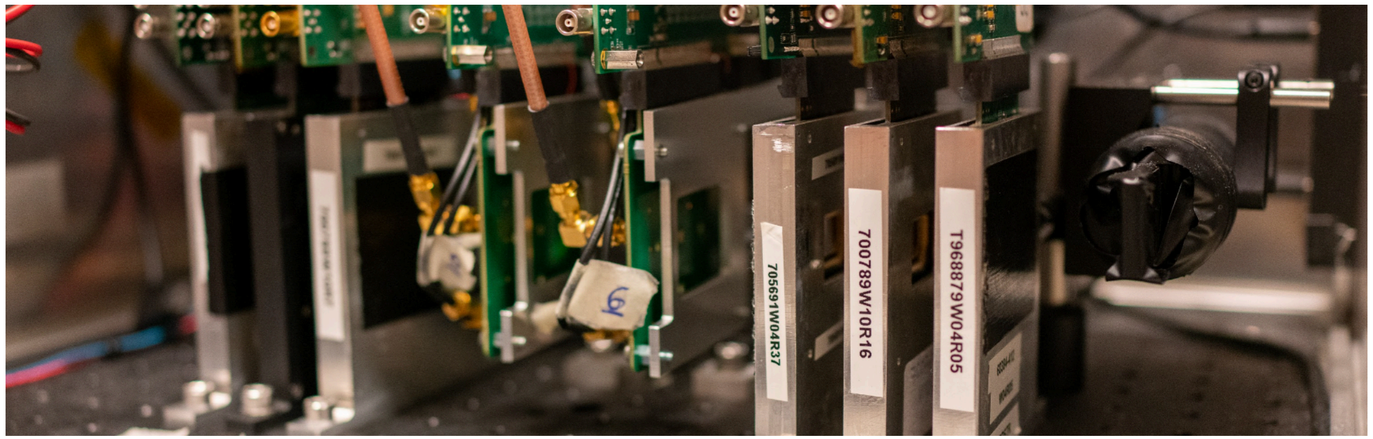

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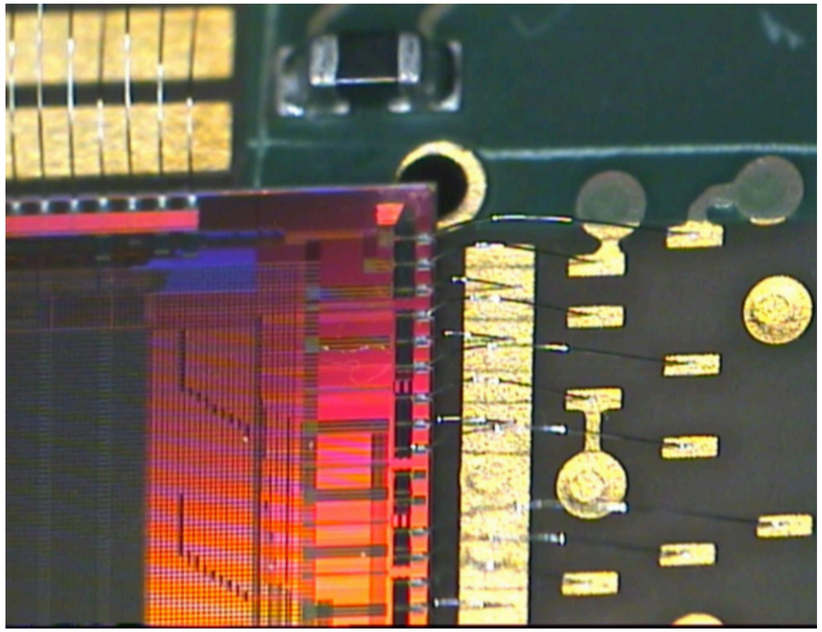
ER1 activity

babyMOSS assembly

Gluing of the babyMOSS to carrier card



Wire-bonding

- Torino performed some of the **post-processing of the babyMOSS**
  - Total **46 babyMOSS** was sent, **33 chips assembled** and returned to CERN
  - 1 babyMOSS fully tested
  - Still **10 babyMOSS chips** waiting for the testing **(WIP)**
    - Bonded on the carrier card v1

ER1 activity

Plans and capabilities

- **Plan for babyMOSS characterisation:**
  - **Temperature dependent performance measurement** using chiller and thermal pad
    - ITS3 Target operating temperature: 15 to 30 ℃
  - More on discussion..
- **Available Materials/Man power for ER2 in Torino:**

Source
- Typical X-ray source **^{55}Fe 37MBq** for energy calibration
- Up to few **10 MeV electron beam** LINAC underground
- **High brilliance x-ray source (HiBriX) with 3 elements anode**, thus multipeak characterisation, e.g. for ToT

Device
- Ultra-fast **oscilloscope (40GS, 25 ps interval)** for analogue signal processing
- **Probe station** connected to a semiconductor **parameter analyzer**
- **Fast pulsed laser setup** (tens of ps pulses in visible range)

Man power
- 2 Postdoc researchers, 1 PhD, 2 BSc students