IFAE ATLAS HL-LHC upgrade and future colliders activities

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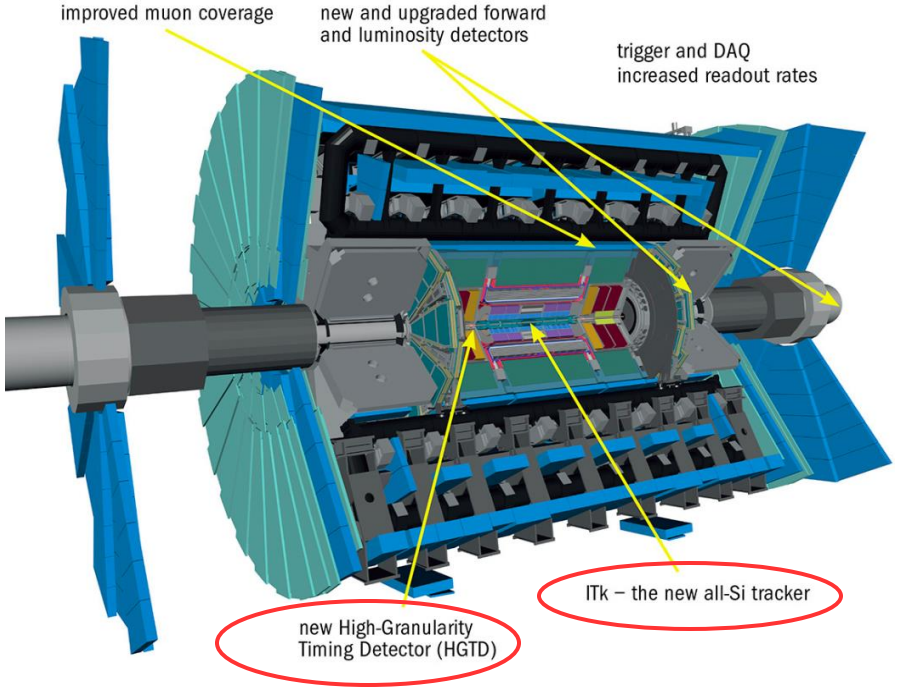
IFAE ATLAS upgrade activities overview

- **IFAE is currently heavily focused on the ATLAS HL-LHC upgrade activities**:
  - Fabrication of the innermost modules of the **ITk pixel detector**
  - Fabrication of modules for the **High-Granularity Timing Detector (HGTD)**



HGTD Module

ITk Linear Pixel Triplet module

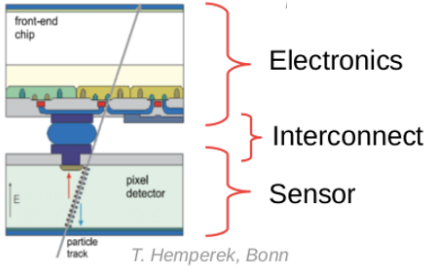
IFAE involvement in DMAPS for upgrade/future colliders

- **Introduction:**

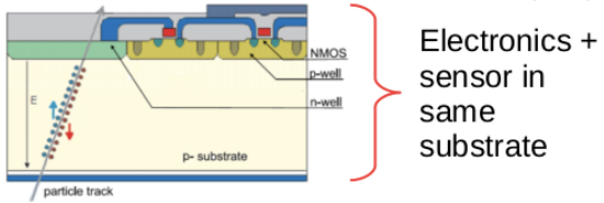
*Depleted Monolithic Active Pixel Sensors

  - Hybrids are used in HGTD but are complicated to fabricate. DMAPS* offer a more elegant/cost effective solution

Hybrid detectors



Monolithic detectors

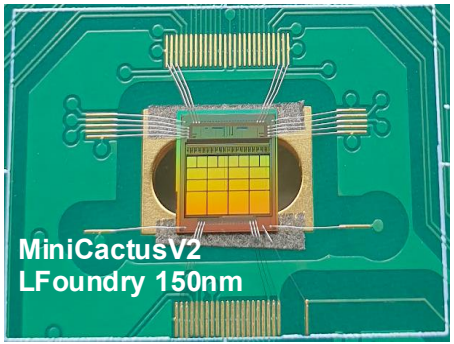


- **IFAE historical activity in DMAPS:**
  - IFAE is working on the HV-CMOS technology (now DMAPS) since ~2014
  - **Initially** worked on the design and characterization (radiation tolerance) of prototypes for the ATLAS HL-LHC upgrade (S. Terzo et al., *JINST 14 P02016 (2019)*)
  - After ATLAS dropped DMAPS for HL-LHC in 2018 (due to the tight schedule) IFAE is exploring DMAPS in the context of RD50/DRD3/AIDA for future colliders:
    - **Tracking** (for the CEPC: T. Wu et al., *JINST 16 P09020 (2021)*)
    - And also for **Timing**

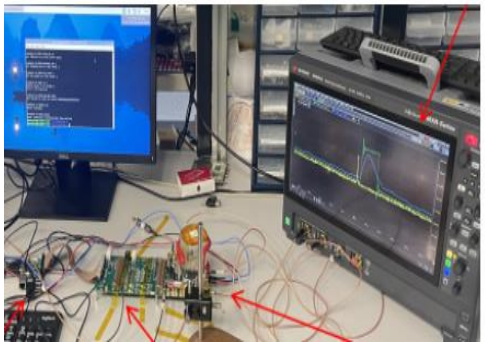
DMAPS for timing (1)

- **Work in DMAPS for timing – two-fold objective:**
  - Investigation of the potential layer replacement of HGTD (beyond Run 4)
  - Potential use in future colliders (FCC-ee)
- **IFAE current activity:**
  - Working on the chip design, fabrication and characterization of DMAPS for timing
  - Currently exploring a new prototype, MiniCactusV2, designed and characterized by IFAE and IRFU (Saclay)

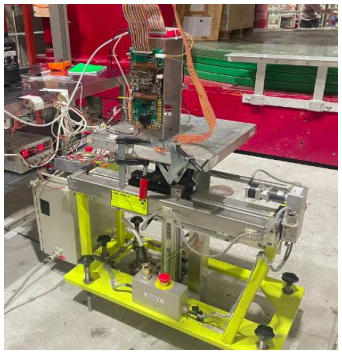
MiniCactusV2 prototype



Test-stand in IFAE with ^{90}Sr source



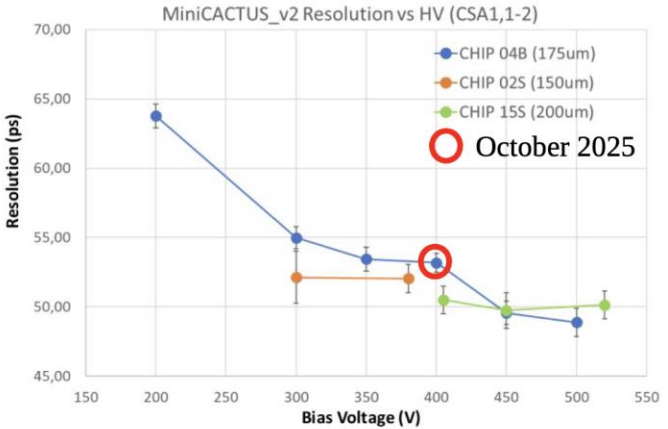
Test-stand at CERN with beam



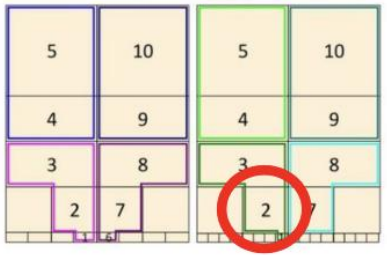
DMAPS for timing (2)

- **Recent preliminary results on MiniCactusV2:**
  - Resolution time of ~50 ps!
    - Before irradiation
    - On 0,5 x 0,5 mm^2 pad size
  - References:
    - Y. Gan et al., *JINST 20 C04013 (2025)*
    - J. Piñol, recent results in talk in DRD3: *https://indi.to/7K9ZK*
  - Resolution of hybrid Low Gain Avalanche Detectors: ~40 ps

Resolution vs bias voltage *J. Piñol*



July 2025 Summary plot on 0.5x0.5 mm^2



- **Planned further improvements:**
  - Exploring DMAPS with a gain layer to further improve the timing resolution

- **Potential use in detectors at FCCee or CEPC, for example**