News on the Chip-On-Board PCB

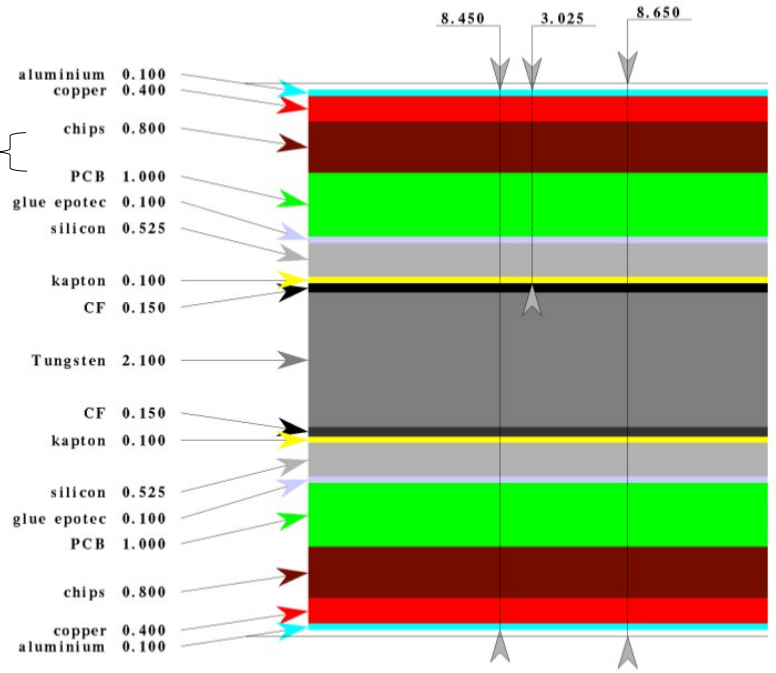
Adrián Irles,

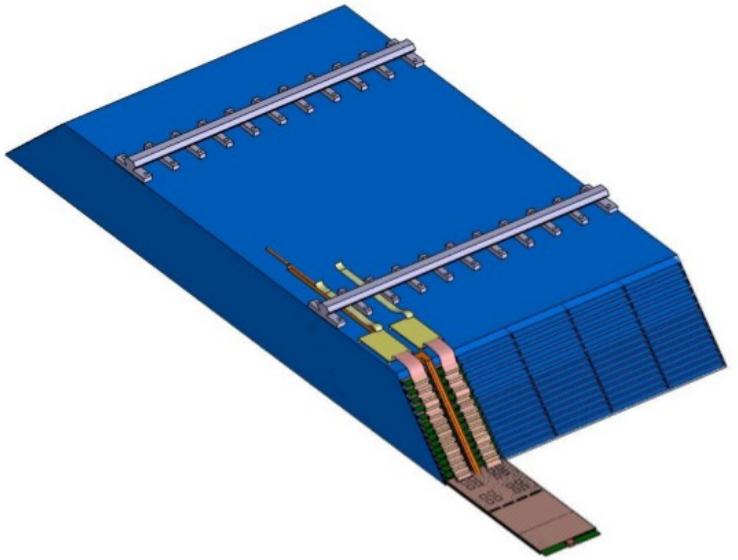
...on behalf of

Support by LPNHE PARIS, KYUSHU UNIVERSITY is acknowledged

CALICE Meeting,
Utrech 11/04/2019

Motivation



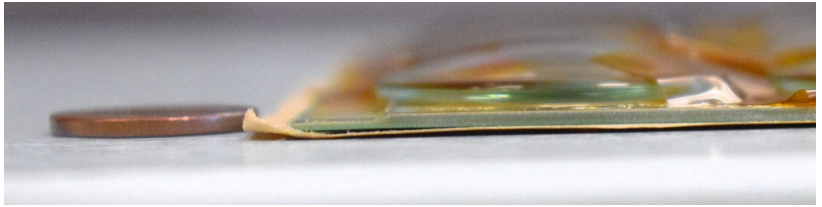


Drawings by Henri Videau for SiW Ecal Technical Design Document

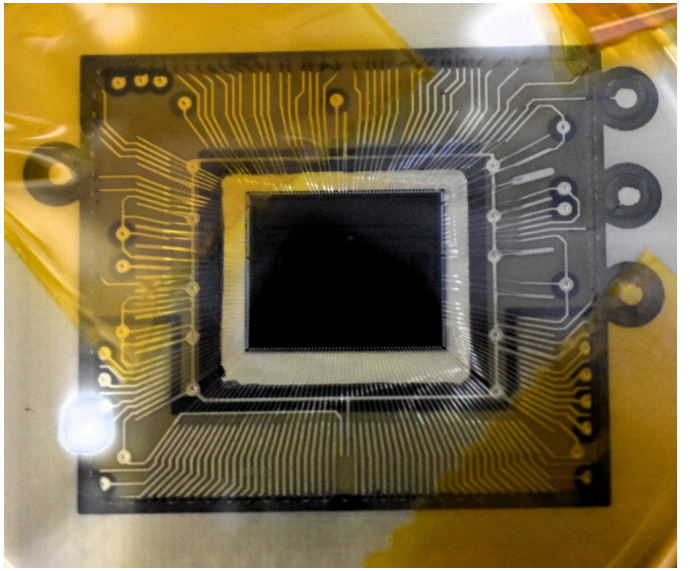
- Design: Total space for ASICs and PCB 1.8mm (was 1.2mm since ~2007)

Ultra thin PCB: Chip On Board

- **LAL & OMEGA** collaboration with **ITAEC/SKKU** (Sungkyunkwan University, Suwon – Corea) and **EOS company** for the PCB production.
- 10 FEV11_COB produced.
  - 1.2mm thickness → 9 layers PCB !
  - Good Planarity (metrology made in LAL) and electrical response.
- **4 boards wirebonded** at **CERN** bonding lab. Also In contact with CAPTINNOV Platform.

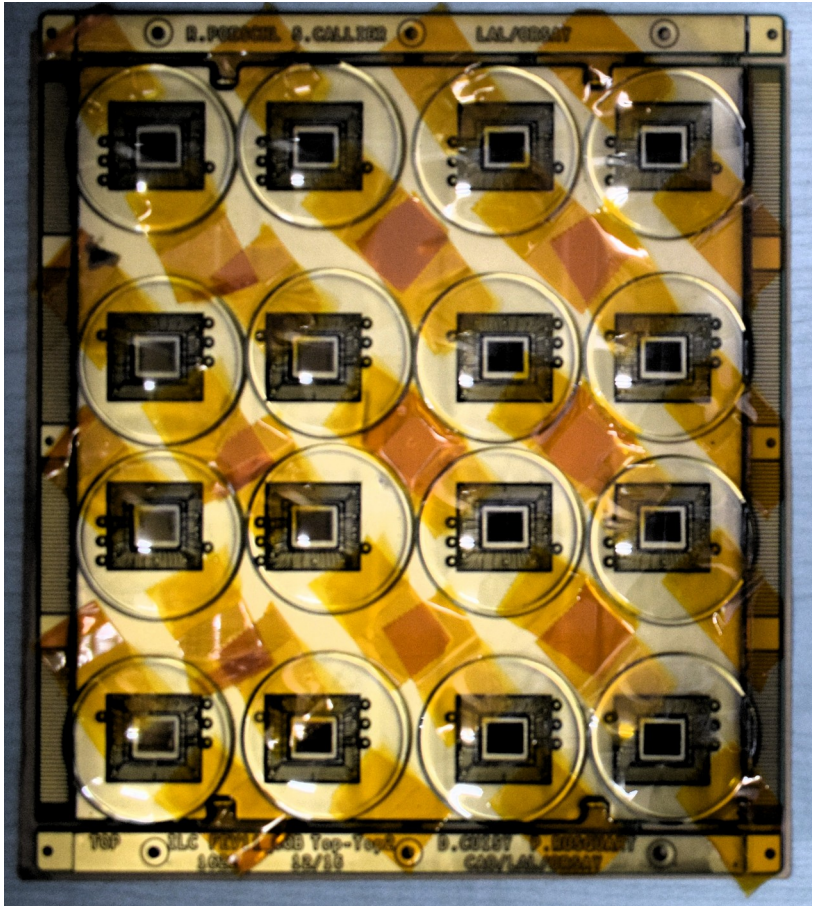


SK2a

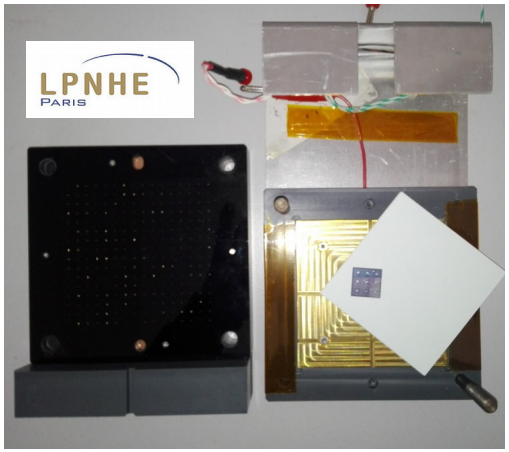


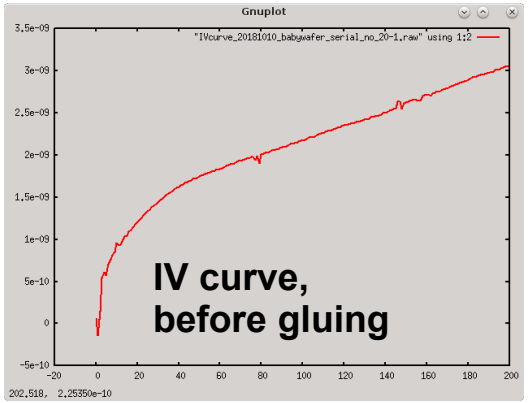
Ultra thin PCB: Chip On Board

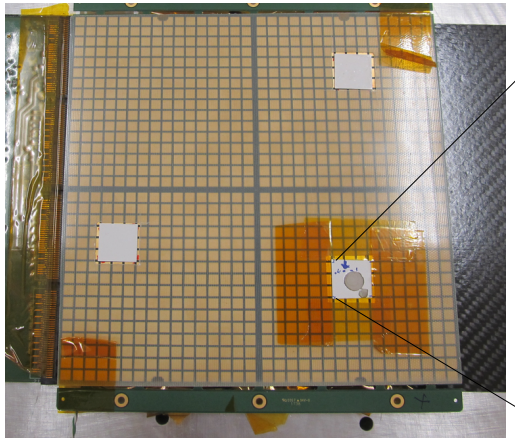
- **Tests** ongoing since April 2018:
  - FEV11_COB_a: all chips respond and are configured (with SMBV4+DIF system and also SL-Board).
  - FEV11_COB_b: equipped with 3 baby wafers. Most of the following results are obtained with this board.
  - FEV11_COB_c and d. Just been wirebonded this week.

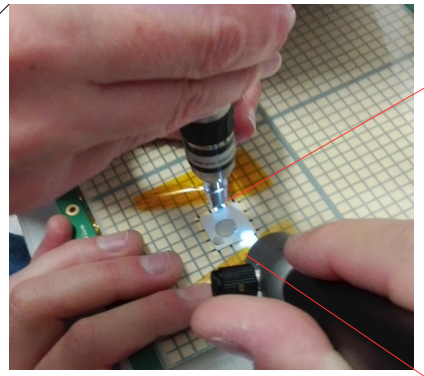


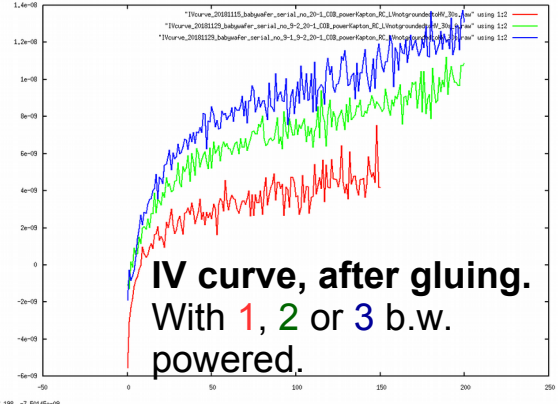
Baby wafer gluing





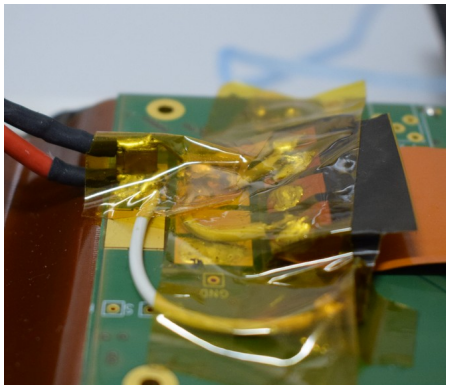


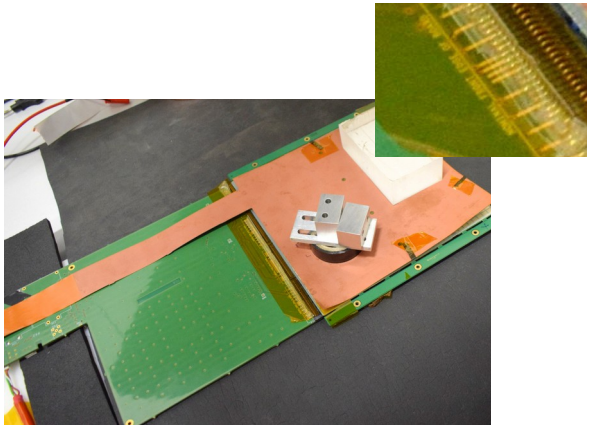




- We got a bunch of S10938-1364(X) “old” baby wafers (split guard rings, 4 rings, cut size B) of 3x3 pixels from T. Suehara.
- IV test bench borrowed from LPNHE. New expertises acquired at LAL (exported to Captinnov). Full wafer characterization will be done at LPNHE.
- 3 baby wafers manually glued.
  - Visual inspection of the glue dots (light fiber system).
  - IV curves after gluing.

Test bench

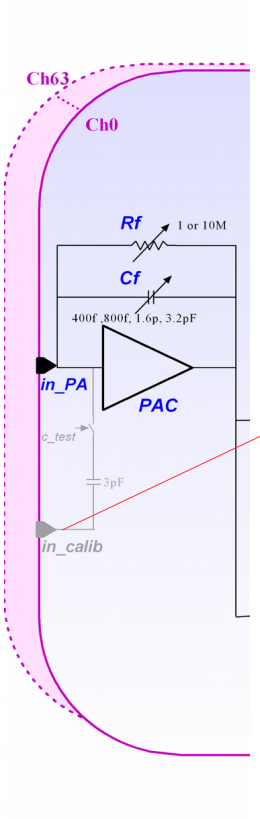


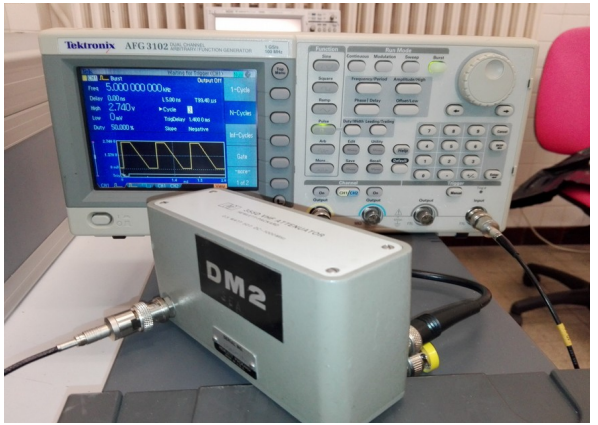


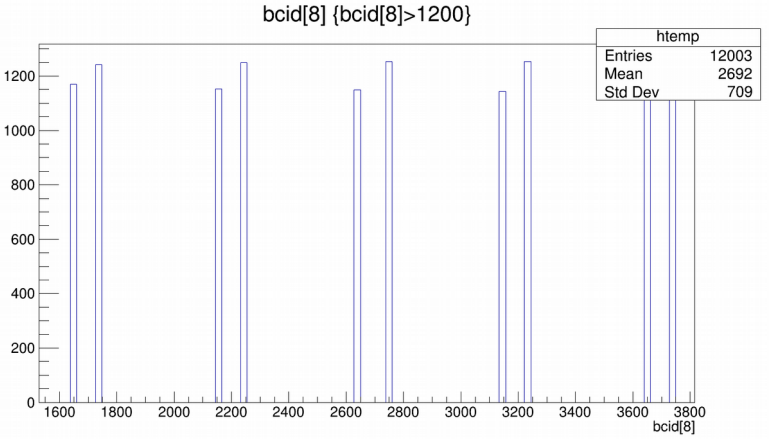
- FEV11_COB wire bonded to SMBv4 (+ DIF)
  - Modification of an SMBv4 prepared for the tests of individual ASU BGA based using temporary connexions by pressure.
  - These connectors were optimized for thicker ASUs… Solution: wire bond the ASU and SMBV4.
- HV directly connected to the kapton sheet connectors (small RC fitler added).
- The baby wafers are polarized by direct contact with the kapton sheet.

Injection tests

- Tests injection signals equivalent to 1-O(100) MIPs
  - Assuming Si sensors of 320 ± 15μm.
  - And that a MIP traversing the PIN parallel to its normal will create ~ 80 h + e −pairs per μm → ~4.1fC in total.
- Pedestal measurement:
  - We inject in one single channel per ASIC and we disable the triggers of all the others.

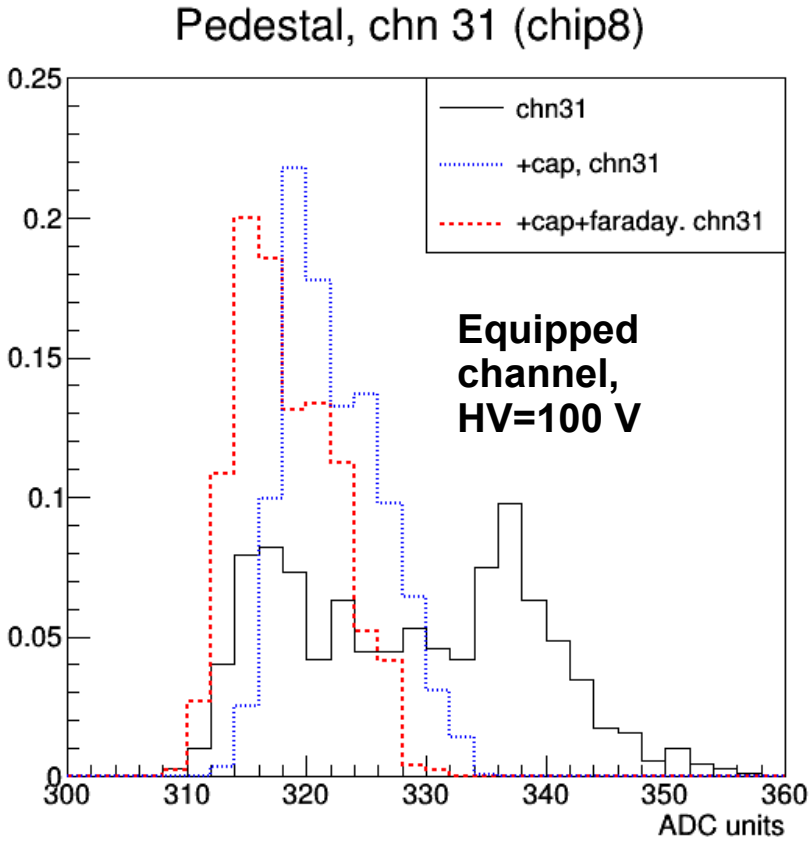






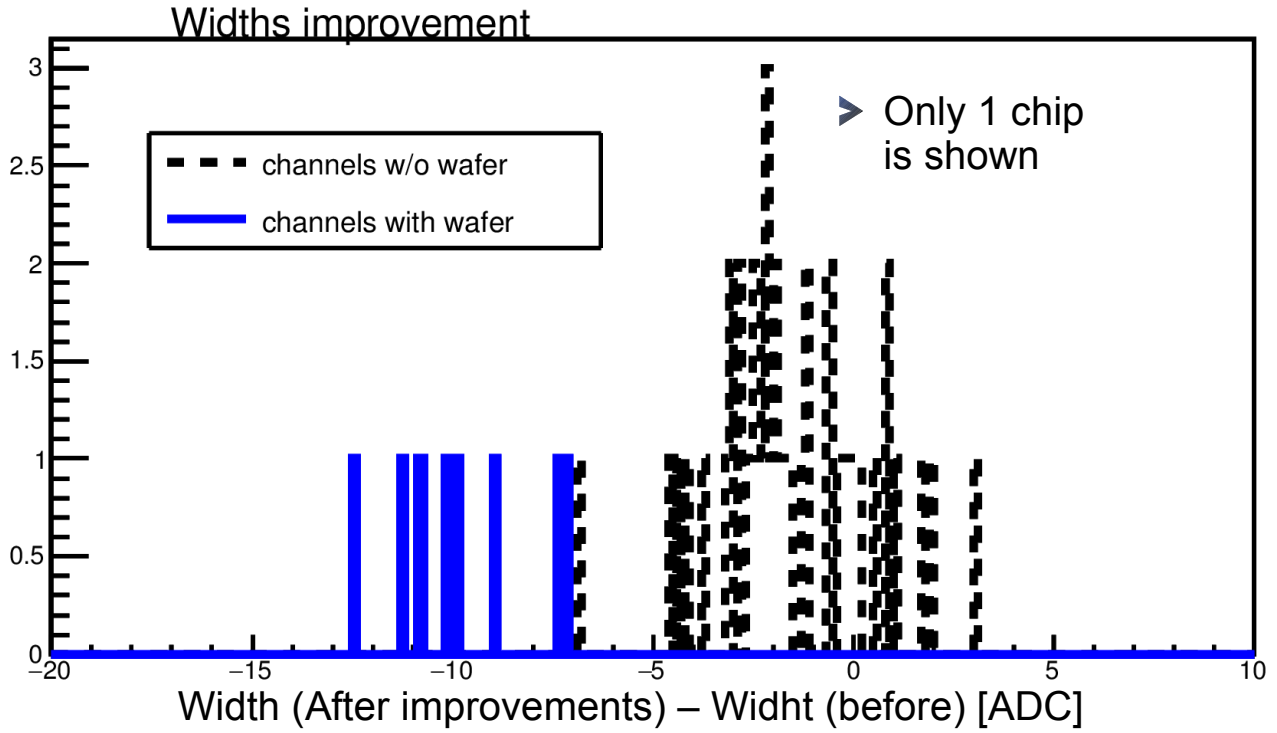
Injection tests (pedestal study)

- First pedestal studies showed wider pedestal distributions compared with the expectations.
- This effect is much larger for channels connected to sensors.
- To minimize this effect, we improved the HV delivery and light isolation +:
  - Add AVDD and DVDD decoupling capacitances at the end of the SLAB (blue curve)
  - Further improvement on the HV delivery, lght and electrical isolation (red curve)



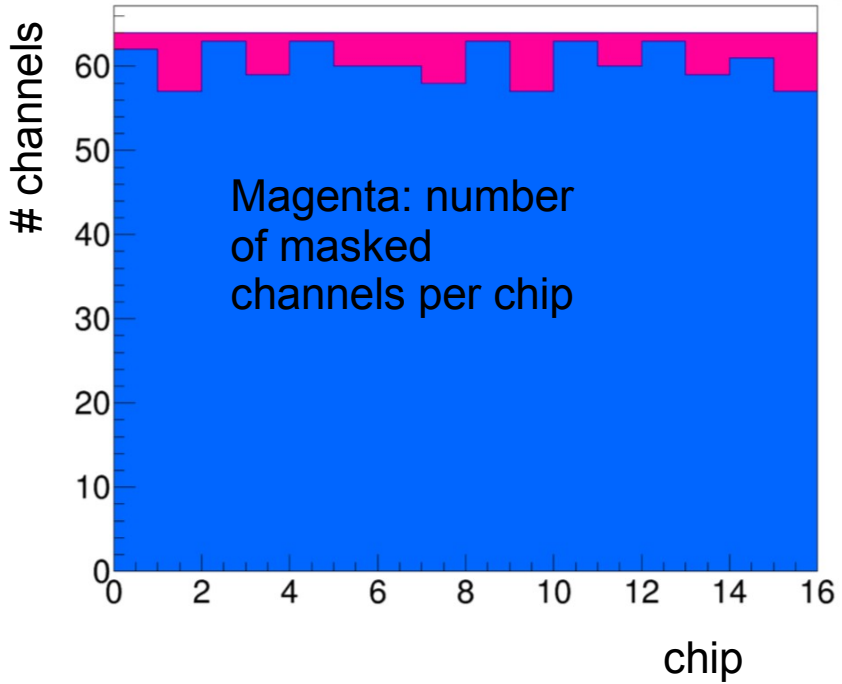
Injection tests (pedestal study)

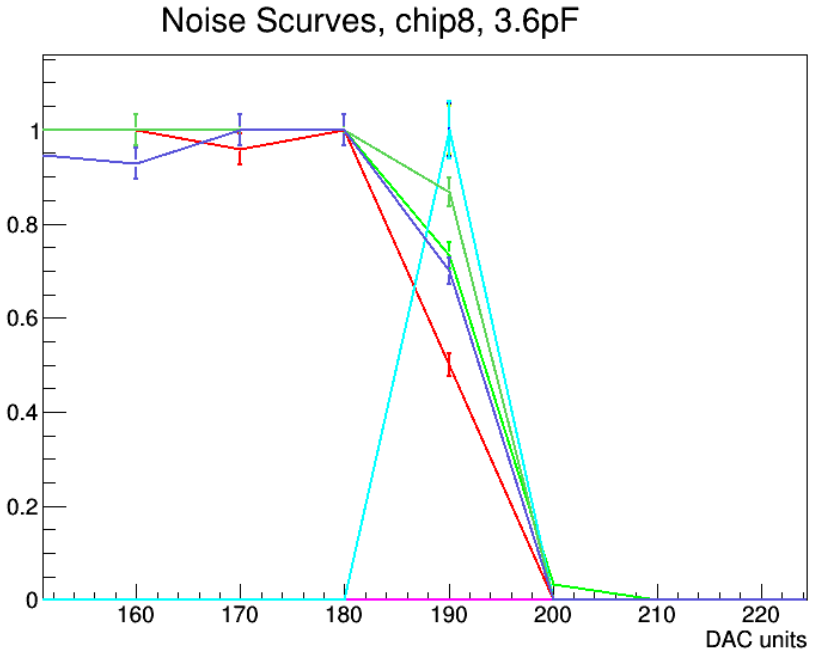
- What is the improvement in the width of the pedestal for each channel?
  - Width defined as the RMS.



Threshold optimization + noisy channels masking

- ~4% of noisy channels masked
- Threshold scans made with all other channels enabled.

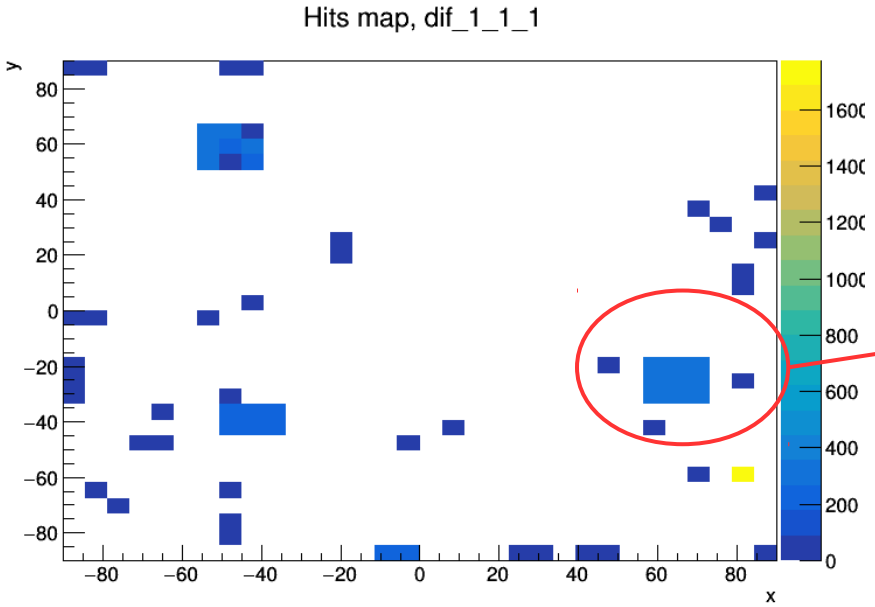


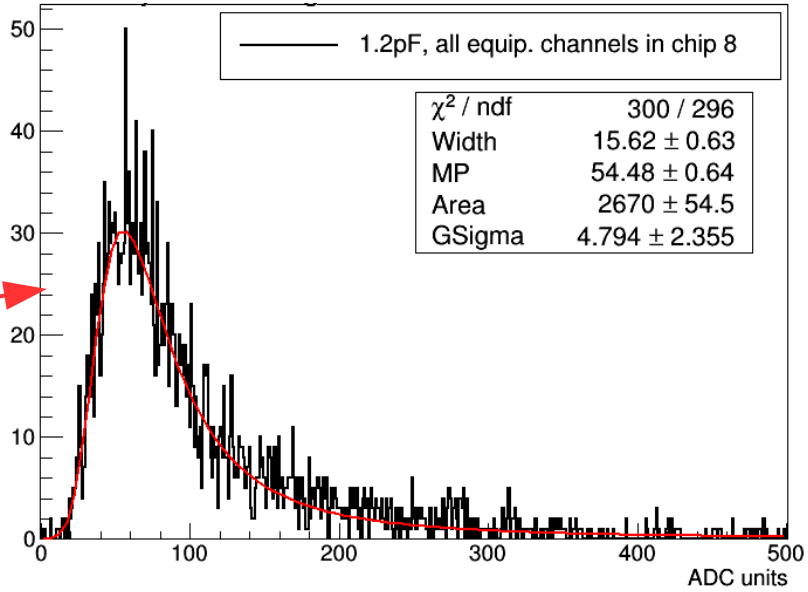


Only equipped channels are shown

Cosmic data

- Using settings from the commissioning described before





Conclusion + outlook

- The COBs are fully functional and nicely recording cosmic ray data.
- Ready for wafer gluing
  - LPNHE got a naked COB to test the feasibility of the gluing using the robot. Positive results of the test. See Roman's talk.
- COBs are been tested with SMBV4+DIF and also with the new SL-board DAQ system.

- Next beam test plans: produce and commission two COBs with glued wafers and connected to SL-boards. See Roman's talk.