ATLAS-CMOS Activities in H8B

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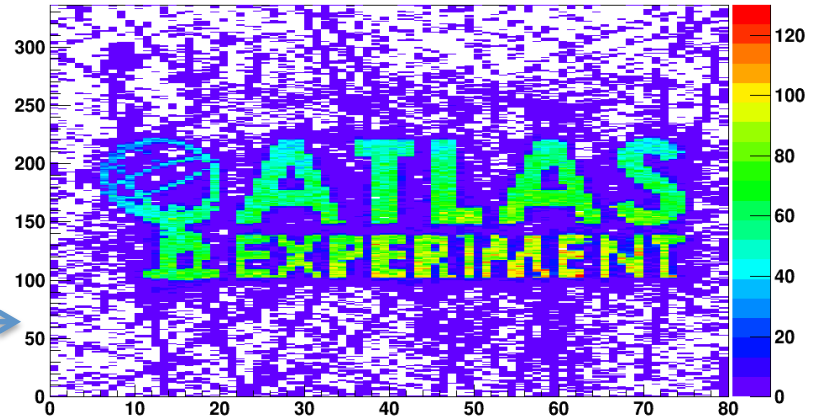
The FEI4 telescope @ SPS

The telescope

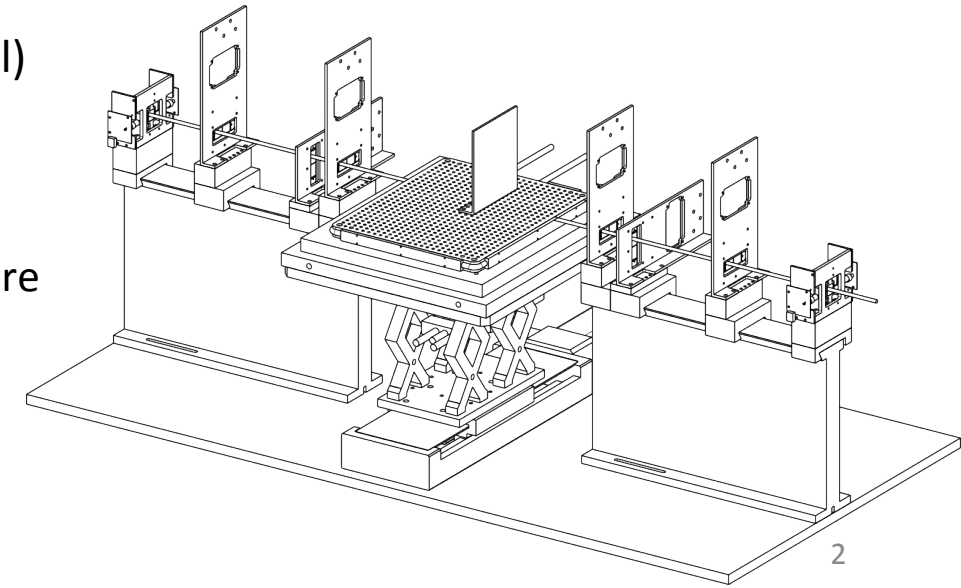
- 6 pixel sensor planes in two arms
- Sensors: IBL double chip sensors (200um n^+-in-n, 250x50um Pitch)
- RCE Readout, up to 4 DUT, 2 DUT optimal
- Trigger: First and last sensor plane, easy generation and application of masks for ROI
- Trigger frequency in SPS H8 beam (average during spill)
  - ~17kHz trigger rate with one DUT (upgrade ongoing)
  - ~4kHz triggering on 3% of FE-I4 (720 pixel)



SPS Data, image-like ROI

Mechanics

- Two movable arms hosting 3 planes each
- 2 out of 6 planes rotated by 90 degrees for more uniform resolution
- Planes can be tilted around x and y
- XY stage with DOBOX style DUT box
- Cooling by chiller



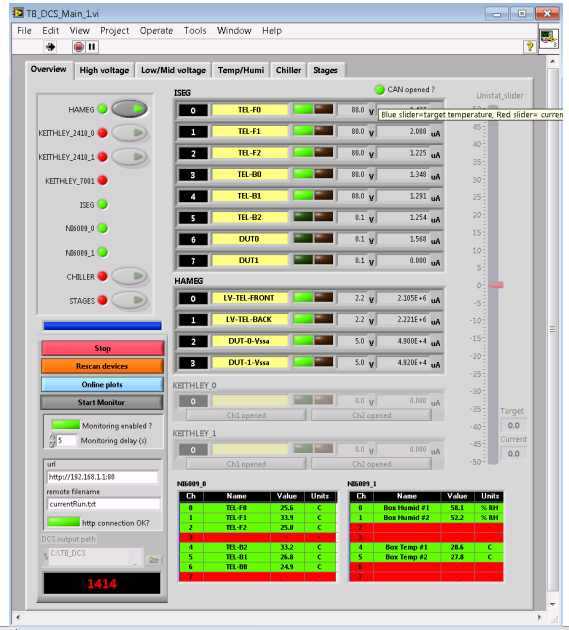
The FEI4 telescope @ SPS

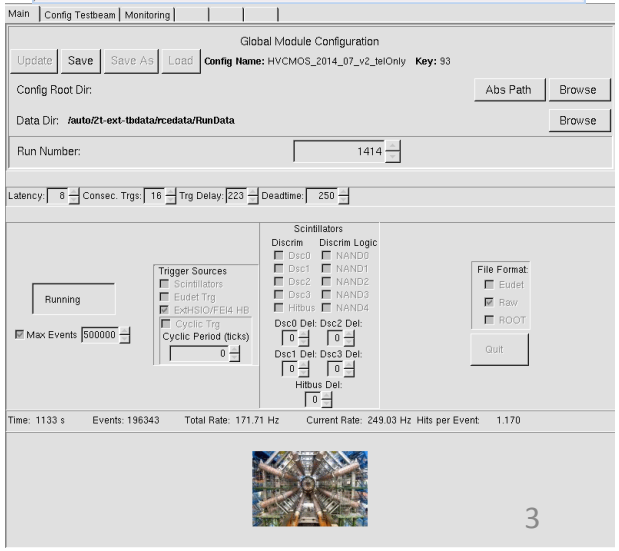
DCS

- Robust interface, ~1 crash a week
- Labview control with data logging vs run numbers and time
- Provides :
  - 16 0-5V LV channels
  - 8 0-120V LV channels
  - 8 0-2kV HV channels (6 for telescope planes)
  - Temperature and humidity probes
  - Cooling using huber chiller
  - Translation stage control for DUT

User interface

- RCE GUI interface
- Online monitoring for FEI4 + Run Control and chip configuration in a single GUI
- Plain text configuration files
- Setup via one shell script
- In case of a failing DAQ (very unlikely): Recovery via one shell script
- Can provide Trigger/Busy signals for other detector integration. Data in root format for quick merge and comparison

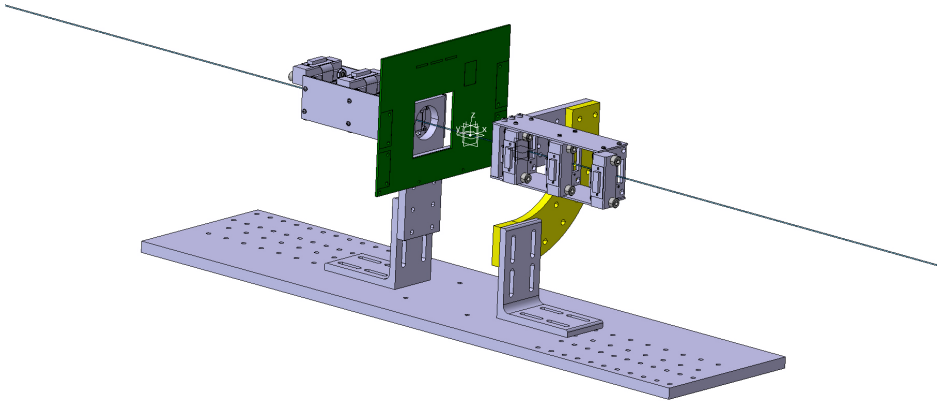




AIDA SBM telescope

Mechanics

- **Compact** DBM-like mechanics
  - **Size 60x20x20 cm^3**
  - Weight 4 kg
- Two DBM-like telescope arms moveable along Z and Y axis.
- One **rotatable arm**
- Max. **400 mm spacing** between the arms
- A clamp for mounting DUTs
- Possibility of mounting PMTs for triggering
- 6 single-chip **FE-I4B** Silicon planar sensors (**250x50 um^2 pitch, ~2x2 cm^2 active area**), 3 per telescope arm

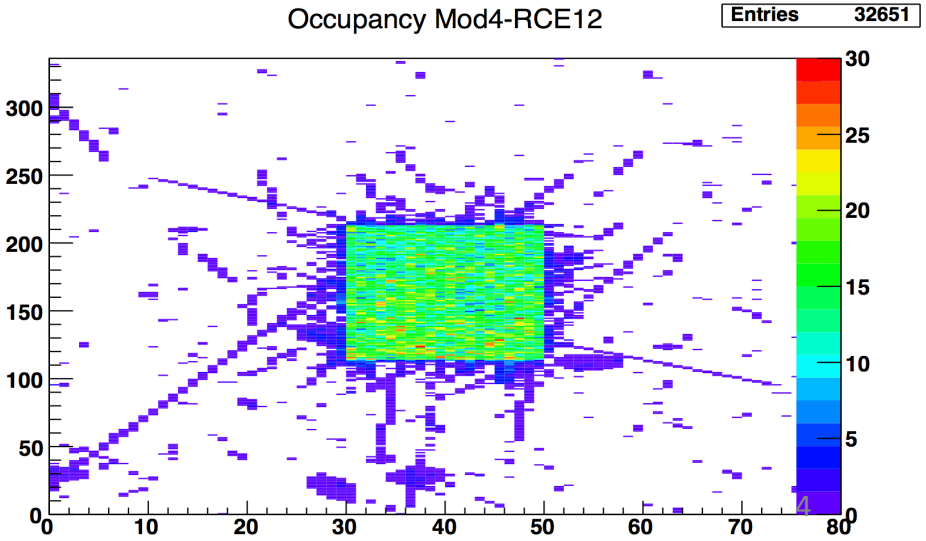


Triggering

- External – PMTs
- Internal – HitOR functionality in FE-I4s. Hitbus chip for HitOR trigger handling (e.g. trigger issued when a hit is recorded in all planes)
- Triggering on a region of interest in FE-I4

2 more copy of the telescope in production

1 copy to be used with the Morpugo magnet



Reconstruction and Analysis

- **Reconstruction based on the Judith framework**
  - Clustering, track fitting and DUT analysis
  - Resolution at DUT ~8/12um for typical telescope configuration
  - Hairbrush effect seen in residuals due to binning effects with large pixels -> Understood in simulation
  - Very good for global efficiency and large statistics or small samples
  - But can also do some in pixel studies !

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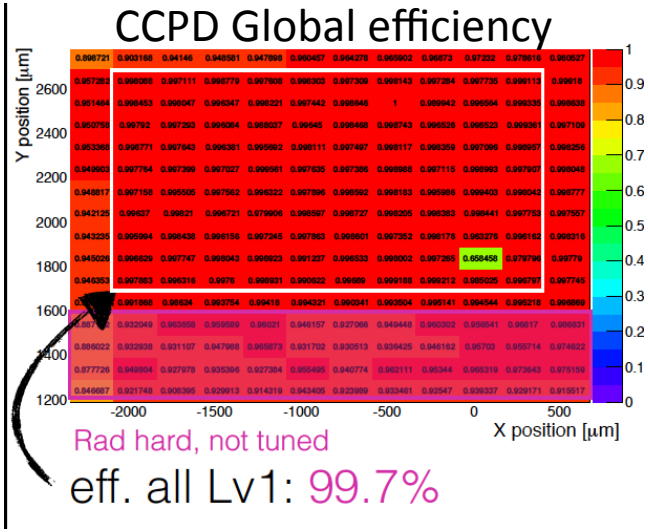
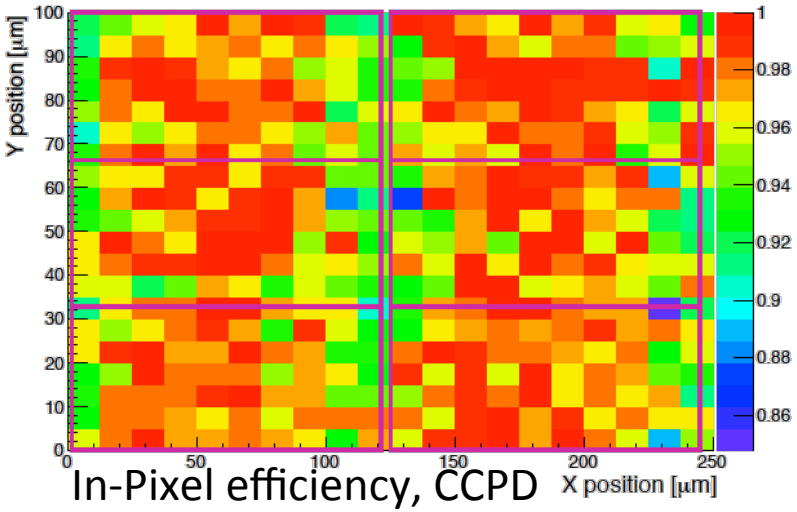
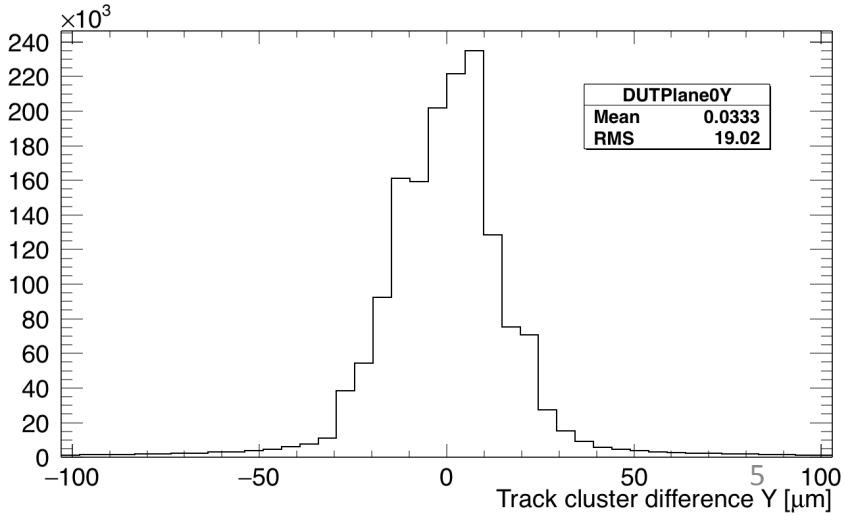
- **EUTelescope-compatible**
  - LCIO files produced with converter for each run taken
  - Comparison with Judith ongoing
  - Preliminary results for tracking show similar performances

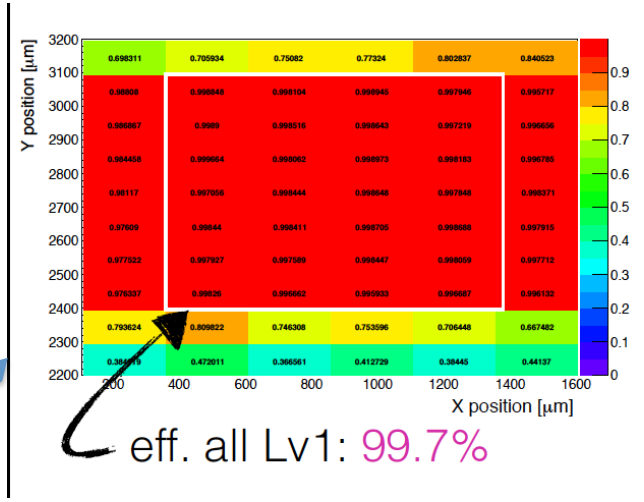


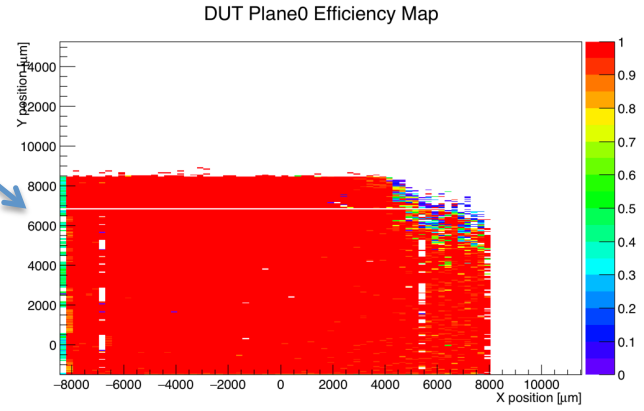


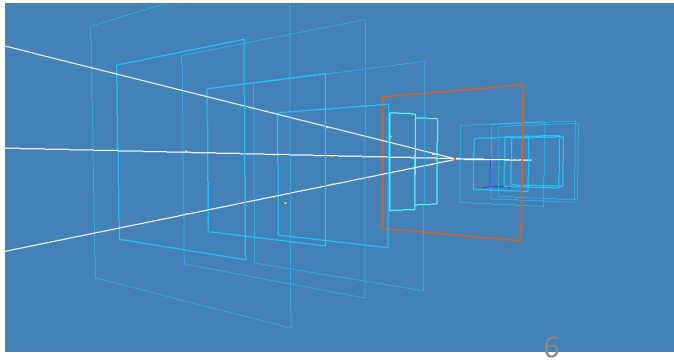


Users results in 2014

- Users in H8B with the FEI4 telescope :
  - Public results :
    - UNIGe : [SPS Test Beam characterization results with CCPDv2 and CCPDv4 capacitively coupled to FEI4, Javier Bilbao.](#) Trento Workshop 2015
    - LAL Orsay: [Test beam data analysis of ATLAS planar pixel sensor with alternative bias rail geometries.](#) Clara Nellist, Trento Workshop 2015
  - Coming soon ! :
    - MPI Munich : High-Eta and High-Phi measurements with FEI4 planar sensor modules
    - U. of Manchester & U. Santa Cruz: see [Measurement of the 2-tracks separation resolution in IBL-3D modules](#) , Itk Pixel Parallel Session, 25-02-15, by Francisca Munoz Sanchez
    - Characterization of DAMPE Strip Ladder, UNIGe

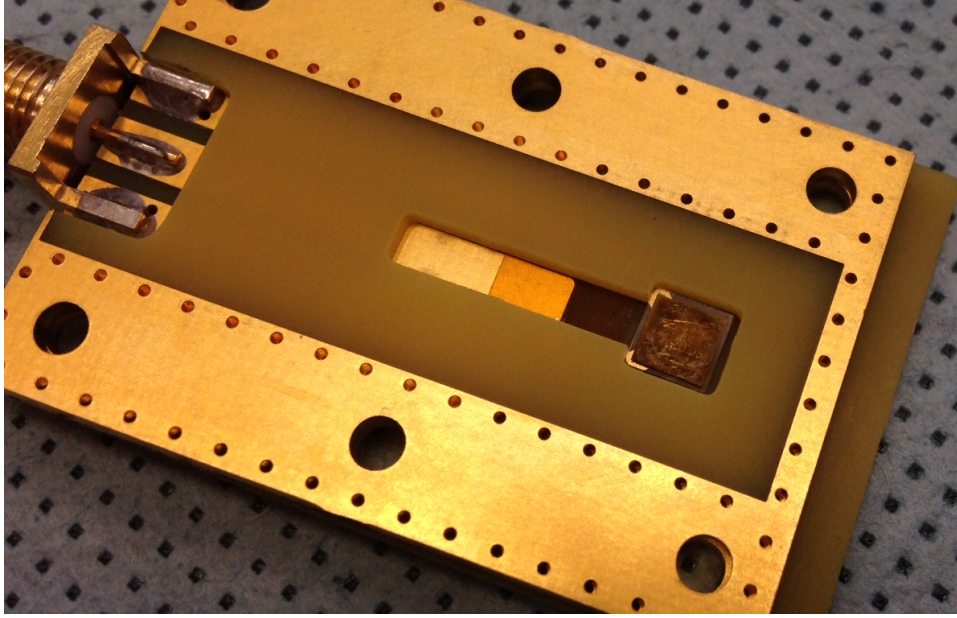


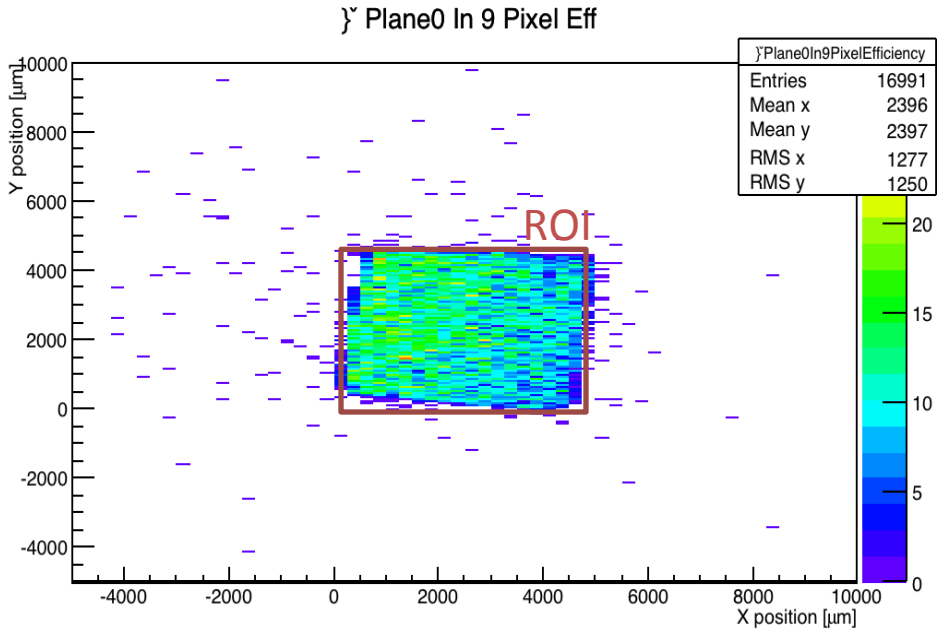


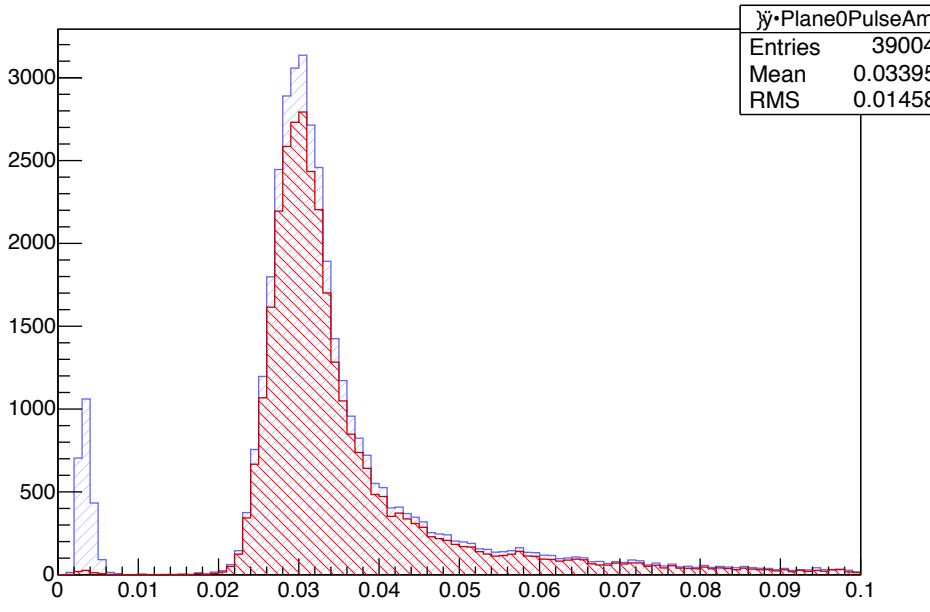


Diamond pad detectors (M.Cerv)

- scCVD diamonds
- 4.7x4.7 mm^2
- 500 µm thick
- CIVIDEC charge preamplifier
- Analog readout using LeCroy oscilloscope
- Irradiation study (charge collection efficiency)

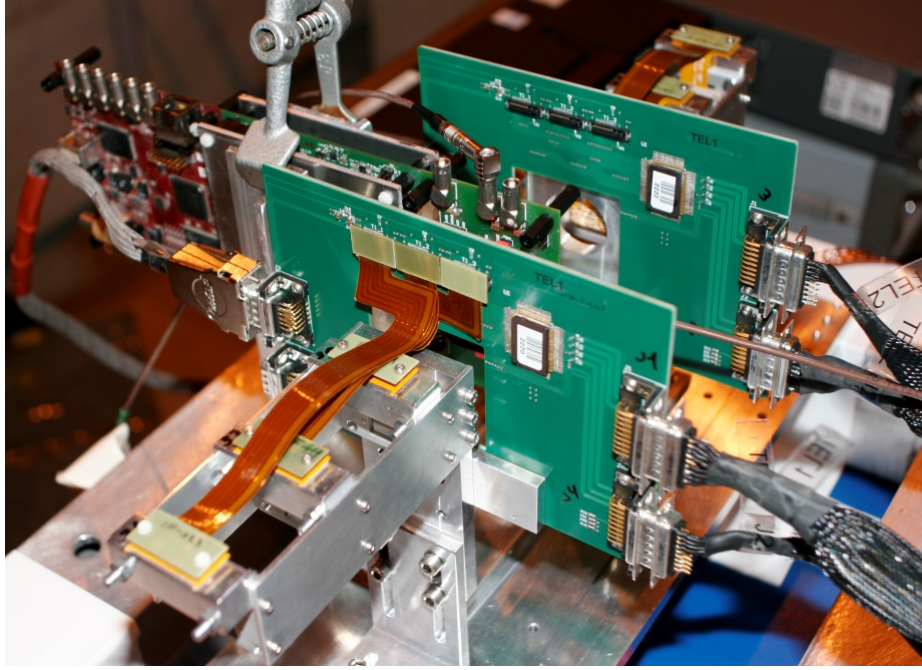


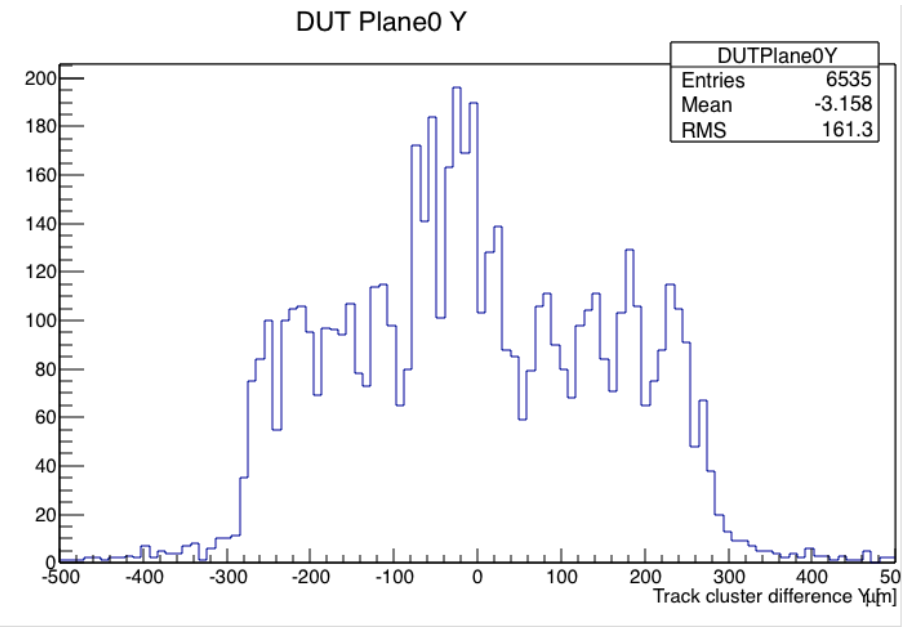


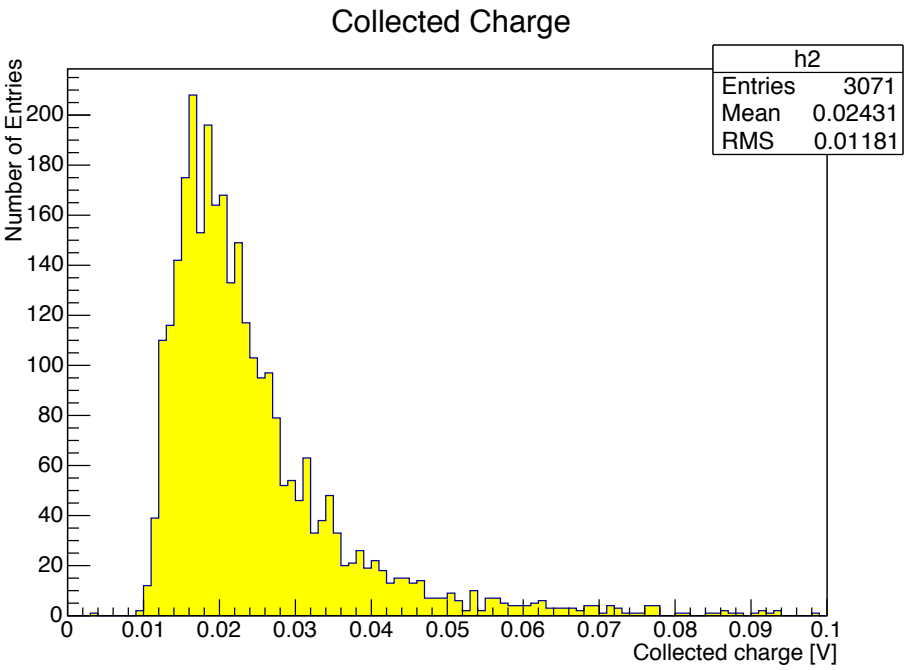


XFAB chip
(S. Fernandez)

- SOI full Monolithic Active Pixel Sensor
- Chip: 300 µm thick
- Size: 5 x 2 mm^2
- 4 matrixes with different pixel sizes: 100×100 μm^2 , 50×50 μm^2 (x2), 25×25 μm^2
- Feature size: 180 nm
- Single pixel analog readout

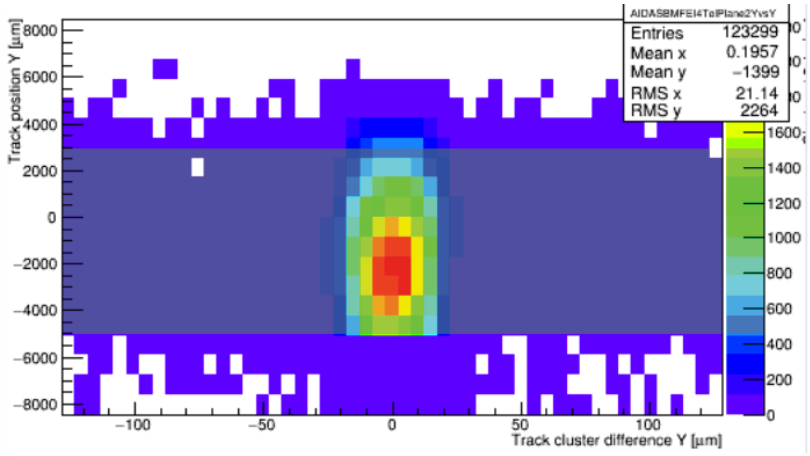


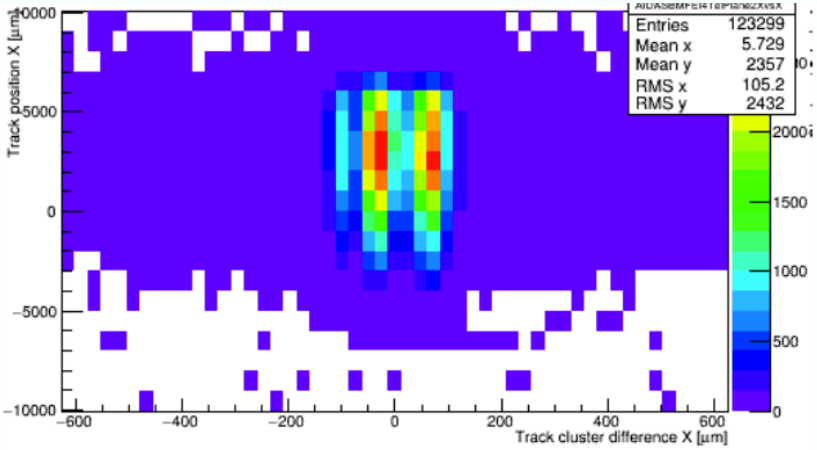


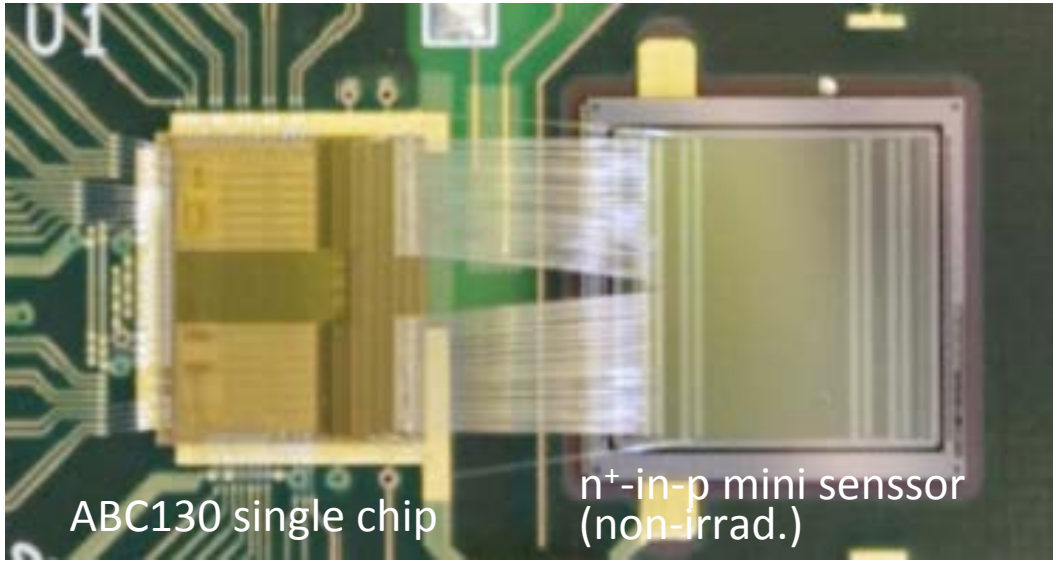


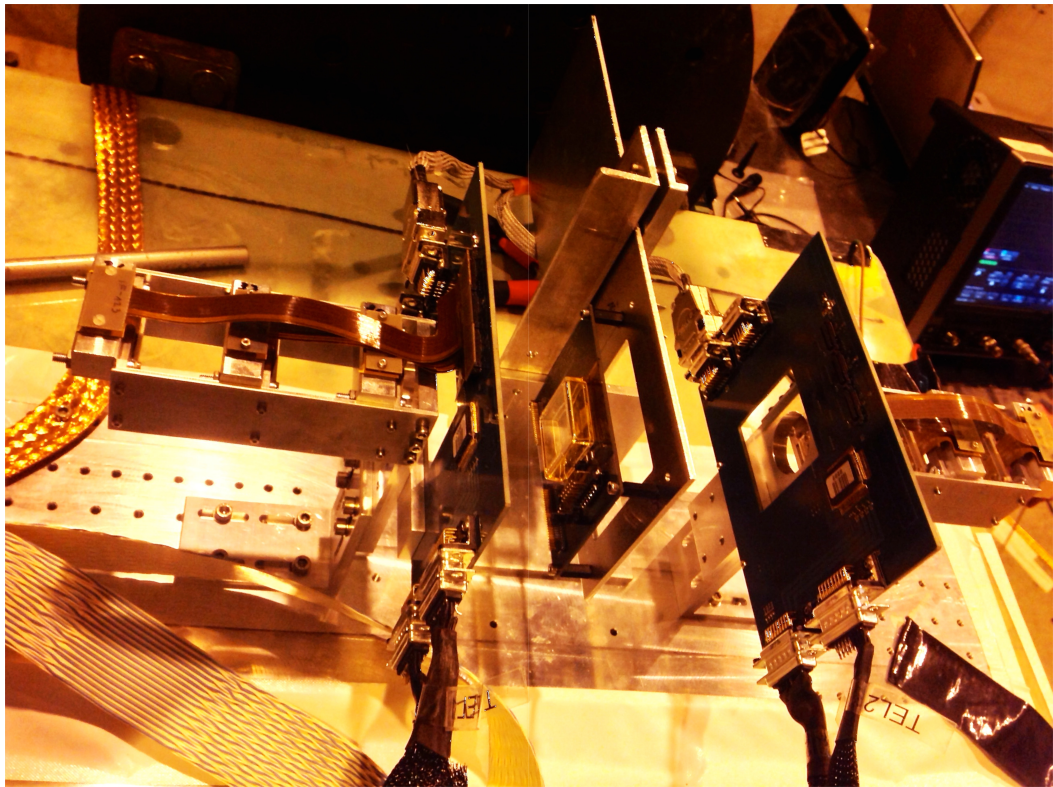
ABC130
(Y. Unno, KEK)

- Silicon strip detector
- 108 strips
- 74.5 x 8000 um pitch
- Dedicated digital readout
- Offline analysis in Judith









Possible use of H8B

- We would like to be in parasitic usage in area H8B during LHCb-assigned weeks, when using High-energy pions for tracking applications
  - 13th to 25th of May 2015
  - 15th to 24th of June 2015
  - 8th of July to August 5th 2015
  - 17th of September to October 7th 2015
  - 4th to 16th of November 2015

- Telescope is available for ITk users and others if requested
  - Already interest from Planar,3D and CMOS community
  - DBM telescope to be used in Murpogo Magnet for SIOPIX tests (see other presentation)
  - A lot of CMOS demonstrator will need to be tested in September to November 2015 following deliveries in the Summer

- Telescope experts are Geneva-based:
  - Setup are compact and easily dismountable. We Can remove ourself from the beamline in 2 hours if needed to install the beampipe or avoid interaction downstream
  - We provide the technical support but users you should provide the shifters