

Status of WP6 Activities at KIT

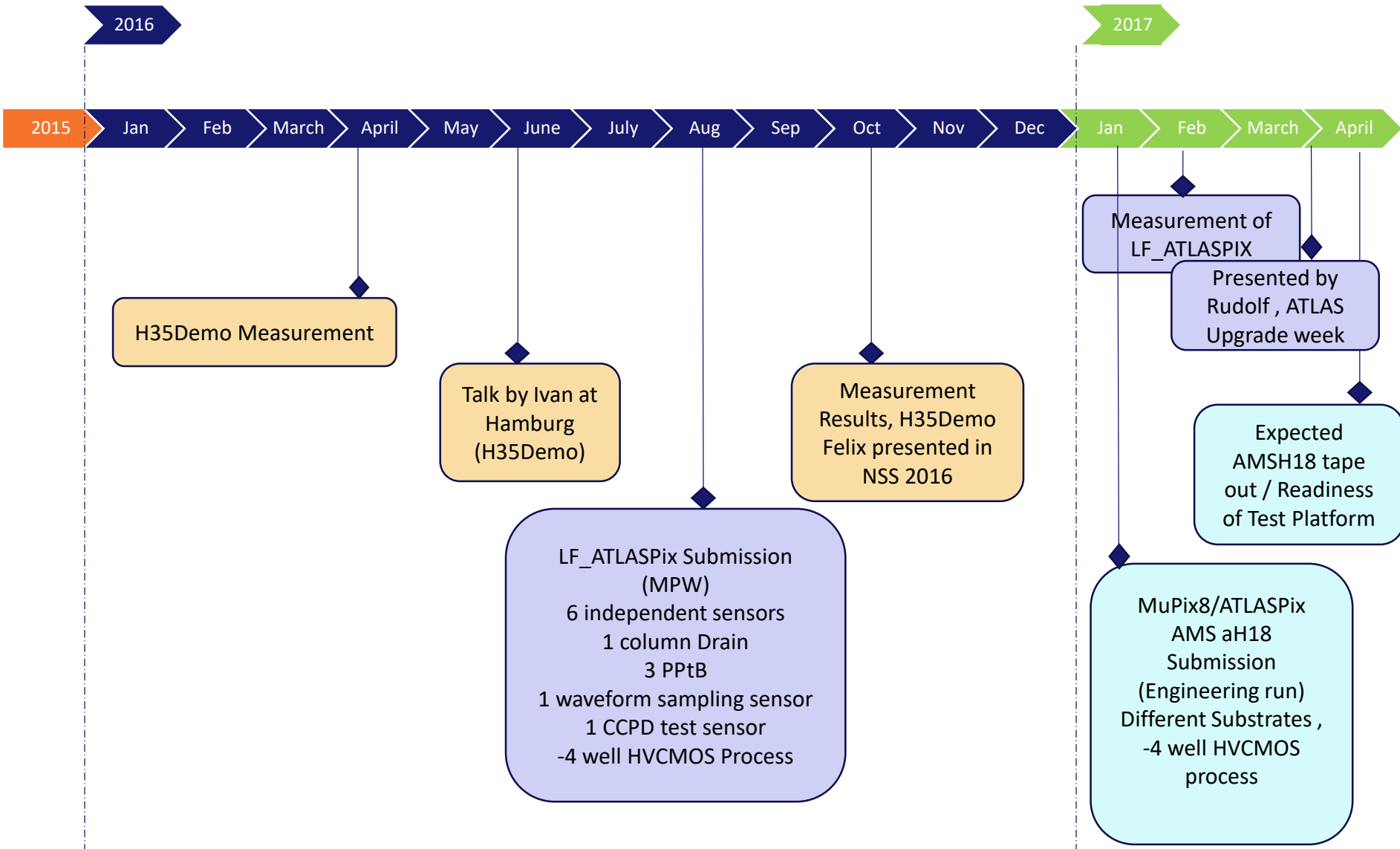
M. Prathapan, F. Ehrler, I. Perić, R. Schimassek

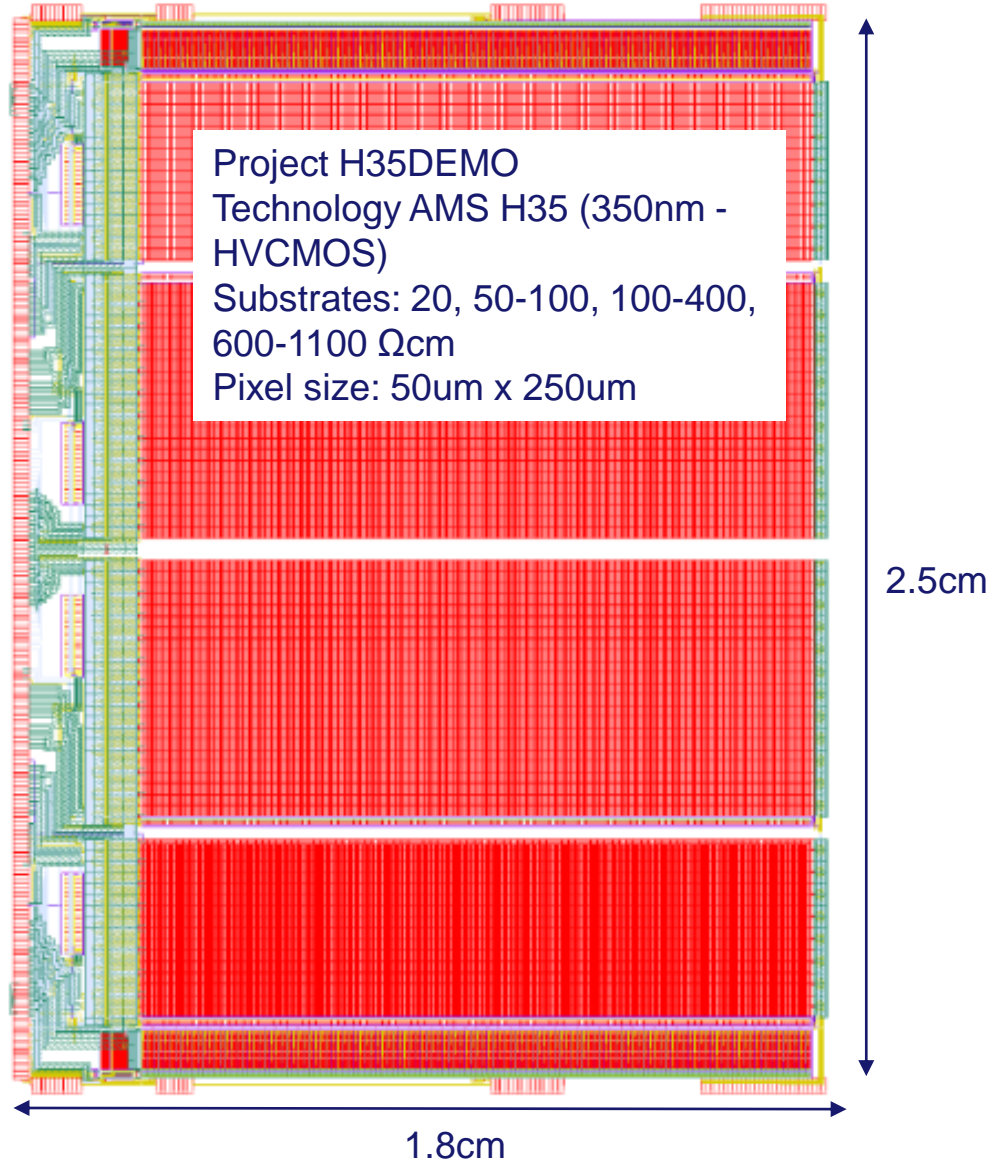
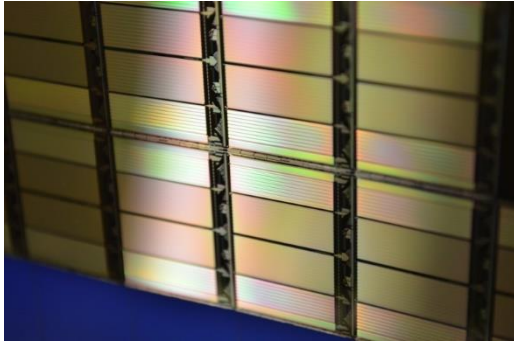
on behalf of

ASIC and Detector Laboratory , IPE, KIT



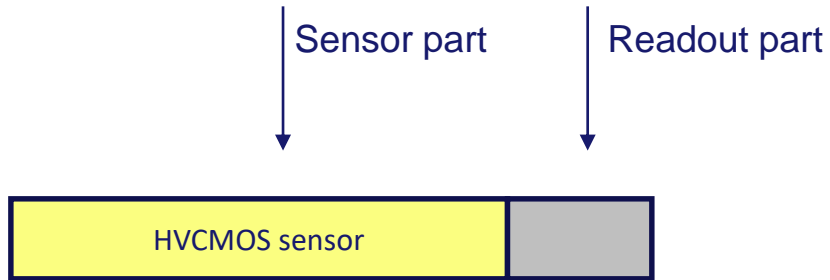
- **Timeline/Status**
 - H35DEMO (CCPD)
 - 2cm x 2cm size sensor in AMS H35 process on high resistivity substrates
 - LF_ATLASPIX
 - LFA15 process on high resistivity substrates with 4 wells. Four monolithic matrices with total area of 1cm x 1cm.
 - ATLASPIX and MUIPIX sensors in AMS aH18 with total area of 2cm x 2cm
- **Design overview**
- CCPD and monolithic sensors
 - Readout types:
 1. Trigger-less (column drain)
 2. Triggered with parallel pixel to buffer connection (PPTB)
 - Pixel types:
 1. Smart diode pixel
 2. Small diode pixel
- **Measurement results at a glance**
 - H35DEMO (Standalone)
 - LF_ATLASPIX and ALPHA monolithic sensors in LFA15 process



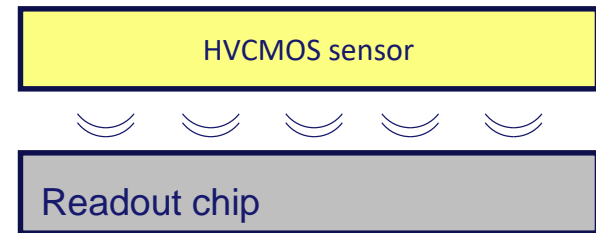


The H35Demo has four independent pixel matrices:

- stand-alone nMOS matrix
- analog matrix A
- analog matrix B
- stand-alone CMOS matrix

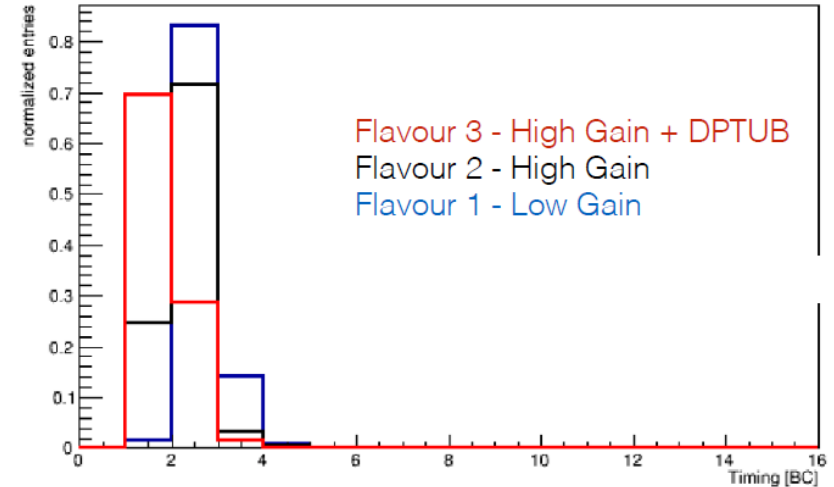
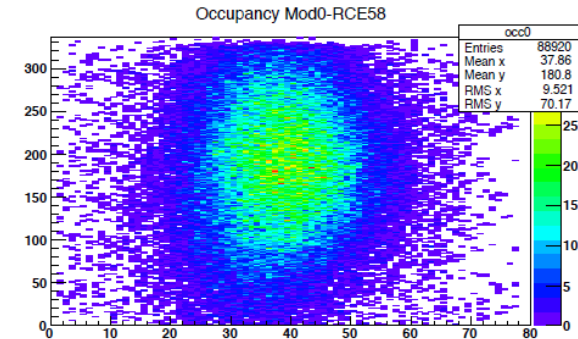
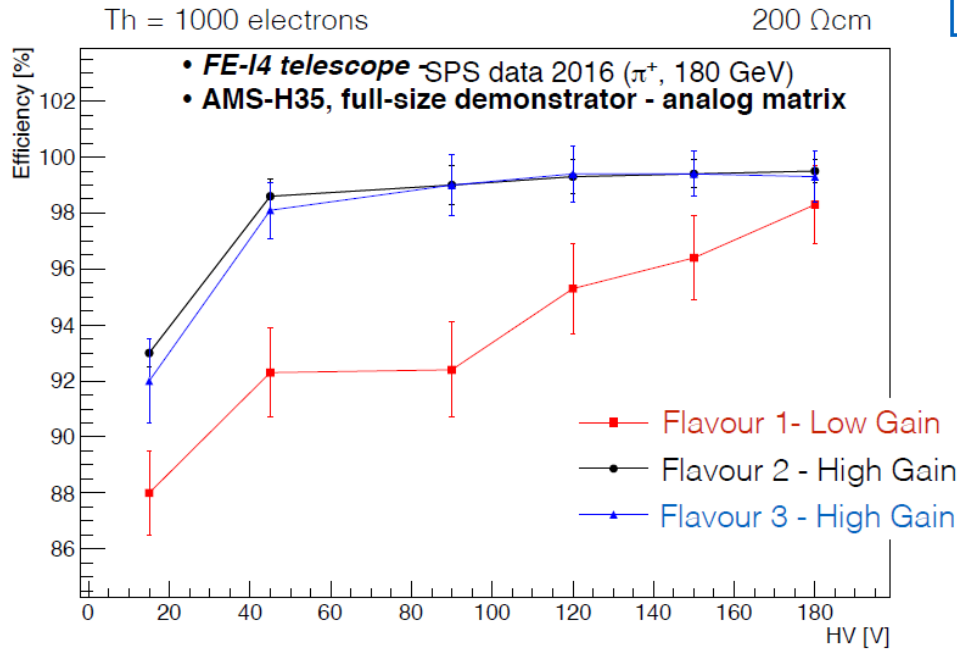


Monolithic detector



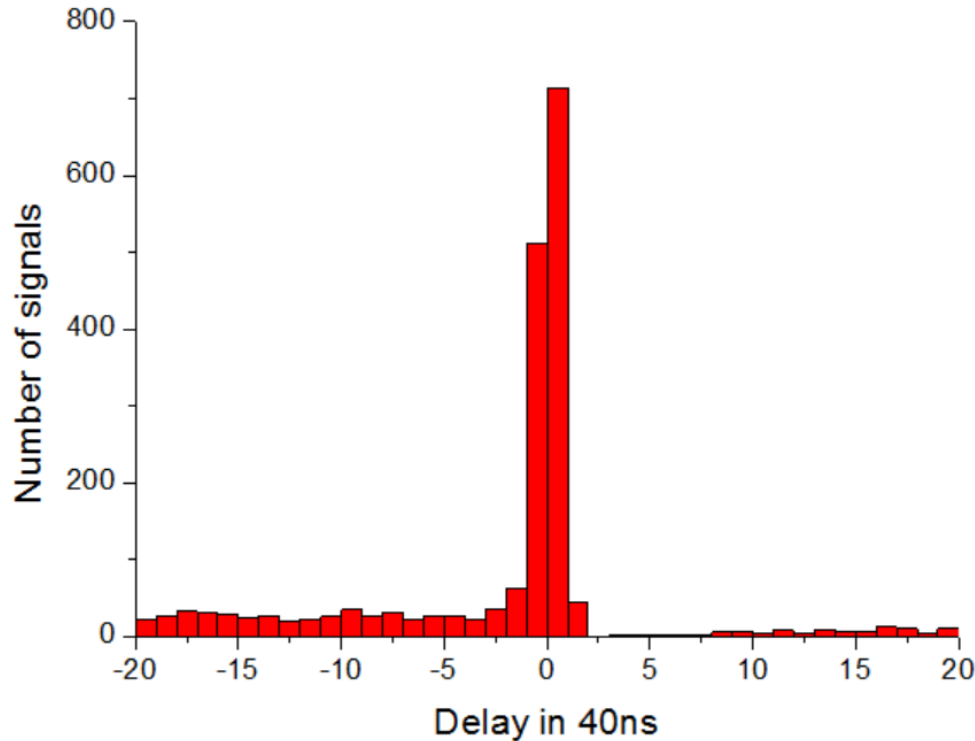
Capacitive coupled pixel detector - CCPD

- Test beam measurement at SPS (September-November 2016)
- > 99% detection efficiency has been measured with matrices
- > 99% of hits have timewalk less than 50ns

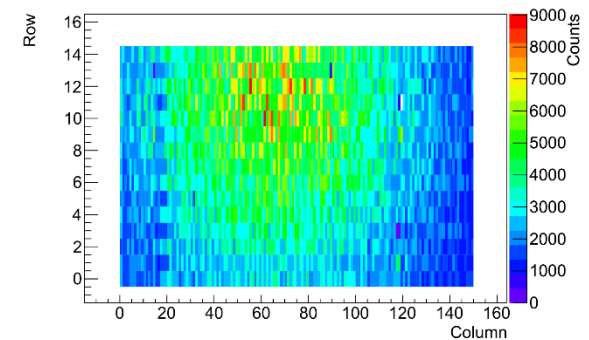
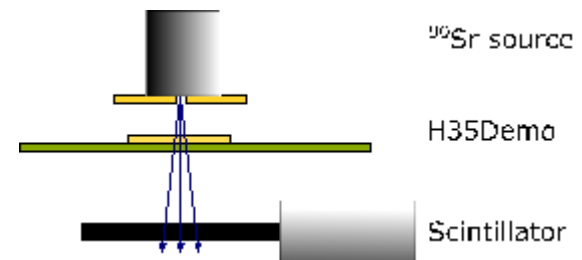


T. Weston et al.,
 “An overview of recent HV-CMOS results”
 12th Trento Workshop on advanced Silicon Radiation Detectors

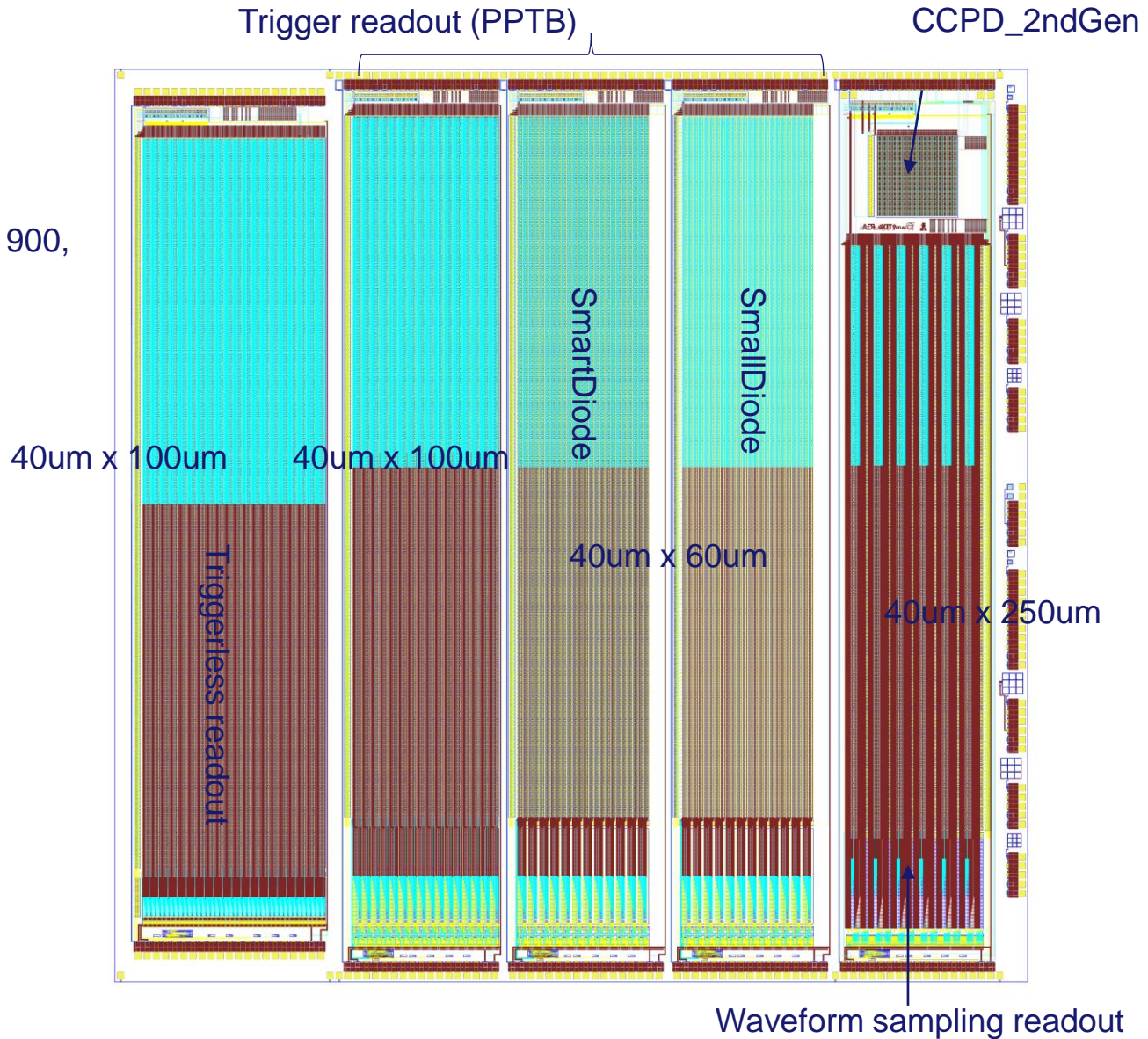
- The H35DEMO has the possibility to be read out as a monolithic sensor
- Histogram of the delay between trigger time stamp and sensor time stamp, measured on a pixel with a Time Walk Compensating Comparator for ^{90}Sr electrons. Two bins are occupied

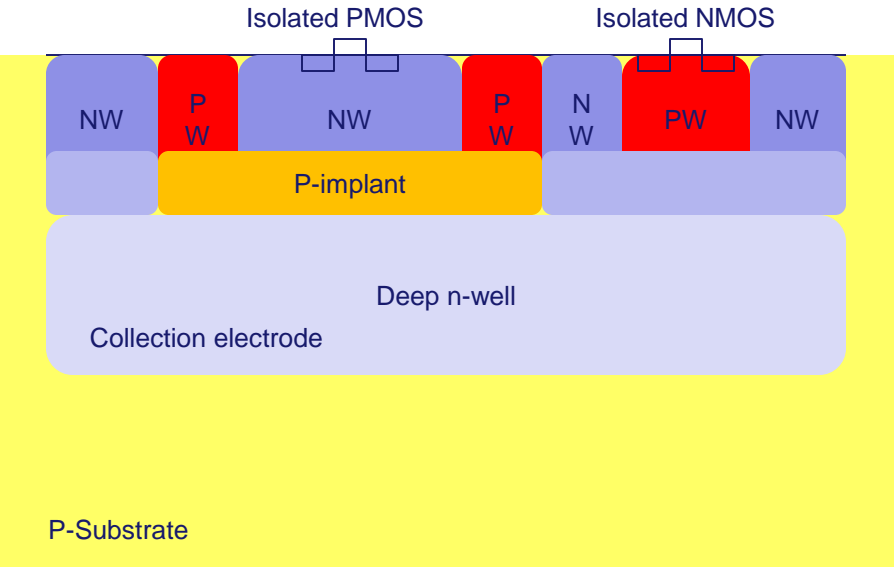


Time resolution – difference between the time stamp and the trigger moment

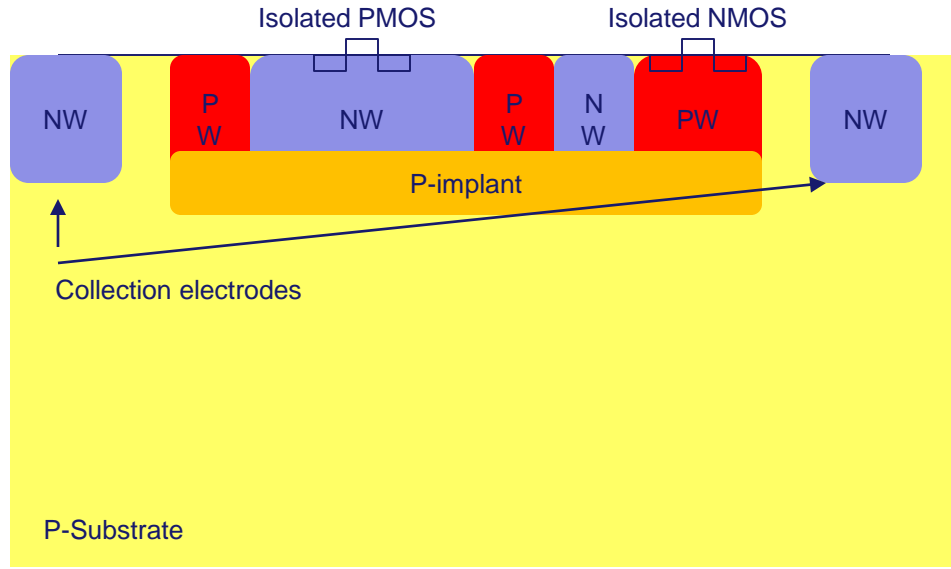


Project LF_ATLASPIX
 Technology LFA15 (150nm)
 Substrates: 100, 500-1100, 1900,
 3800 Ωcm
 4-well HVCMOS process



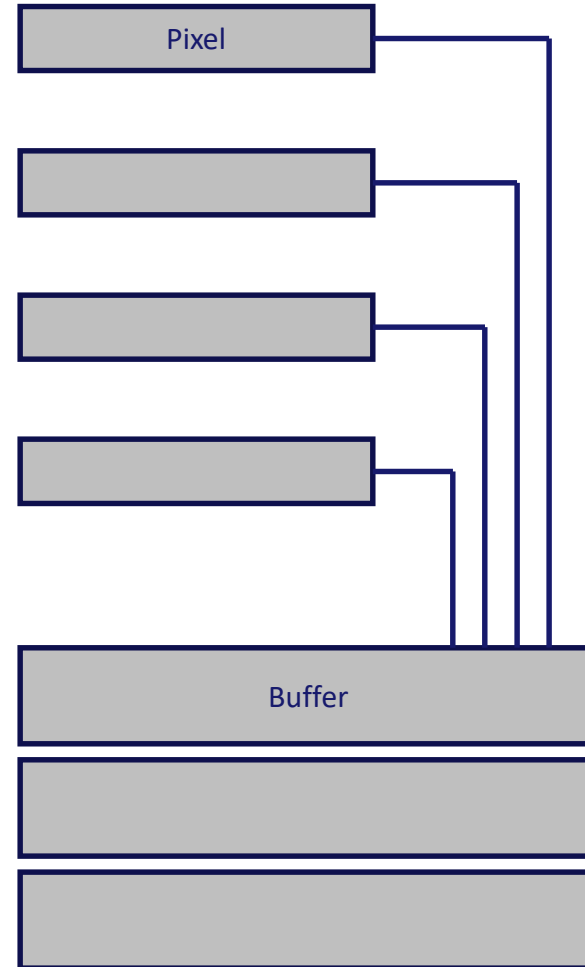
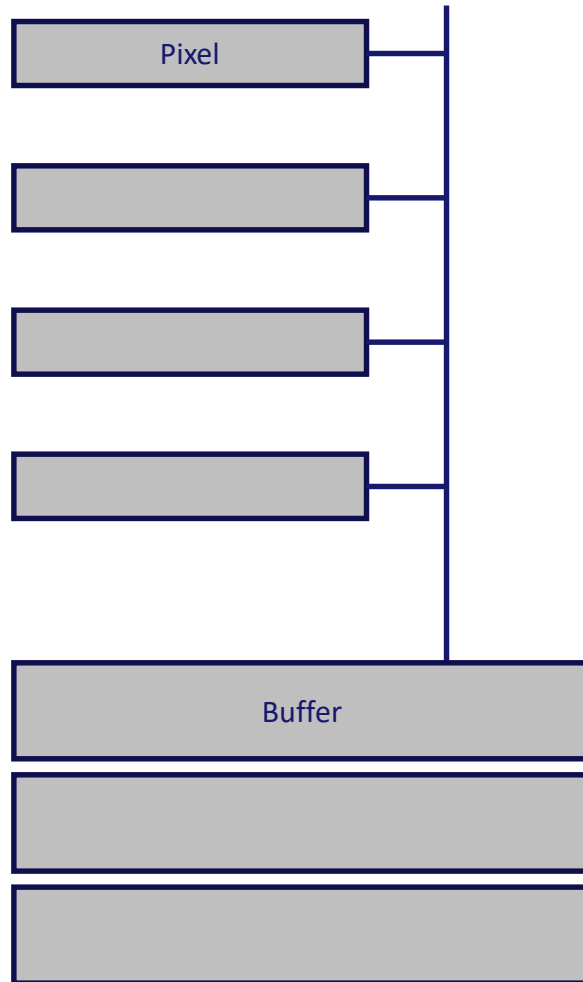


Smart diode pixel in AMS H18 and all LFA15 sensors

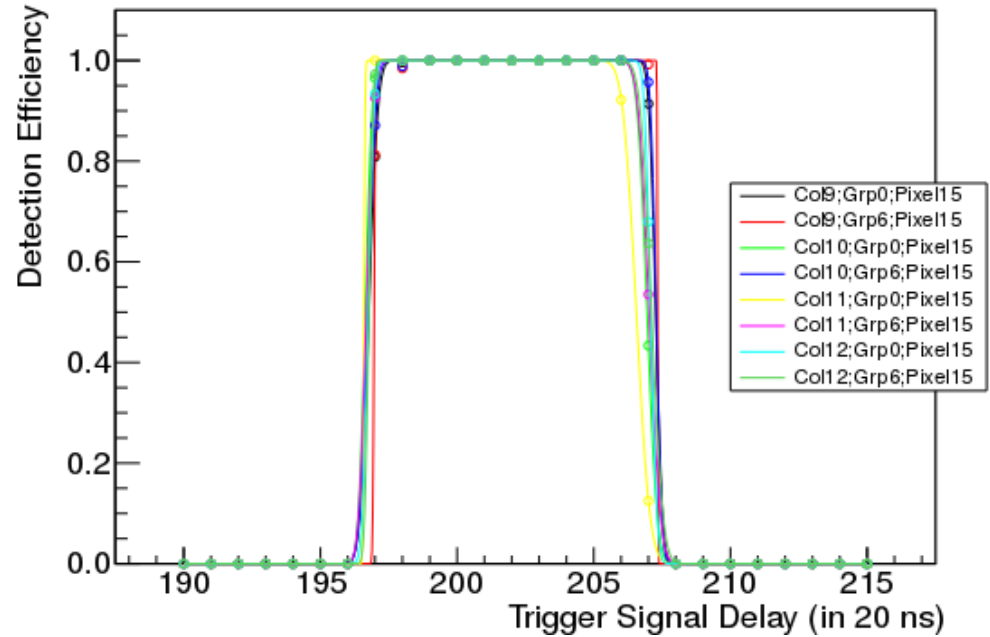
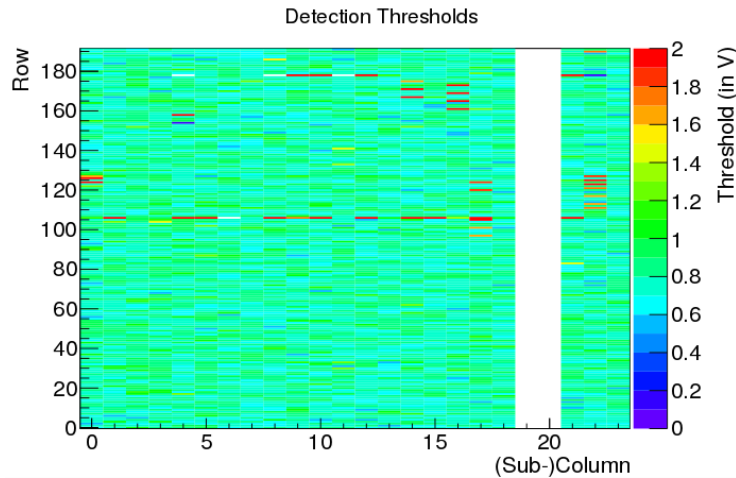
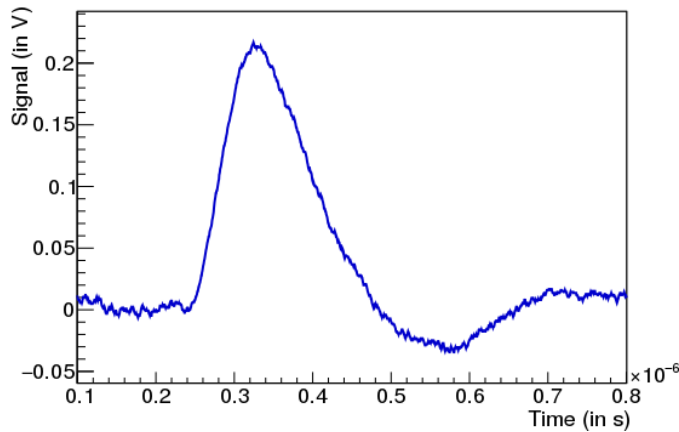


Small diode pixel in LFA15

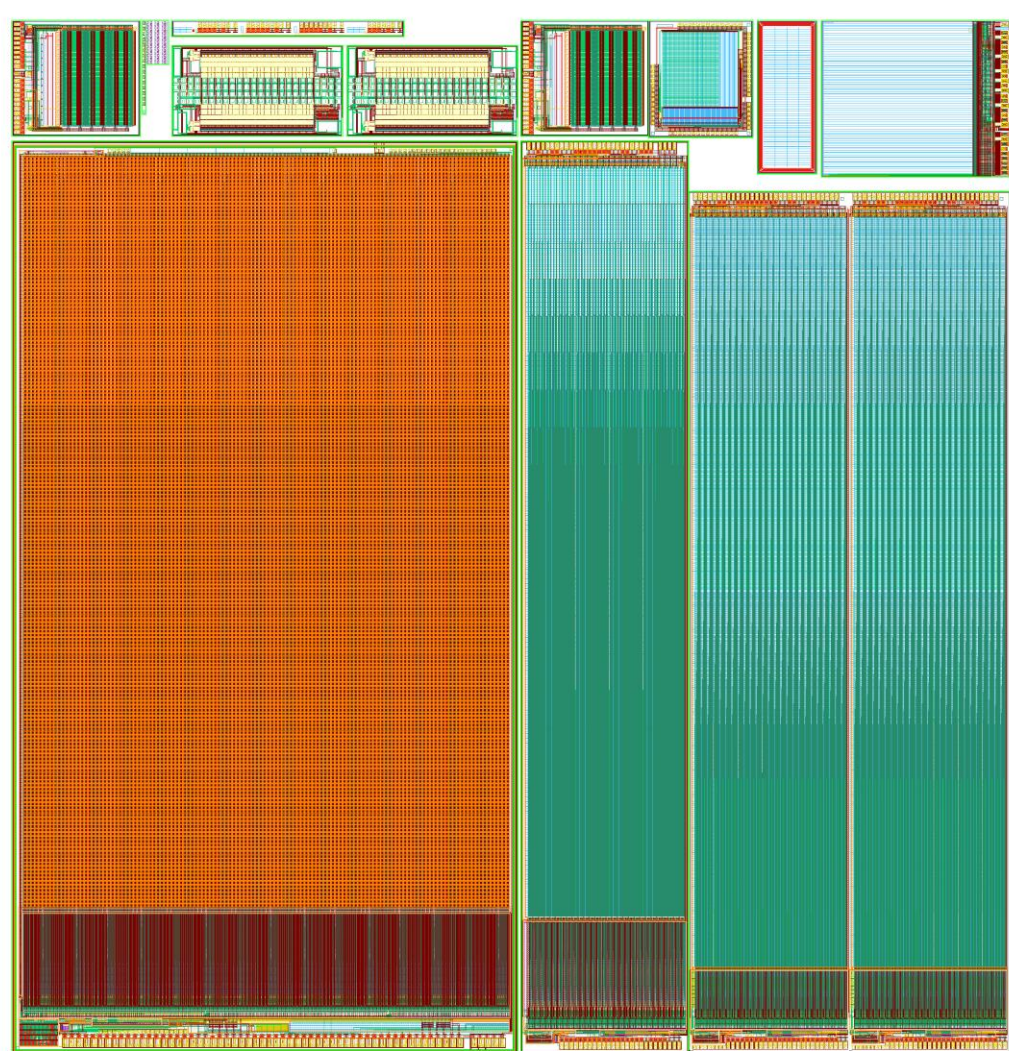
- Left: Column drain readout
- Right: Parallel pixel to buffer readout

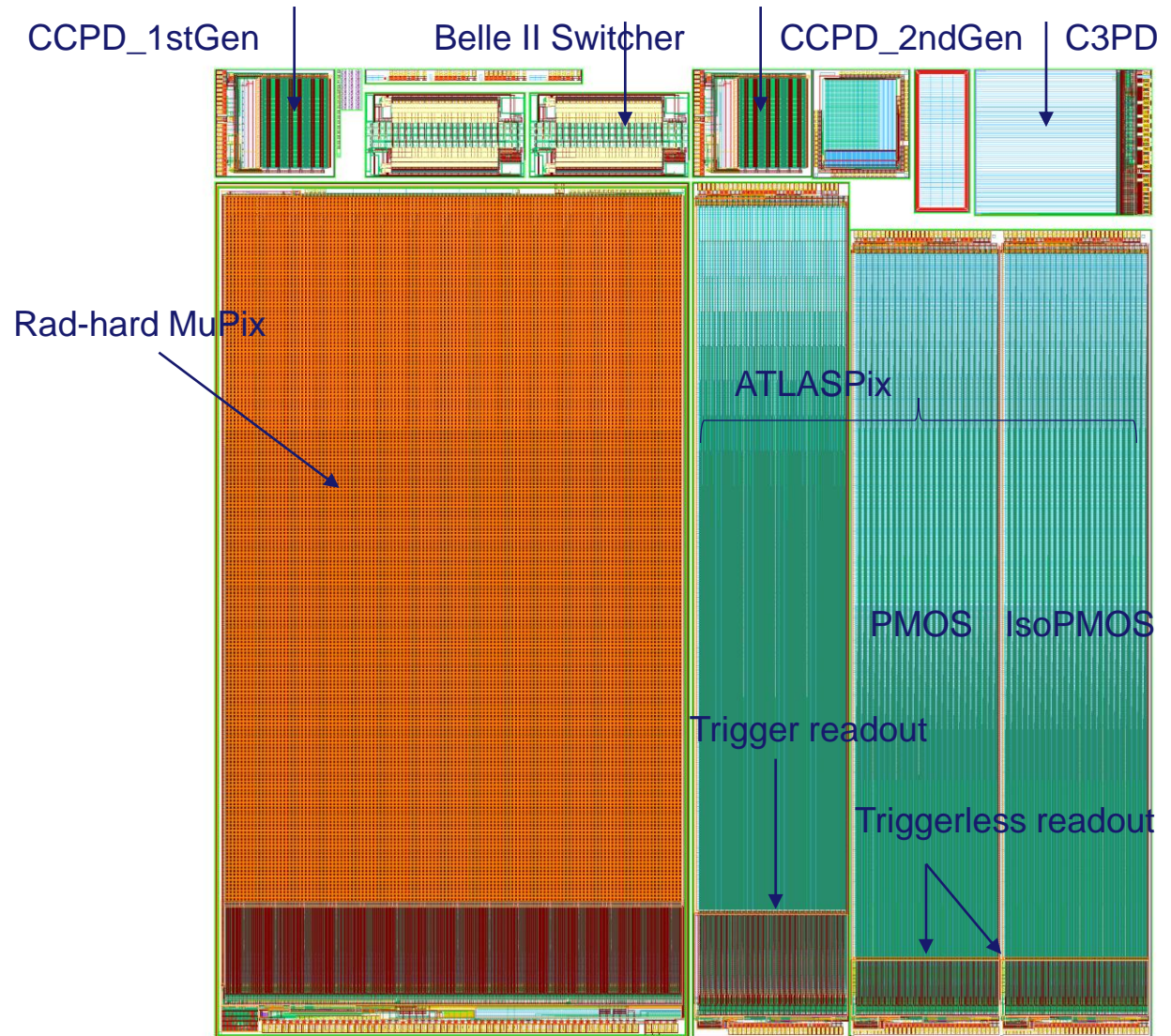


- 1. Amplifier output in response to ^{90}Sr source
- 2. Test of the trigger readout
- 3. Threshold scan of full matrix

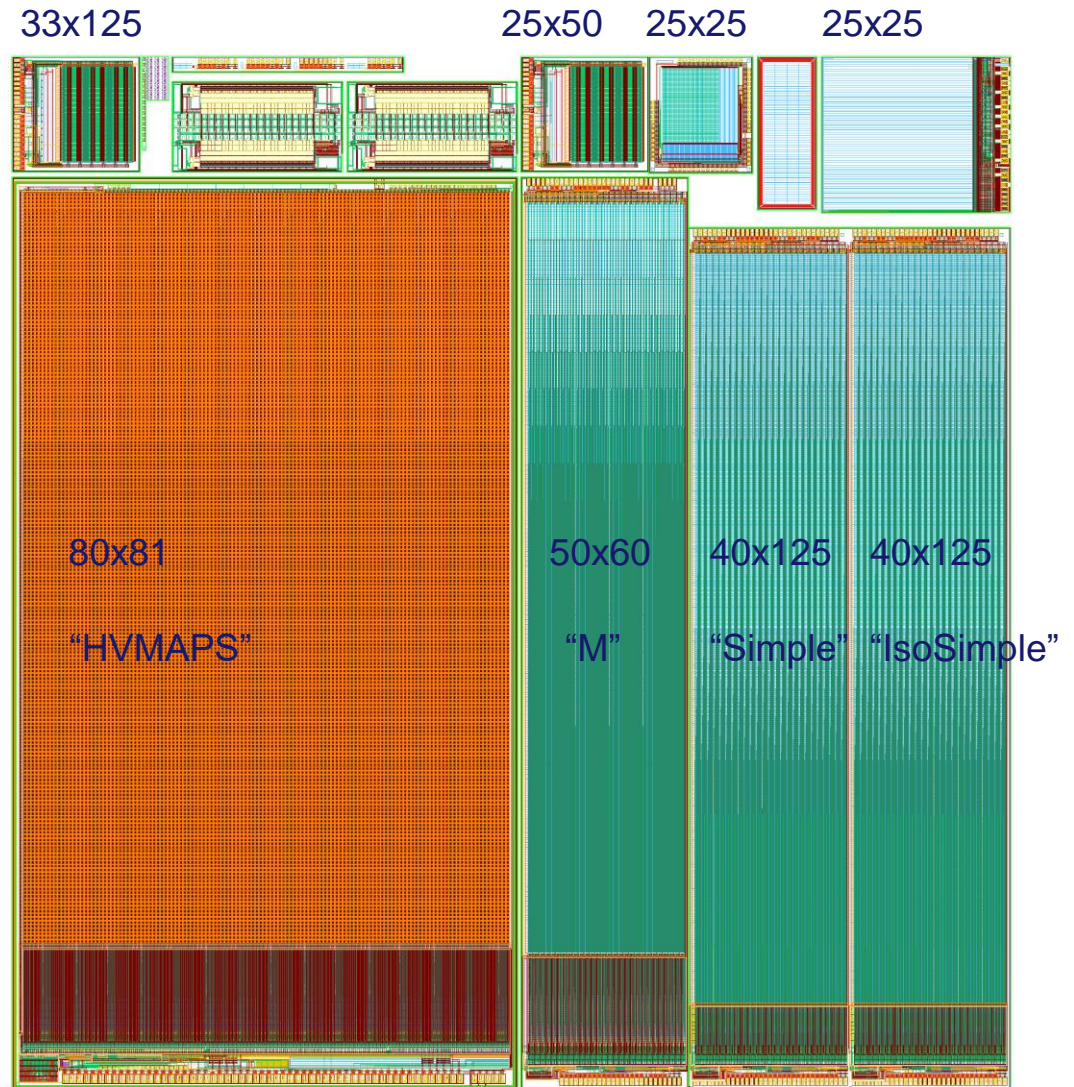


Project MUIPIX/ATLASPIX
 Technology AMS aH18 (180nm)
 Substrates: 20, 50-100, 100-400,
 600-1100 Ωcm
 4-well HVCMOS process

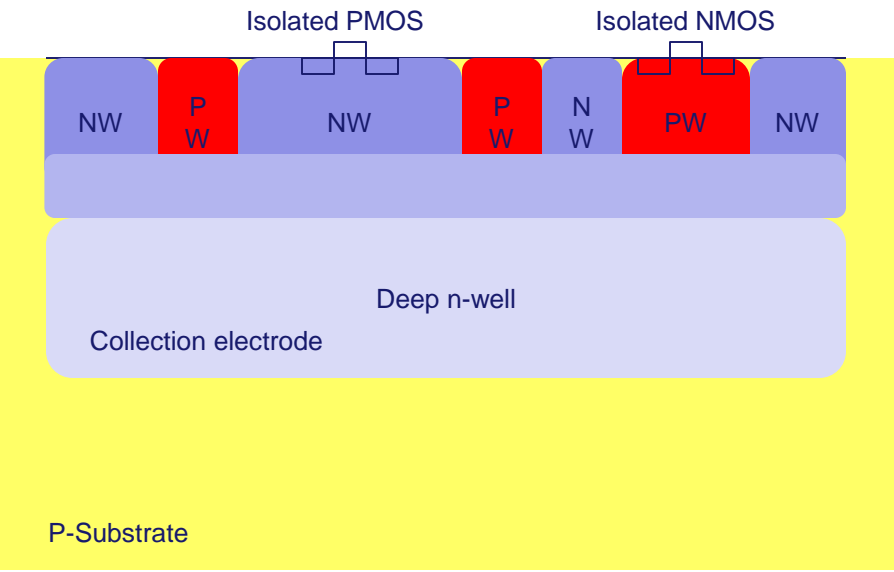




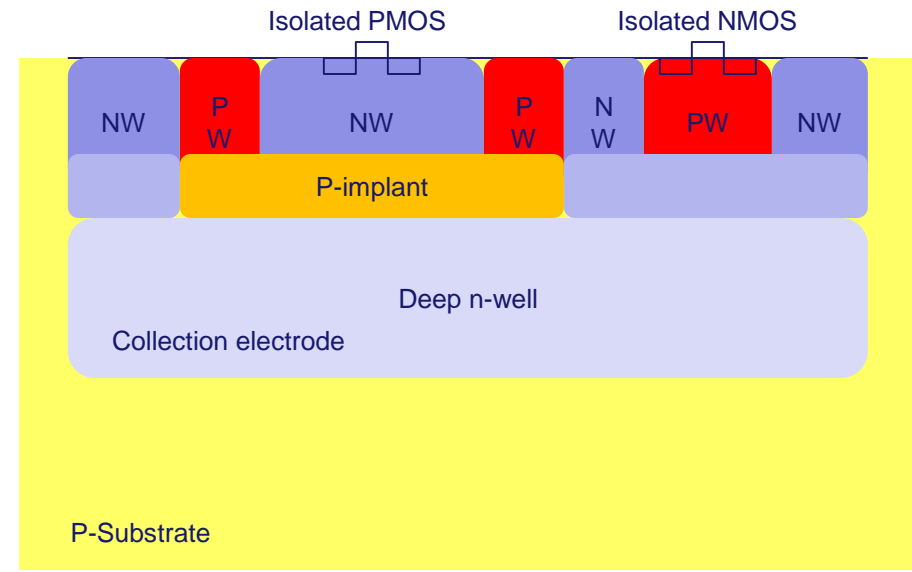
Pixel size (um)



MuPix8, ATLASPIX



MuPix8, all AMS H18 sensors except „IsoSimple“



IsoSimple in AMS aH18 and all LFA15 sensors

- Large scale (2cm x 2cm) HVCMOS sensors in AMS 350nm technology produced and tested
- The sensor is implemented of 4 different substrate materials, it contains various tests structures and can be attached (capacitively or with bumps) and readout by FEI4. Monolithic readout is also possible. The sensor can be used for development of interconnection technology. Test beams and irradiations are planned
- Various designs in LFoundry 150nm process have been submitted
- Sensors produced in LFoundry LFA 150 nm process are working. Parallel-Pixel-to-Buffer (PPtB) Readout Principle is working. Triggered Readout is working with an accuracy of the order of 20 ns
- Monolithic and CCPD designs have been submitted in AMS aH18 (180nm) process. Expected tape out by end of April 2017.

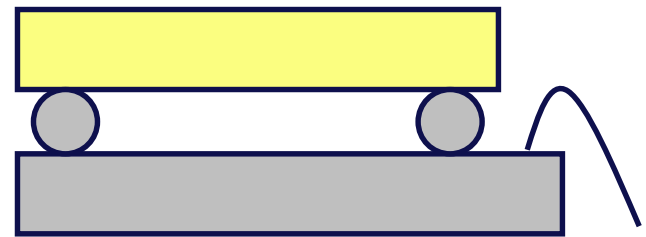
THANK YOU !

BACK UP

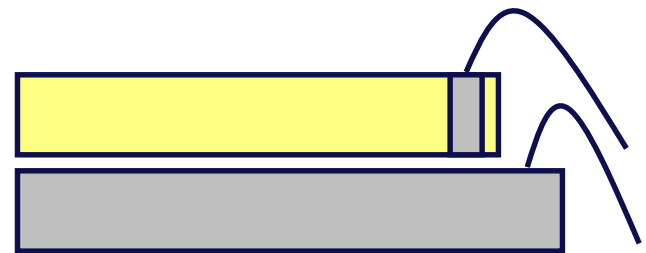
1st generation



2nd generation



CCPD with a few standard bumps



CCPD with TSVs

Adapter PCBs

- 1x H35 PCB
- 1x test signals
- 1x trigger board

Trigger board

- Trigger in
- Busy out
- RJ45

External pulse generator



Xilinx ZC706 FPGA board

- Same as CaRIBOu system

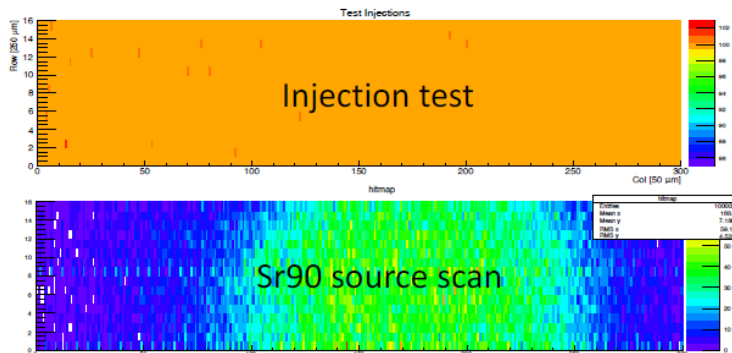
H35demo PCB

- External voltage regulators
- Sensor bias input
- Injection pulse input
- Analog signal output

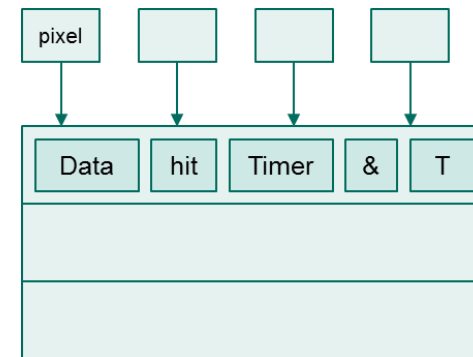
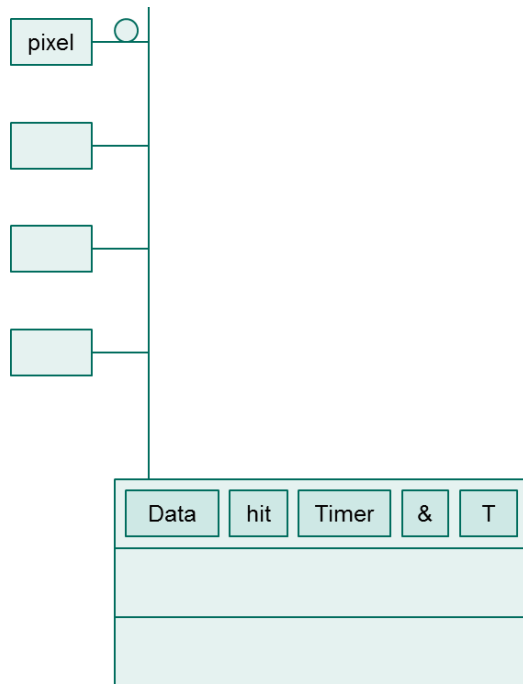
H35demo chip

- Both **CMOS** and **nMOS** matrices wire-bonded

PCBs, FPGA firmware and software developed at **IFAE**

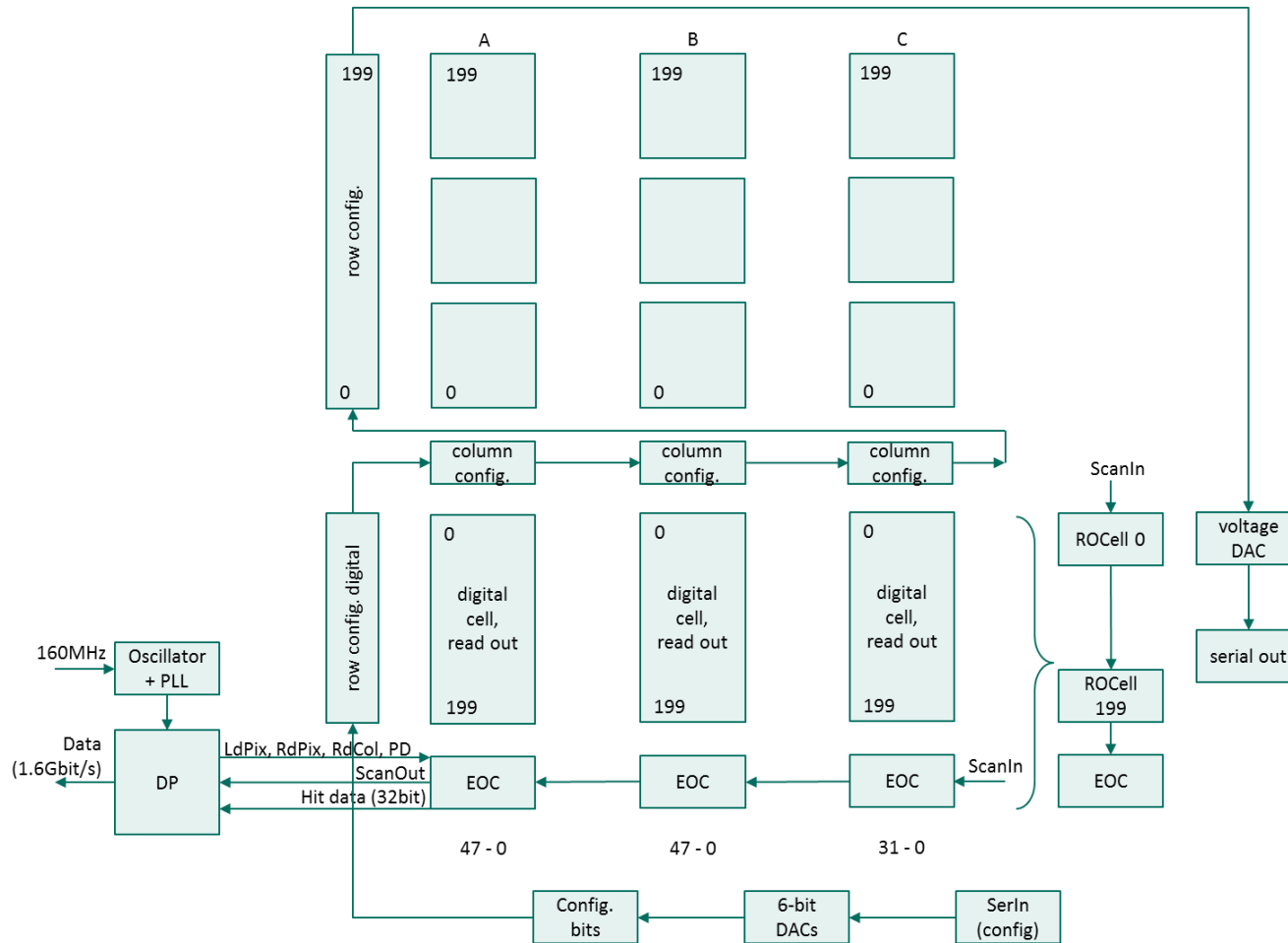


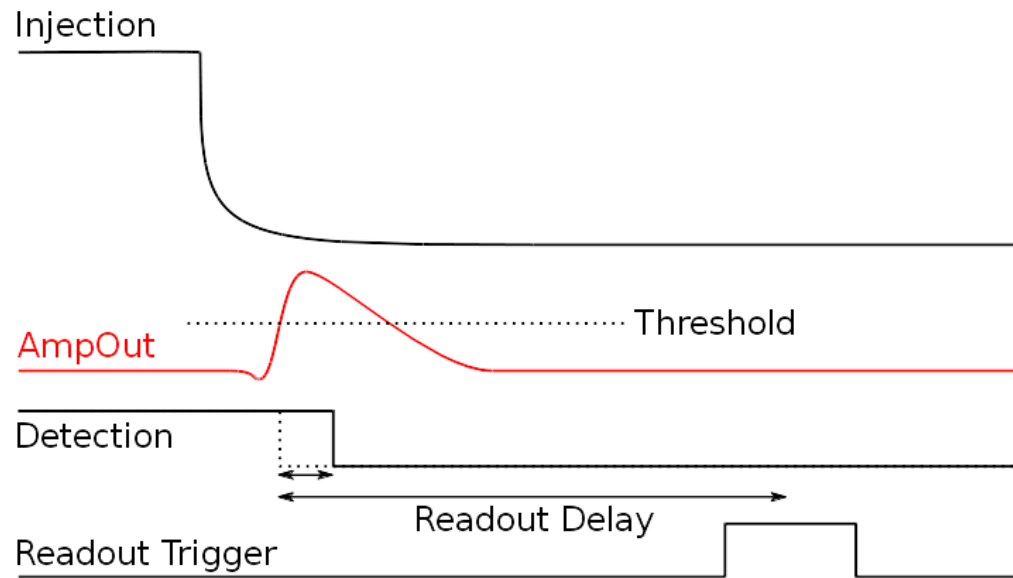
- 1) Hit driven, triggerless, readout (MuPix8, Simple ATLASPix)
- 2) Triggered ReadOut (ATLAS_M2)

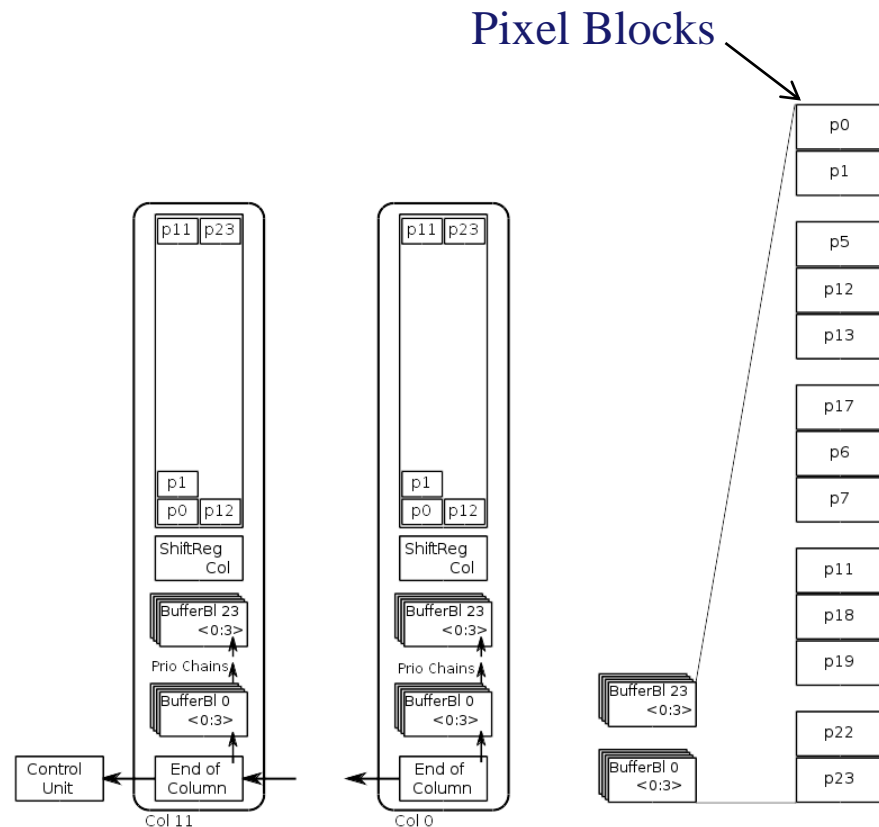
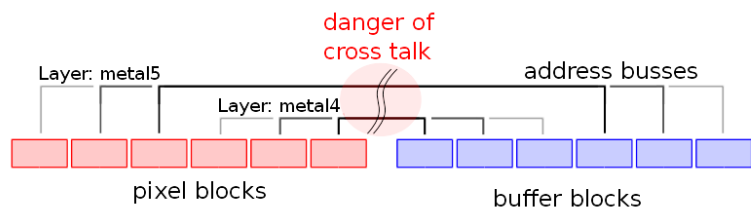


- priority circuit and bus
- All data will be sent in ascending order from pixels
 - without external trigger
 - Advantage: simple and small bus

- 16 pixels have 4 buffers
- pixel to buffer connection: parallel bus
 - trigger signal
- Advantage: faster data transmission







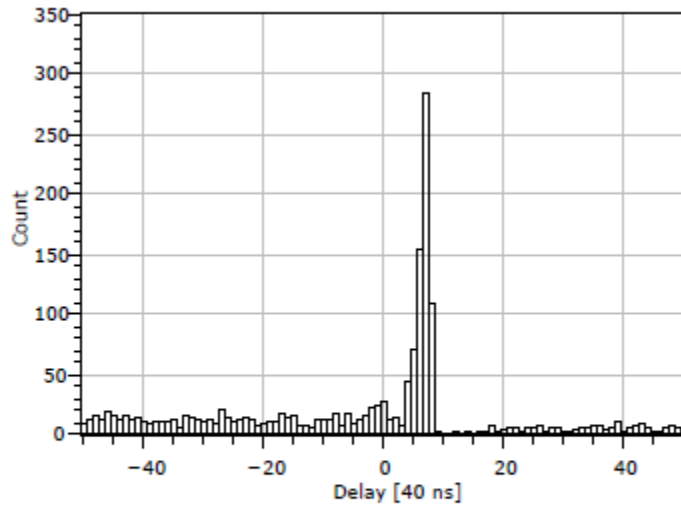


Fig. 22: Histogram of the delay between trigger time stamp and sensor time stamp, measured on a pixel without time walk compensation for ^{90}Sr electrons. Five bins are occupied.

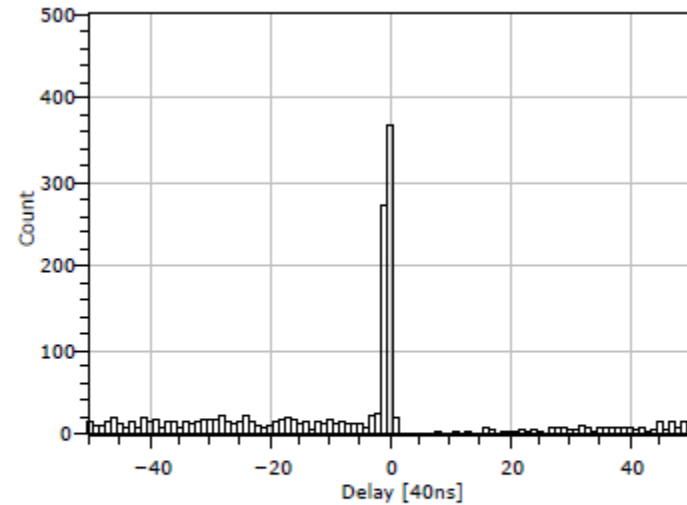


Fig. 23: Histogram of the delay between trigger time stamp and sensor time stamp, measured on a pixel with a Time Walk Compensating Comparator for ^{90}Sr electrons. Two bins are occupied.