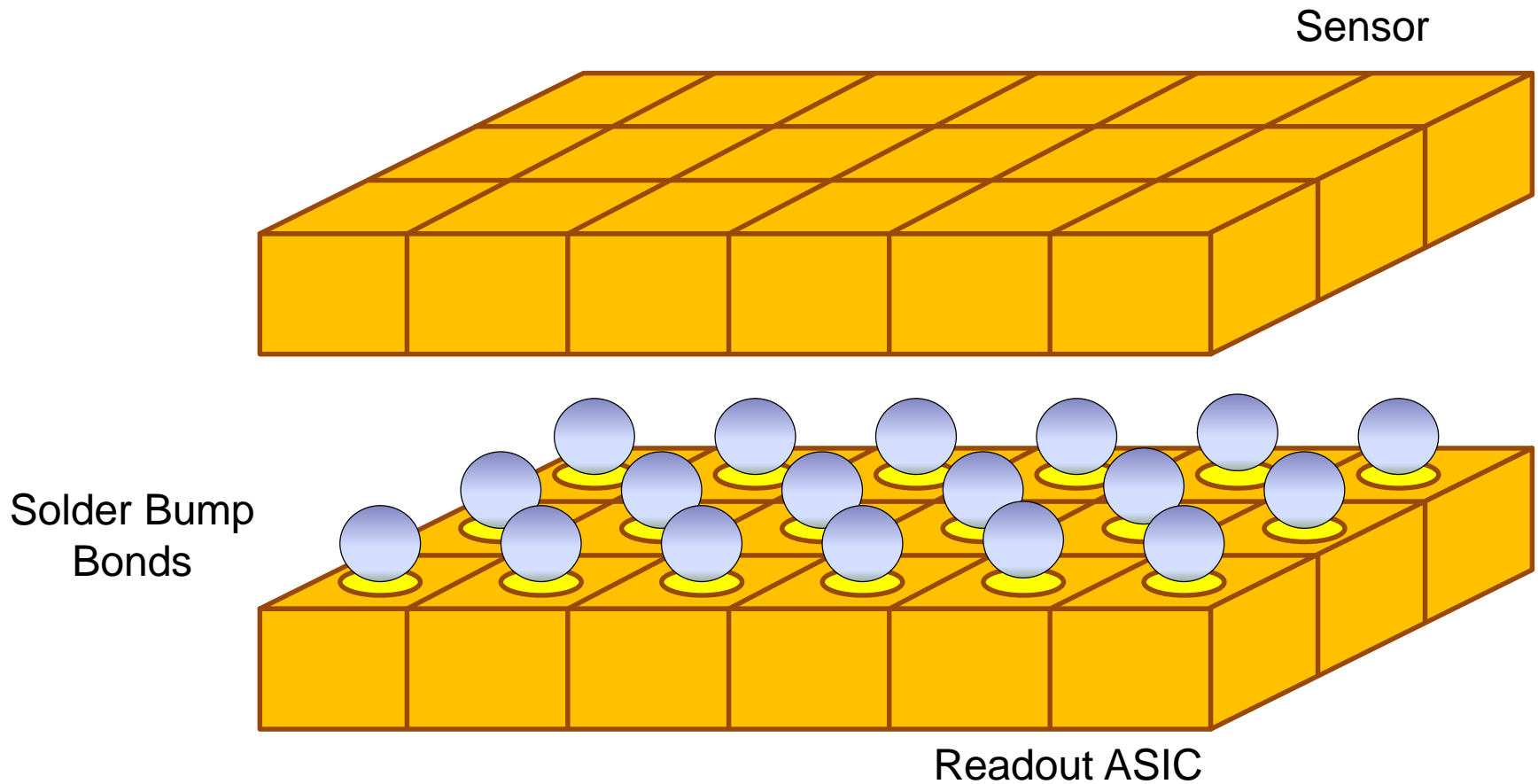


Timepix Lab

Kazu Akiba, Irina Nasteva, Franciole Marinho

Hybrid Pixel Detectors

A hybrid pixel detector assembly consists of a sensor chip bonded to a readout ASIC



The Medipix/Timepix

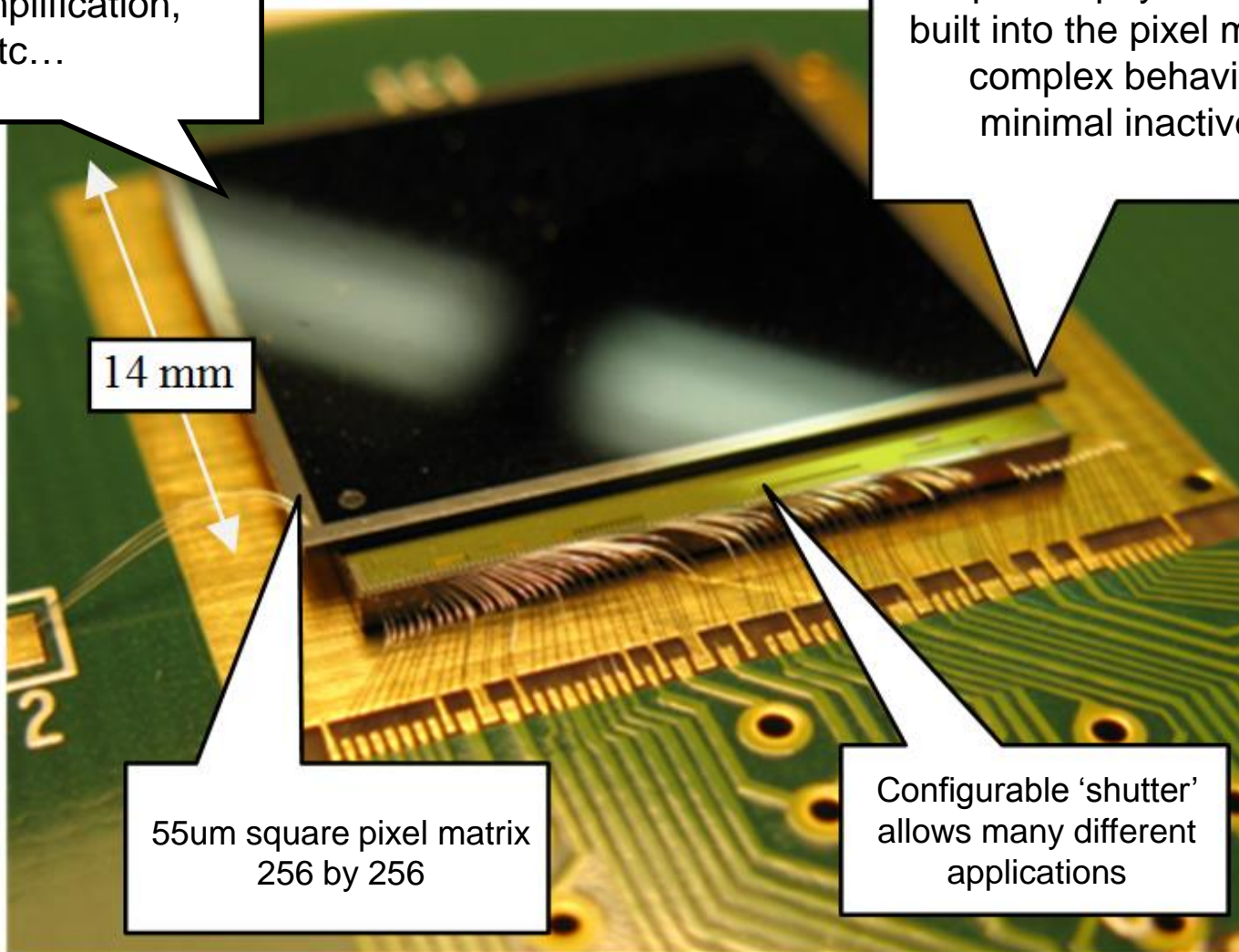
Silicon, 3D,
CdTe, GaAs,
Gas Amplification,
etc...

A philosophy of functionality
built into the pixel matrix allows
complex behavior with a
minimal inactive region

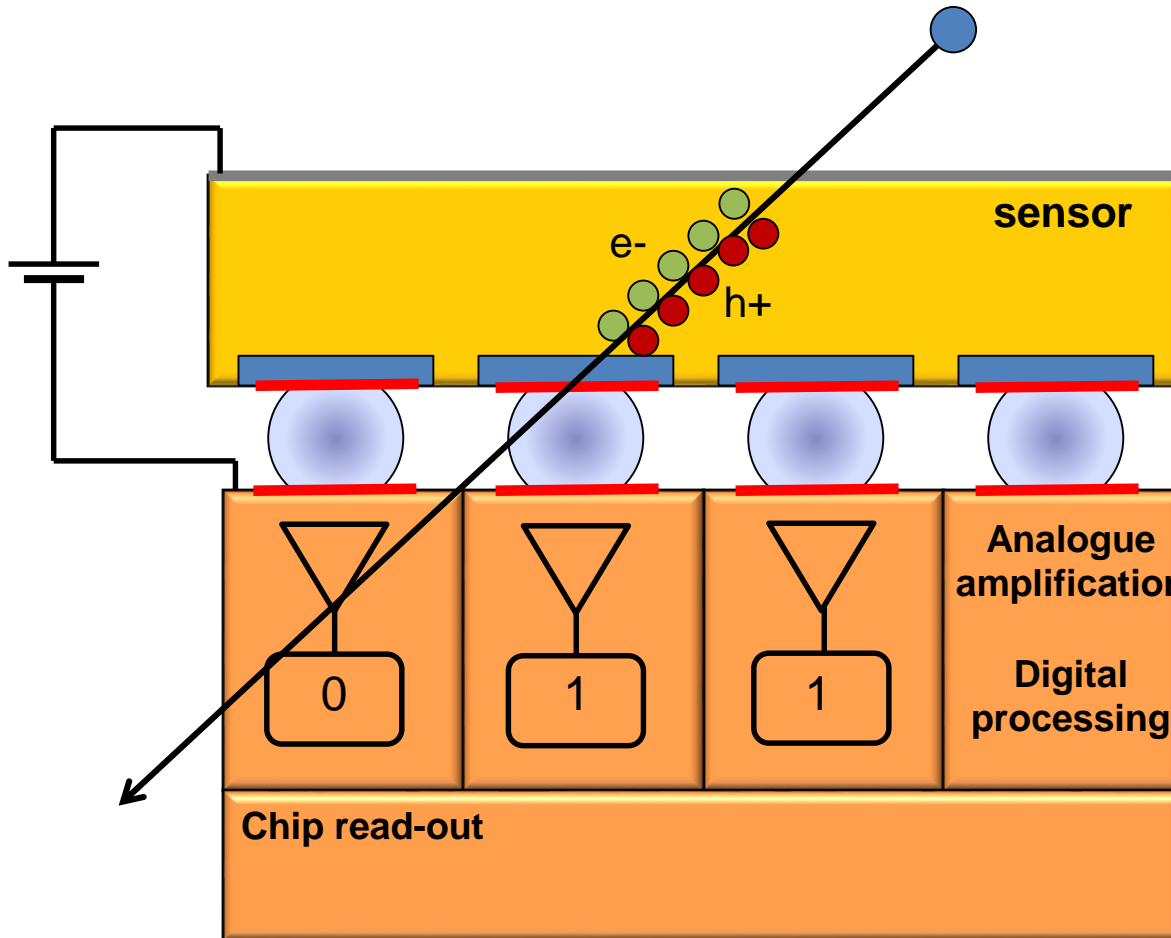
14 mm

55um square pixel matrix
256 by 256

Configurable 'shutter'
allows many different
applications



Hybrid Pixel Detectors



An ionising particle deposits charge in the silicon sensor

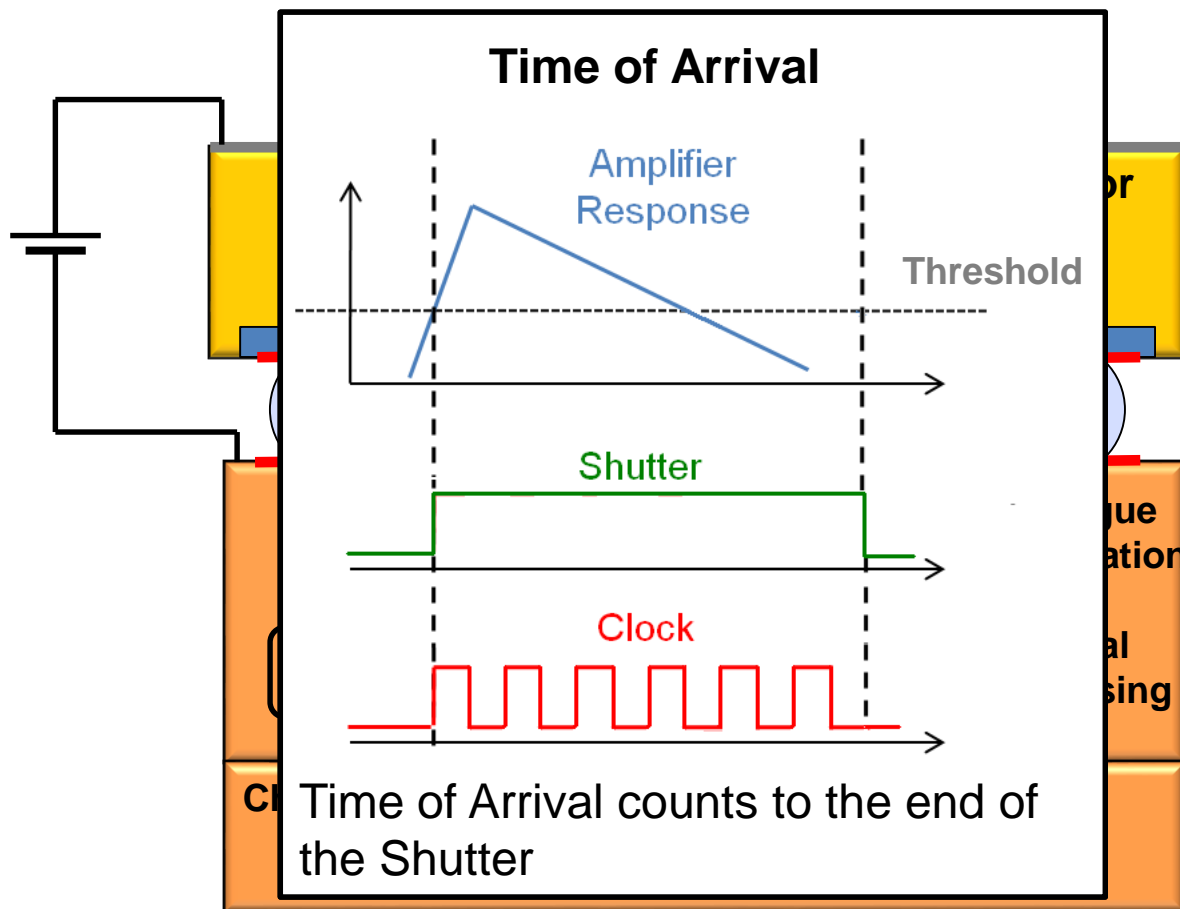
The reverse biasing of the sensor diode structure drives the charge to the readout chip

The charge is shaped and a threshold applied

Digital processing occurs

The data is read out off the chip

Timepix (2006)



Conventional Medipix2 counting mode remains.

Addition of a clock up to 100MHz allows two new modes.

Time over Threshold

Time of Arrival

Pixels can be individually programmed into one of these three modes

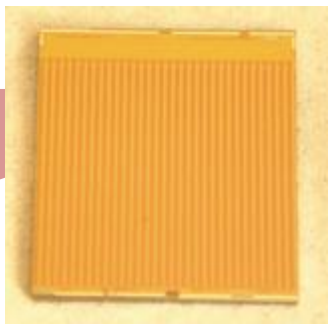
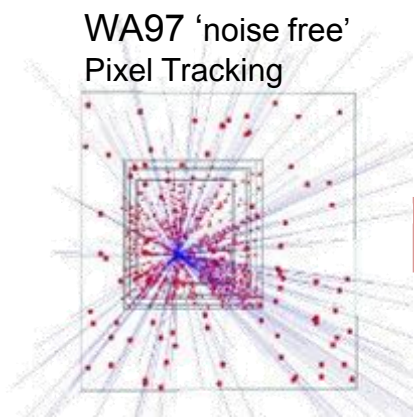
→ In order to evaluate the charge collected in a sensor we need to calibrate well the electronics response to known energy values

Objectives

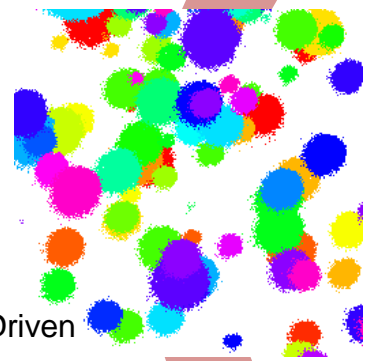
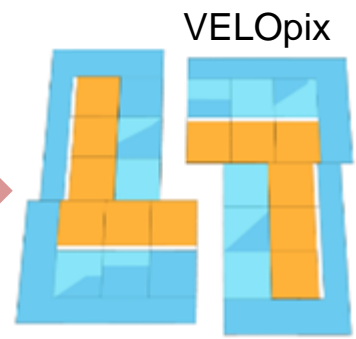
- Get acquainted with hybrid pixel detectors
- Perform the tuning of the electronics of a Timepix assembly
- Understand the different forms of readout and how to use the detector information
- Calibrate a Timepix detector for Energy measurements

BACKUP

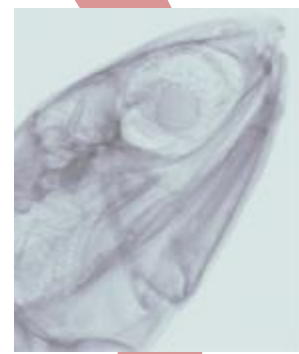
Spinning Back into HEP



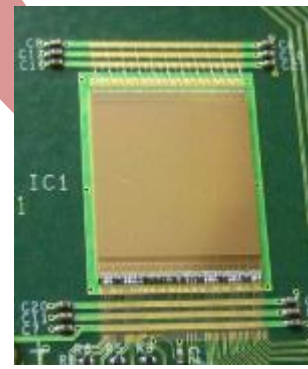
LHCBPIX1
ALICE SPD
1st pixel trigger



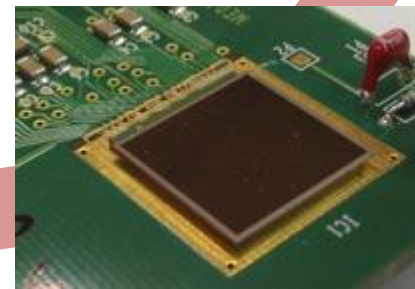
Timepix3
1ns, Data Driven
Timepix



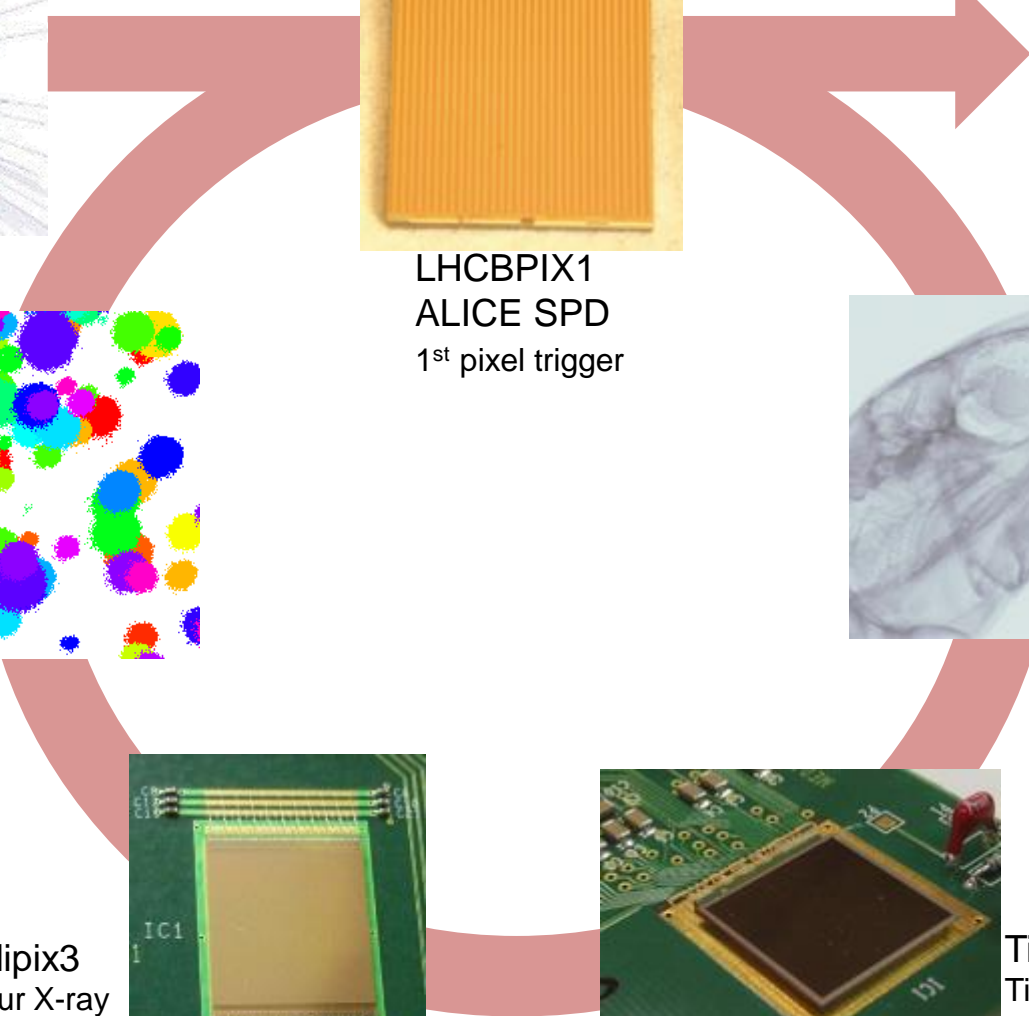
Medipix2
Photon Counting



Medipix3
Colour X-ray
imaging



Timepix
Time Tagging or
Time over Threshold



Low Noise Operation

- Small physical size and proximity to readout = low capacitance
- Typically low threshold operation $\sim < 1,200 e^-$
- Getting better as technology improves Medipix3 $< 100 e^-$ noise
- A Minimum Ionizing Particle (MIP) deposits $\sim 22k e^-$ in a 300um silicon sensor
- Even in highly irradiated sensor MIP deposits $\sim 8ke^-$
- Possible to have a threshold well above noise for 'noise free' operation
- For photons 3.6eV per eh pair \rightarrow 8keV x-ray produces $\sim 2,200$ electrons