Centre of Applied Physics and Advanced Detection Systems
http://capads.fjfi.cvut.cz/

Joint Czech Group @ SPD

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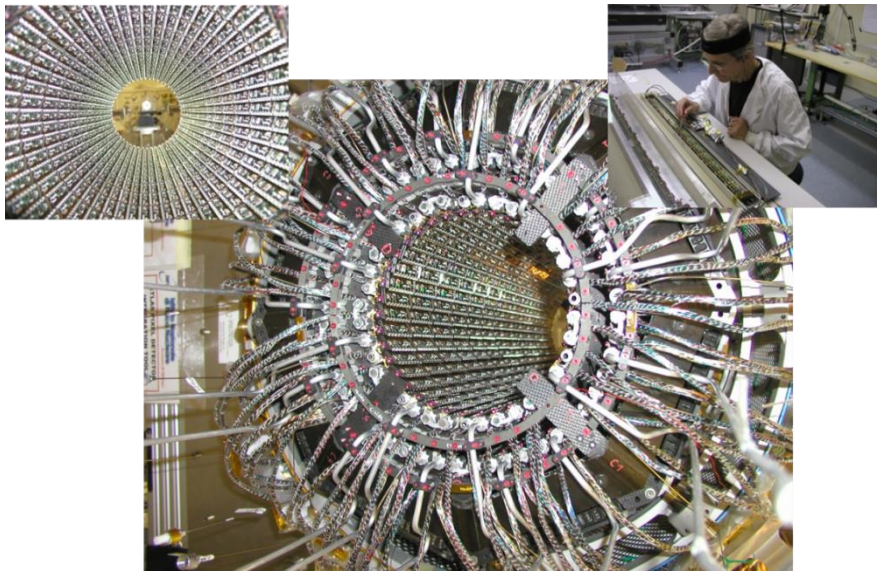
The team profile

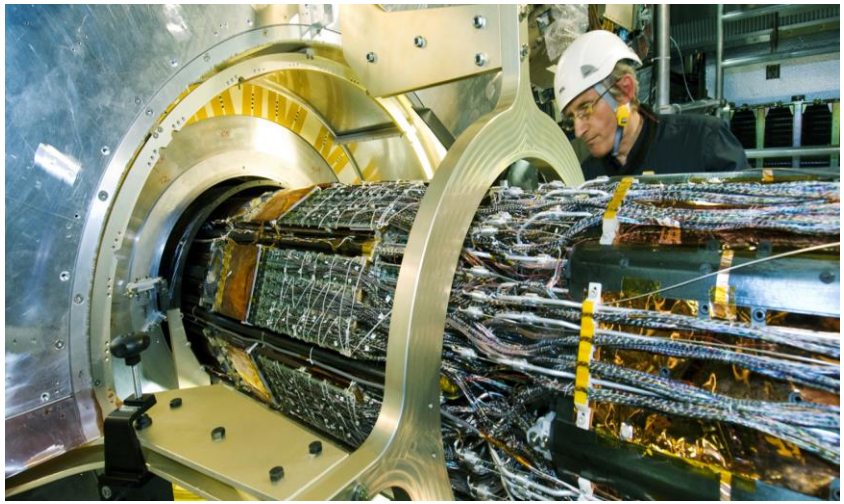
The team more then two decades worked with world leading laboratories as CERN (CH), Fermilab (US), BNL (US) and LBNL (US) in essential R&D projects concerning development microelectronic detectors for particle physics experiments.

We significantly contributed to the R&D and instrumentation of world-wide experiments – ATLAS (CERN), DZERO (Fermilab), PHENIX (BNL) by precise detectors based on advanced microelectronic technologies. These detectors have been crucial for fundamental discoveries done in recent years.

In collaboration with ON Semiconductor our team developed a fabrication process of radiation resistant sensors (1998-2006) for which ON Semiconductor received CERN award: http://cds.cern.ch/record/1074318, The ATLAS Pixel Detector played a key role in the Higgs boson discovery in 2012 .



Pixel detector assembly at CERN

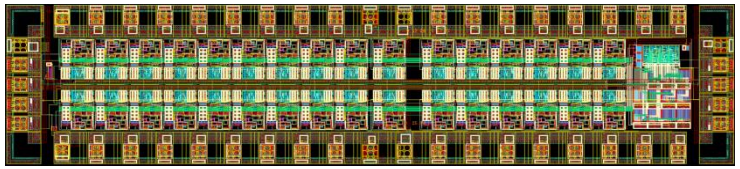


Michal Tomasek from our group during the installation of the Pixel Detector in the ATLAS underground experimental hall
https://atlas.cern/discover/detector/inner-detector

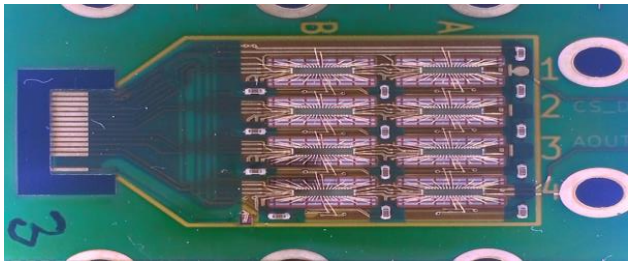
Our present activities

In recent years our R&D in concentrated in following main directions:

❖ ***Development of ASIC readout chips for strip detectors***

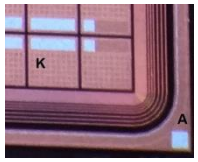


❖ ***Development of ASIC readout chips for macro-pixel detectors***



➢ Allowing for (much cheaper) wire-bonding instead of flip-chip bonding

❖ ***Development of corresponding Si strip and macro-pixel sensors***



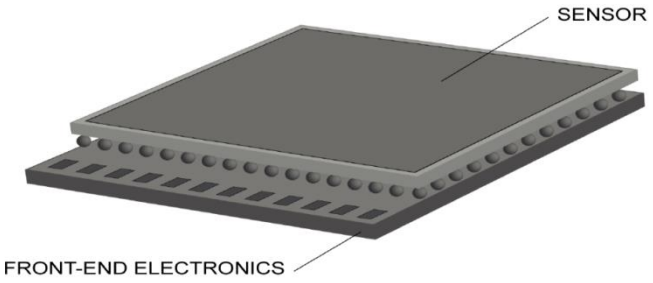
❖ ***Development of SOI Monolithic Active Pixel Sensors (MAPS) detectors***

➢ Abilities of SOI MAPS ➔ next slides

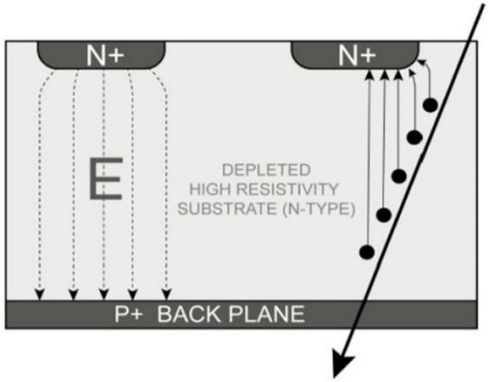
➢ Suitable for vertex detector in particle physics experiments

Hybrid vs Monolithic

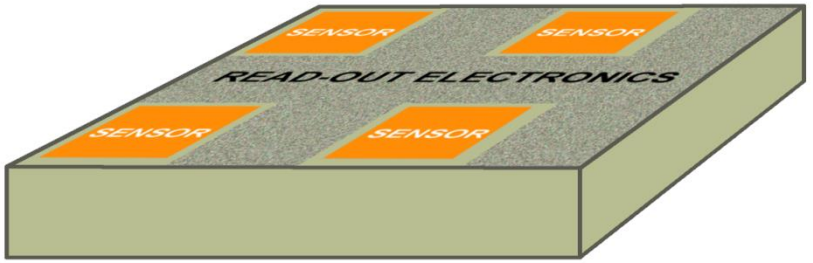
Hybrid pixel detector



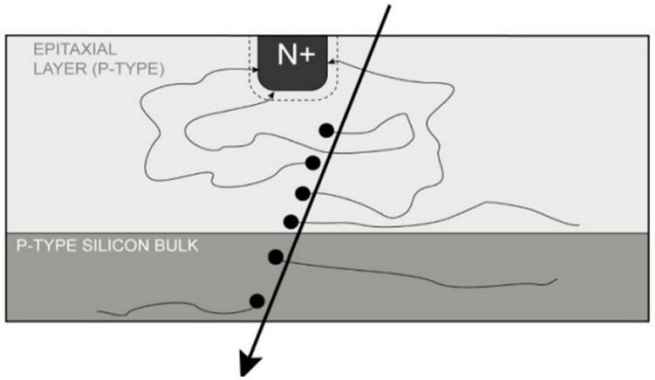
- Sensor array and read-out chip are separate components interconnected by (quite costly) flip-chip bonding
- Limitation of mass reduction possibilities



Monolithic detector



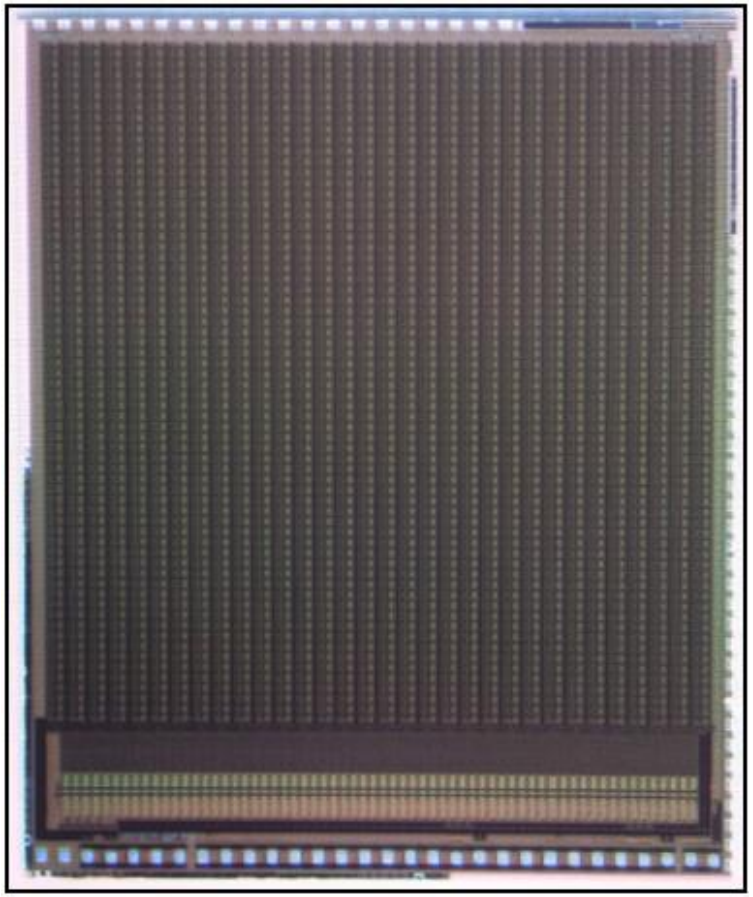
- All integrated in one chip
- Significant reduce of mass
- One technology
- Fast “time to market”
- Low cost



X-CHIP-03

SOI MAPS sensor designed for:

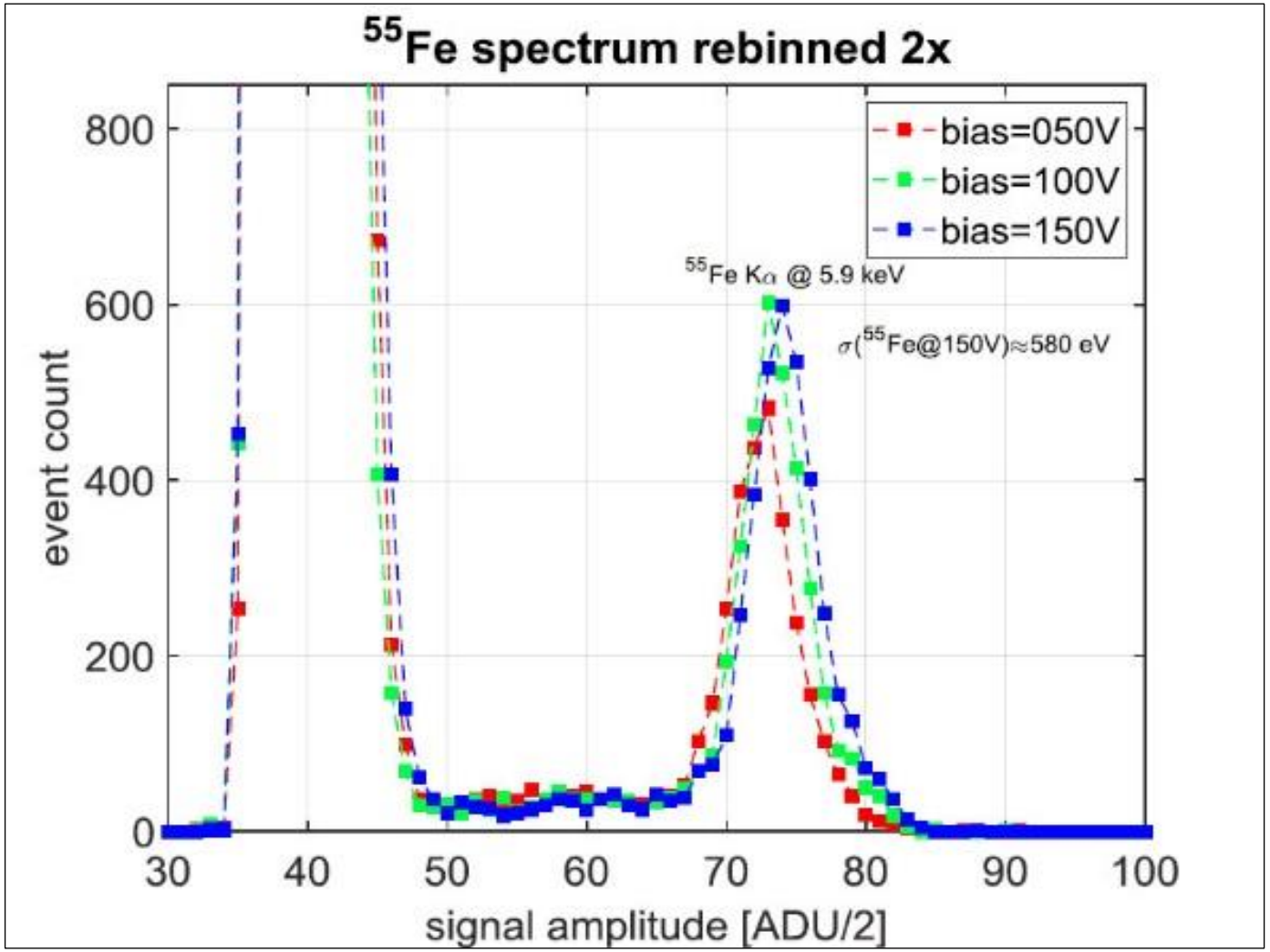
- radiation imaging
- Dosimetry
- Fabrication technology: SOI CMOS 180 nm



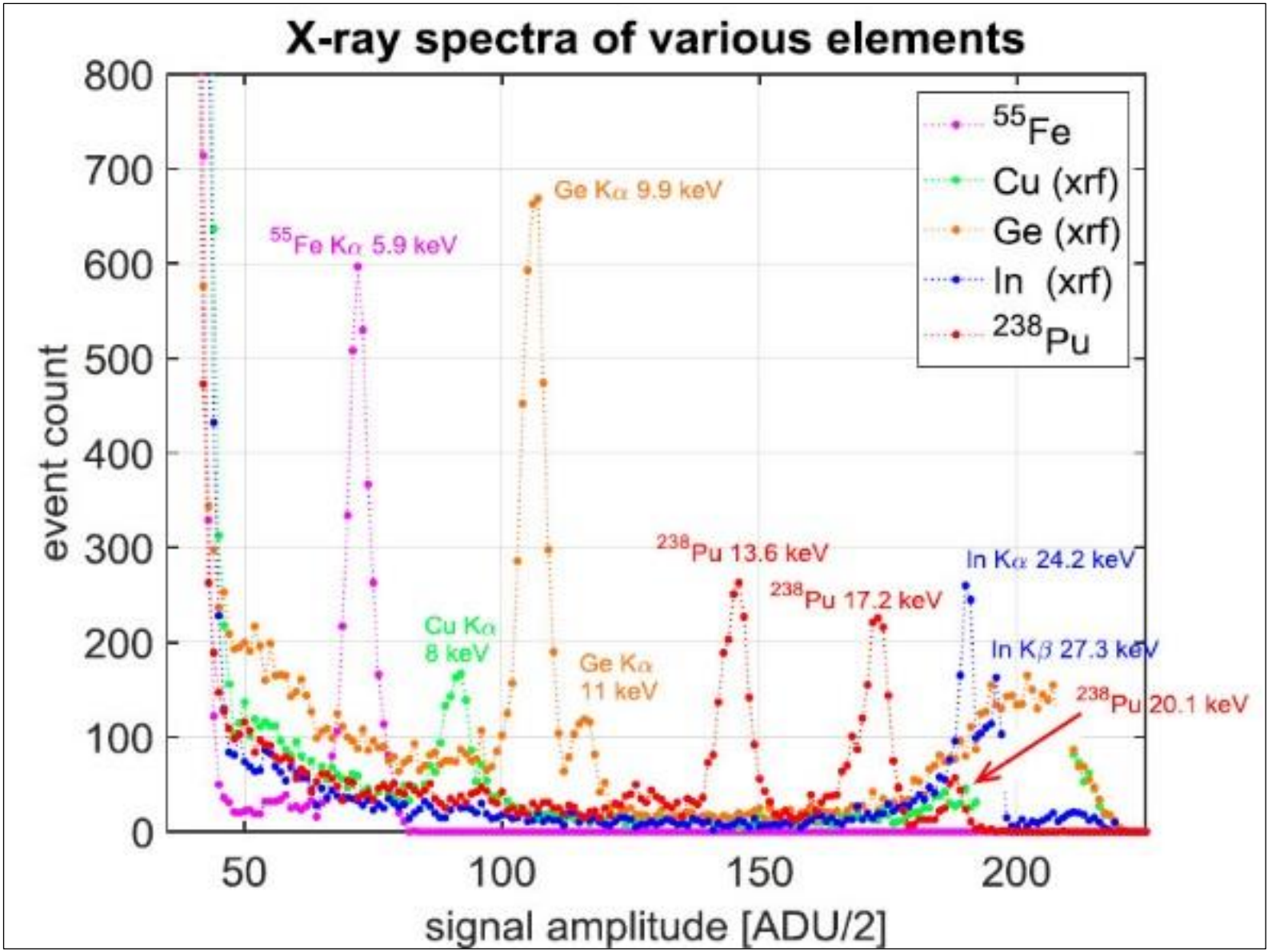
Matrix dimensions:	64×64 pixels
Pixel size:	60×60 μm^2
Hit counting range:	16 bit
ADC resolution:	10 bit
Readout speed:	400 Mbit/s* (LVDS)
Readout modes:	CMOS and LVDS
Technology:	SOI CMOS 180 nm
Supply voltage:	1.8 V
Sensor bias voltage:	-150 V
Chip dimensions:	3.96×4.76 mm^2
Power consumption:	< 50 mW (depends on configuration)

Spectrum measurements I.

Spectrum measured by a single pixel of X-CHIP-03

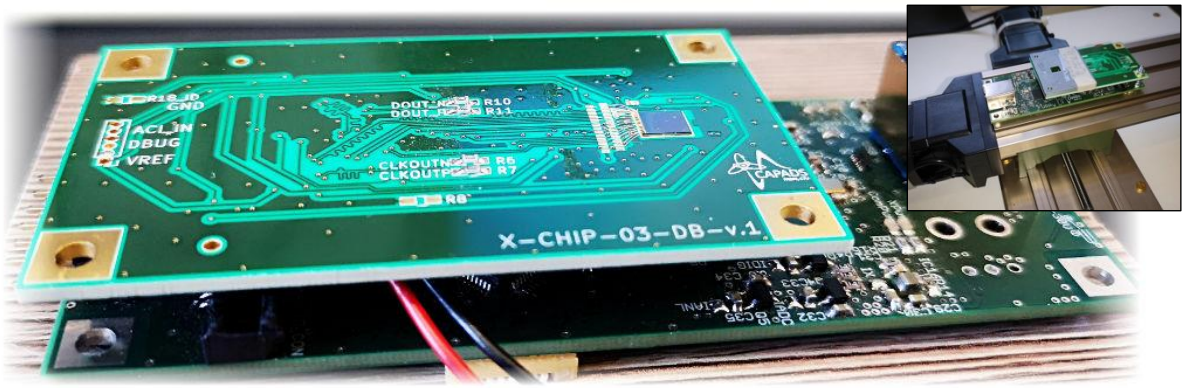


Spectrum measurements II.

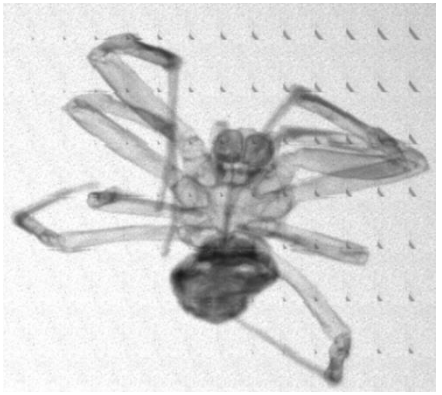


Radiation imaging

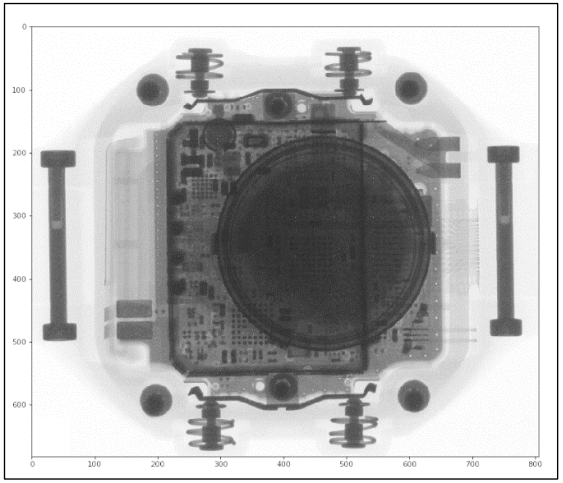
Images taken by X-CHIP-03-A in hit-counting mode



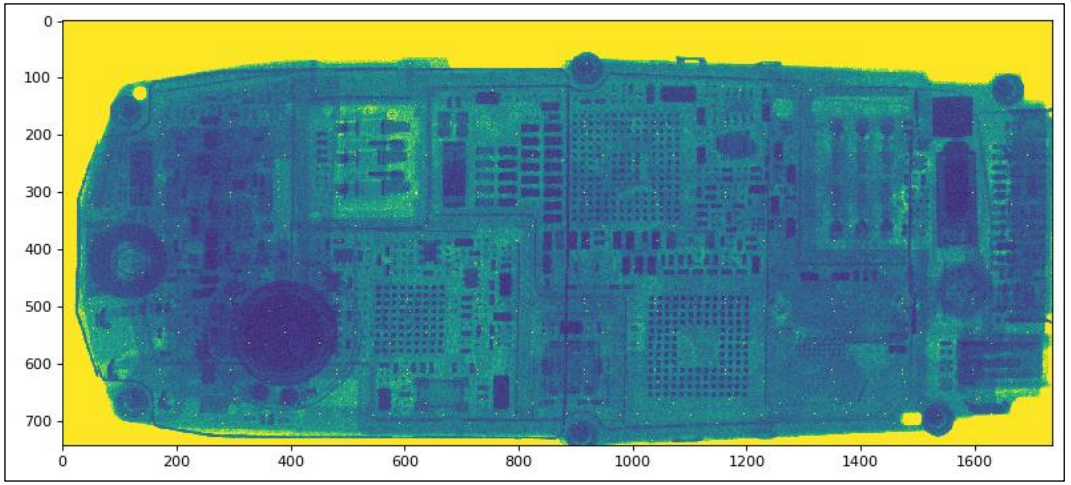
Measurement setup



X-ray image of the spider



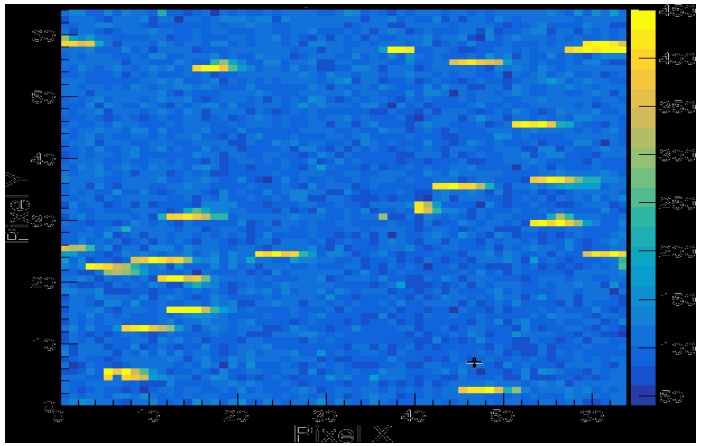
X-rai image of the watch



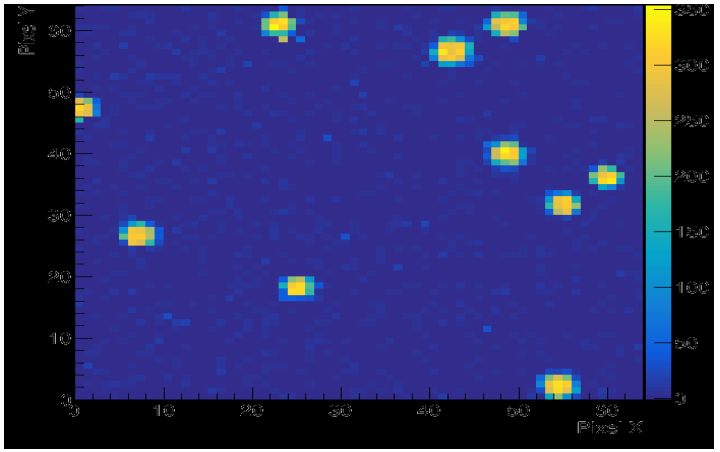
X-ray image of the mobile phone

Dosimetry and pattern recognition abilities

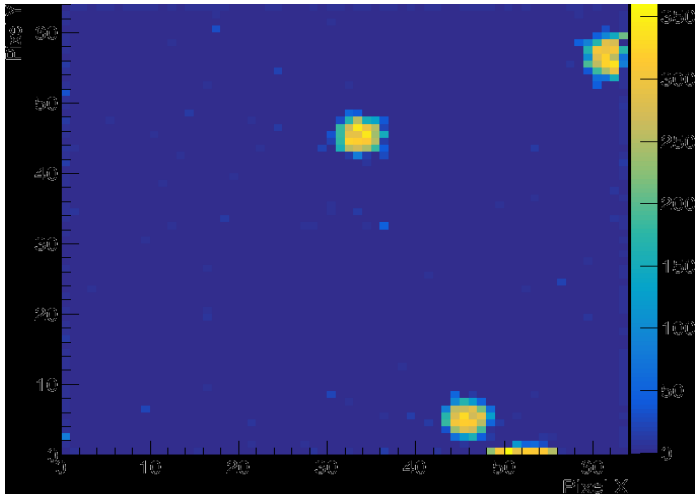
Heavy ion cluster imaging



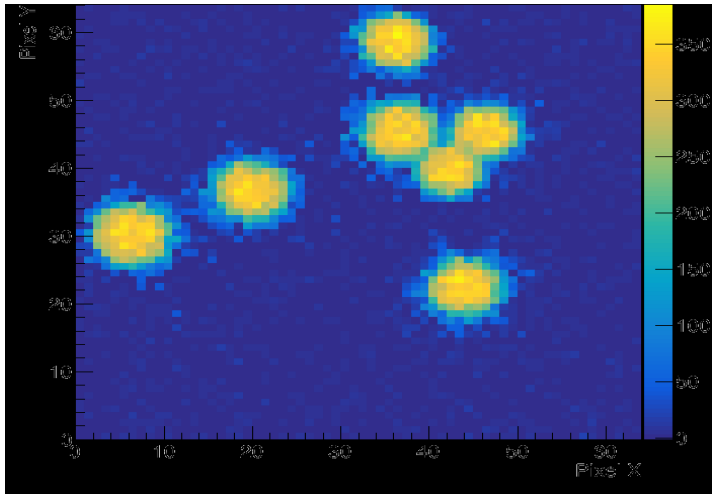
Sideward 1H ions @ PTC



22Ne ions @ U400M



86Kr ions @ U400M



136Xe ions @ U400M

Conclusions

- **SOI MAPS 180 nm technology is mastered and available**
- **Adjustment of the tracking abilities is needed**

Thank you for your attention