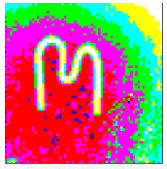
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITY OF WEST BOHEMIA

Institute of Experimental and Applied Physics
Czech Technical University in Prague

Timepix Demonstration

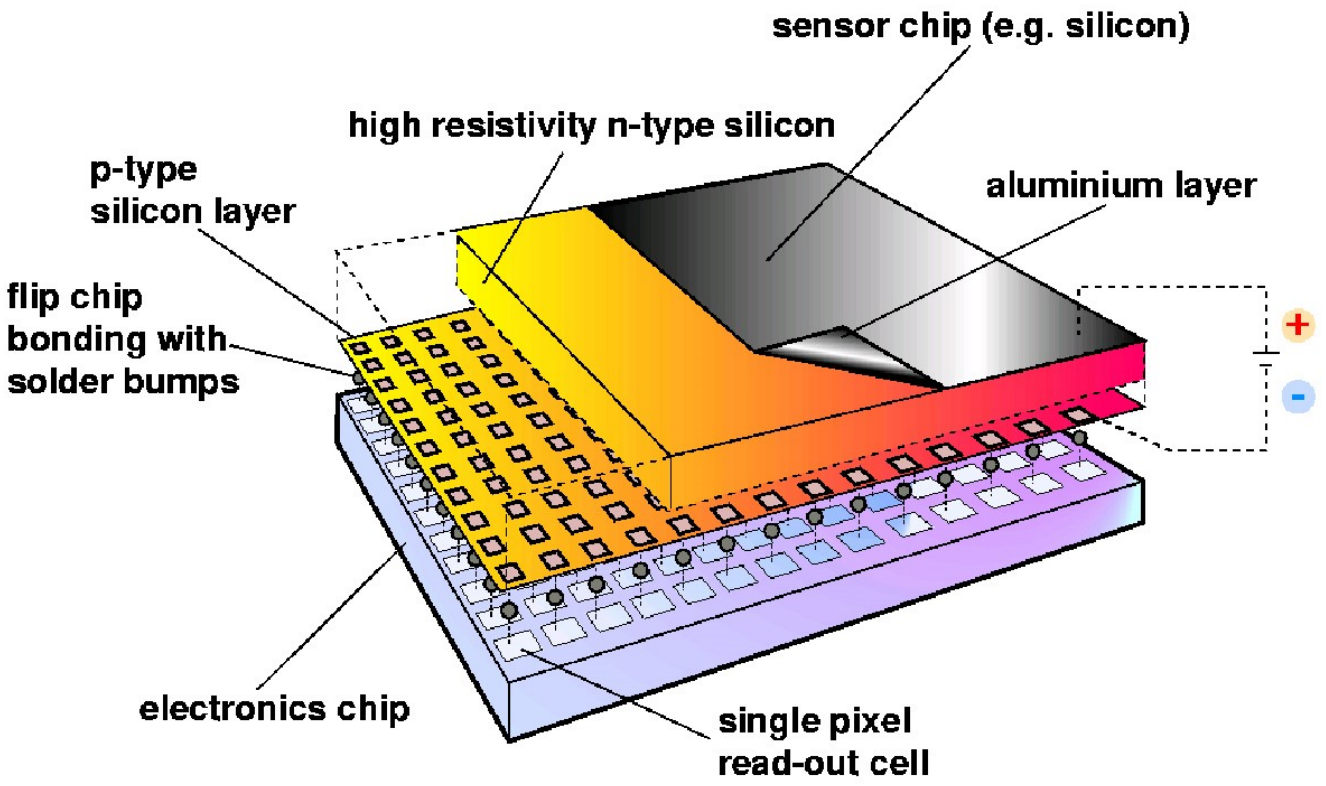
Michael Holik

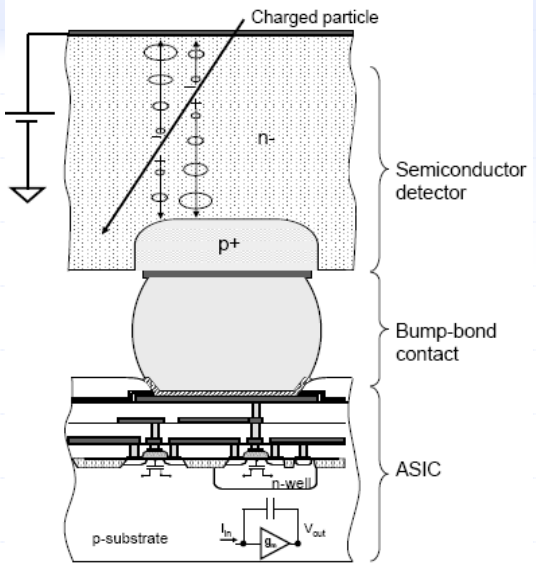
on behalf of Medipix/Timepix team of the
Institute of Experimental and Applied Physics
Czech Technical University in Prague
and
Faculty of Electrical Engeneering
University of West Bohemia in Pilsen

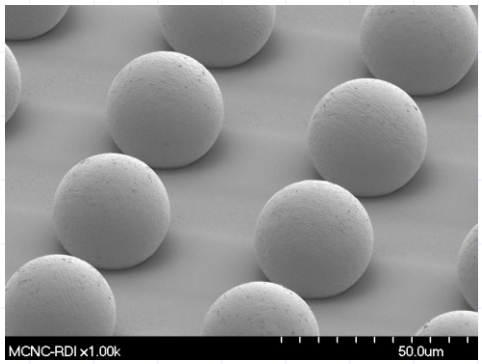


CERN

Timepix - Hybrid Pixel Detector with Single Particle Detection Capability







Sensor part and readout electronics part are optimized separately (sensor materials – Si, CdTe, GaAS)

Pixel detector as "Active emulsion"

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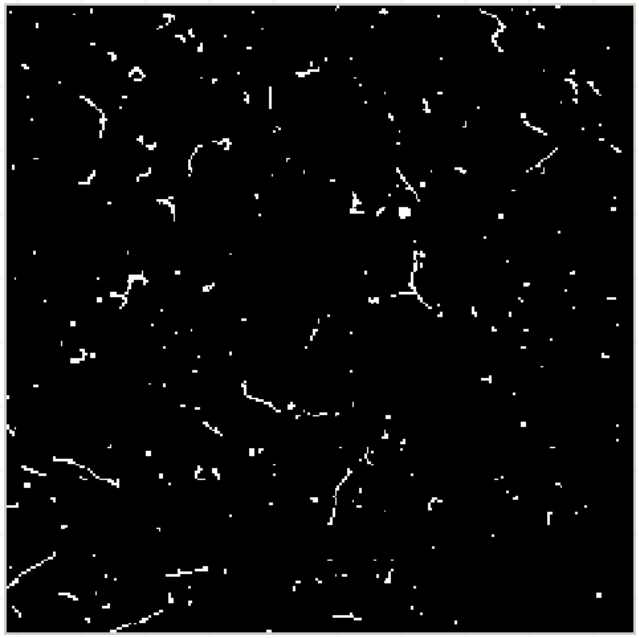
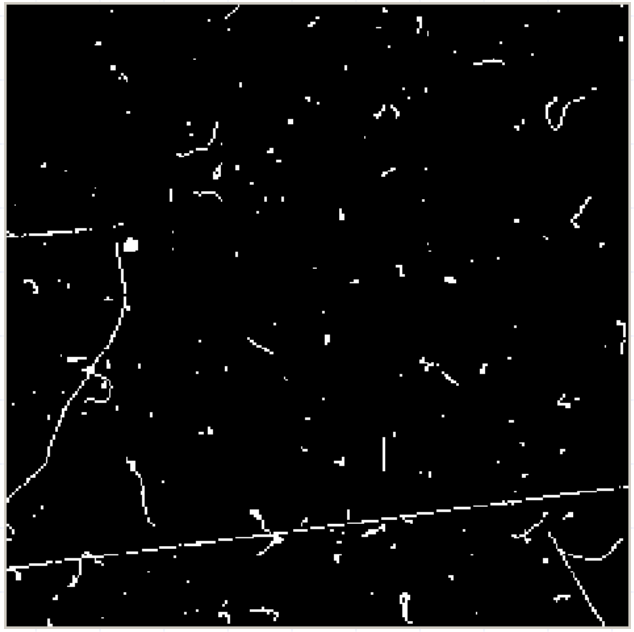
- Some particles can be identified from shape of their tracks as in formerly used nuclear emulsions.
- Example: Cosmic rays and natural background





Are particles photogenic?
Yes, they are when observing them with Timepix detector ☺

Particle Tracking and Recognition

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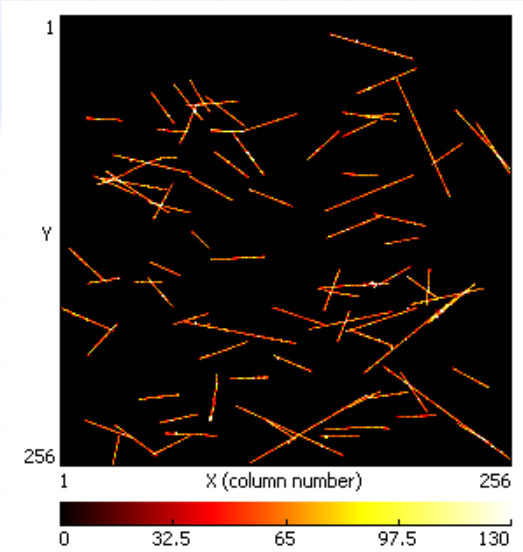
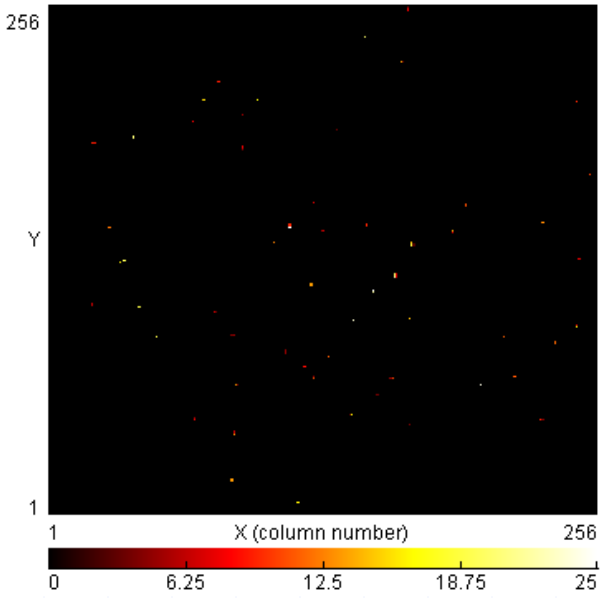
Type of interacting particle can be recognized by its specific track left in the pixel matrix

Track shape depends on interacting particle energy, mass, sensor material, bias voltage, angle,...

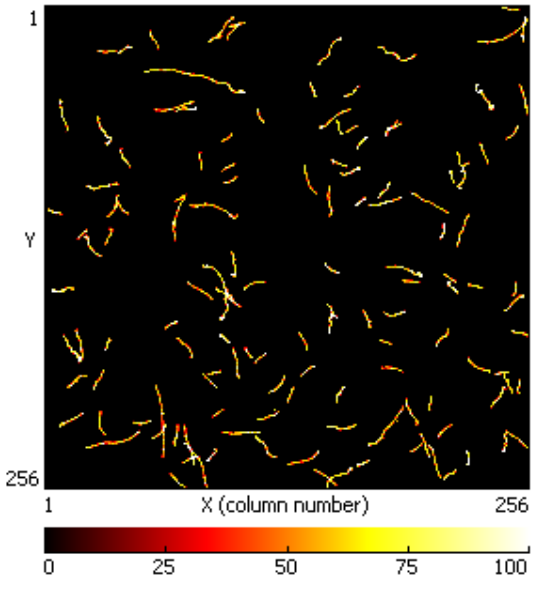
muons



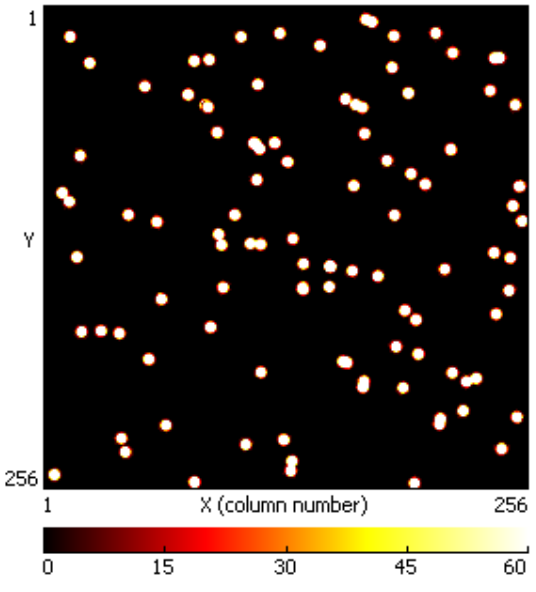
gammas/xrays



electrons



alphas



Review of the characteristic patterns

Event by event processing - track pattern recognition

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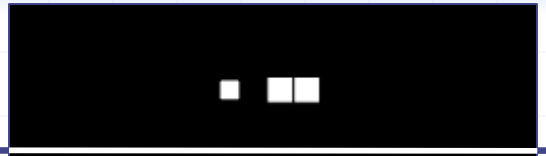
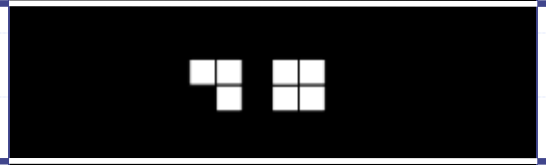
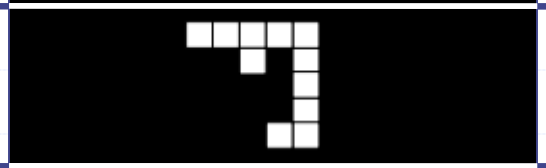
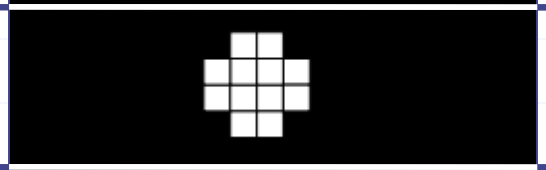
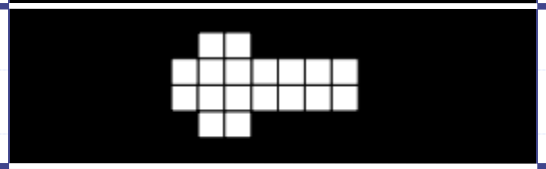
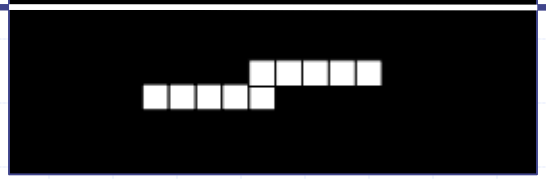
1) Dot		Photons and electrons (10keV)
2) Small blob		Photons and electrons
3) Curly track		Electrons (MeV range)
4) Heavy blob		Heavy ionizing particles with low range (alpha particles,…)
5) Heavy track		Heavy ionizing particles (protons,…)
6) Straight track		Energetic light charged particles (MIP, Muons,…)

Timepix Educational Kit
MX-10 Particle Camera

JABLOTRON
CREATING ALARMS

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URANIUM Glass Radioactivity

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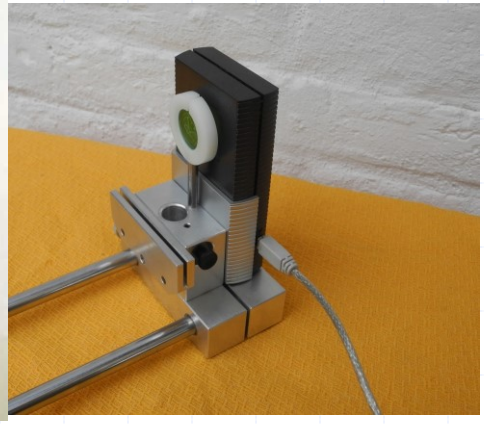

Sample used

Uranium

^{235}U, 0.72%, $T_{1/2}$ = 7,0.10^8 years

^{238}U, 99.274%, $T_{1/2}$ = 4,5.10^9 years

Standard glass colorant
Freely available on the market

Uranium Glass Radioactivity
as seen by the Timepix pixel detector

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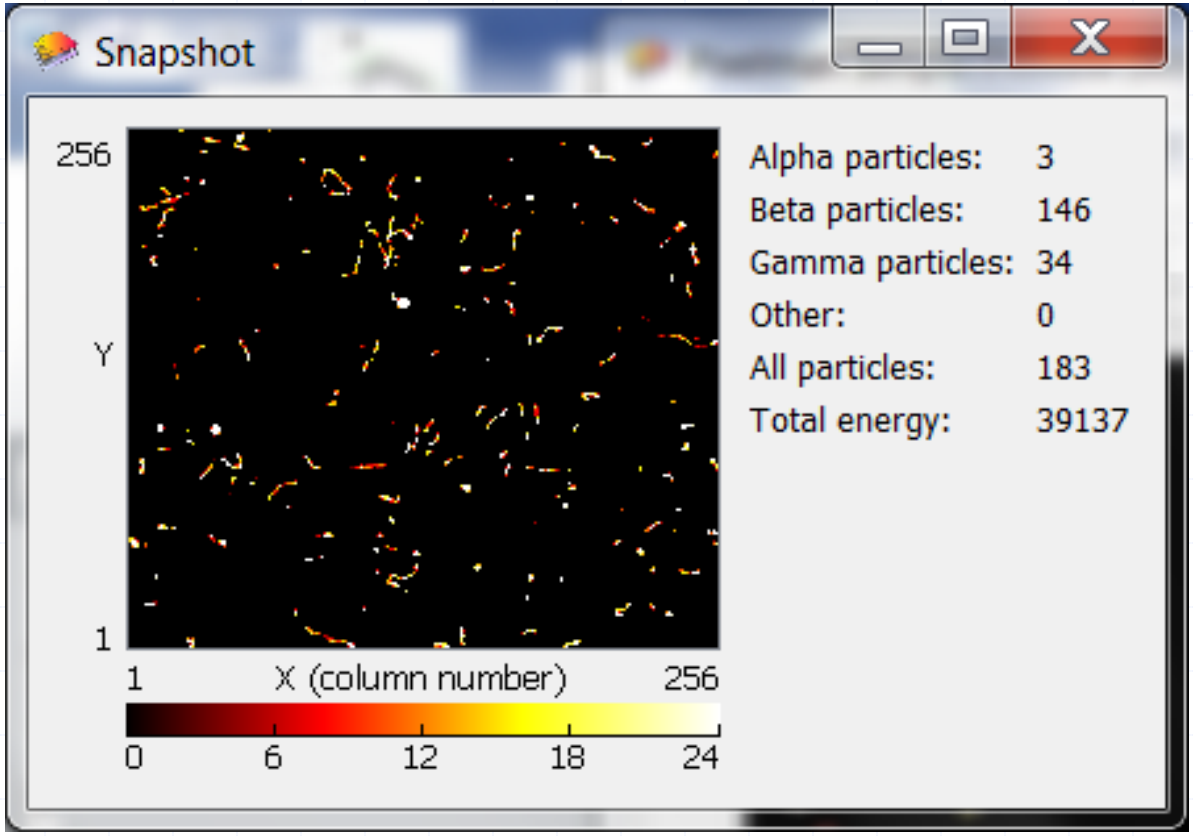

Americium ^{241}Am Alpha (Gamma) source

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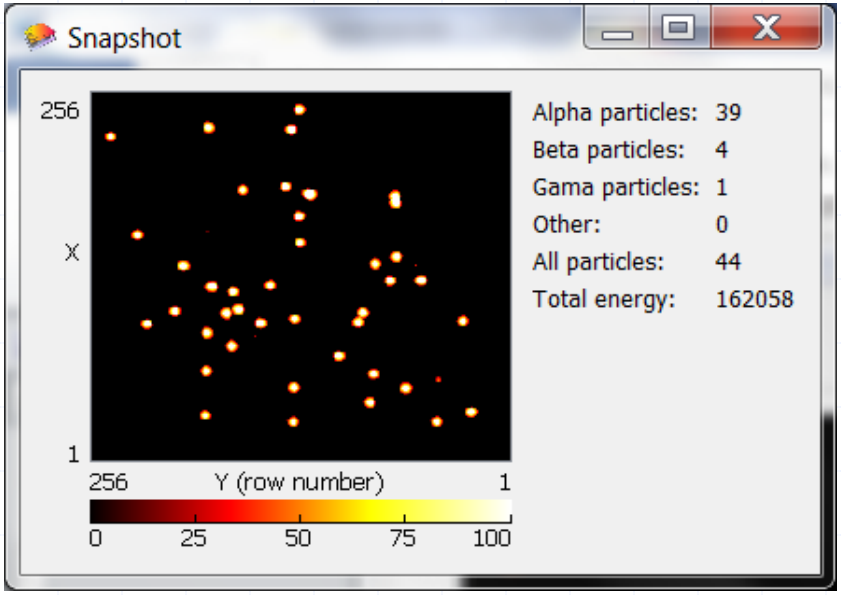
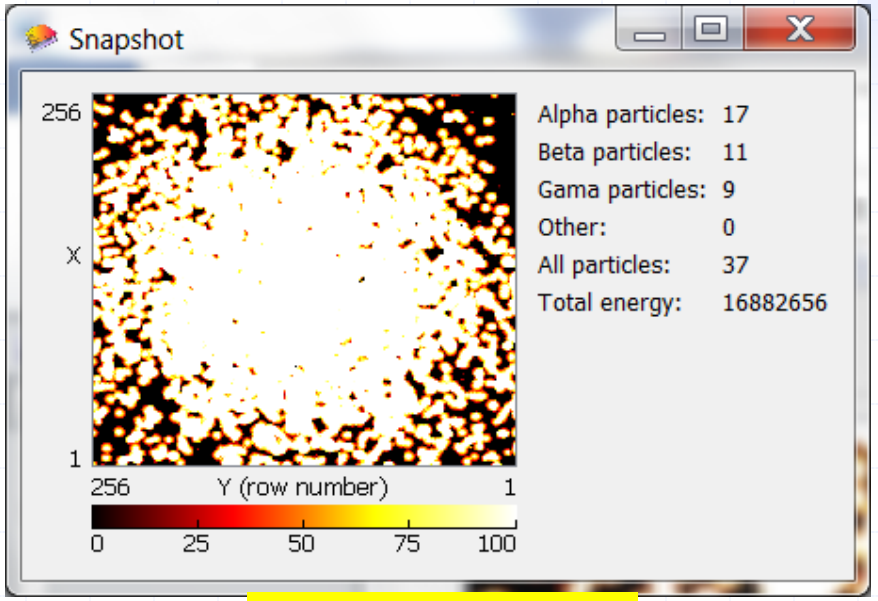
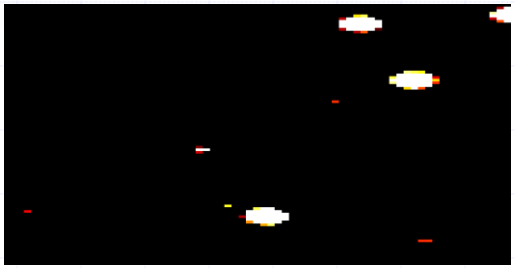




Integral Frame



Zoom

Alfa decay - Americium:

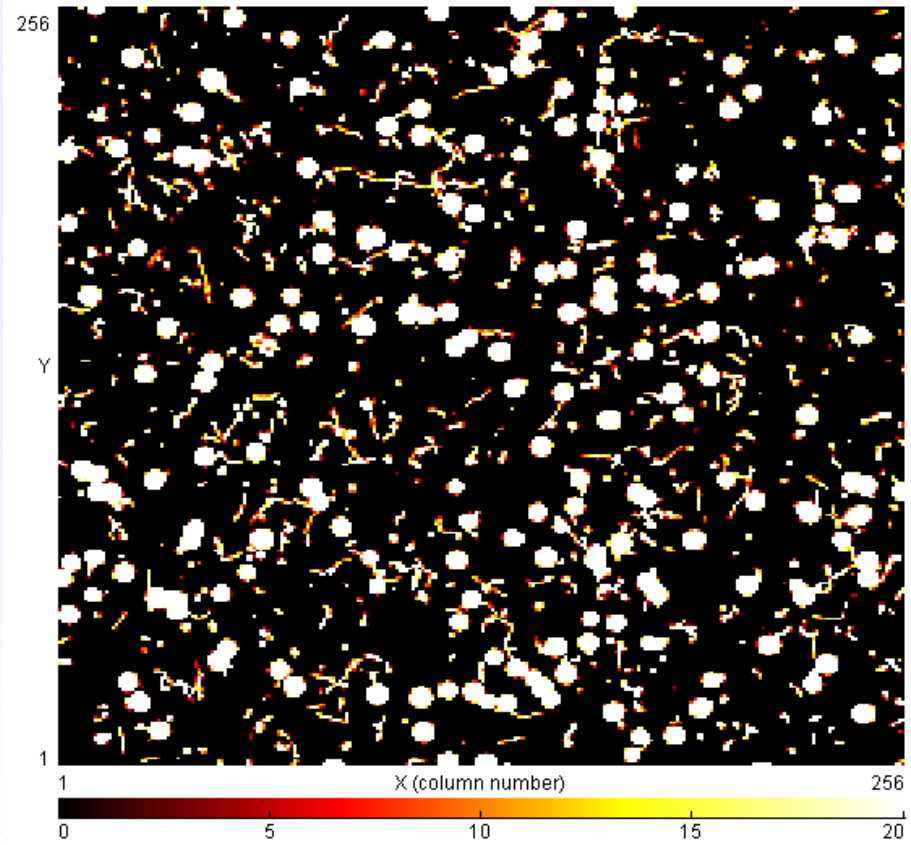
$$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$$

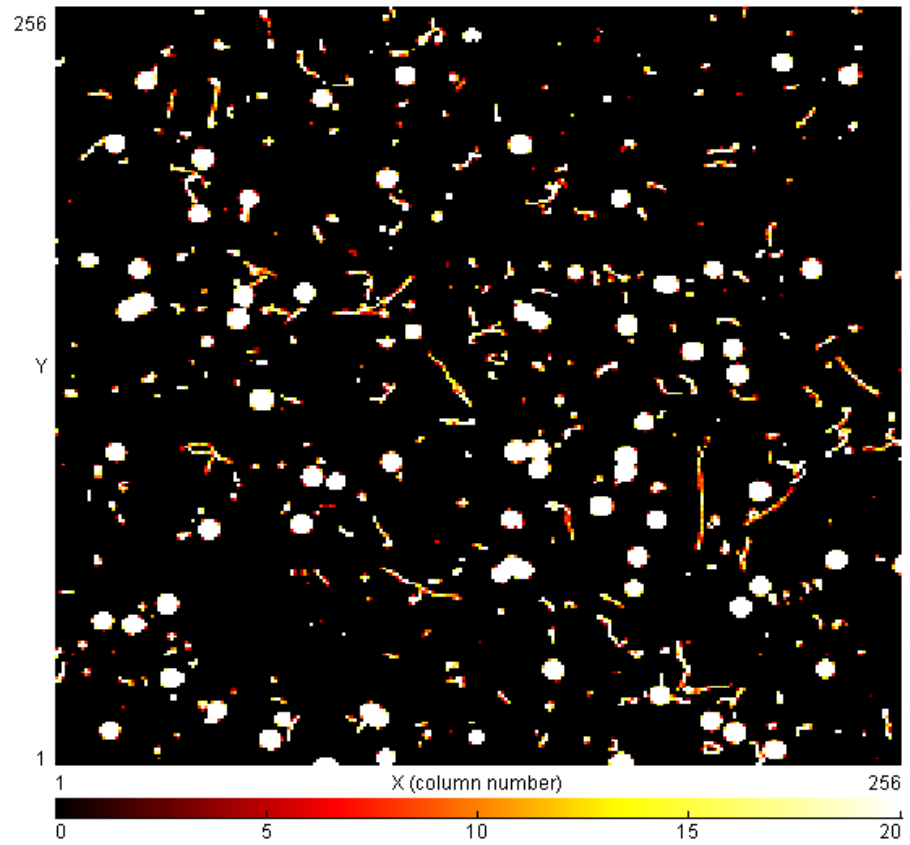
$E(\alpha)$ = 5 500 keV

$E(\gamma)$ = 59.5keV

Half-life ^{241}Am - 432 years.

Not-ventilated (left) and ventilated (right) room





Visualizations of the radioactivity of the paper tissue that was used as an air filter in one house in Pardubice – Czech Republic.
The filtering took 5 minutes and exposure time was 10 minutes in both cases.

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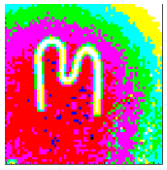
Thank You For Your Attention

Acknowledgement

The presented results have been achieved within research activities cultivated at IEAP CTU in Prague. They result from extensive partnerships in frame of the Medipix collaboration.



Radon – common source of background radioactivity

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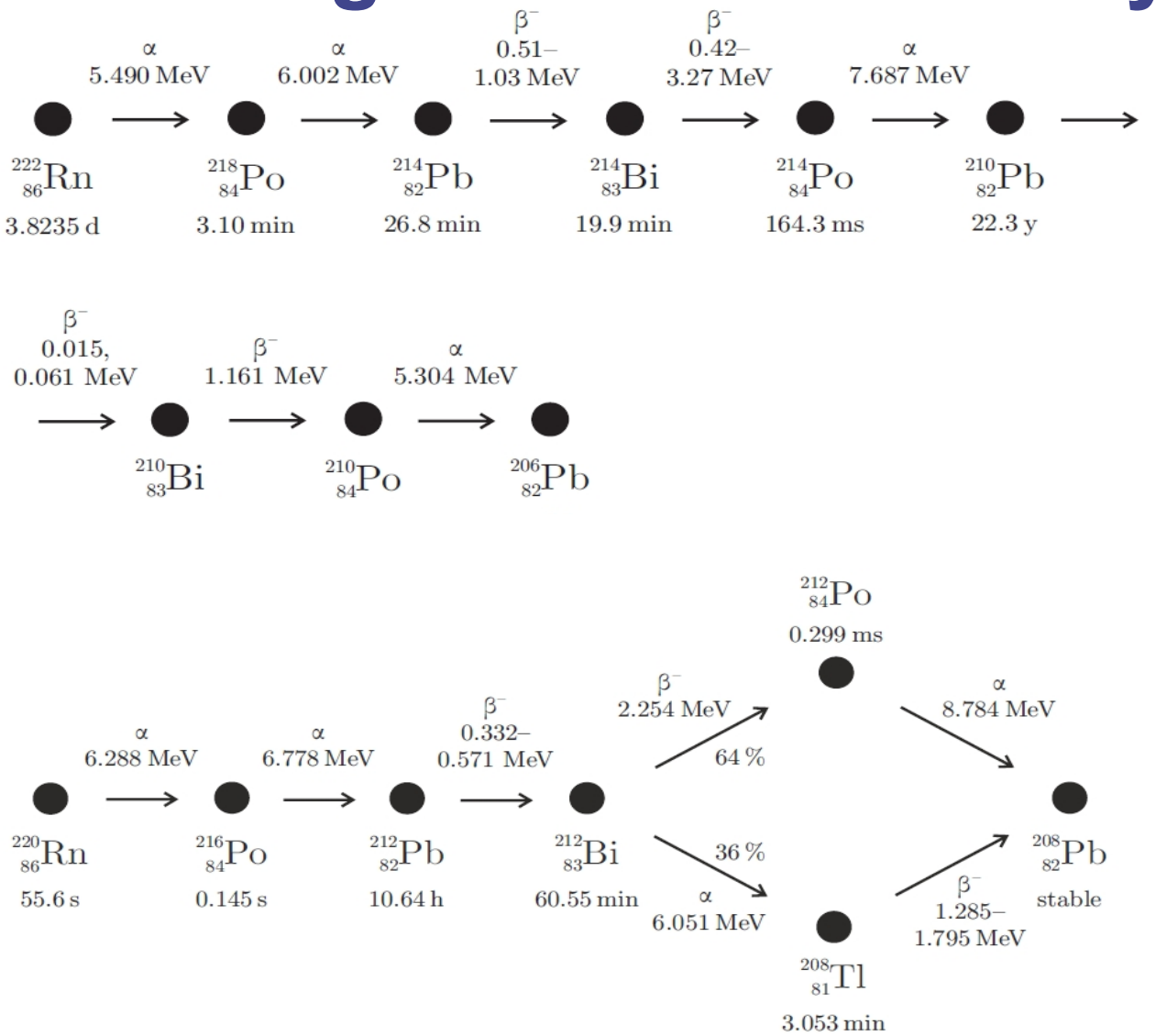

Background Radiation with Origin in Space

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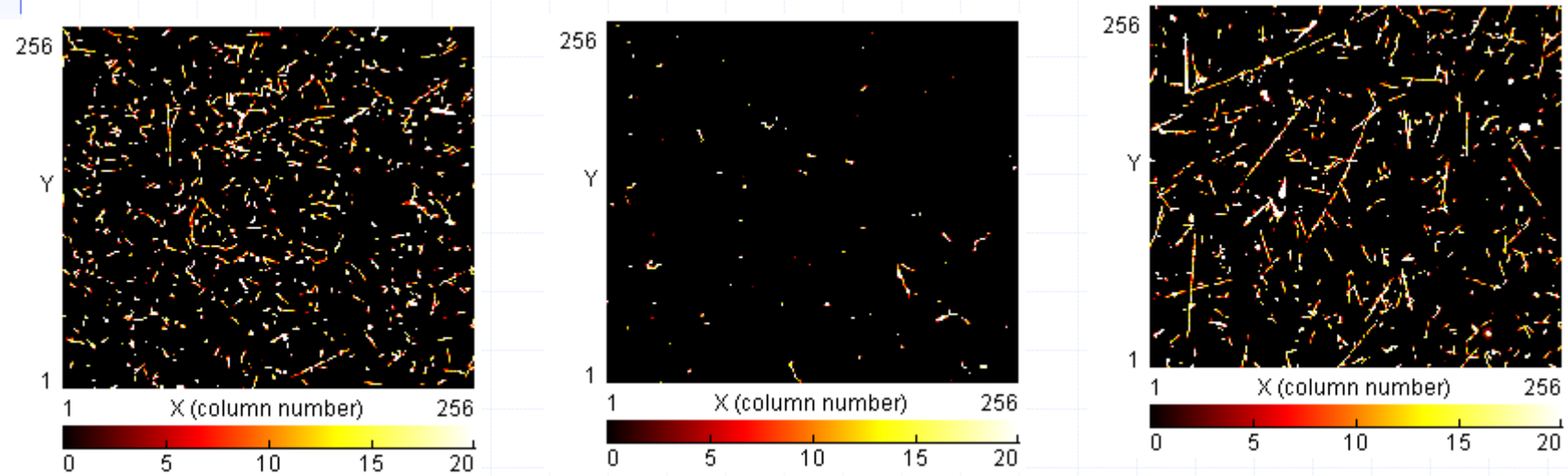
Detection of cosmic muons and their contribution to background radiation on the ground.

Exemplar frames measured at different conditions: one frame represents response acquired at the vertically oriented sensor at the airport. The next one was acquired on board of the airplane on the standard flight level at the vertical sensor orientation and the last one at the horizontal sensor orientation.



Let's see how is it with muons while playing with Timepix detectors on the upcoming practical exercises ☺