

Double counts in STIX's Caliste-SO detectors

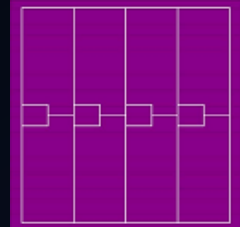
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**PROGRESS ON EUV & X-RAY
SPECTROSCOPY AND IMAGING II
WROCŁAW – 17-19.11.2015**

STIX & Caliste-SO

- Caliste-SO – hybrid component integrating the sensor material and dedicated front-end electronics.



- Main parameters of STIX's
 - Energy range 4-150 keV
 - Energy resolution 1-15 keV (energy dependent)
 - Angular resolution 7 arcsec
 - Pointing accuracy 4 arcsec
 - Field of view 2°
 - Time resolution 0.1 s (statistics limited)
- Detector electronics module (DEM)
 - 32 CdTe sensors on Caliste-SO hybrids
 - Analog-to-digital converters
 - Data processing unit (IDPU)
 - Low-voltage/sensor bias power supplies

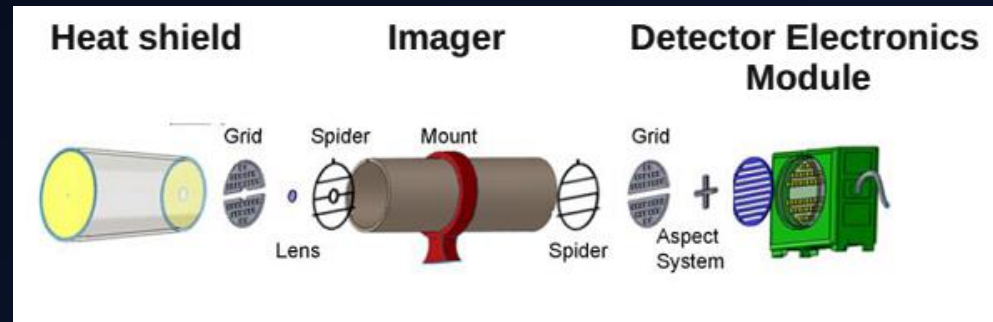
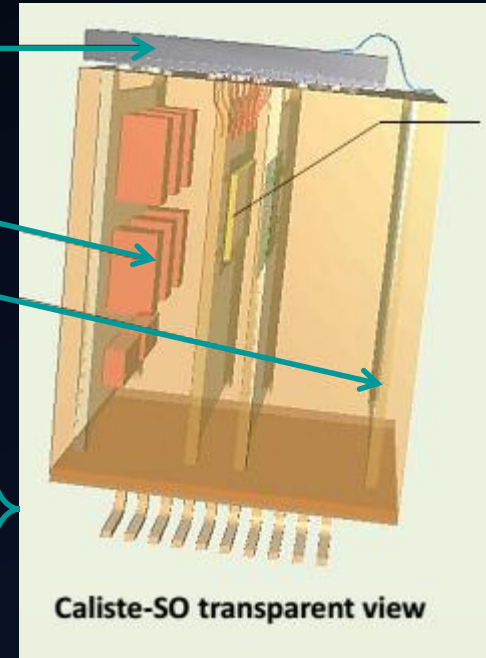
CdTe pixel detector

Passive filtering parts

High voltage routing

Electrical SOP interface

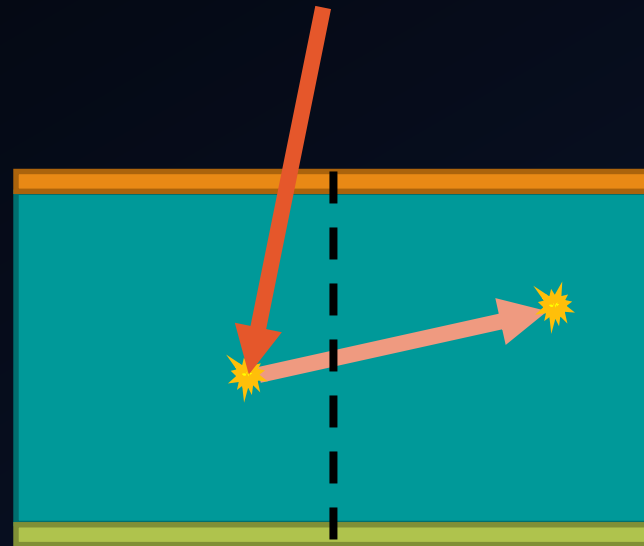
- ASIC power supplies
- Sensor high bias voltage
- Slow control I/O
- Test injection
- Differential analog output



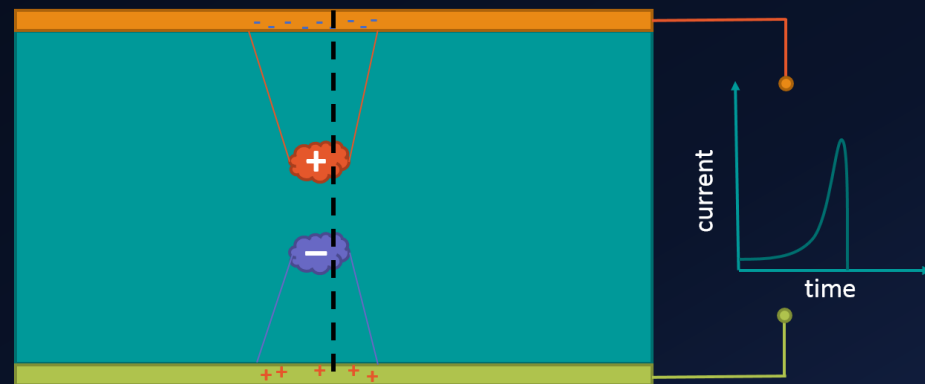
How does double
counting will influence
measured solar spectra?

Double counts

- Double count - one photon simultaneously measured in more than one pixel
- Two effects occur double counts:
 1. Secondary photons illumination

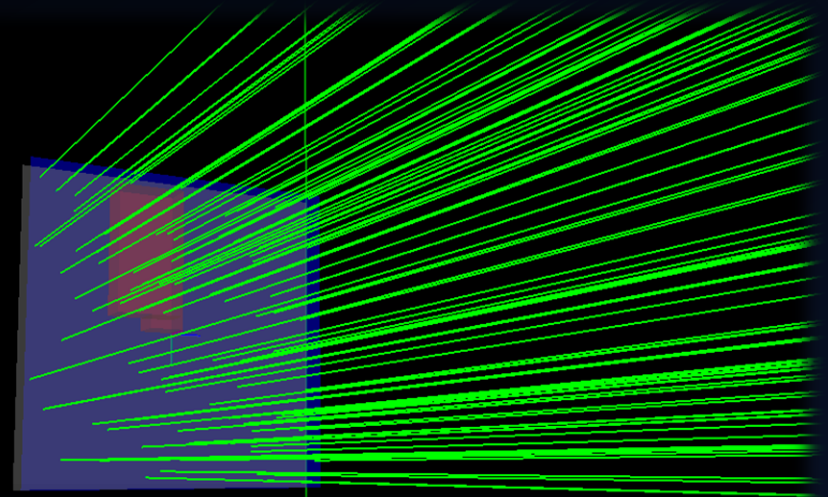


2. Charge sharing

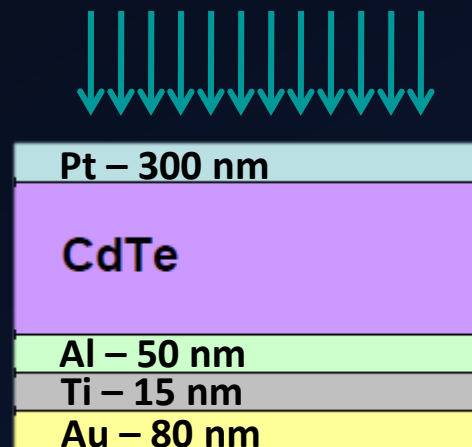


Geant4 simulation

- Source:
 - Monoenergetic photons
 - Energy from 4 to 150 keV with step 0.1
- Active volume:
 - whole crystal
- Photon beam covers entire detector area
- List of physics process:
 - Photons
 - Photoelectric effect
 - Compton scattering
 - Gamma conversion
 - Rayleigh scattering
 - Electrons
 - Multiple scattering
 - Ionization
 - Bremsstrahlung

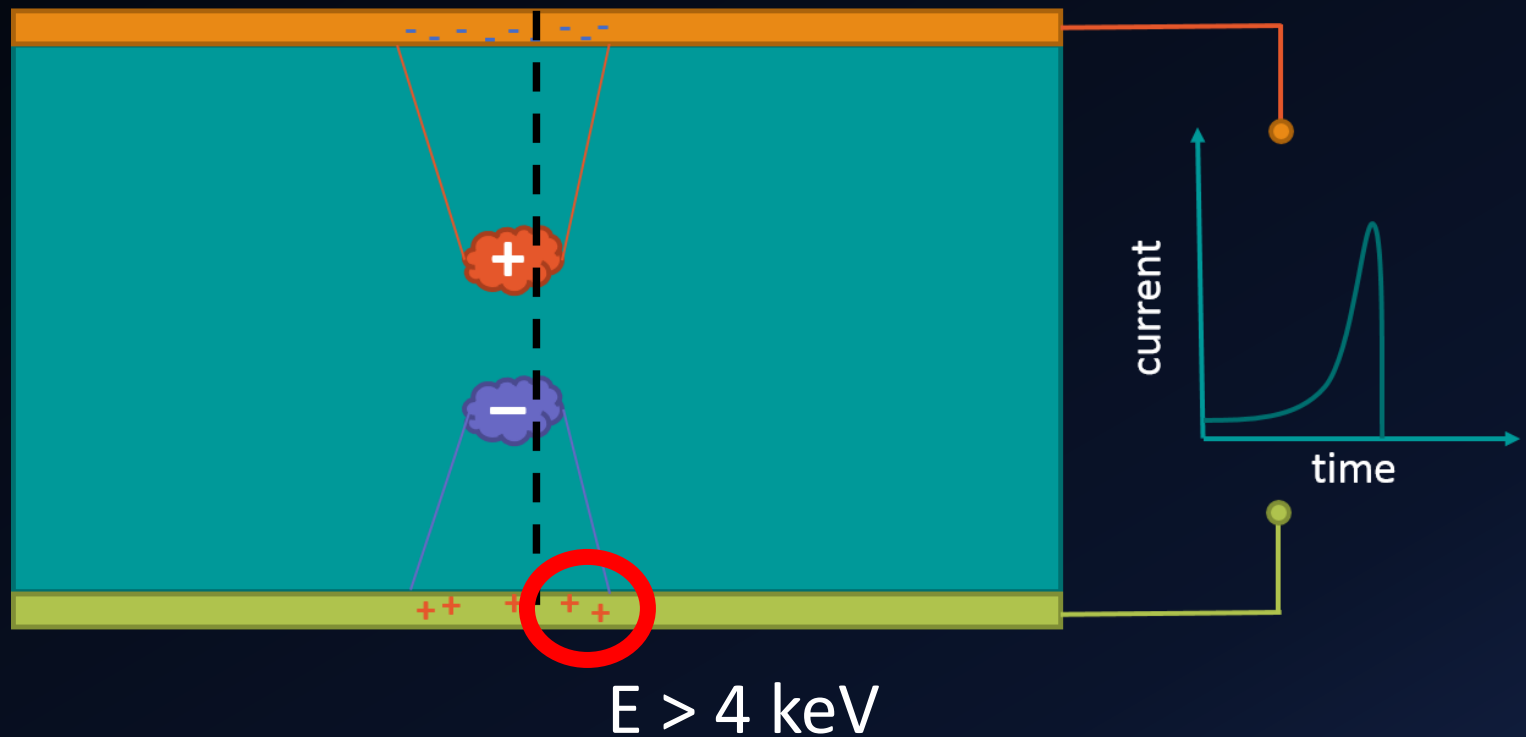


Particle source direction



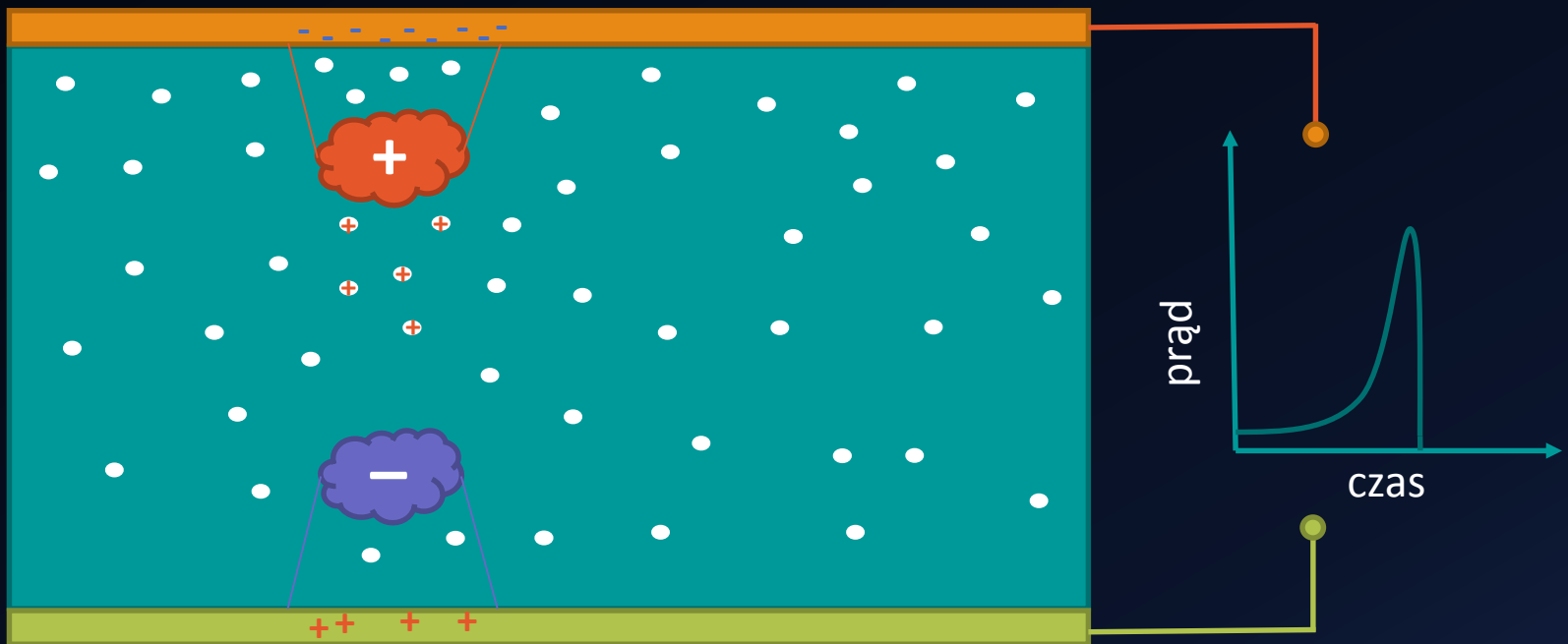
STIX's threshold

- STIX is measuring photons with energy more than 4 keV.



Hole tailing

- Measured lower energies



Damage layer

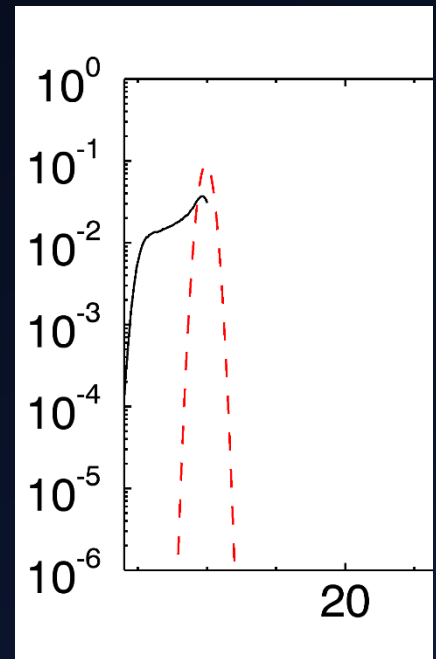
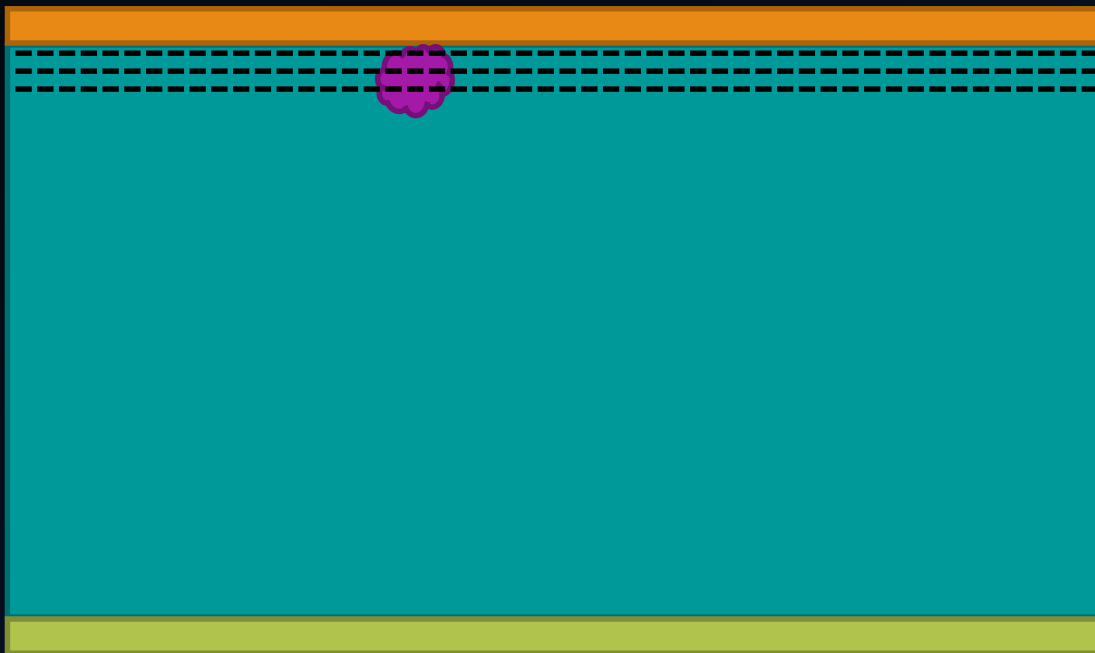
- Measured lower energies

$$n_0 = n_0(1 - e^{-x/\lambda_{\text{entrance}}})$$

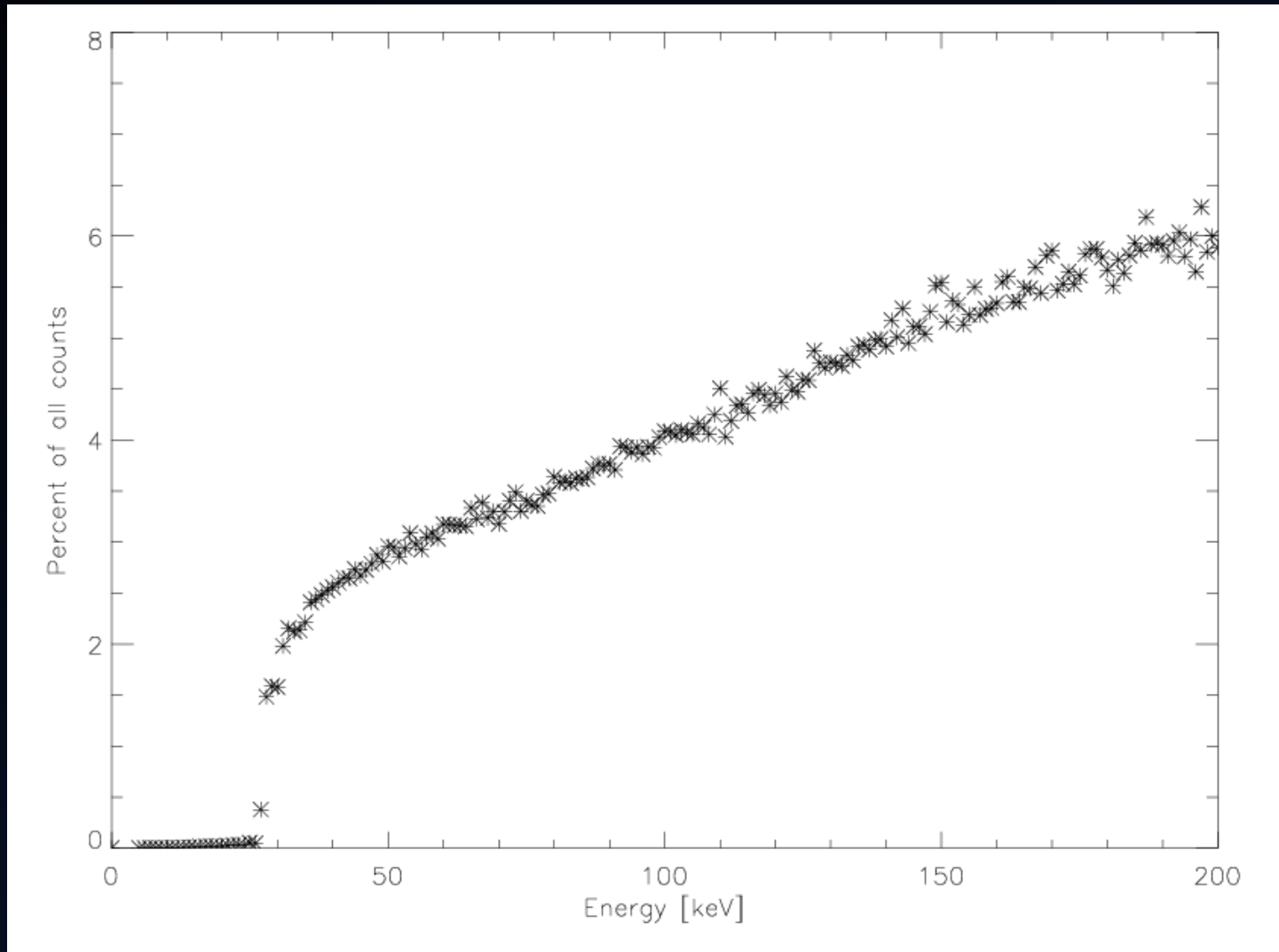
n_0 – number of electrons and holes initially created,

x – absorption depth

$\lambda_{\text{entrance}}$ – damage layer thickness – 5 μm

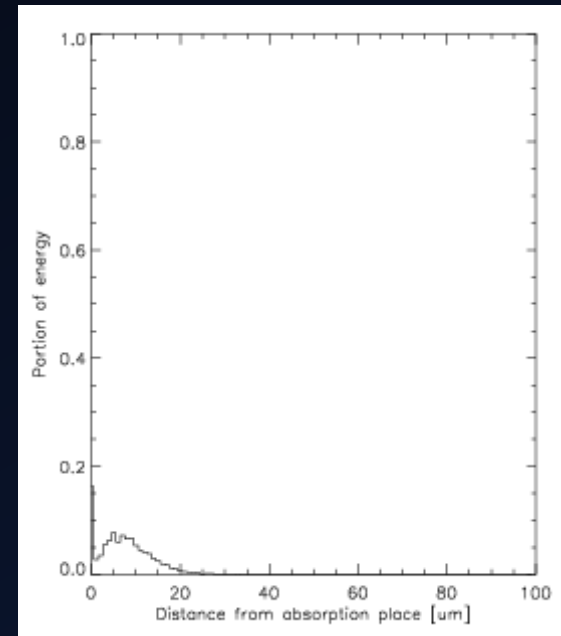
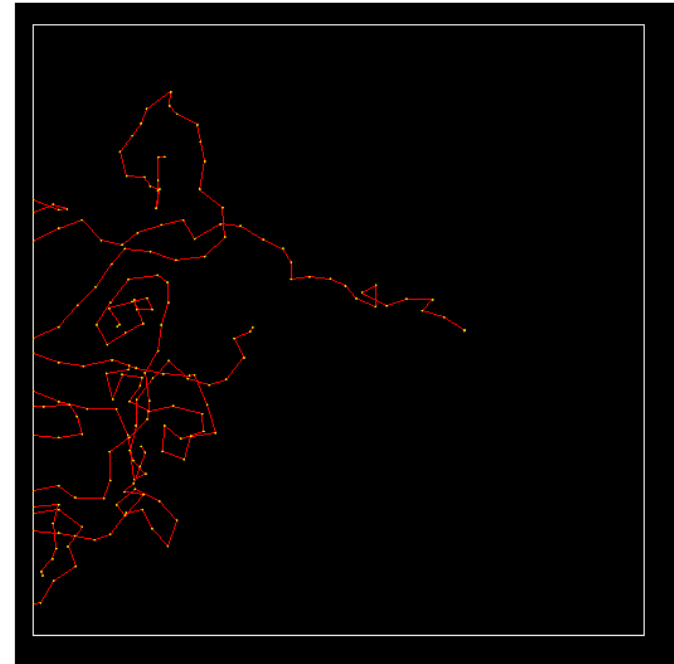
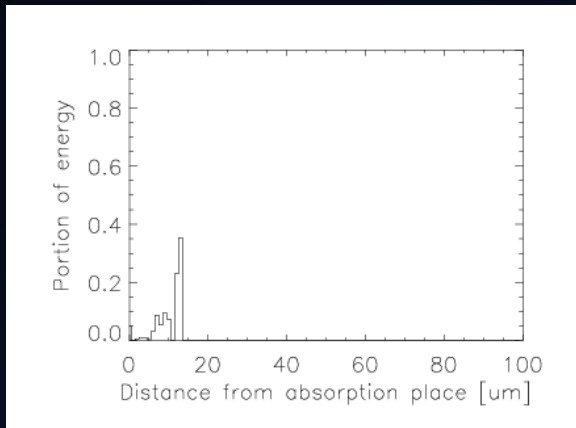
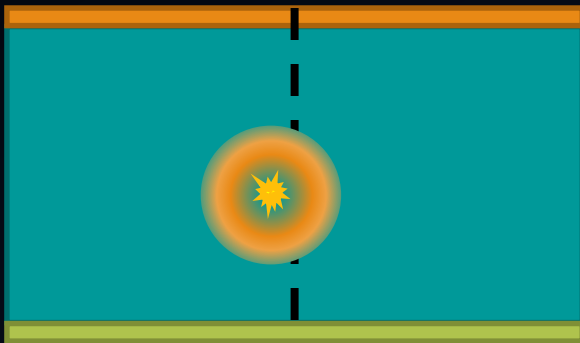


1. Secondary photon illumination



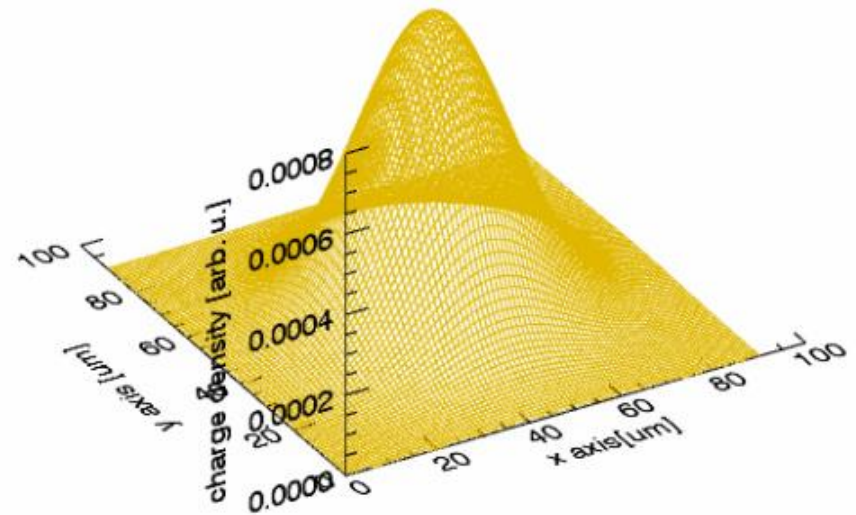
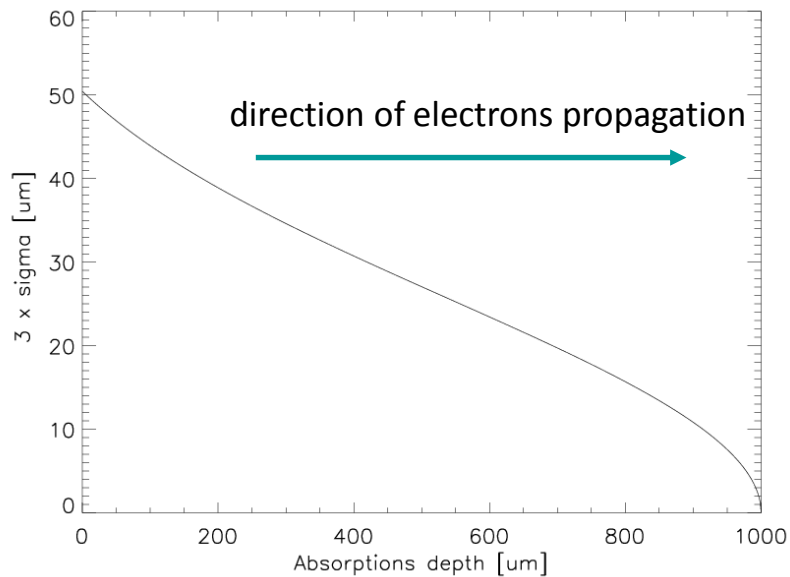
Clouds shape

- Most part of electrons energies is deposited near the end of track.
- Sum of carriers clouds is symmetrica



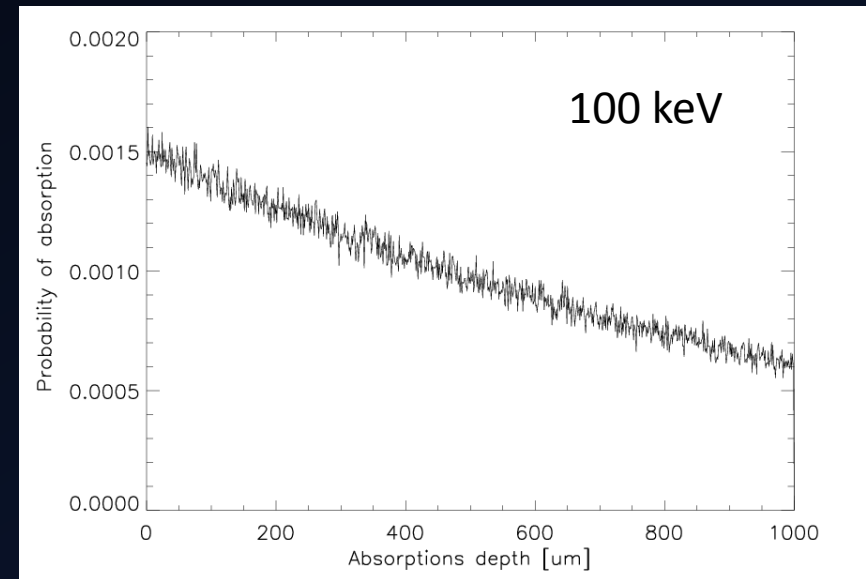
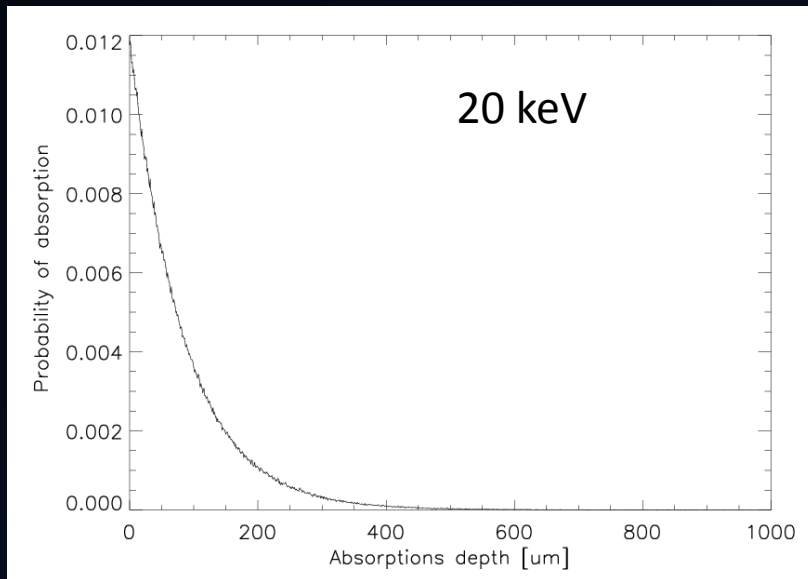
Charge sharing

- Initial distribution: spherically symmetric, normalised Gaussian.
- The expansion of a charge cloud is governed by Fick's second law.
- Electric field perpendicular to electrodes.

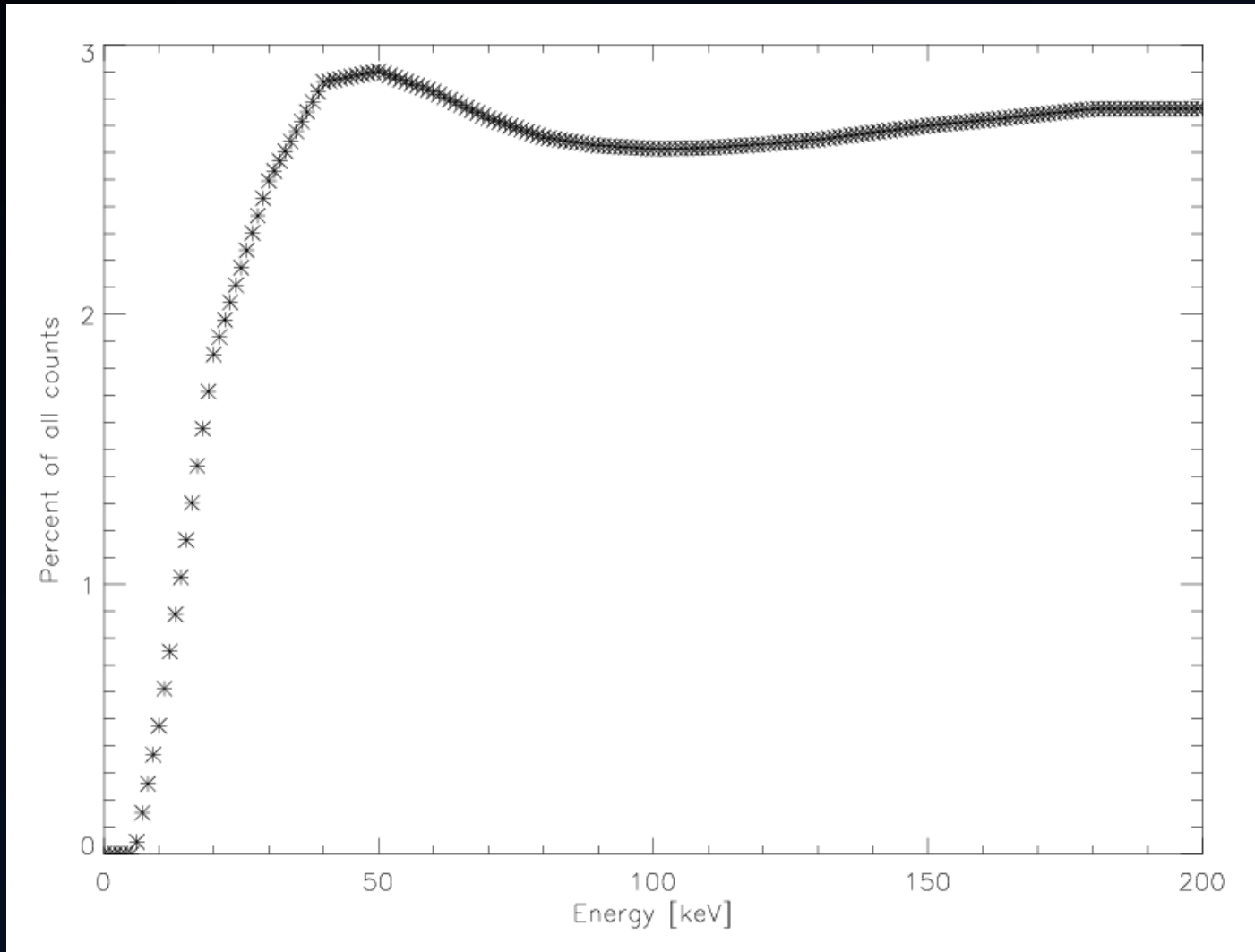


Absorption depth

- We compute surface area, where double events occur, for each absorption depth.
- In next step, we divide this surface area by surface area of whole detector -> probability of double count.

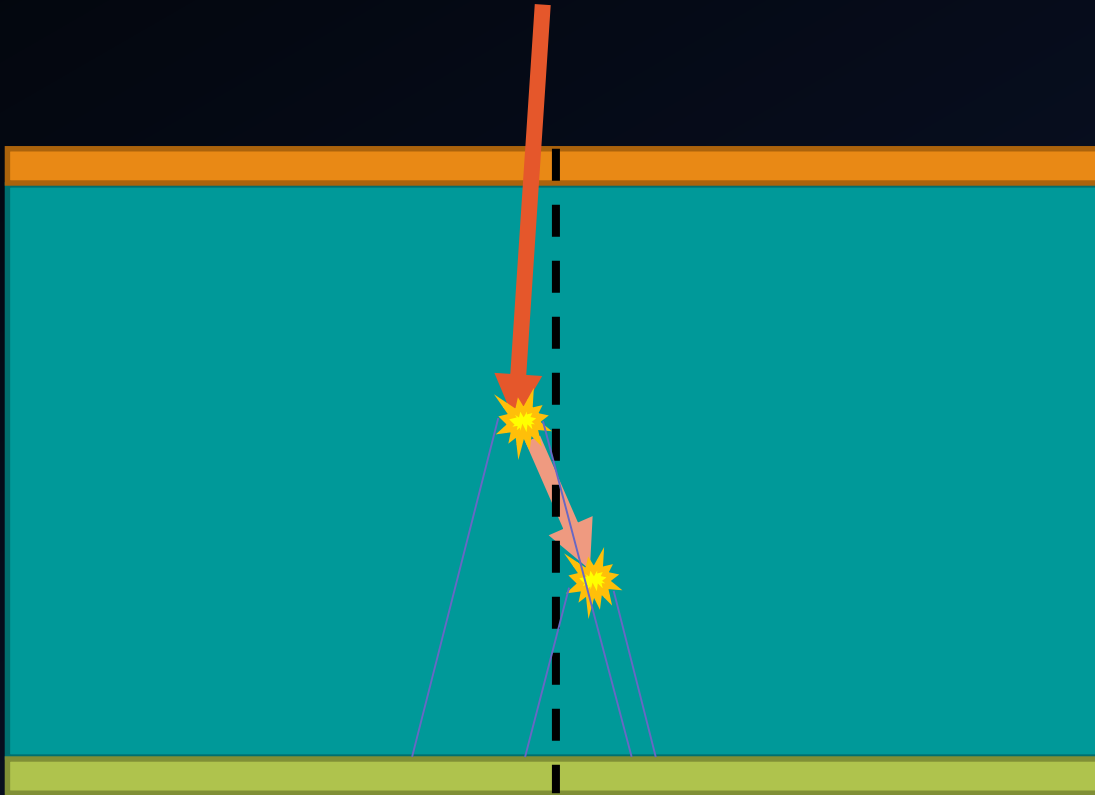


2. Charge sharing

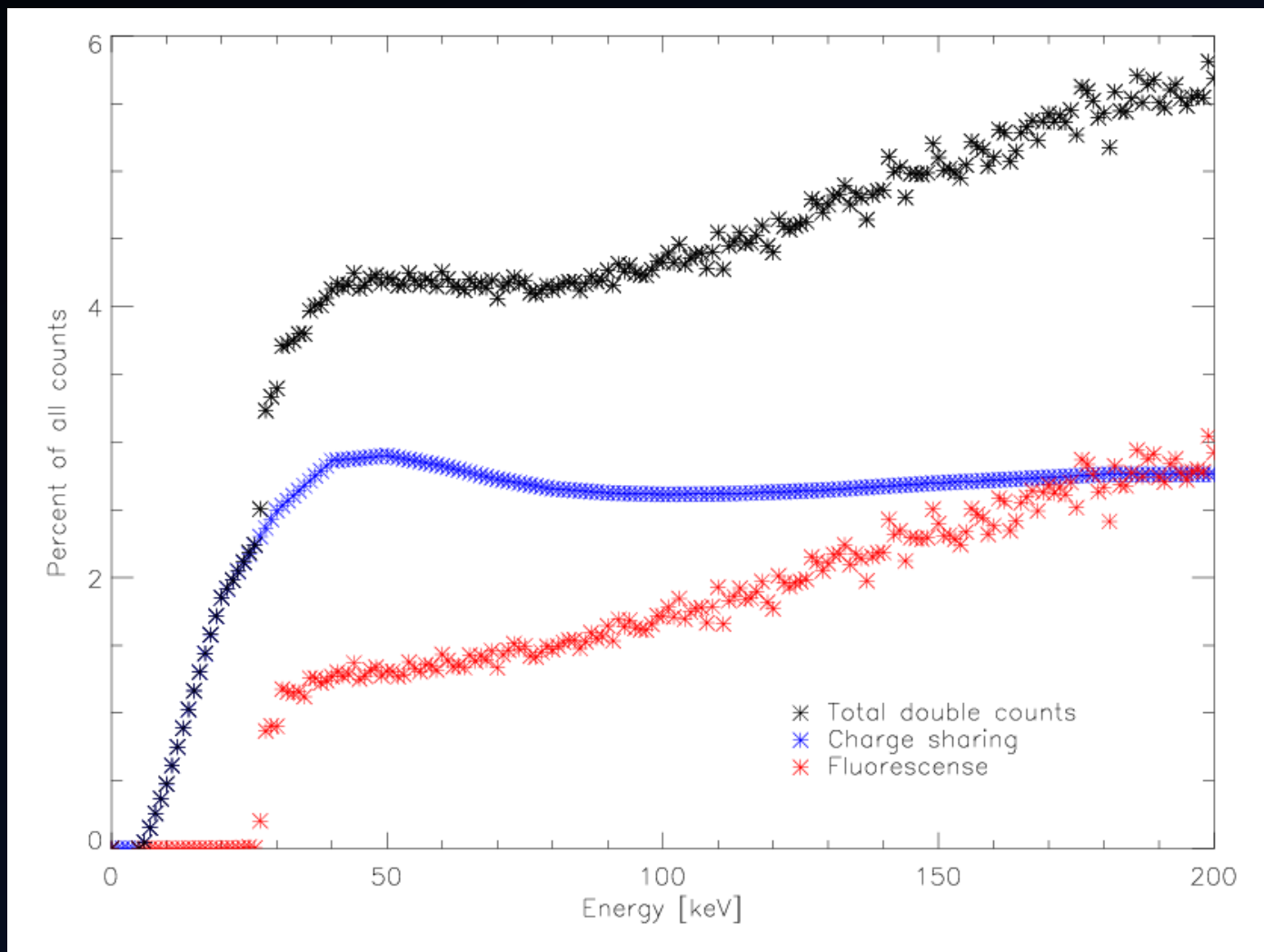


Particular case

- This cases are twice counted.
- We remove such cases from fluorescent double counts.



Total double counts





Thank you

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