implementation of a geometry with two sensors per layer

issue: overlapping volumes

Overlapping volumes from *wrappers*

Tim Rogoschinski

26.11.2020

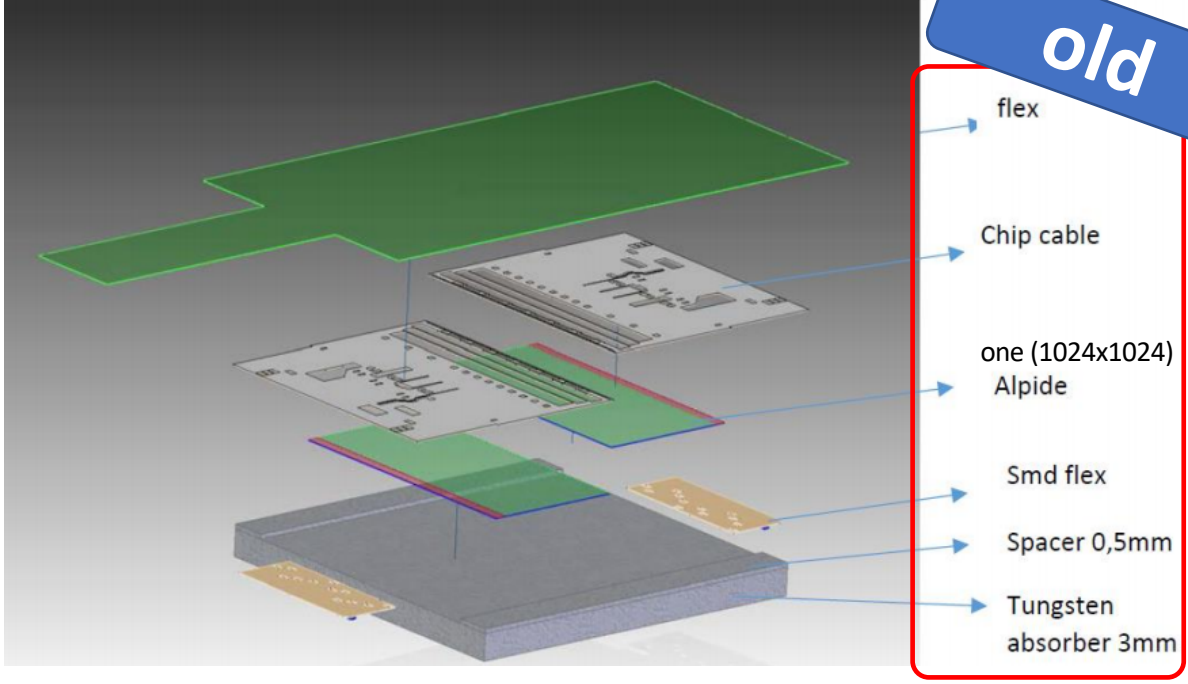
Current setup:
one big sensor

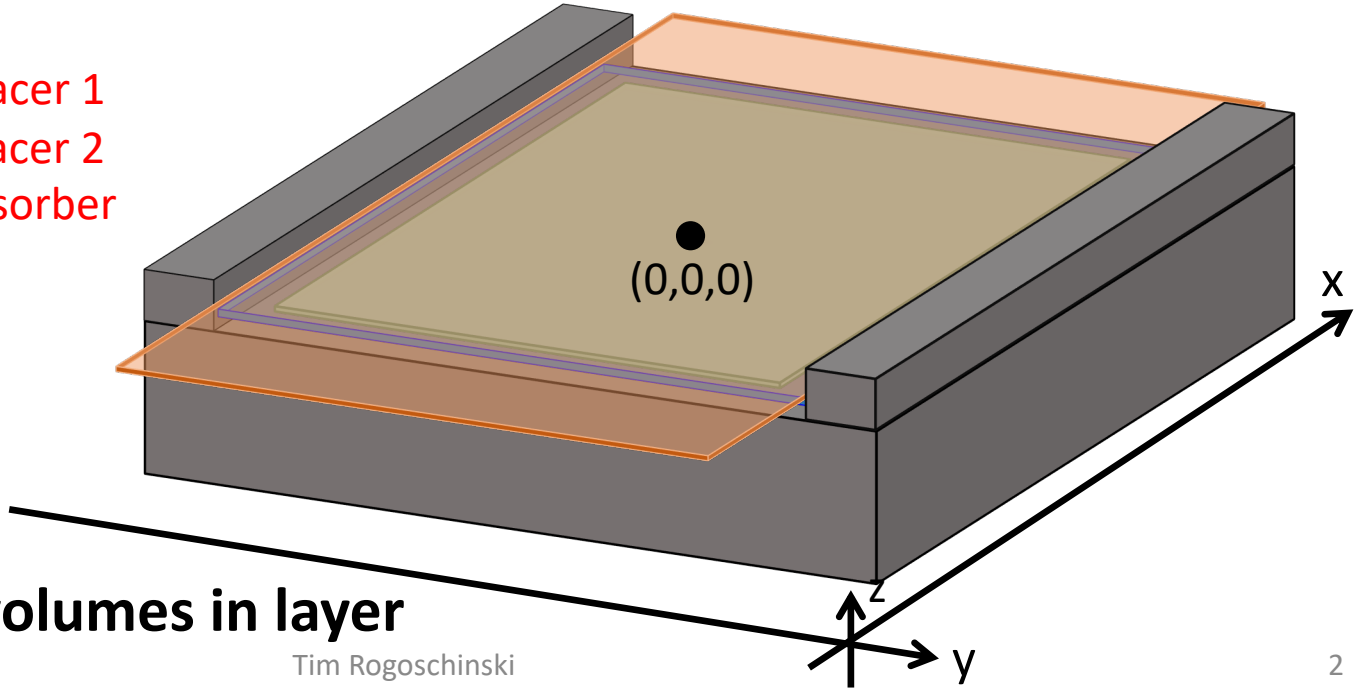
1) ALPIDE sensor

2)
[support] chip cable

3)
[support] flex cable

4)
[support] Tungsten spacer 1
[support] Tungsten spacer 2
[support] Tungsten absorber

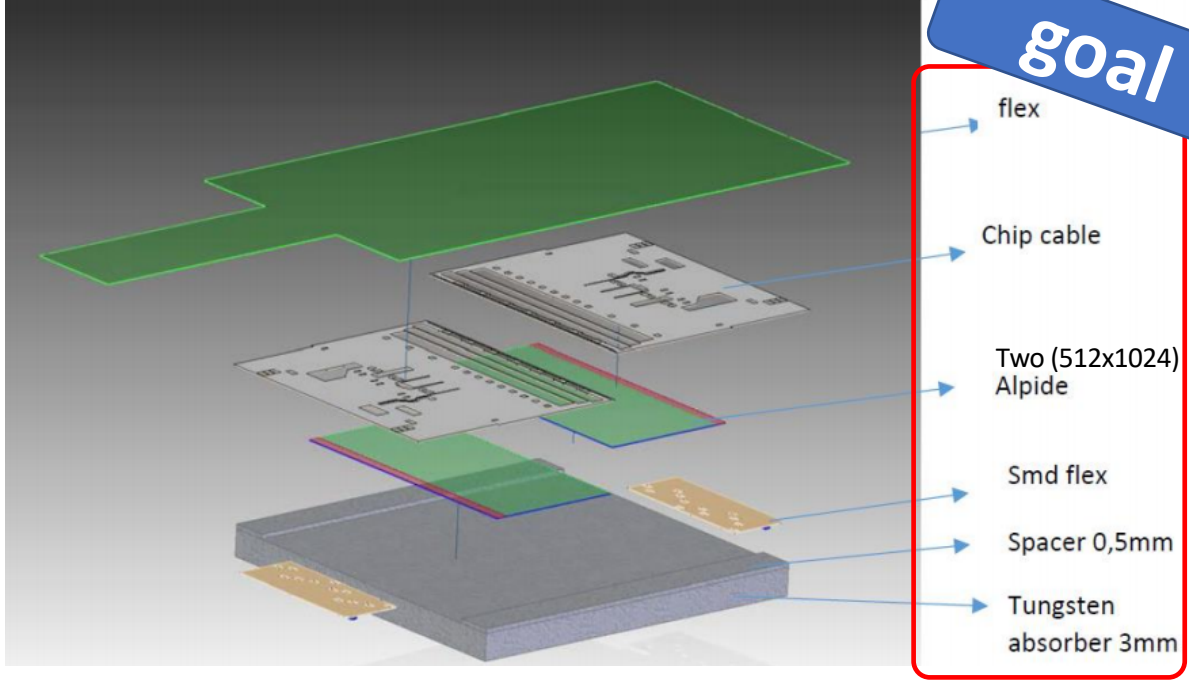


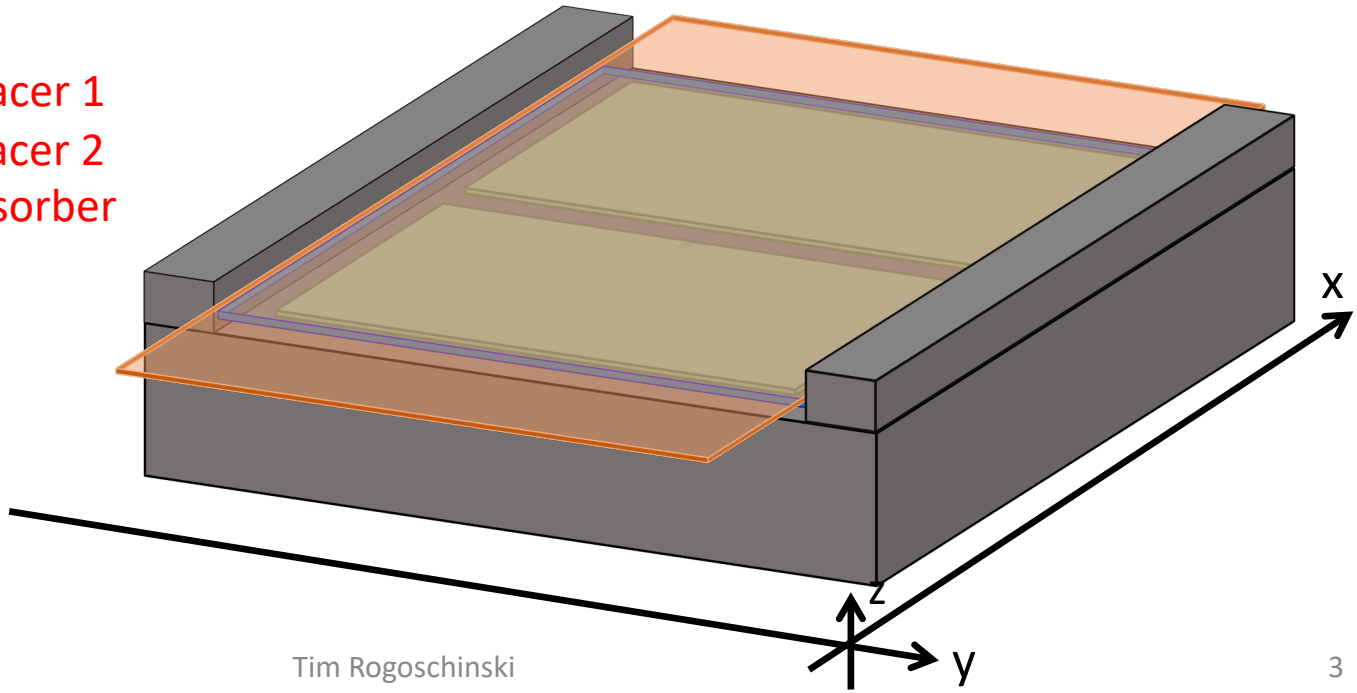


→ **No overlapping volumes in layer**

Goal setup:
two sensors

1) 2x ALPIDE sensor with gap
2) [support] chip cable
3) [support] flex cable
4) [support] Tungsten spacer 1
[support] Tungsten spacer 2
[support] Tungsten absorber





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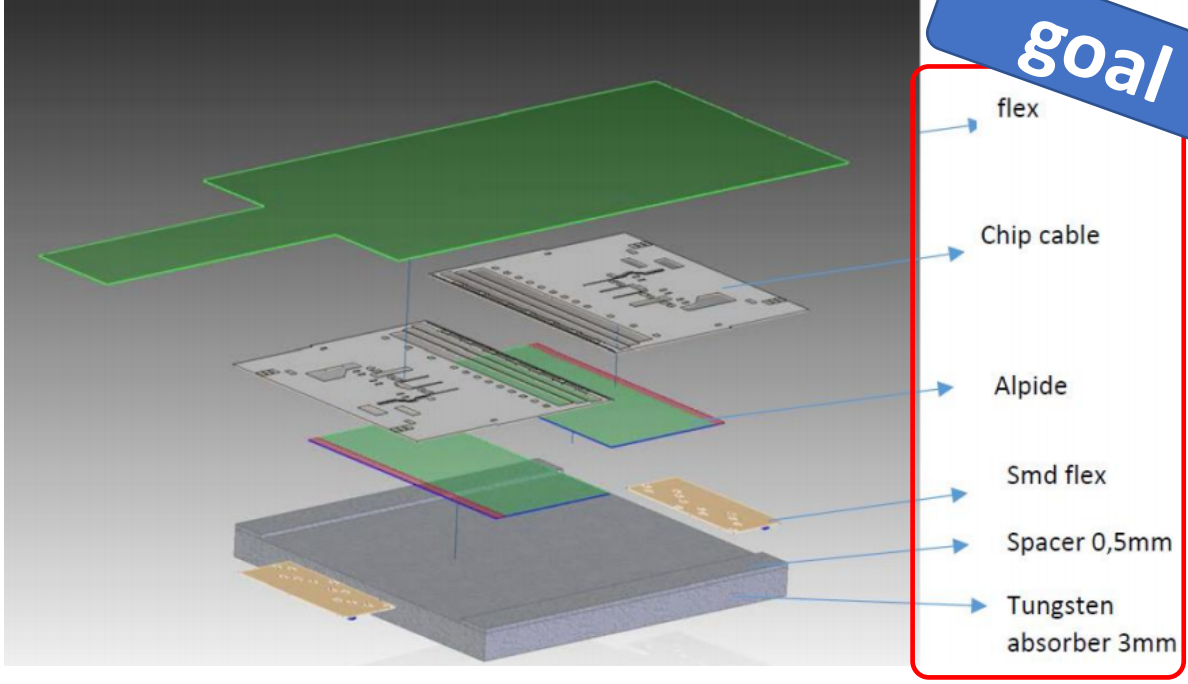
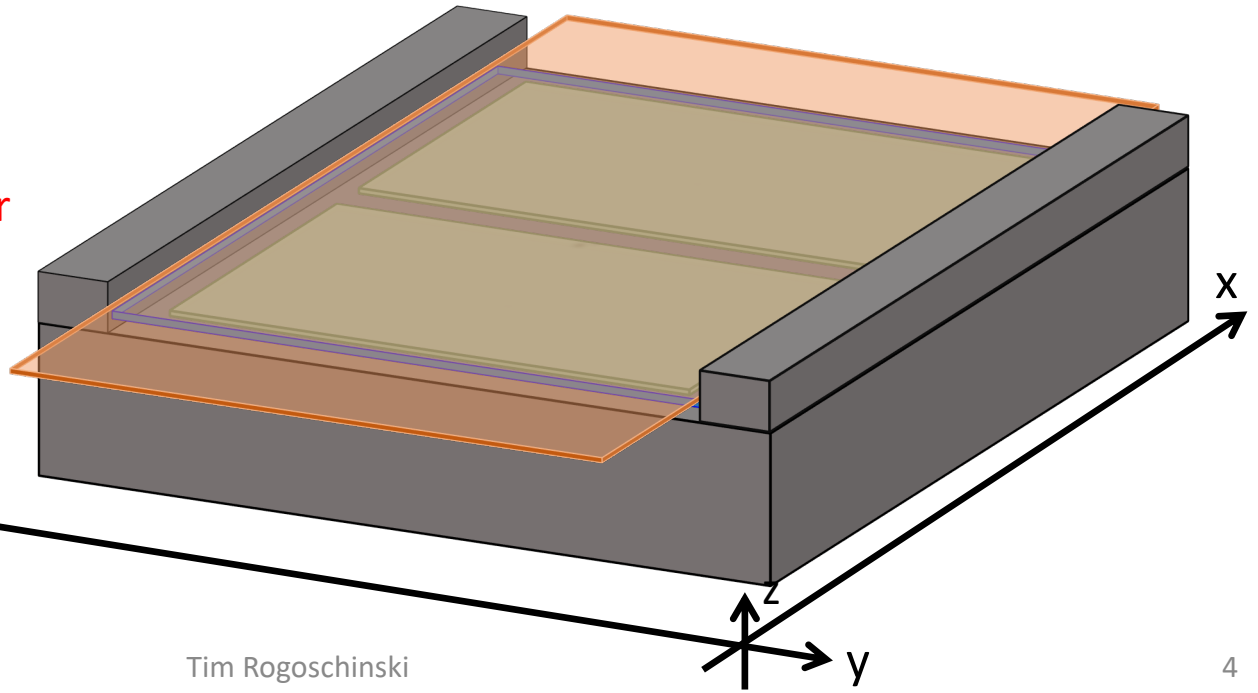
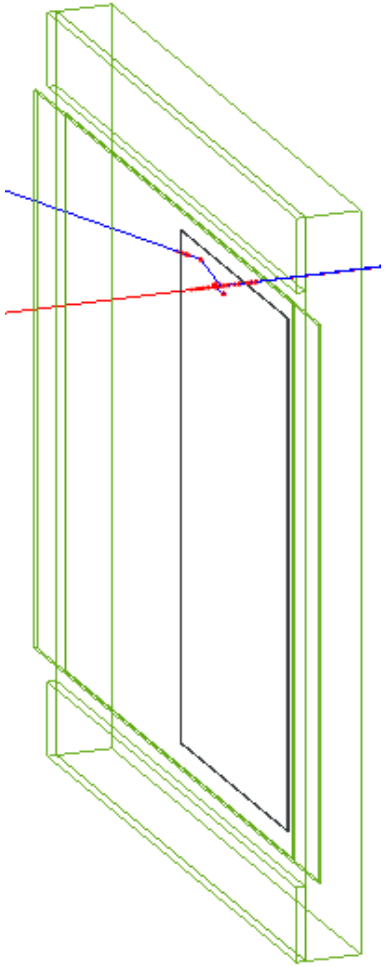




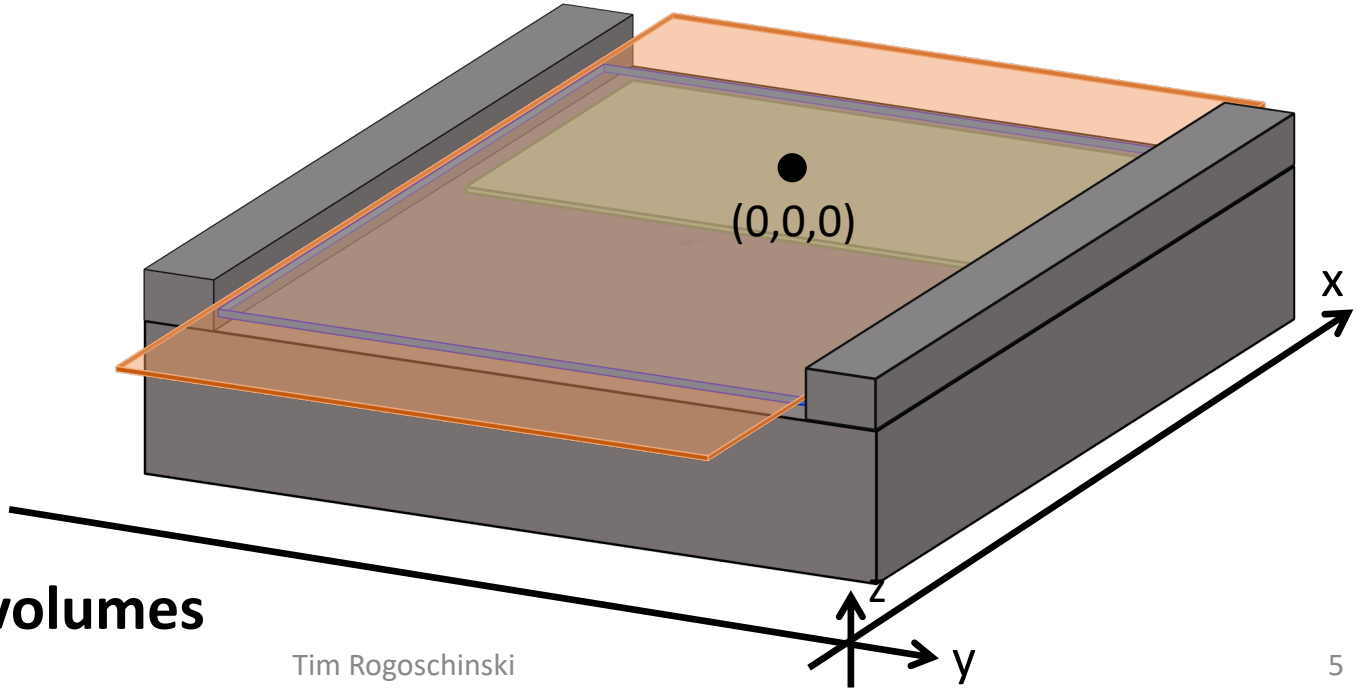
Only one sensor per layer is possible in allpix → 2 layers, shift one layer without support into the other with support structures

Start with one smaller sensor and shift support



type = "monolithic"
number_of_pixels = 512 1024
pixel_size = 29.24um 26.88um
implant_size = 3um 3um
chip_thickness = 5um

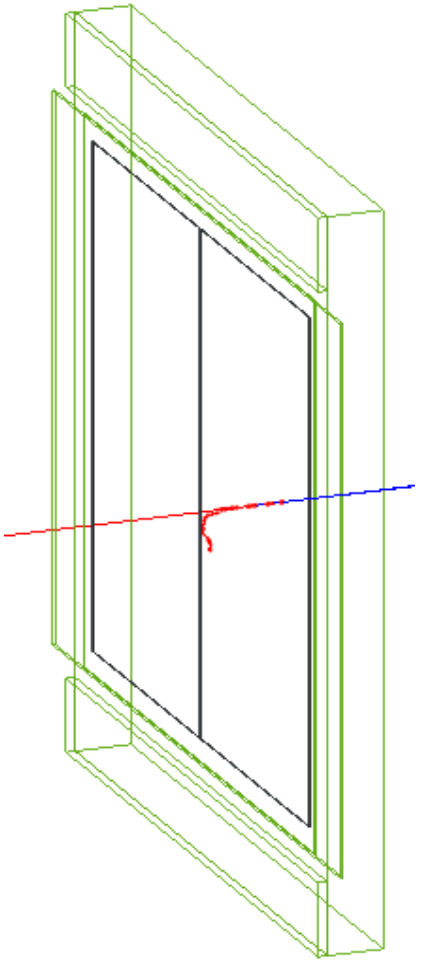
sensor_thickness = 50um
sensor_excess_right = 1208um
sensor_excess_left = 50um
sensor_excess_top = 30um
sensor_excess_bottom = 30um



→ **No overlapping volumes**

Add a second layer with the same sensor, but no support, rotate around z-axis by 180deg and shift

Shift second sensor in x-direction by:
-(512 x 29.24um + 50um +50um)



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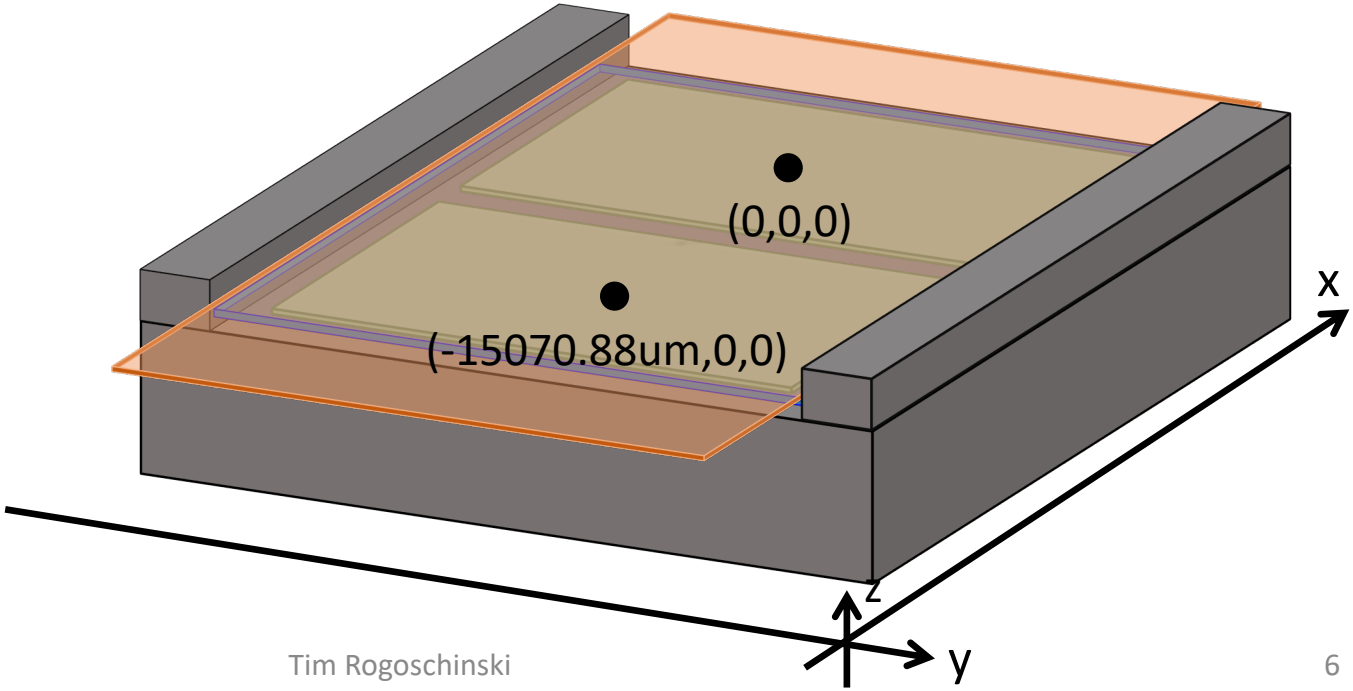

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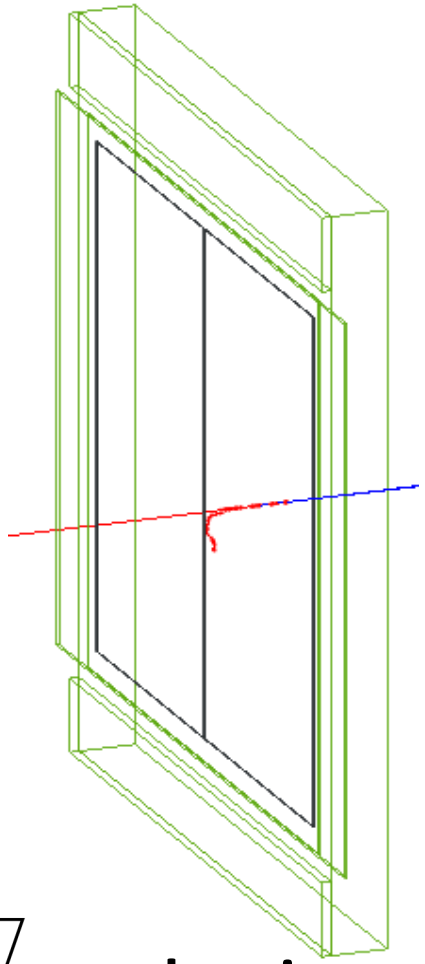
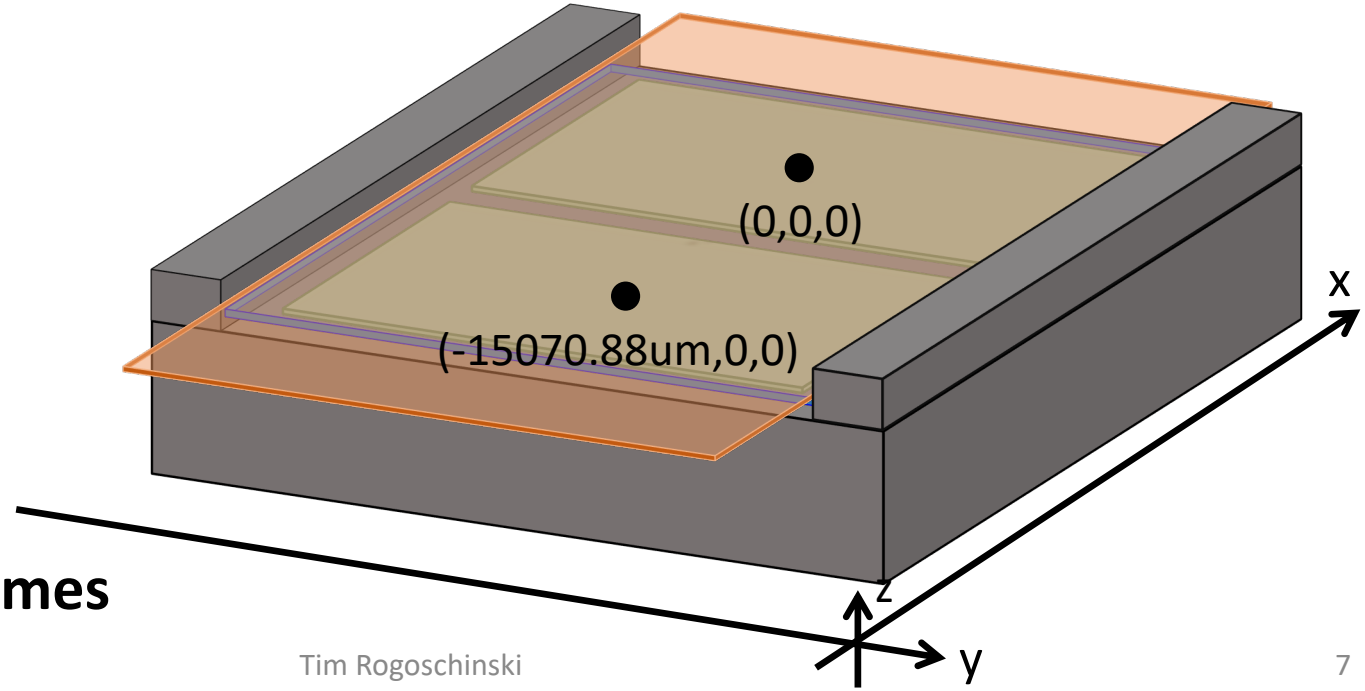


ERROR: Overlap with volume already placed !
Overlap is detected for volume
wrapper_layer1_phys:0 (G4Box) with
wrapper_layer0_phys:0 (G4Box) volume's
local point (-17.3678,10.5048,-1.25), overlapping by at least: 500 um



overlapping volumes

Idea to solve the issue:

Just two layers with one sensor each

→ *wrapper* dimension should be exactly of the size of the sensor

→ Add the support structures/cables in form of passive materials

Two sensors without support

Shift second sensor in x-direction by:
-(512 x 29.24um + 50um +50um)
= -15070,88um

type = "monolithic"
number_of_pixels = 512 1024
pixel_size = 29.24um 26.88um
implant_size = 3um 3um
chip_thickness = 5um

sensor_thickness = 50um
sensor_excess_right = 1208um
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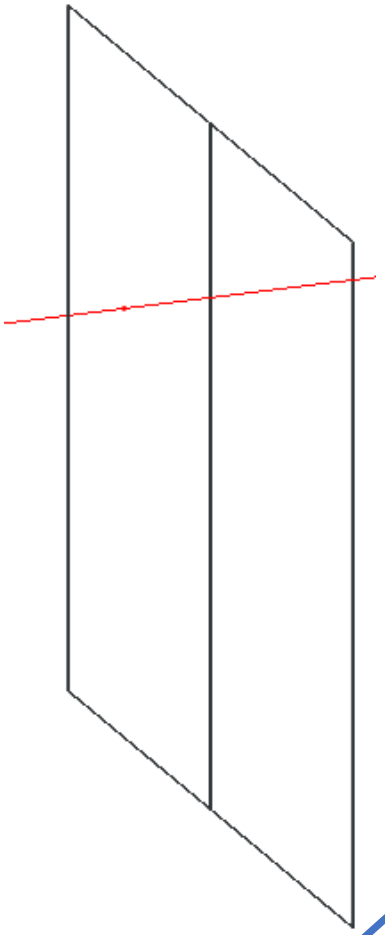
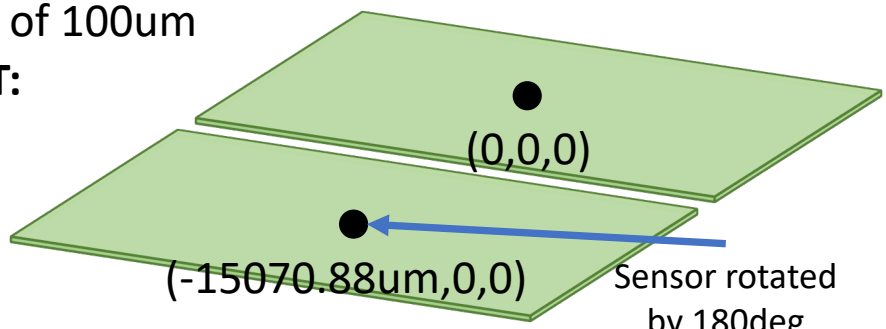
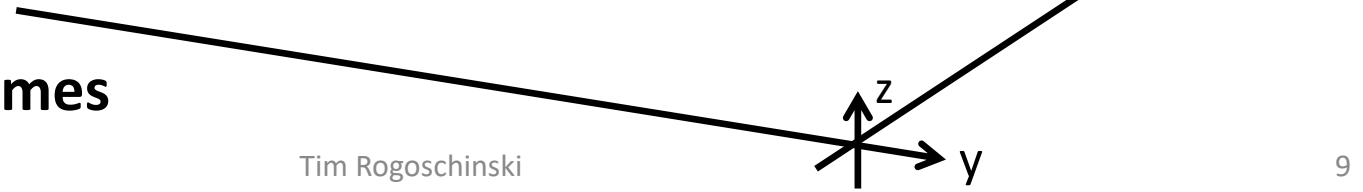


- Seems right for me, shift by the whole sensor size and two times the sensor excess right to account for the excess which would correspond to a gap of 100um
- **BUT:**





overlapping volumes

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sensor_excess_right = 1208um
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sensor_excess_bottom = 30um

GEANT4/Allpix Info:

Sensor dimensions:
(16.2289mm,27.5851mm,50um)
Wrapper dimensions of model:
(17.3869mm,27.5851mm,55um)
Chip dimensions:
(16.2289mm,27.5851mm,5um)

X-dimension:

Sensor dimension should be:
512x29,24um = 14,97088mm
In fact Allpix adds the sensor excess left and right
512x29,24um+1208um+50um = 16,22888mm
Wrapper dimension should be
512x29,24um+1208um+50um = 16,22888mm
In fact Allpix adds two times excess right
512x29,24um+1208um+1208um = 17,38688mm

Overlap due to wrapper dimension being lager than the sensor size + excess

Y-Dimension:

Sensor dimension should be:
1024x26,88um=27,52512mm
In fact Allpix adds the sensor excess top and bottom
1024x26,88um+30um+30um = 27,58512mm

Two sensors without support

Shift second sensor in x-direction by:
-(512 x 29.24um + 50um +50um)
= -15070,88um

type = "monolithic"
number_of_pixels = 512 1024
pixel_size = 29.24um 26.88um
implant_size = 3um 3um
chip_thickness = 5um

sensor_thickness = 50um
~~sensor_excess_right = 1208um~~
~~sensor_excess_left = 50um~~
sensor_excess_top = 30um
sensor_excess_bottom = 30um

GEANT4/Allpix Info:

Sensor dimensions:
(14.9709mm,27.5851mm,50um)
Wrapper dimensions of model:
(14.9709mm,27.5851mm,55um)
Chip dimensions:
(14.9709mm,27.5851mm,5um)

Options:

1) Understand how allpix defines the wrapper dimensions and change it
2) Use setup without excess and add a passive material (silicon) between the two sensors as excess

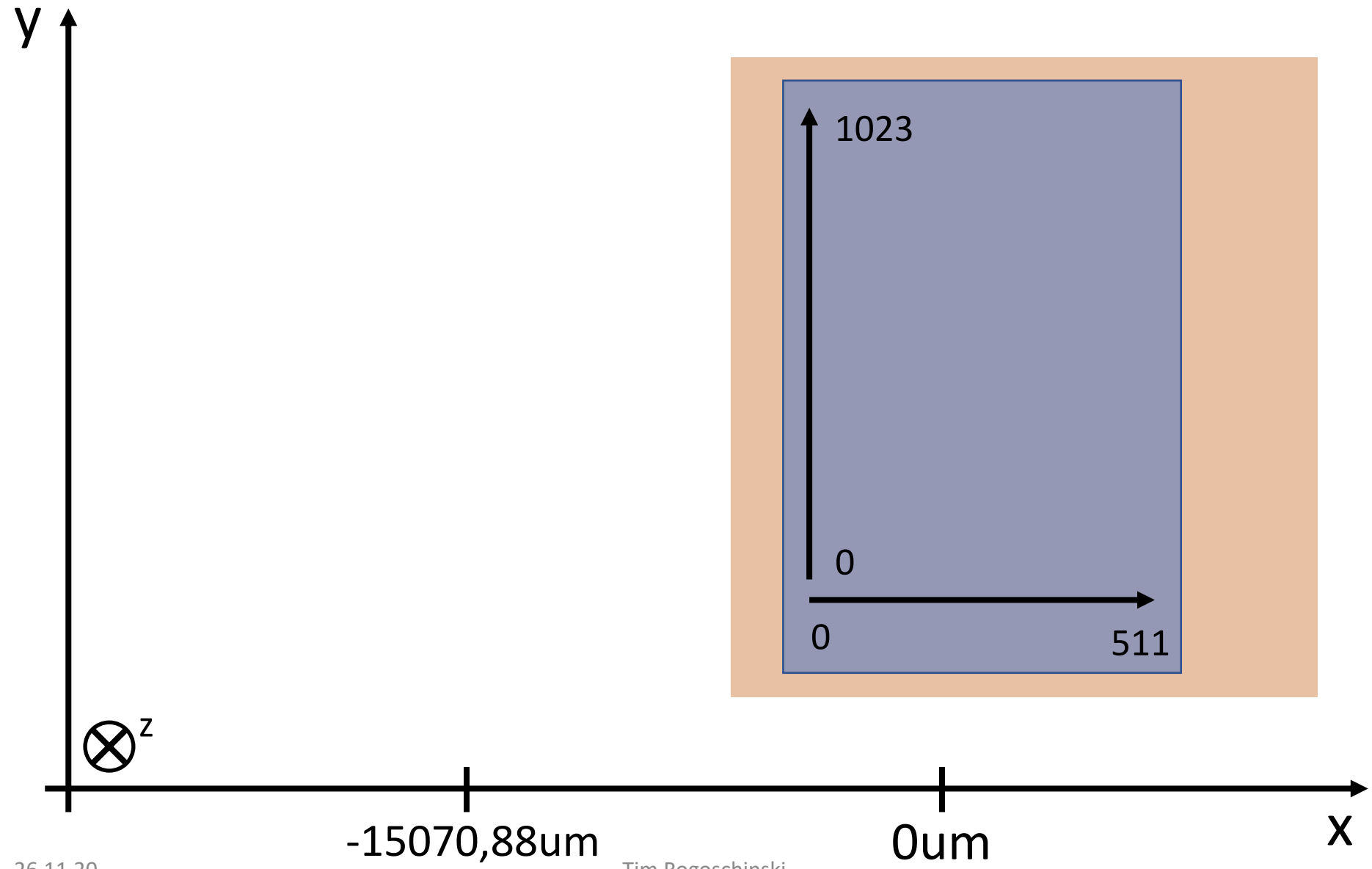
X-dimension:

Sensor dimension should be:
512x29,24um = 14,97088mm
Now the sensor dimension is correct
512x29,24um = 14,97088mm
Wrapper dimension should be
512x29,24um = 14,97088mm
Now Wrapper dimension is right
512x29,24um = 14,97088mm

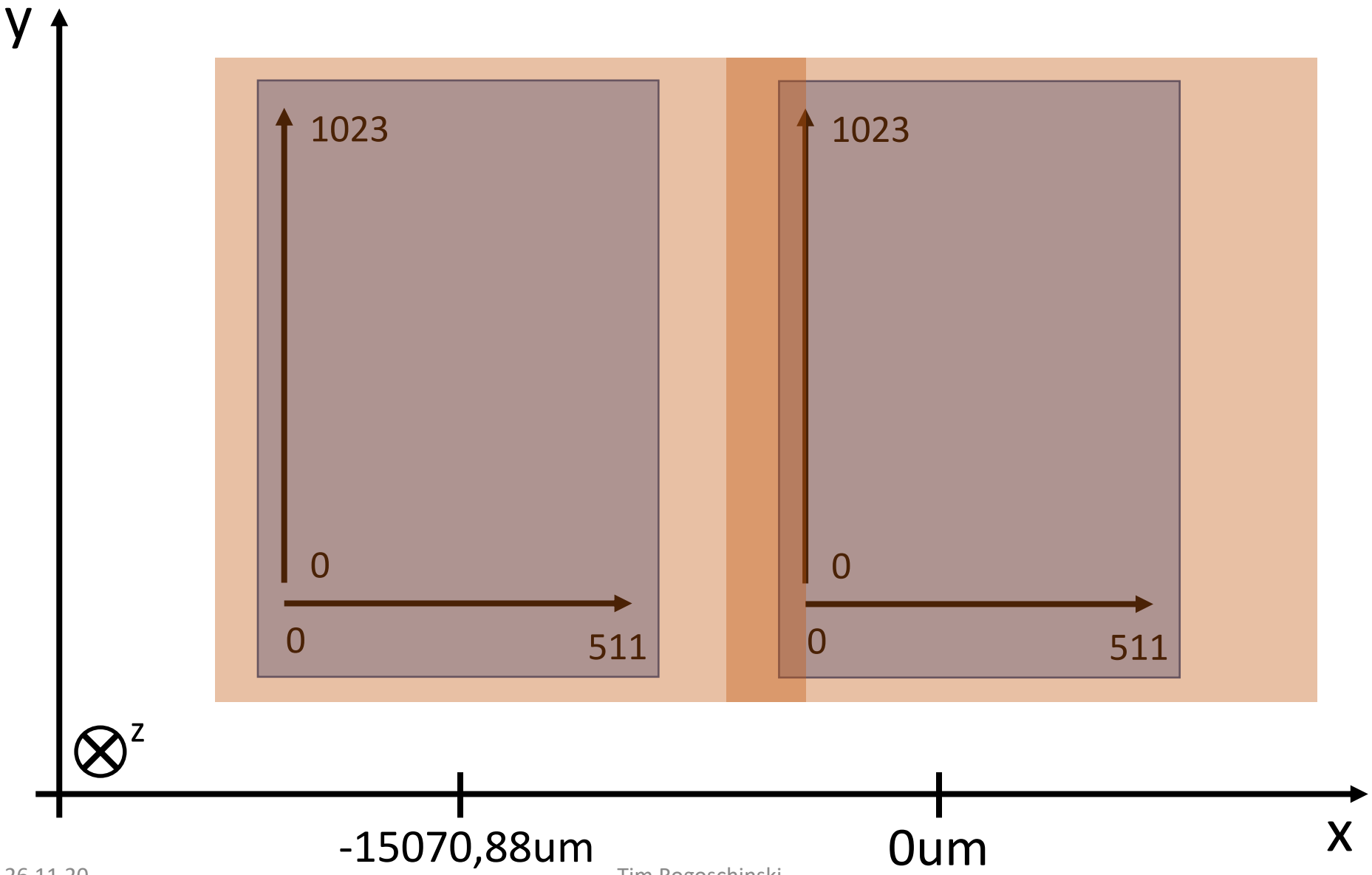
Y-Dimension:

Sensor dimension should be:
1024x26,88um=27,52512mm
In fact Allpix adds the sensor excess top and bottom
1024x26,88um+30um+30um = 27,58512mm

Pixel-matrix in the setup: first sensor

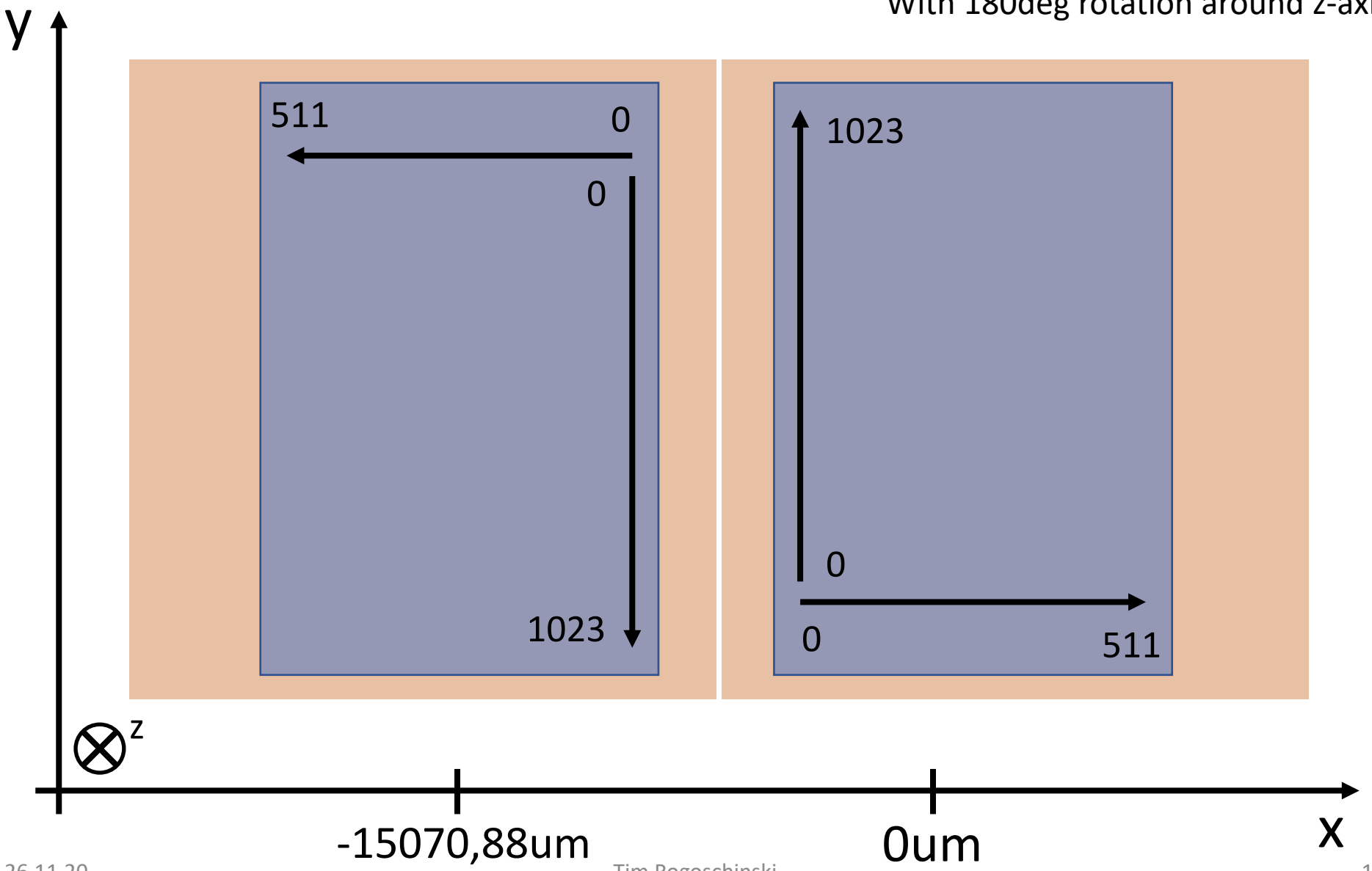


Pixel-matrix in the setup: second sensor



Pixel-matrix in the setup: second sensor

With 180deg rotation around z-axis



Pixel-matrix in the setup: second sensor

→ Allpix output-format fits TB-data format

With 180deg rotation around z-axis