

Dutch Photonics Event 2024

# ACCURATE ALIGNMENT SYSTEM FOR PHOTONIC BASED BIOSENSOR CARTRIDGES

Cas Damen



# Diagnostic point-of-care testing



Image from: <https://www.healthdirect.gov.au/urine-tests>



Image from [Ian Humes/Flickr, CC BY-NC-ND](#)

Specifics:

- Use photonic sensor chips
- Disposable cartridge
- Easy to use
- Low-Cost



Image from [https://www.bd.com/assets/images/our-products/microbiology-solutions/veritor-plus-system\\_RC\\_DS\\_DT\\_1116-0001.png](https://www.bd.com/assets/images/our-products/microbiology-solutions/veritor-plus-system_RC_DS_DT_1116-0001.png)

# Consortium

2 Research Groups Saxion

1 University

9 Companies

2 Branche organisations



DELTA  
DIAGNOSTICS

HUYGENS ENGINEERS



SALLAND Engineering  
*Test Technology Center*



Quirin BV



PHOTONICS ASSEMBLY



TAKING YOU  
STEPS AHEAD



UNIVERSITY OF TWENTE.

SURFIX  
*diagnostics*



SIA

Regieorgaan

MinacNed

Association for Microsystems and Nanotechnology



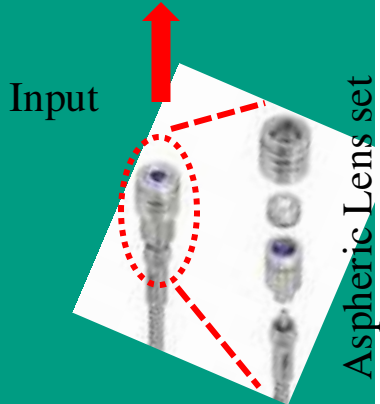
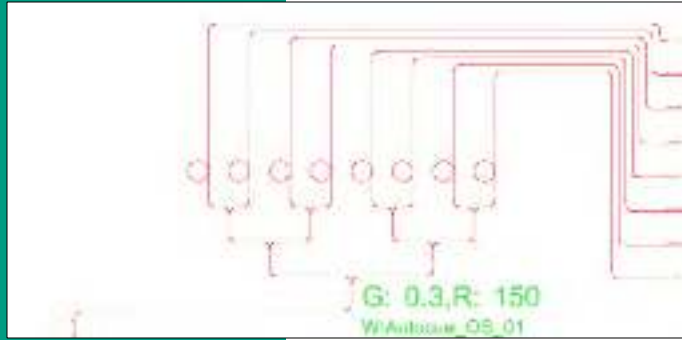
PhotonicsNL

Choice:

Active components not  
in cartridge  
→  
accurate alignment  
required

# AutoCUE project



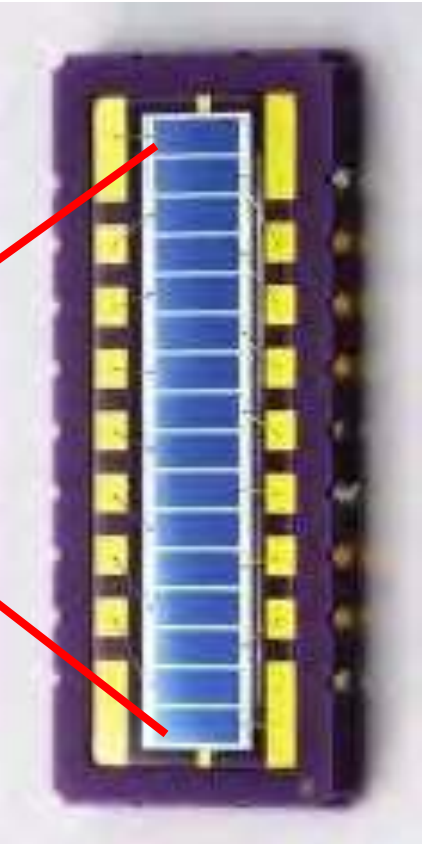


High Accuracy Needed

Low Accuracy Needed



3.2 times magnification imaging system



Hamamatsu s8558 Si PIN photodiode array

# Concept

# Two stage

Passive Alignment

Active Alignment

Design of cartridge  
and acceptor

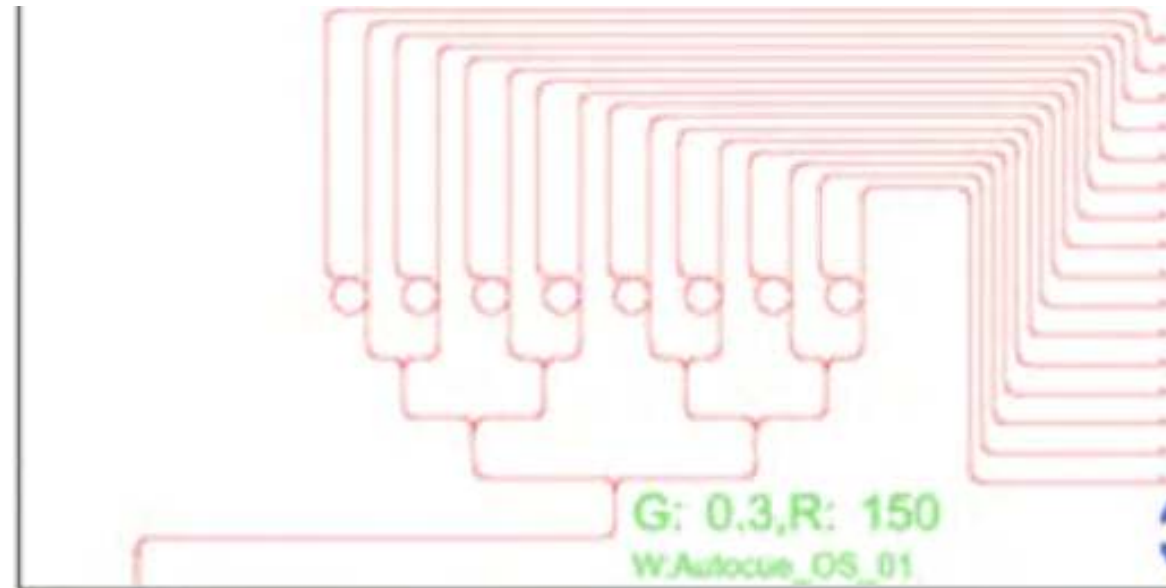
Design of stage  
and algorithms

First light

Measurement

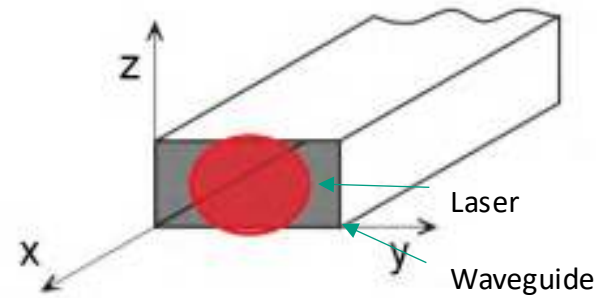
Which accuracy is needed

# Photonic Chips



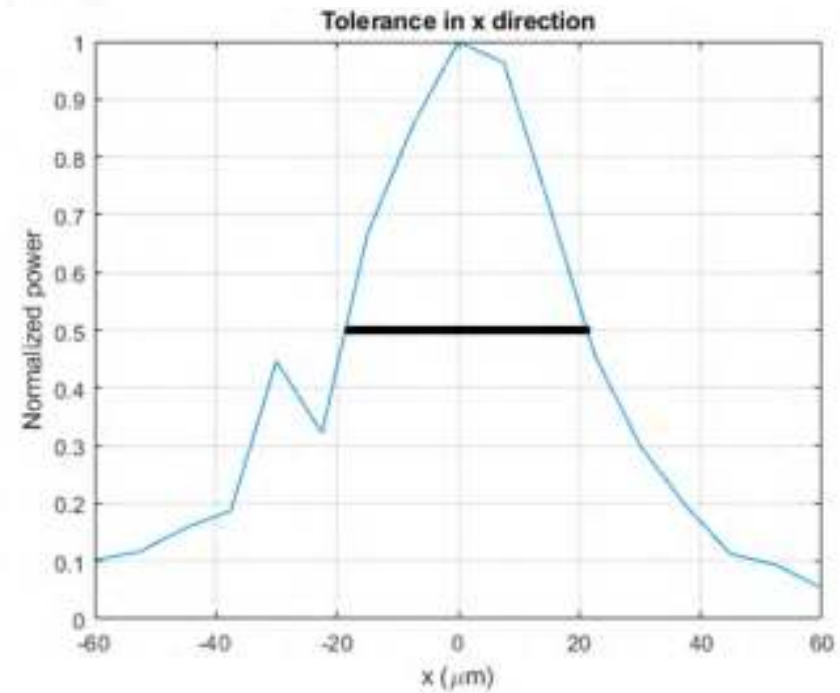
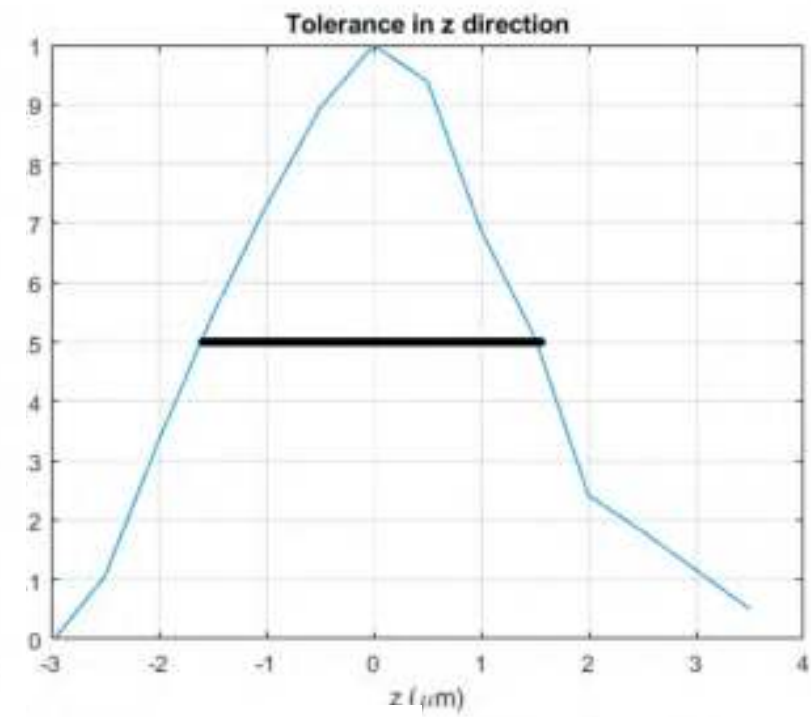
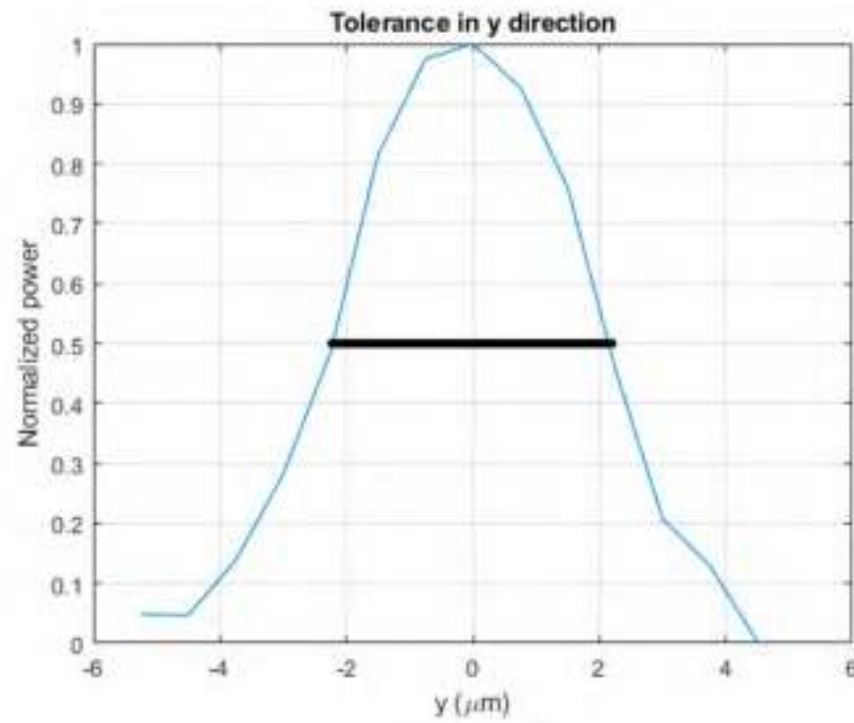
Which accuracy is needed

# Alignment tolerances for optical coupling between lens and laser



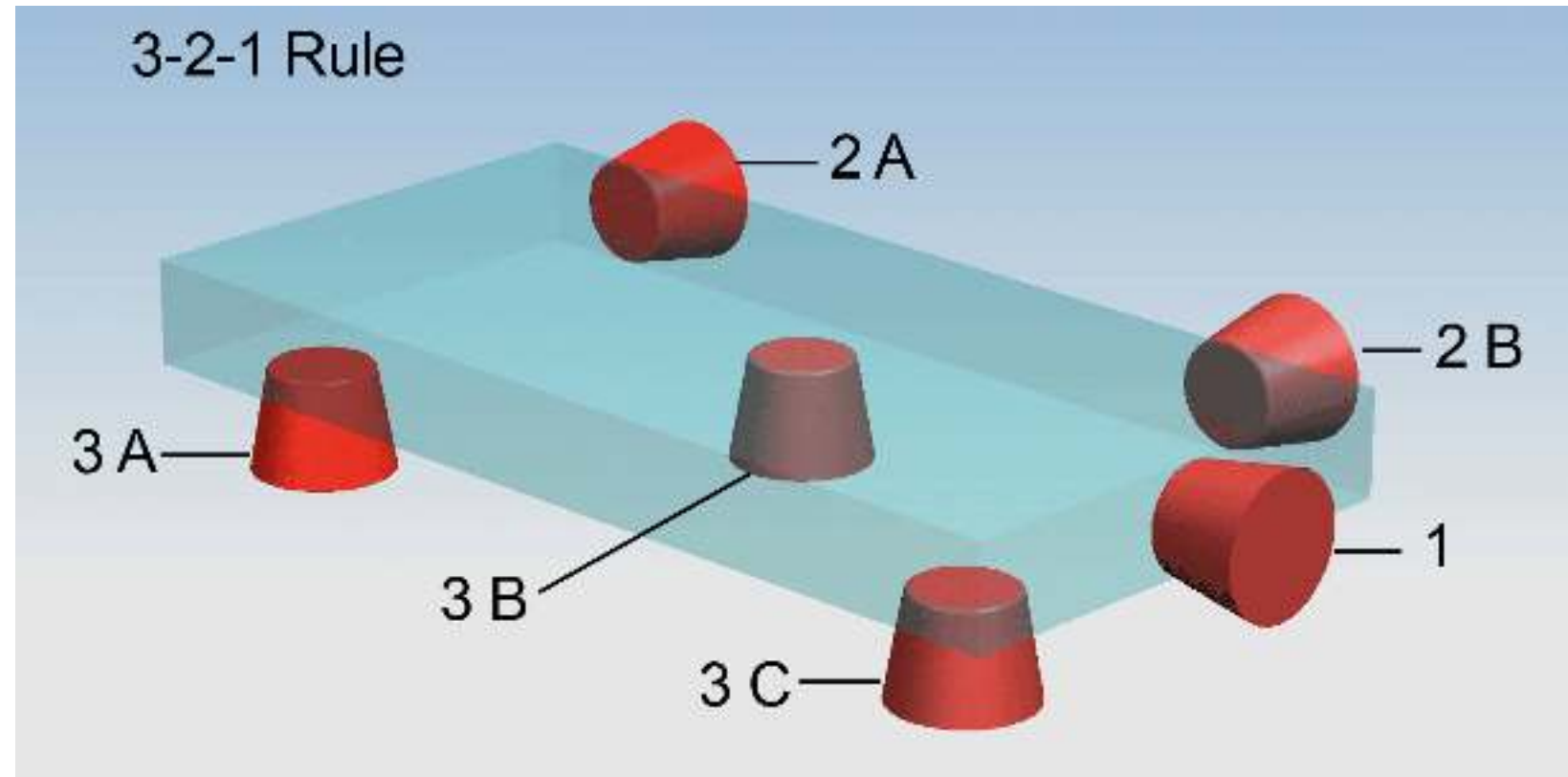


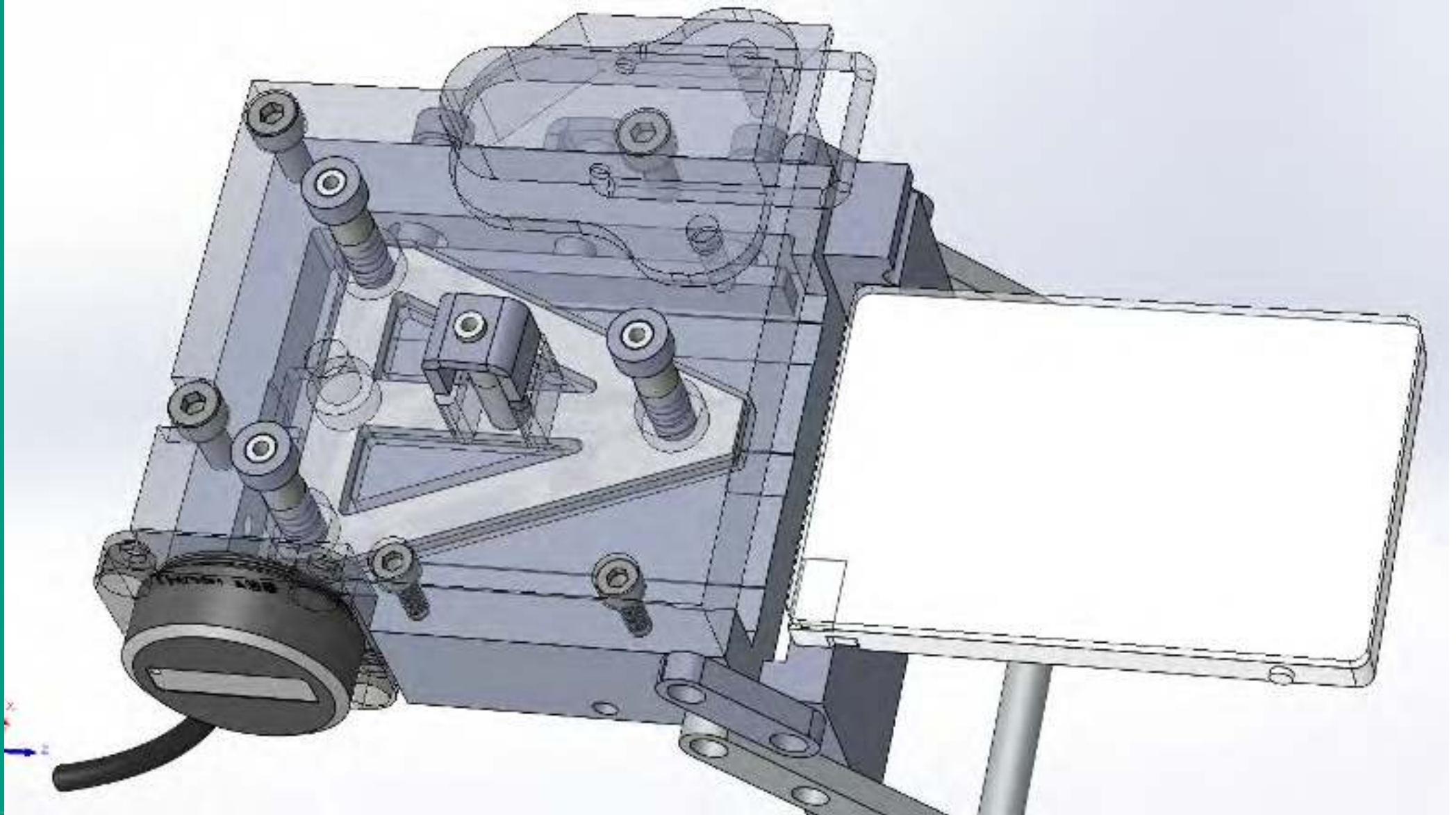
# Which accuracy is needed



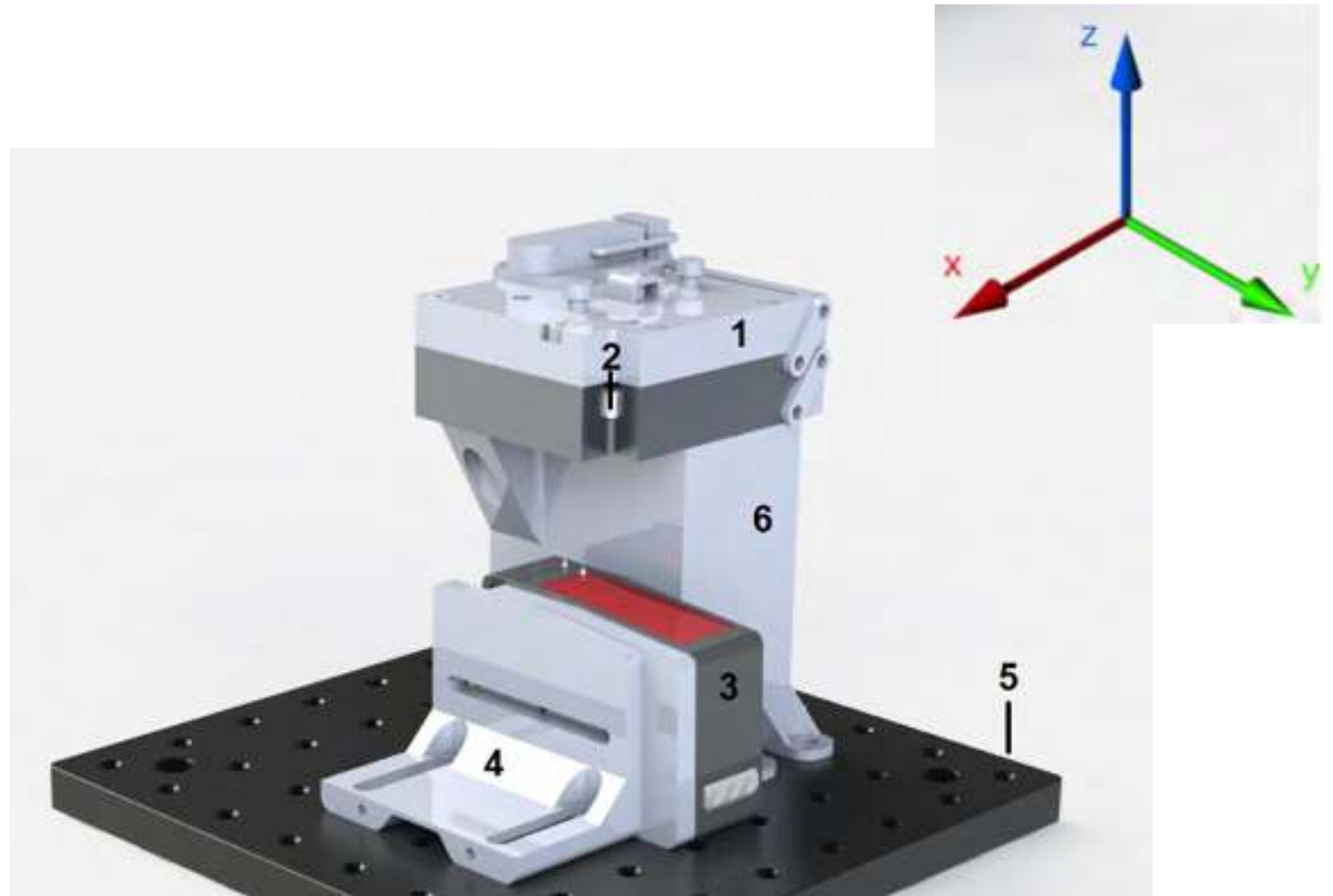
How to achieve the accuracy by passive alignment of cartridge?

# 3-2-1 positioning





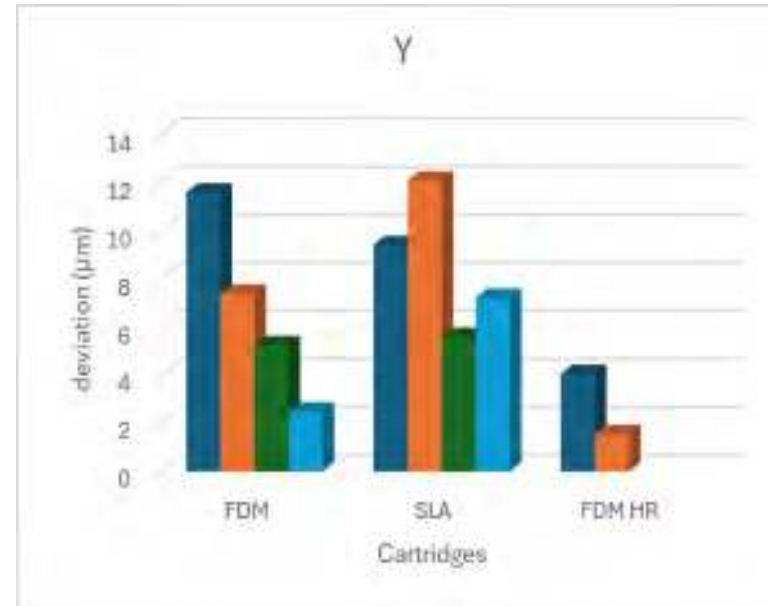
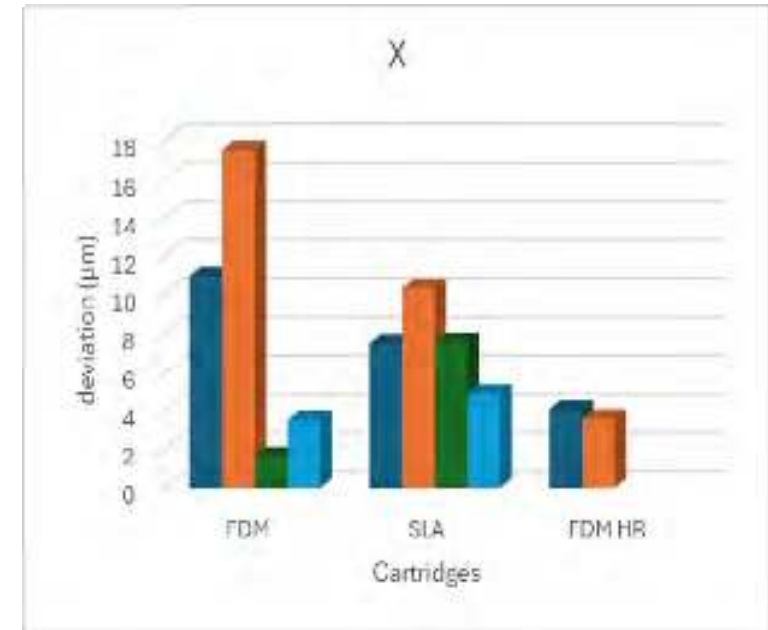
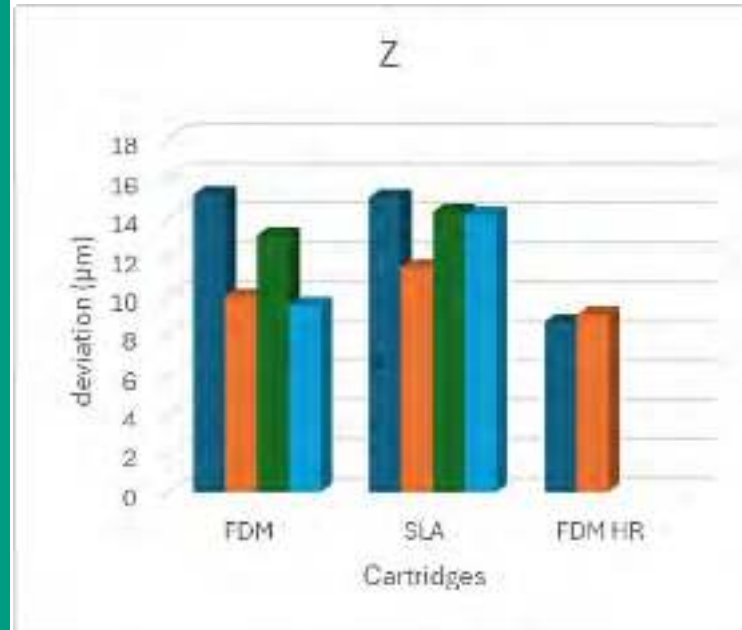
Which accuracy is achieved



# Results

- Depending
  - Production method
  - Material
    1. FDM generic (4x)
    2. SLA generic (4x)
    3. FDM high resolution (2x)

## Re-insertion deviation



## Results cartridges

FDM High Resolution performed the best.

Best FDM High Resolution cartridge (value in  $\mu\text{m}$ )

	Deviation	FWHM
x	3,59	40
y	1,57	4
z	9,02	3

Note: Highly depending on the production method of the cartridge to get close to first light.

# Active alignment



# WP4 Active Alignment

Labview

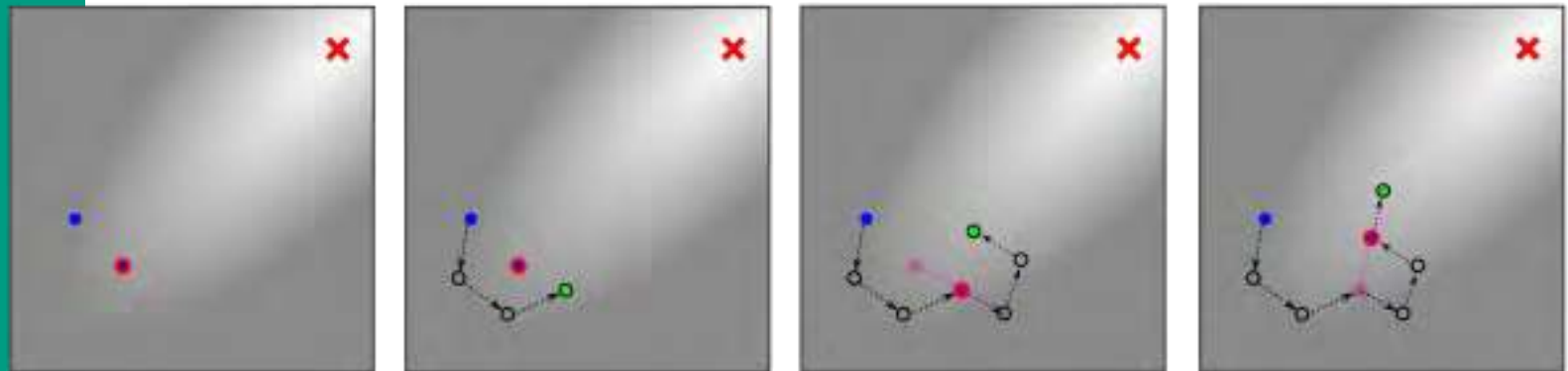
## Demonstration and research

Newport translation stage MLT25 (XYZ)

Light source Thorlabs 850 nm

PM101 Thorlabs power meter

Spiral Algorithm





Microsoft Edge  
Spatial Experiments Platform Steps

File Edit View Project Operate Tools Window Help

XY Graph

Spin in

Spin out

Done?

Next setpoint

X	-0.007
Y	0.58102
Z	0.28225

Optical Power: 7561.49 mW

Cursor	X	Y
Cursor 0	1.04130	0.71264

Input in this window

item	code
<input checked="" type="checkbox"/>	<input type="text"/>

source

Output out

item	code
<input checked="" type="checkbox"/>	<input type="text"/>

source

Demo Video AutoCue

Camera

00:00

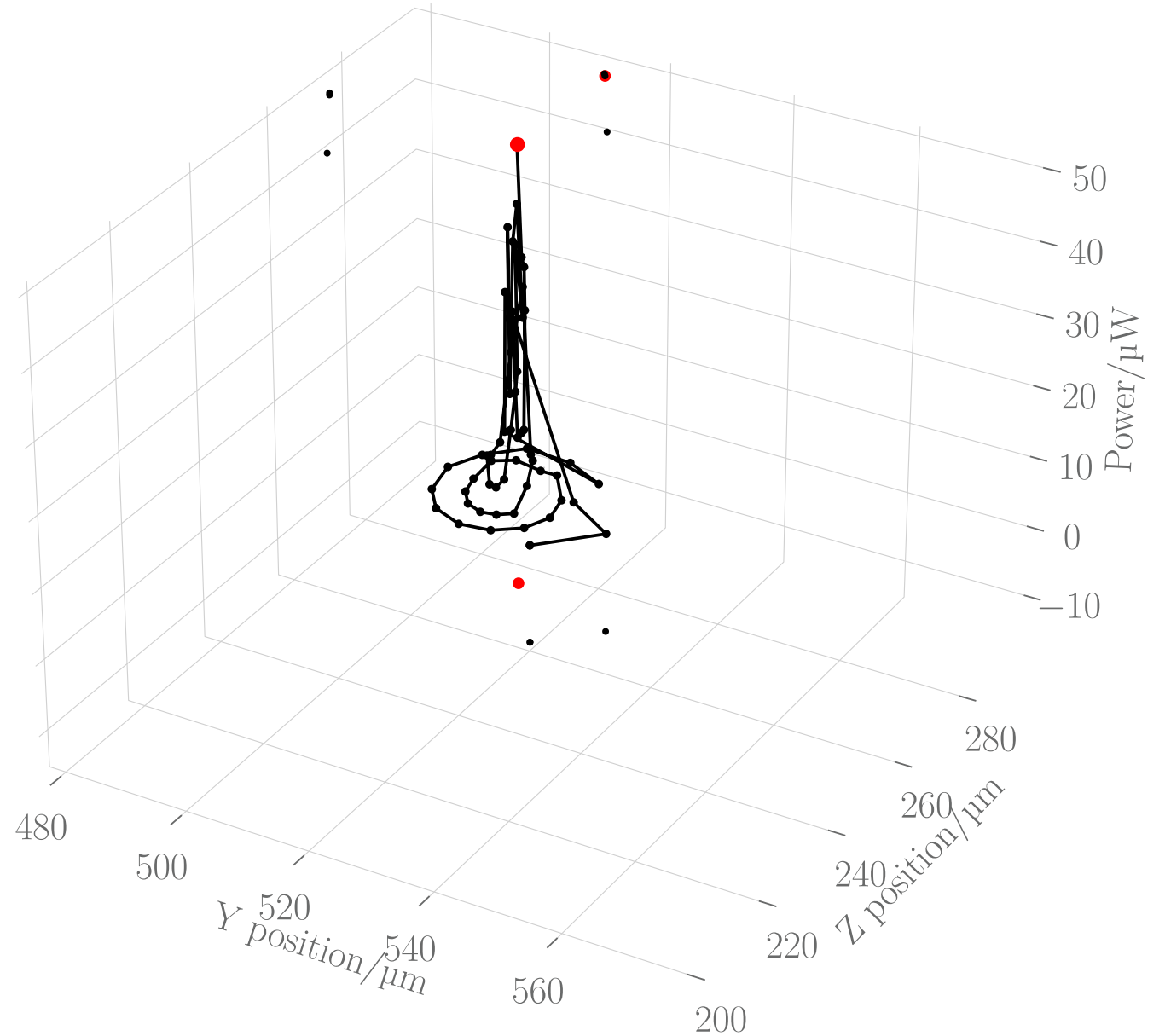
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00:00

# Measurement set 7

## Active alignment

- Initial MAP of a 100x100  $\mu\text{m}$  area
- Followed by a spiral algorithm



# Repeatability

Repeatability: 10 insertions, 1 cartridge

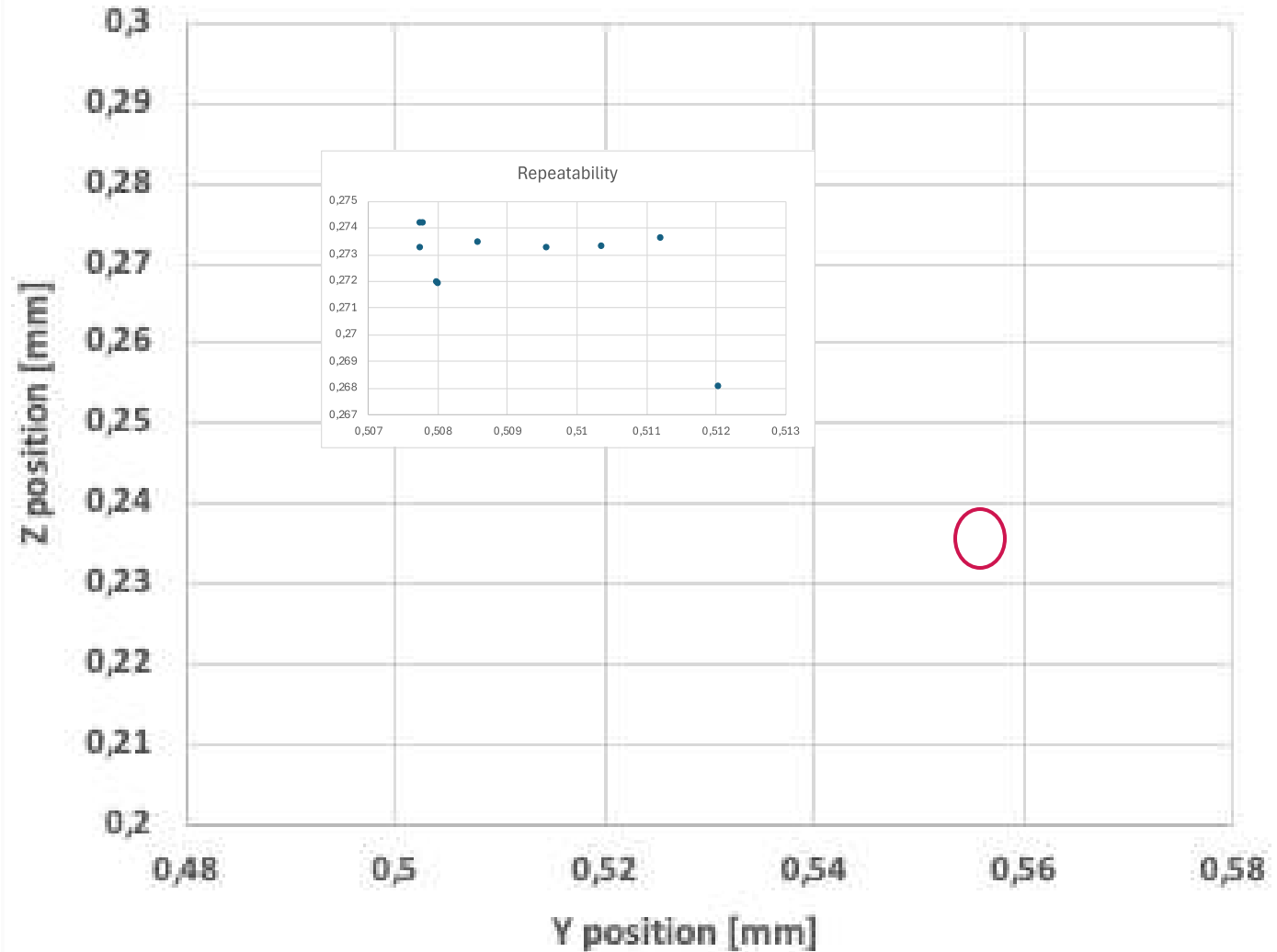
Y-deviation: 1.6  $\mu\text{m}$

Z-deviation: 1.8  $\mu\text{m}$

Y-deviation: 1.3  $\mu\text{m}$

Z-deviation: 0.8  $\mu\text{m}$

Repeatability spot location spiral [mm]



Questions ?

Contact: [c.a.j.damen@saxion.nl](mailto:c.a.j.damen@saxion.nl)



Please also visit the demonstrator setup