TEST TARGET FOR BEACON ALIGNMENT IN OGS

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Scenario

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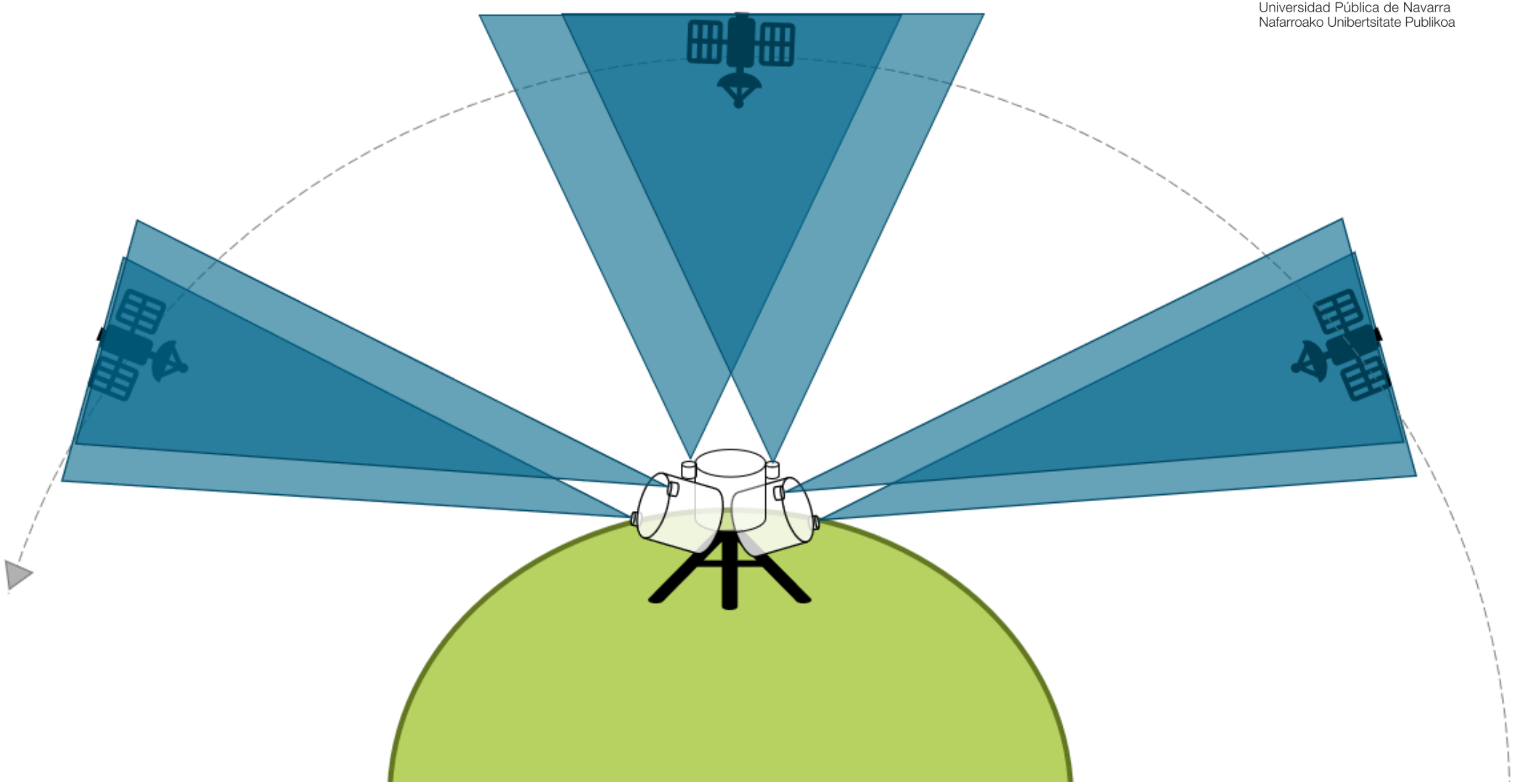

Beacon Adjustment: Direction adjustment

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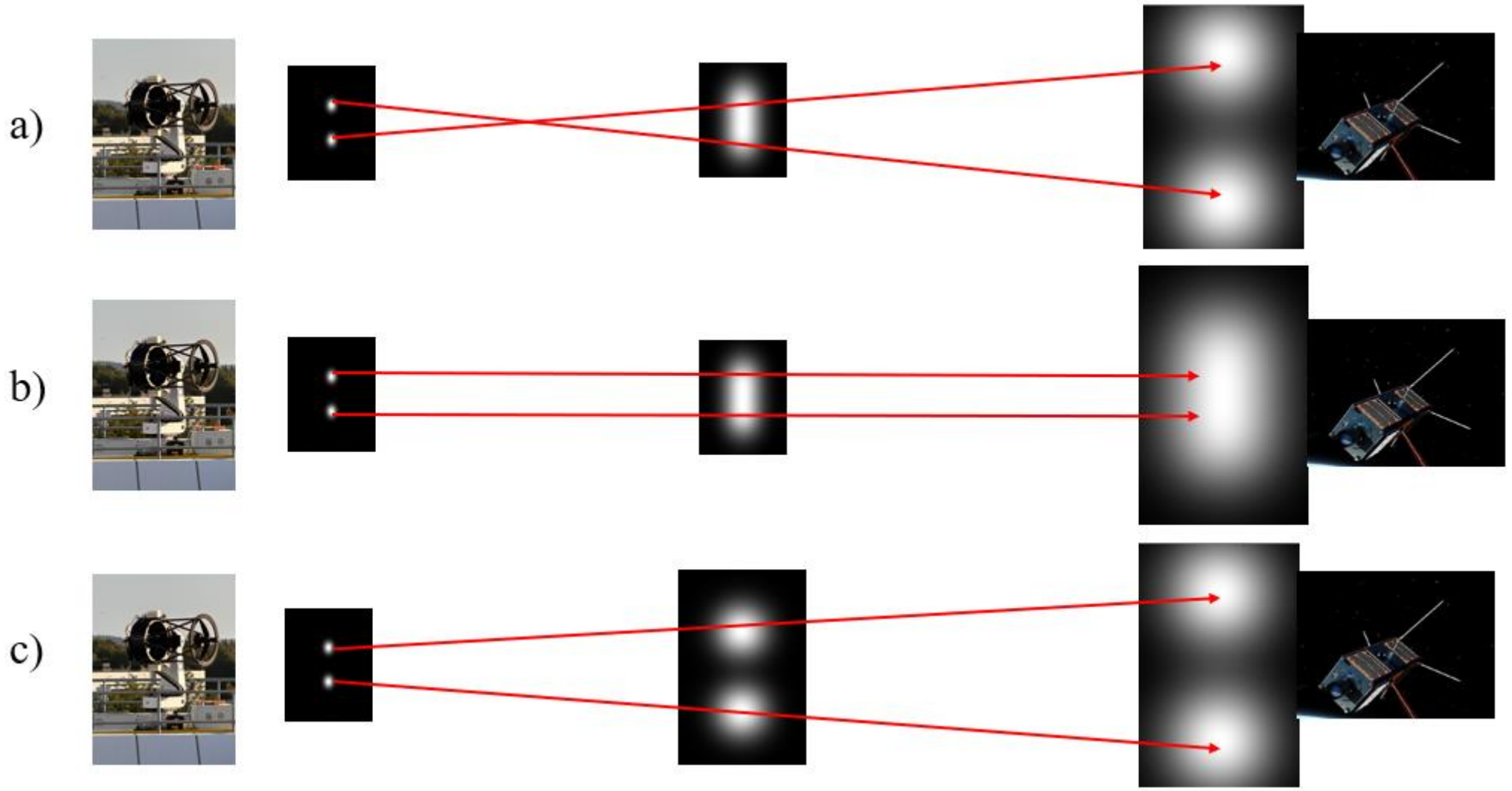
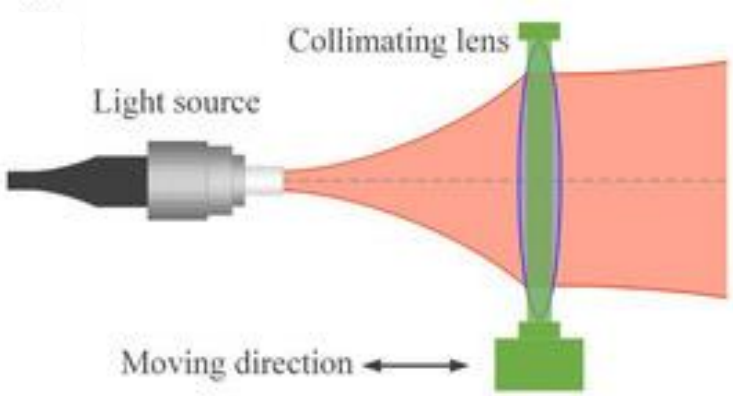
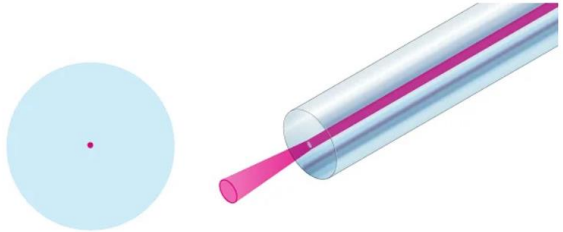
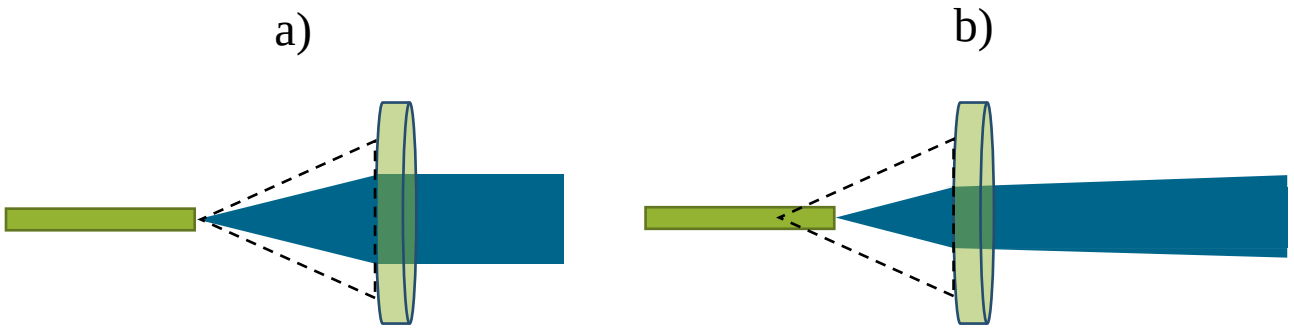


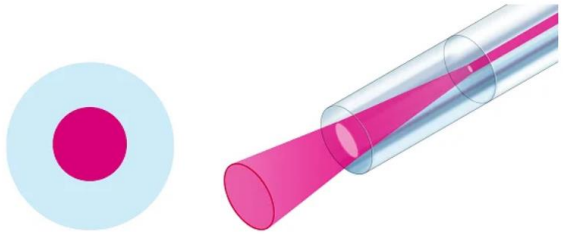
Beacon Adjustment: Divergence adjustment





No end-cap





Coreless end-cap

Objective

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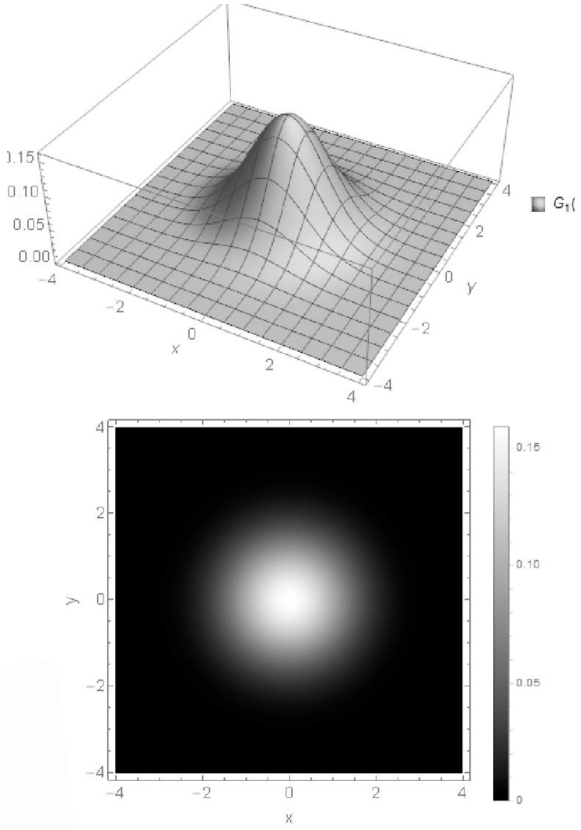
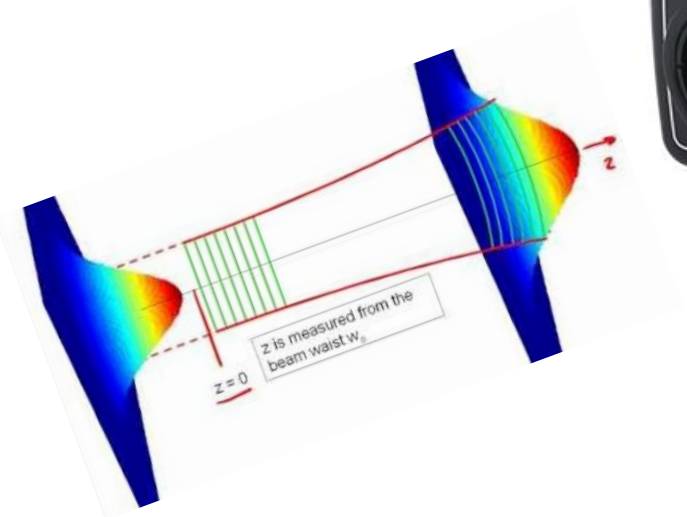
Divergence measurement from images





➡ Prx

Verification of link budget and beam parameters

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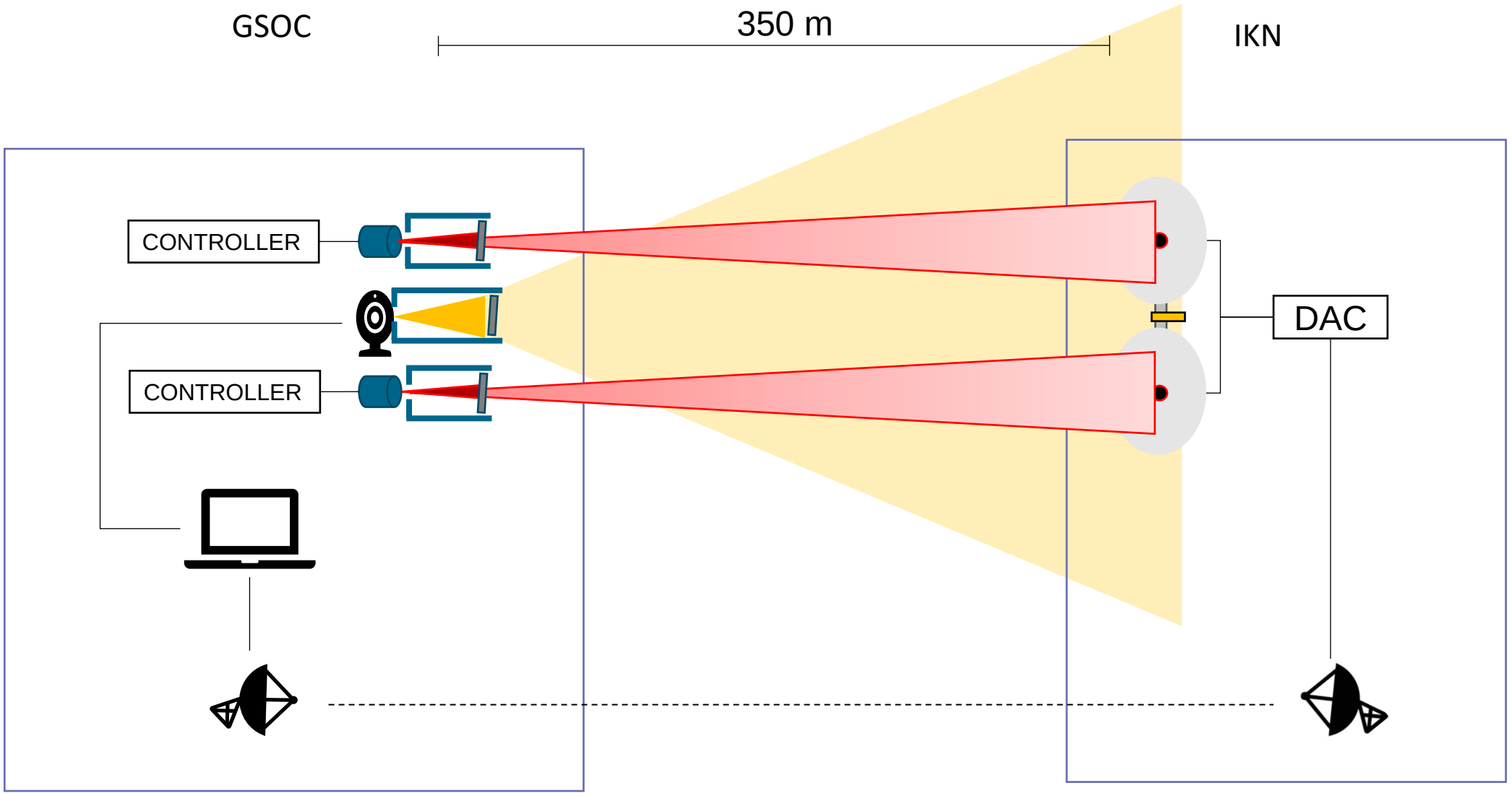
SYSTEM DESIGN

Bildquelle hier angeben

Setup diagram



Real setup

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RECEIVER

TRANSMITTER

Transmitter elements

Θ: 0.925 mrad

Θ: 0.545 mrad

Θ: 0.329 mrad

Θ: 0.164 mrad

Θ: adjustable

1562 nm
LASER DIODE

Goldeye G-130
VSWIR TEC1

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Focal length: 200mm

1550nm with 30nmBW

Receiver elements

RETROREFLECTIVE FOIL

3M Diamond grade, 4000 series

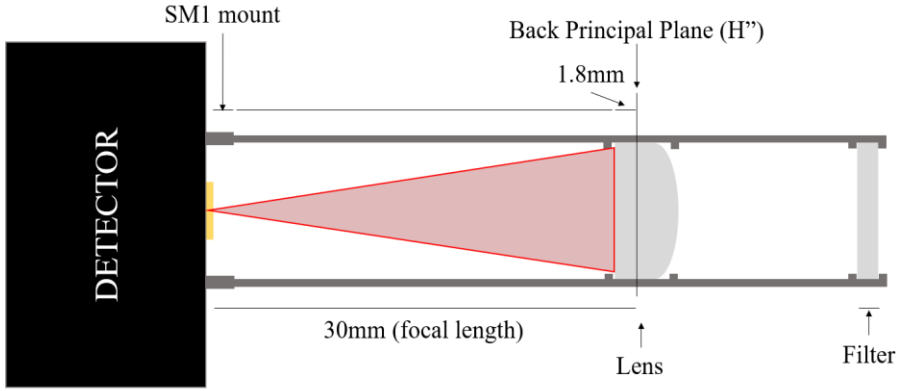
DAQ

MCC E-1608

PHOTODETECTOR PDA20CS2

Focal length:
200mm

1550nm with
30nmBW



Receiver data calculation

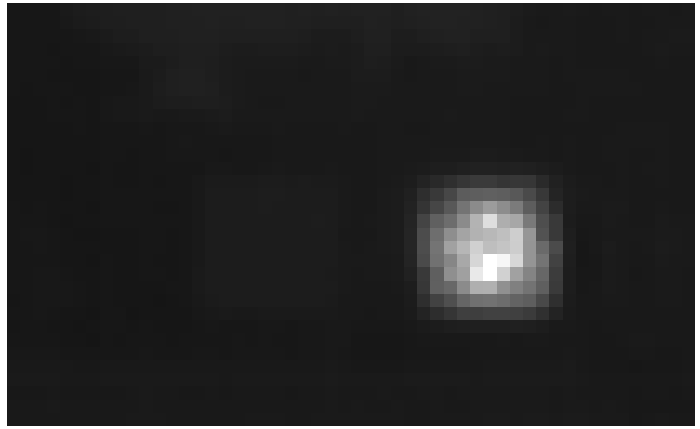
Short length terrestrial test → Simplified link budget by geometrical calculation

Gaussian distribution consideration → Adjusted received power calculation → Integral of gaussian intensity distribution from 0 to r

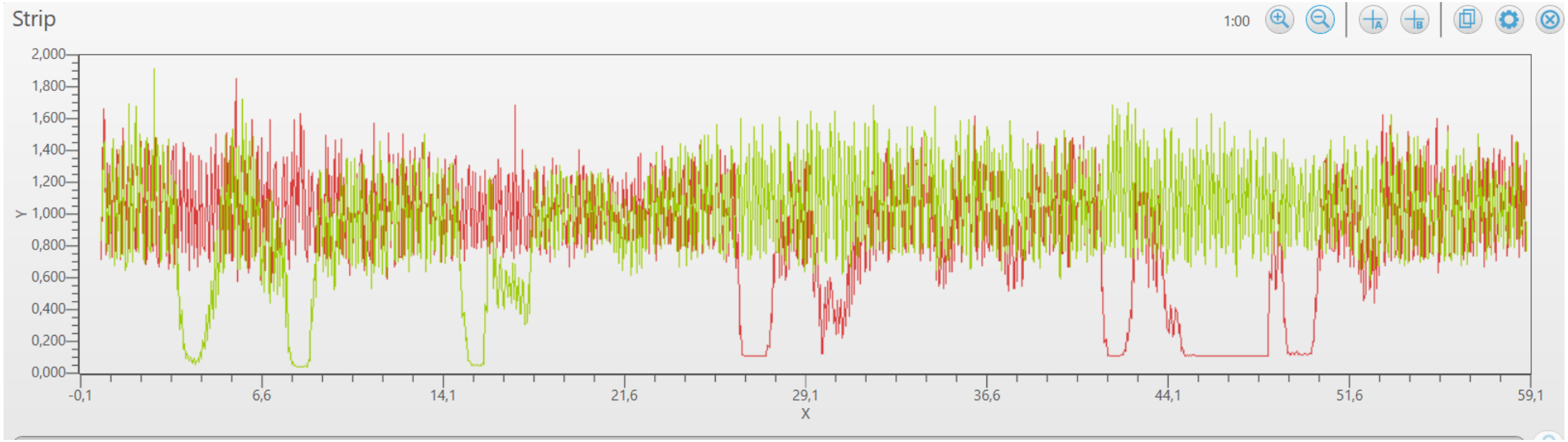
$$P(r,z) = P_o\left[1 - e^{-\frac{2r^2}{w_o^2(z)}}\right]$$

Parameter	Value
Collimators used	0.925mrad, 0.545mrad, 0.329mrad, 0.164mrad
Power used for each collimator	10 mW, 10 mW, 1 mW, 1 mW
Expected power at receiver	29.1 µW, 83.7 µW, 22.8 µW, 88 µW

Alignment

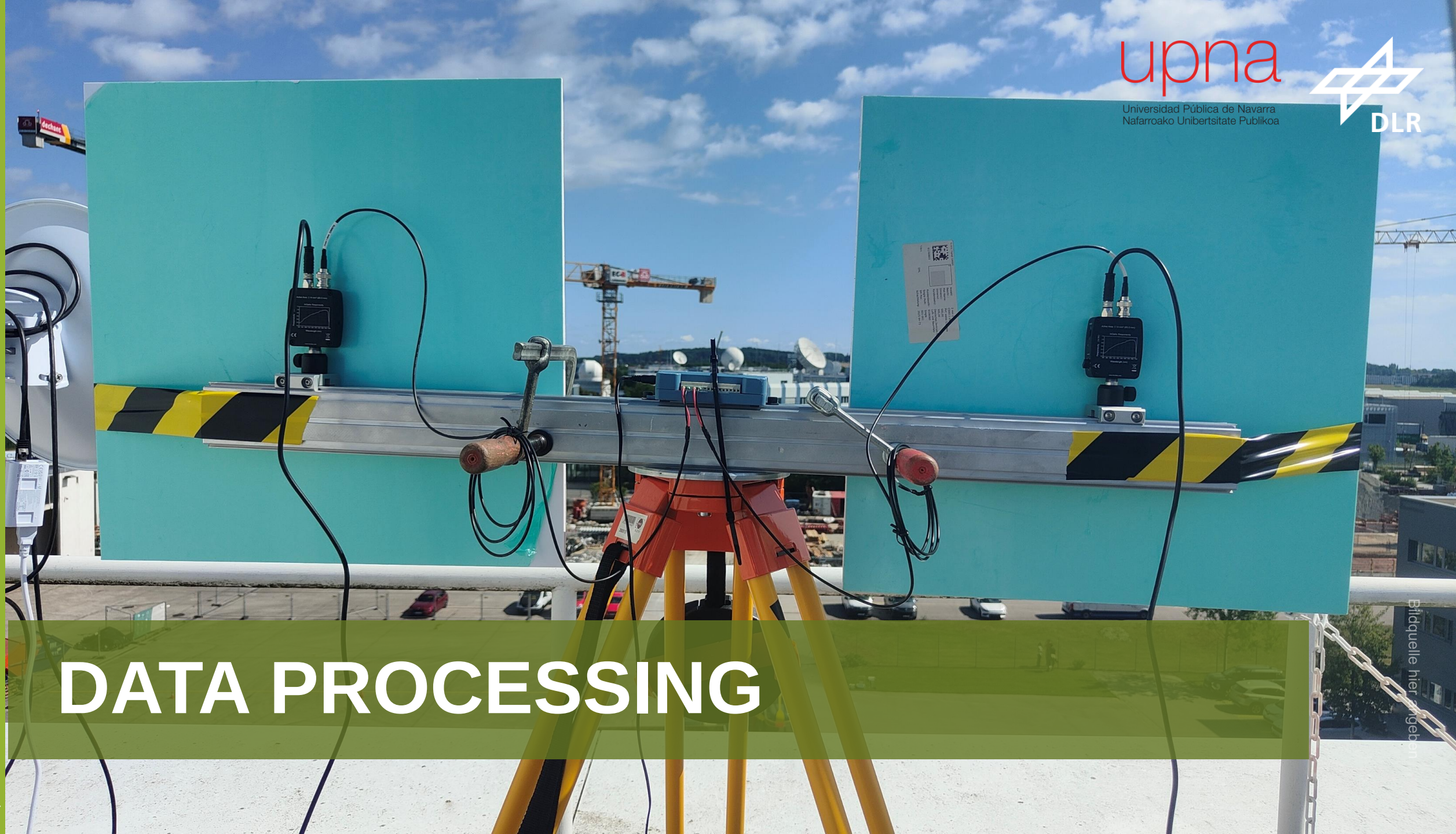


- Left beam
- Right beam



Voltage at detector (V)

Time (s)



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DATA PROCESSING

Bildquelle hier angeben

Image processing: Mean for scintillation

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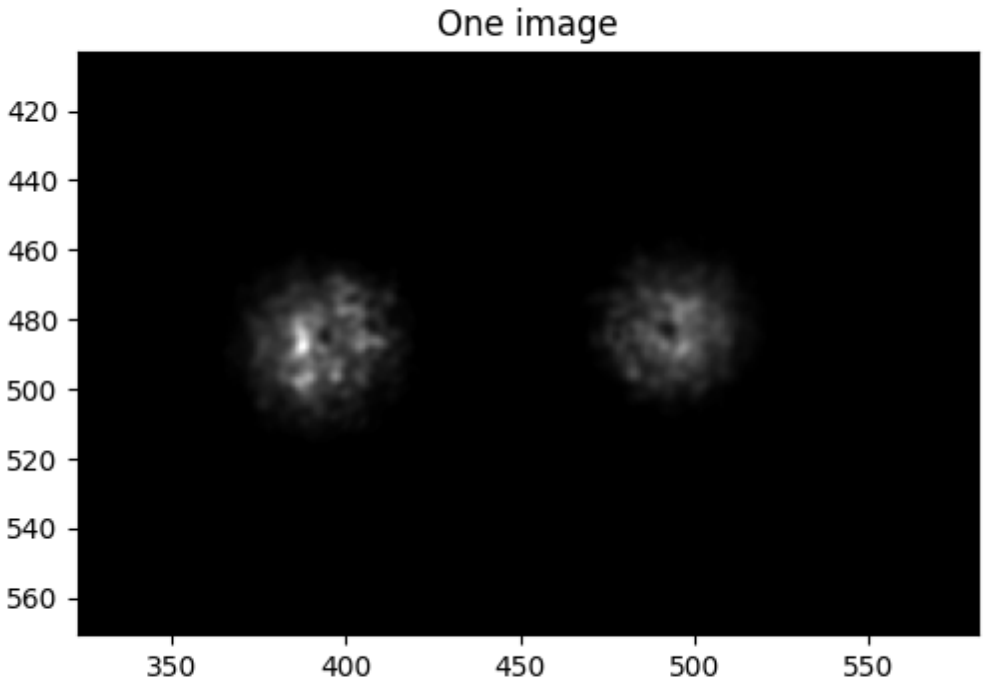


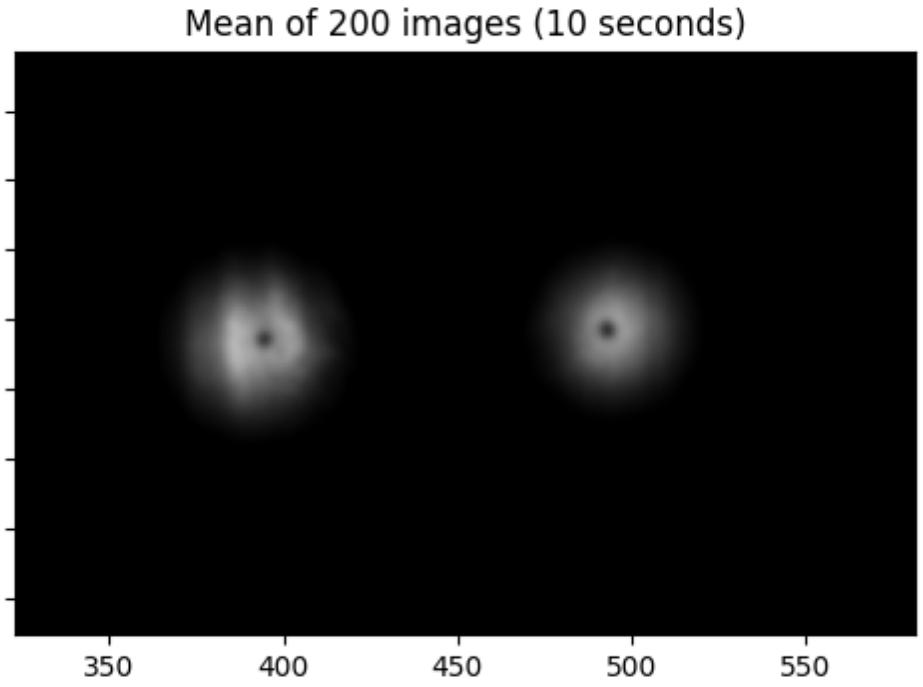
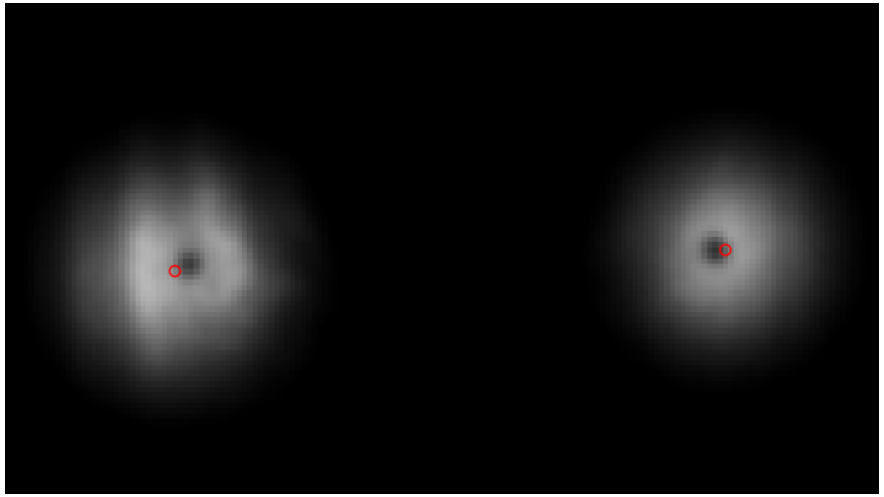
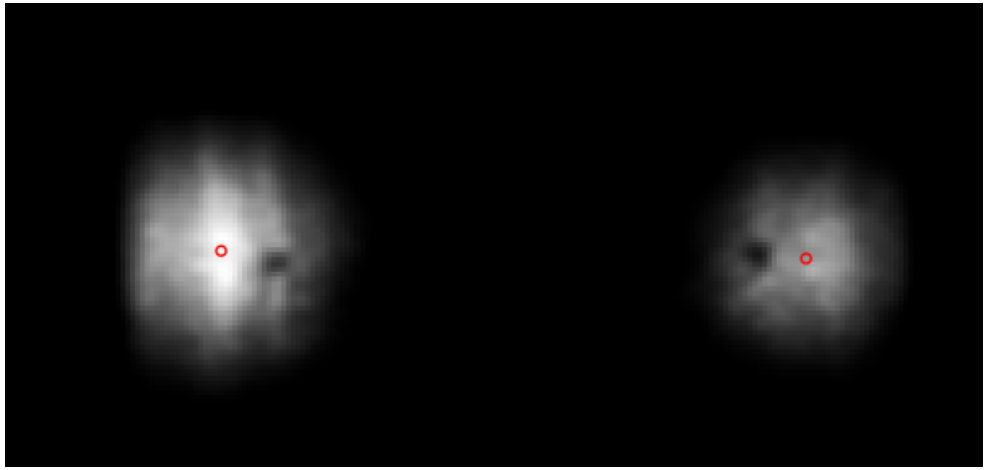


Image processing: Beam center, intensity distribution

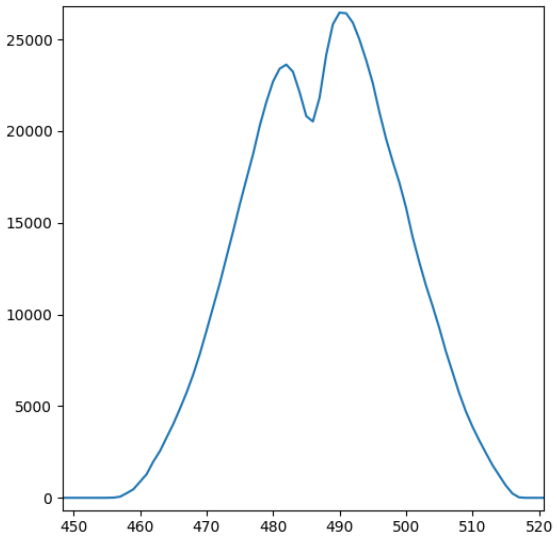
Beam centered at the detector

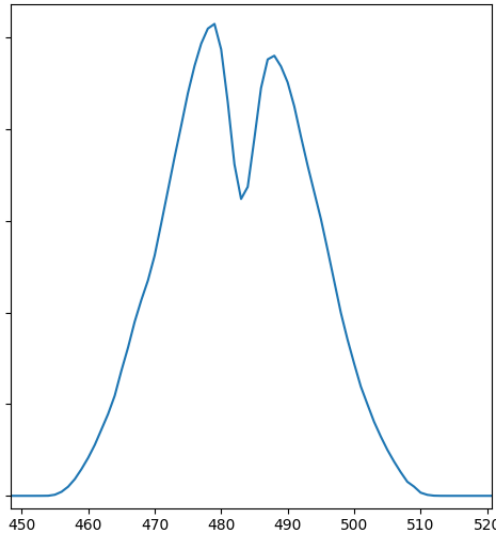


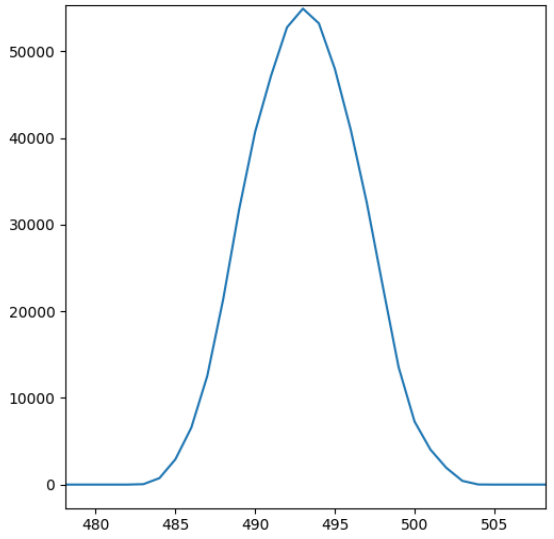
Beam off centered



Intensity distribution







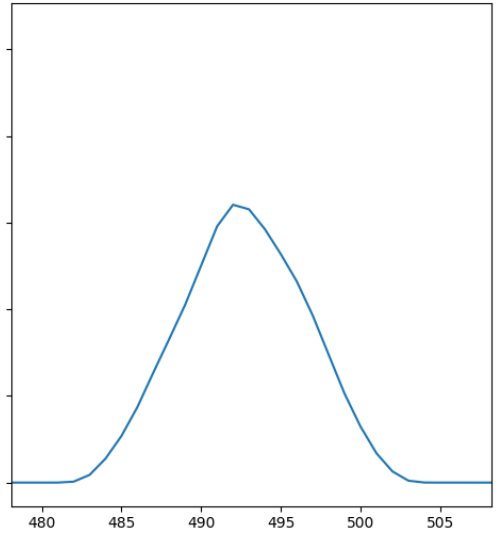


Image processing: Subpixel interpolation, FWHM divergence

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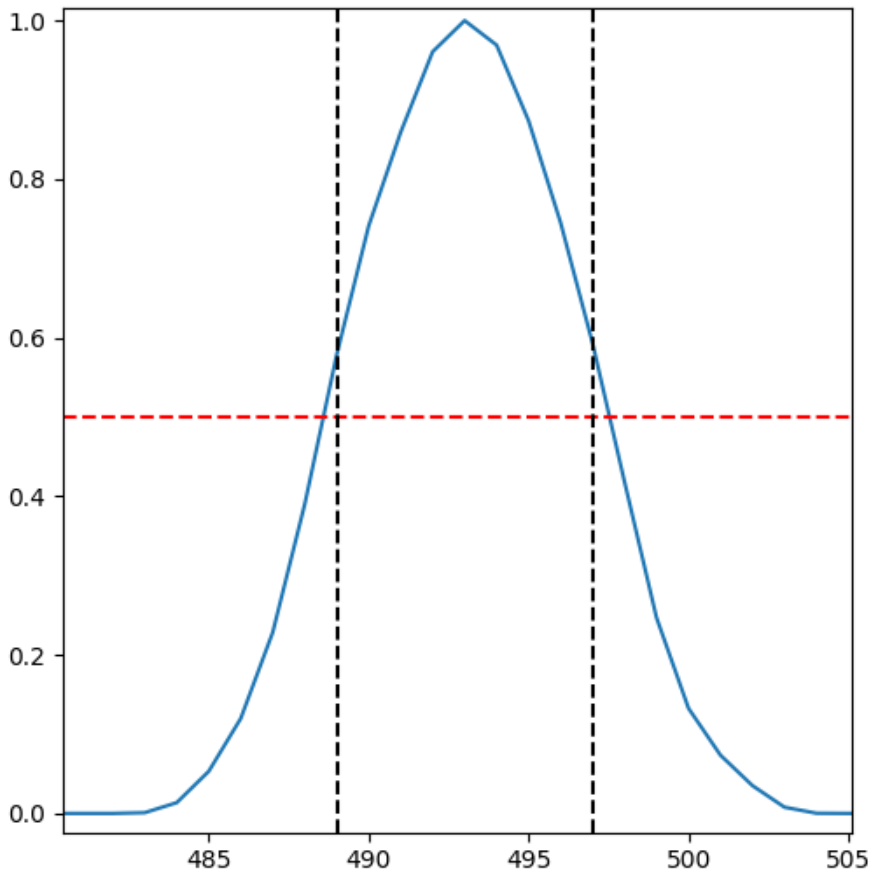
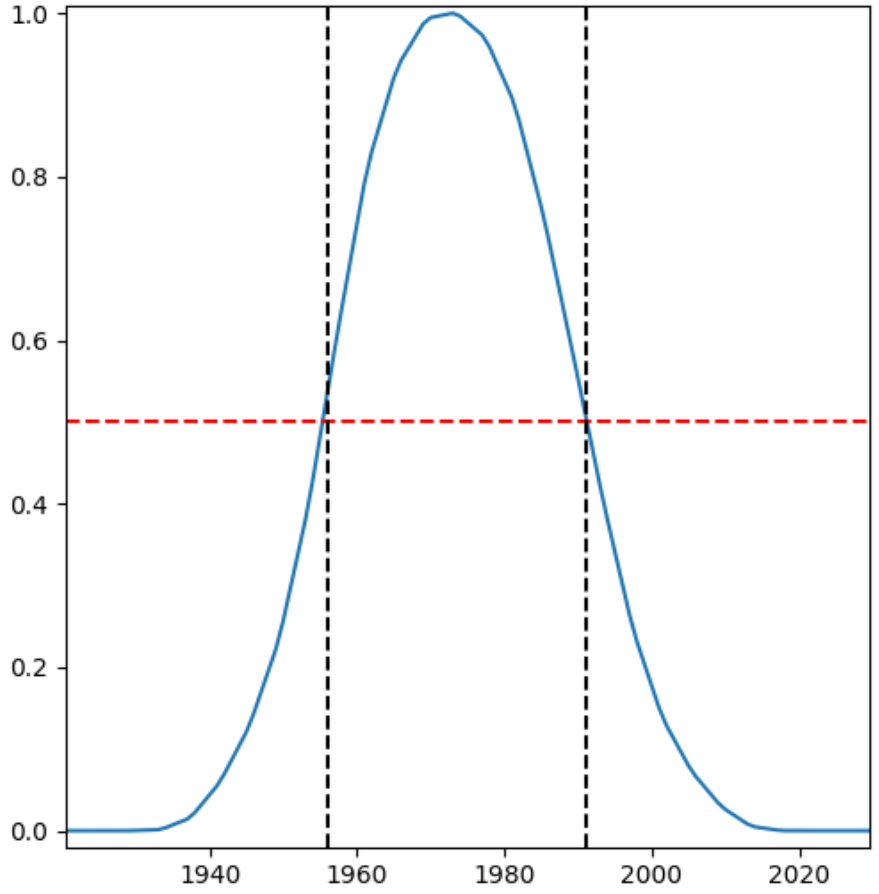
Without interpolation



Divergence of 0.2 mrad

With interpolation



Divergence of 0.2185 mrad

Image processing: Complications to get divergence

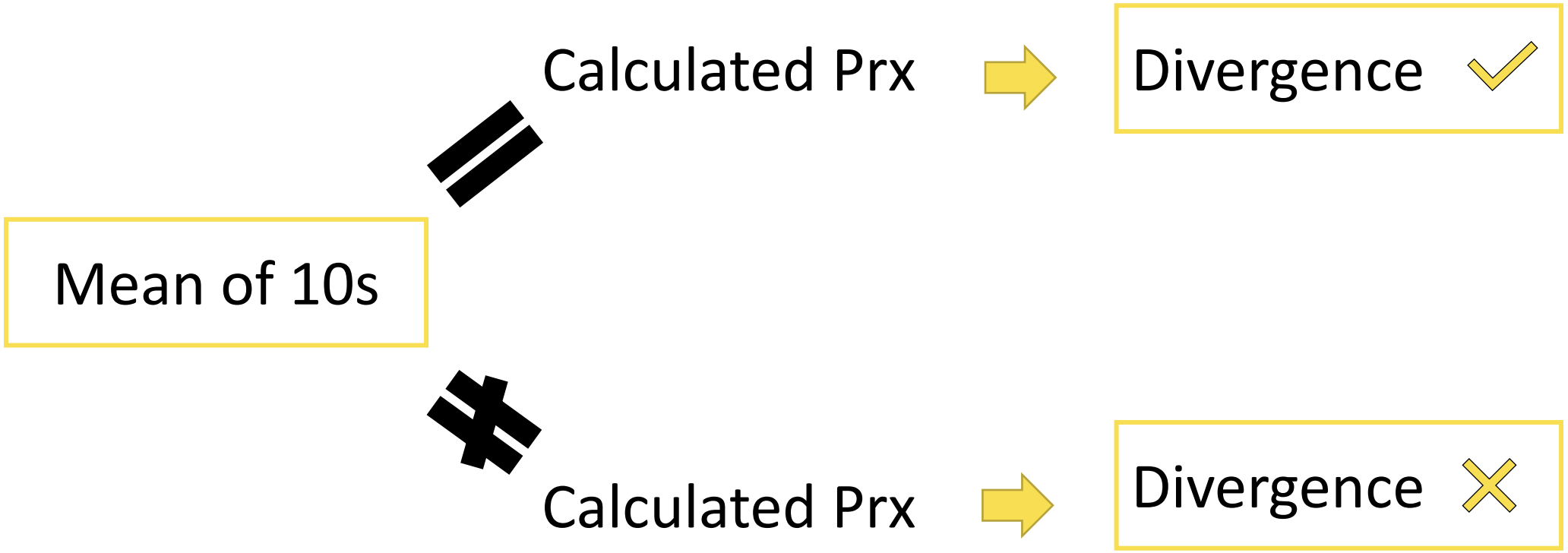
Beam wander + mean of images

Slightly larger spot size

Slightly larger divergence

Filter elements by size, saturation and roundness

Receiver data processing



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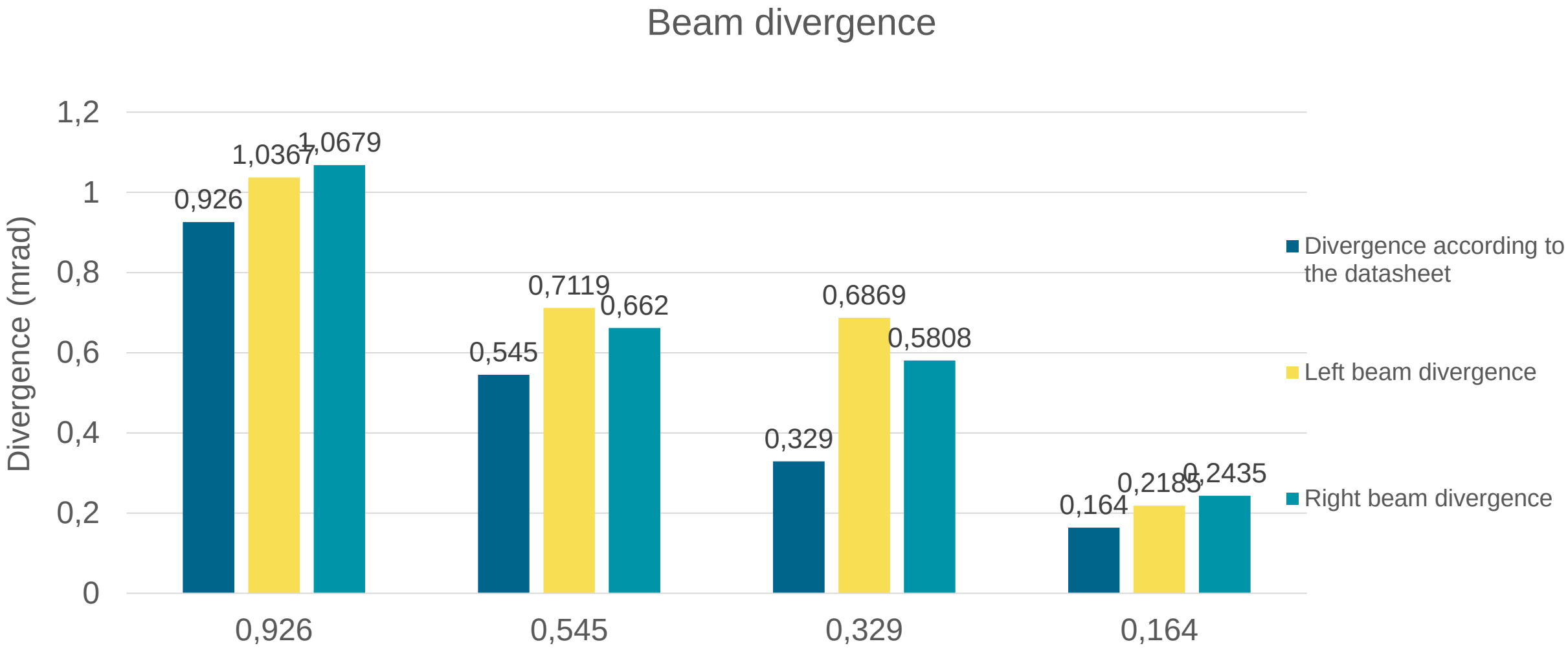
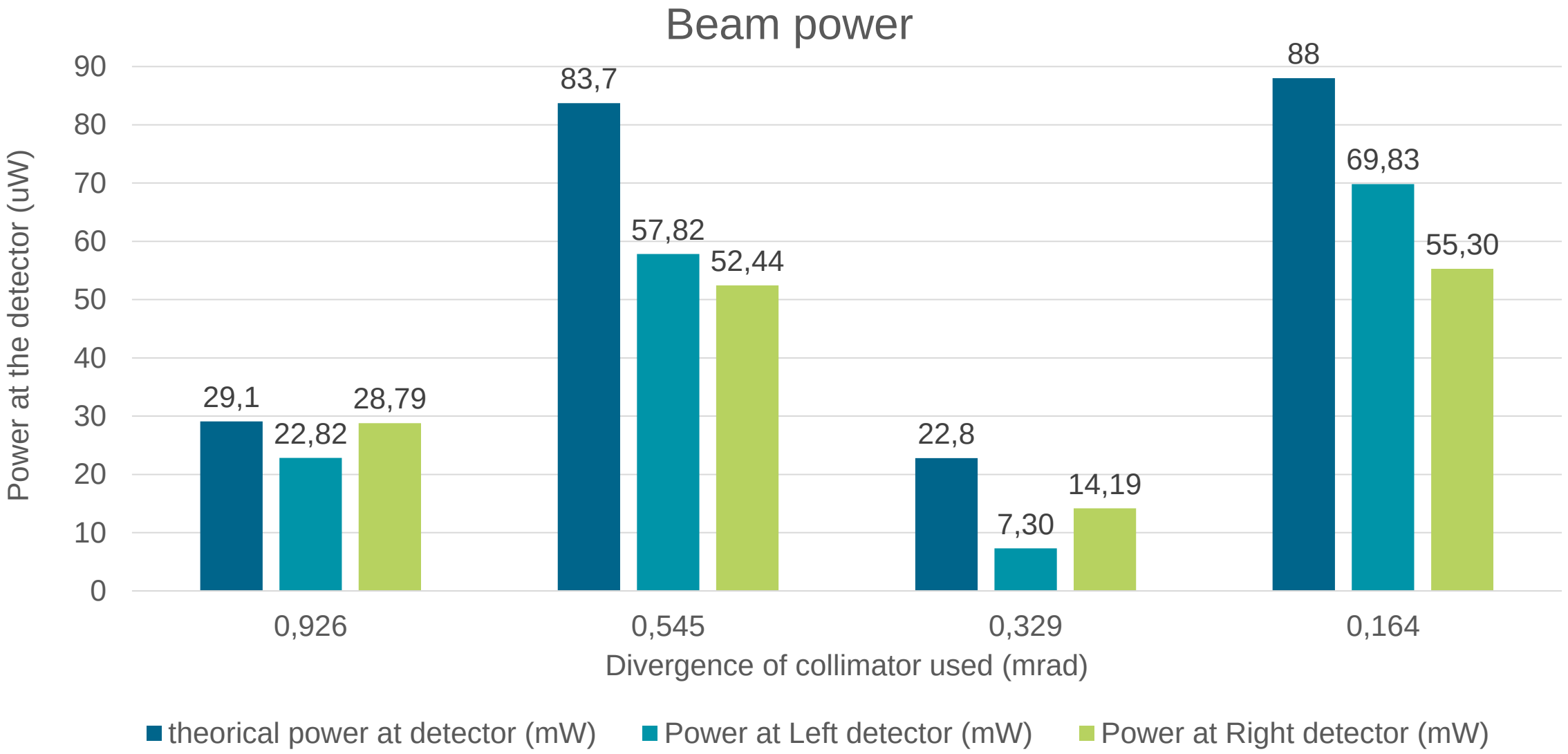
RESULTS

Bildquelle hier angeben

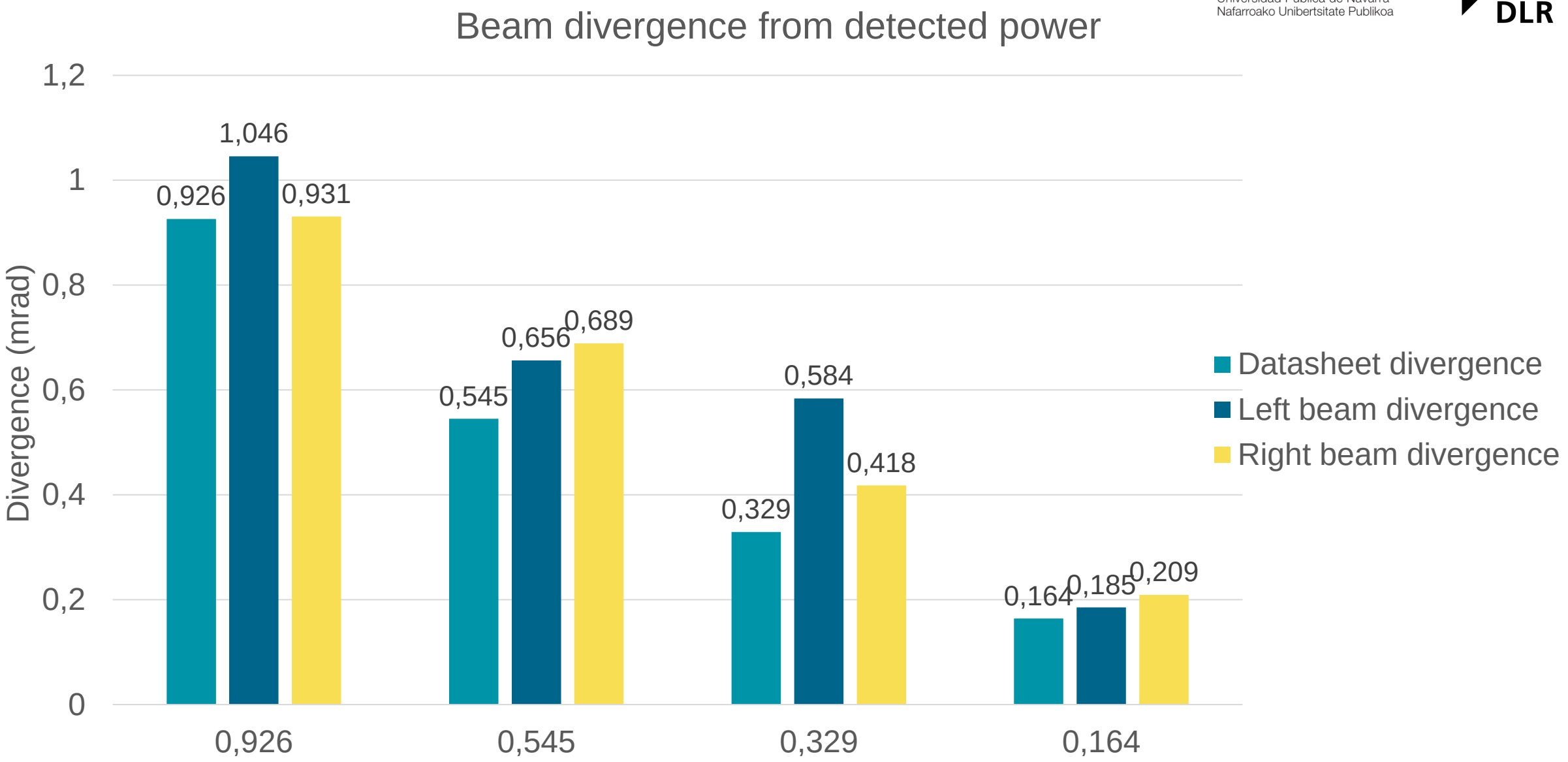
Results: Collimator divergence from camera images



Results: Received power



Results: Collimator divergence from received power



Conclusions

Divergence analysis:

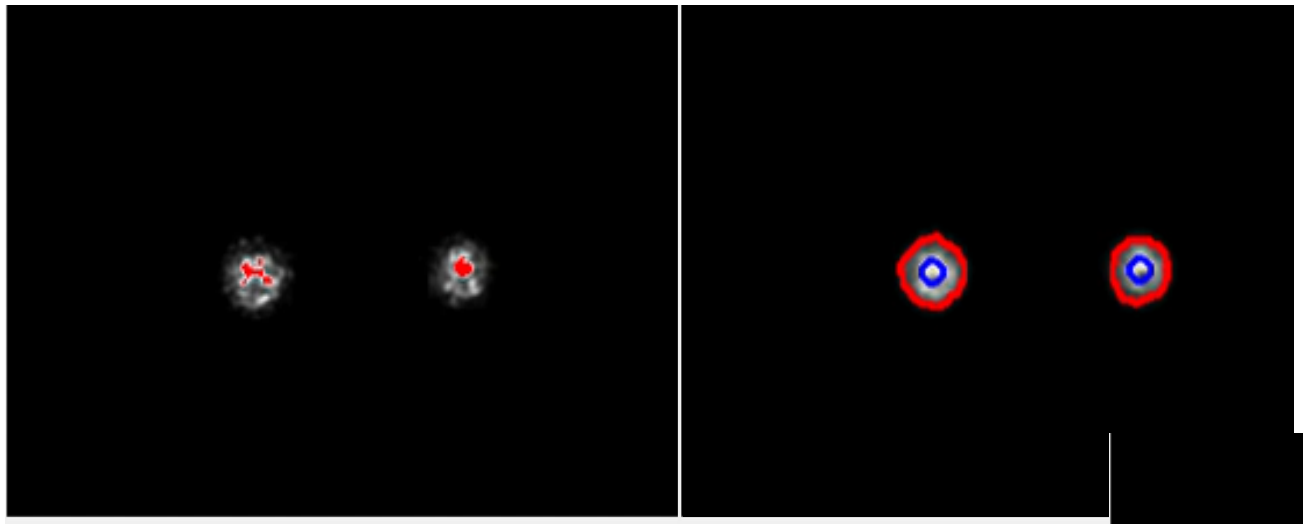
- Δ Divergence → Beam wonder
- Δ Divergence 0.329 mrad → Manufacturing error

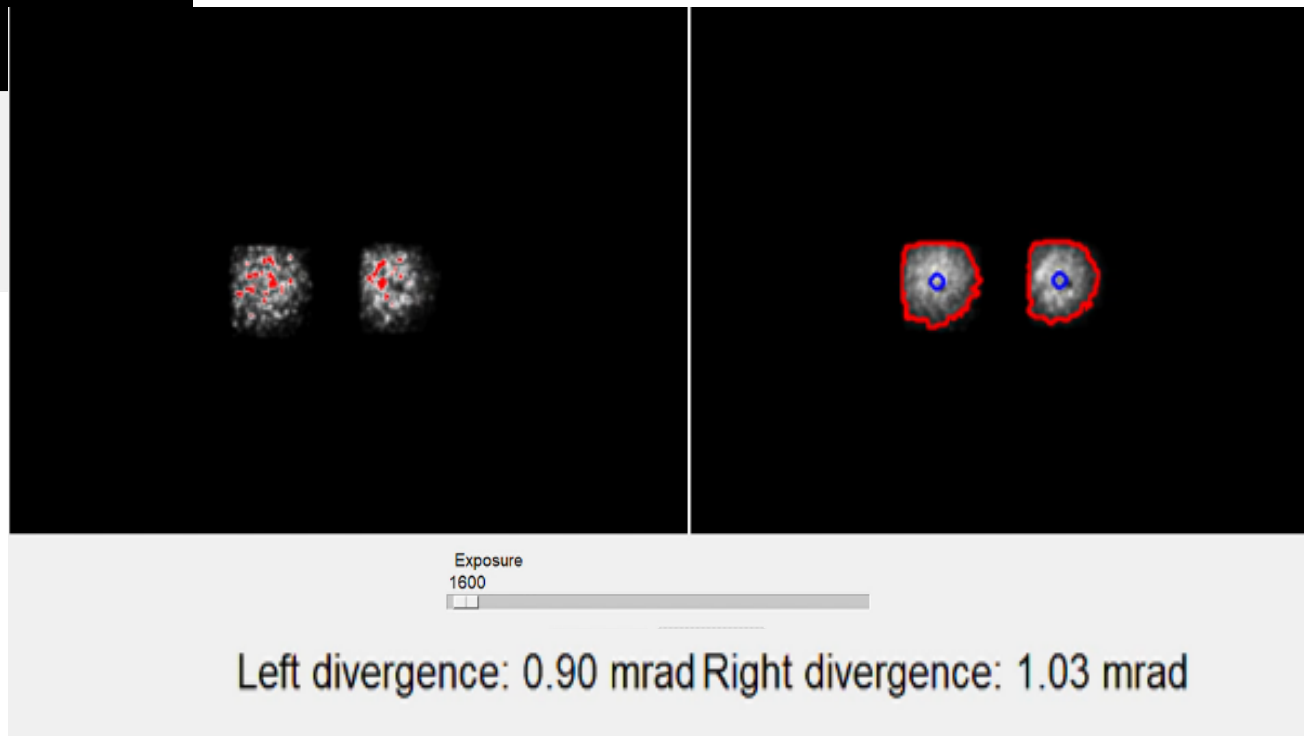
The need to use adjustable collimators

Prx analysis:

- Slight variation → Beam wonder and scintillation
- Δ Divergence 0.329 mrad → link budget doesn't apply

Interface for adjustable collimator





Future development

Future development:

- Beam wonder correction
- System design correction
- New testing environment

- Use of larger devices for eye safety and controlled adjustments
- Fiber end-cap analysis

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THANK YOU FOR YOUR ATTENTION

General data

Transmitter	
Description	Value
Wavelength	1550 nm → 1562 nm
Number of transmitters	2
Divergence angle at FWHM*	924 urad, 545 urad, 329 urad, 164 urad
Theoretical output beam diameter ($1/e^2$)	0.84 mm, 1.68 mm, 2.54 mm, 5.24 mm
Maximum transmitter power	50 mW

Receiver / Test Target	
Description	Value
Wavelength	1550 nm → 1562 nm
Number of receivers	2