Guides and gravity in McStas
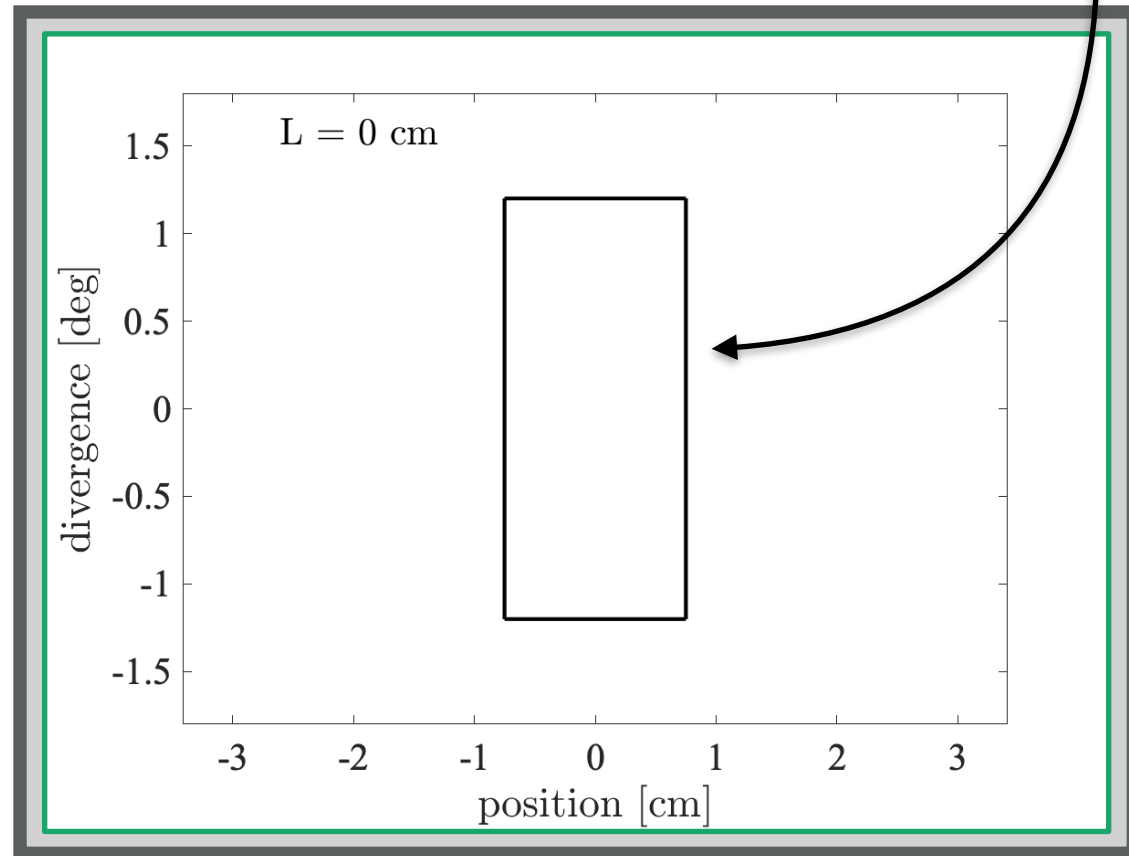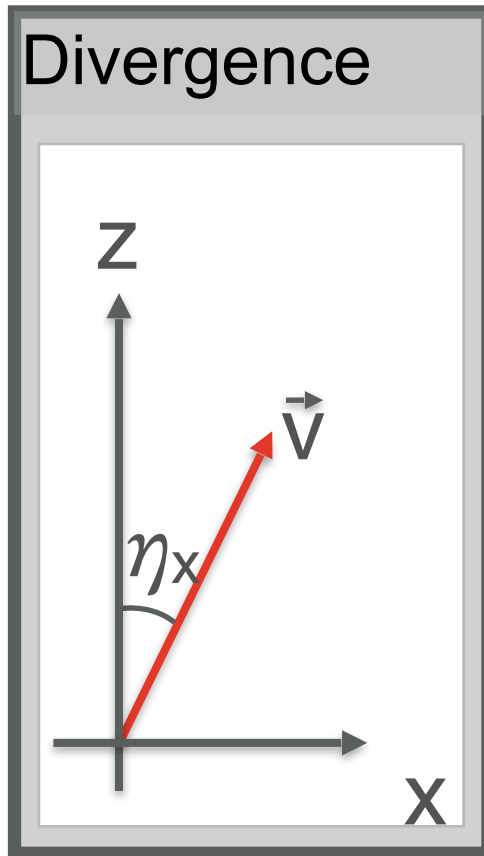
Peter Willendrup (slides from Mads Bertelsen)

Overview

- Description of phase-space and propagation
- Reflectivity
- McStas coordinate system
- Gravitation in McStas
- Guide components with support for gravity
  - Guide_gravity
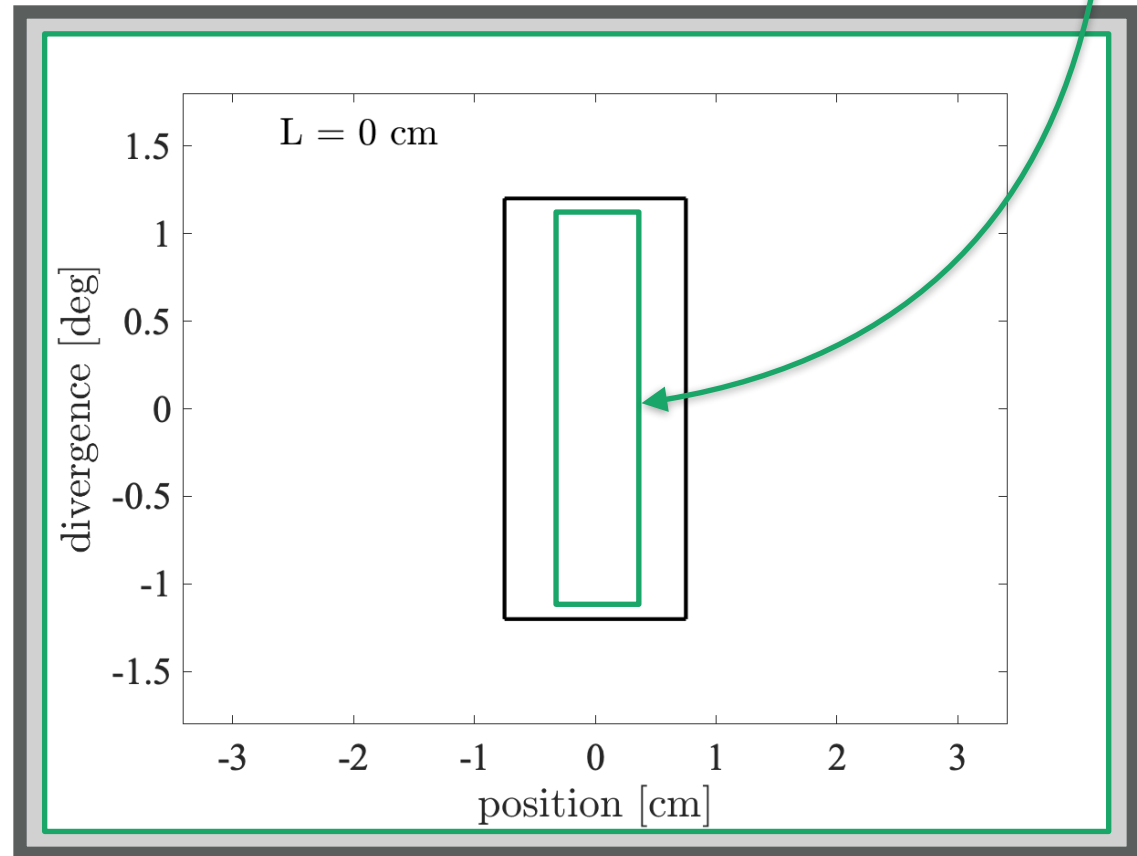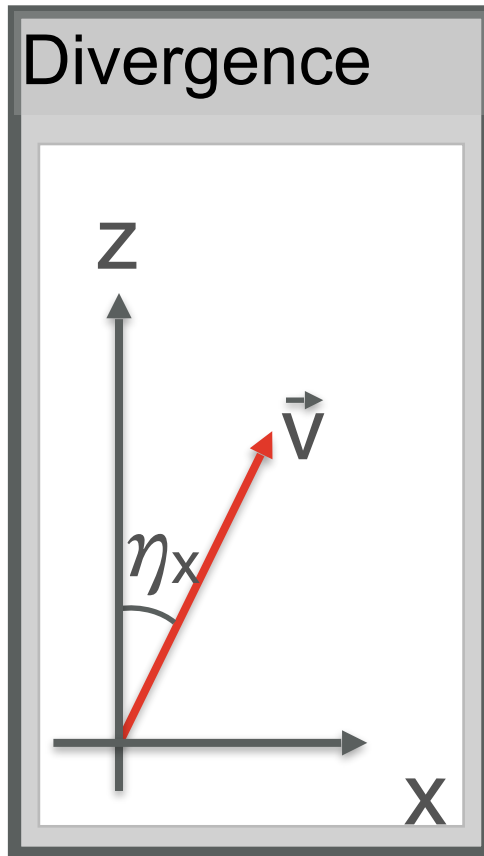 - Elliptic_guide_gravity
- Breaking line of sight
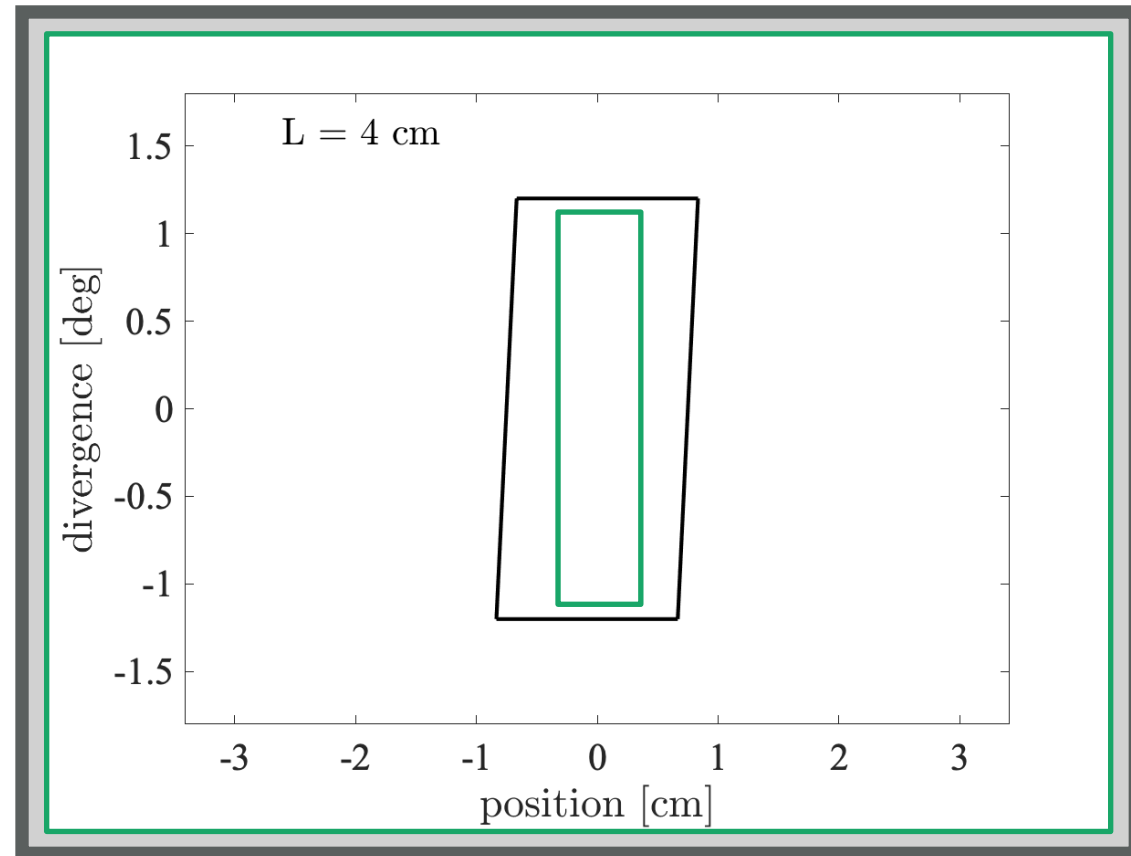- Exercise

Beam propagation in free space

Beam propagation in free space

Beam propagation in free space

Beam propagation in free space

Divergence

Beam propagation in free space

Beam propagation in free space

Beam propagation in free space

Beam propagation in free space

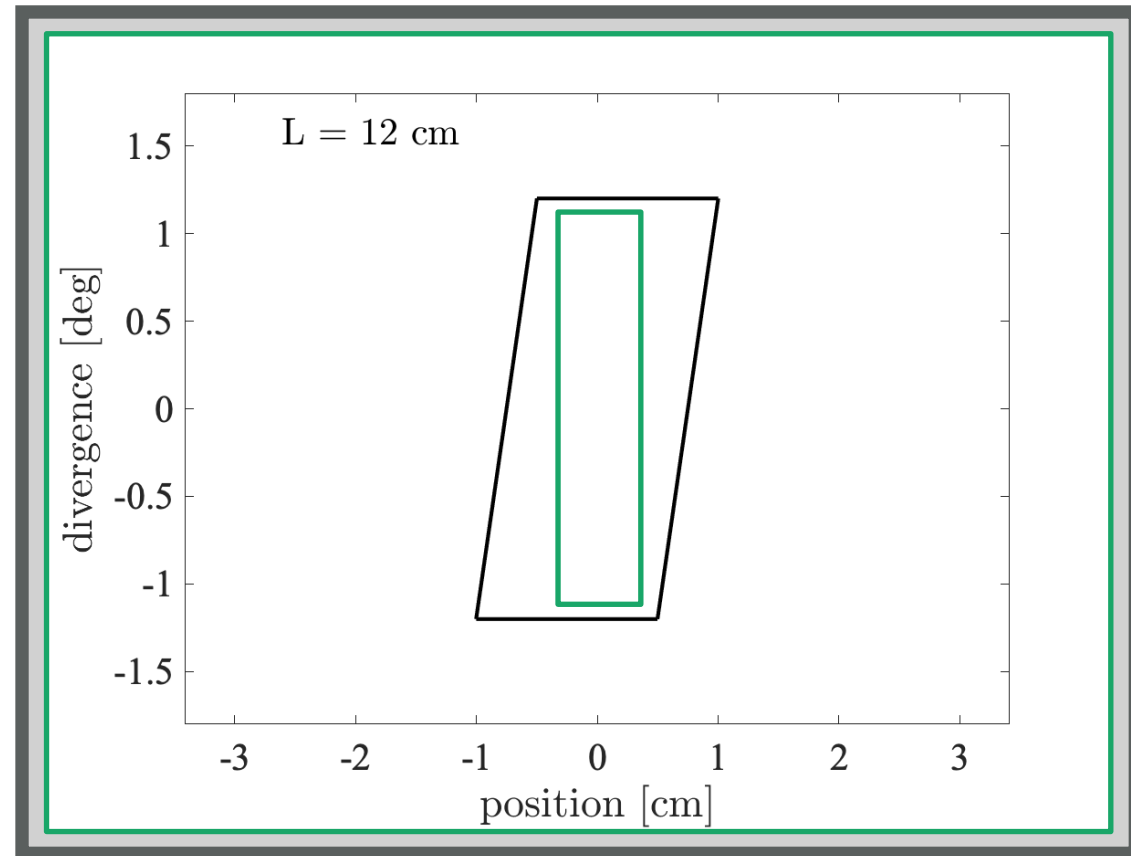# Beam propagation in free space

Beam propagation in free space

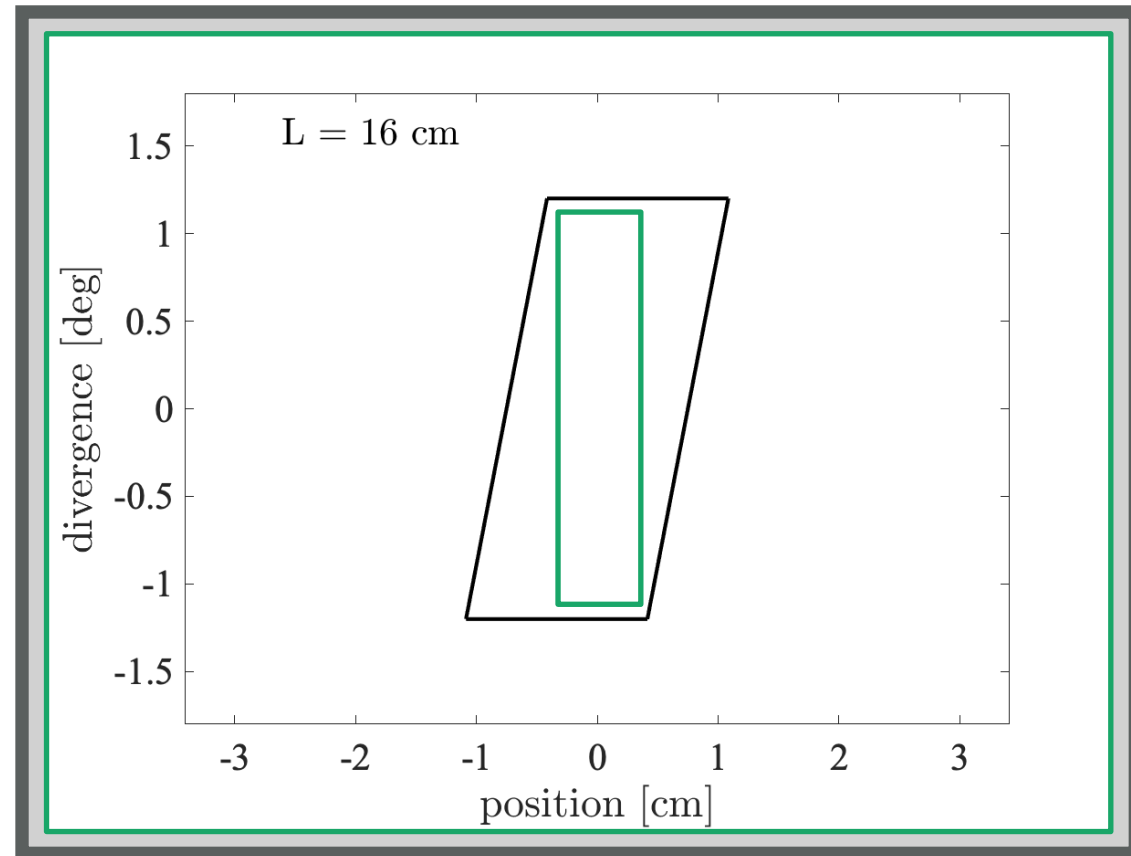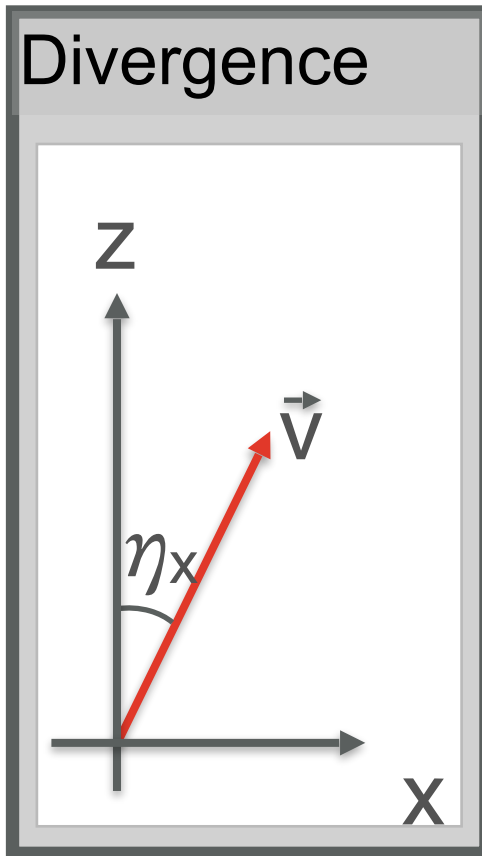# Beam propagation in free space
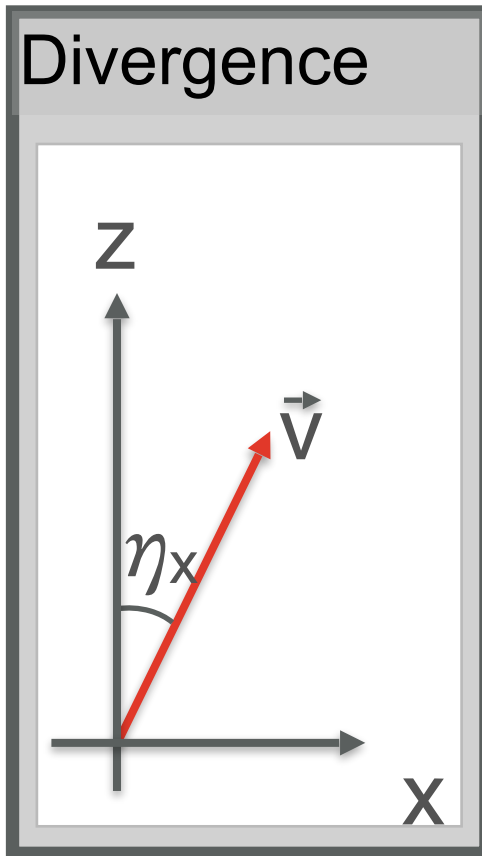
Beam propagation in free space

Beam propagation in free space
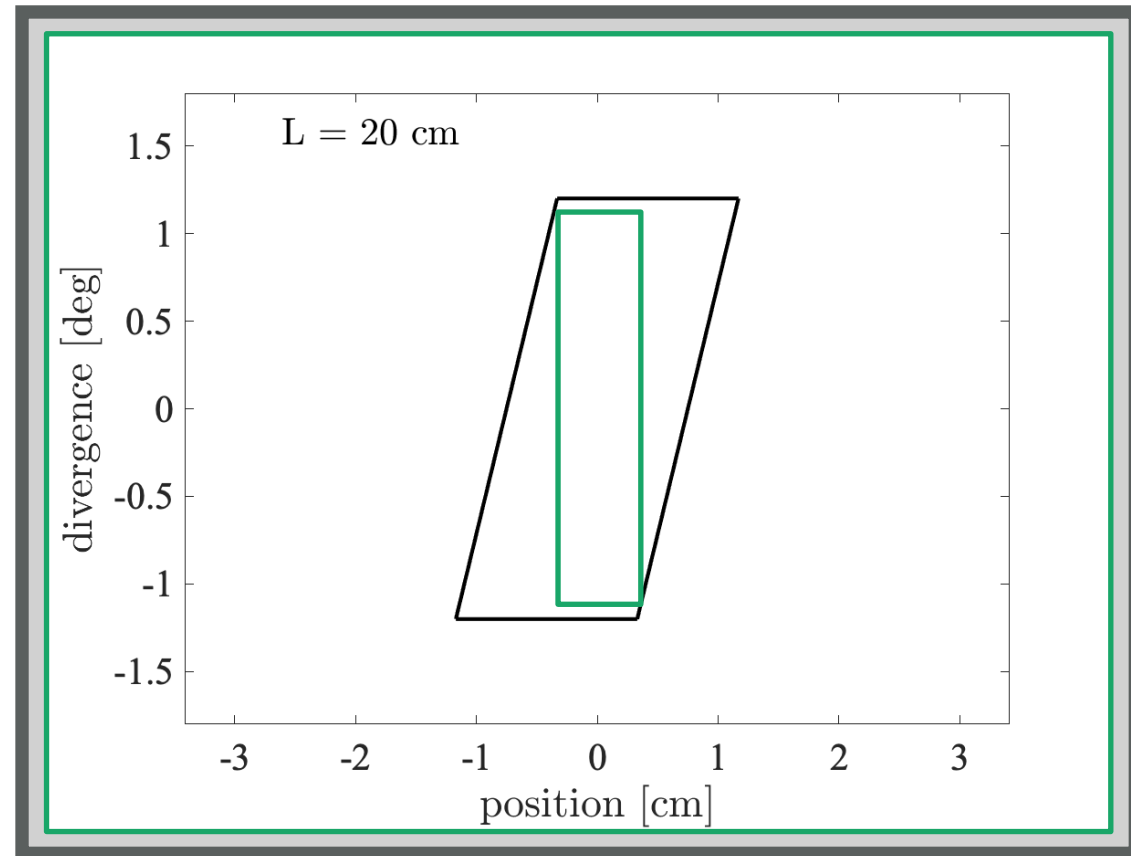
Beam propagation in free space
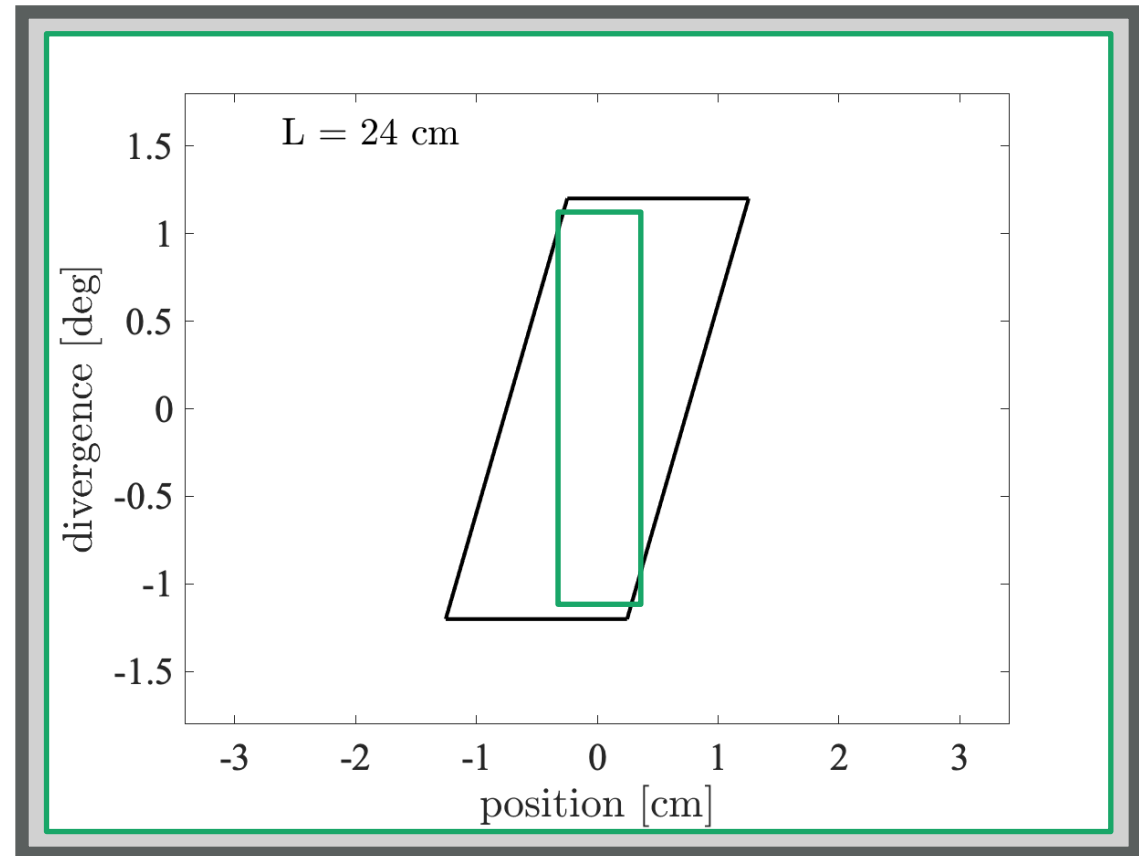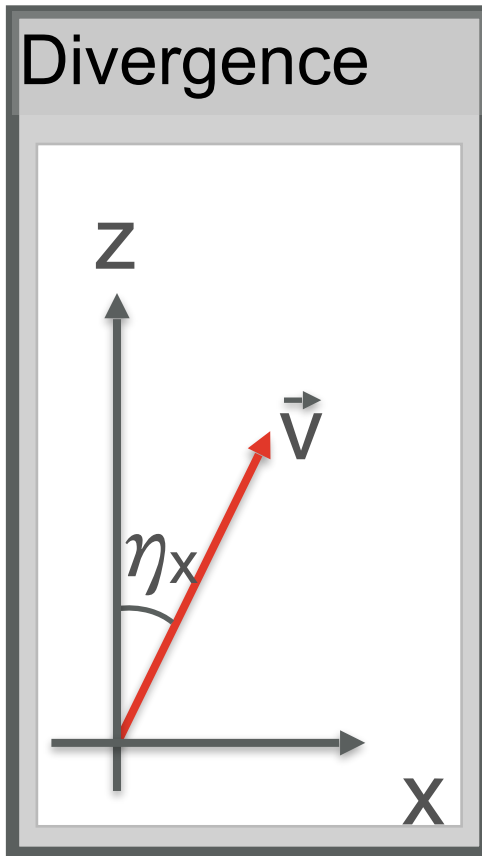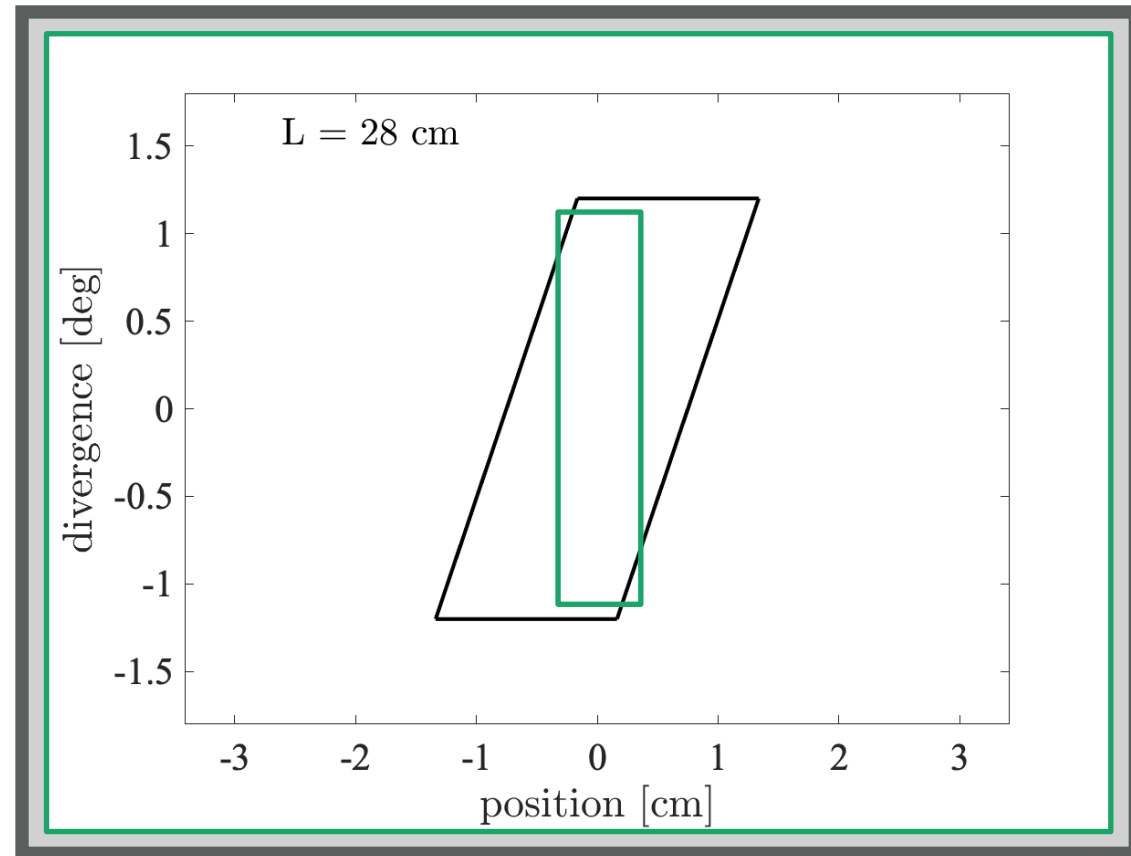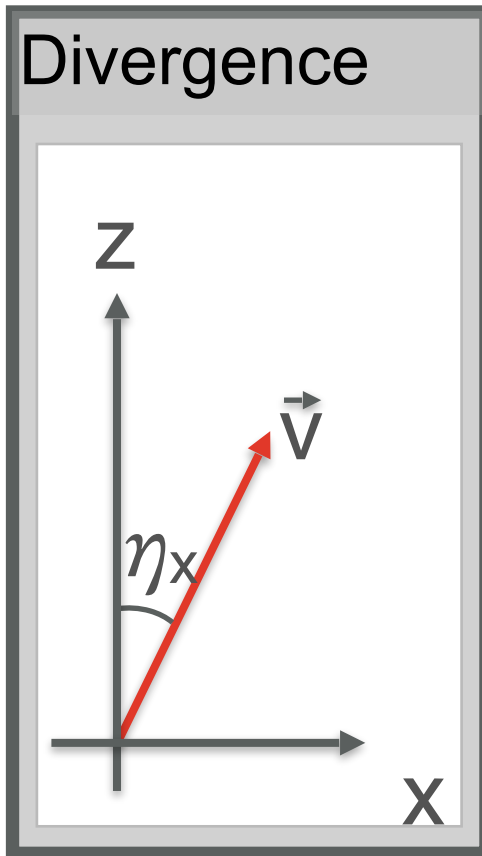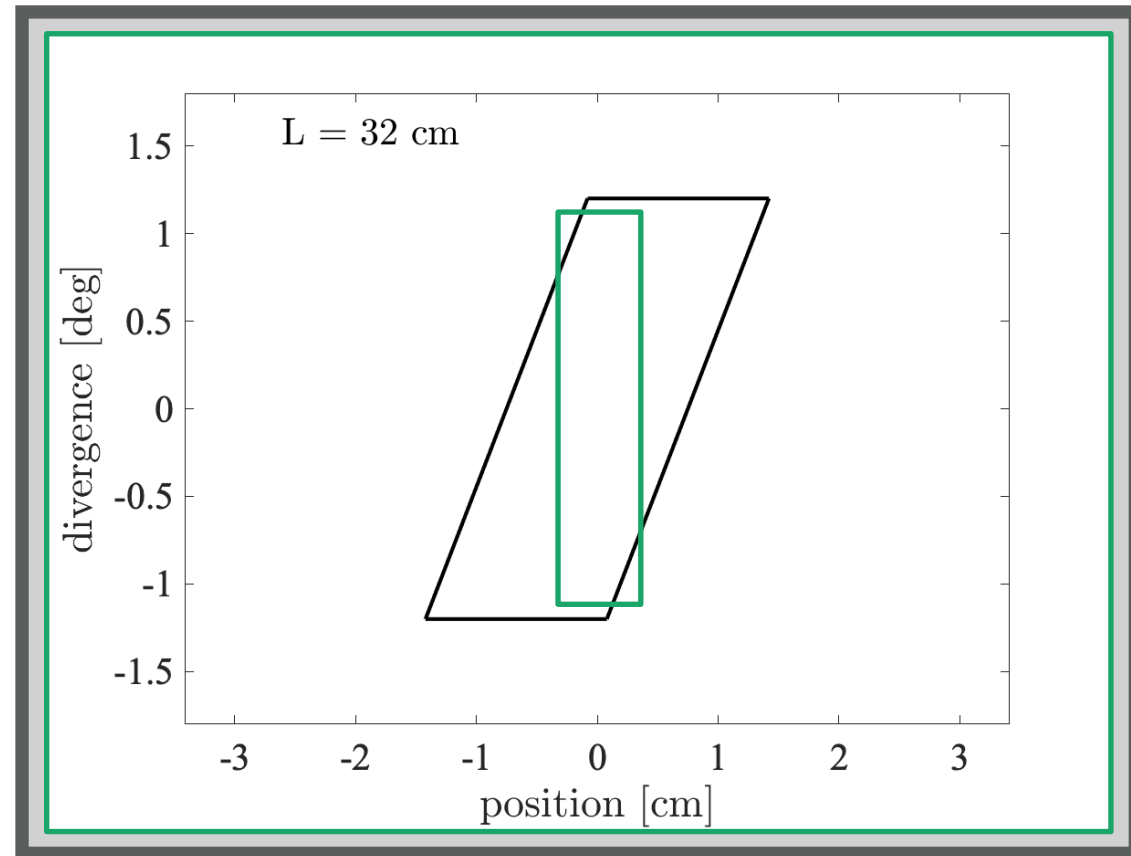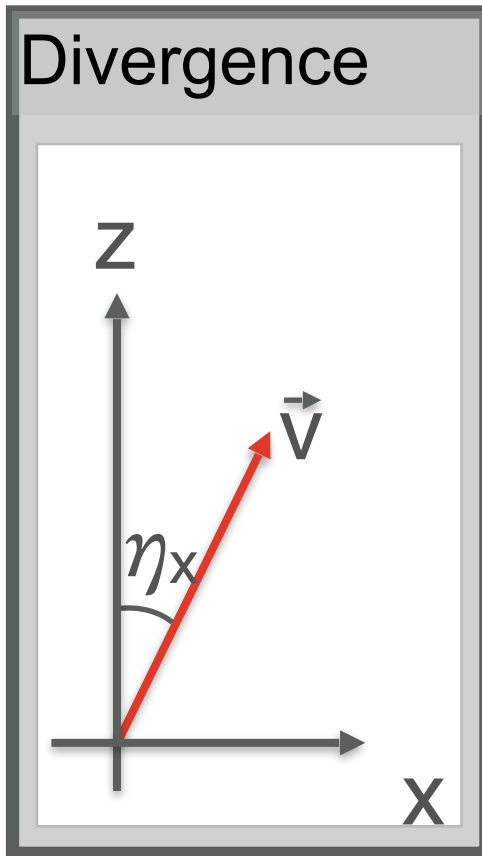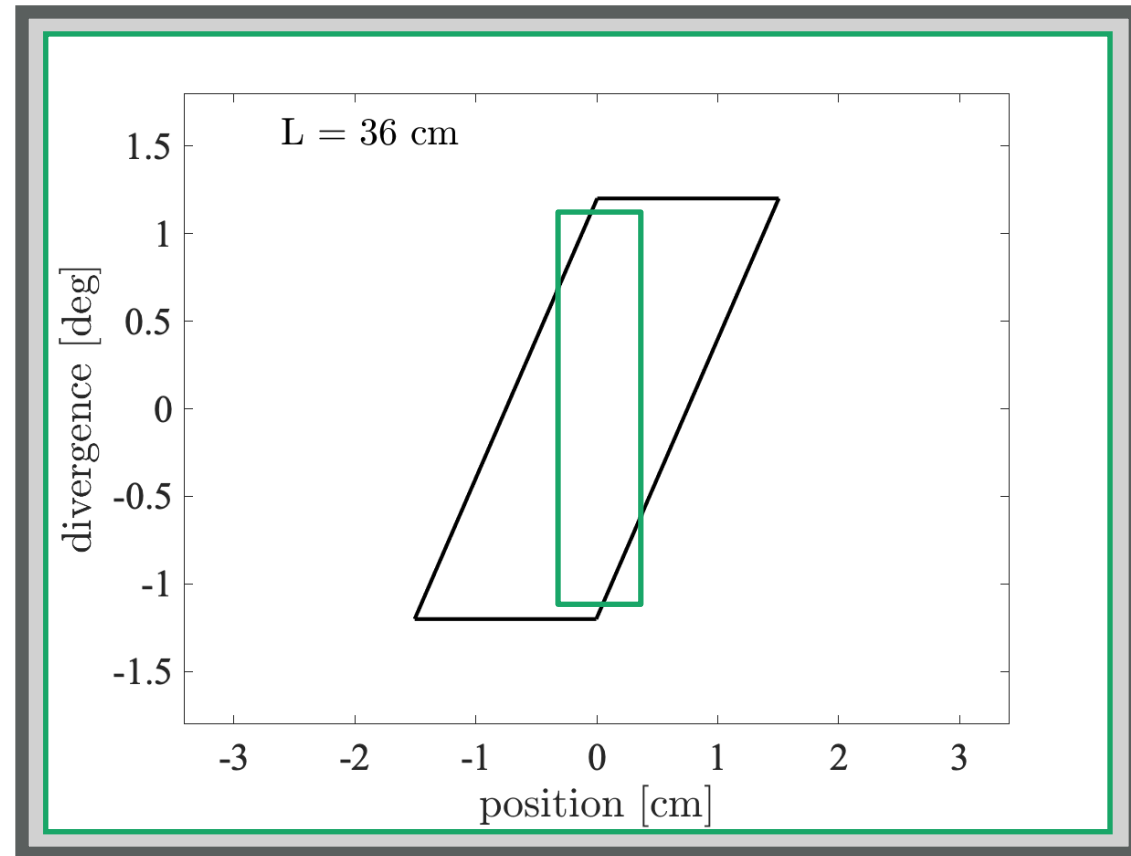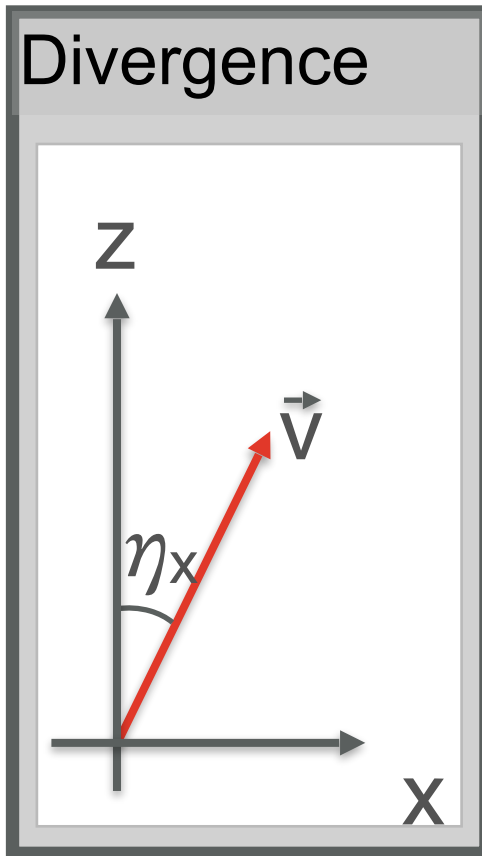
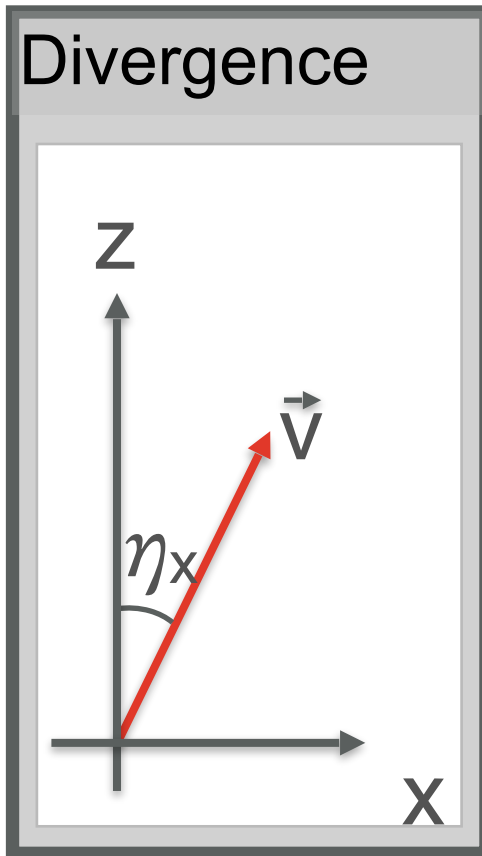# Beam propagation in free space

Beam propagation in free space

Beam propagation in free space

- We lost some phase-space to propagation

Divergence

Beam propagation in guide

Wanted "phase-space" at sample
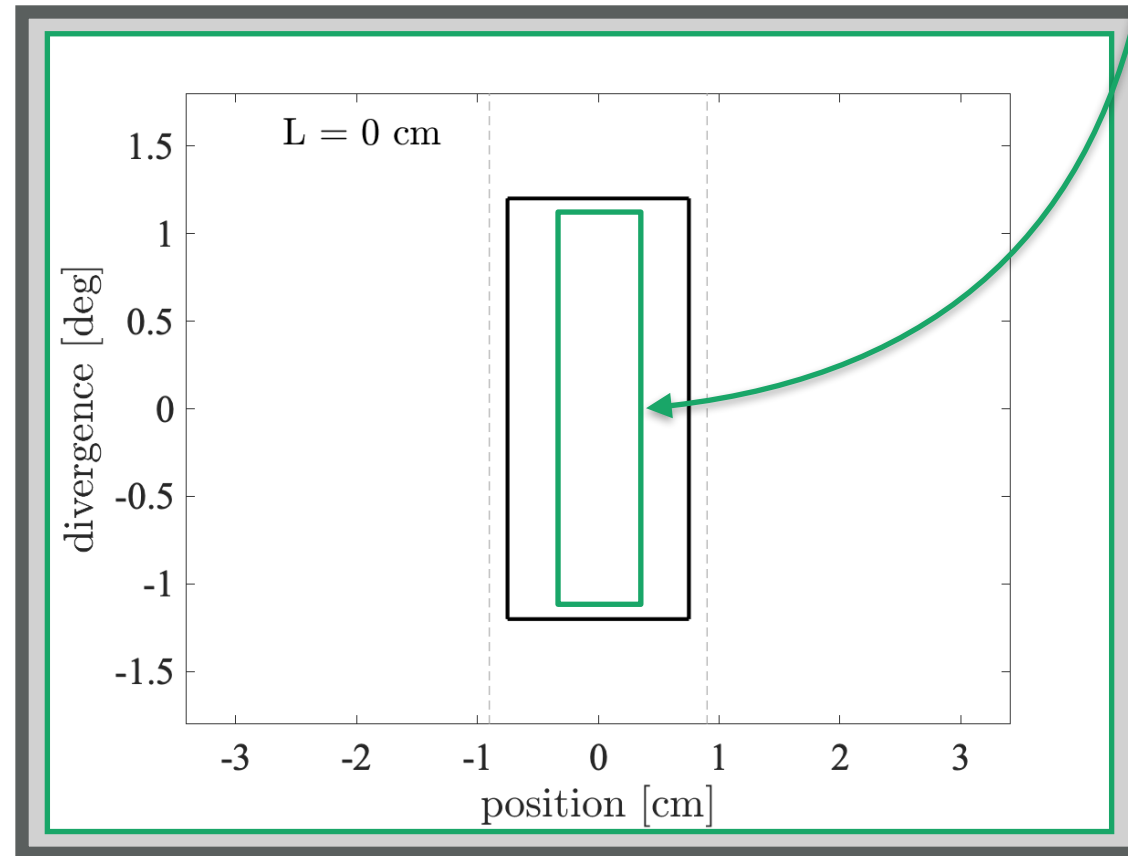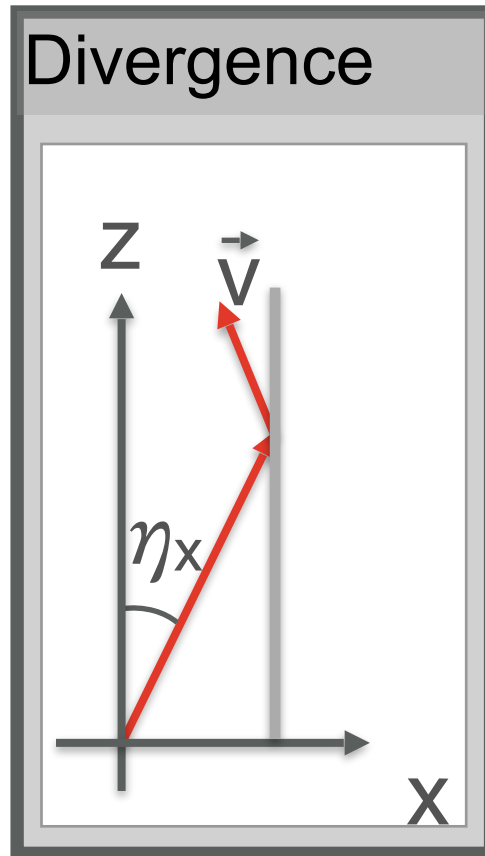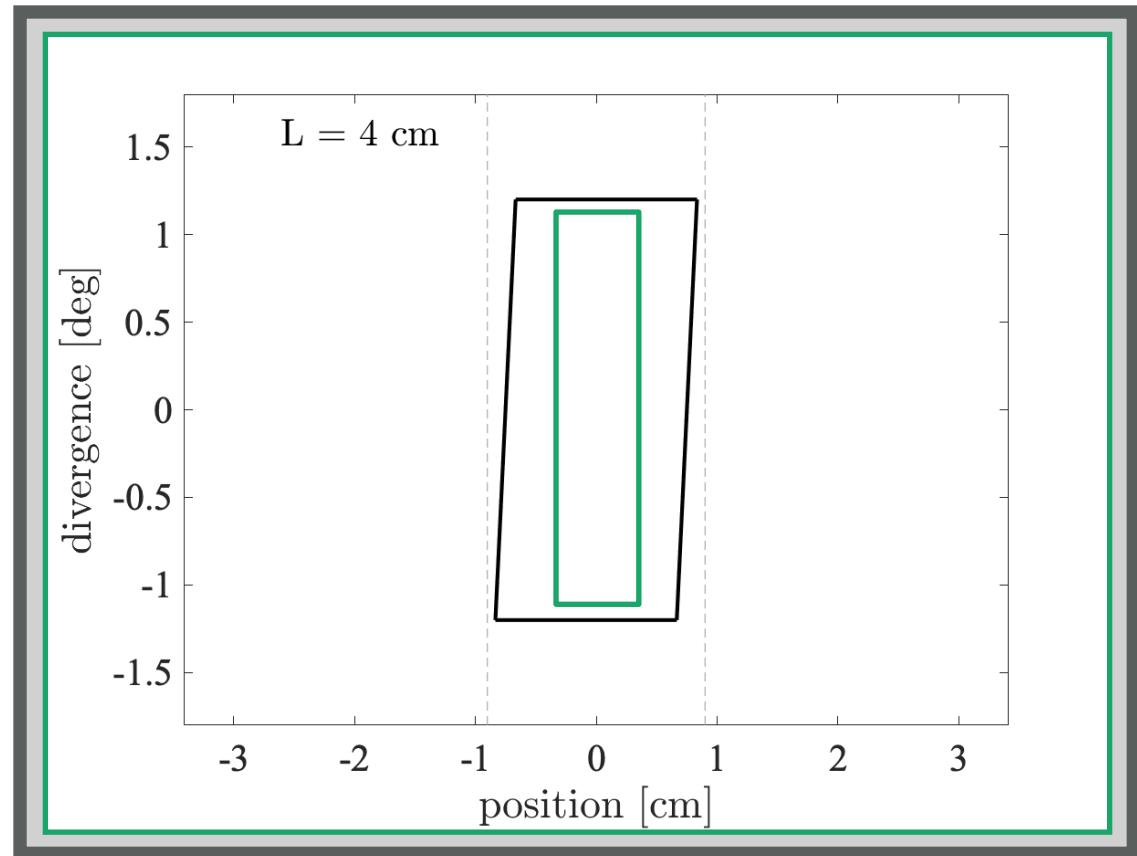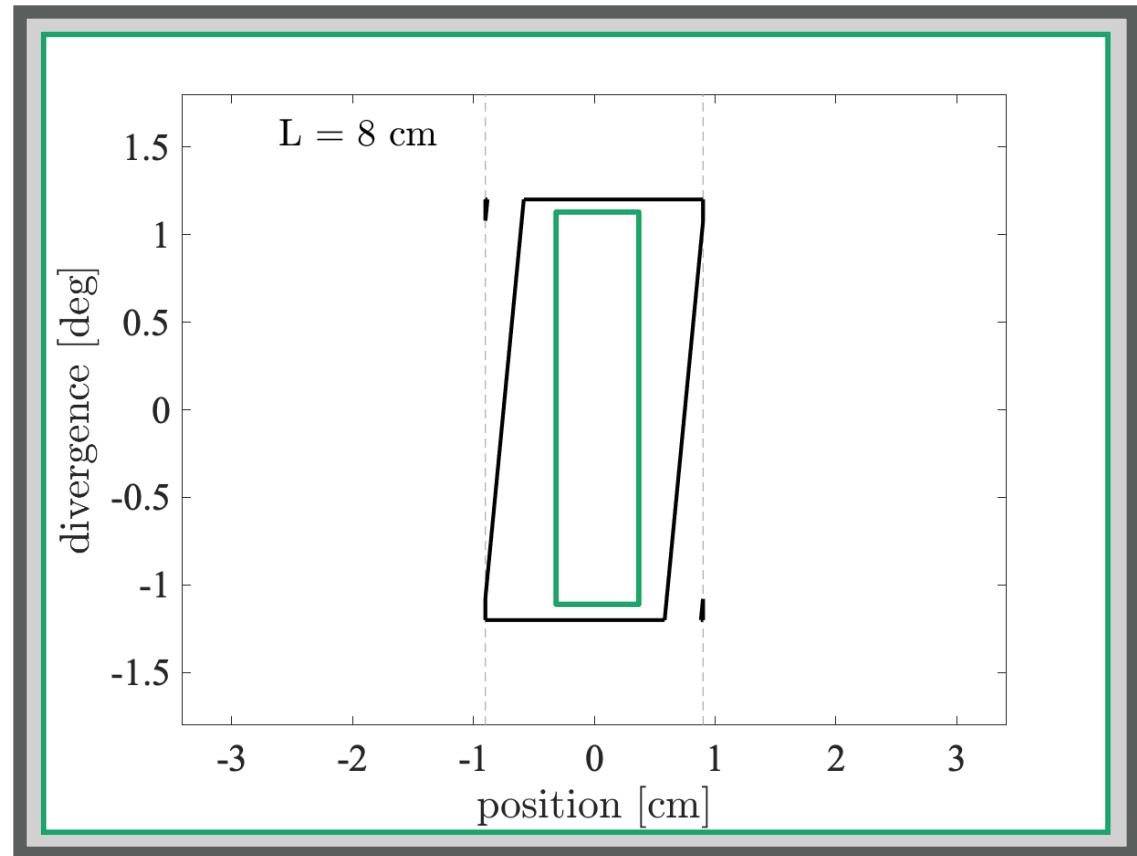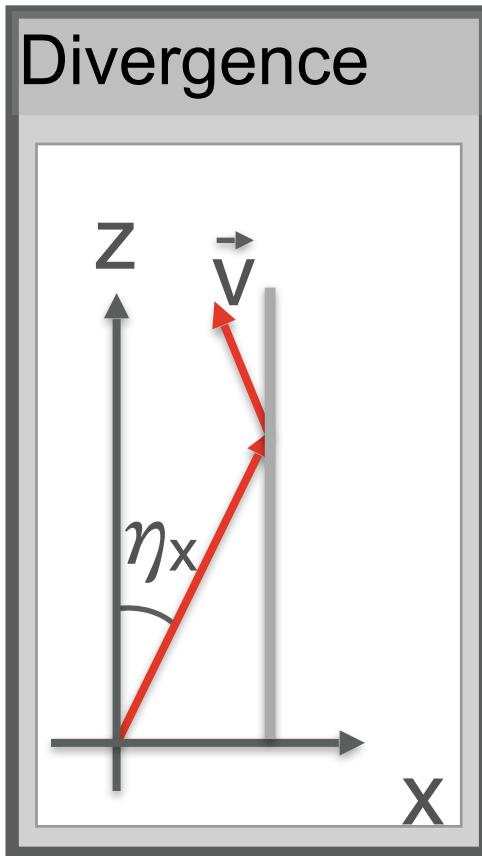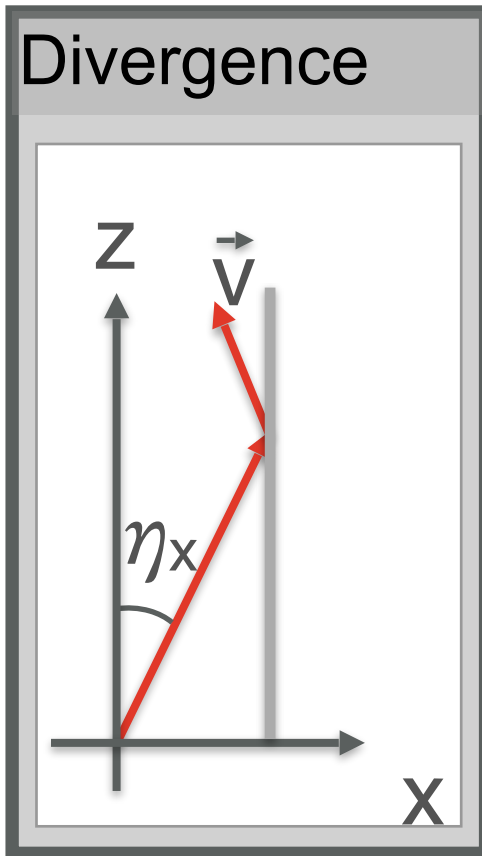
Divergence

Beam propagation in guide

Beam propagation in guide

Beam propagation in guide
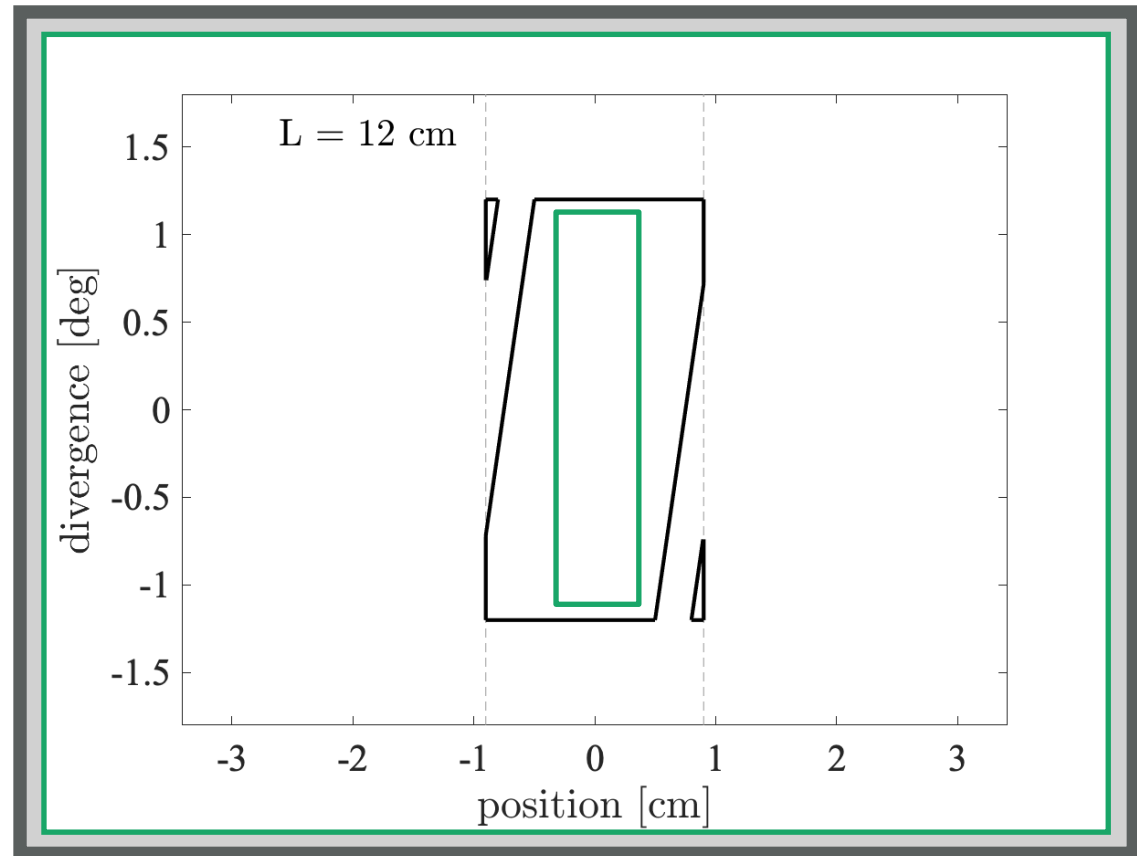
Beam propagation in guide
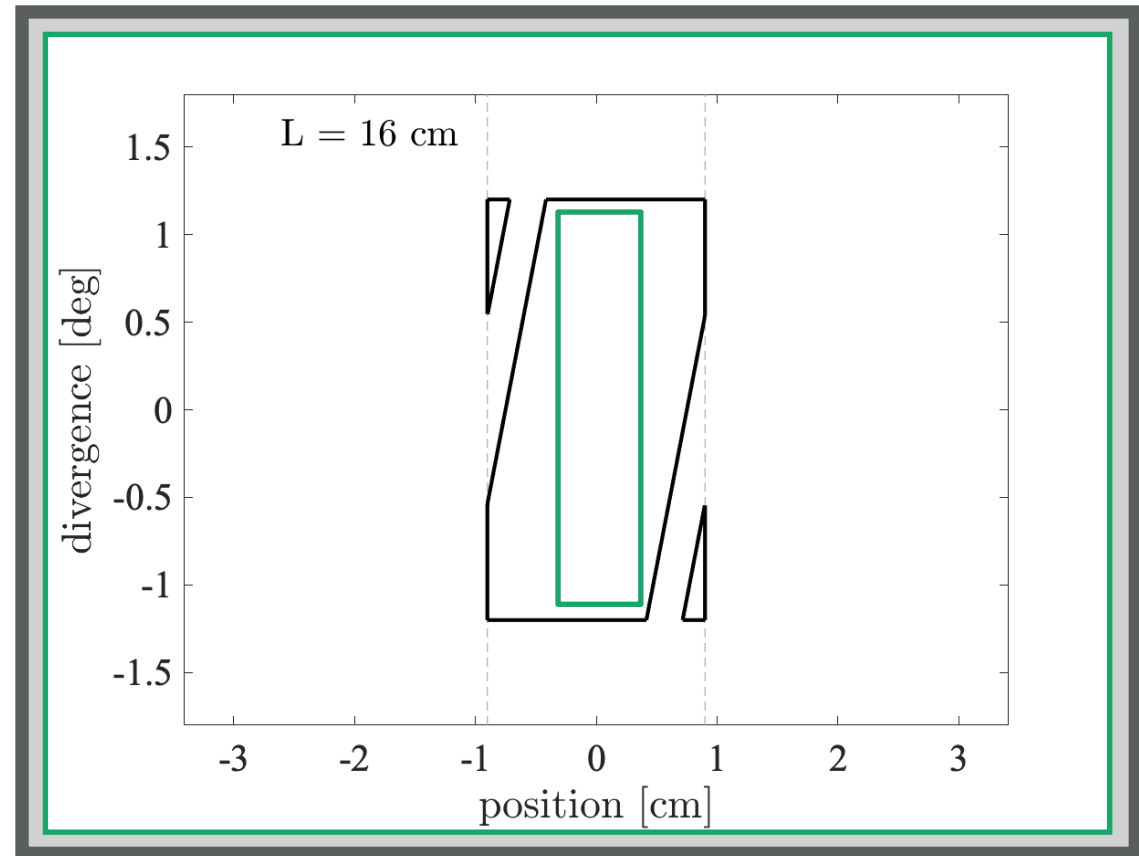
Beam propagation in guide
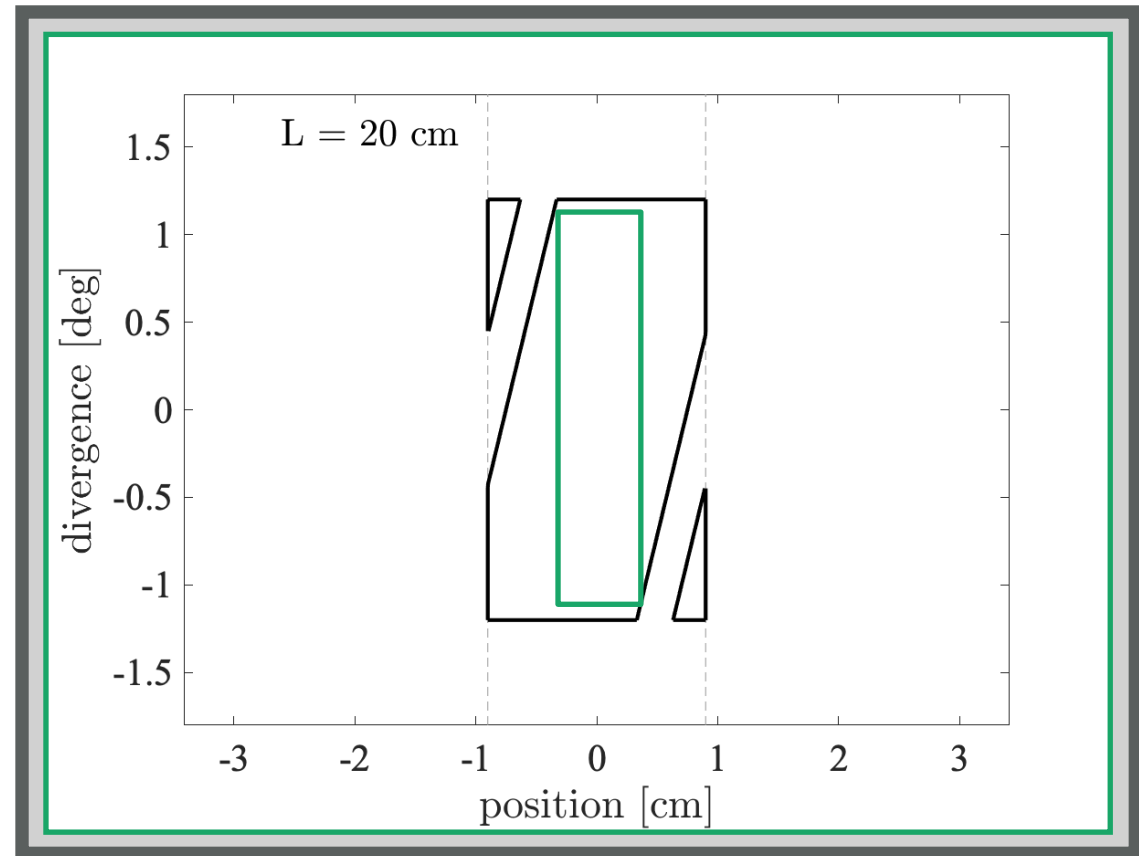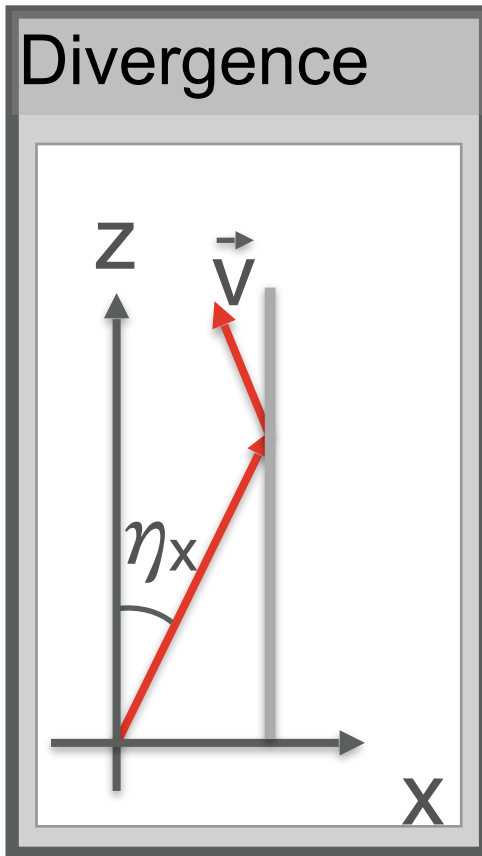
Beam propagation in guide
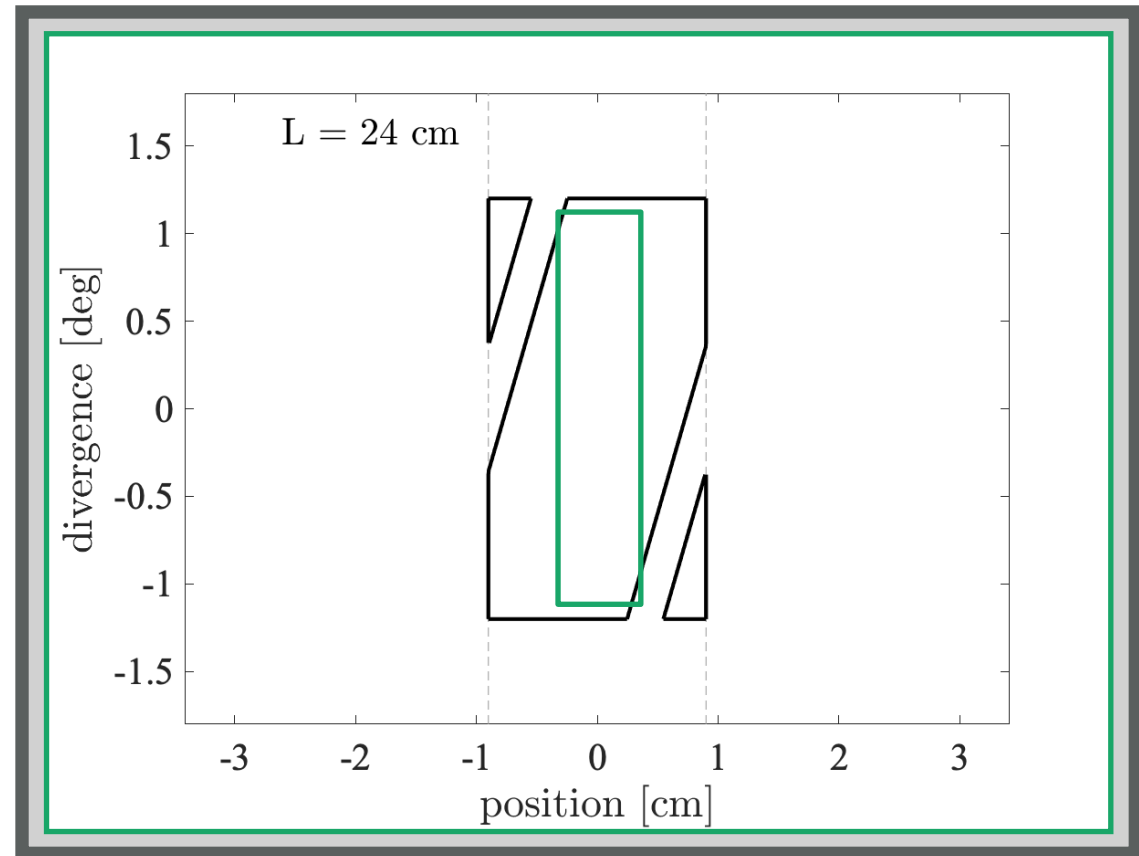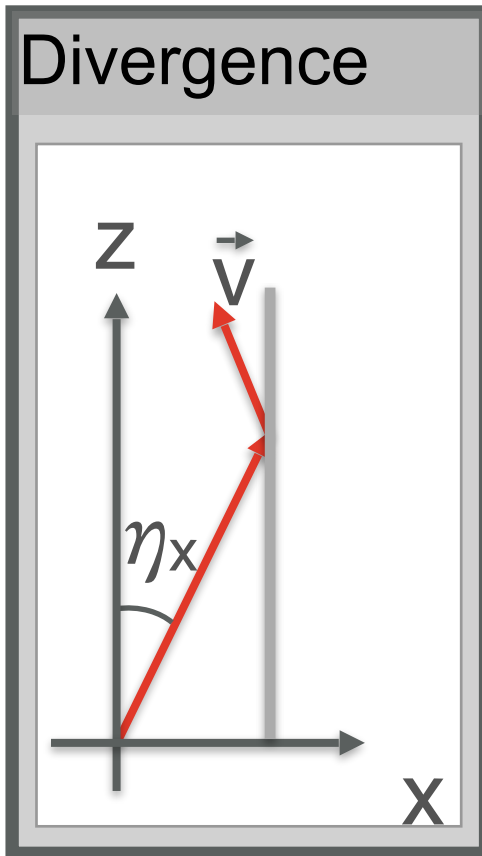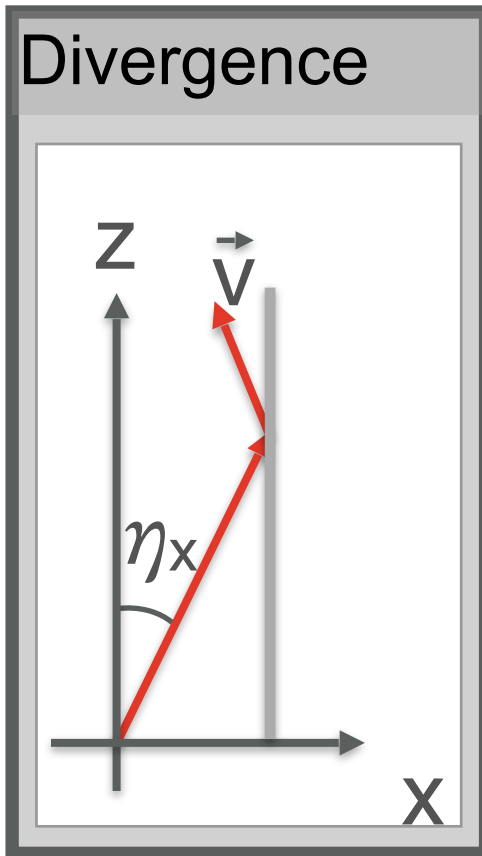
Beam propagation in guide
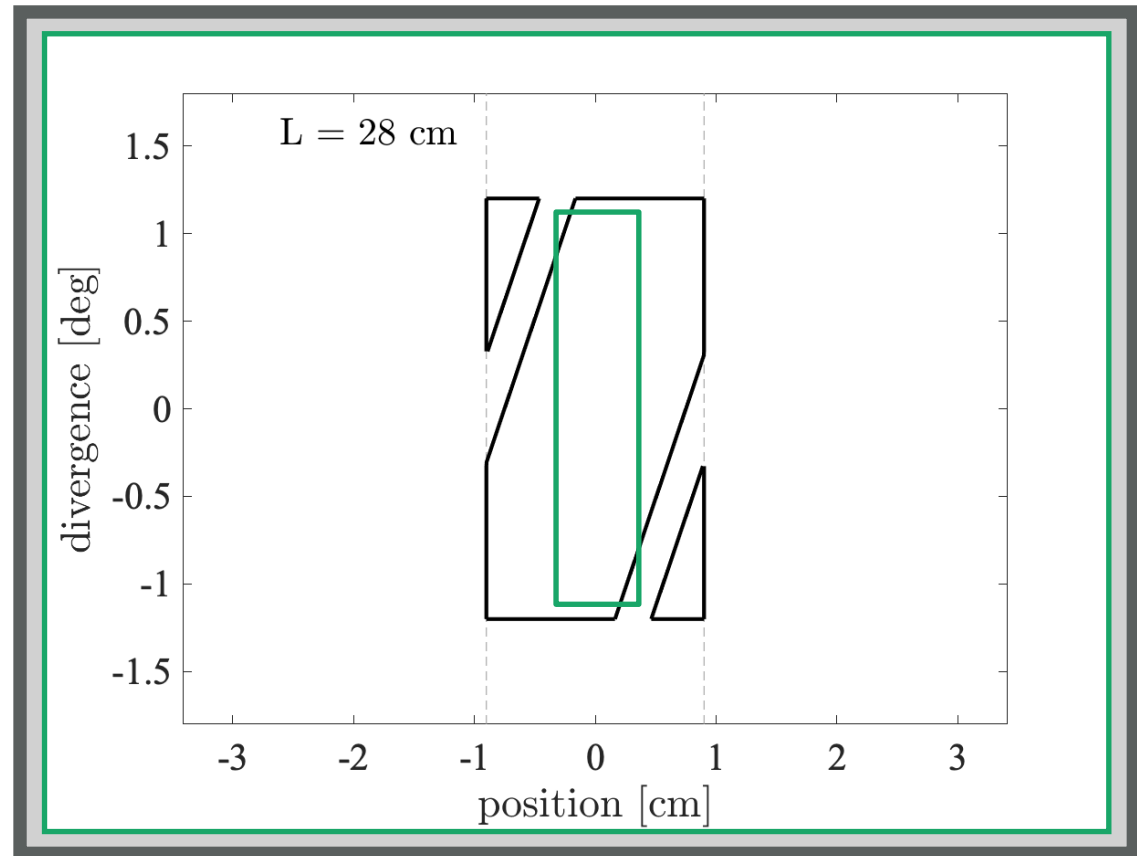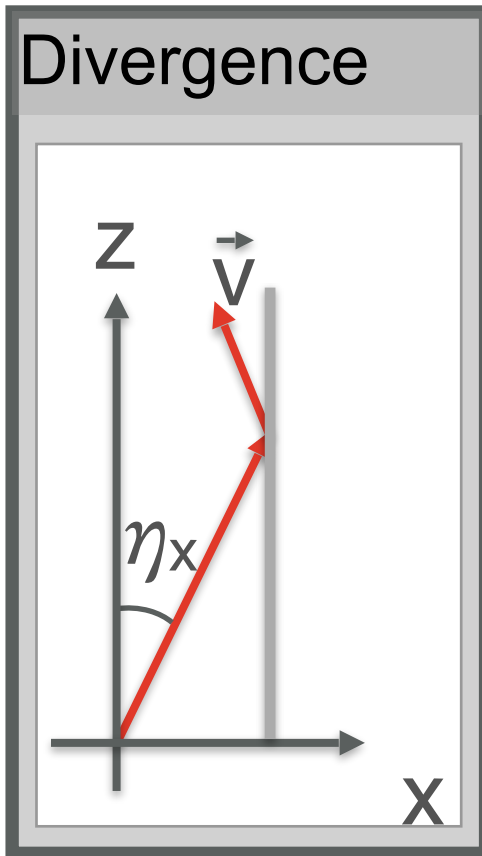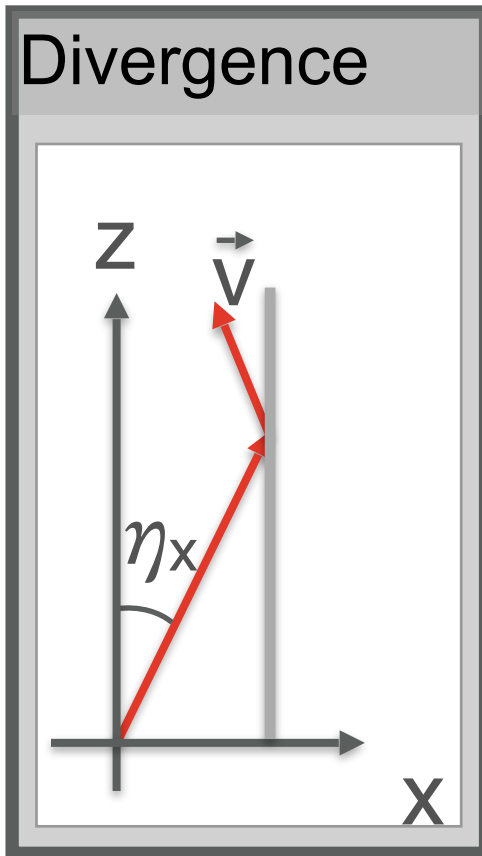
Beam propagation in guide
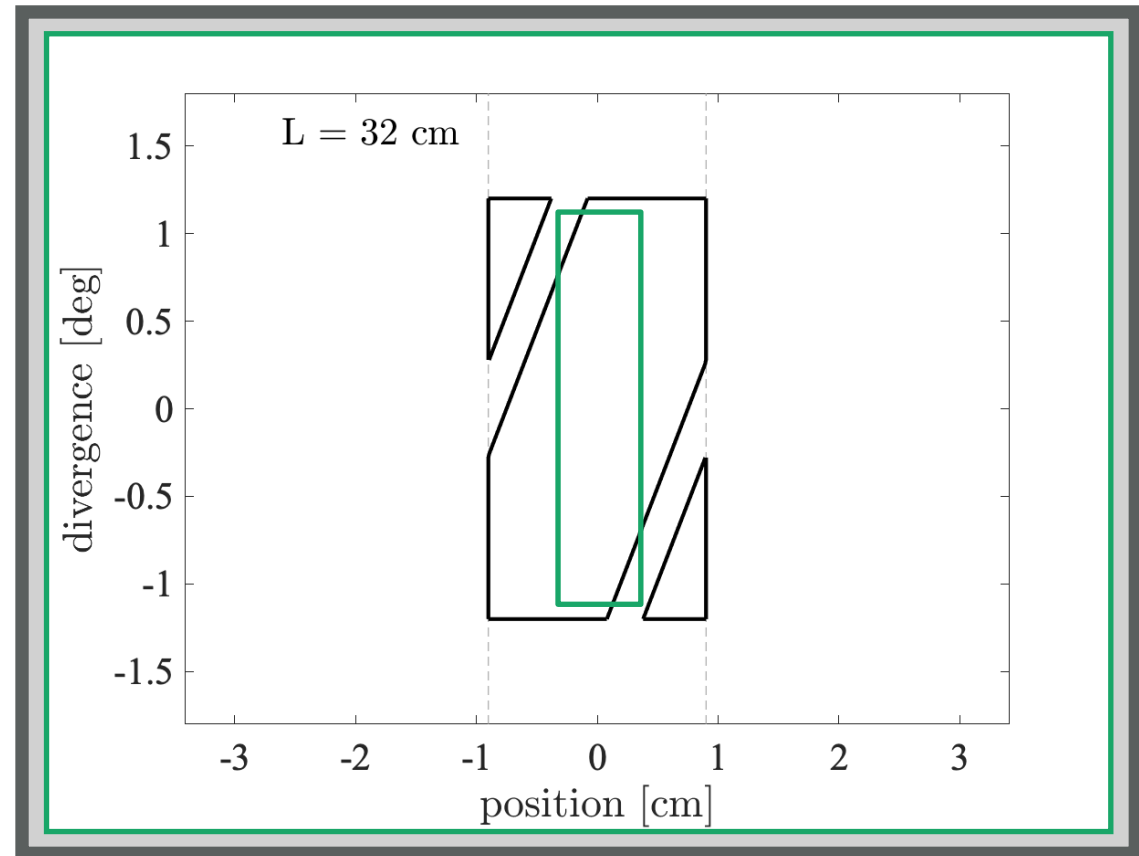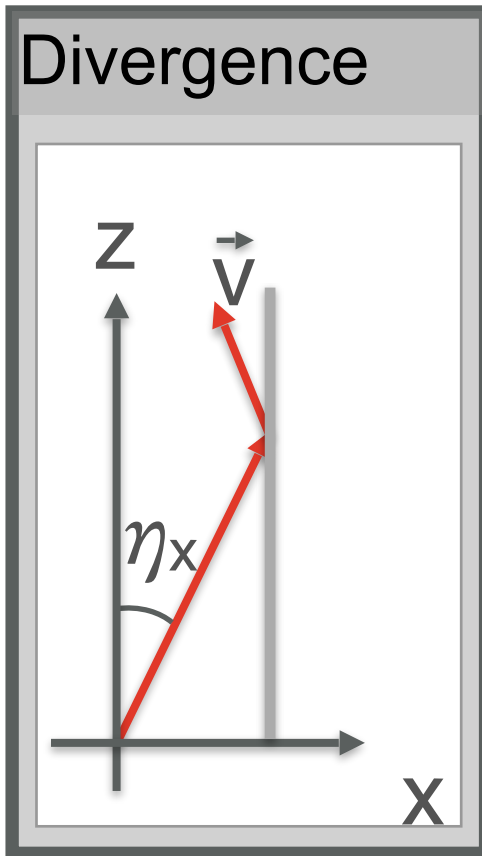
Beam propagation in guide
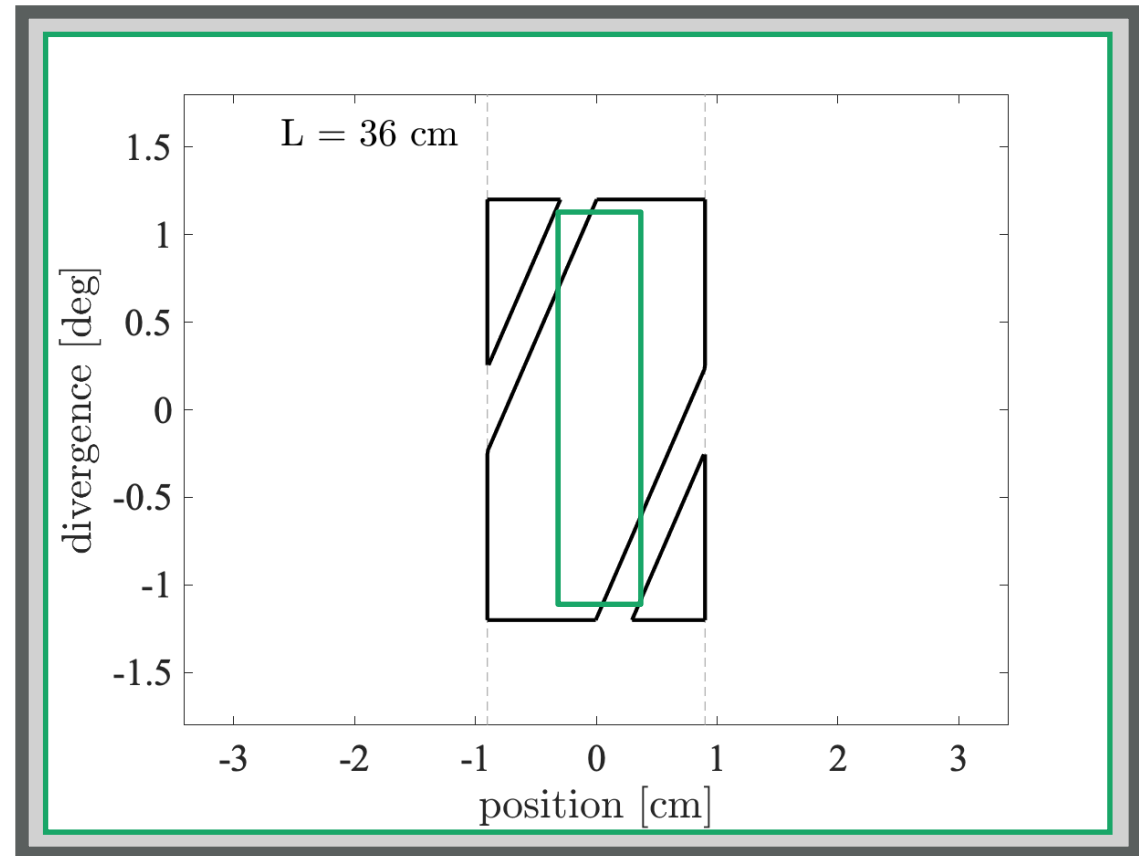
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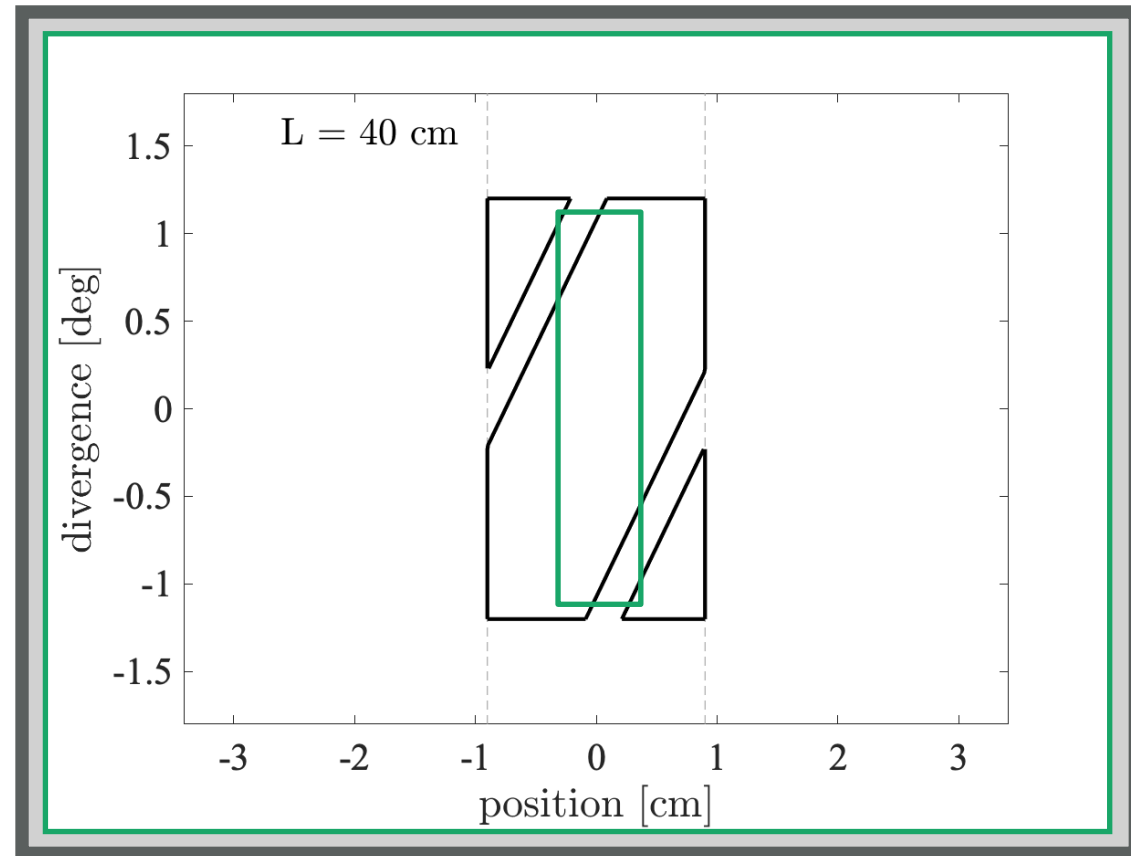
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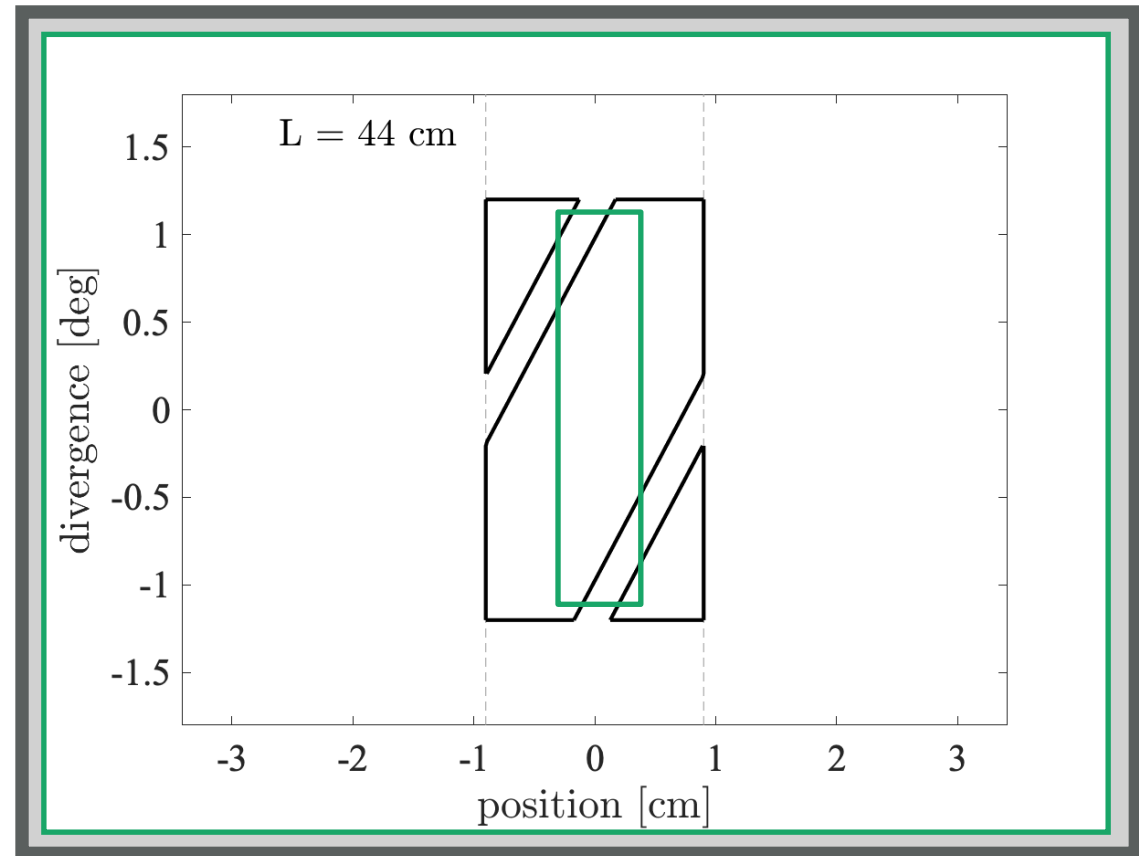
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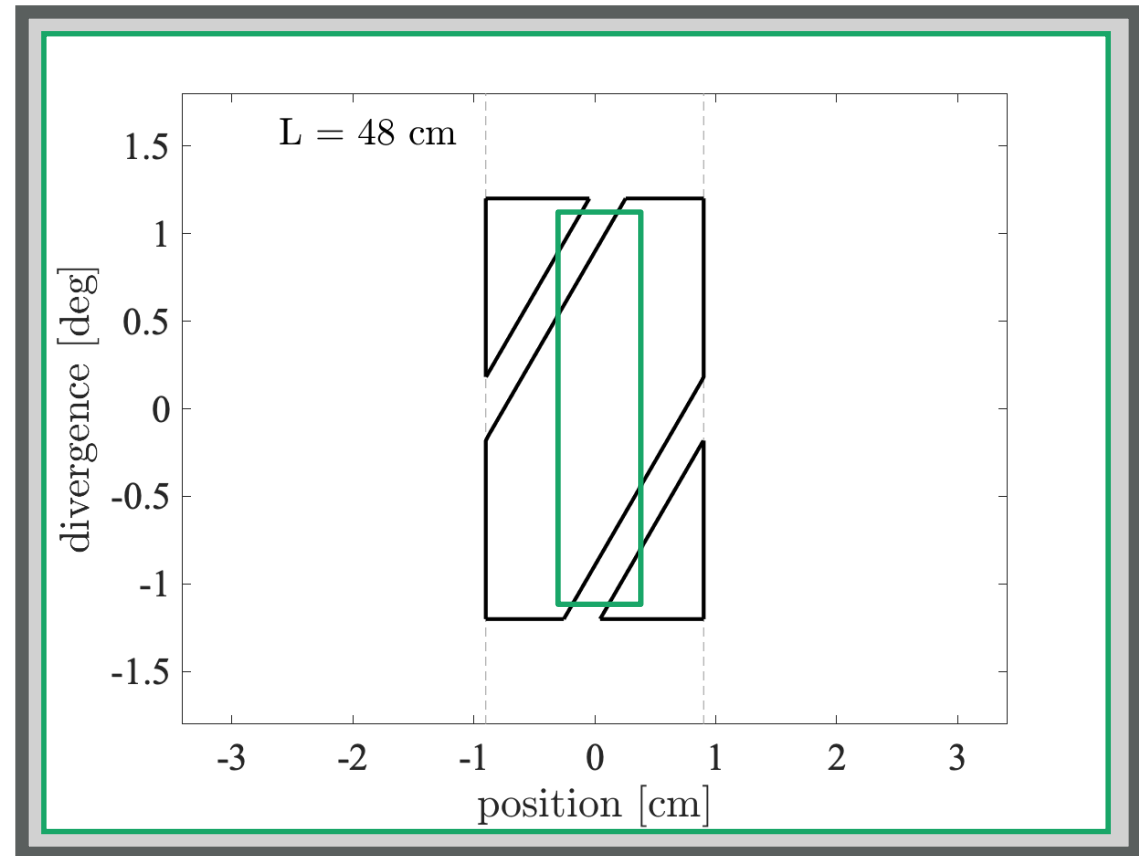
Beam propagation in guide
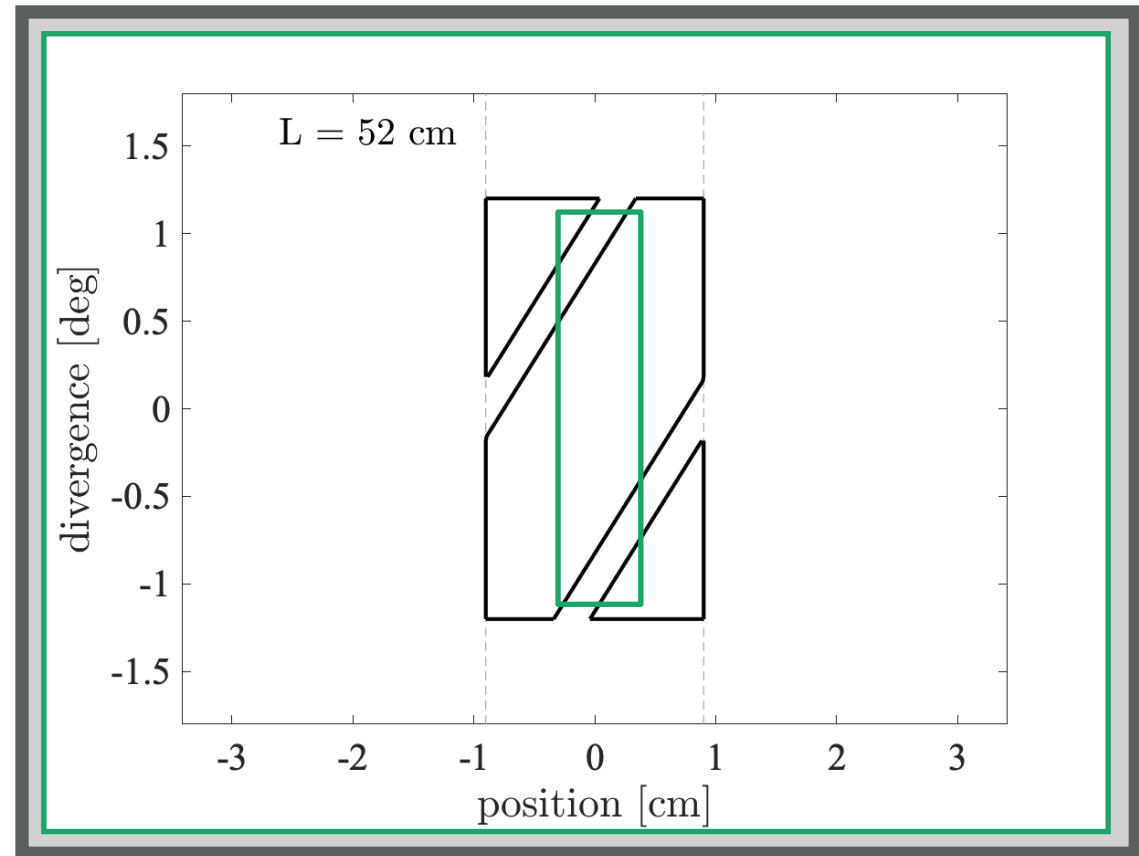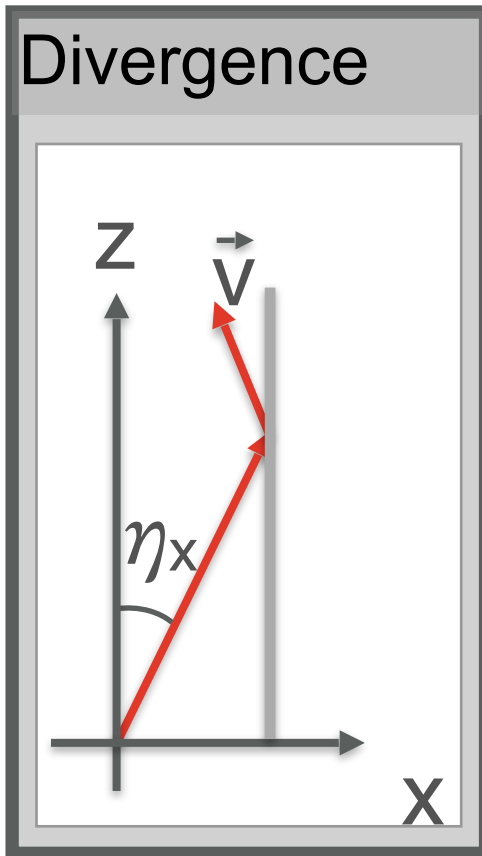
Beam propagation in guide
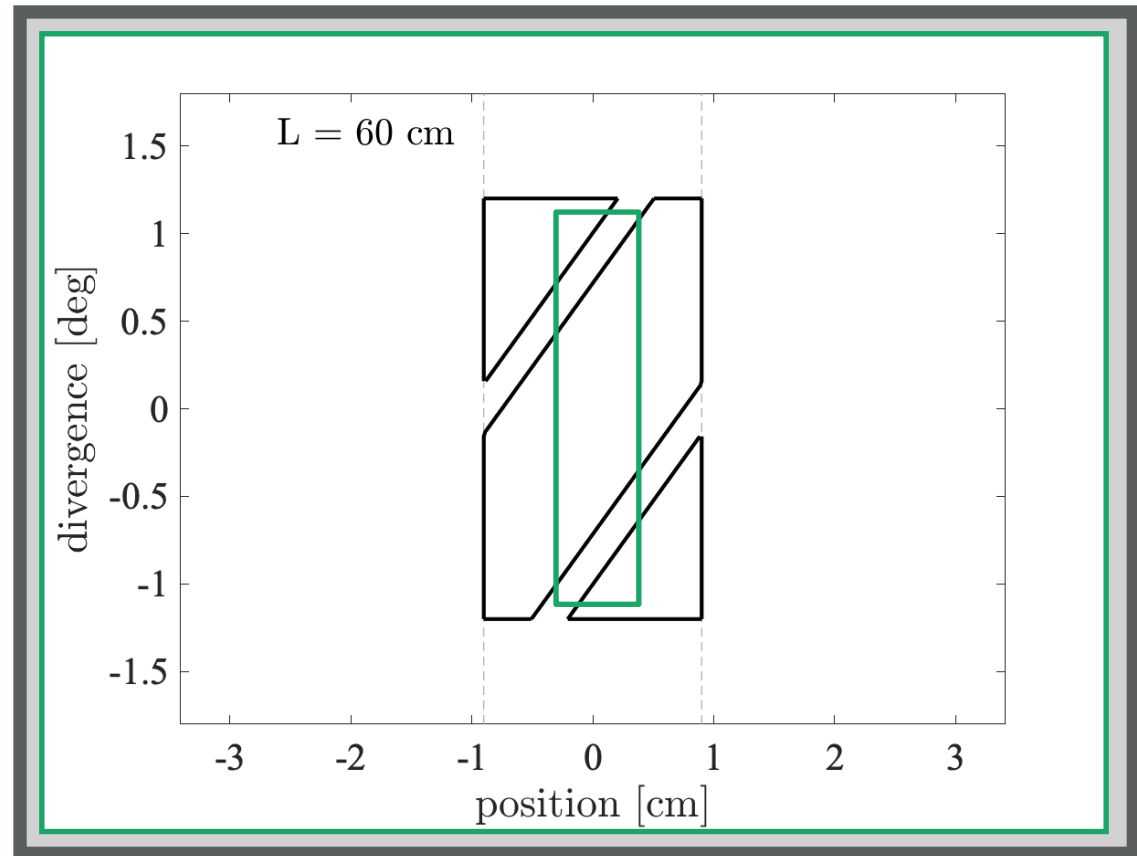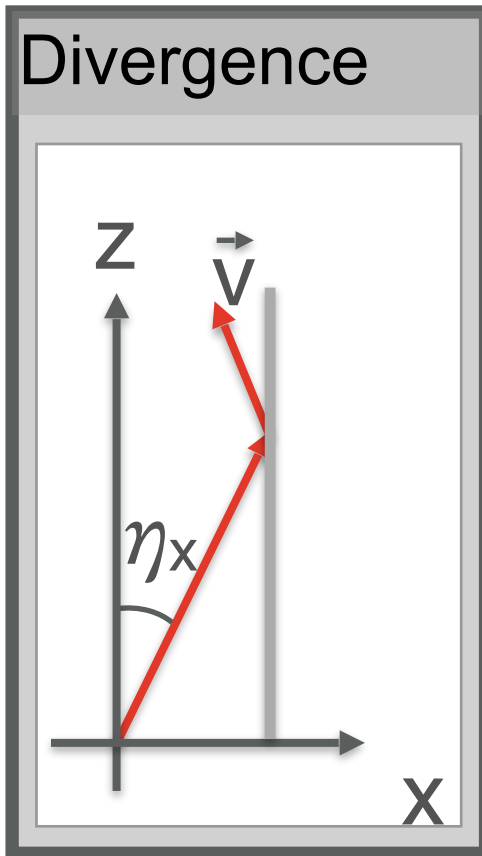
Beam propagation in guide

With a guide we lost less phase-space area!

Divergence
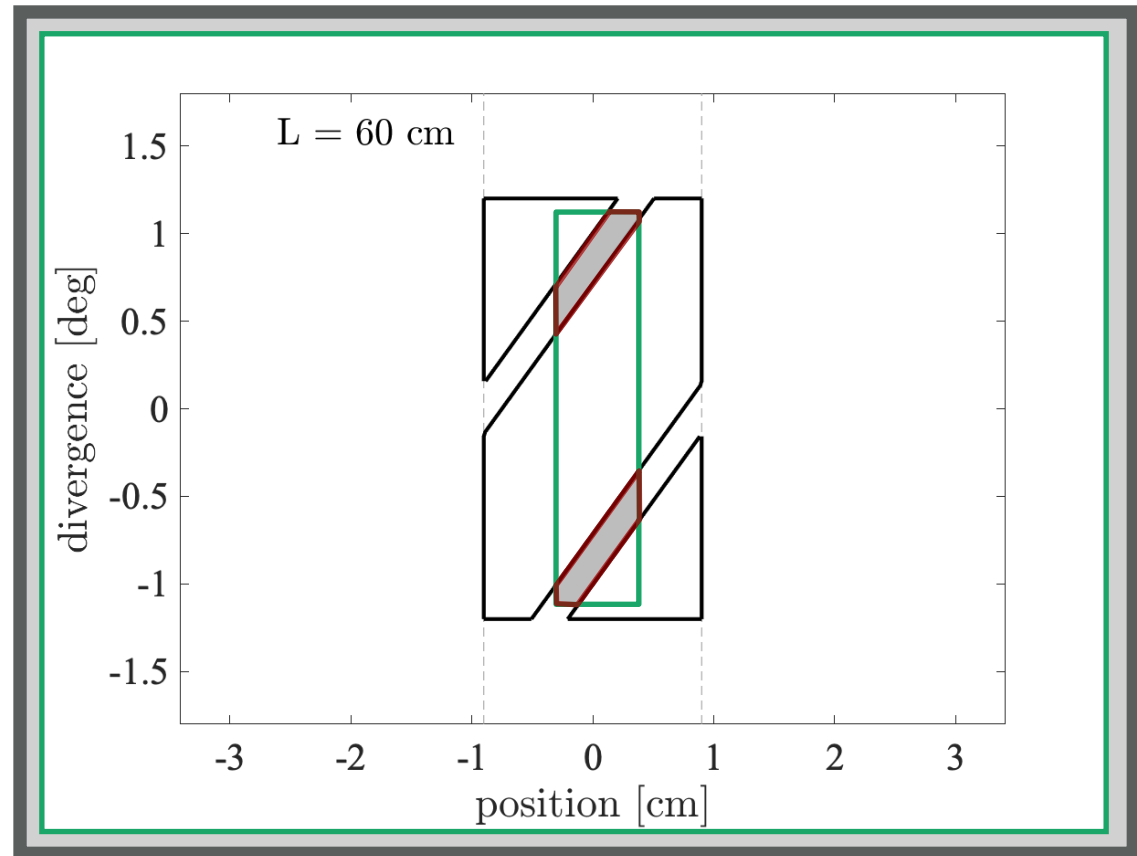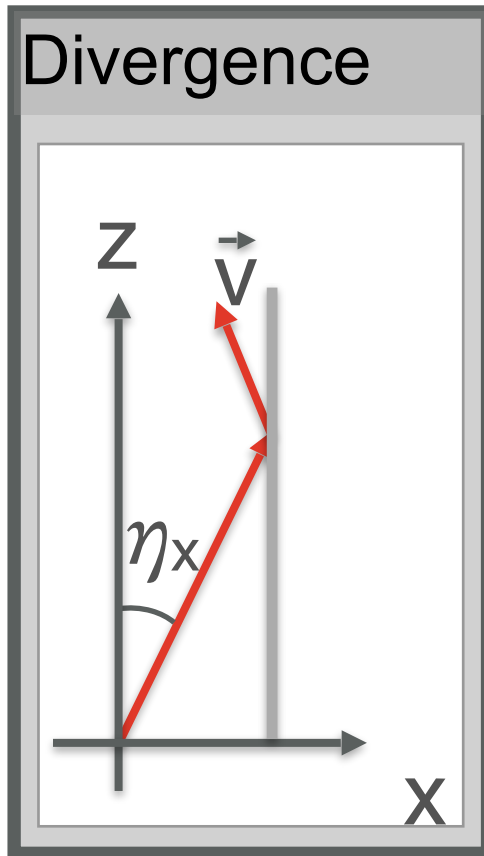
Reflectivity curves

- Reflectivity, super mirror, reflectivity curve

$$m = \frac{\theta_{mirror}}{\theta_{Ni}}$$

Multilayer stack with varying d

Substrate
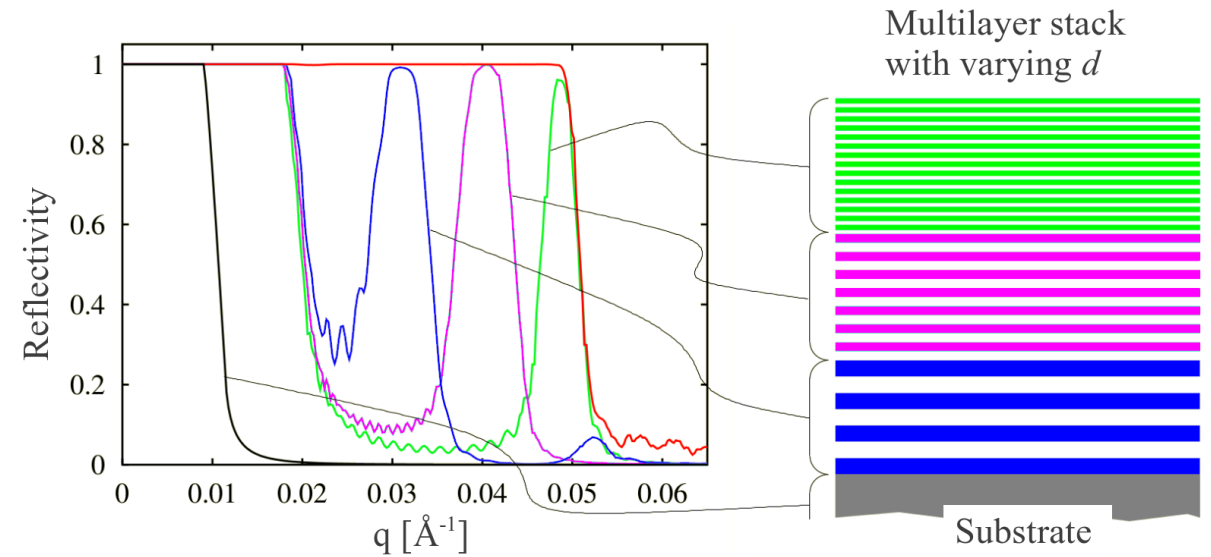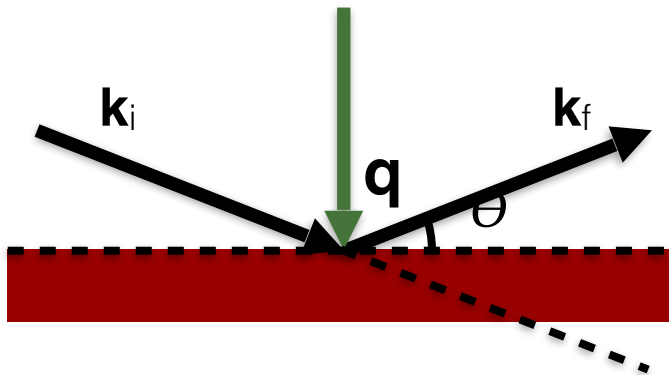
Reflectivity curves in McStas

$$R(q) = \begin{cases} R_0 & \text{if } q < q_c \\ R_0(1 - \tanh((q - mq_c)/W))(1 - \alpha(q - q_c))/2 & \text{otherwise} \end{cases}$$

McStas standard model

Slope: $-\alpha$

Cutoff: $\dfrac{\tanh}{W}$

Legend:
- $m = 2$
- $m = 3$
- $m = 4$
- $m = 5$
- $m = 6$
- $m = 7$

Reflectivity vs q [Å^{-1}]
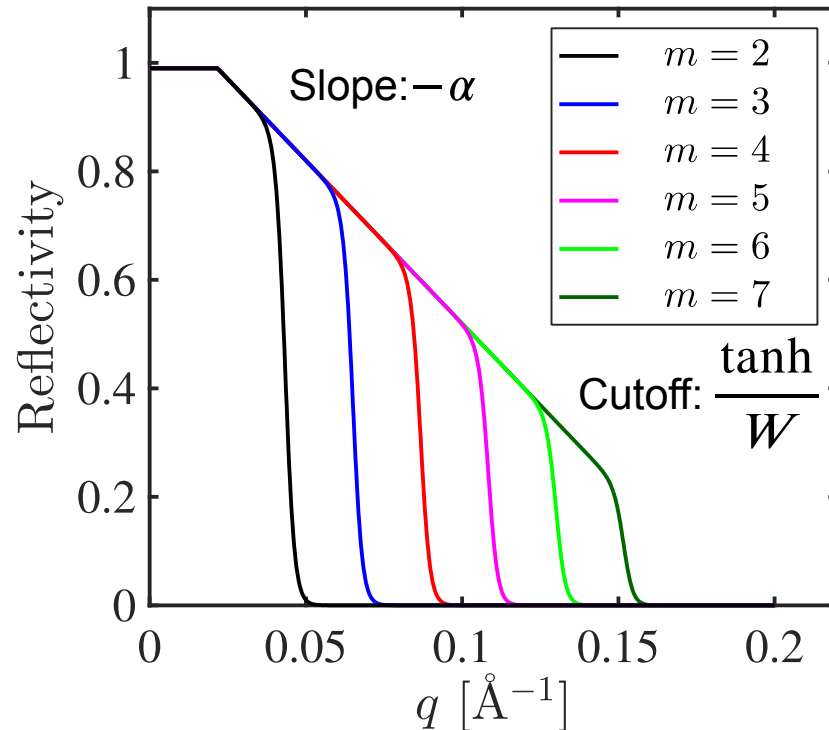
McStas fitted model

Legend:
- $m = 2$
- $m = 3$
- $m = 4$
- $m = 5$
- $m = 6$
- $m = 7$
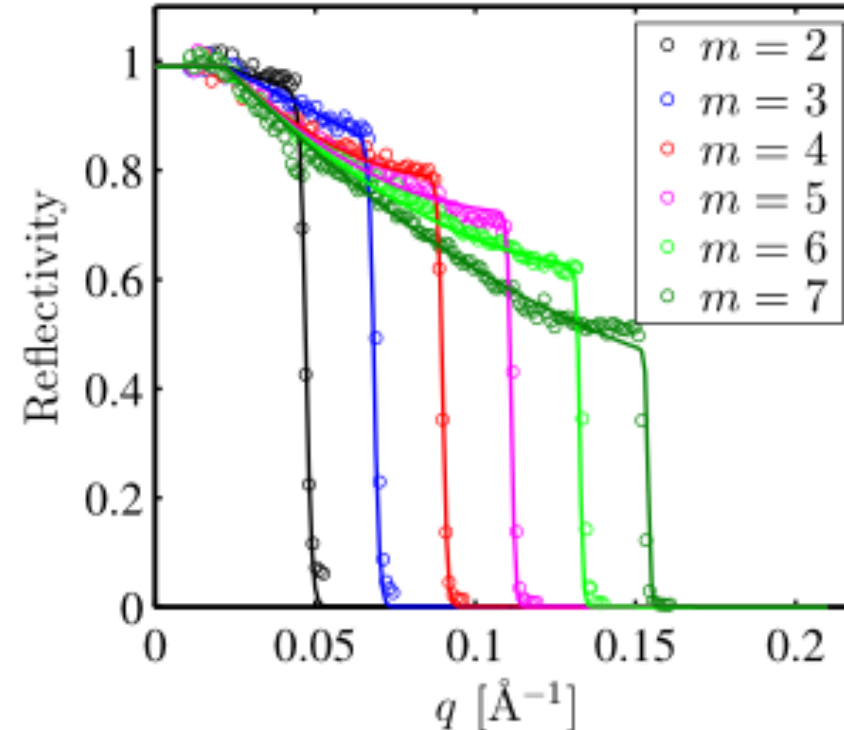
$\alpha = 0$
$W = 0$

Only m matters

Better mirrors available today

Guide placement in McStas

- The center is the front of the guide element
- Tip: Insert a guide at the end of the guide

COMPONENT Source
AT (0,0,0) ABSOLUTE

COMPONENT Guide(length=A)
AT (0,0,2) RELATIVE Source

COMPONENT Arm
AT (0,0,A) RELATIVE Guide
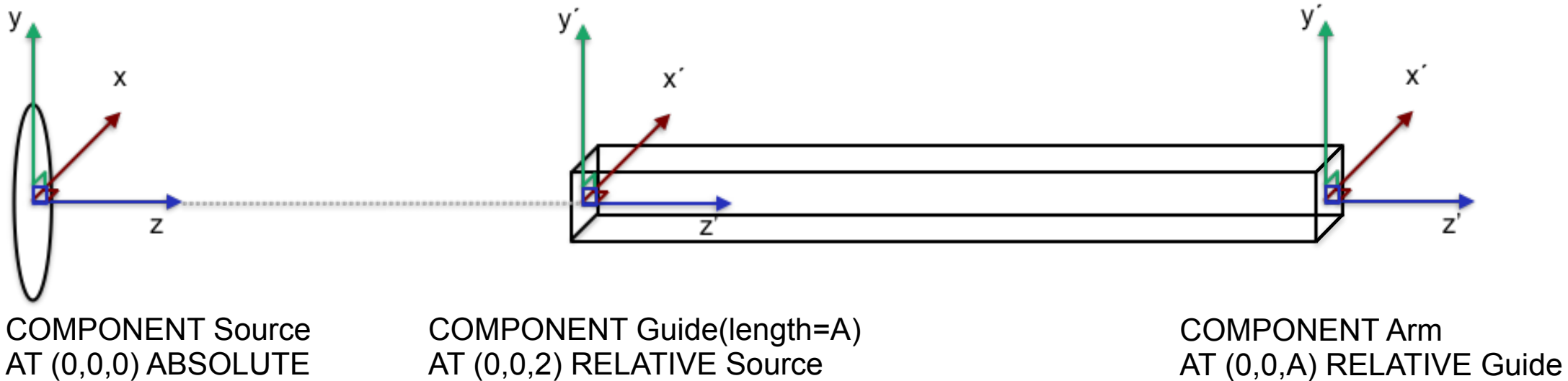
Gravitation in McStas

- Enabled by adding -g / --gravitation on command line or by selecting "Gravity On" in mcgui

- Default ~ gravity on earth
  #define GRAVITY 9.81   /* [m/s^2] gravitational acceleration */

  (If on the moon, use -DGRAVITY=1.62 ;-))

- For guides, only Guide_gravity and Elliptic_guide_gravity support parabolic propagation. (Many others propagate linearly in $\vec{v}$ direction.)

- As you will see in the practical, implications are greatest with long wavelengt

- *"How about e.g. elliptic mirror optic X that does not support gravity?"*

  - often a good workaround is to add a monitor close to the surface of object X, this takes care that propagation up to the monitor includes gravitation:

  - Gravity is enabled in any call to PROP_DT, PROP_Z0 etc., but not in intersect_* routines (most monitors use PROP_Z0 directly, no intersect_ call first

  - OK to propagate without gravitation e.g. within sample, through velocity selector etc. / range of ~cm's
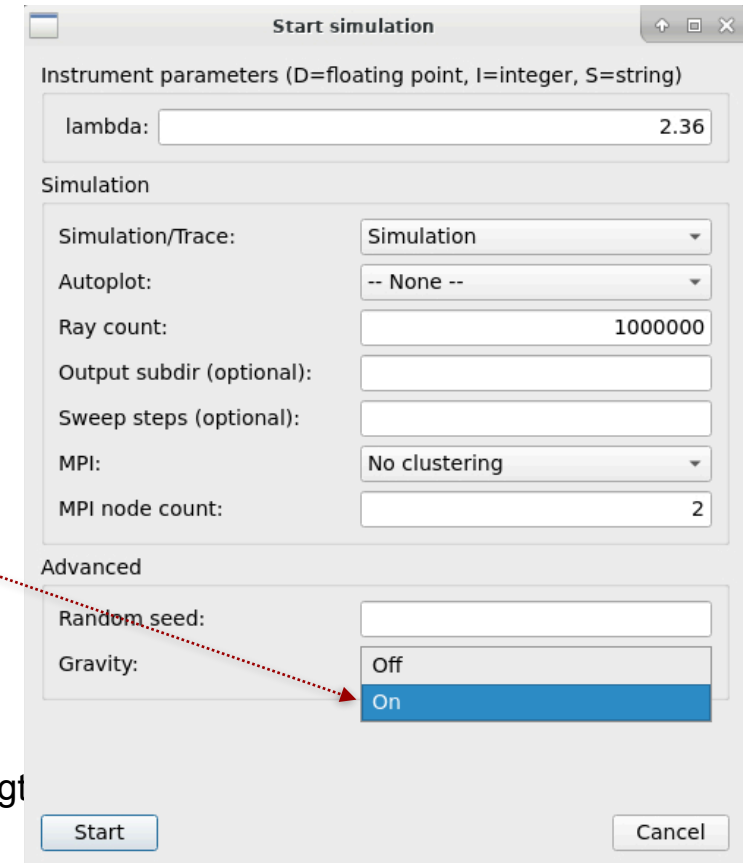
Start simulation

Instrument parameters (D=floating point, I=integer, S=string)

lambda: 2.36

Simulation

Simulation/Trace: Simulation
Autoplot: -- None --
Ray count: 1000000
Output subdir (optional):
Sweep steps (optional):
MPI: No clustering
MPI node count: 2

Advanced

Random seed:
Gravity: Off
On

Start   Cancel

Popular guide components: Guide_gravity

- Typical guide component with gravity, parameter-interface similar to e.g. Guide.comp
- Many additional features, channels, fermi chopper, … (see mcdoc pages for more info)
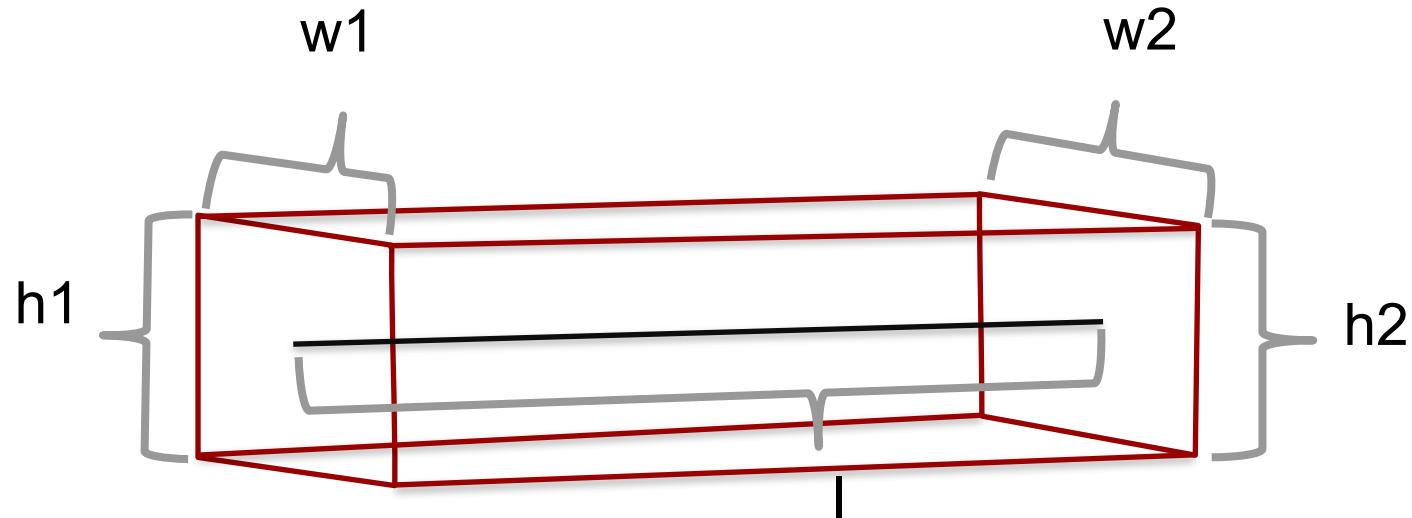
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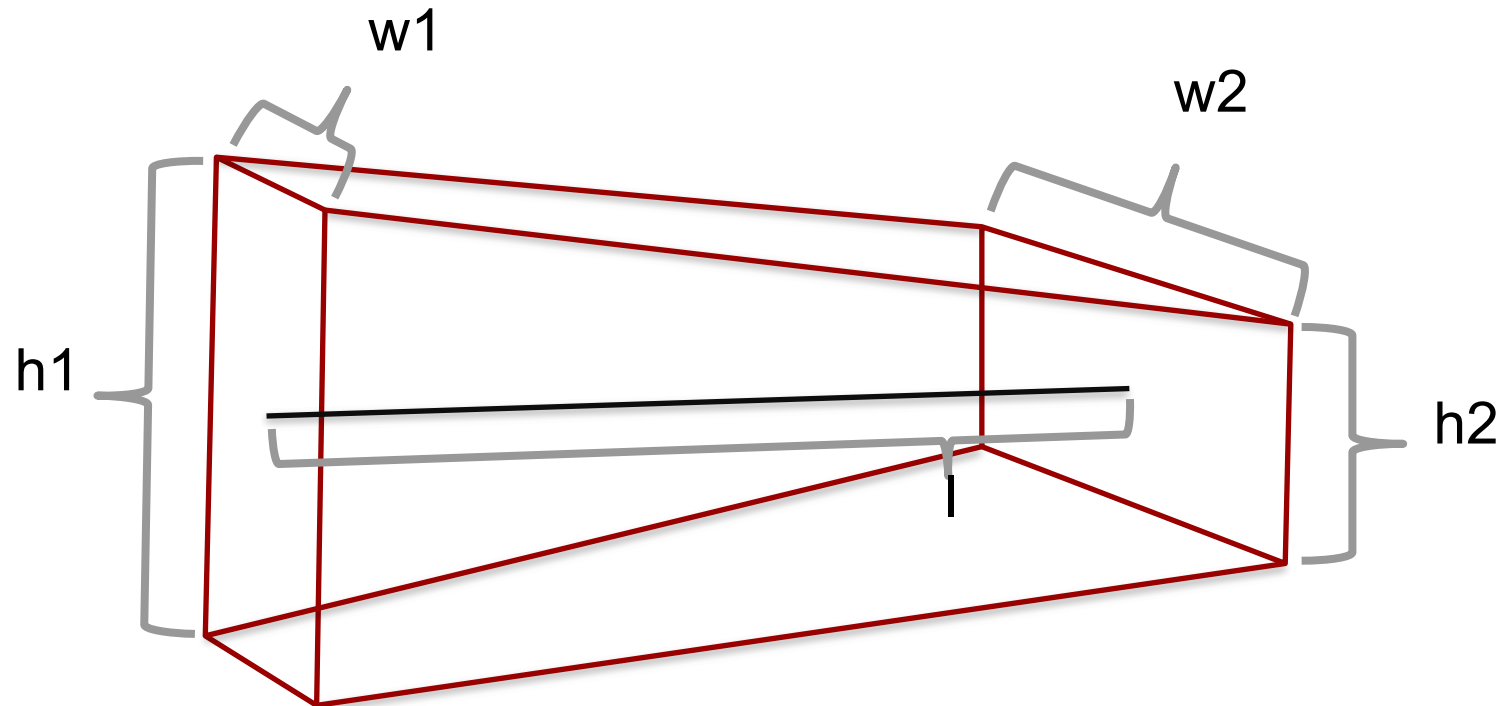
Popular guide components: Guide_gravity

- Typical guide component with gravity

Popular guide components: Elliptical_guide_gravity

- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution, …

xwidth and yheight at DimensionsAt = "entrance" , "mid" or "exit"
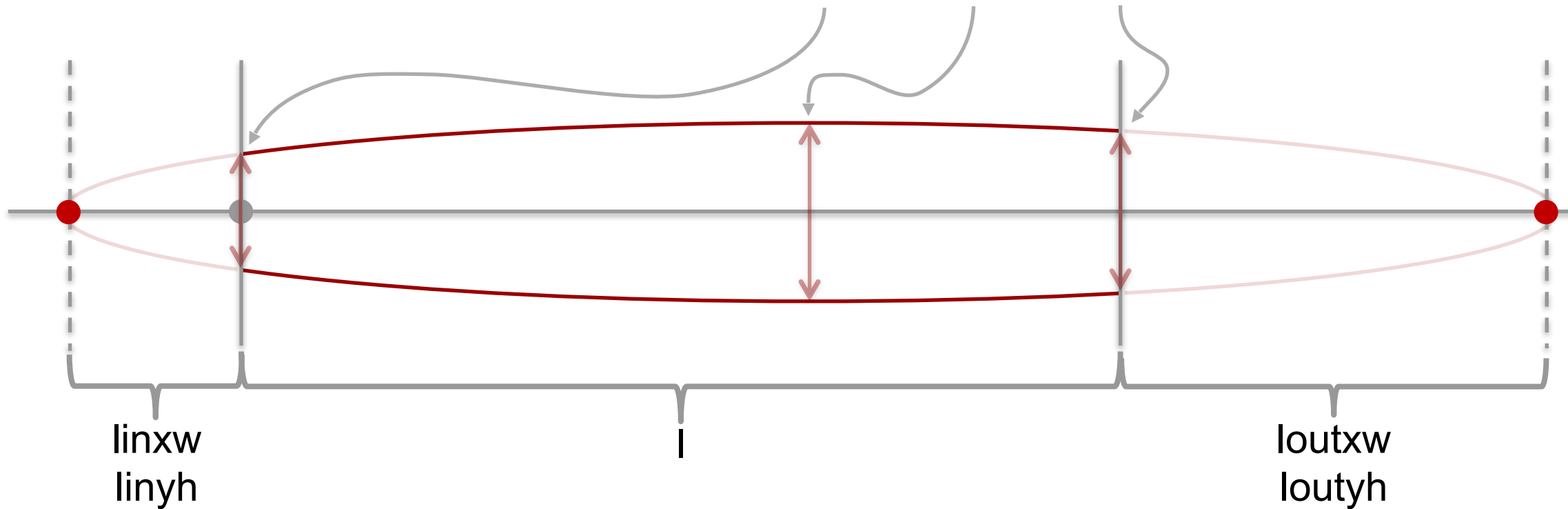
linxw
linyh

l

loutxw
loutyh

Popular guide components: Elliptical_guide_gravity

- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution, …
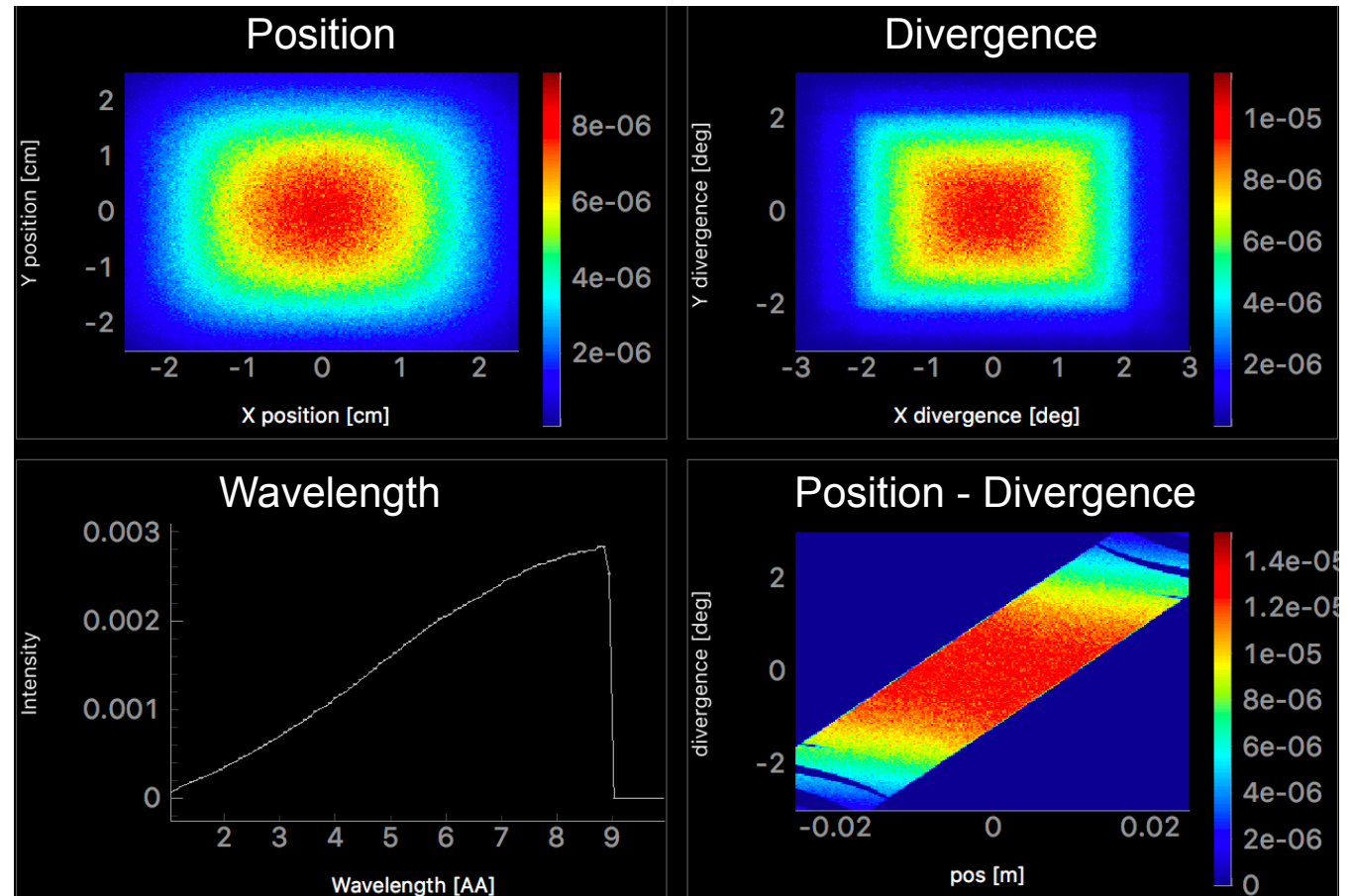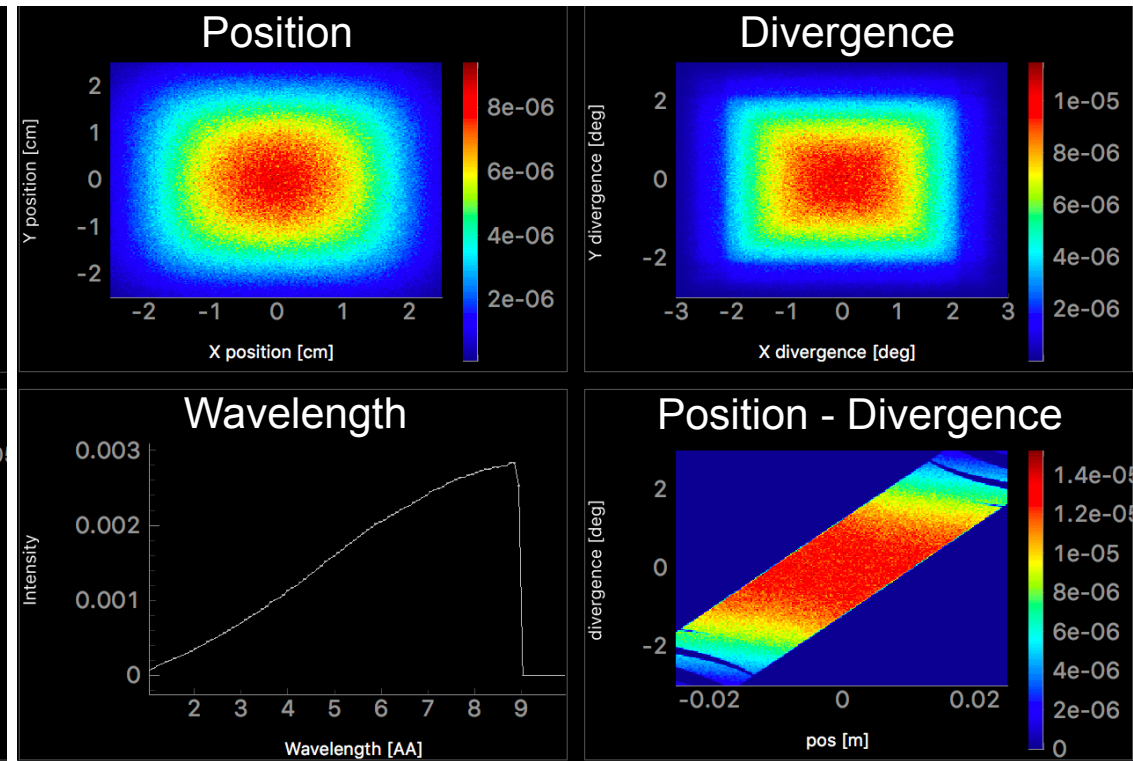
Comparison: Guide_gravity and Elliptic_guide_gravity
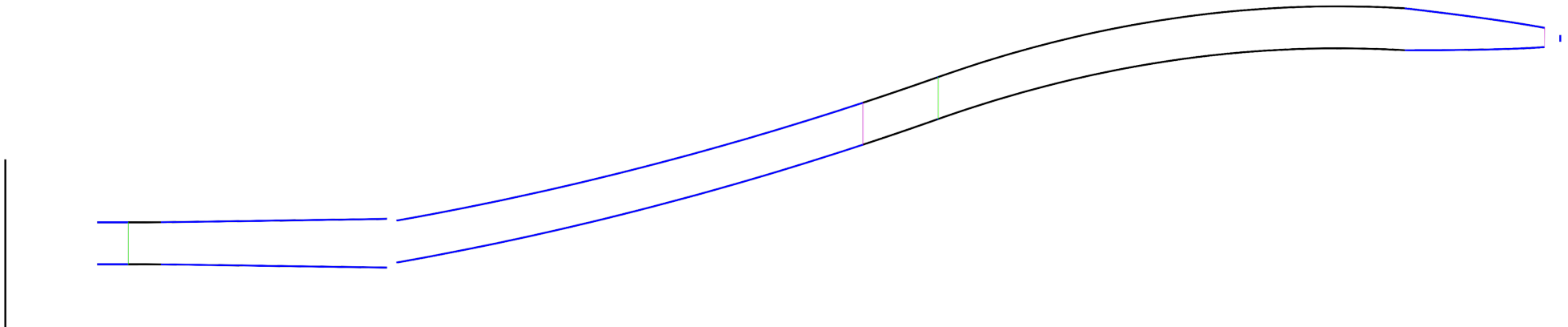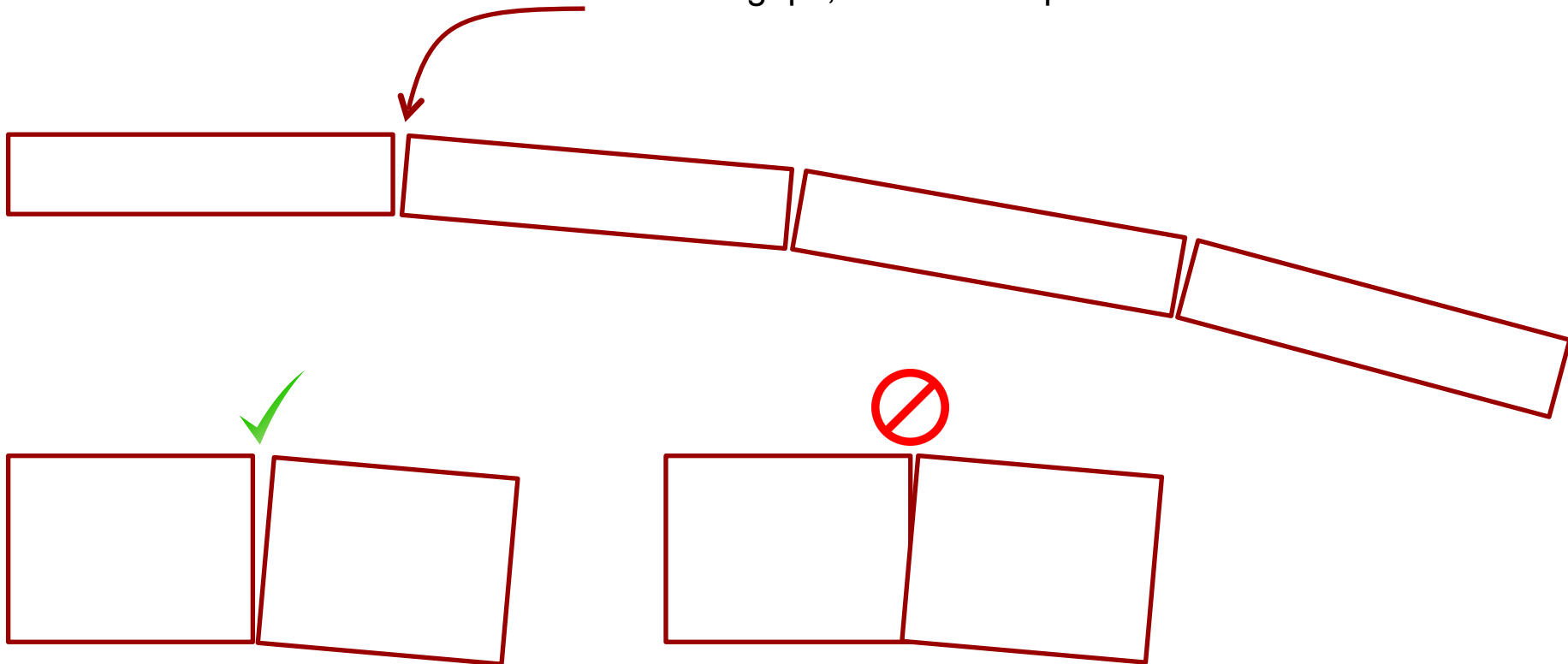
Guide_gravity
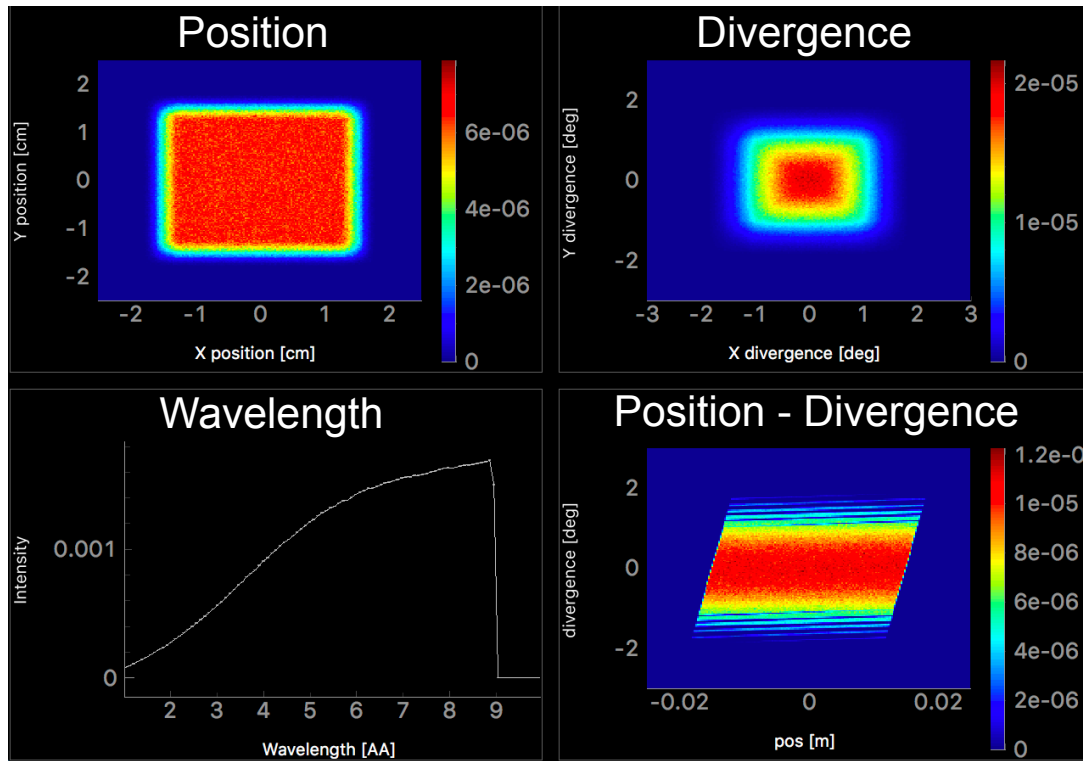
Elliptic_guide_gravity

Breaking line of sight

- Importance of breaking line of sight, ways of doing so, …

Breaking line of sight

- Bender / Guide_curved component or many straight sections

Mind the gaps, avoid overlap

Guide exercise

- Start with instrument file provided on github

- Task 1)
  - Compare output for two different guide lengths
- Task 2)
  - Introduce a parameter that control width of the guide
  - Compare two runs with different guide widths
- **Optional** Task 3)
  - Check how much gravity impacts the output
- **Optional** Task 4)
  - Exchange the last 20% of the guide with an elliptic nose.
  - See the geometry with mcdisplay
  - Identify how the resulting beam have changed
    - .