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# Guides and gravity in McStas

Peter Willendrup

Adapted from slides by Mads Bertelsen, ESS

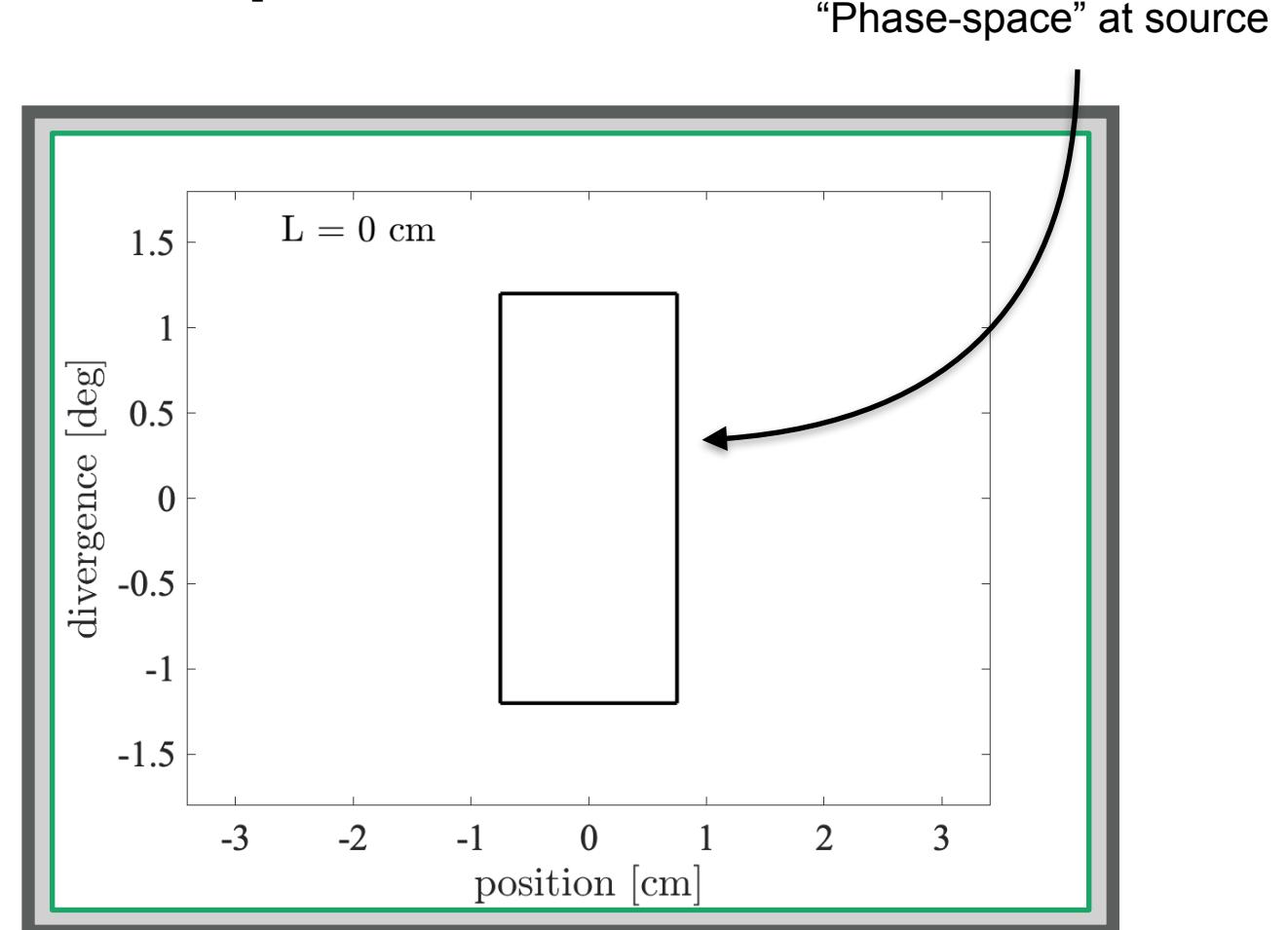
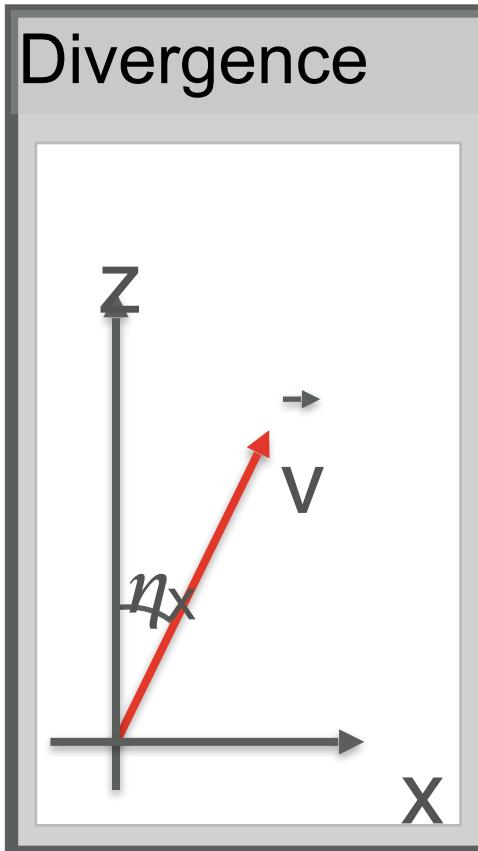


# Overview

- 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
- Example
- Exercise



# Beam propagation in free space

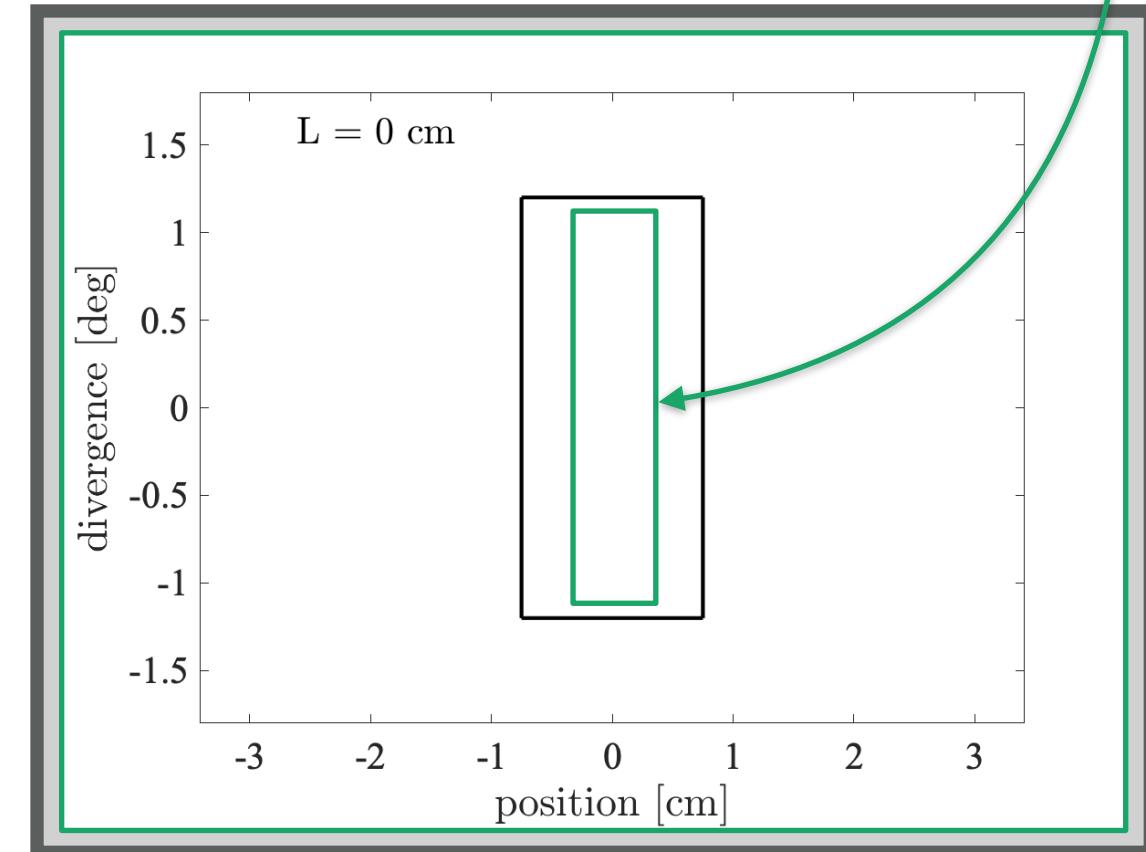
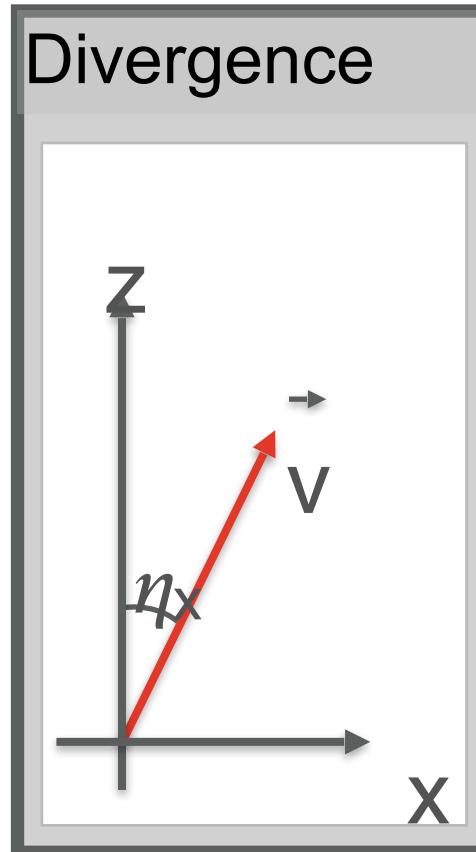




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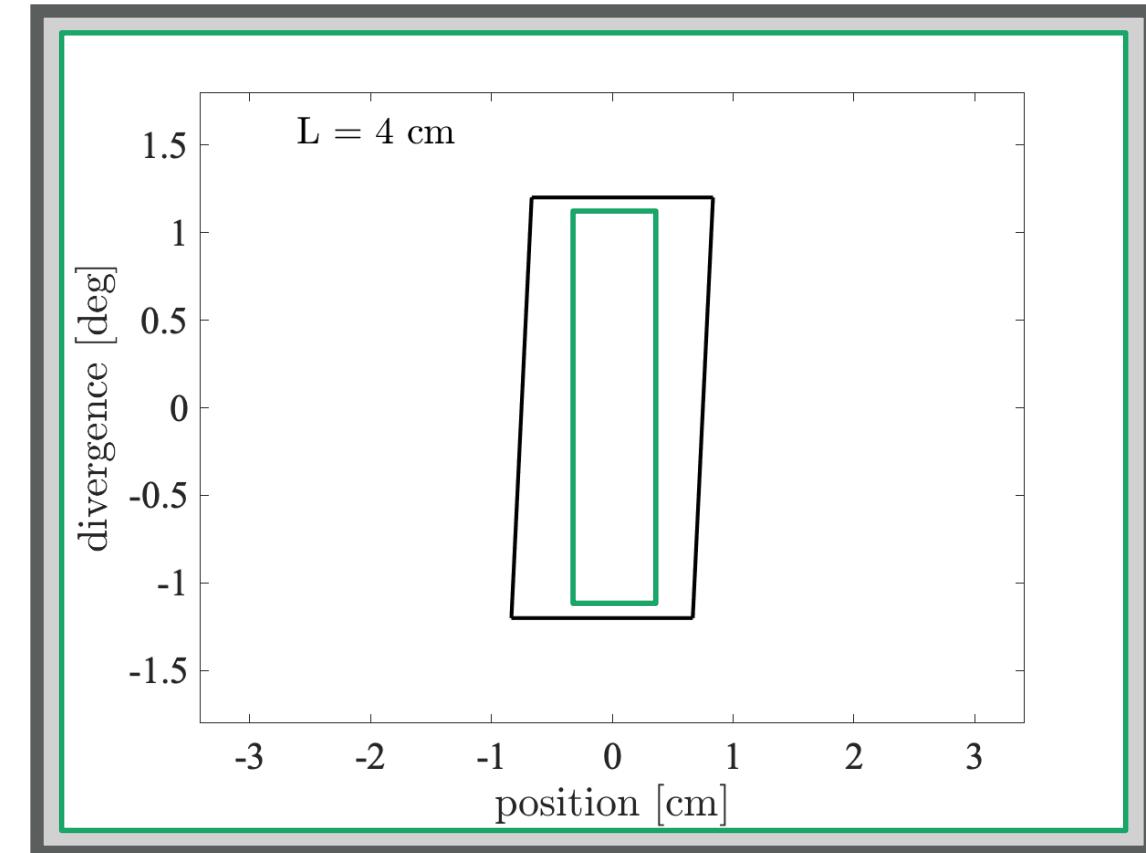
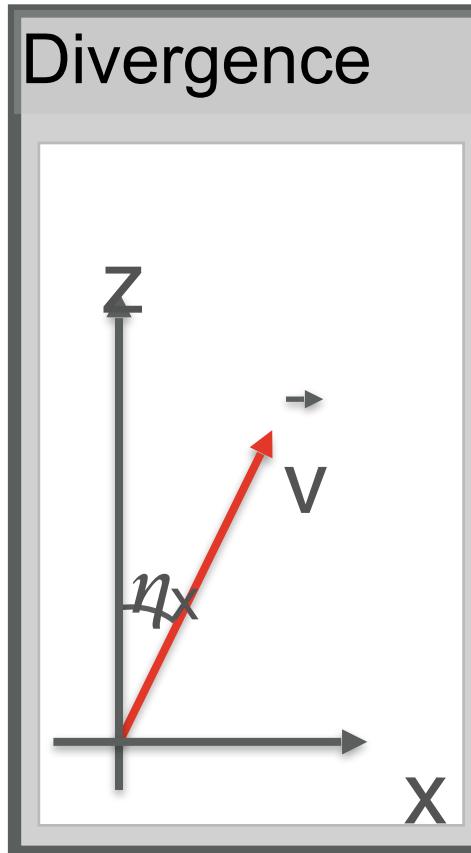


Wanted “phase-space” at sample



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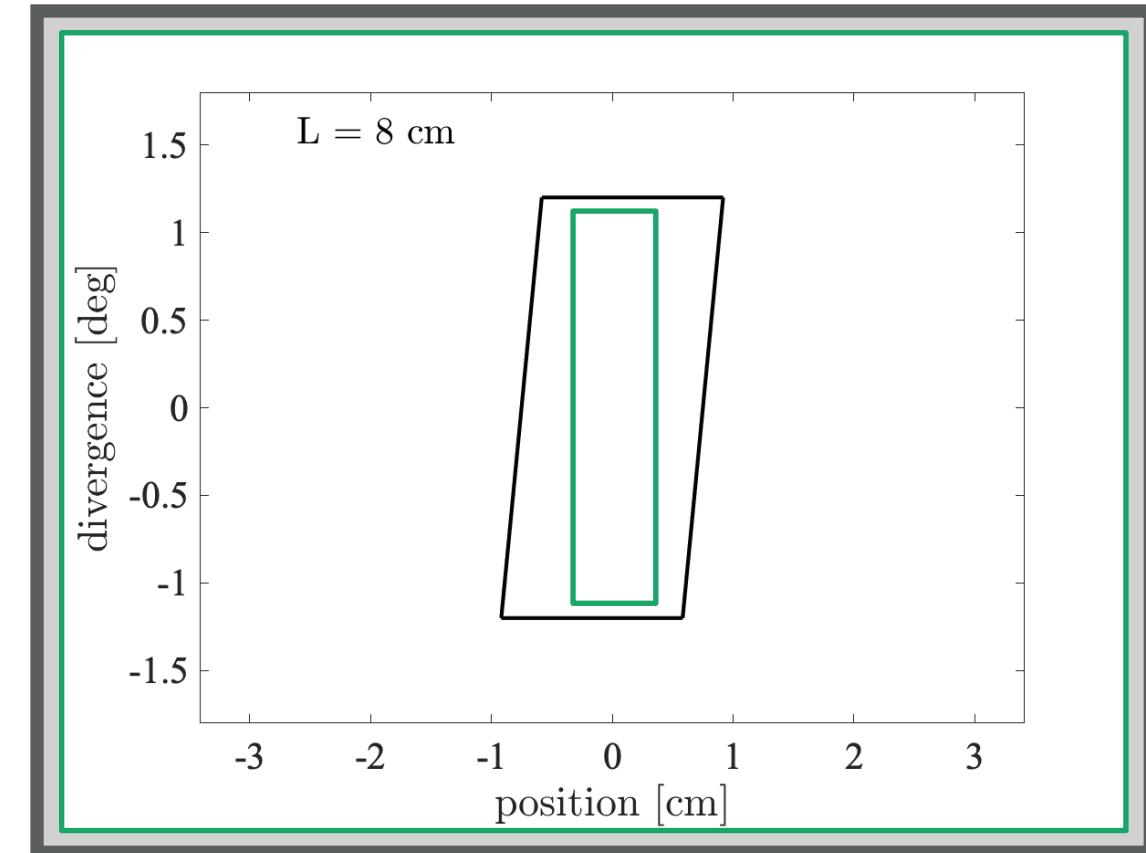
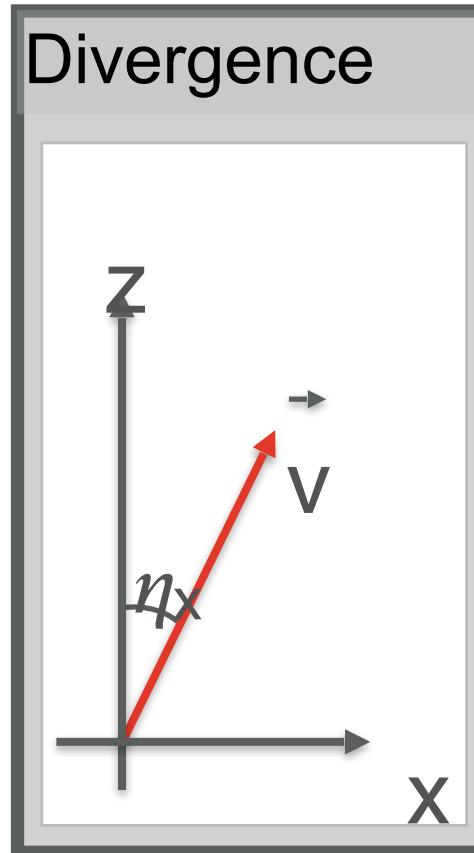
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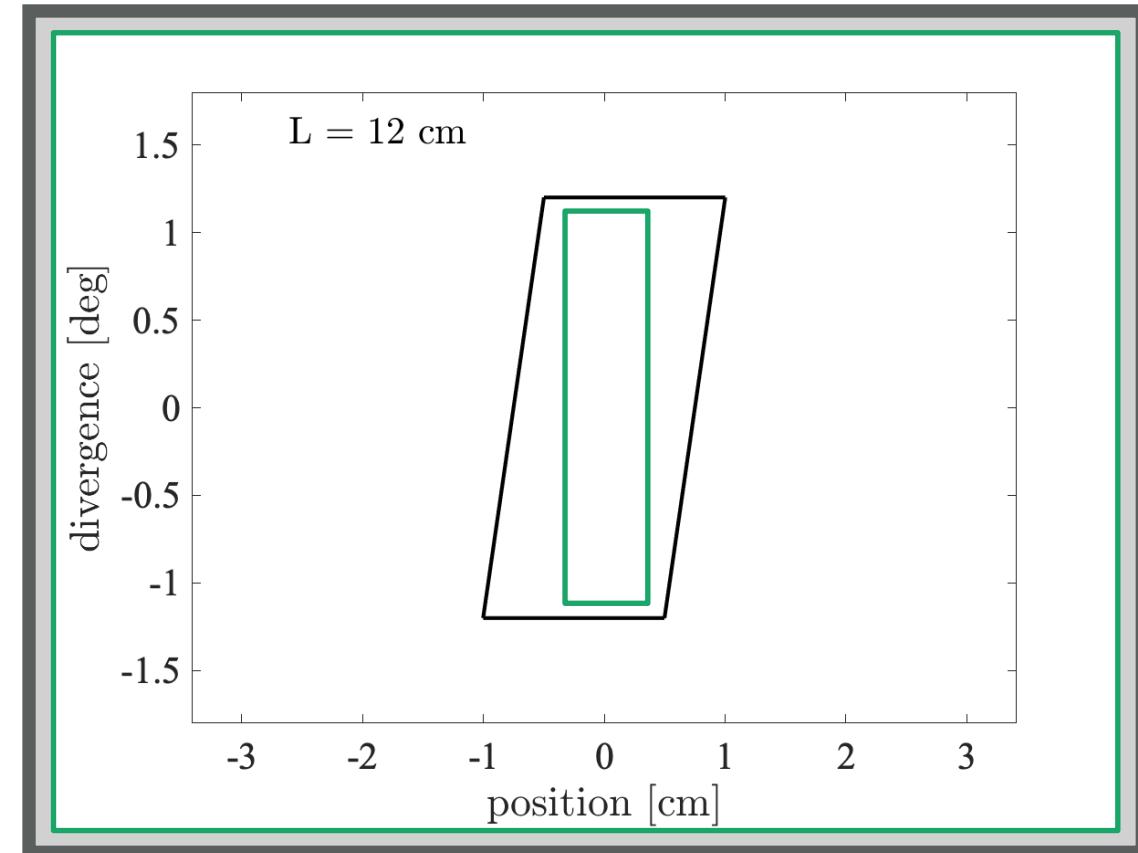
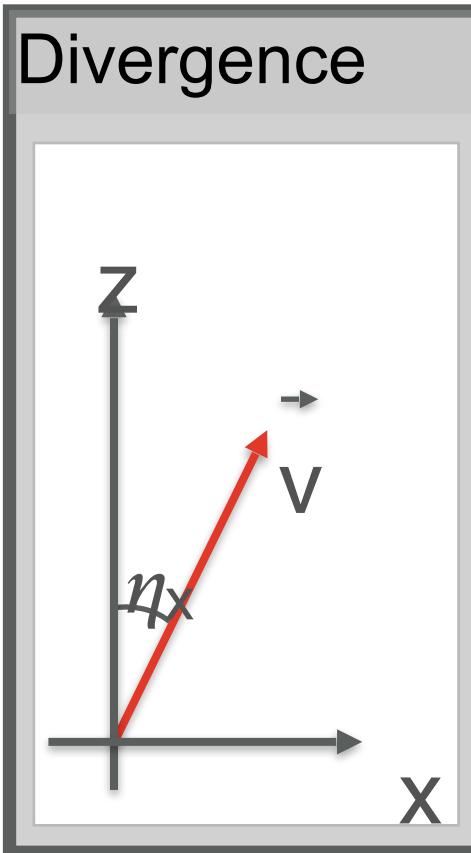
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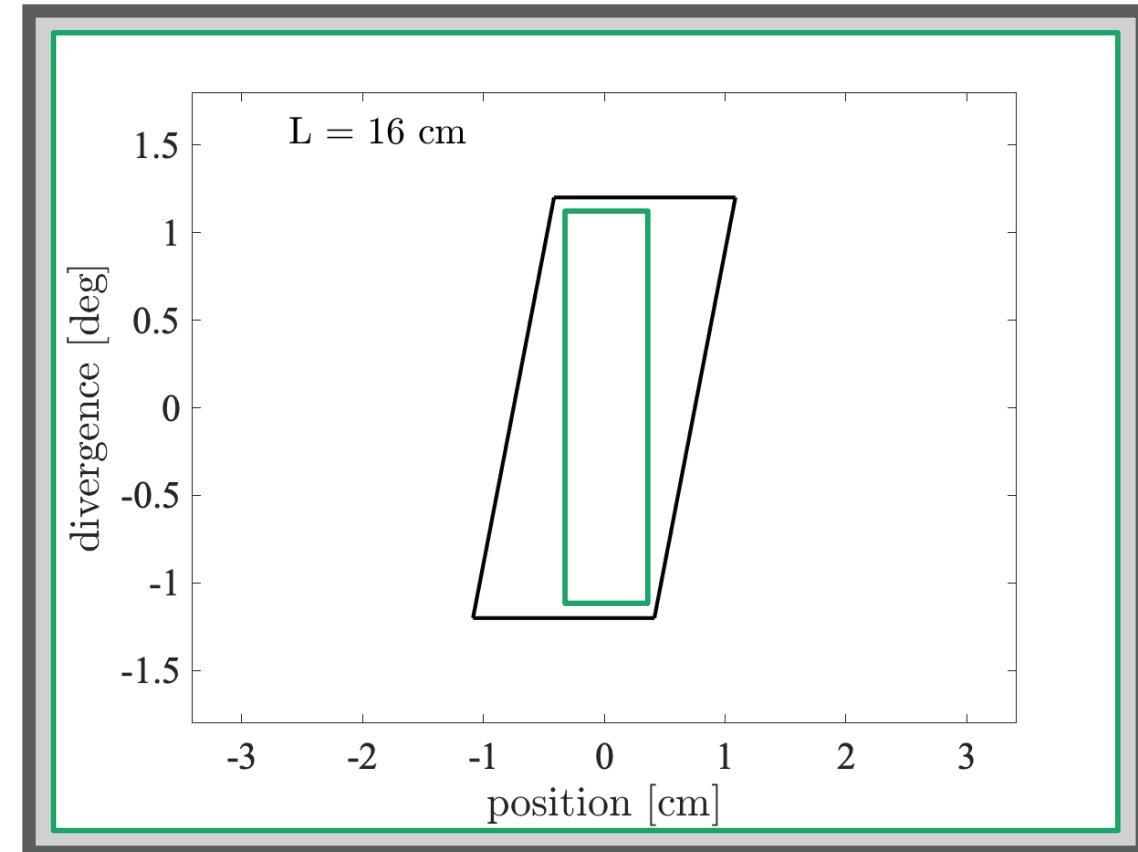
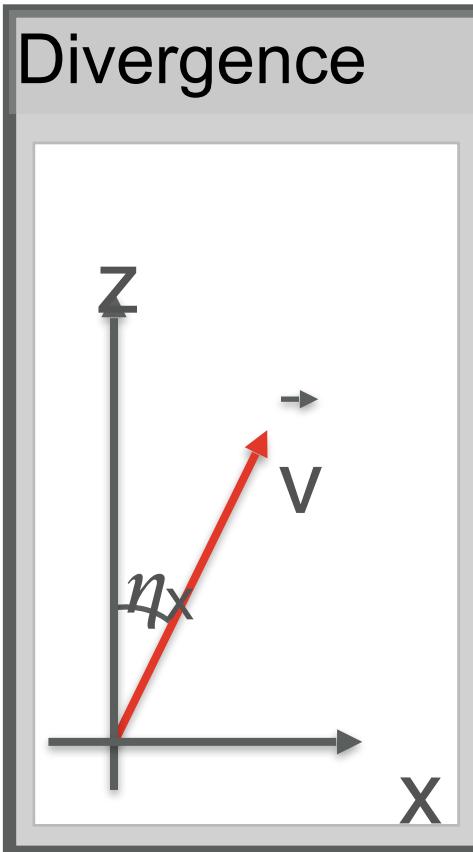
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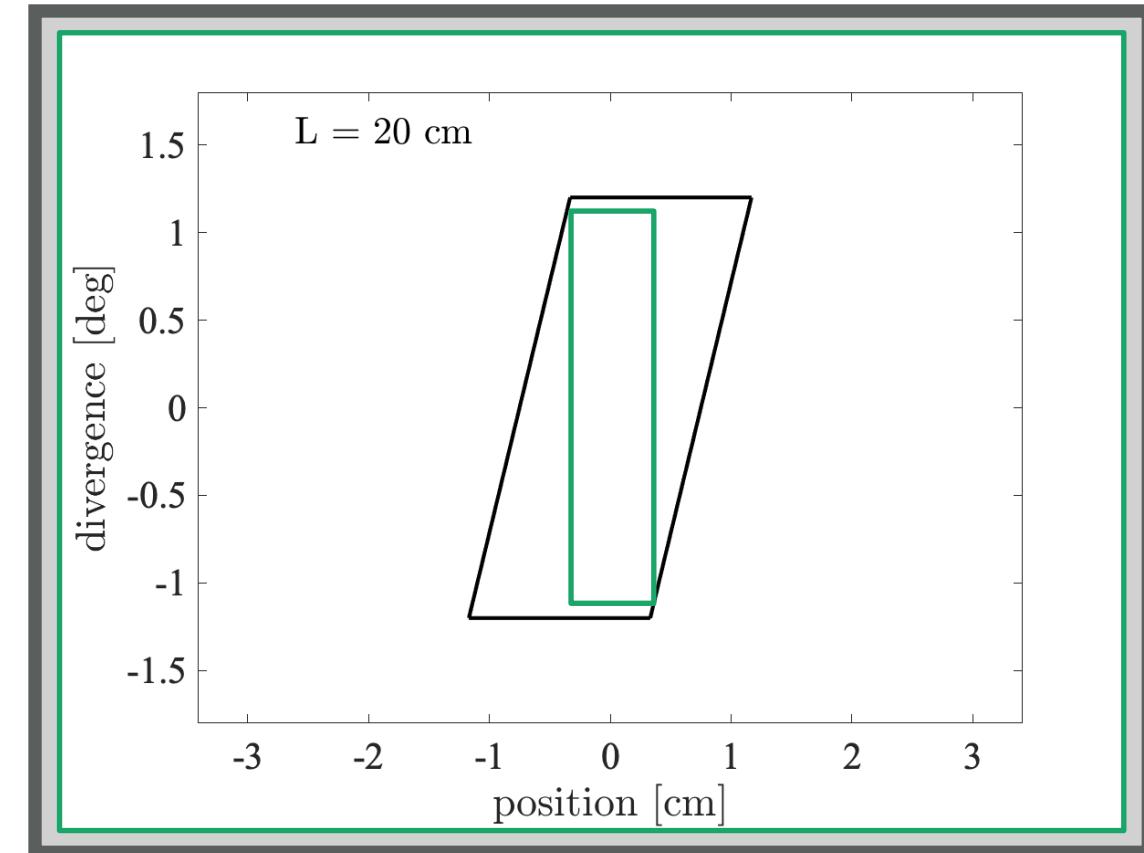
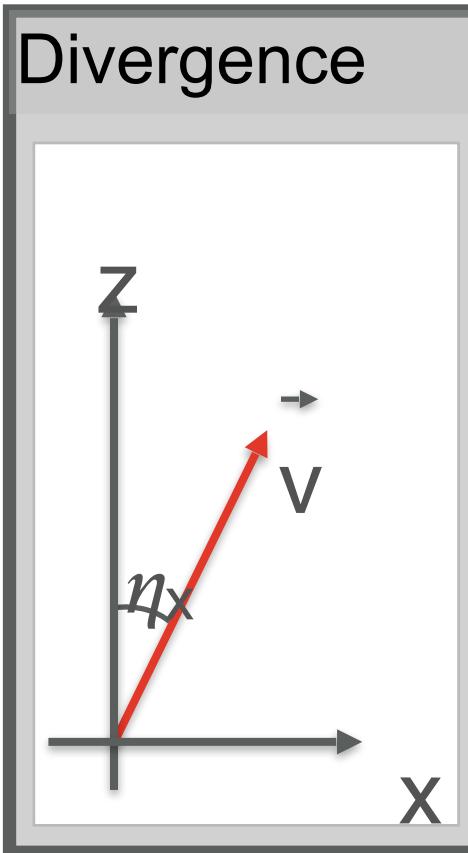
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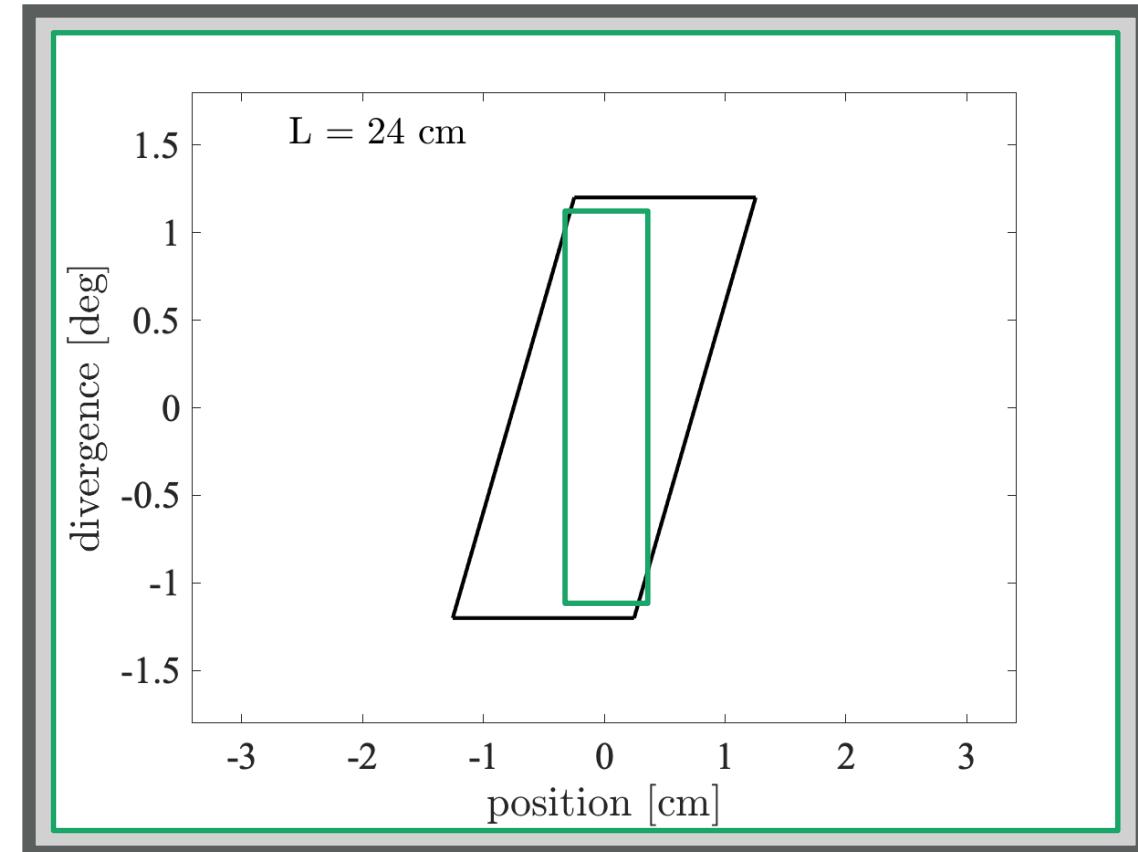
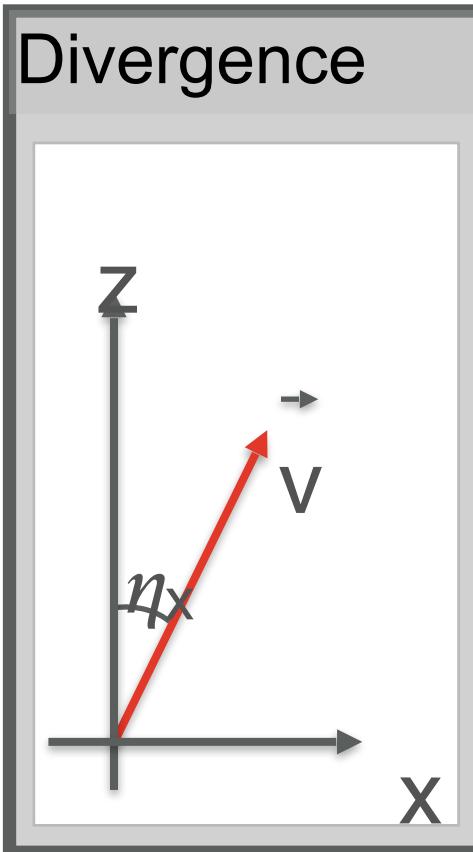
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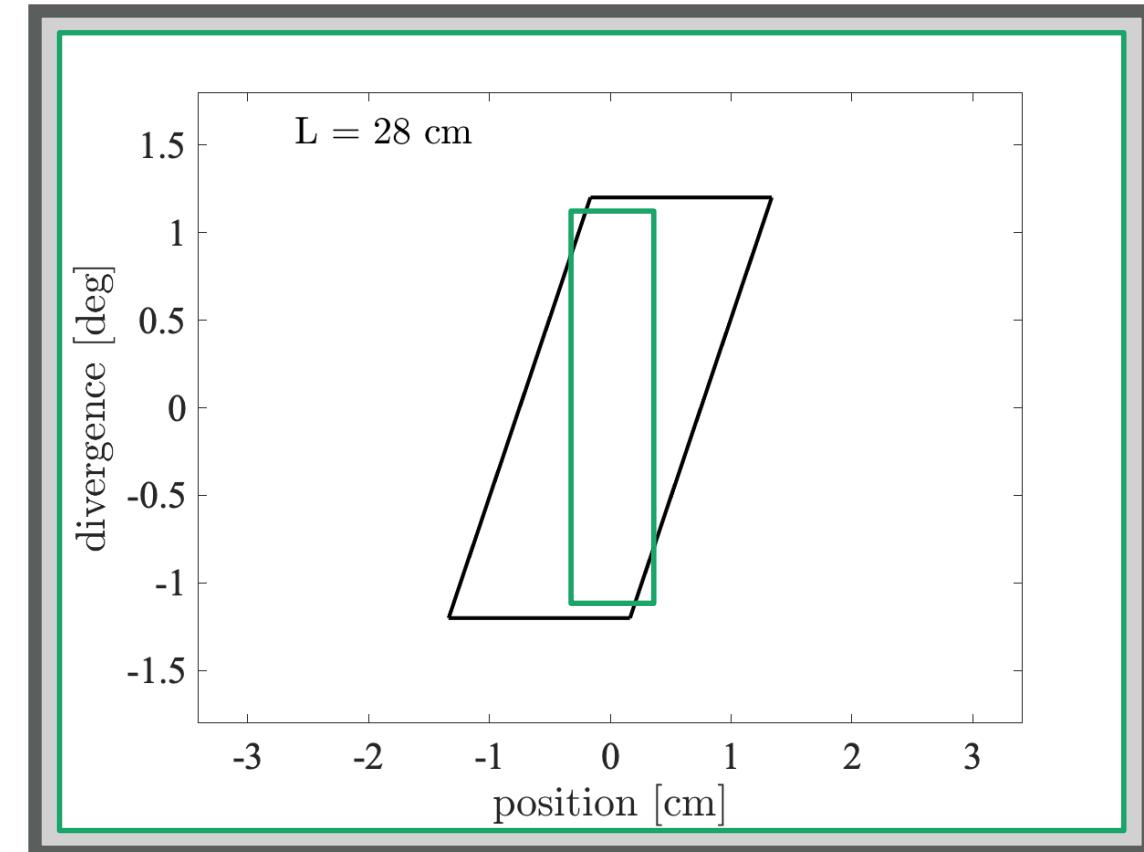
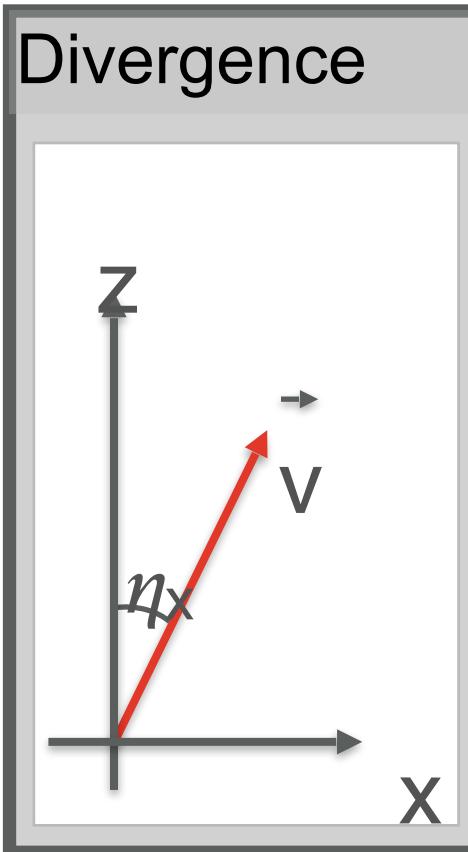
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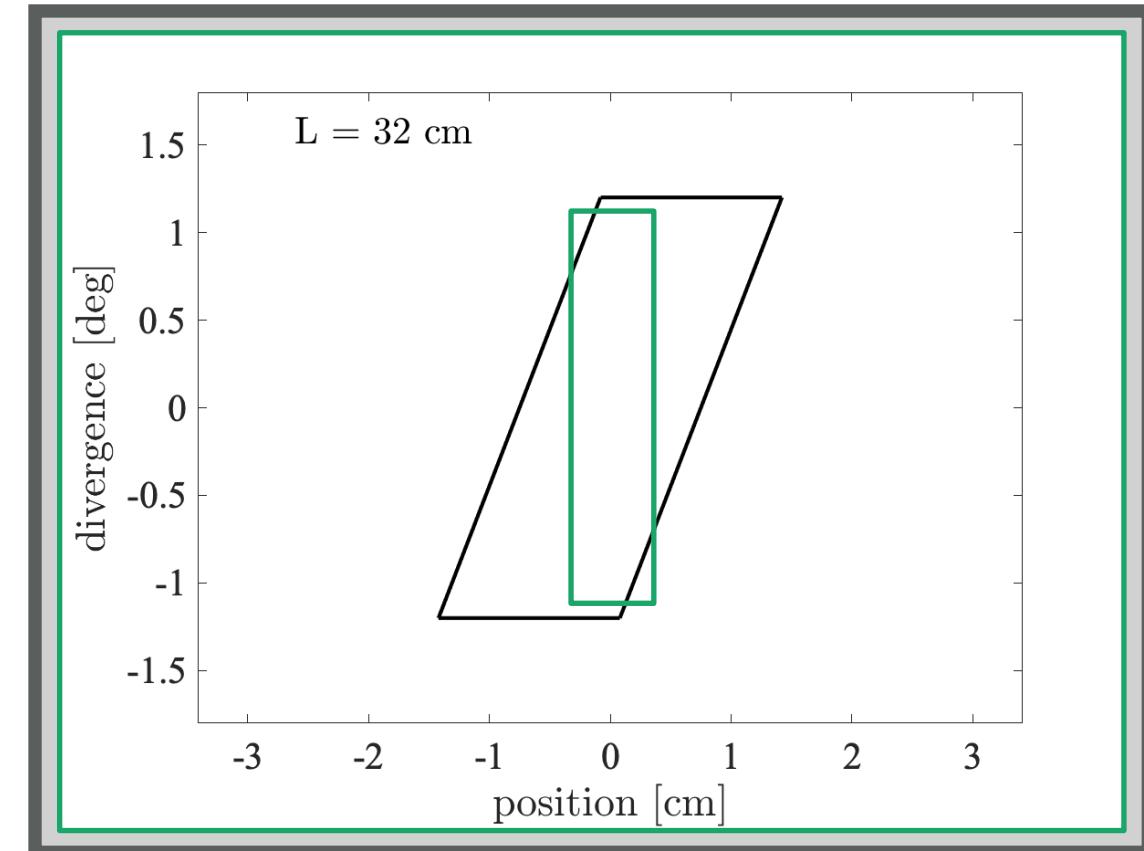
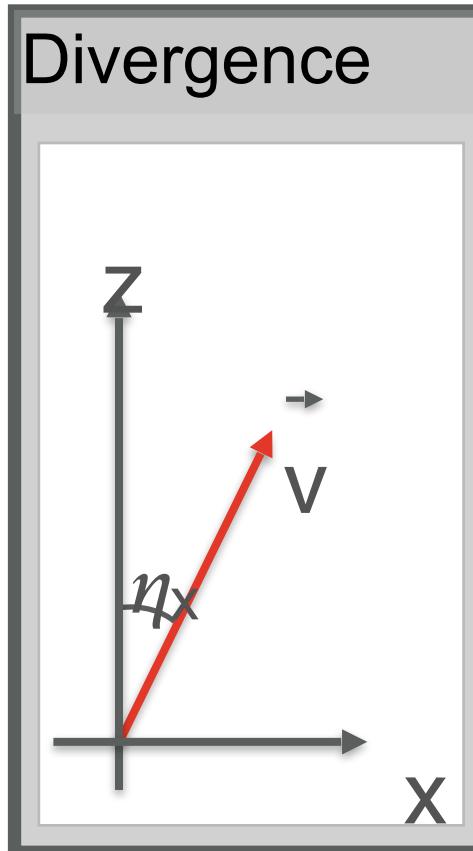
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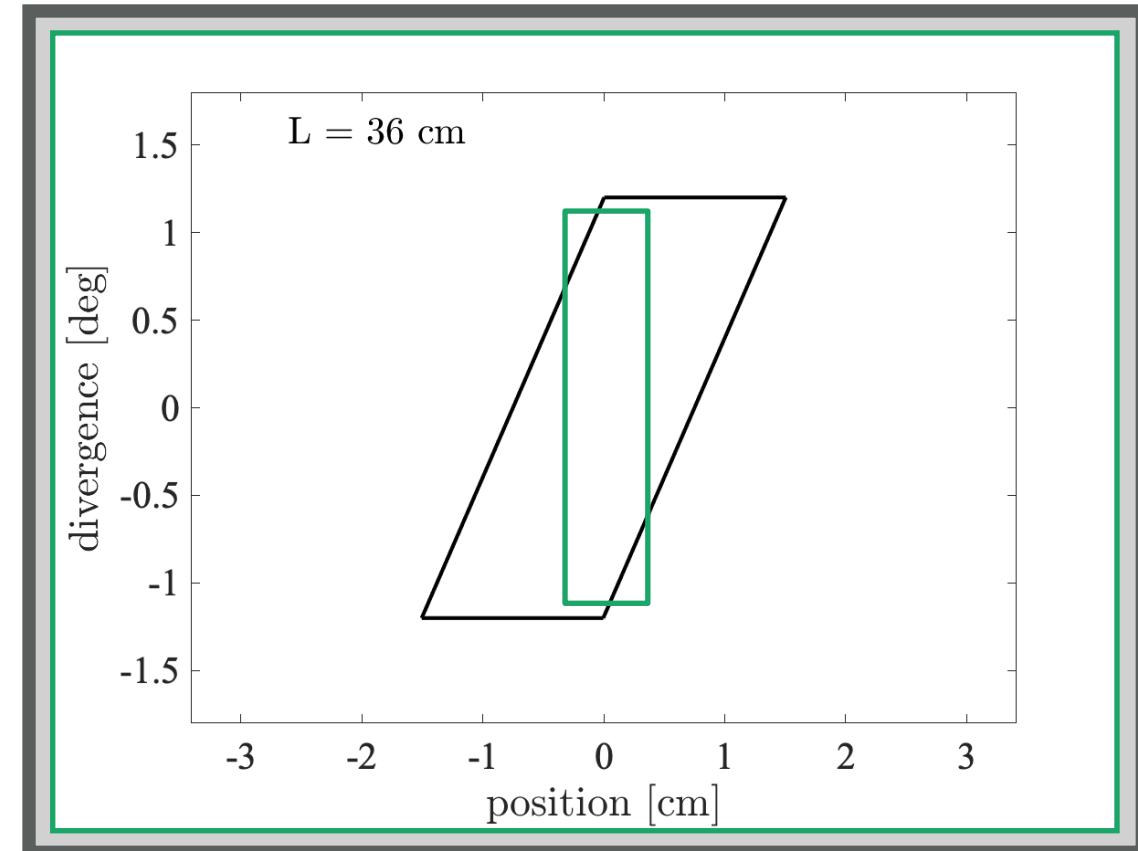
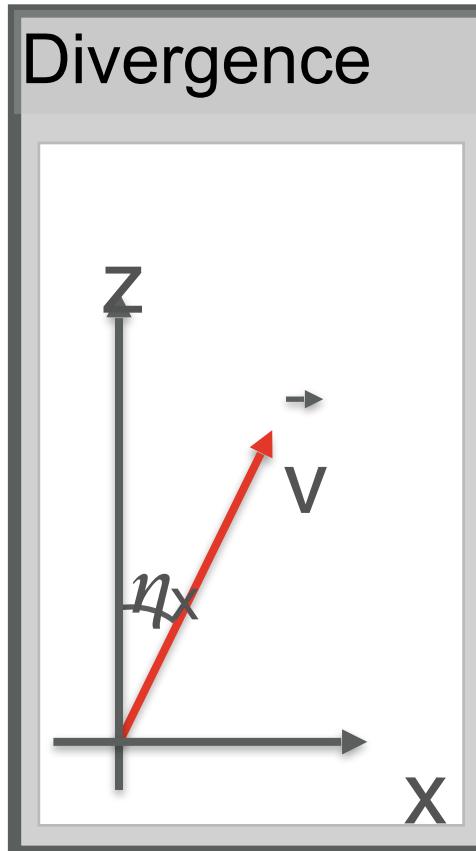


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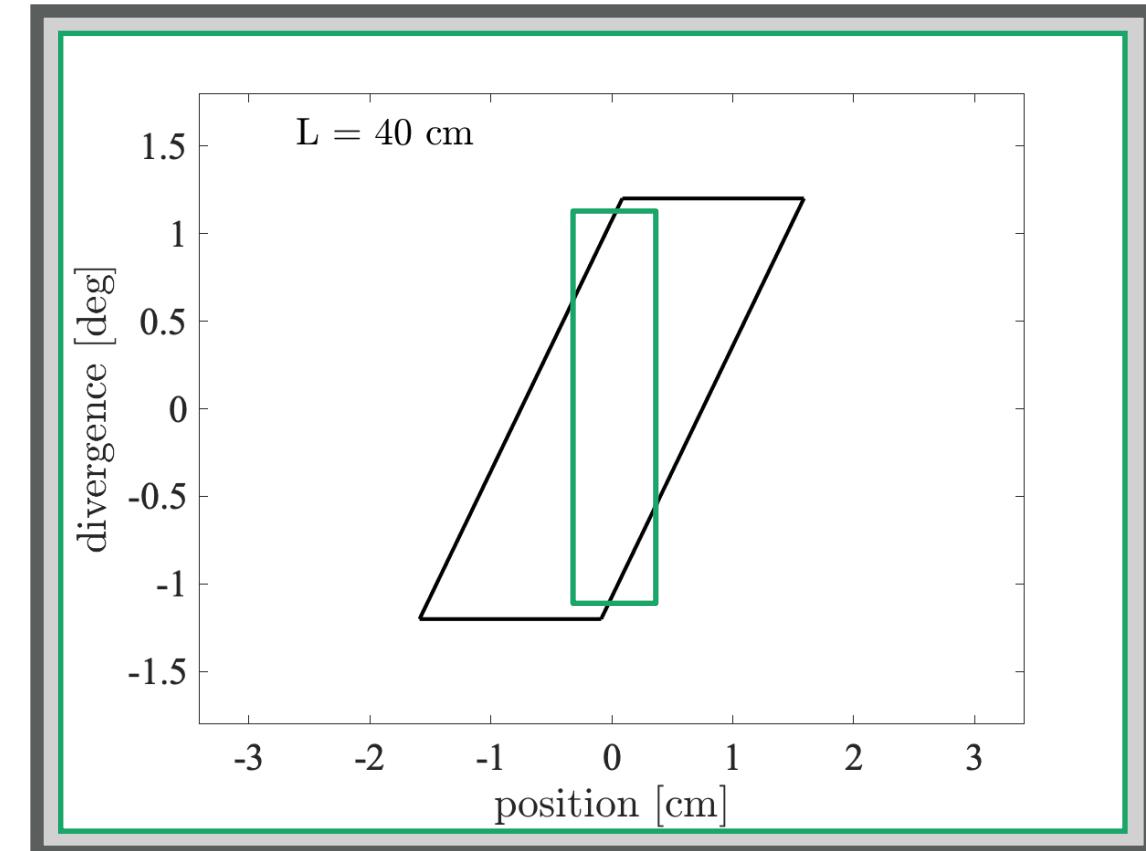
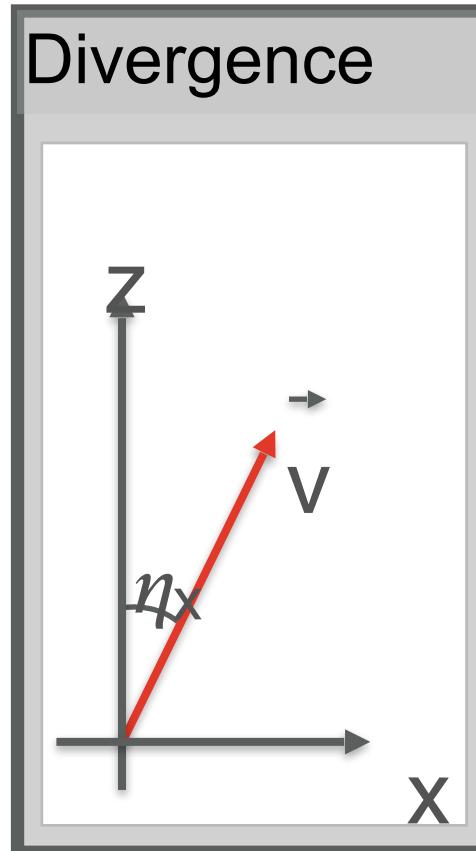


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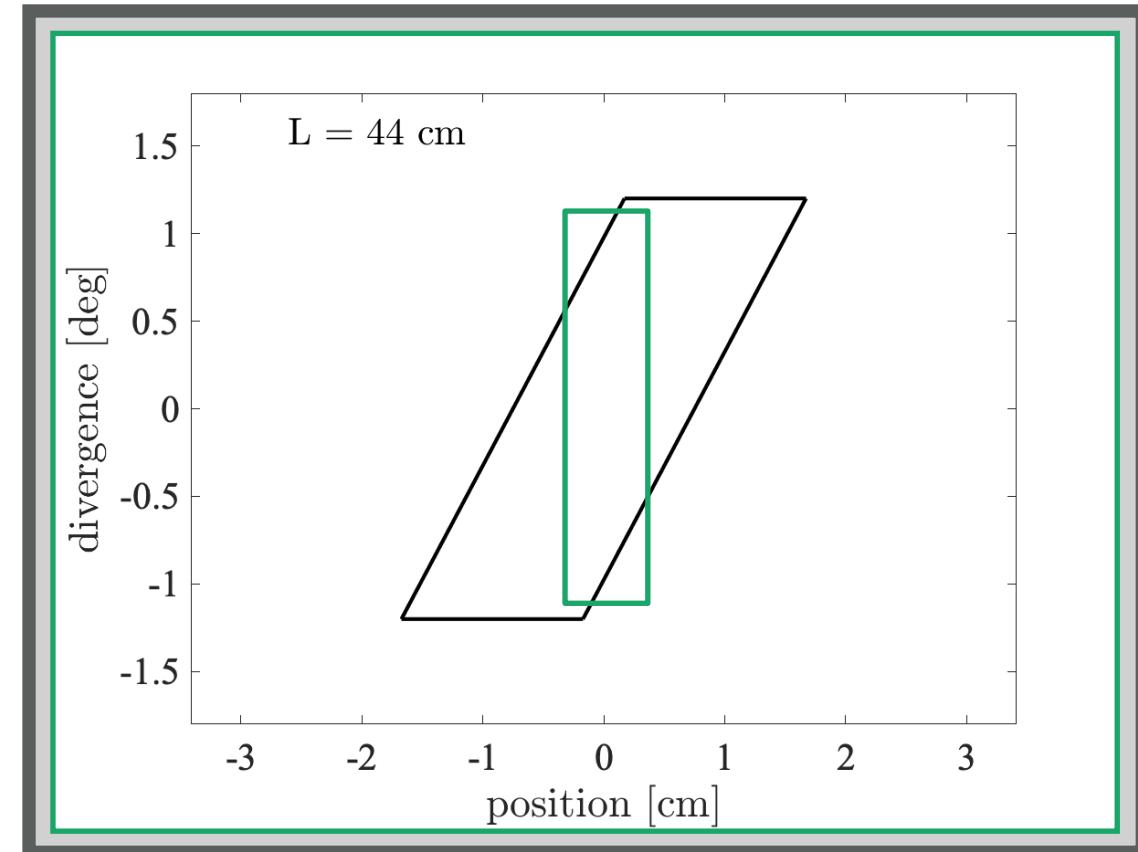
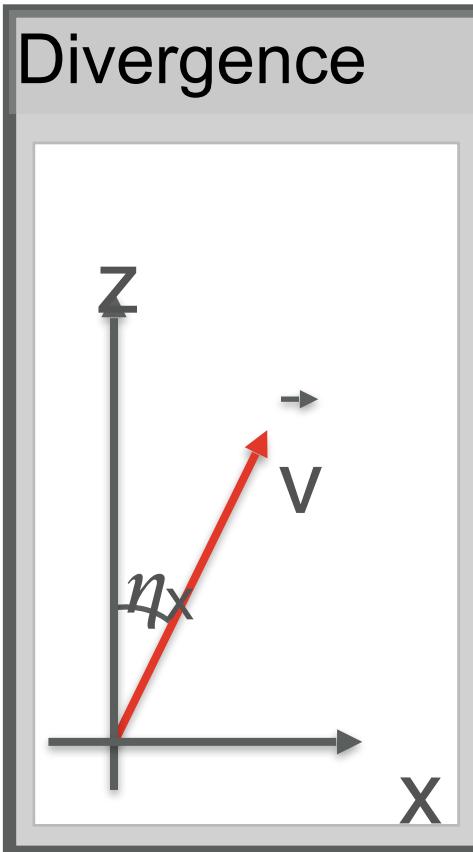
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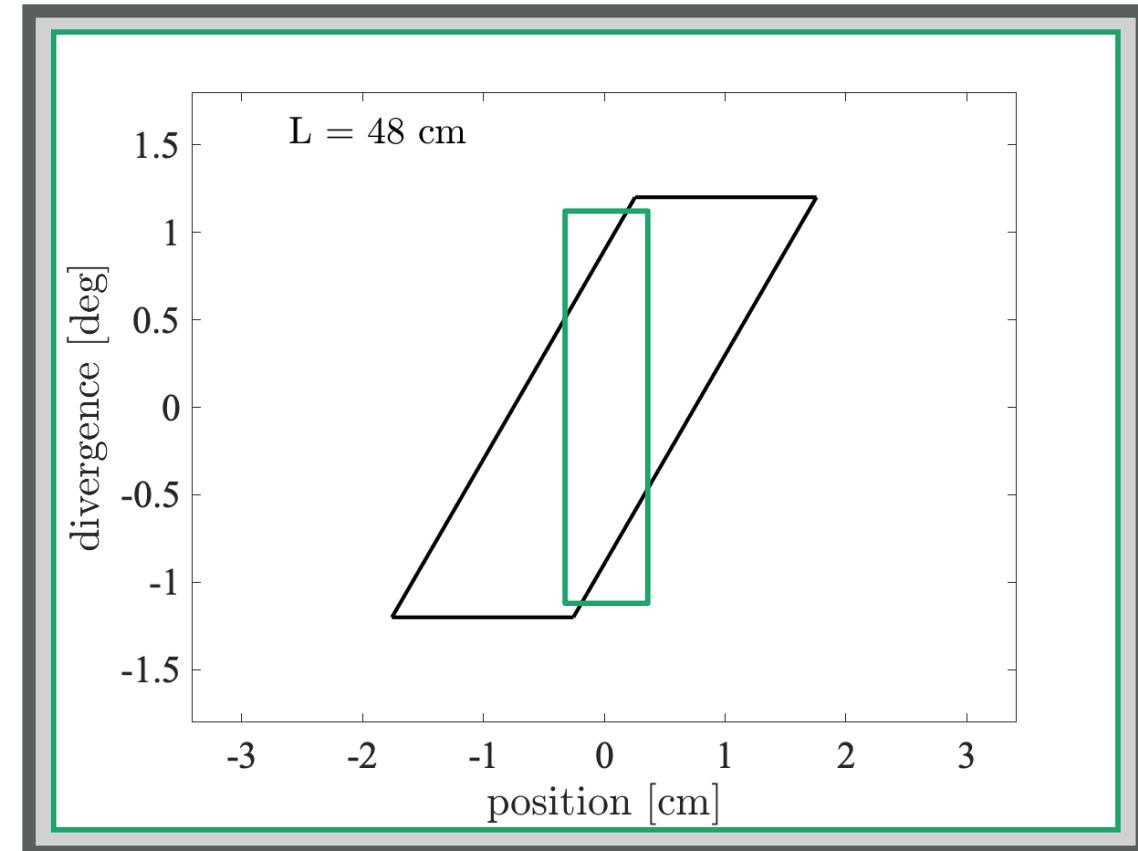
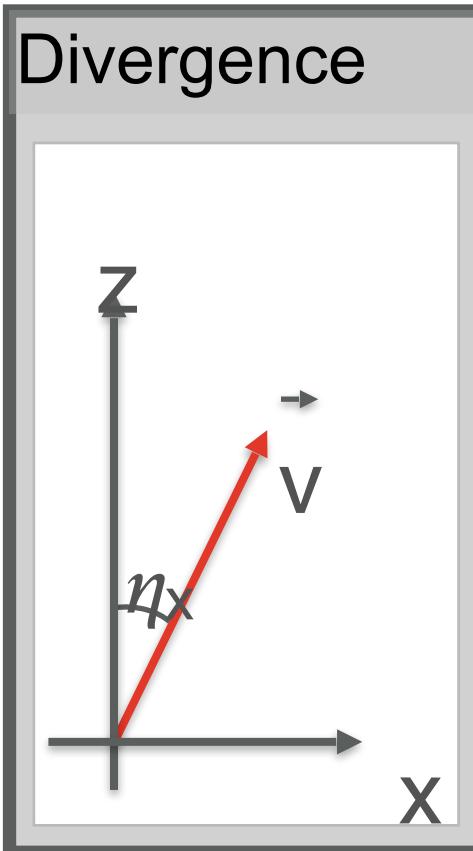
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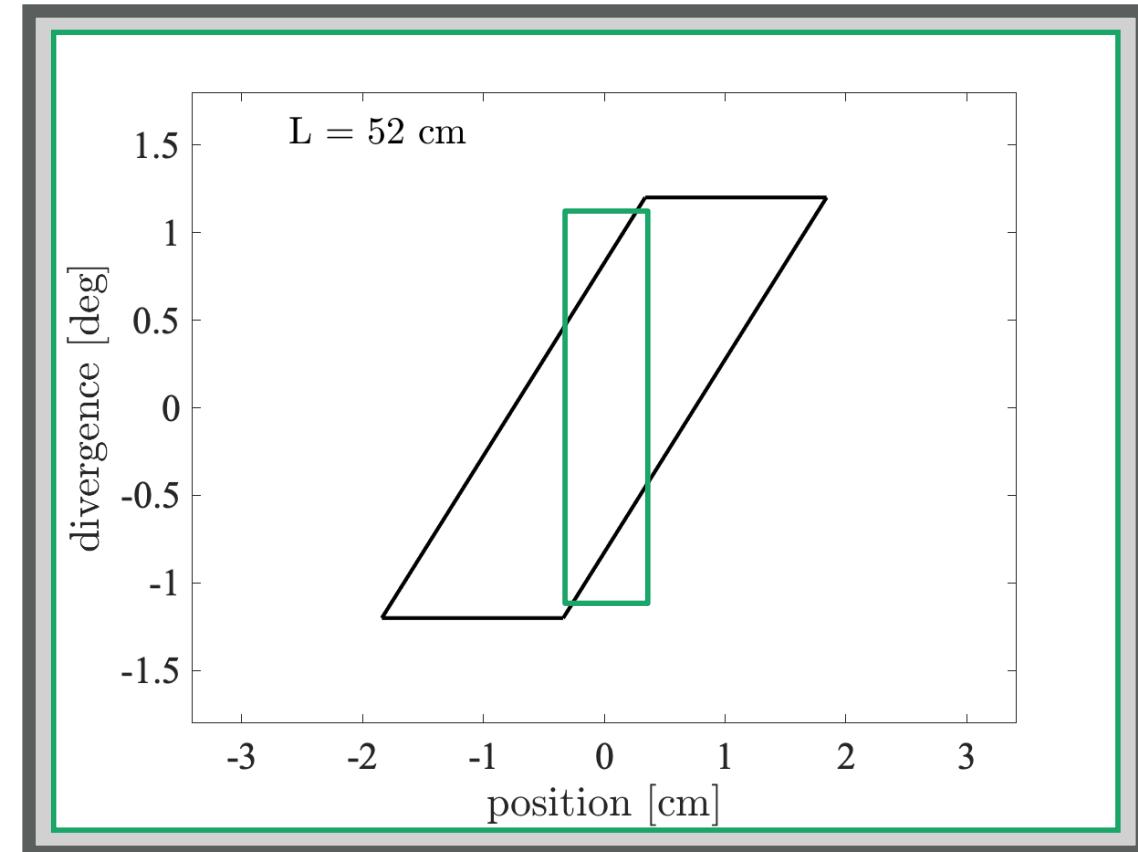
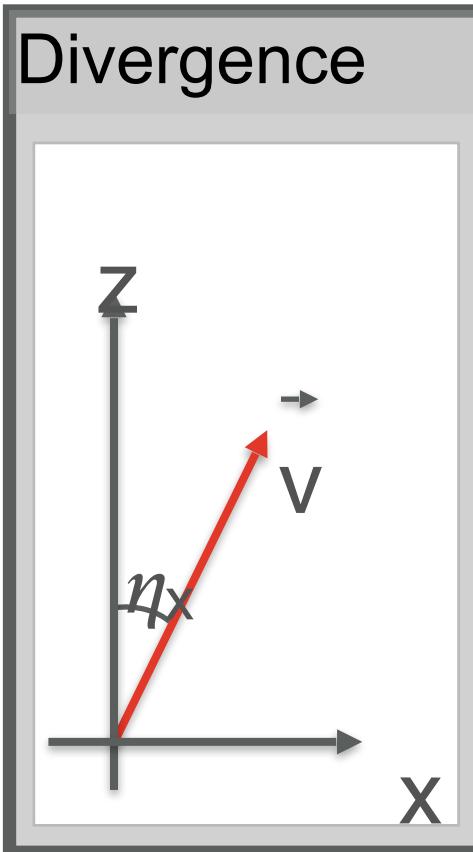
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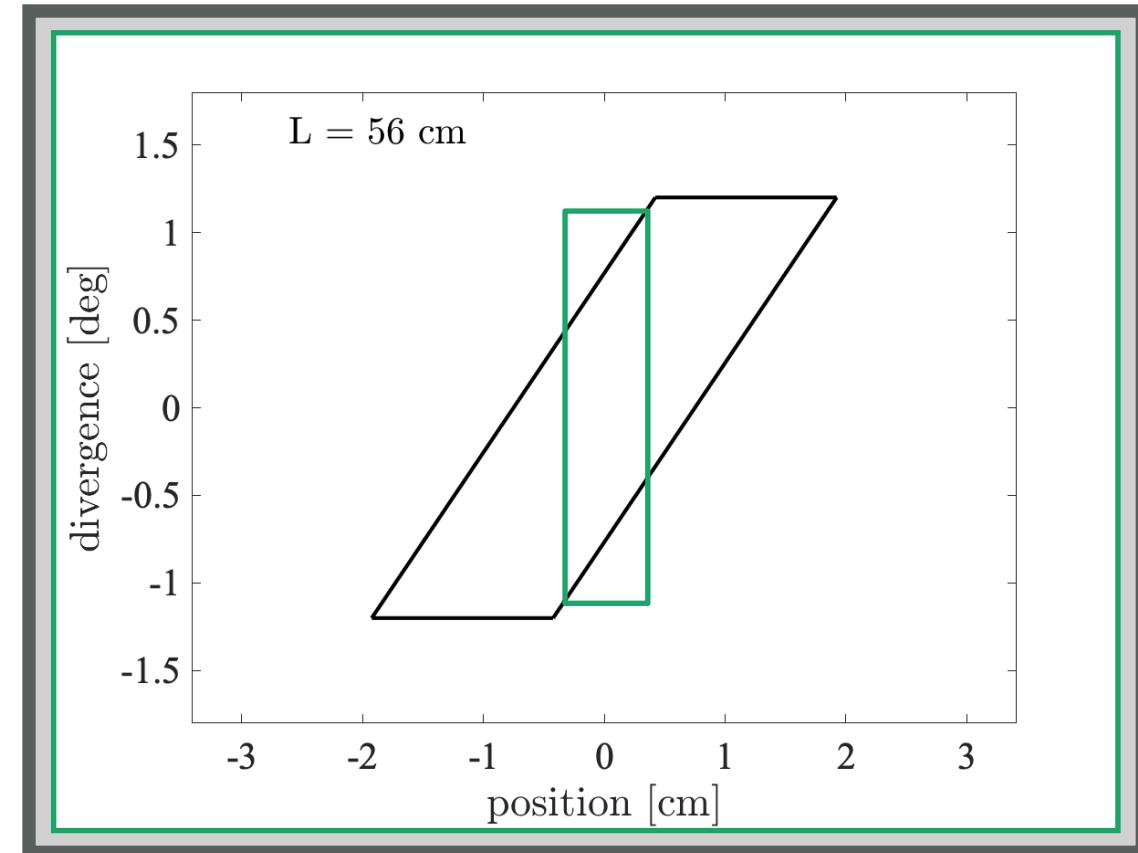
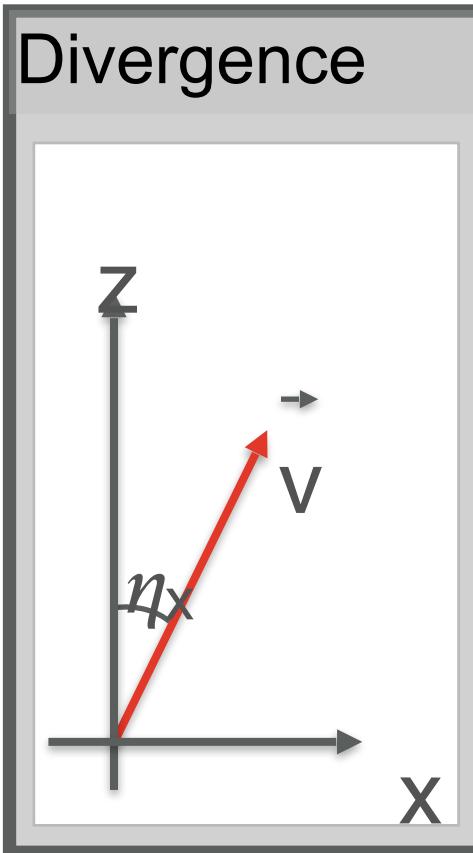
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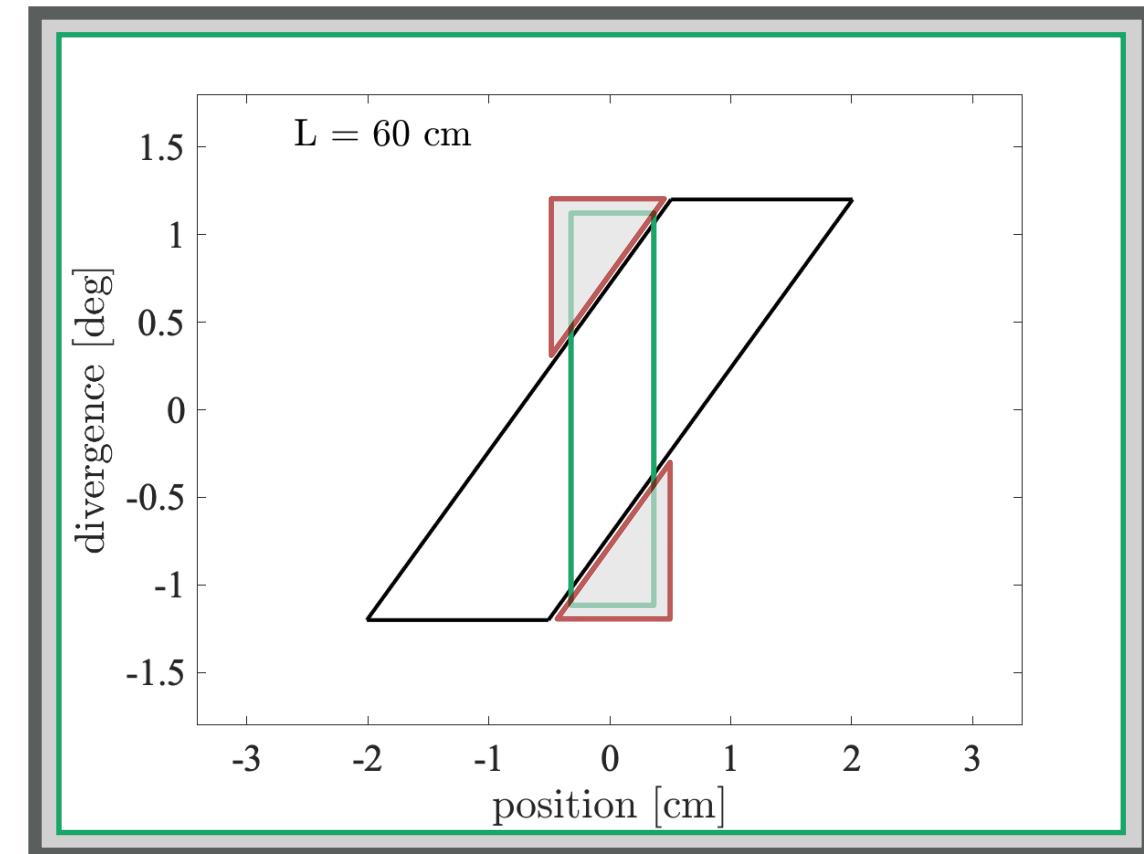
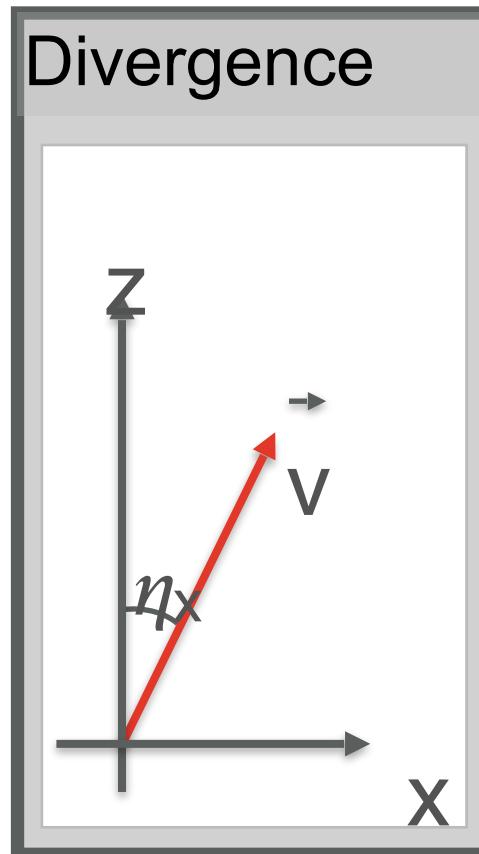




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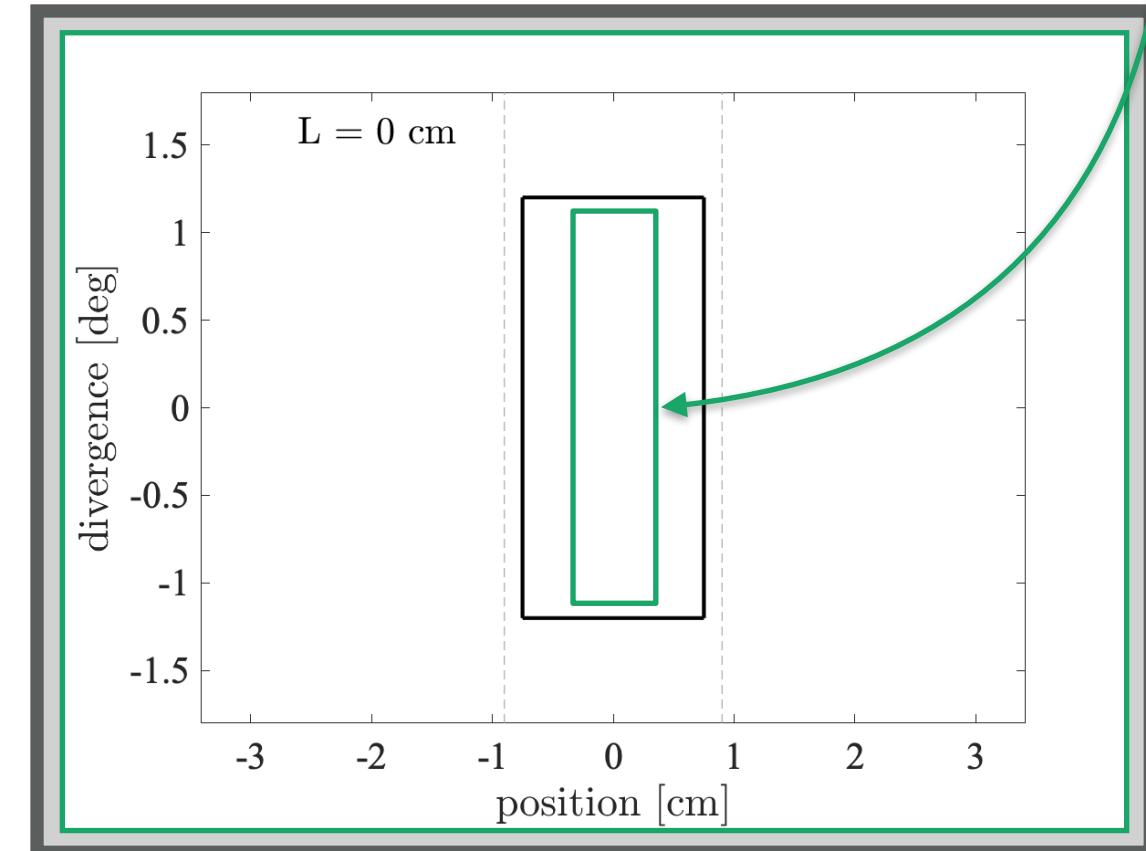
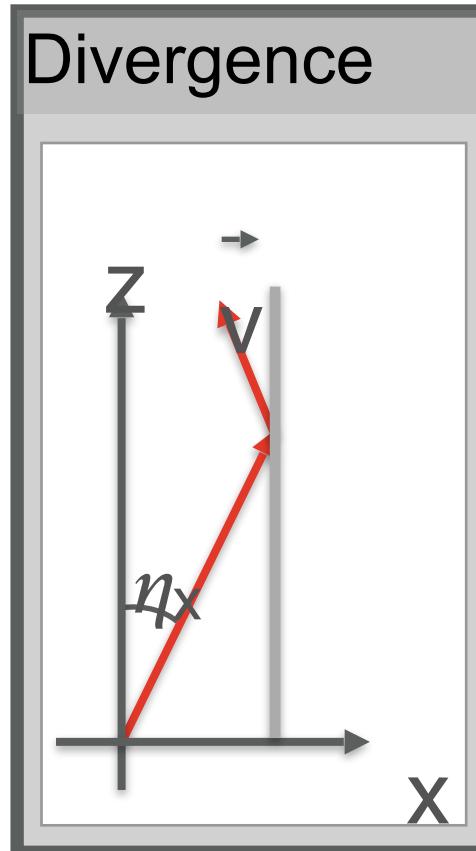
# Beam propagation in free space

- We lost some phase-space to propagation





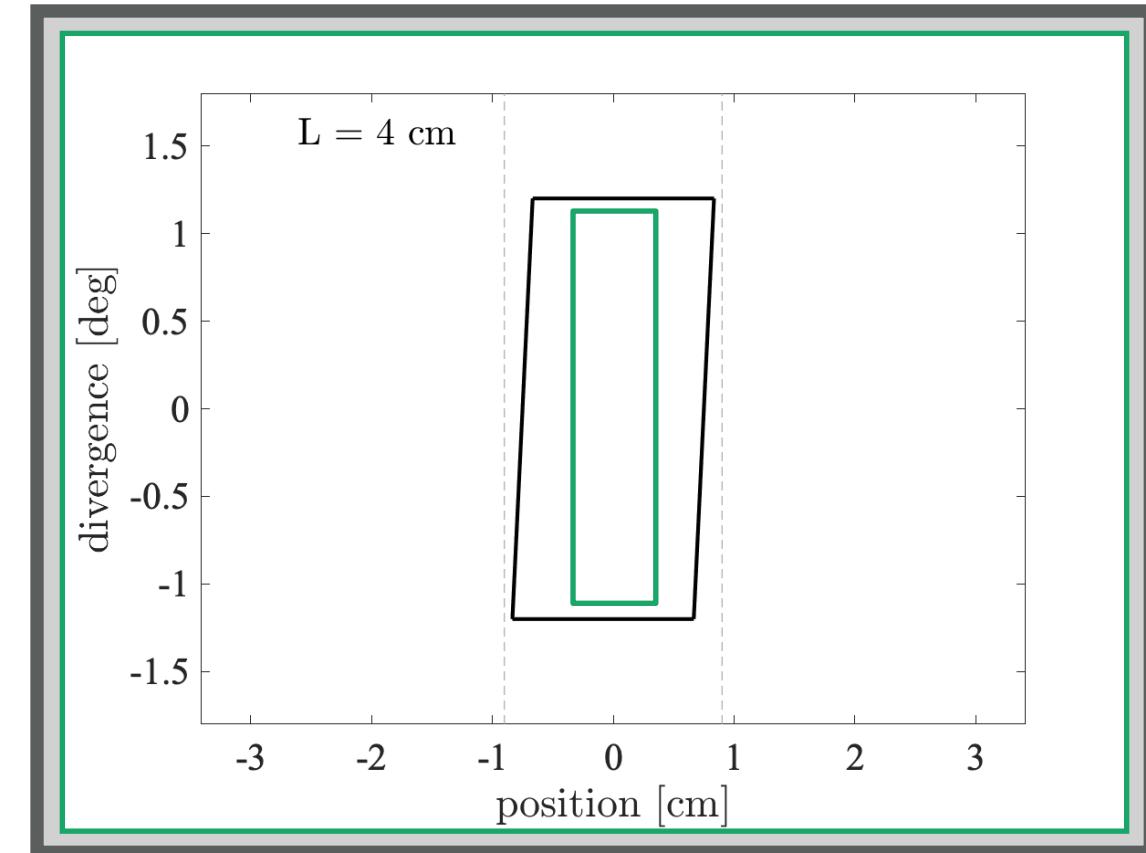
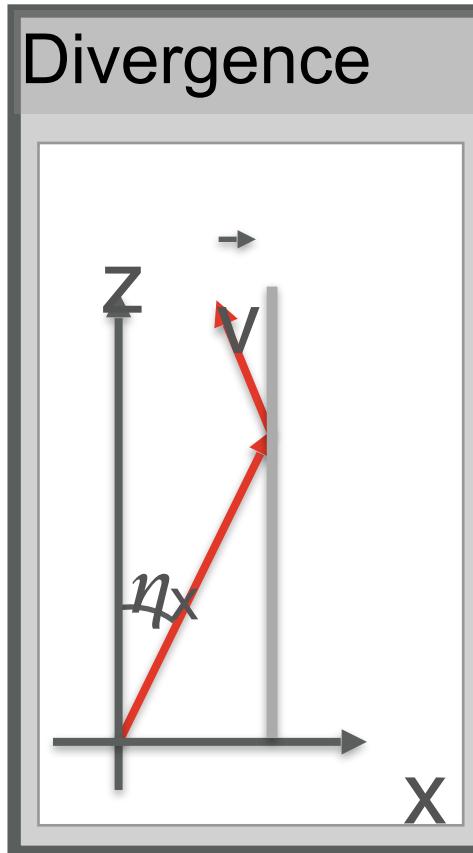
# Beam propagation in guide





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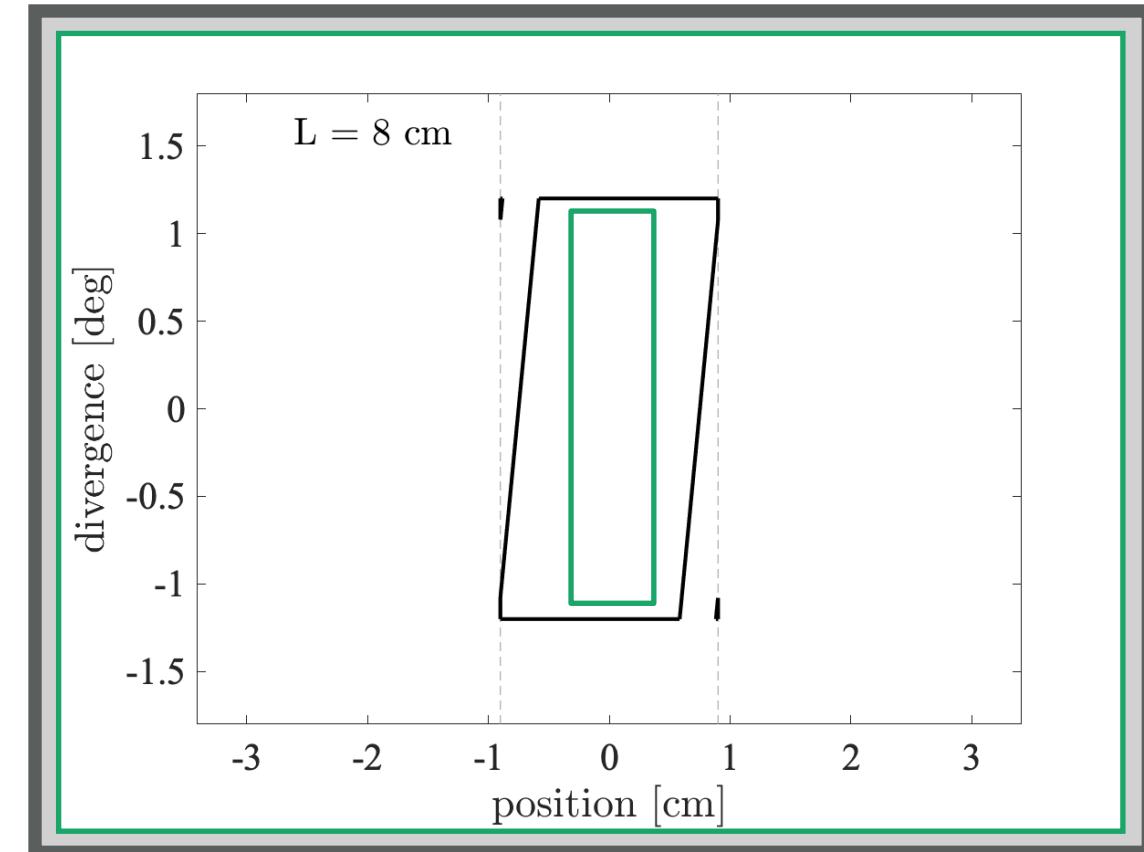
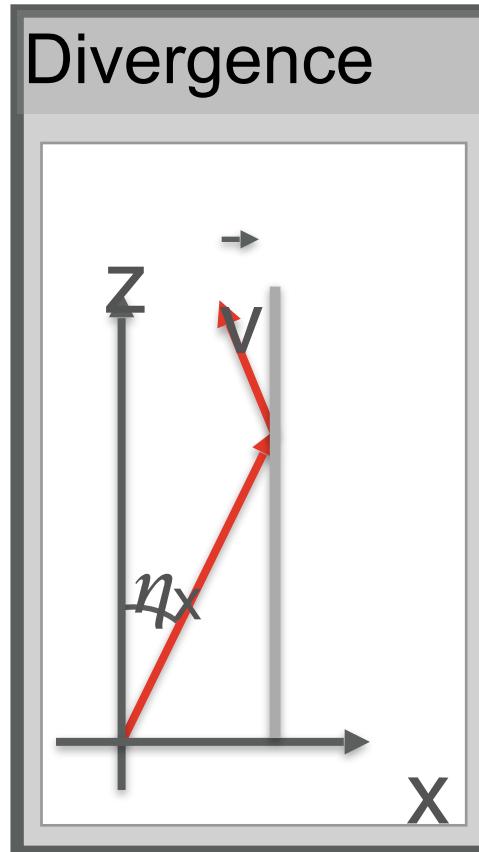
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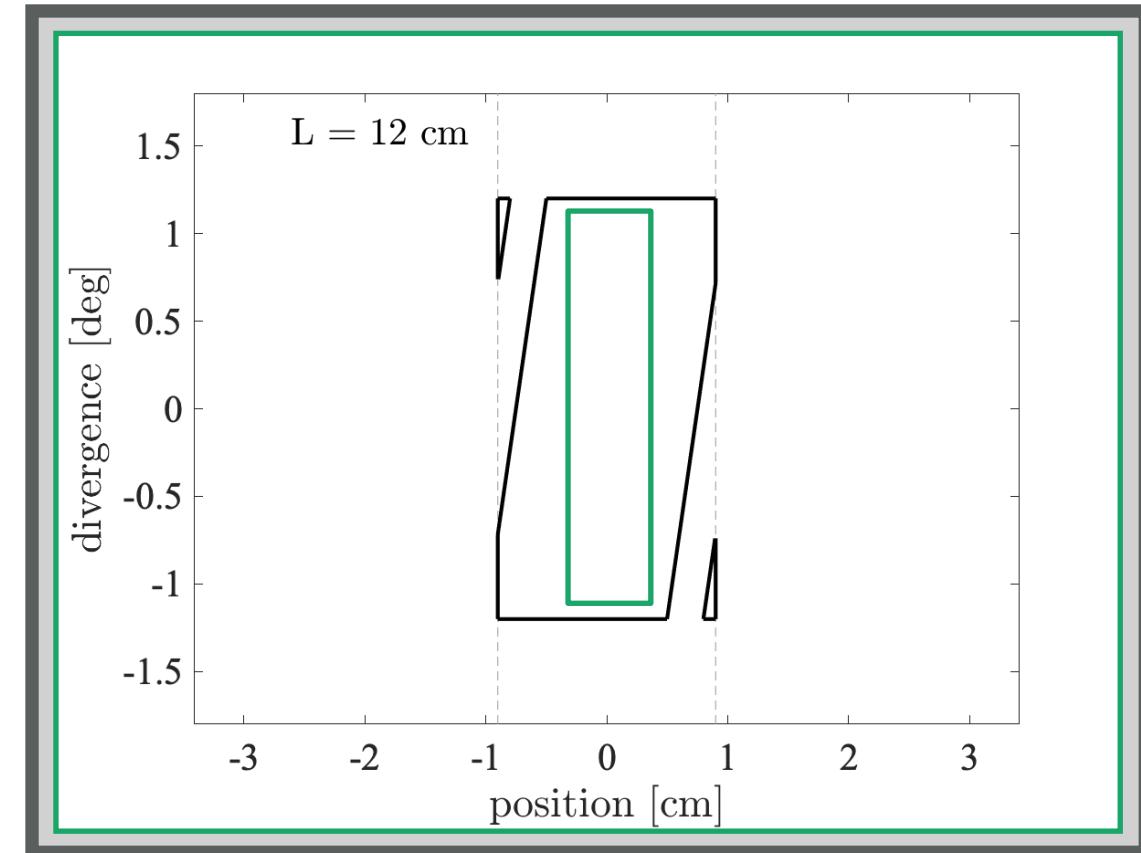
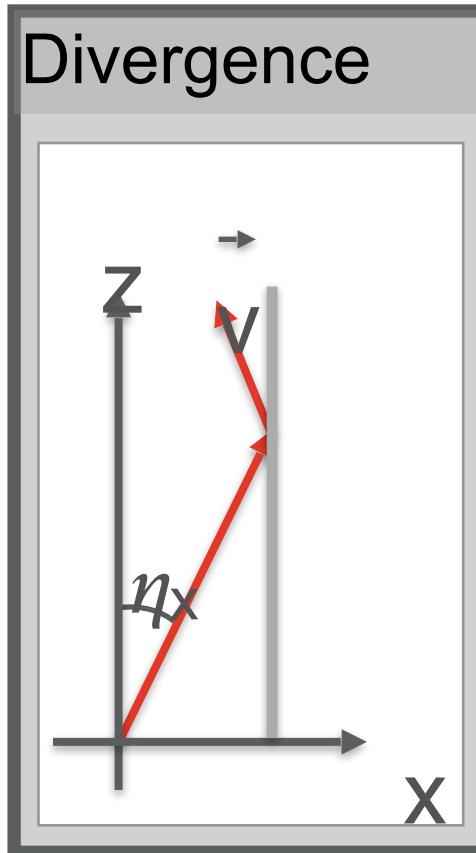
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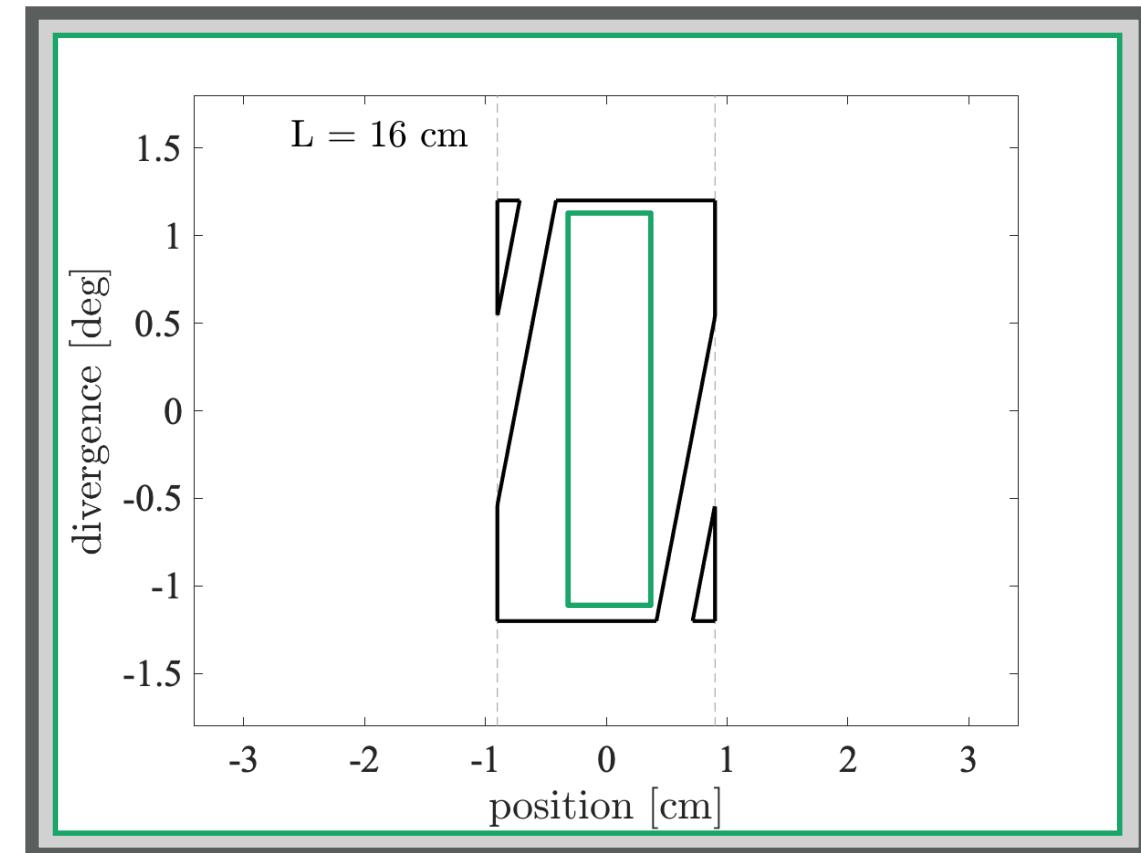
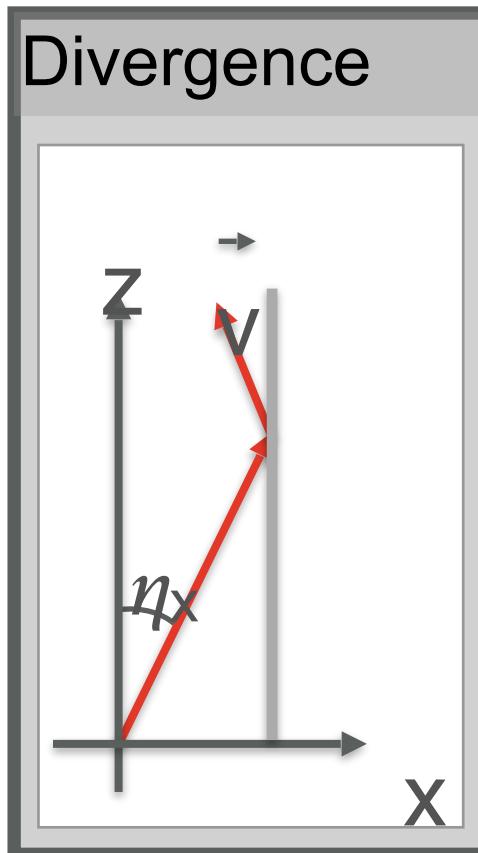
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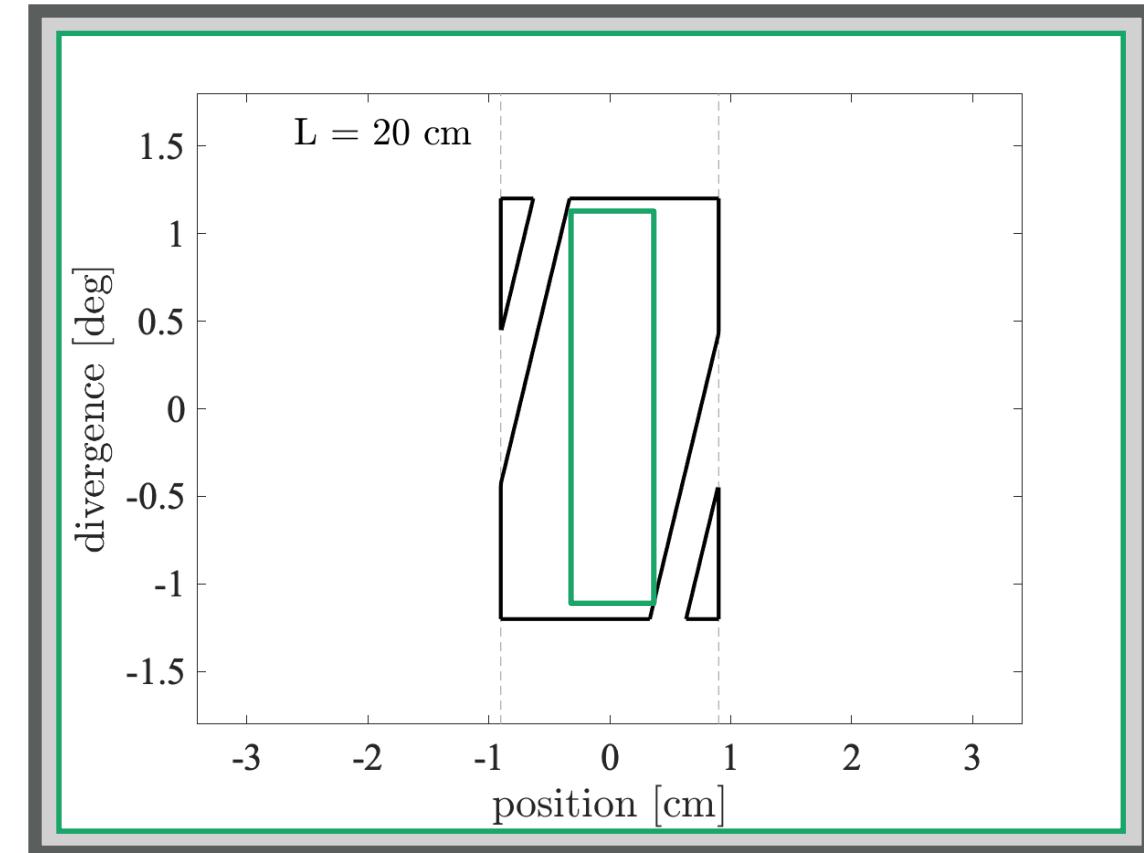
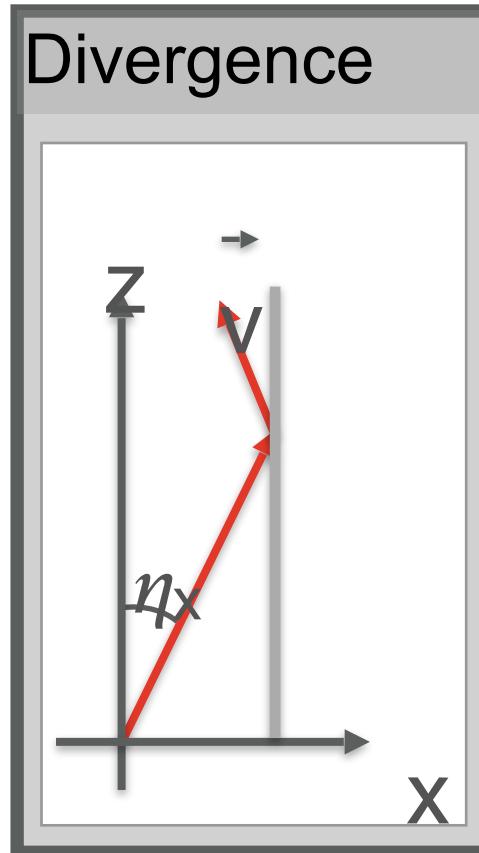
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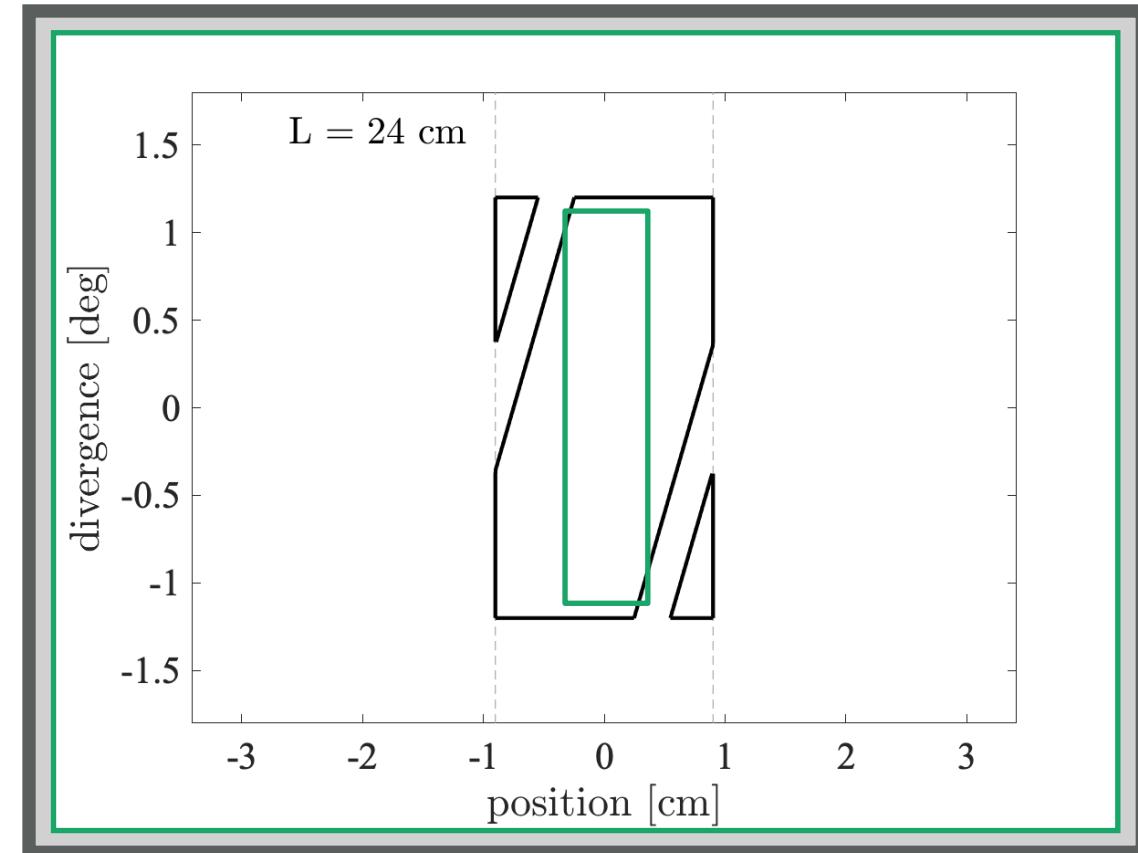
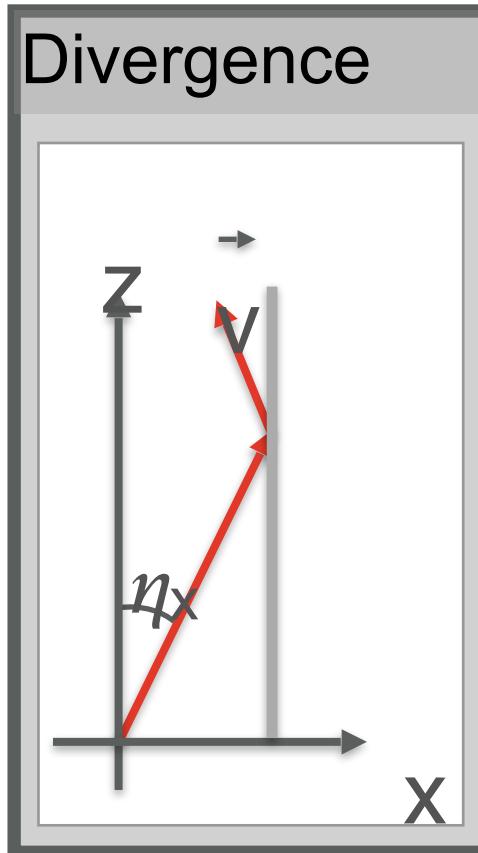
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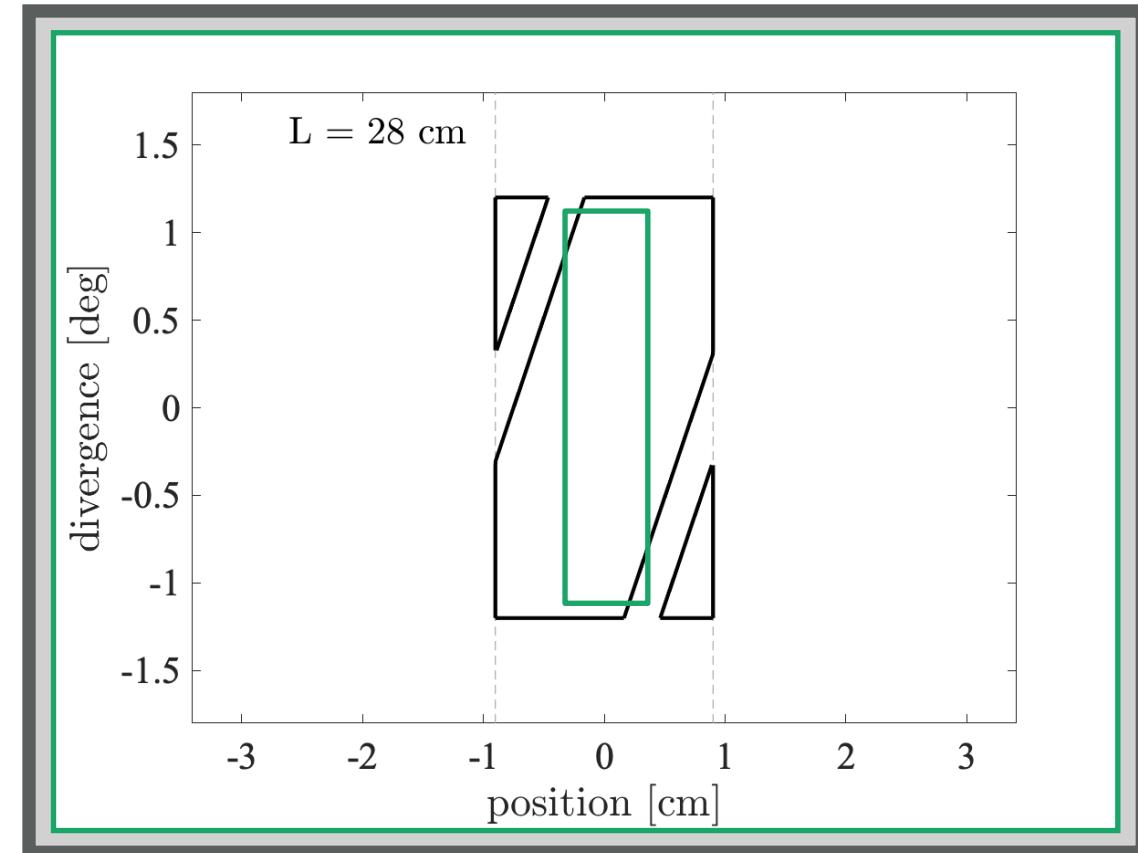
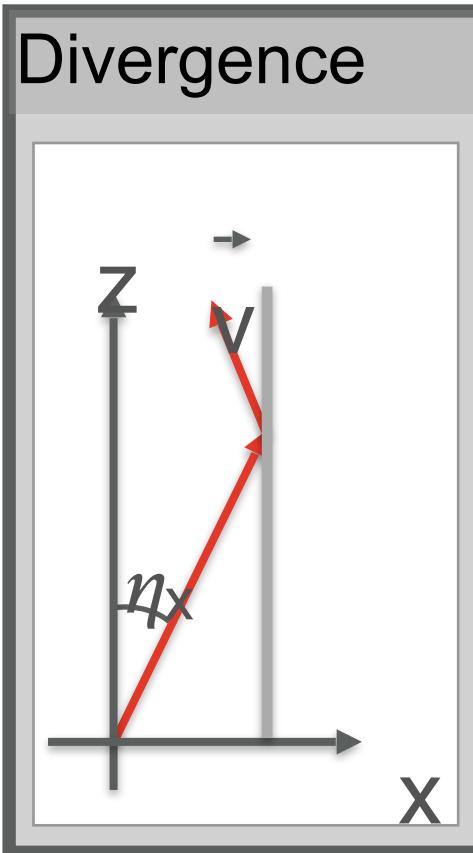
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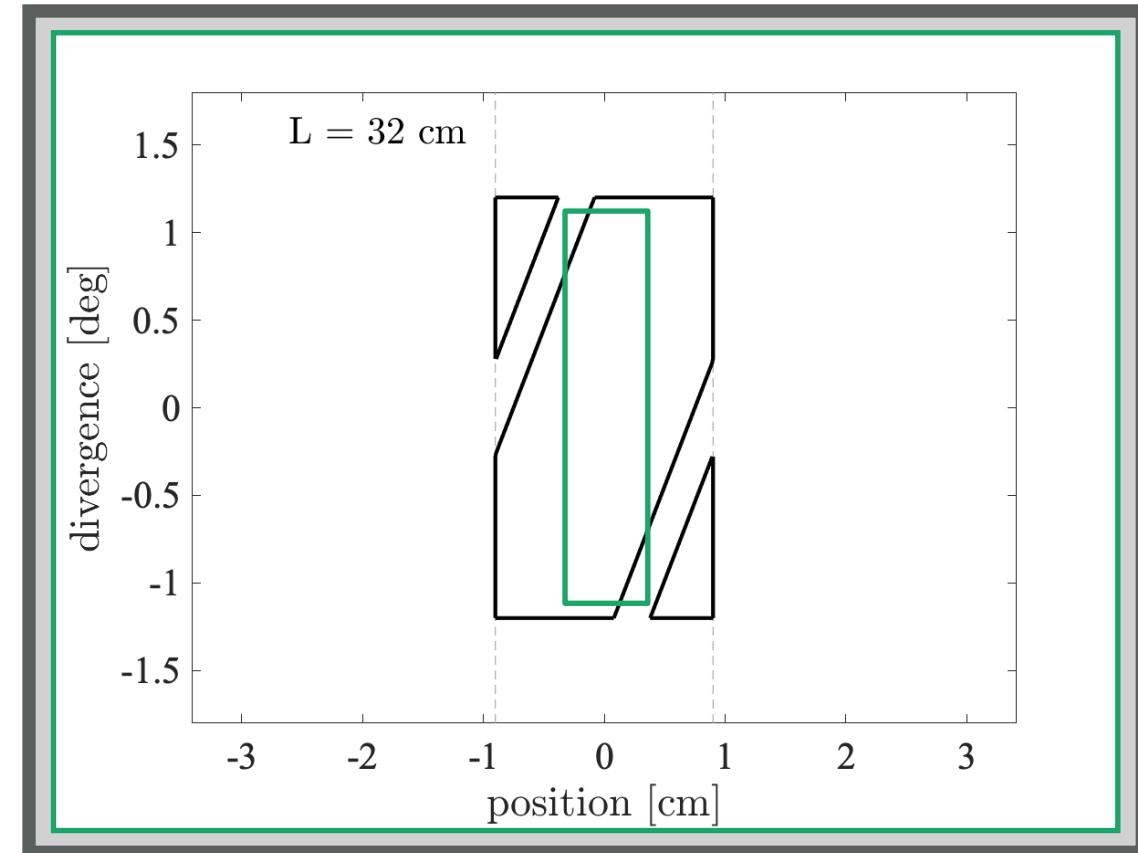
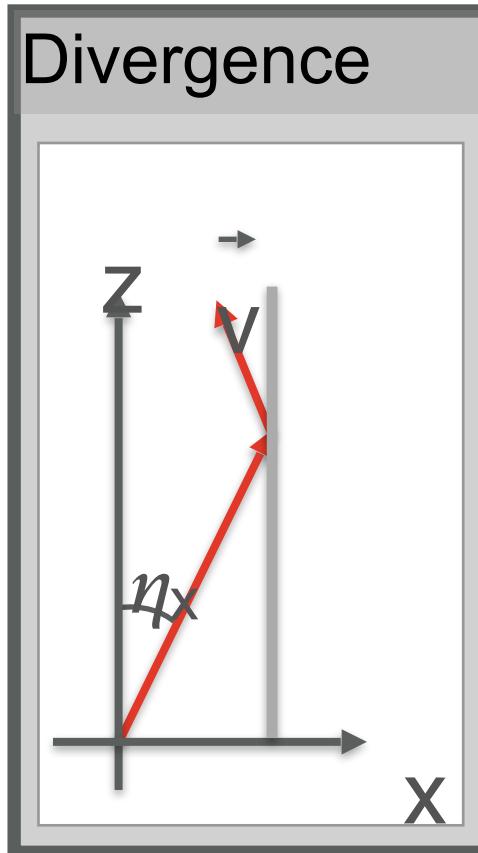
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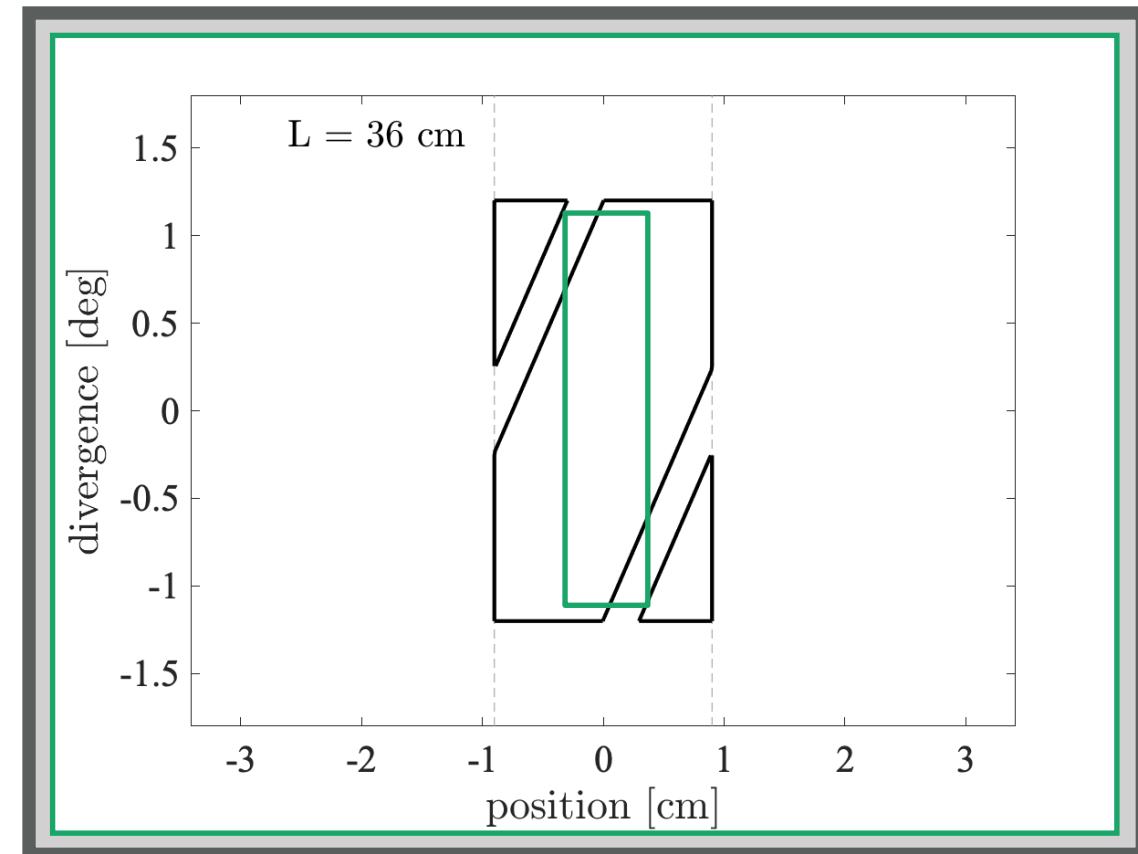
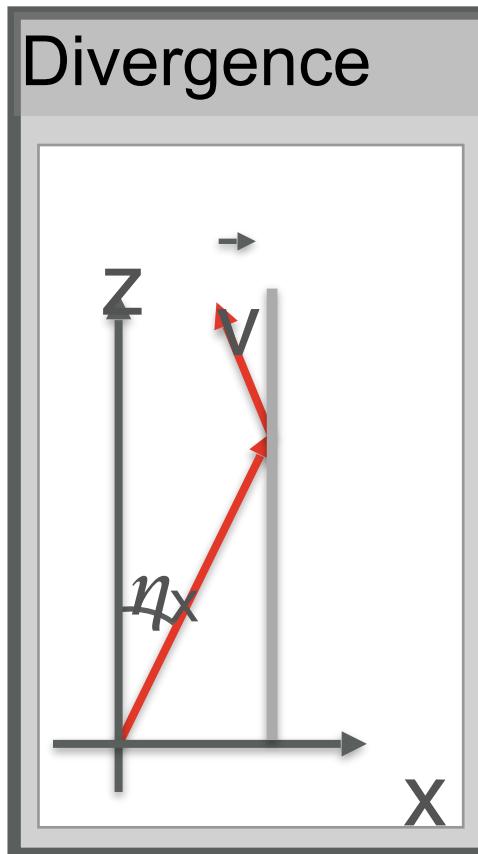
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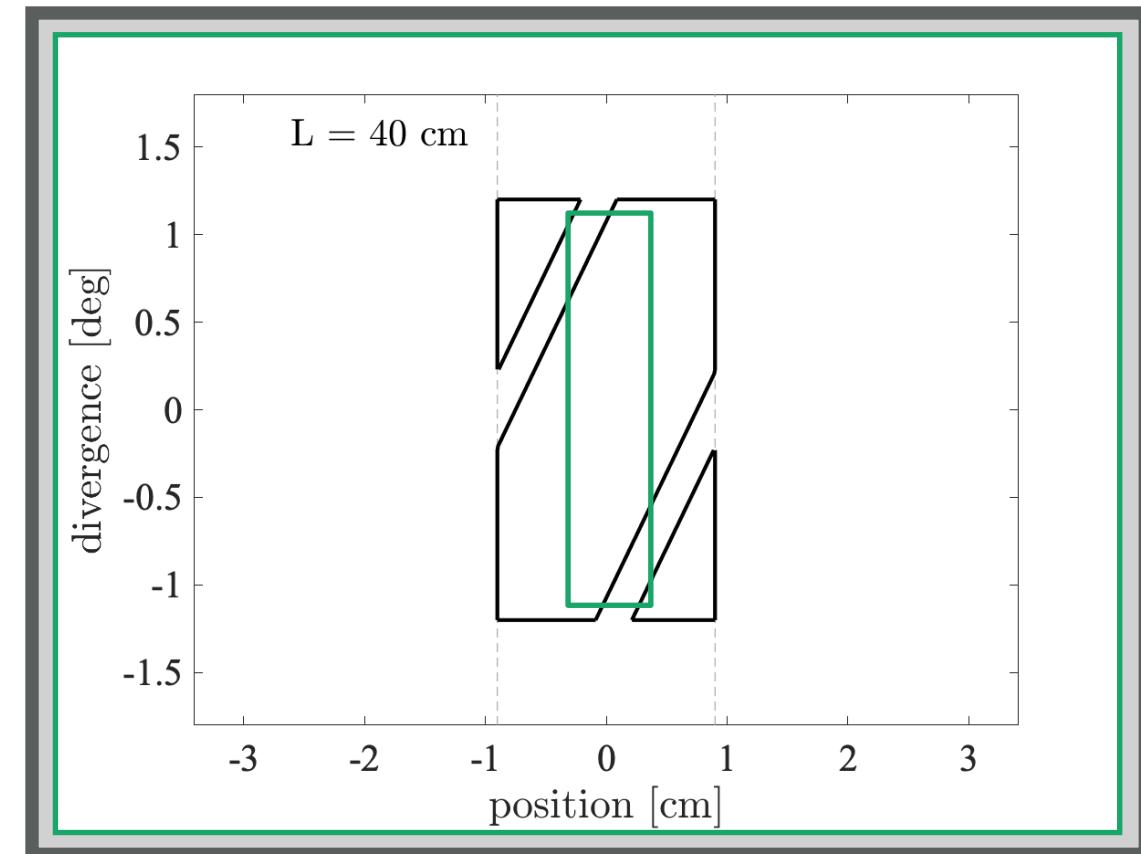
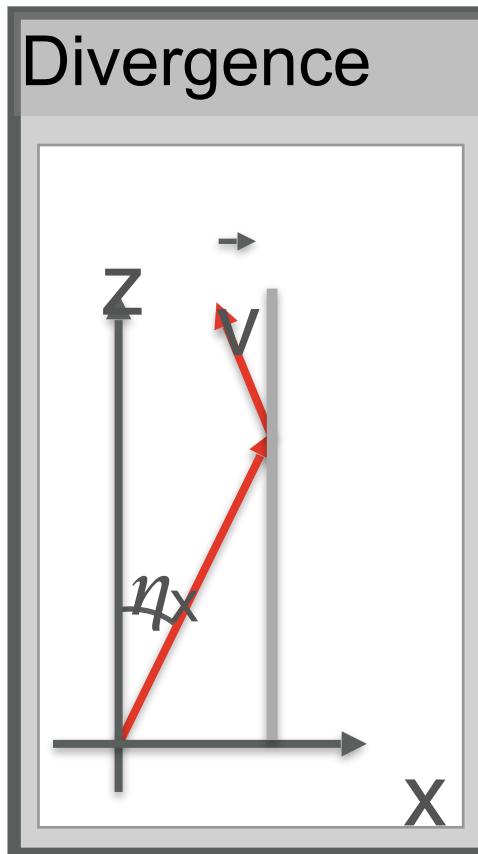


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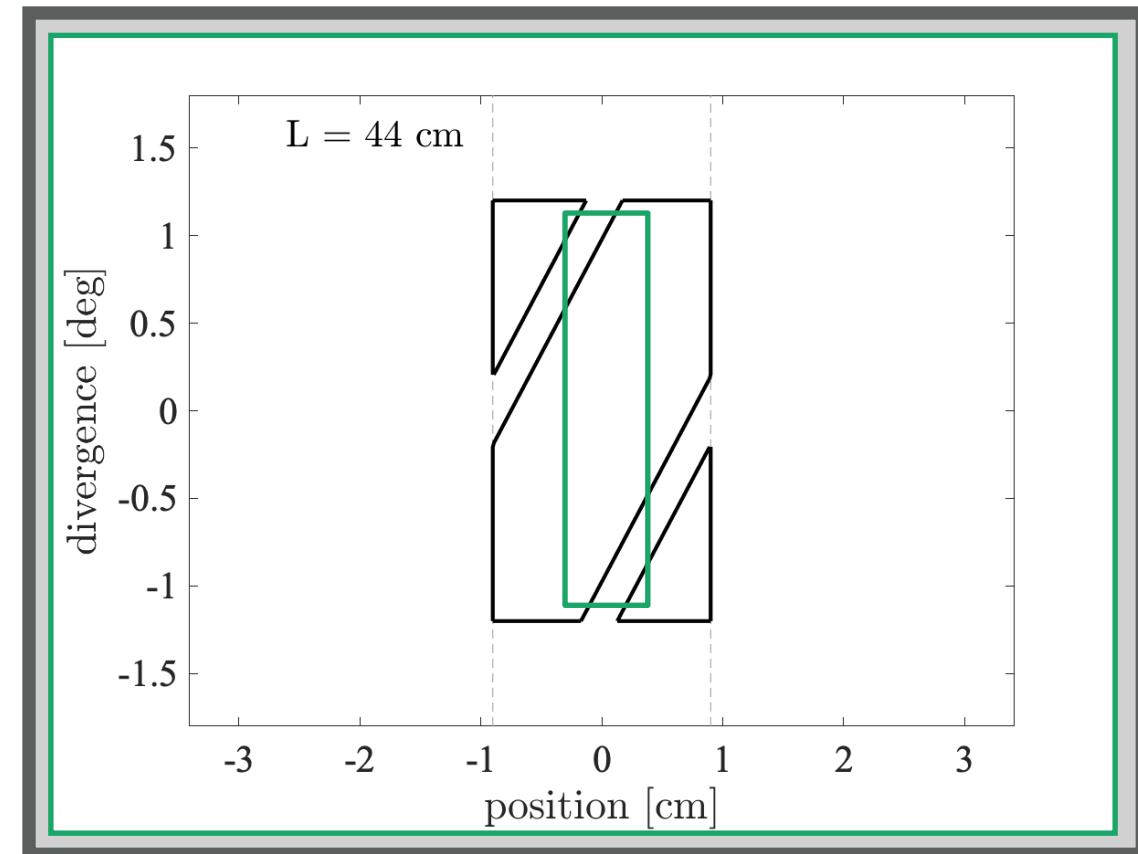
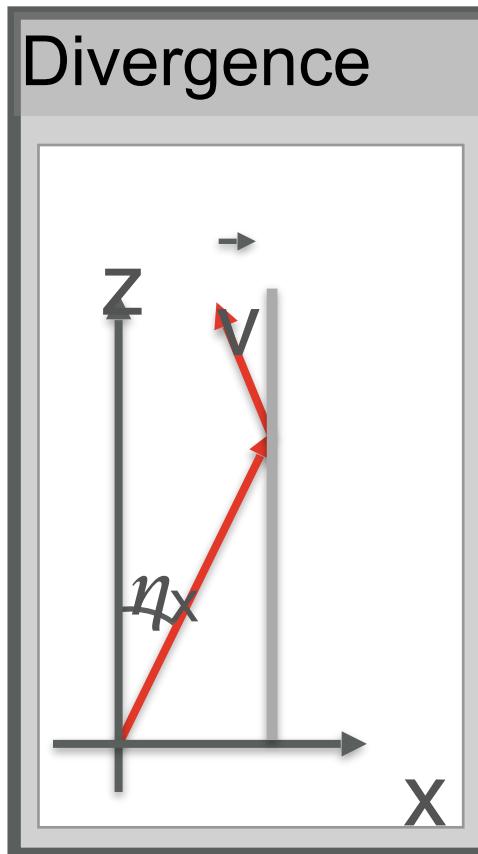


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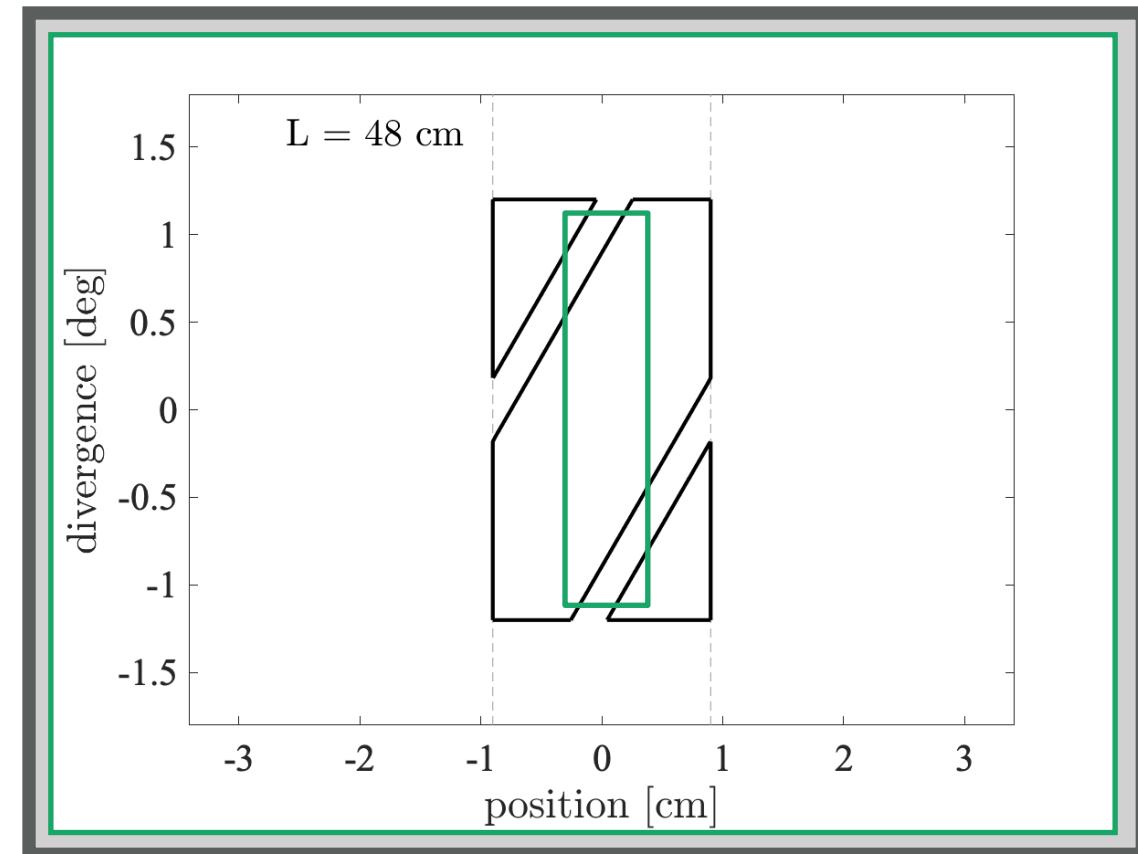
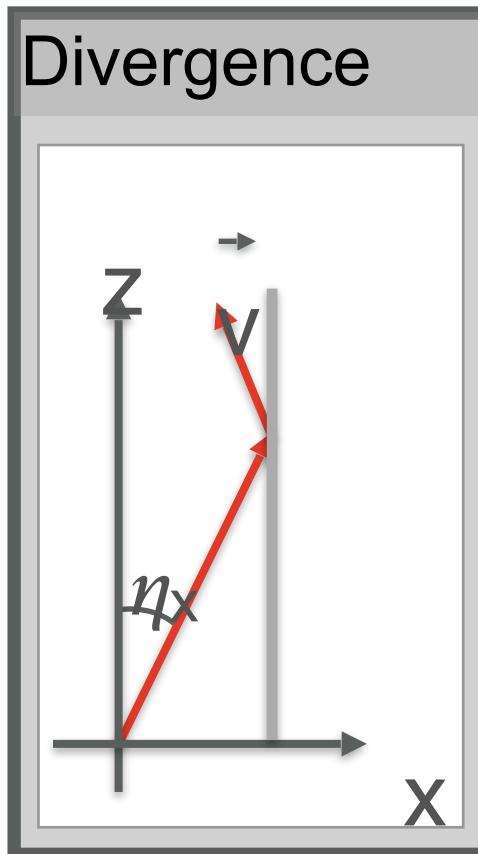


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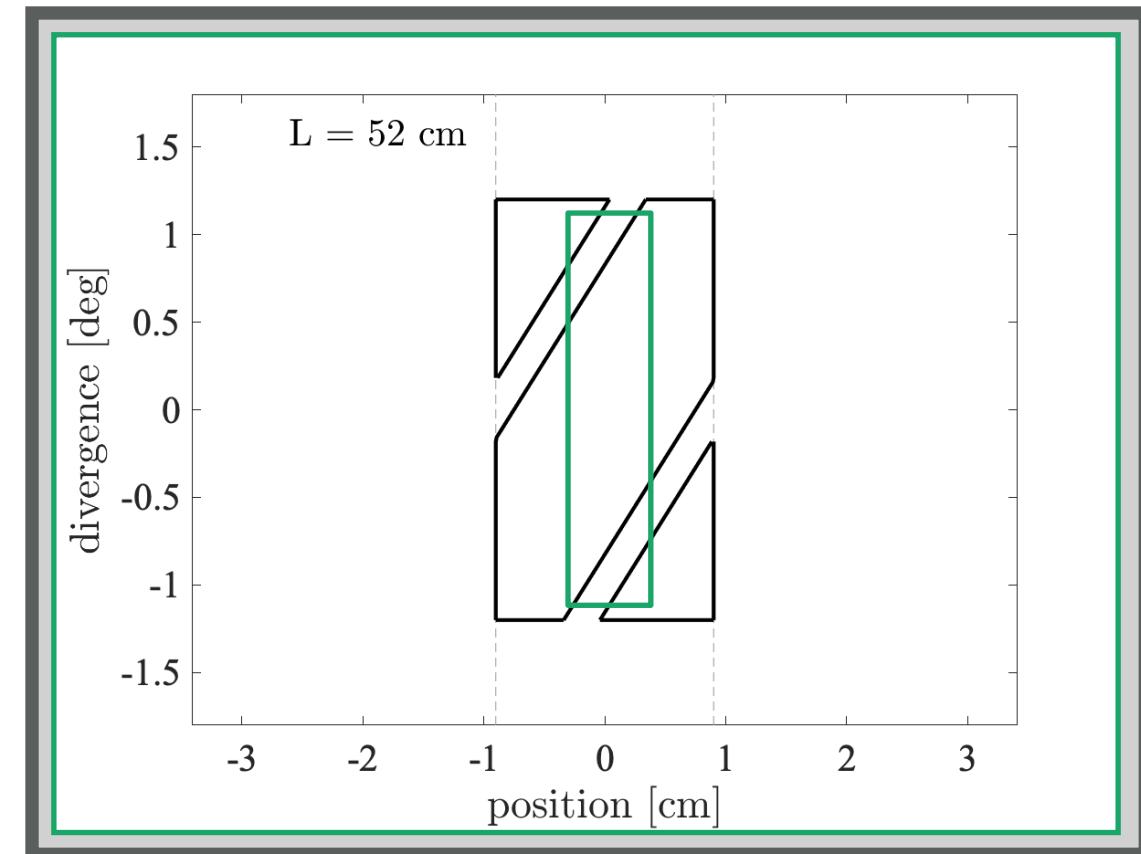
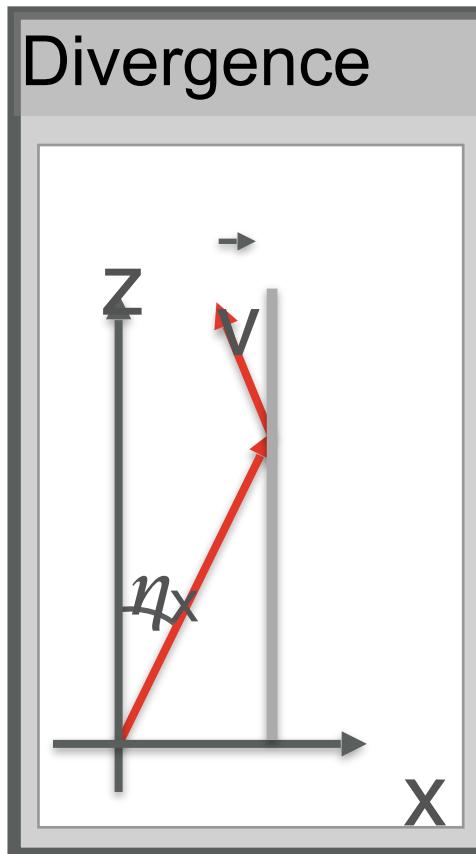


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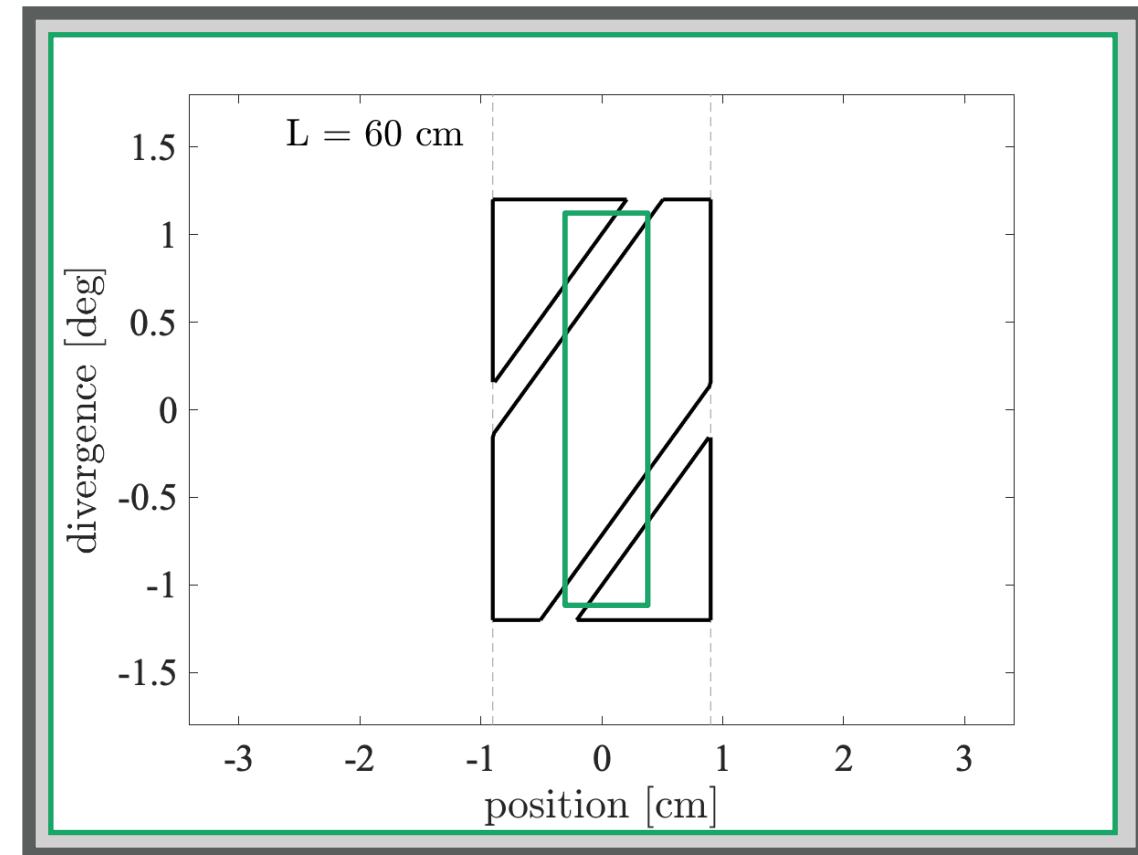
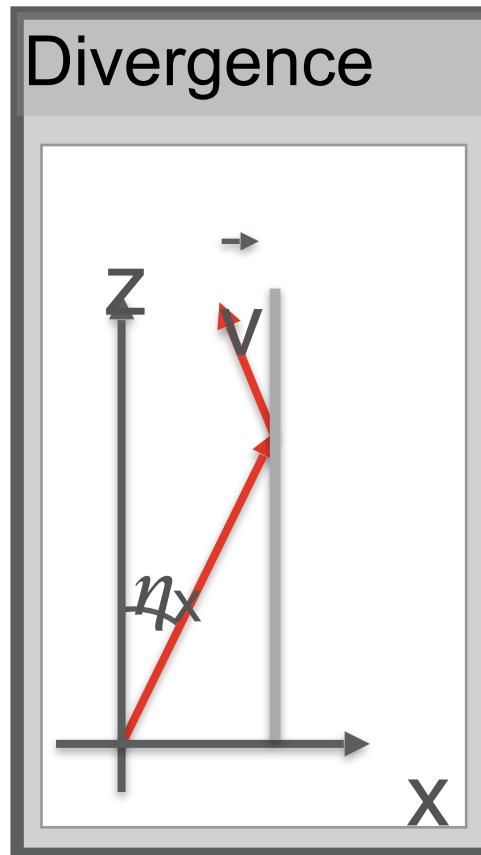


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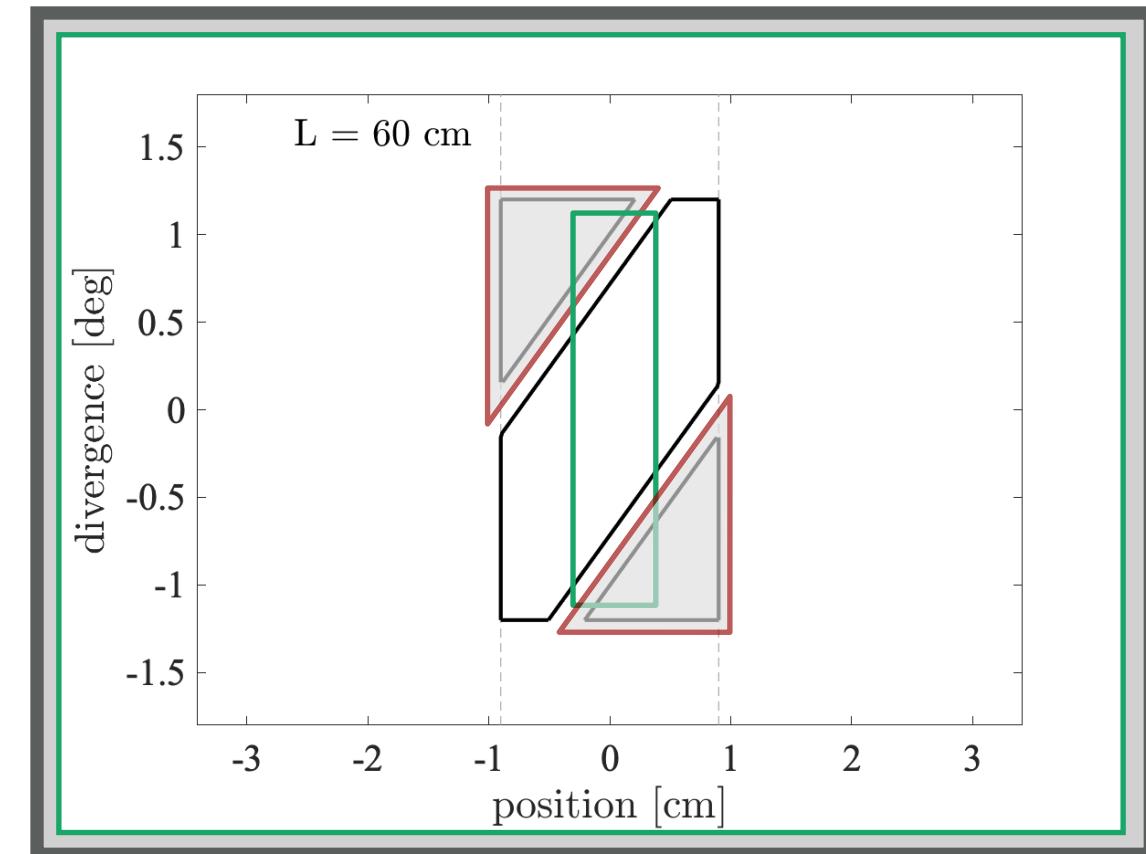
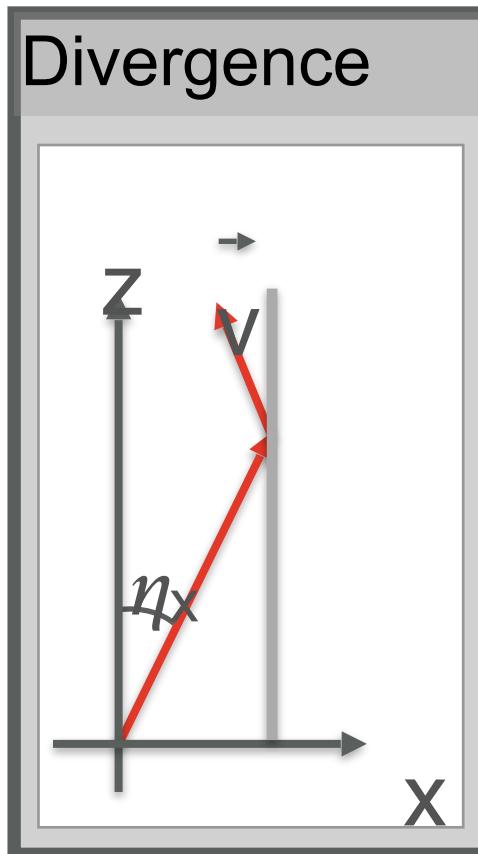


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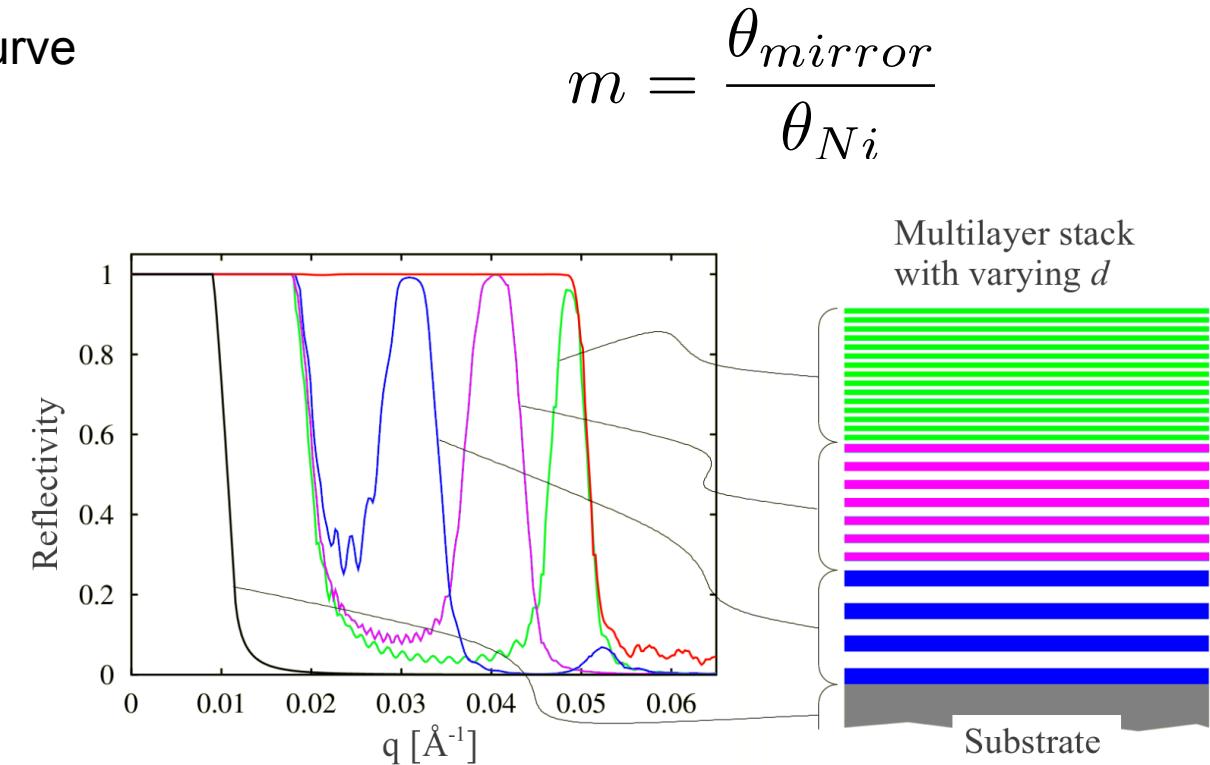
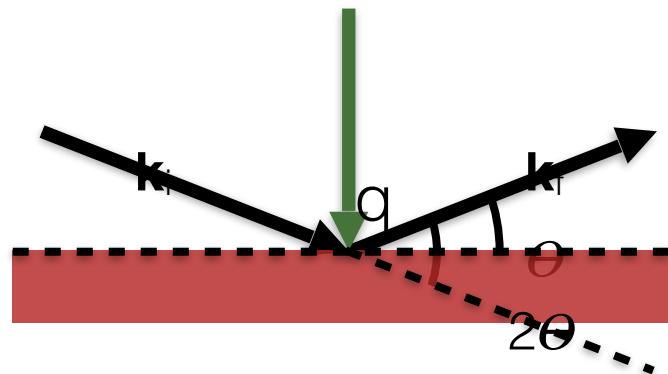
# Beam propagation in guide





# Reflectivity curves

- Reflectivity, super mirror, reflectivity curve

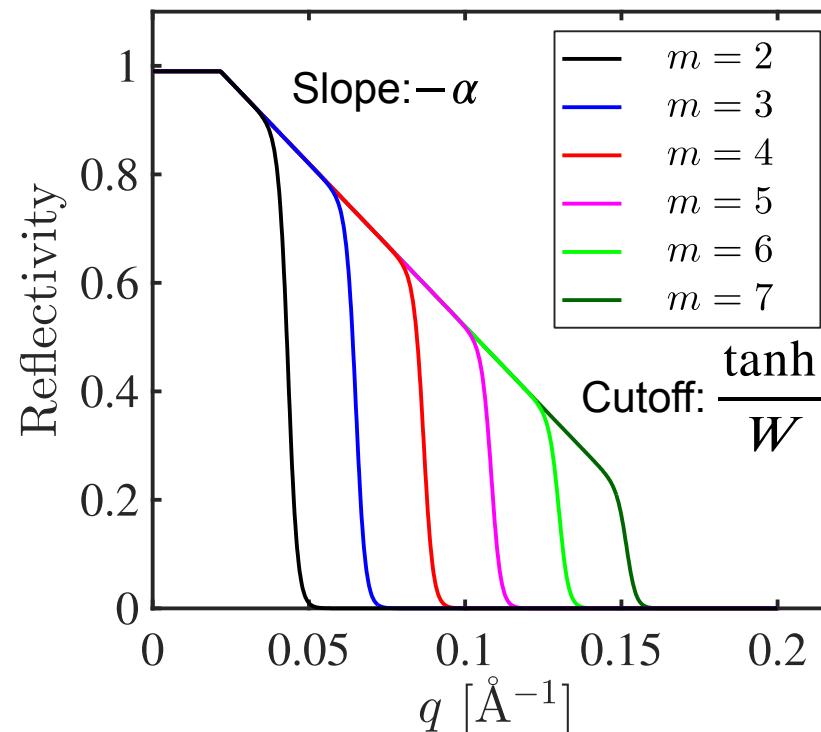




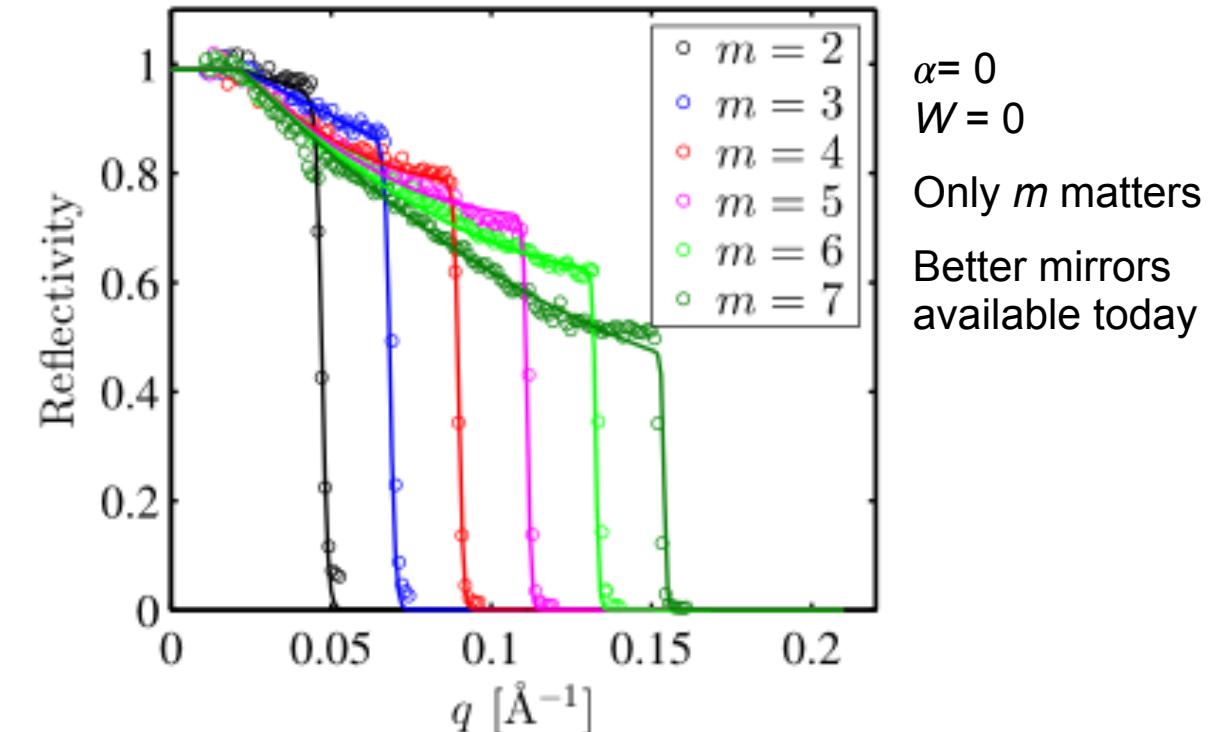
# Reflectivity curves in McStas

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

McStas standard model



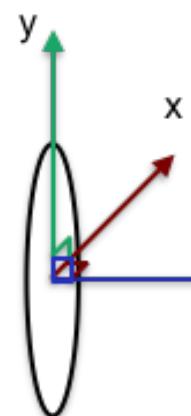
McStas fitted model



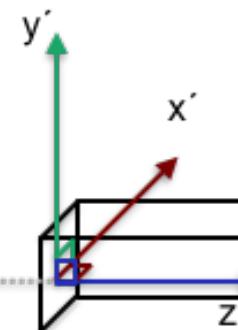


# Guide placement in McStas

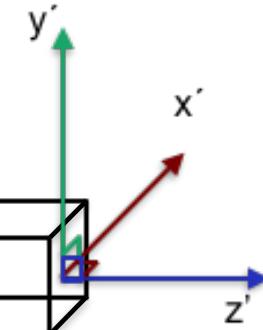
- The center is the front of the guide element
- Tip: Insert a guide at the end of the guide



COMPONENT Source  
AT (0,0,0) ABSOLUTE



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

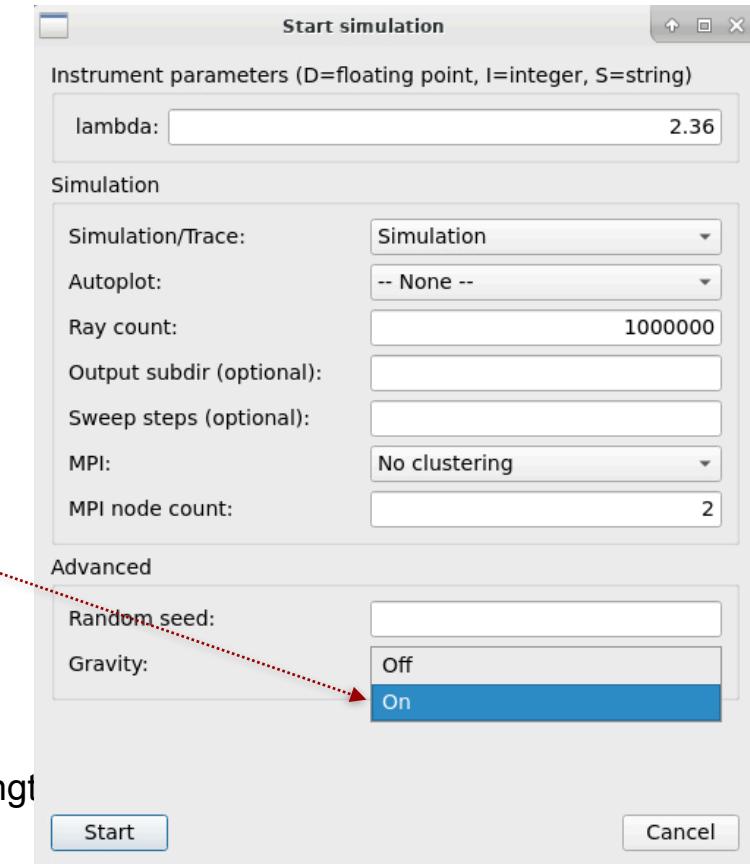


COMPONENT Arm  
AT (0,0,A) RELATIVE Guide



# Gravitation in McStas

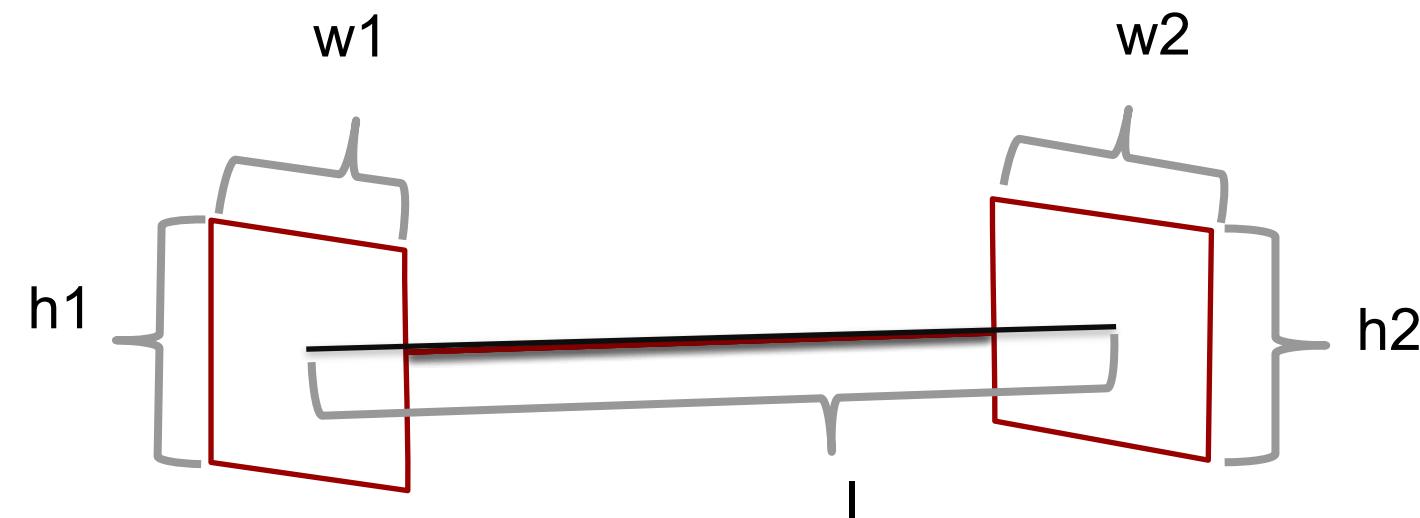
- Enabled by adding `-g` / `--gravitation` on command line or by selecting “Gravity On” in mcgui
- Default ~ gravity on earth  
`#define GRAVITY 9.81 /* [m/s^2] gravitational acceleration */`  
 ( If on the moon, use `-DGRAVITY=1.62 ;-` )
- For guides, only `Guide_gravity` and `Elliptic_guide_gravity` support parabolic propagation. (Many others propagate linearly in  $\vec{v}$  direction.)
- As you will see in the practical, implications are greatest with long wavelength
- “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





# Popular guide components: Guide\_gravity

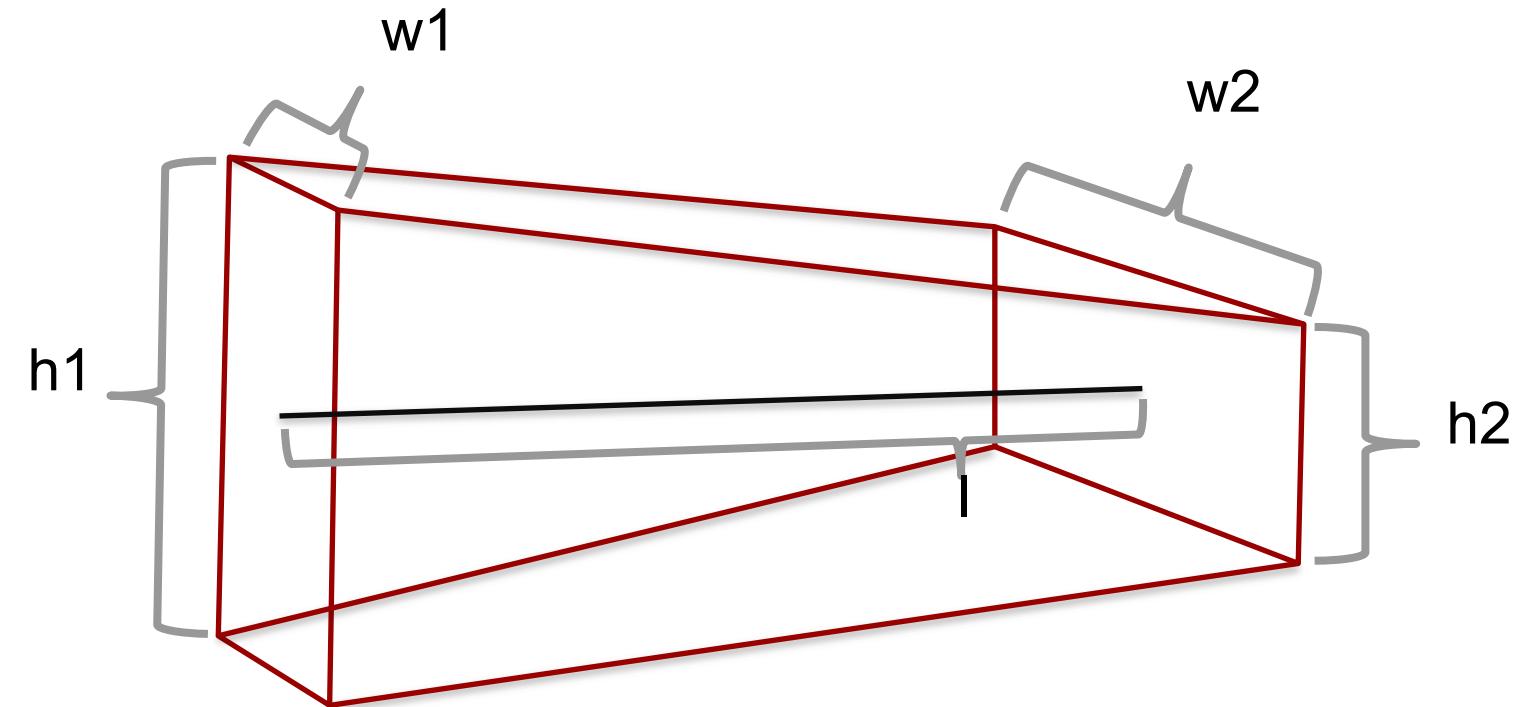
- Typical guide component with gravity, parameter-interface similar to e.g. Guide.comp
- Many additional features, channels, fermi chopper, ... (see mcdoc pages for more info)





# Popular guide components: Guide\_gravity

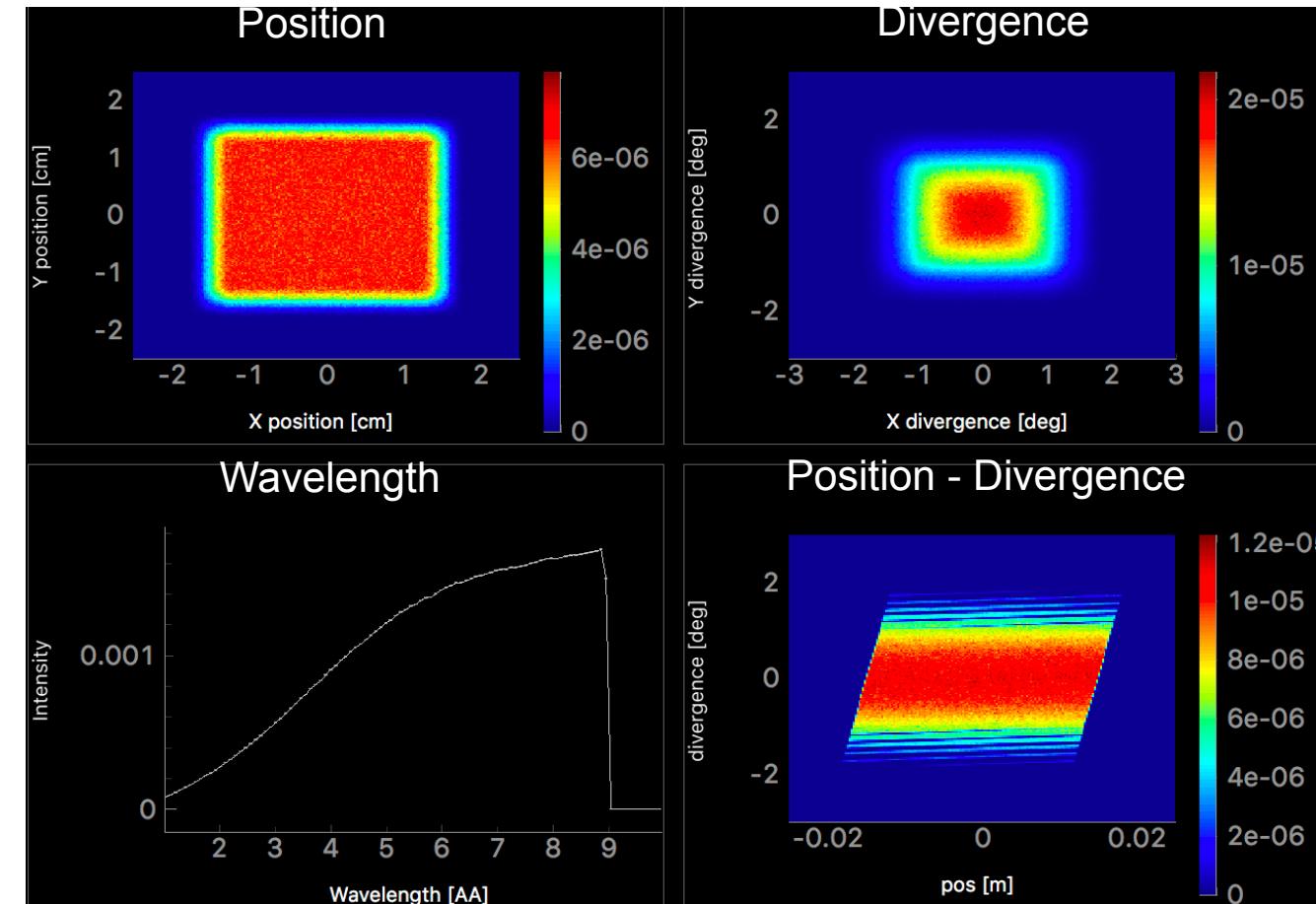
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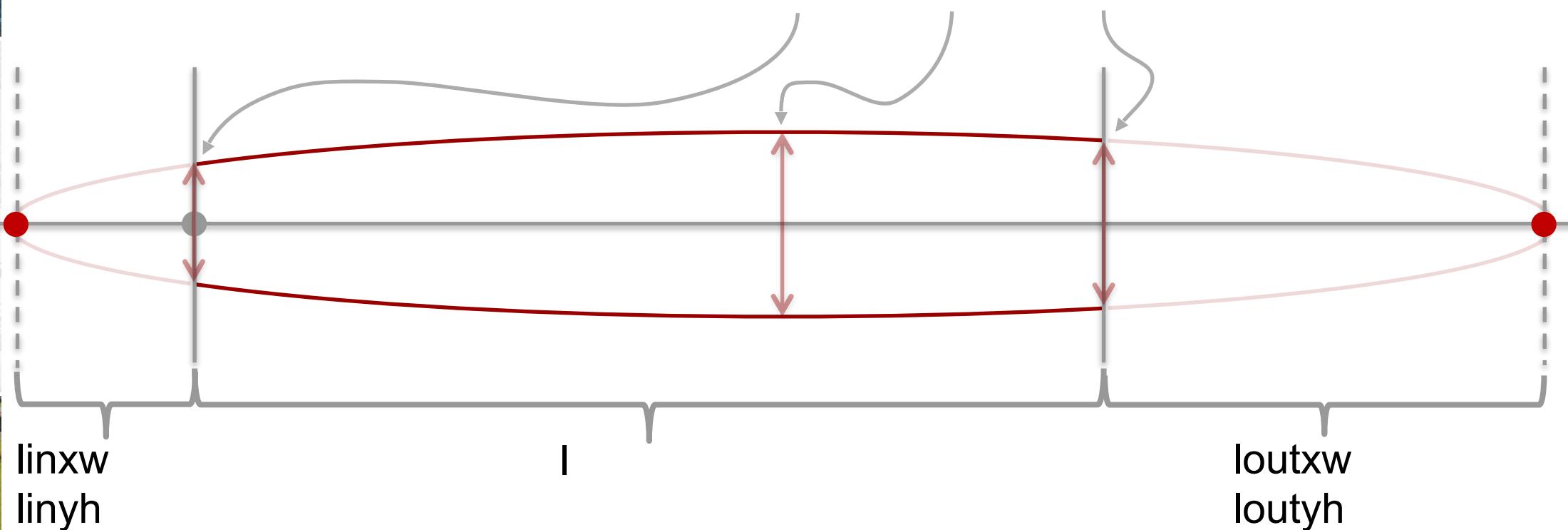
- Typical guide component with gravity





# 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"



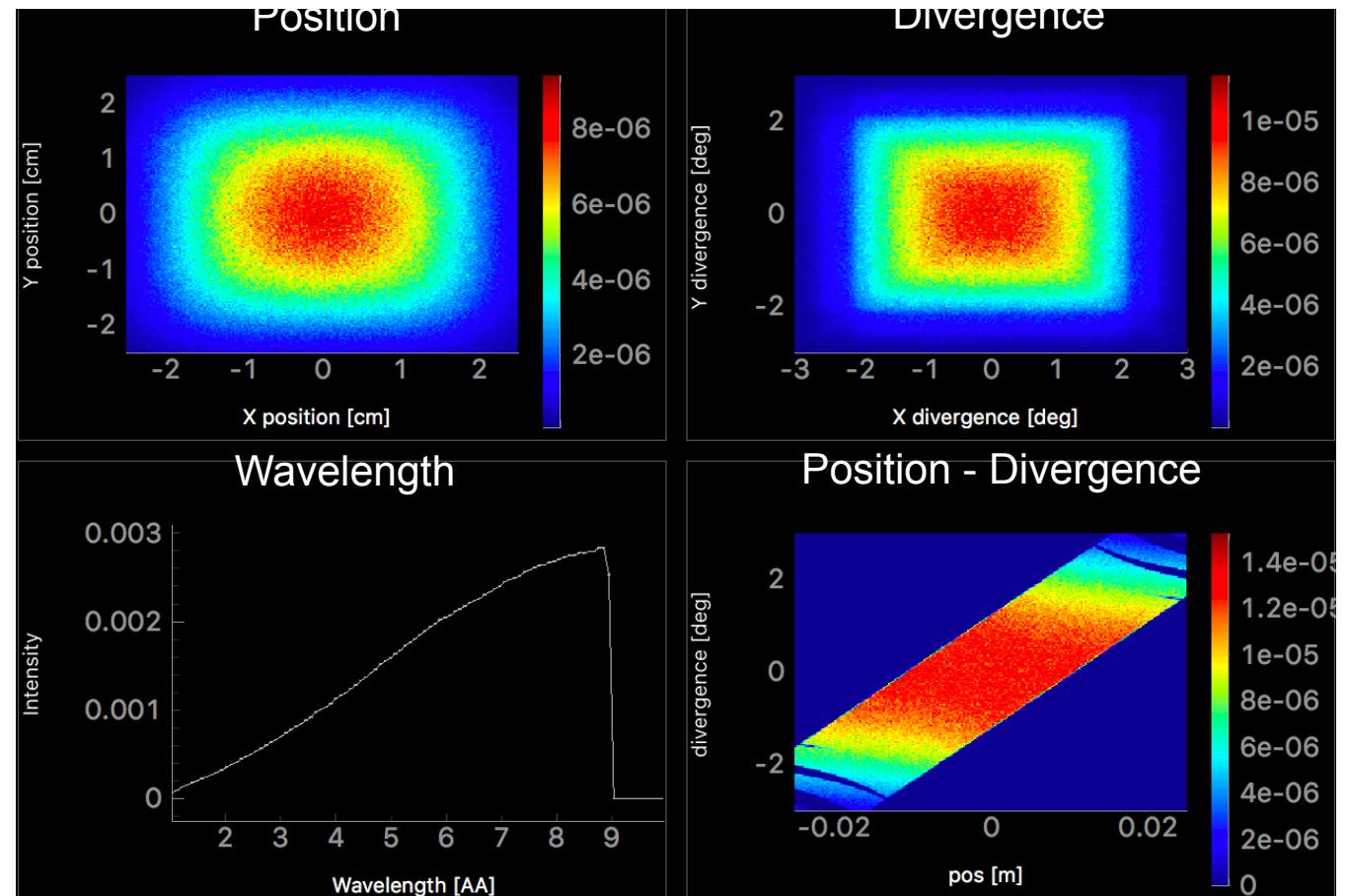
linxw  
linyh

loutxw  
loutyh



# Popular guide components: Elliptical\_guide\_gravity

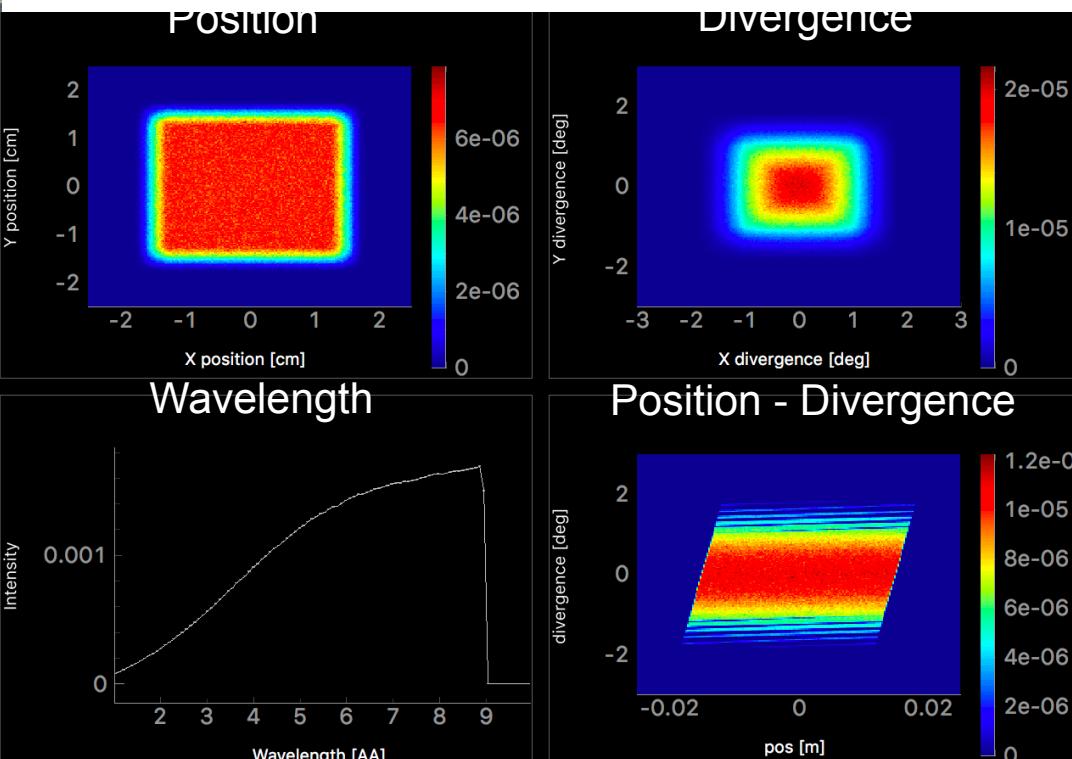
- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution,  
...



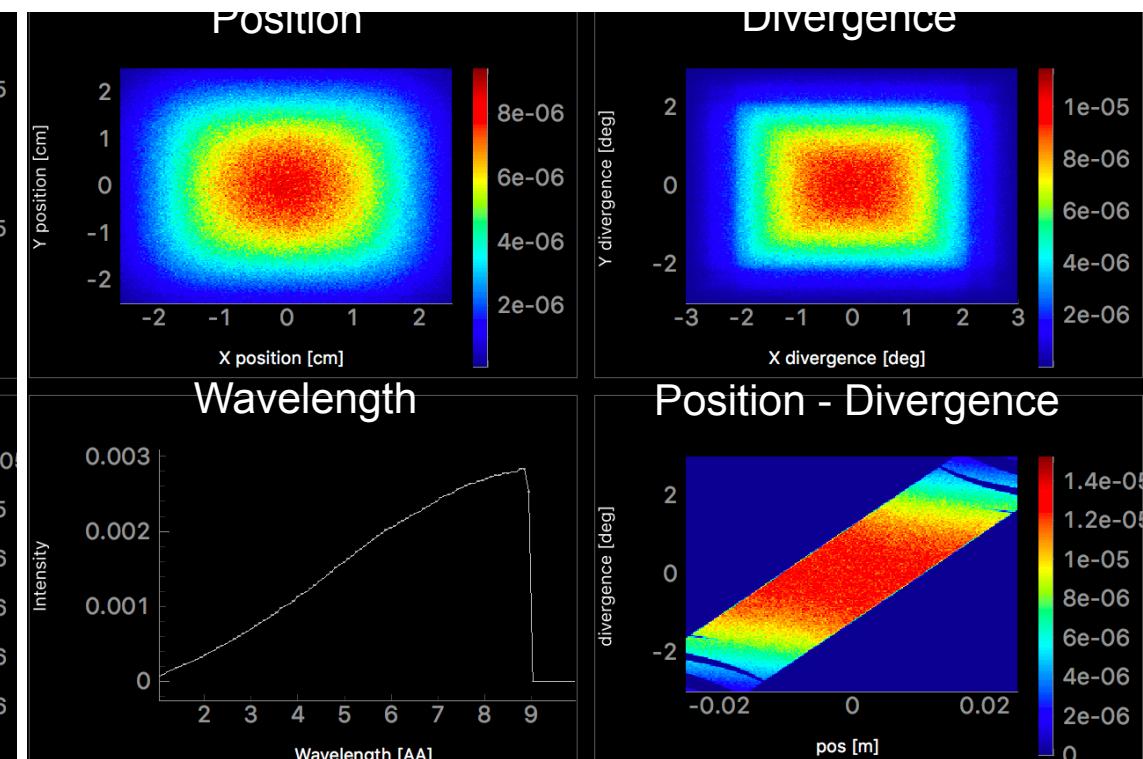


# Comparison: Guide\_gravity and Elliptic\_guide\_gravity

## Guide\_gravity



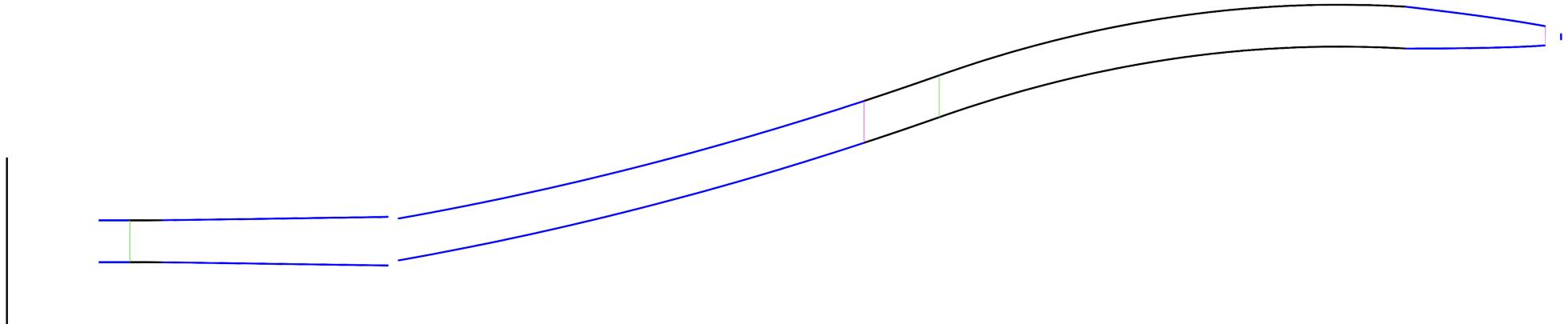
## Elliptic\_guide\_gravity





# Breaking line of sight

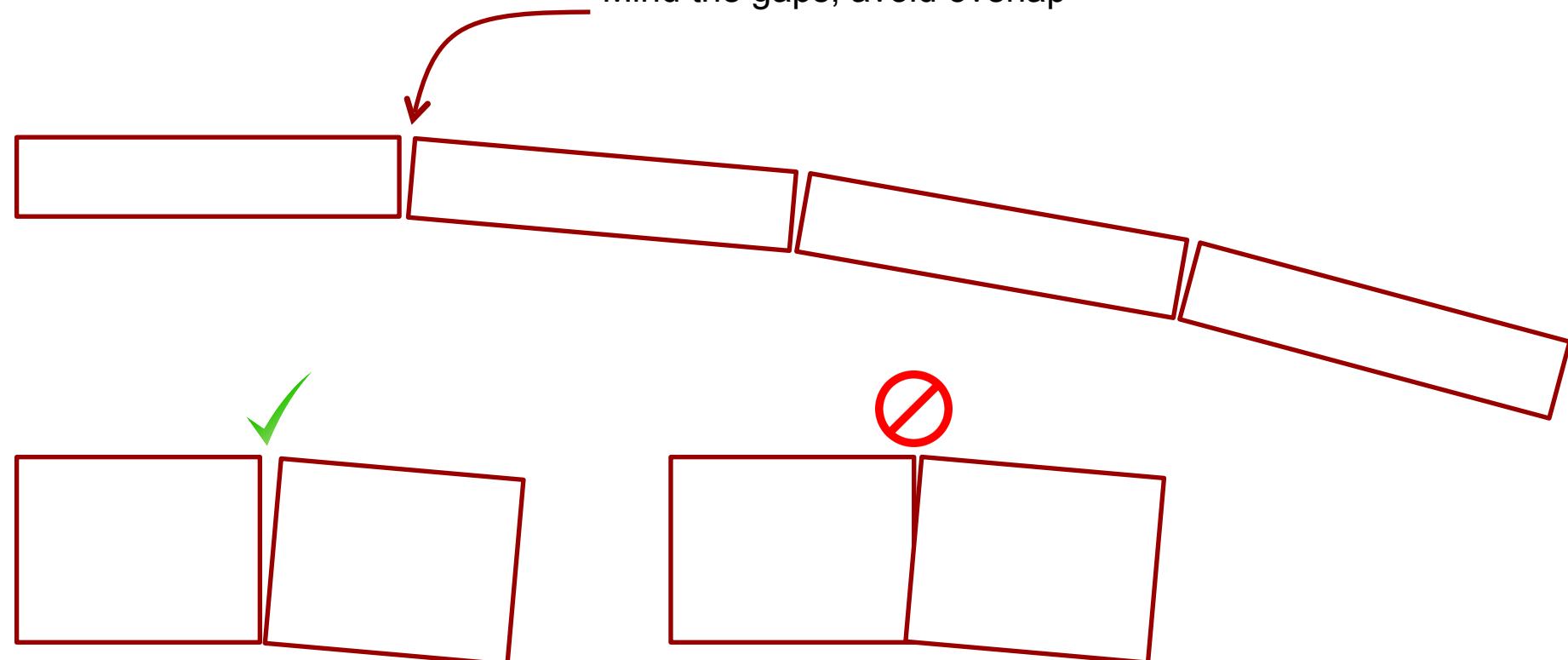
- Importance of breaking line of sight, ways of doing so, ...





# Breaking line of sight

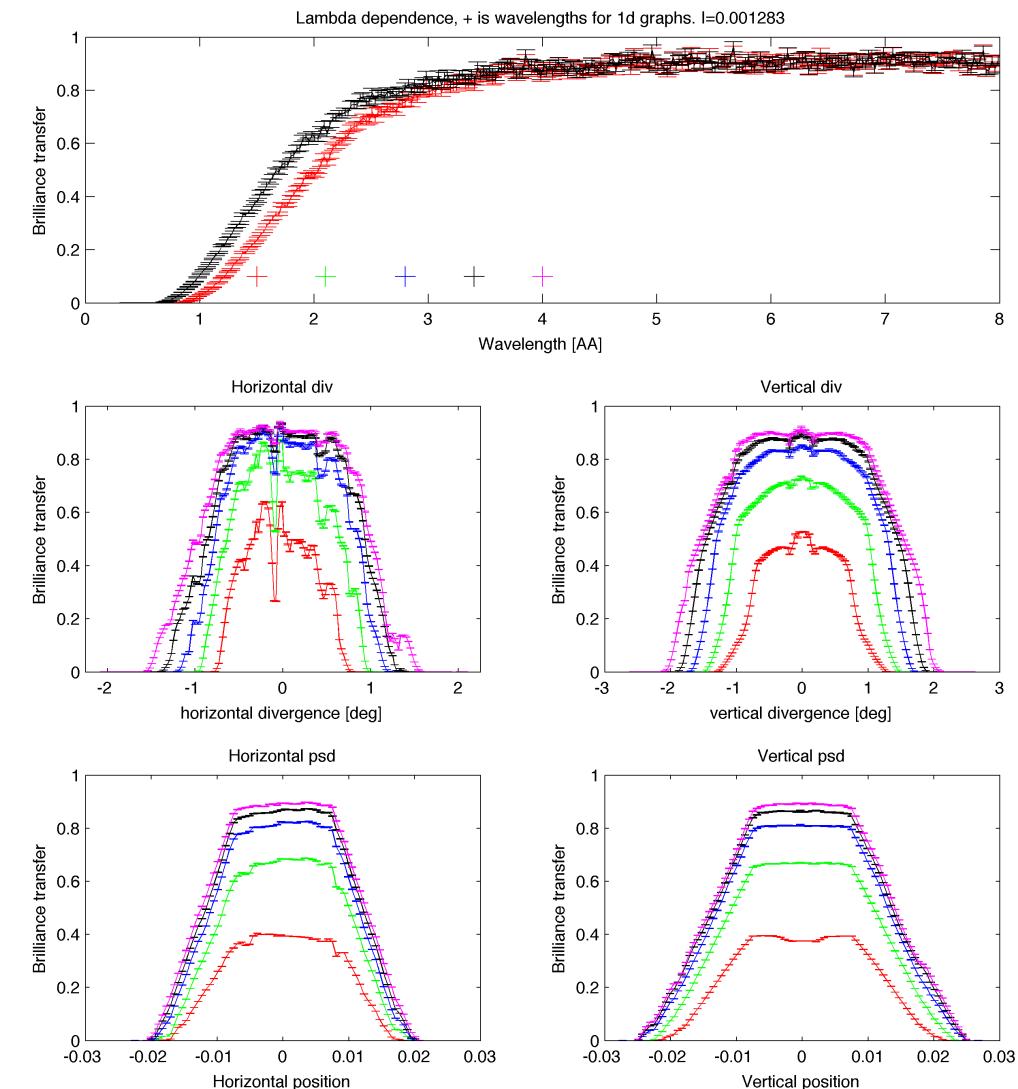
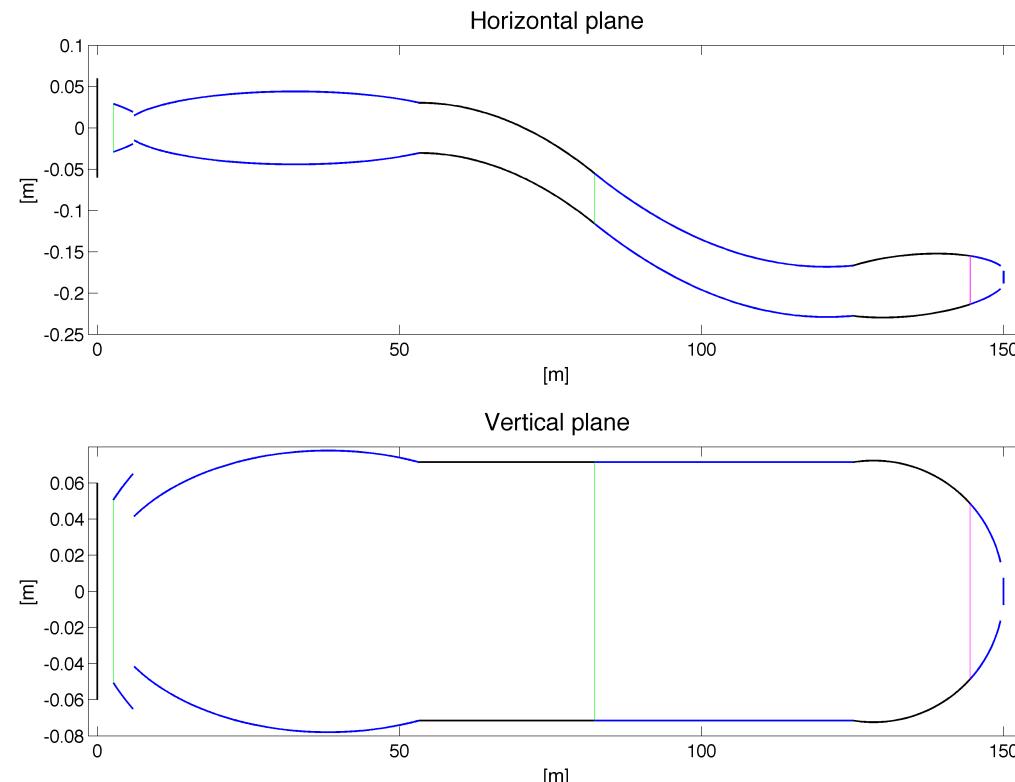
- Bender / Guide\_curved component or many straight sections  
Mind the gaps, avoid overlap





# A guide design

- To be continued in Thursday guidebot talk by Mads Bertelsen





*Solution on github, use if you are stuck*

# Guide exercise

- Insert a guide and use an instrument input parameter to set the length
  - Use monitors to see the resulting beam
    - PSD\_monitor (spatial distribution)
    - Divergence\_monitor (divergence distribution)
    - L\_monitor (wavelength distribution)
    - Posdiv\_monitor (acceptance diagram)
  - Extra tasks:
    - Scan guide length
    - Introduce a gap by using two guide components
    - Use Guide\_gravity and extend to 100 m length
    - Investigate the effect of gravity on the transport of long-wavelength neutrons