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Guides and gravity in McStas

Peter Willendrup

Adapted from slides by Mads Bertelsen, ESS



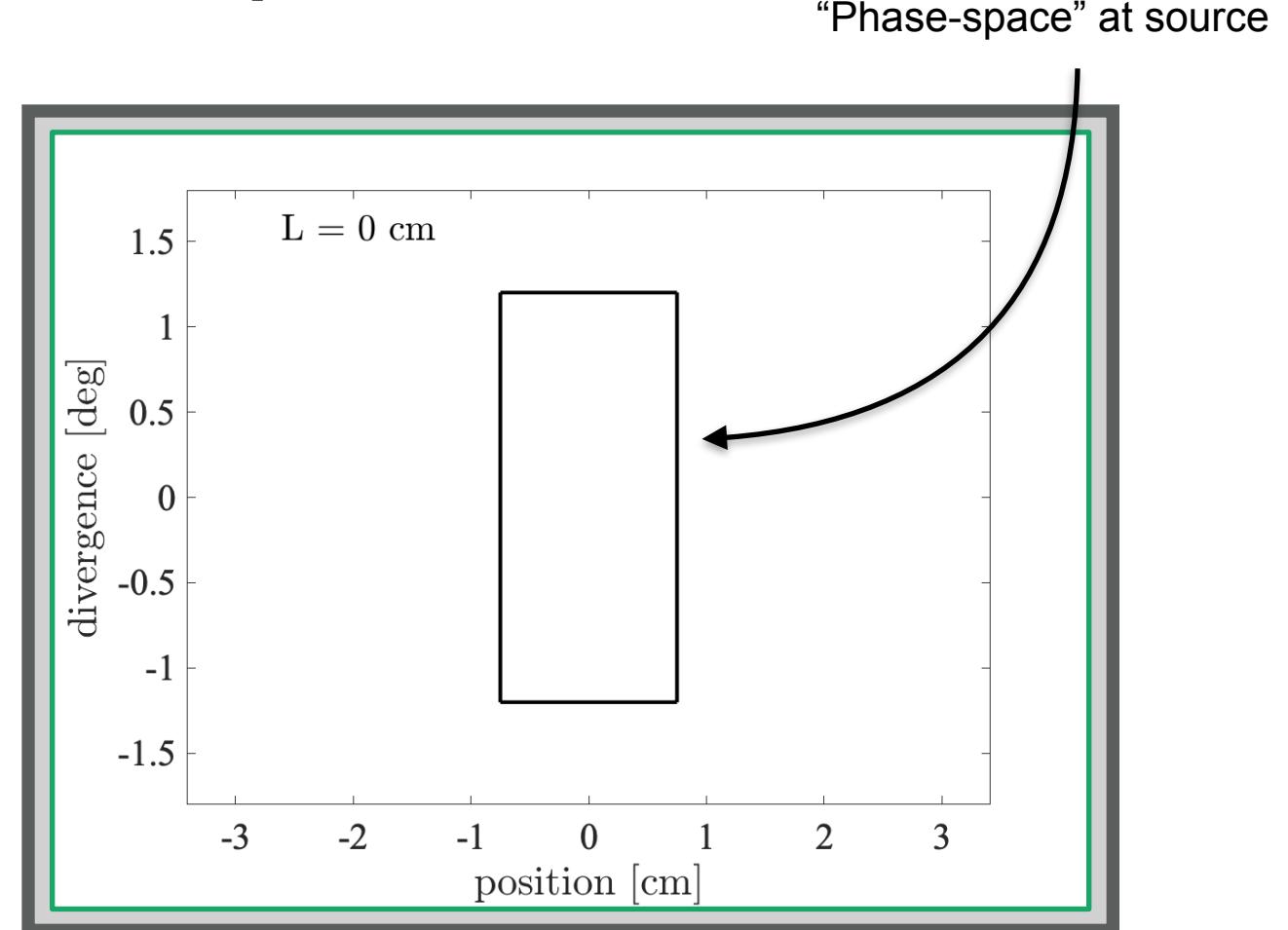
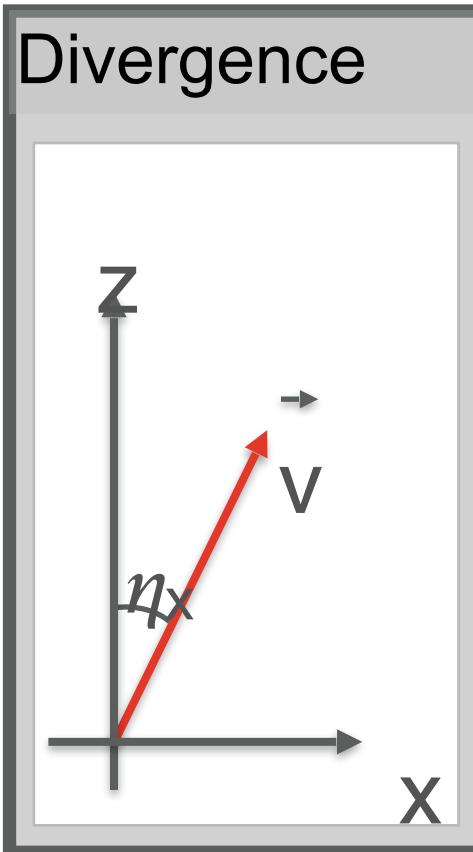
Overview

- 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



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Beam propagation in free space

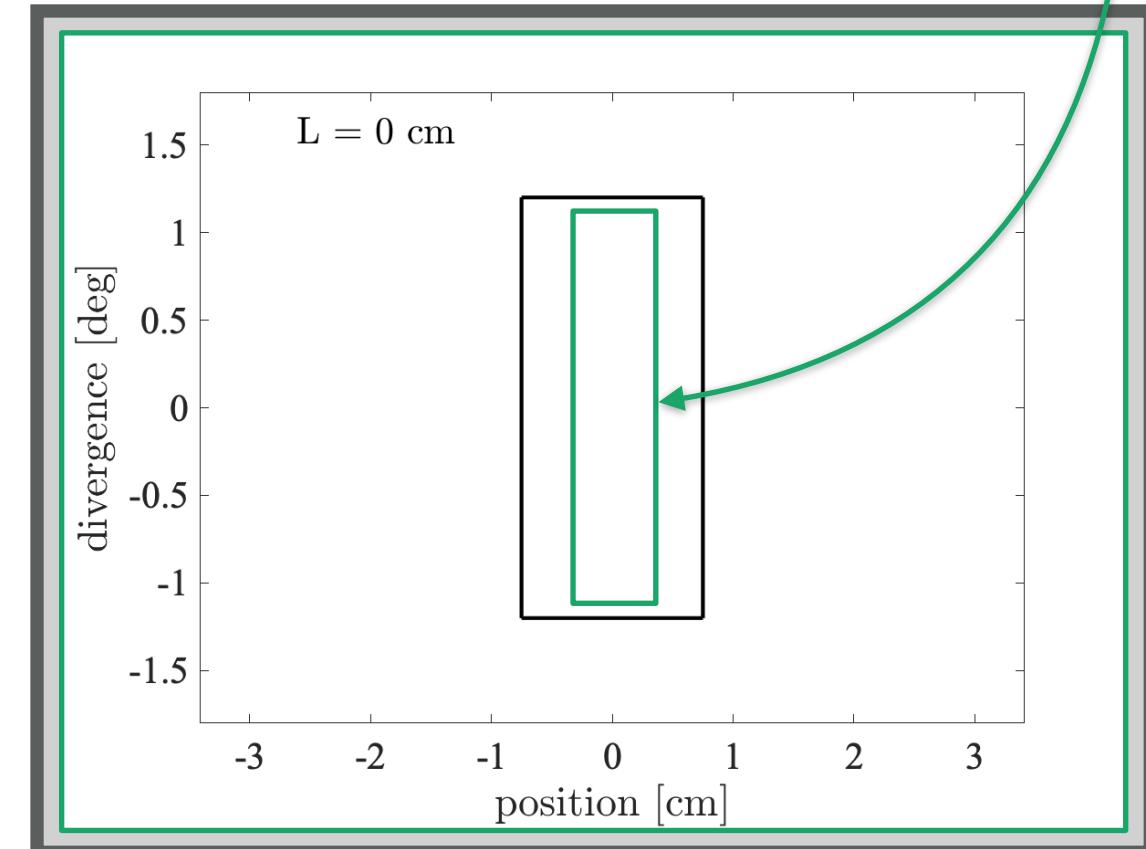
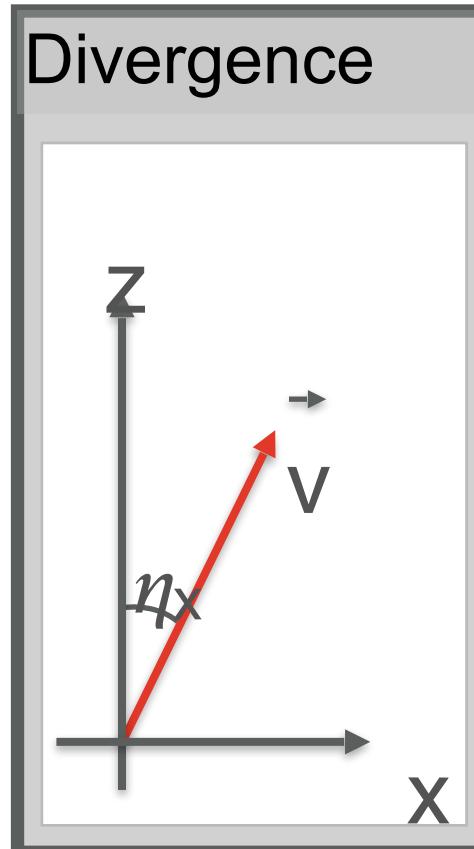




Beam propagation in free space



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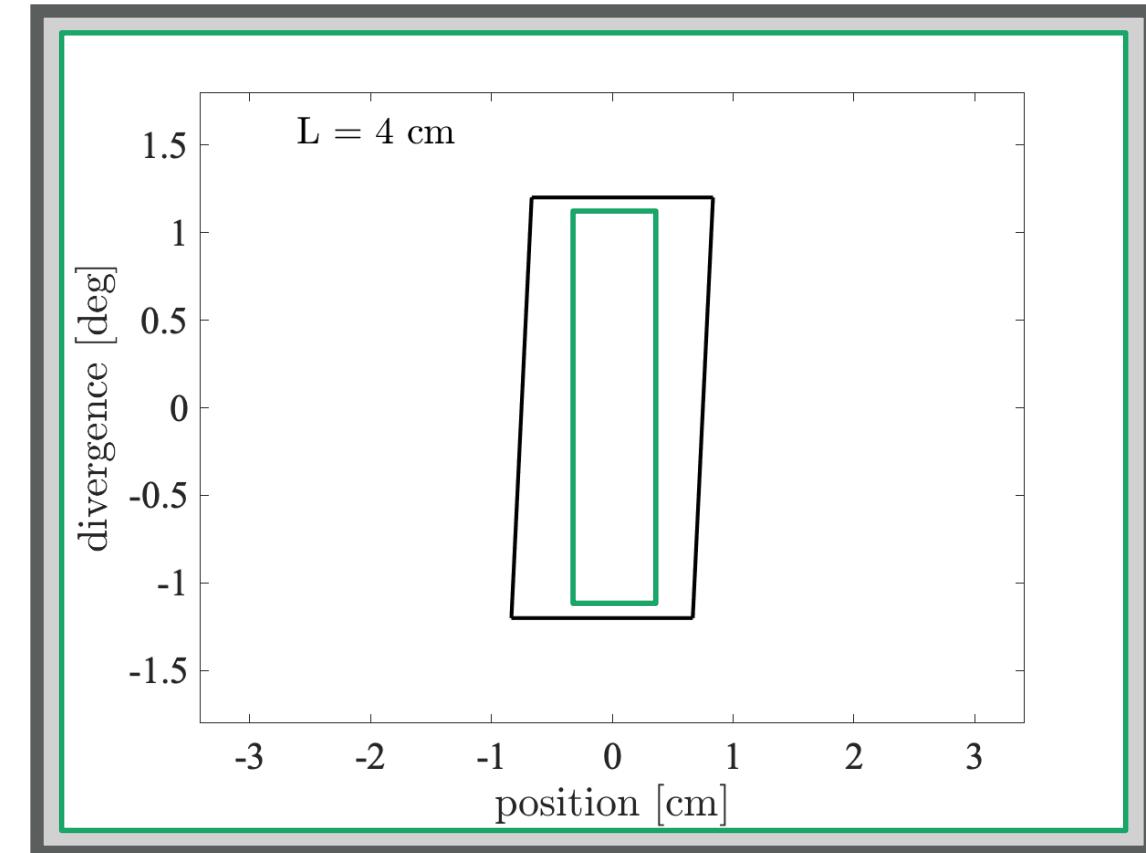
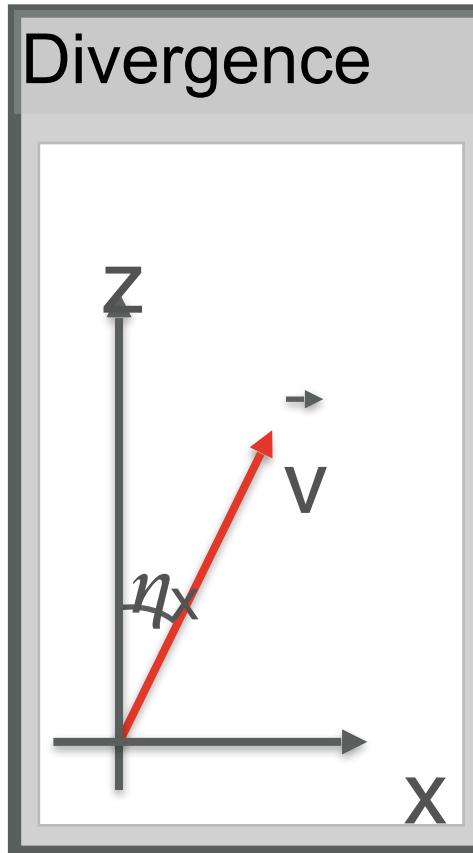


Wanted “phase-space” at sample



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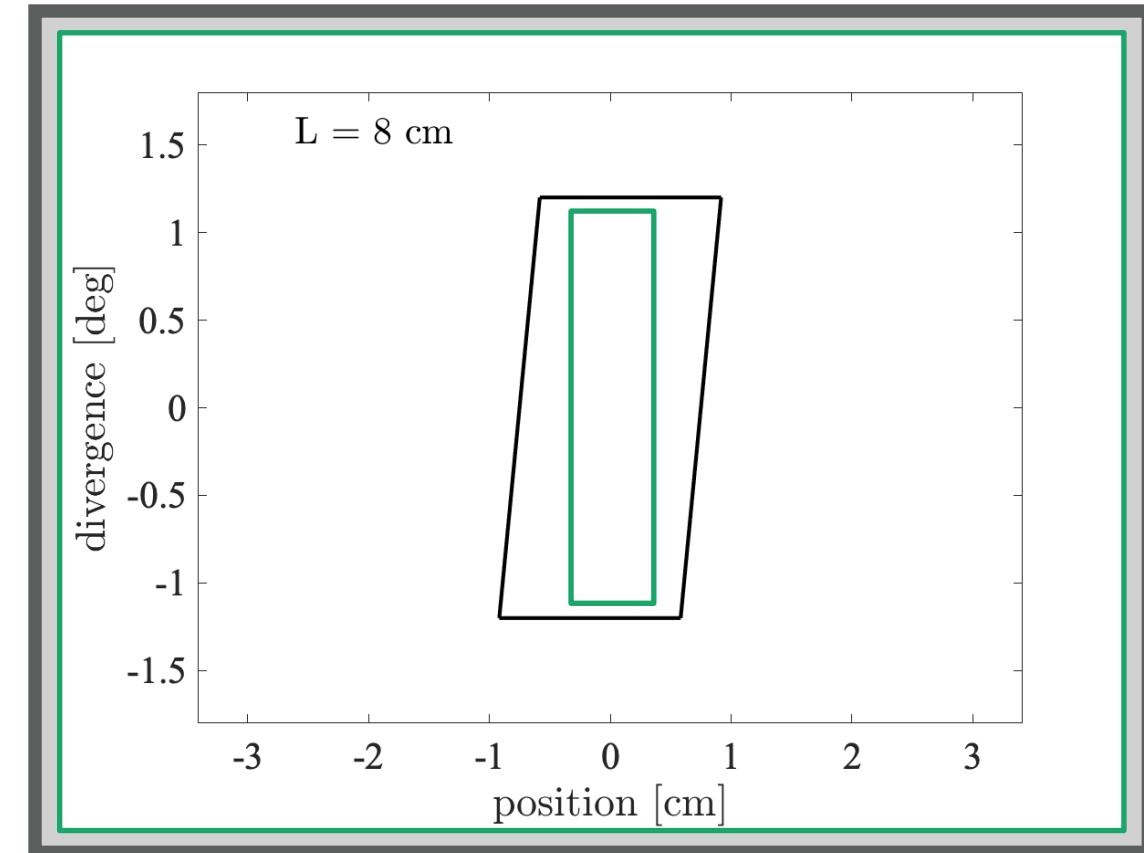
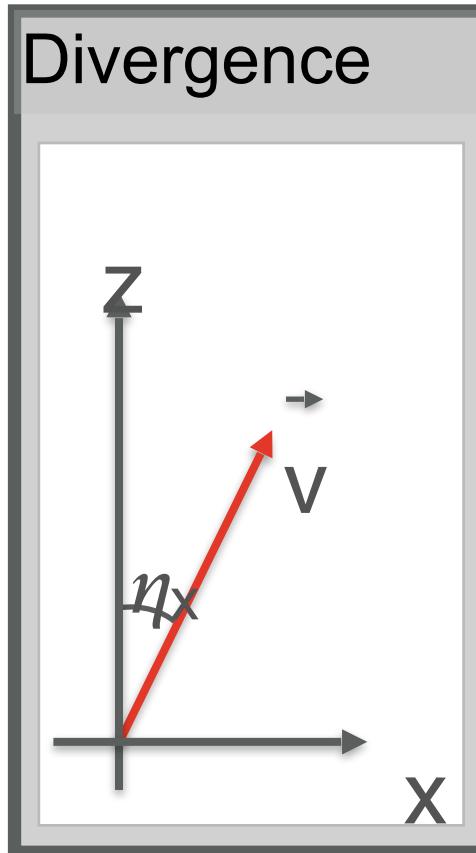
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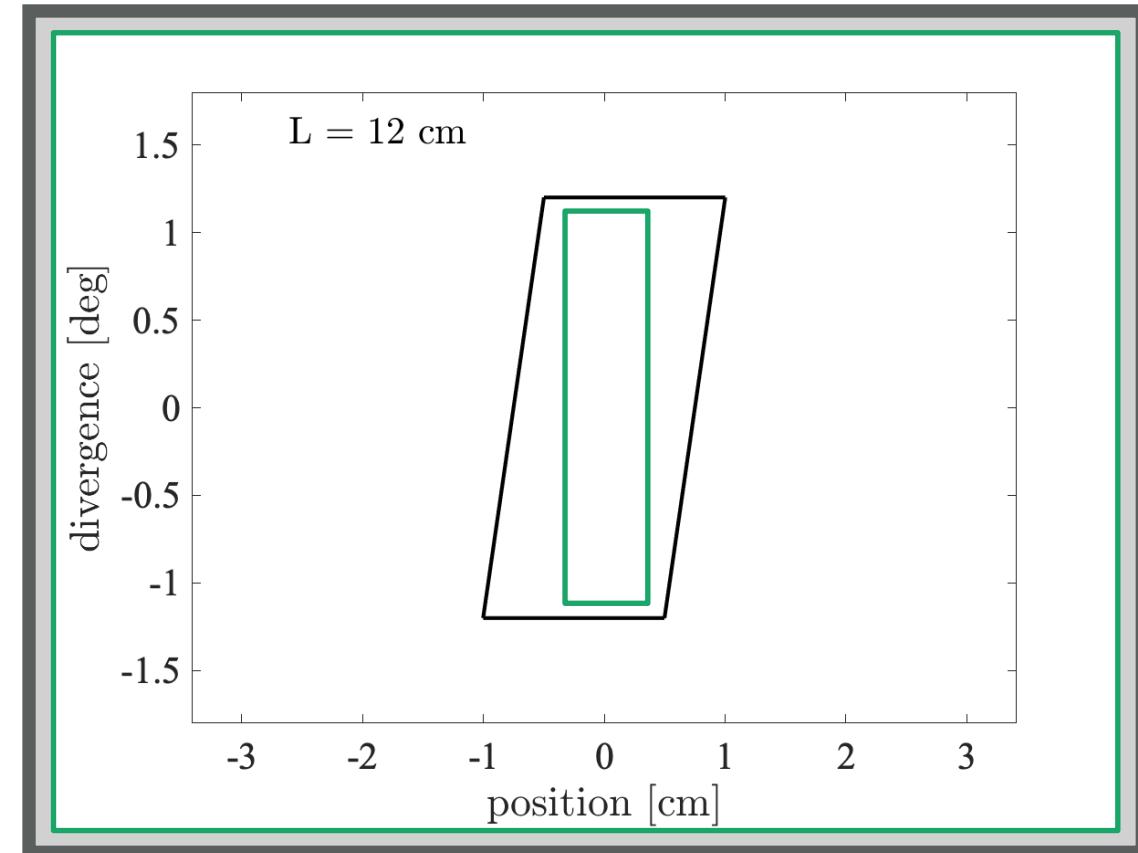
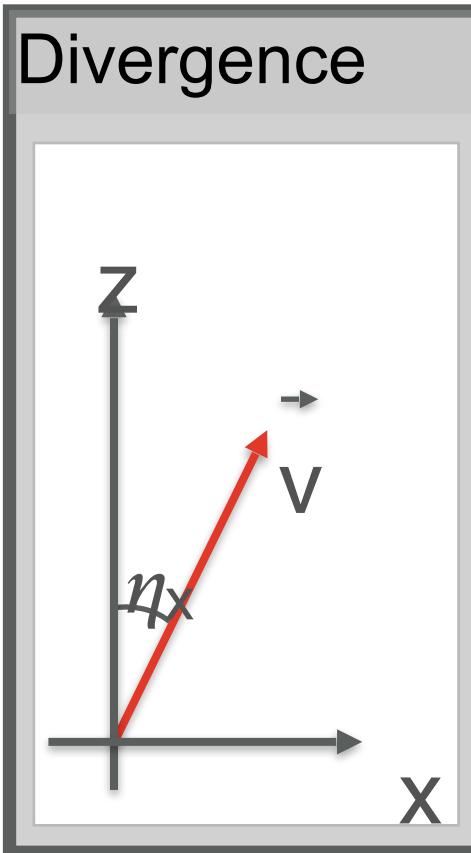
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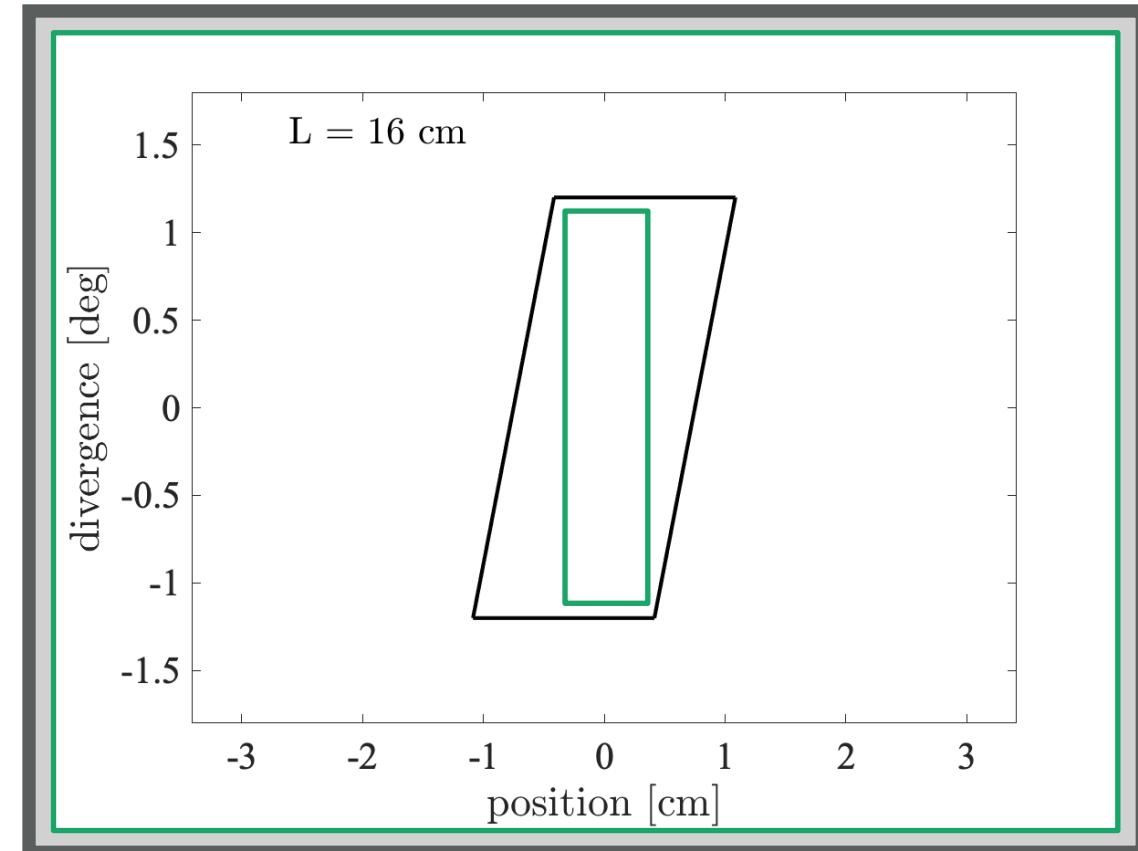
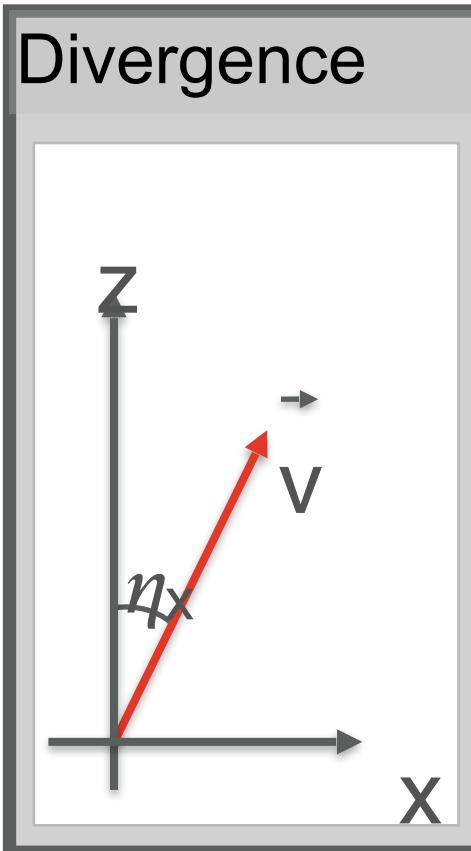
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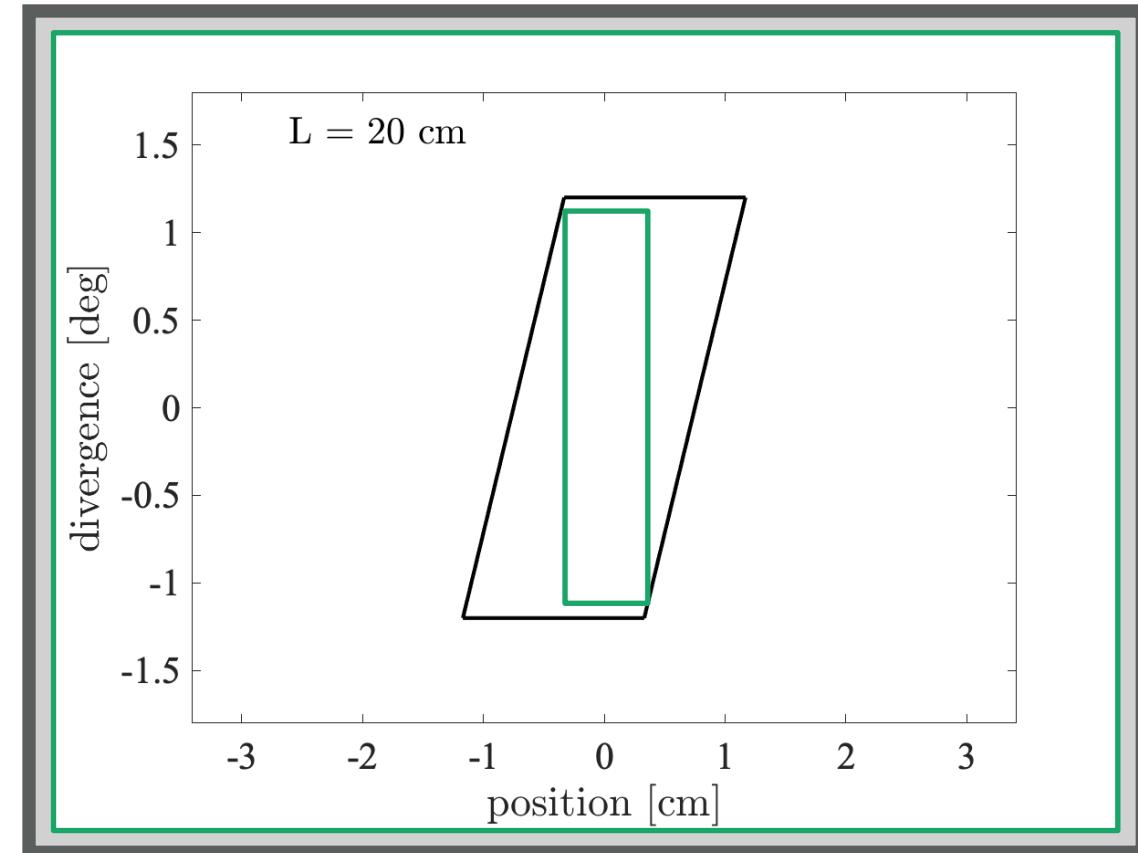
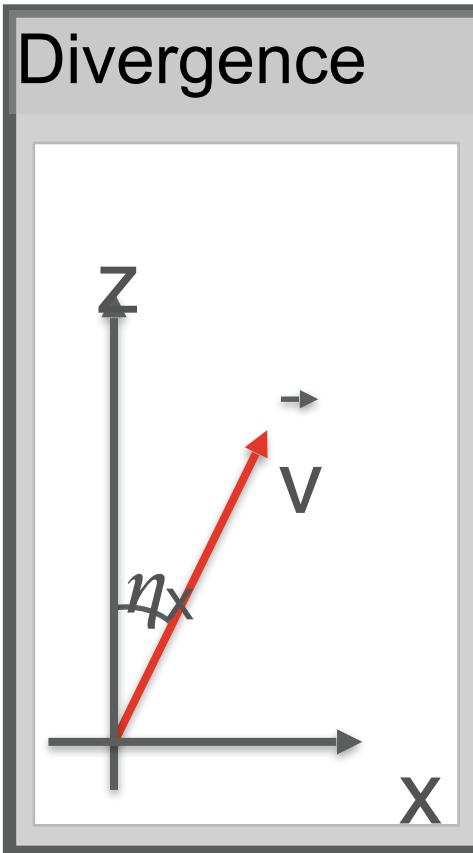
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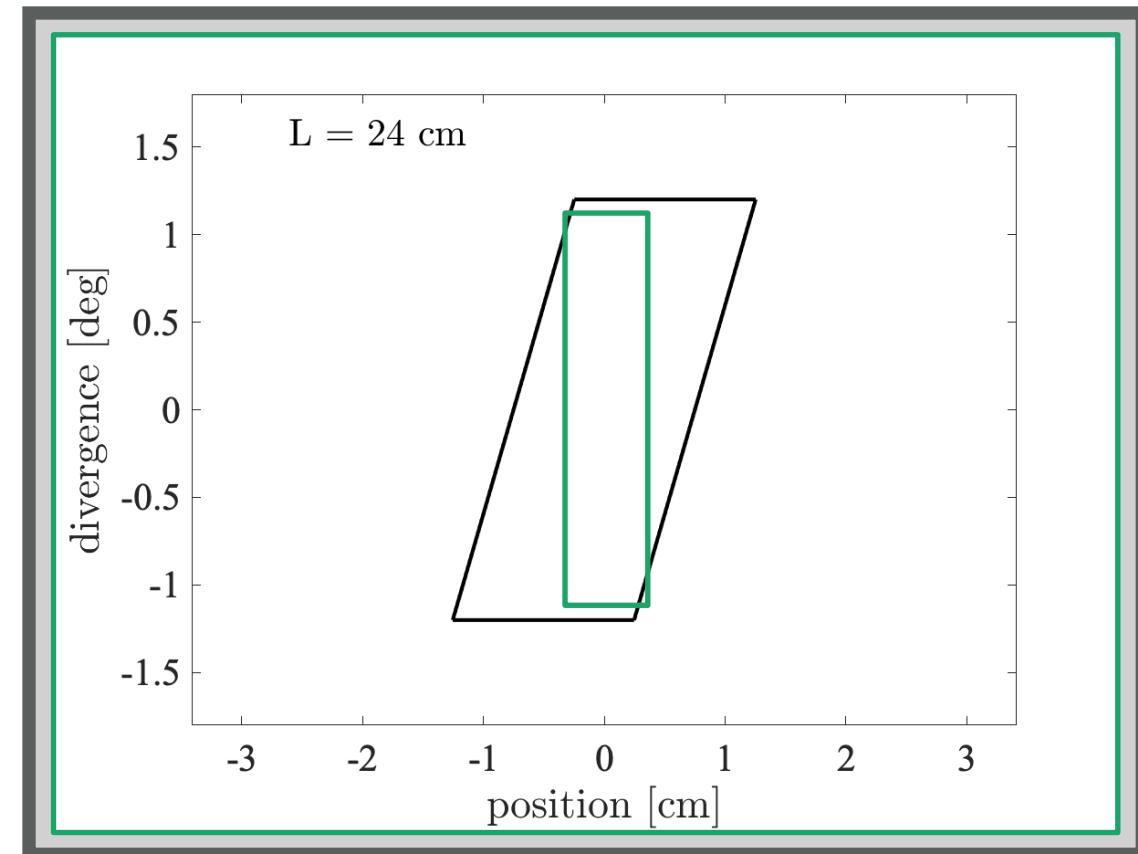
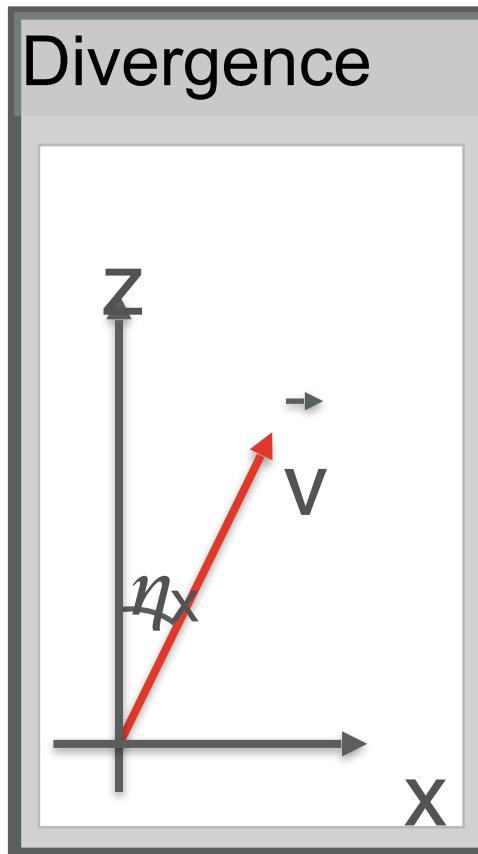
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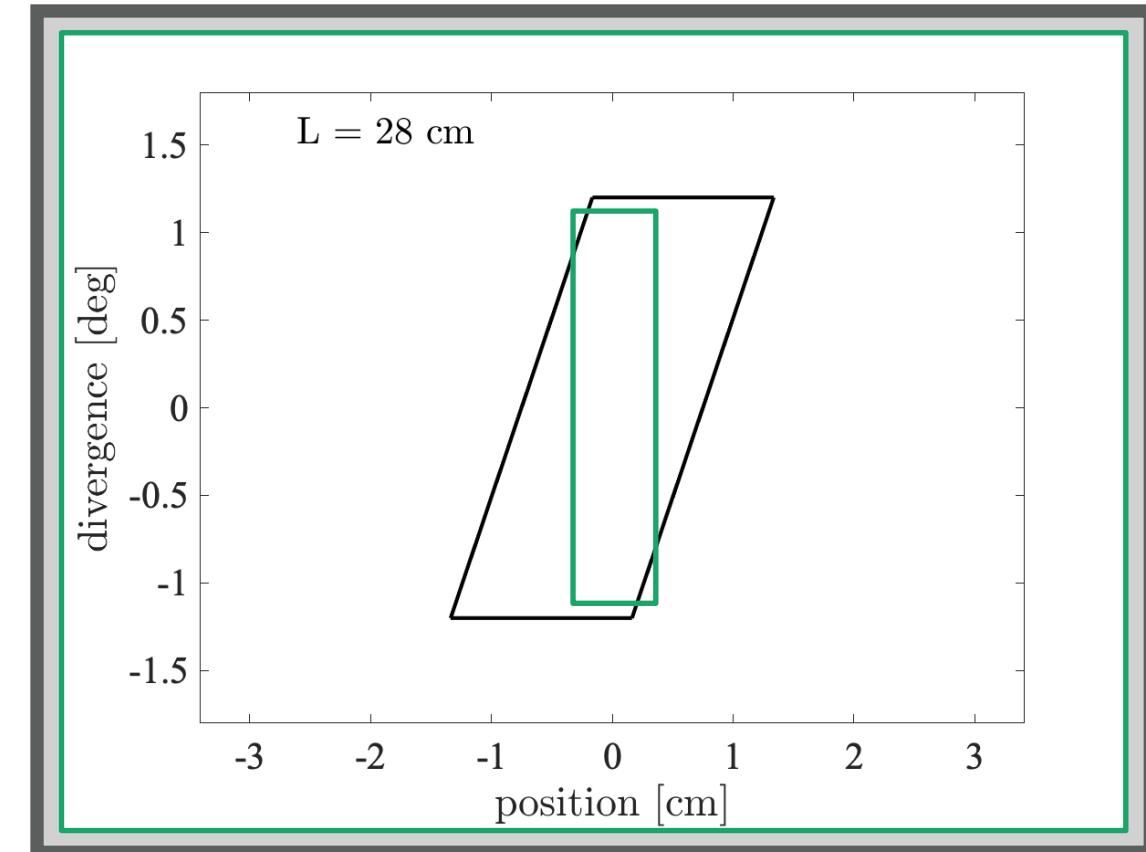
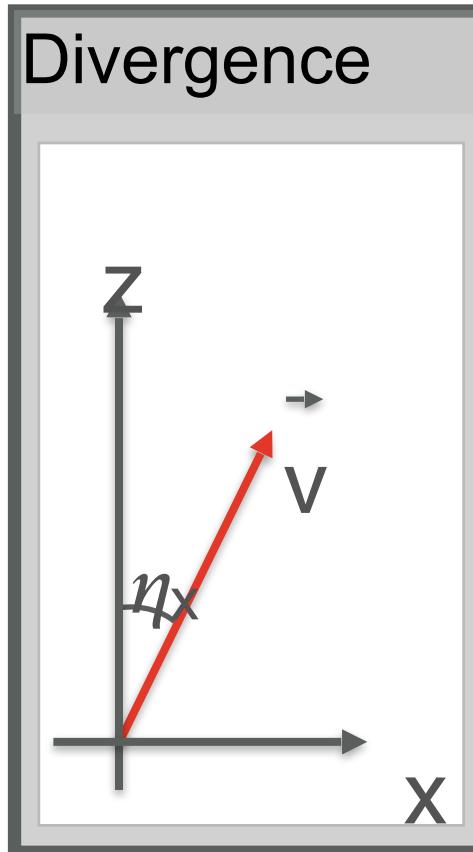
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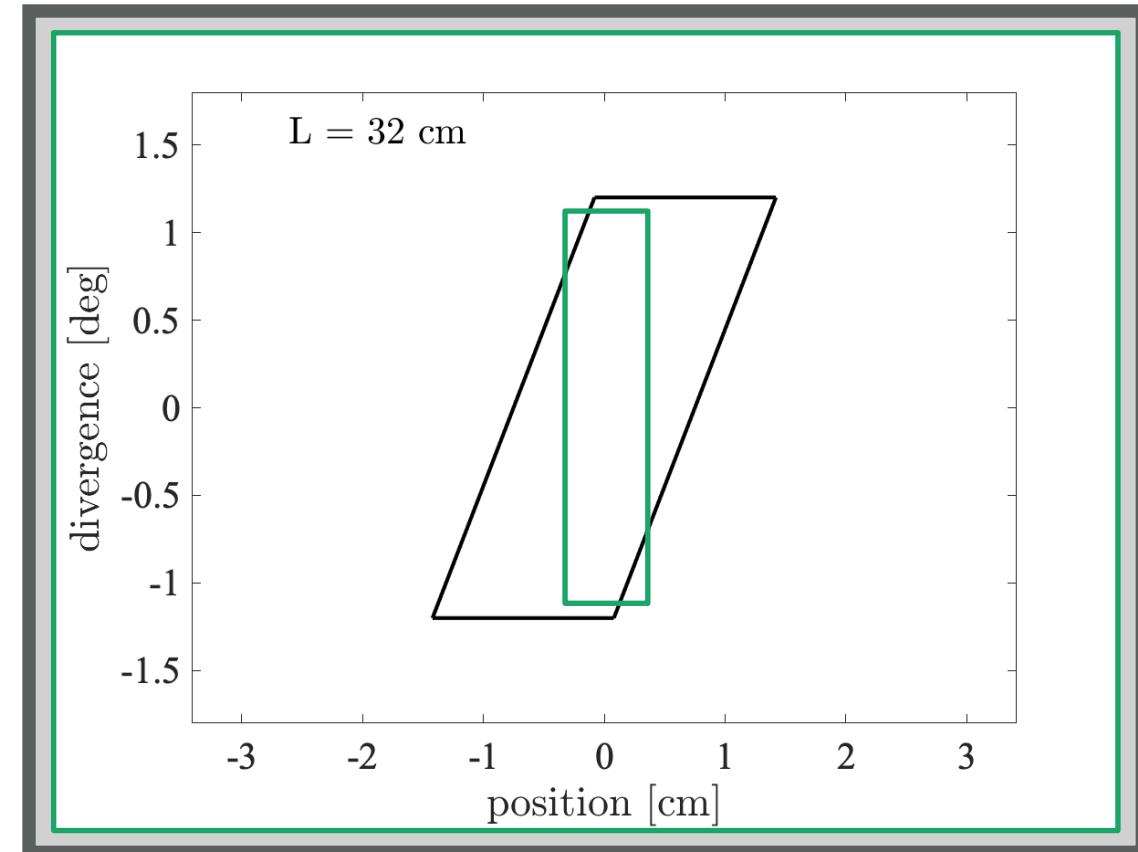
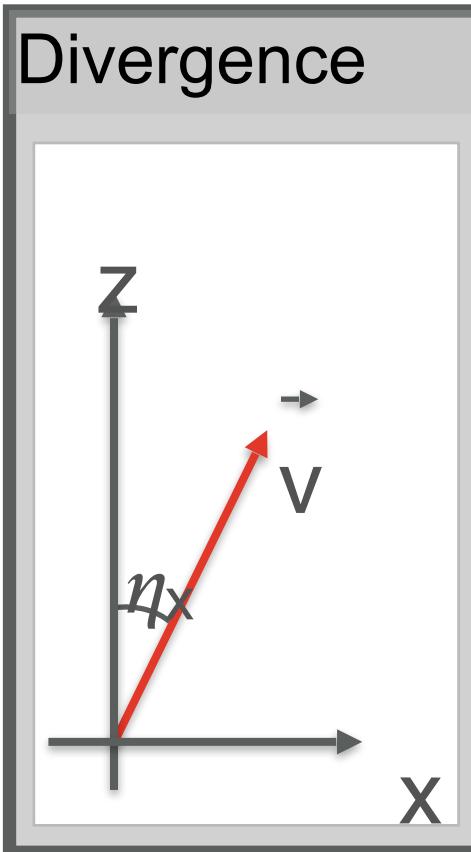
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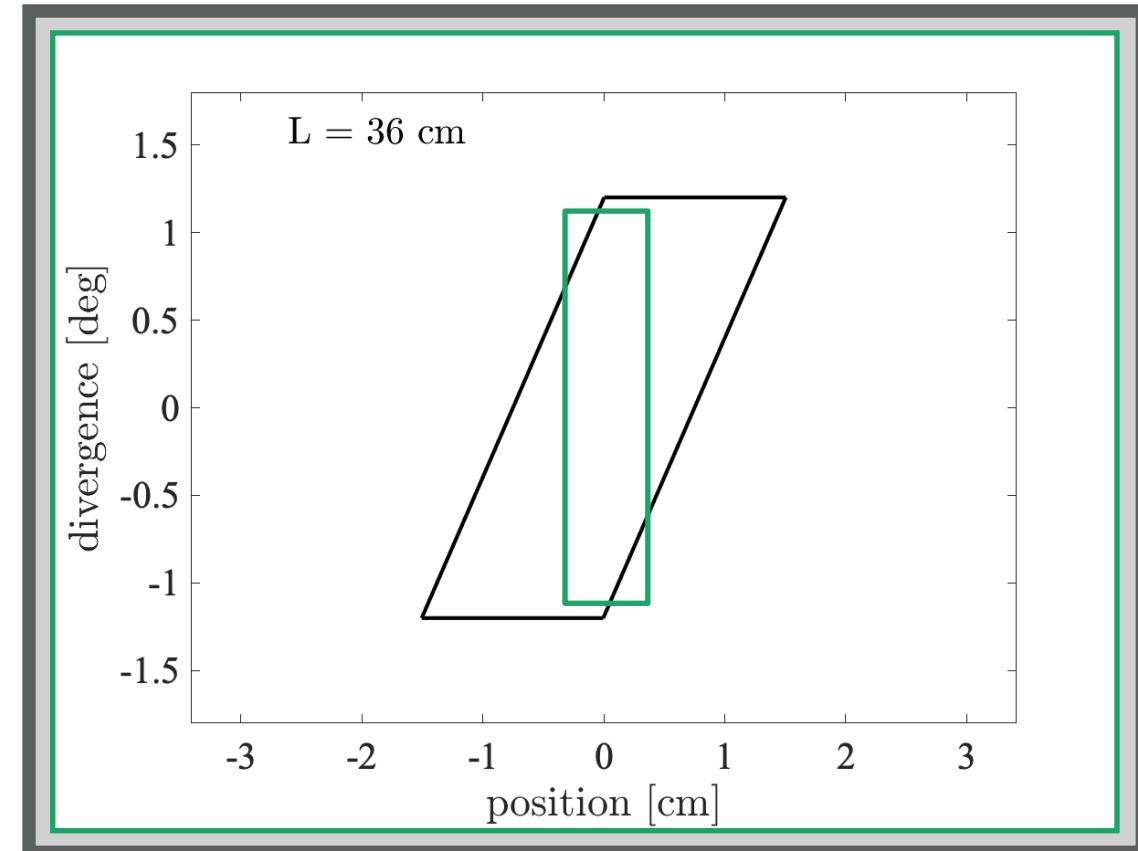
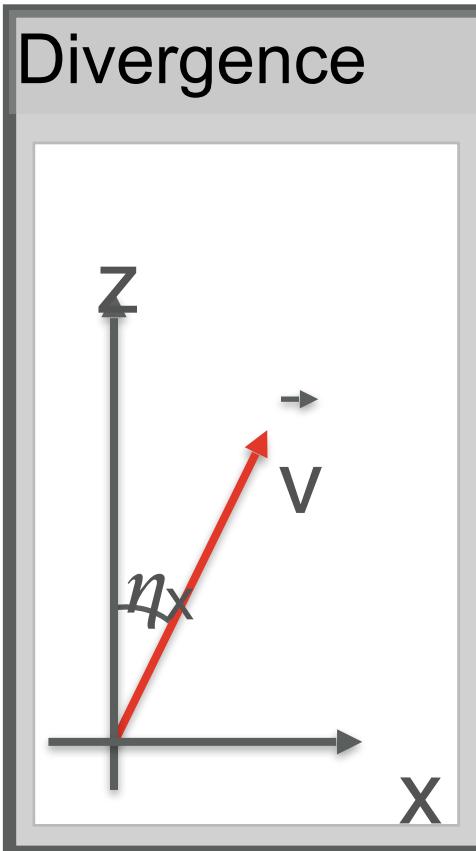
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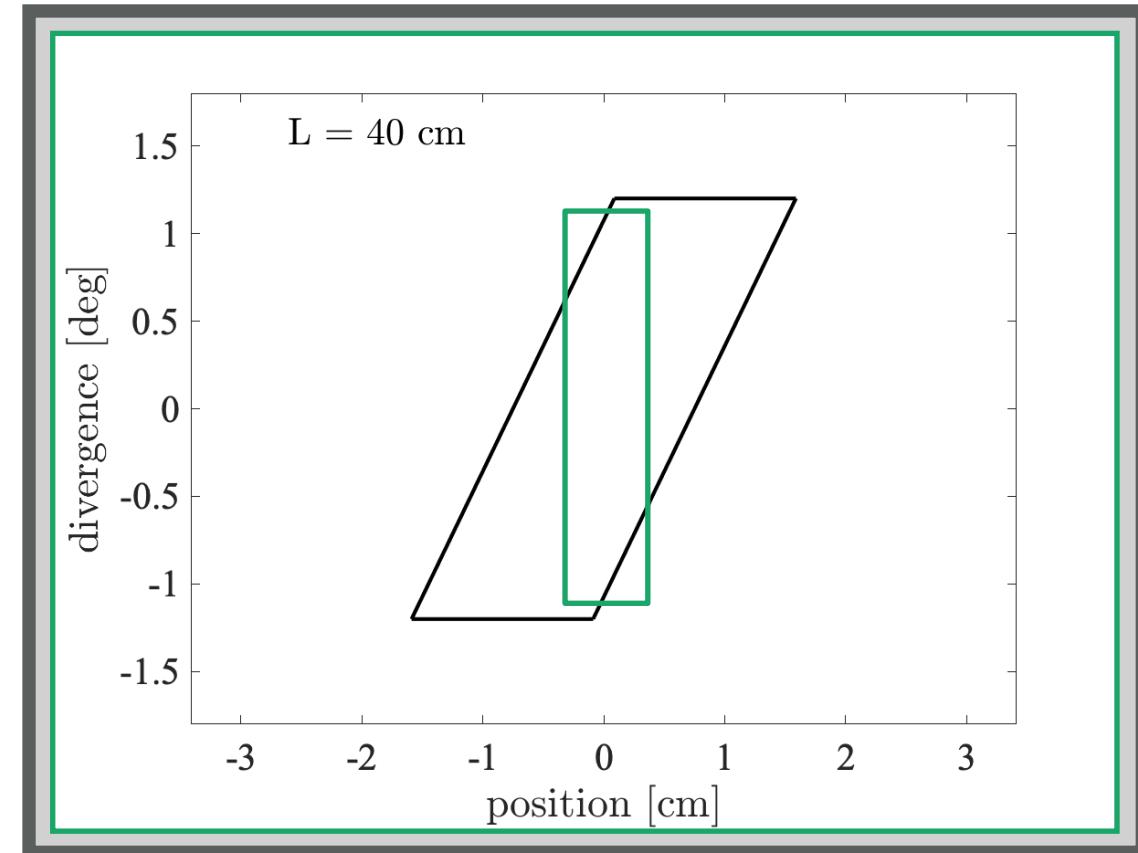
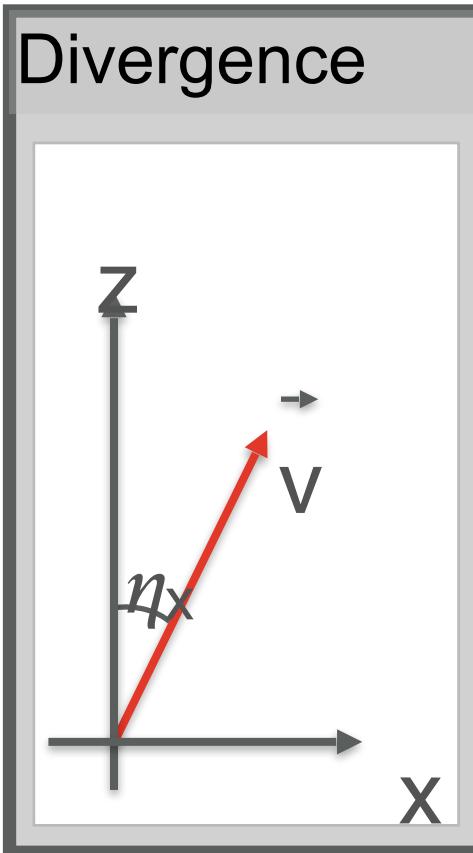
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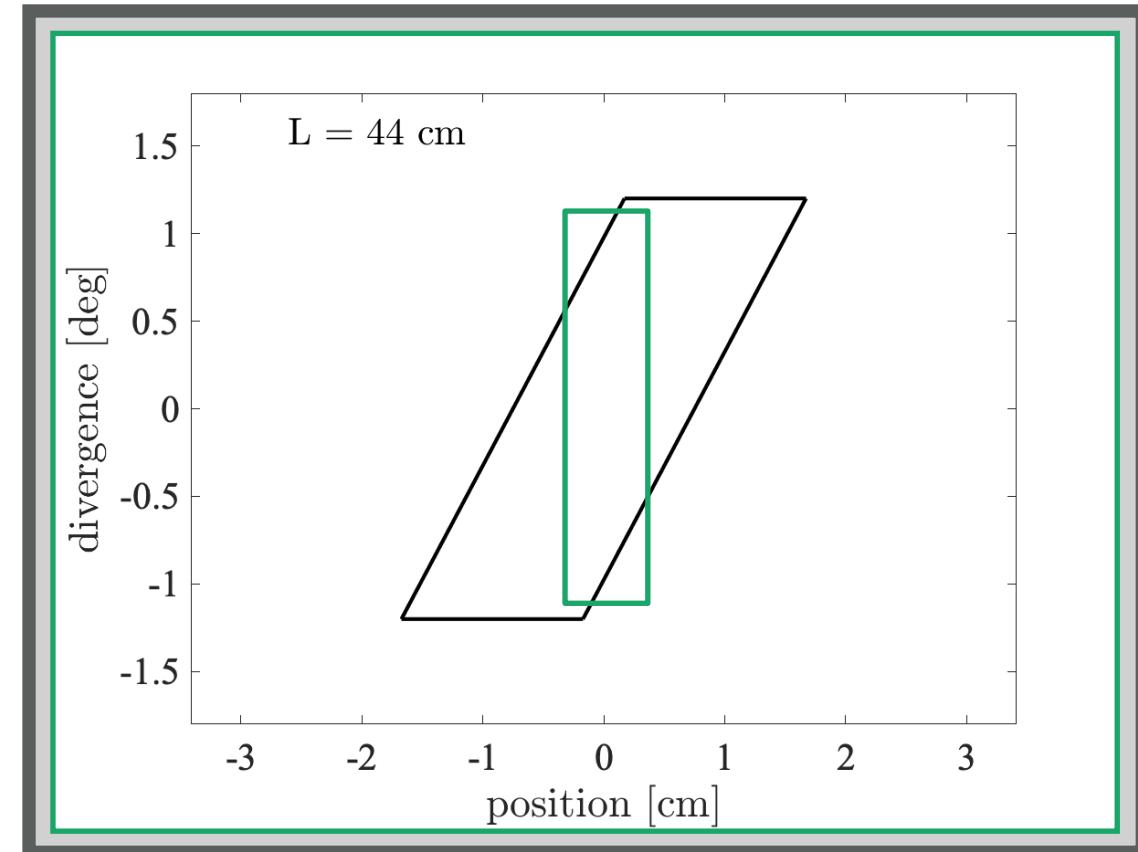
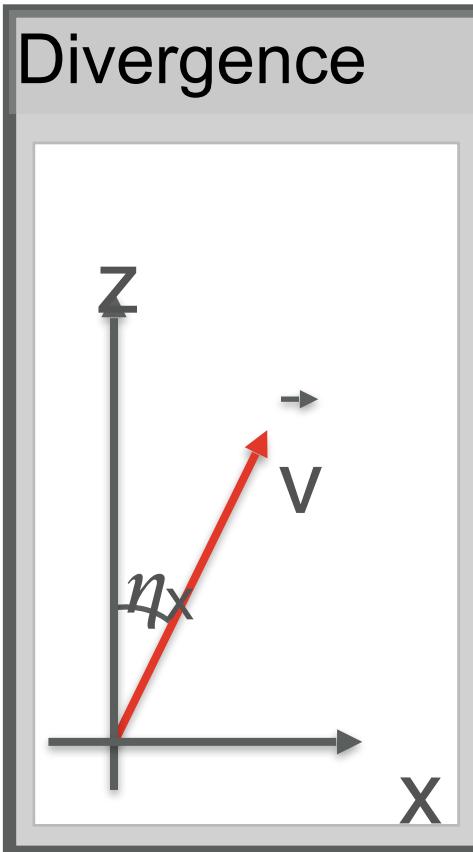
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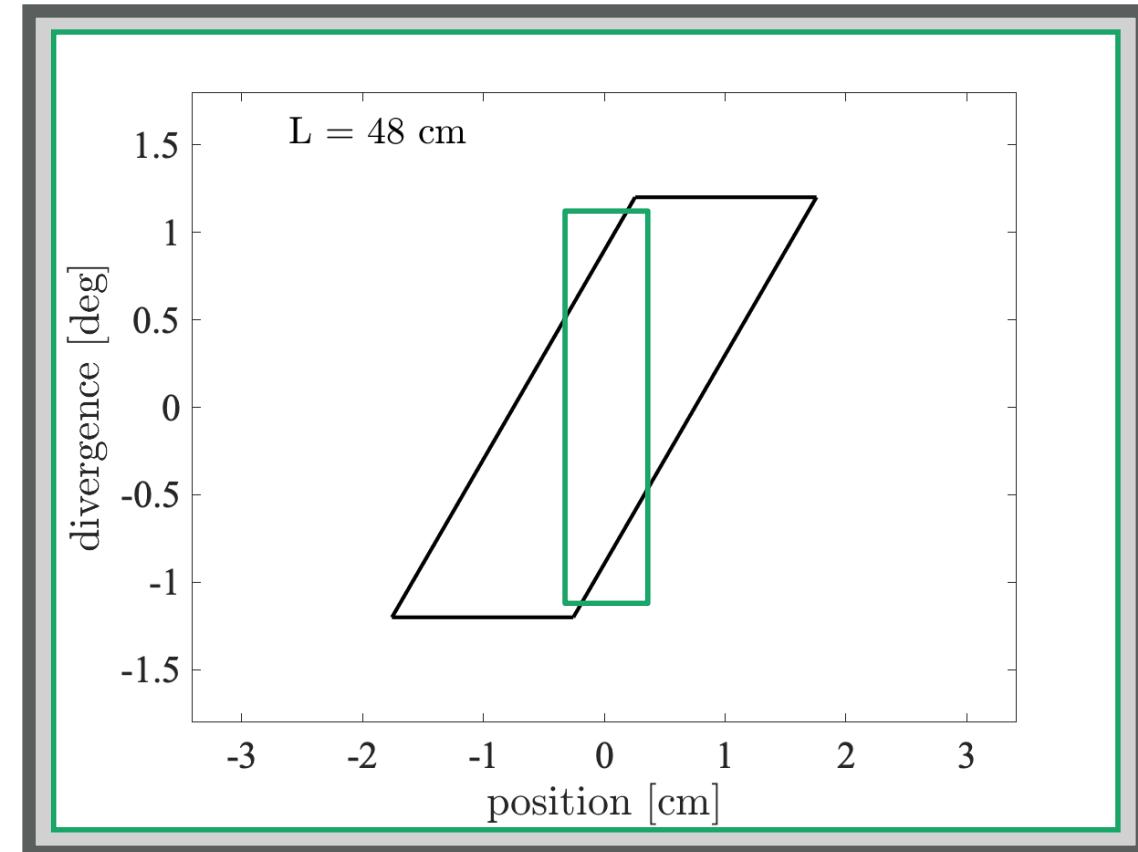
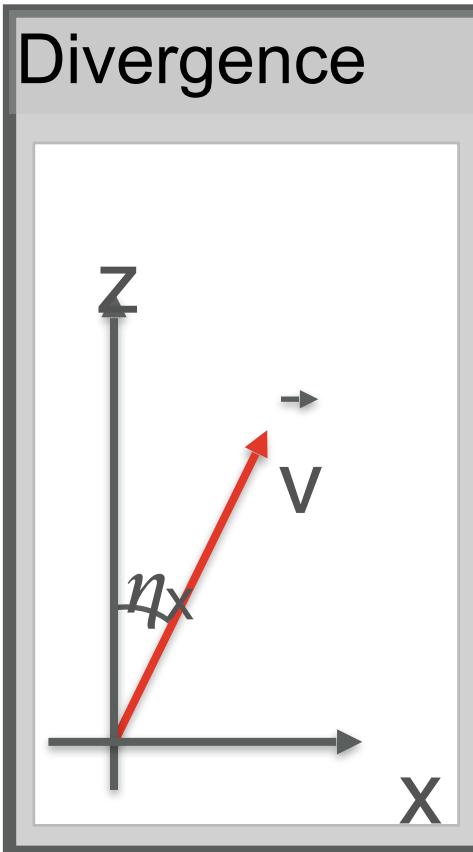
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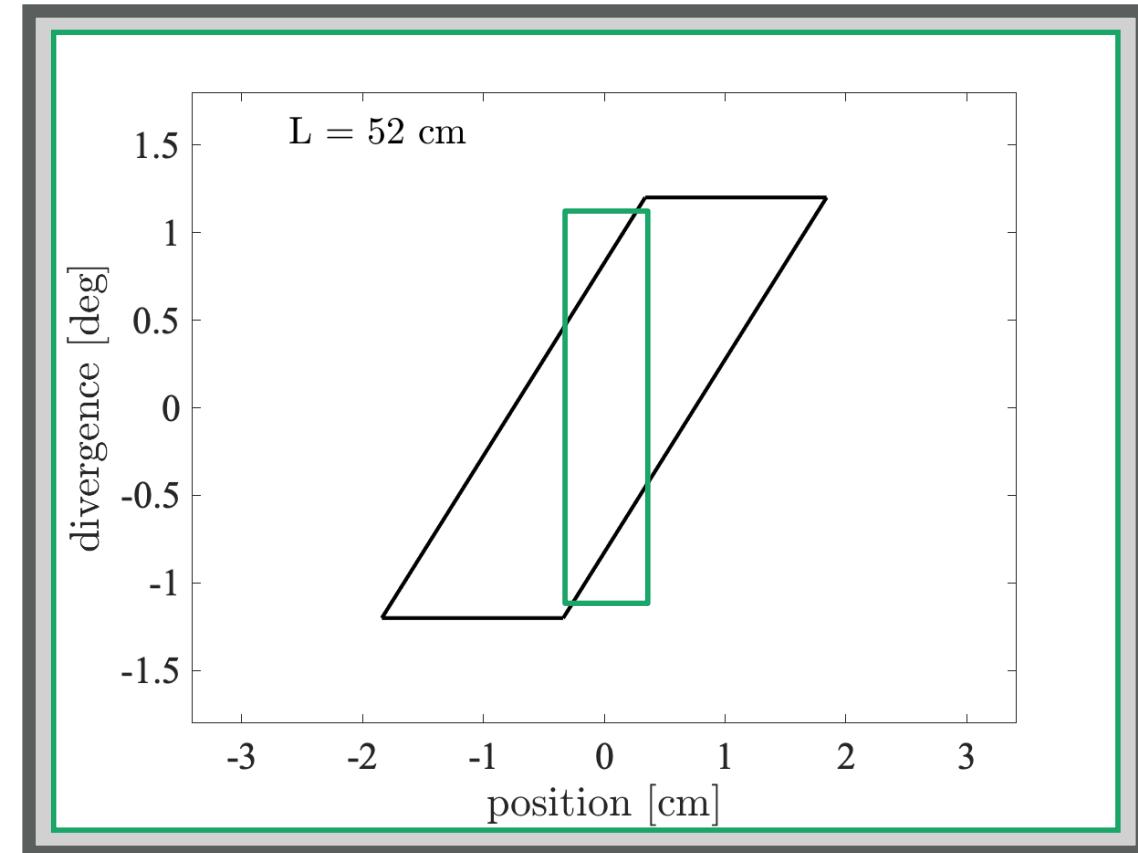
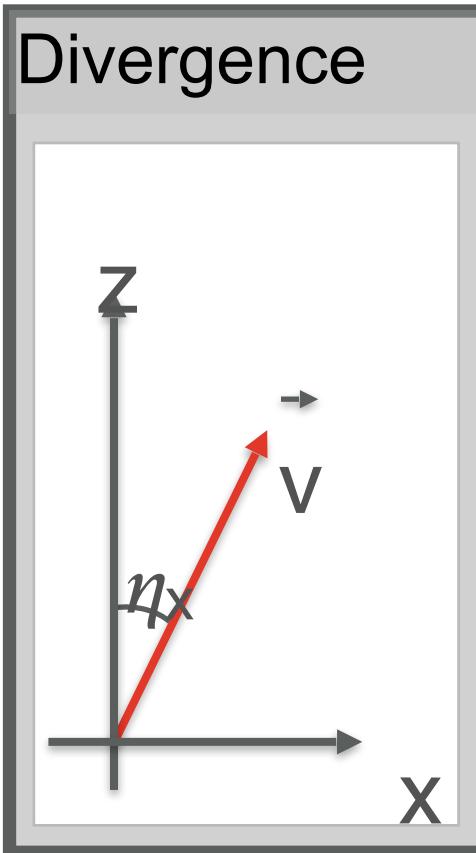
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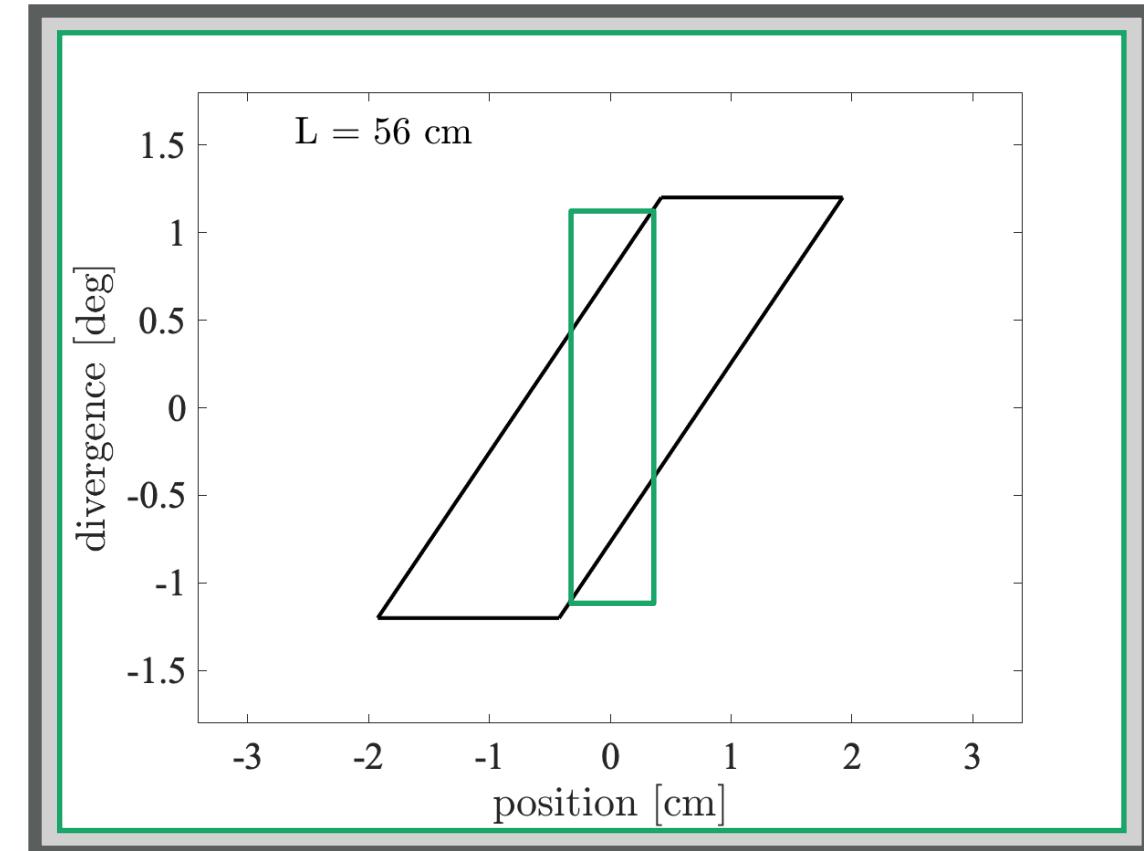
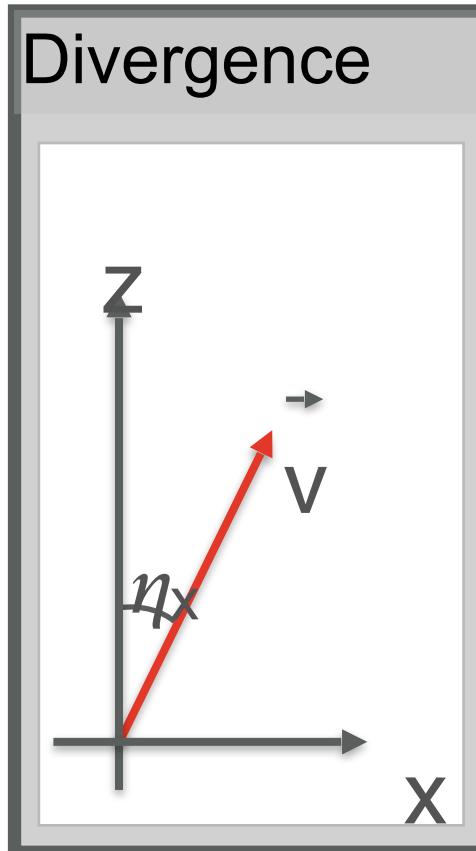
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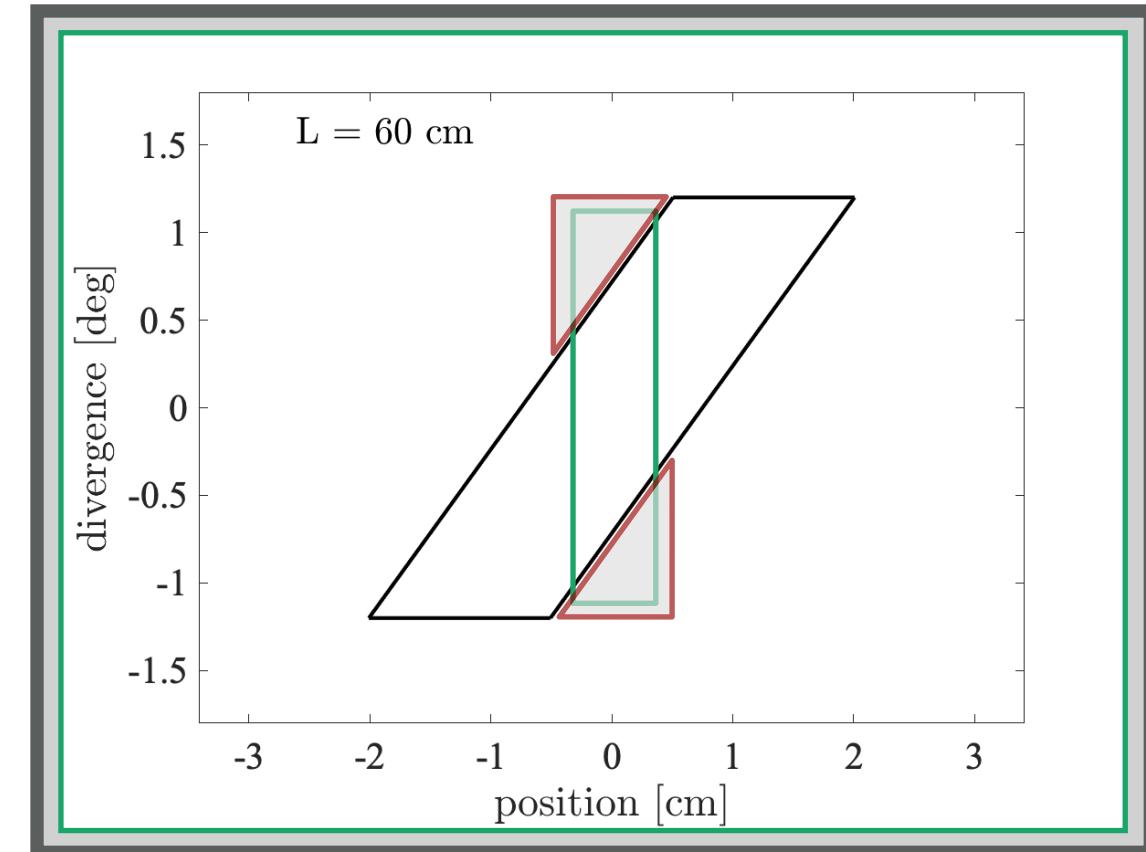
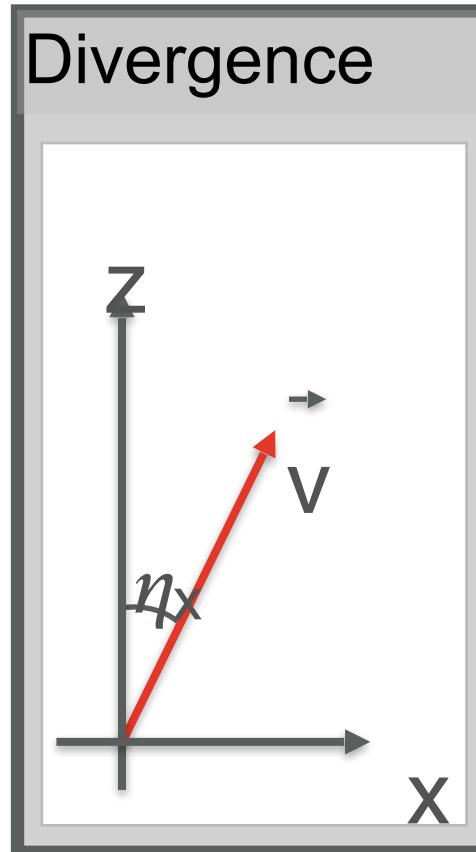




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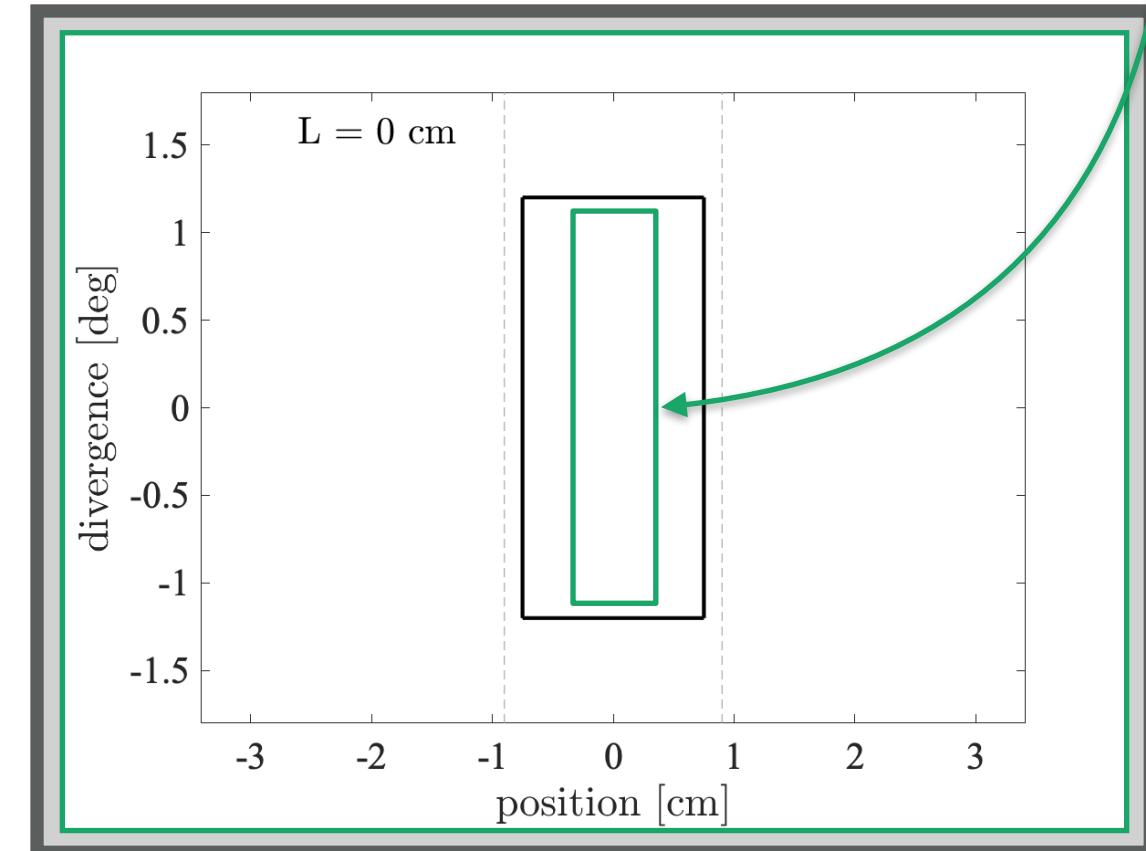
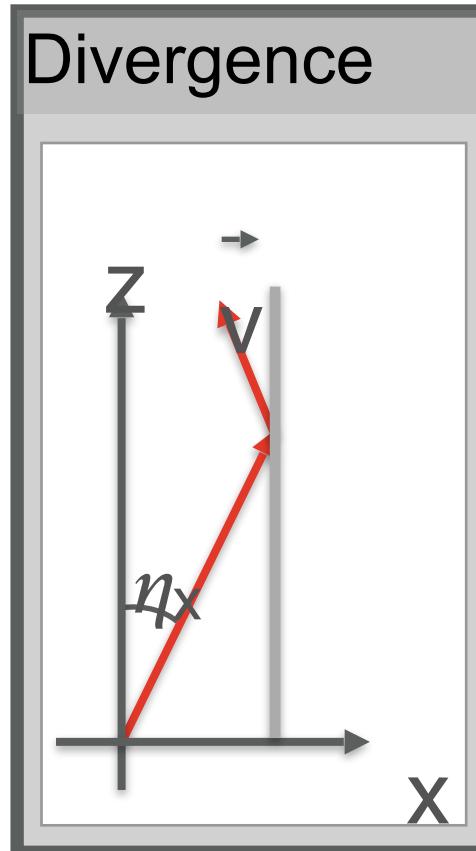
Beam propagation in free space

- We lost some phase-space to propagation





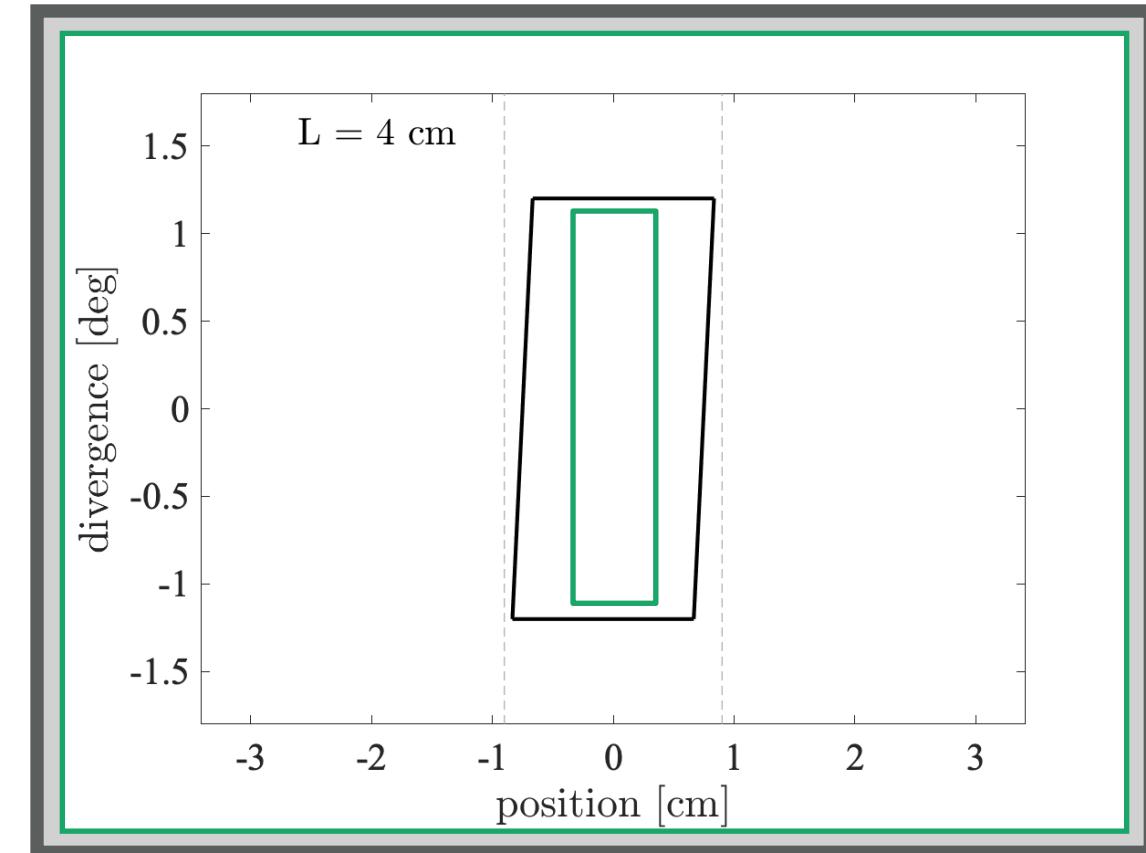
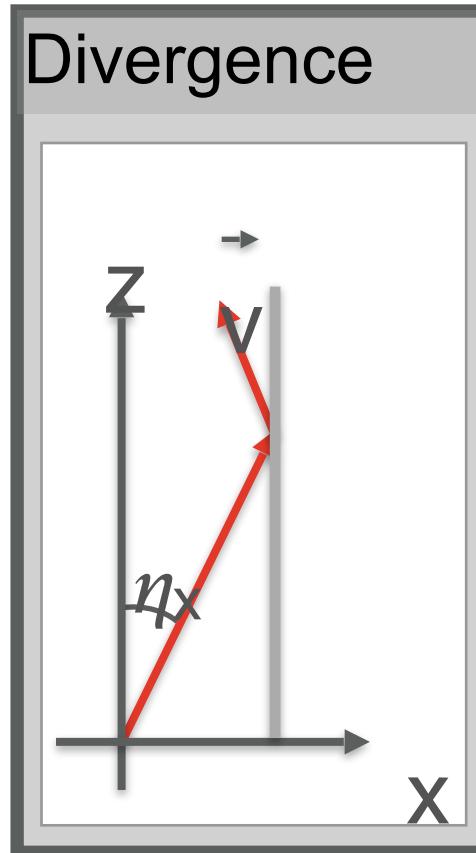
Beam propagation in guide





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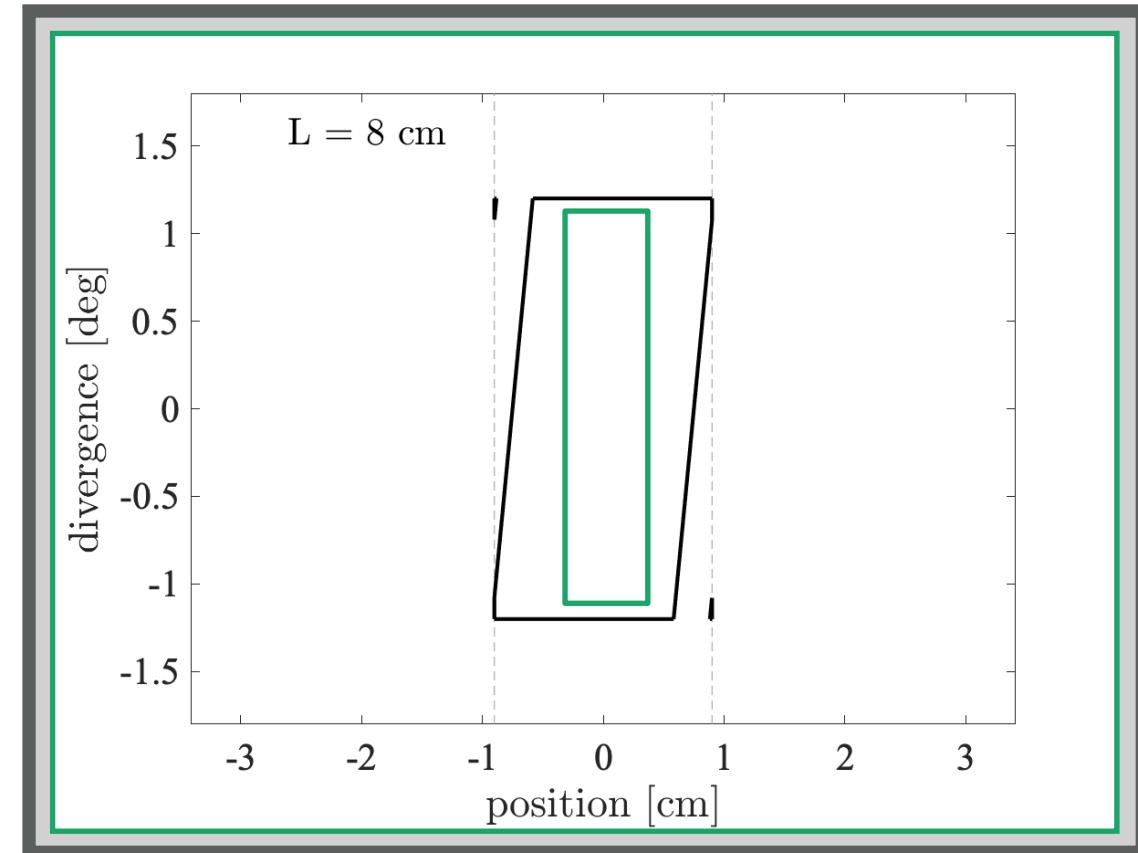
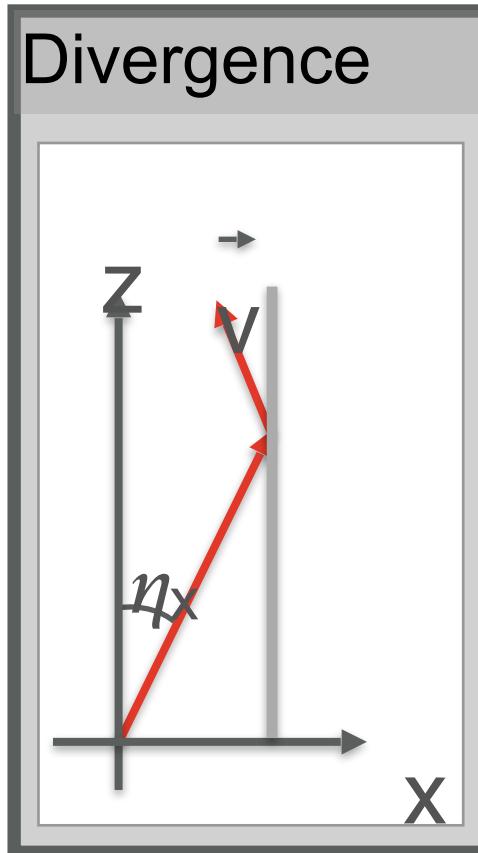
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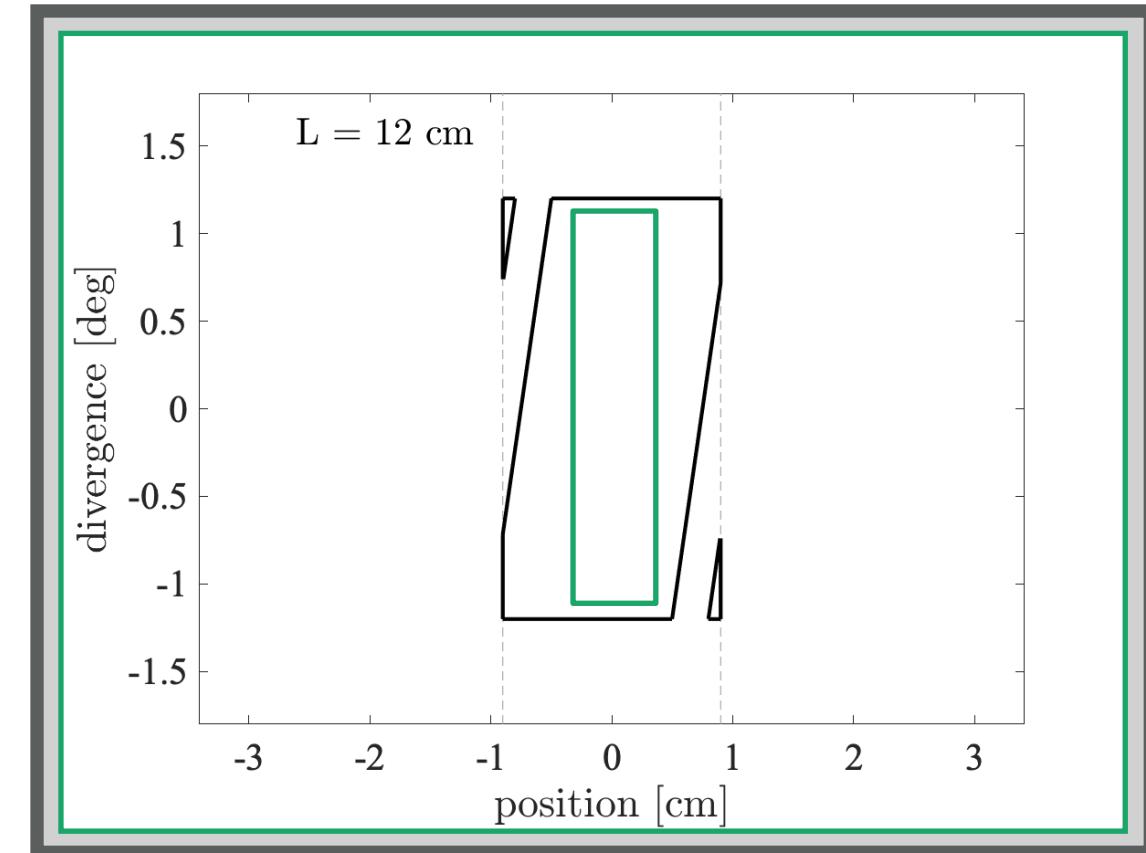
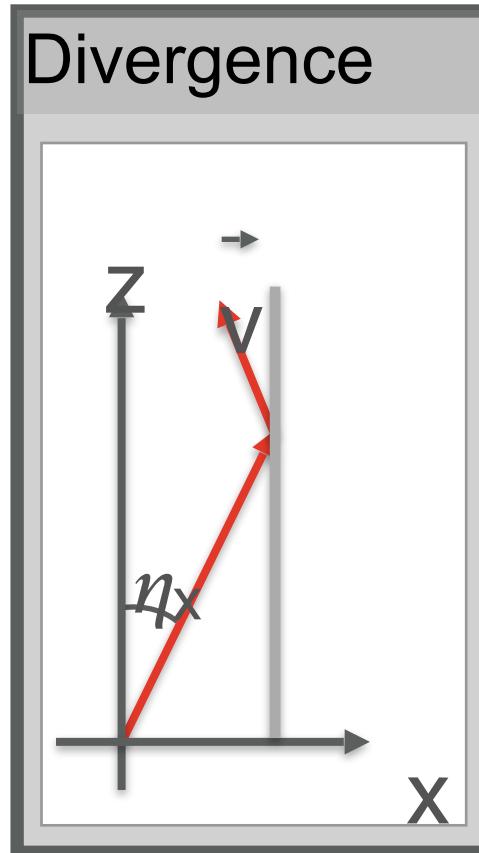
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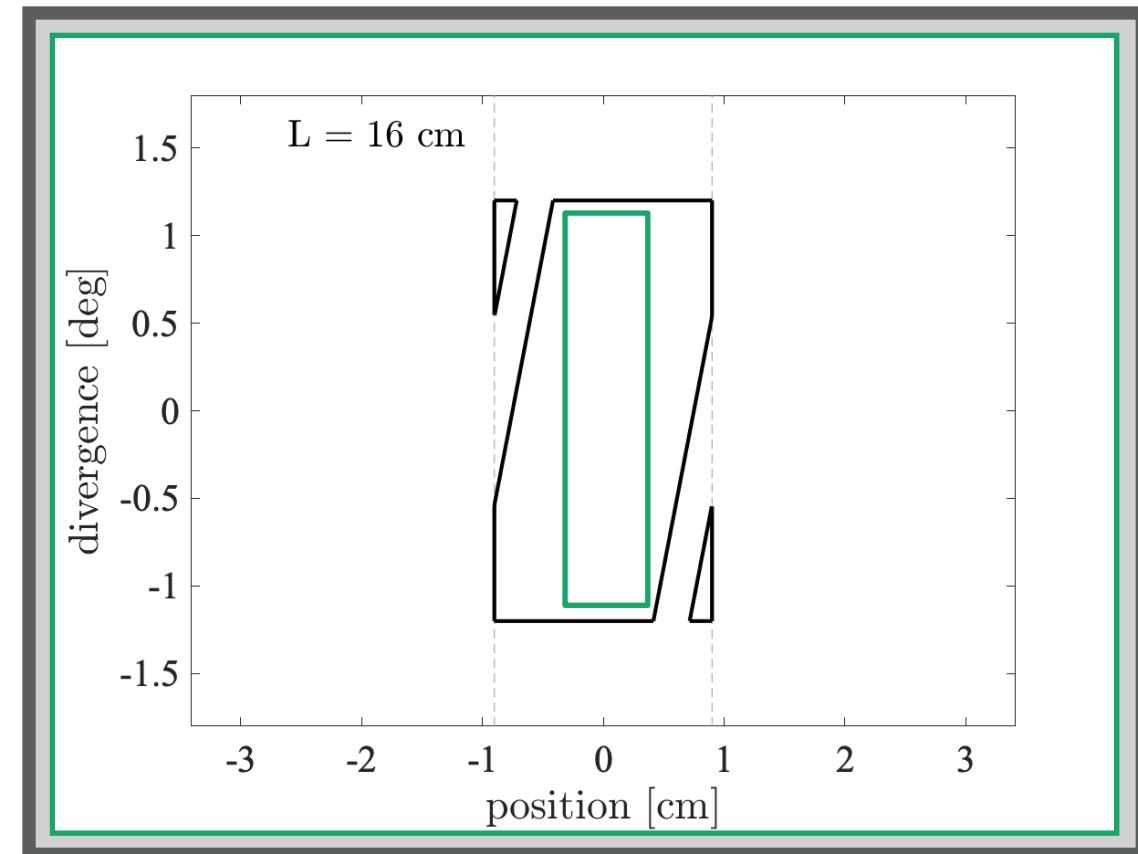
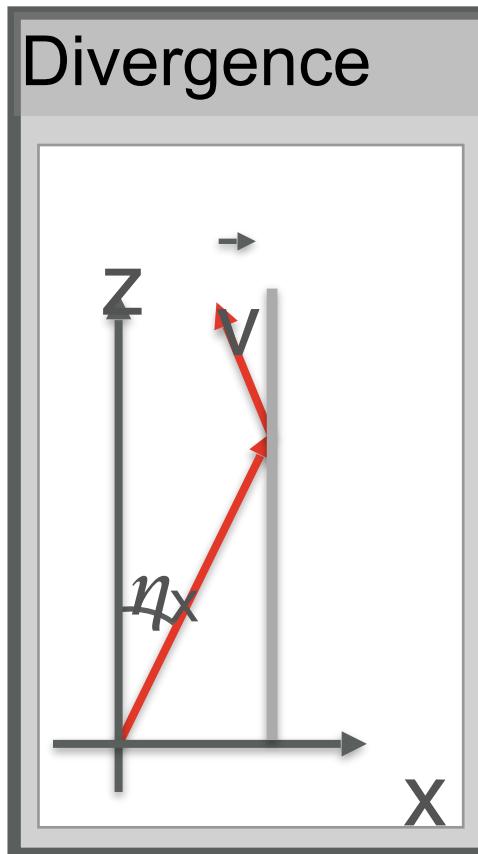
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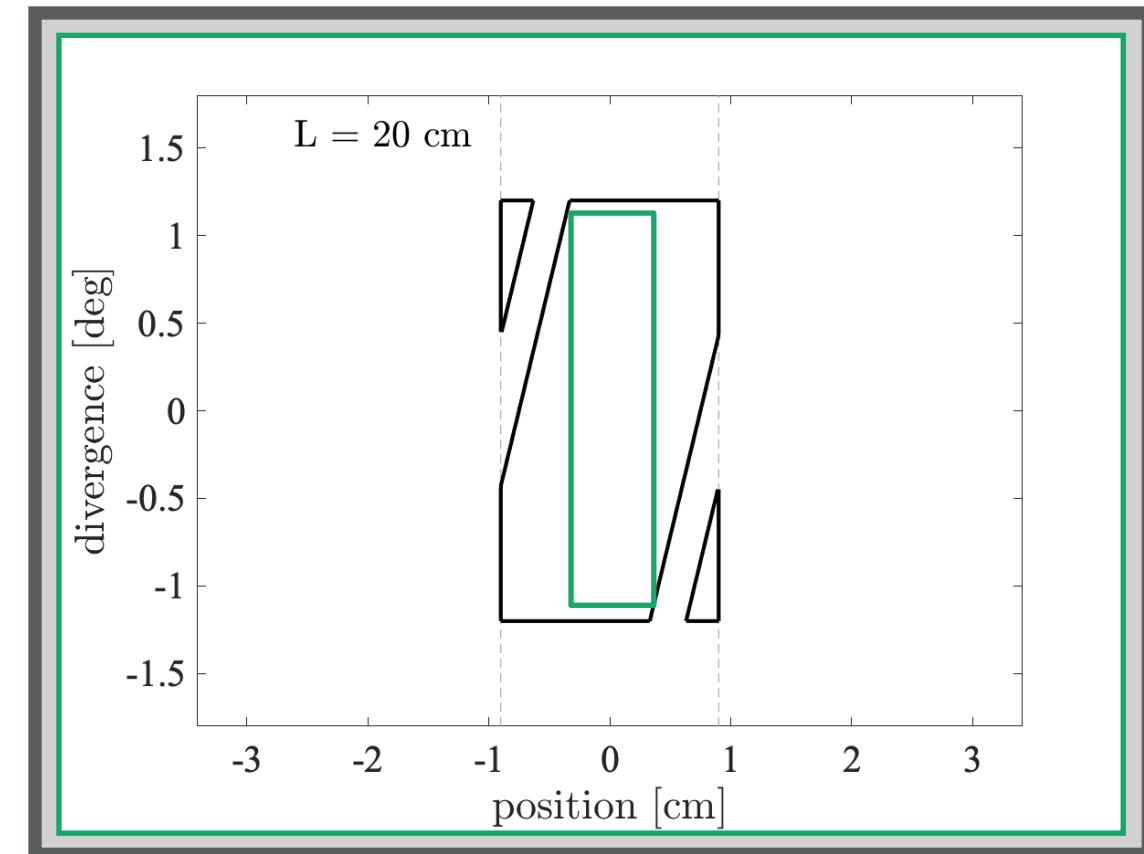
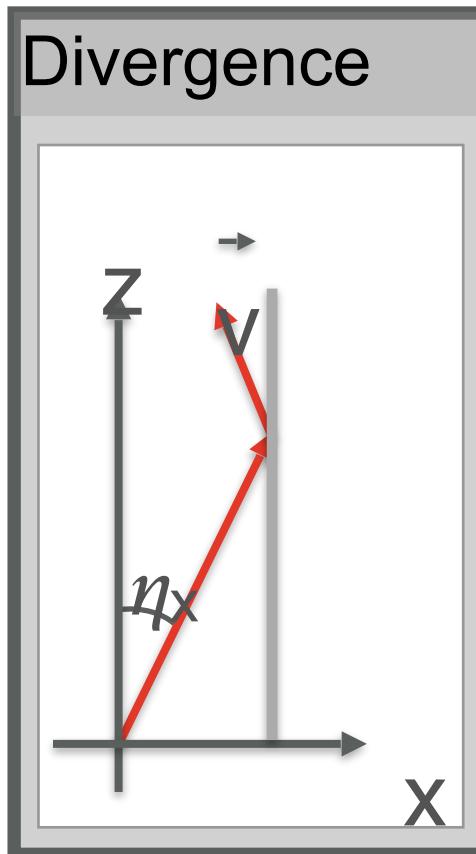


Beam propagation in guide



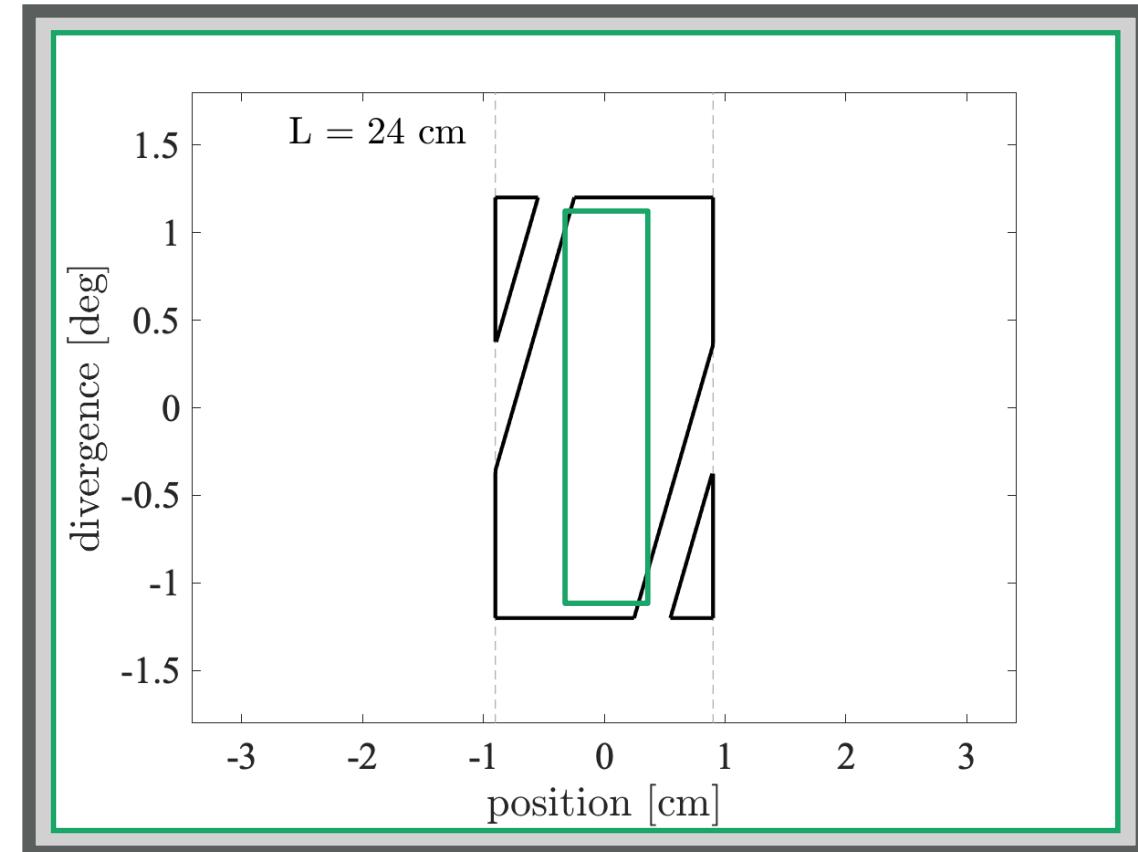
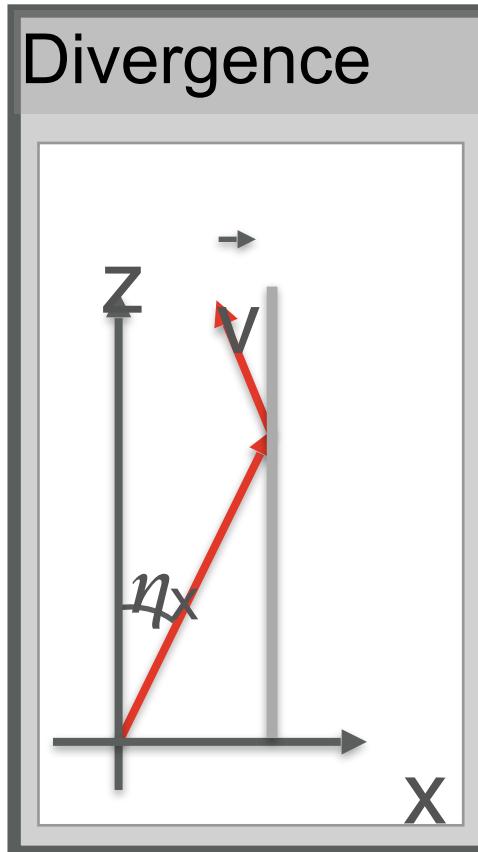


Beam propagation in guide



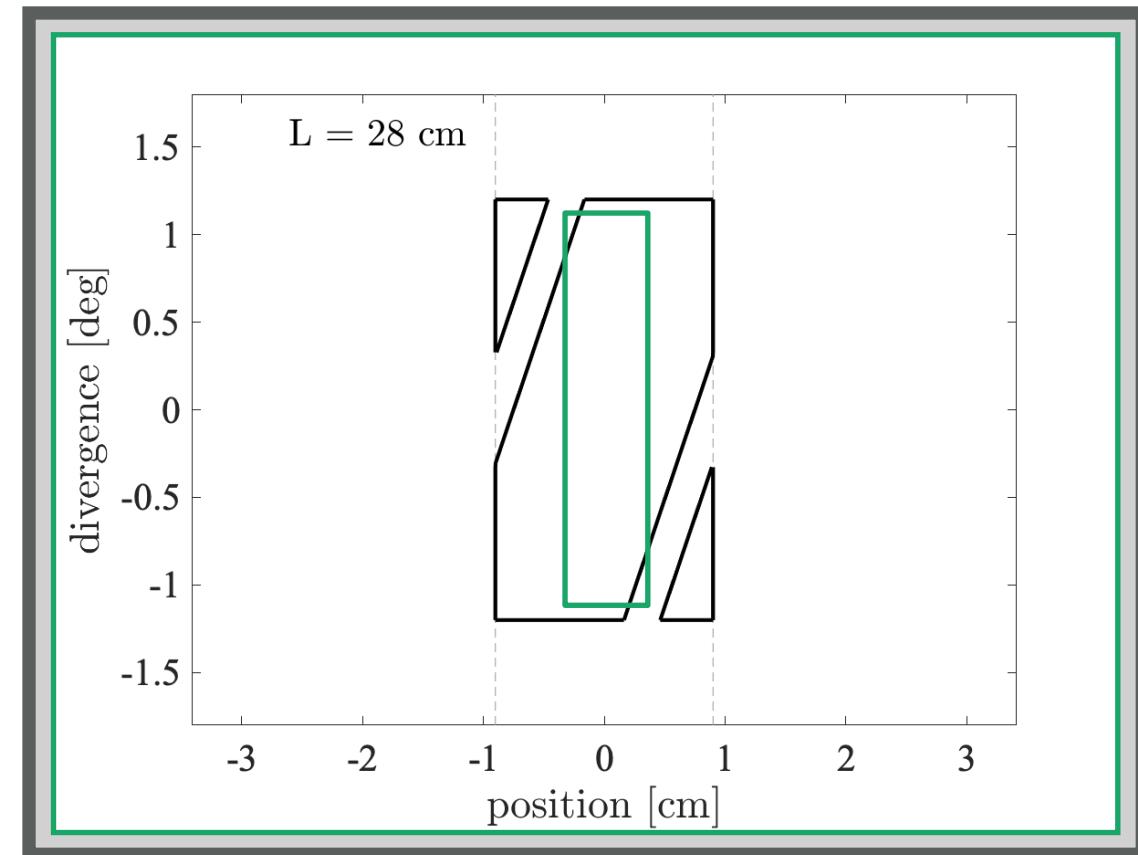
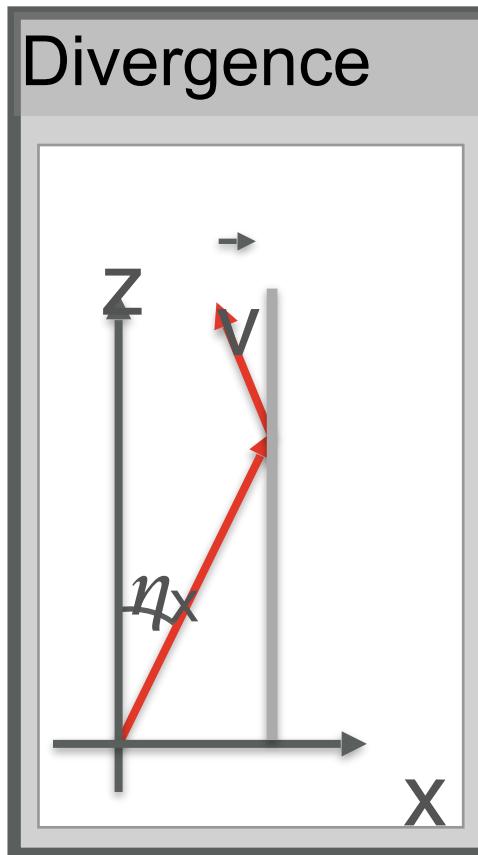


Beam propagation in guide





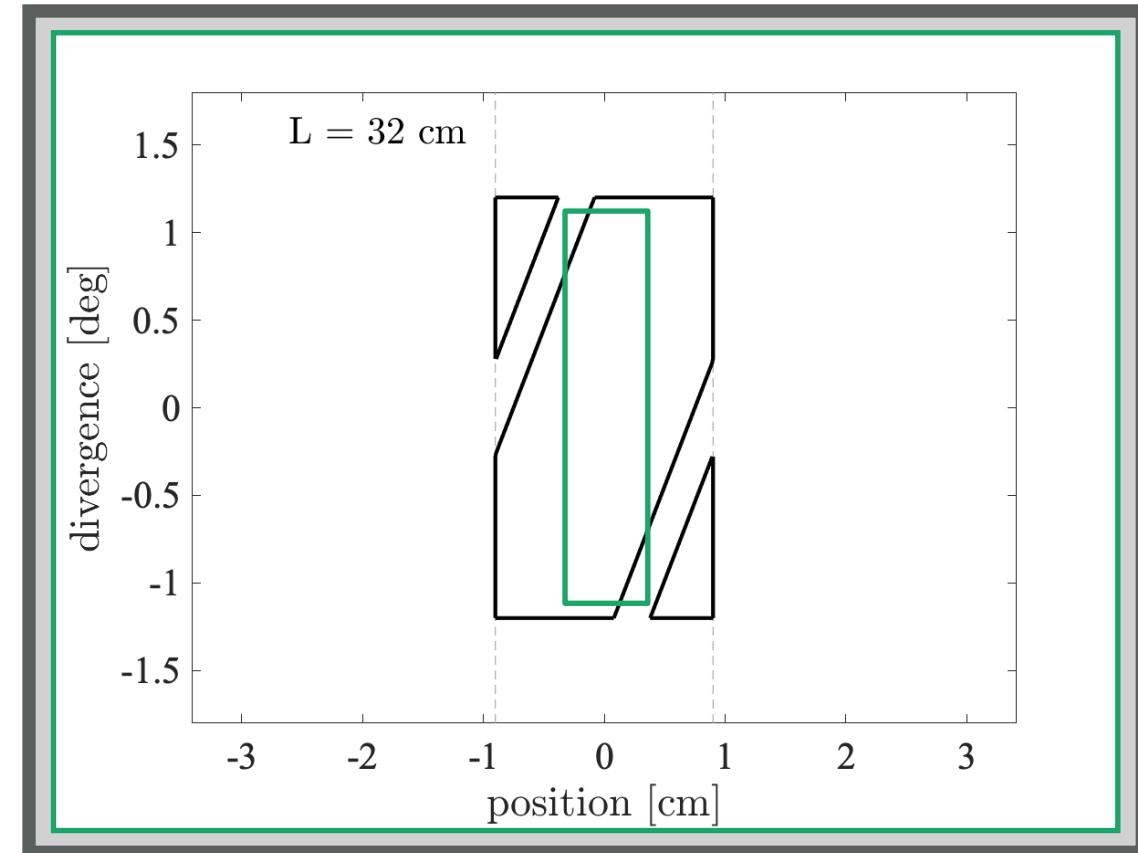
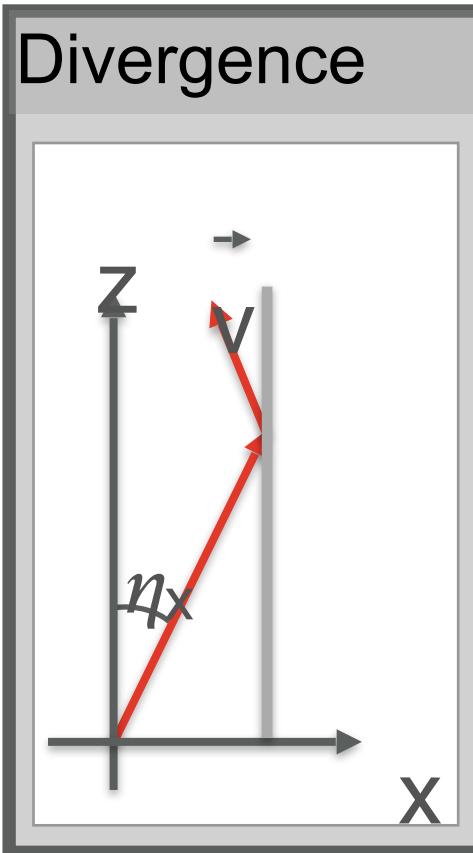
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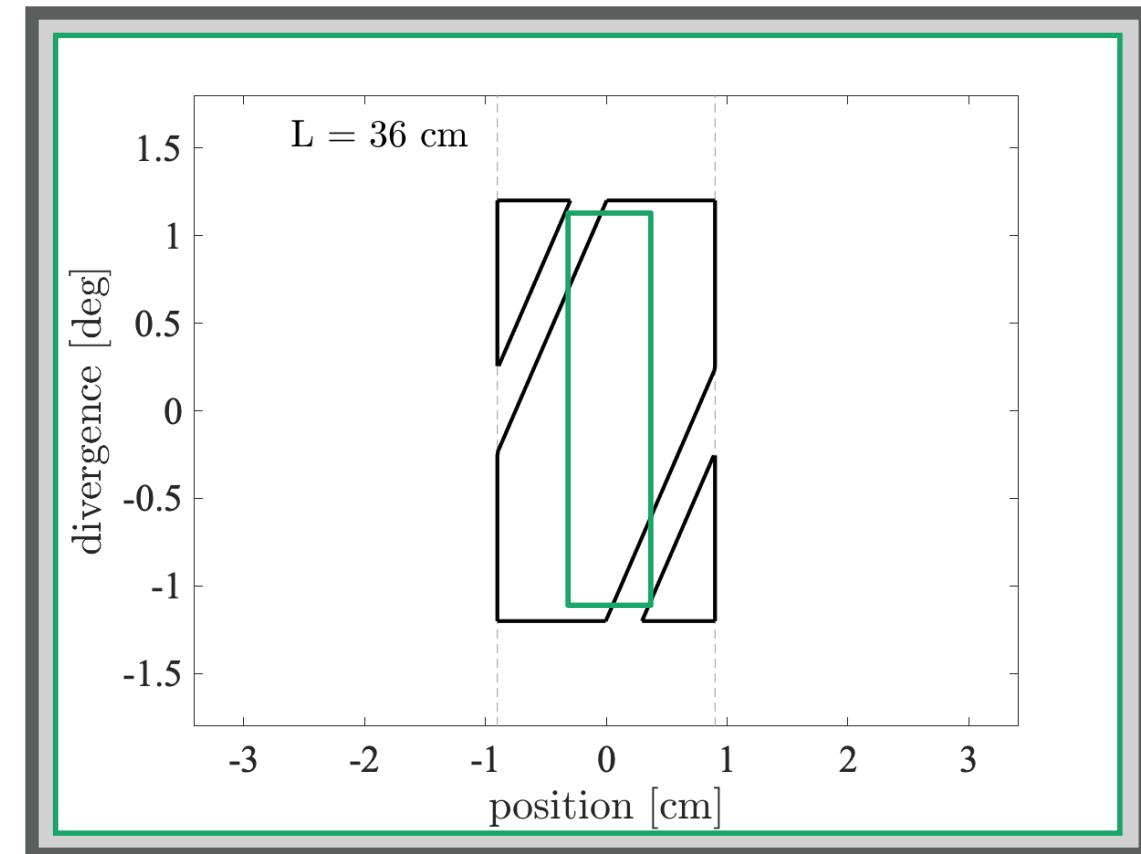
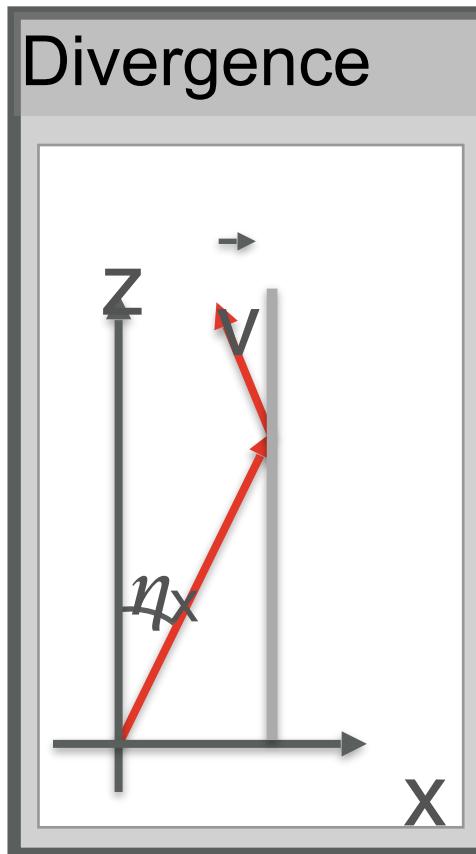
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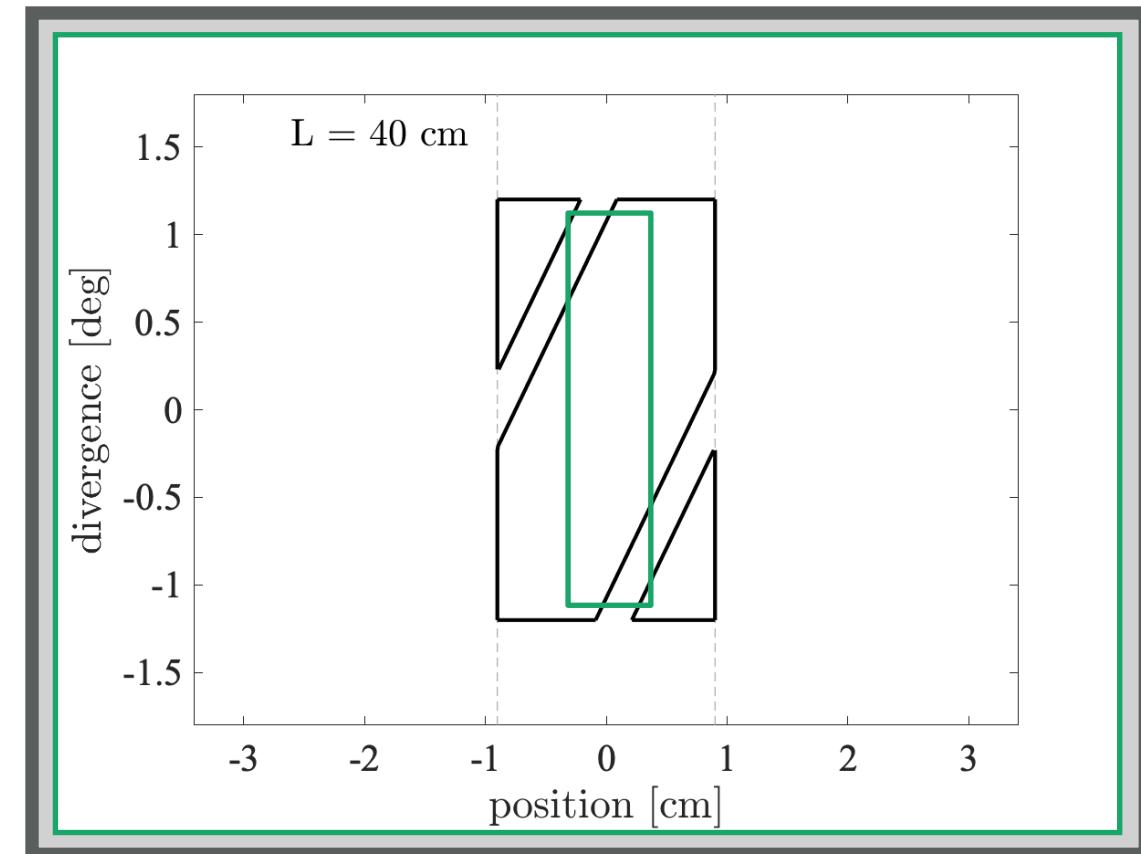
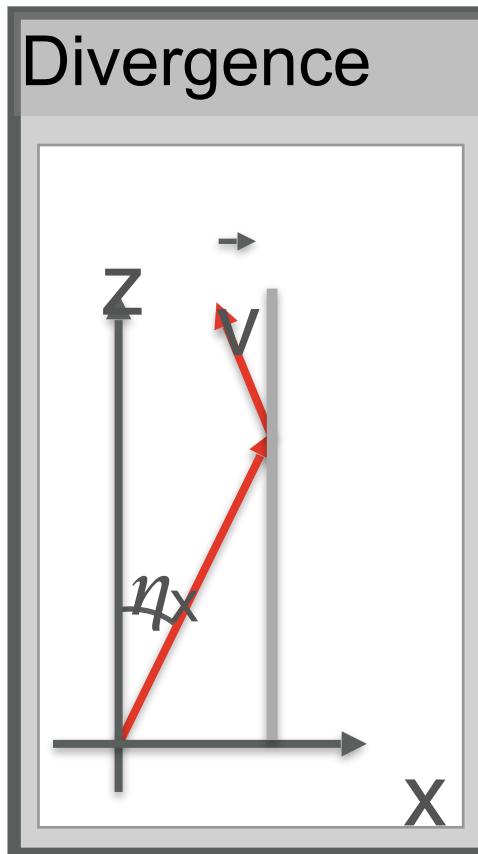


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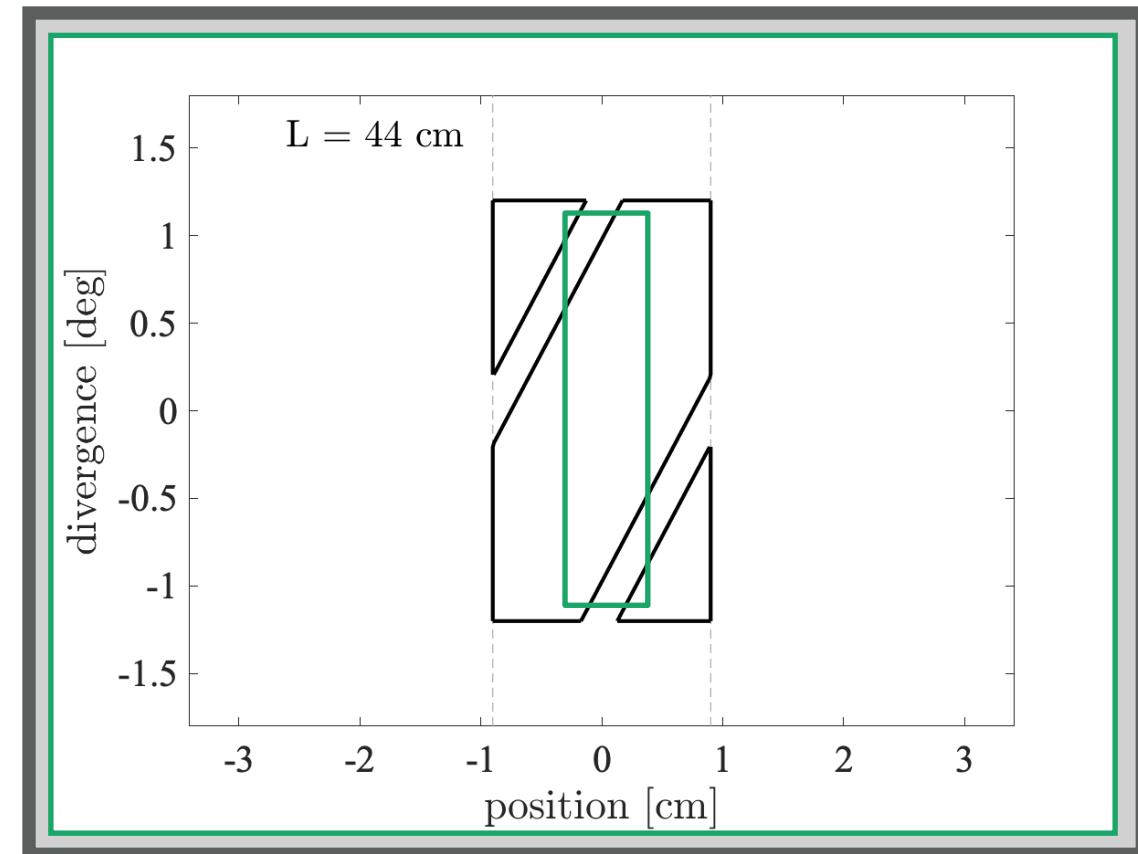
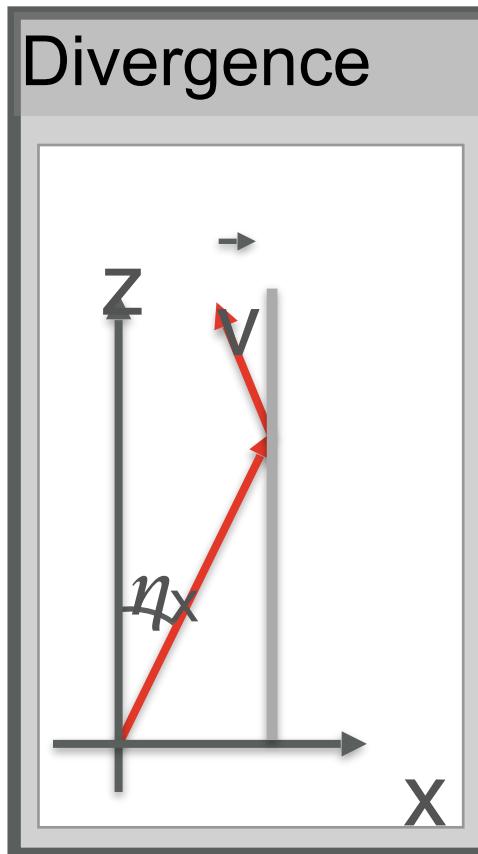


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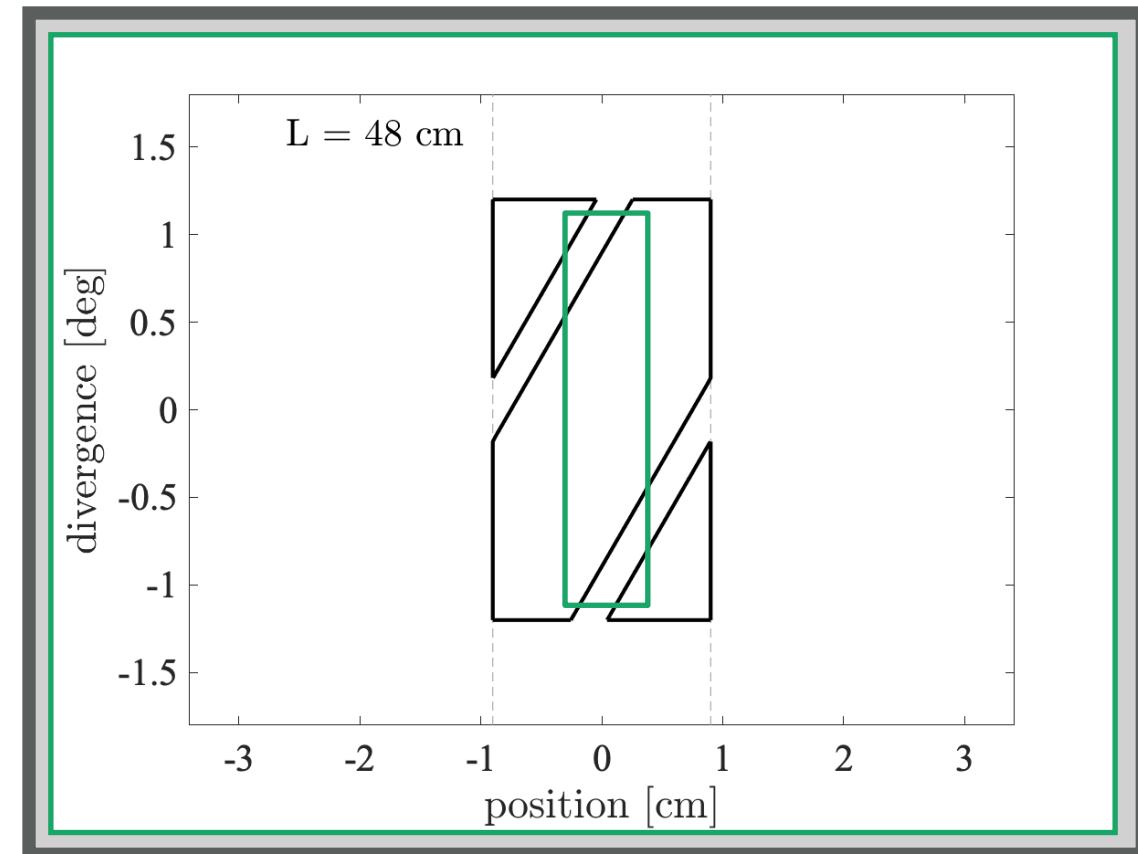
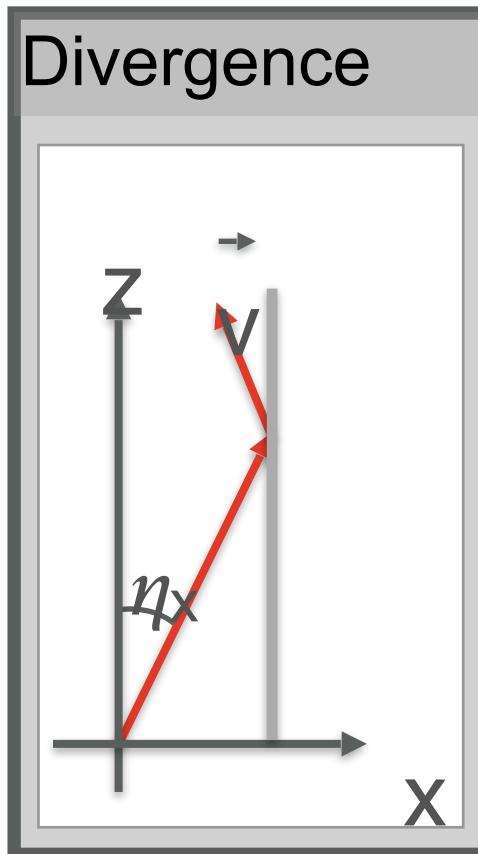


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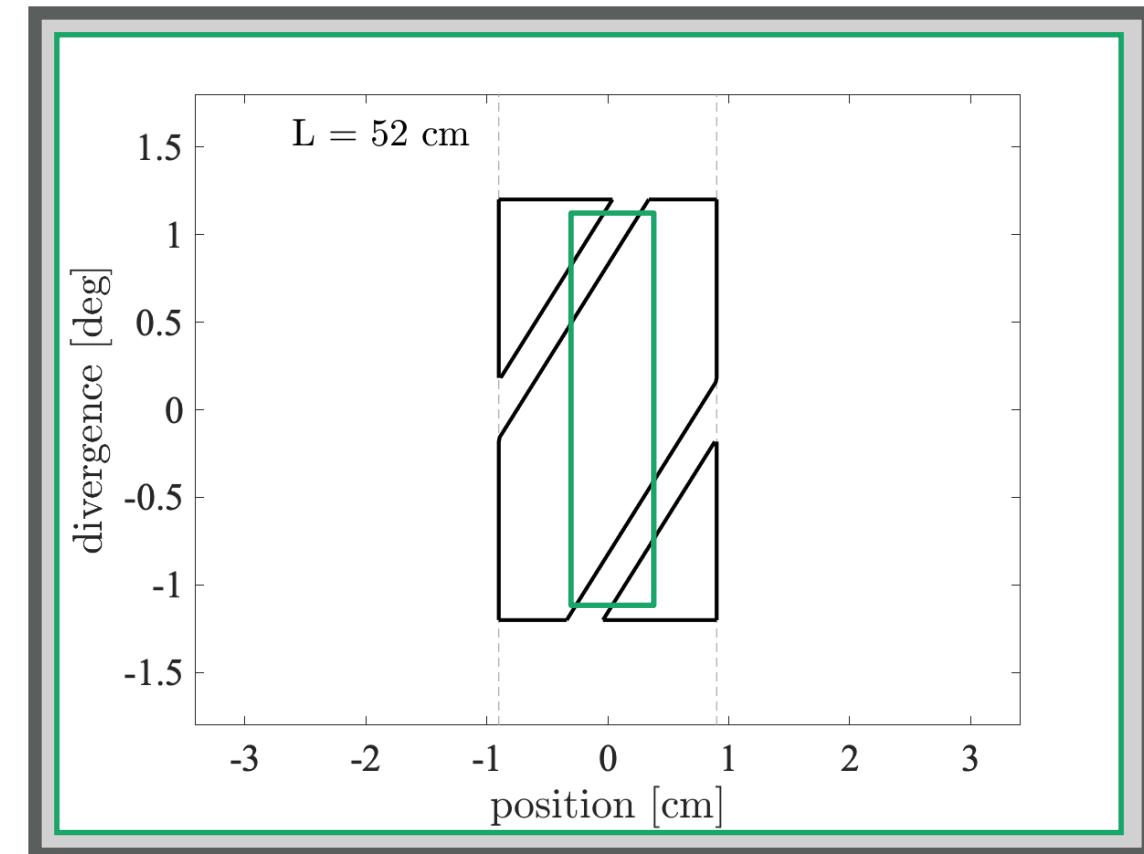
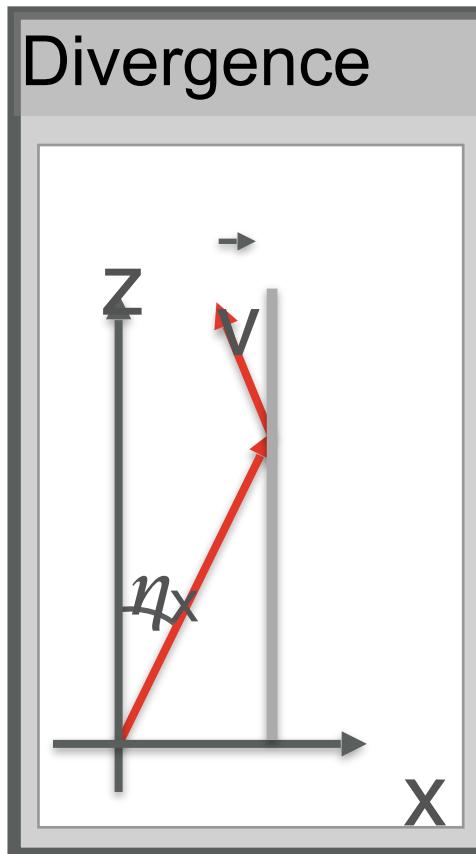


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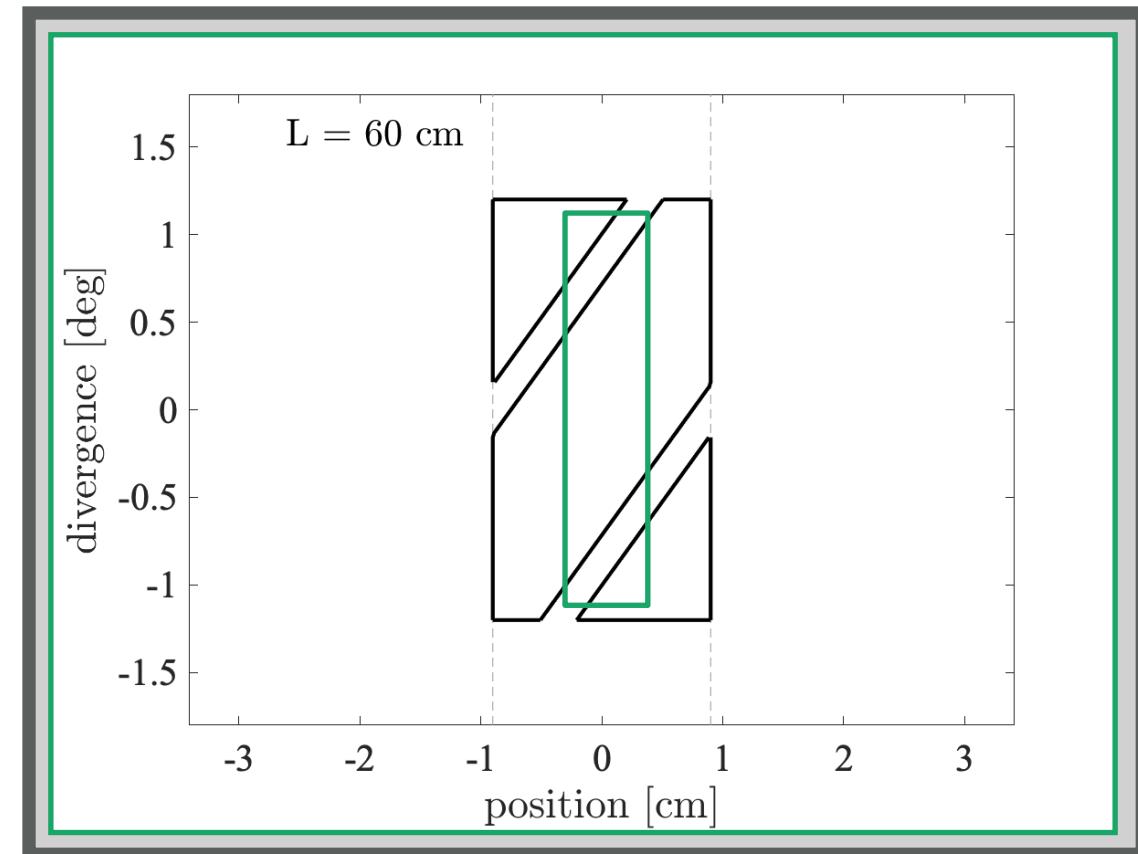
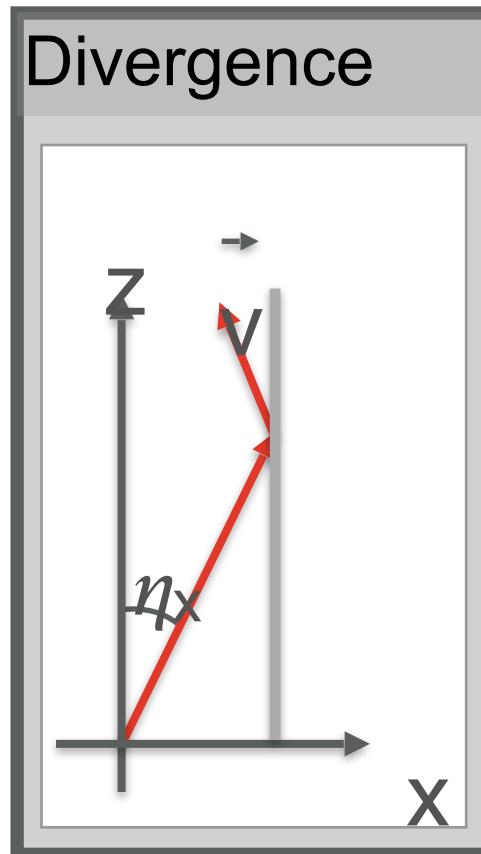


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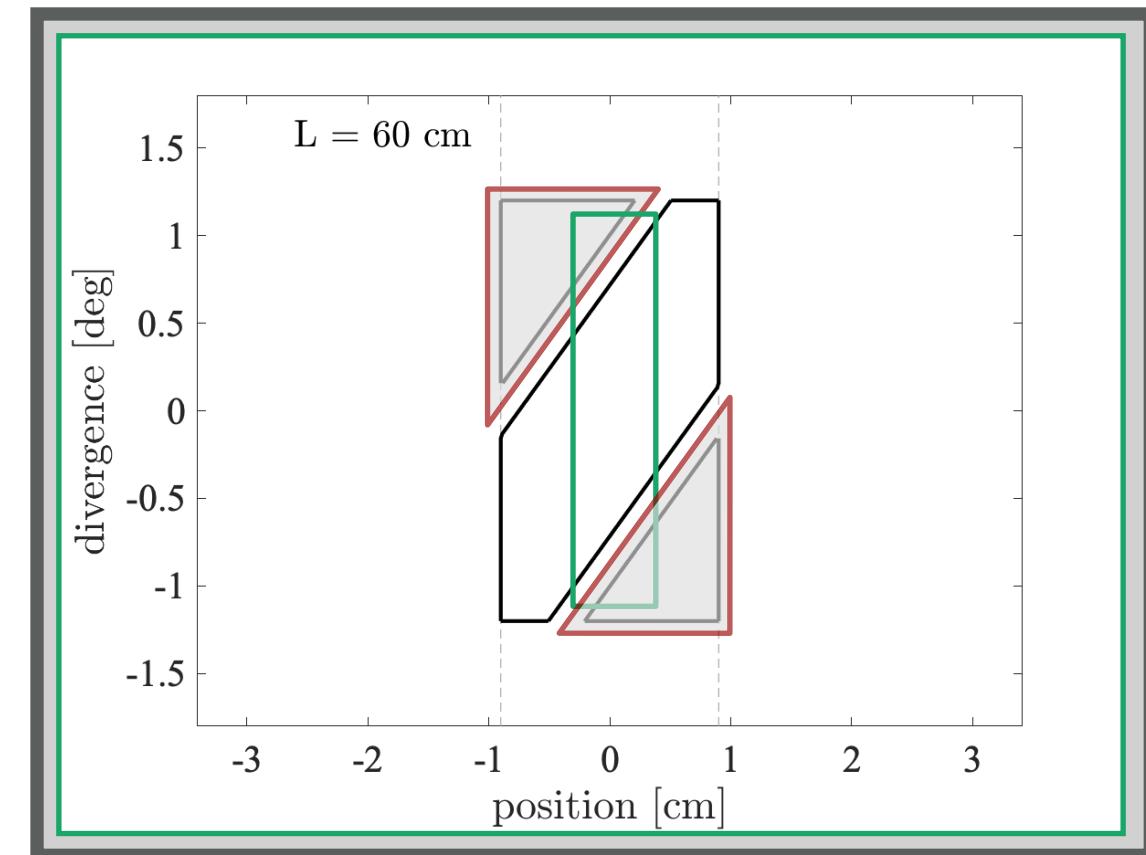
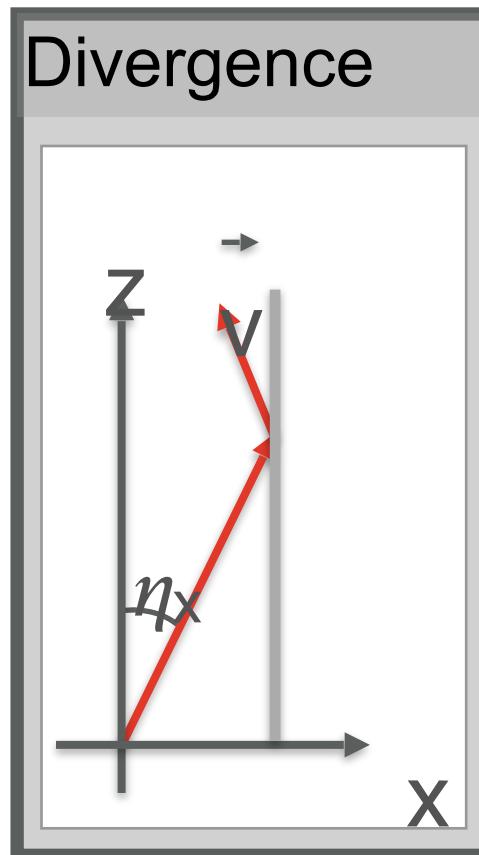
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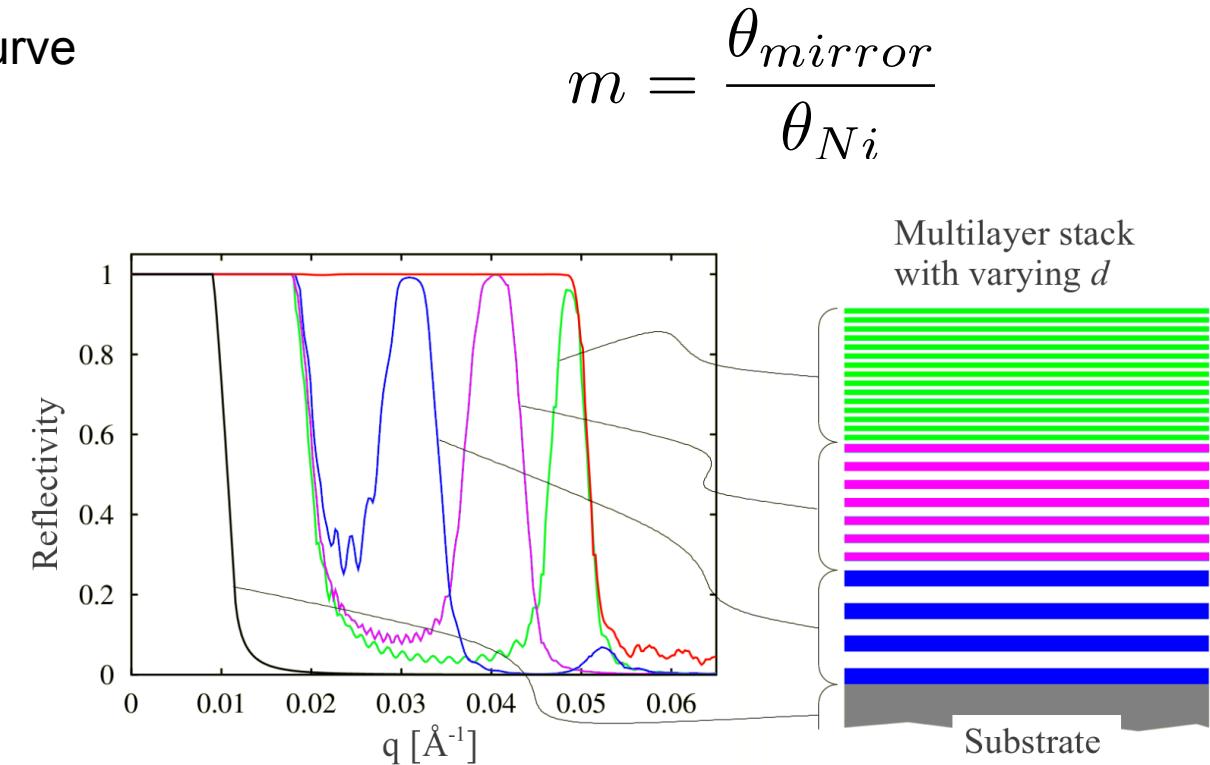
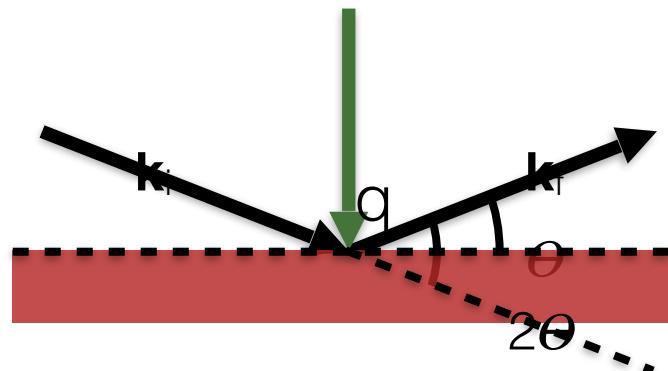
Beam propagation in guide





Reflectivity curves

- Reflectivity, super mirror, reflectivity curve

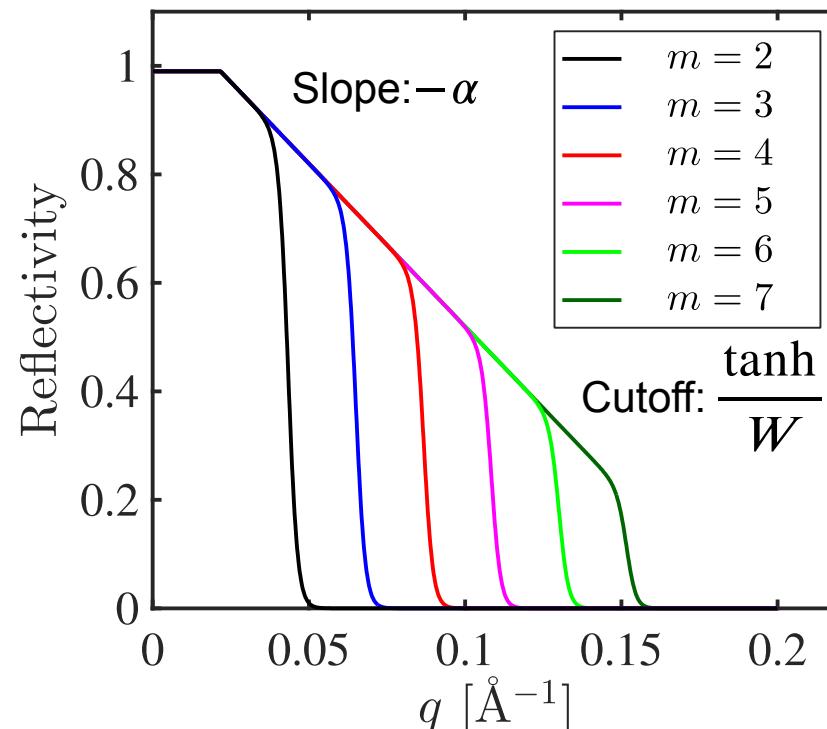




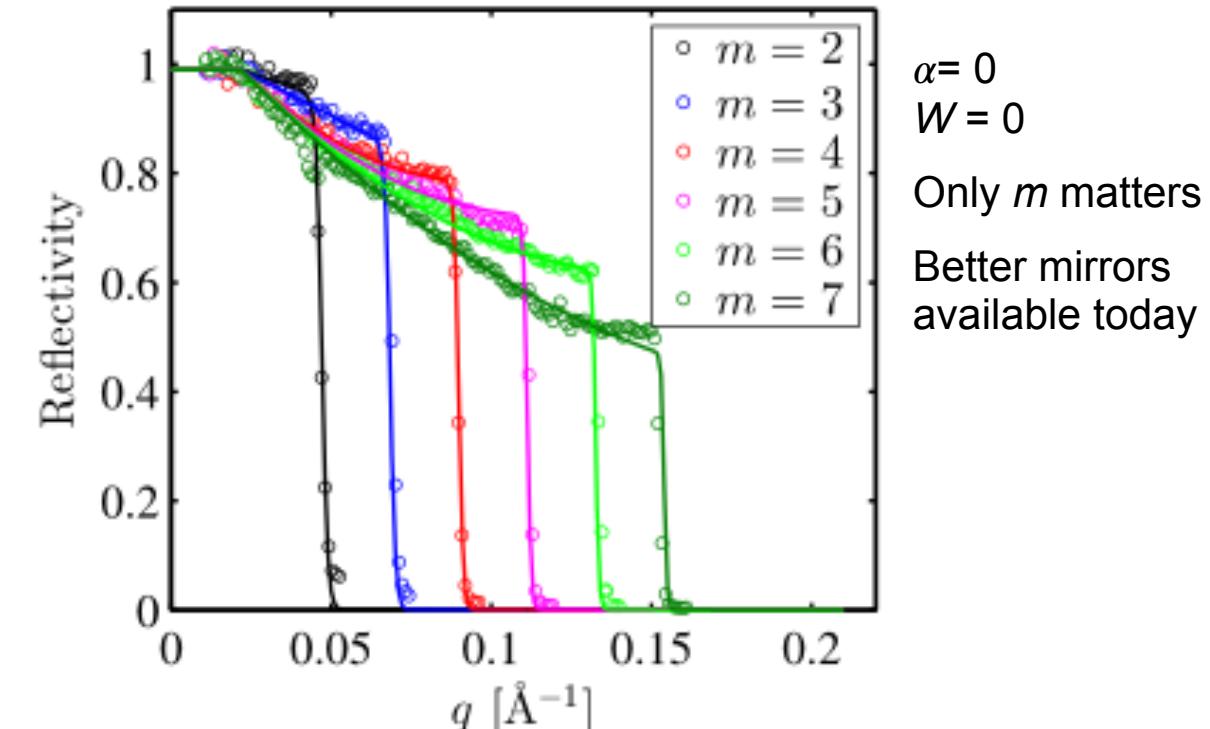
Reflectivity curves in McStas

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

McStas standard model



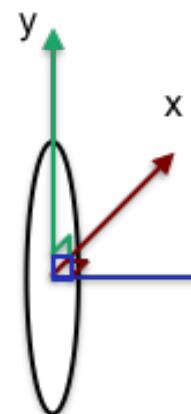
McStas fitted model



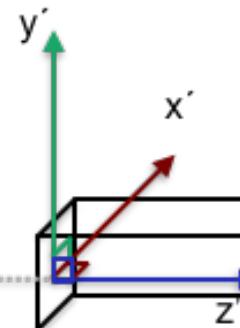


Guide placement in McStas

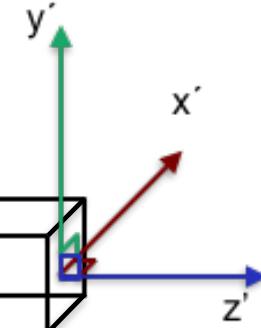
- The center is the front of the guide element
- Tip: Insert a guide at the end of the guide



COMPONENT Source
AT (0,0,0) ABSOLUTE



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



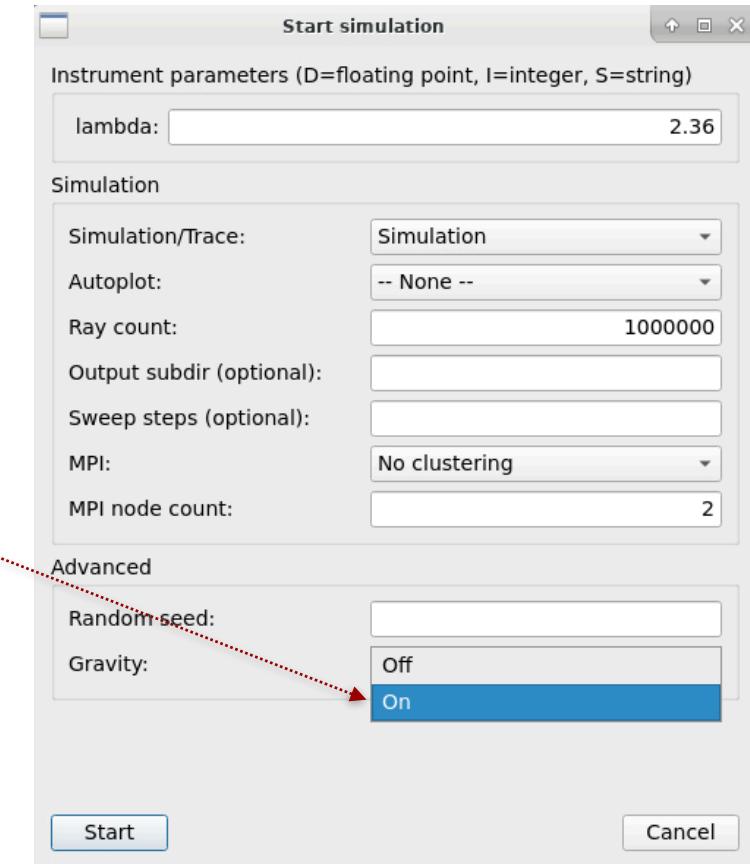
COMPONENT Arm
AT (0,0,A) RELATIVE Guide



Gravitation in McStas

- Is enabled via mcrun -g / --gravitation or by selecting “Gravity On” in mcgui
- Default ~ gravity on earth ;-)

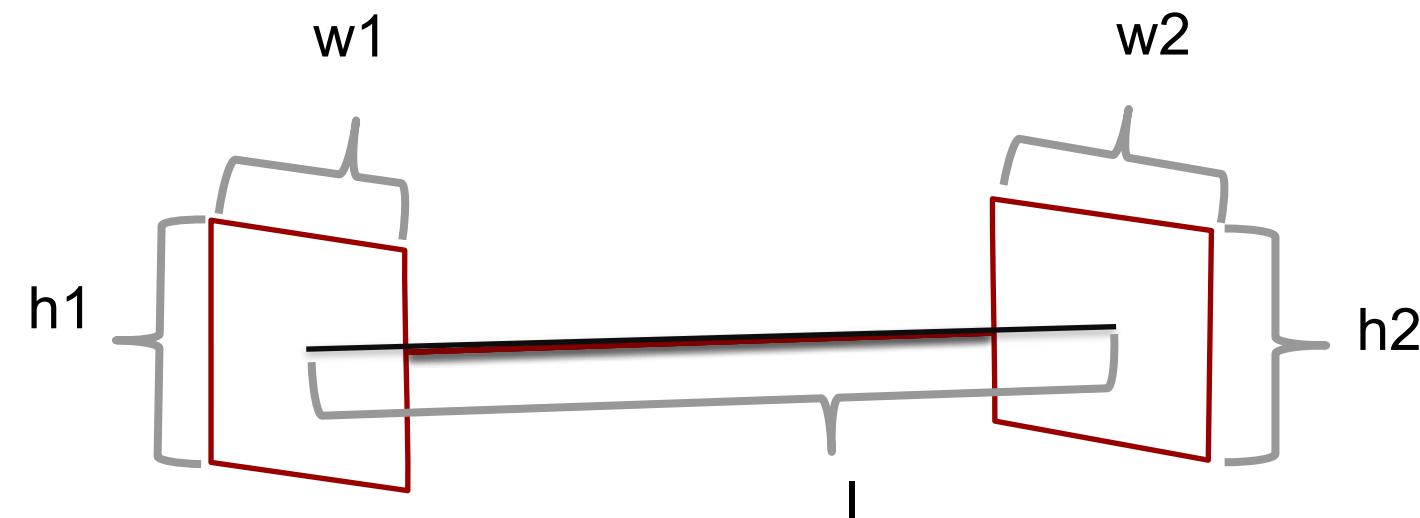
```
#define GRAVITY 9.81      /* [m/s^2] gravitational acceleration */
```
- Enabled in any call to PROP_DT, PROP_X0 etc., (i.e. “between” components, but not always inside)
- For guides, only Guide_gravity and Elliptic_guide_gravity support parabolic propagation
- As you will see in the practical, implications are greatest with long wavelengths and at long distances





Popular guide components: Guide_gravity

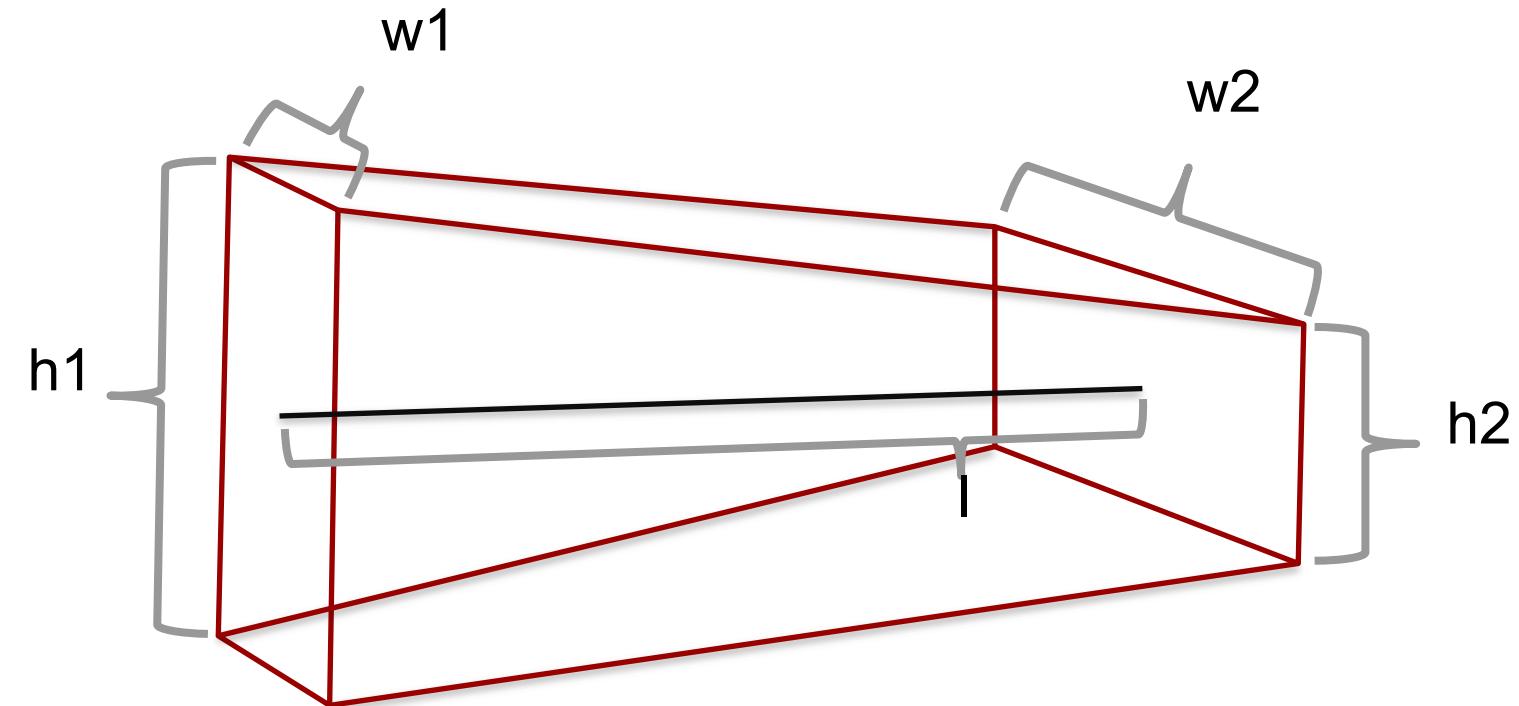
- Typical guide component with gravity
- Many additional features, channels, fermi chopper, ...





Popular guide components: Guide_gravity

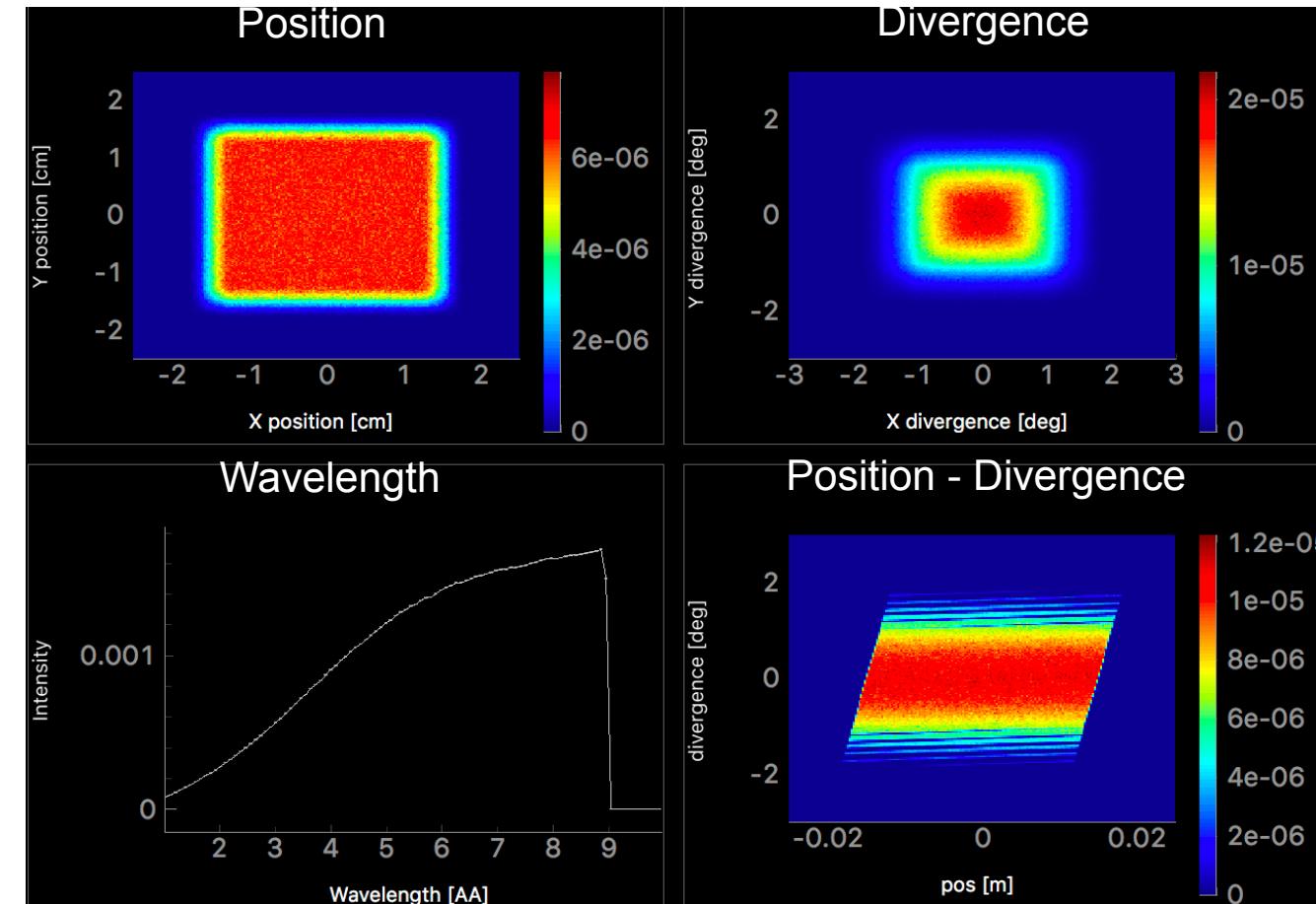
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Popular guide components: Guide_gravity

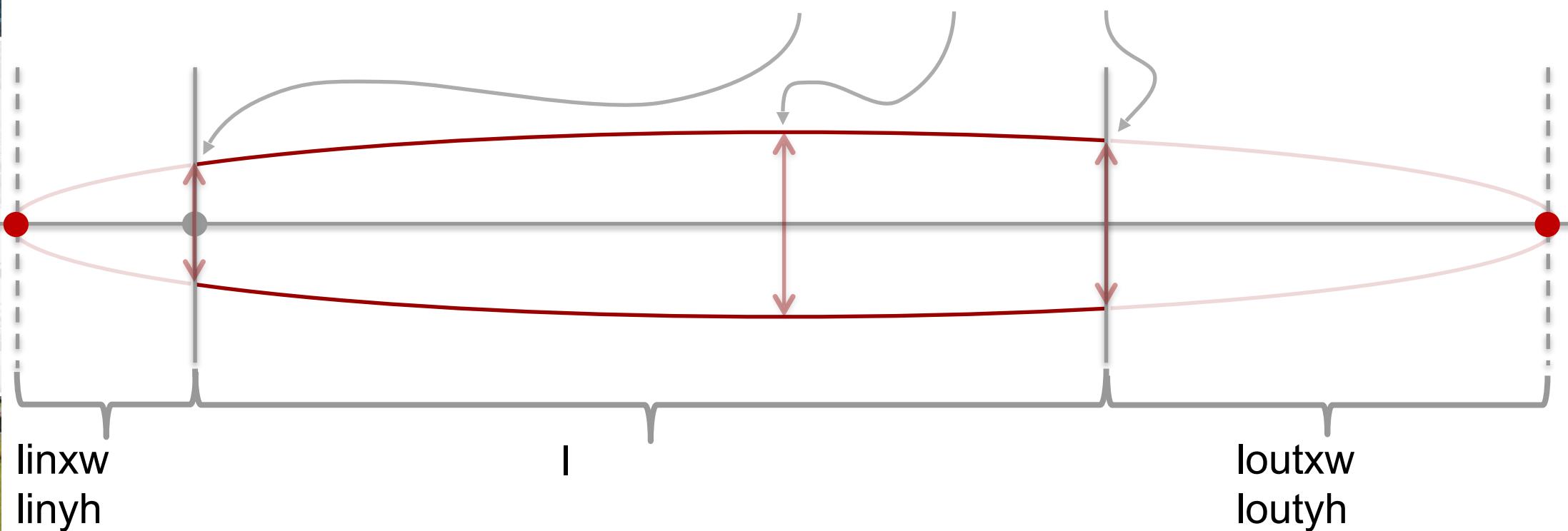
- Typical guide component with gravity





Popular guide components: Elliptical_guide_gravity

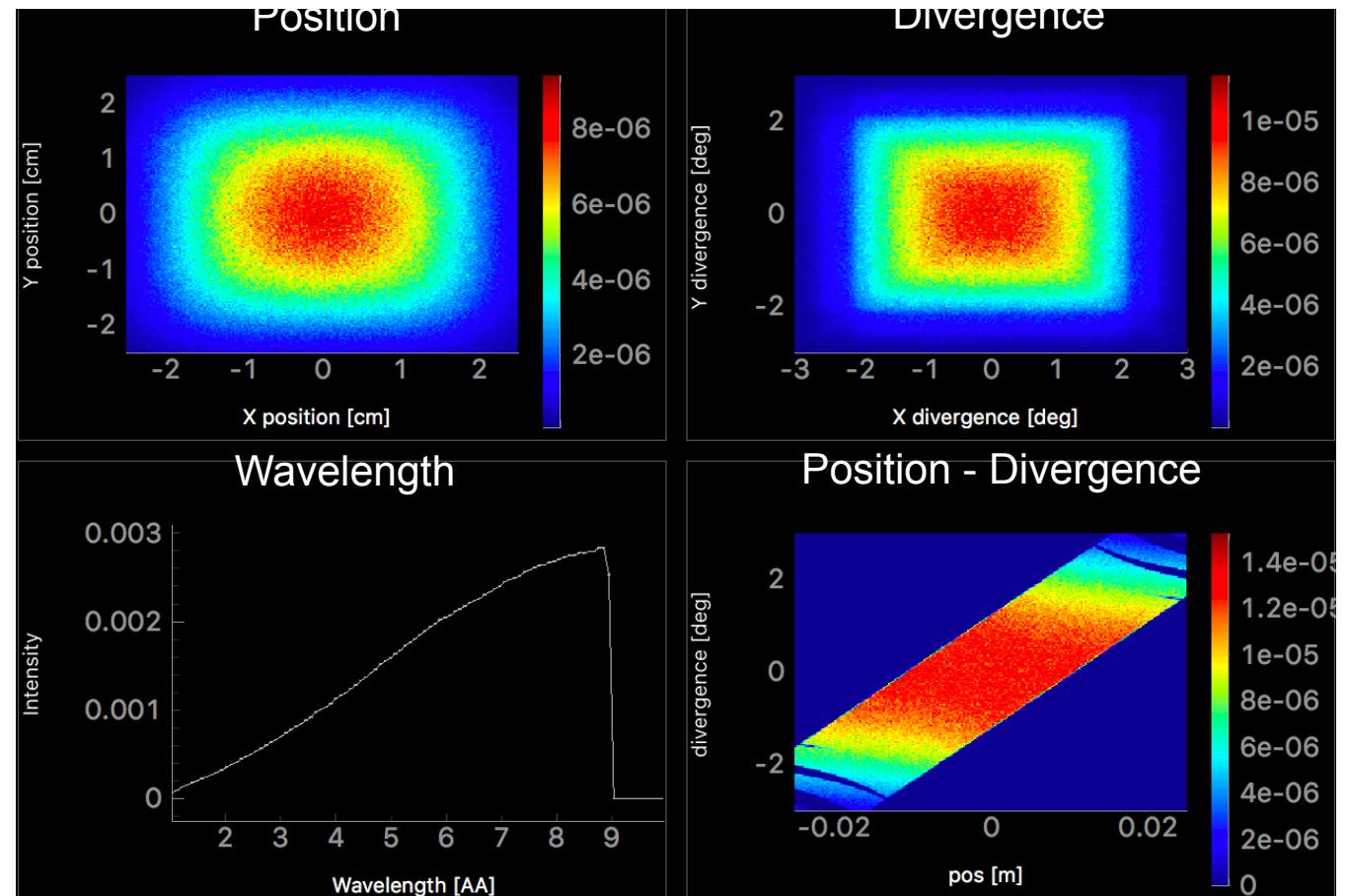
- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution, xwidth and yheight at DimensionsAt = "entrance" , "mid" or "exit"





Popular guide components: Elliptical_guide_gravity

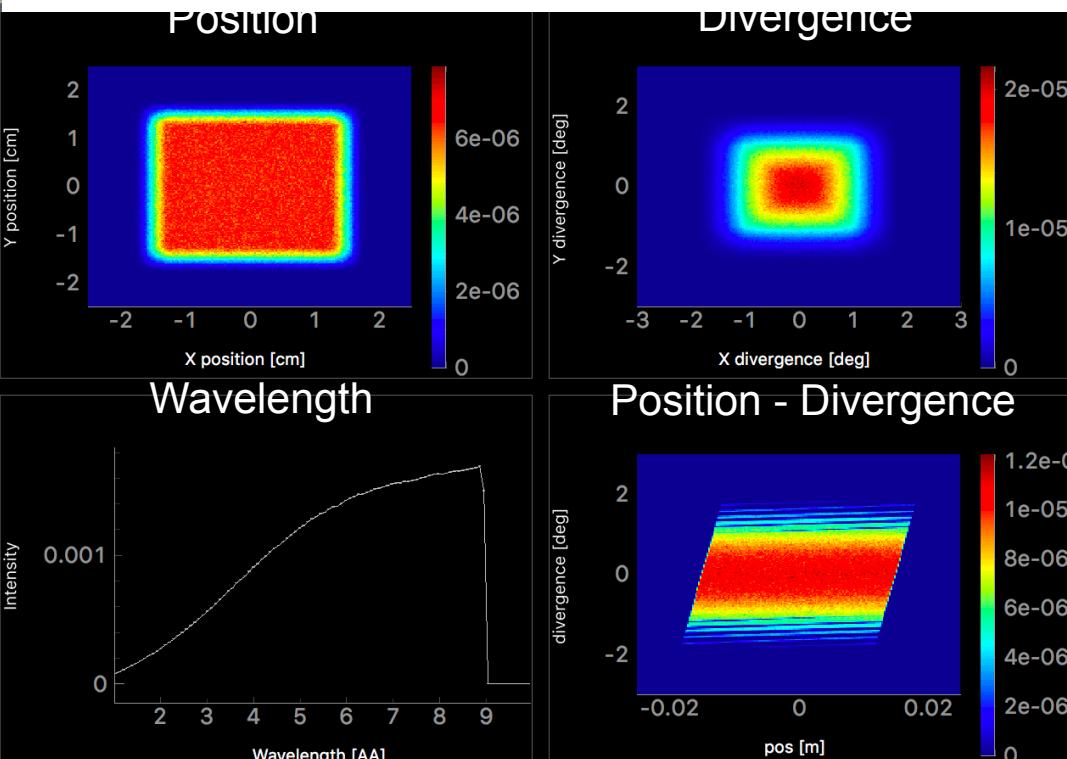
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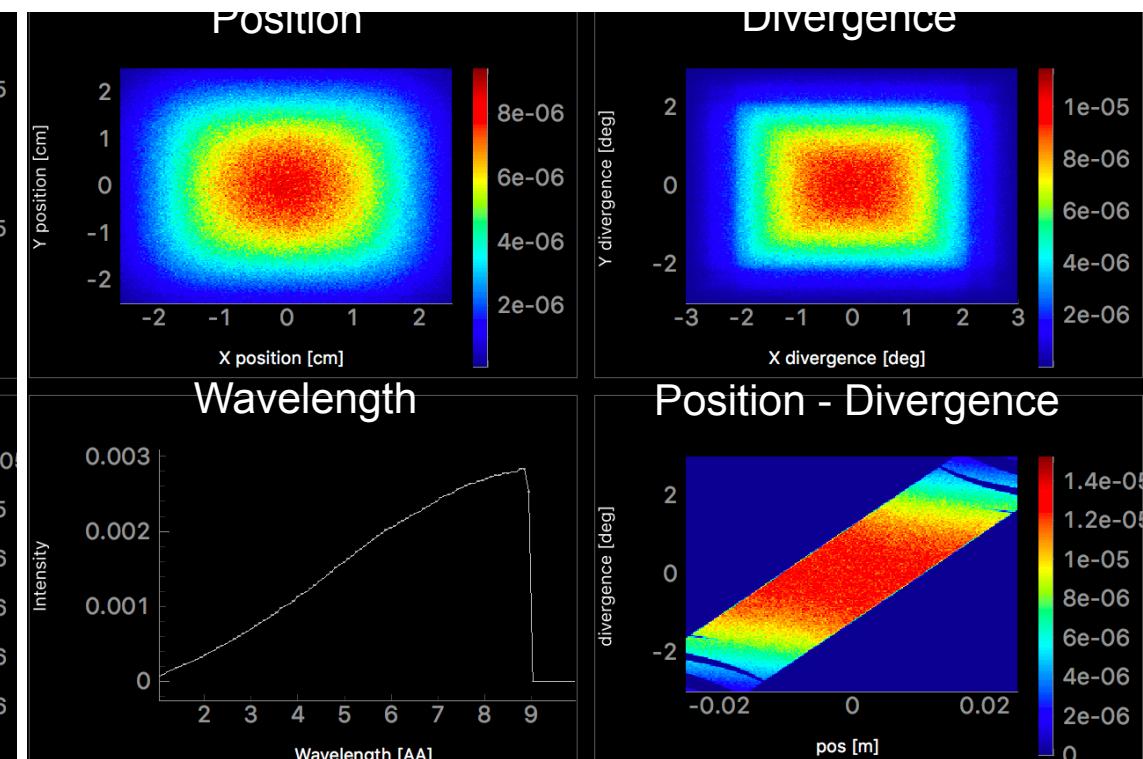


Comparison: Guide_gravity and Elliptic_guide_gravity

Guide_gravity



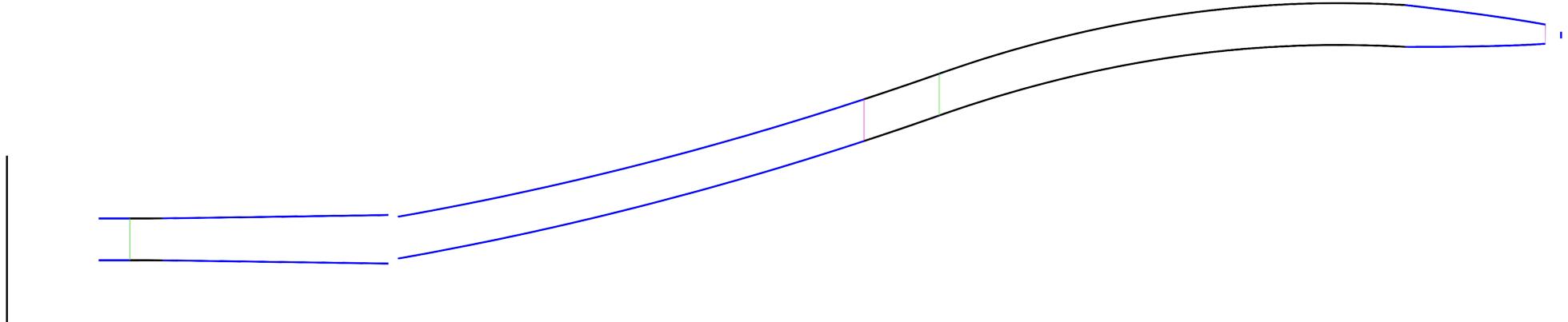
Elliptic_guide_gravity





Breaking line of sight

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

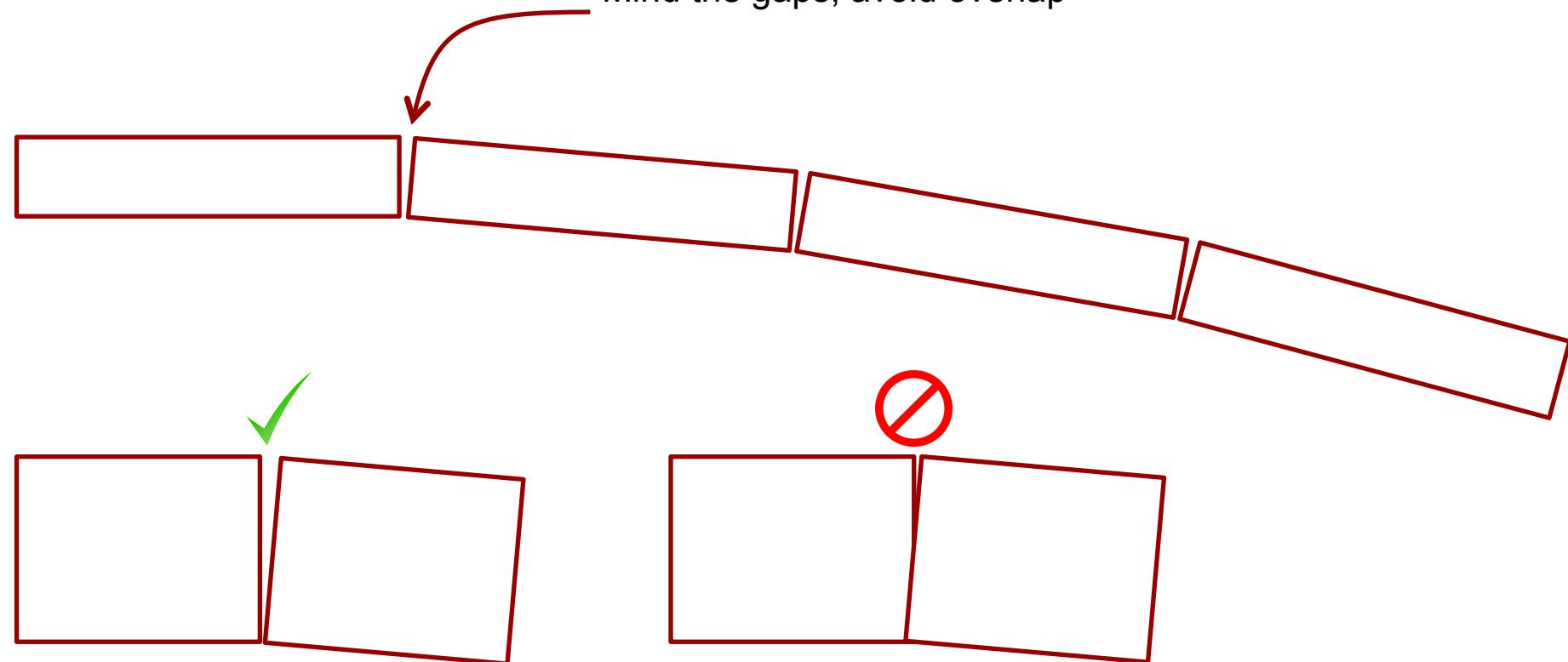




Breaking line of sight

- Bender component or many straight sections

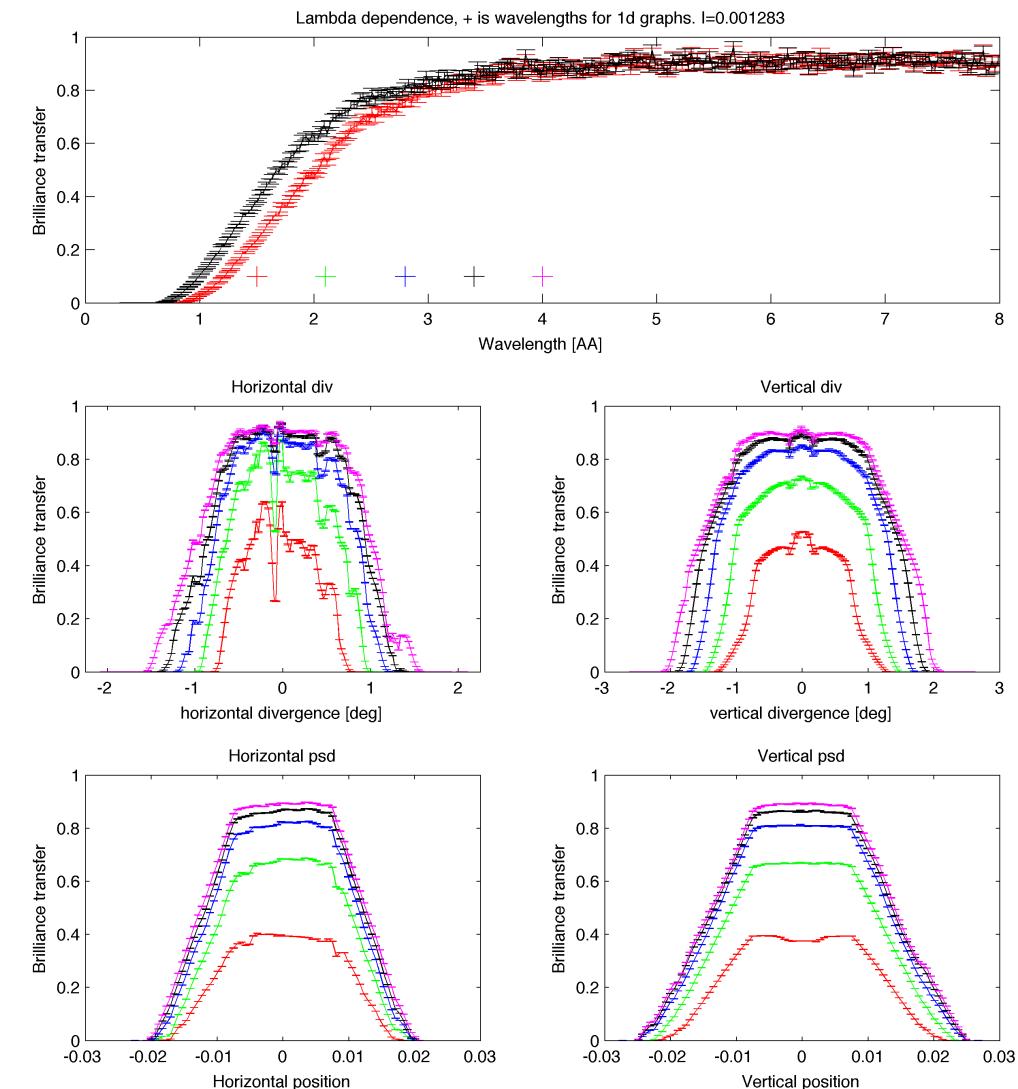
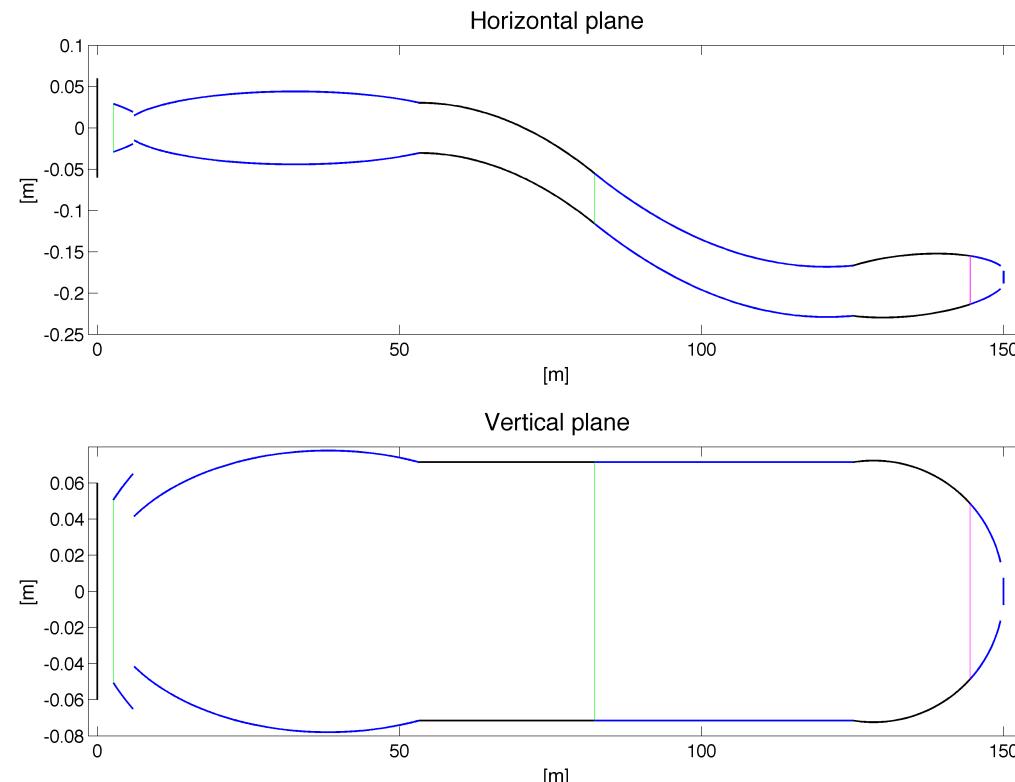
Mind the gaps, avoid overlap





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