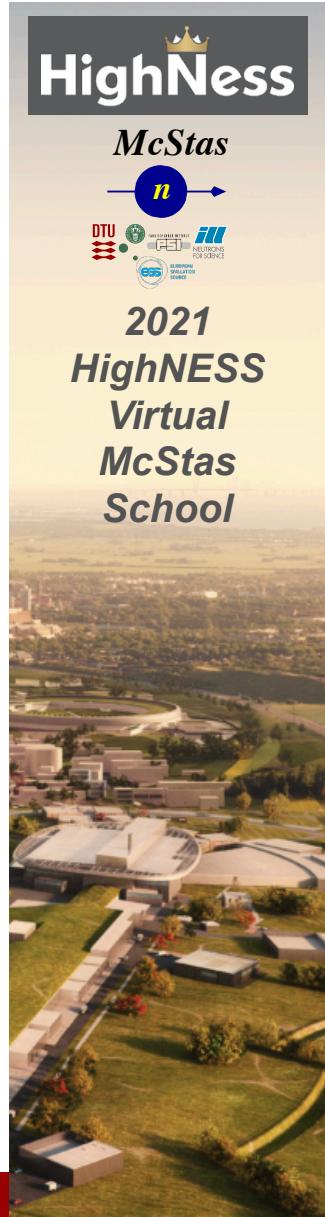


Guides and gravity in McStas

Peter Willendrup



Adapted from slides by Mads Bertelsen, ESS



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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

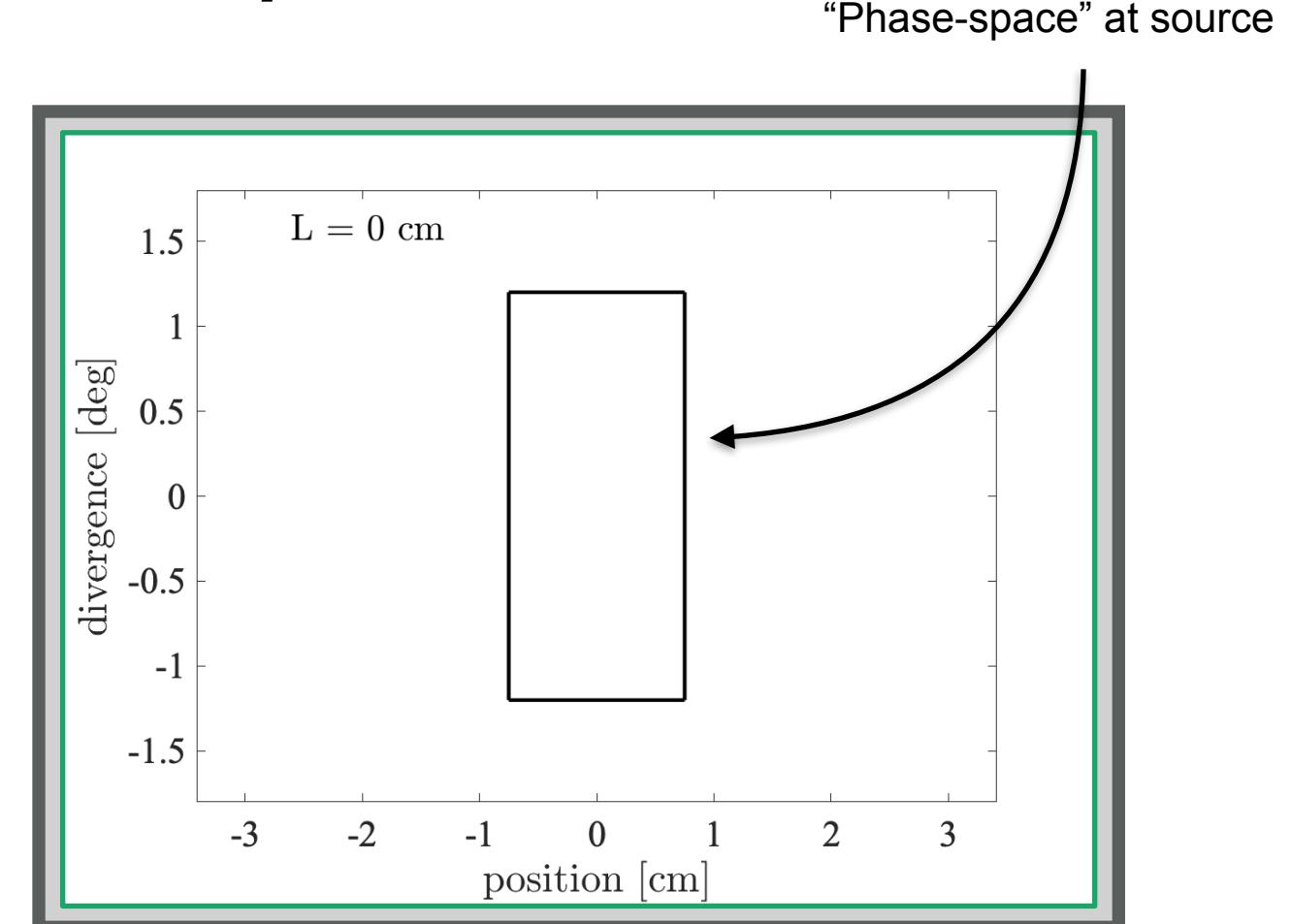
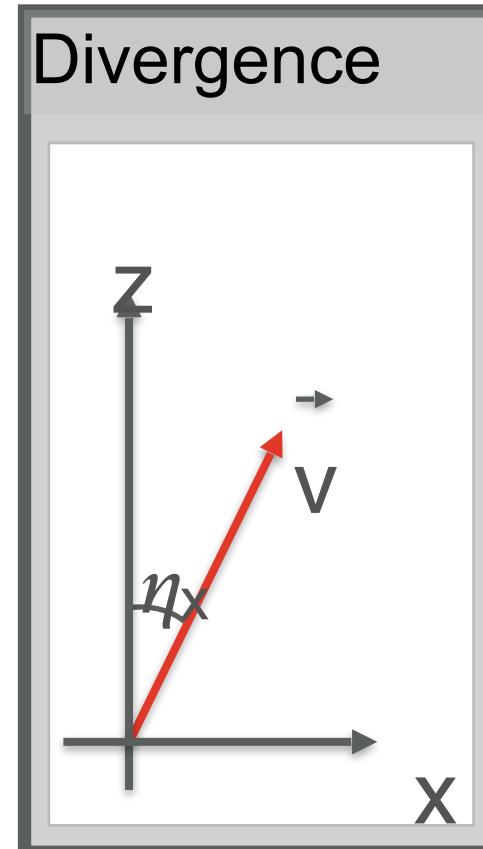




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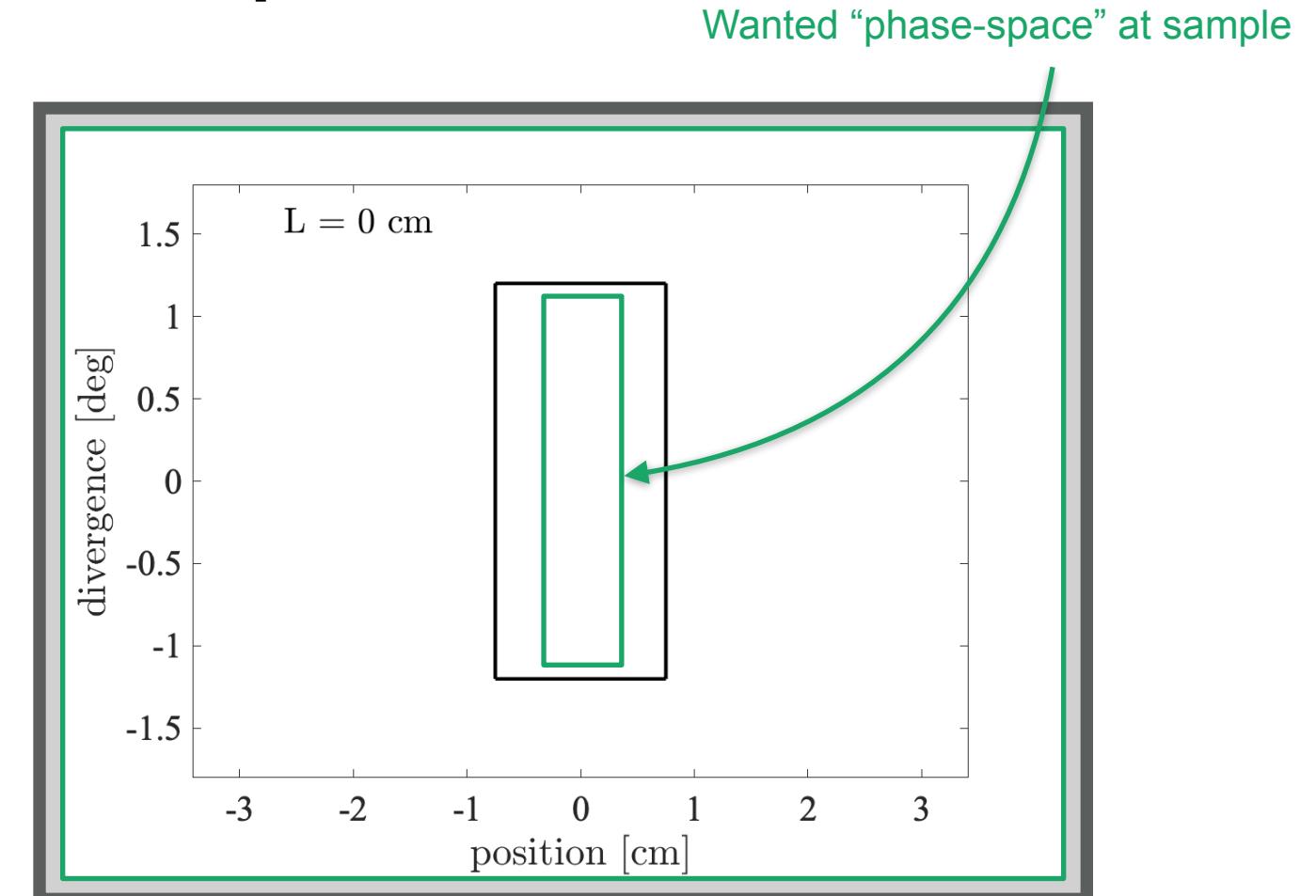
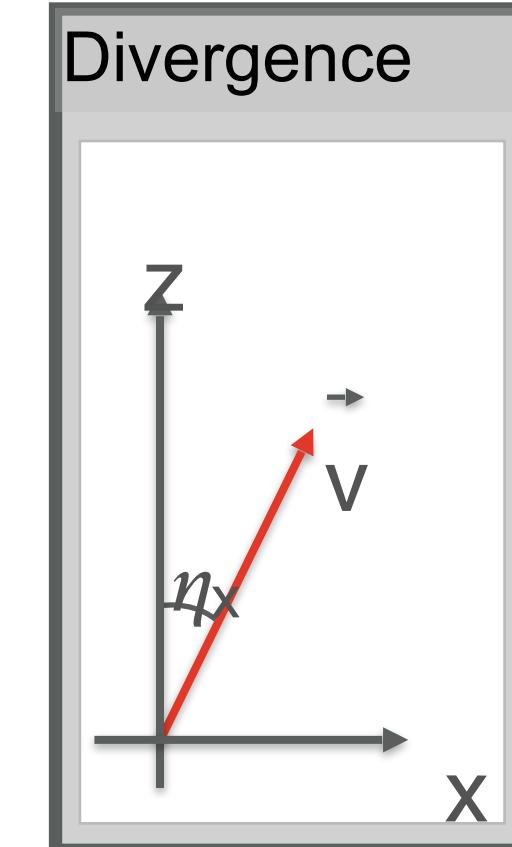
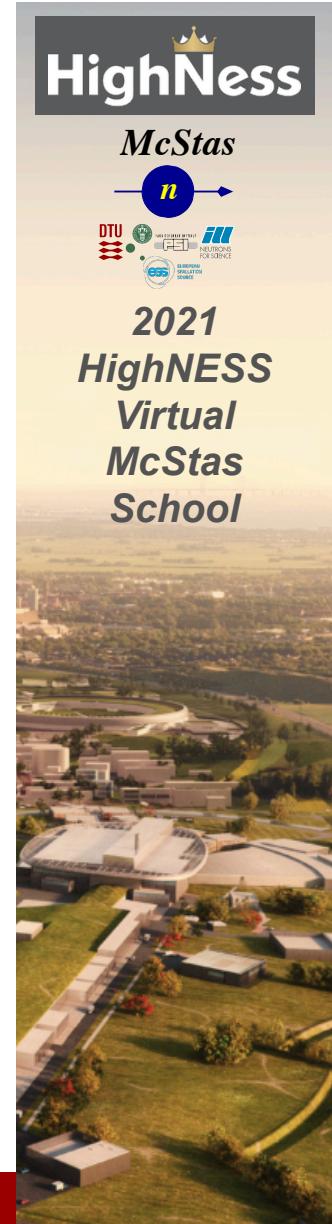


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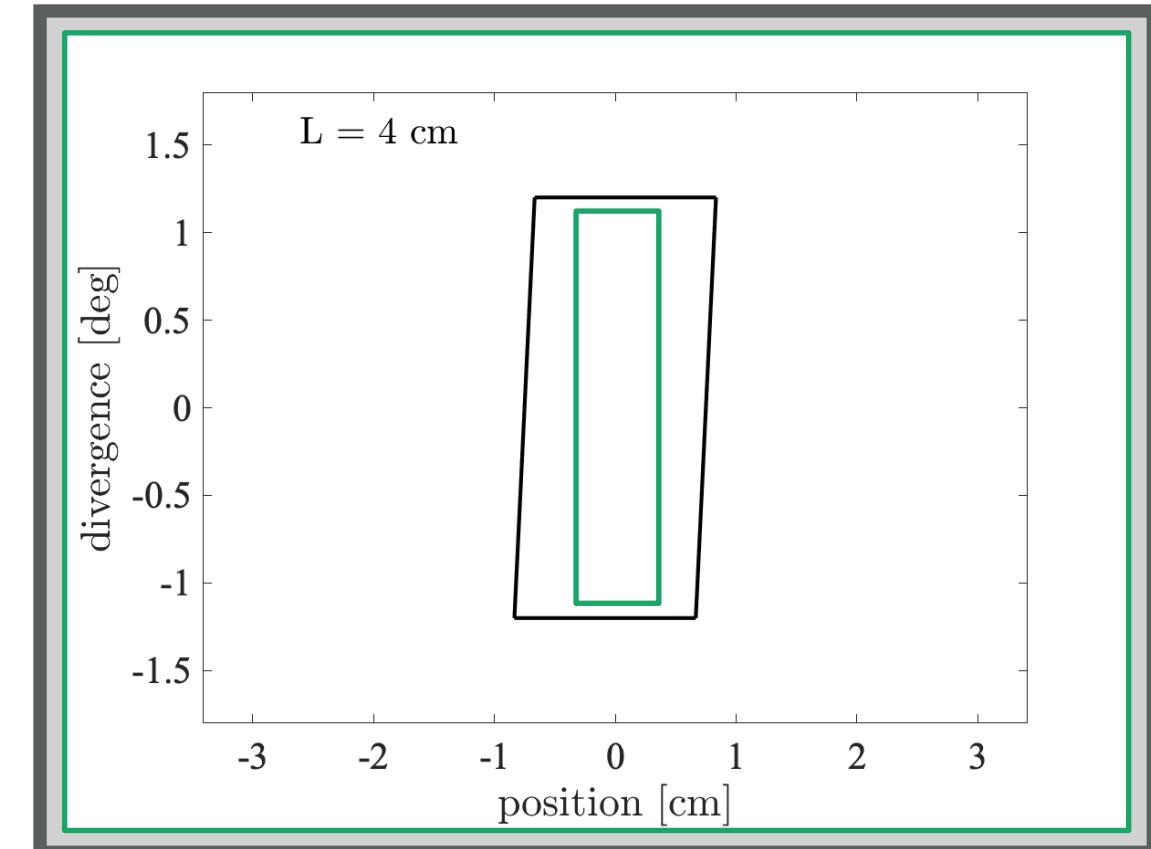
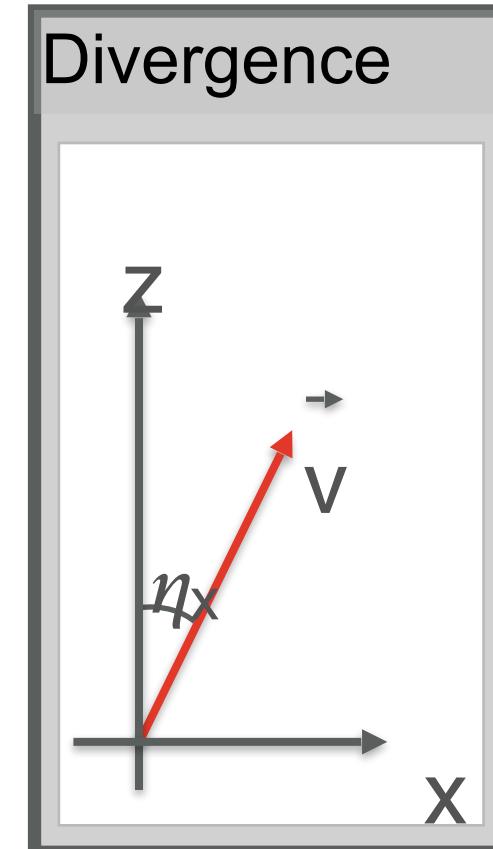




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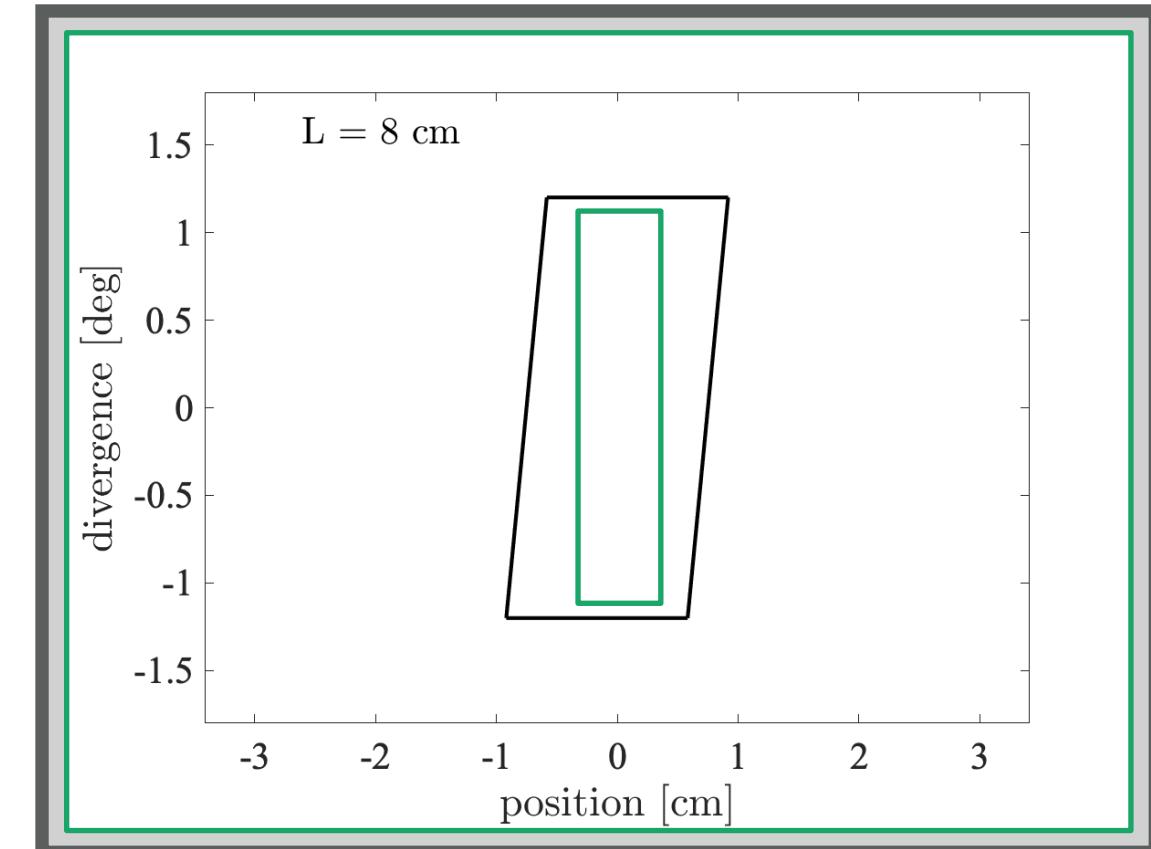
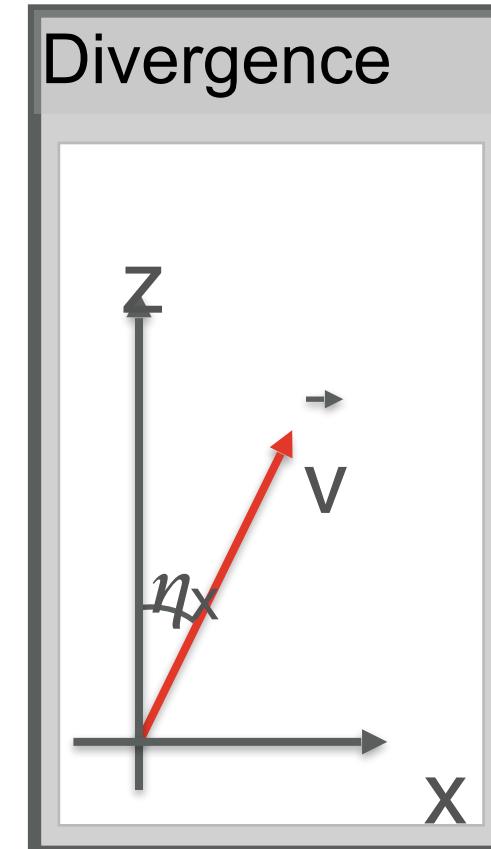




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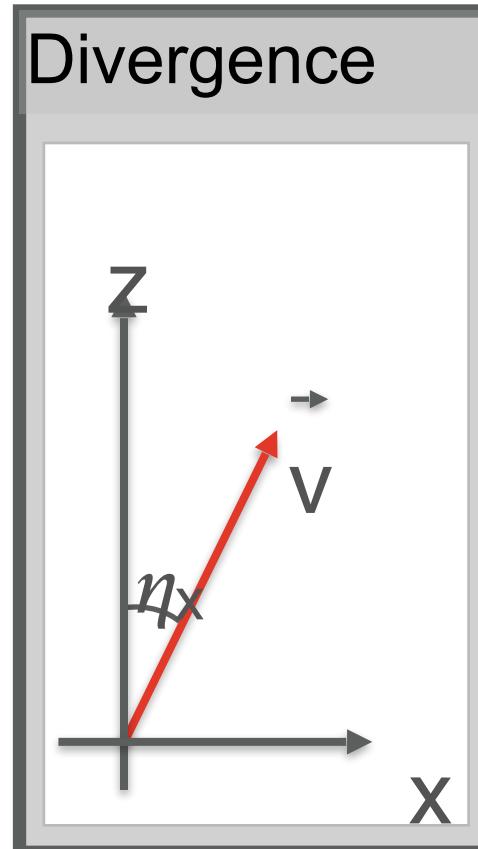




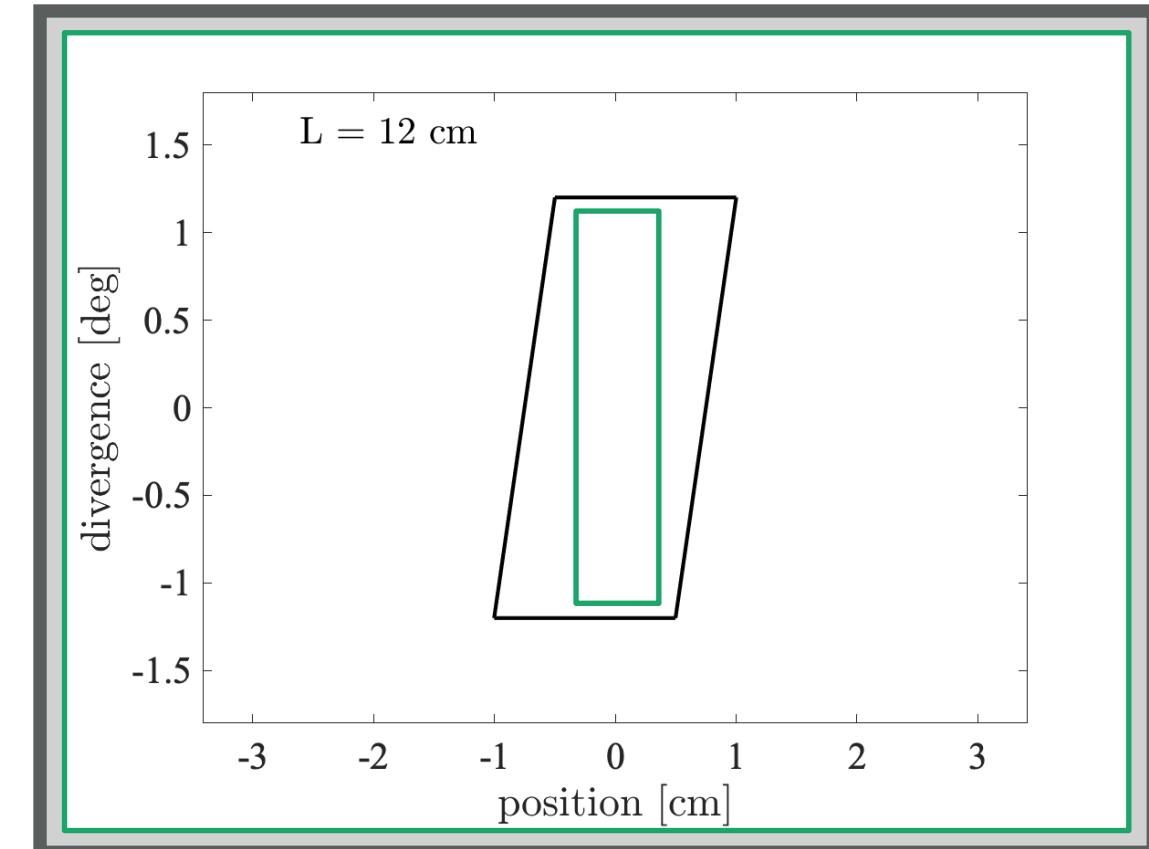
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Beam propagation in free space

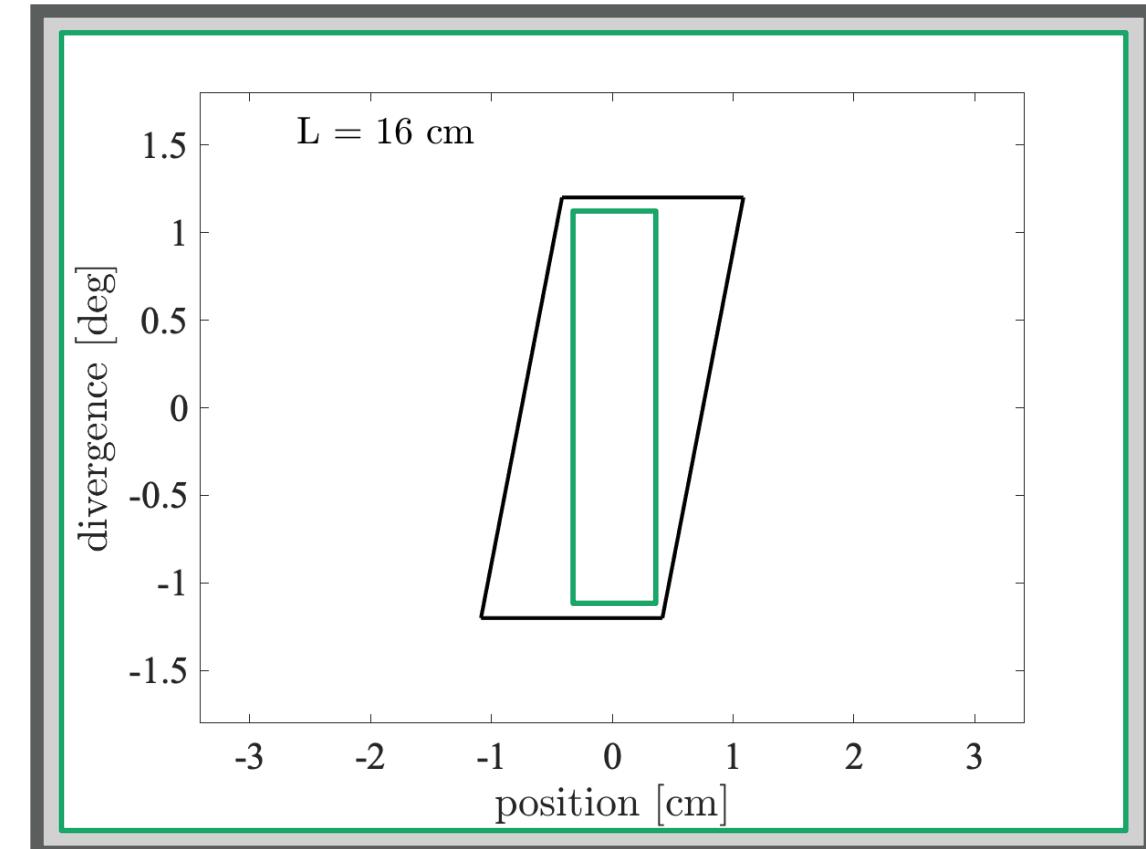
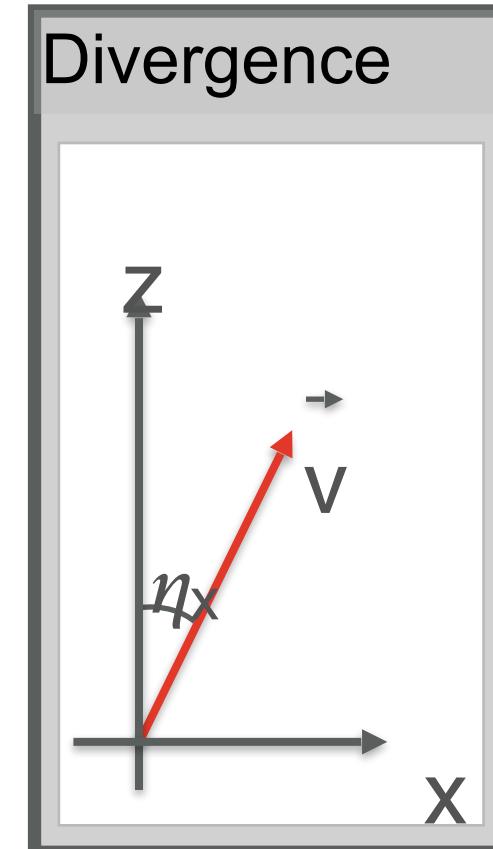




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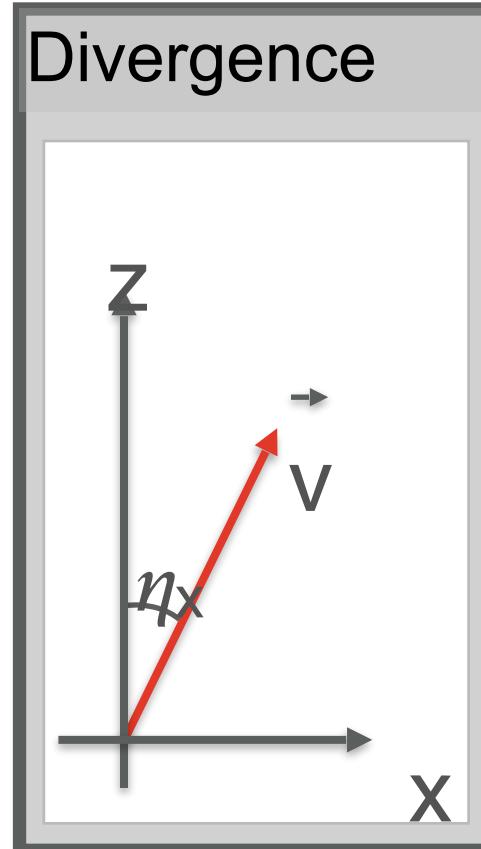




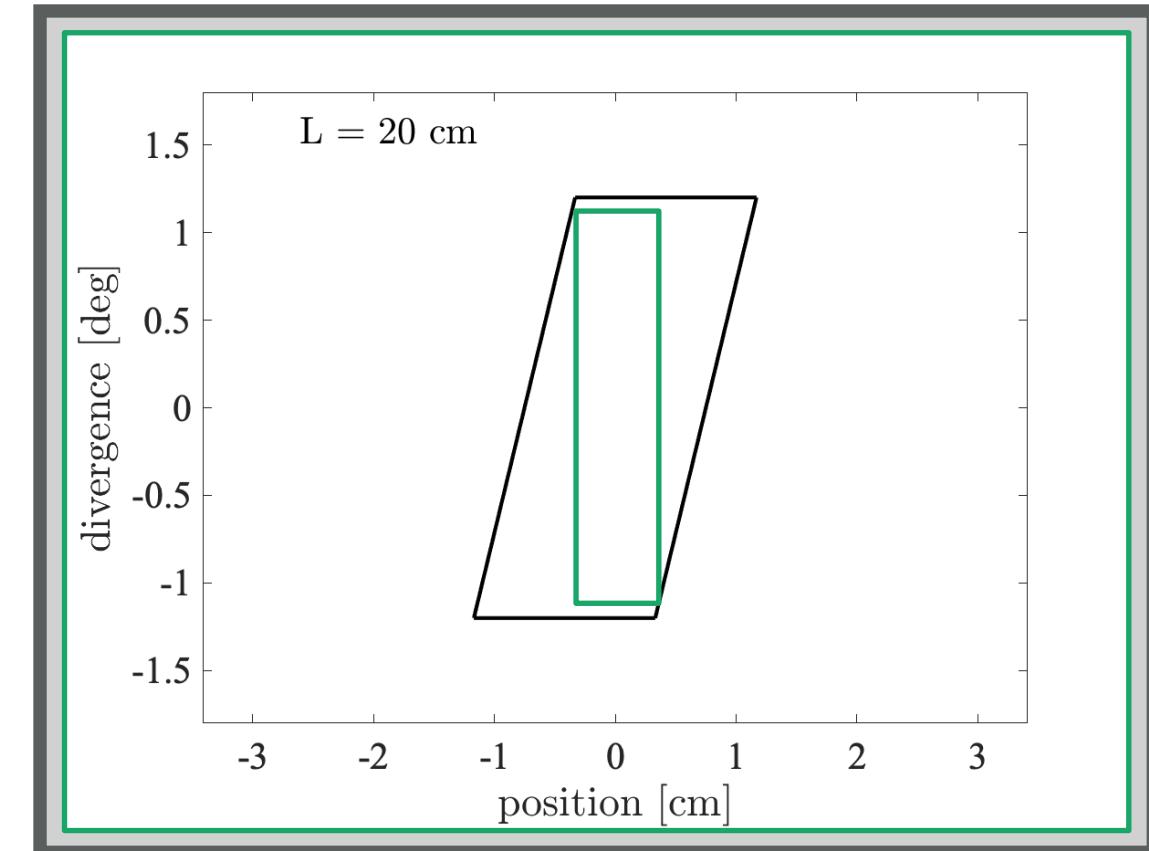
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Beam propagation in free space

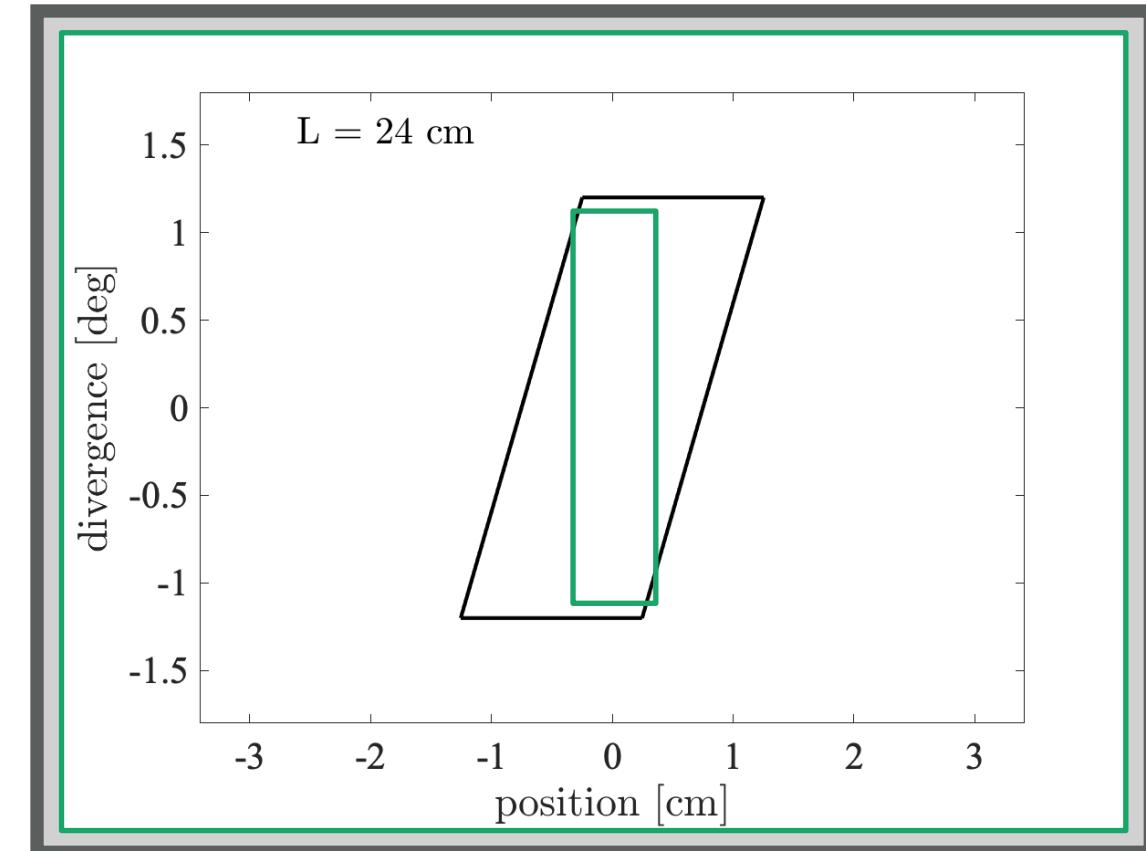
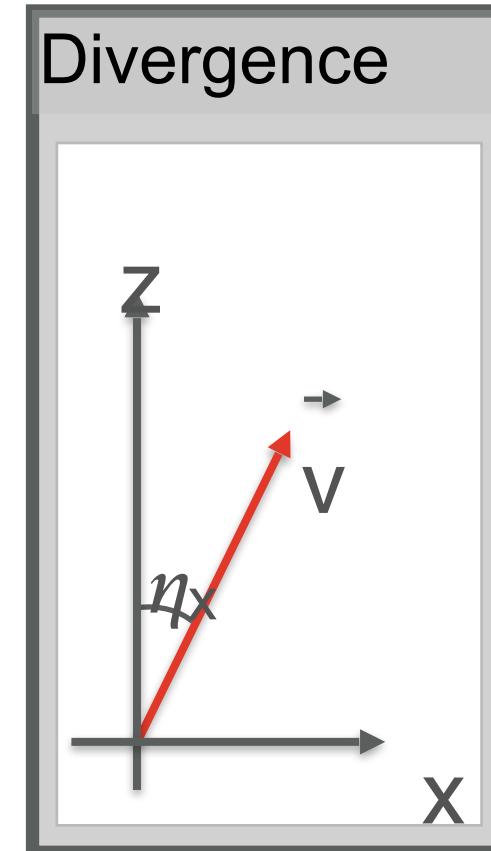




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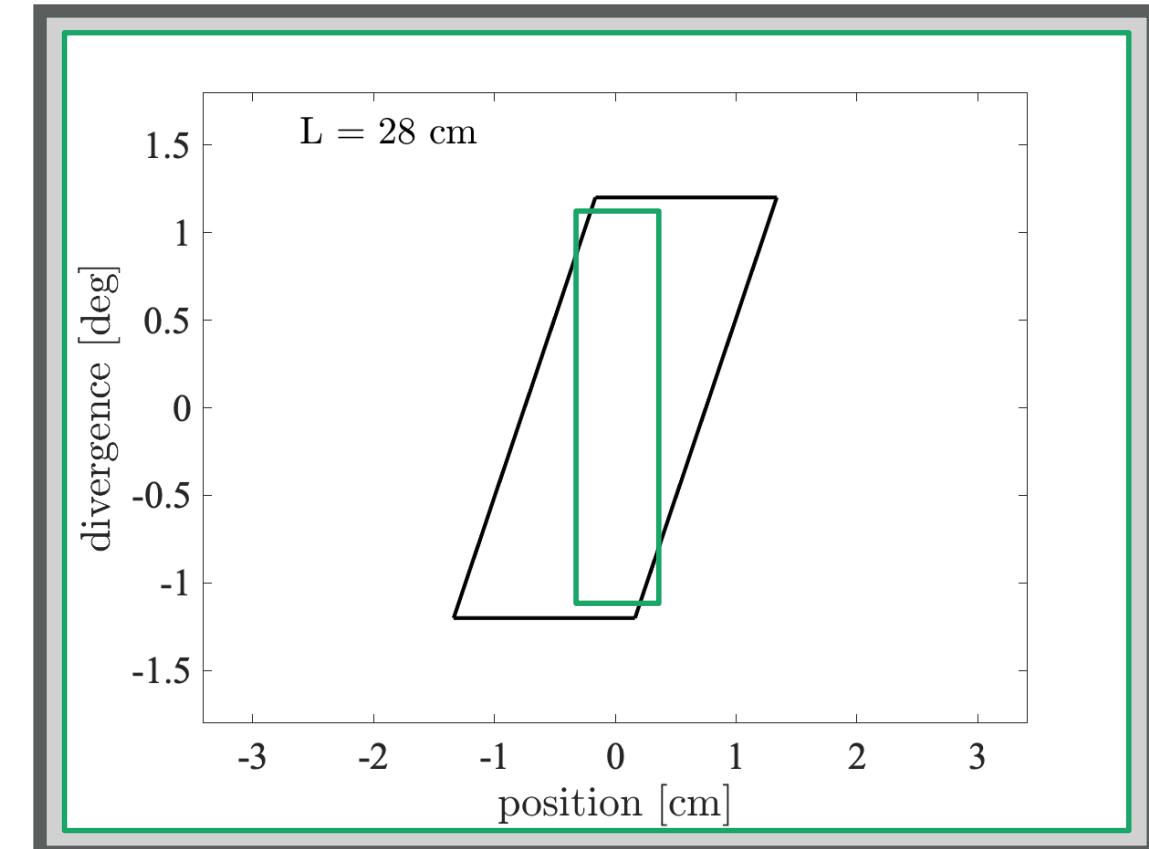
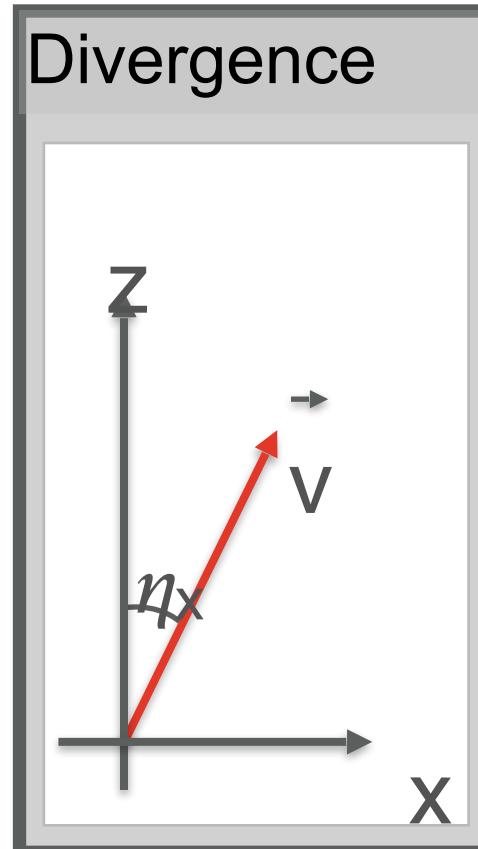




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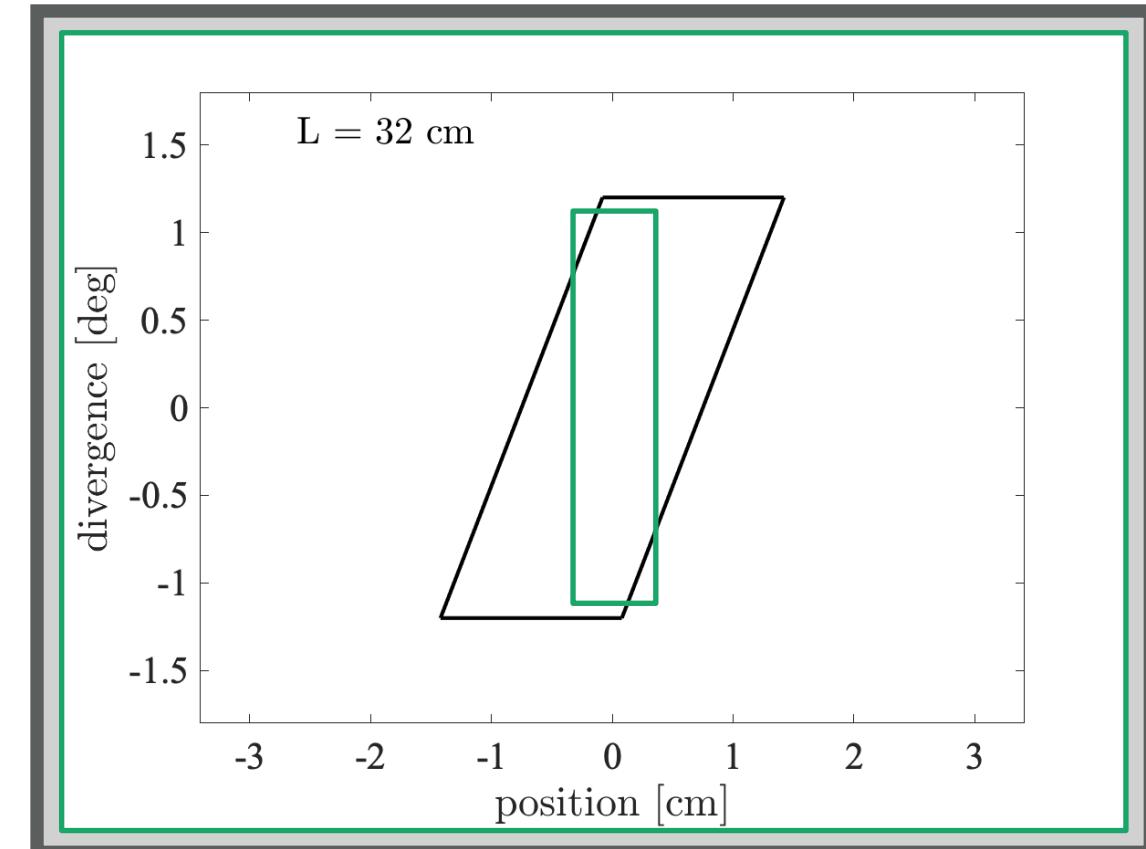
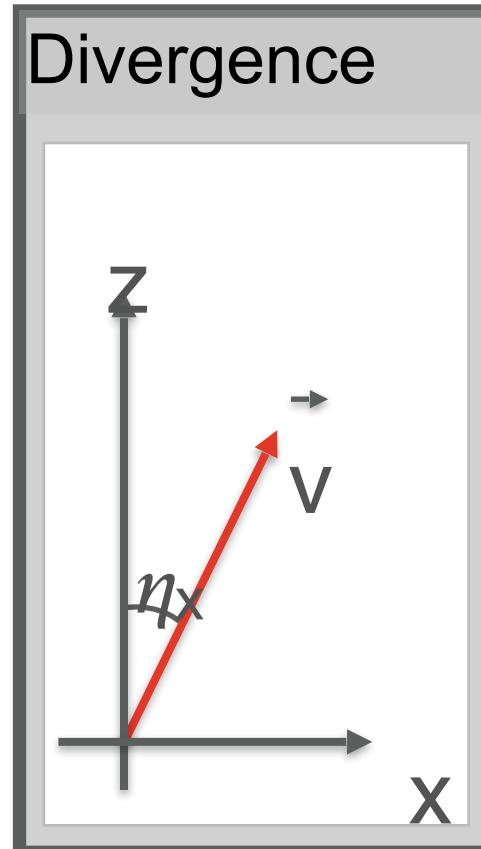




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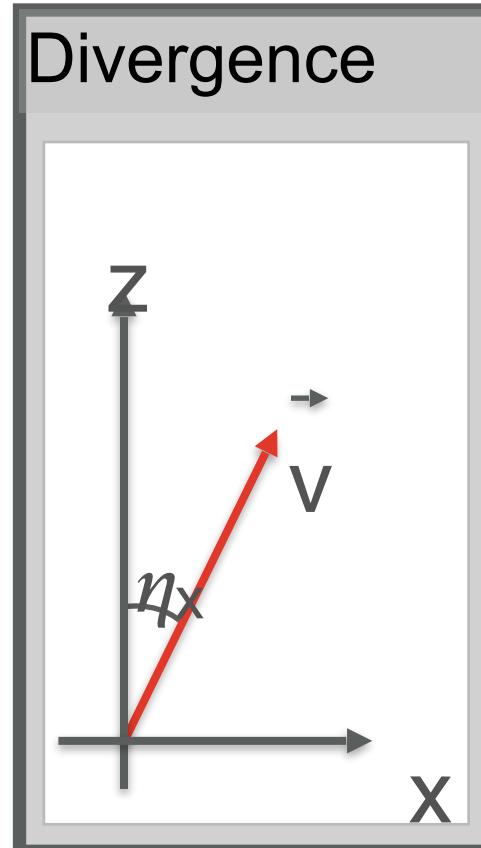




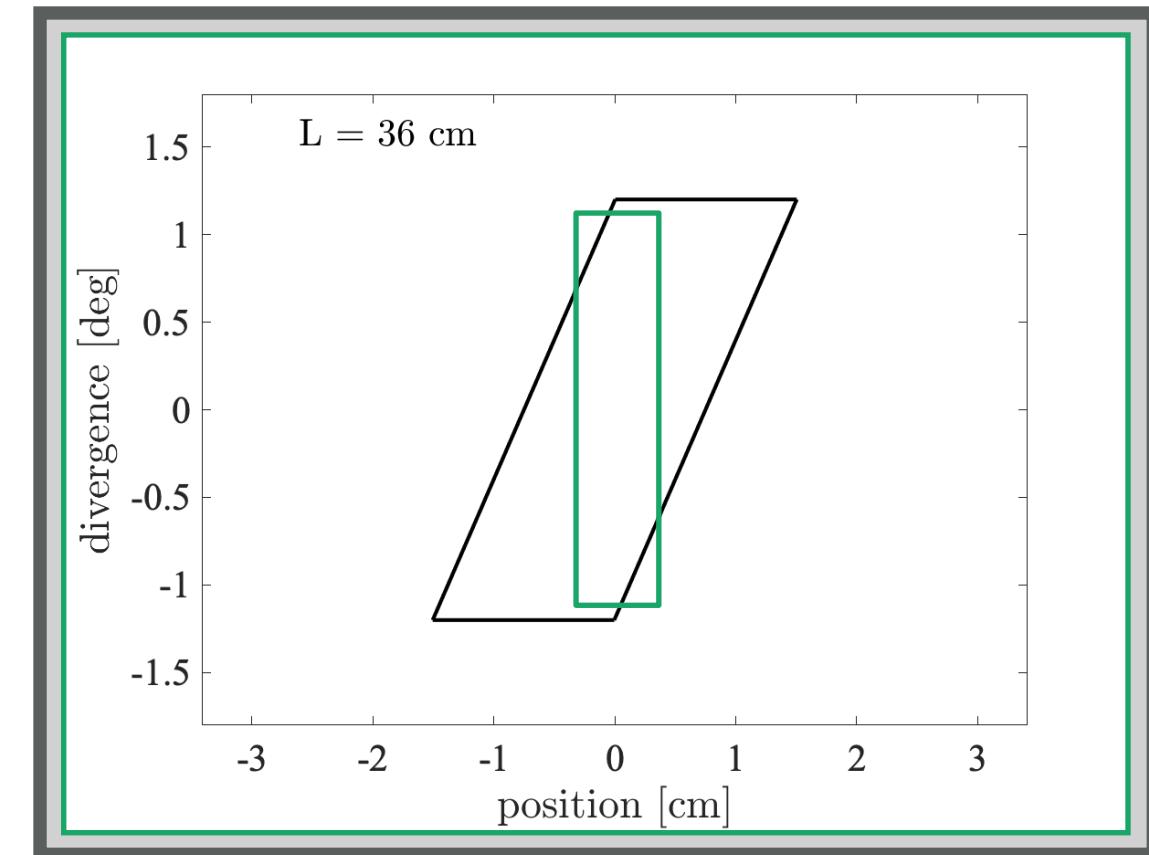
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Beam propagation in free space

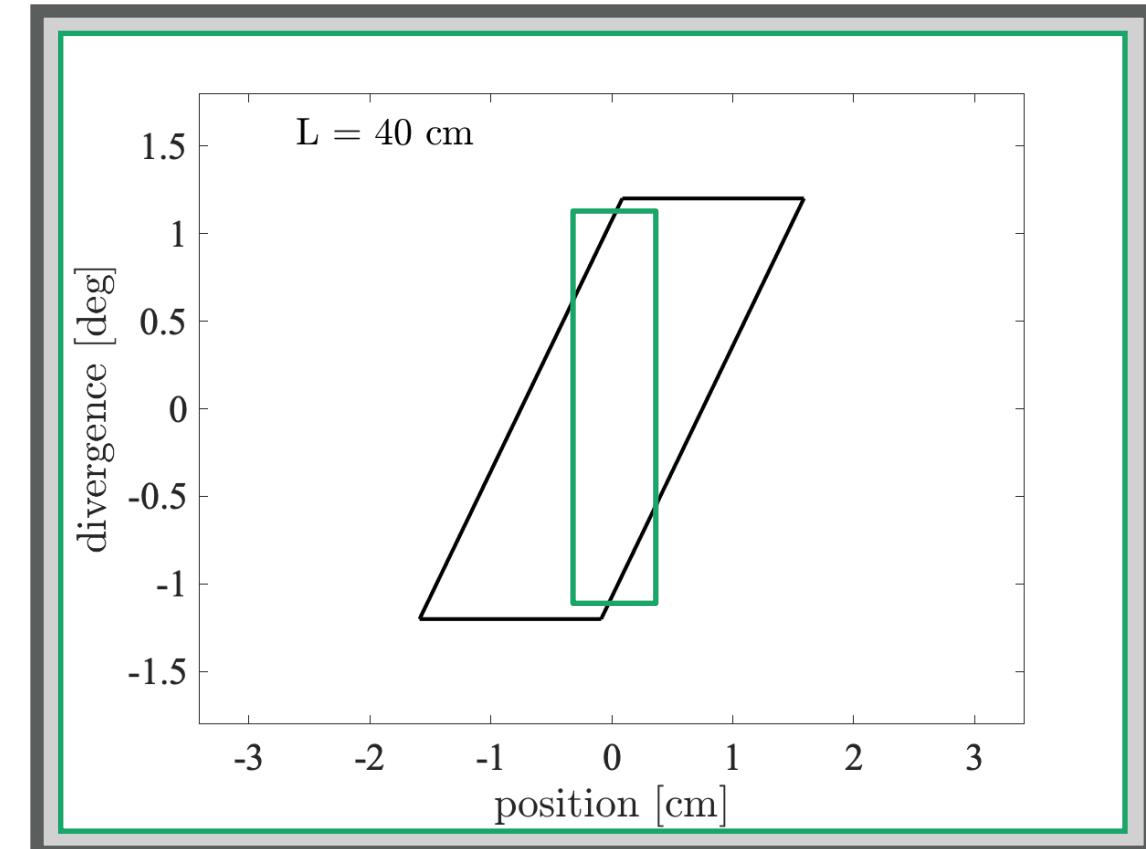
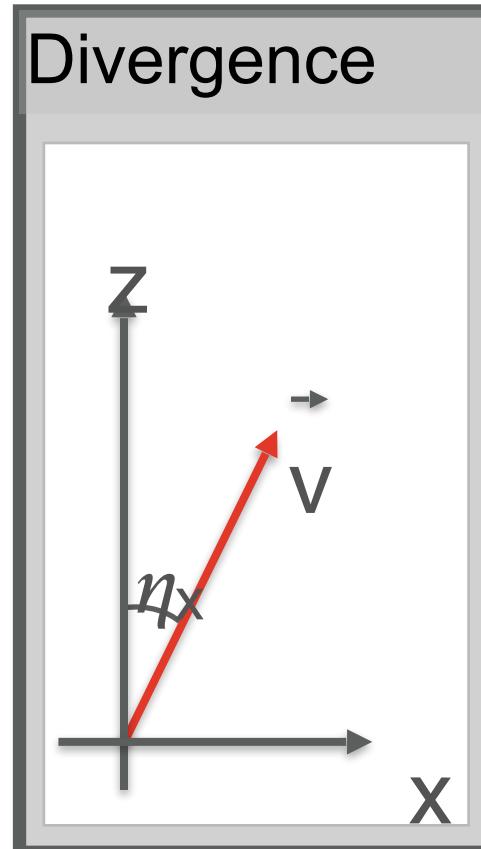




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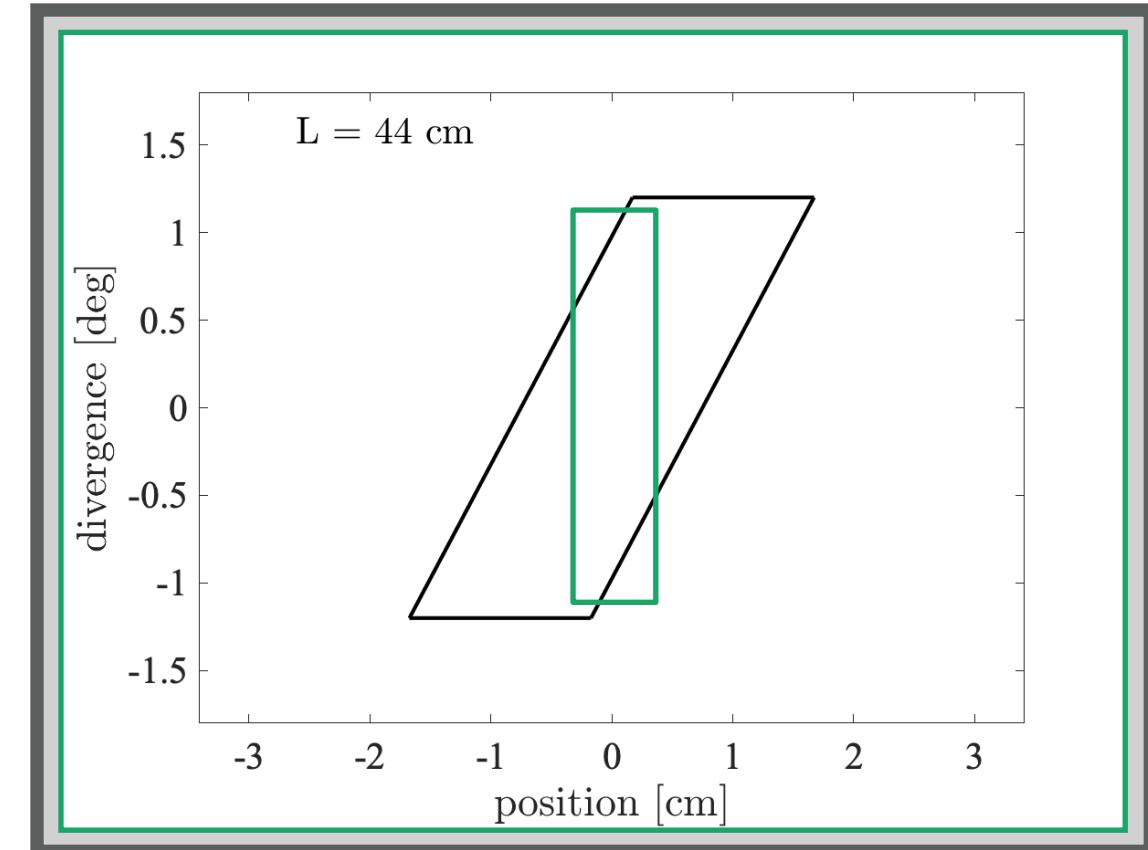
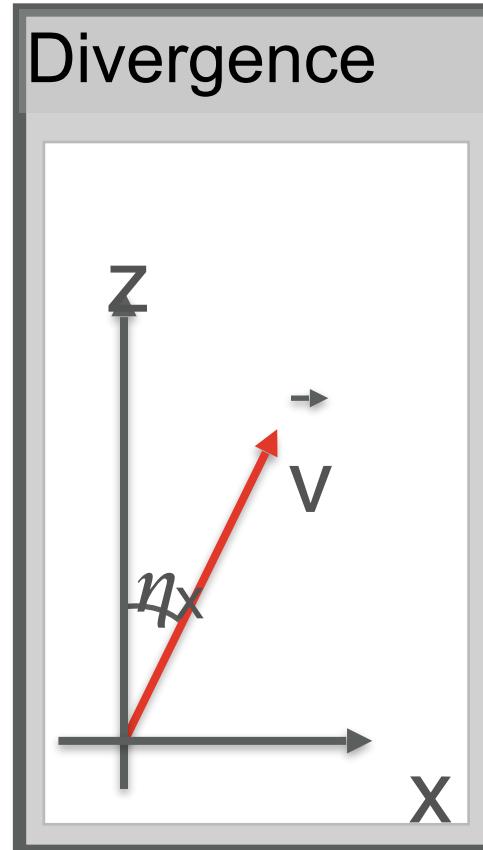




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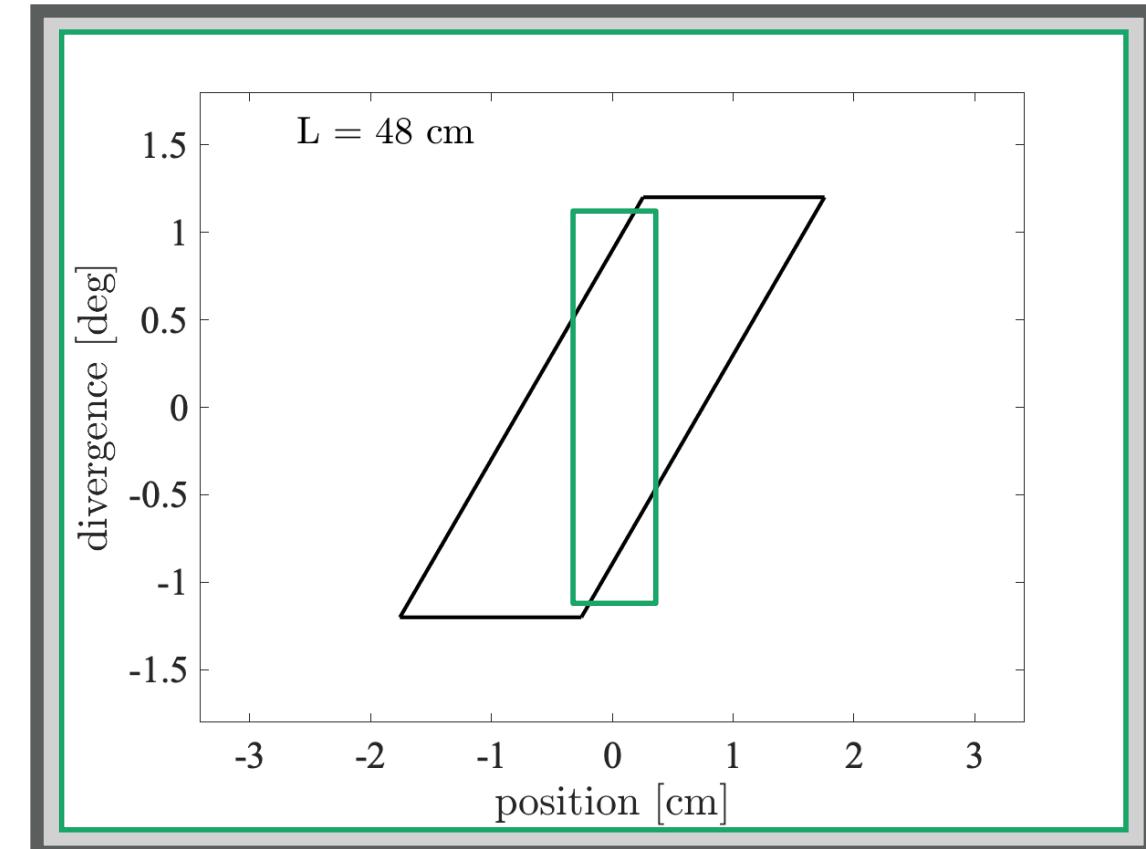
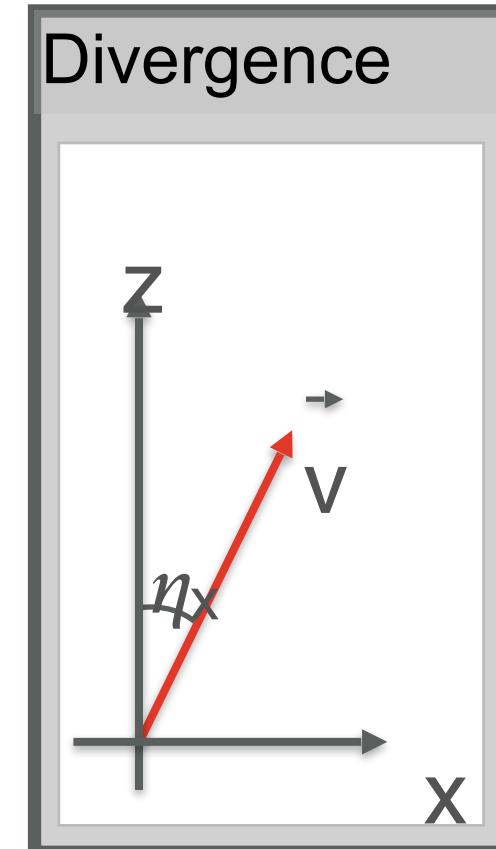




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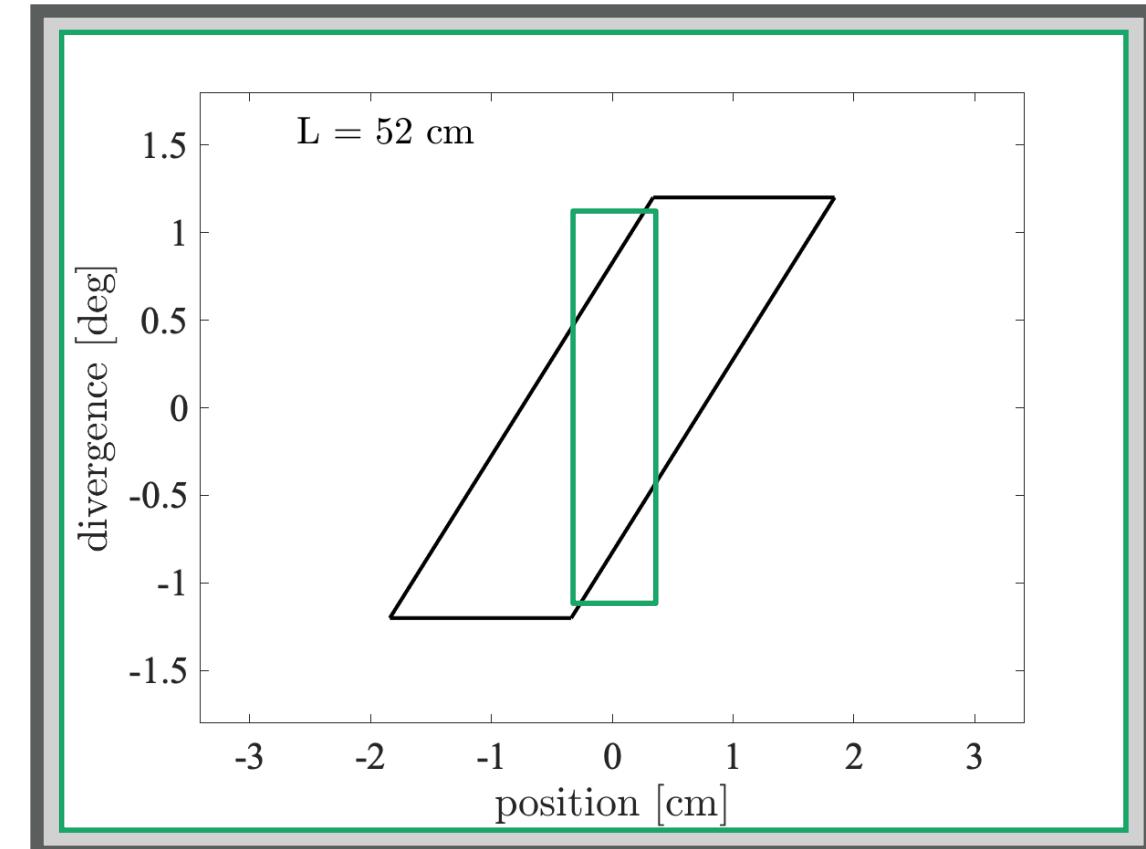
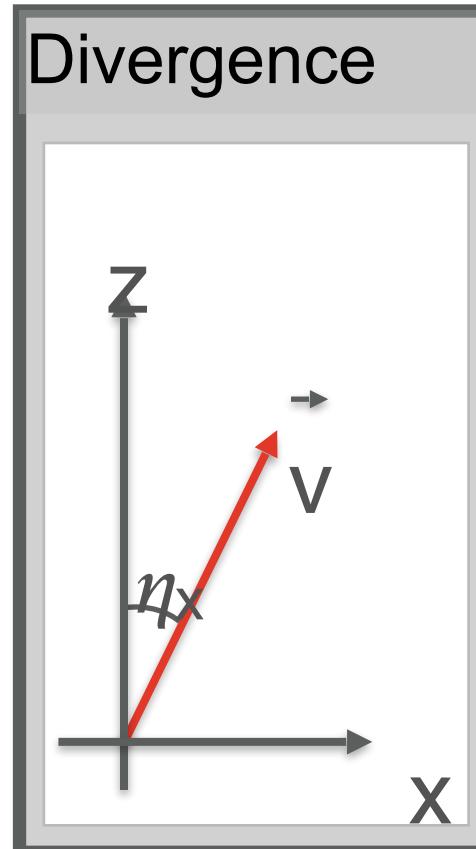




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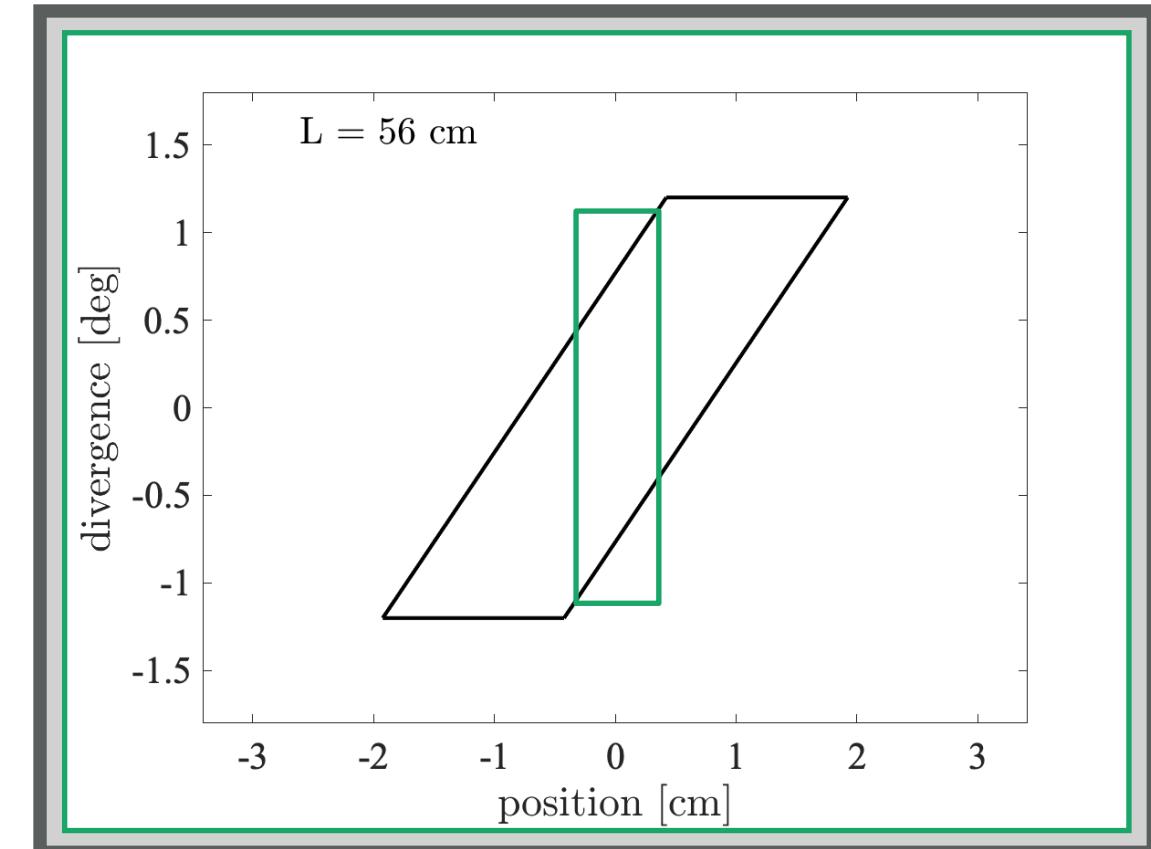
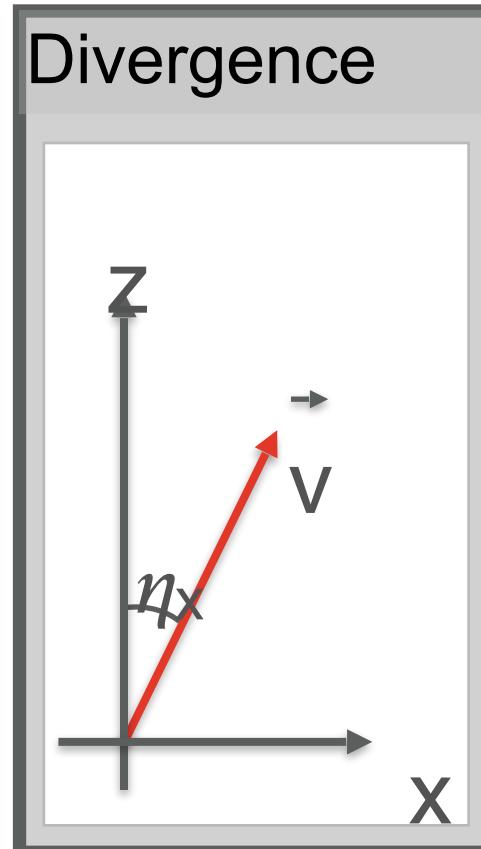




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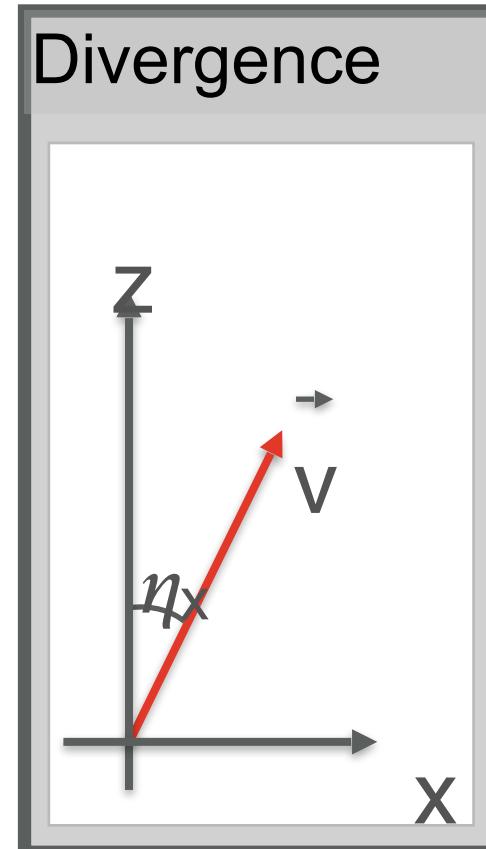




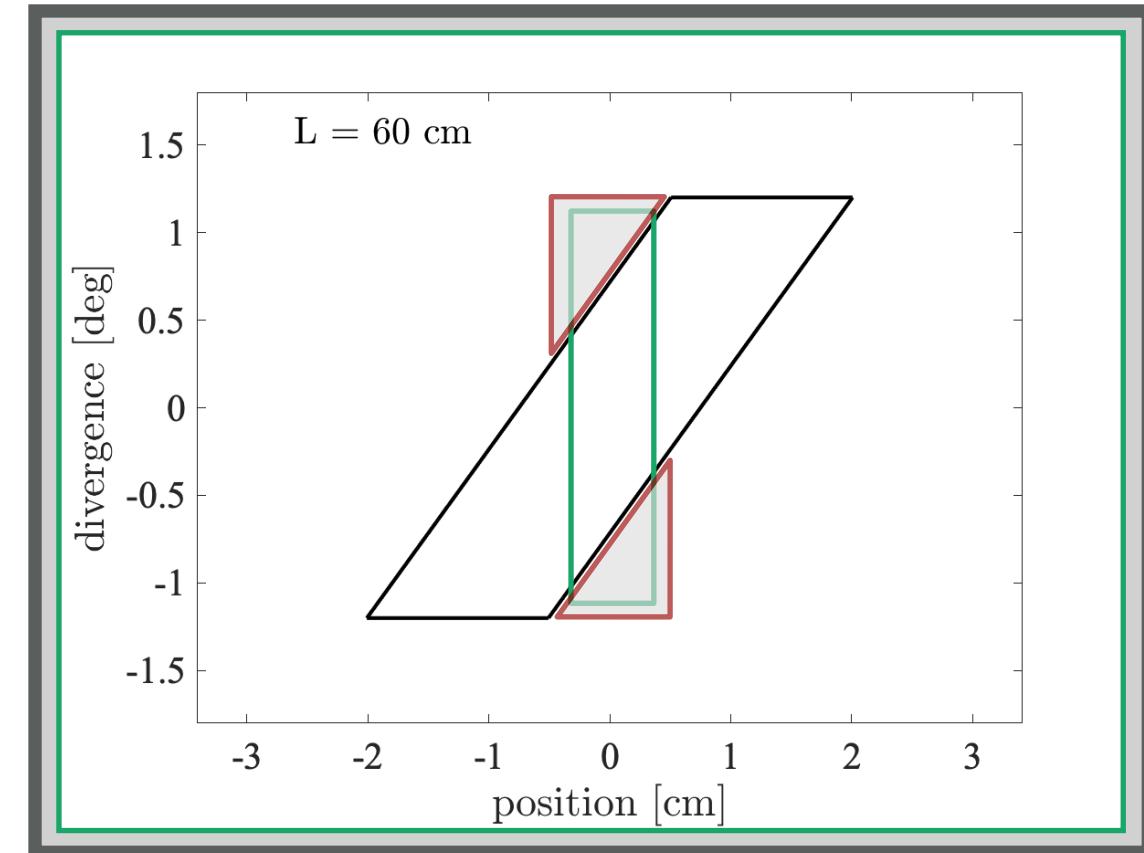
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- We lost some phase-space to propagation

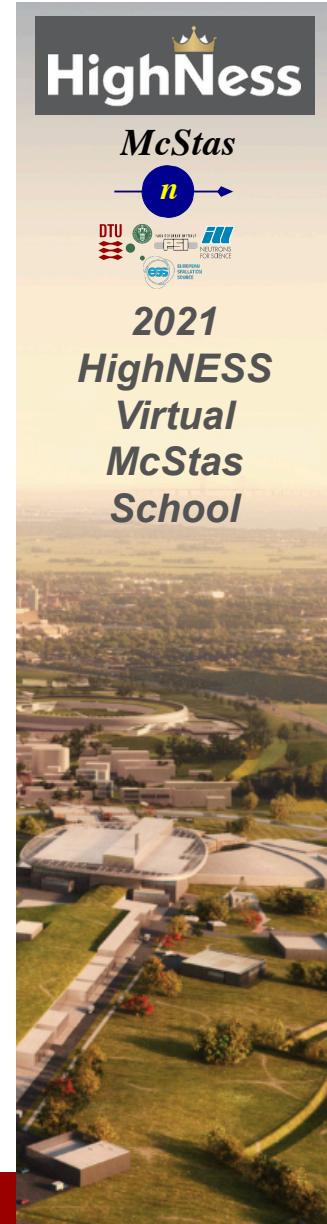




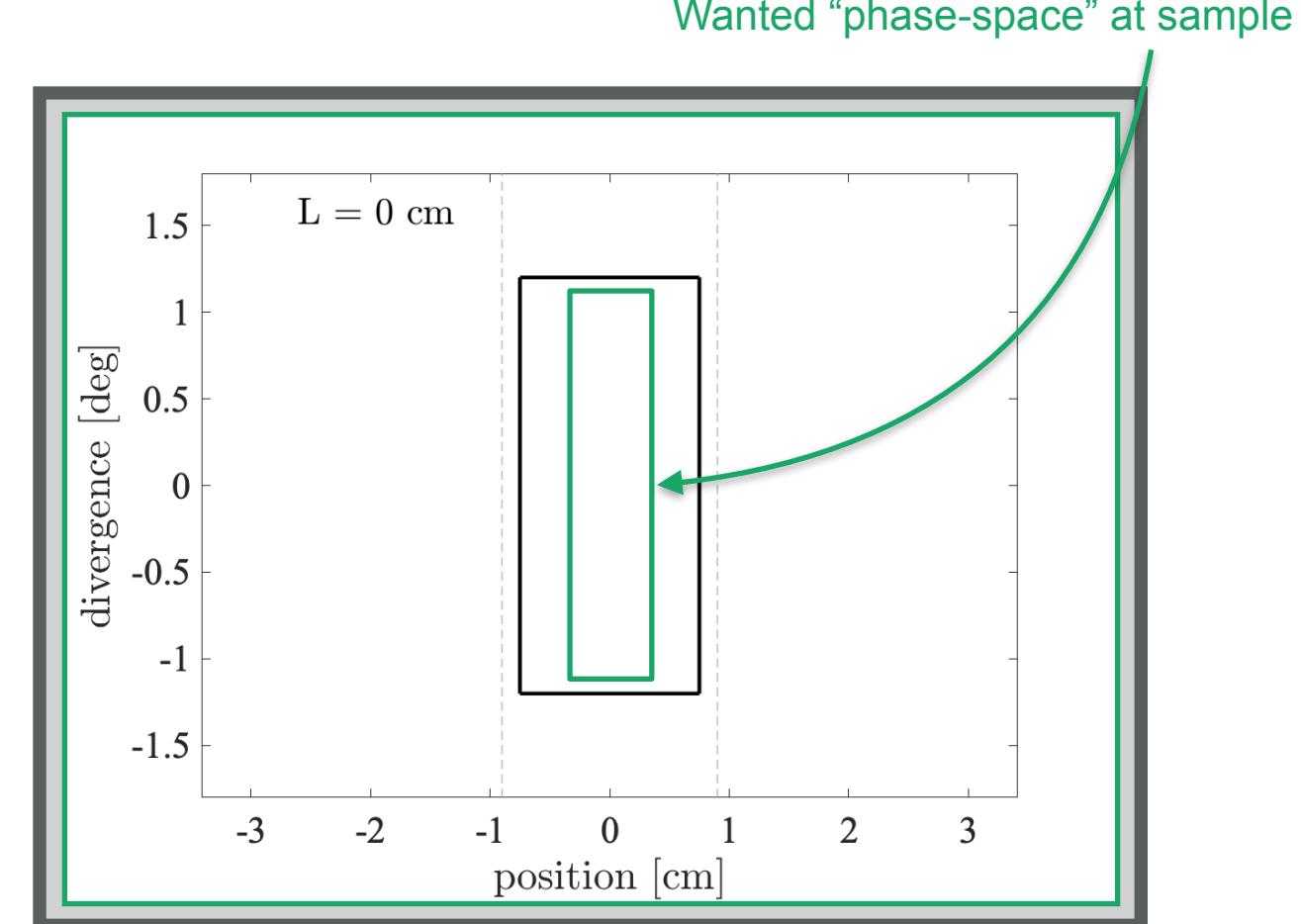
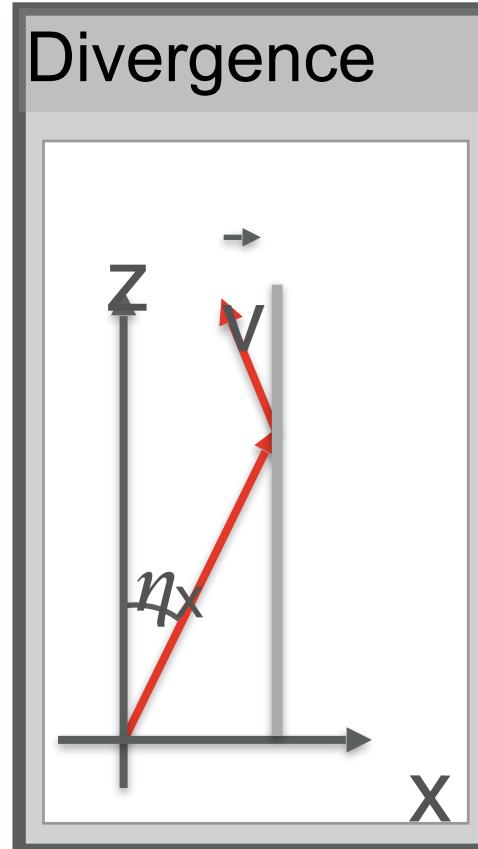
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Beam propagation in guide

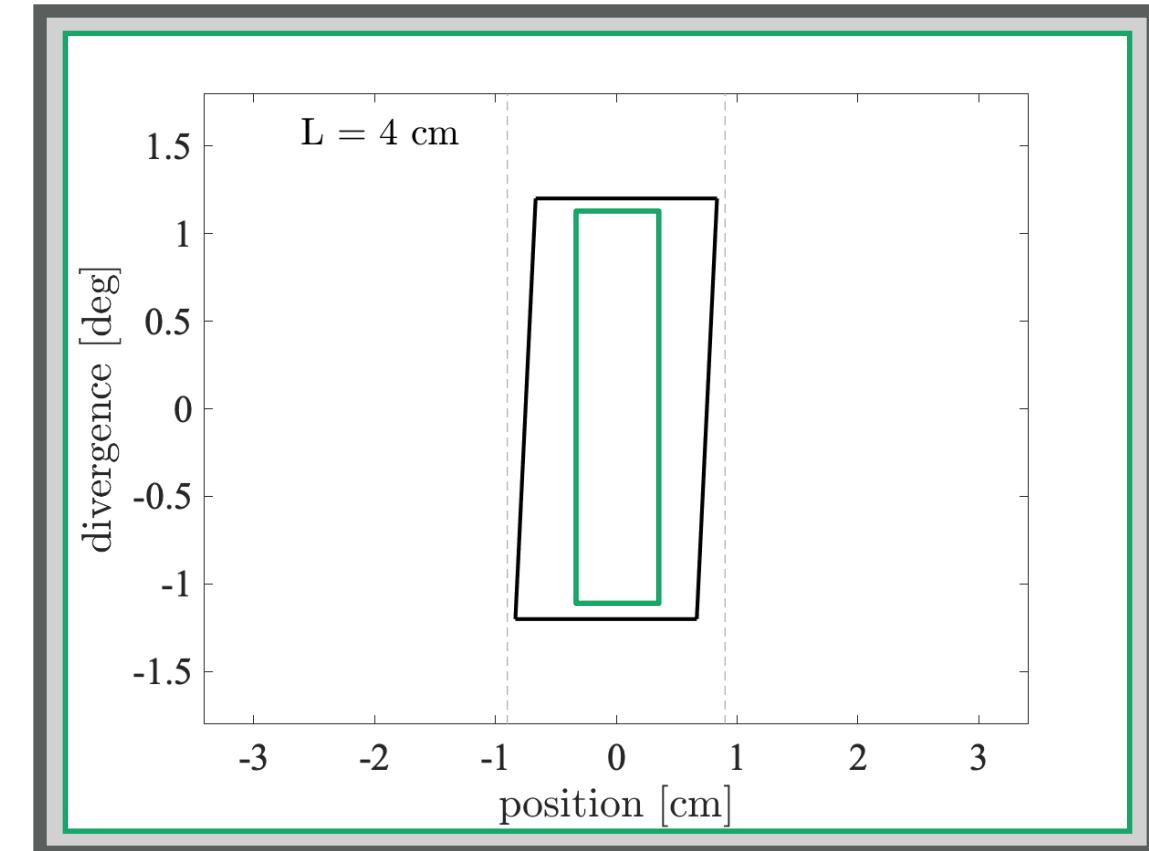
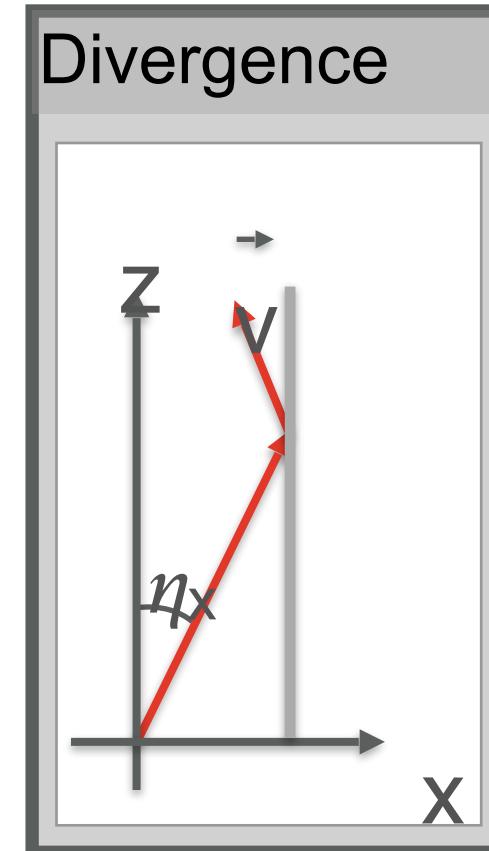




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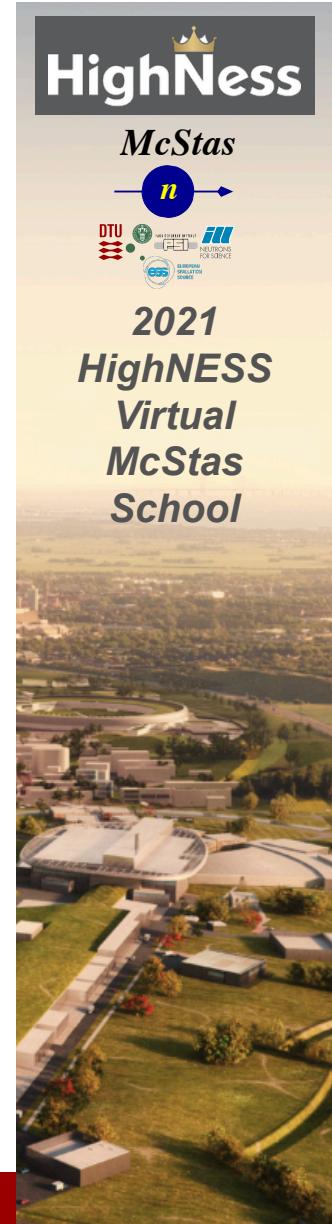




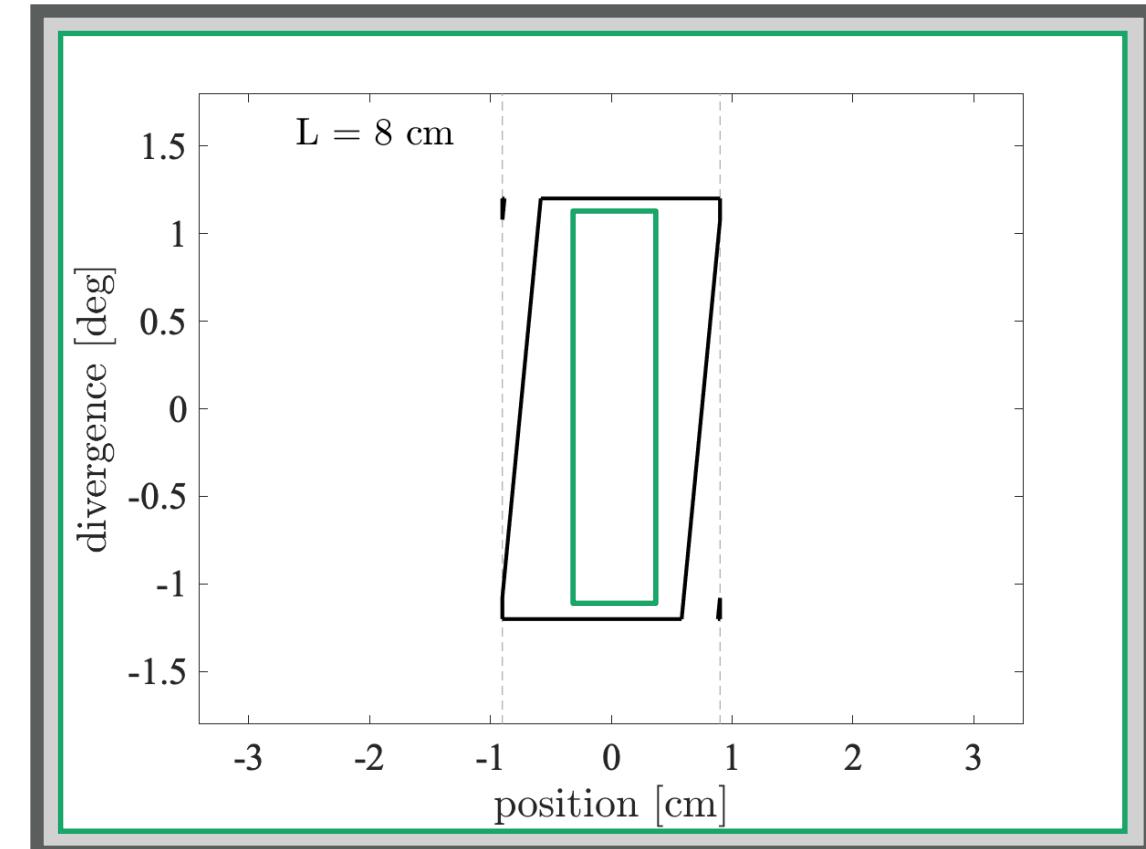
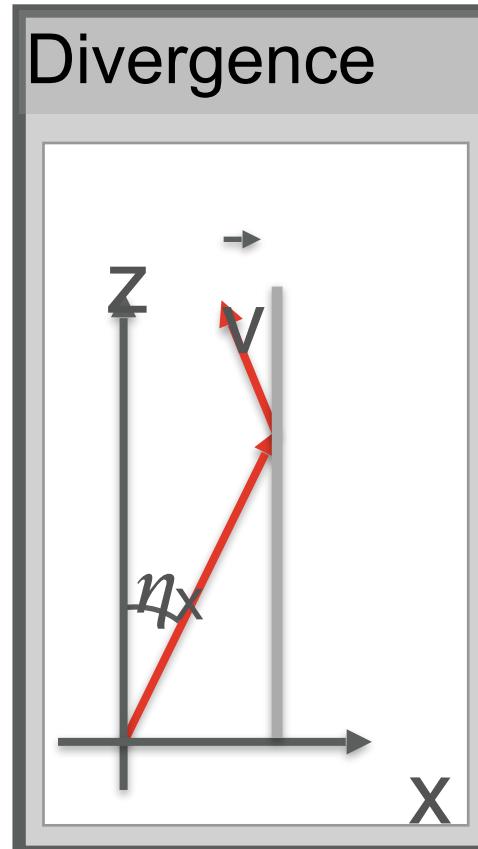
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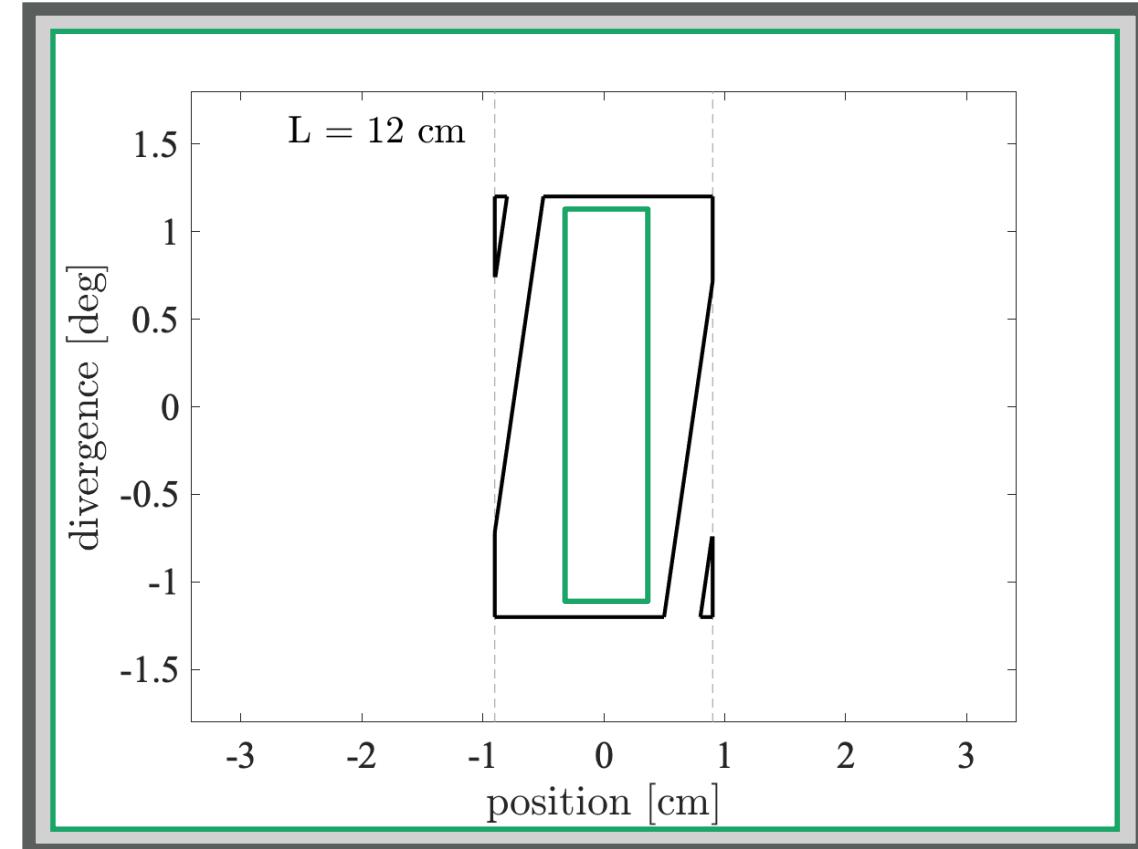
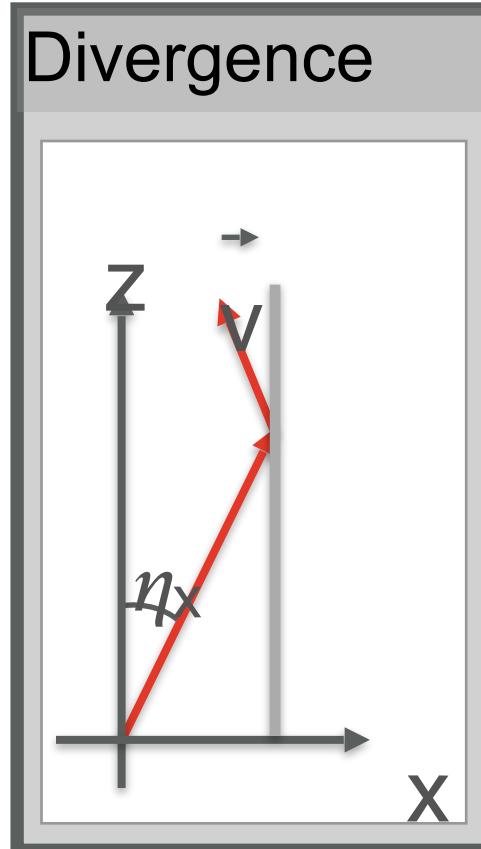
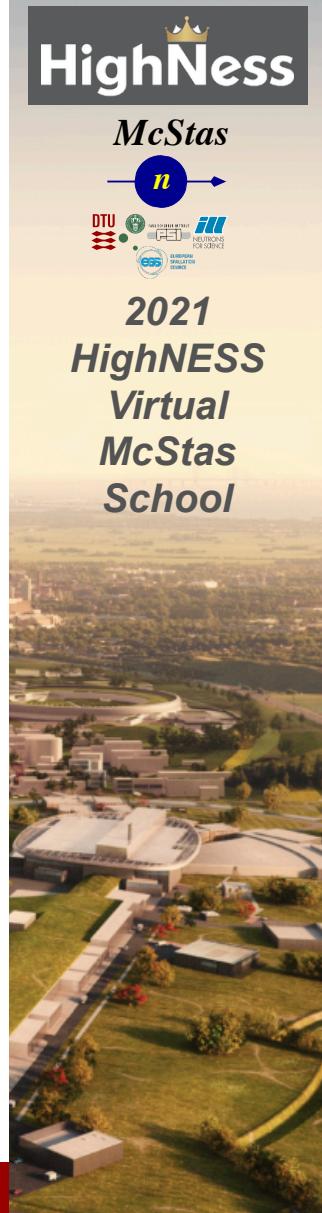
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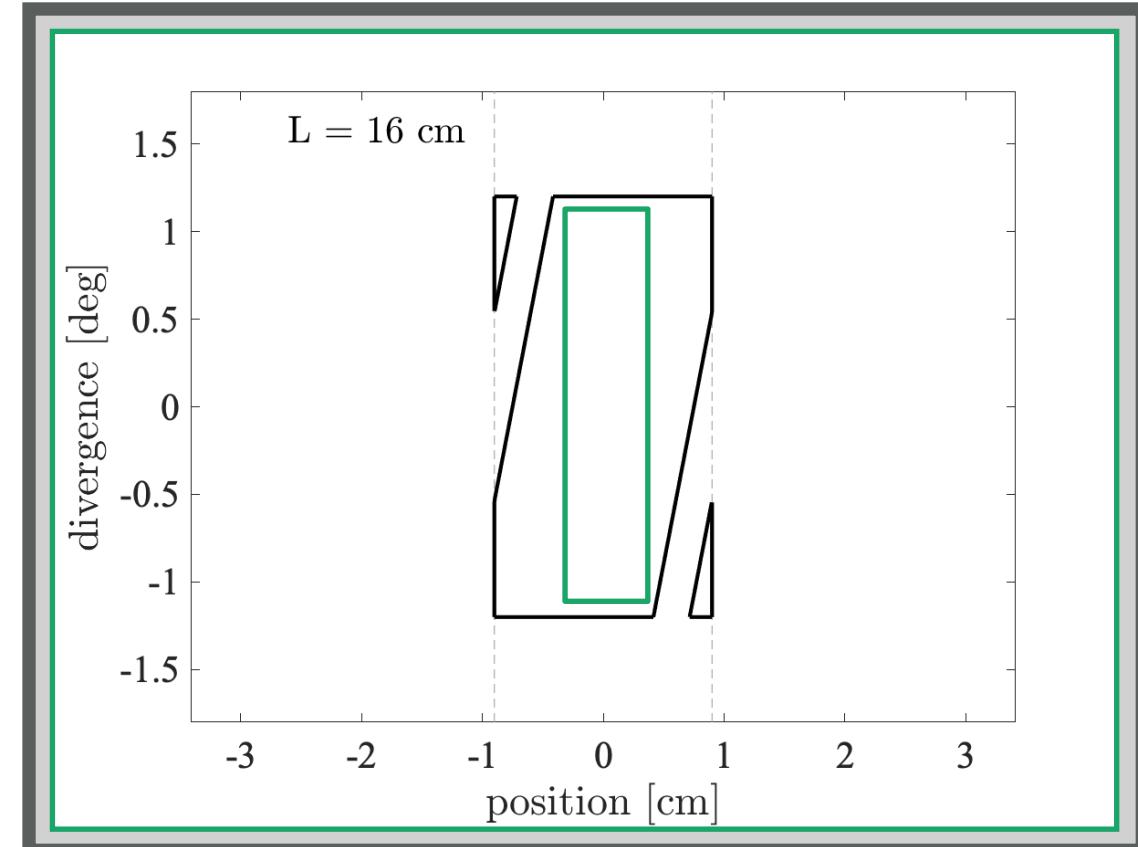
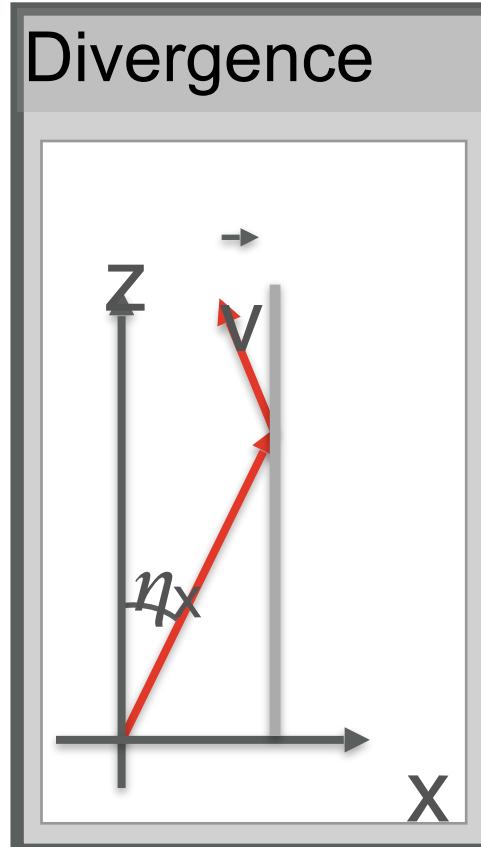
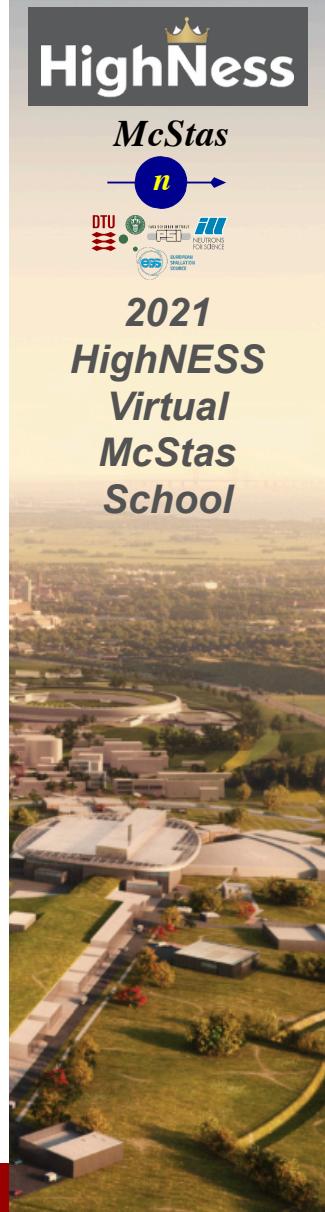
Beam propagation in guide



Beam propagation in guide



Beam propagation in guide

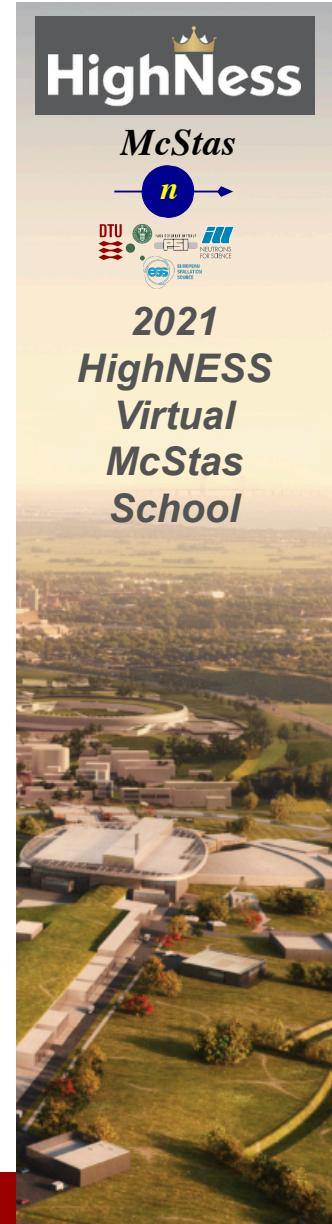




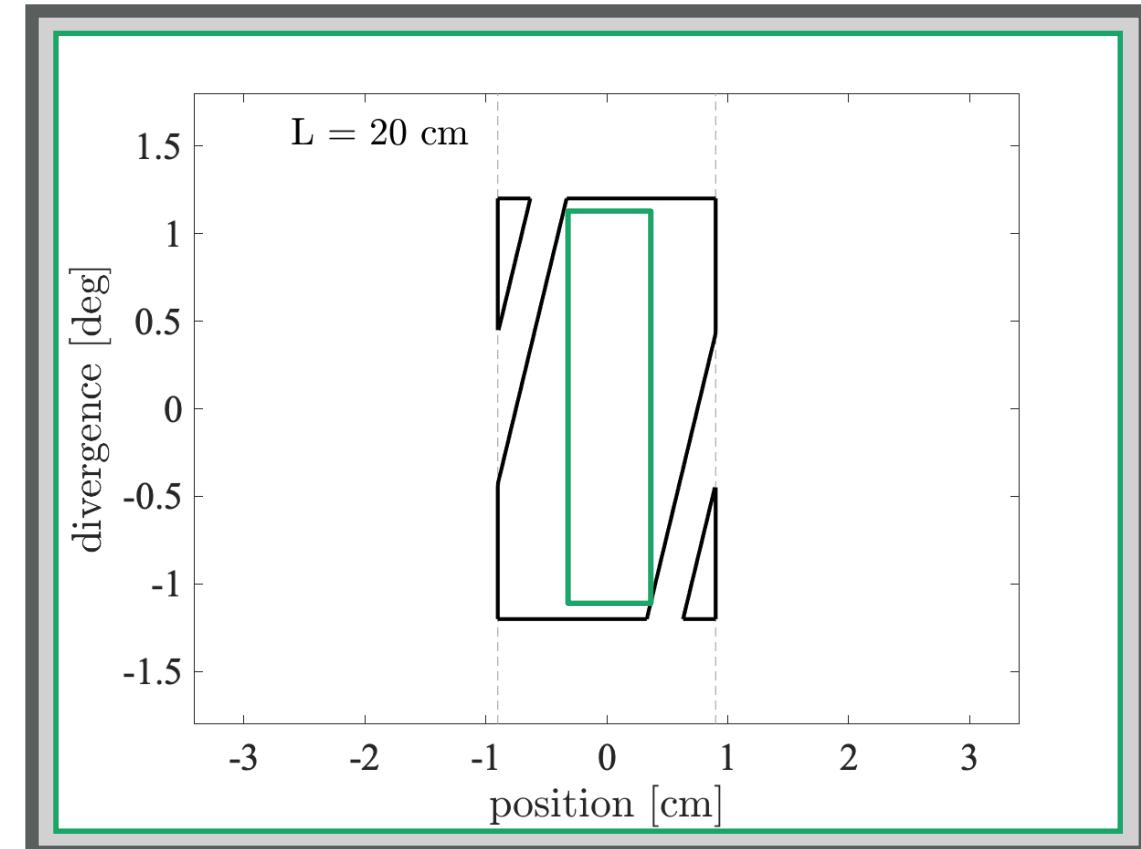
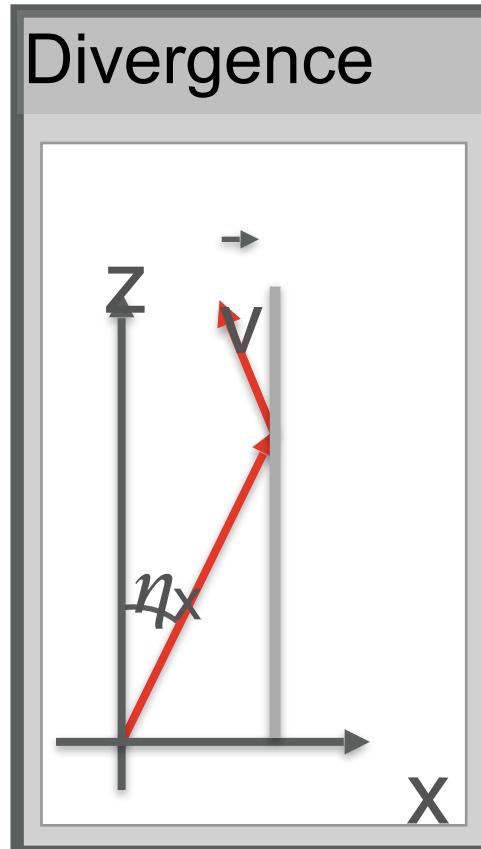
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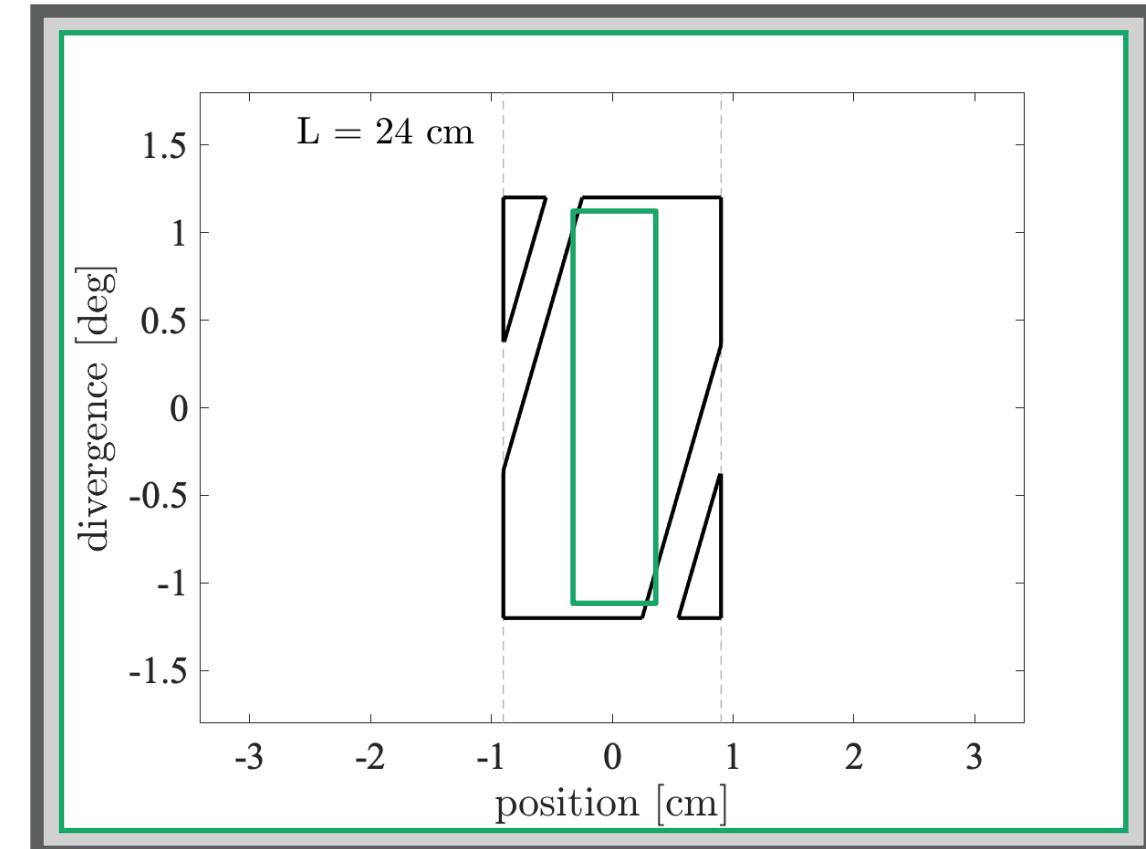
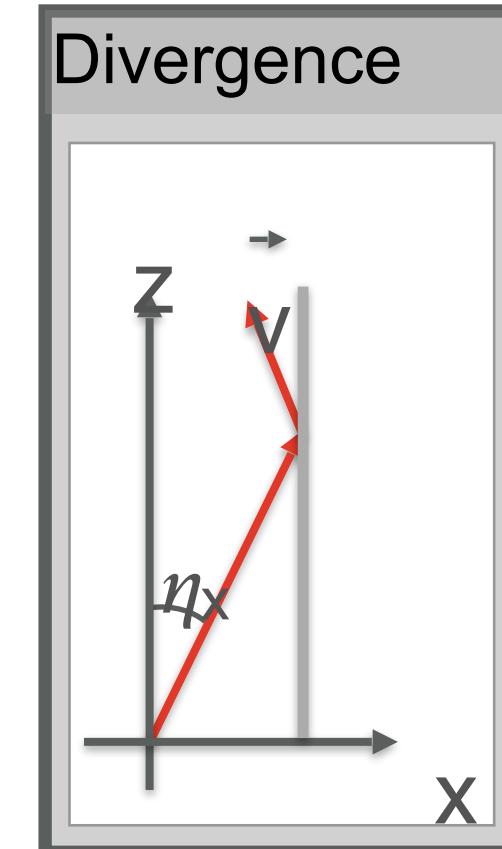
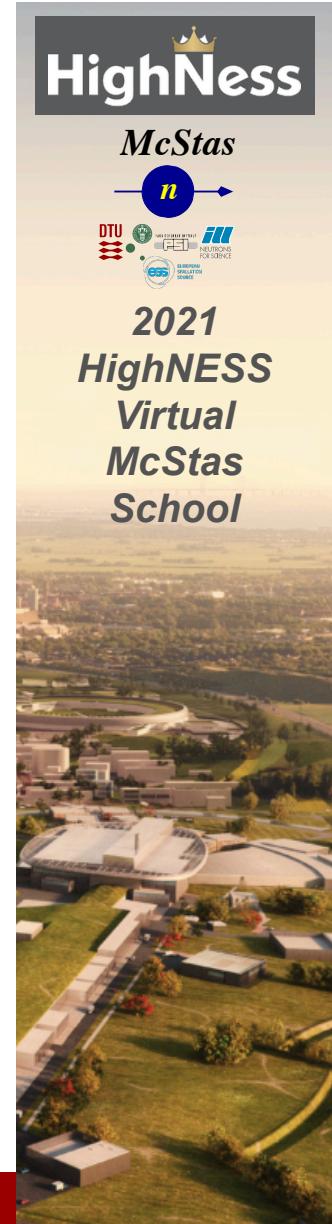


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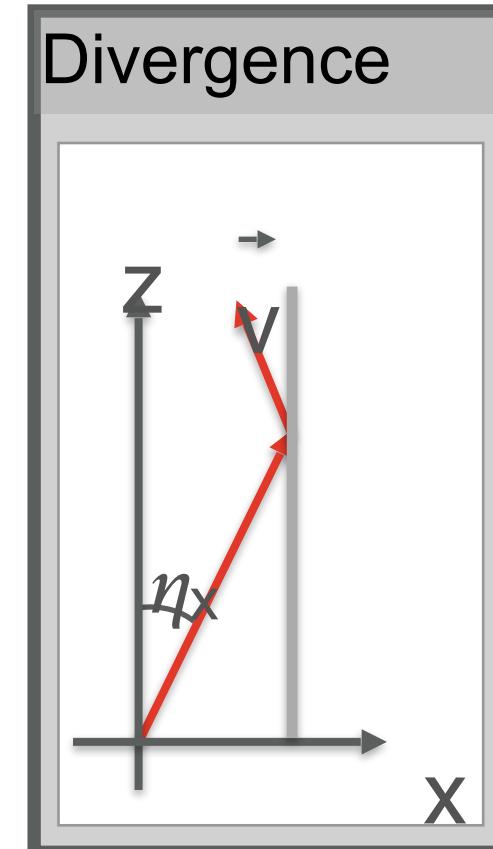




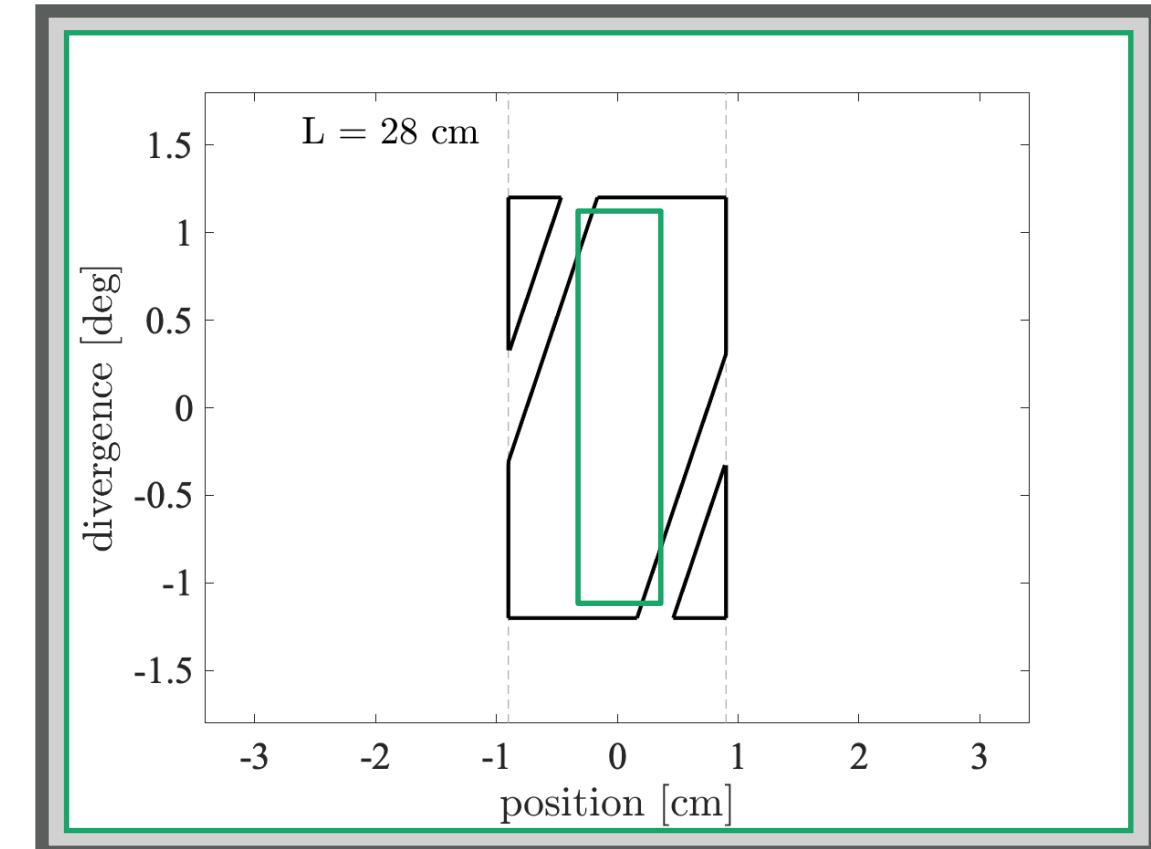
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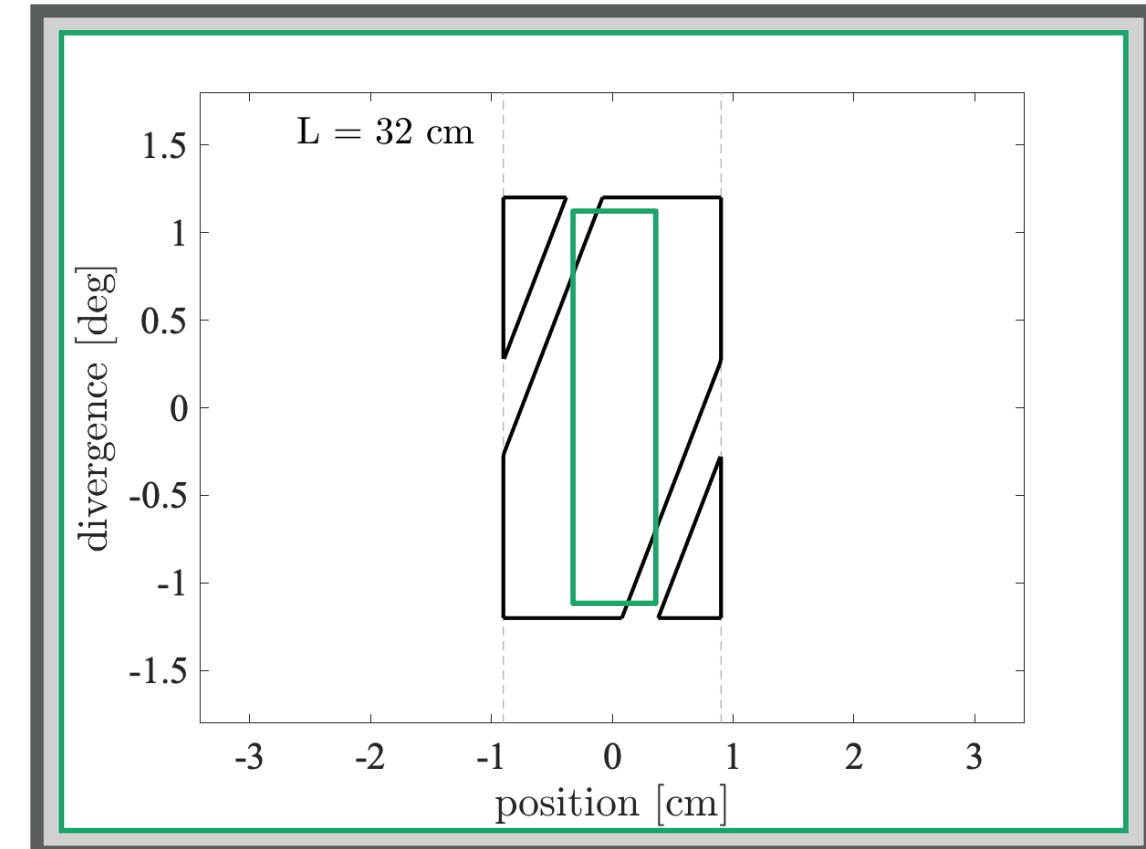
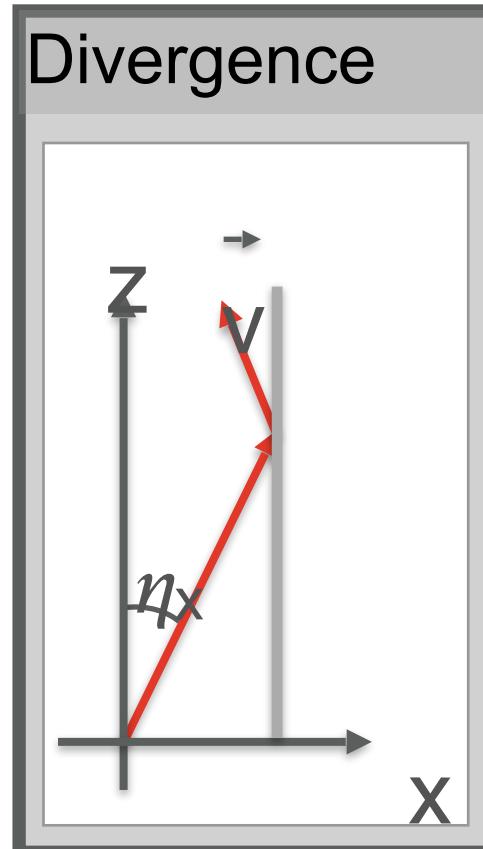
Beam propagation in guide



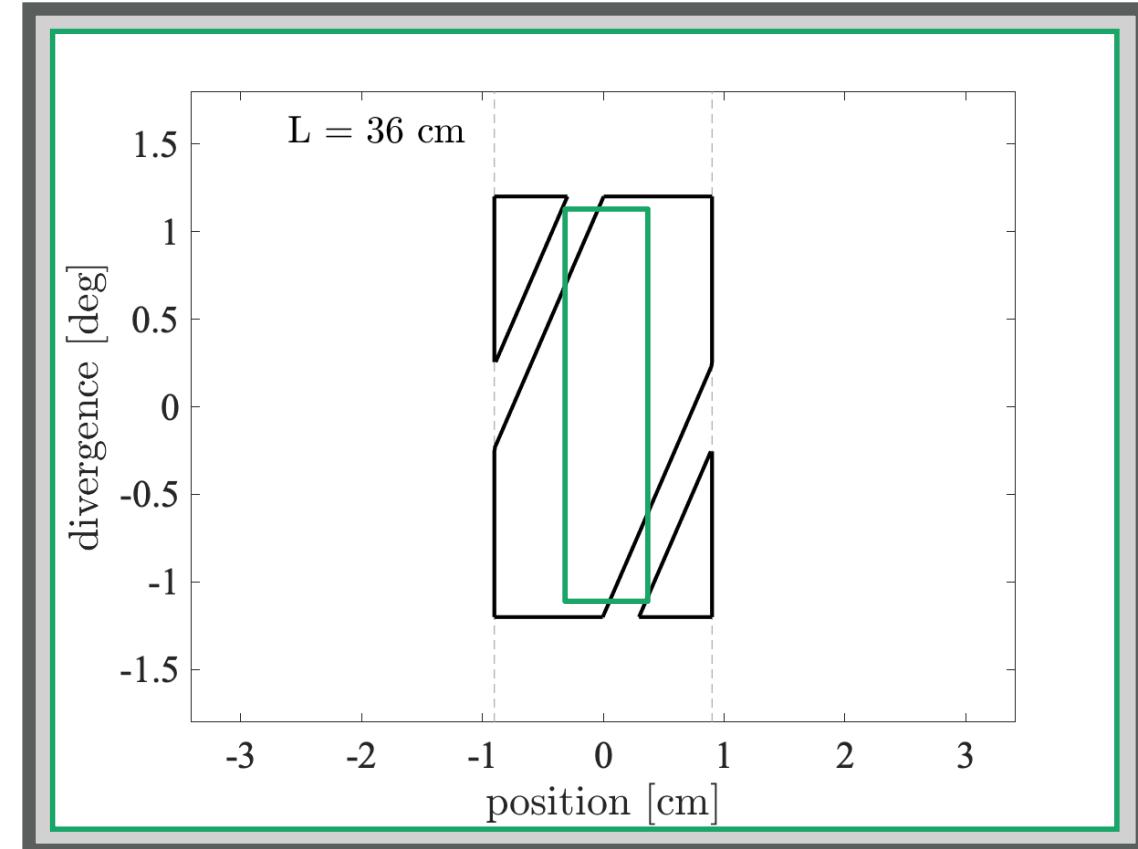
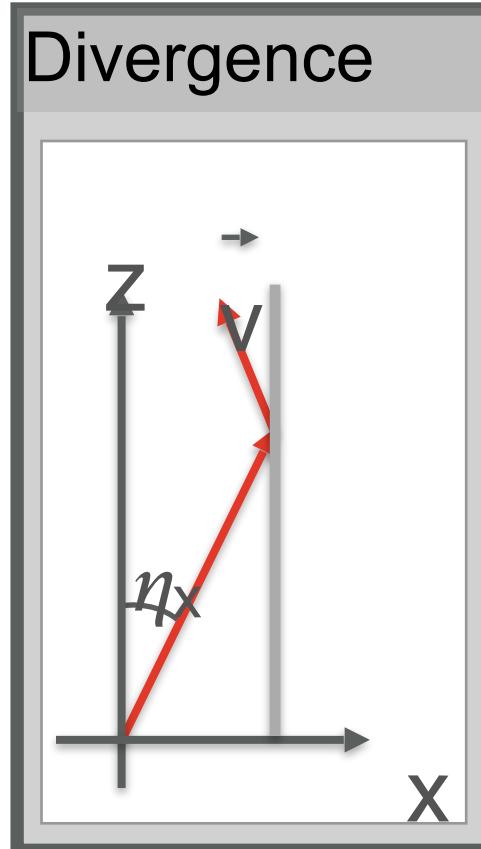
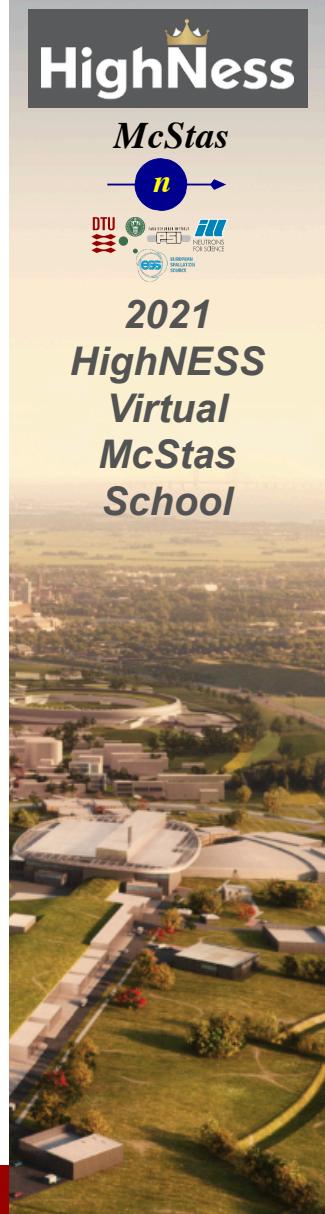
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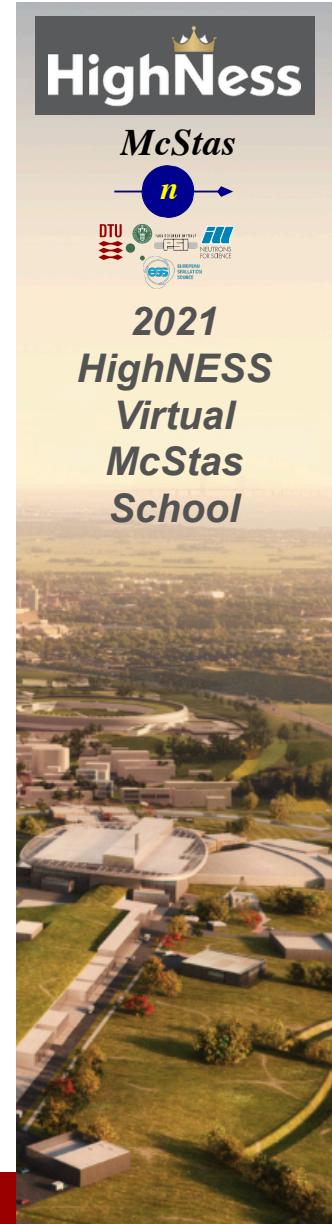
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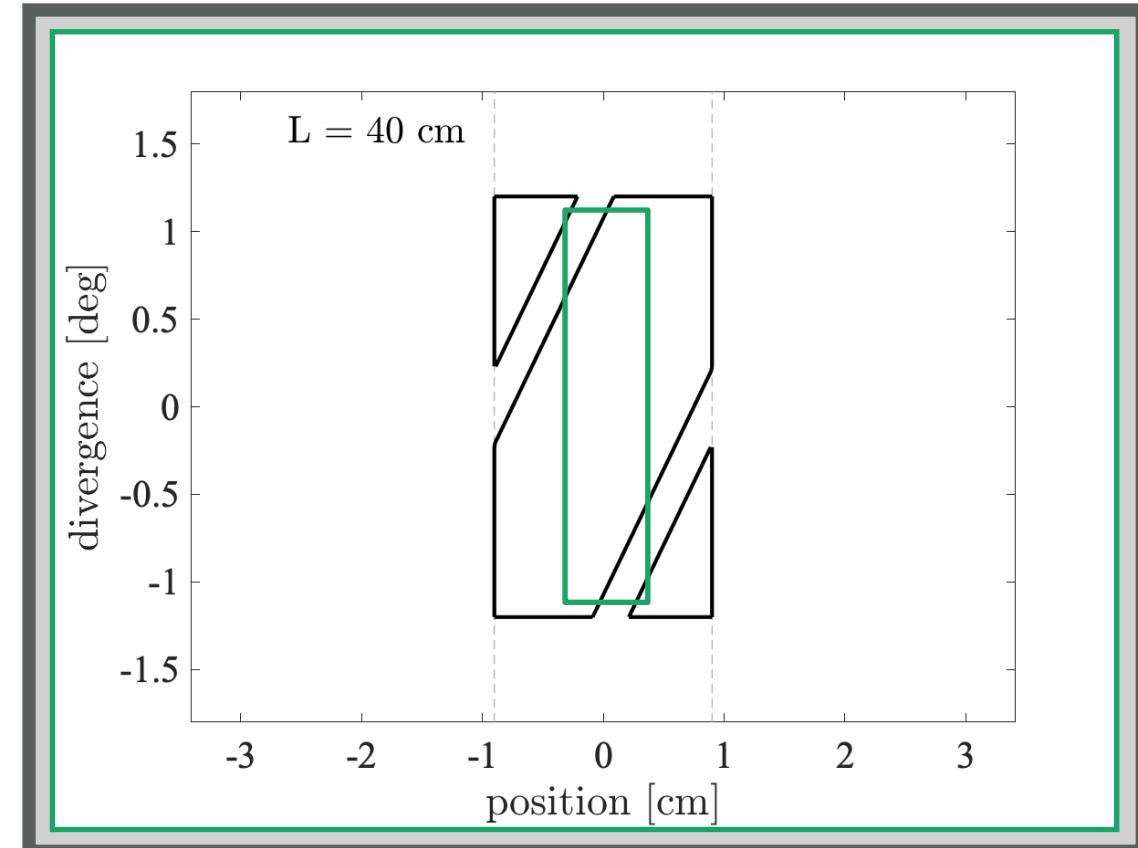
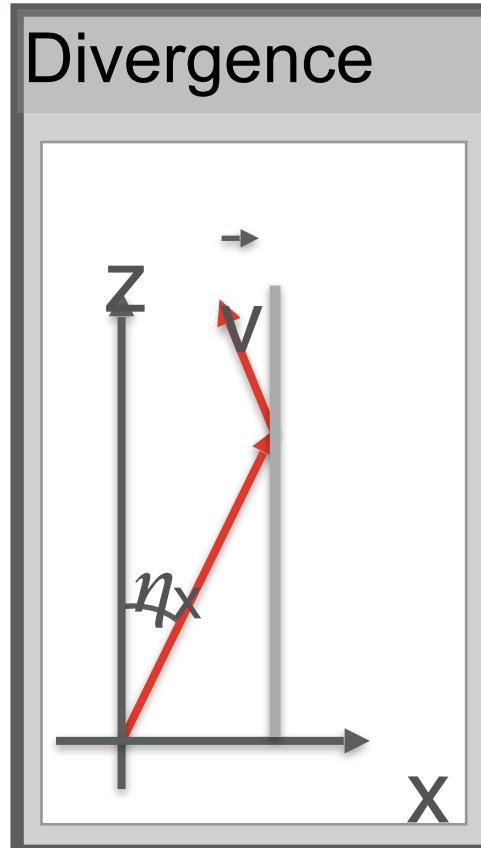


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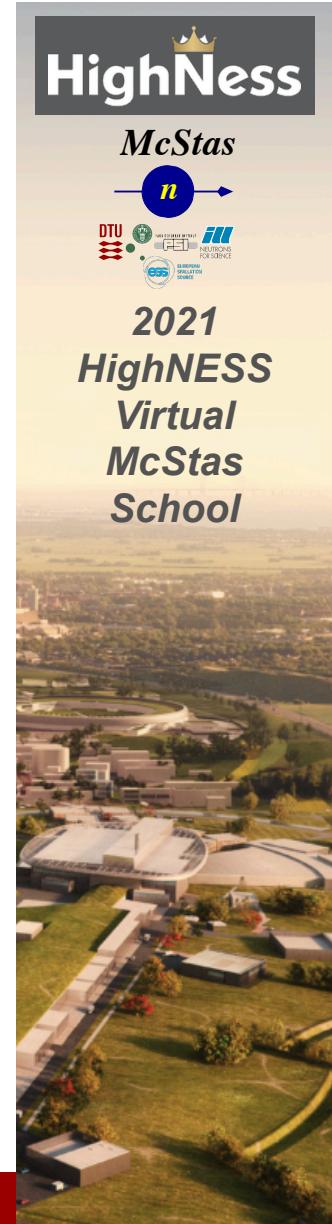




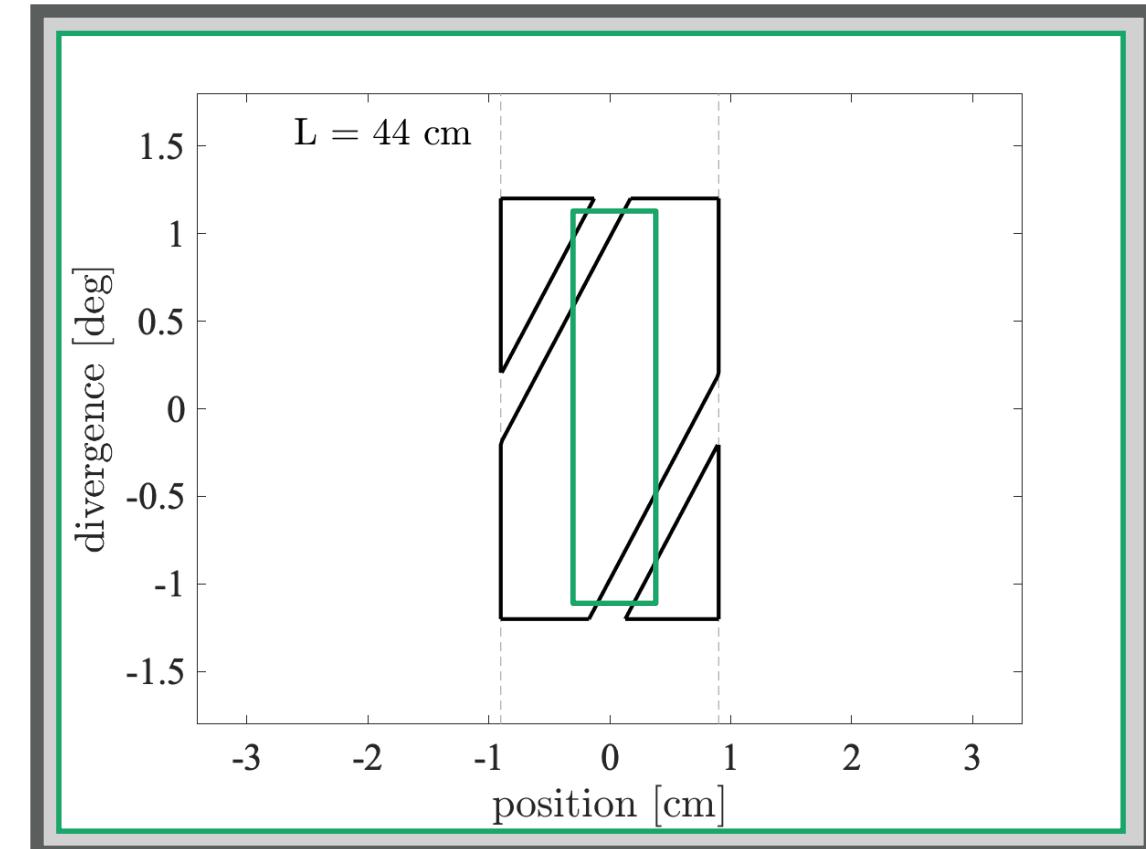
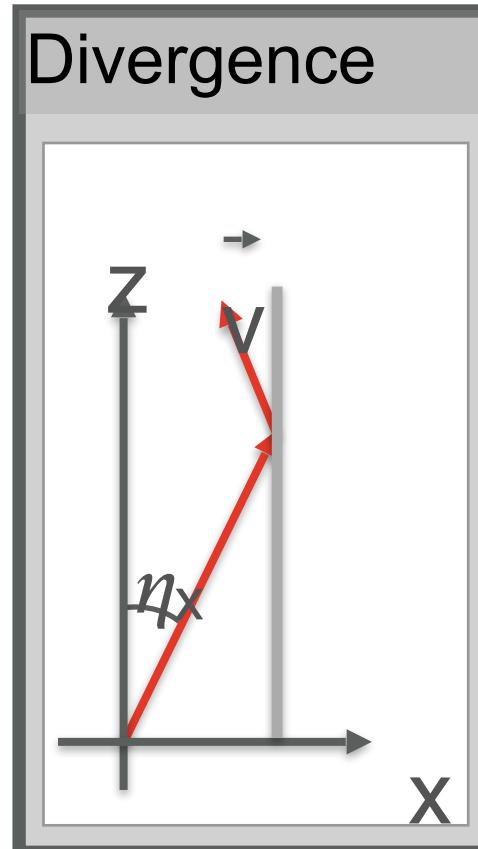
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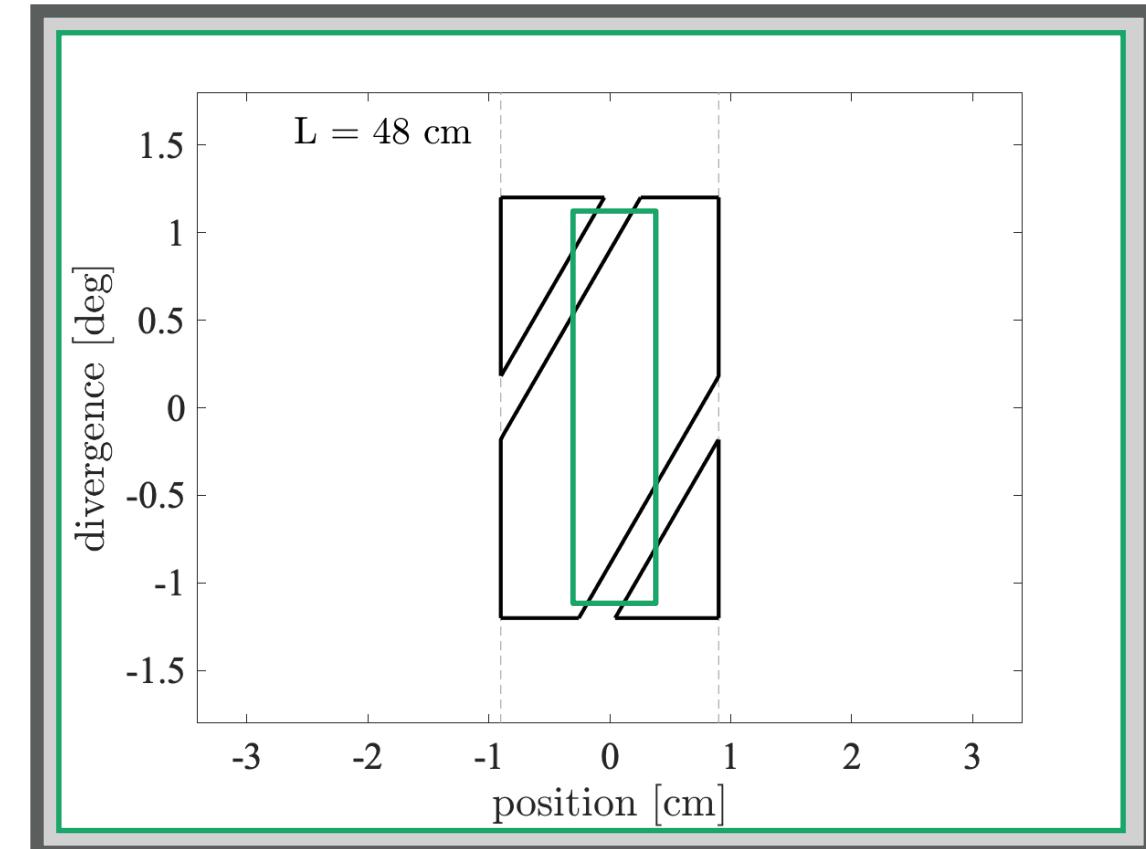
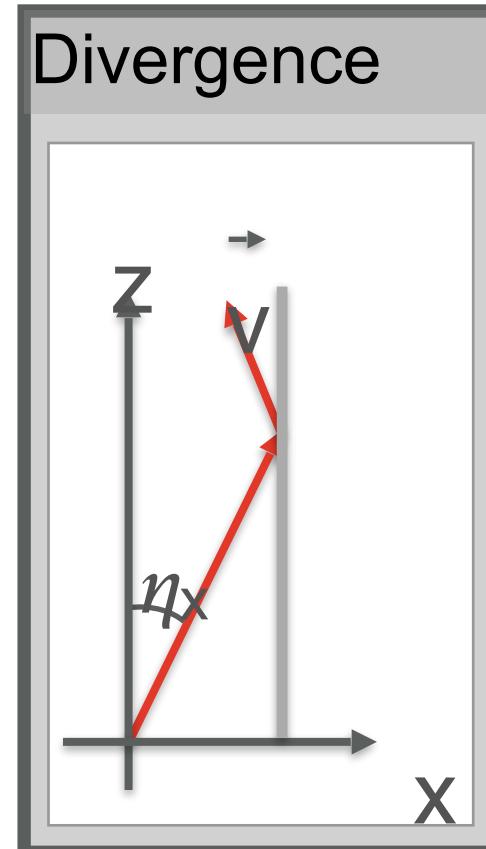


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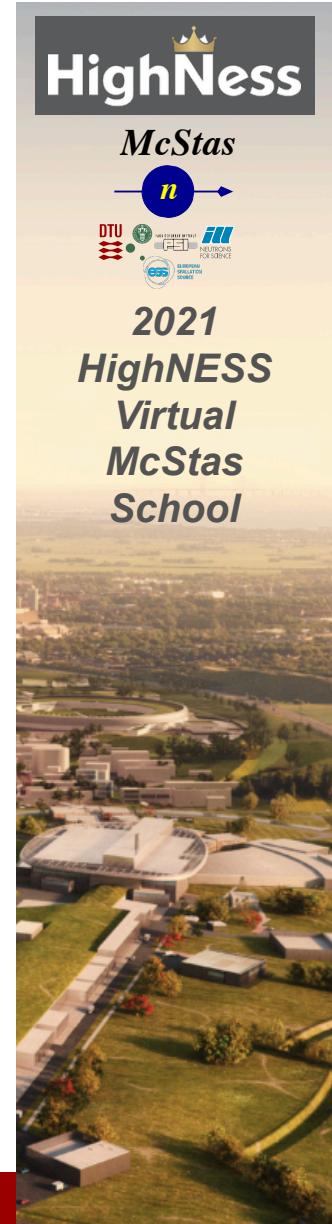


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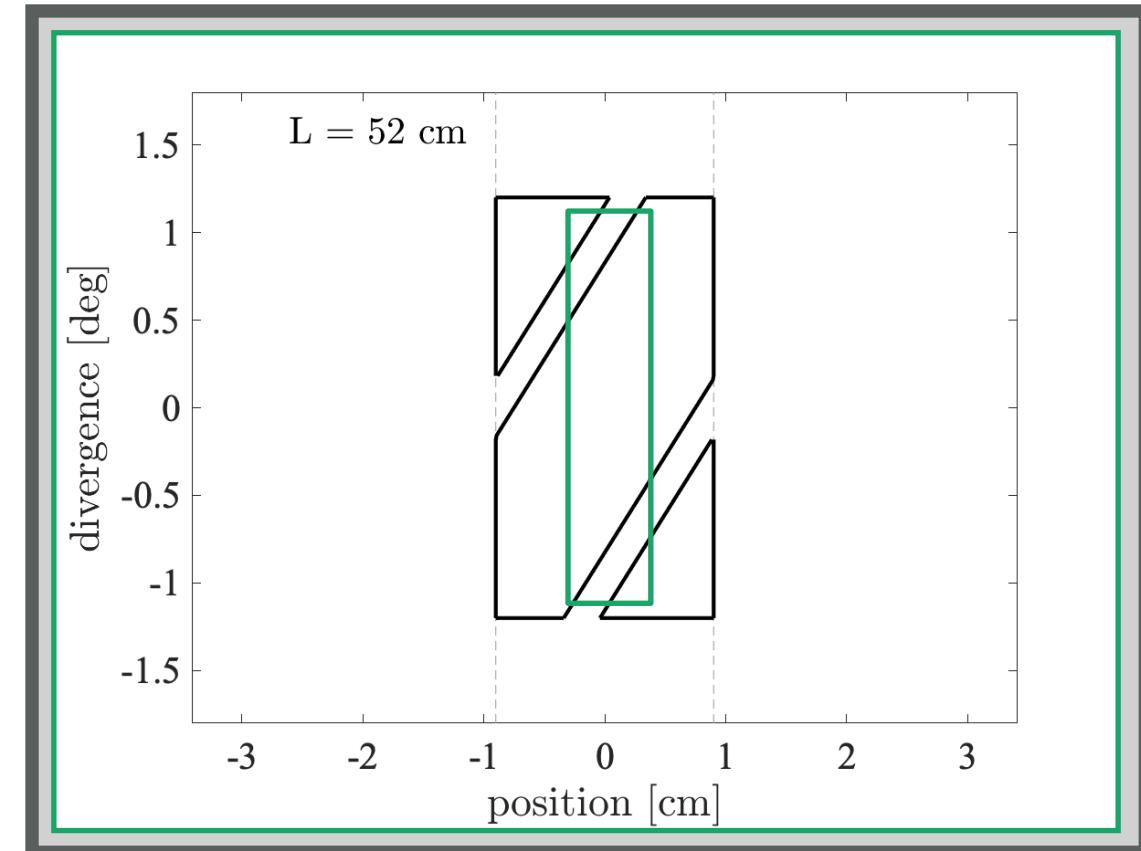
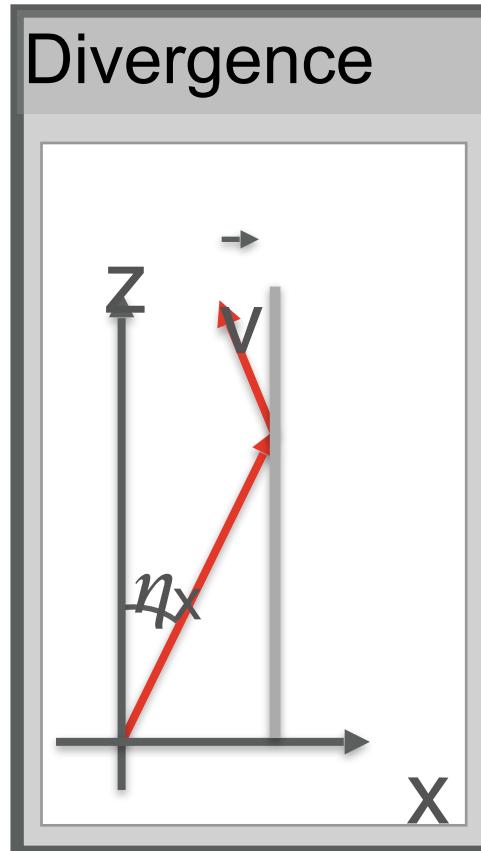
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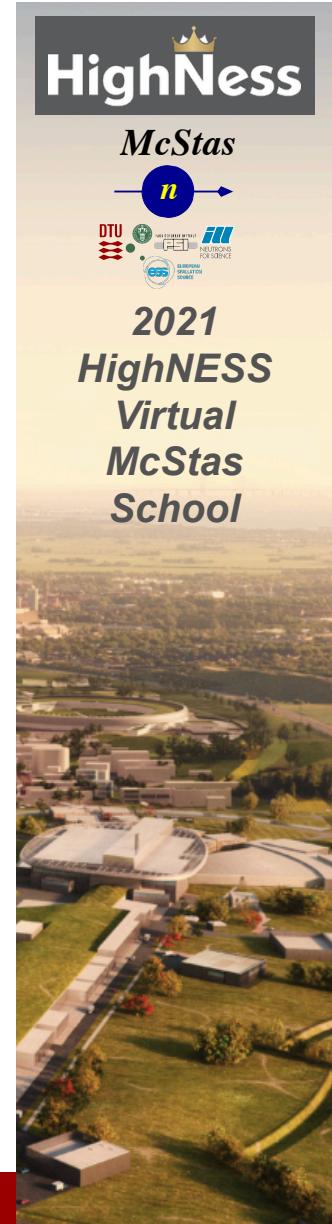


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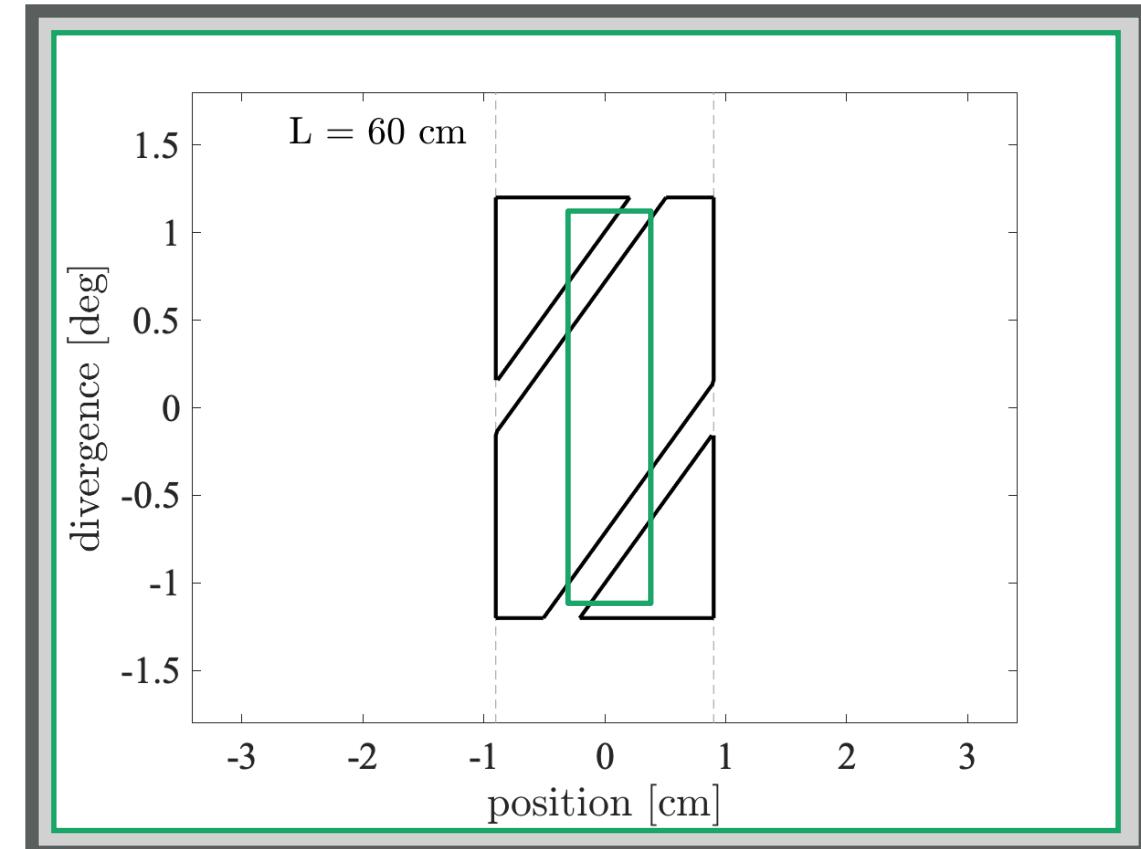
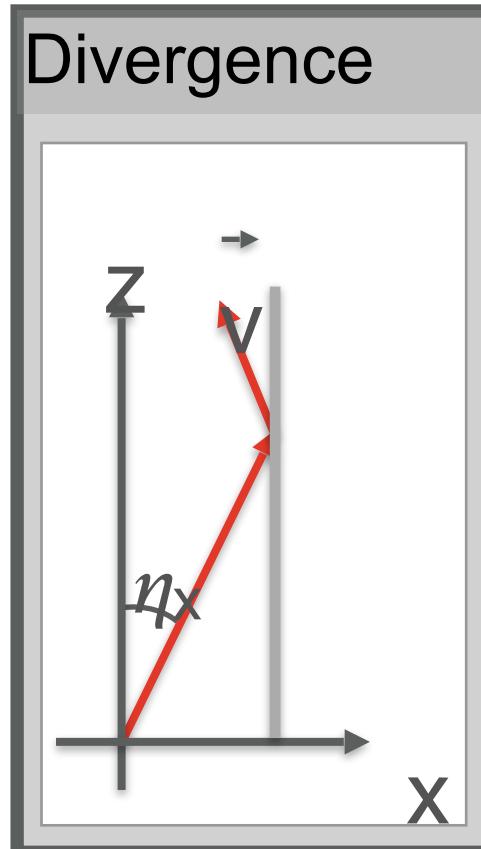
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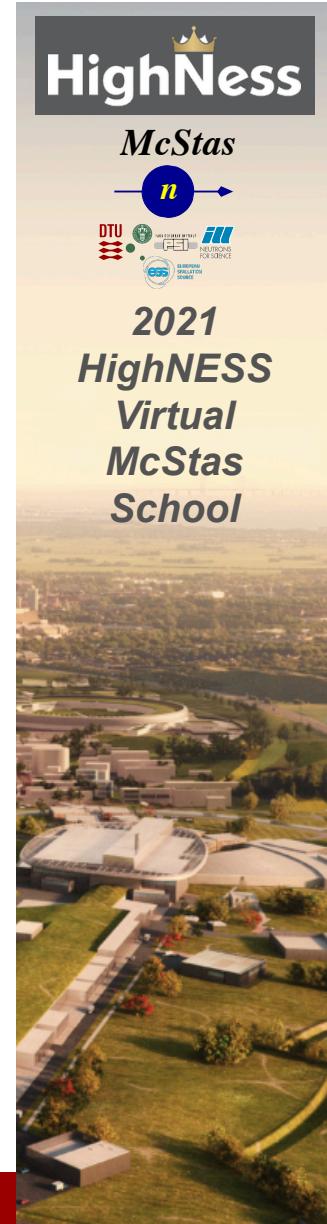




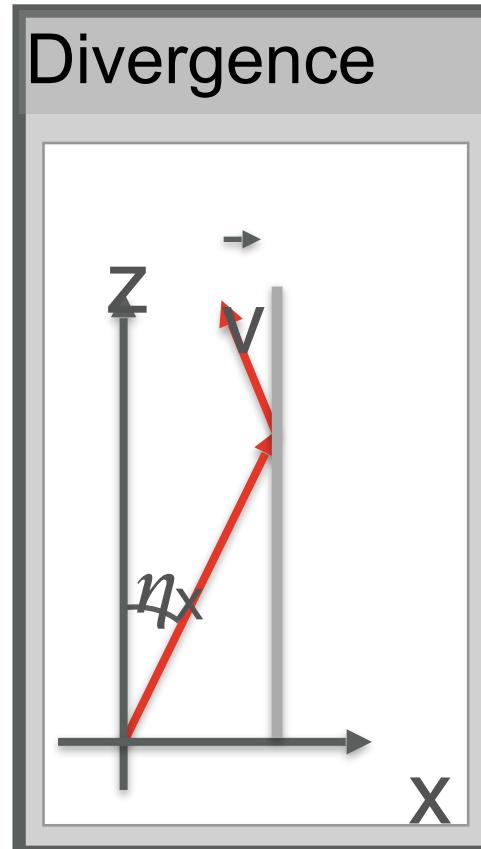
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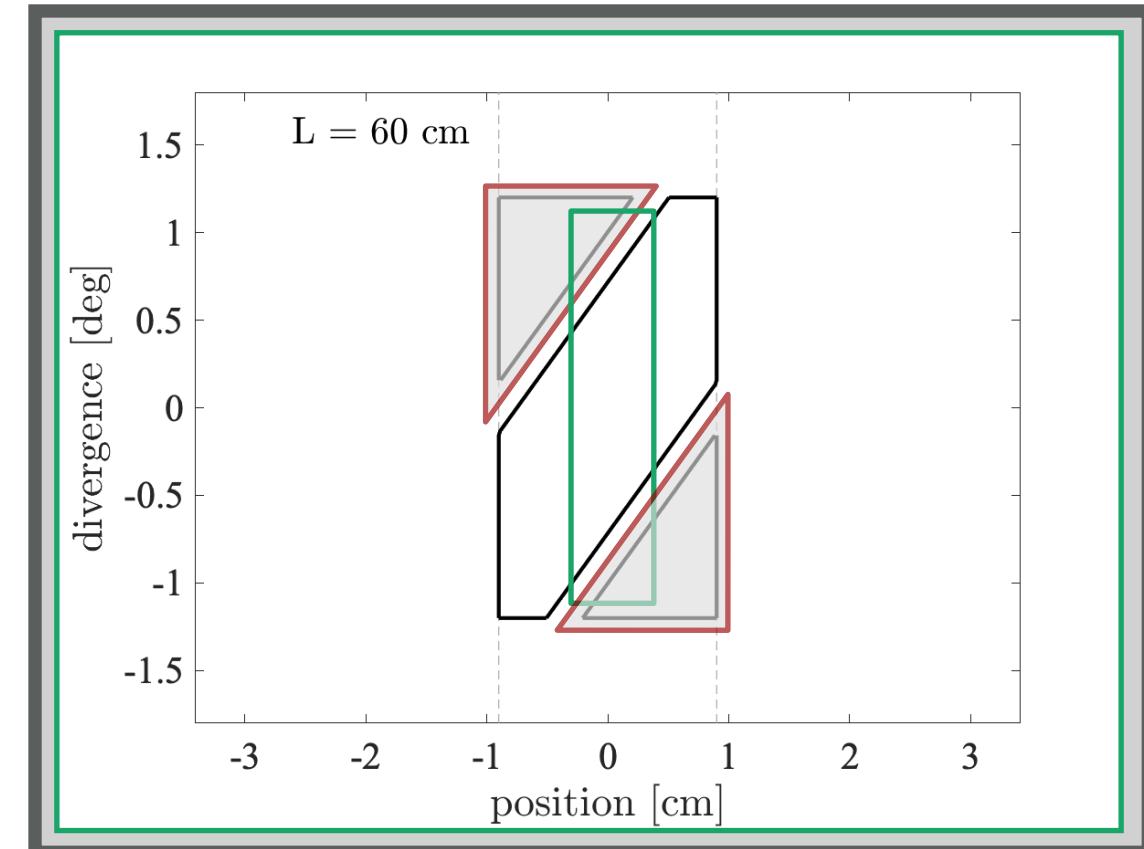
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Beam propagation in guide



We got some phase-space back from guide reflection!



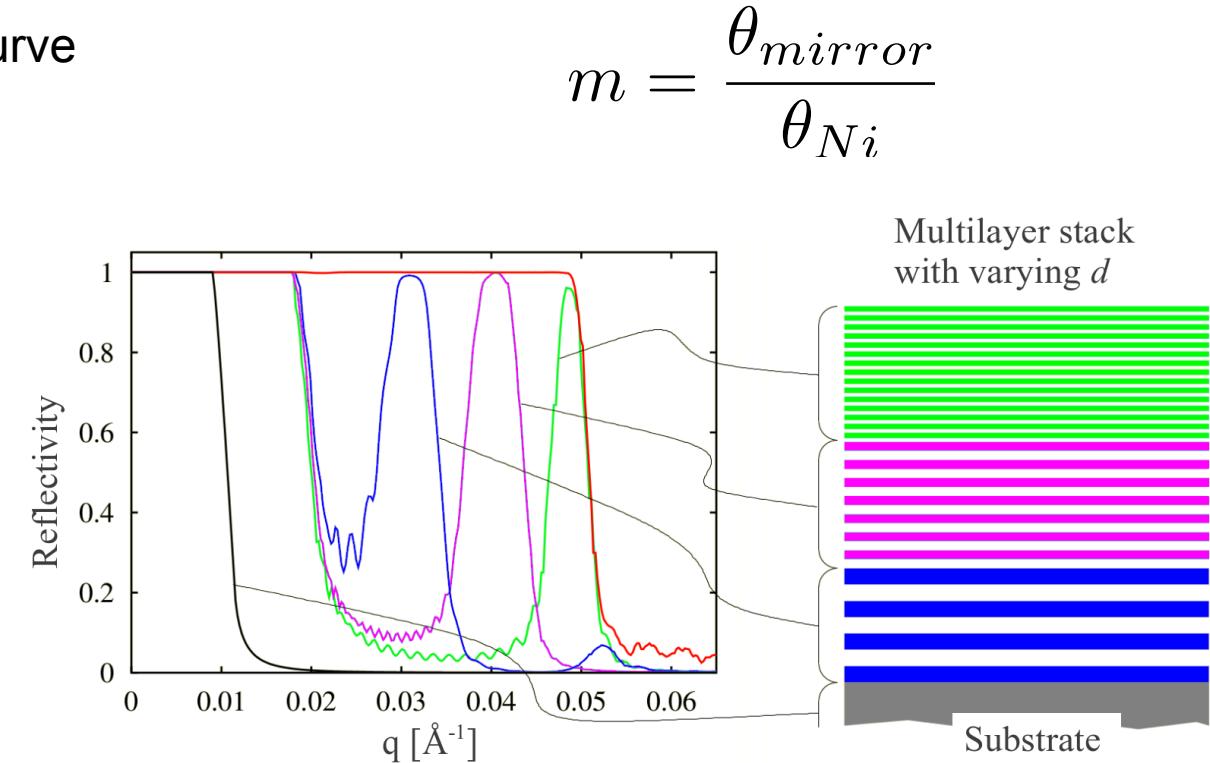
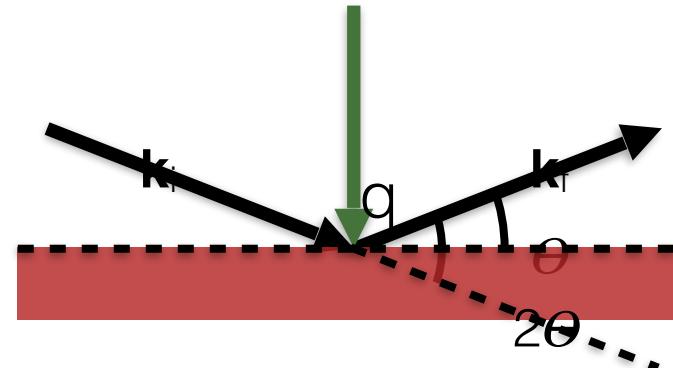
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Reflectivity curves

- Reflectivity, super mirror, reflectivity curve

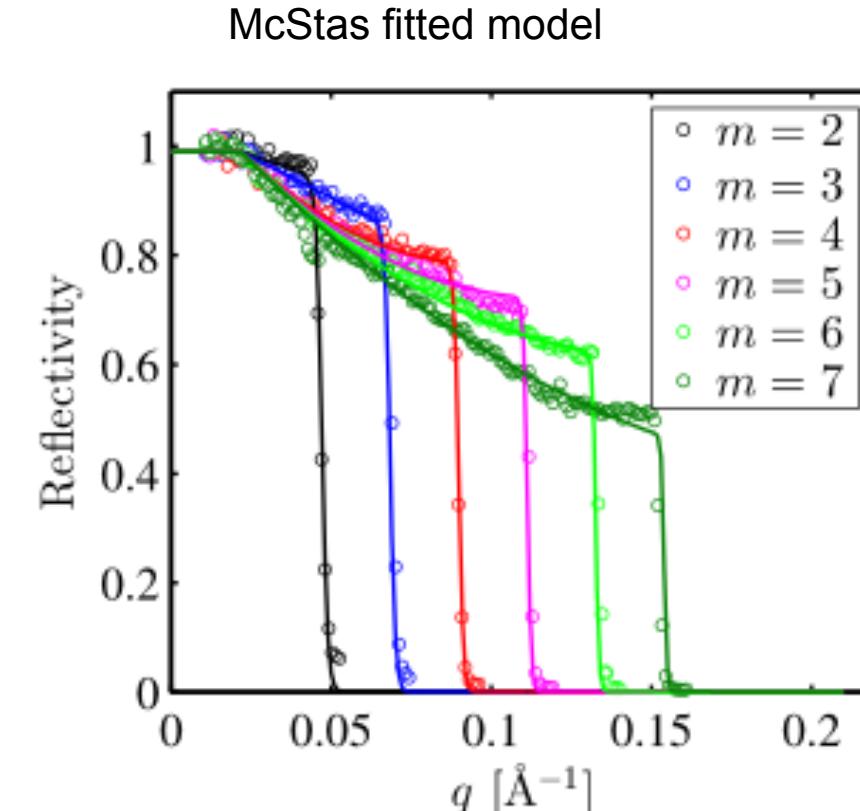
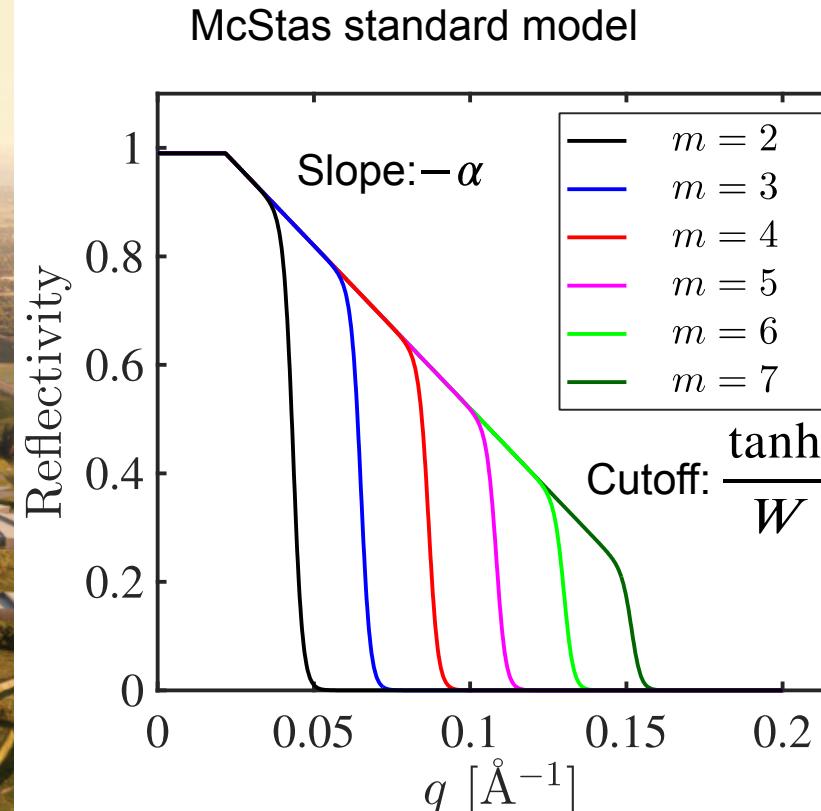




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Reflectivity curves in McStas

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

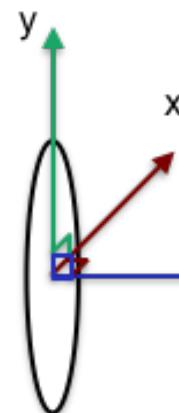




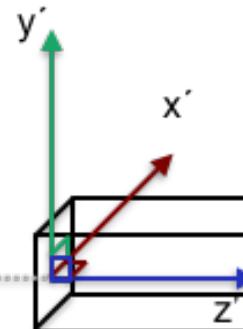
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Guide placement in McStas

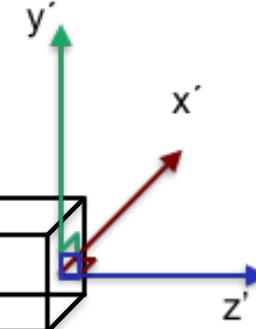
- The center is the front of the guide element
- Tip: Insert a guide at the end of the guide



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

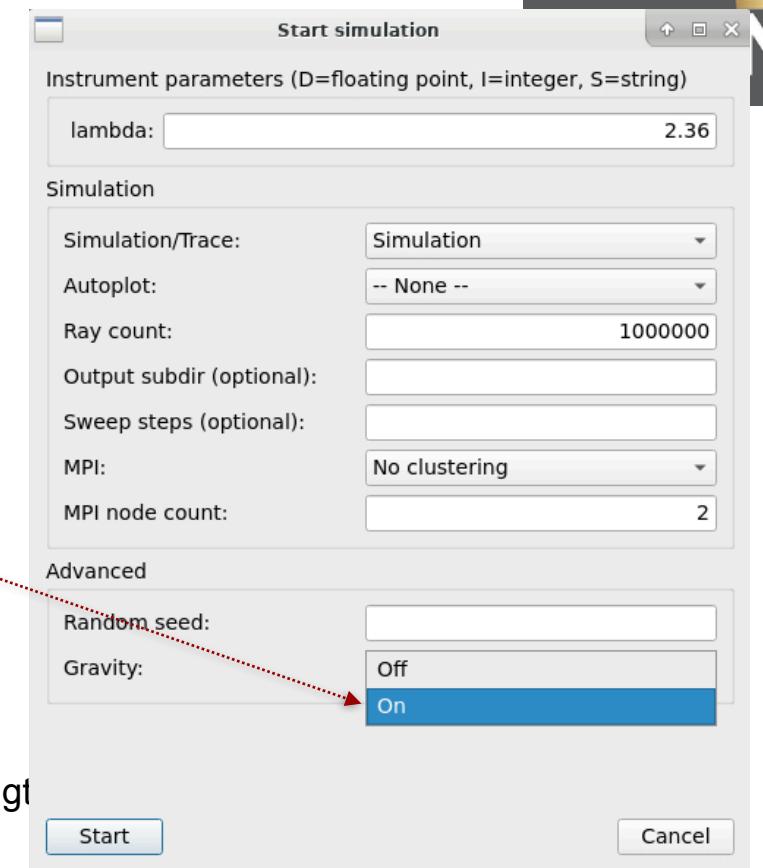
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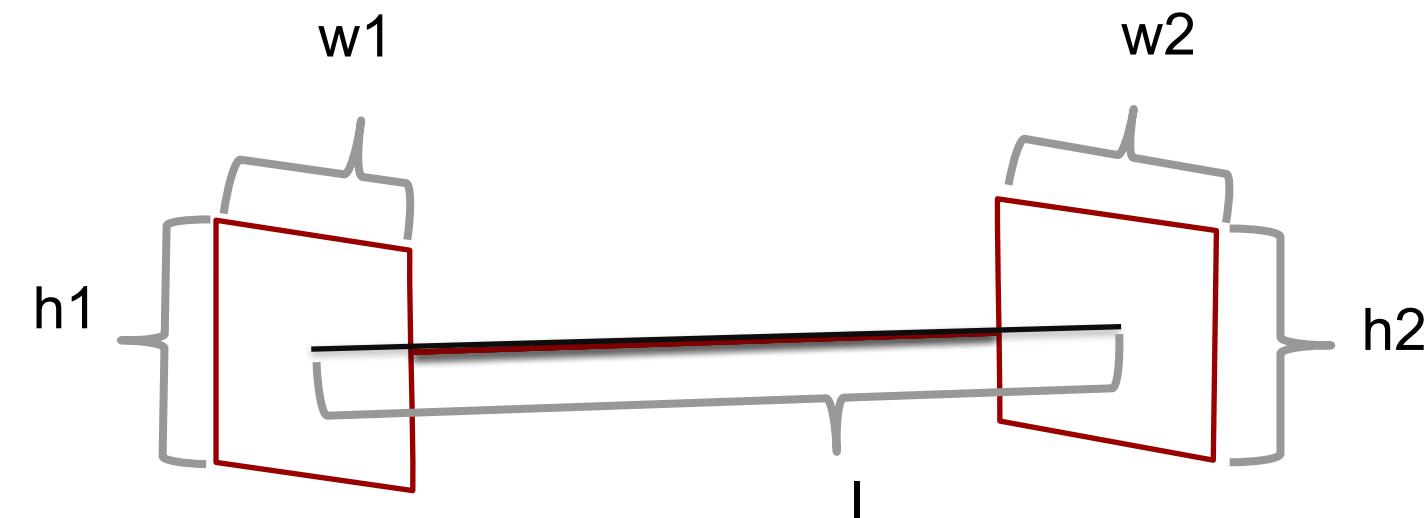
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- Enabled by adding `-g` / `--gravitation` on command line or by selecting “Gravity On” in mcgui
- Default ~ gravity on earth
`#define GRAVITY 9.81 /* [m/s^2] gravitational acceleration */`
 (If on the moon, use `-DGRAVITY=1.62` ;-)
- For guides, only `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



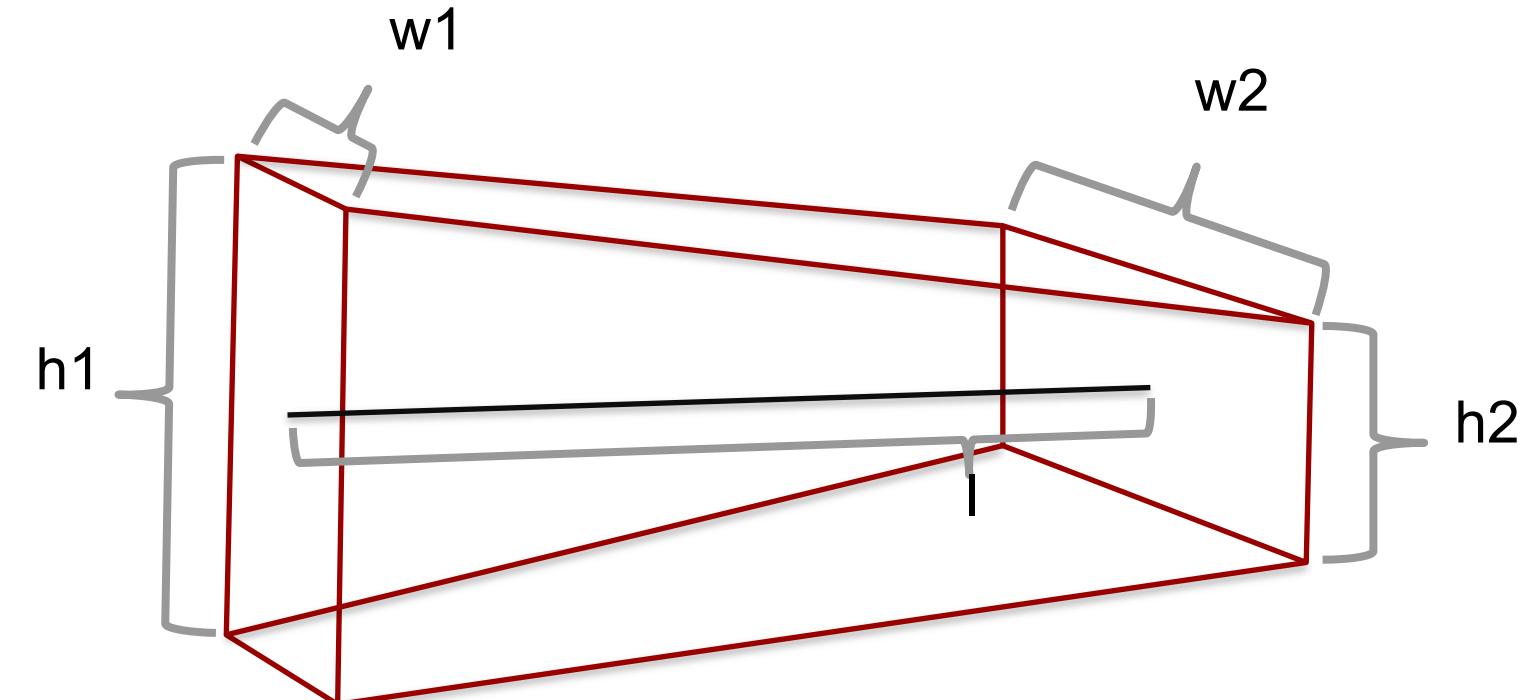
Popular guide components: Guide_gravity

- 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)



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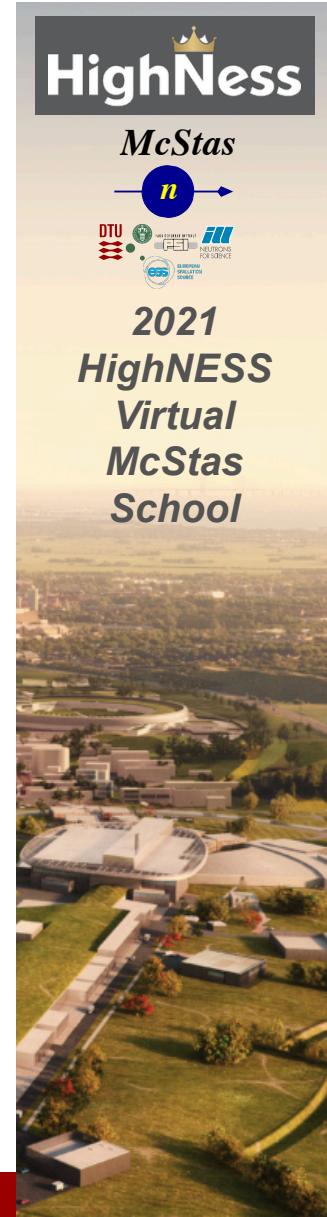


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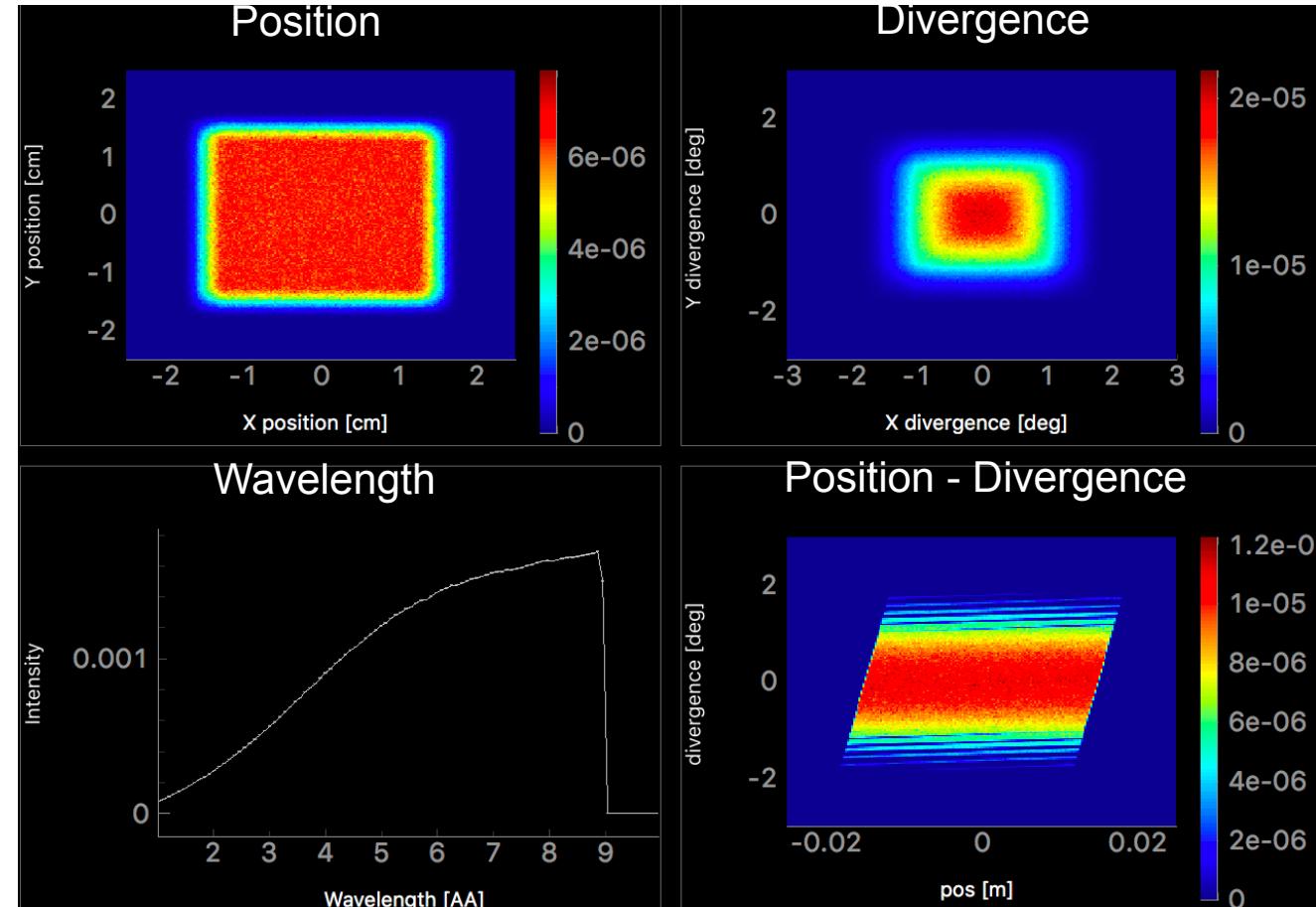


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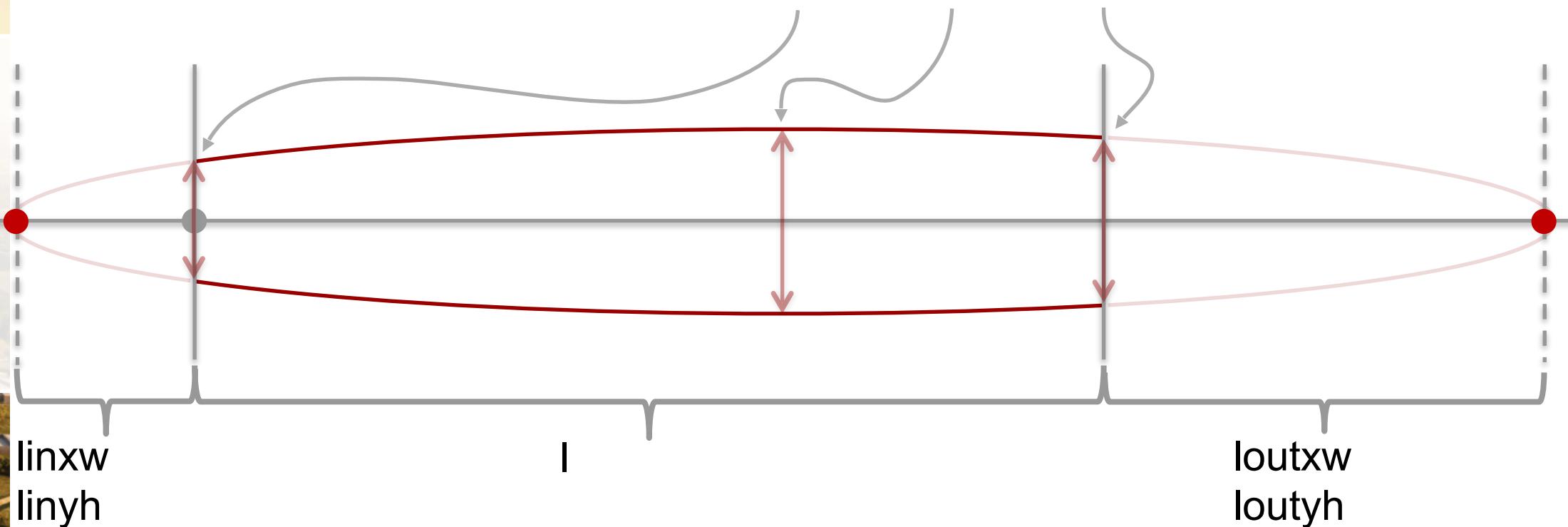
Popular guide components: Guide_gravity

- 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"

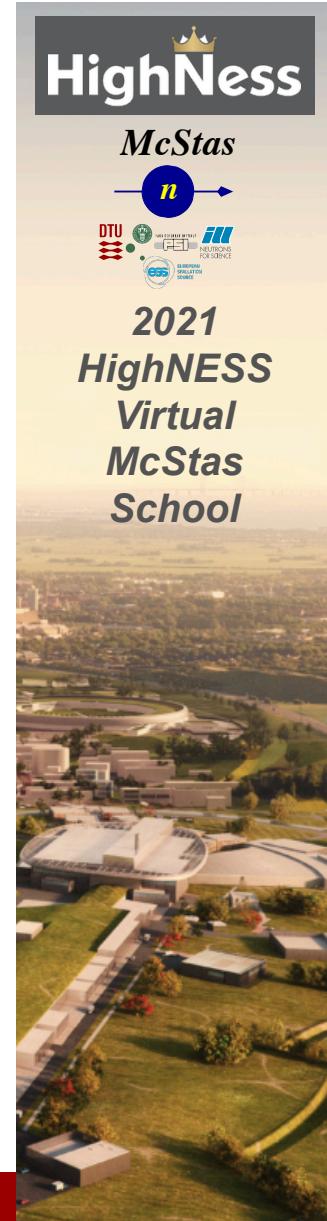




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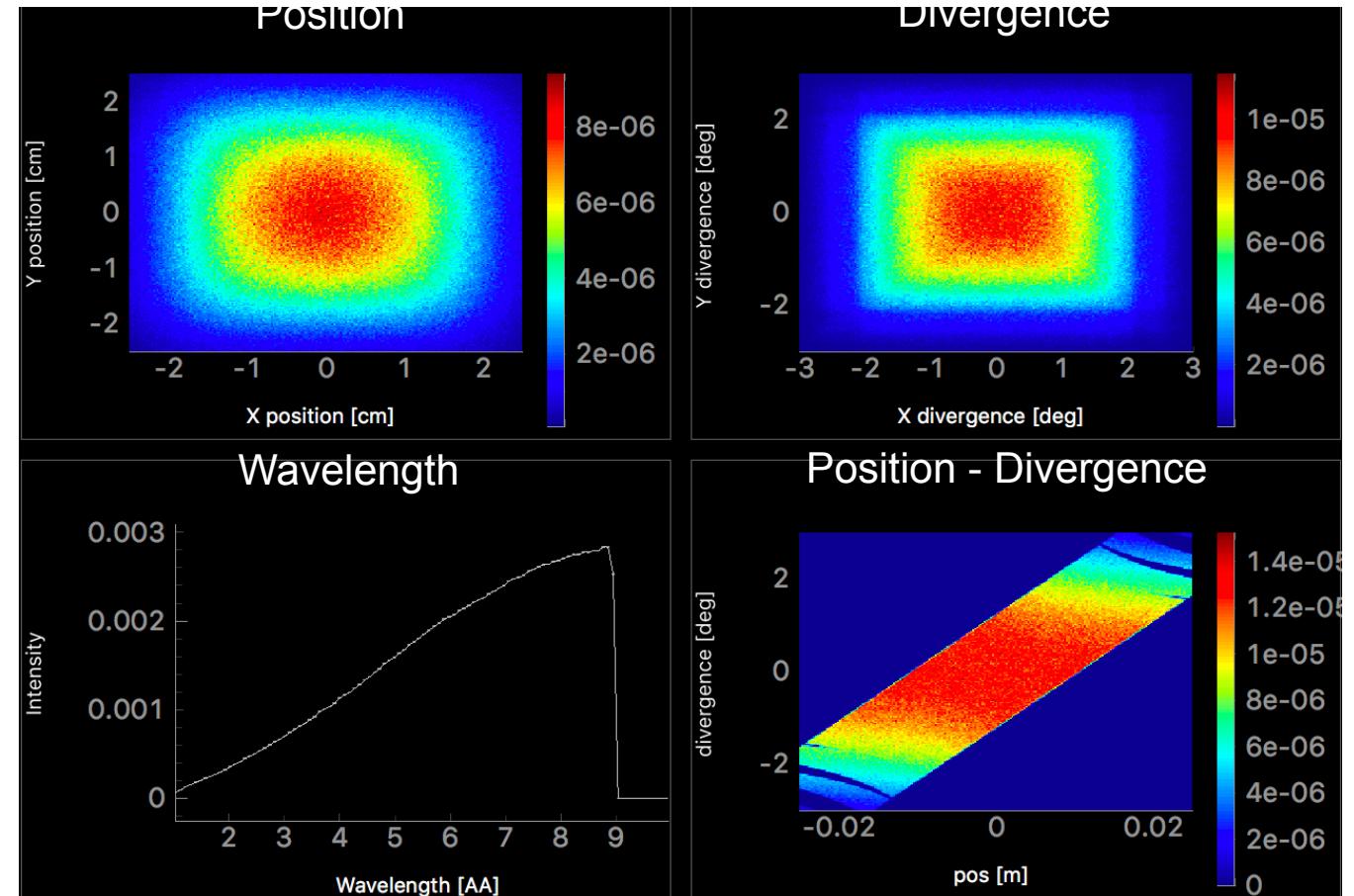


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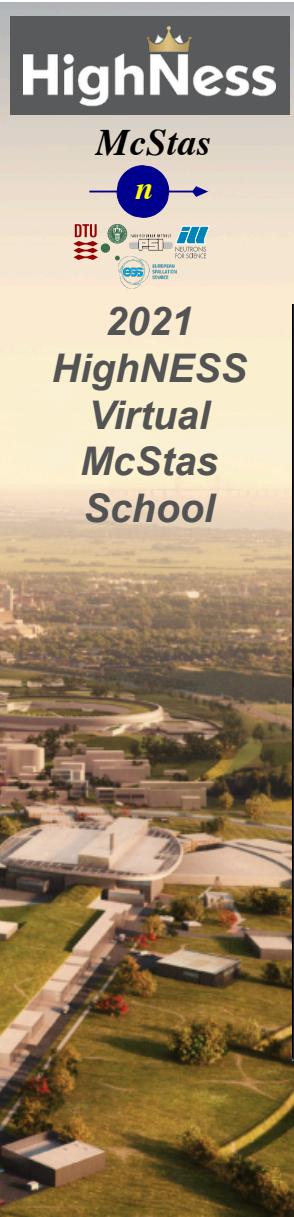


Popular guide components: Elliptical_guide_gravity

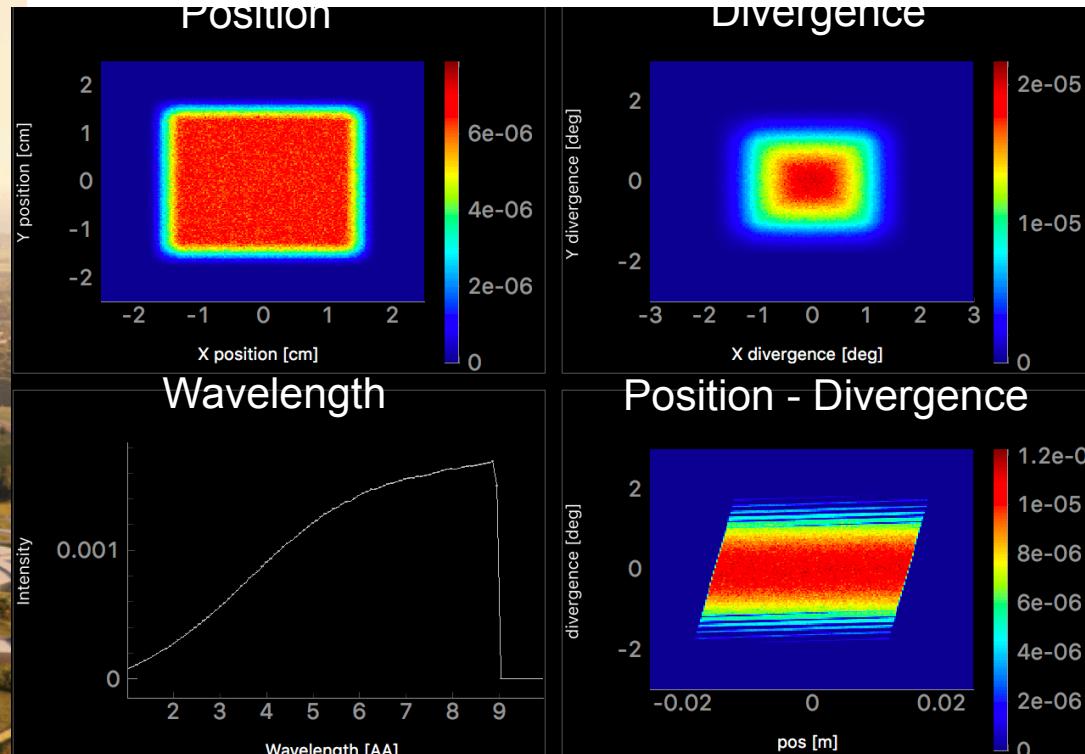
- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution,
...



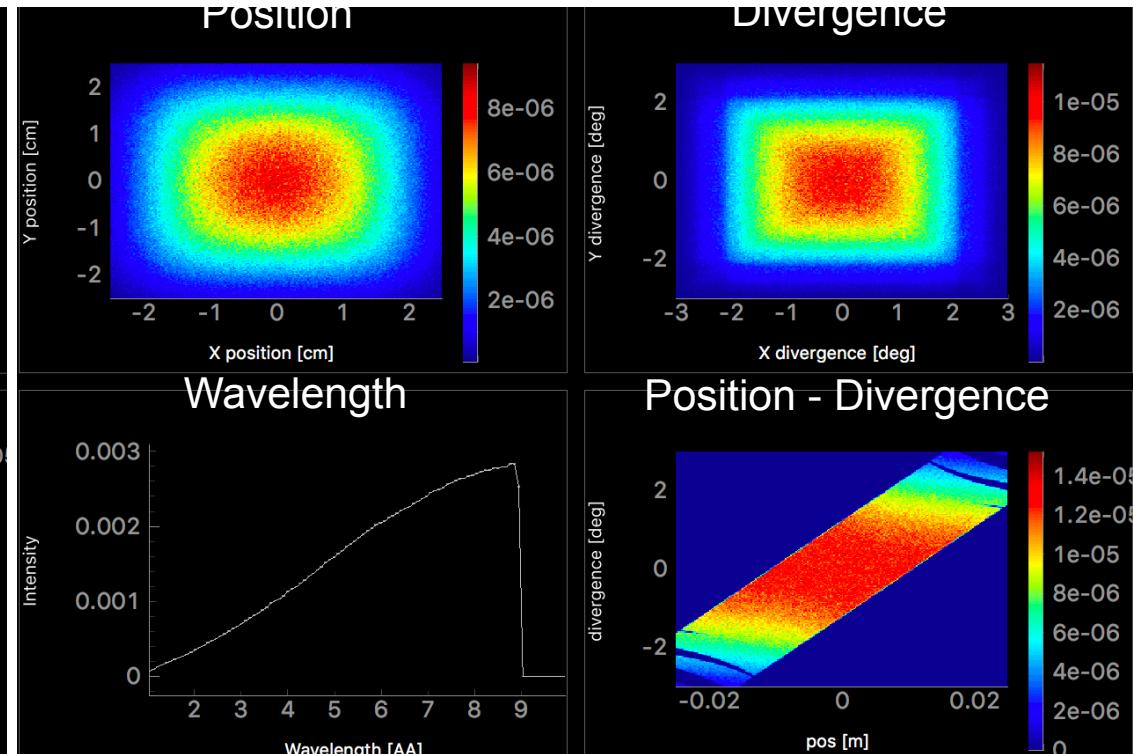
Comparison: Guide_gravity and Elliptic_guide_gravity



Guide_gravity



Elliptic_guide_gravity





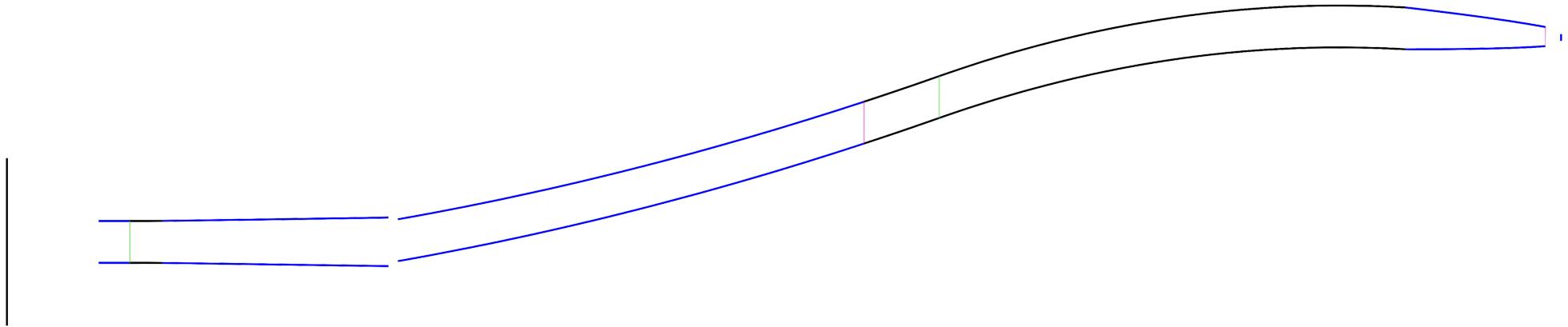
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Breaking line of sight

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





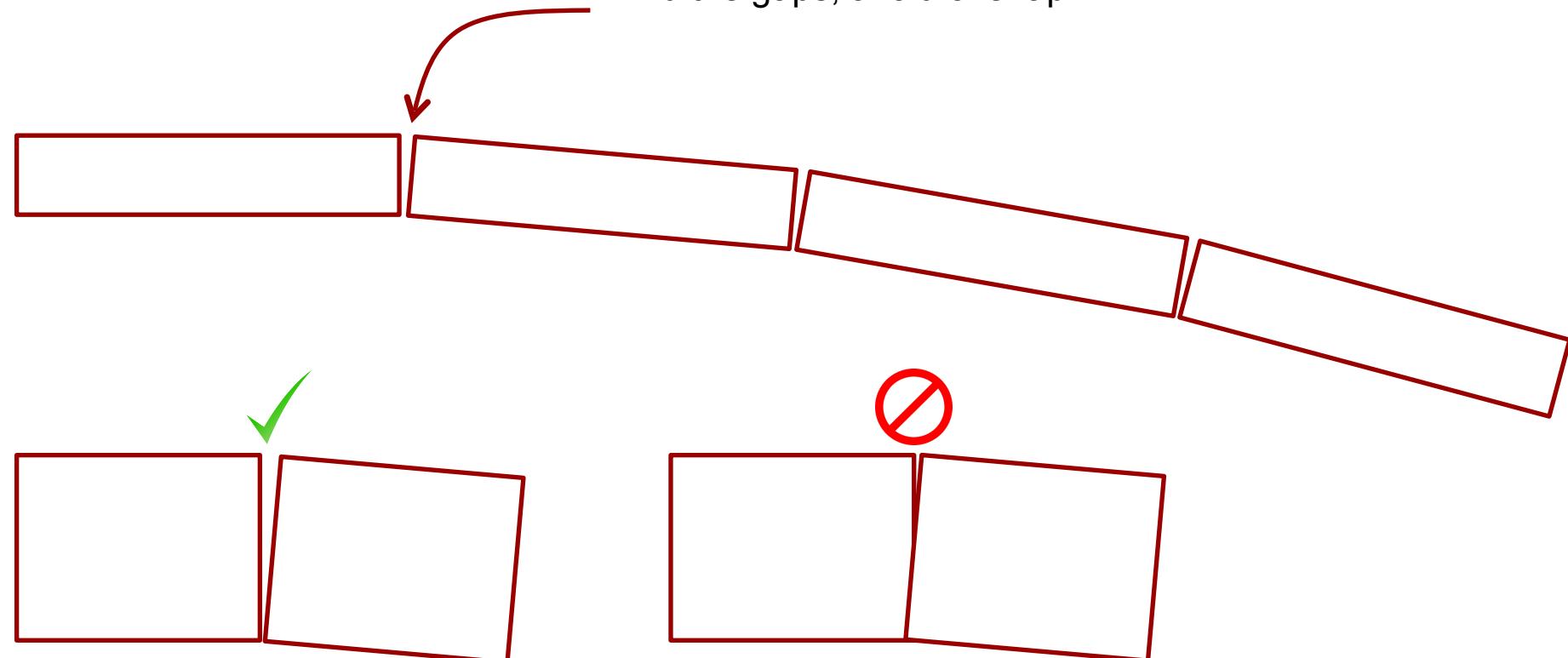
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Breaking line of sight

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



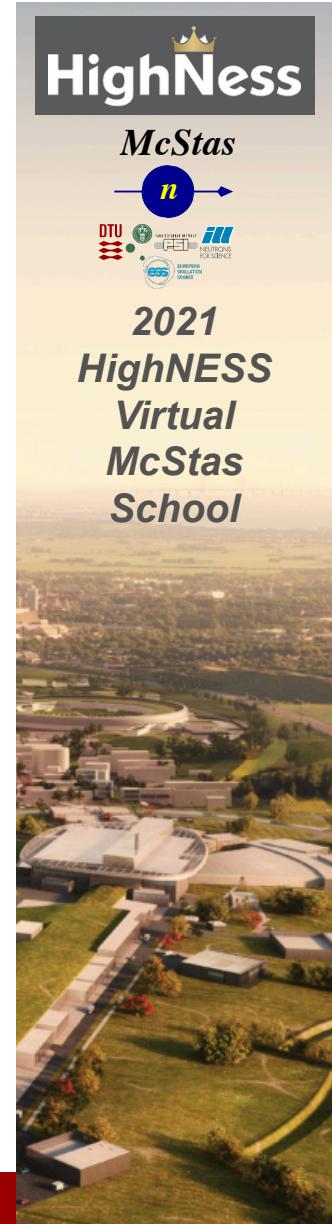


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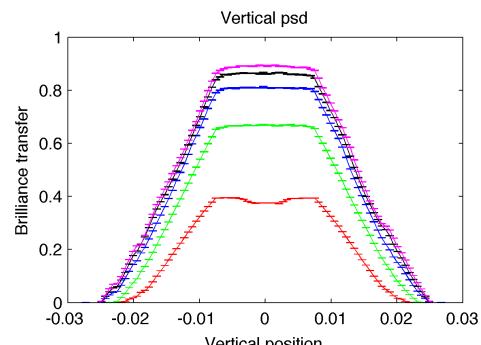
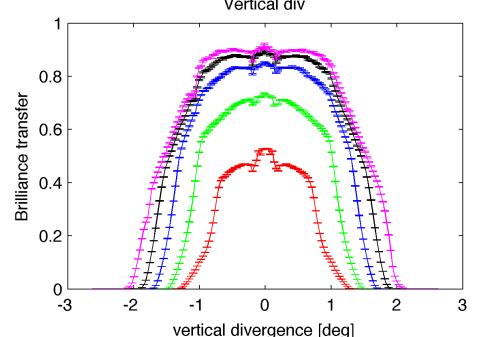
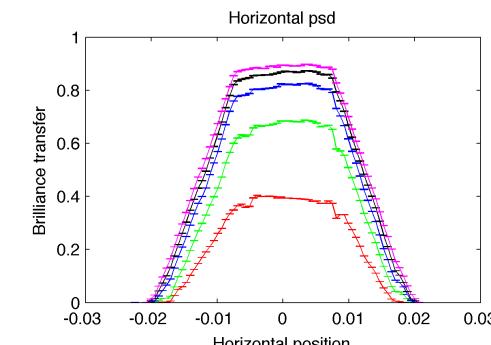
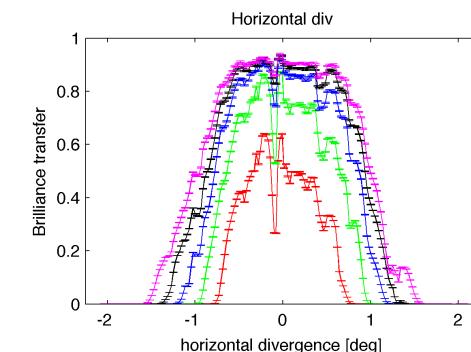
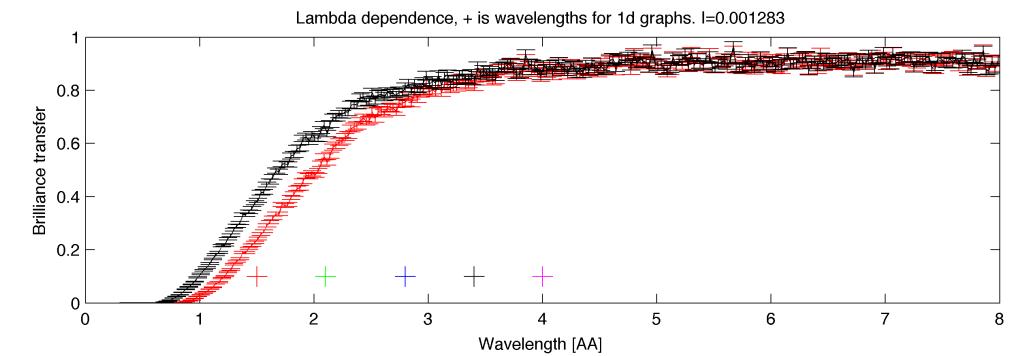
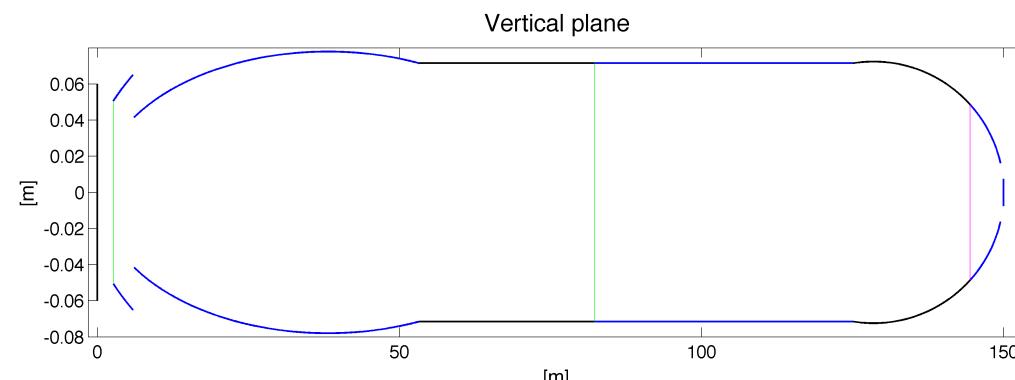
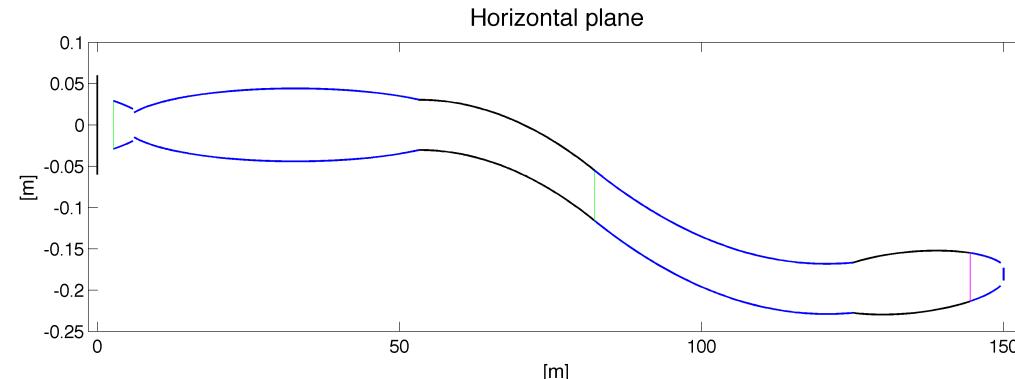
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A guide design

- To be continued in Thursday guidebot talk by Mads Bertelsen



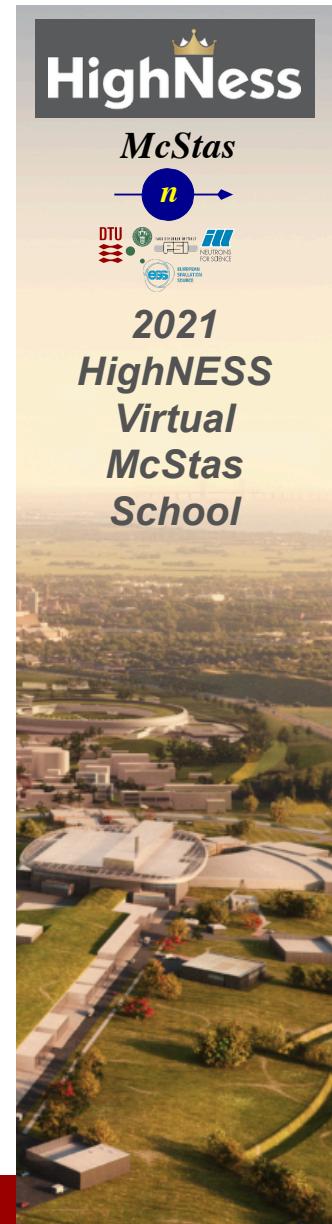
Solution on [github](#), use if you are stuck



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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

