

Guides and gravity in McStas

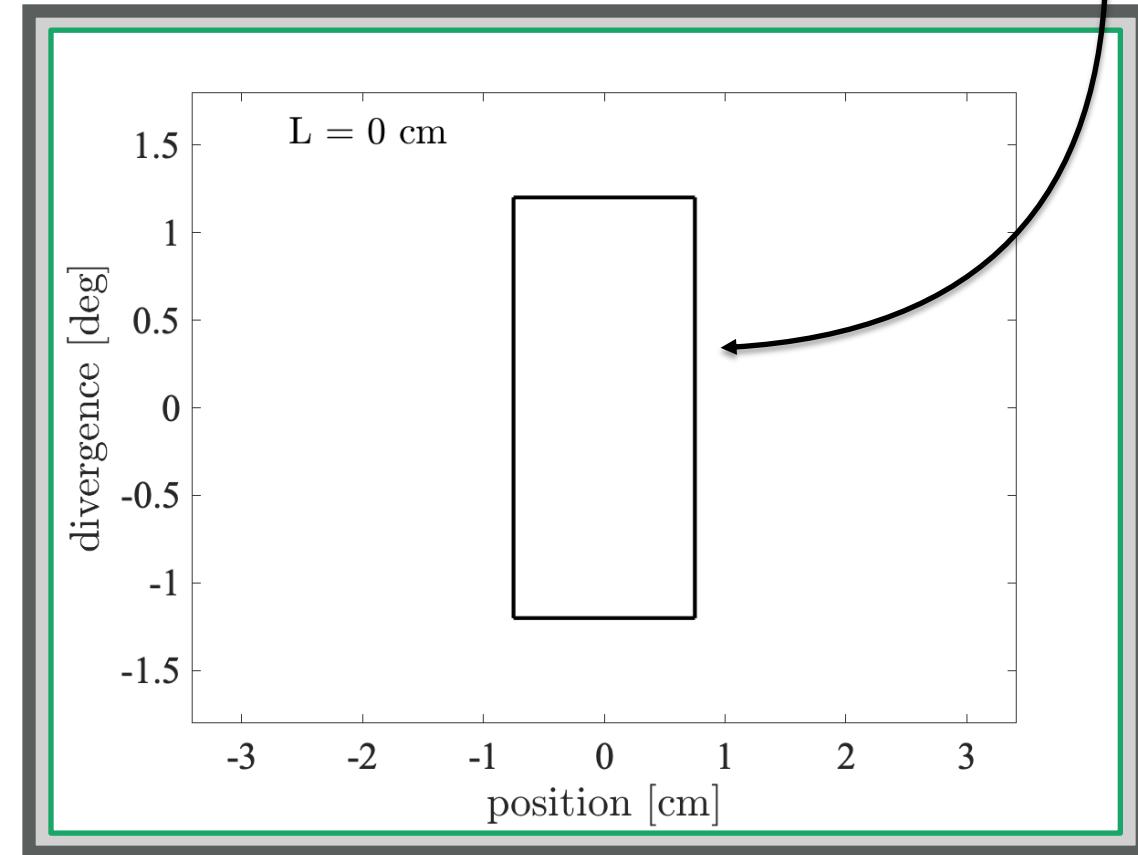
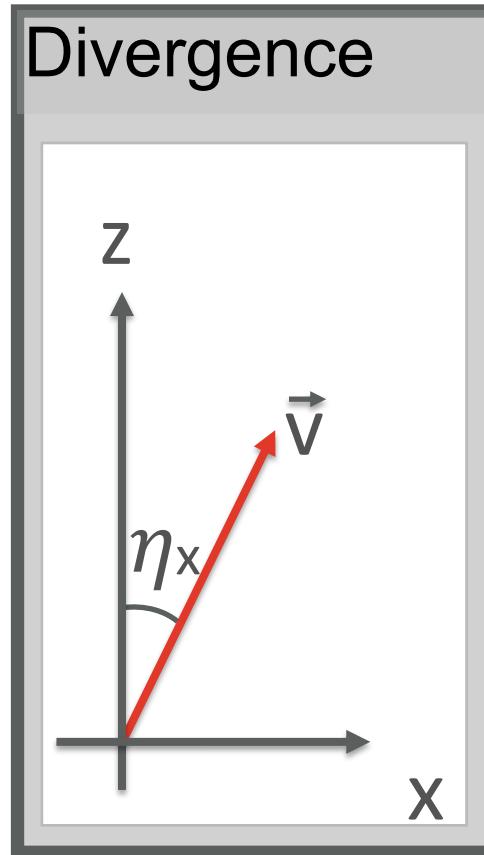
Mads Bertelsen

Overview

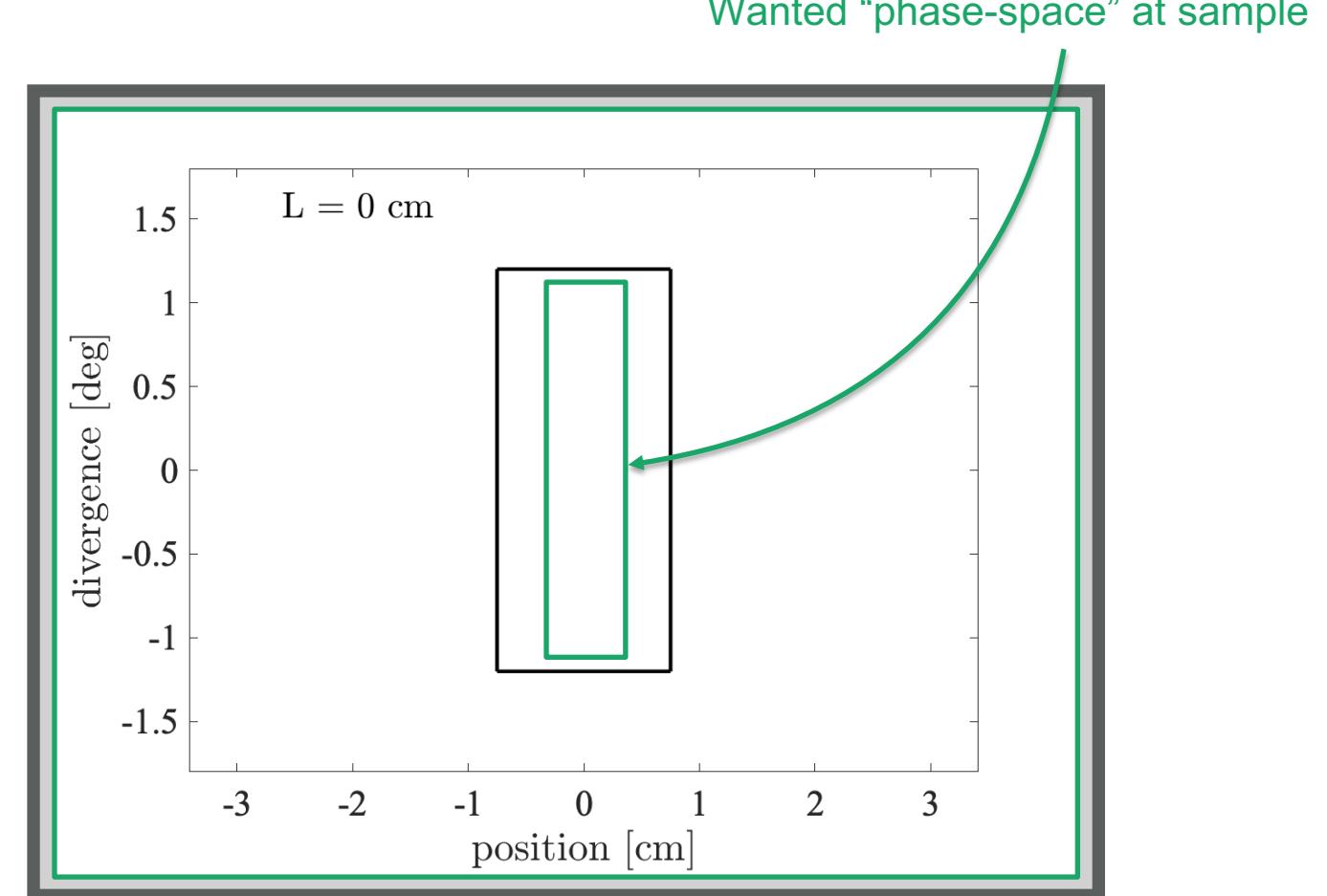
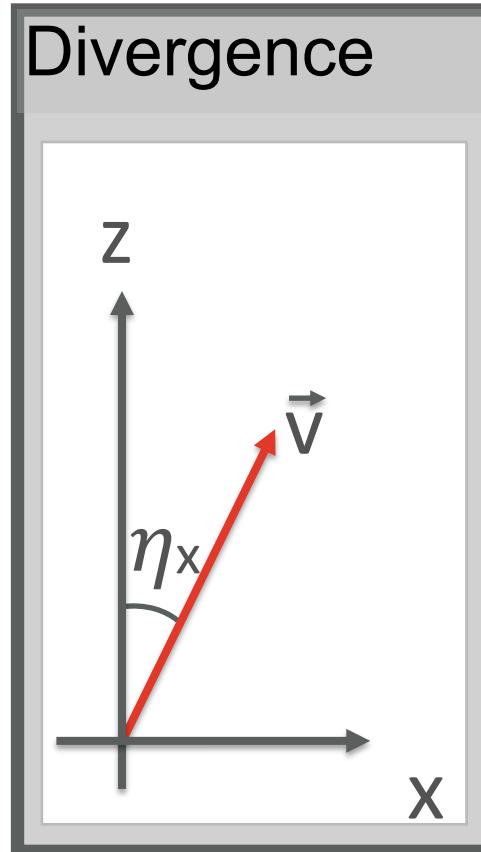
- Description of phase-space and propagation
- Reflectivity
- McStas coordinate system
- Gravitation in McStas
- Guide components with support for gravity
 - Guide_gravity
 - Elliptic_guide_gravity
- Breaking line of sight
- Examples from guide_bot
- Exercise

Beam propagation in free space

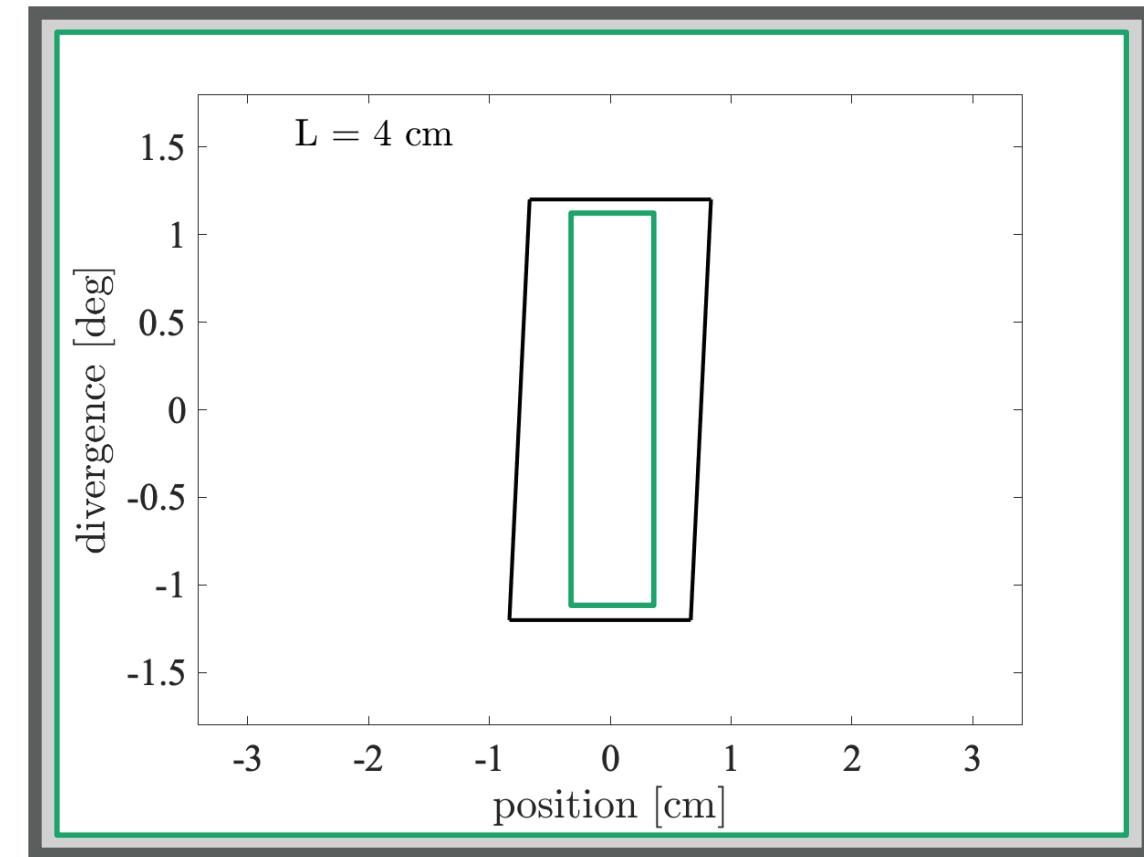
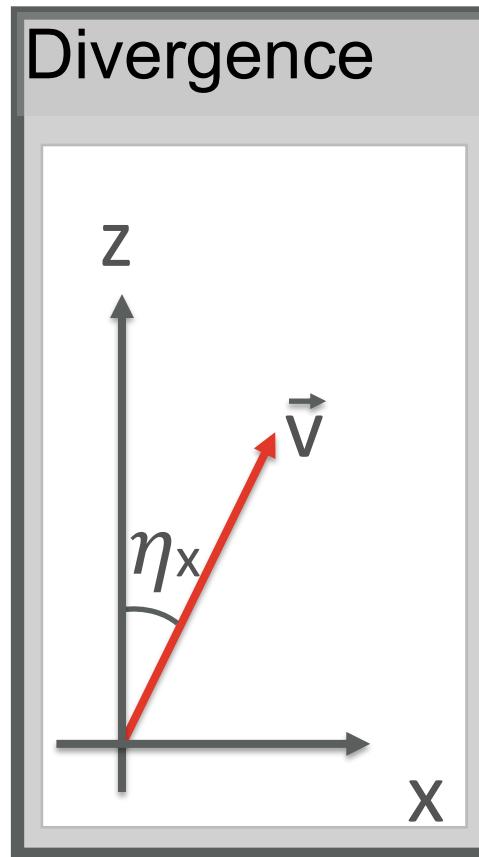
“Phase-space” at source



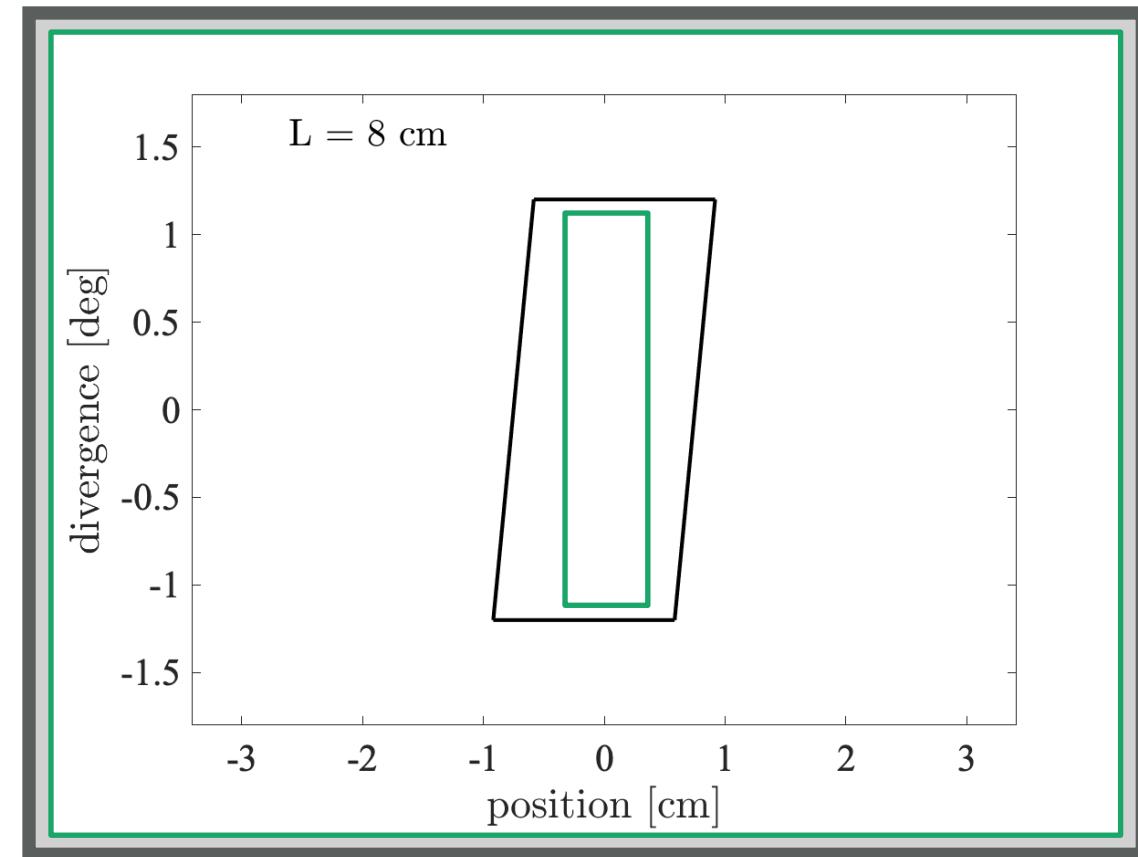
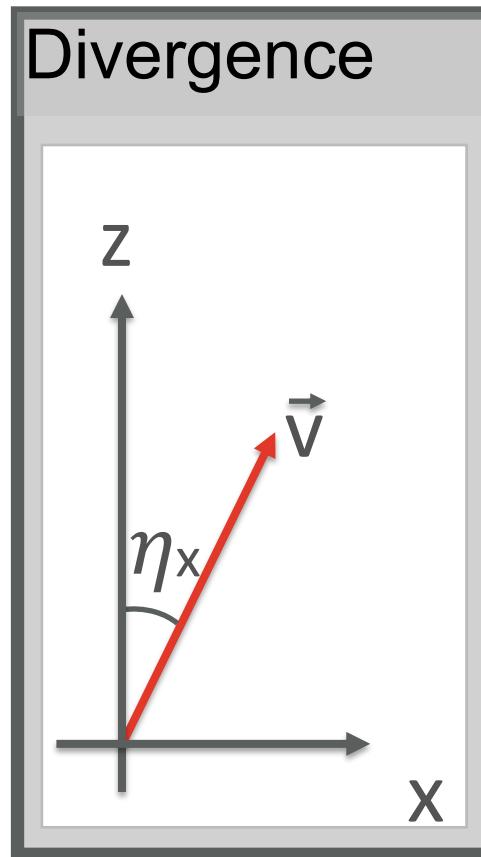
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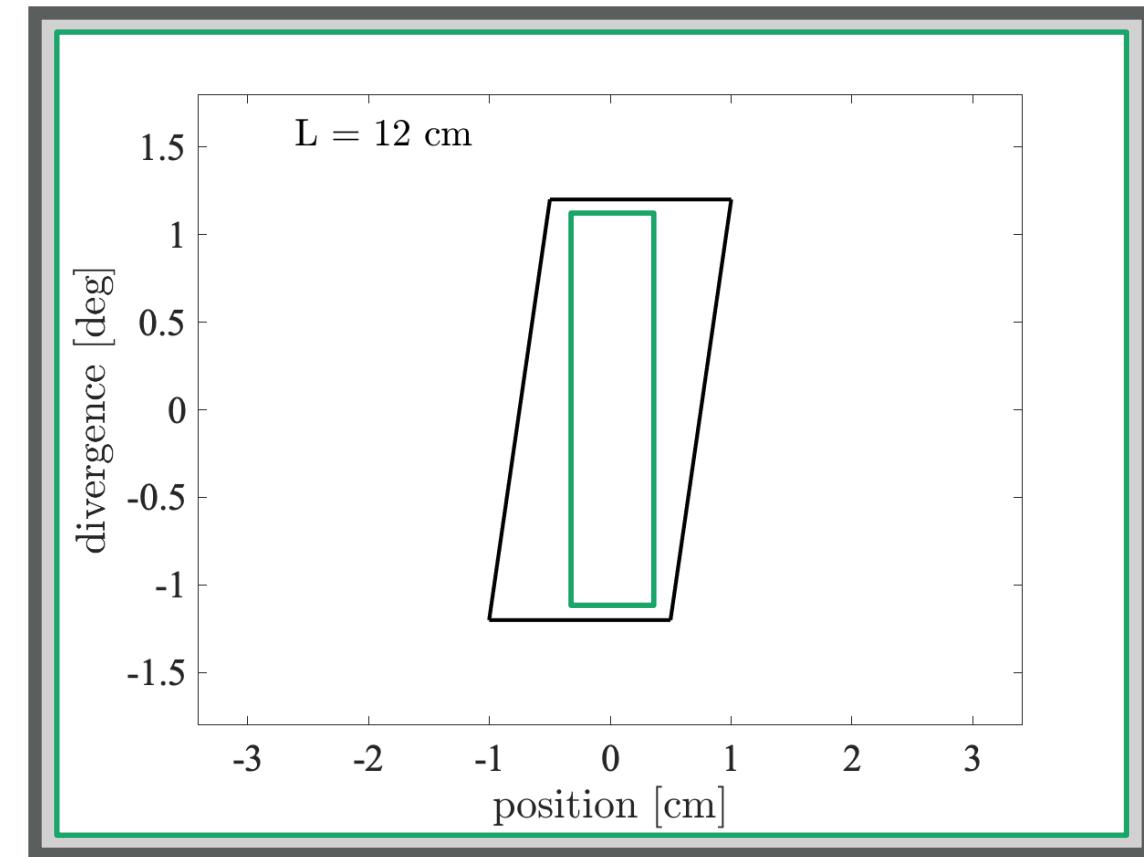
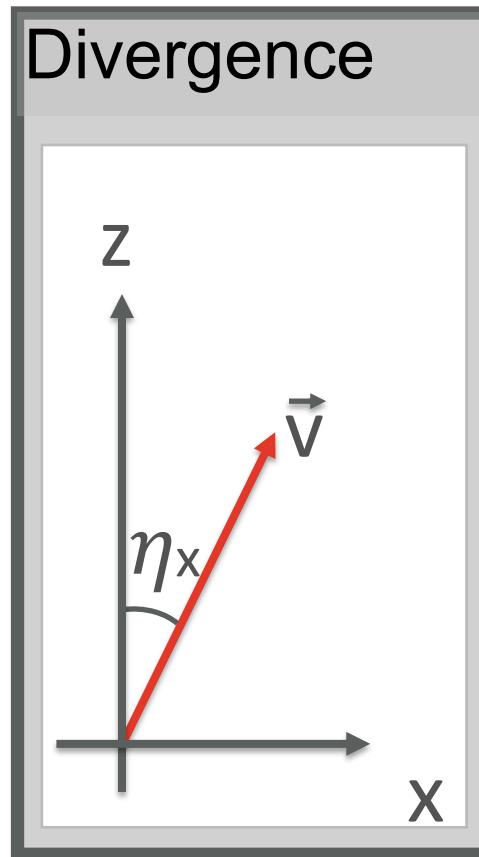
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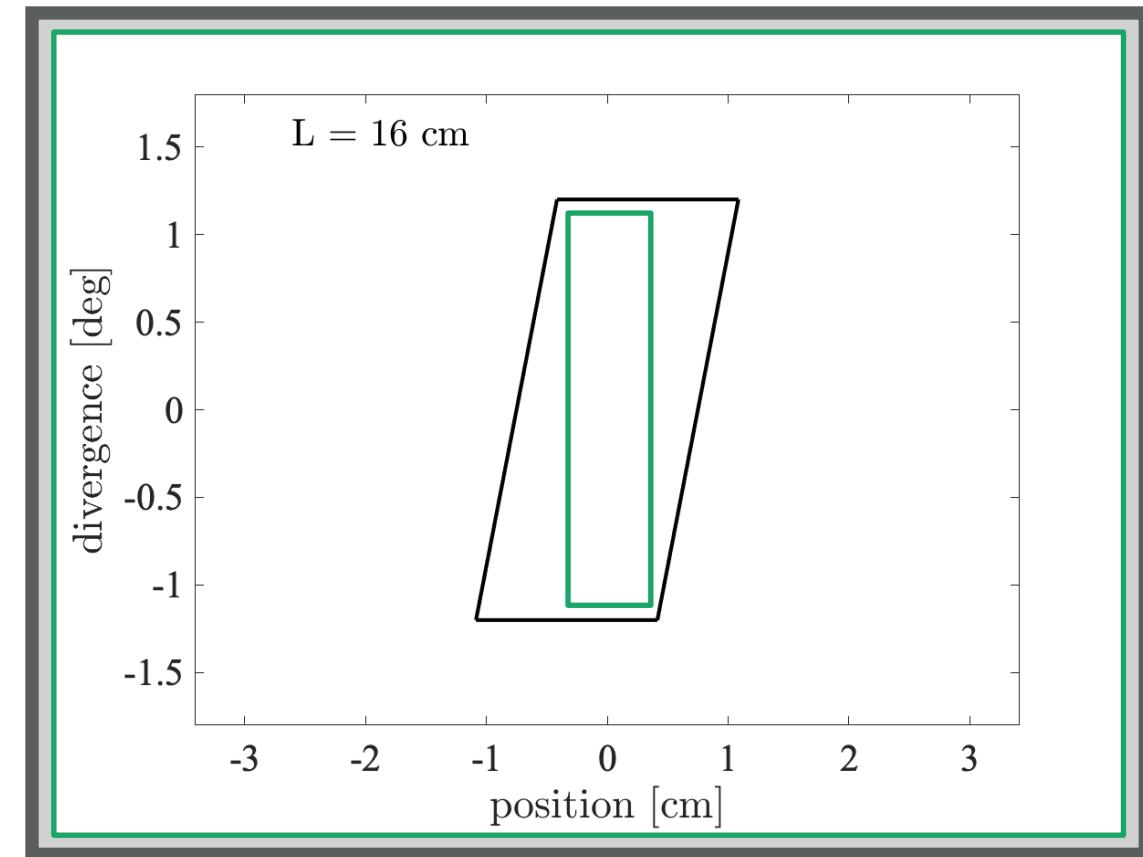
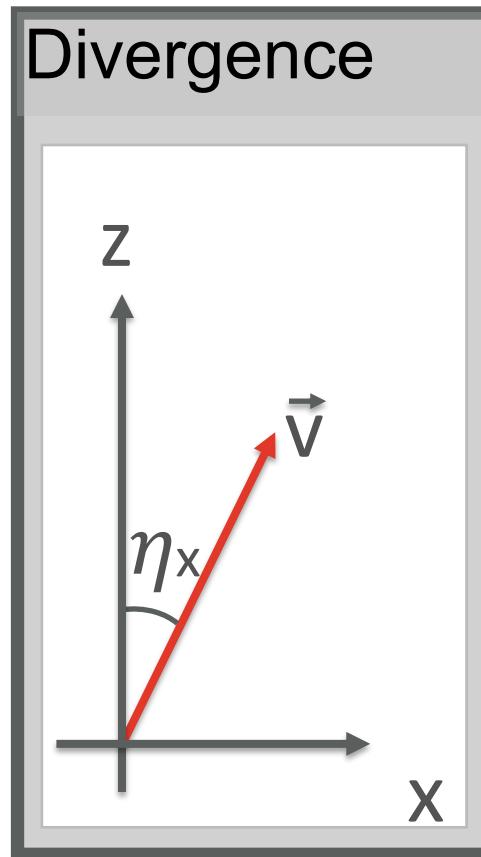
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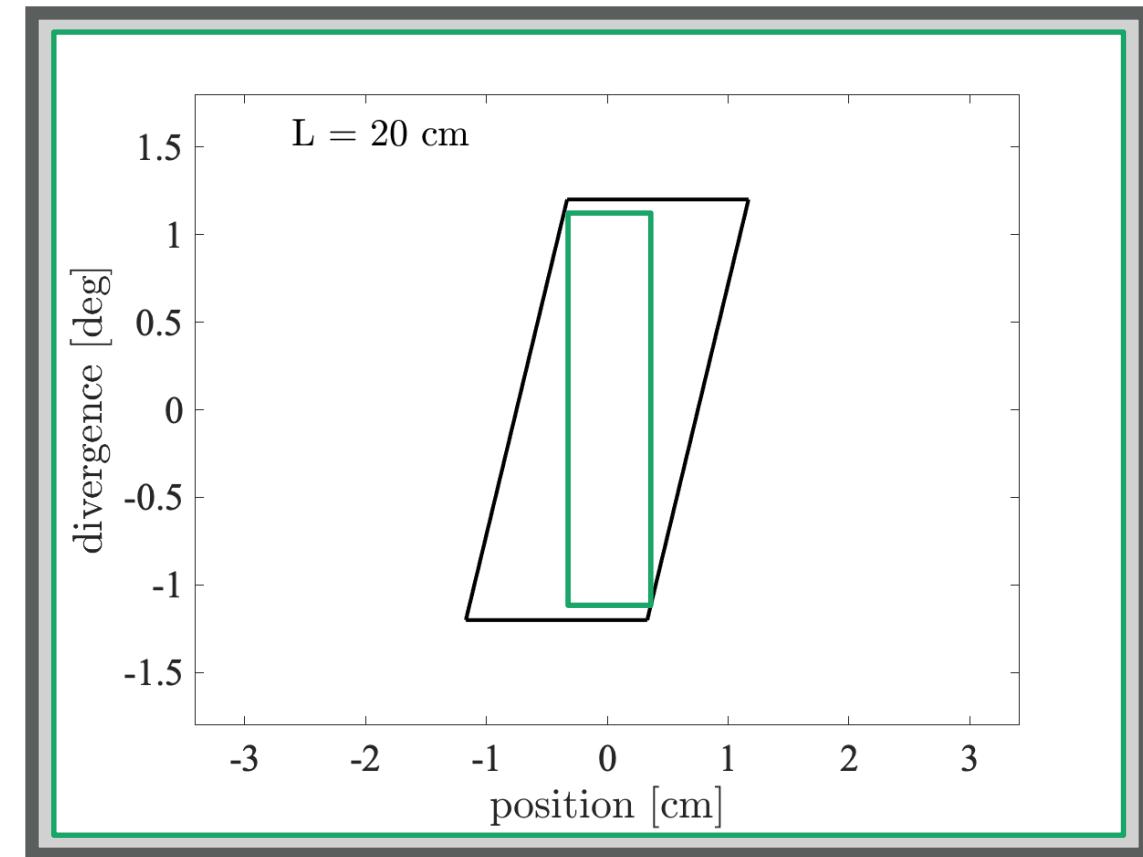
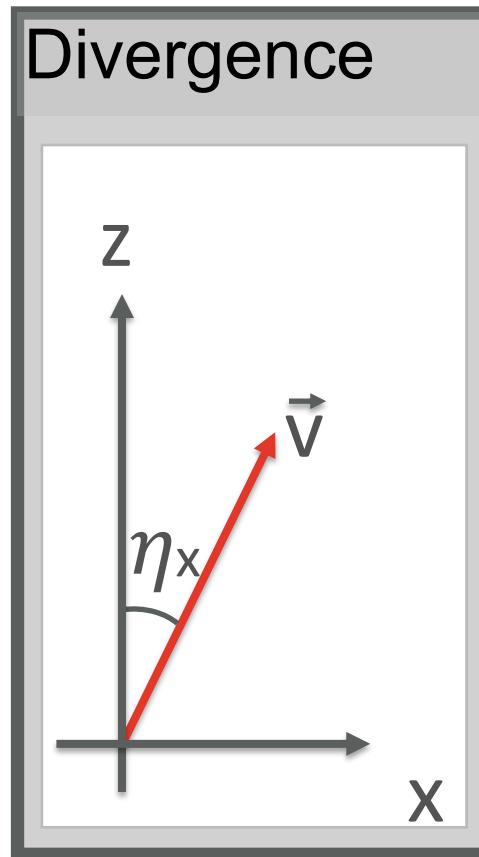
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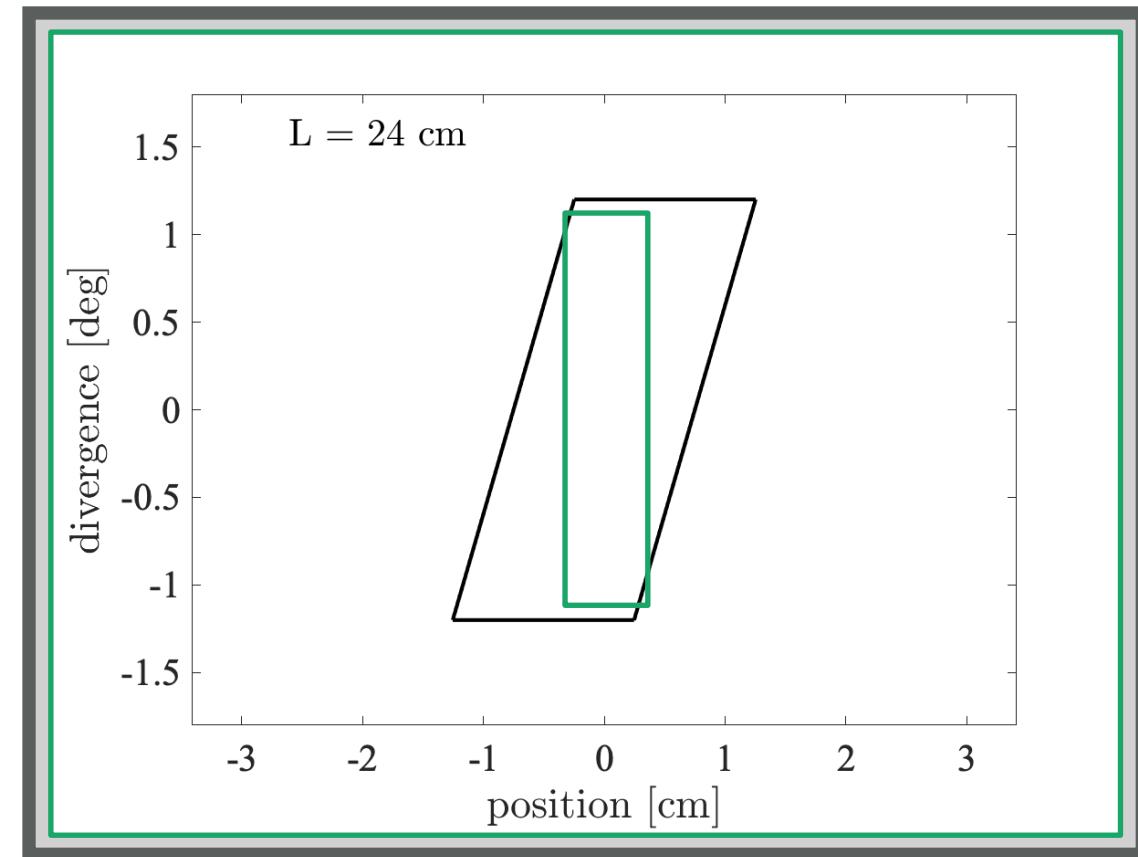
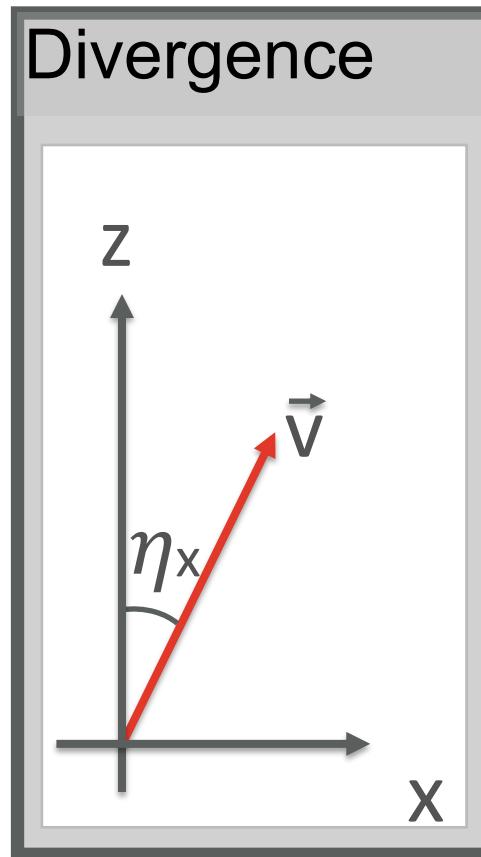
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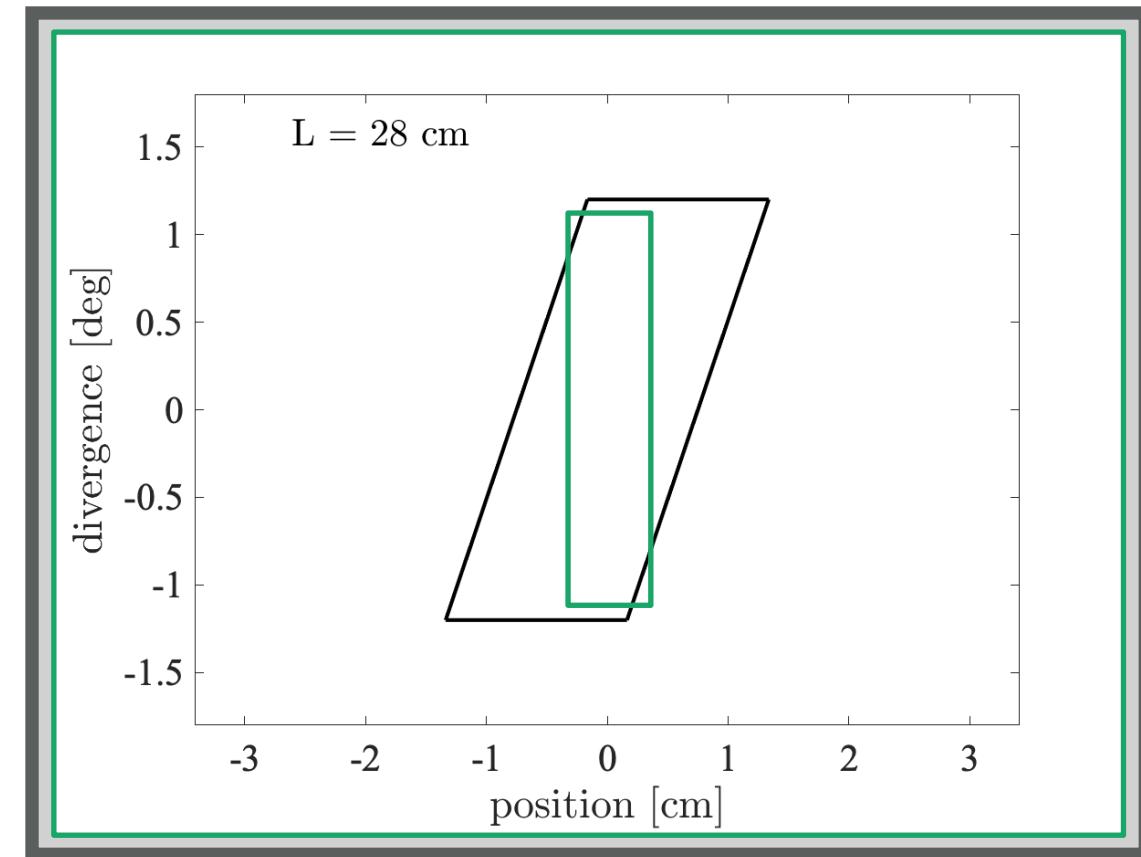
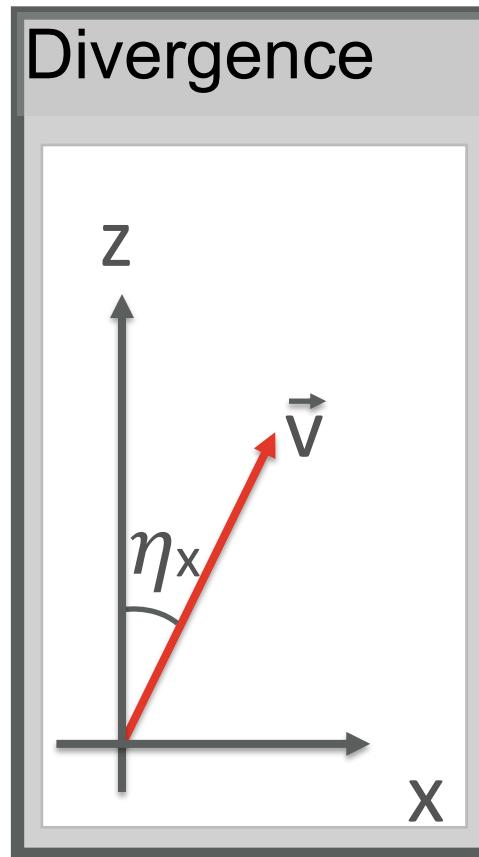
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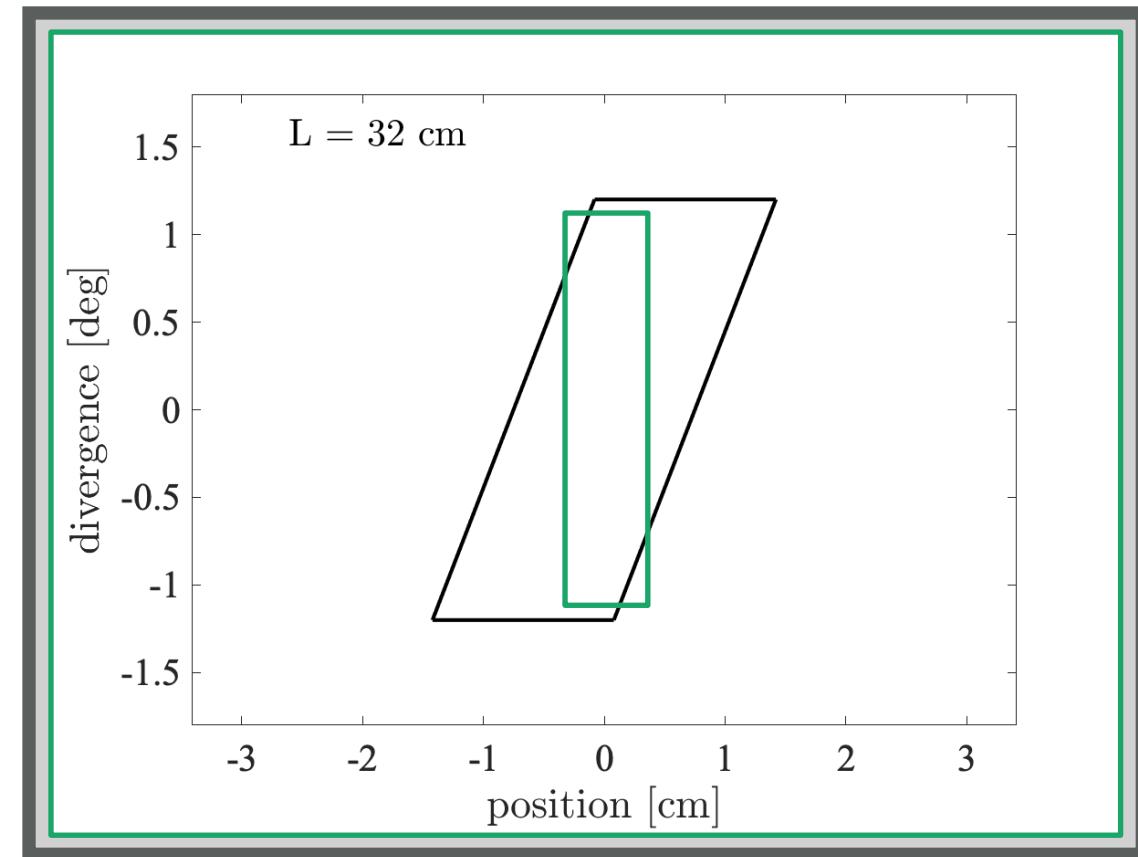
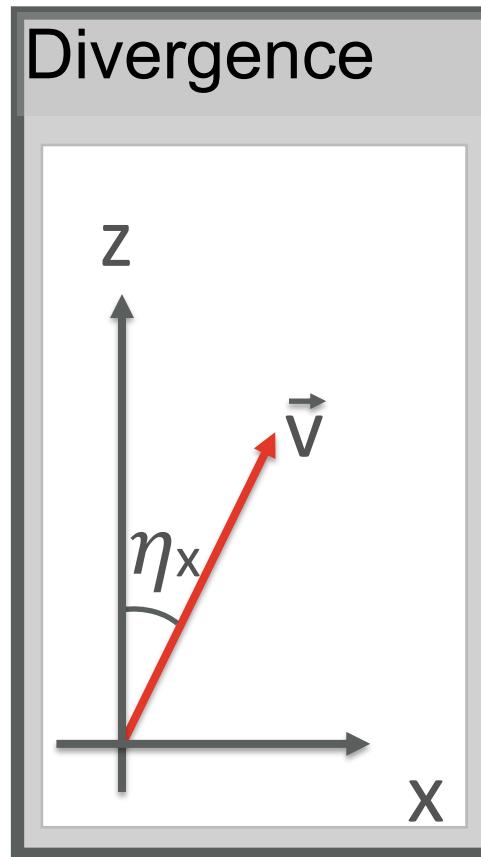
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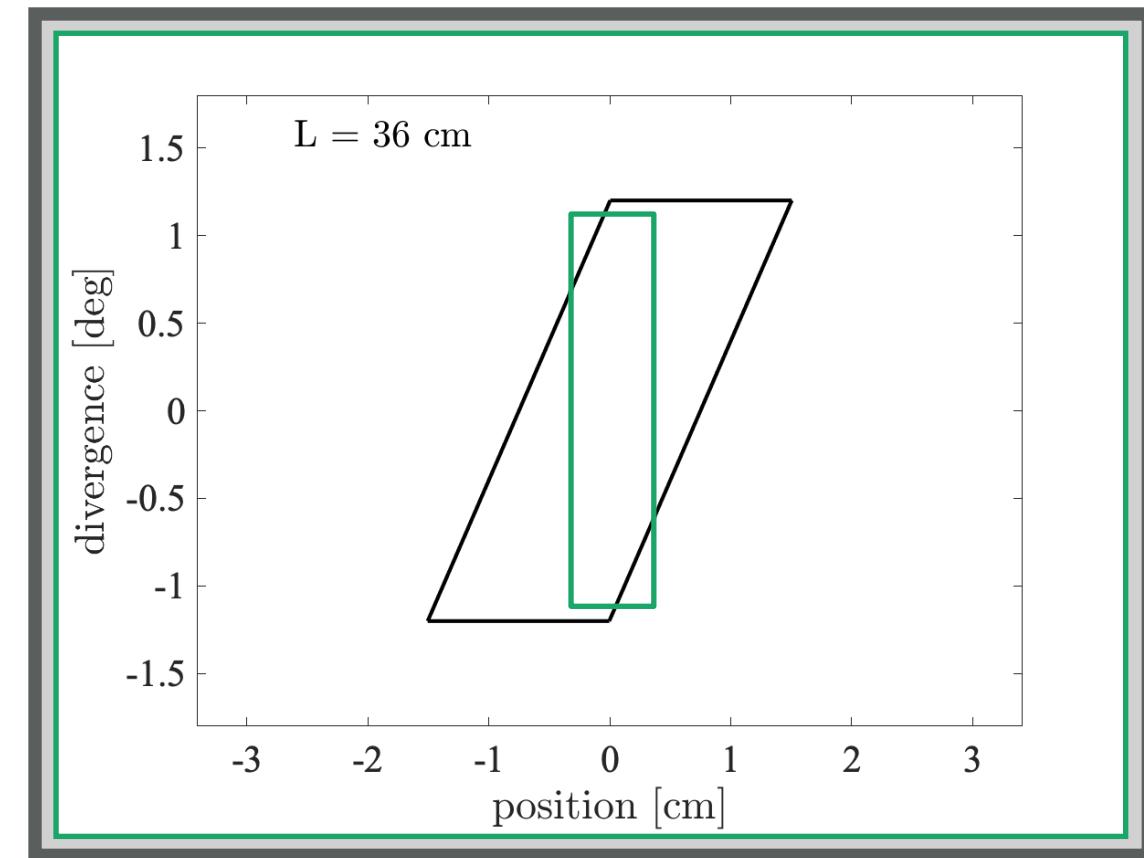
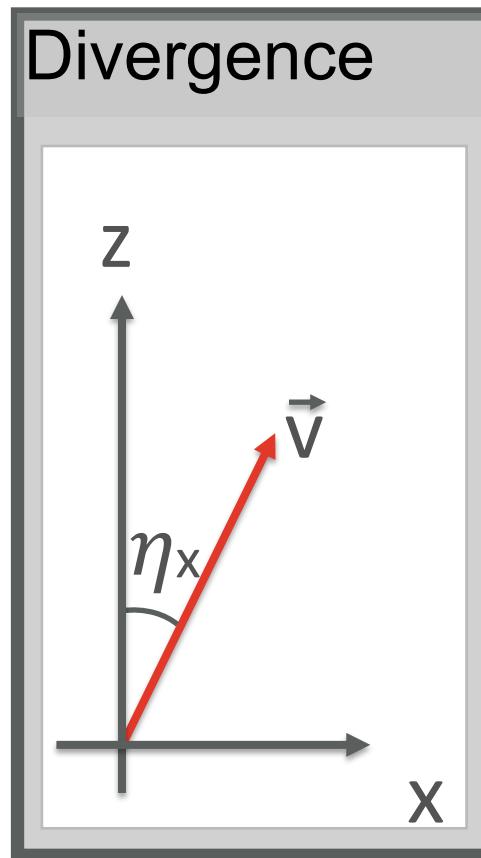
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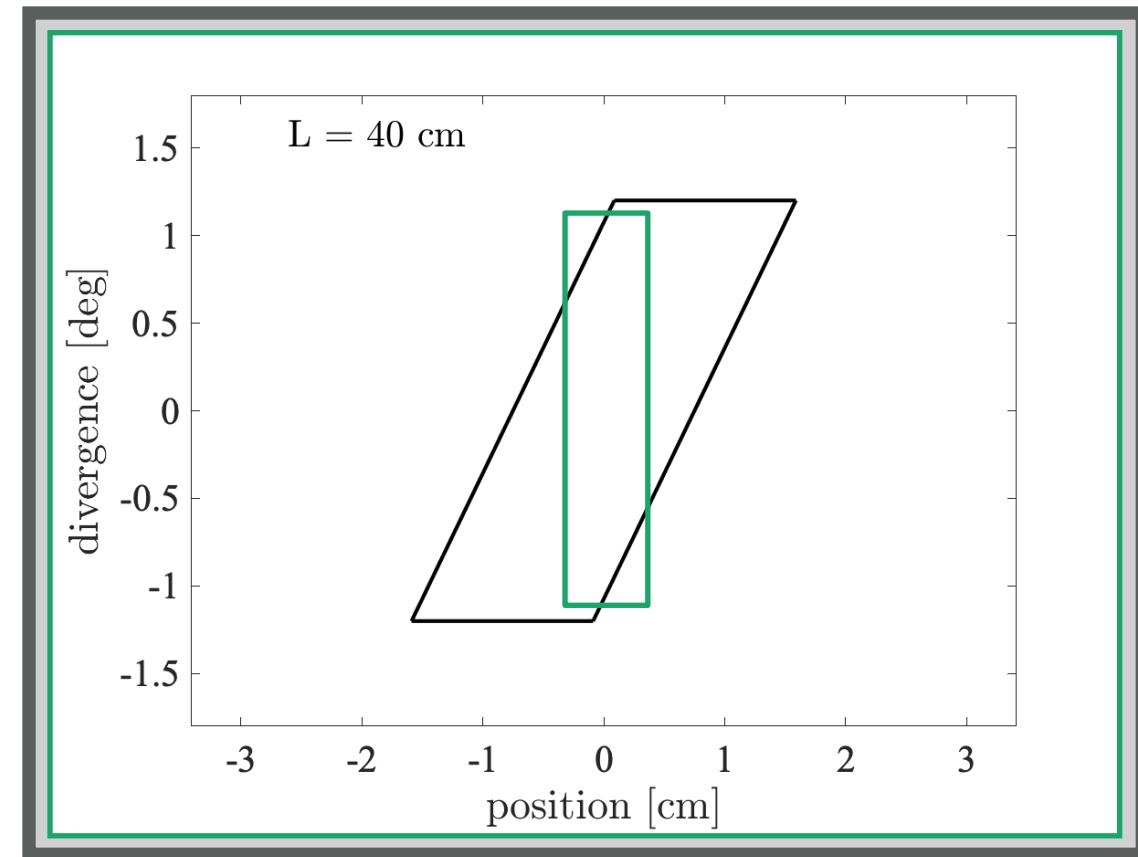
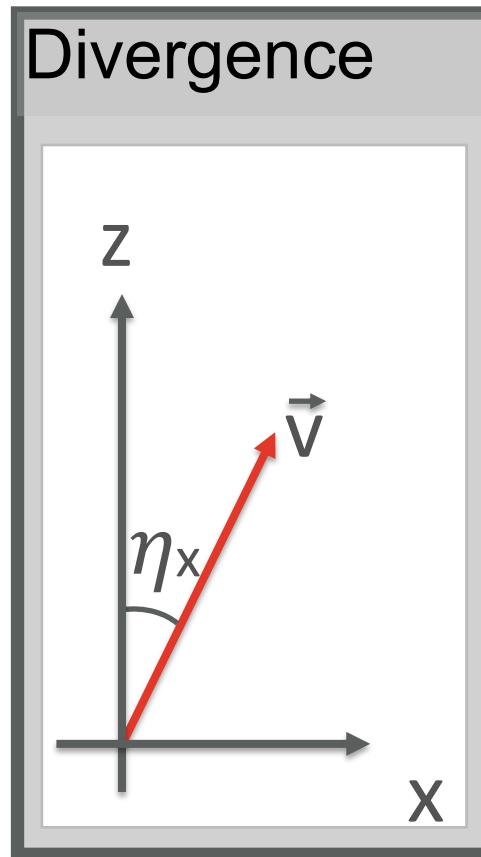
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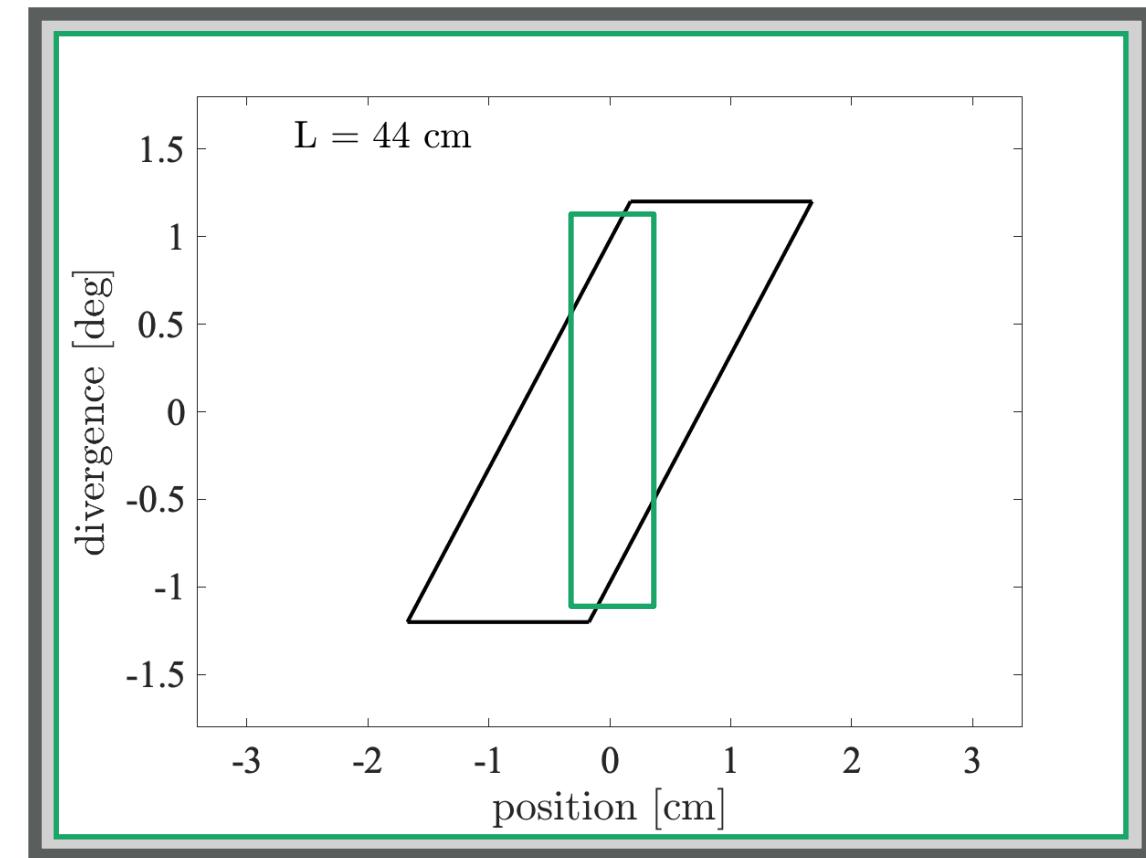
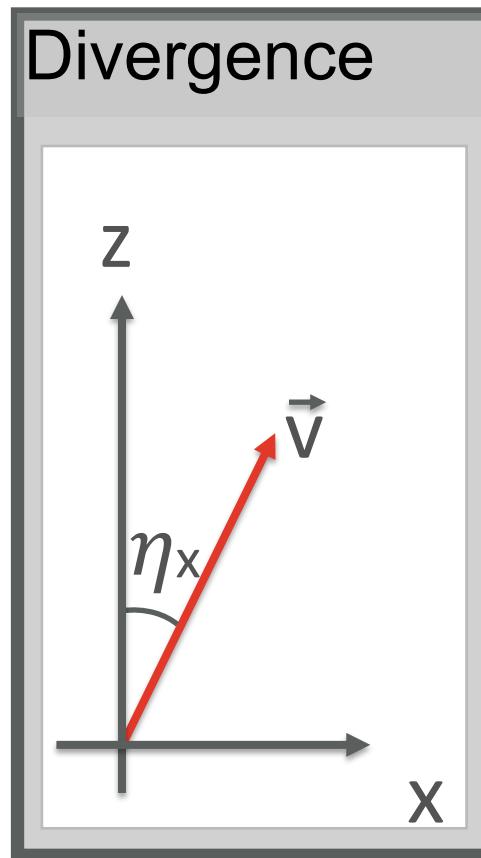
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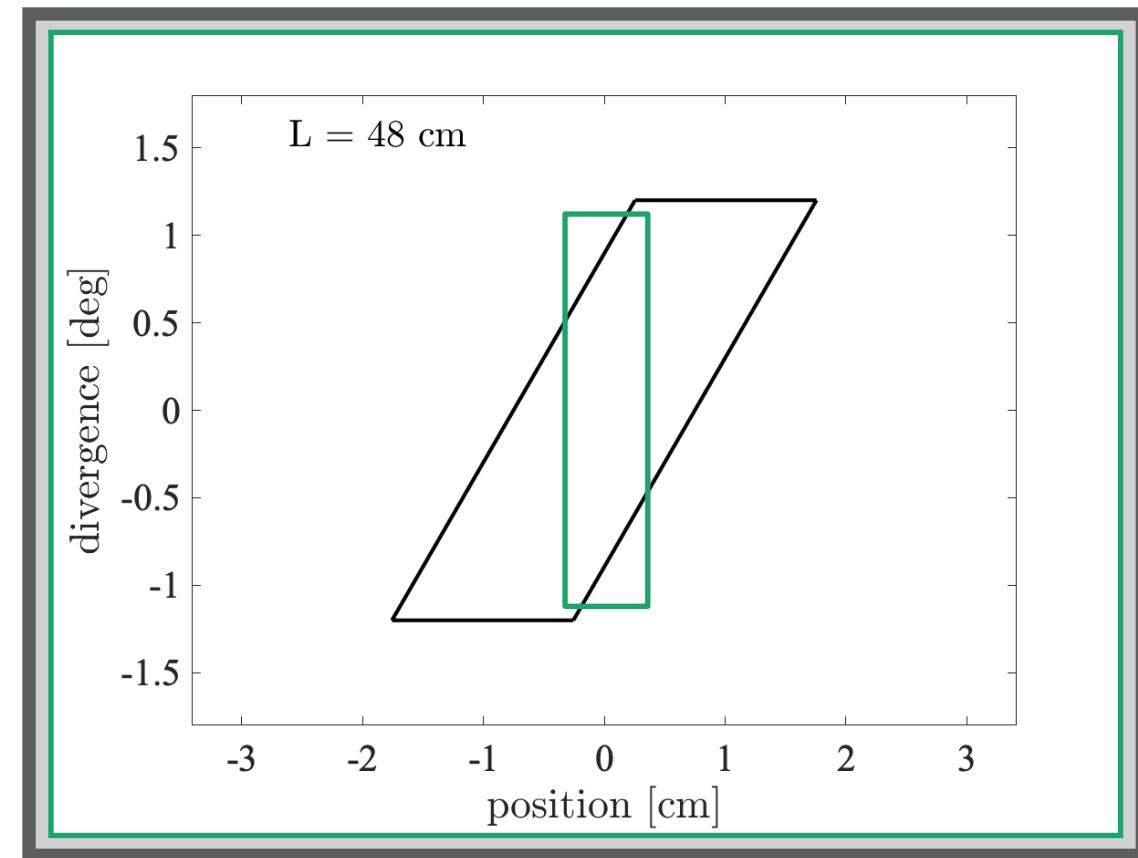
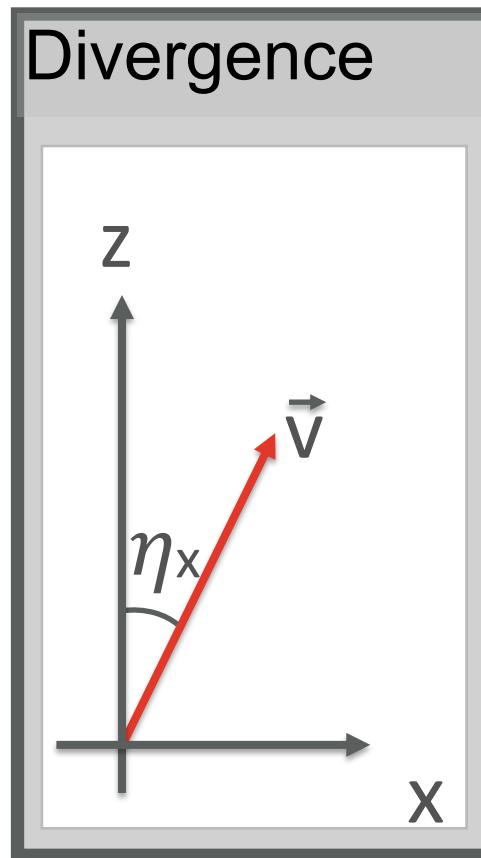
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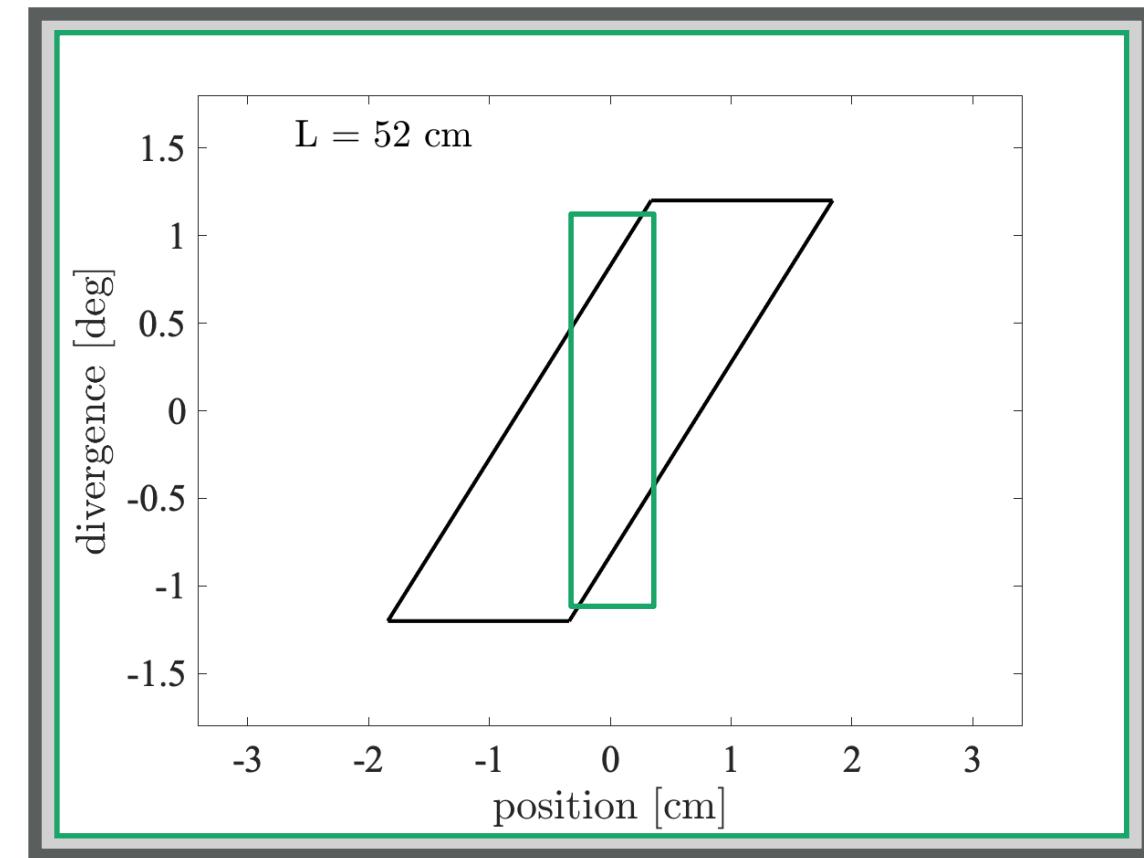
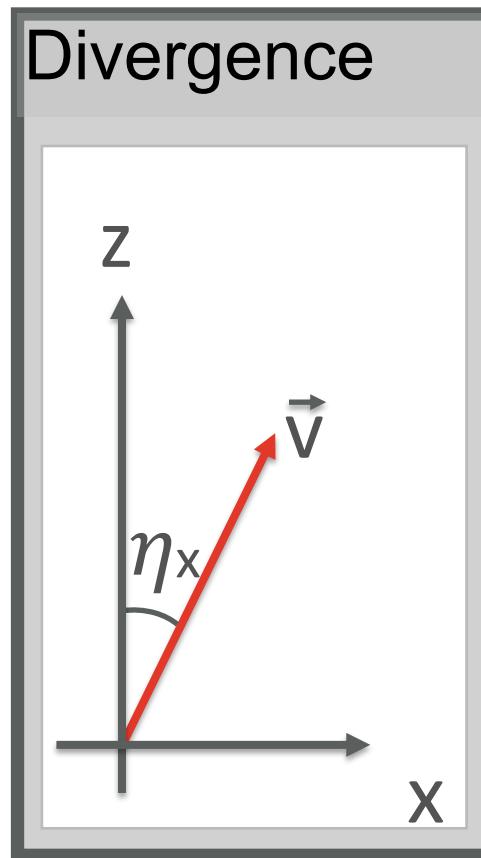
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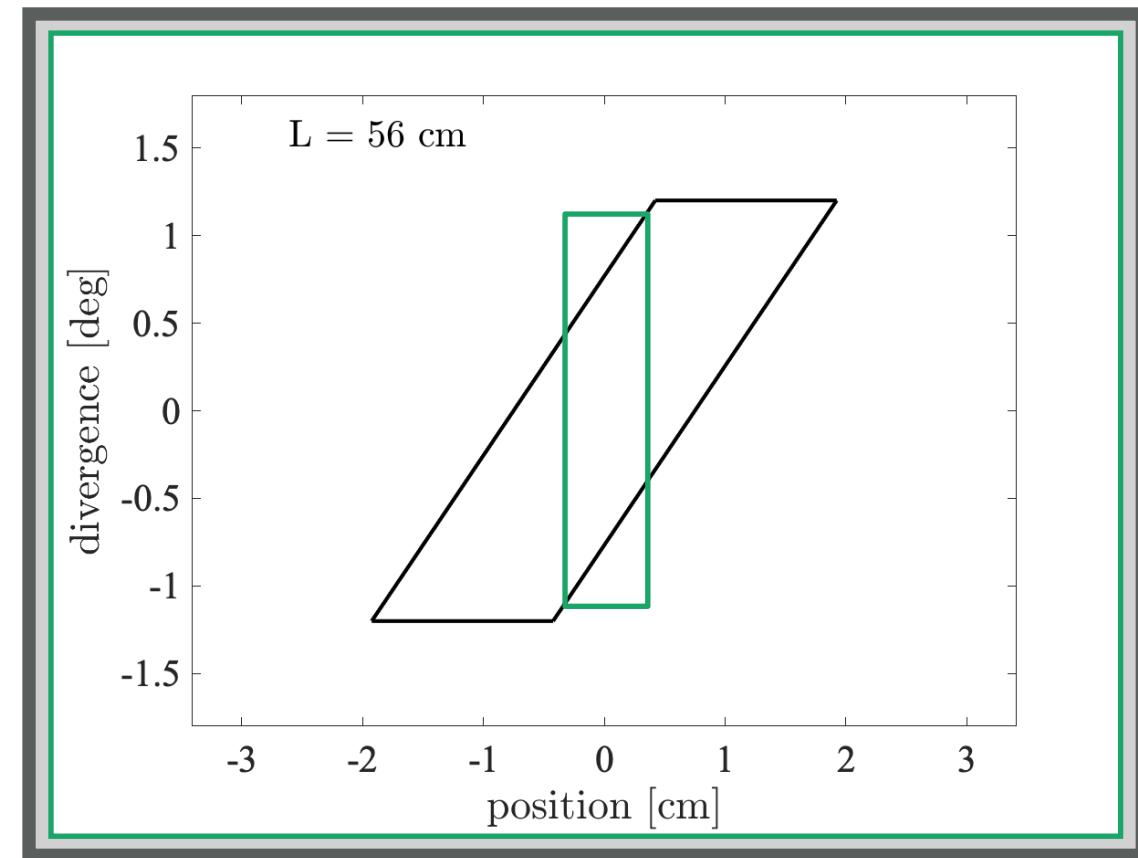
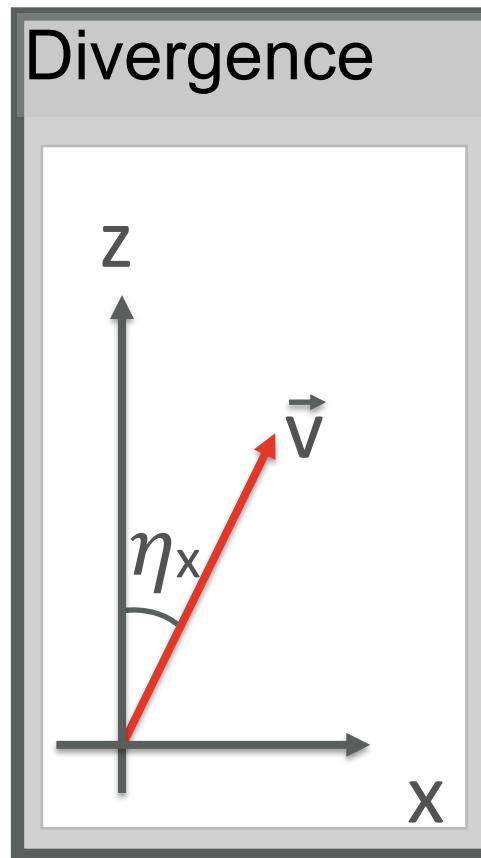
Beam propagation in free space



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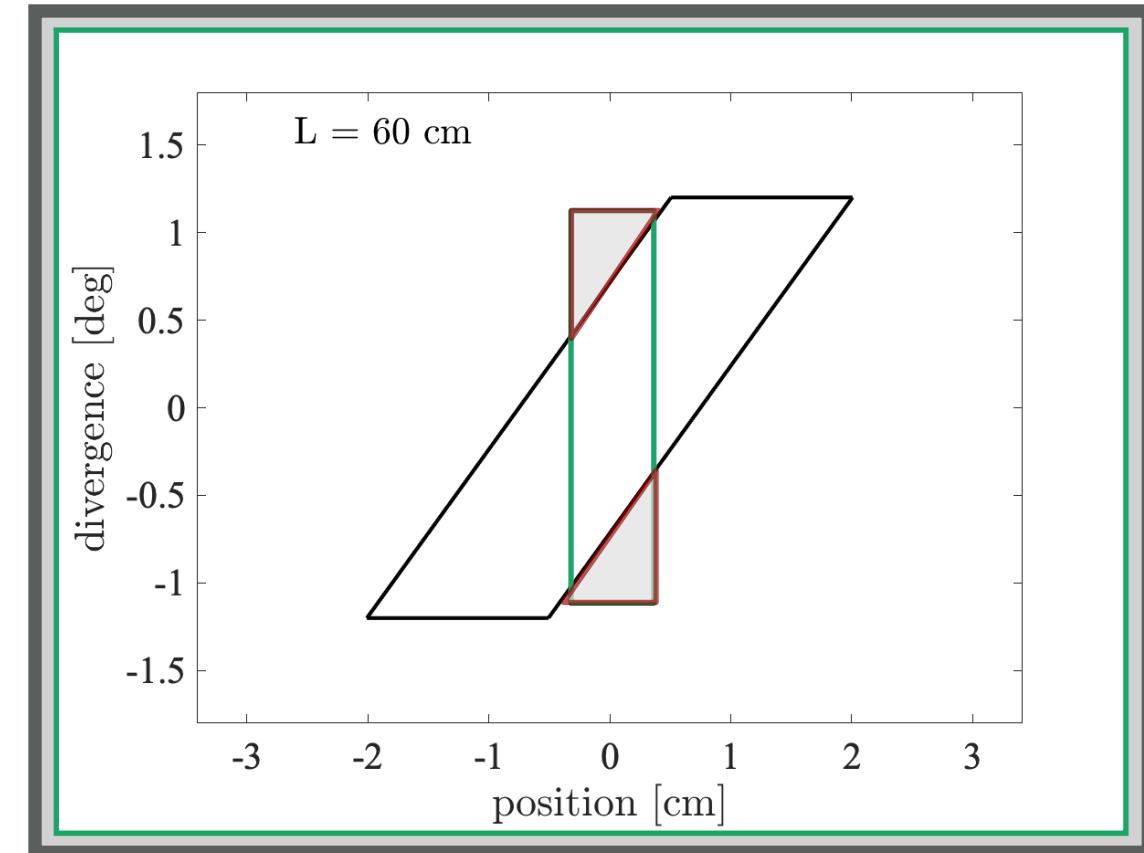
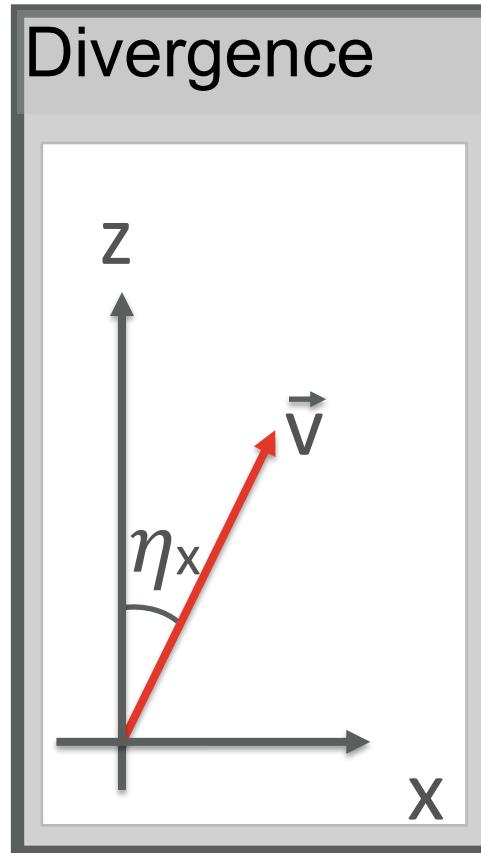


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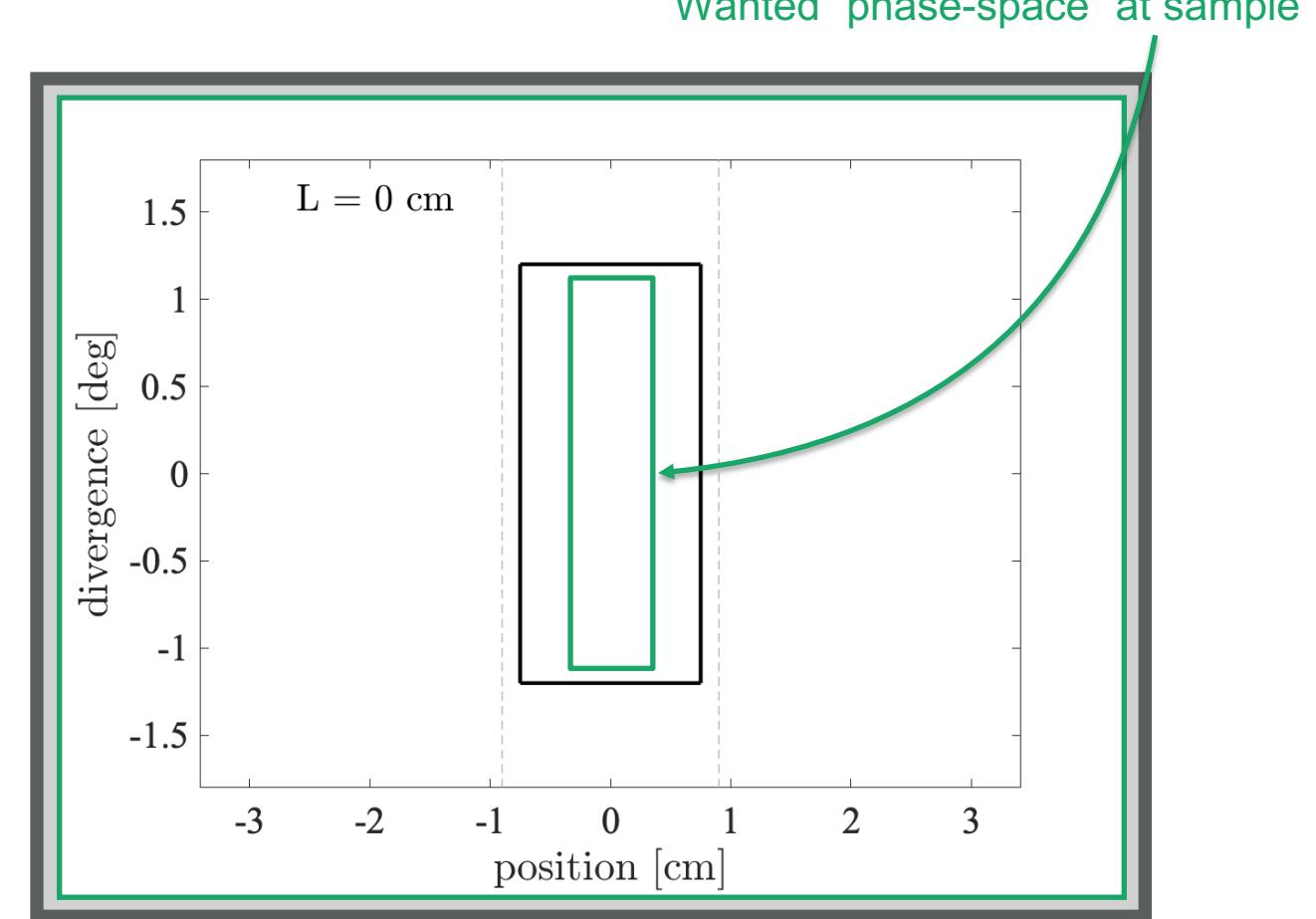
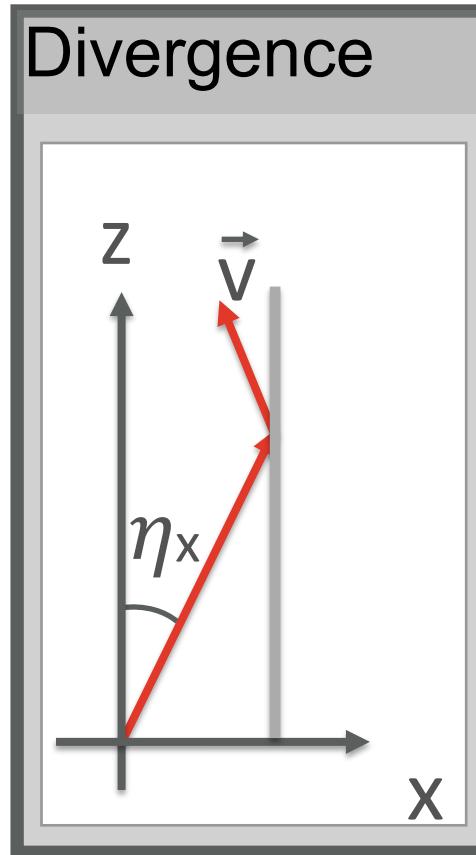


Beam propagation in free space

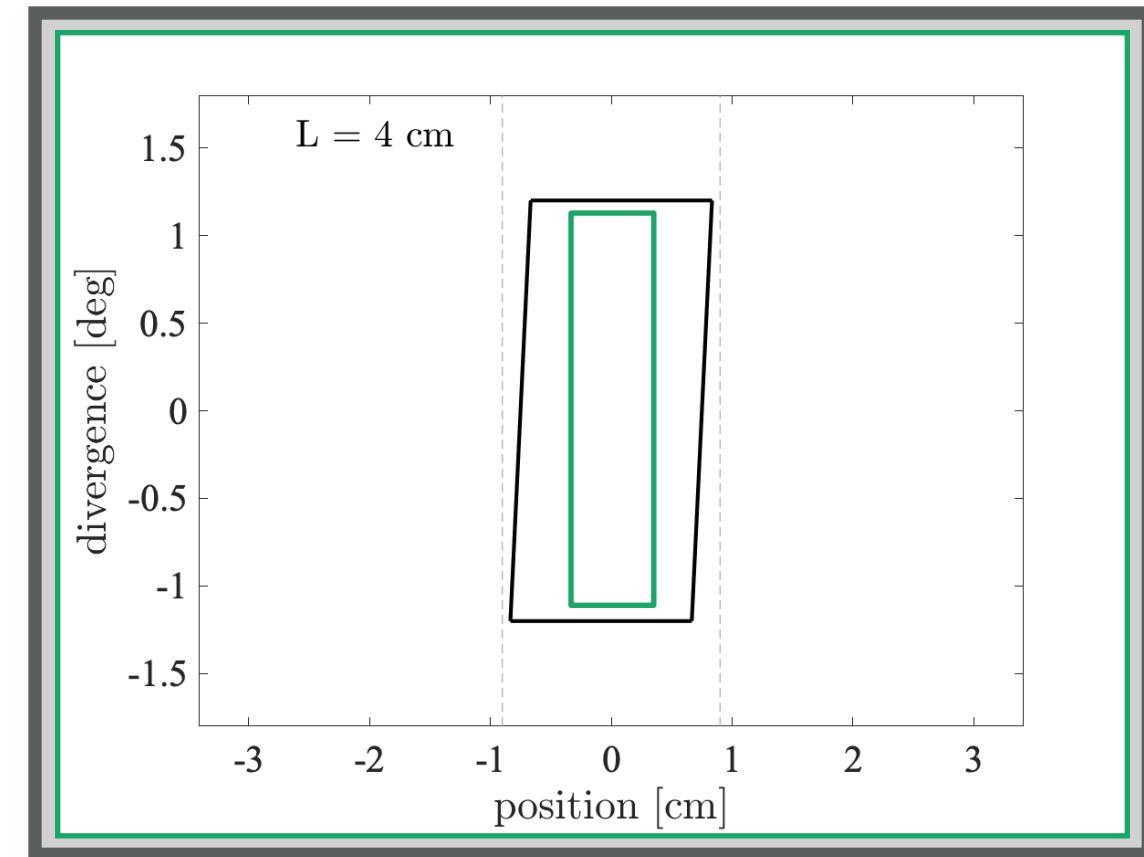
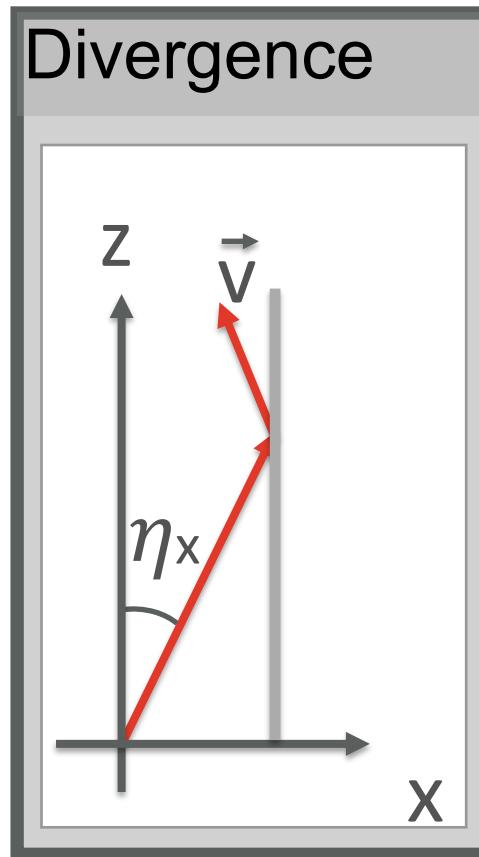
- We lost some phase-space to propagation



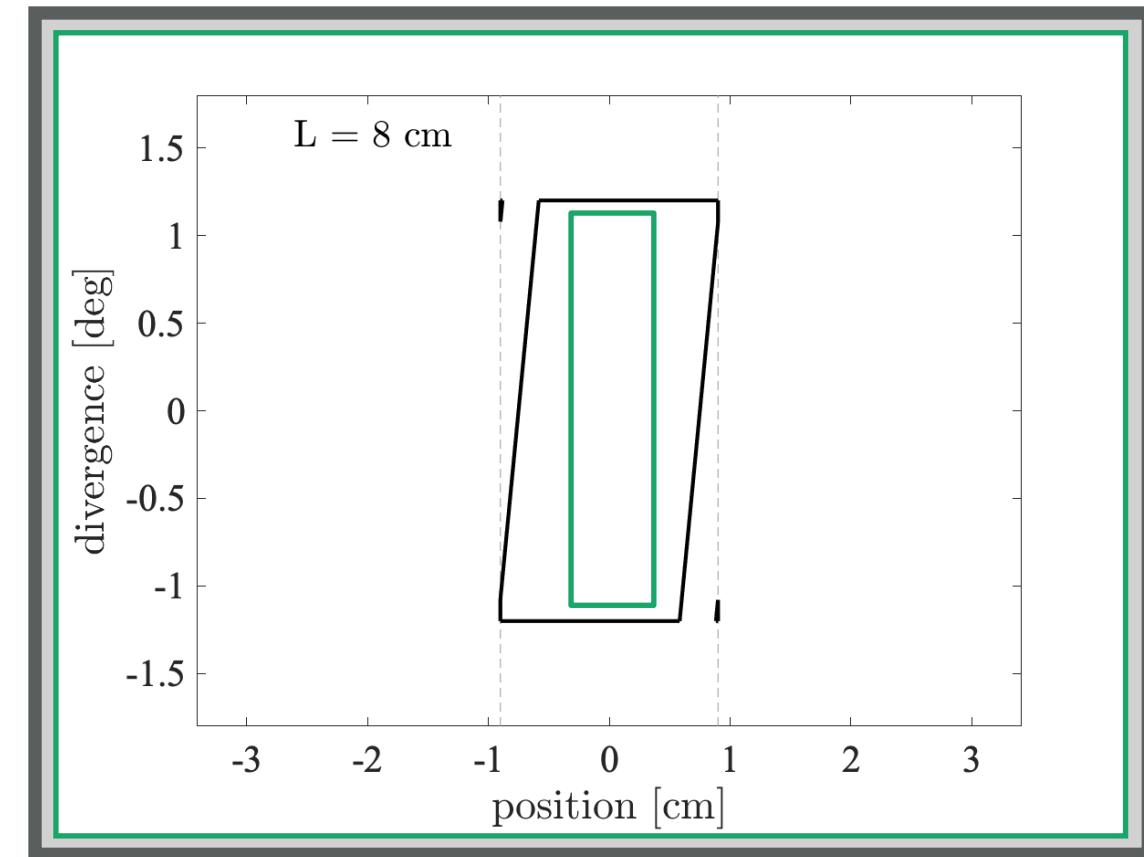
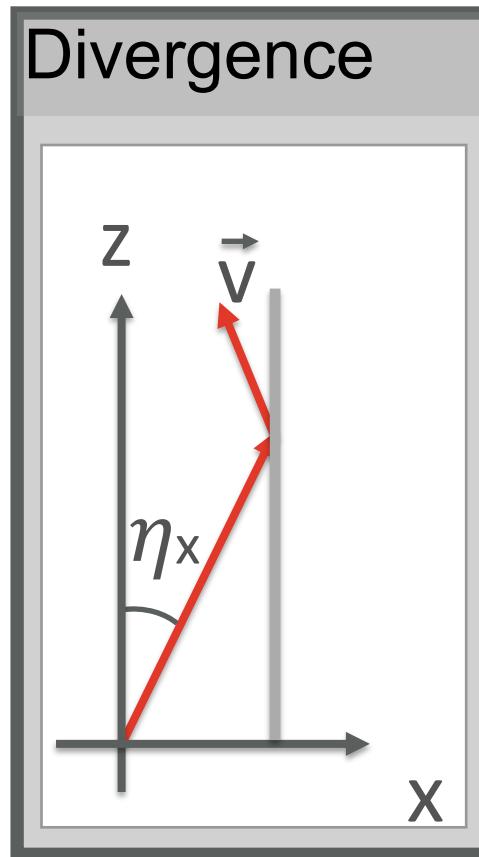
Beam propagation in guide



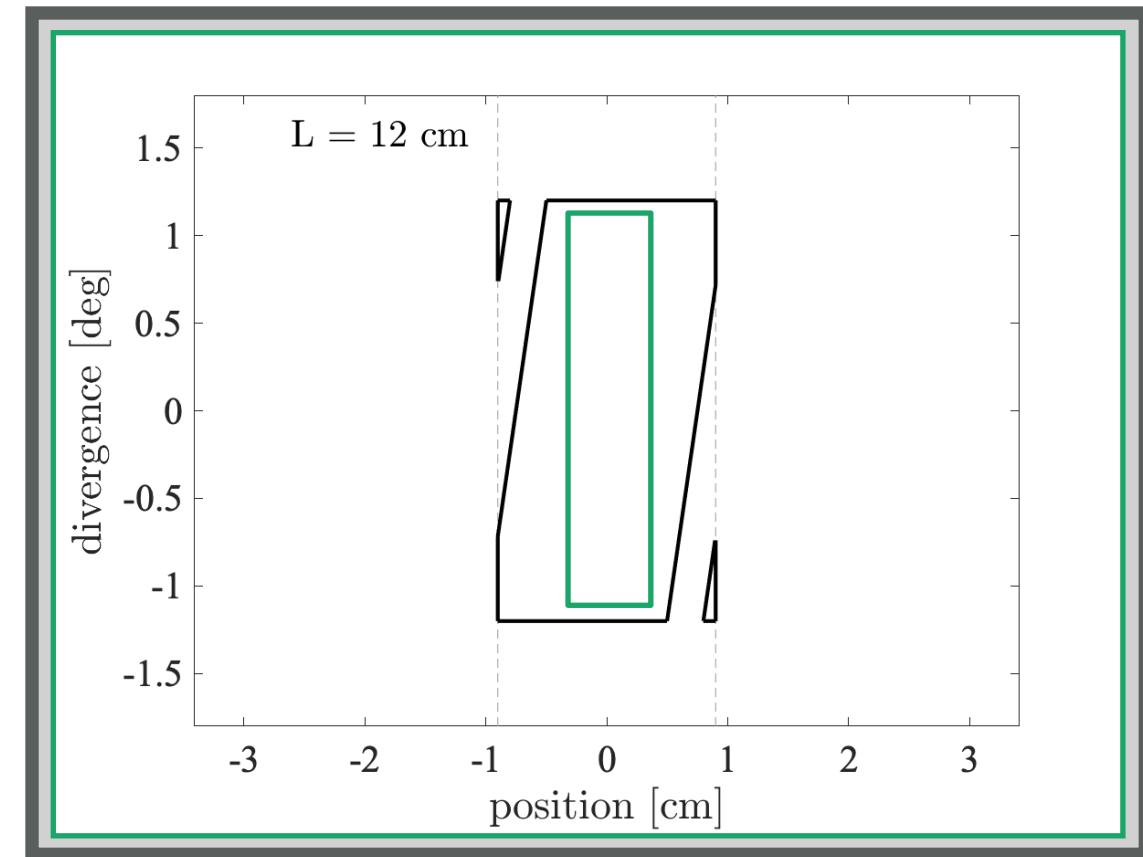
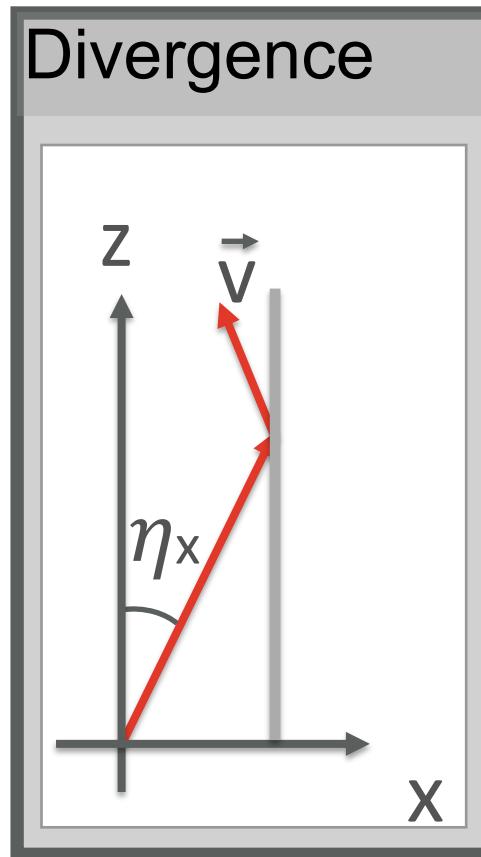
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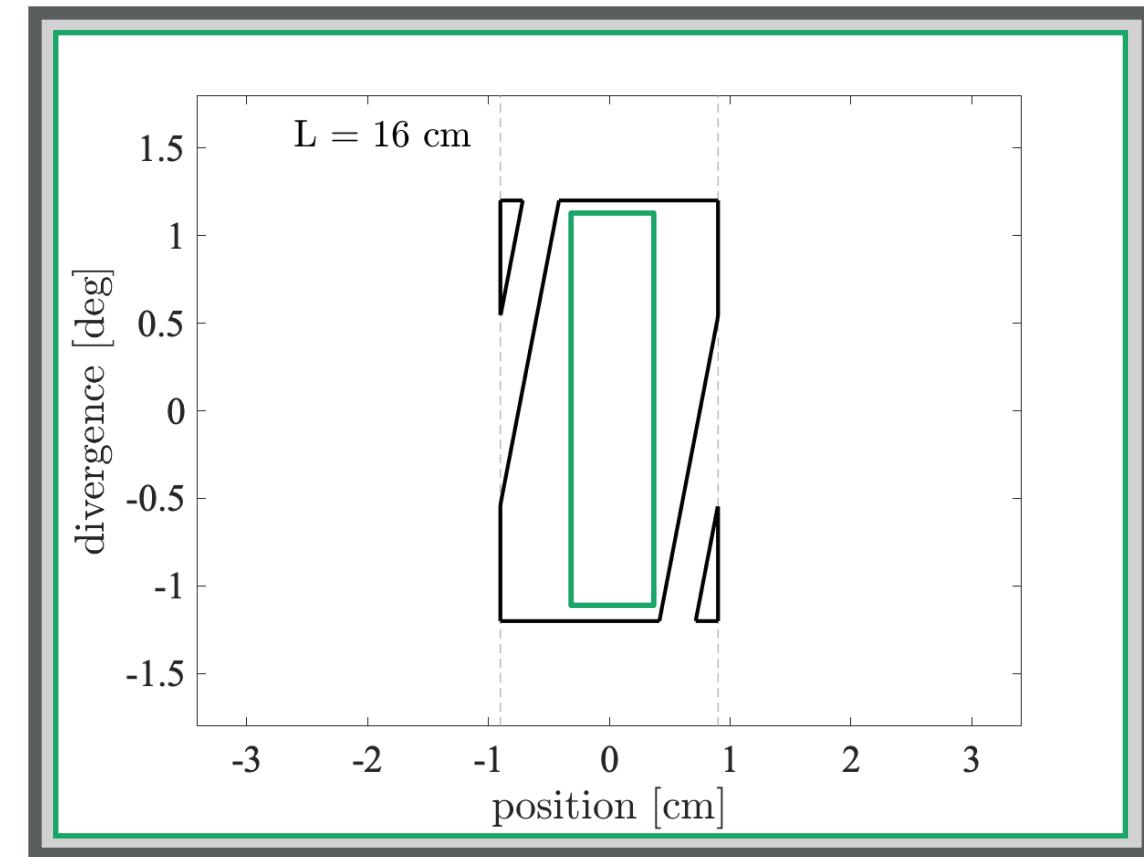
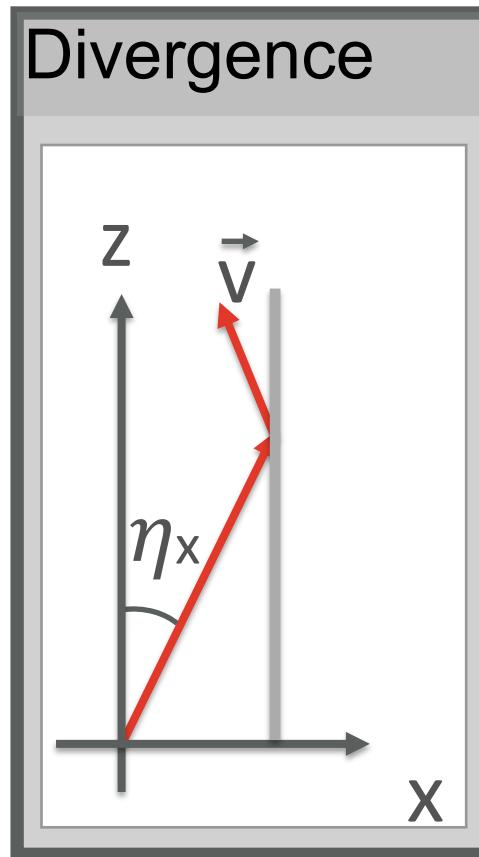
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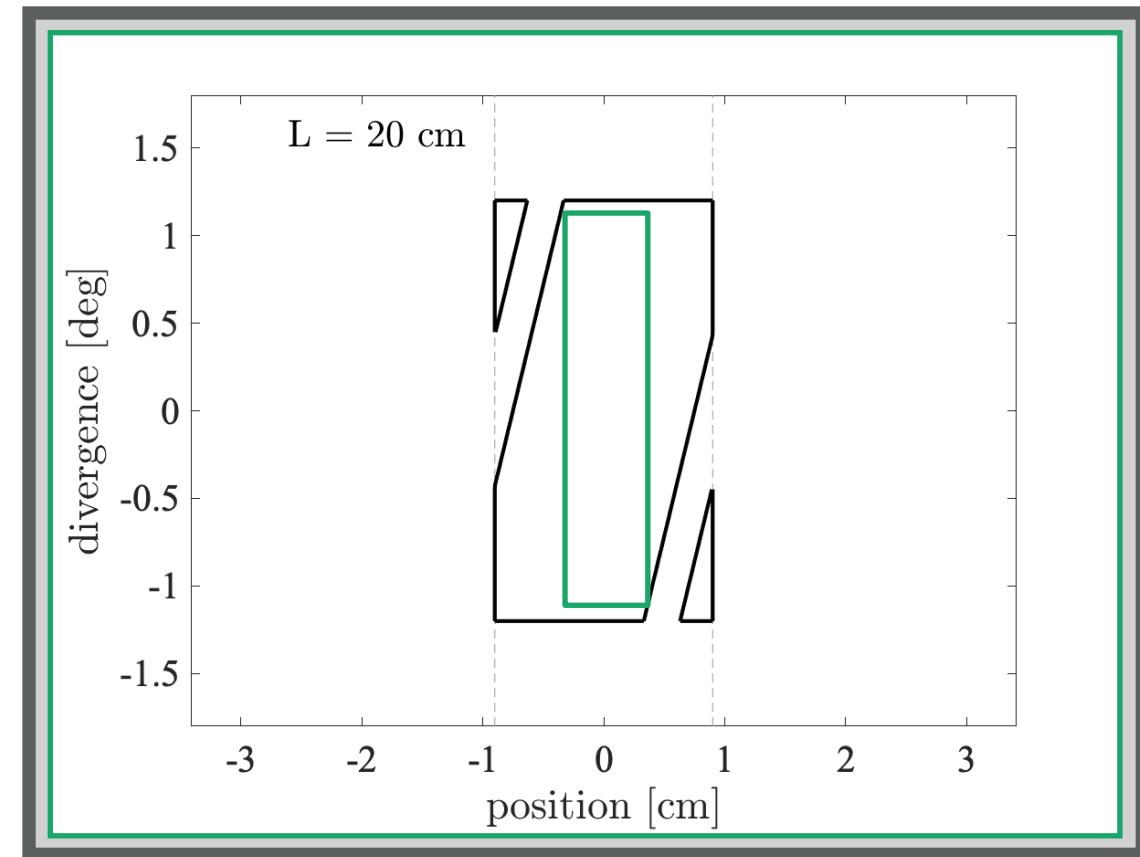
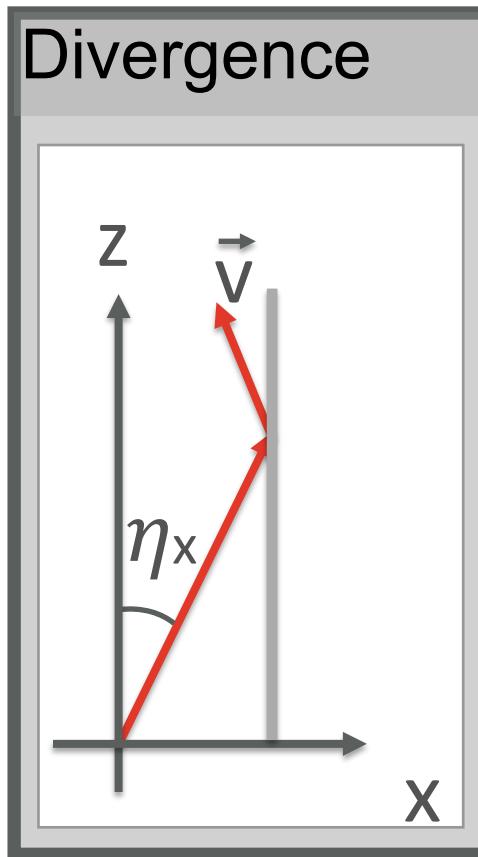
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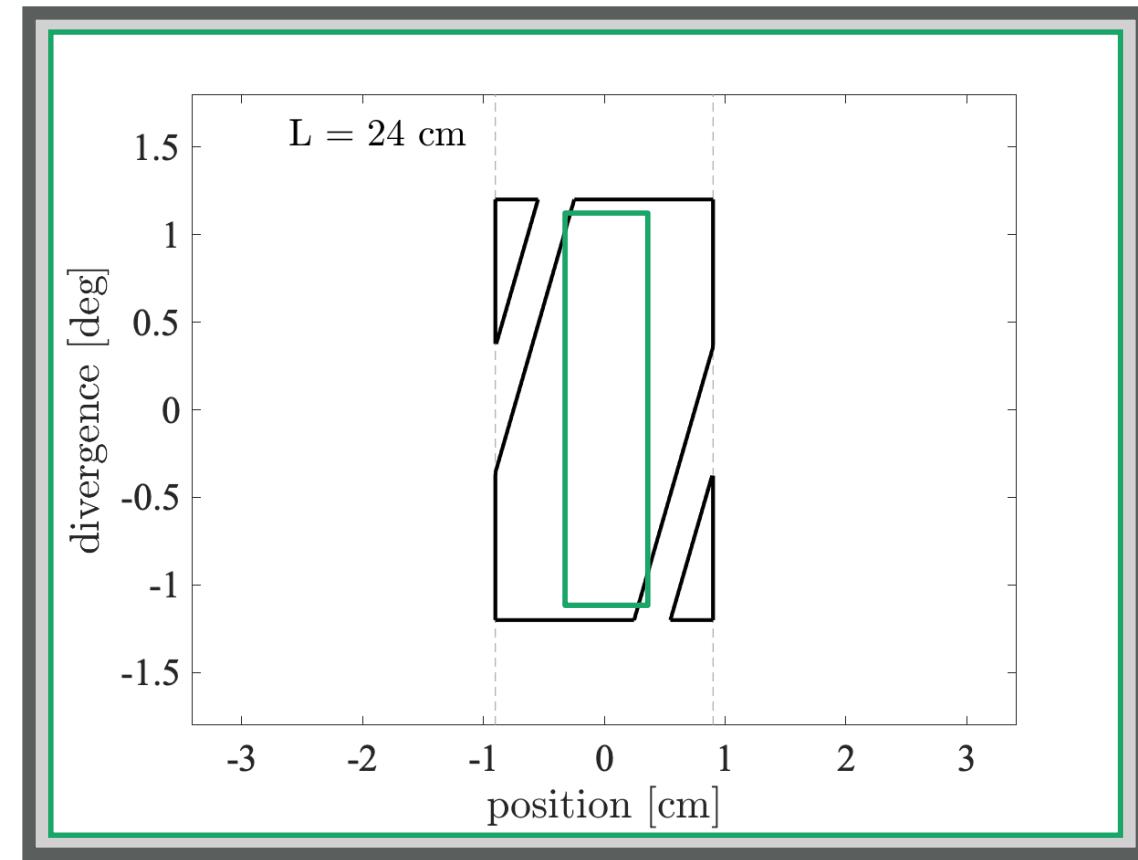
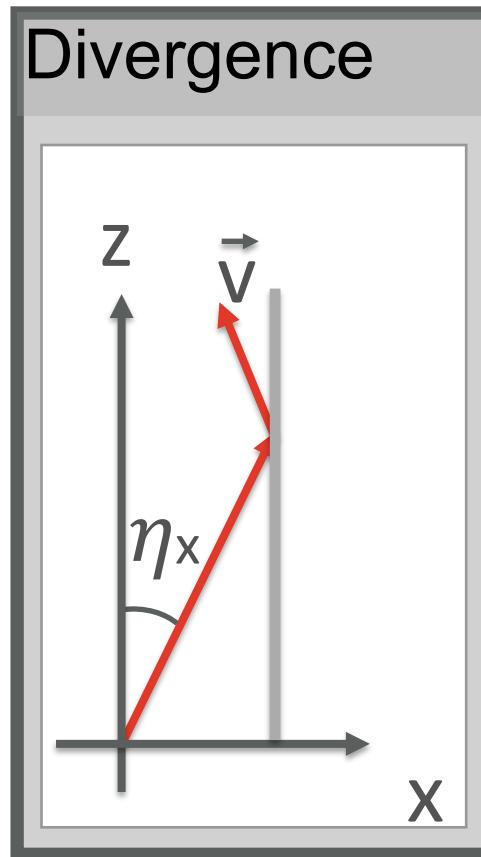
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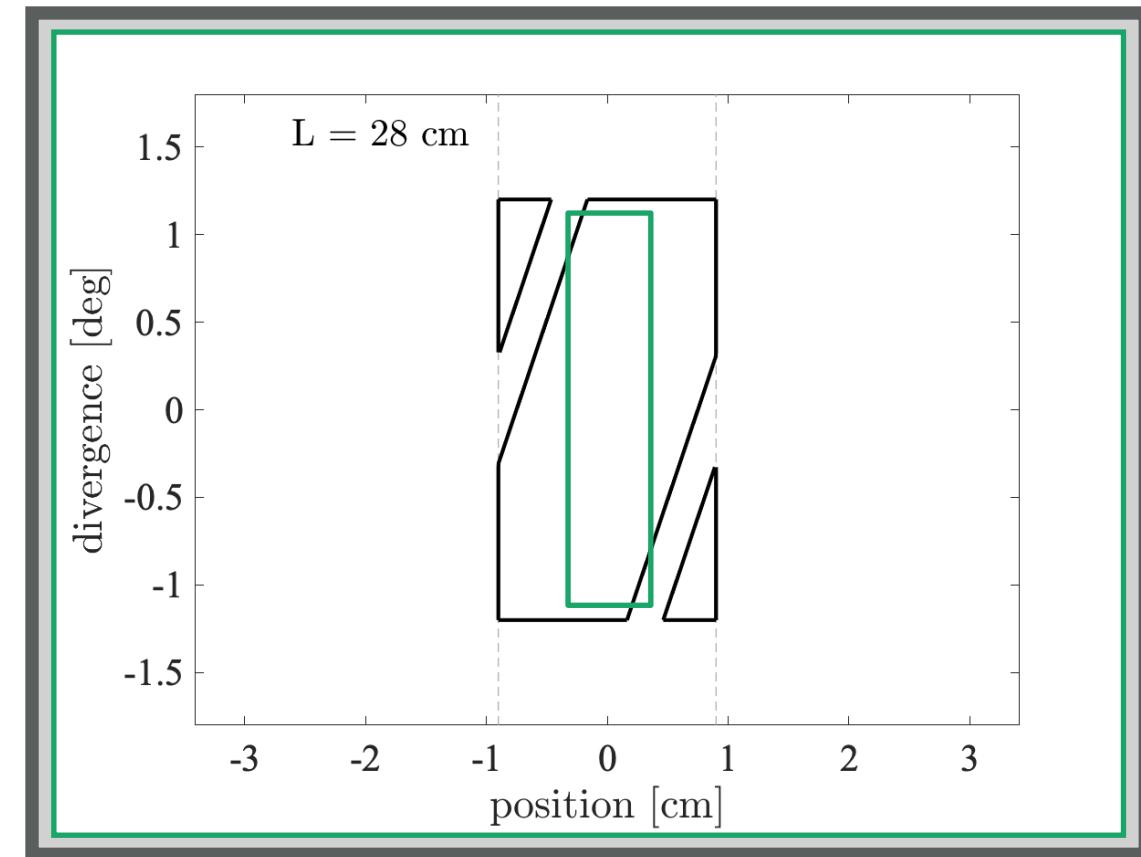
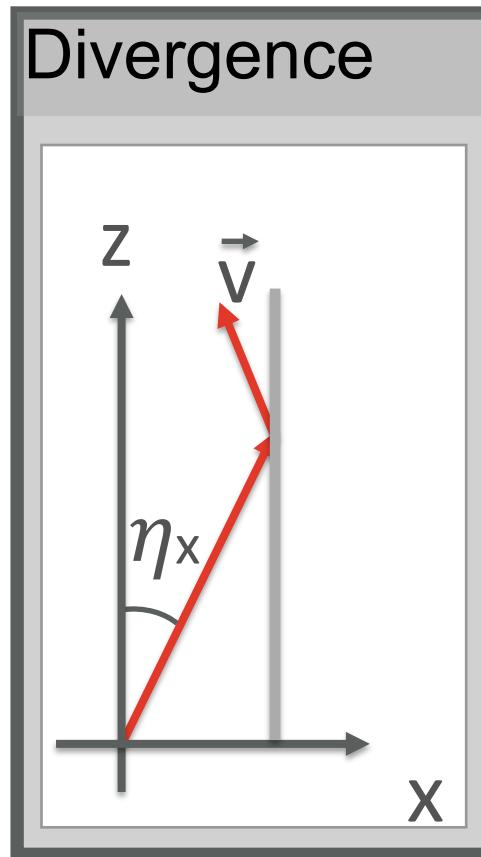
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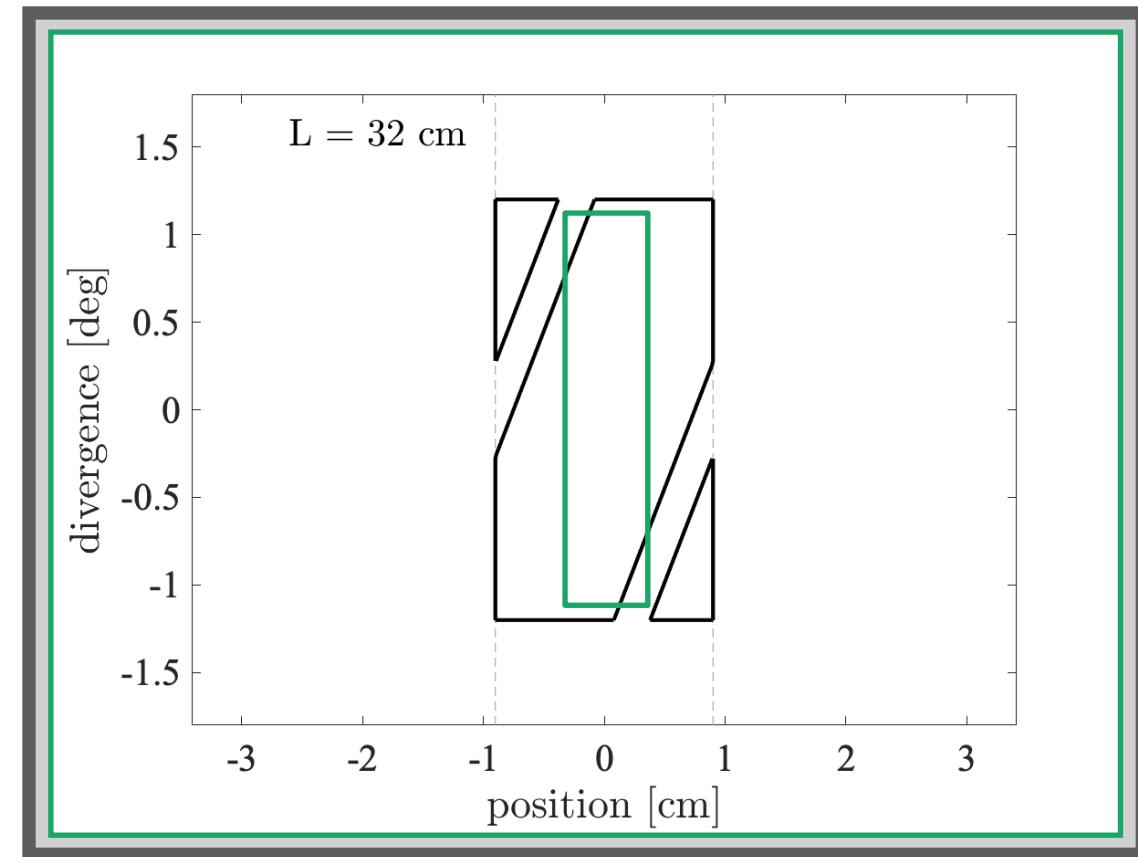
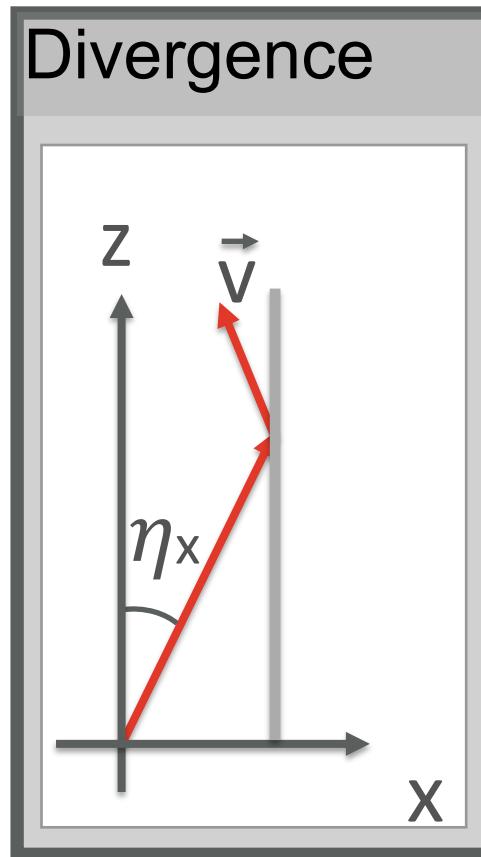
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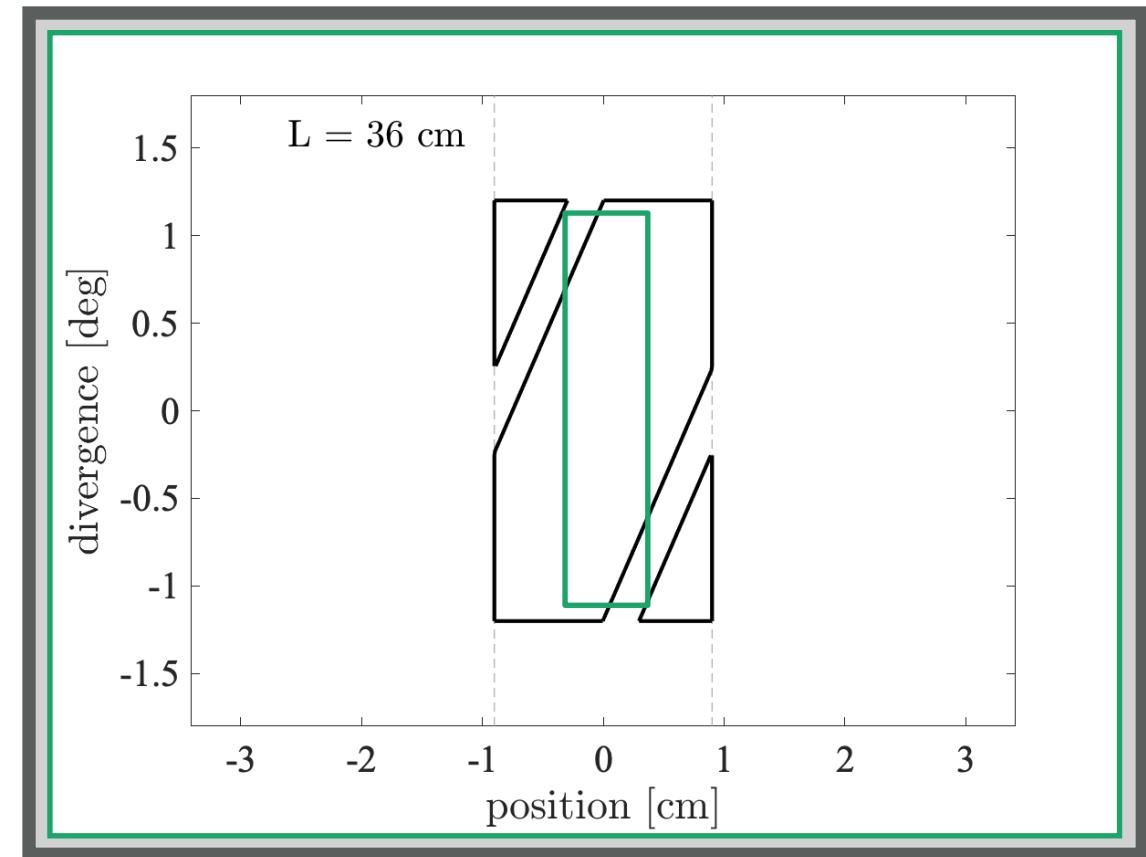
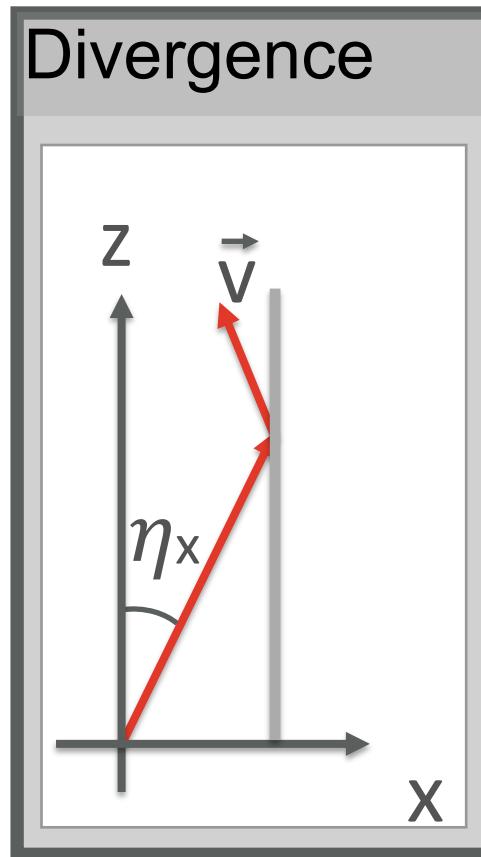
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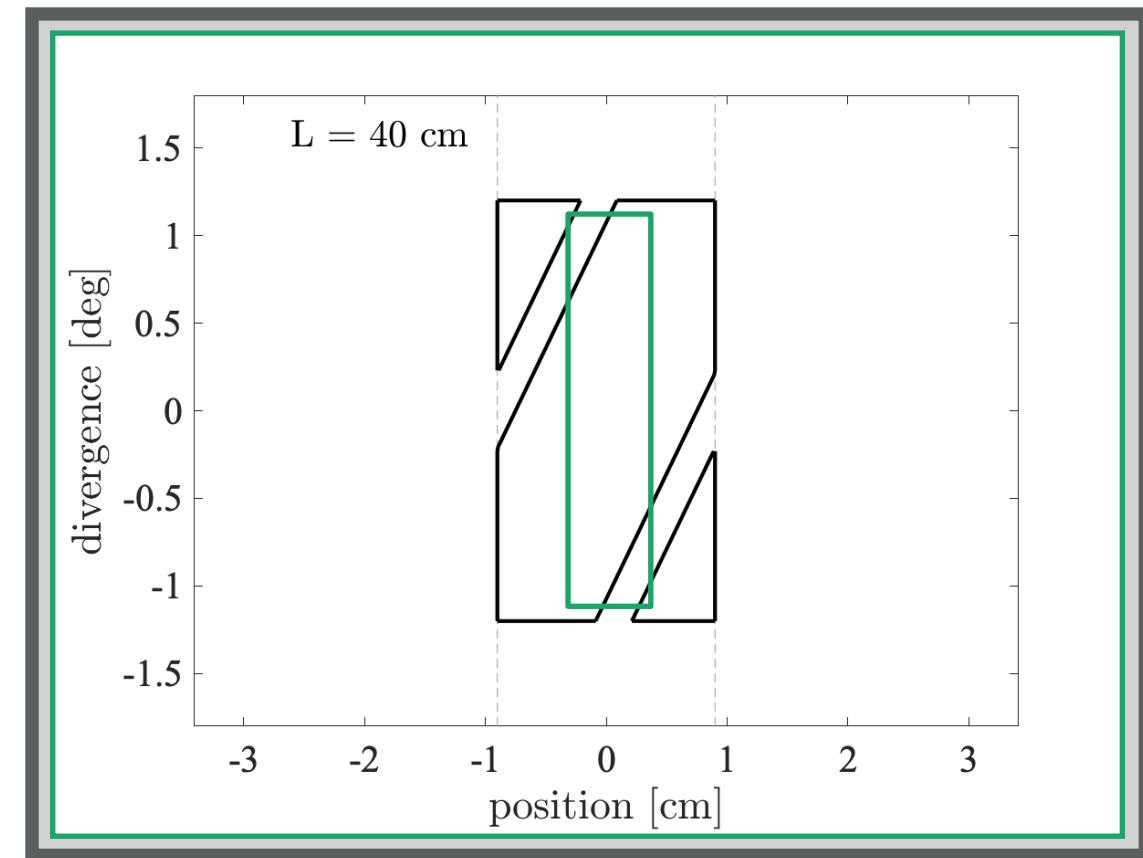
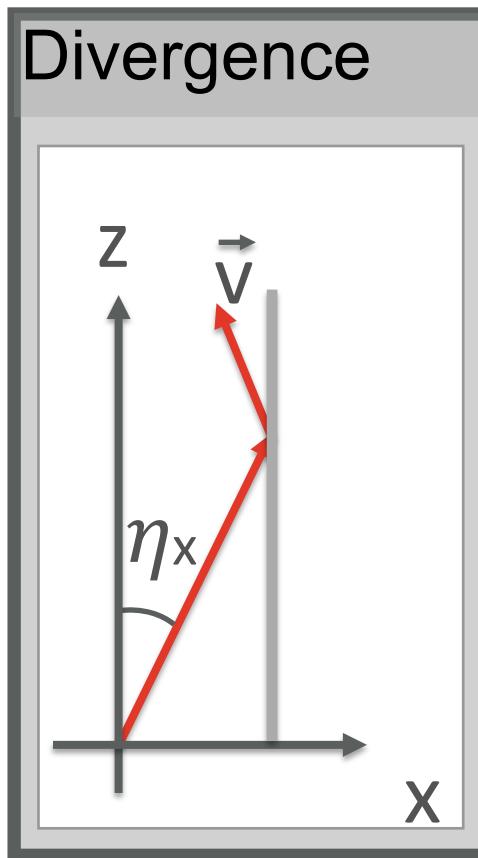
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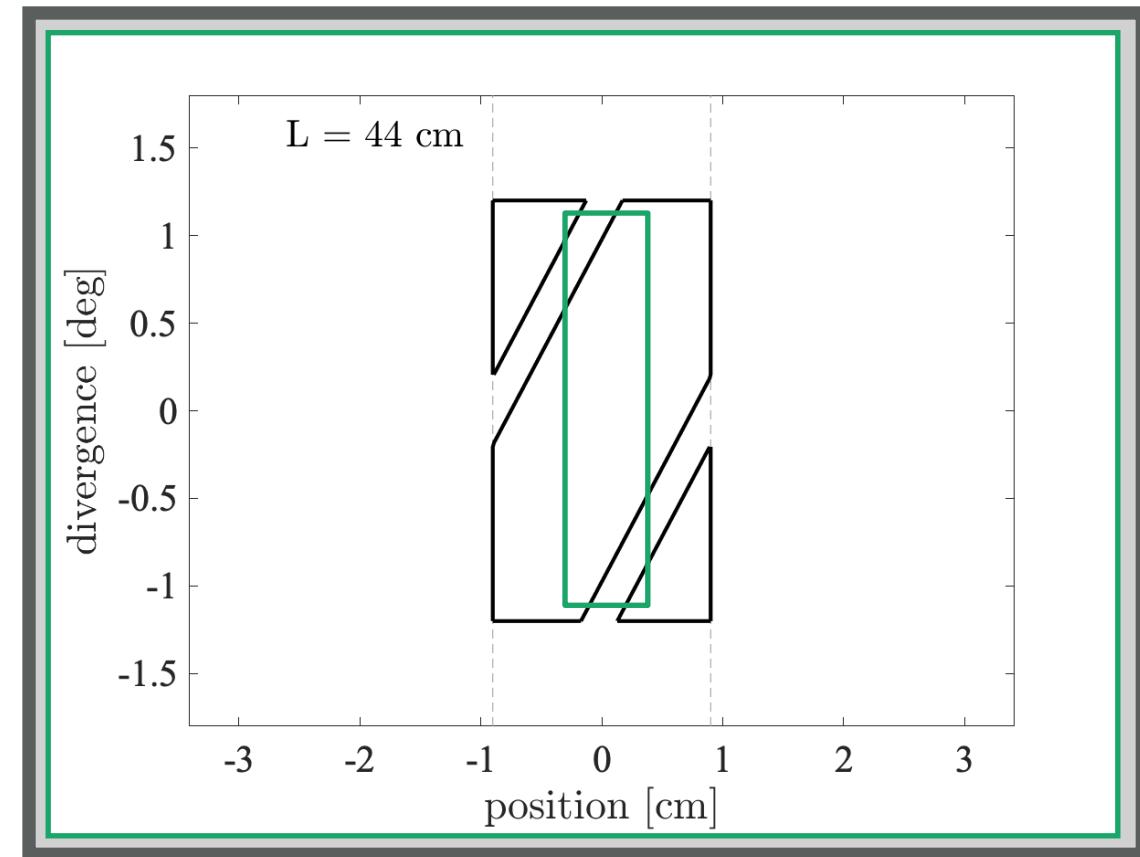
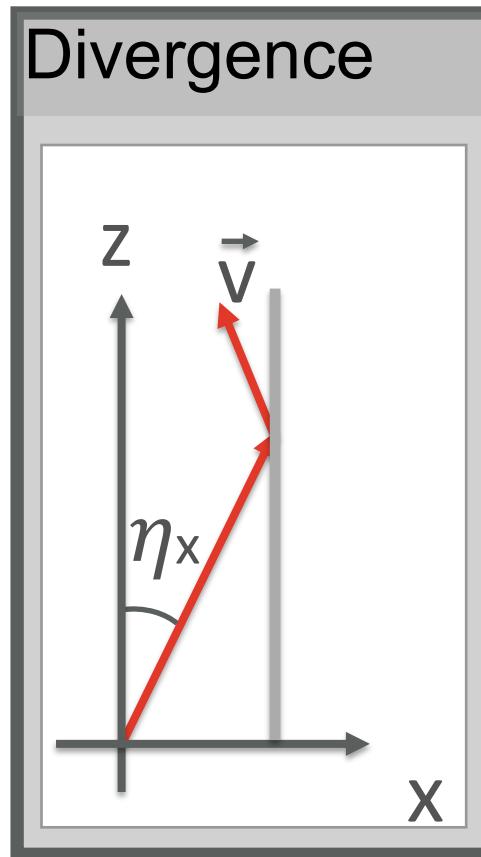
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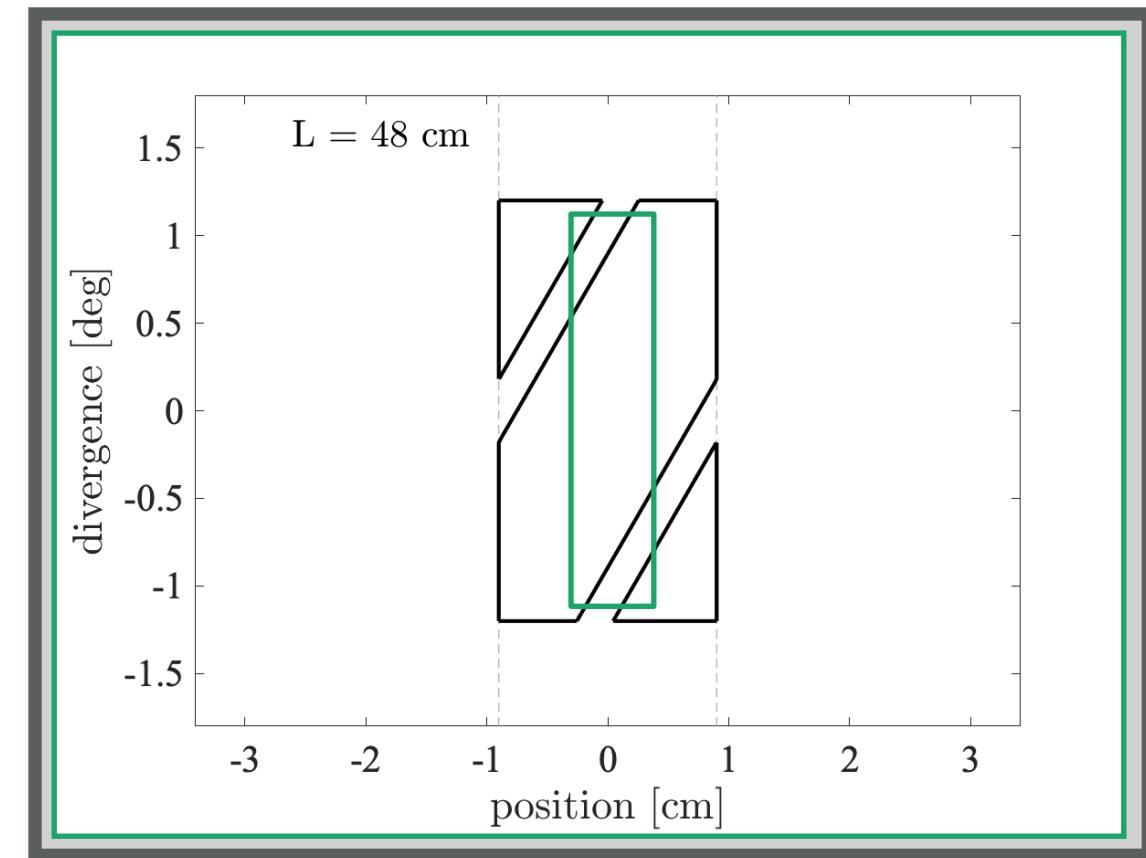
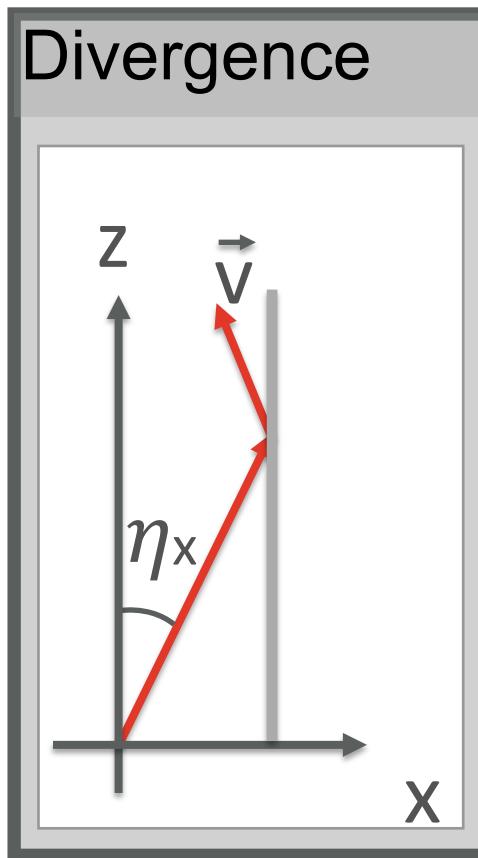
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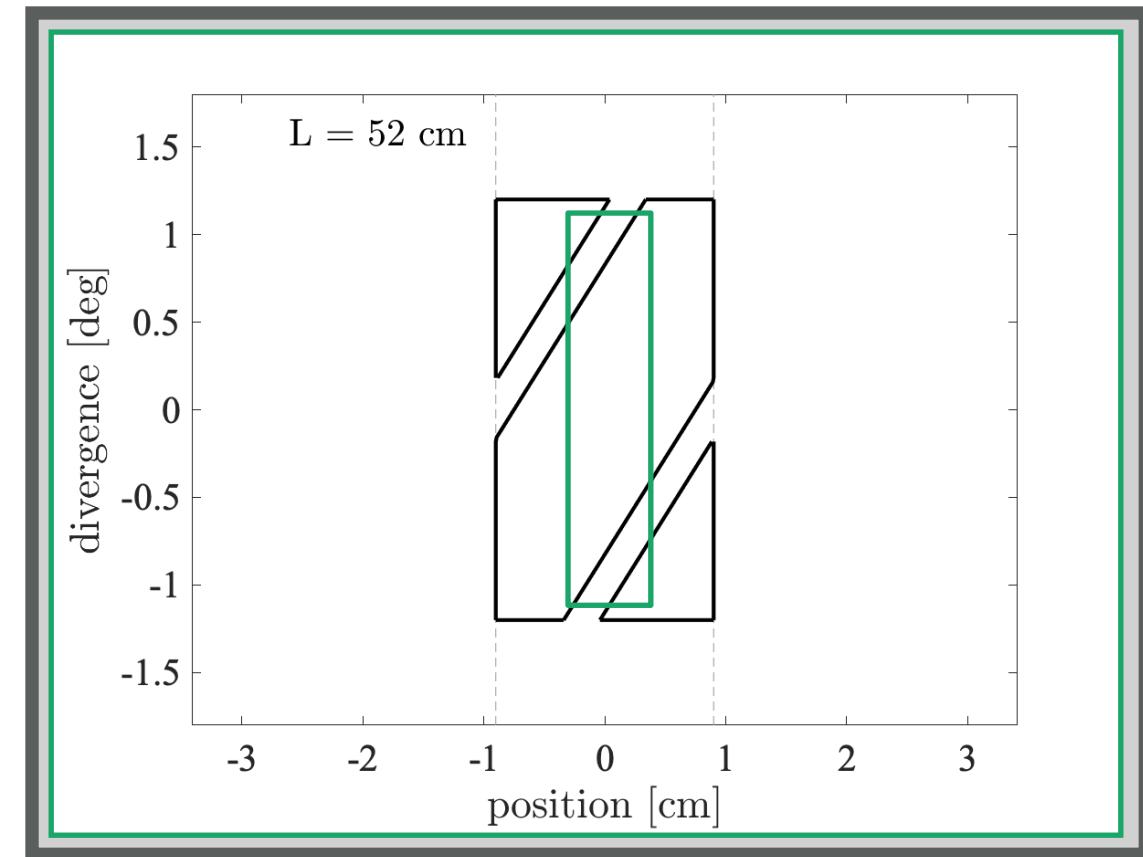
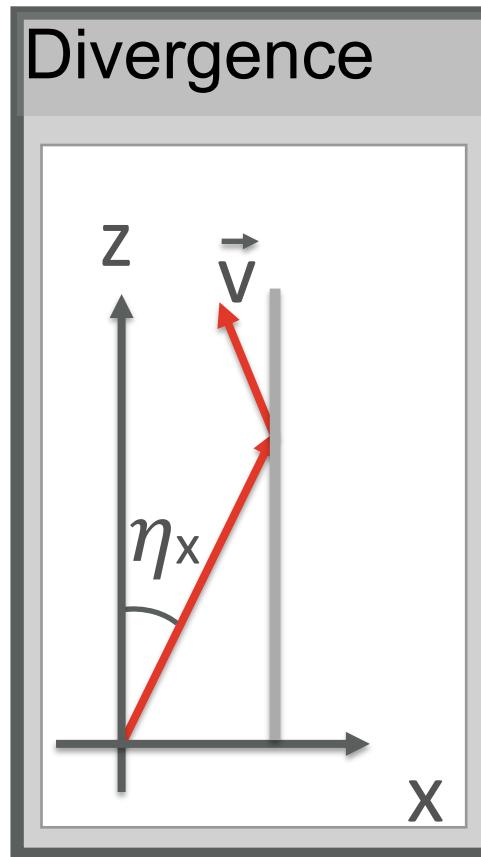
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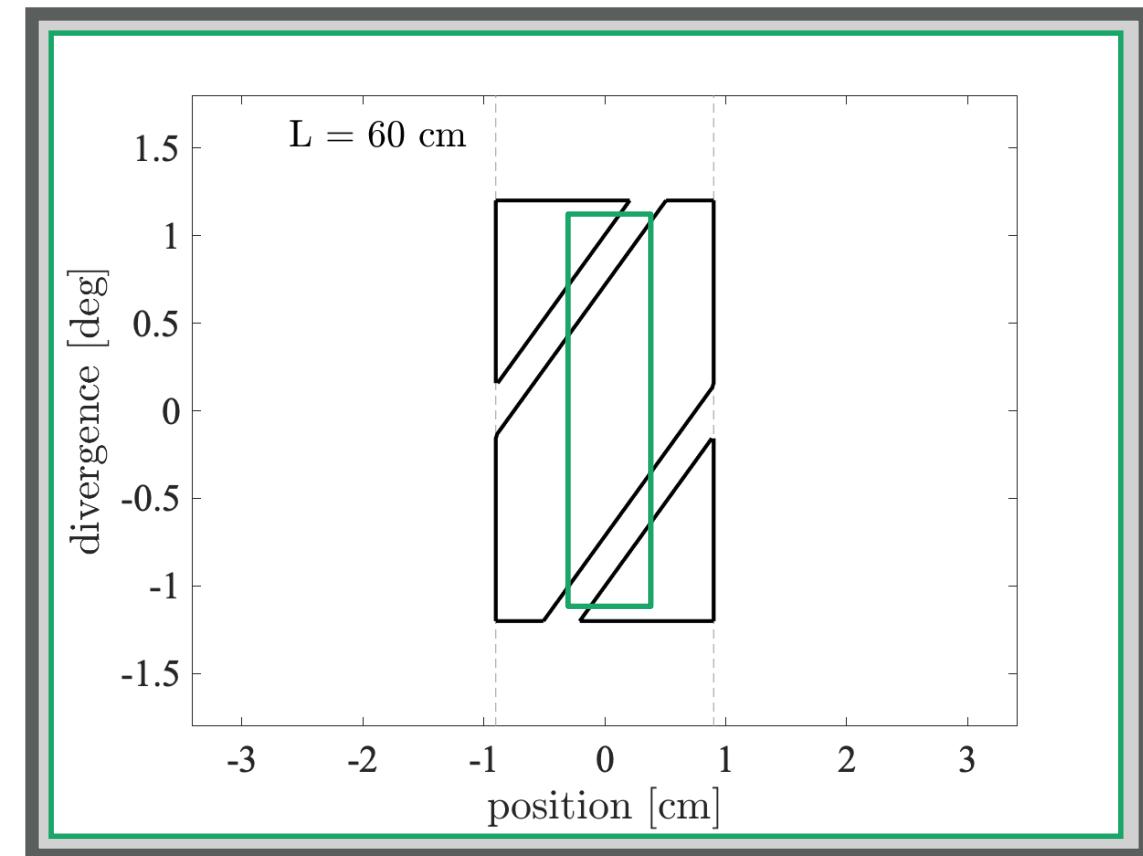
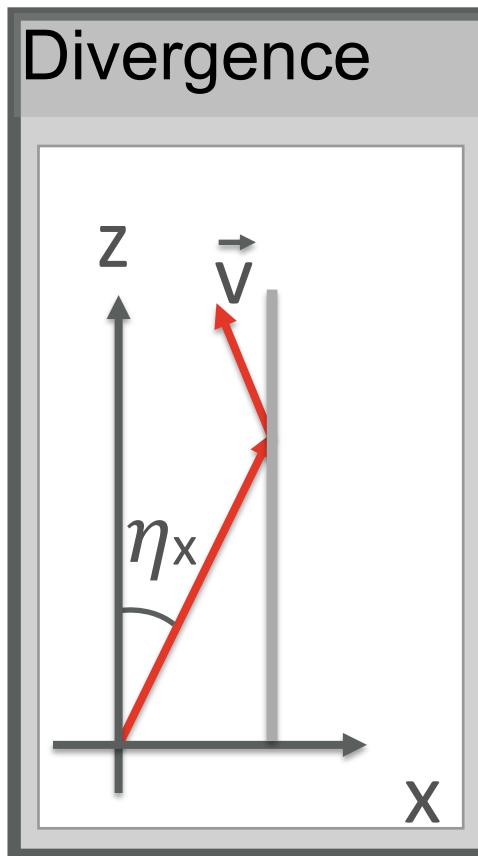
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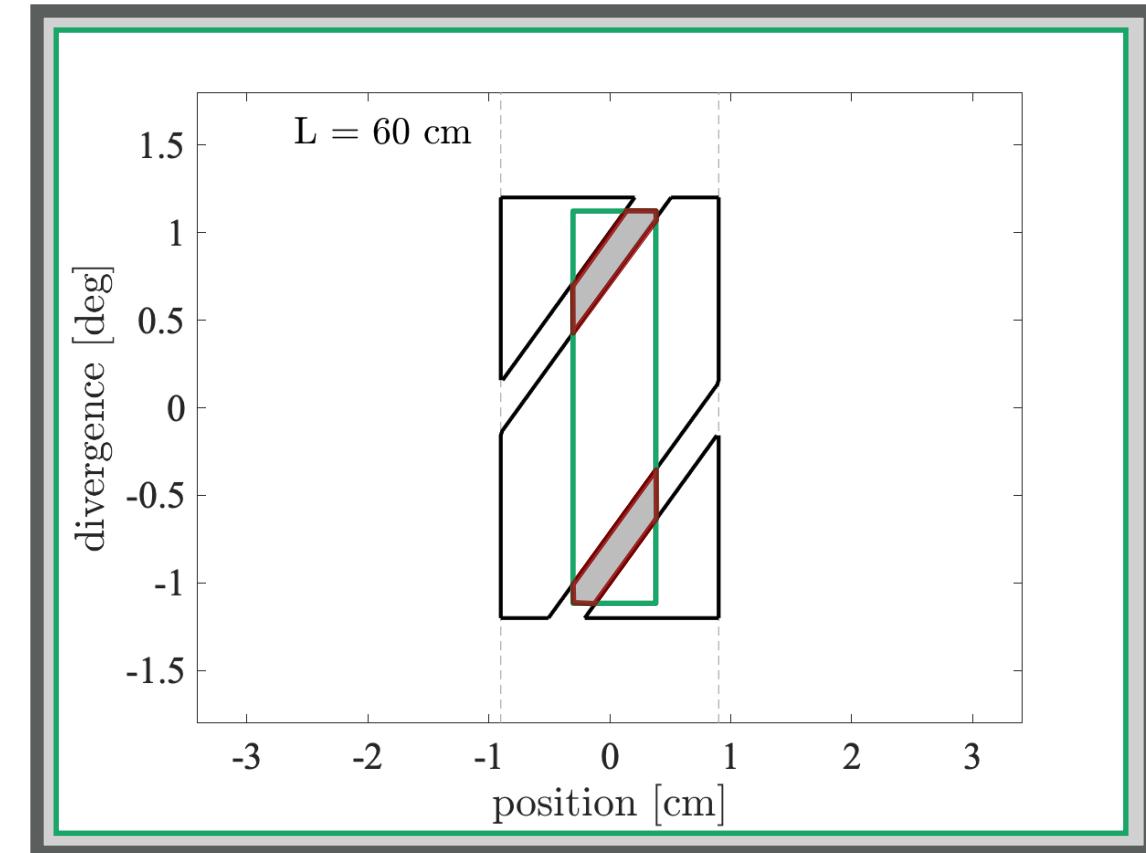
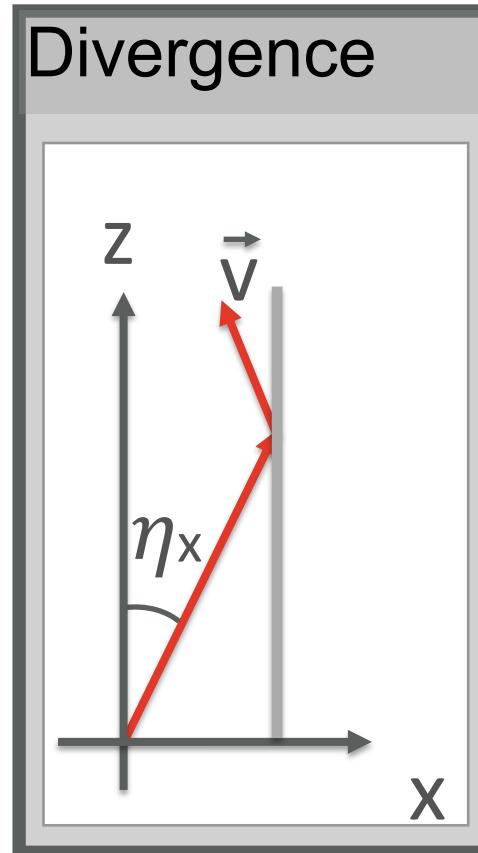


Beam propagation in guide



Beam propagation in guide

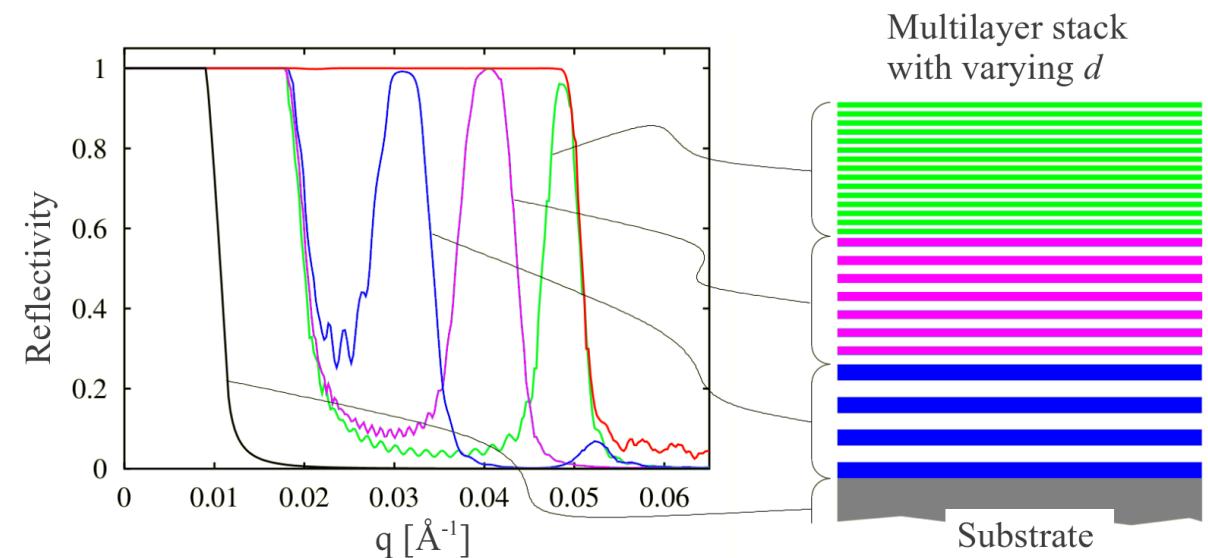
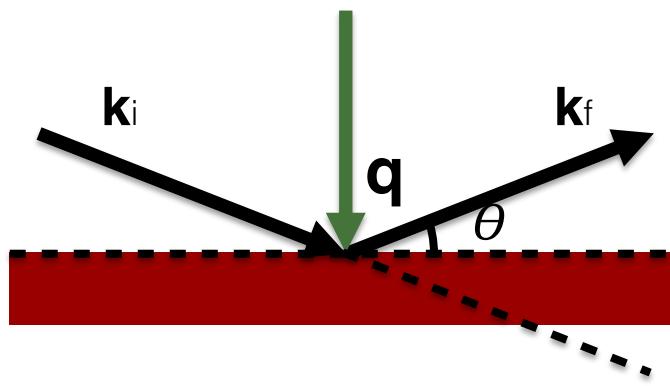
With a guide we lost less phase-space area!



Reflectivity curves

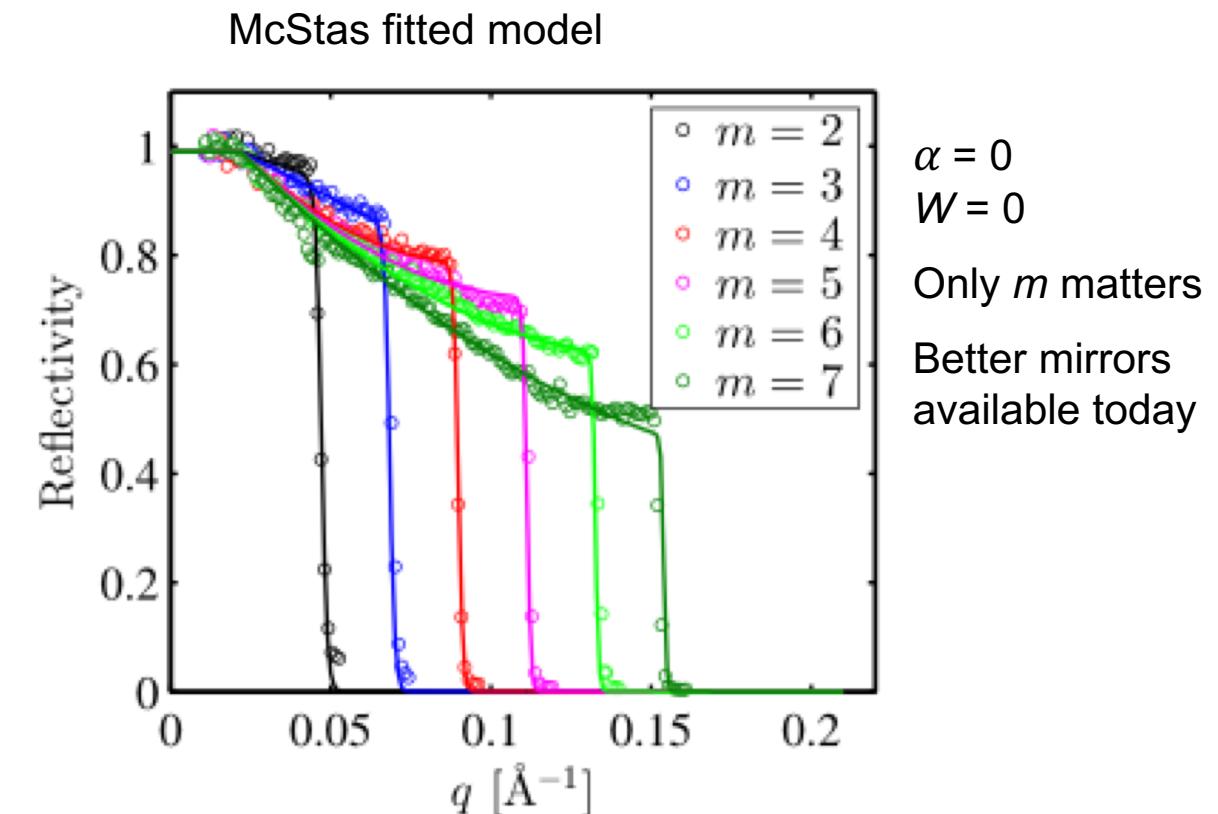
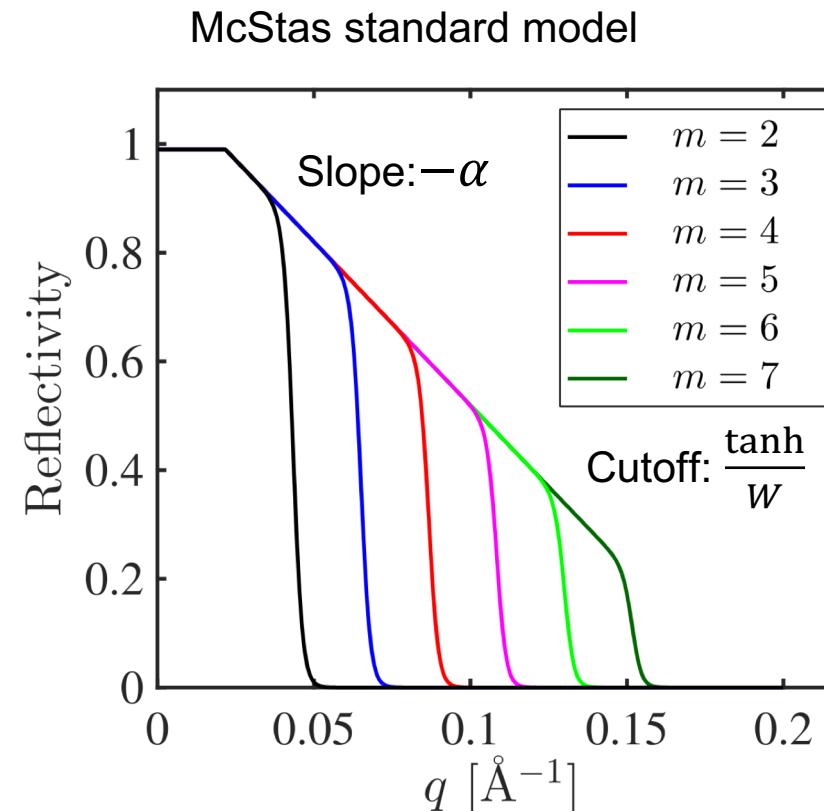
- Reflectivity, super mirror, reflectivity curve

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



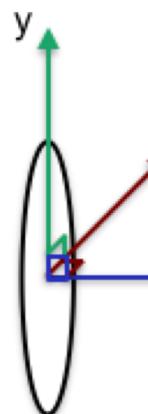
Reflectivity curves in McStas

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

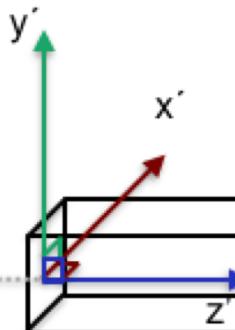


Guide placement in McStas

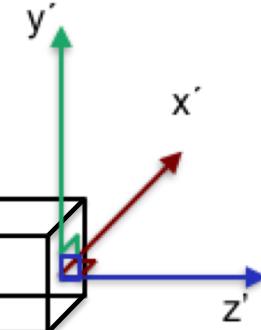
- The center is the front of the guide element
- Tip: Insert a guide at the end of the guide



COMPONENT Source
AT (0,0,0) ABSOLUTE



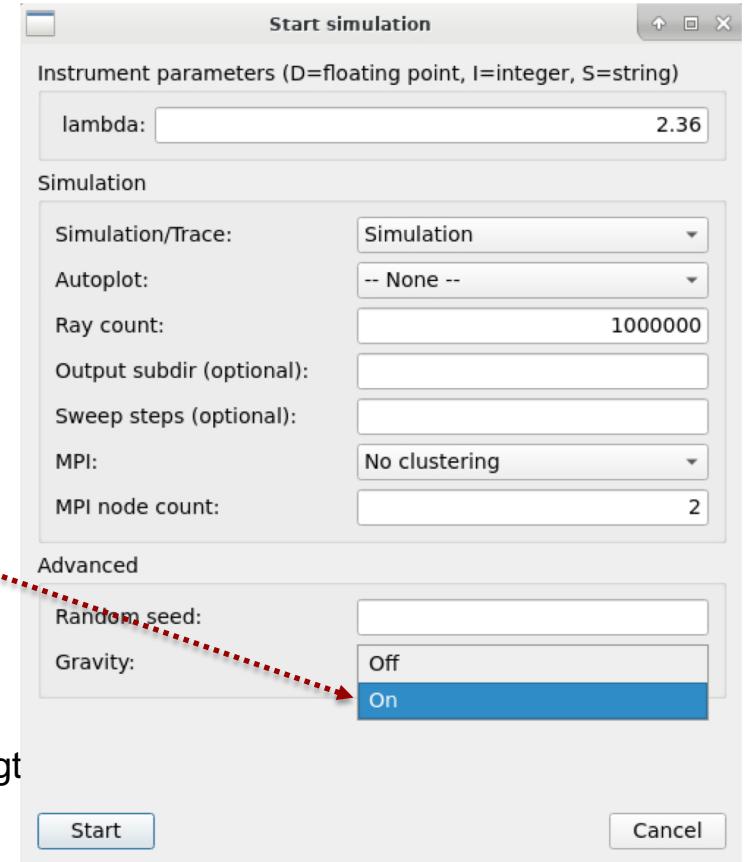
COMPONENT Guide(length=A)
AT (0,0,2) RELATIVE Source



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

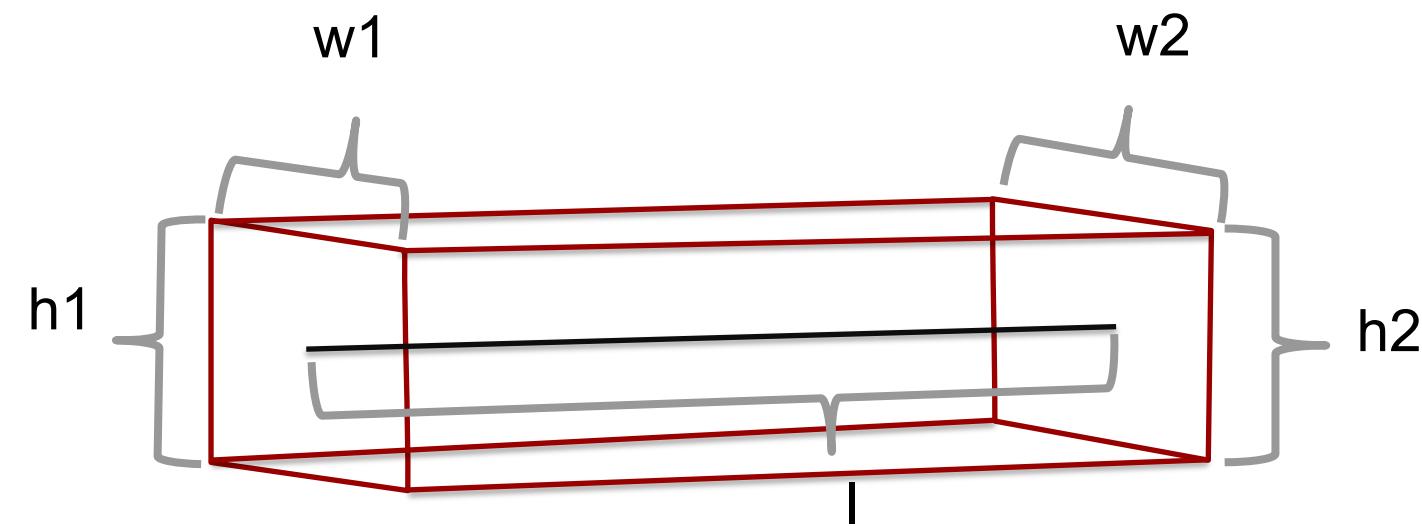
Gravitation in McStas

- 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 ~~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



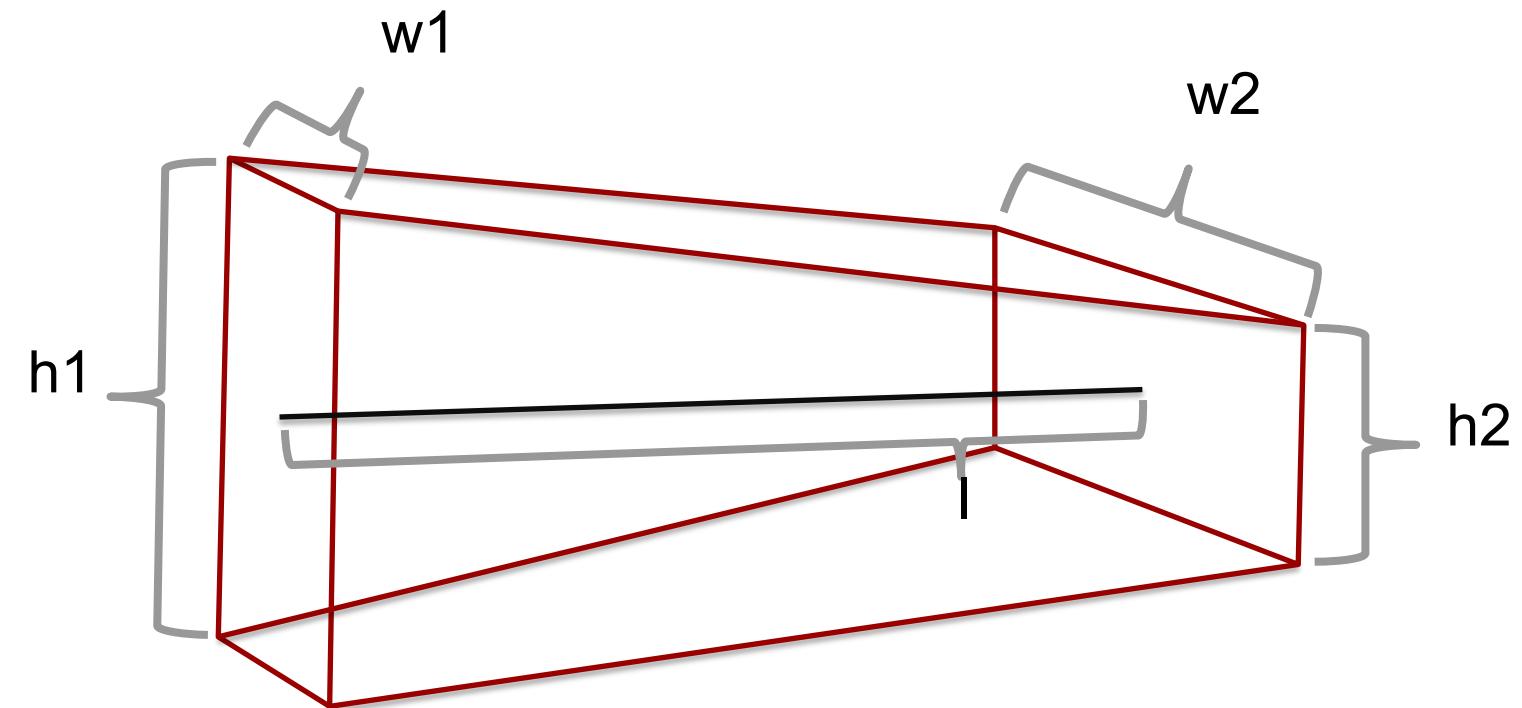
Popular guide components: Guide_gravity

- 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)



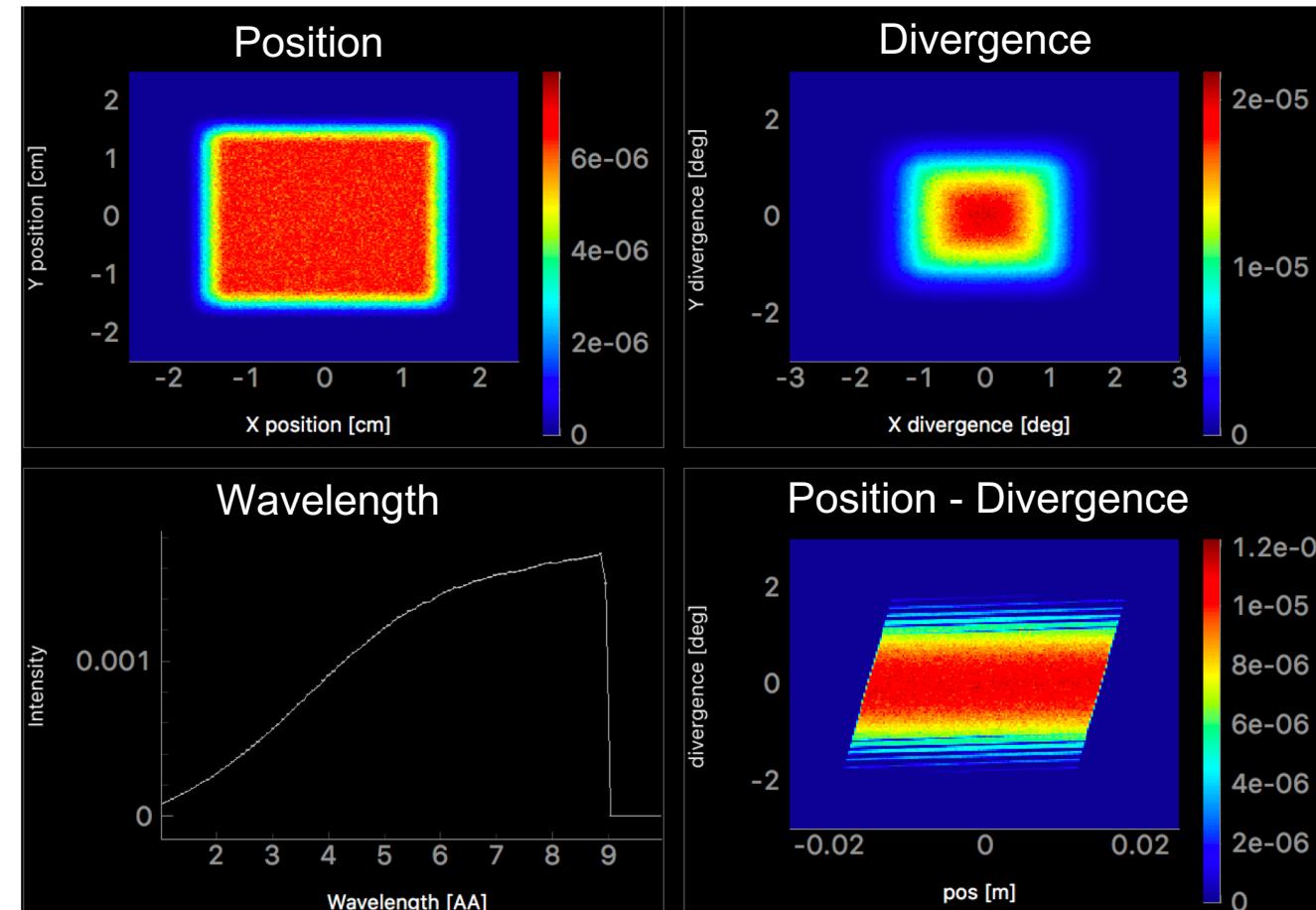
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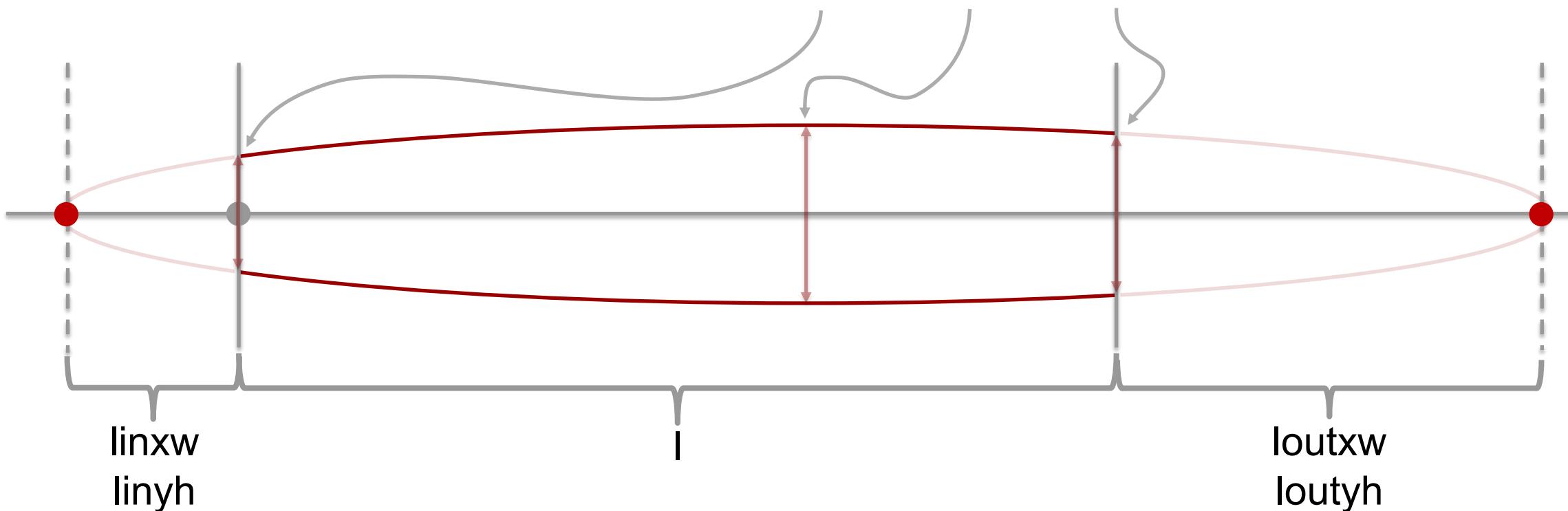
- Typical guide component with gravity



Popular guide components: Elliptical_guide_gravity

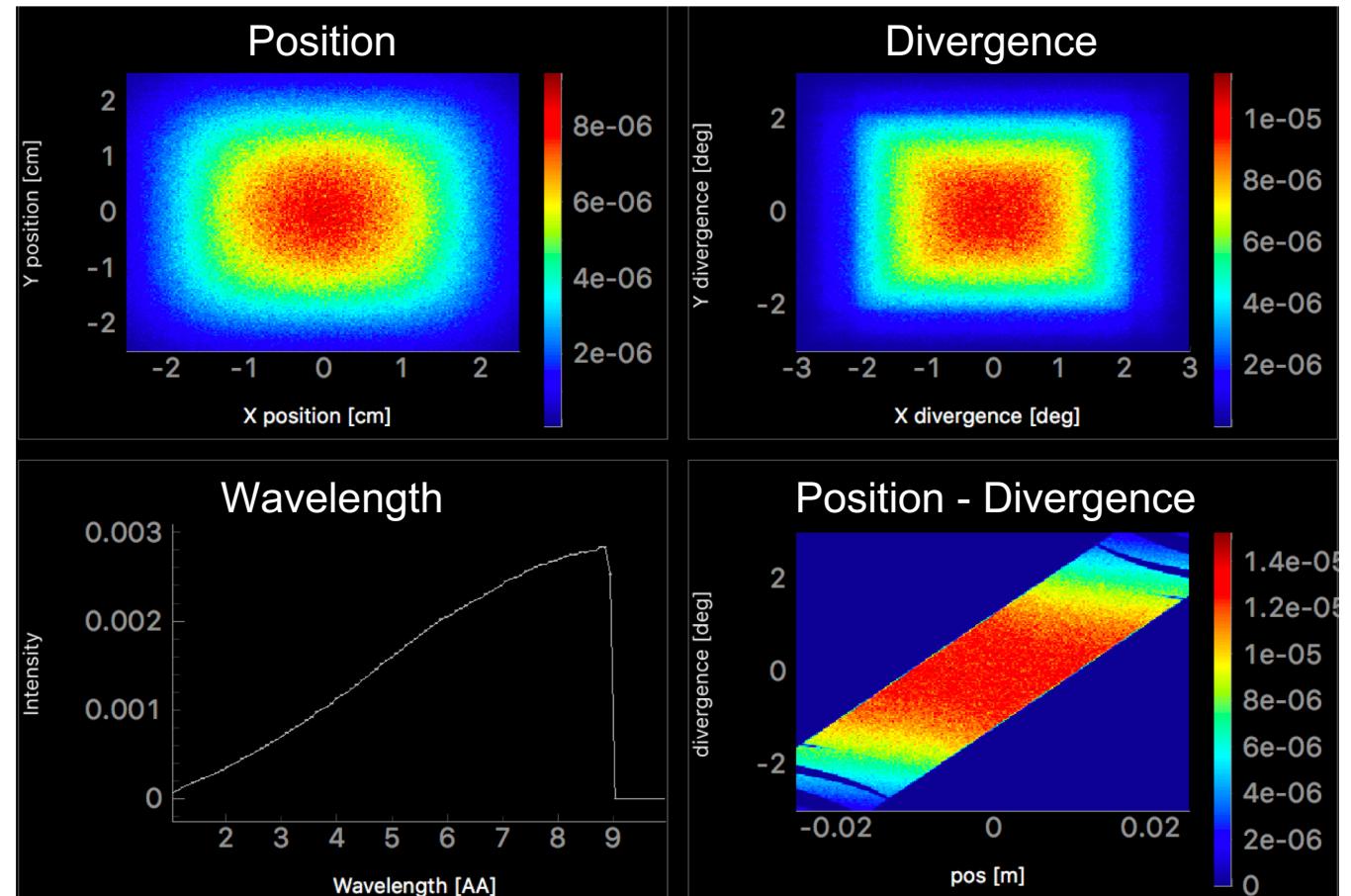
- Useful for elliptic and parabolic guide geometries, focusing, ballistic, coating distribution, ...

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



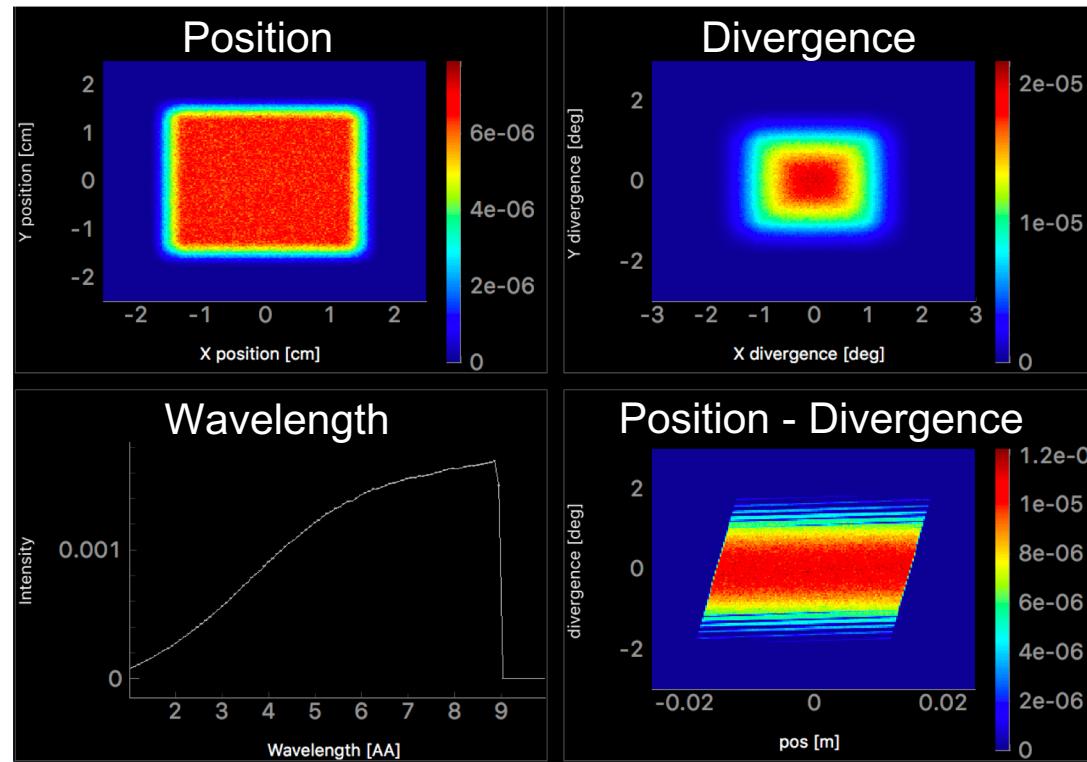
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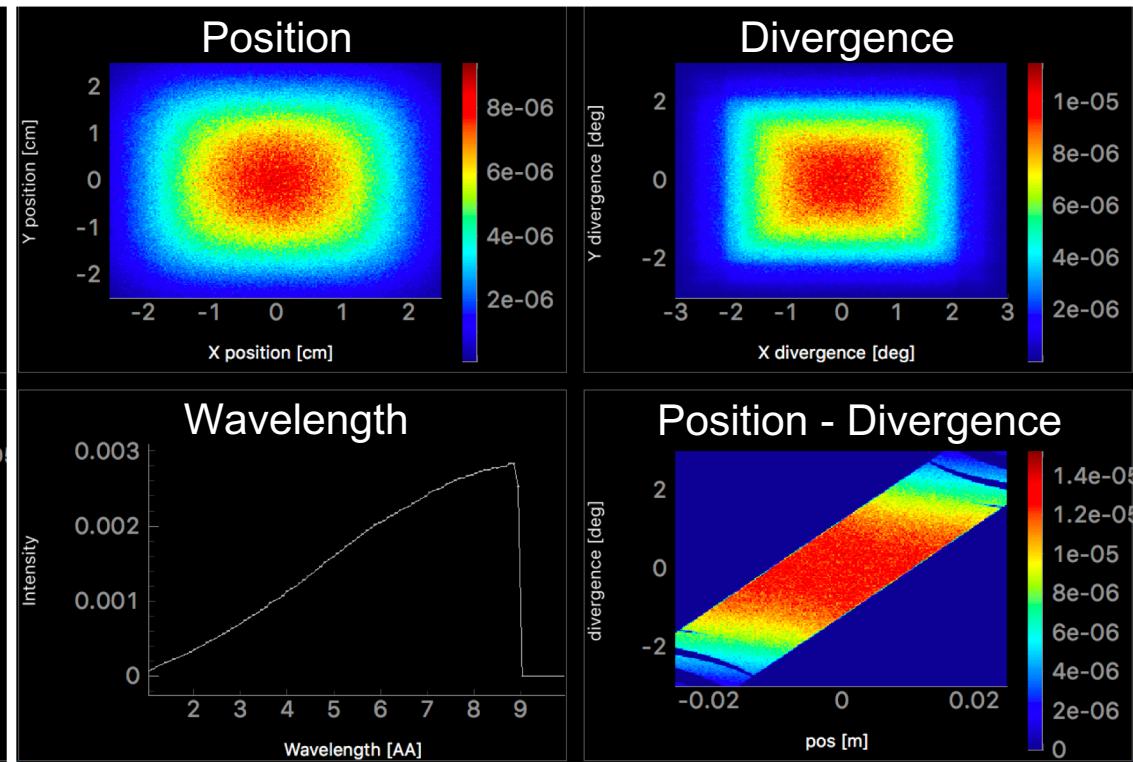


Comparison: Guide_gravity and Elliptic_guide_gravity

Guide_gravity

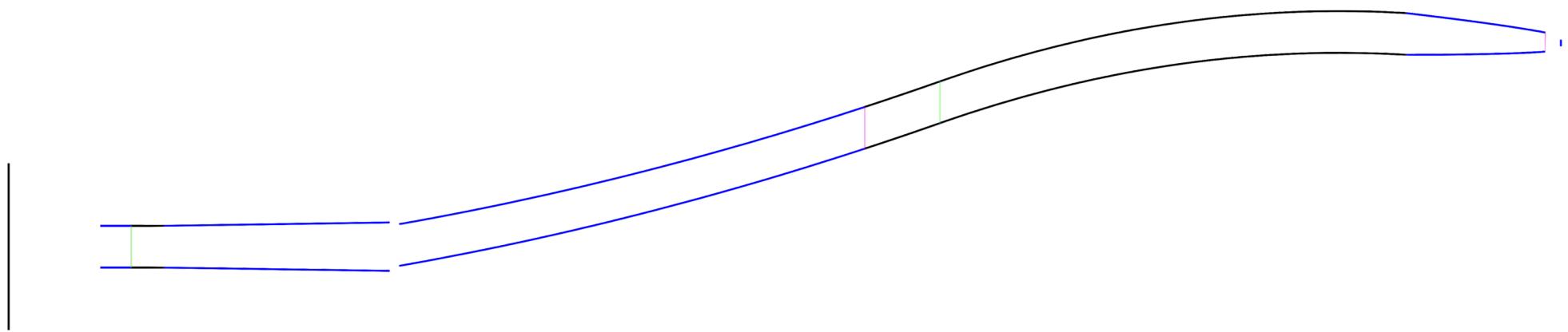


Elliptic_guide_gravity



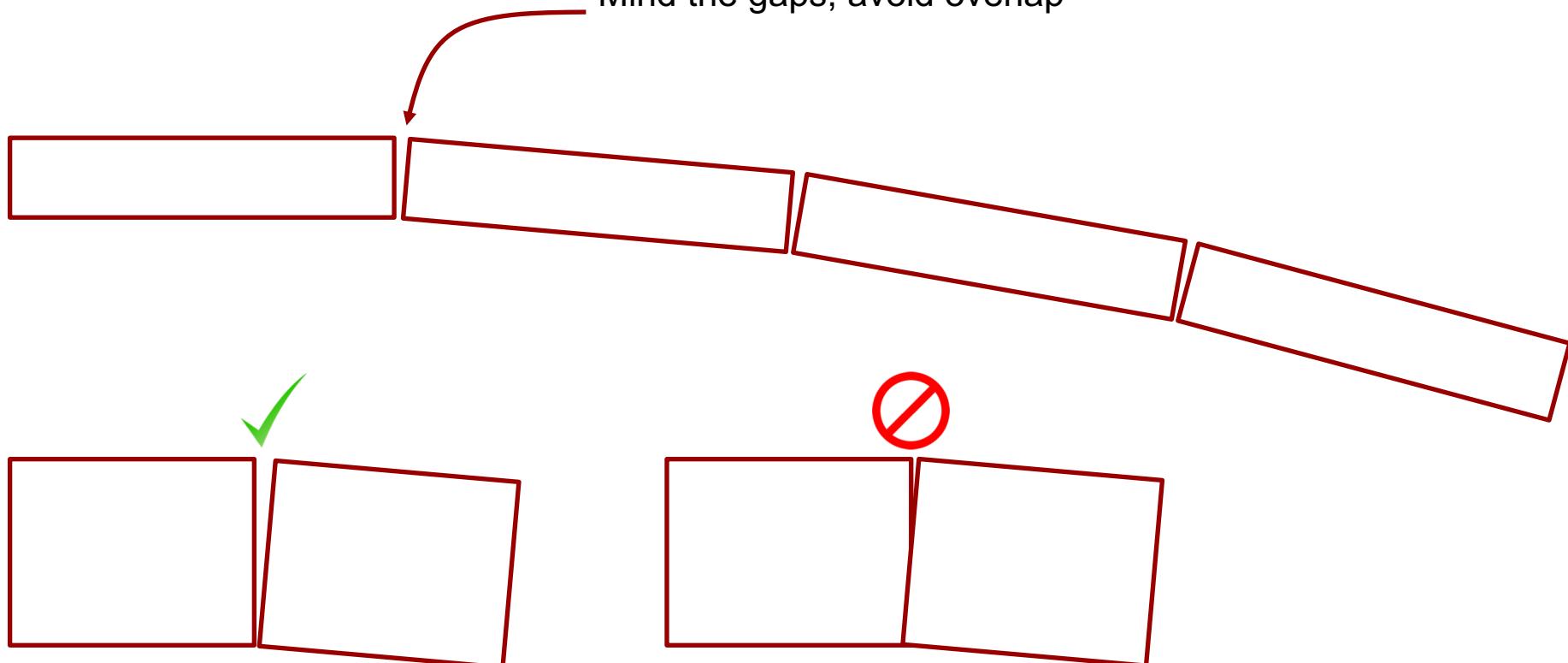
Breaking line of sight

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



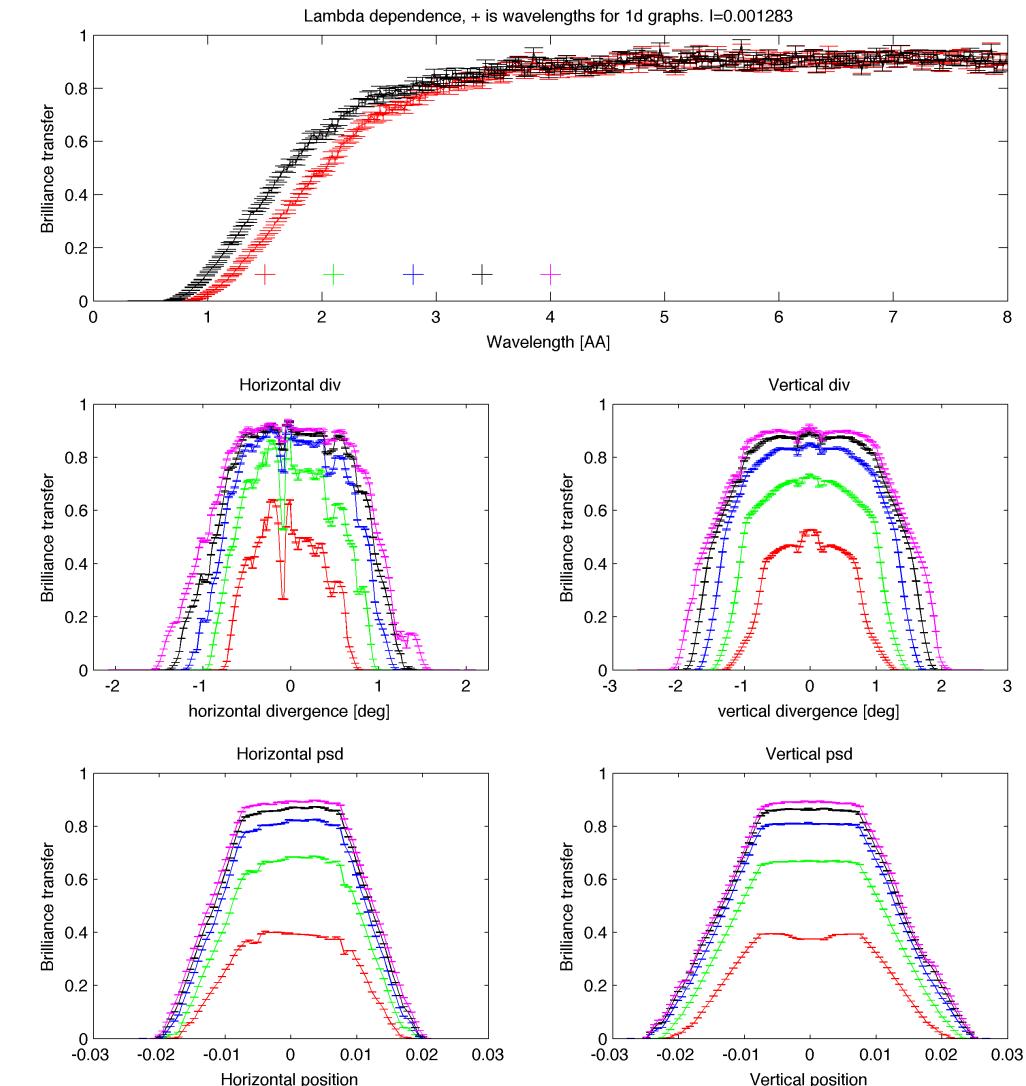
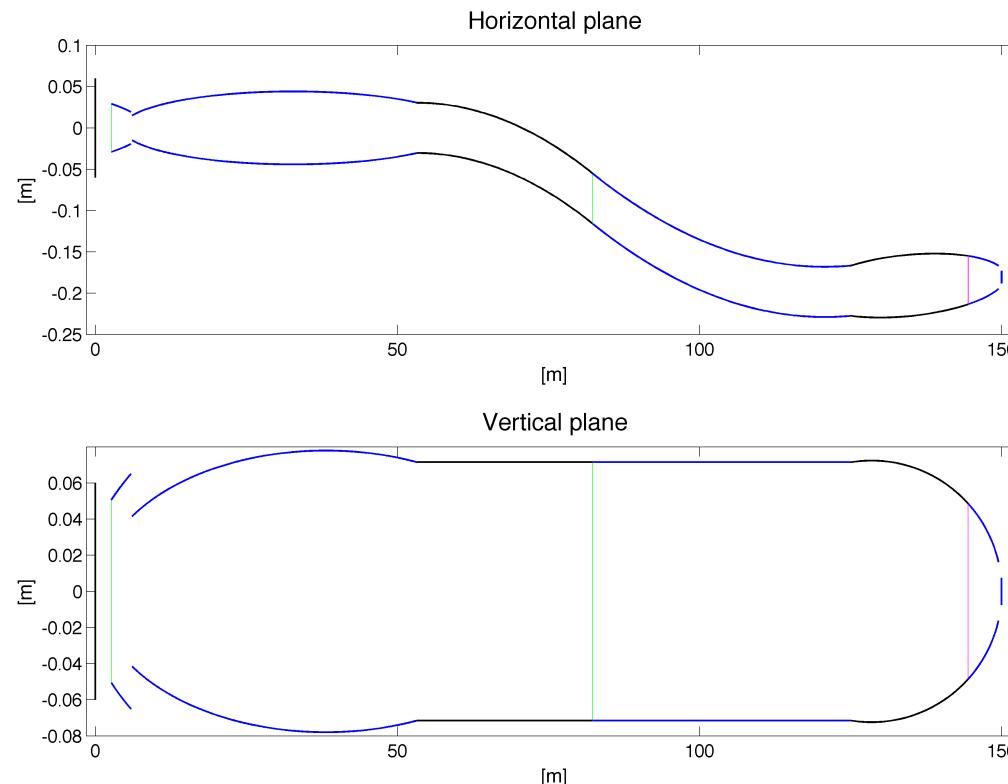
Breaking line of sight

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



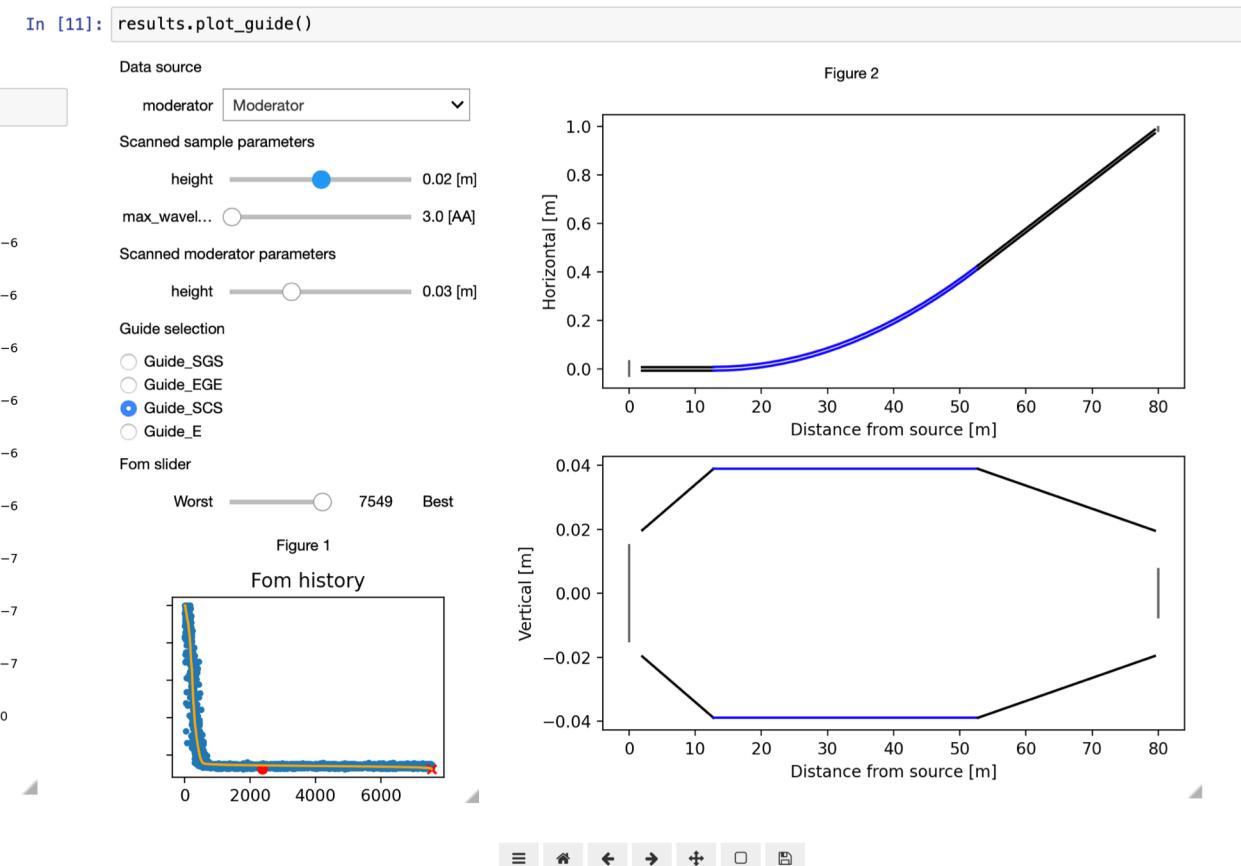
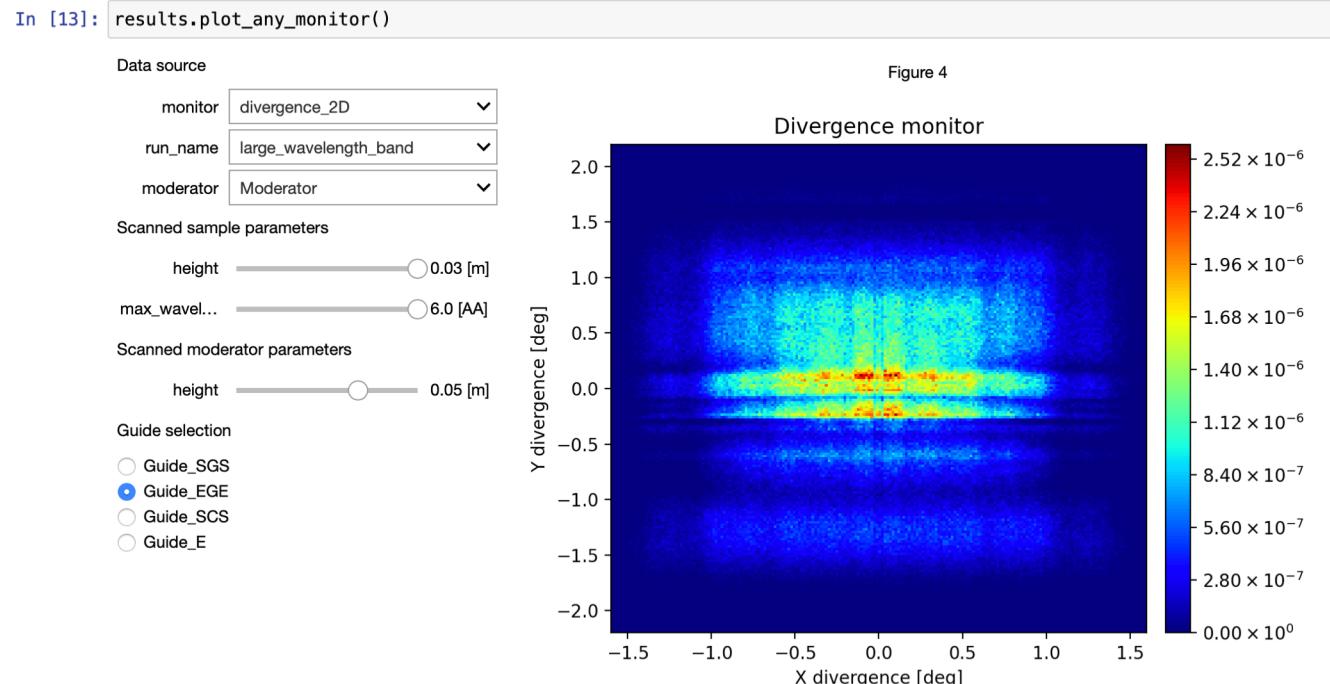
Guide optimization

- Optimization result from MATLAB guide_bot
- Python guide_bot available



Guide optimization

- Optimization results from python guide_bot
- pip install guide_bot --upgrade



Solution on github, use if you are stuck

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
- Task 3)
 - Check how much gravity impacts the output
- 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