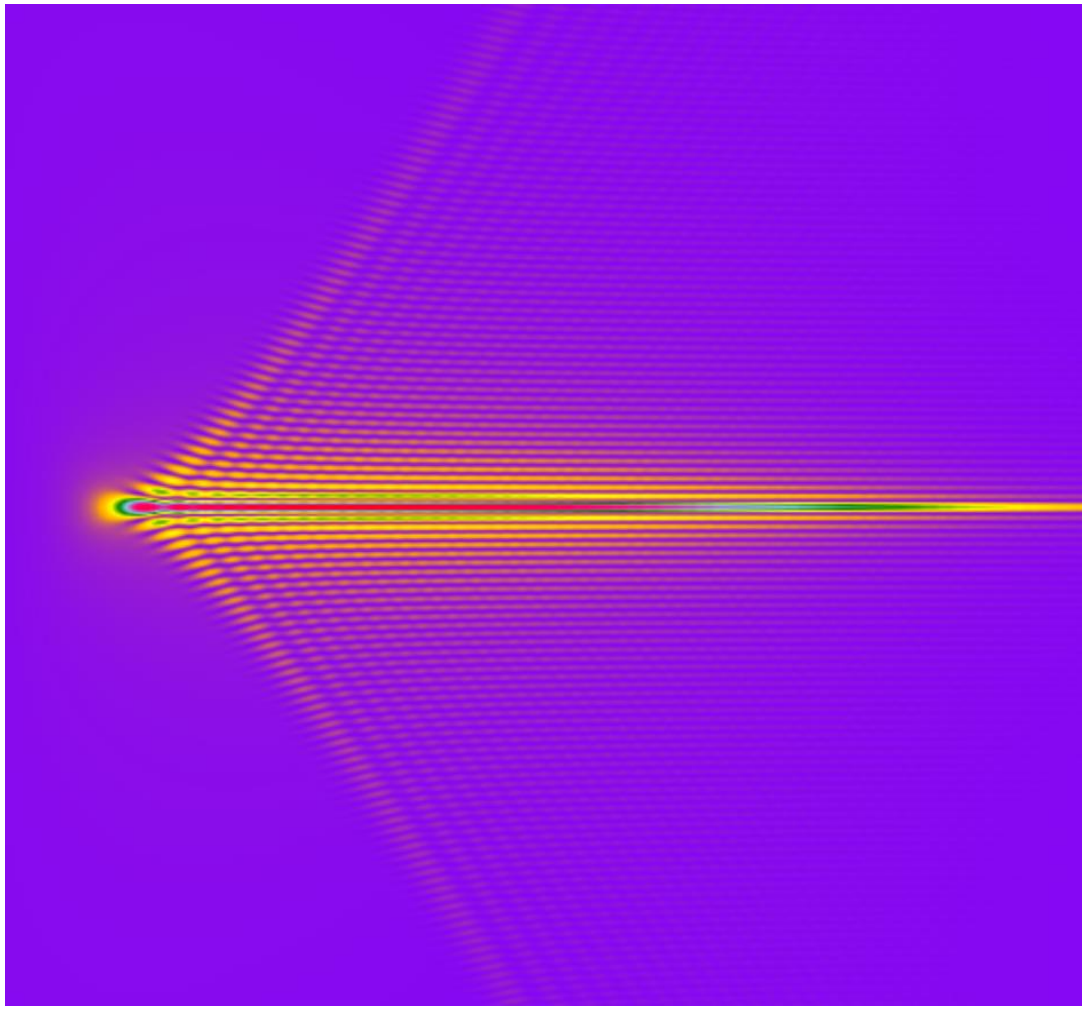
Modeling of Bessel Beam Generation from Axicon with Round Tip

Abstract



Bessel beams, due to their non-diffracting property, are drawing attentions for different applications. They are typically generated from axicons. An ideal axicon with infinite tip does not exist, and, in practice, an axicon comes with a rounded tip. In this example, we investigate the effect of the round tip on the generated Bessel beams, following the research work in [O. Brzobohatý, *et al*., Opt. Express 16, 12688-12700 (2008)]. Particularly, we simulate beam evolution along z and compare the results.

Modeling Task

How does the generated Bessel beam evolve along z, especially with respect to different round tips?

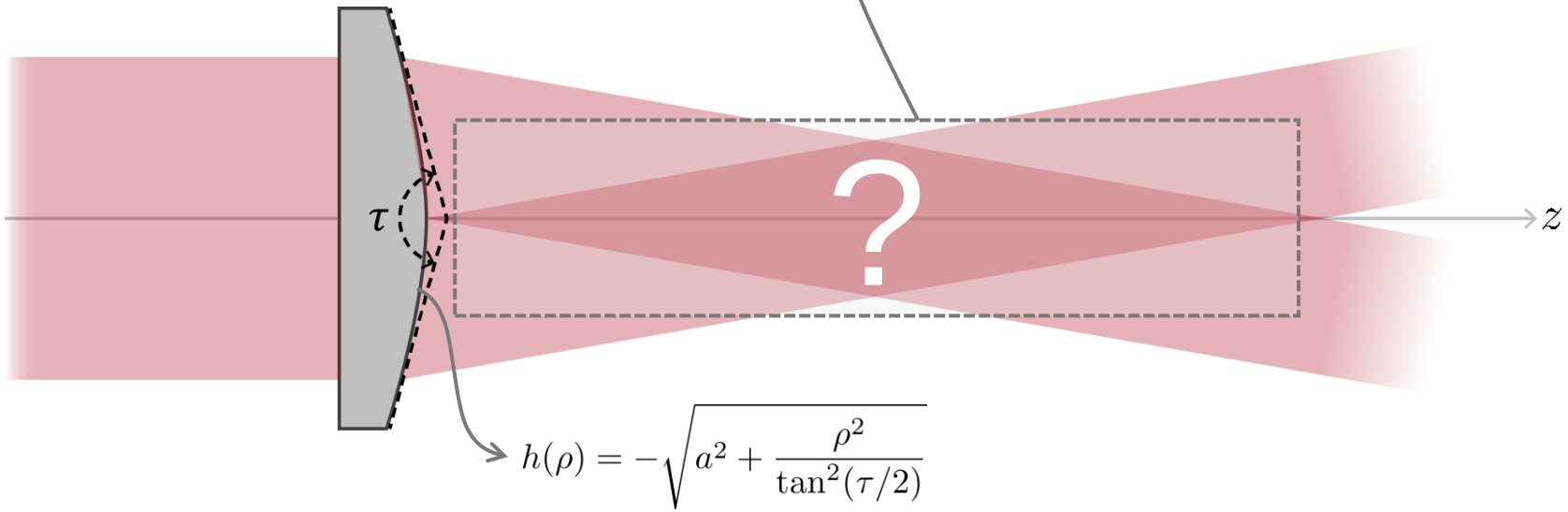
round-tip axicon

parameters and model following O. Brzobohatý, *et al.*, Opt. Express 16, 12688-12700

- refractive index $n = 1.50669$
- apex angle $\tau = 170°$
- round-tip parameter $a = 10, 30, 60\,\mu m$
- modeled as a transmission function

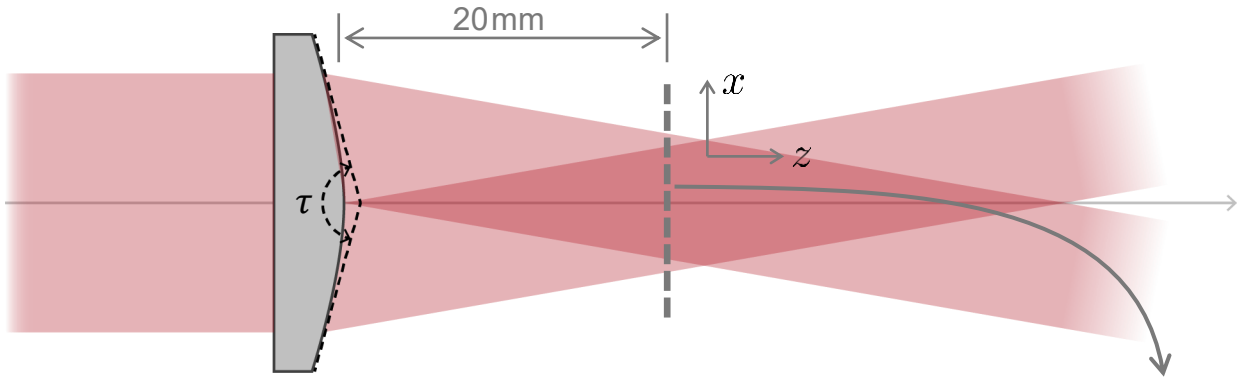
input field

- fundamental Gaussian
- wavelength 1064 nm
- waist radius 2140 µm

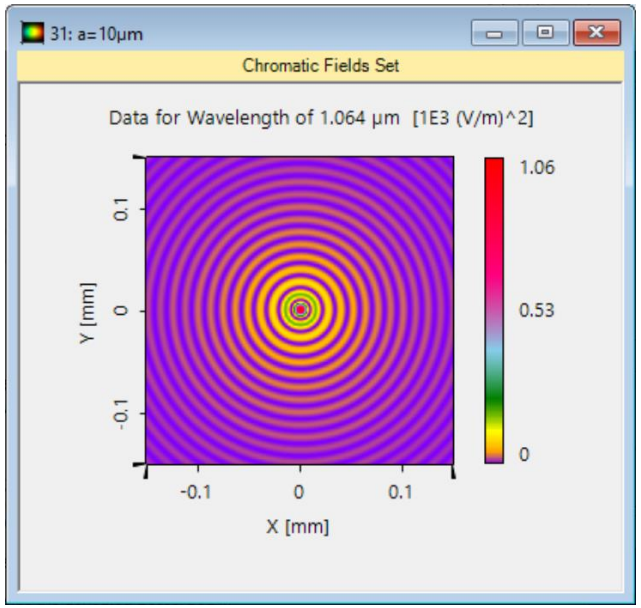


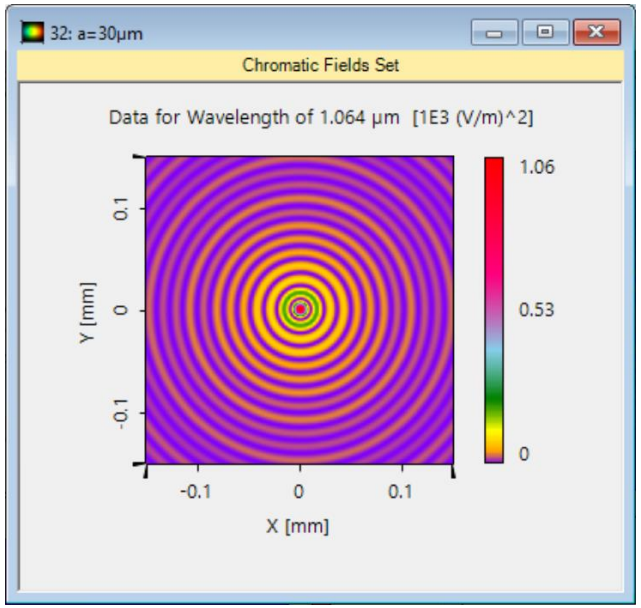
$$h(\rho) = -\sqrt{a^2 + \frac{\rho^2}{\tan^2(\tau/2)}}$$

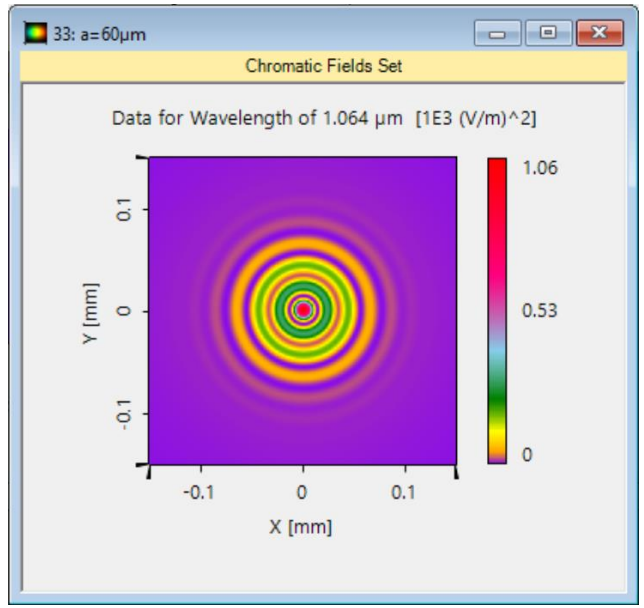
Bessel Beam at a Fixed Z-Position



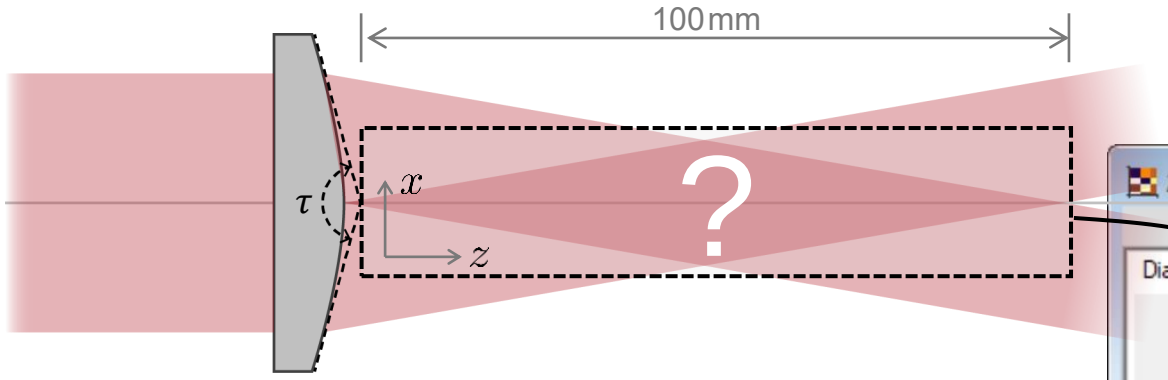
round-tip axicon
- $n = 1.50669$
- apex angle $\tau = 170°$
- **a = 10, 30, 60 µm**



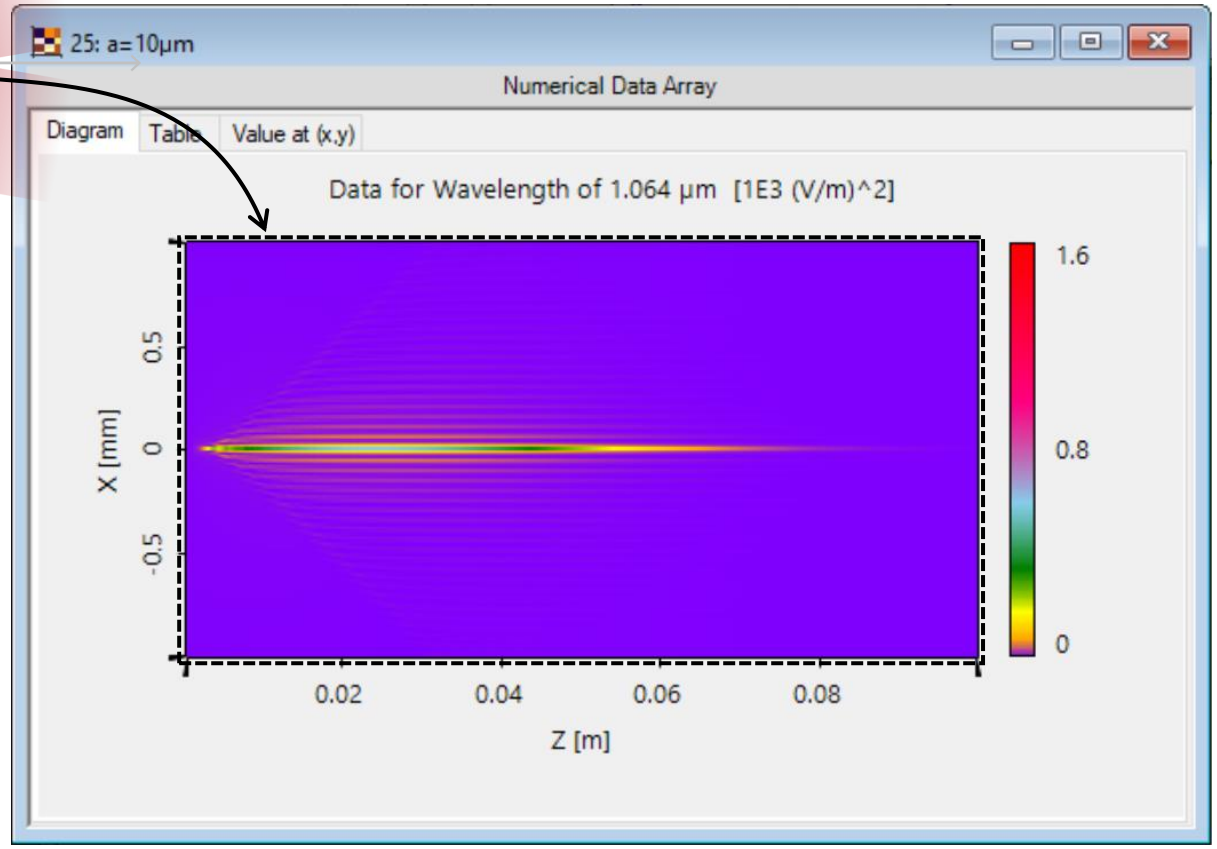




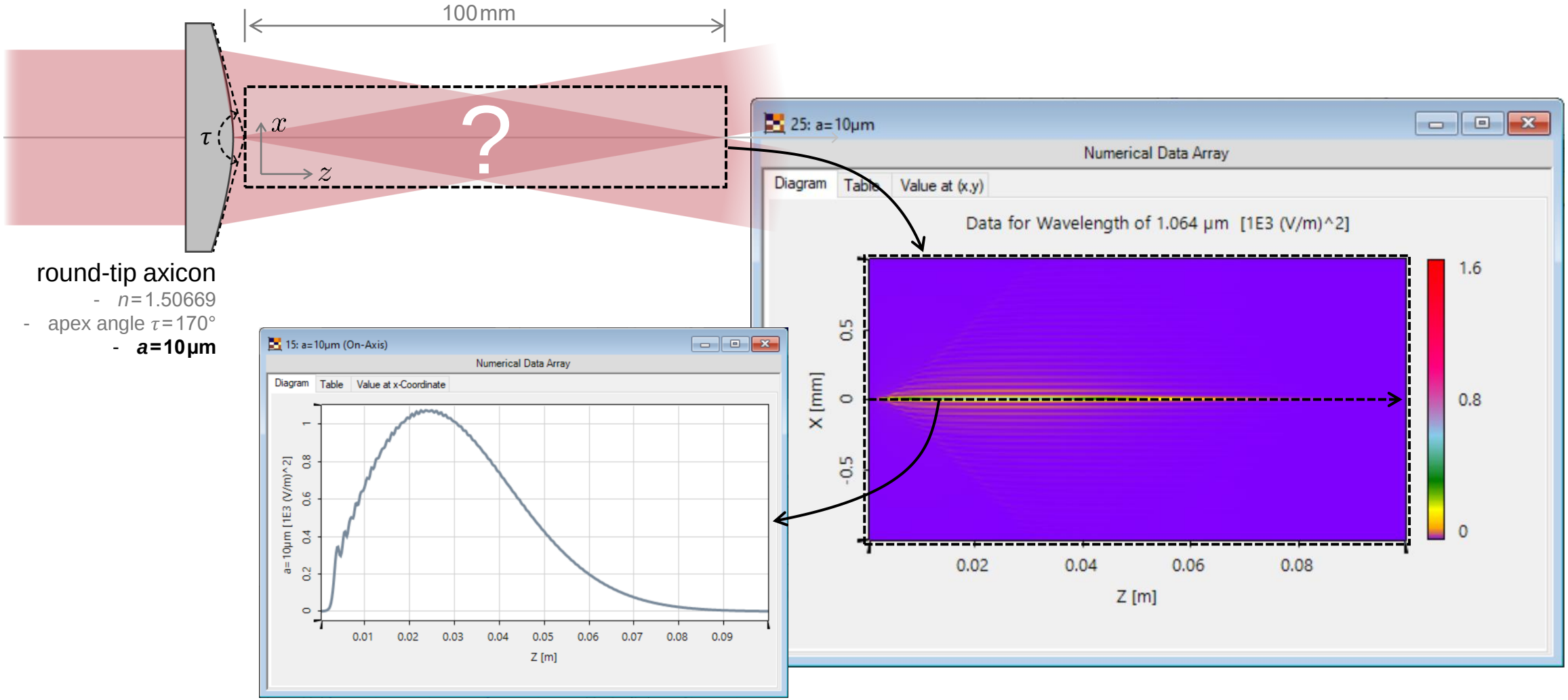
Bessel Beam Evolution Along Z (a=10µm)



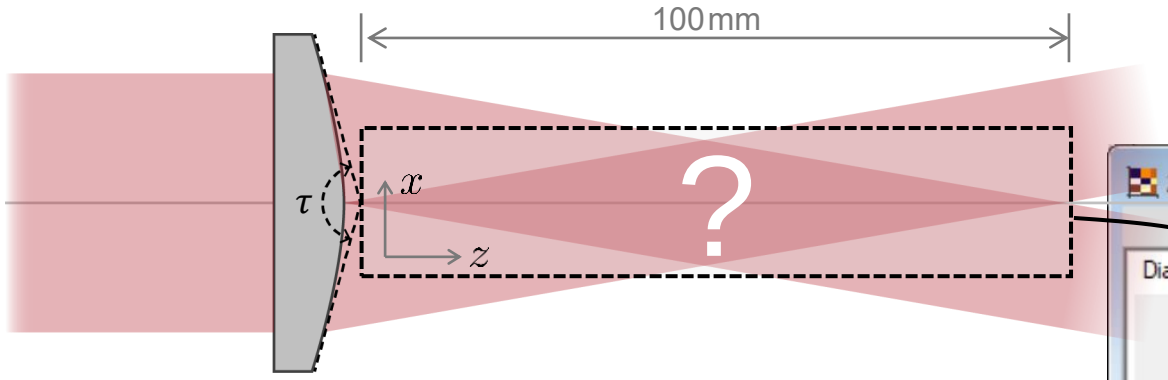
round-tip axicon
- n=1.50669
- apex angle τ=170°
- **a=10µm**



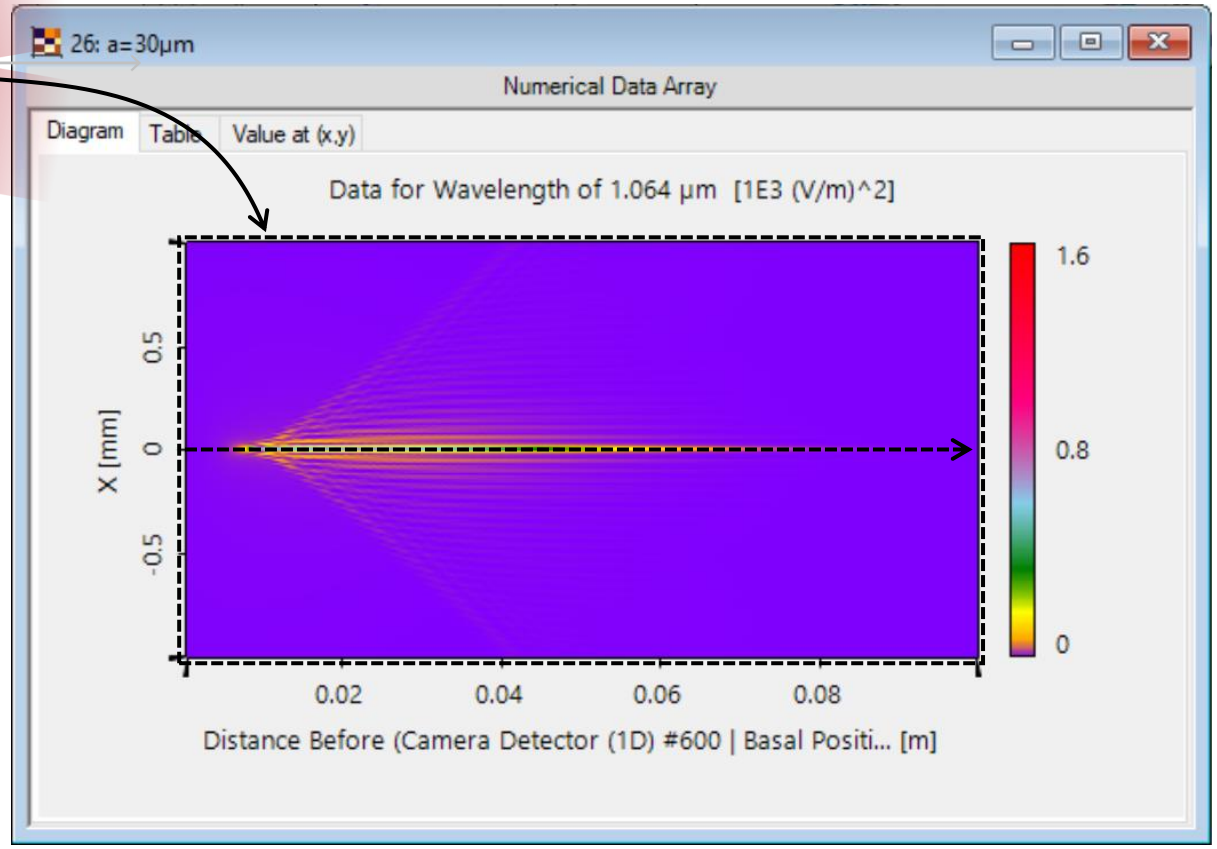
Bessel Beam Evolution Along Z (a=10µm)



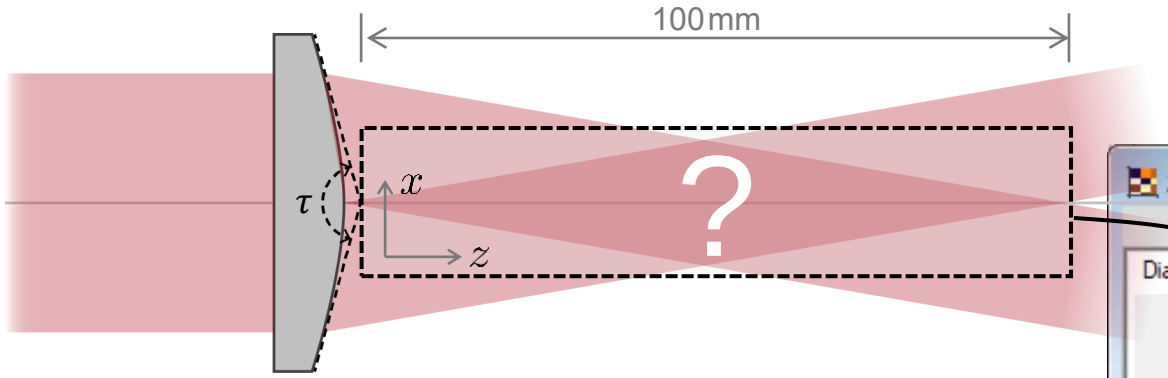
Bessel Beam Evolution Along Z (a=30µm)



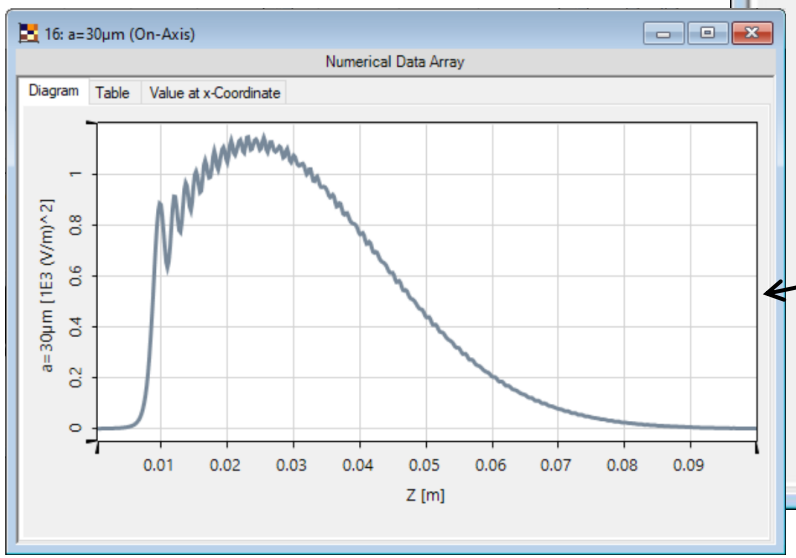
round-tip axicon
- n=1.50669
- apex angle τ=170°
- ***a*=30µm**

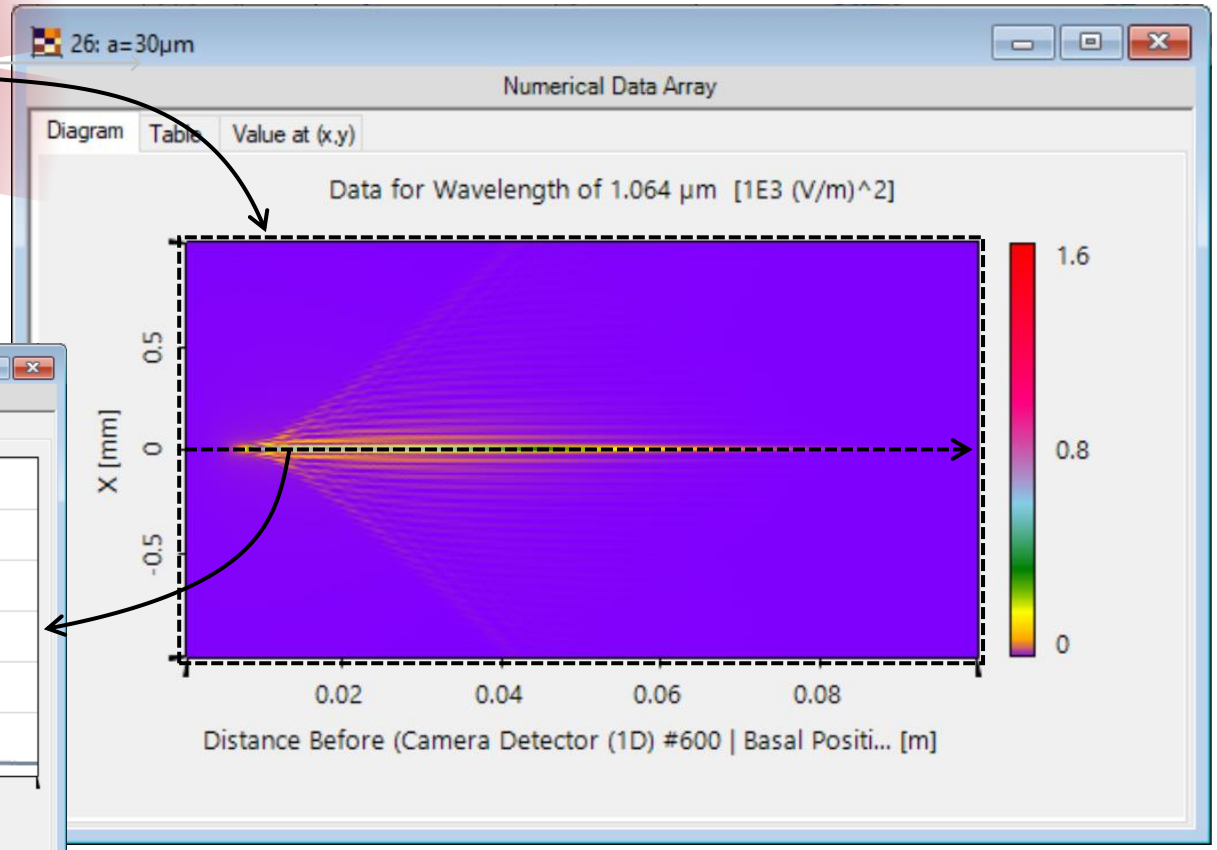


Bessel Beam Evolution Along Z (a=30µm)

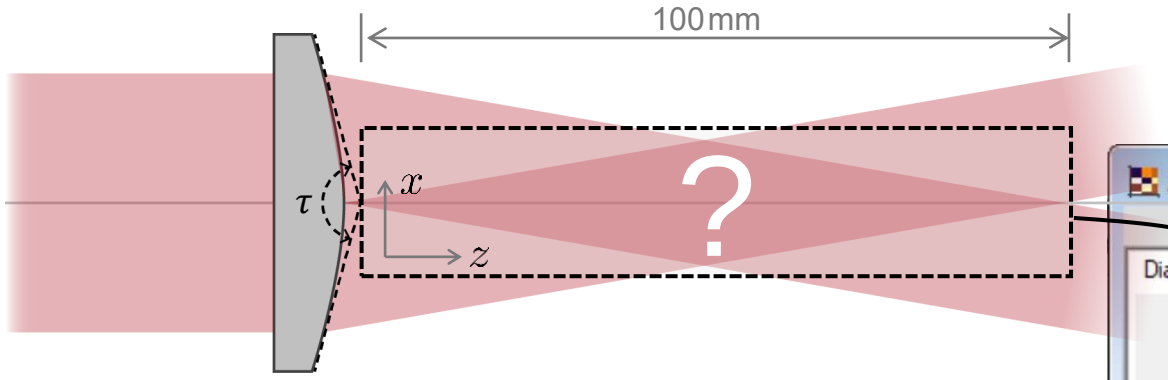


round-tip axicon
- n=1.50669
- apex angle τ=170°
- ***a*=30µm**



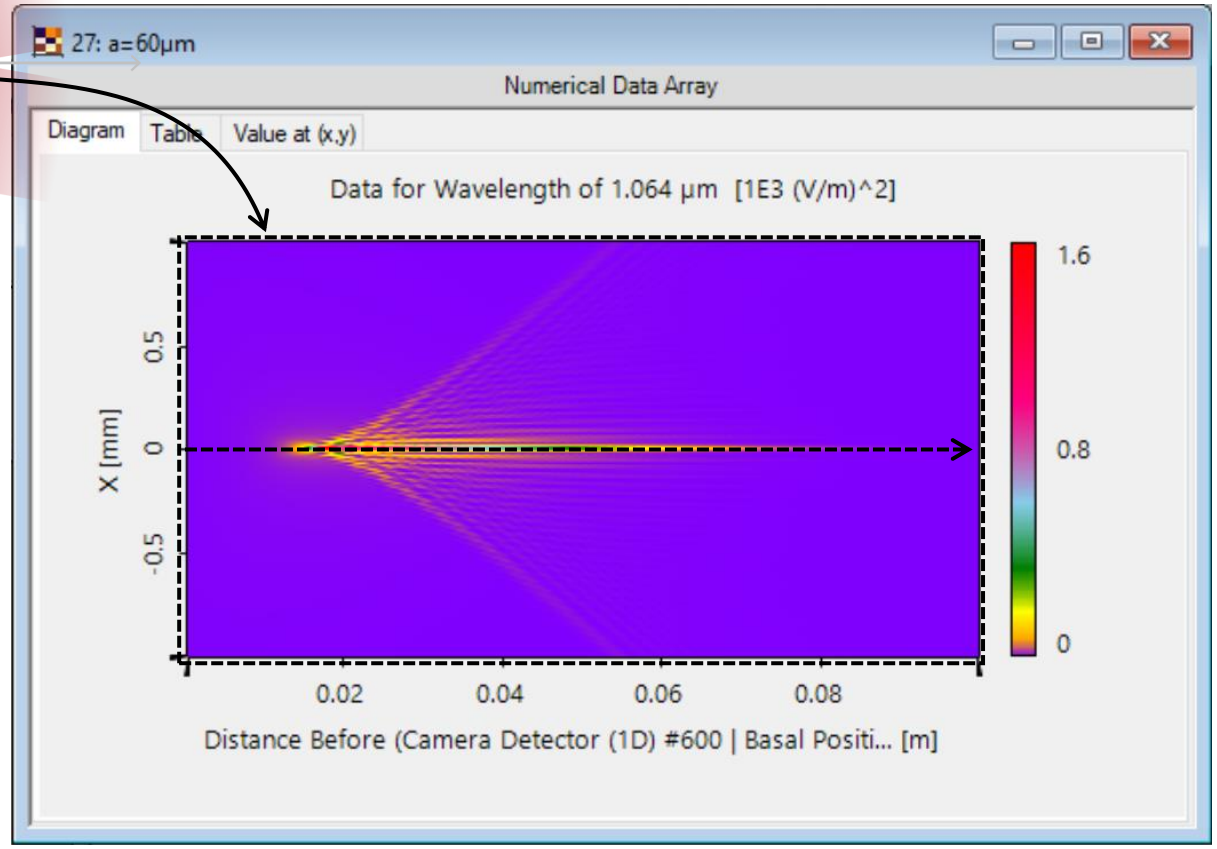


Bessel Beam Evolution Along Z (a=60µm)

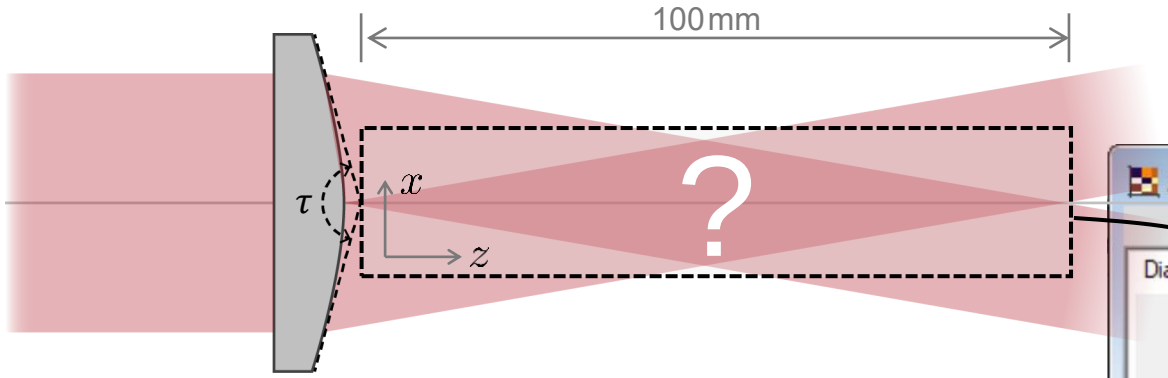


round-tip axicon

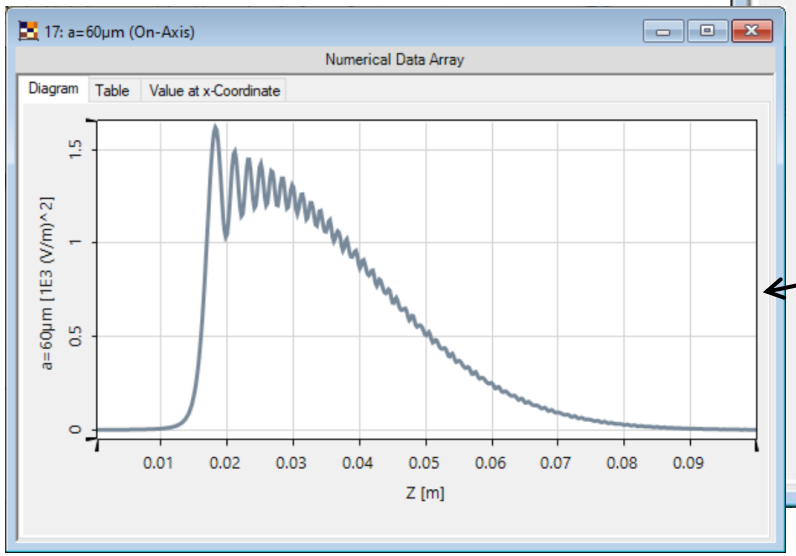
- n=1.50669
- apex angle τ=170°
- ***a*=60µm**

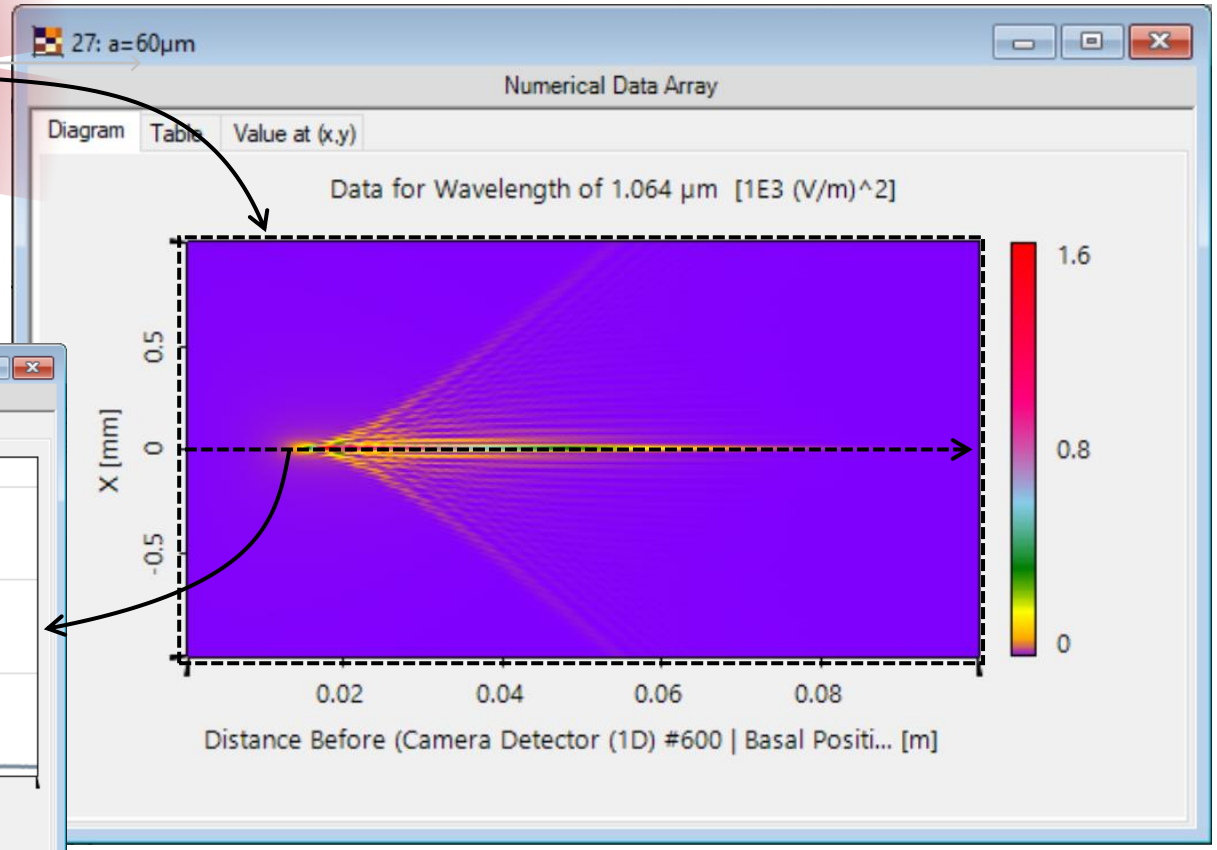


Bessel Beam Evolution Along Z (a=60µm)



round-tip axicon
- n=1.50669
- apex angle τ=170°
- ***a*=60µm**





On-Axis Distribution and Comparison

simulation result in VirtualLab Fusion

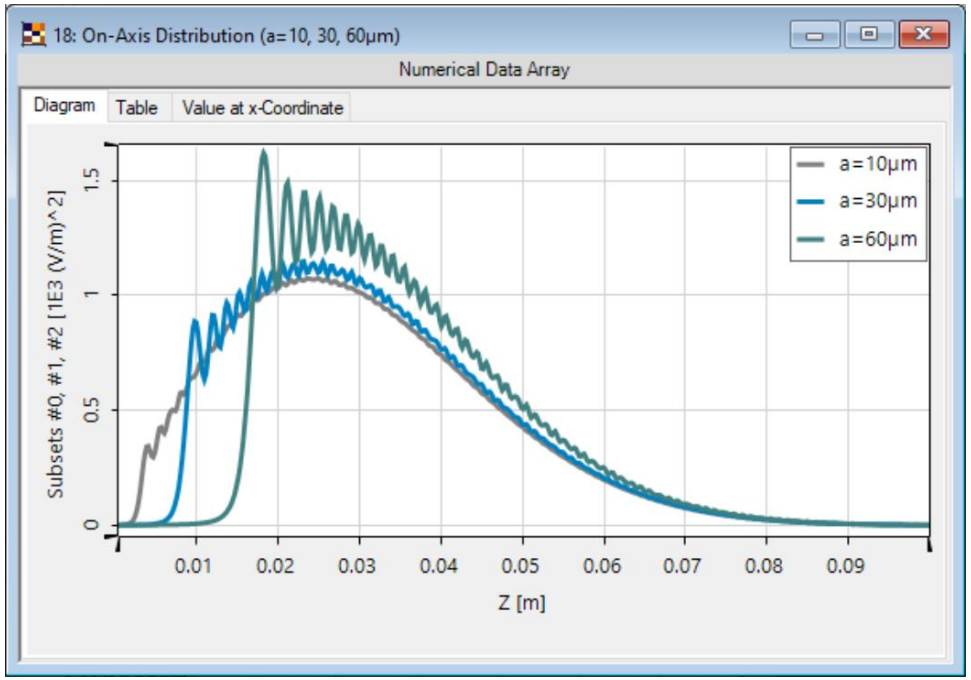
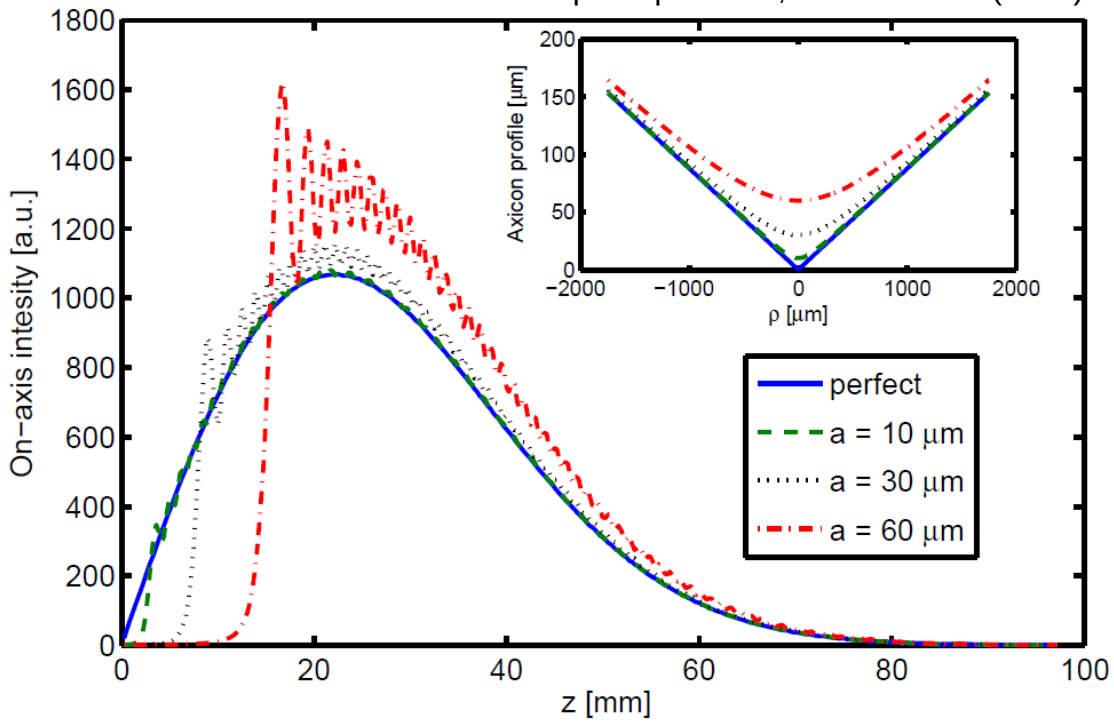
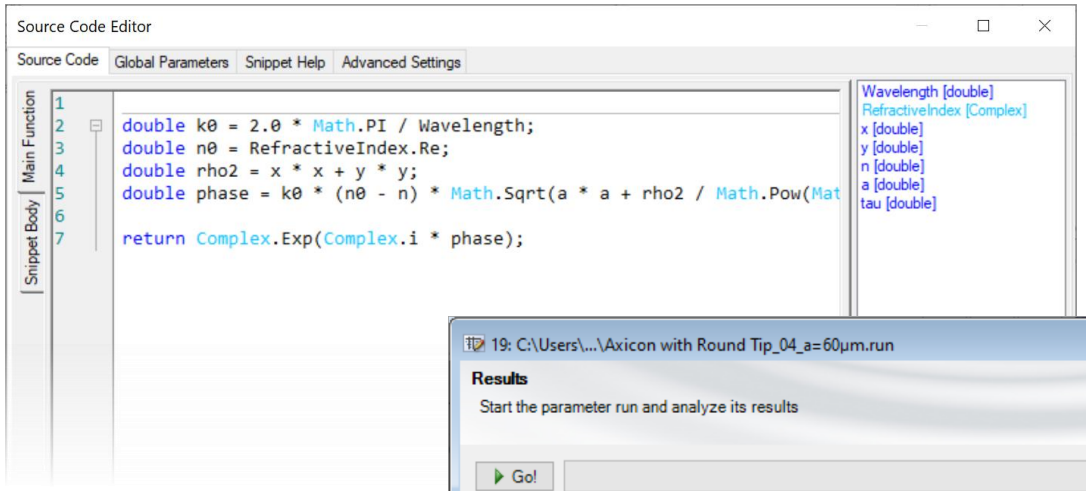


Fig. 2 from O. Brzobohatý, *et al.*,
Opt. Express 16, 12688-12700 (2008)

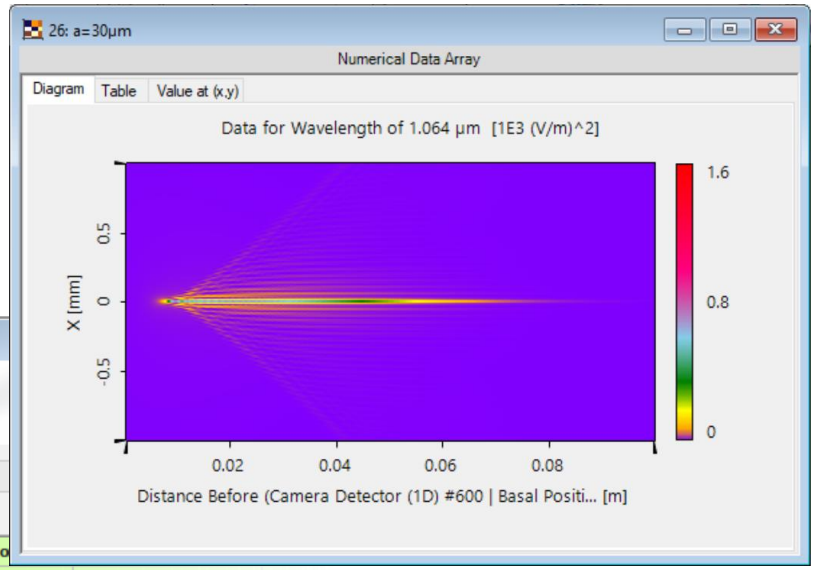


Peek into VirtualLab Fusion

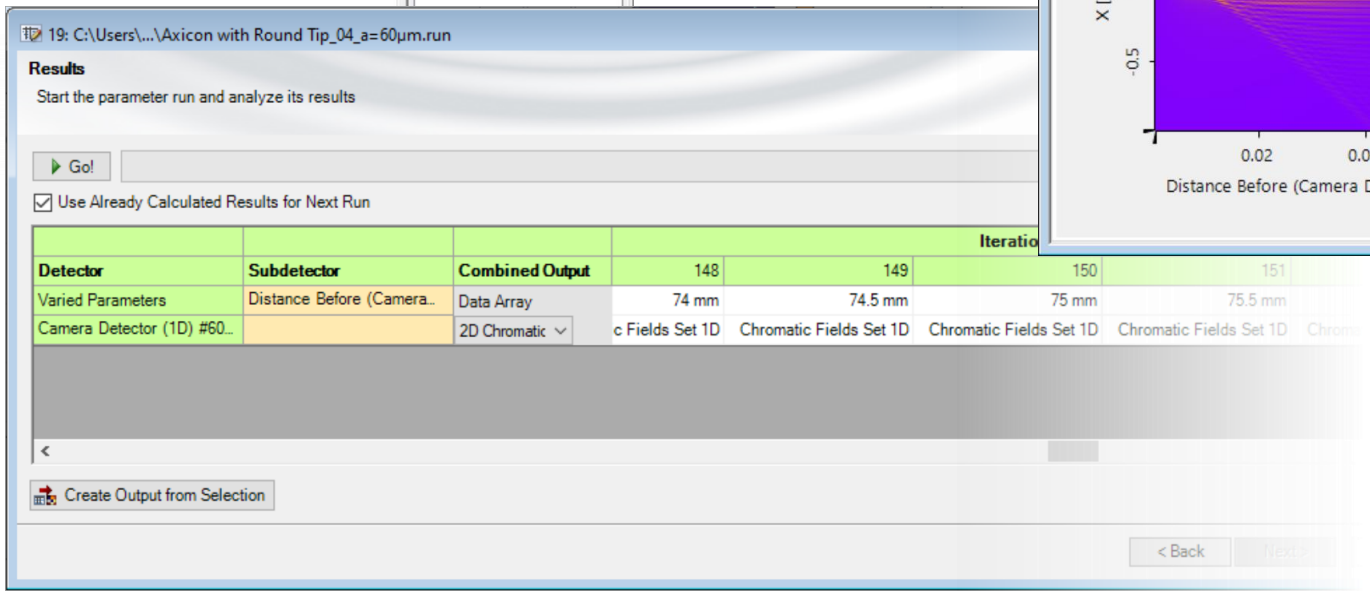
customizable and flexible transmission definition



field visualization and analysis

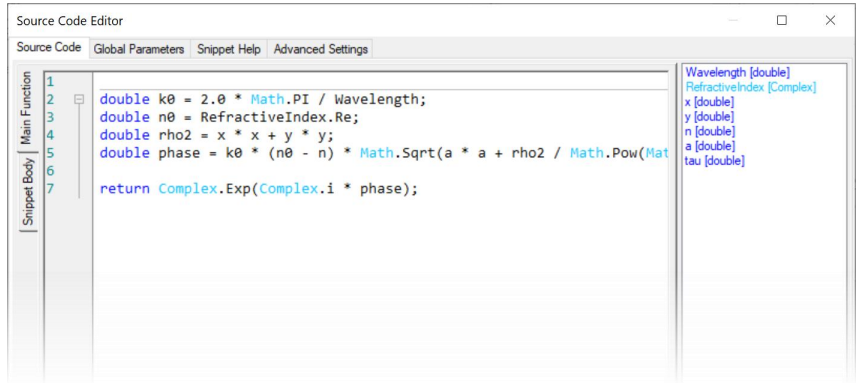


parameter sweep

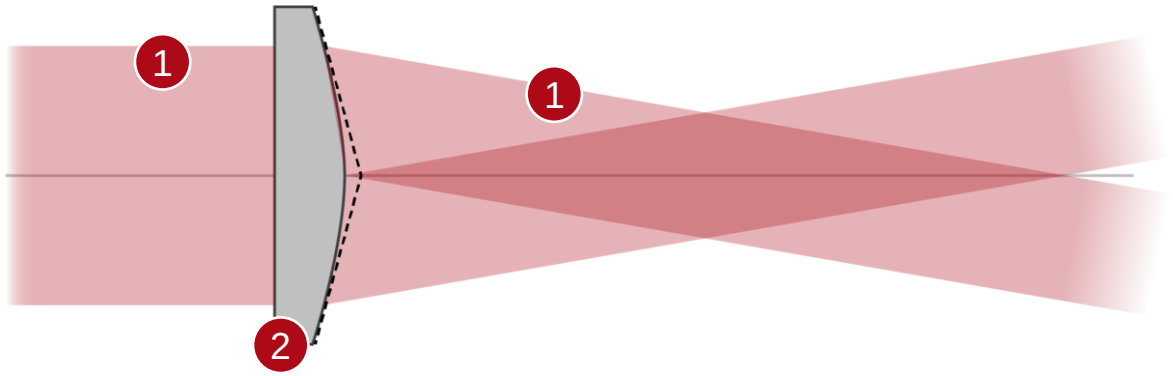


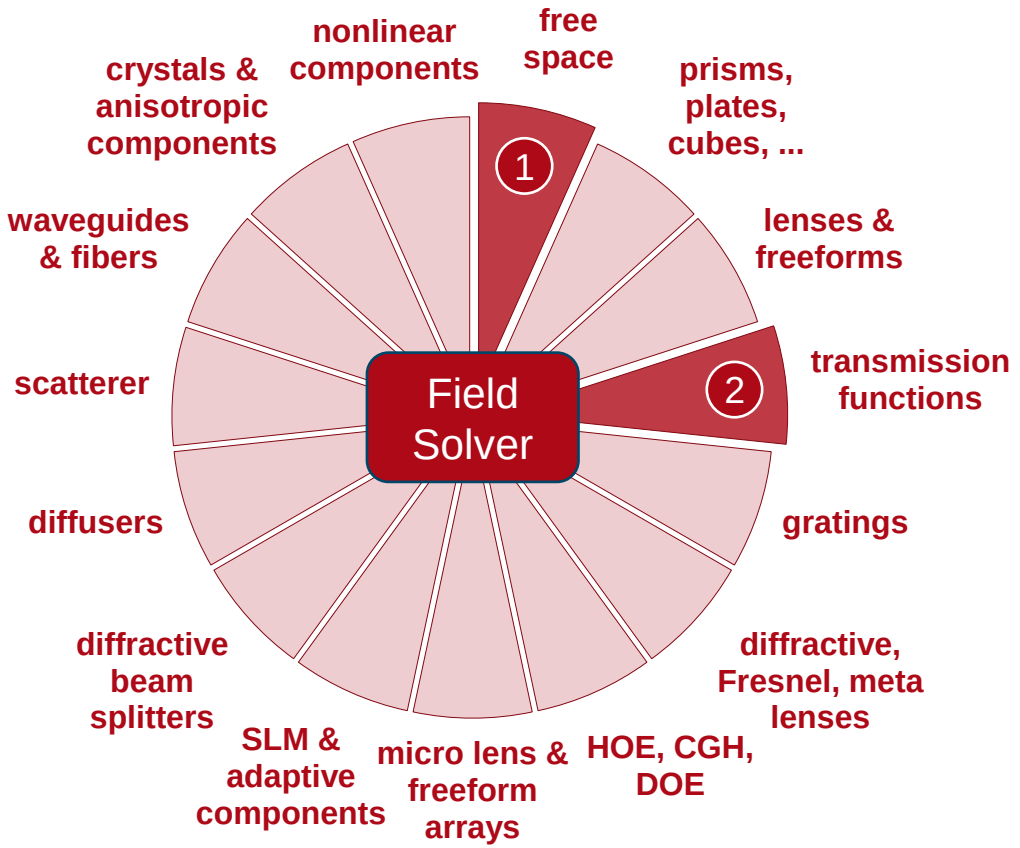
Workflow in VirtualLab Fusion

- Set up input Gaussian field
  - Basic Source Models [Tutorial Video]
- Set the position and orientation of components
  - How to Work with the Programmable Function & Example (Cylindrical Lens) [Use Case]
- Sweep the parameters and check the influence
  - Usage of the Parameter Run Document [Use Case]



VirtualLab Fusion Technologies





Document Information

title	Modeling of Bessel Beam Generation from Axicon with Round Tip
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software version	2020.1 (Build 1.202)
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further reading	- Programming an Axicon Transmission Function - Diffraction Patterns behind Different Apertures - Focal Spots for Different Aberrations