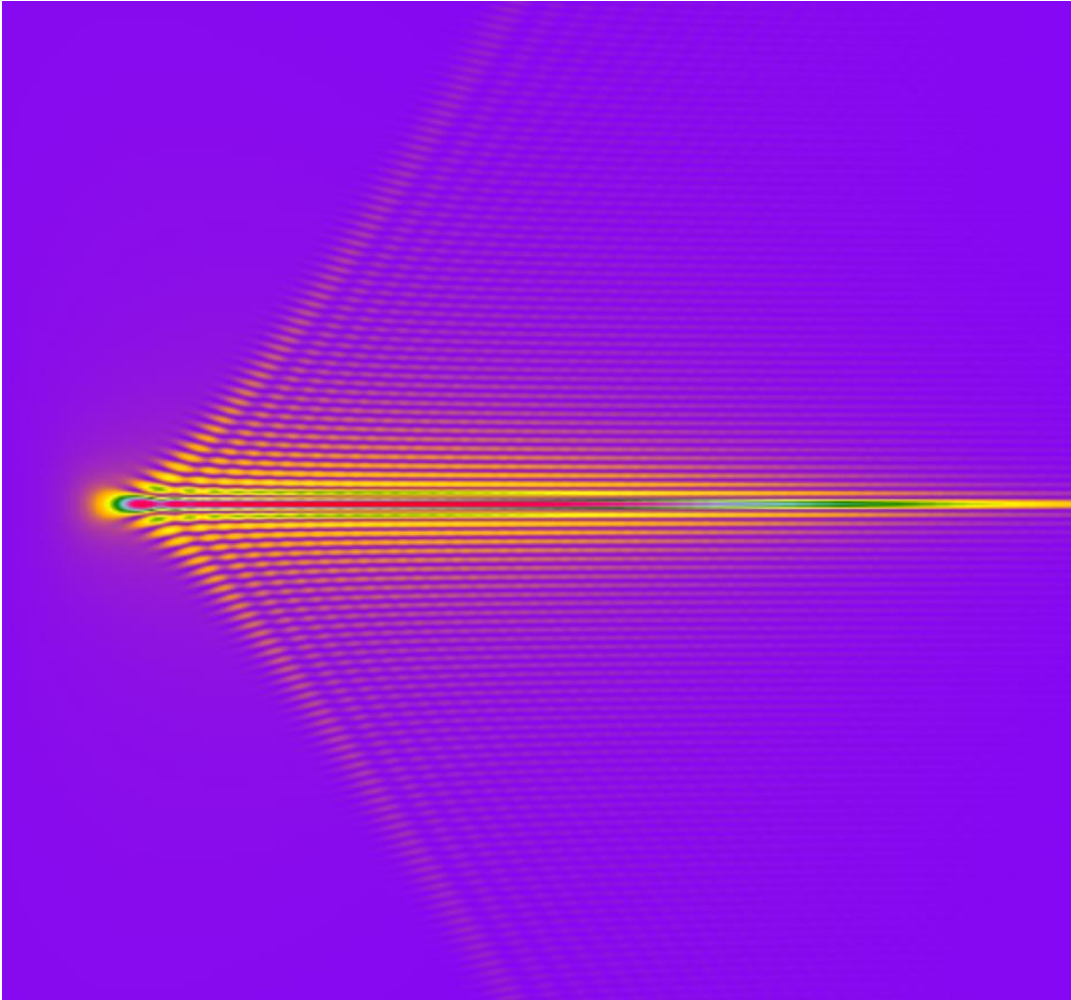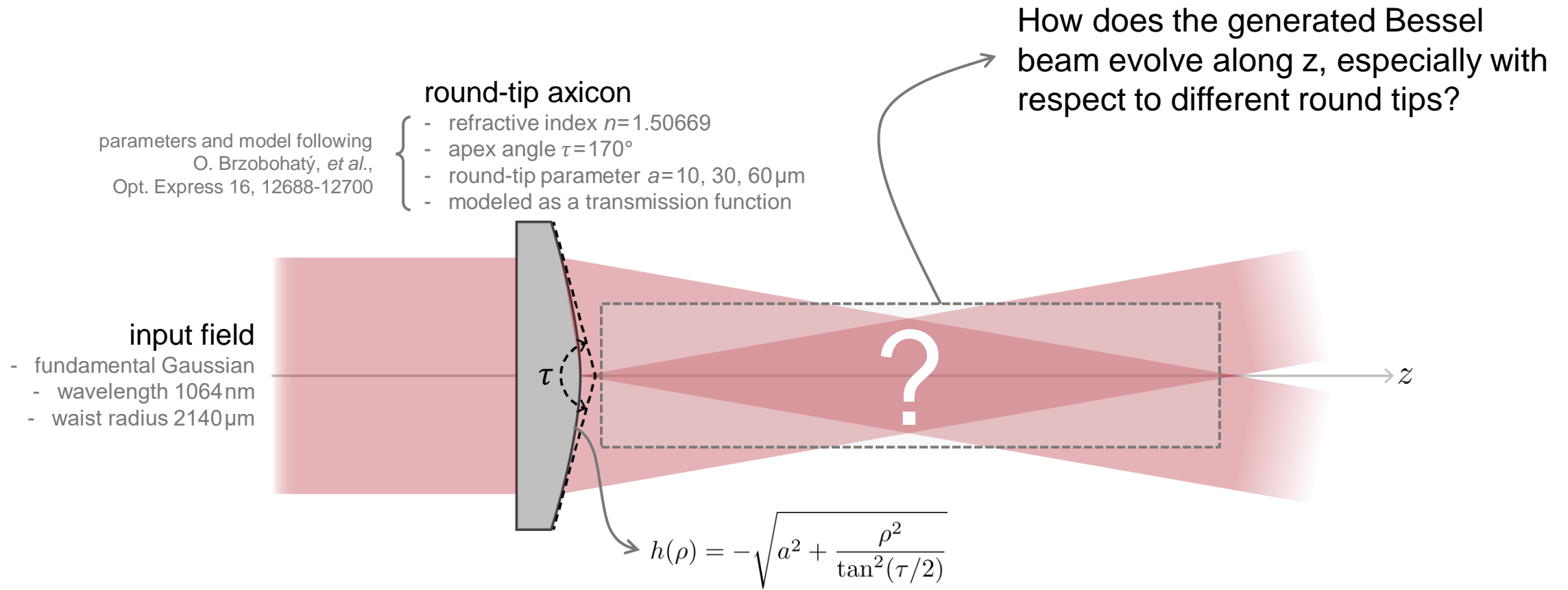# Modeling of Bessel Beam Generation from Axicon with Round Tip
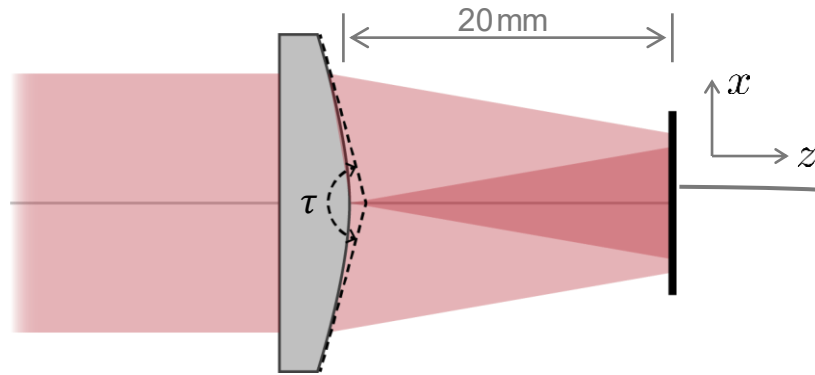
Abstract

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.
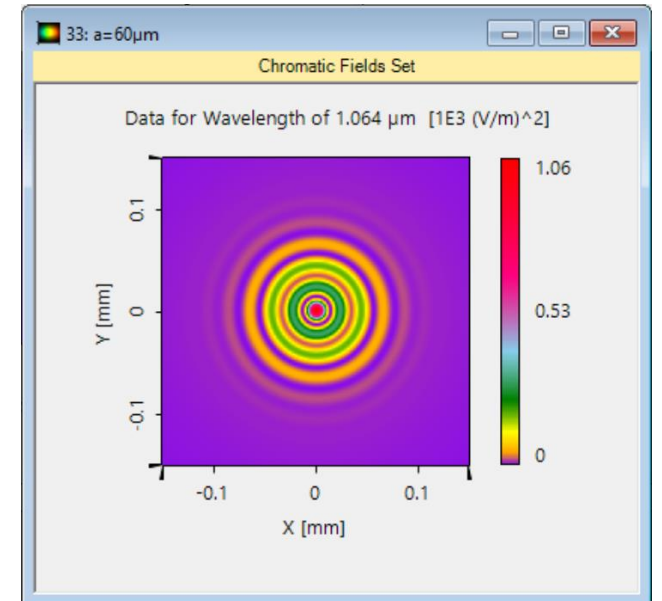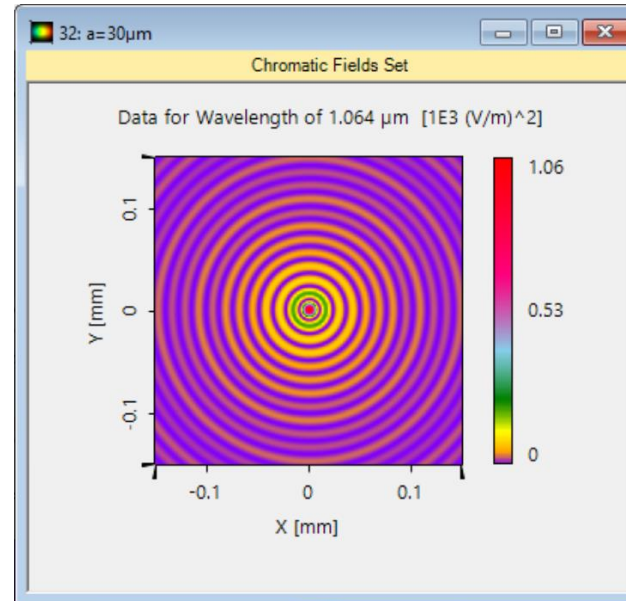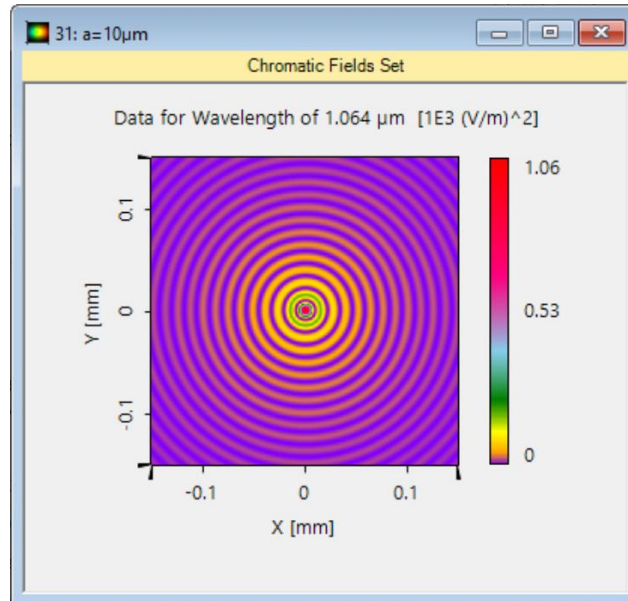
Modeling Task

round-tip axicon

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

- refractive index n=1.50669
- apex angle τ=170°
- round-tip parameter a=10, 30, 60 μm
- modeled as a transmission function

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

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

τ

?

z

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

Bessel Beam at a Fixed Z-Position

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

Bessel Beam Evolution Along Z (a=10µm)

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

100 mm

25: a=10µm

Numerical Data Array

Diagram | Table | Value at (x,y)

Data for Wavelength of 1.064 µm [1E3 (V/m)^2]

Bessel Beam Evolution Along Z (a=10μm)

round-tip axicon
- $n = 1.50669$
- apex angle $\tau = 170°$
- **$a = 10\,\mu m$**

round-tip axicon
- $n=1.50669$
- apex angle $\tau=170°$
- **$a=30\,\mu m$**
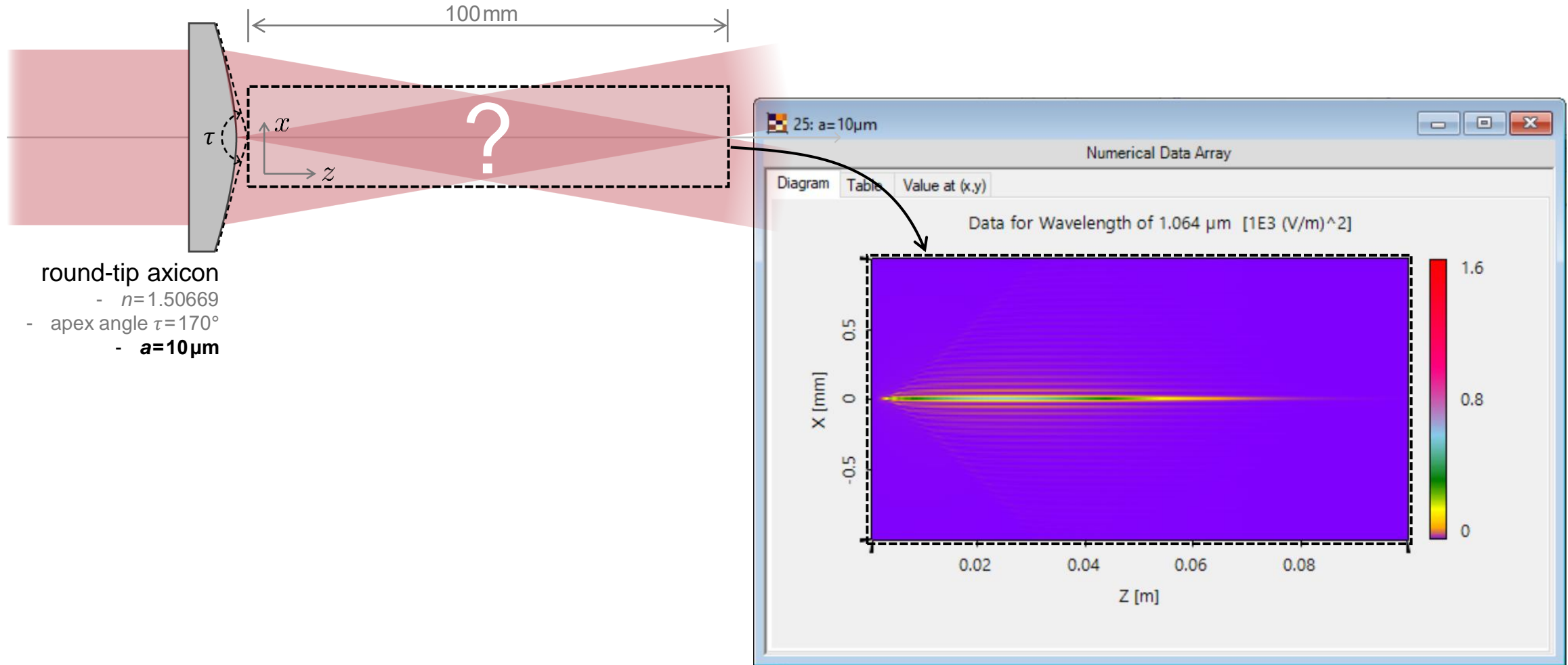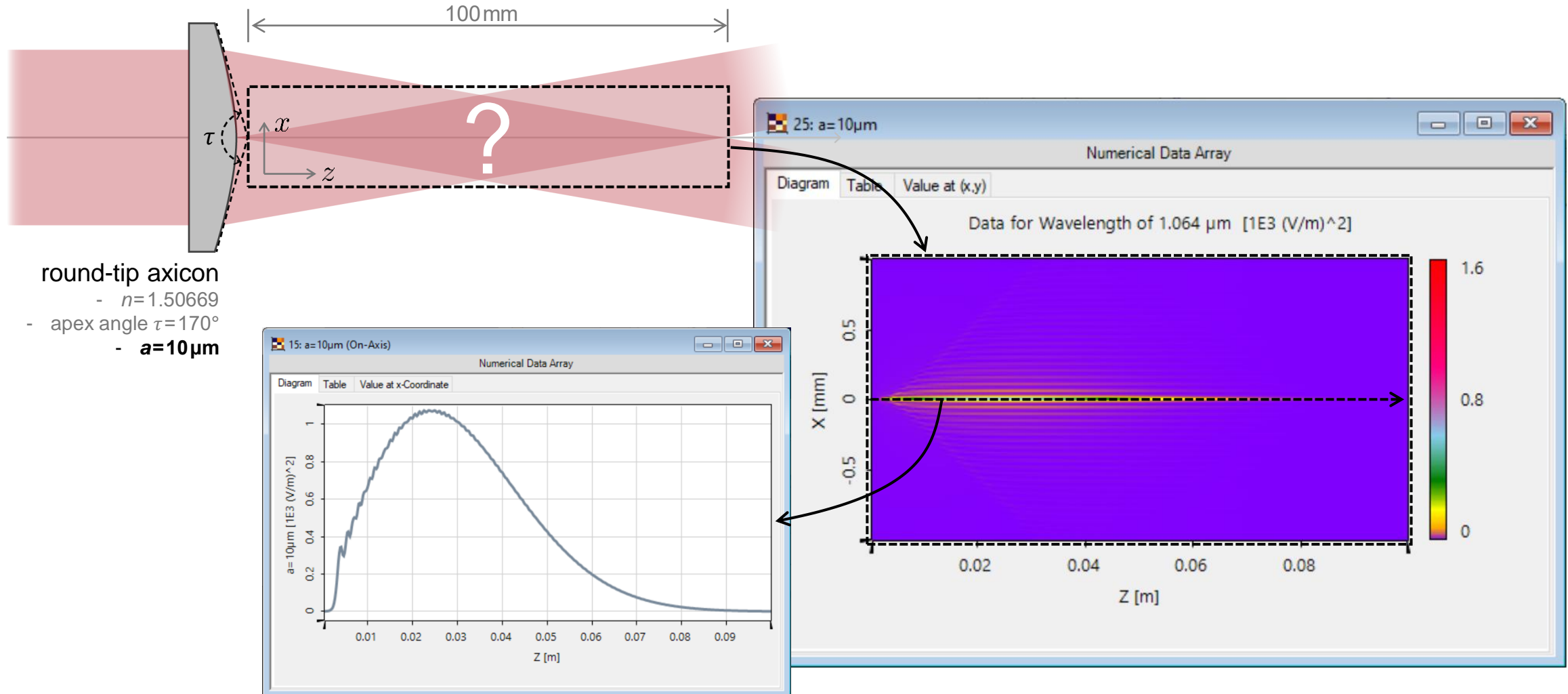
Bessel Beam Evolution Along Z (a=30 µm)
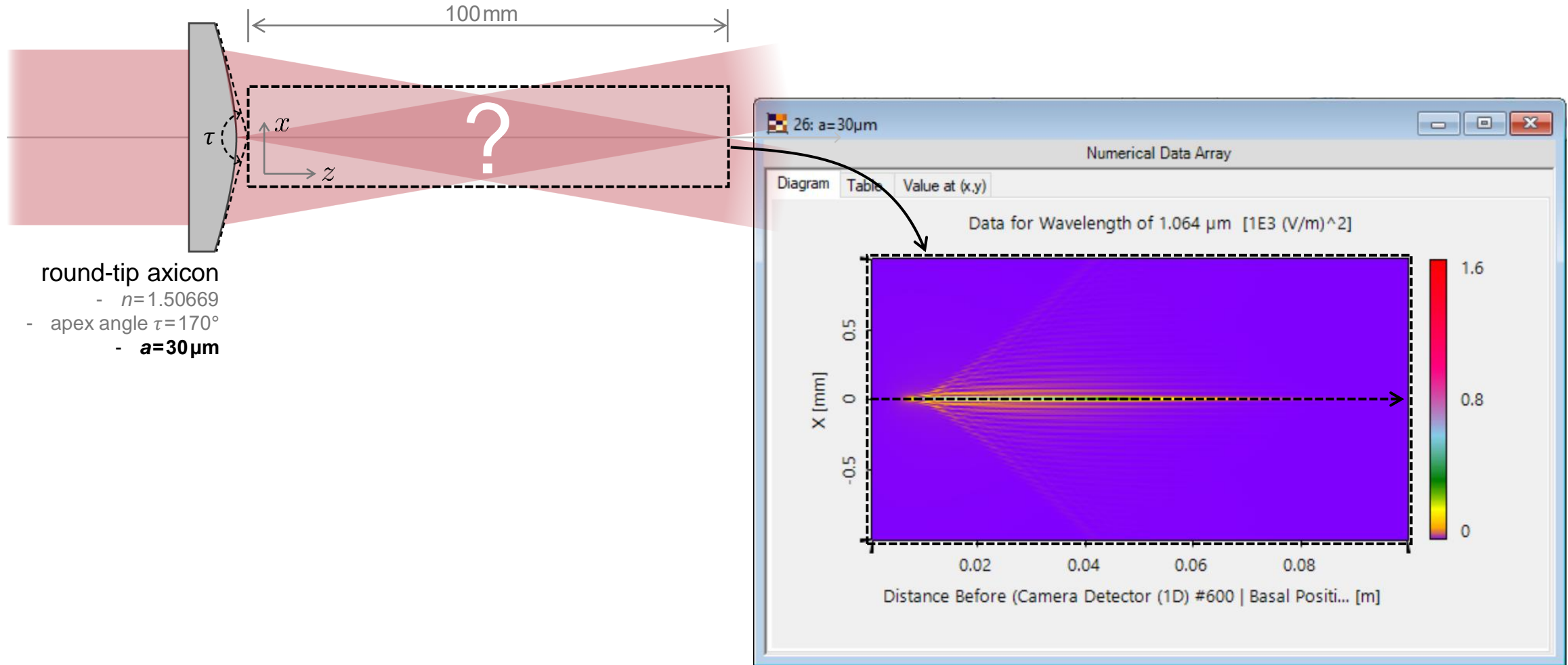
Bessel Beam Evolution Along Z (a=60 µm)
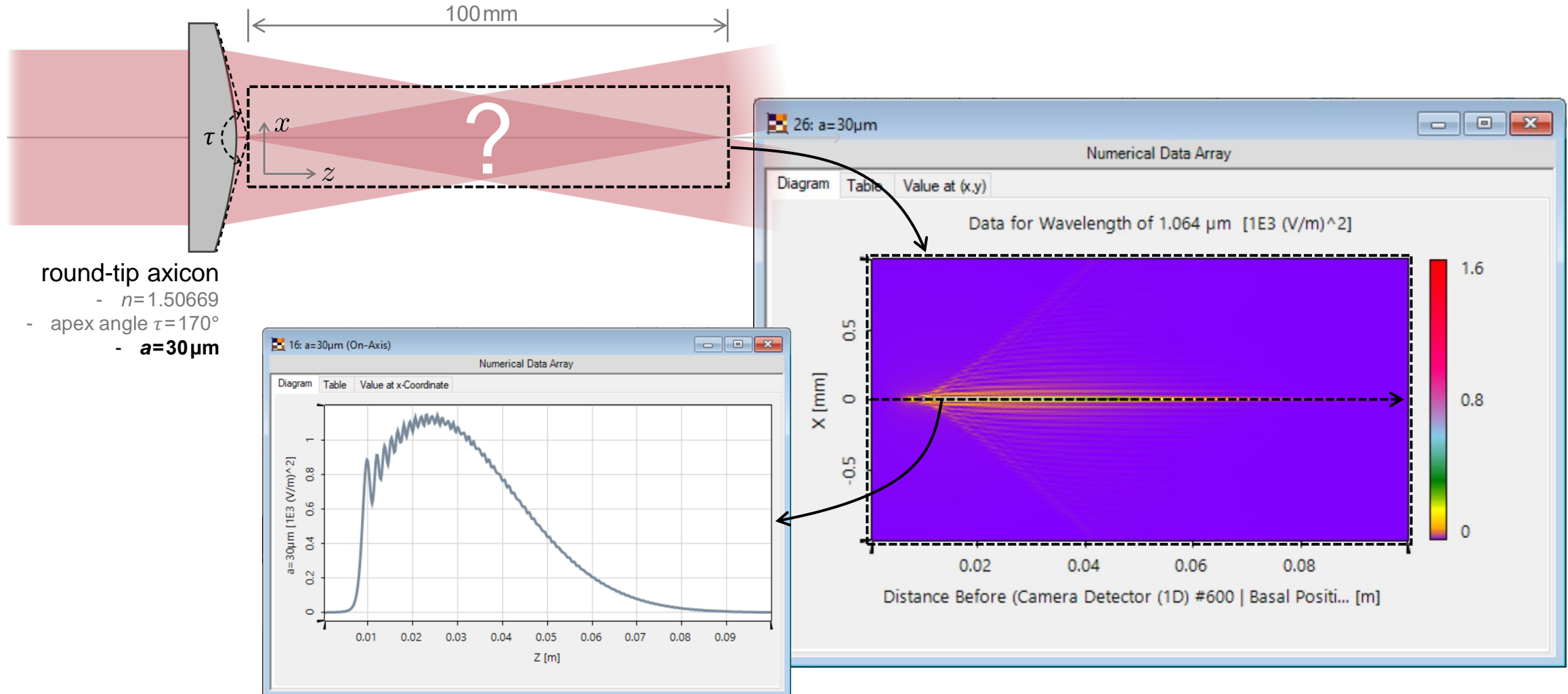
Bessel Beam Evolution Along Z (a=60 µm)
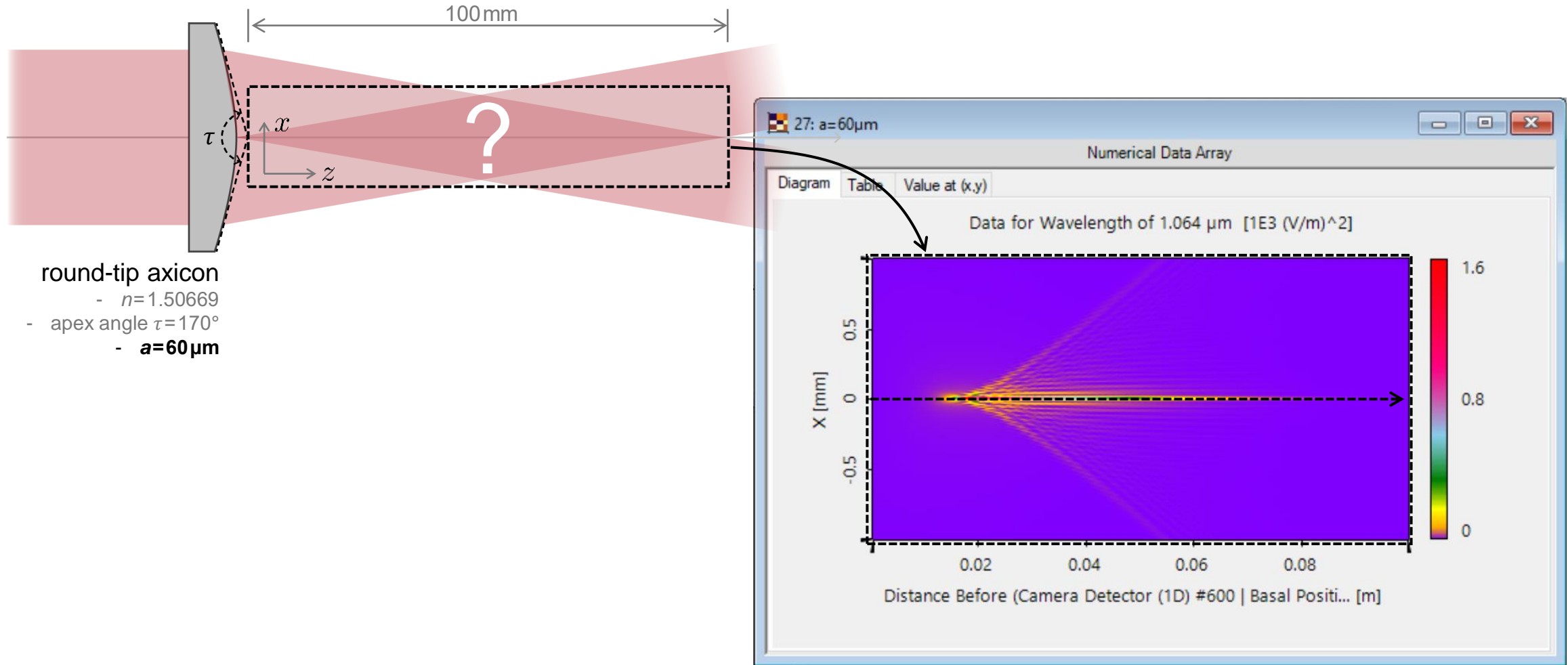
round-tip axicon
- n = 1.50669
- apex angle τ = 170°
- **a = 60 µm**
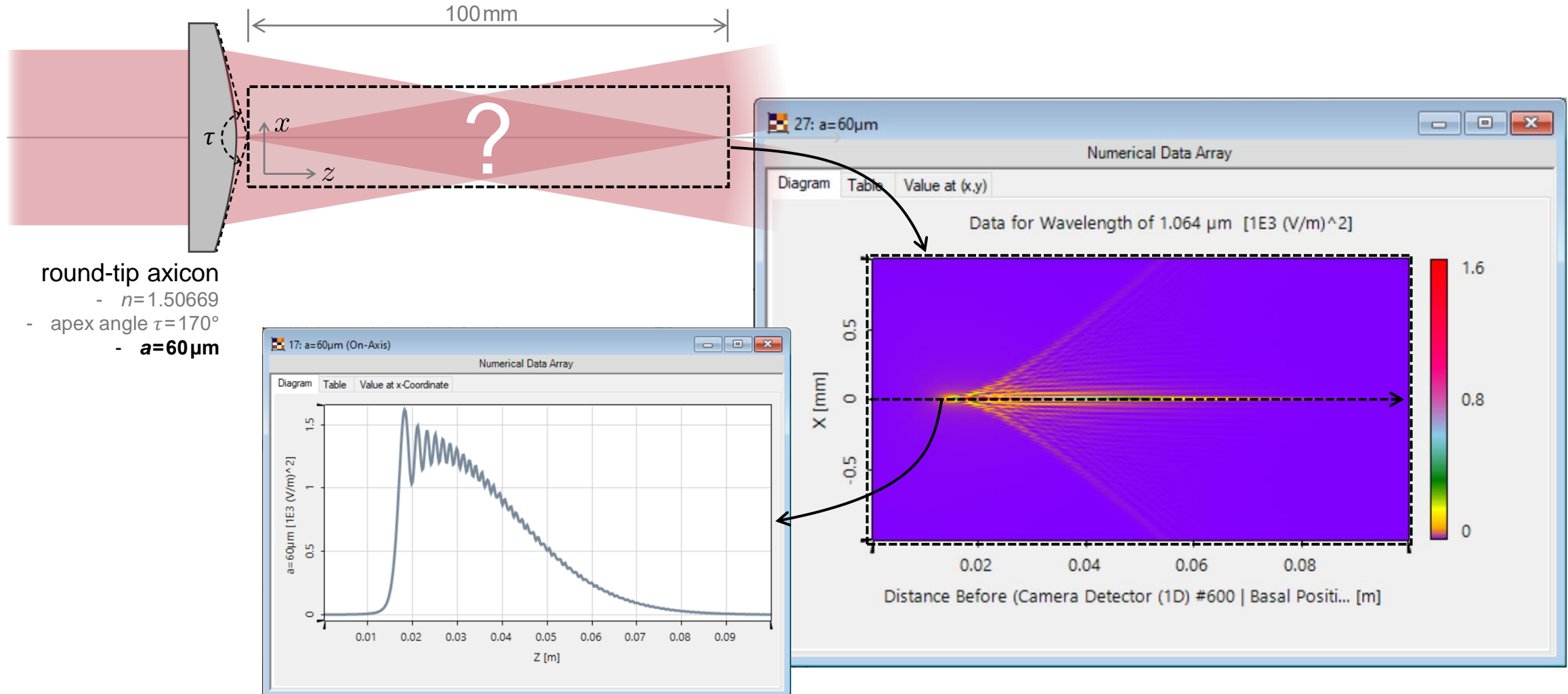
On-Axis Distribution and Comparison

simulation result in VirtualLab Fusion
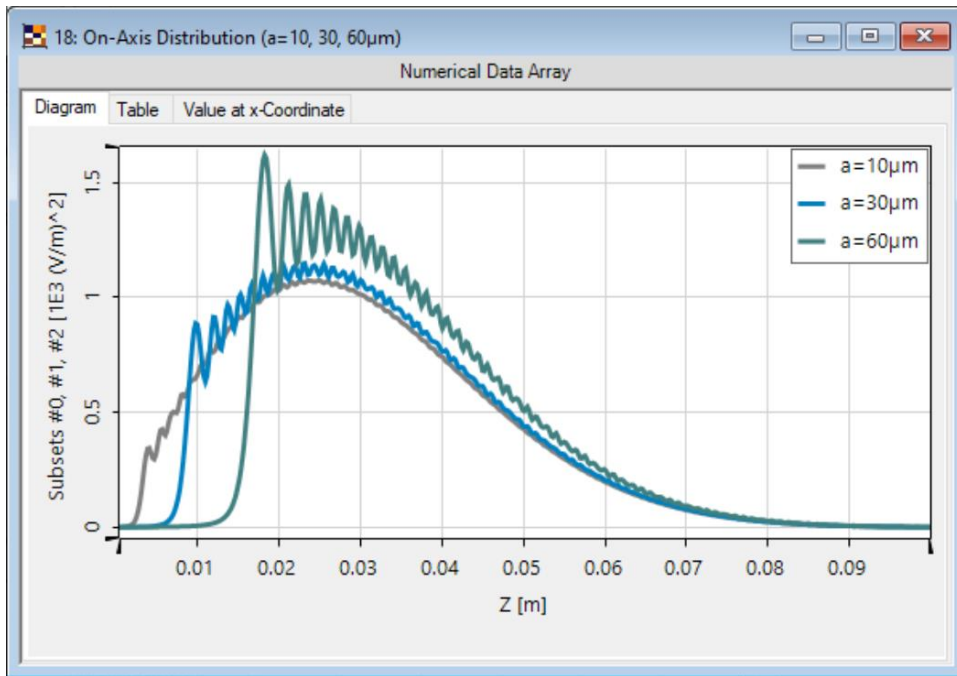
Fig. 2 from O. Brzobohatý, *et al.*,
Opt. Express 16, 12688-12700 (2008)
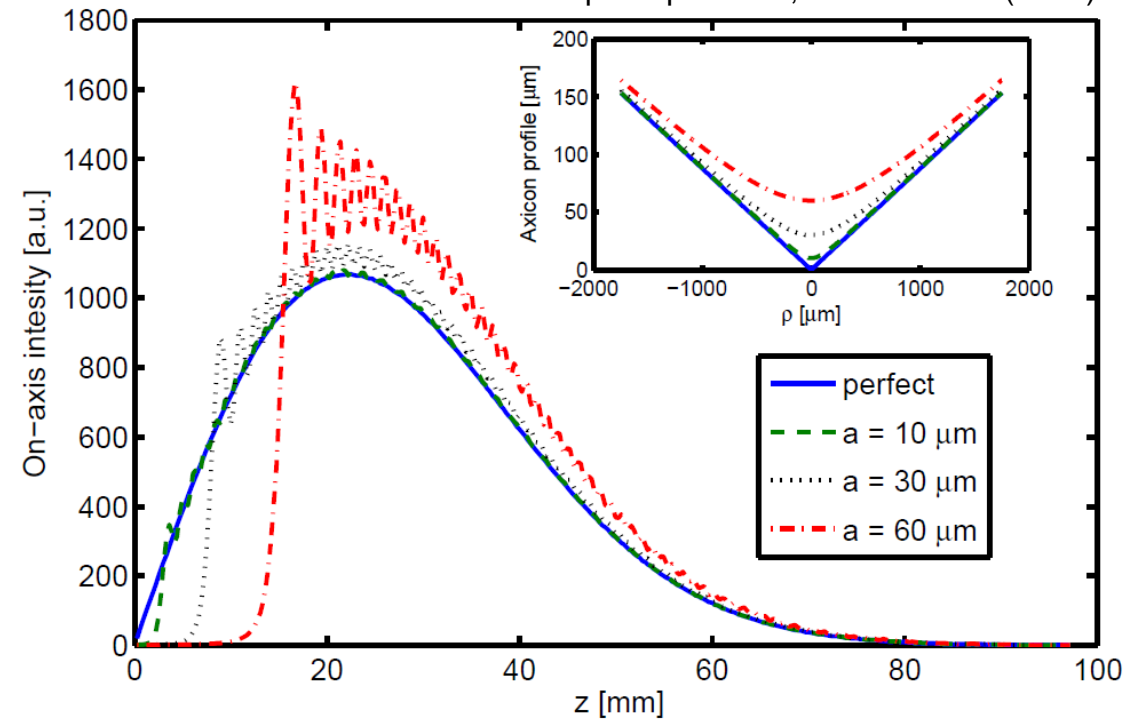
Peek into VirtualLab Fusion

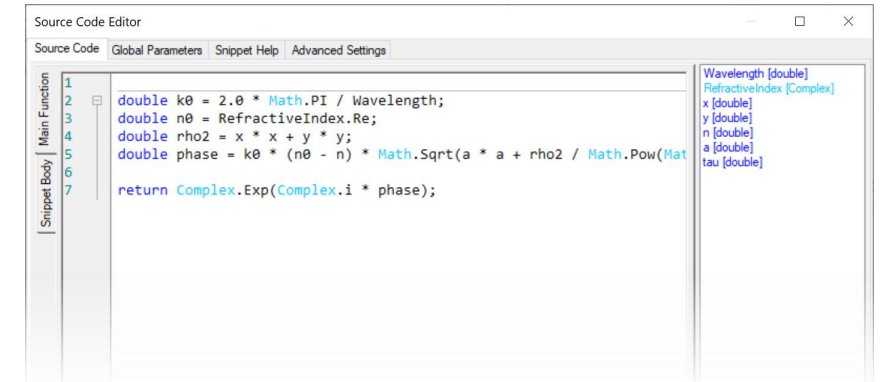customizable and flexible transmission definition

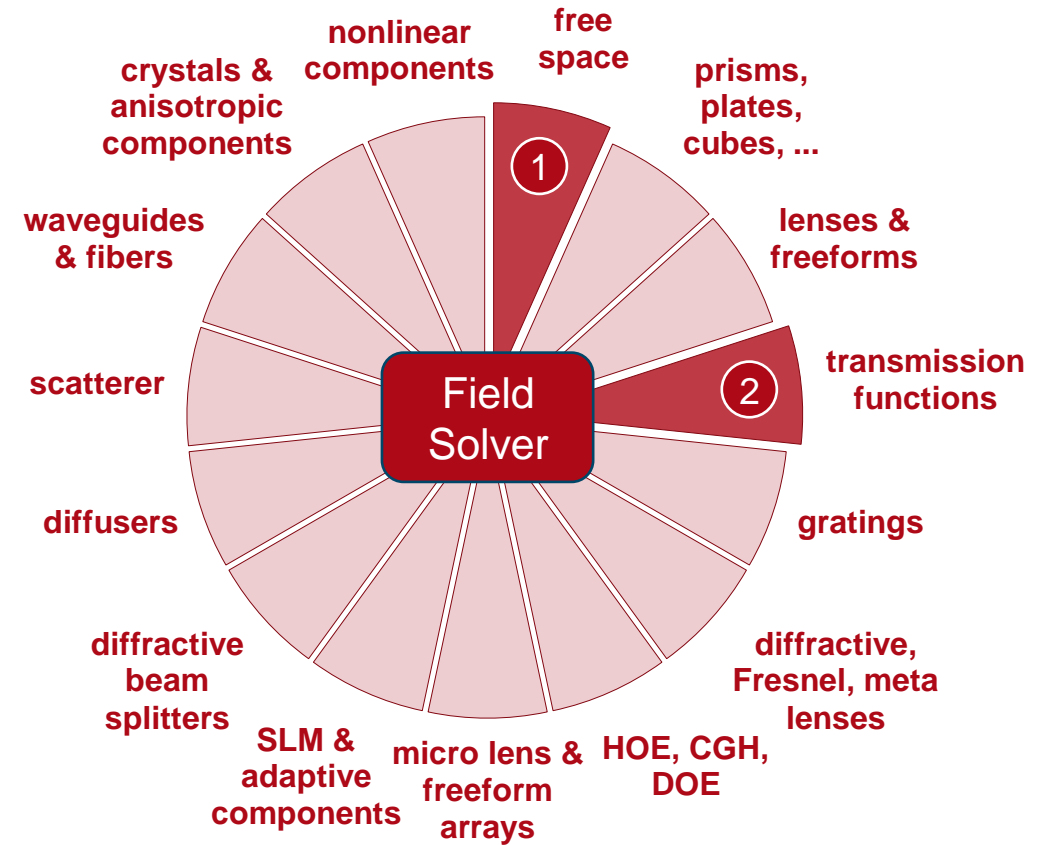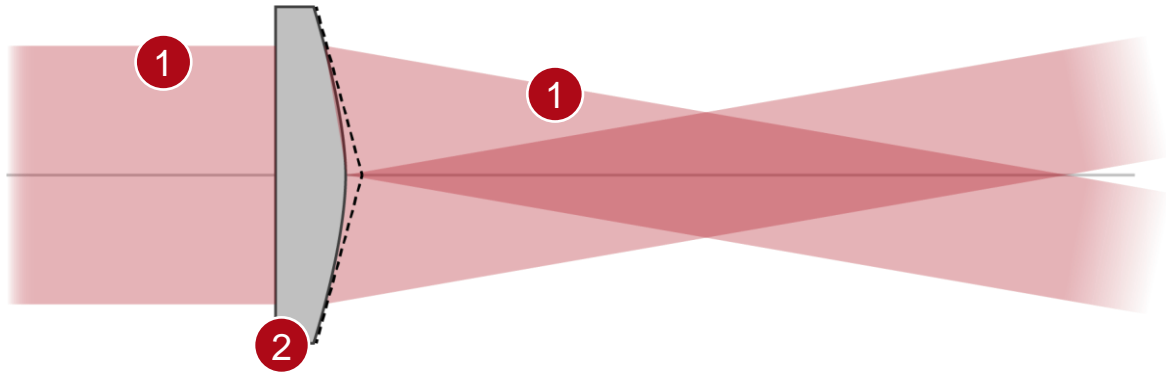field visualization and analysis
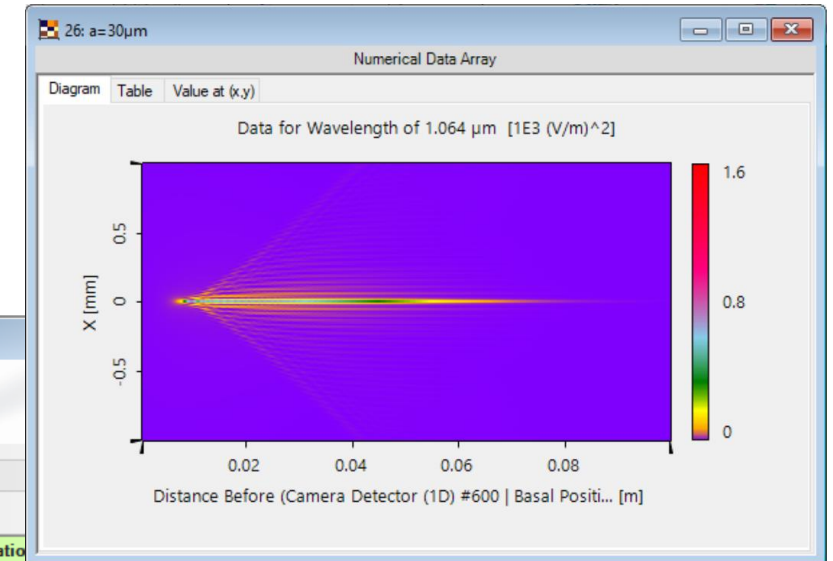
parameter sweep

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
document code	MISC.0009
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	VirtualLab Fusion Summer Release 2019 (7.6.1.18)
category	Application Use Case
further reading	- Programming an Axicon Transmission Function - Diffraction Patterns behind Different Apertures - Focal Spots for Different Aberrations