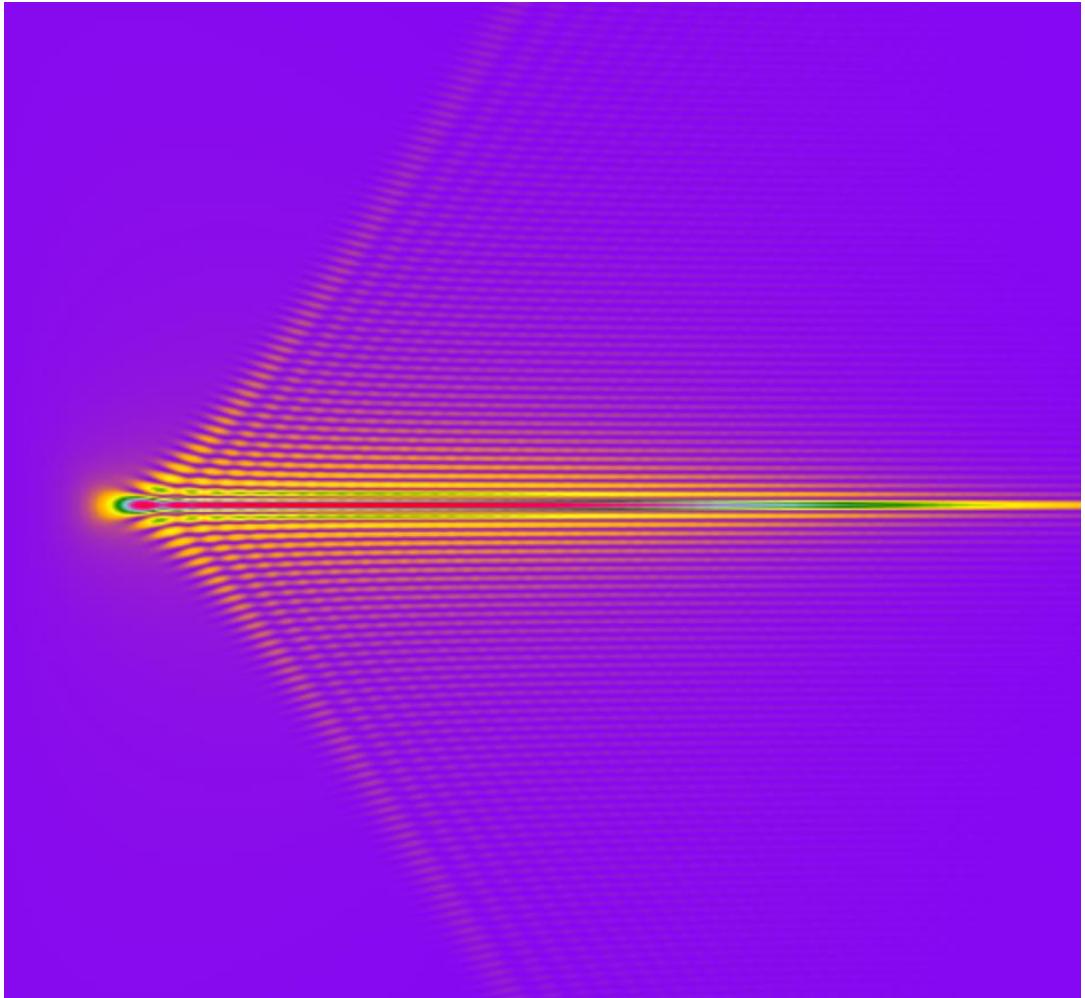




Modeling of Bessel Beam Generation from Axicon with Round Tip

Abstract



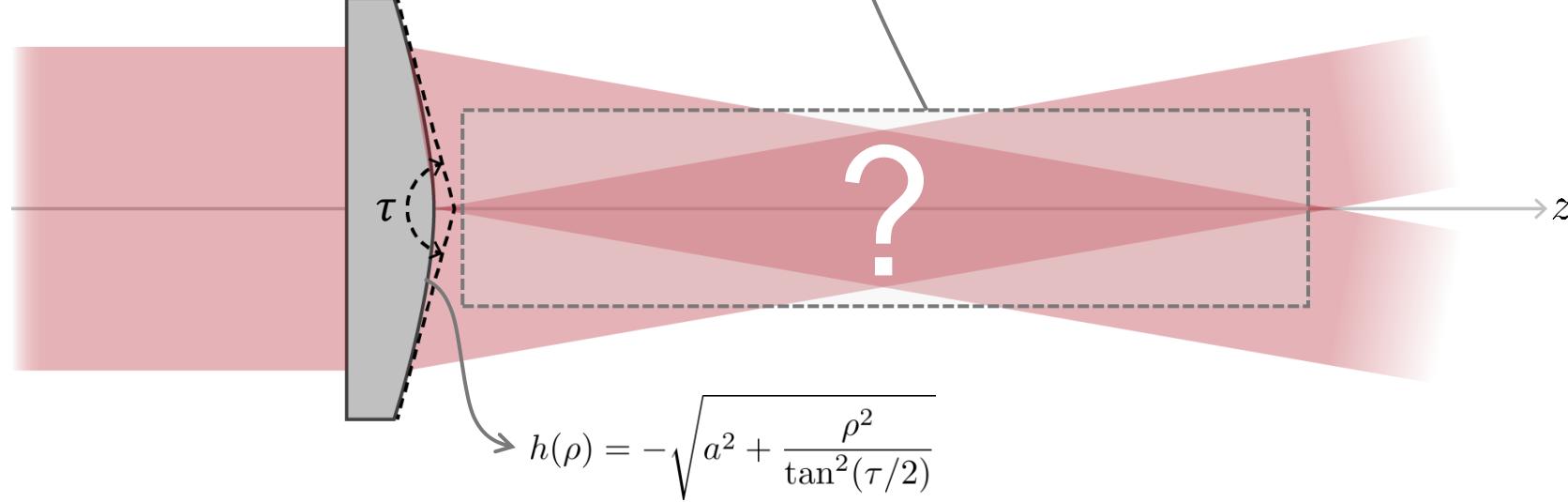
Bessel beams, due to their non-diffracting property, are drawing attentions for different applications. They are typically generated from axicons. An ideal axicon with infinite tip does not exist, and, in practice, an axicon comes with a rounded tip. In this example, we investigate the effect of the 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

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

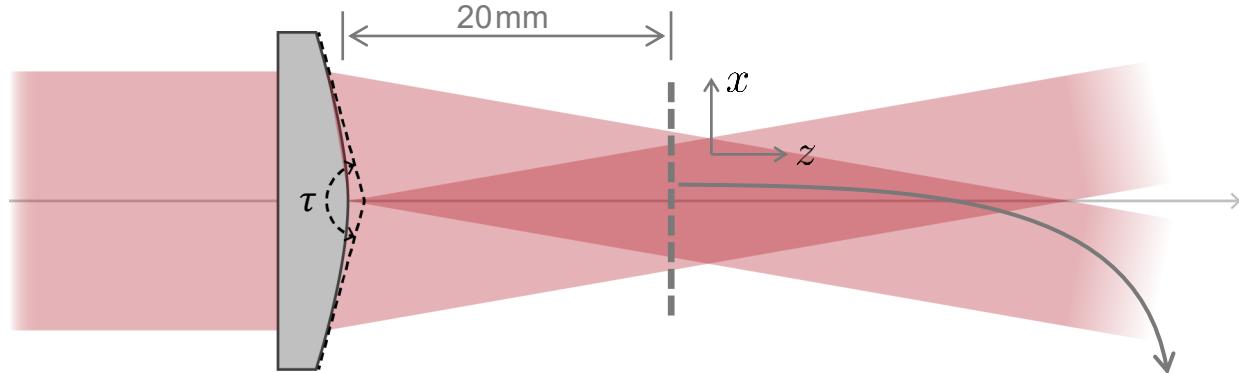
- round-tip axicon
- refractive index $n=1.50669$
 - apex angle $\tau=170^\circ$
 - round-tip parameter $a=10, 30, 60\mu\text{m}$
 - modeled as a transmission function

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



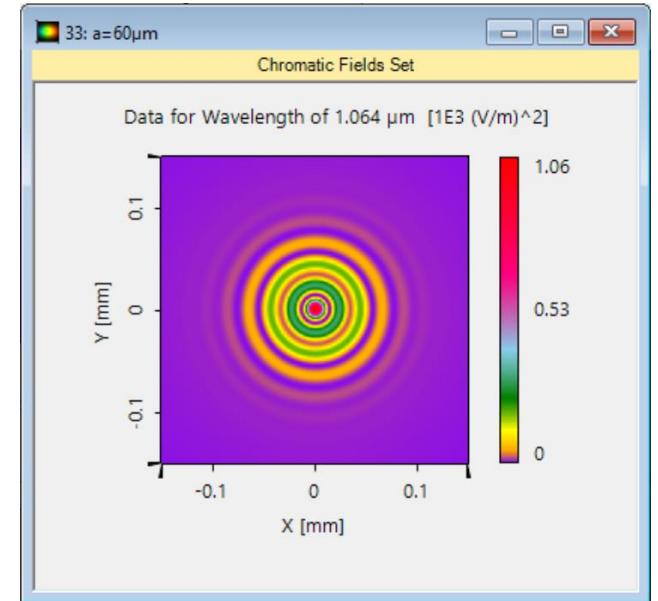
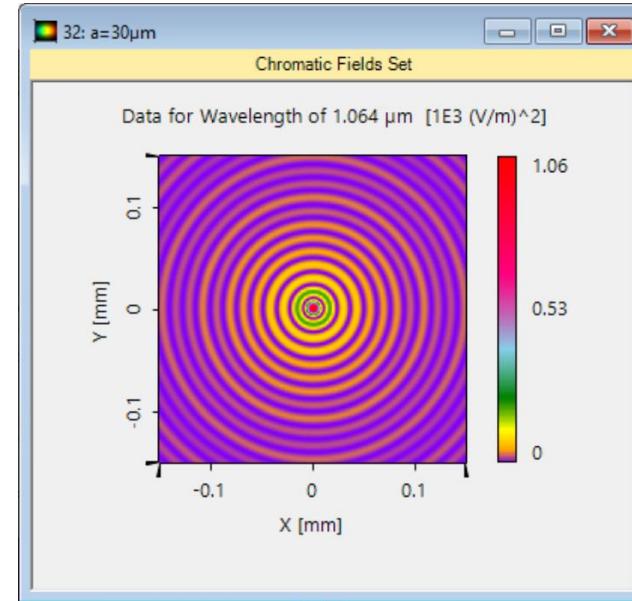
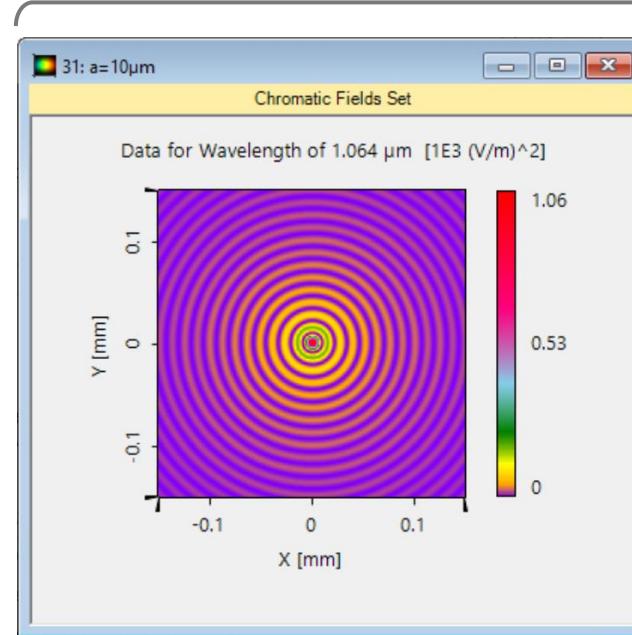
How does the generated Bessel
beam evolve along z , especially with
respect to different round tips?

Bessel Beam at a Fixed Z-Position

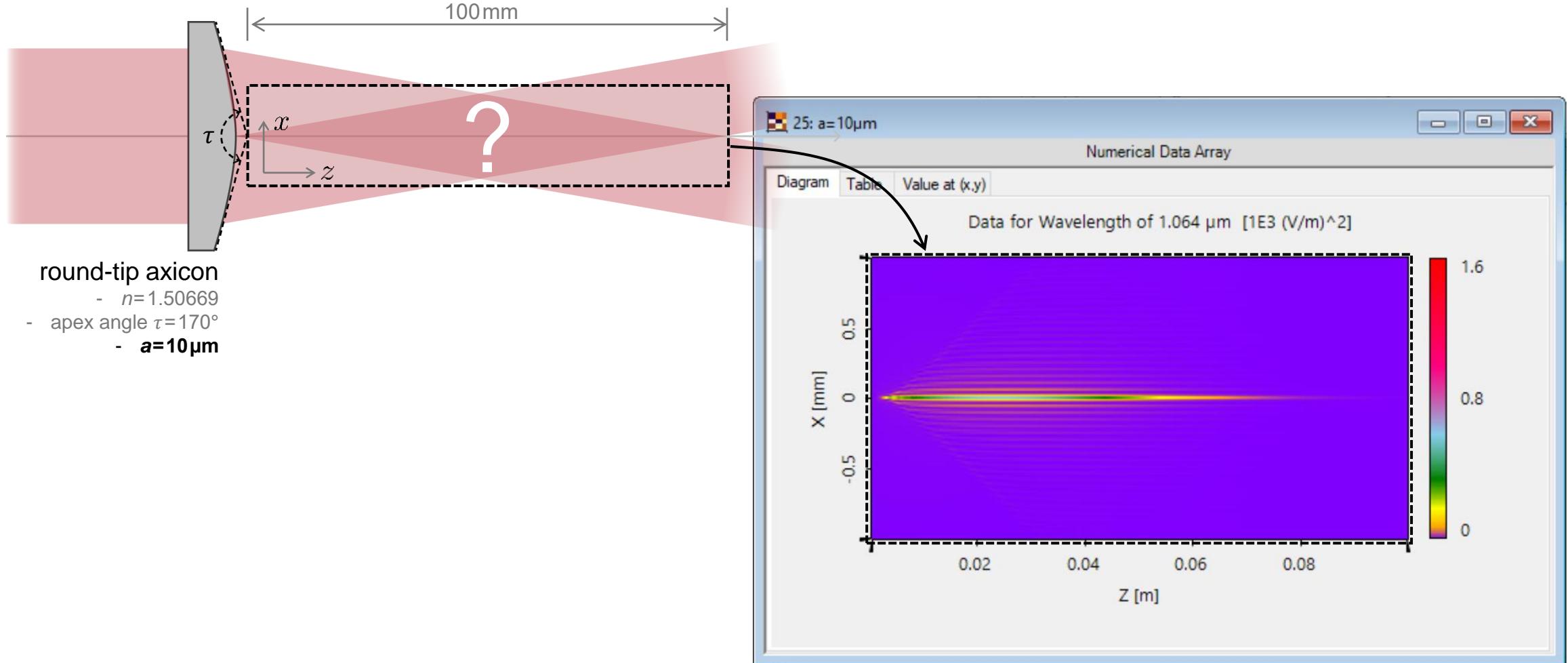


round-tip axicon

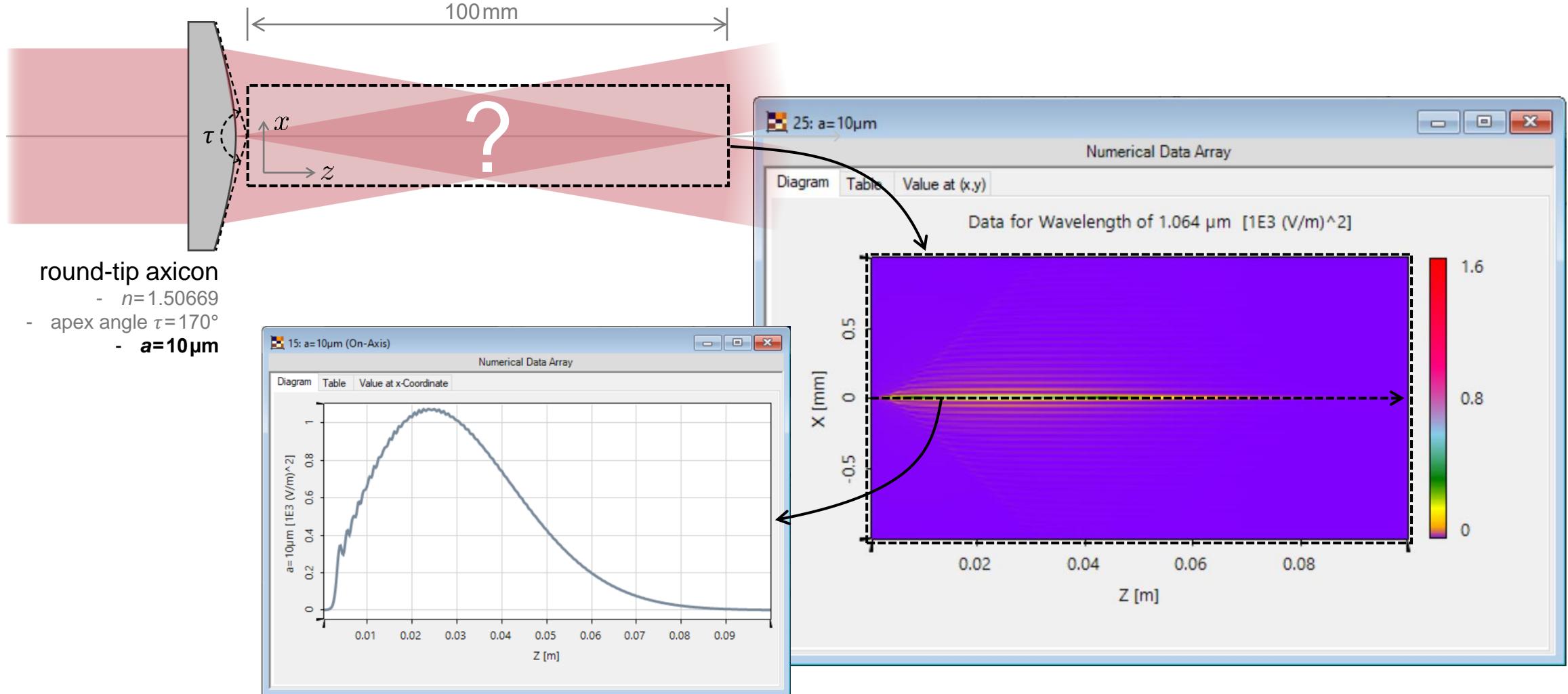
- $n=1.50669$
- apex angle $\tau=170^\circ$
- **a=10, 30, 60 μm**



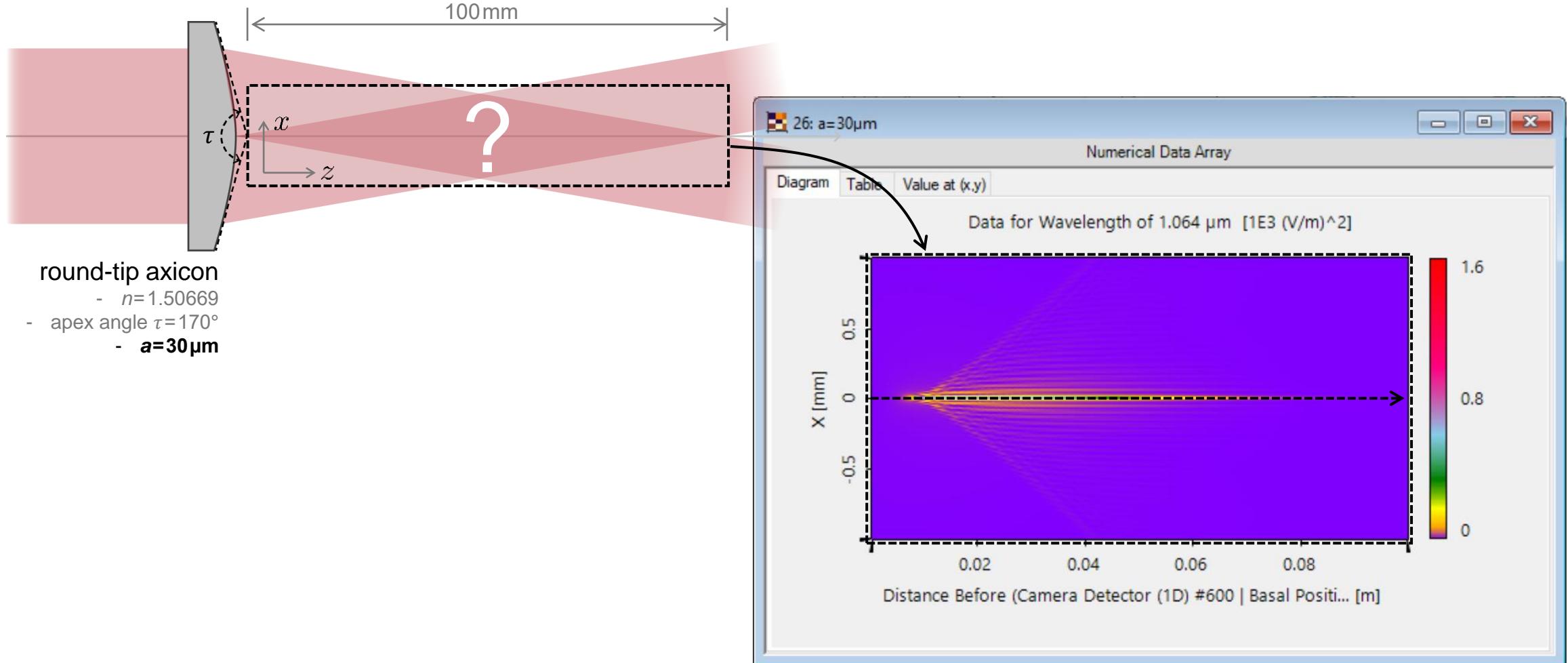
Bessel Beam Evolution Along Z (a=10μm)



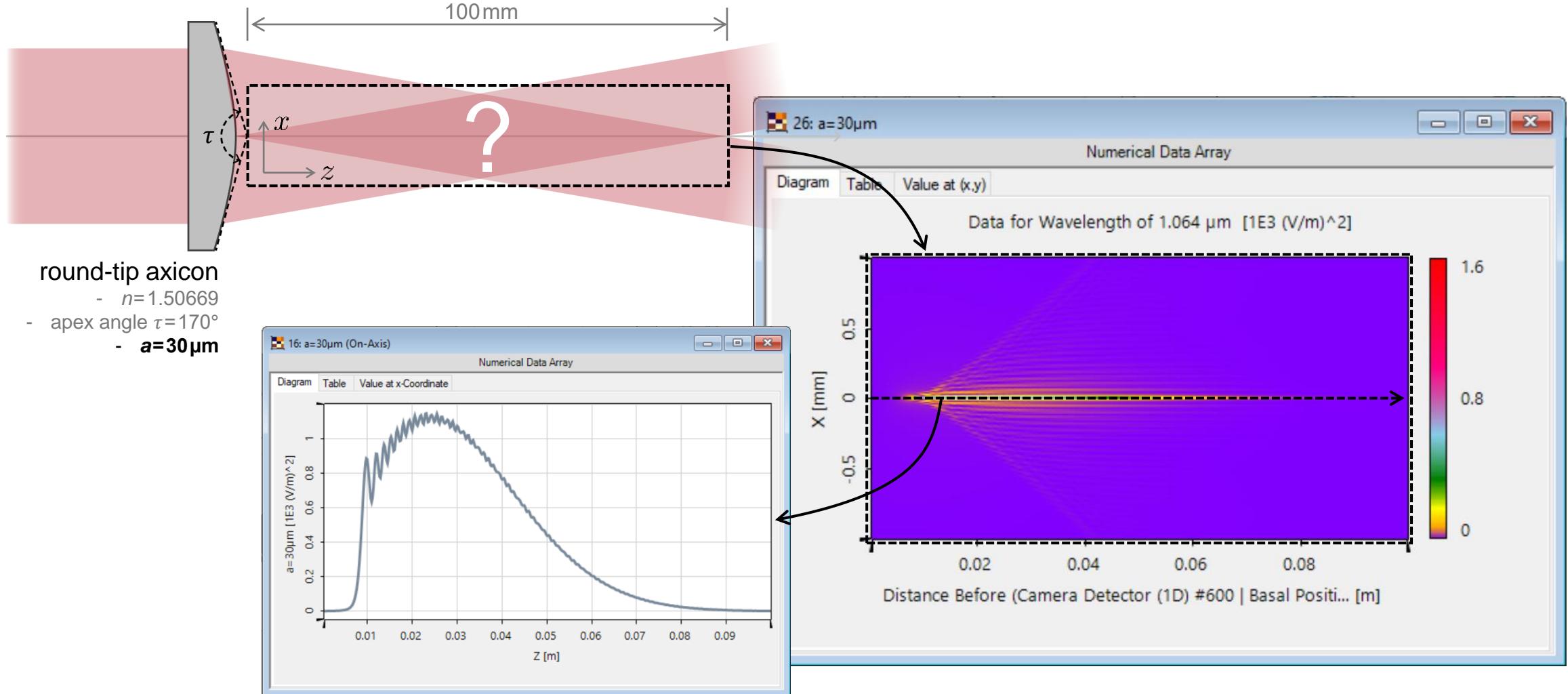
Bessel Beam Evolution Along Z ($a=10\mu\text{m}$)



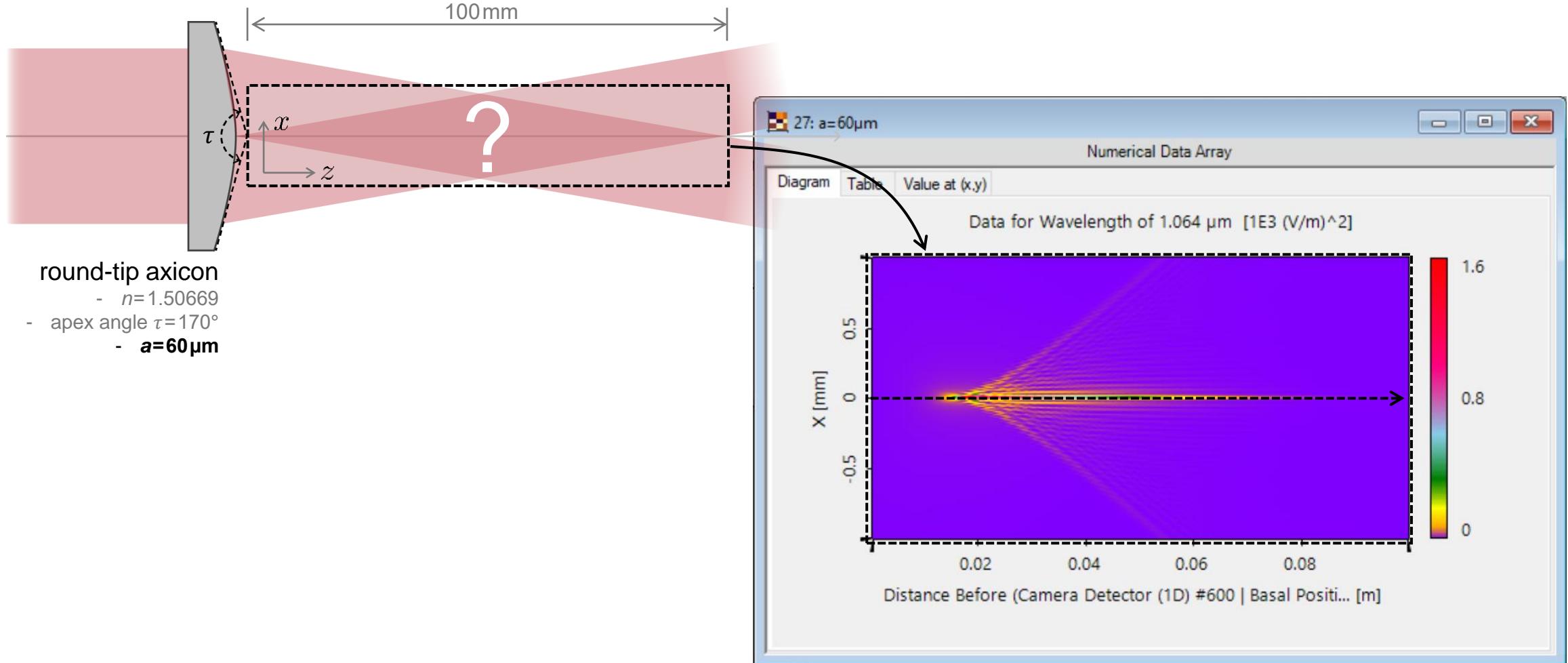
Bessel Beam Evolution Along Z (a=30μm)



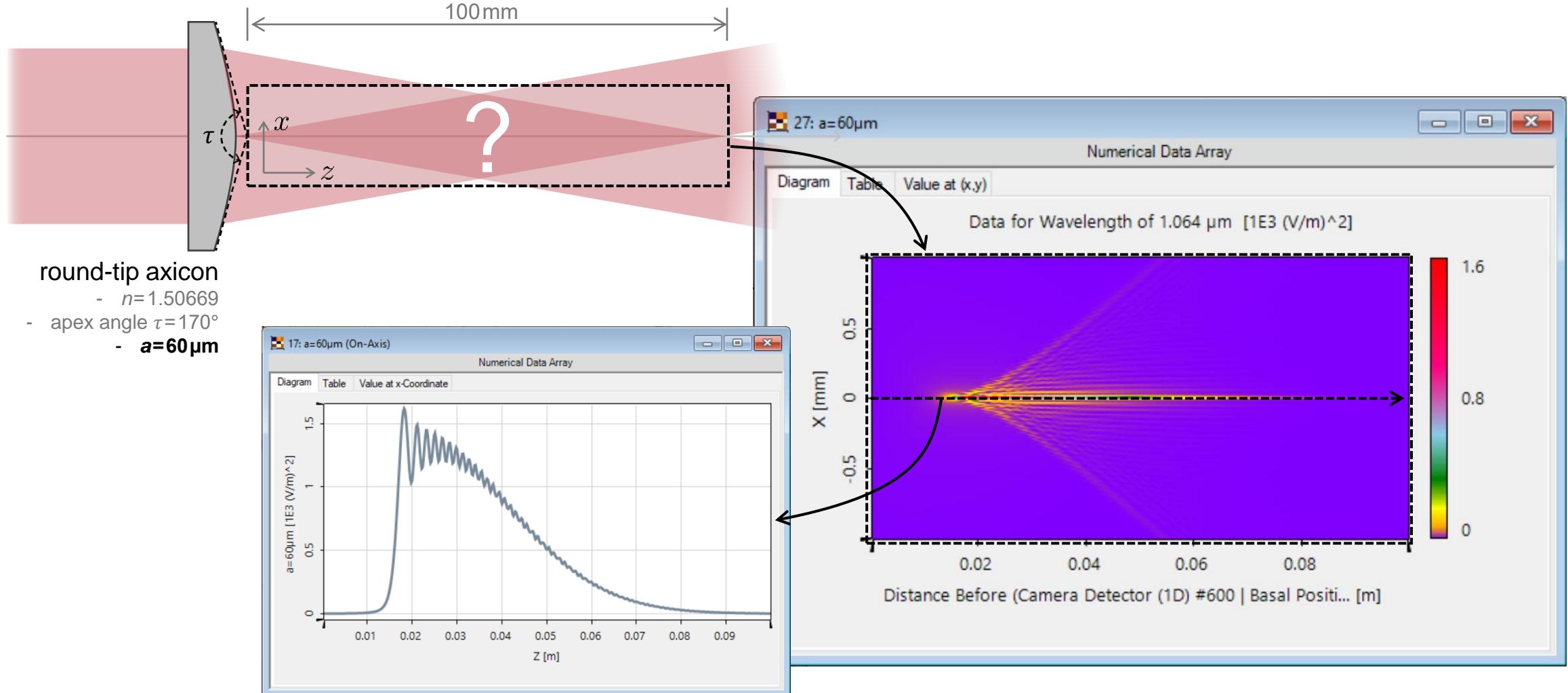
Bessel Beam Evolution Along Z (a=30μm)



Bessel Beam Evolution Along Z (a=60μm)



Bessel Beam Evolution Along Z (a=60μm)



On-Axis Distribution and Comparison

simulation result in VirtualLab Fusion

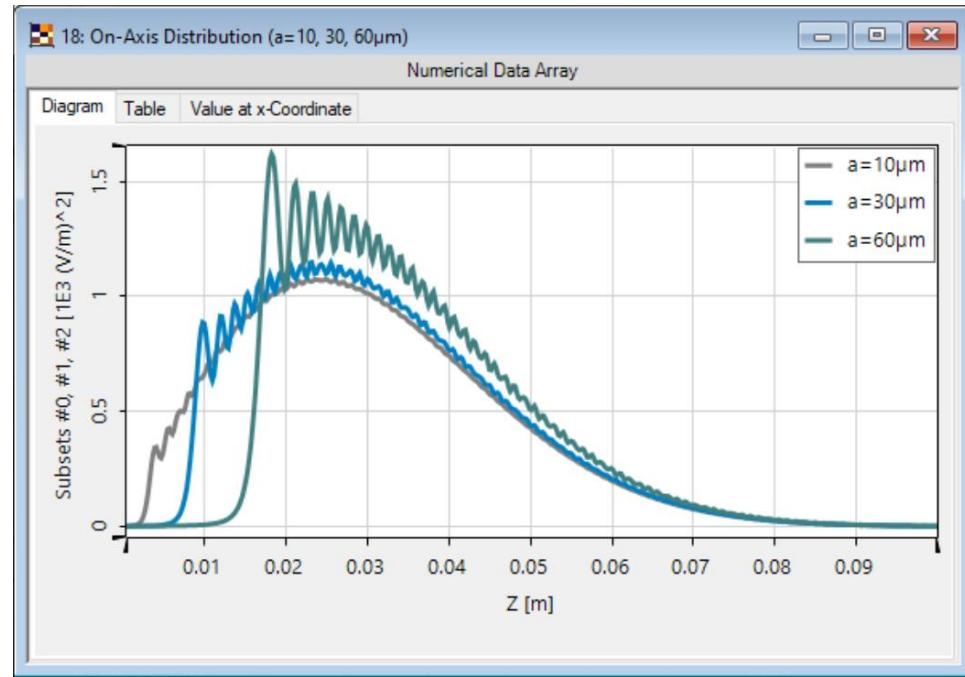
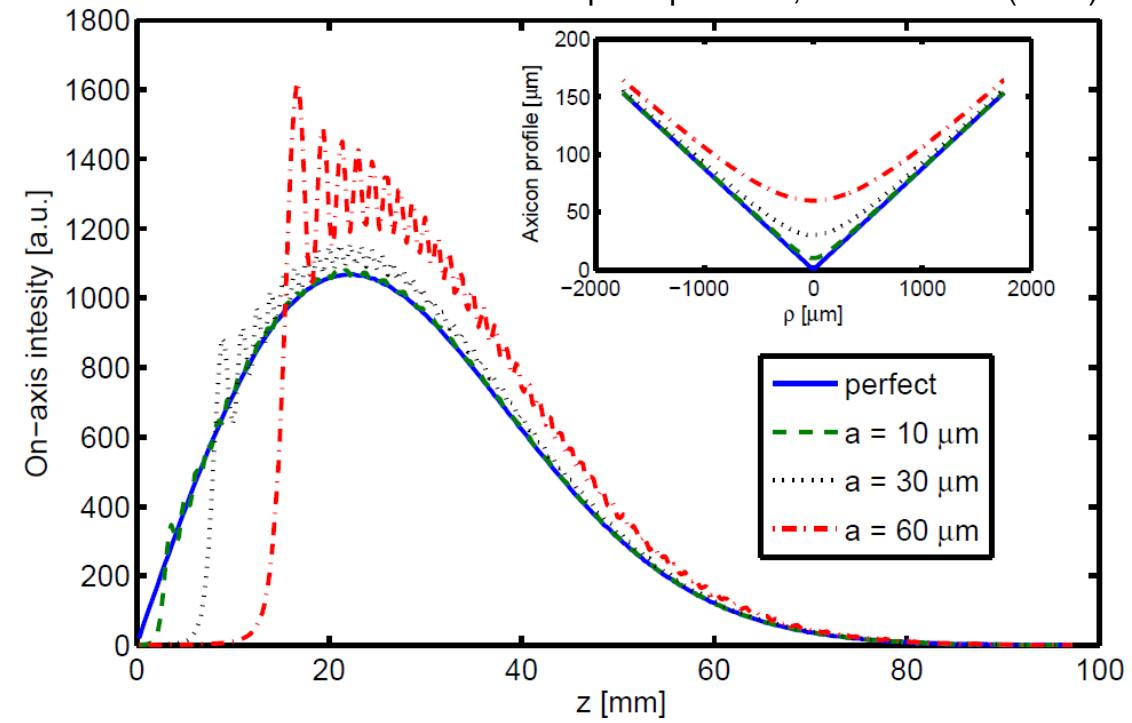


Fig. 2 from O. Brzobohatý, et al.,
Opt. Express 16, 12688-12700 (2008)



Peek into VirtualLab Fusion

customizable and flexible transmission definition

Source Code Editor

Source Code | Global Parameters | Snippet Help | Advanced Settings

Main Function

```
1 double k0 = 2.0 * Math.PI / Wavelength;
2 double n0 = RefractiveIndex.Re;
3 double rho2 = x * x + y * y;
4 double phase = k0 * (n0 - n) * Math.Sqrt(a * a + rho2 / Math.Pow(Mat
5
6
7 return Complex.Exp(Complex.i * phase);
```

Wavelength [double]
RefractiveIndex [Complex]
x [double]
y [double]
n [double]
a [double]
tau [double]

19: C:\Users...\Axicon with Round Tip_04_a=60µm.run

Results

Start the parameter run and analyze its results

Go!

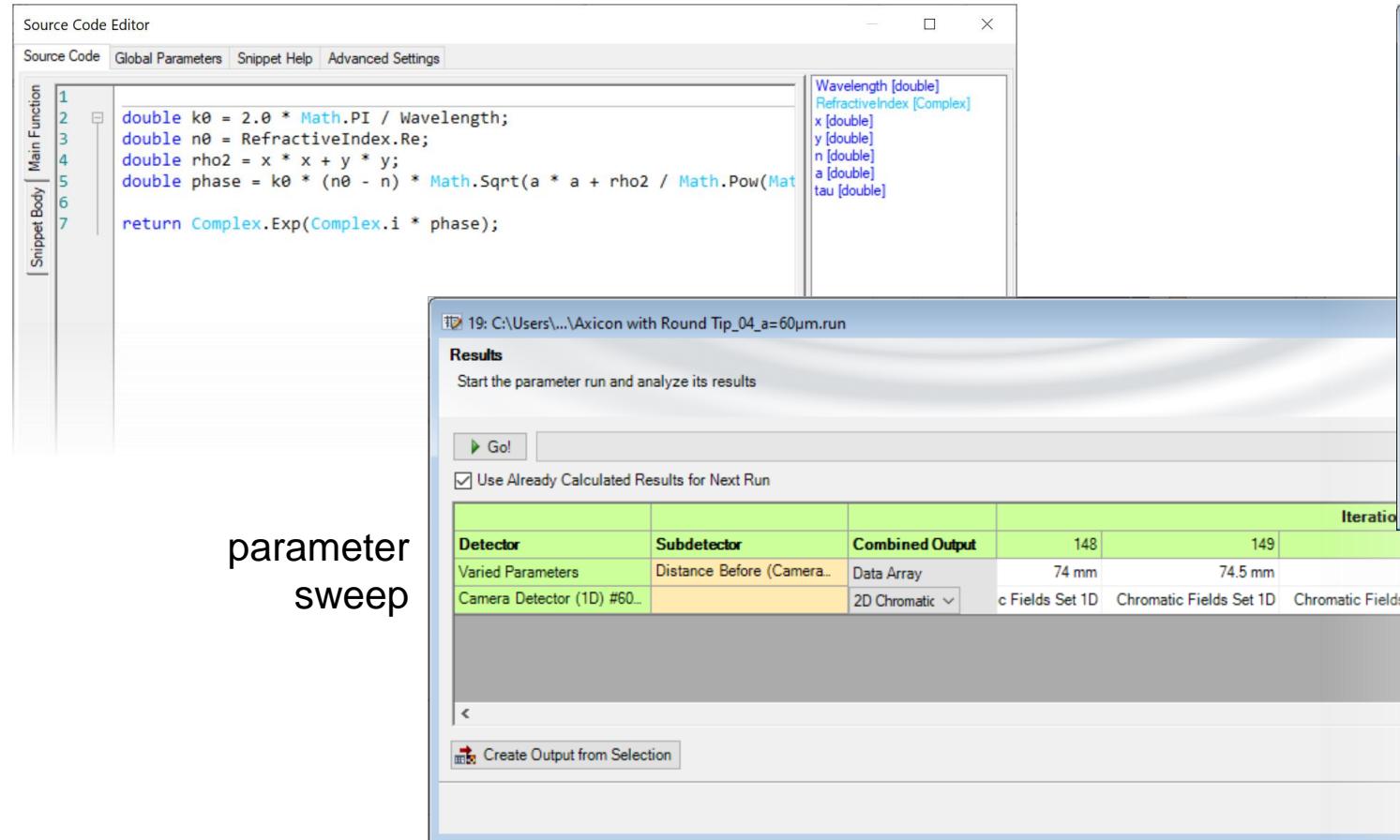
Use Already Calculated Results for Next Run

Detector	Subdetector	Combined Output	Iteration
Varied Parameters	Distance Before (Camera...	Data Array	148 149 150 151
Camera Detector (1D) #60...		2D Chromatic	74 mm 74.5 mm 75 mm 75.5 mm
		c Fields Set 1D	Chromatic Fields Set 1D
		Chromatic Fields Set 1D	Chromatic Fields Set 1D
		Chromatic Fields Set 1D	Chromo...

<

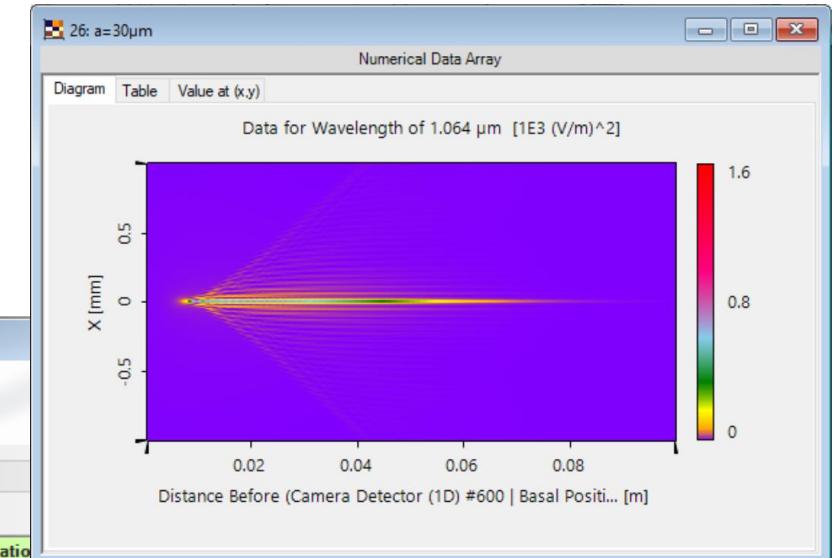
Create Output from Selection

< Back | Next >



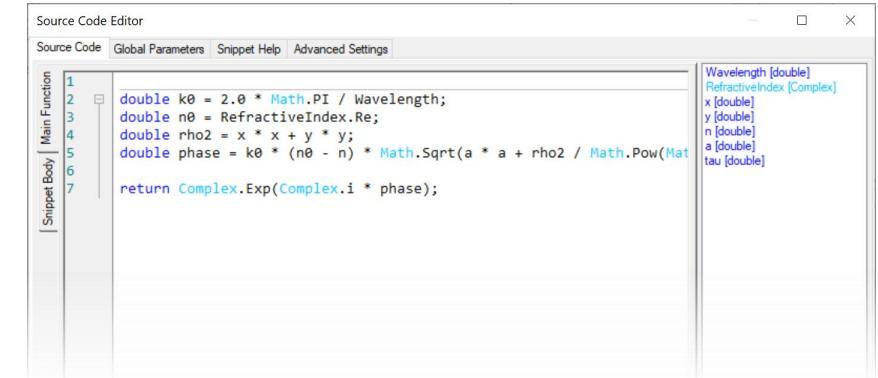
parameter
sweep

field visualization and analysis



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]



The screenshot shows the Source Code Editor interface. The main window displays a snippet of Java code within a 'Main Function' block:

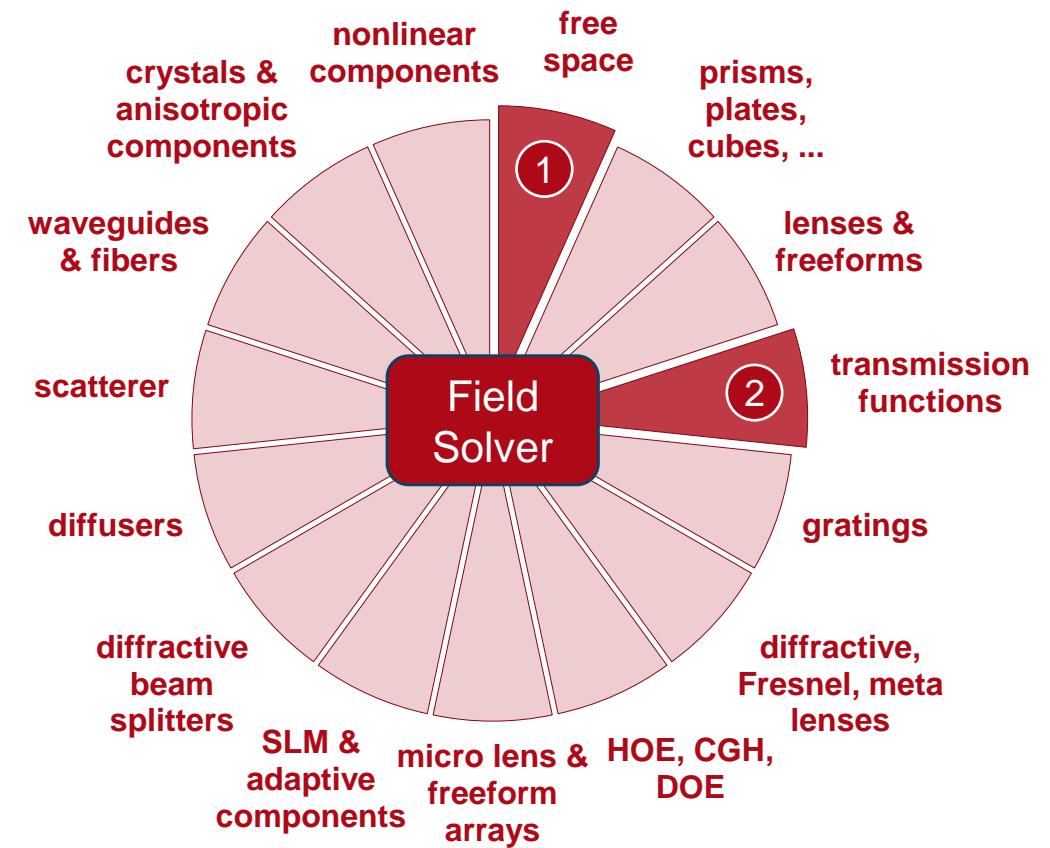
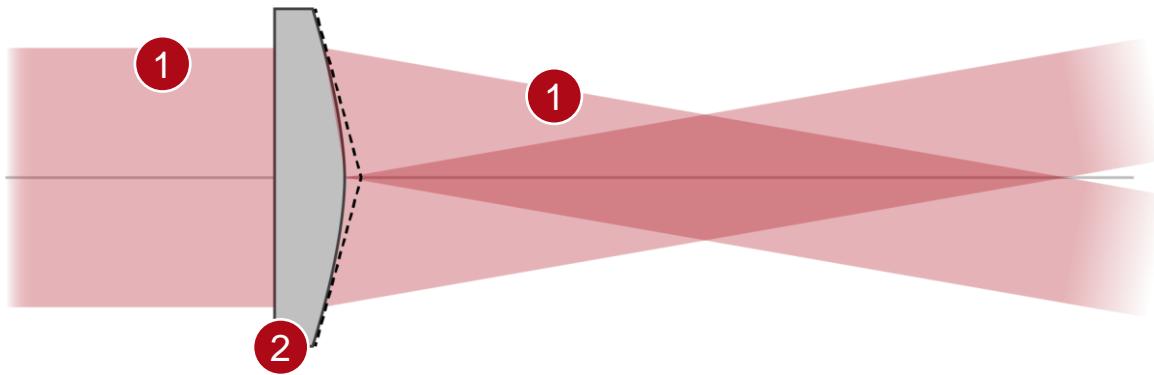
```
Source Code Editor
Source Code Global Parameters Snippet Help Advanced Settings

Main Function
1 double k0 = 2.0 * Math.PI / Wavelength;
2 double n0 = RefractiveIndex.Re;
3 double rho2 = x * x + y * y;
4 double phase = k0 * (n0 - n) * Math.Sqrt(a * a + rho2) / Math.Pow(Math.Sqrt(a * a + rho2), 2);
5
6 return Complex.Exp(Complex.i * phase);
7
```

To the right of the code editor, a sidebar lists global parameters:

- Wavelength [double]
- RefractiveIndex [Complex]
- x [double]
- y [double]
- n [double]
- a [double]
- tau [double]

VirtualLab Fusion Technologies



Document Information

title	Modeling of Bessel Beam Generation from Axicon with Round Tip
document code	MISC.0009
version	1.2
edition	VirtualLab Fusion Basic
software version	2020.1 (Build 1.202)
category	Application Use Case
further reading	<ul style="list-style-type: none">- Programming an Axicon Transmission Function- Diffraction Patterns behind Different Apertures- Focal Spots for Different Aberrations