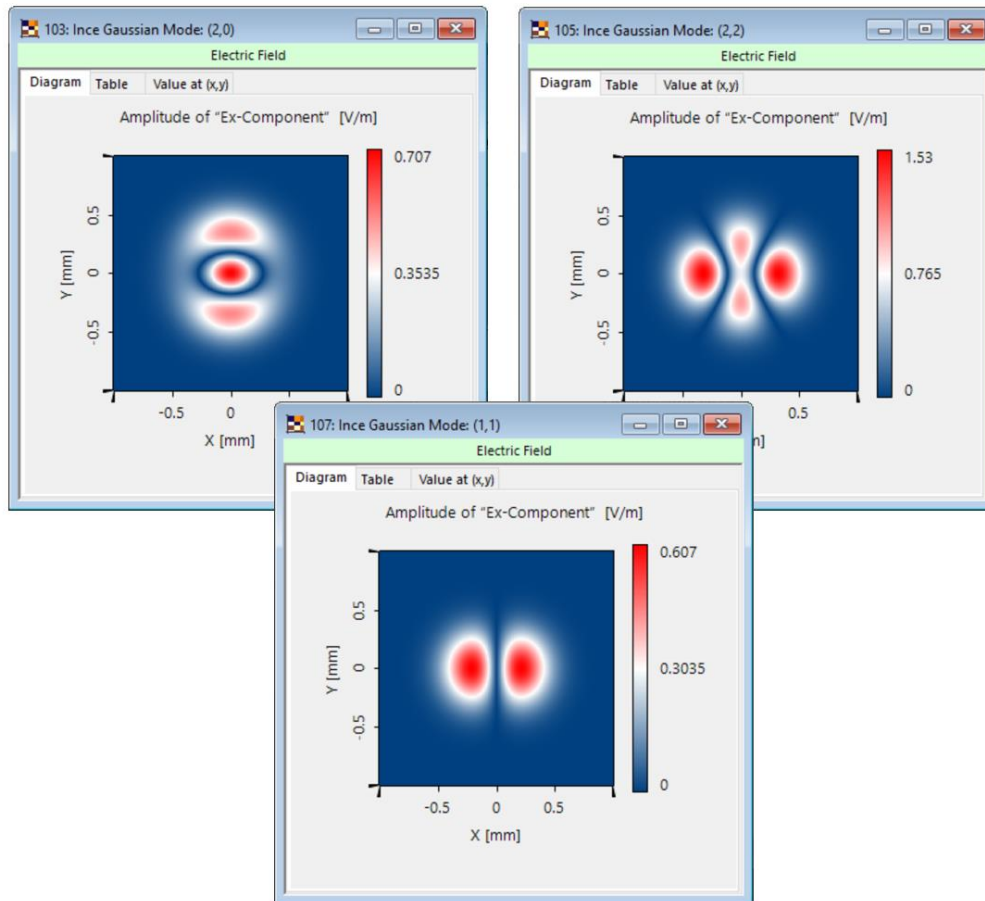


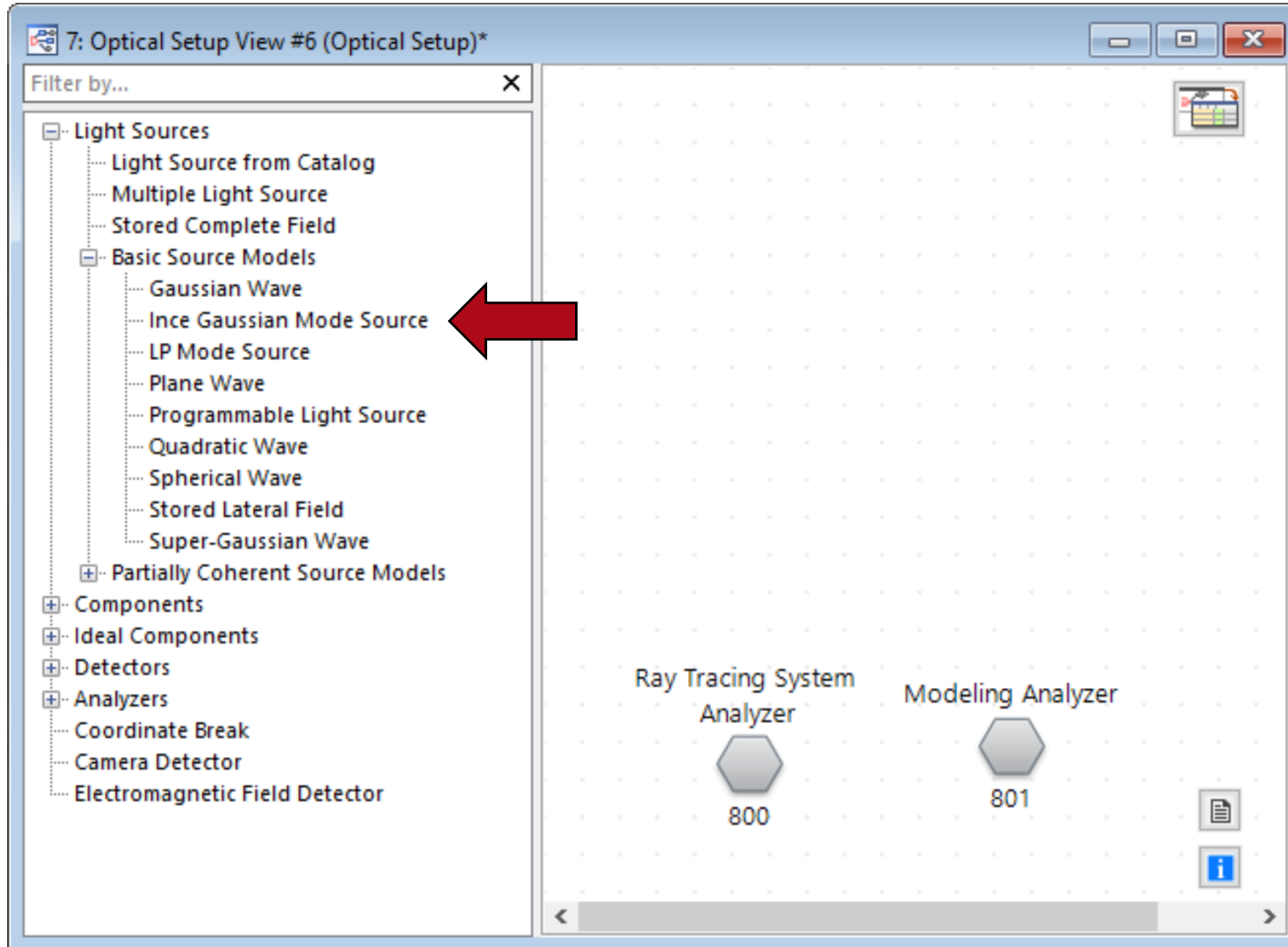
Ince Gaussian Modes

Abstract



Apart from Hermite- and Laguerre-Gaussian modes there is a third kind of rigorous and orthogonal solution family for the paraxial wave equation – the so-called Ince Gaussian modes. These solutions are defined in elliptical coordinates and have the benefit of allowing for a transition between Hermite- and Laguerre-Gaussian modes by means of an elliptical parameter. These modes have advantages in the area of optical tweezers and particle-trapping applications. This use case presents the Ince-Gaussian Beam Source in VirtualLab Fusion and shows how to define an individual mode.

How to Access Ince Gaussian Mode Source?



You can access the *Ince Gaussian Mode Source* in the Optical Setup under the section *Light Sources / Basic Source Models*

Source Options – Compact Overview

mode definition

- Ince-Gaussian modes can be defined with both even and odd polynomials
- *Order* and *Degree* define the mode according to:

Bandres MA, Gutiérrez-Vega JC. Ince-Gaussian beams. Opt Lett. 2004 Jan 15;29(2):144-6. doi: 10.1364/ol.29.000144. PMID: 14743992.

Edit Programmable Light Source

Polarization Mode Selection Sampling Ray Selection

Basic Parameters Spectral Parameters Spatial Parameters

☐ Generate Cross Section

Algorithm

Snippet Edit Validity: ✓

Parameters

WaistRadius 300 μm

EllipticityParameter 1000

☒ EvenPolynomials

Order 5

Degree 3

Help

Default Parameters Ok Cancel Help

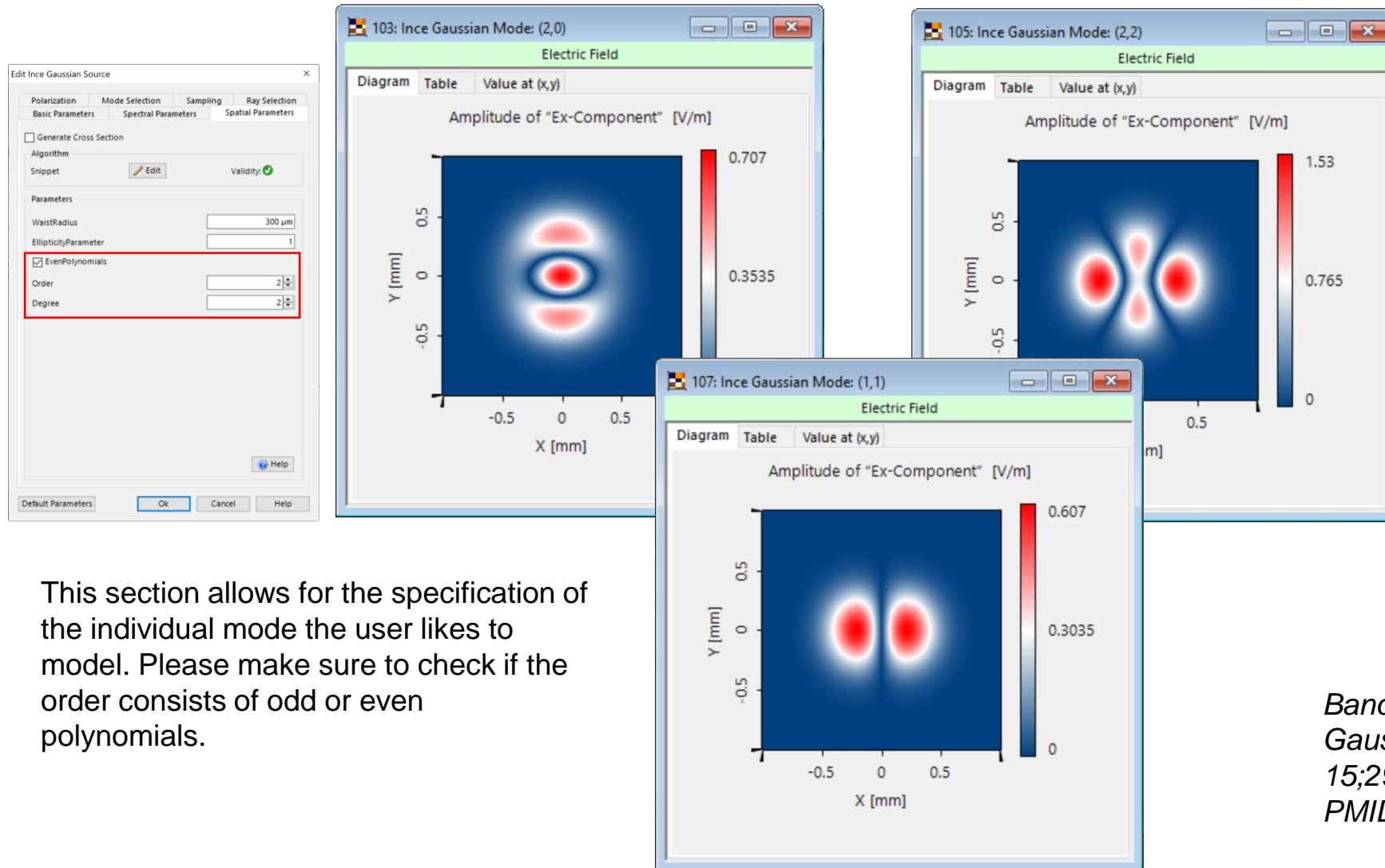
size and divergence

- The Parameter *WaistRadius* determines the size and divergence of the displayed mode

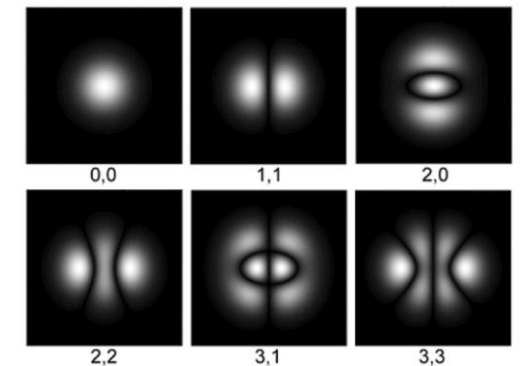
ellipticity

- This parameter determines the ellipticity of the mode

Order Definition – Even Polynomials

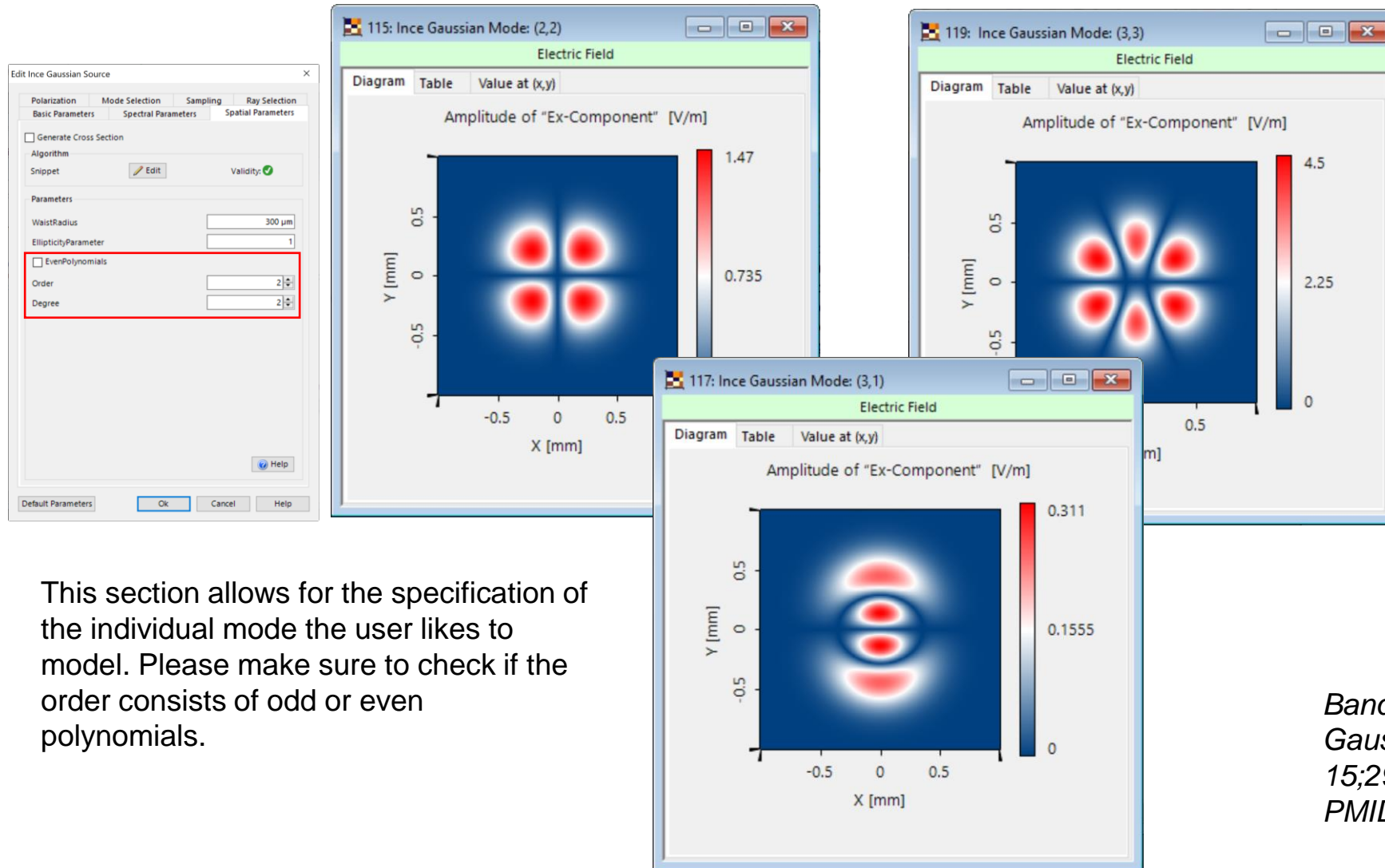


This section allows for the specification of the individual mode the user likes to model. Please make sure to check if the order consists of odd or even polynomials.

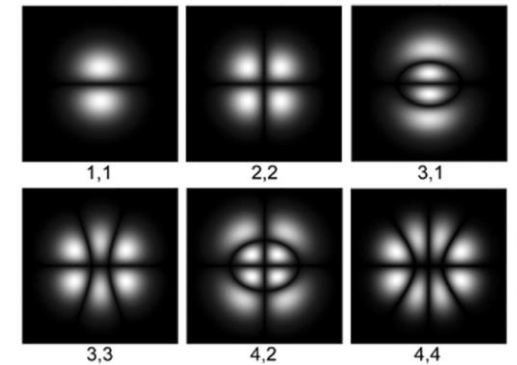


Bandres MA, Gutiérrez-Vega JC. Ince-Gaussian beams. *Opt Lett*. 2004 Jan 15;29(2):144-6. doi: 10.1364/ol.29.000144. PMID: 14743992.

Order Definition – Odd Polynomials

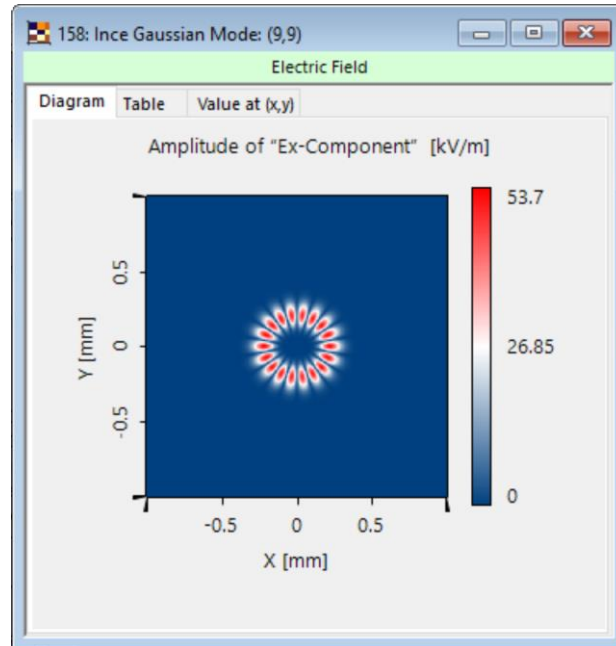
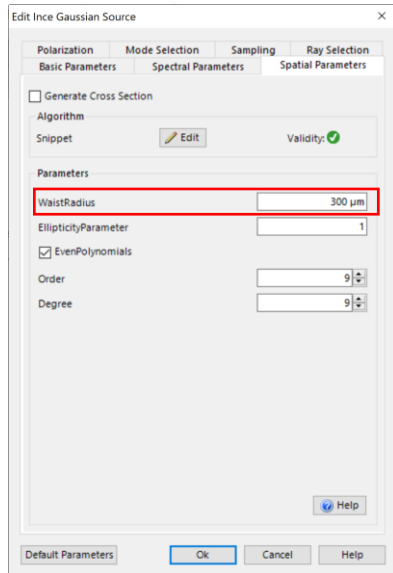


This section allows for the specification of the individual mode the user likes to model. Please make sure to check if the order consists of odd or even polynomials.

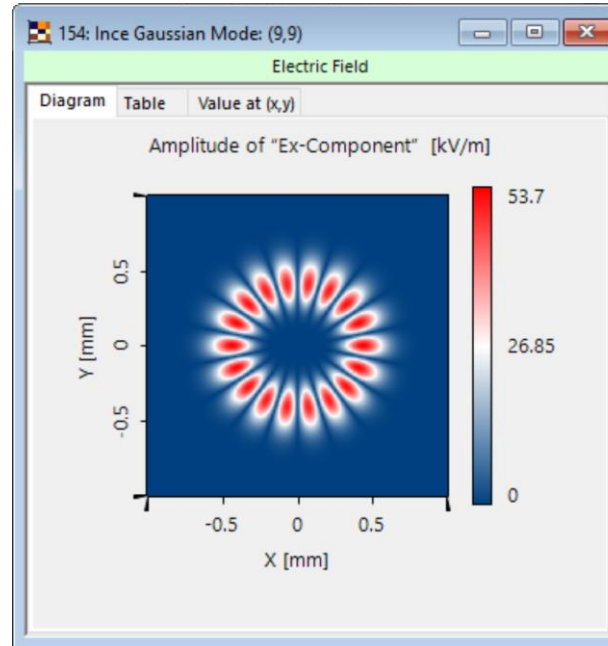


Bandres MA, Gutiérrez-Vega JC. Ince-Gaussian beams. *Opt Lett*. 2004 Jan 15;29(2):144-6. doi: 10.1364/ol.29.000144. PMID: 14743992.

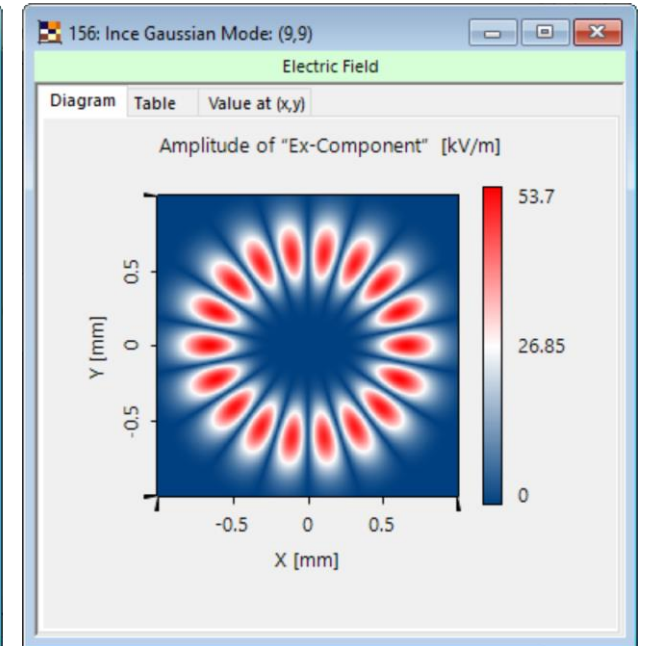
Size



waist diameter = 100 μm



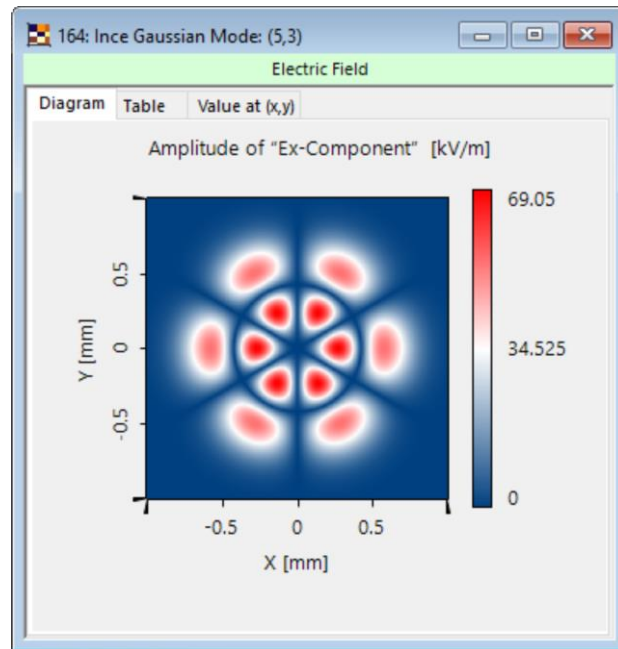
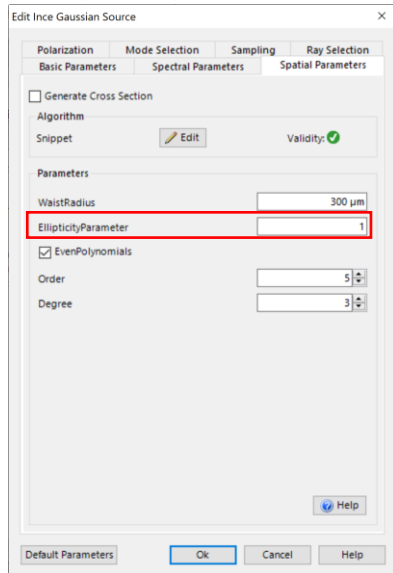
waist diameter = 200 μm



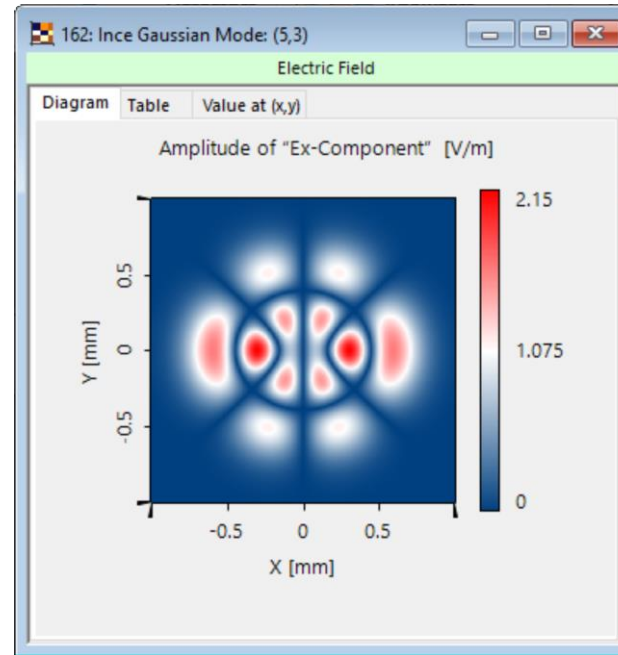
waist diameter = 300 μm

The user can determine size and divergence of the field by setting the waist diameter of the mode.

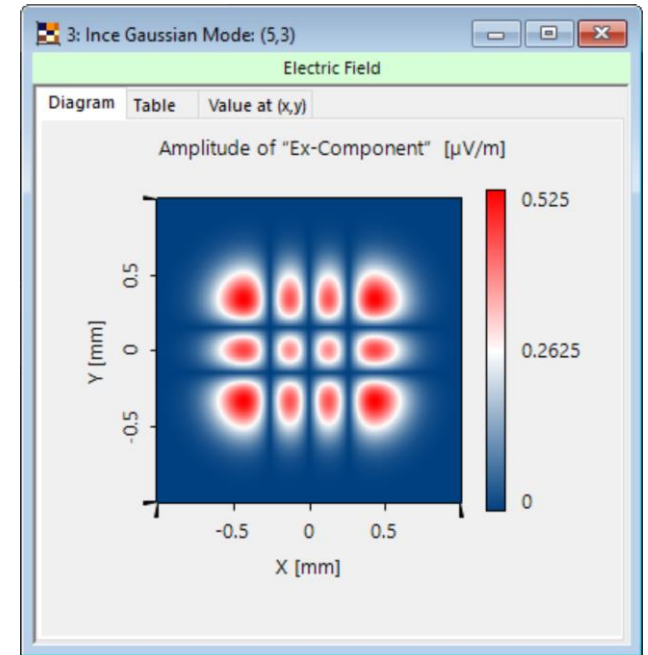
Ellipticity Parameter



ellipticity parameter = 0.001



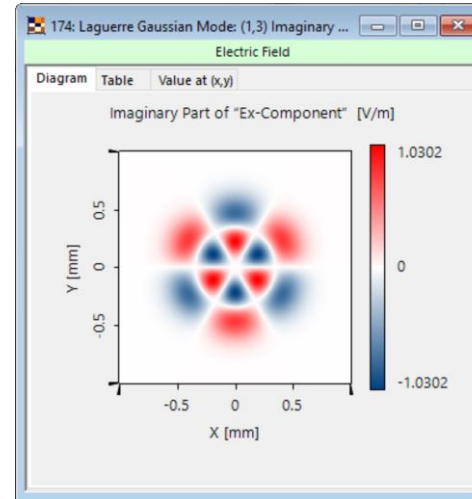
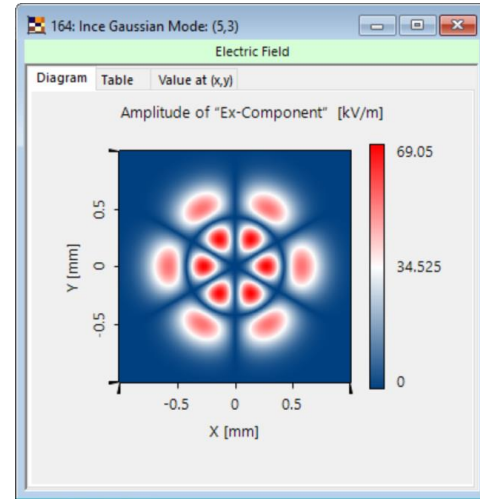
ellipticity parameter = 1



ellipticity parameter = 1000

Comparison with Hermite- and Laguerre-Gaussian Modes

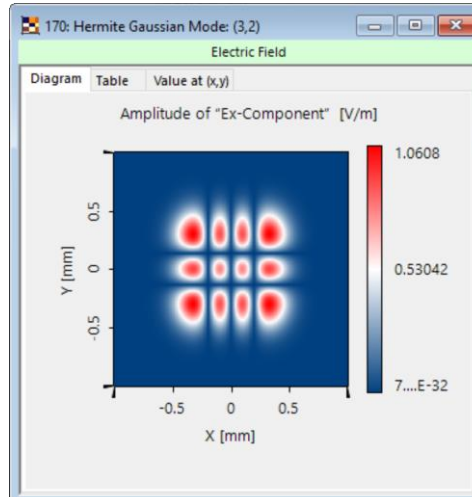
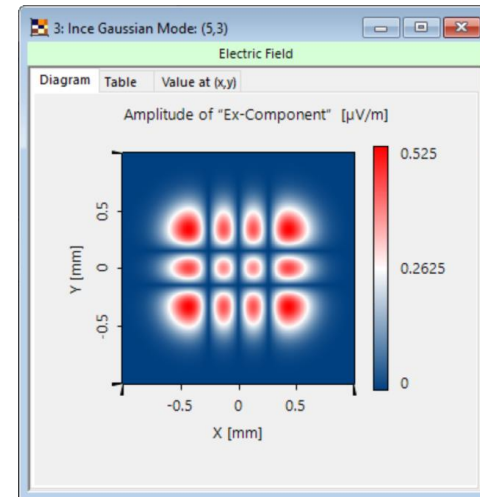
Ince (5,3) elliptical parameter = 0.001



Laguerre (1,3)

Depending on the elliptical parameter the Ince-Gaussian Mode shifts between a Laguerre Gaussian and a Hermite Gaussian Mode!

Ince (5,3) elliptical parameter = 1000



Hermite (3,2)

Document Information

title	Ince Gaussian Modes
document code	SRC.0001
version	1.0
edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.176)
category	Application Use Case
further reading	<ul style="list-style-type: none">- <u>Observation of Vortex Array Laser Beam Generation from Ince-Gaussian Beam</u>- <u>Focusing of an Ince-Gaussian Beam</u>