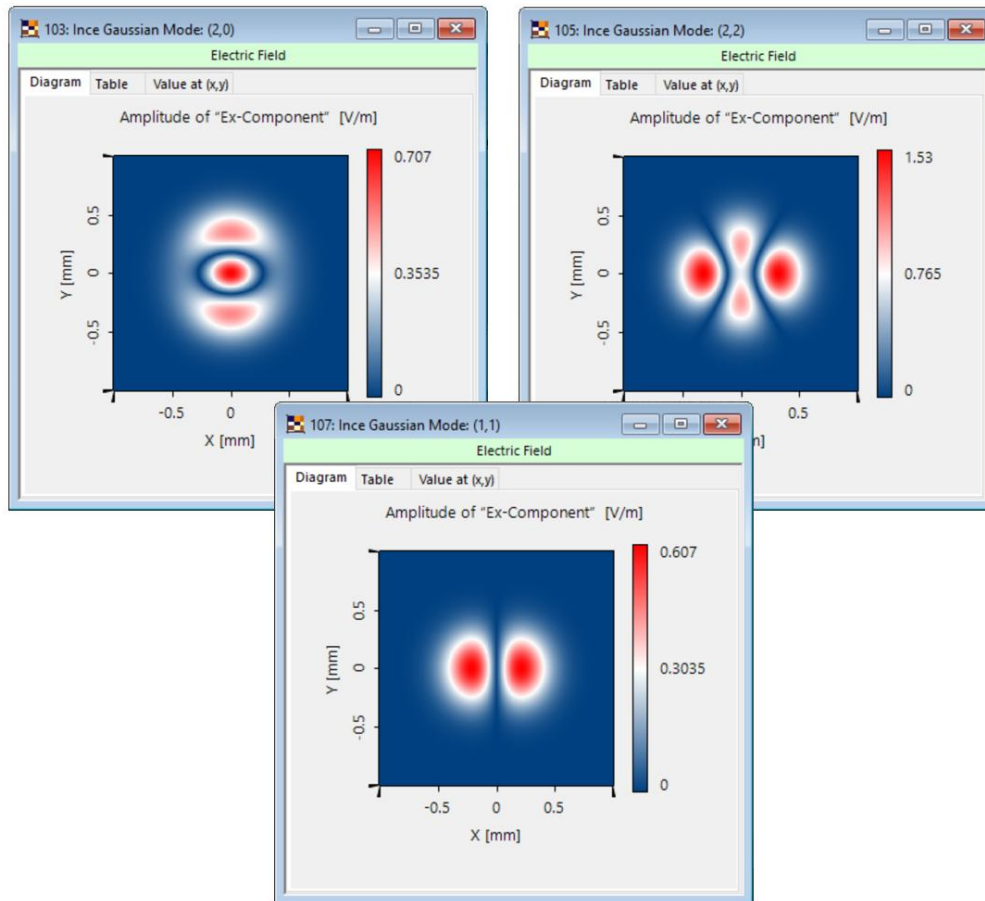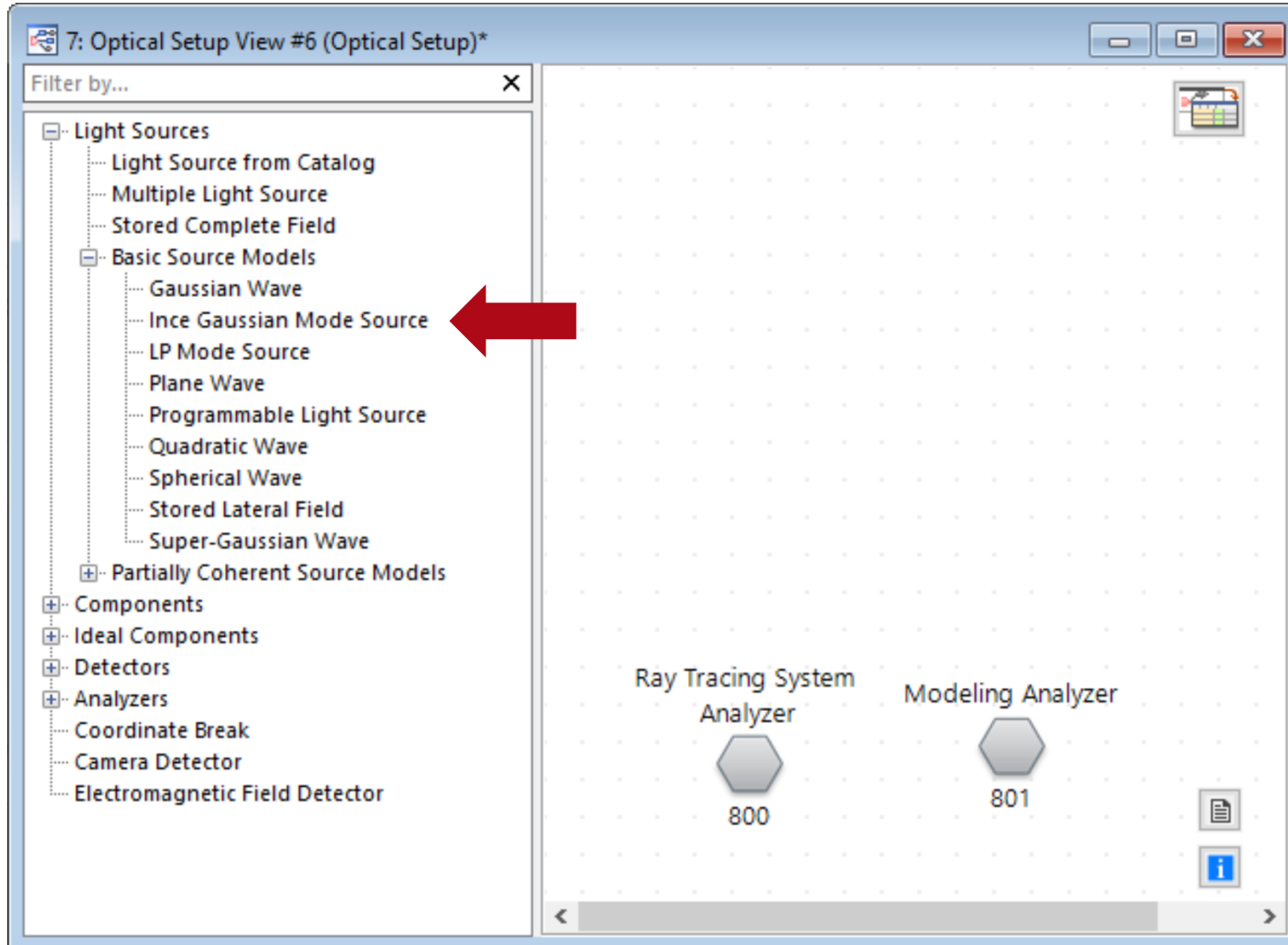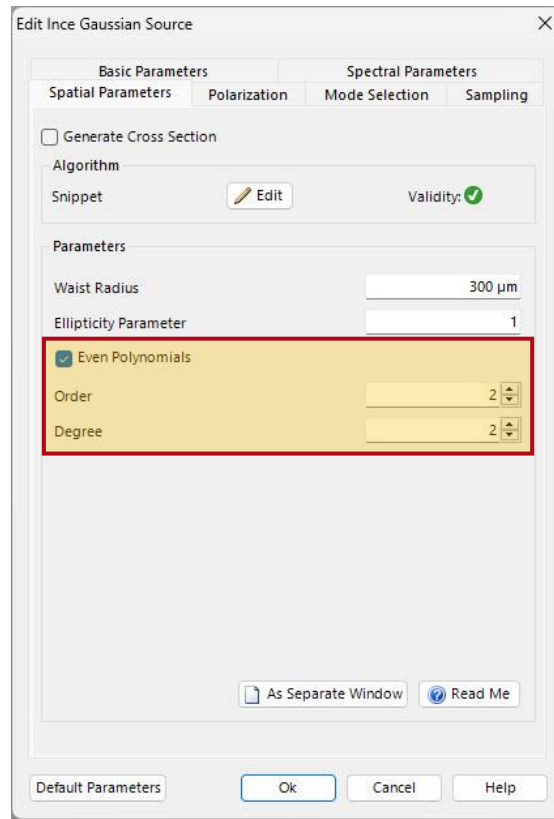# Ince-Gaussian Modes

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.*
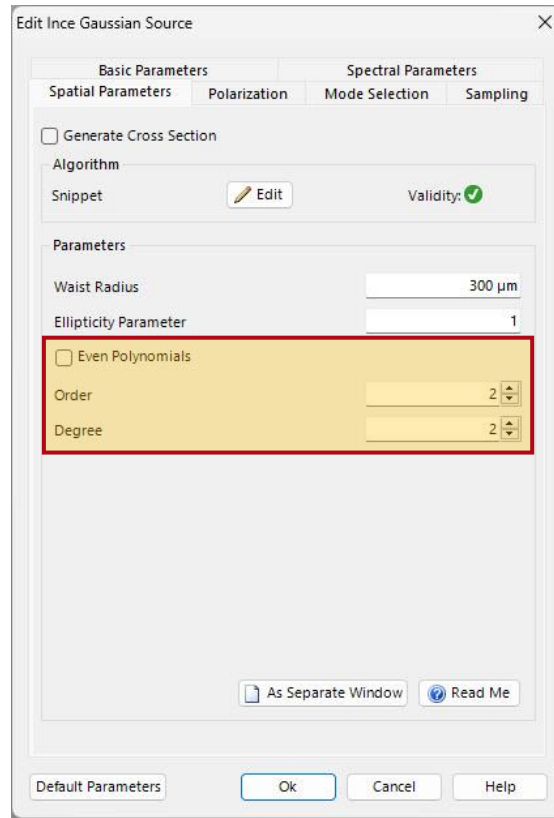
Order Definition – Even Polynomials

This section allows for the specification of the individual mode the user would like to generate. Please pay attention to whether the order consists of odd or even polynomials.
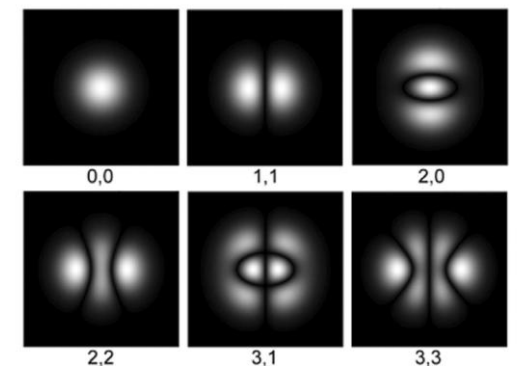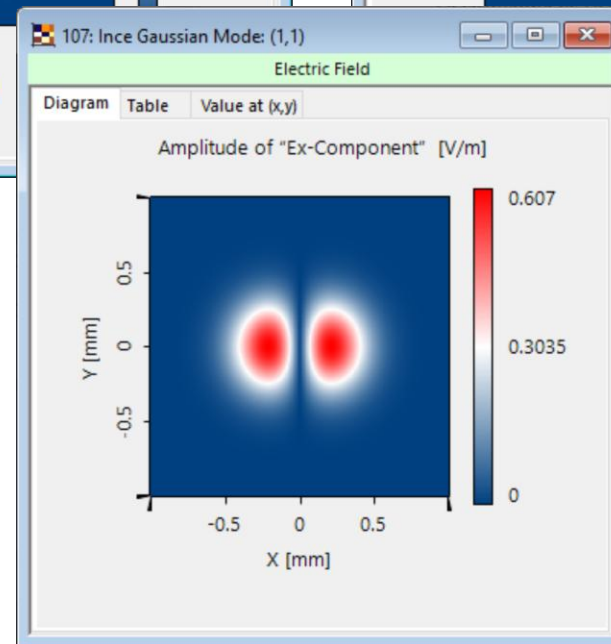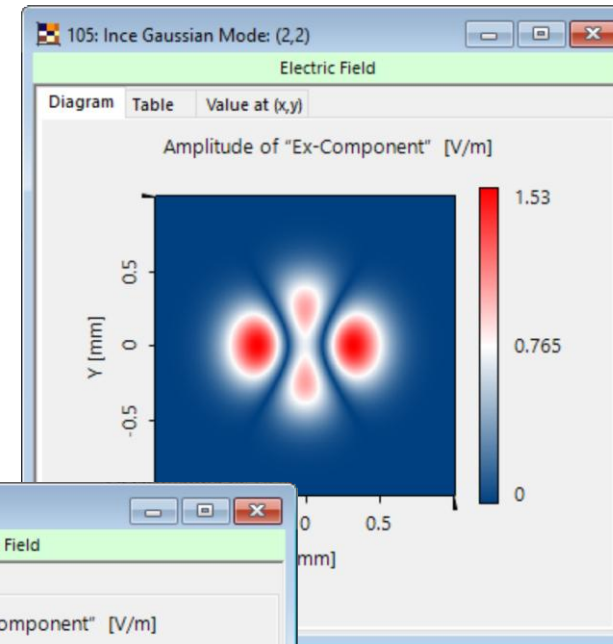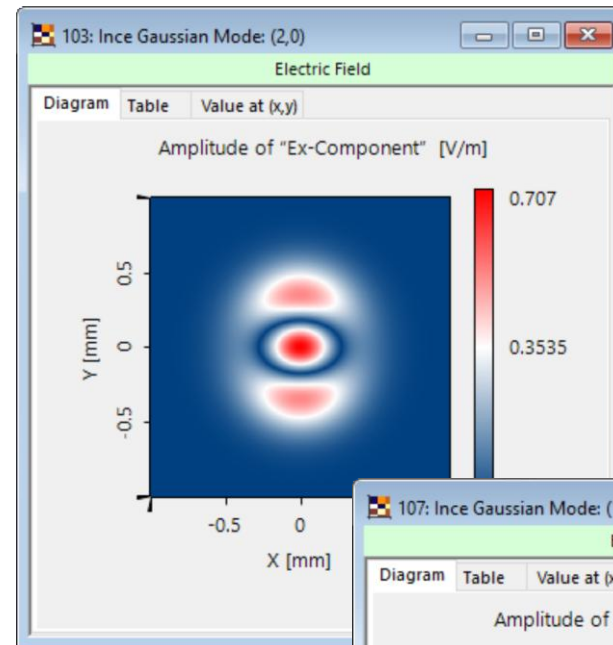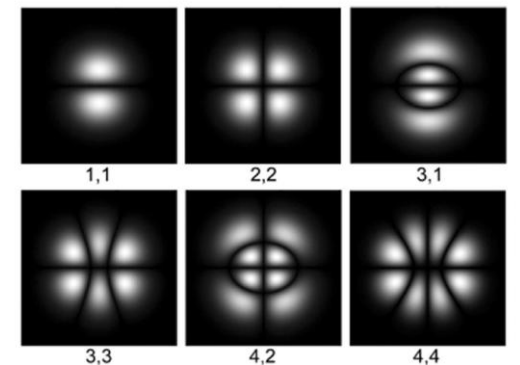
Bandres MA, Gutiérrez-Vega JC. Ince-Gaussian beams. Opt Lett. 2004 Jan 15;29(2):144-6. doi: 10.1364/ol.29.000144. PMID: 14743992.

Order Definition – Odd Polynomials

This section allows for the specification of the individual mode the user would like to generate. Please pay attention to whether the order consists of odd or even polynomials.
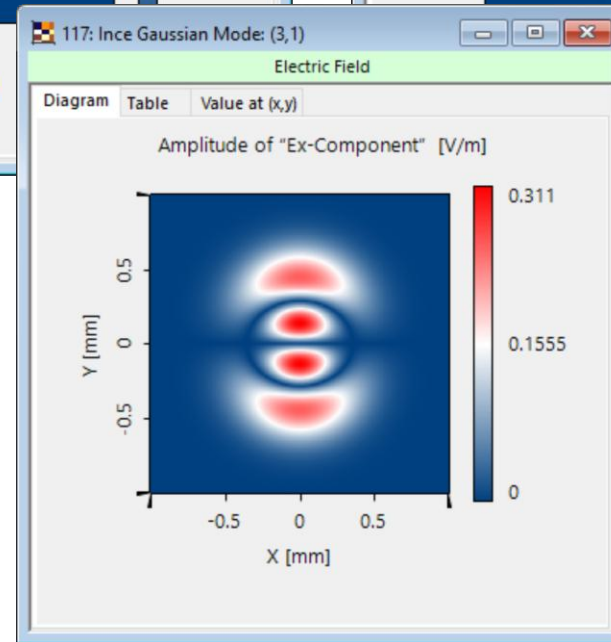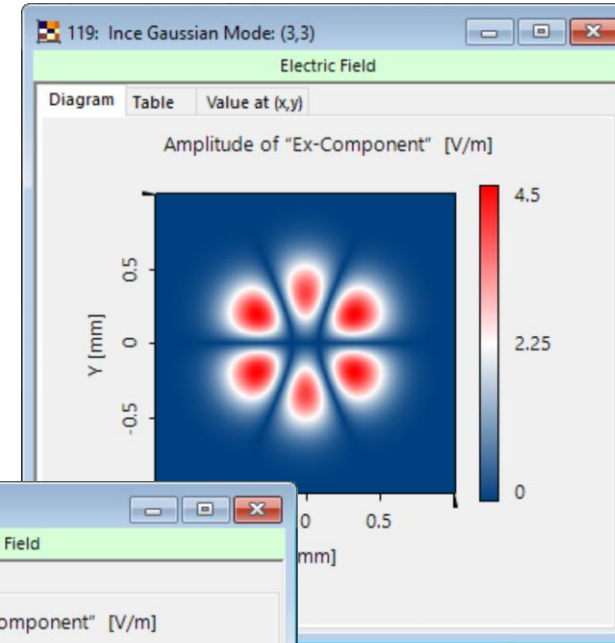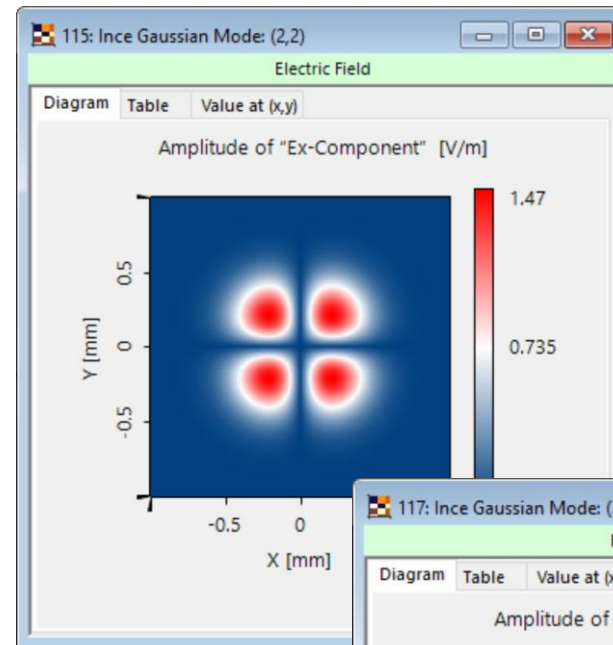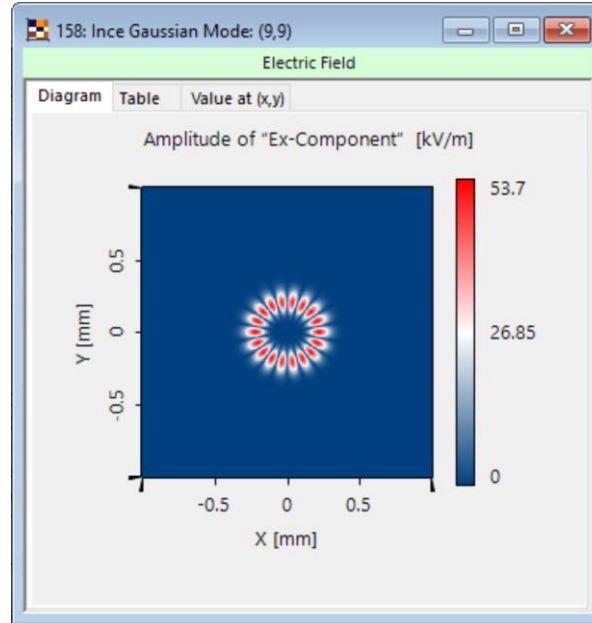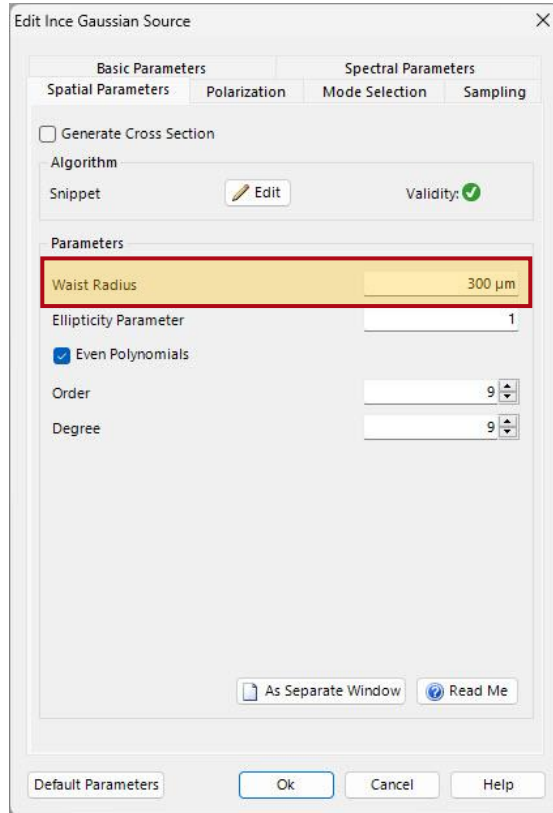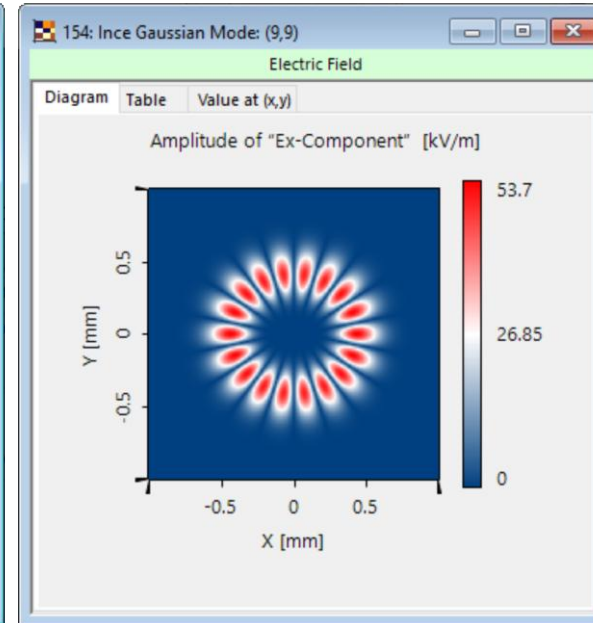

Bandres MA, Gutiérrez-Vega JC. Ince-Gaussian beams. Opt Lett. 2004 Jan 15;29(2):144-6. doi: 10.1364/ol.29.000144. PMID: 14743992.
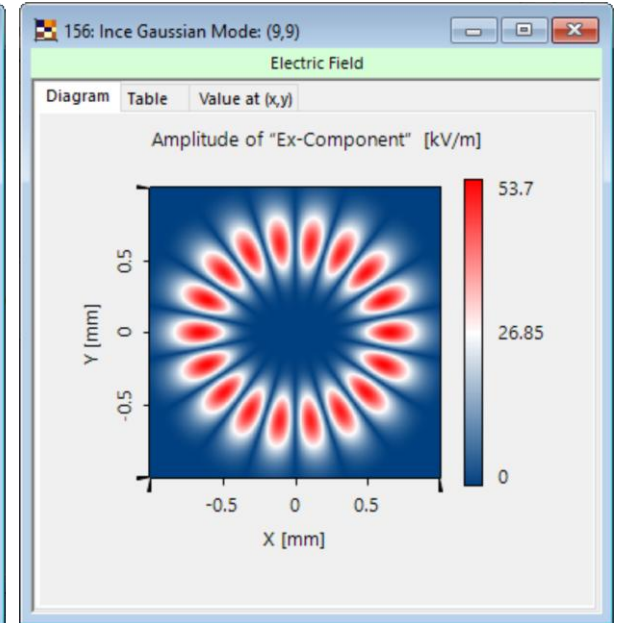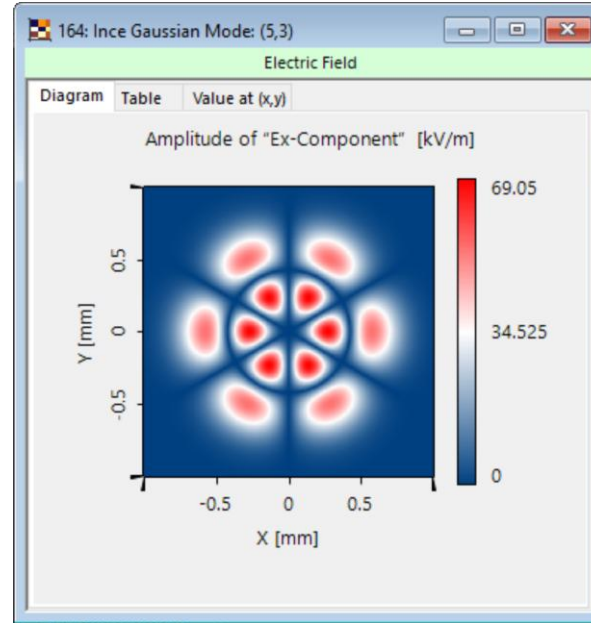
Size

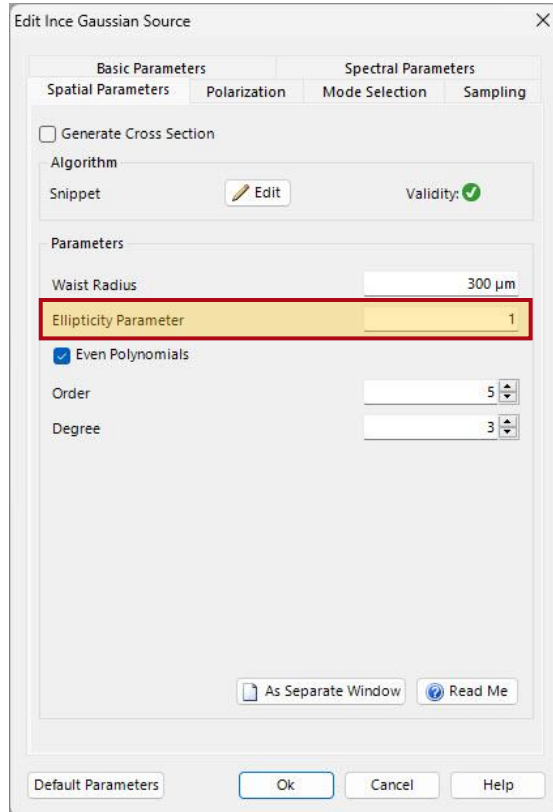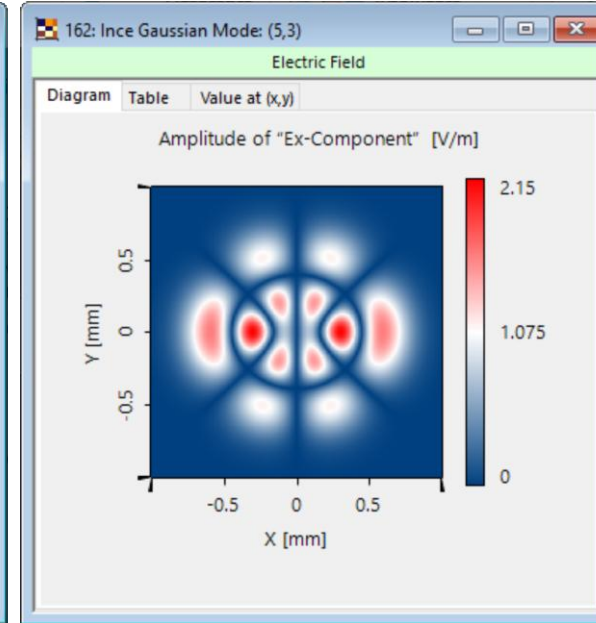waist radius = 100 µm   waist radius = 200 µm   waist radius = 300 µm

The user can determine the size and divergence of the field by setting the waist radius of the mode.
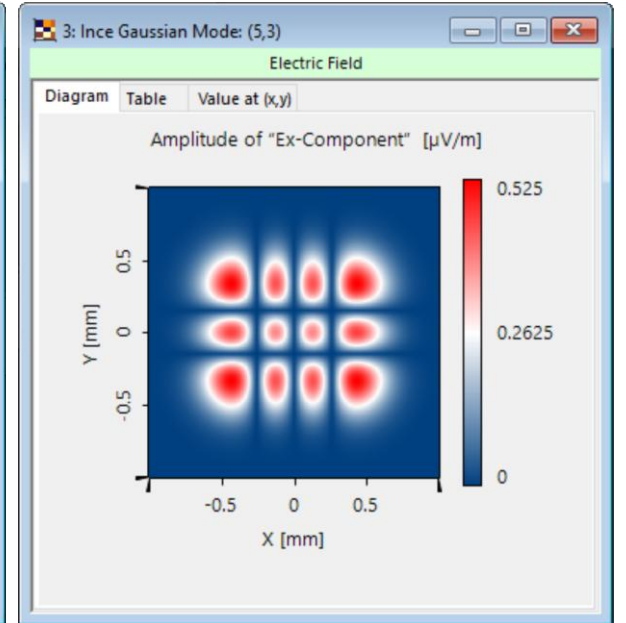
Ellipticity Parameter

ellipticy parameter = 0.001   ellipticy parameter = 1   ellipticy parameter = 1000
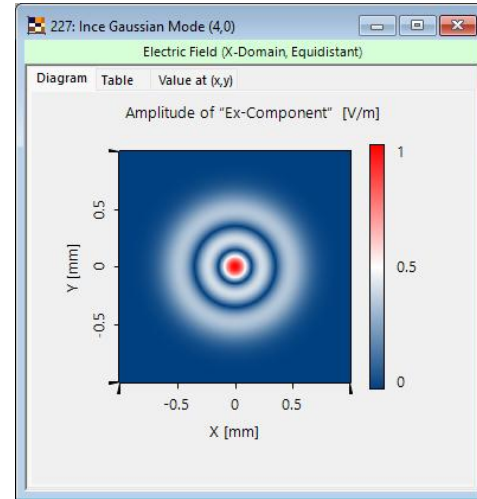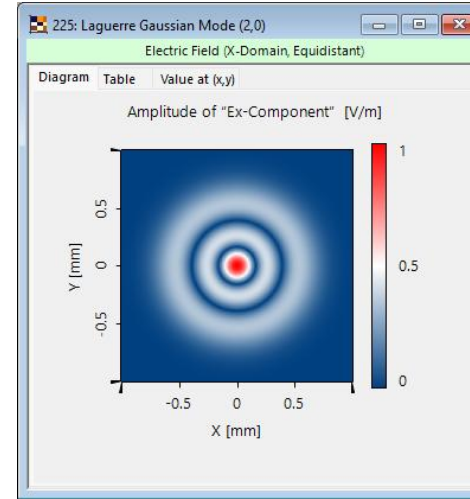
Depending on the ellipticity parameter the Ince-Gaussian mode will become between a Laguerre Gaussian and a Hermite Gaussian mode!

Comparison with Hermite- and Laguerre-Gaussian Modes

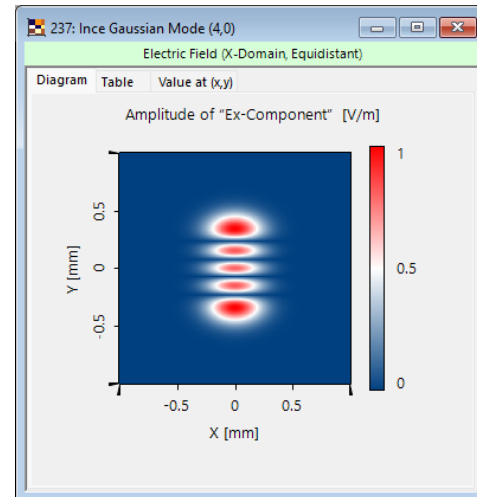Ince (4,0)
ellipticity parameter = 0.001
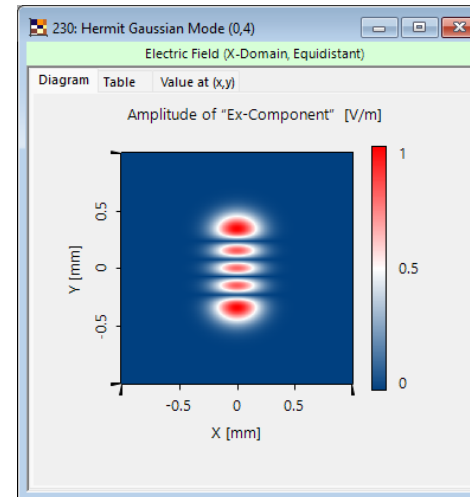

Laguerre (2,0)

Depending on the ellipticity parameter the Ince-Gaussian mode will become between a Laguerre Gaussian and a Hermite Gaussian mode!

Ince (4,0)
ellipticity parameter = 1000

Hermite (0,4)

Document Information

title	Ince-Gaussian Modes
document code	USC.0211
version	1.1
edition	VirtualLab Fusion Basic
software version	2023.1 (Build 1.556)
category	Feature Use Case
further reading	• Observation of Vortex Array Laser Beam Generation from Ince-Gaussian Beam • Focusing of an Ince-Gaussian Beam