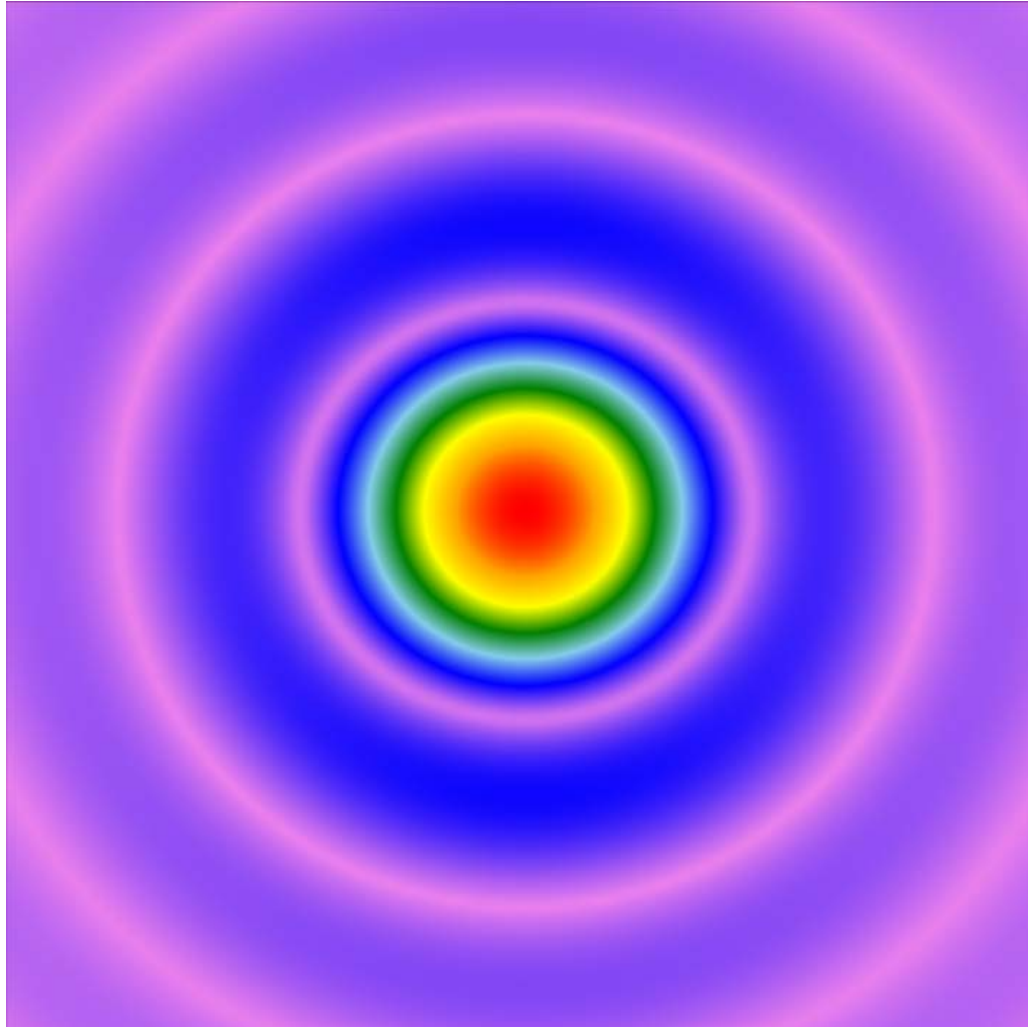


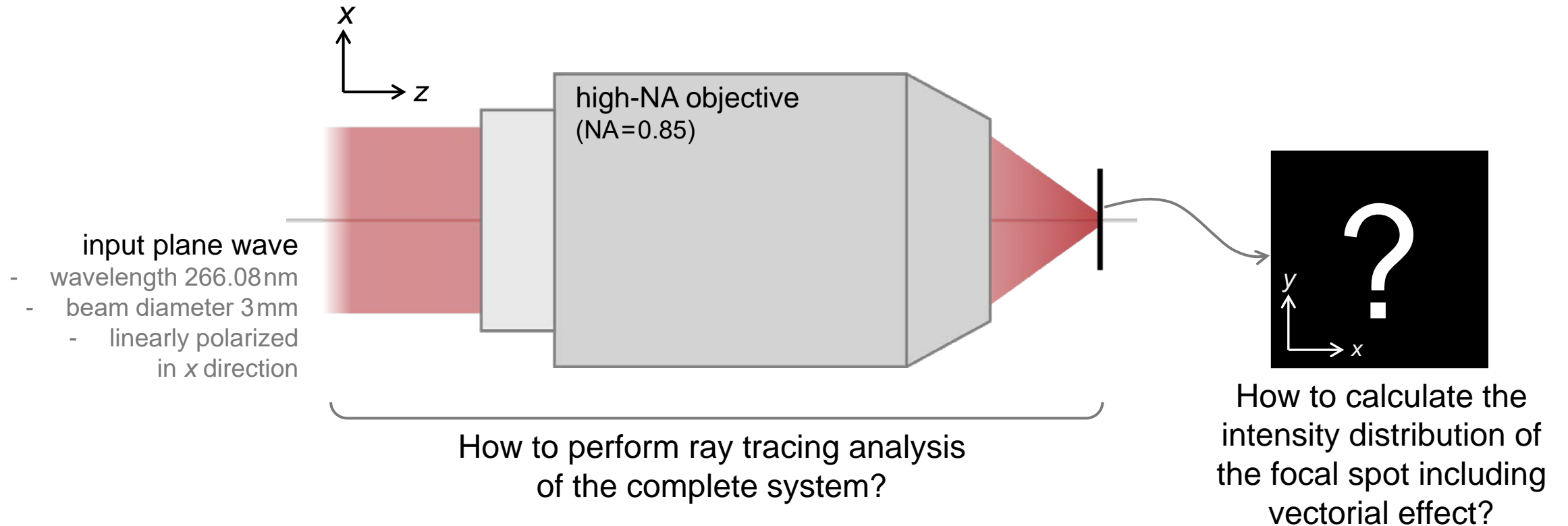
# Analyzing High-NA Objective Lens Focusing

# Abstract



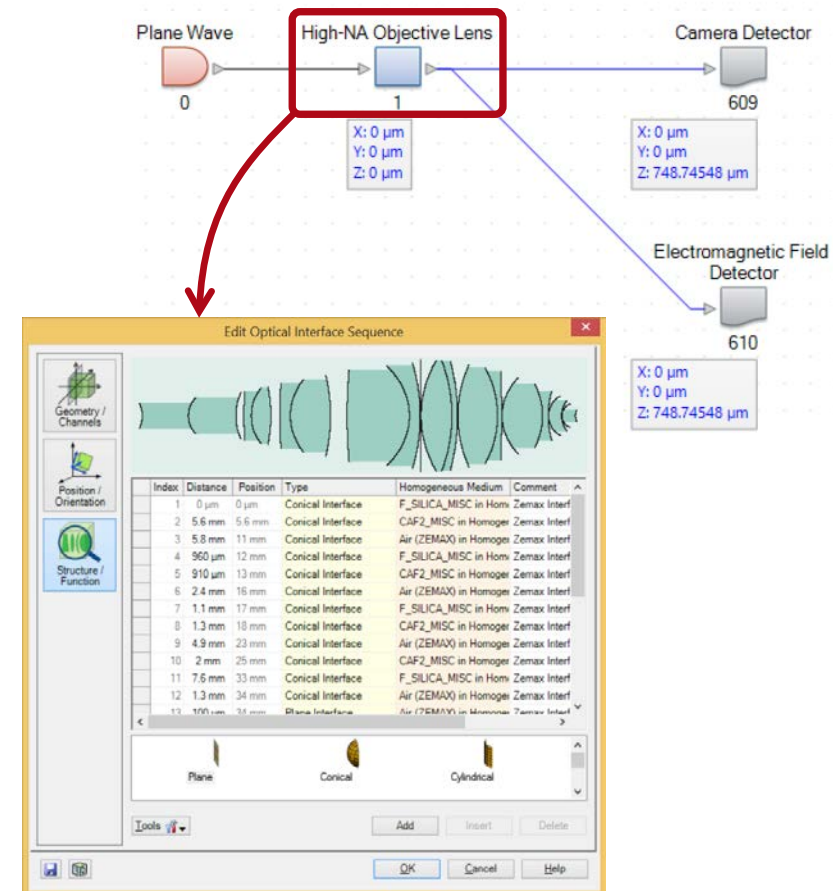
High-NA objective lenses are widely used in optical lithography, microscopy, etc. Consideration of the vectorial nature of light in the simulation of the focusing is therefore fundamental. VirtualLab supports both ray and field tracing analysis of such lenses with great ease. With field tracing, the asymmetric focal spot can be clearly demonstrated, which stems from the vectorial effects. The camera detector and the electromagnetic field detector provide full flexibility in the investigation of the field in focal region, with insights into the vectorial effect.

# Modeling Task



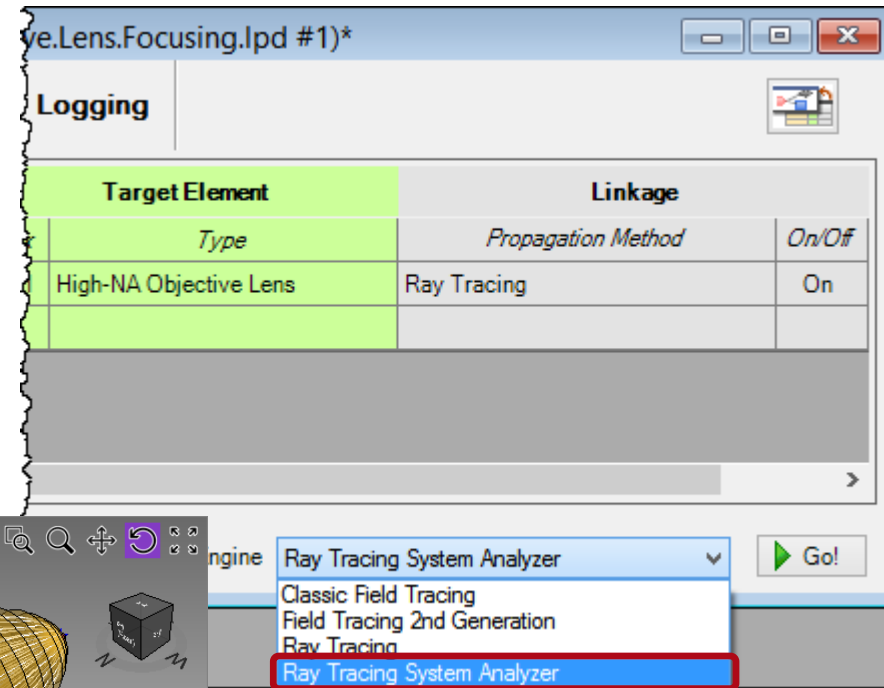
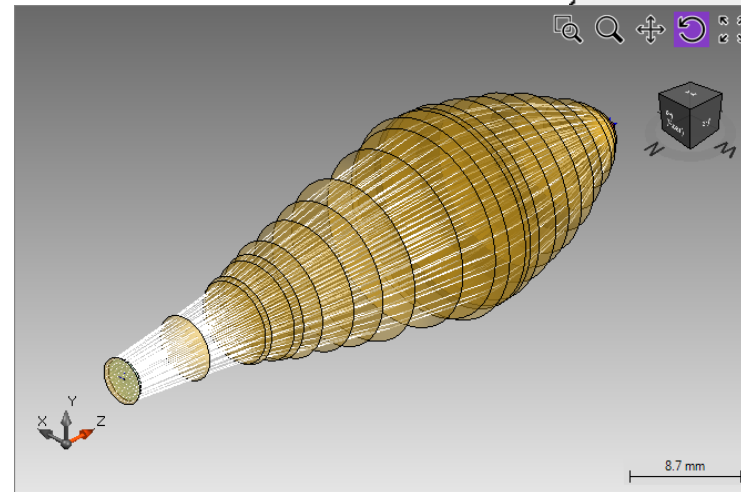
# Overview

- The sample system is preset with the high-NA objective lens included.
- Next, we demonstrate how to perform simulation on the sample system following the recommended workflow in VirtualLab.



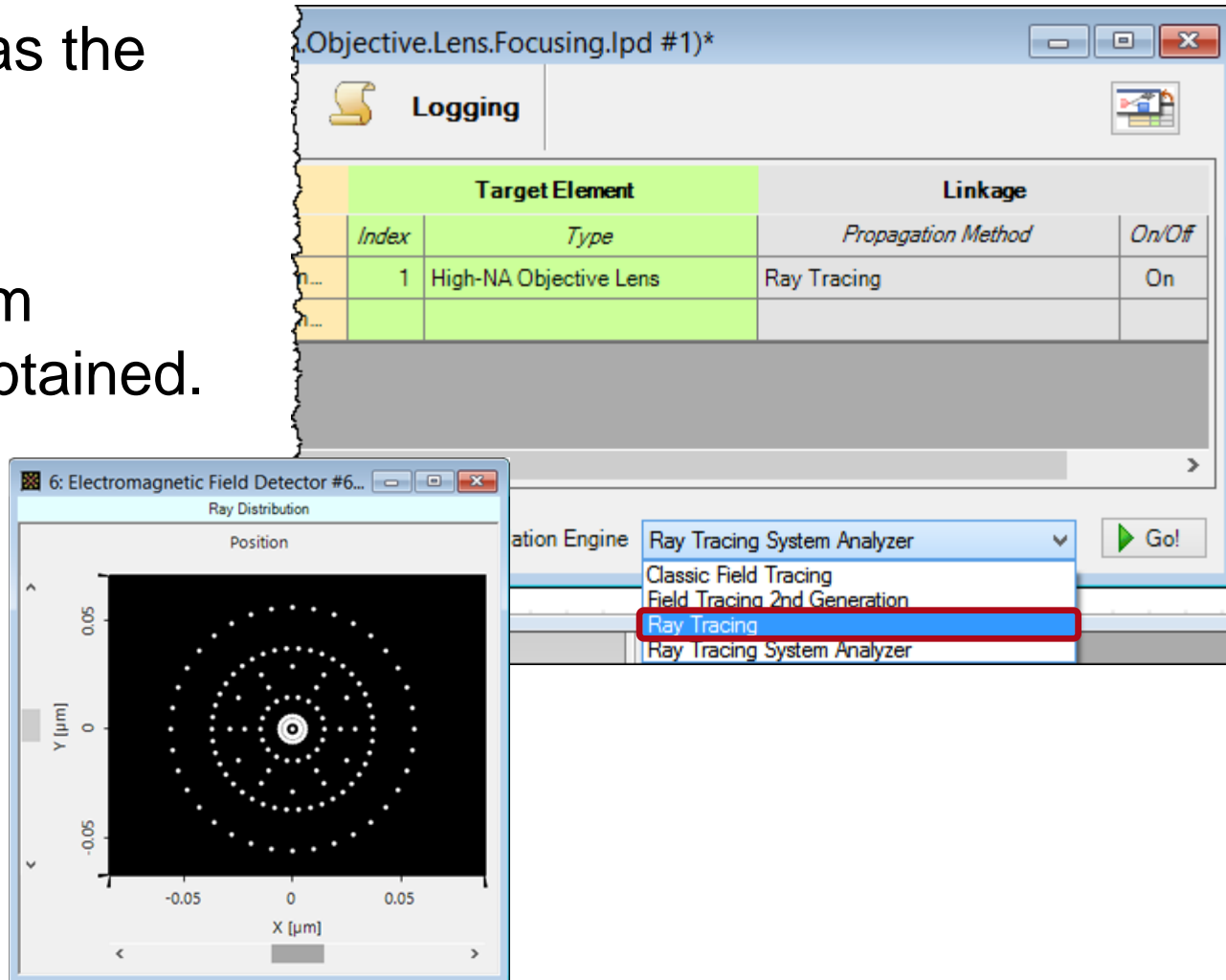
# Ray Tracing Simulation

- Choose Ray Tracing System Analyzer as the simulation engine at first.
- Click on Go!
- The 3D ray tracing result is obtained.



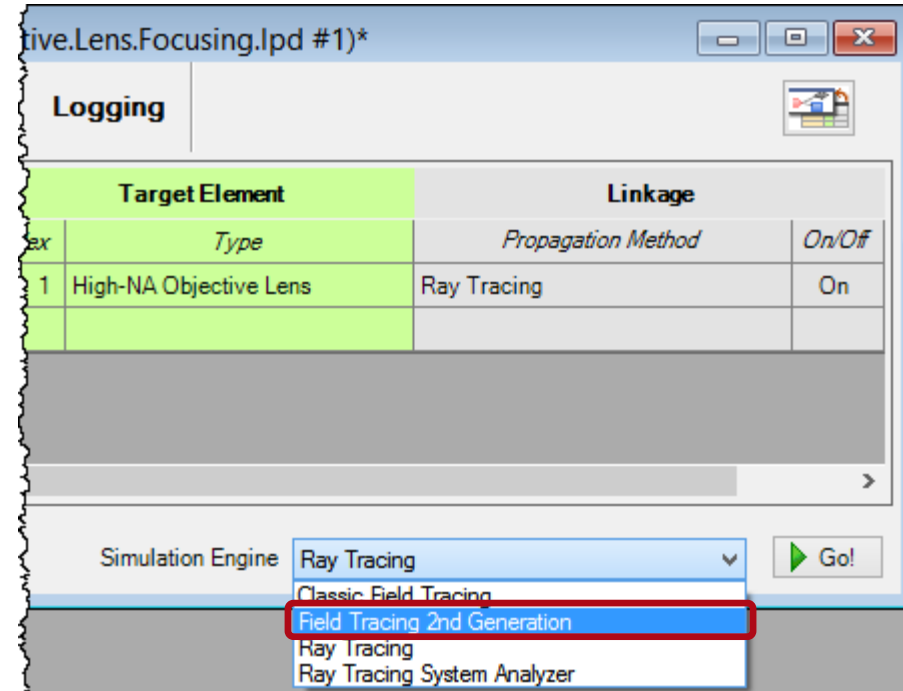
# Ray Tracing Simulation

- Then, select Ray Tracing as the simulation engine.
- Click Go!
- As a result, the dot diagram (2D ray tracing result) is obtained.



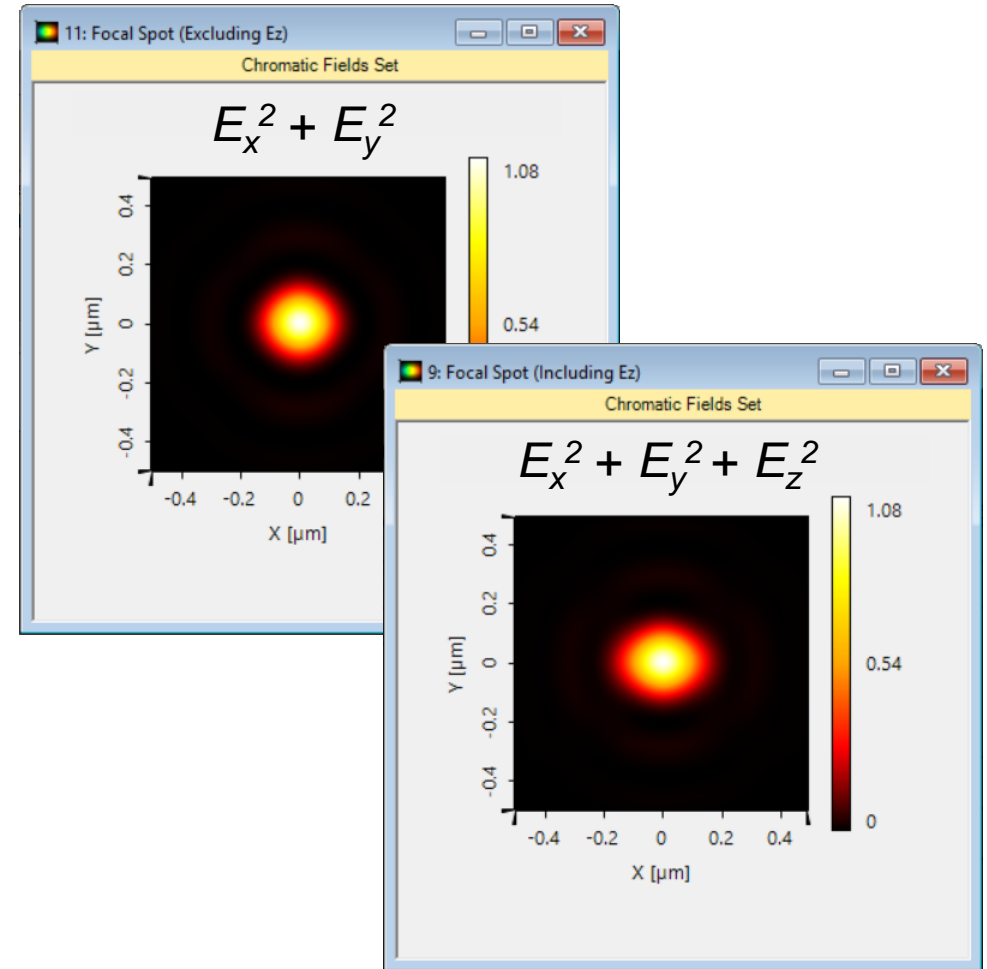
# Field Tracing Simulation

- Switch to field tracing and select Field Tracing 2<sup>nd</sup> Generation as the simulation engine.
- Click Go!



# Field Tracing Results (Camera Detector)

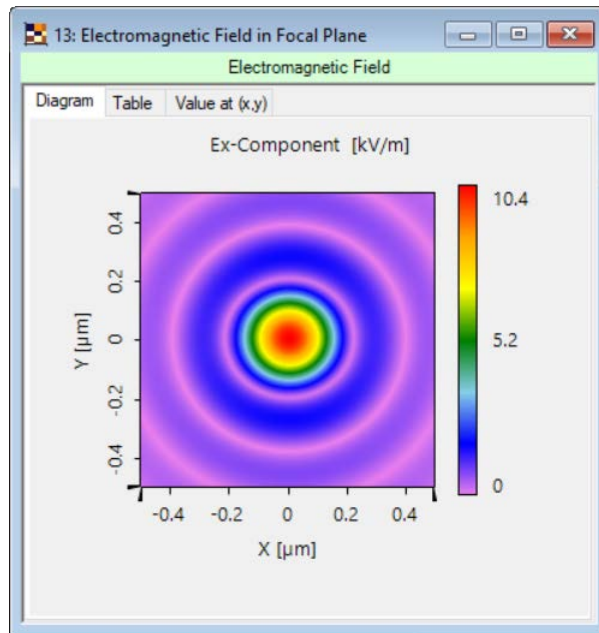
- The top figure shows the intensity by integrating  $E_x$  and  $E_y$  field components only.
- The bottom figure shows the intensity by integrating  $E_x$ ,  $E_y$  and  $E_z$  components: an obvious asymmetry is seen due to the relatively large  $E_z$  component in high-NA situation.



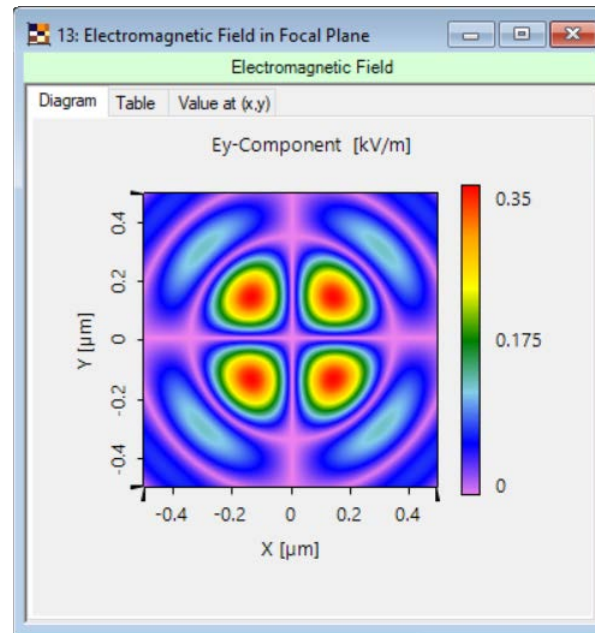


# Field Tracing Results (Electromagnetic Field Detector)

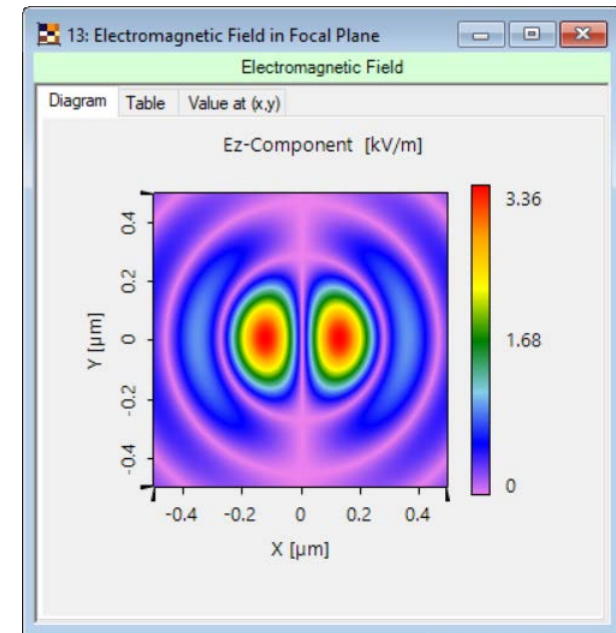
- All electromagnetic field components are obtained by using the Electromagnetic Field Detector.



amplitude of  $E_x$



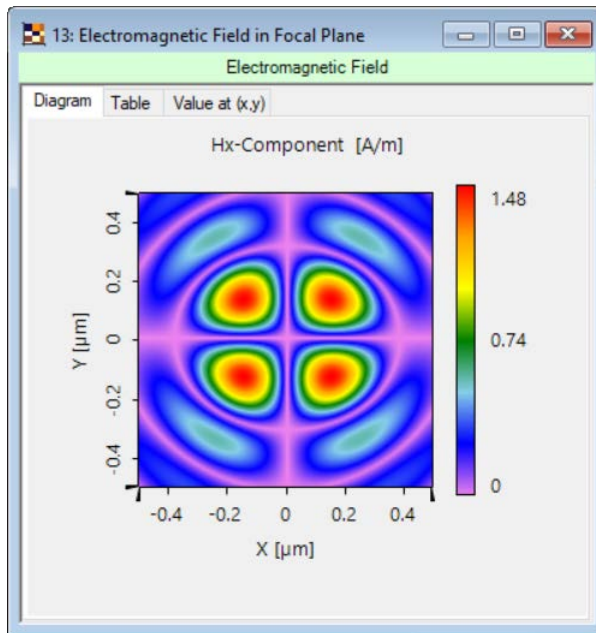
amplitude of  $E_y$



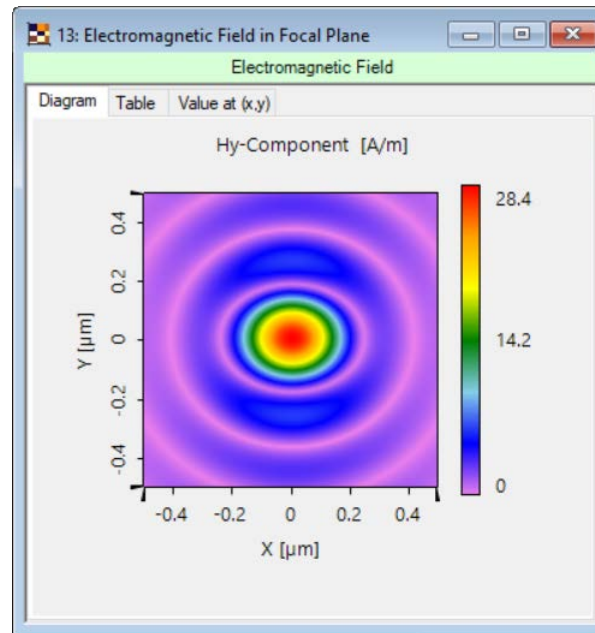
amplitude of  $E_z$

# Field Tracing Results (Electromagnetic Field Detector)

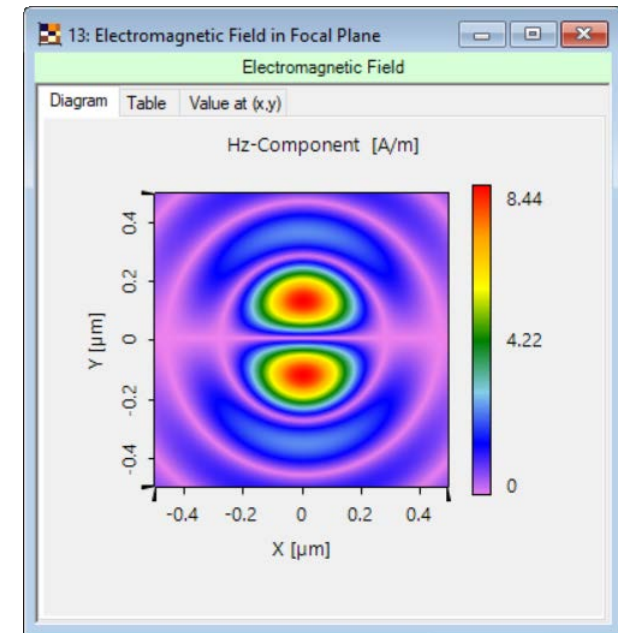
- All electromagnetic field components are obtained by using the Electromagnetic Field Detector.



amplitude of  $H_x$



amplitude of  $H_y$



amplitude of  $H_z$

# Document Information

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title	Analyzing High-NA Objective Lens Focusing
document code	MISC.0008
version	1.1
toolbox(es)	Starter Toolbox
VL version used for simulations	7.4.0.49
category	Feature Use Case
further reading	<ul style="list-style-type: none"><li>- <a href="#">Optical System for Inspection of Micro-Structured Wafer</a></li><li>- <a href="#">Imaging of Sub-Wavelength Gratings by Using Vector Beam Illumination</a></li></ul>