

UseCase.0083 (1.0)

## High NA Lens System - Analysis by Geometric Field Tracing Plus

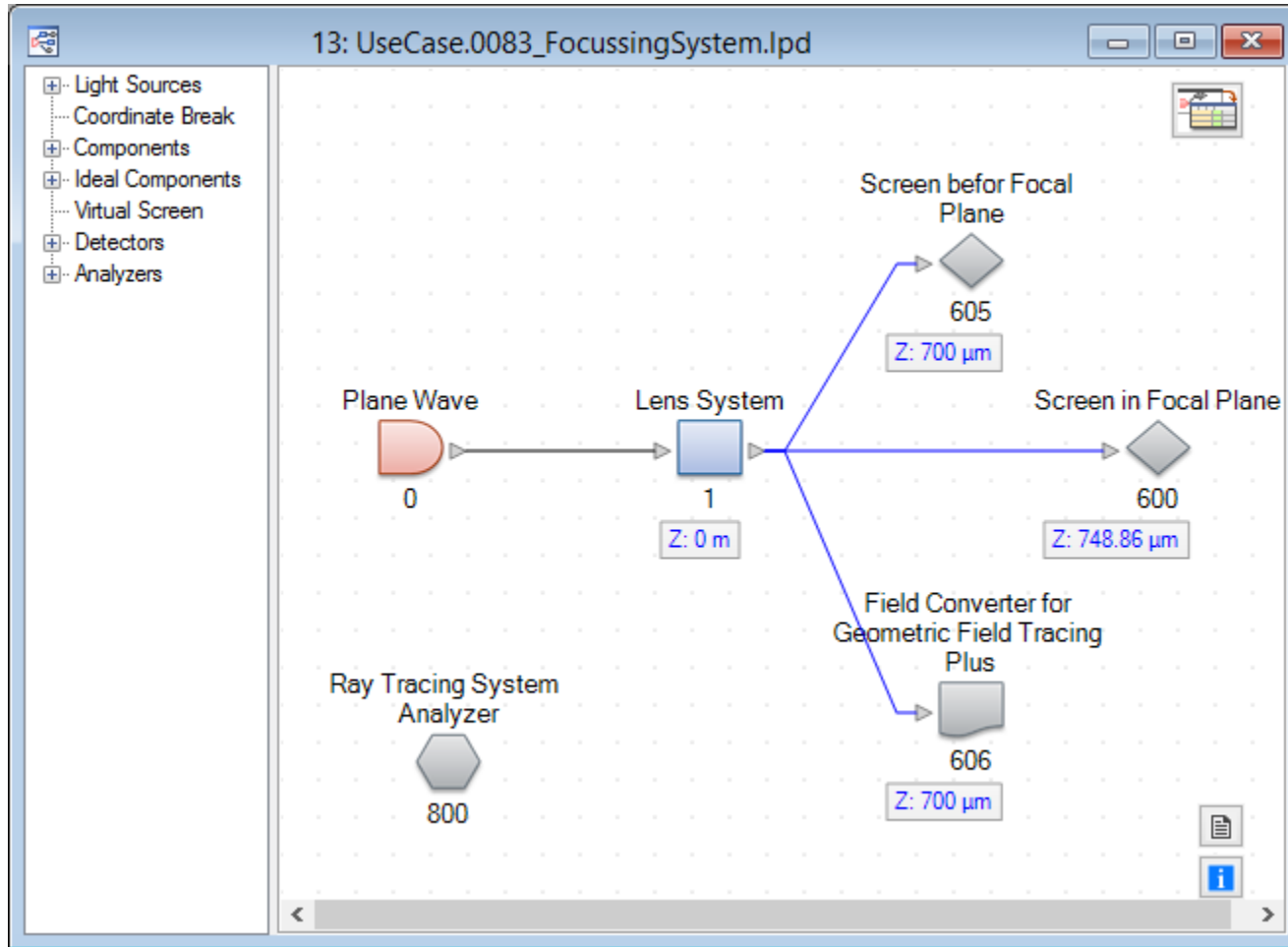
**Keywords:** field component, high numerical aperture, geometric propagation, diffractive propagation

# Description

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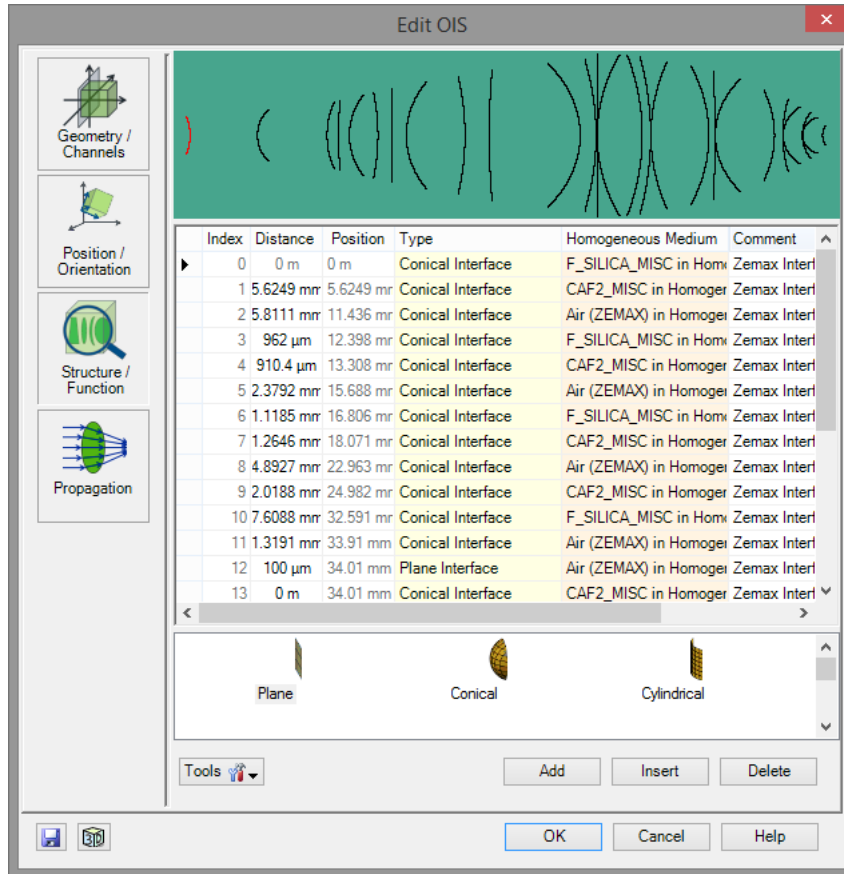
- This use case shows the capability of the Geometric Field Tracing Plus engine to calculate the light distribution generated by a lens system with a high numerical aperture.
- It is shown that all harmonic field components are available within the Geometric Field Tracing Plus engine.
- We will also use the result of the Geometric Field Tracings Plus engine and perform a diffractive propagation step to calculate the diffraction spot within the focal plane.

# The System



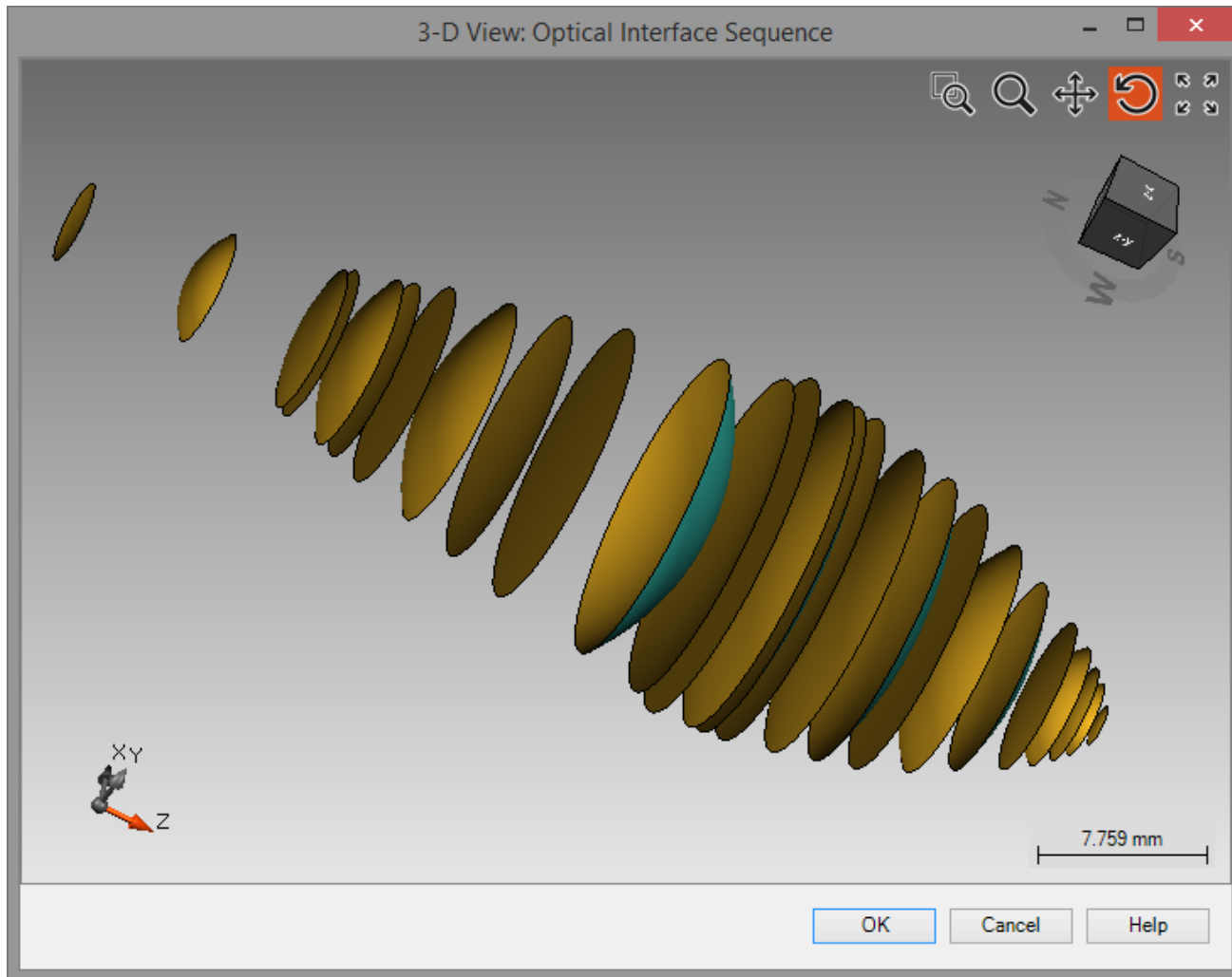
File name: UseCase.0083\_FocussingSystem.Ipd

# Edit the Lens System Component

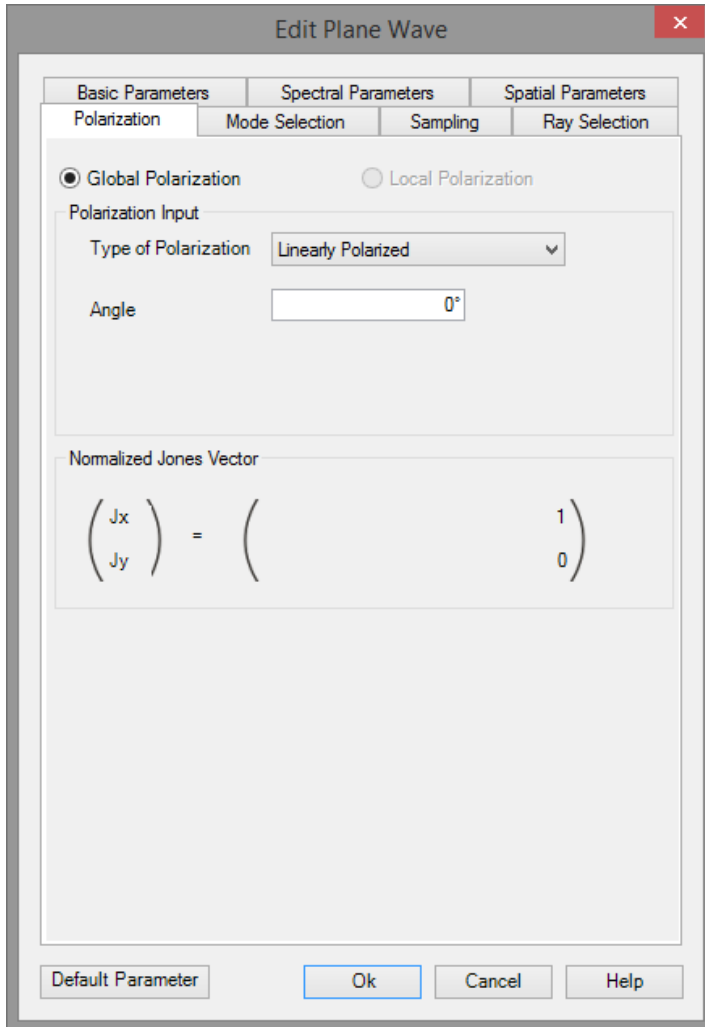


- By double clicking the lens system element within the Light Path view, the editor of the element is shown.
- The lens system is defined by an Optical Interface Sequence (OIS).
- It contains a sequence of optical interfaces and optical media.

# 3-D View of the Lens System

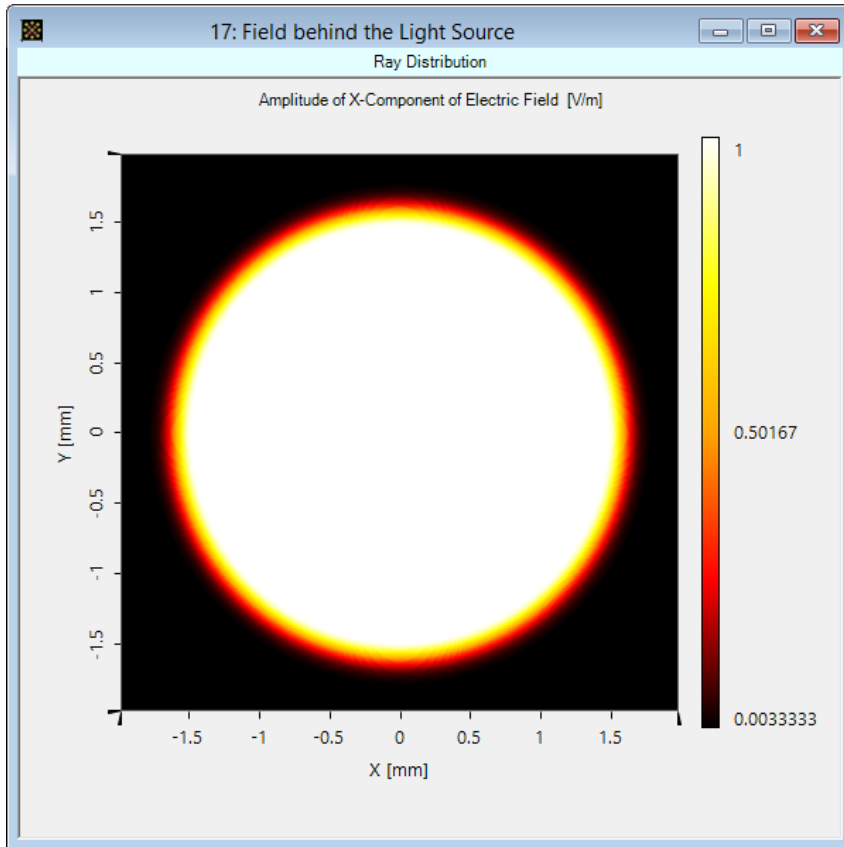


# Additional System Parameters

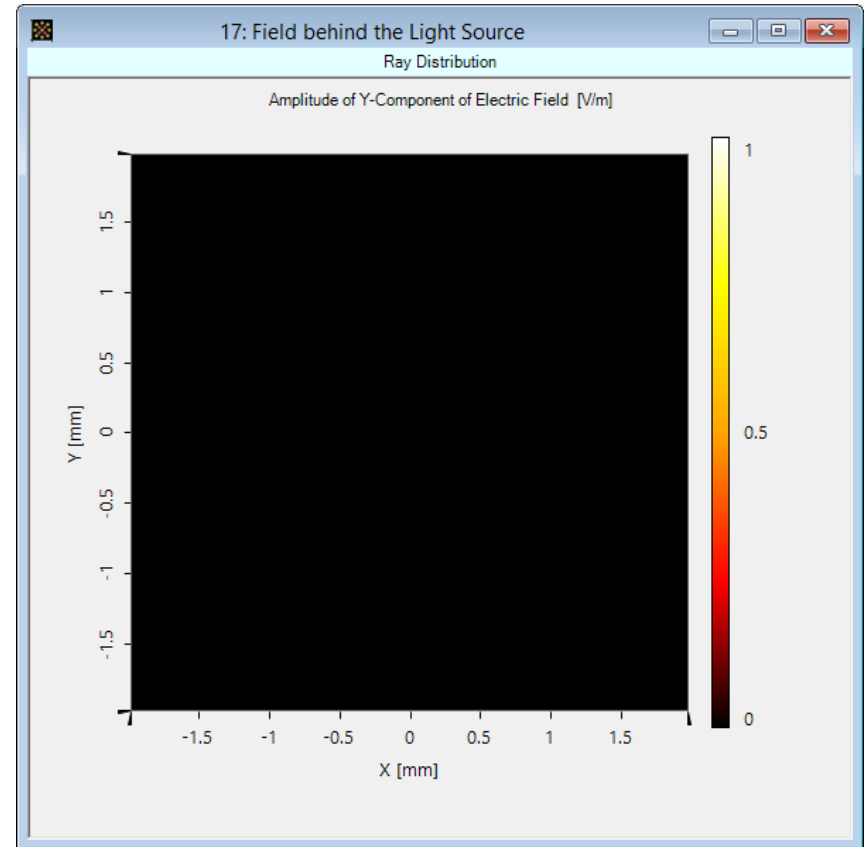


- The lens system is illuminated with a monochromatic plane wave (wavelength is set to 266.08 nm).
- The polarization of the illuminating source is set to be linearly polarized with 0°.
- Thus the light source emits a field with only an  $E_x$  component. The  $E_y$  component is zero.

# Emitted Fields of the Light Source

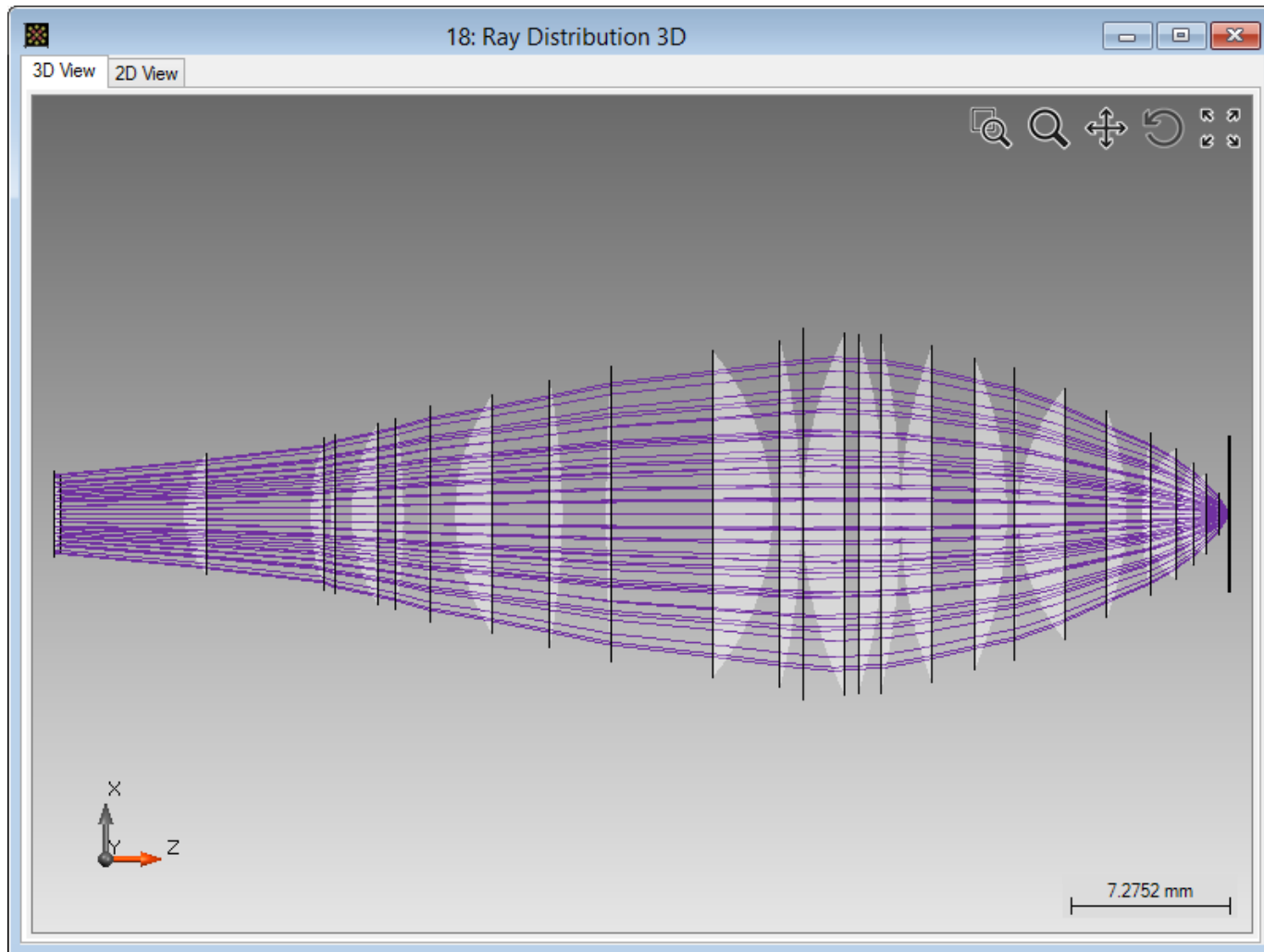


$E_x$  Component of Emitted Field



$E_y$  Component of Emitted Field

# Result of 3D Ray Tracing System Analyzer



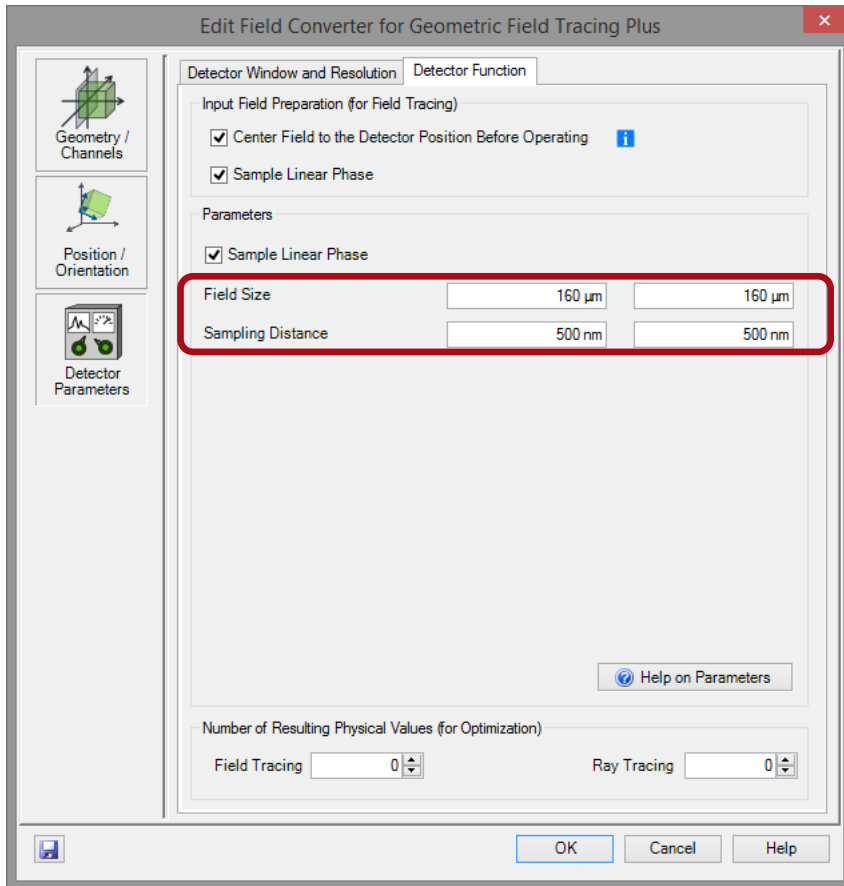


# Used Detectors

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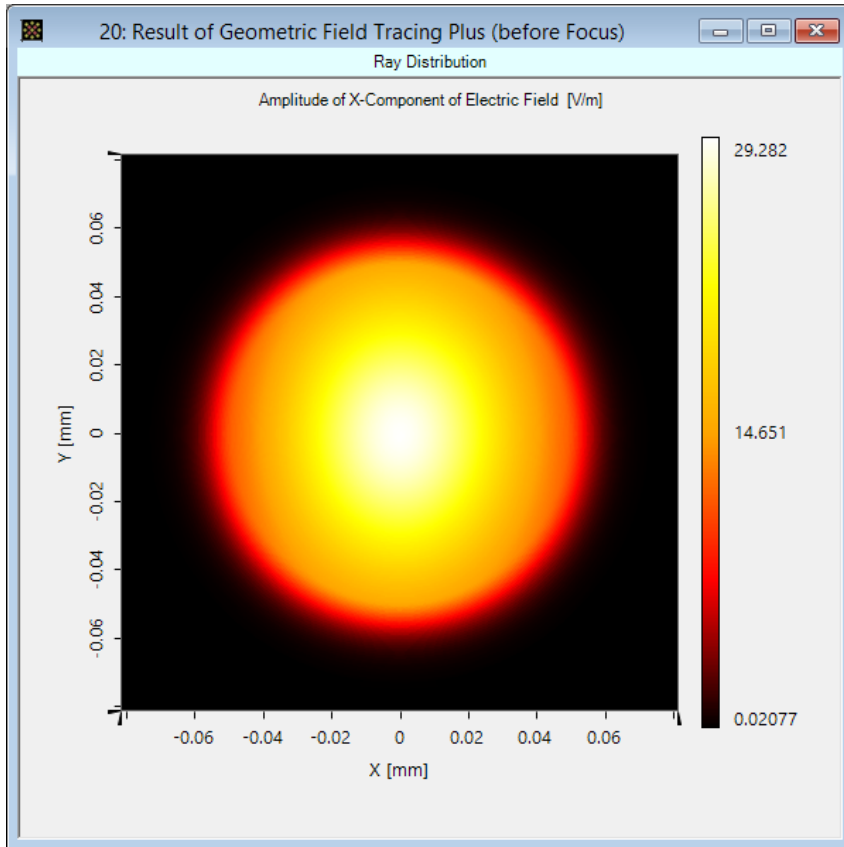
- Within the optical setup we use two detectors:
  - Virtual Screen
  - Field Converter for Geometric Field Tracing
- The converter is part of the User Experience Program. It is not yet available as integrated component.
- **The conversion of the result data of the Geometric Field Tracing Plus engine into a harmonic field (set) will be automatized soon. This is part of the User Experience Program.**

# Edit Options of the Converter

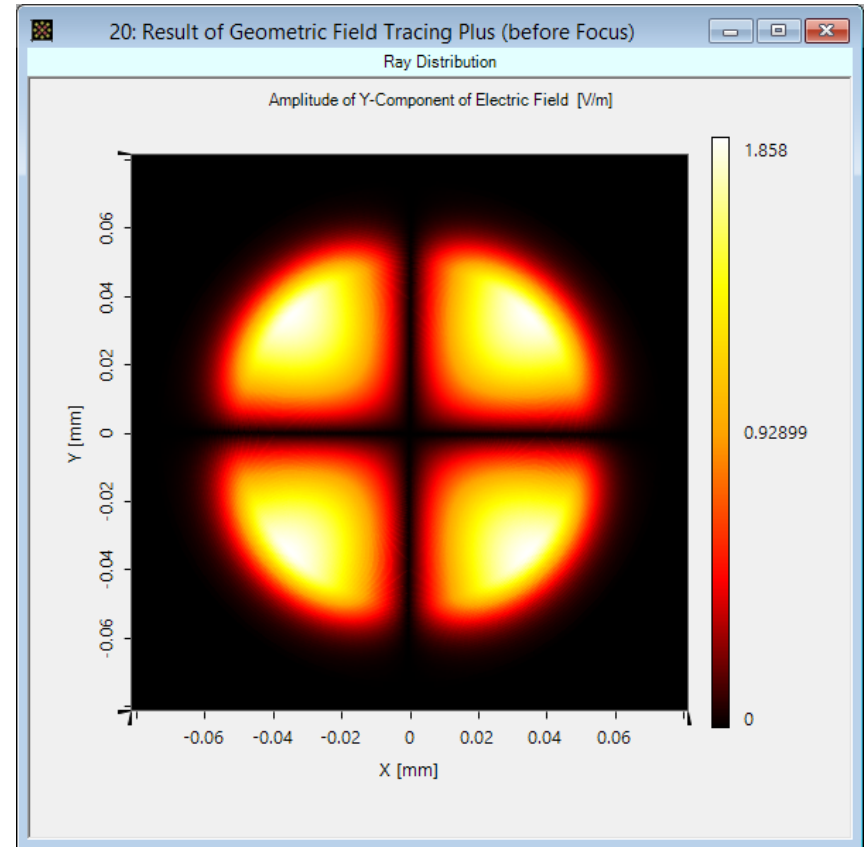


- On the left side the edit dialog of the field converter is shown.
- The user can enter
  - Field Size
  - Sampling Distance
- These parameters will be used for conversion.
- This function will be automated soon.

# Result of Geometric Field Tracing (Before Focus)

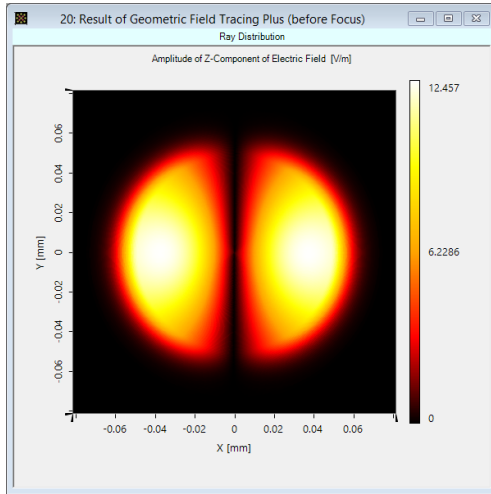


$E_x$  Component of Field

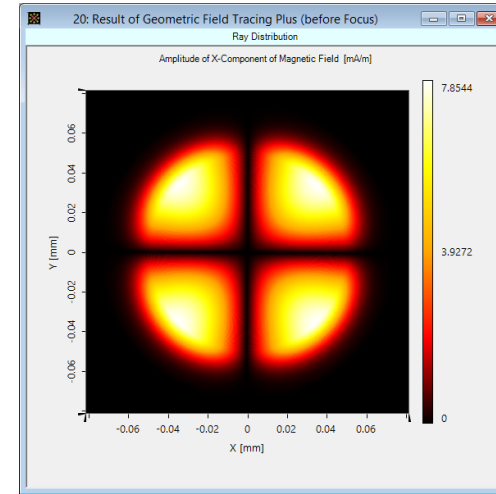


$E_y$  Component of Field

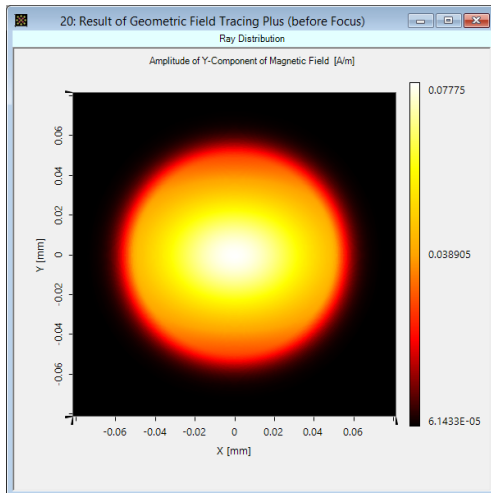
# Result of Geometric Field Tracing (Before Focus)



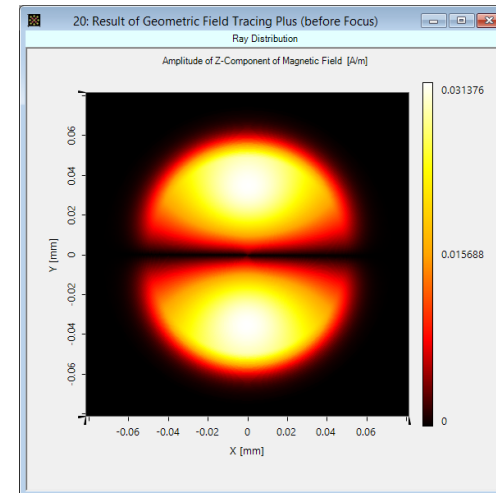
$E_z$



$H_x$

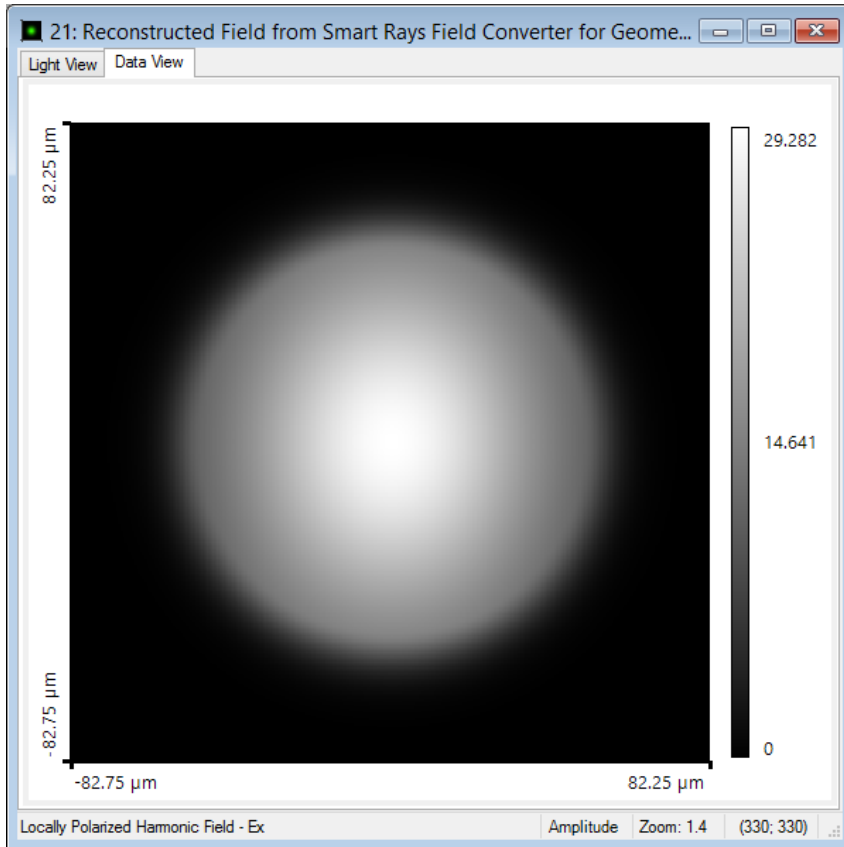


$H_y$



$H_z$

# Result of Field Converter

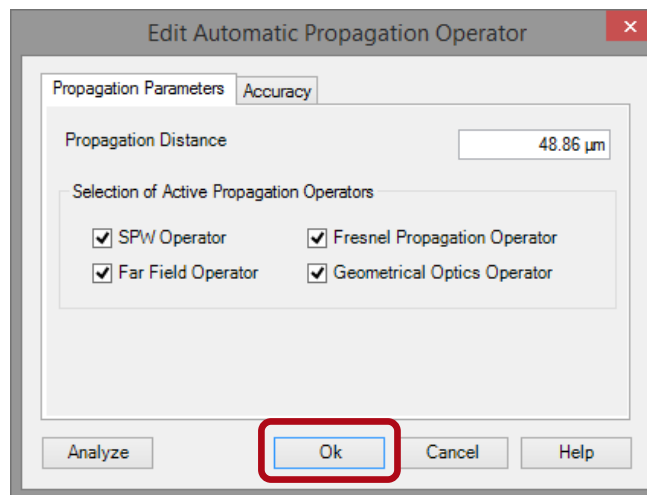


$E_x$  Component of Converted Field

- The field converter converts the output of the Geometric Field Tracing Plus engine into a harmonic field.
- This harmonic field can be used for further operations/propagations.

# Perform Diffractive Propagation Step into Focus

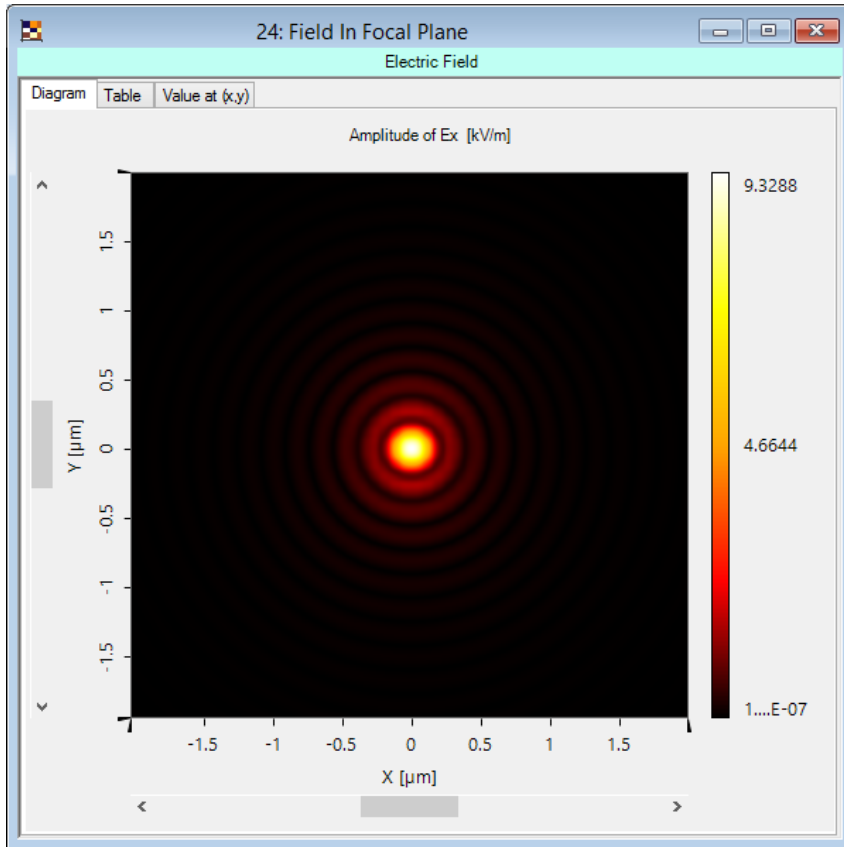
- The converted field is now used to perform a free space propagation into the focal region.
- Here, we use the Automatic Propagation operator to propagate the converted field by  $48.86 \mu\text{m}$ .
- The operator which will be selected is Far Field Propagation.



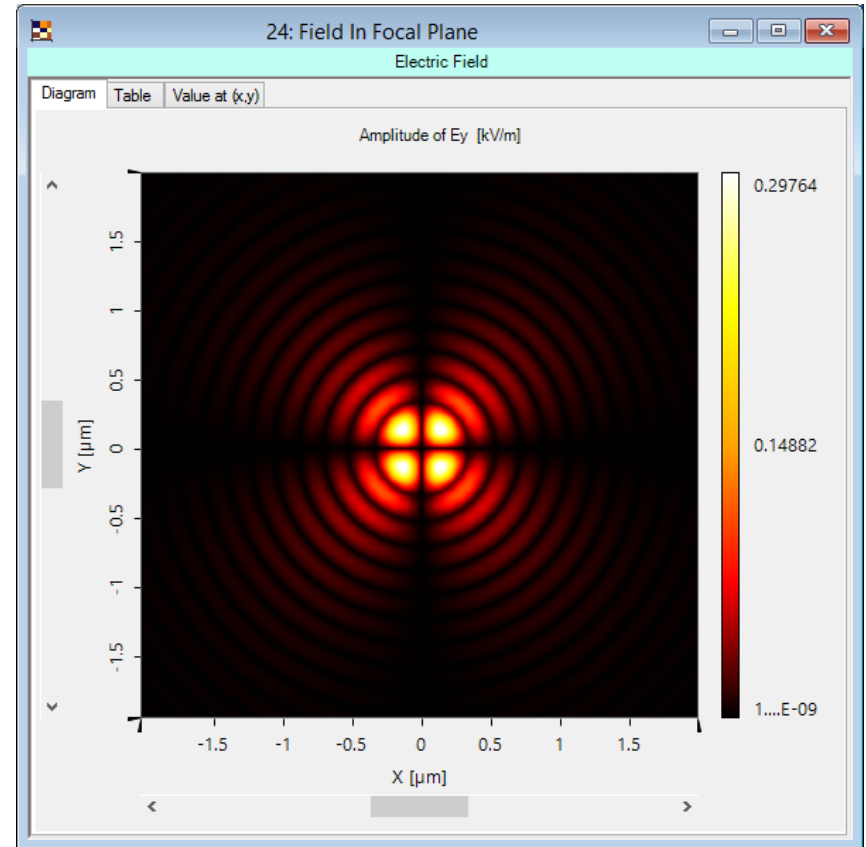
Results in



# Field in Focal Plane

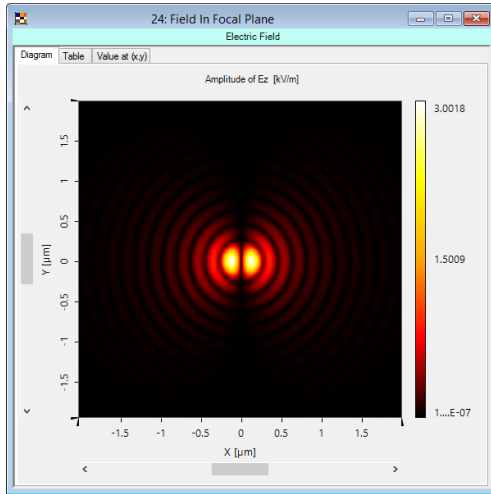


$E_x$  Component of Field

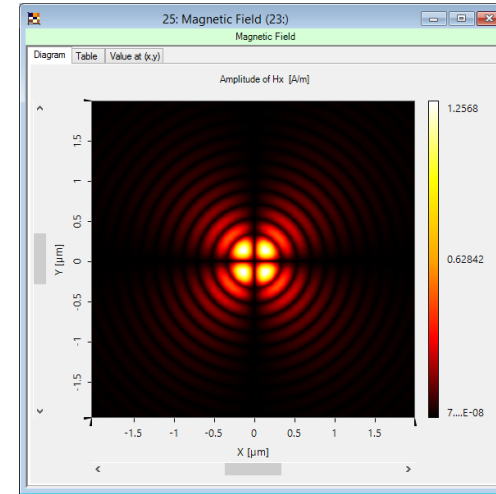


$E_y$  Component of Field

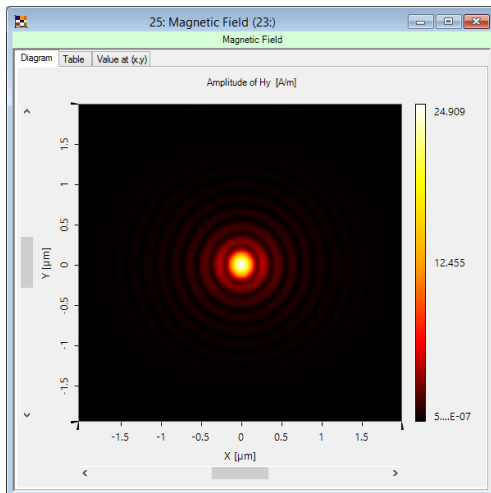
# Field in Focal Plane



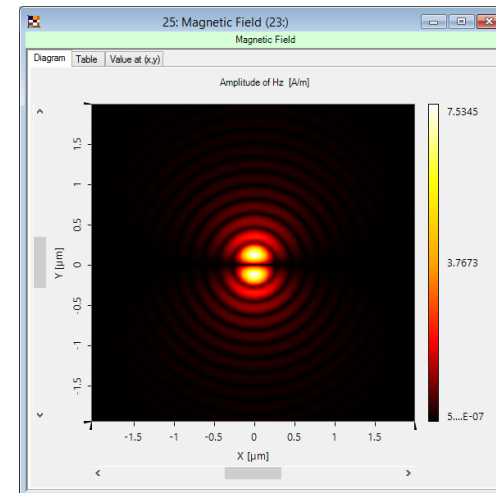
$E_z$



$H_x$



$H_y$



$H_z$



# Summary

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- The Geometric Field Tracing Plus engine, which is included in VirtualLab, handles electric and magnetic field values very consistent.
- By propagation through a surface (or a set of surfaces) Fresnel effects that appear at the surface(s) are taken correctly into account.
- It was also demonstrated that polarization effects like cross talk between the components of the electric field are included in the simulation.
- VirtualLab allows to combine geometric and diffractive propagation techniques (for example the propagation into the focal region).