WYROWSKI PHOTONICS

Feature.0006

High-NA Objective Lens Focusing

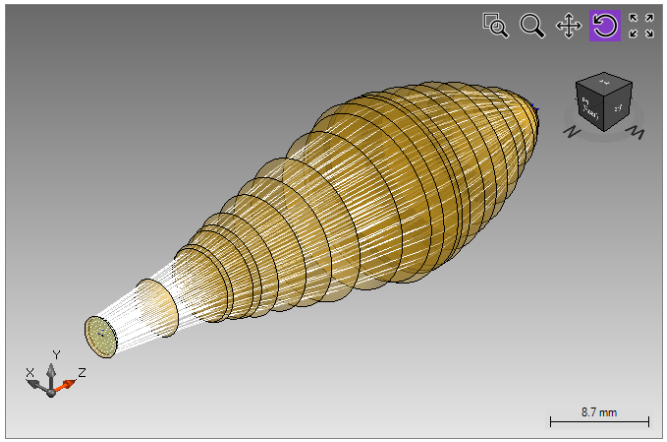
How does light propagate through the high-NA objective lens to the focal plane? What does light look like in the focal plane?

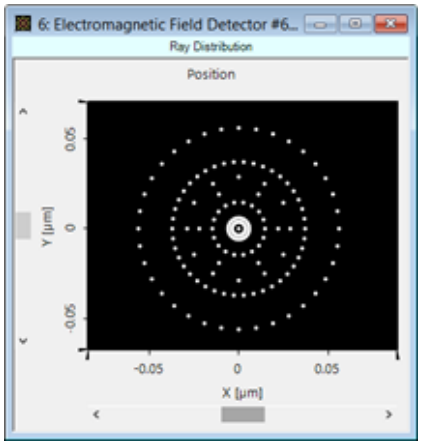
About This Use Case

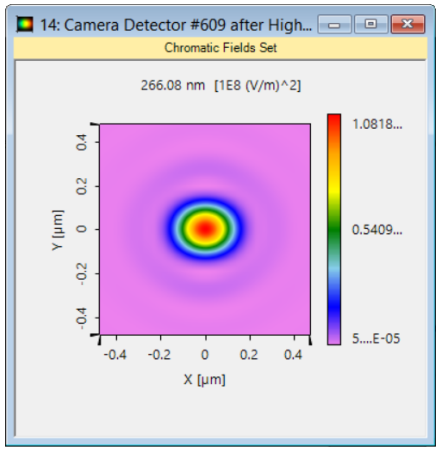
- The following toolbox is required
  - Starter toolbox
- This use case was produced with VirtualLab Fusion (Build 7.0.0.35).
- Get your free Trial Version here!

This Use Case Shows...

- 3D ray tracing of the objective lens focusing.
- the dot diagram at the focal plane.
- field intensity and field amplitude at the focal plane.







Overview

- 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 switching the ray and field tracing with great ease.
- The focal spot is shown, demonstrating the well-known asymmetry which stems from the vectorial effects.

Overview: System Parameters

- Input plane wave

Parameter	Description / Value & Unit
wavelength	266.08 nm
polarization	linear in *x*-direction (0°)
diameter	3 mm

- Objective Lens

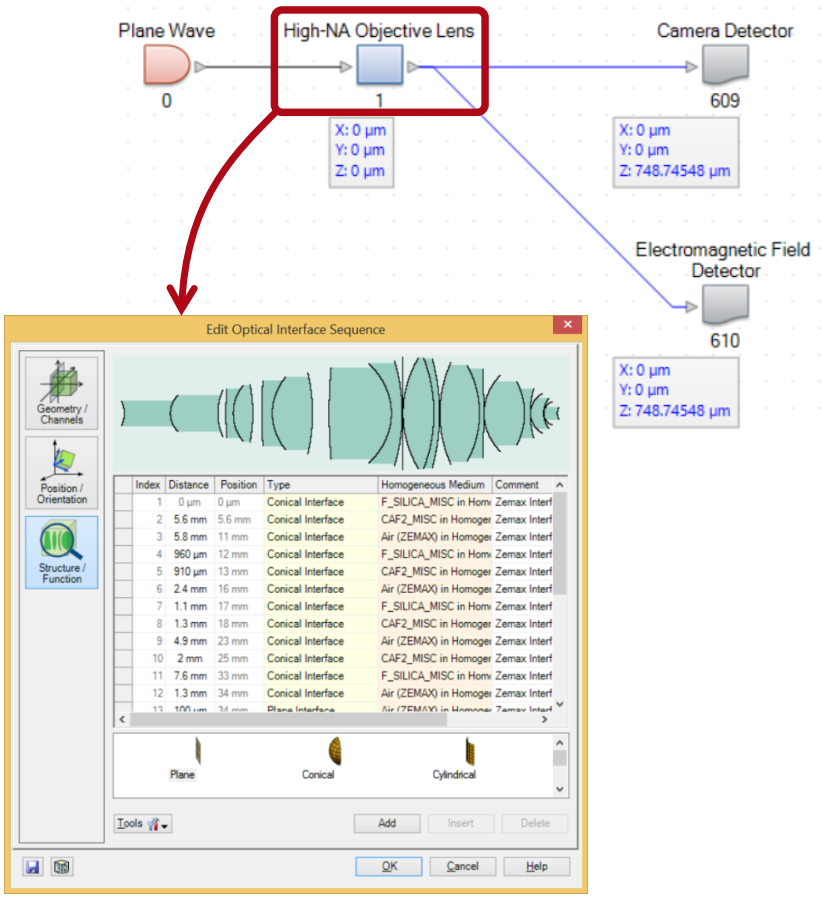
Parameter	Description / Value & Unit
NA of condenser lens	0.85
number of interfaces	26

- Detector

Parameter	Description / Value & Unit
window size	1 µm × 1 µm

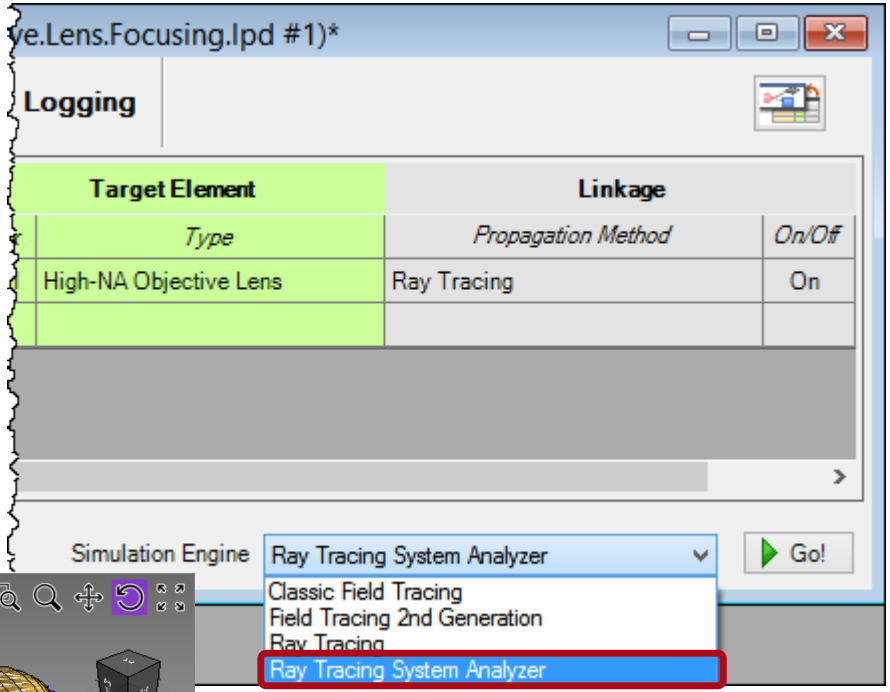
Overview

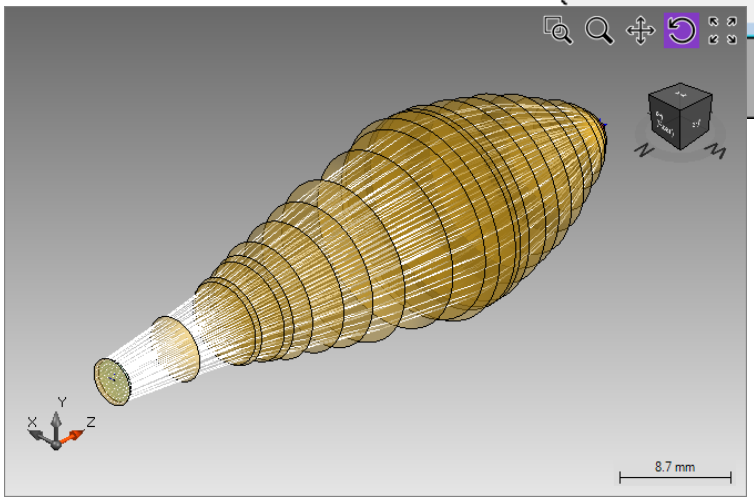
- The sample system is preset with the complicated objective lens included.
- Next, we demonstrate how to perform simulation on the sample system following the recommended workflow in VirtualLab.



Ray Tracing Simulation

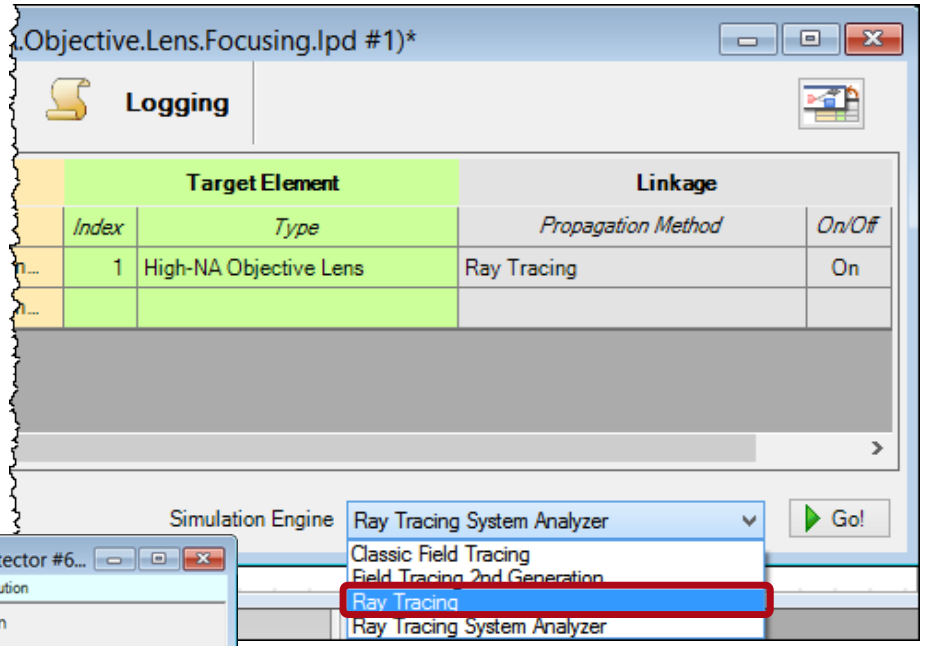
- Choose *Ray Tracing System Analyzer* as the simulation engine at first.
- Click on *Go!*
- The 3D ray tracing result is obtained.

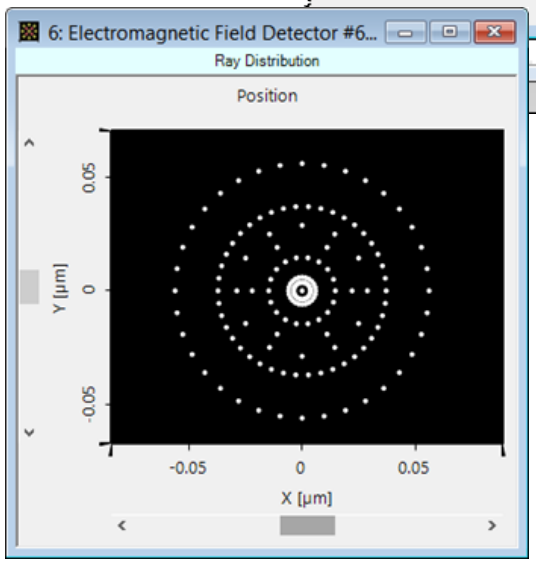




Ray Tracing Simulation

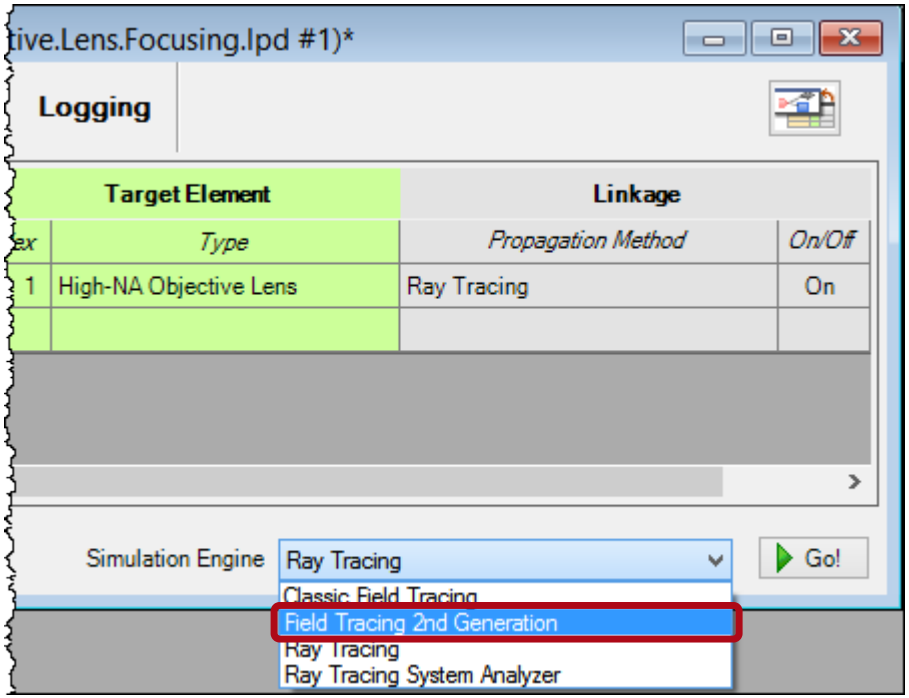
- Then, select *Ray Tracing* as the simulation engine.
- Click *Go!*
- Then the dot diagram (2D ray tracing result) is obtained.





Field Tracing Simulation

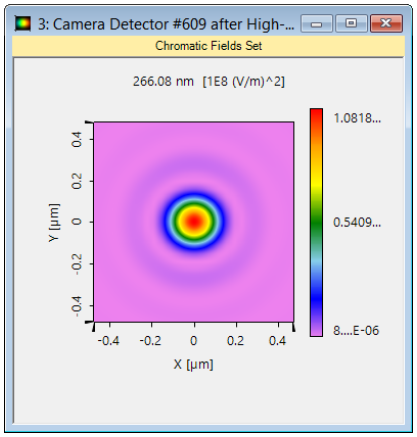
- Switch to field tracing and select *Field Tracing 2nd Generation* as the simulation engine.
- Click *Go!*



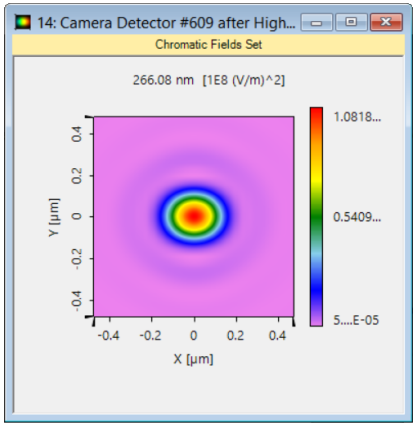
Field Tracing Results (Camera Detector)

- The top figure shows the field intensity by integrating E_x and E_y components only.
- The bottom figure shows the field 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.

$E_x^2 + E_y^2$

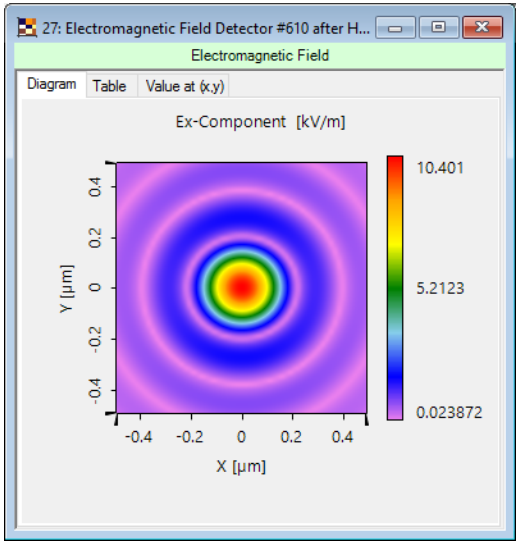


$E_x^2 + E_y^2 + E_z^2$

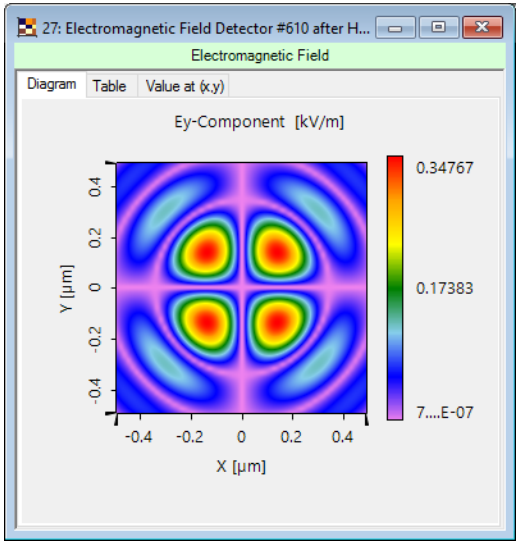


Field Tracing Results (EM Field Detector)

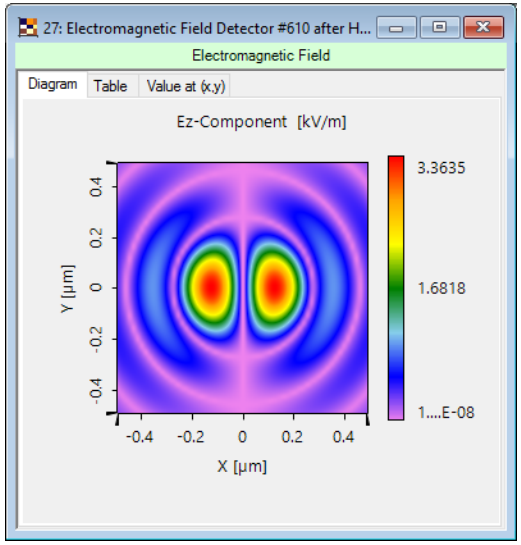
- All electromagnetic field components are obtained by using the Electromagnetic Field Detector.



Amplitude of E_x



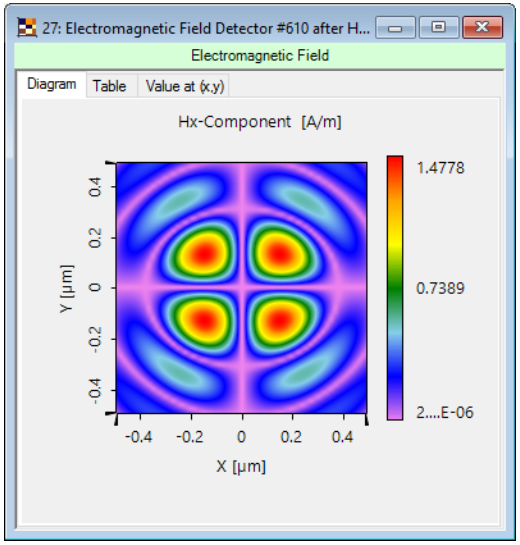
Amplitude of E_y



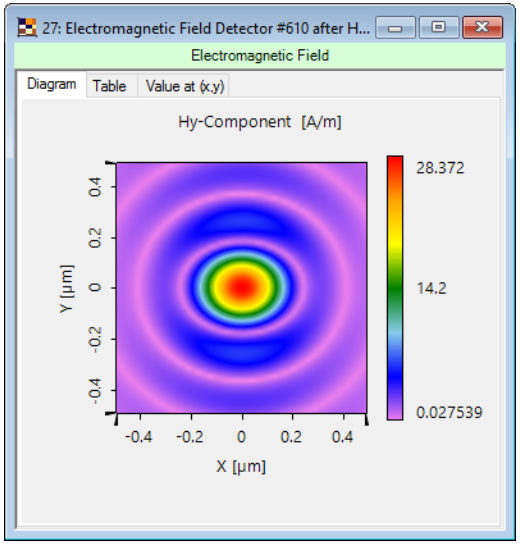
Amplitude of E_z

Field Tracing Results (EM Field Detector)

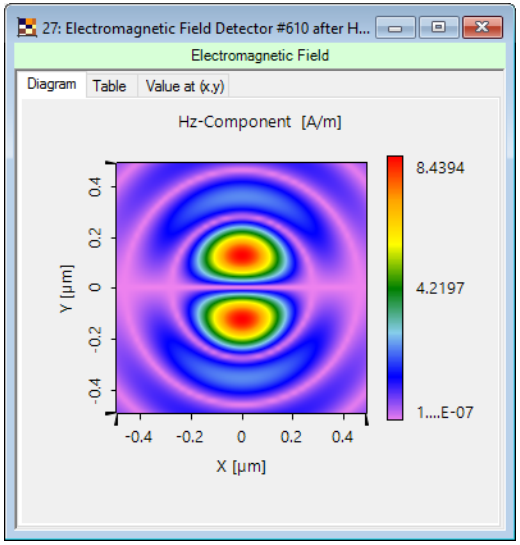
- All electromagnetic field components are obtained by using the Electromagnetic Field Detector.



Amplitude of H_x



Amplitude of H_y



Amplitude of H_z

Document & Technical Info

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