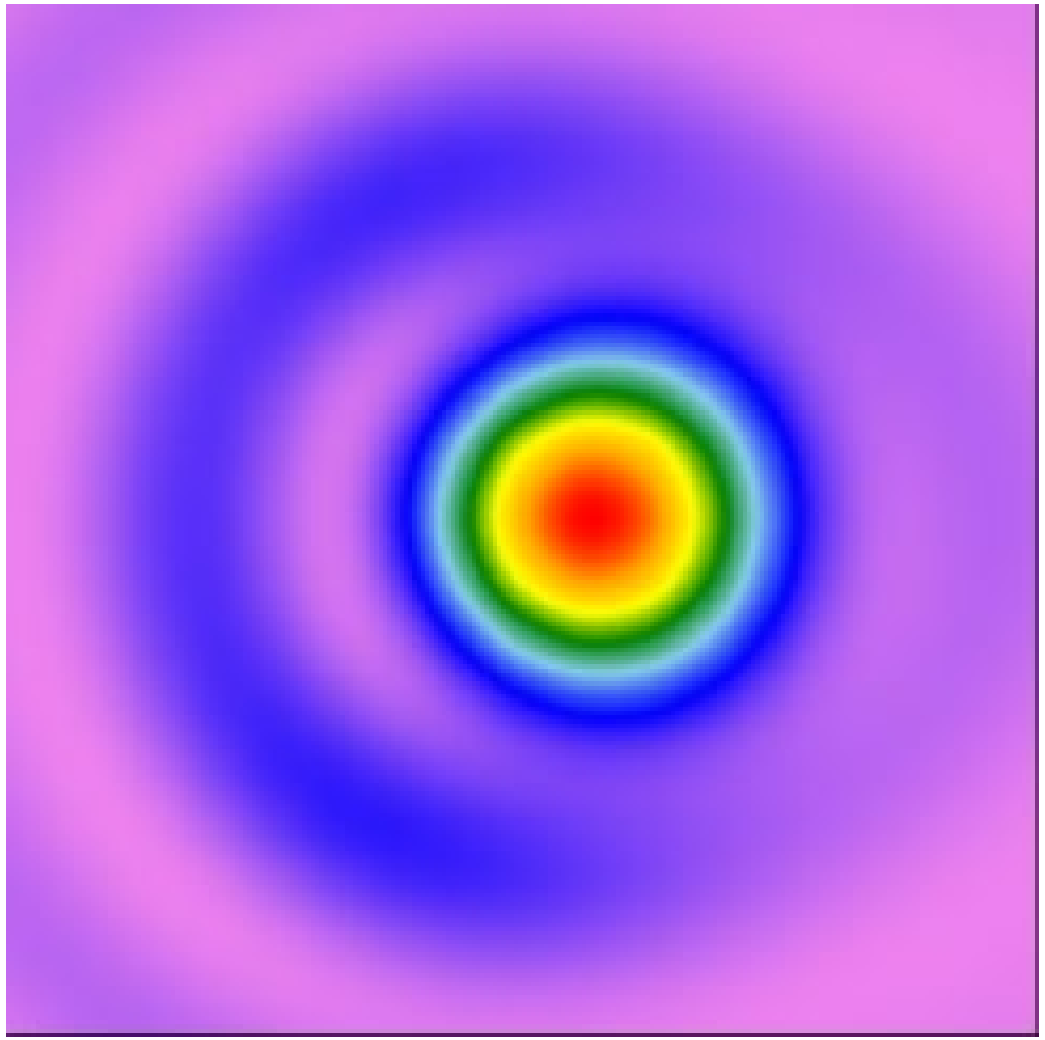
Analysis of Off-Axis Imaging by a High-NA Microscope

Abstract



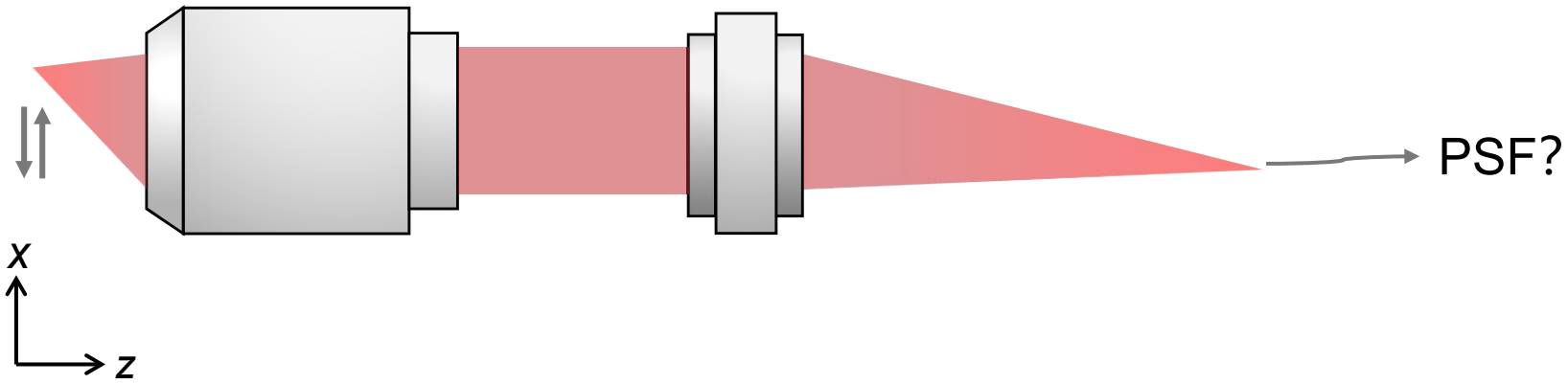
The off-axis PSF for imaging often suffers from the aberration of the microscopy system. It makes the microscopy system not perfectly shift-invariant as expected. VirtualLab Fusion provides a fast and convenient way to check the PSF for off-axis imaging with a high-NA microscope. This use case demonstrates the imaging of off-axis object points with different lateral shift distances, to check the influence of the aberrations.

Scenario

input spherical wave
- wavelength 587.5nm
- circularly polaried
- lateral shift in *x*-direction 20μm, 40μm, 60μm, 80μm, 100μm

objective lens: Nikon
- NA=1.4, 60X
- US6519092B2

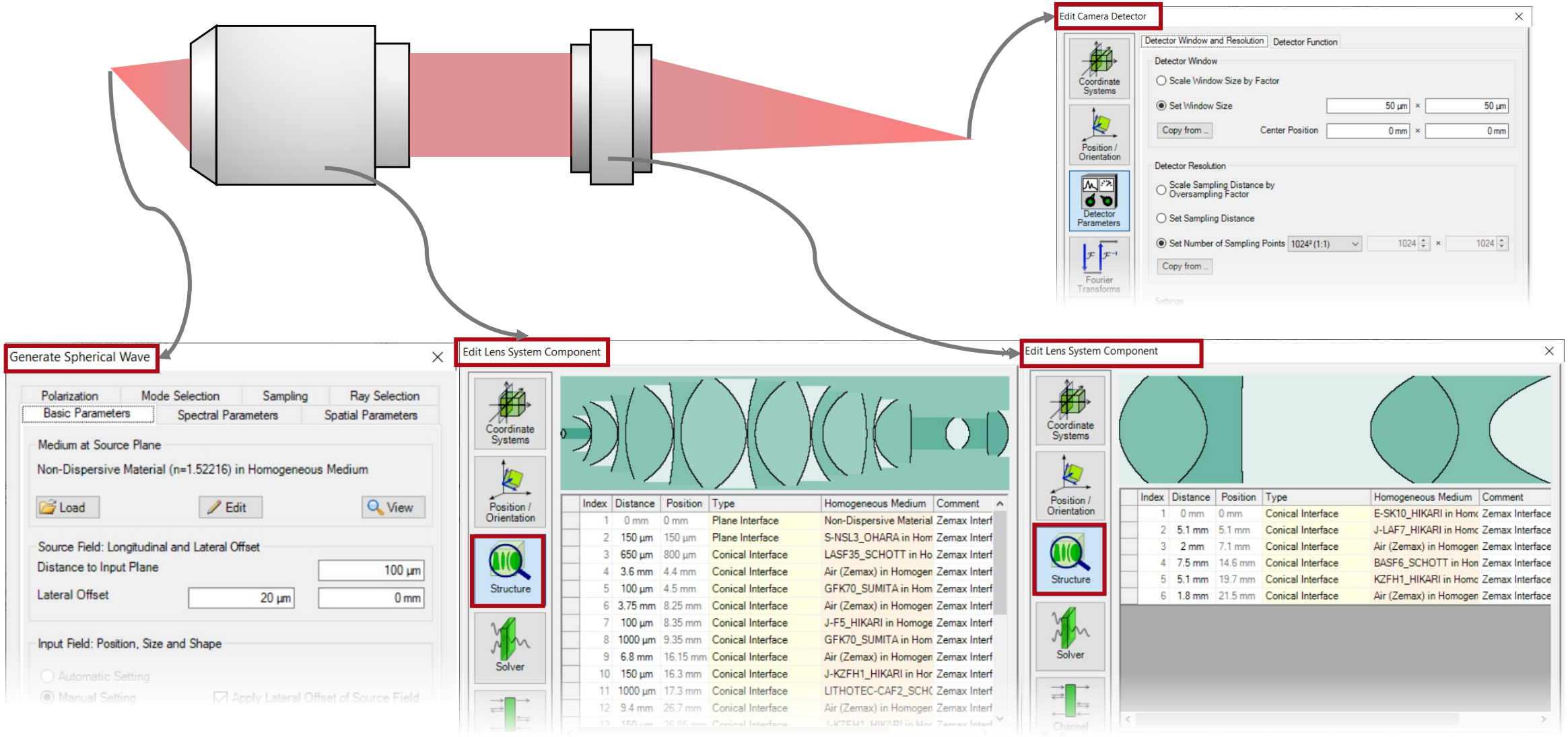
tube lens



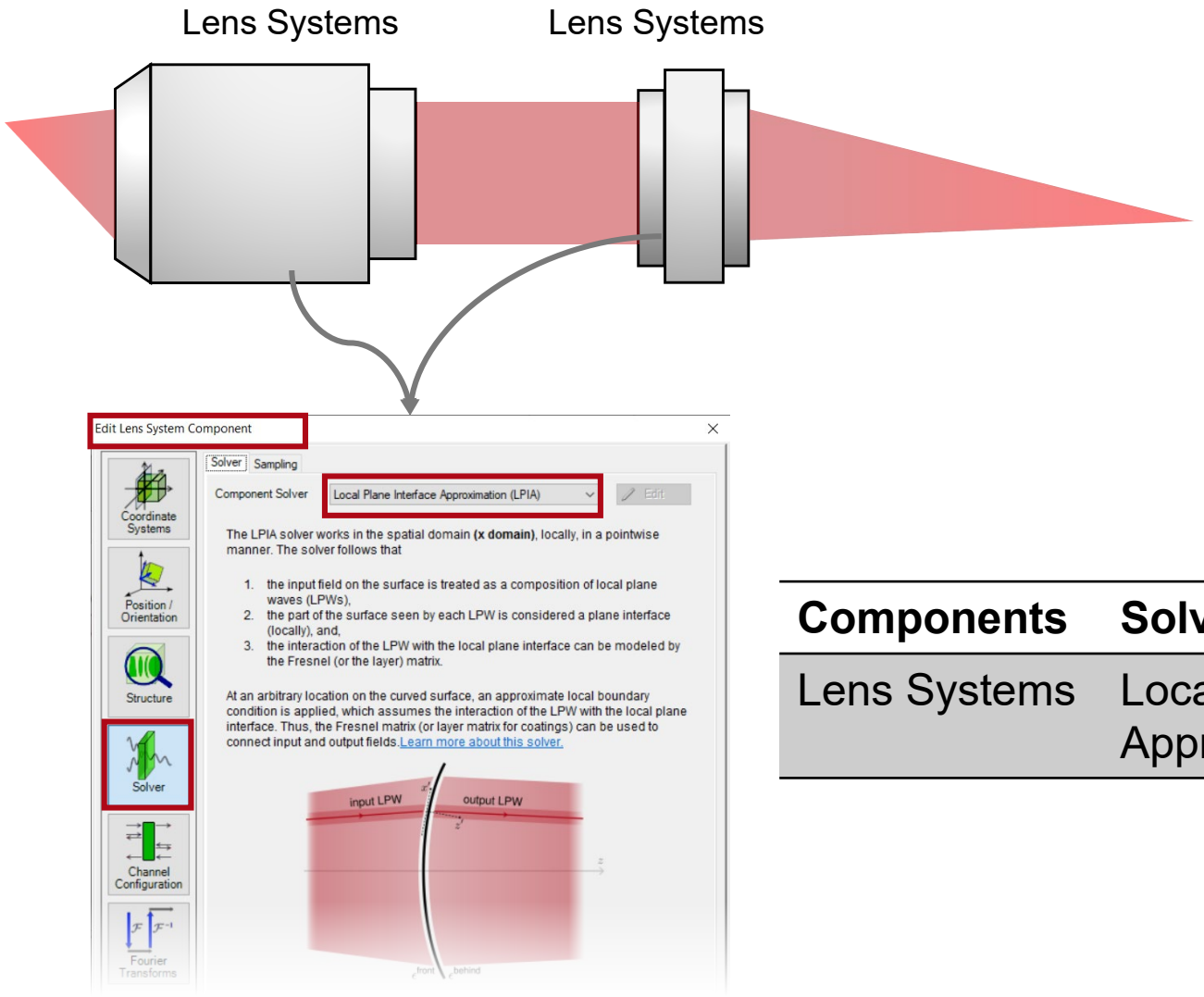
How is the PSF influenced by the aberrations in the case of off-axis imaging?

Building the System in VirtualLab Fusion

System Building Blocks



Solvers for Components

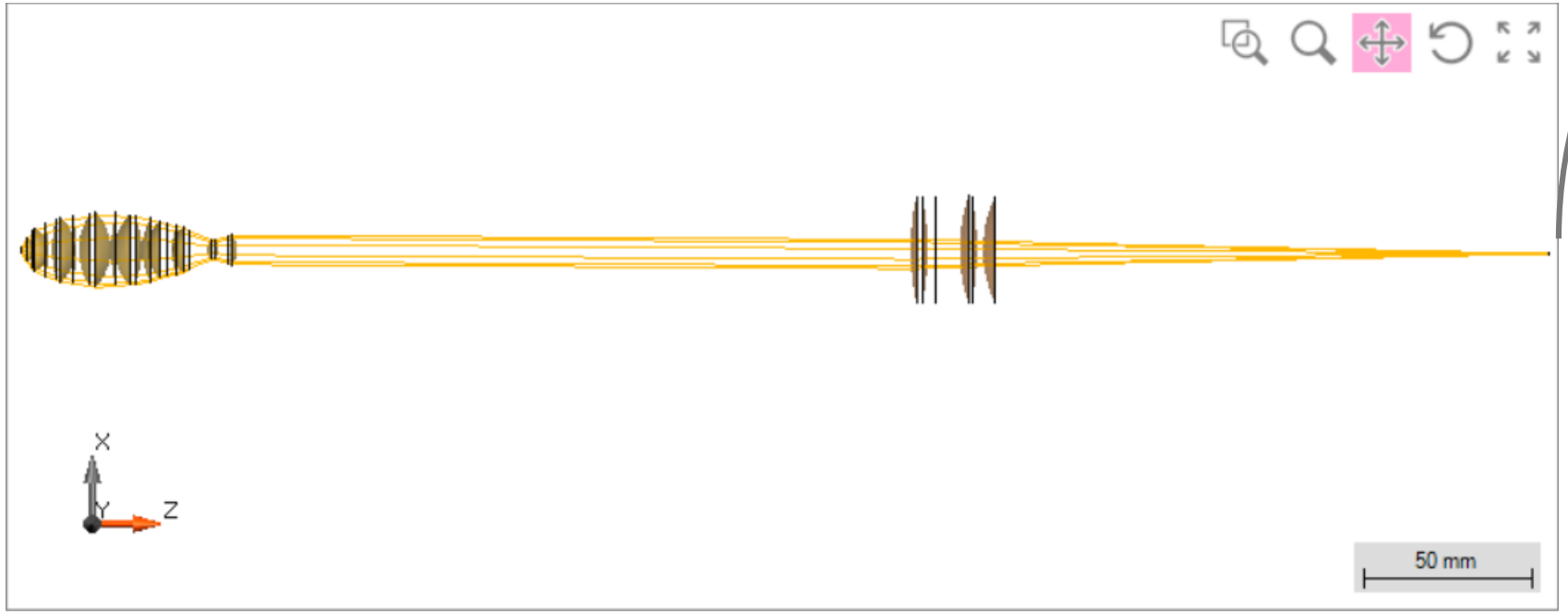


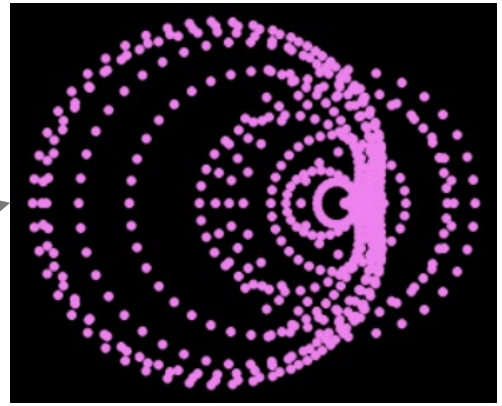
Components	Solvers
Lens Systems	Local Plane Interface Approximation (LPIA)

Geometric-Optics Simulations

by Ray Tracing

Results: Ray Tracing

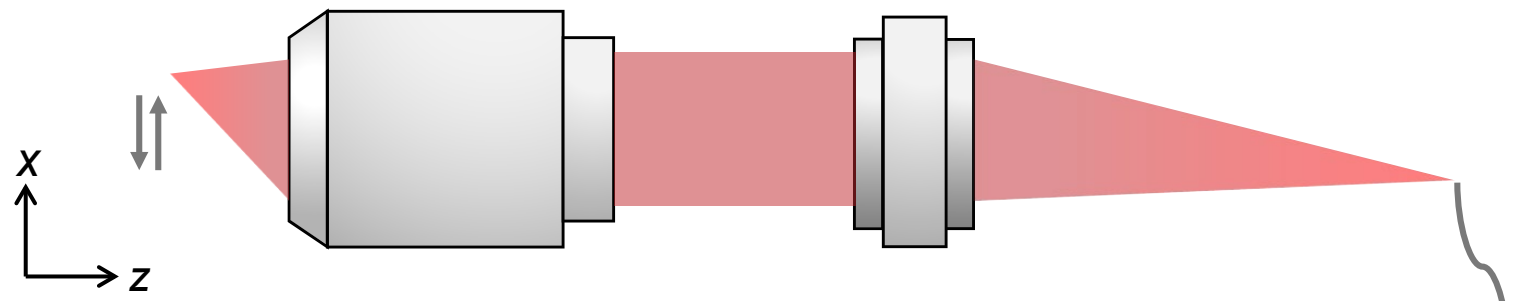




Fast Physical-Optics Simulations

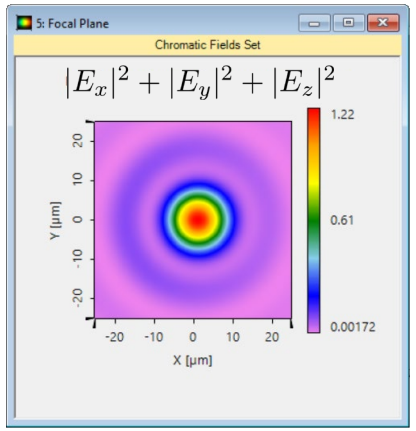
by Field Tracing

PSF at Focal Plane with Lateral Shifts

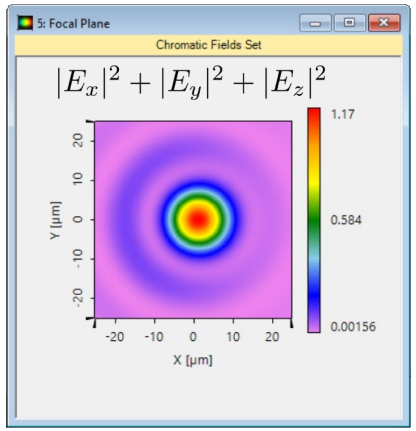


The distorted PSF is demonstrated when the lateral shift is 100 μm, i.e., the field of view is ~200 μm.

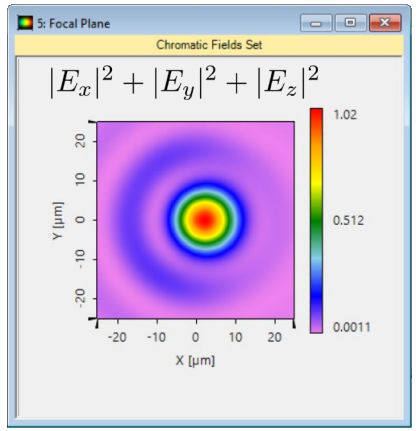
x=20 μm



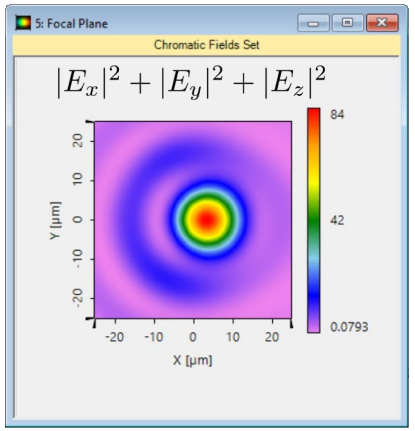
x=40 μm



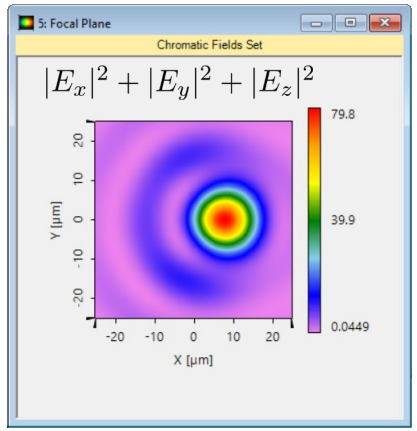
x=60 μm



x=80 μm



x=100 μm



Document Information

title	Analysis of Off-Axis Imaging by a High-NA Microscope
document code	MIC.0016
version	1.0
edition	VirtualLab Fusion Basic
software version	2020.2 (Build 1.116)
category	Application Use Case
further reading	- Debye-Wolf Integral Calculator - Analyzing High-NA Objective Lens - Resolution Investigation for Microscope Objective Lenses by Rayleigh Criterion