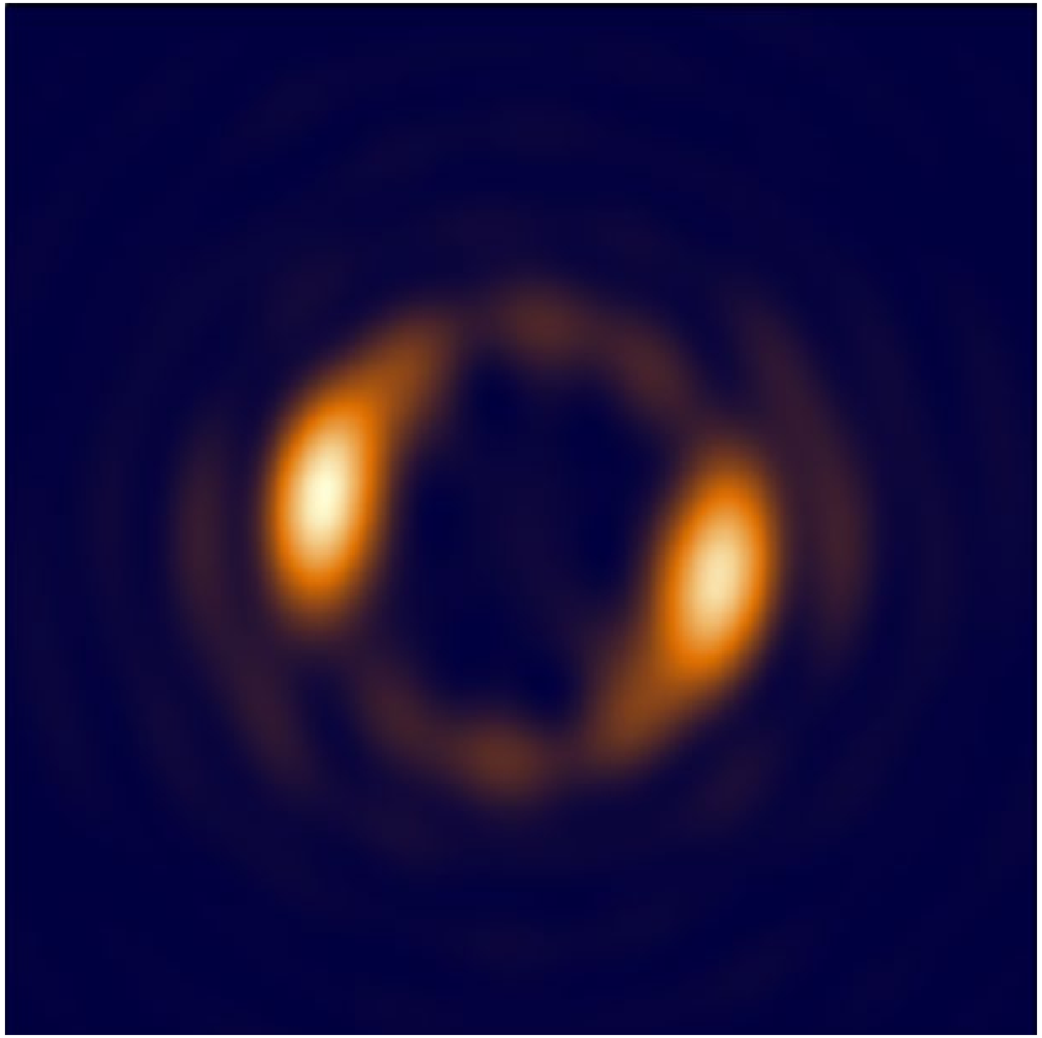
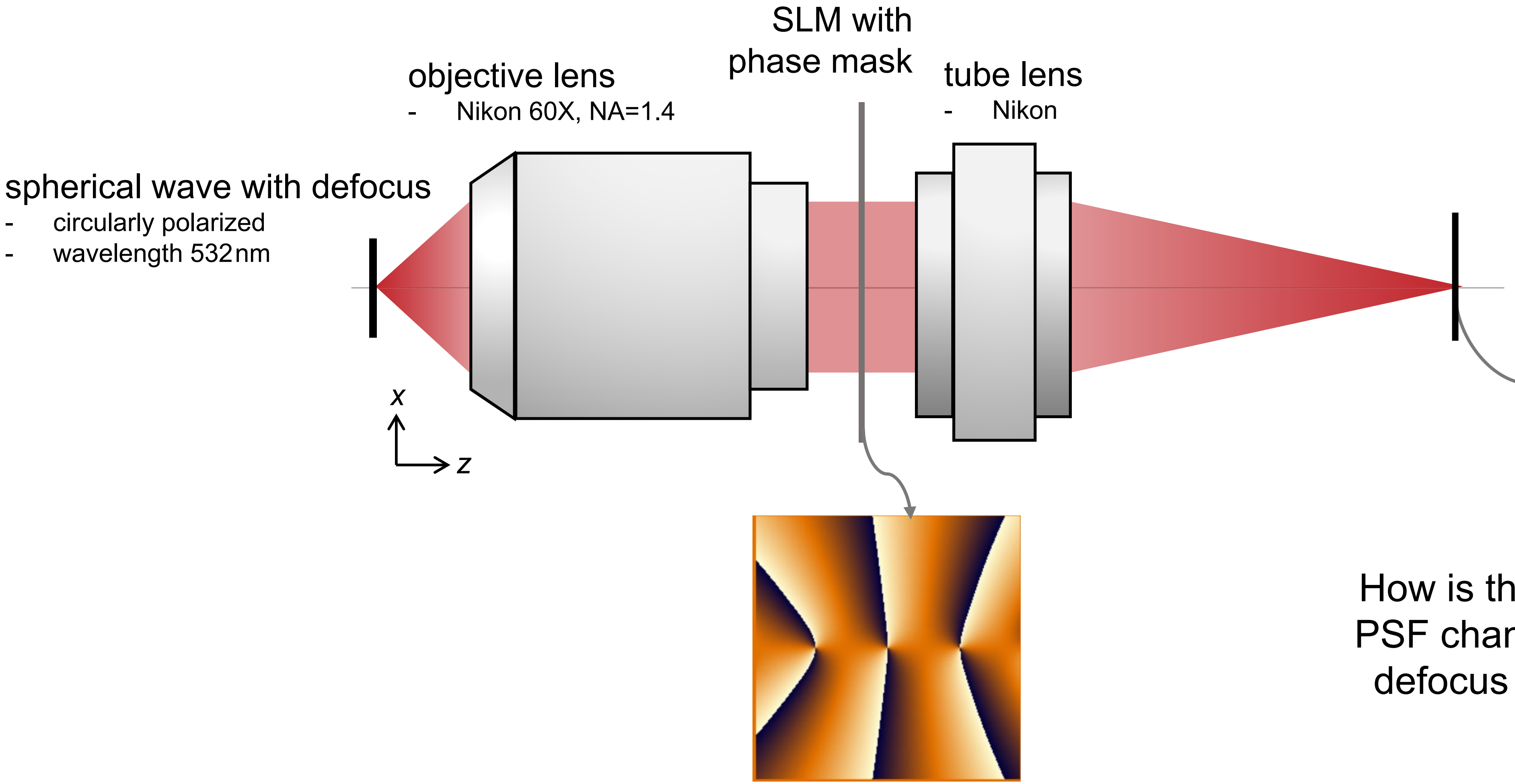
Double-Helix PSF for 3D Imaging Microscopy

Abstract



The Double-Helix (DH) PSF engineering provides a high resolution in the longitudinal direction for 3D imaging. It can be produced by adding a phase mask with vortices in the pupil plane [Ginni Grover et al., Opt. Exp. 2012]. VirtualLab Fusion provides a fast and convenient way to calculate the DH PSFs for small defocuses of a high-NA microscopy system. This use case demonstrates the DH-PSFs have obvious changes with a defocus of ~130 nm.

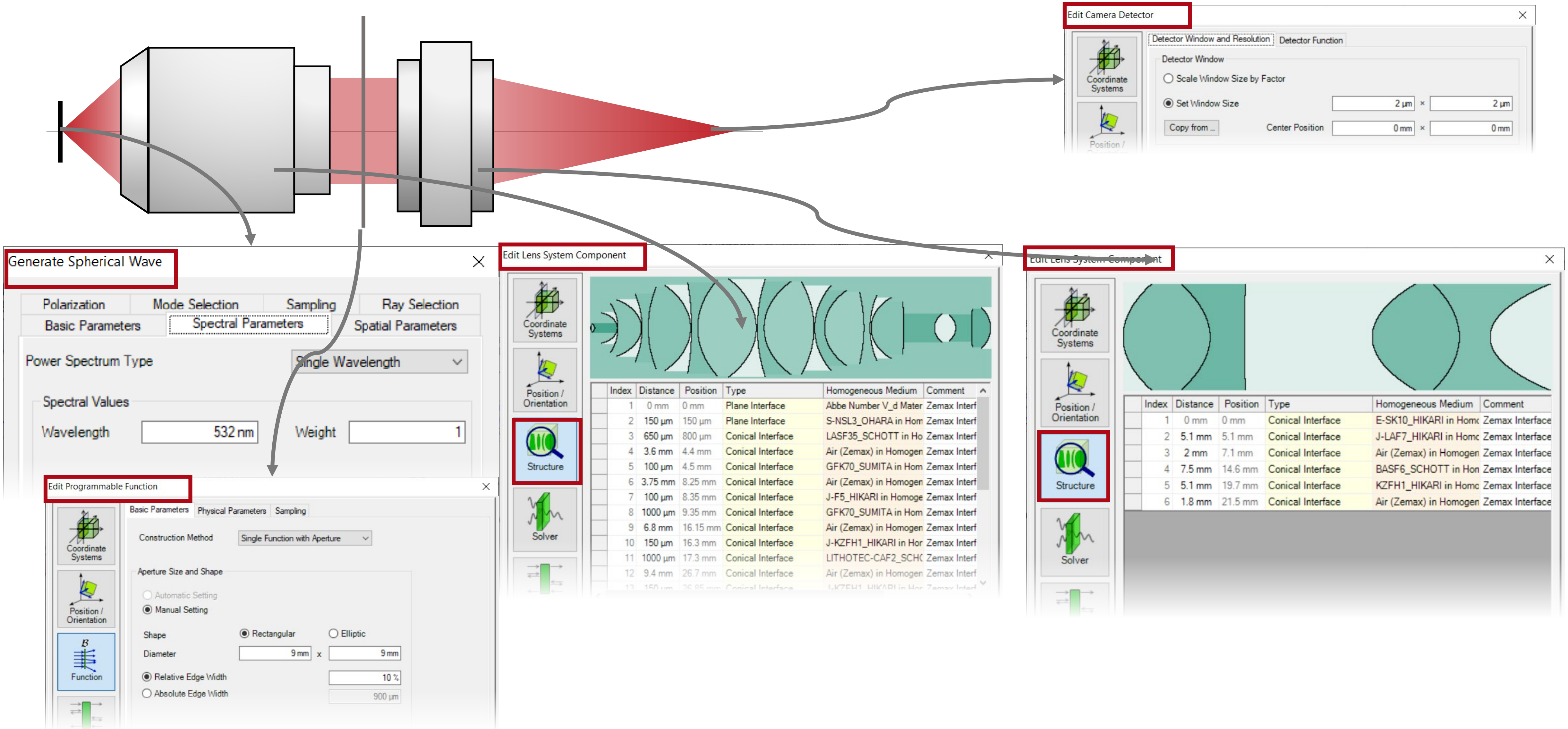
Modeling Task



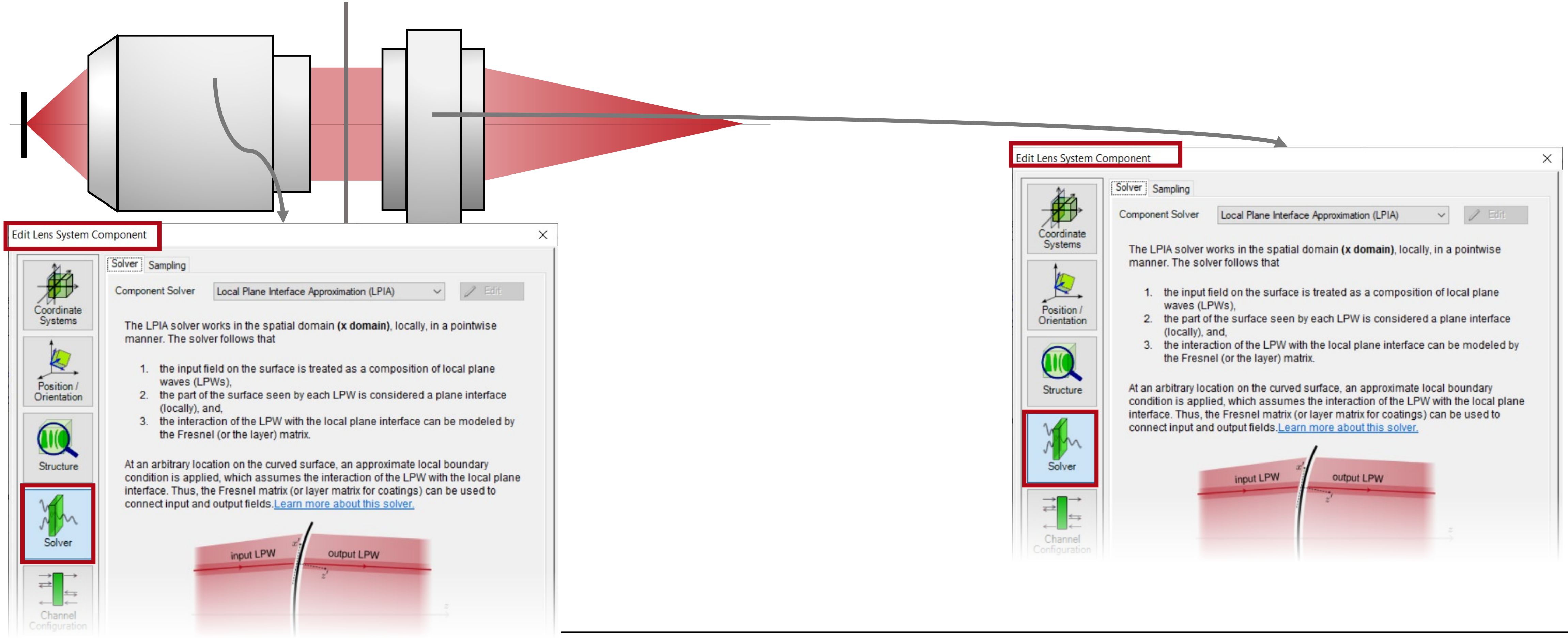
How is the double helix PSF change for a small defocus in longitudinal direction?

Building the System in VirtualLab Fusion

System Building Blocks



Solvers for Components

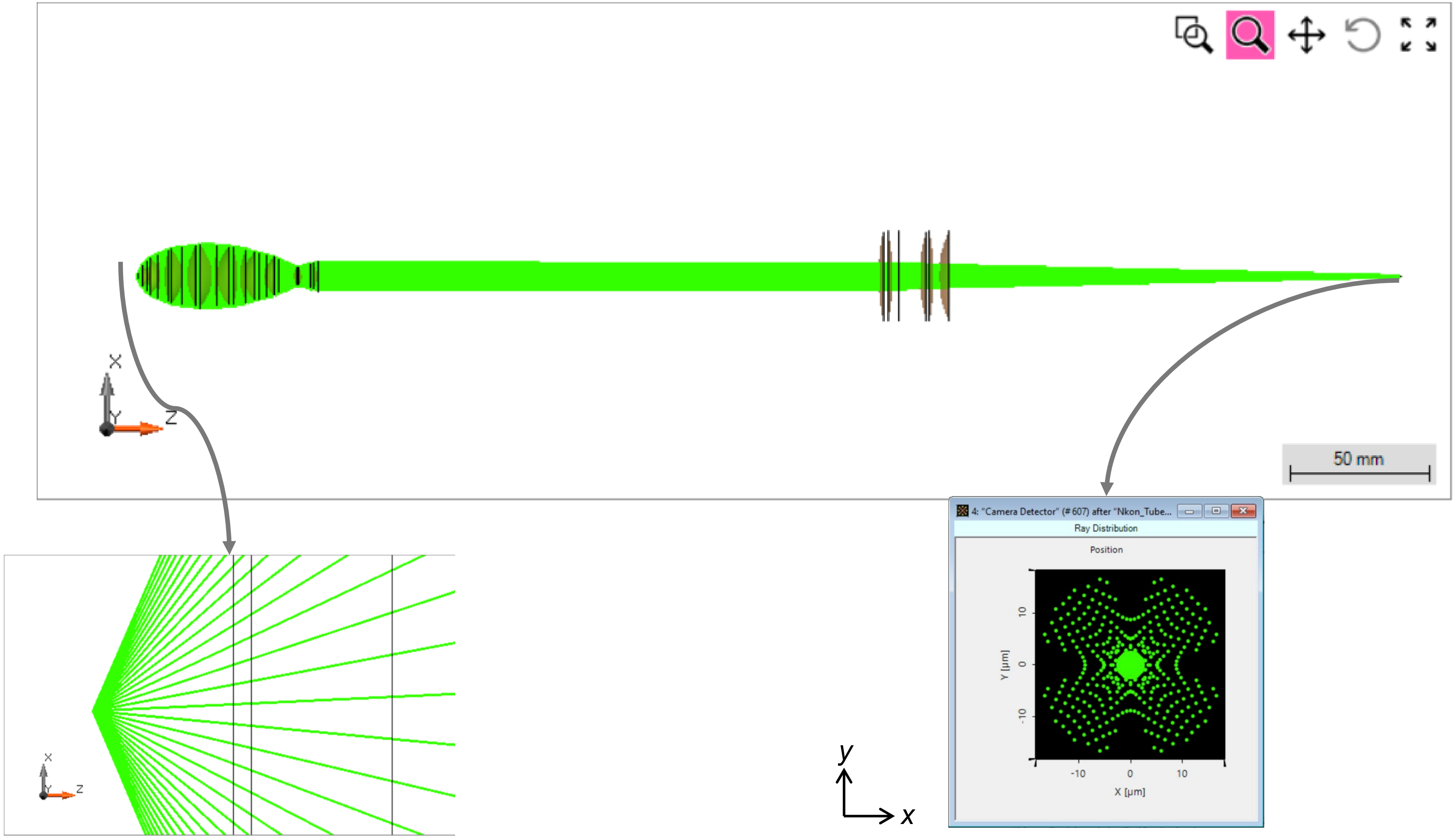


Components	Solvers
Lens Systems	Local Plane Interface Approximation (LPIA)

Geometric-Optics Simulations

by Ray Tracing

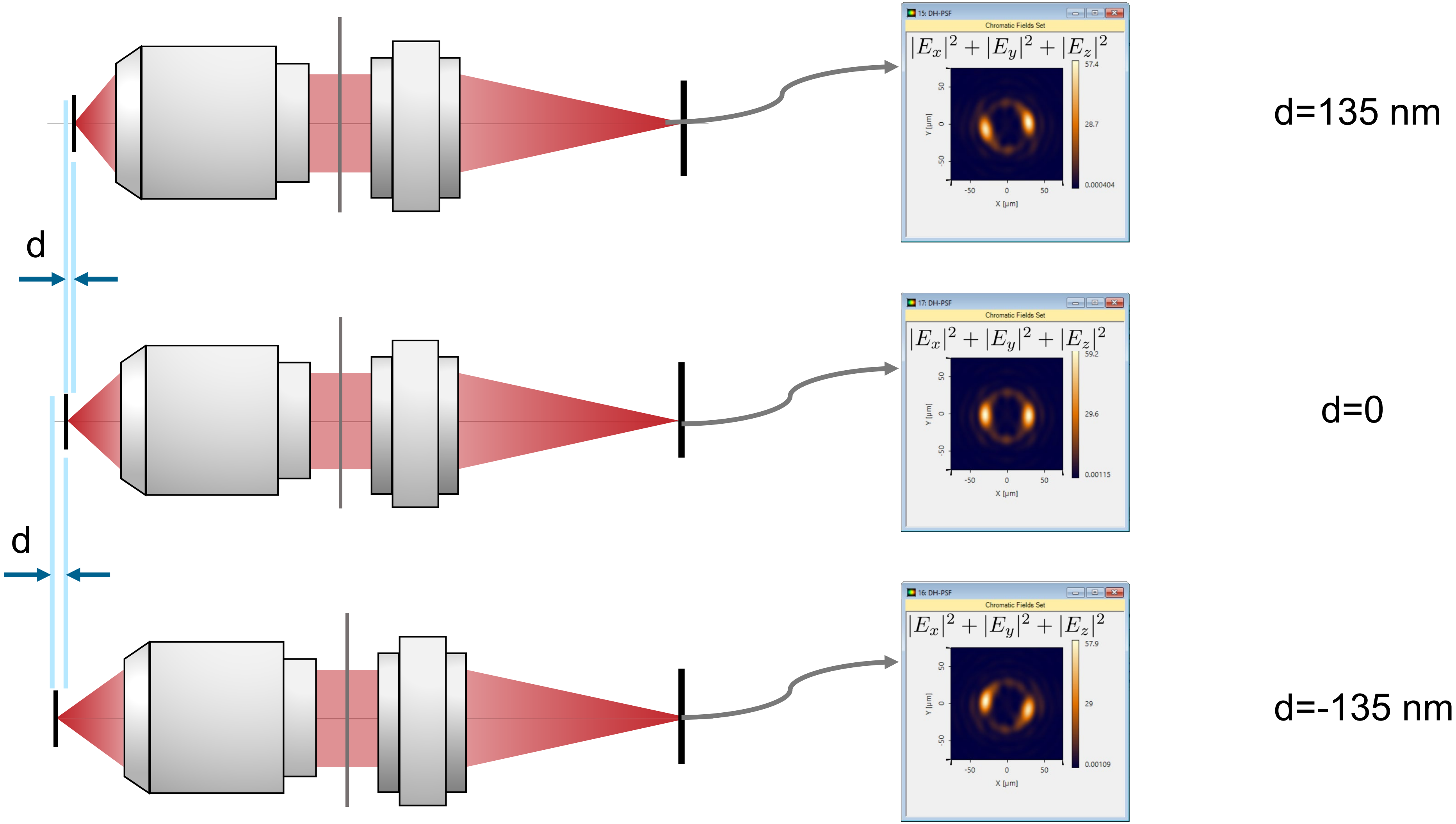
Results: Ray Tracing



Fast Physical-Optics Simulations

by Field Tracing

Double Helix PSFs at Image Plane for Different Defocuses



Document Information

title	Double-Helix PSF for 3D Imaging Microscopy
document code	MIC.0019
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