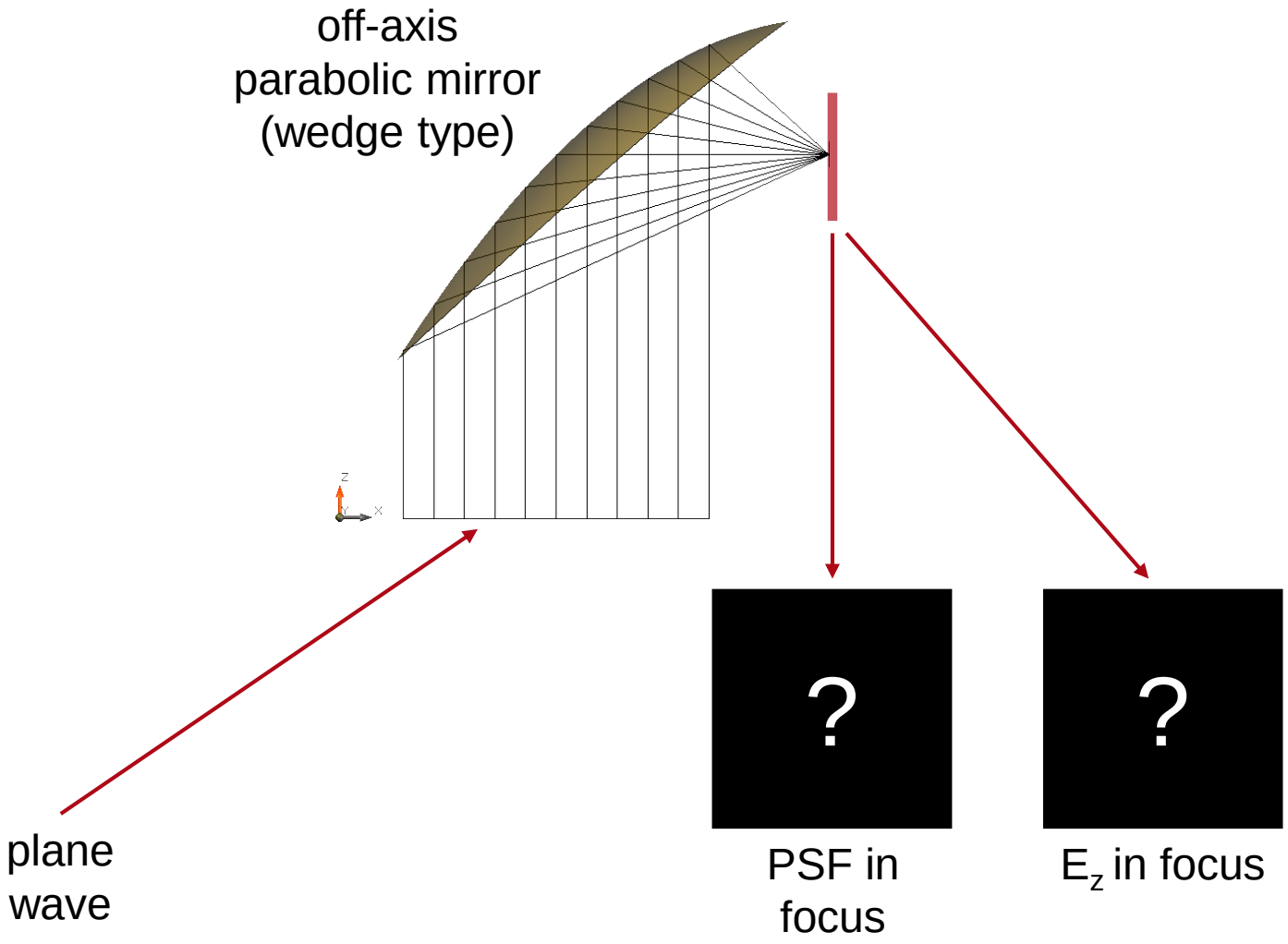
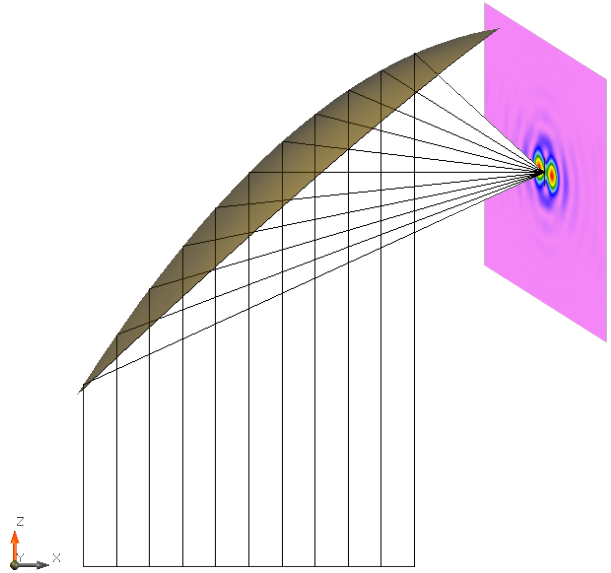
Imaging Systems > Advanced PSF & MTF

High-NA Focusing by Off-Axis Parabolic Mirror

Task/System Illustration



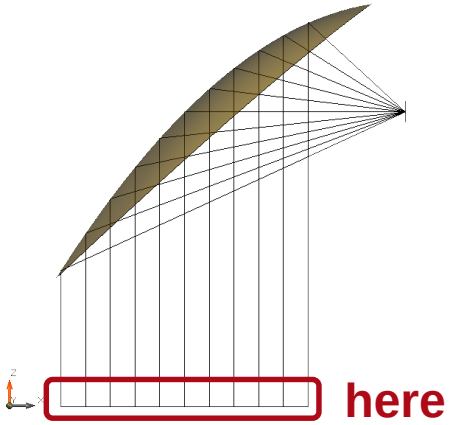
Highlights



- fast simulation of PSF including polarization effects in high numerical aperture optical systems

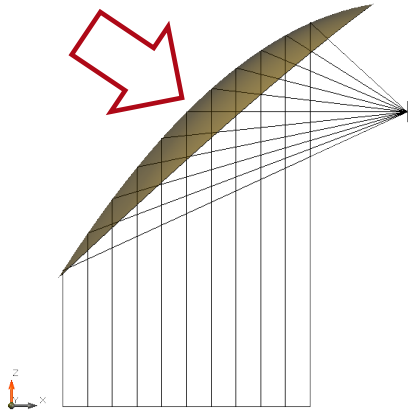
- full vectorial analysis (e.g. calculation of E_z)

Specification: Light Source



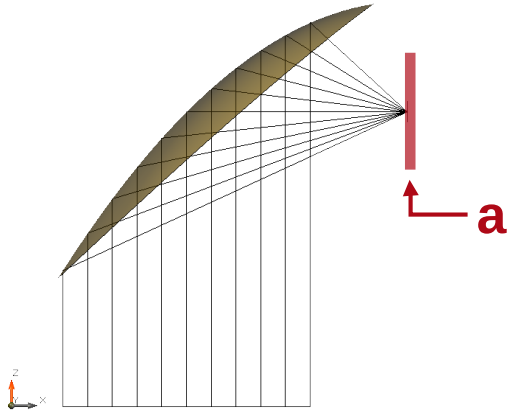
Parameter	Description / Value & Unit
type/number	Plane wave
wavelength	532 nm
polarization	linear in x-direction 0° / 45°
aperutre at next surface	7 x 7 mm

Specification: Off-axis Parabolic Mirror



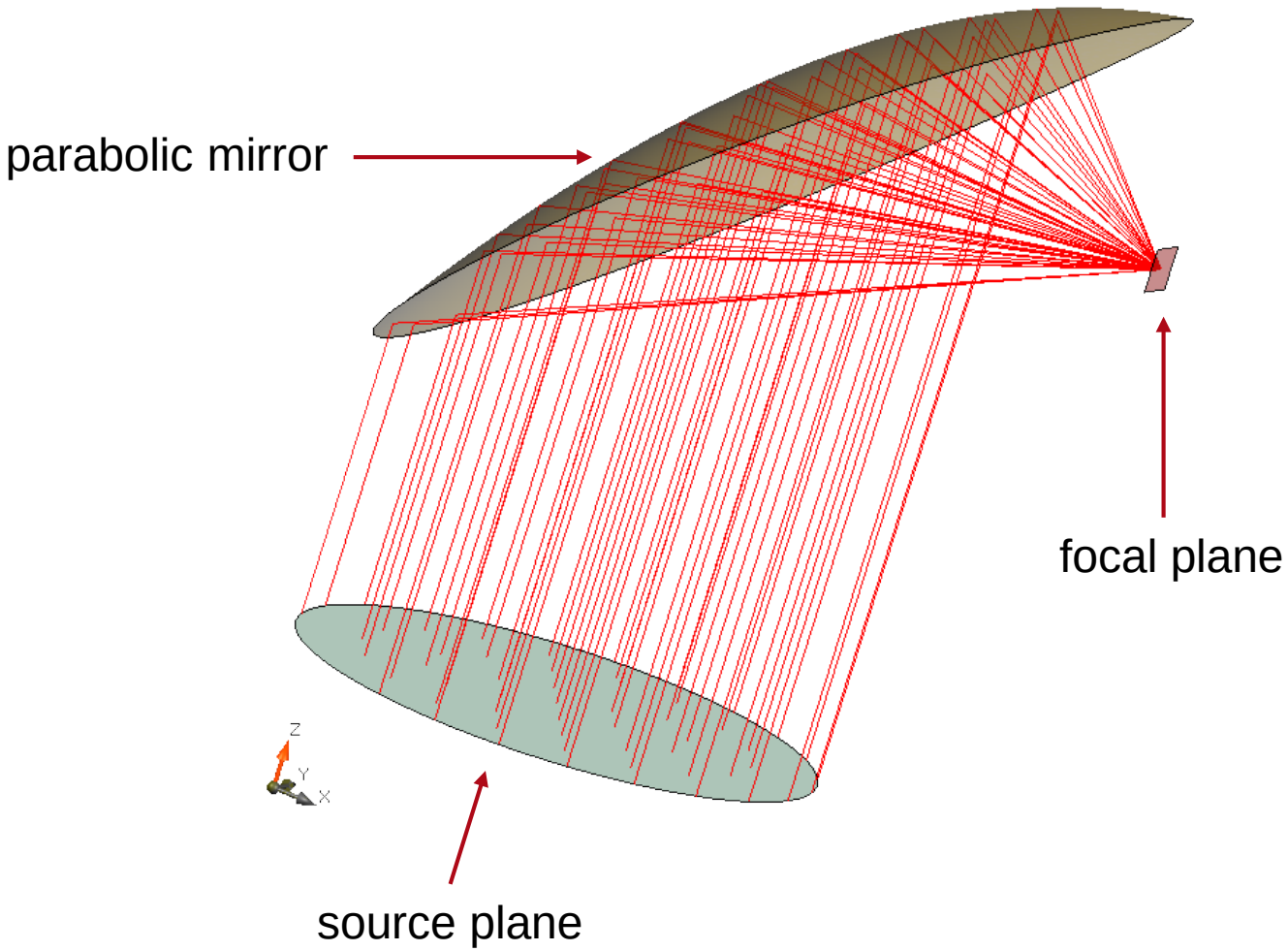
Parameter	Description / Value & Unit
type	off-axis parabolic mirror (wedge type)
off-axis angle	90°
numerical aperture (NA)	~0.47
focal length	7.5mm
material	ideal mirror

Specification: Detectors



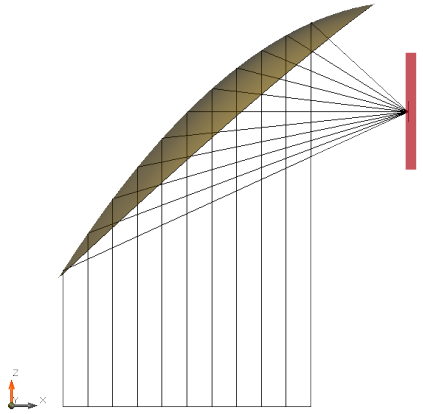
Position	Modeling Technique	Detector/Analyzer
full system	3D ray tracing	3D ray tracing system visualization
a	field tracing	2D PSF calculation in focus (false color view)

Result: 3D Ray Tracing

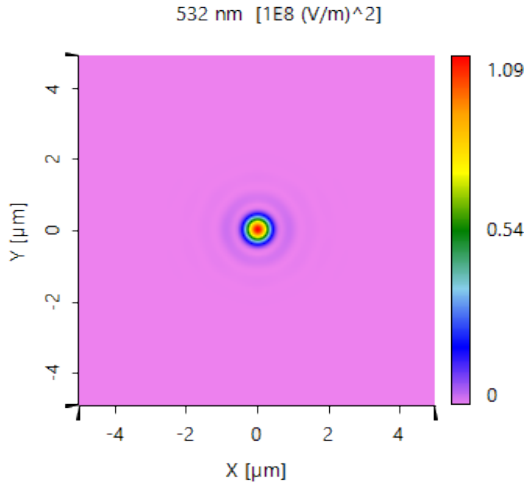


Result: Evaluation of Full Vectorial Light Field

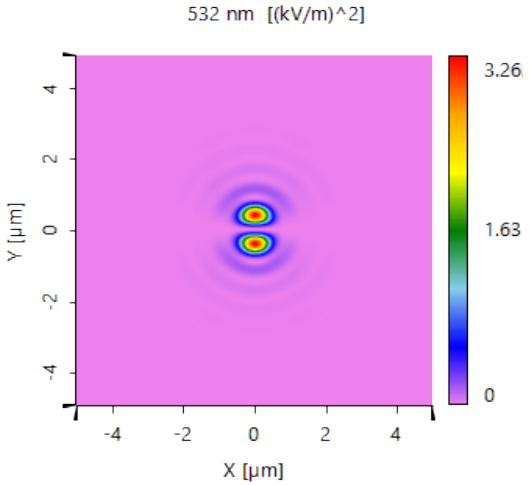
Due to focusing with high numerical aperture initially negligible field components exhibit significant contributions.



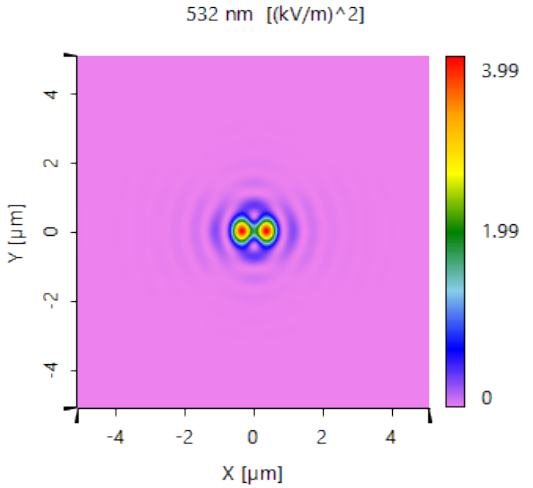
simulation time: ~5s



$E_x \stackrel{\text{def}}{\cong} 100\%$



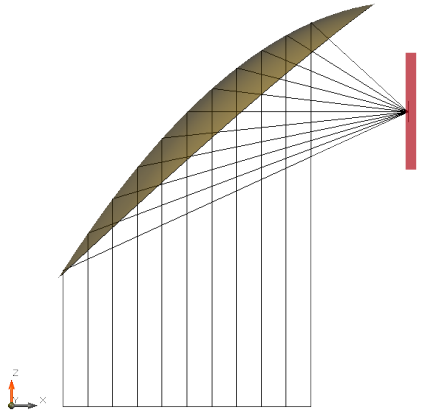
$E_y \cong 3\%$



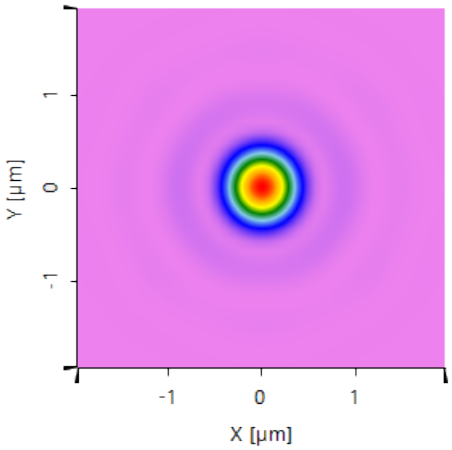
$E_z \cong 4\%$

Result: PSF calculation

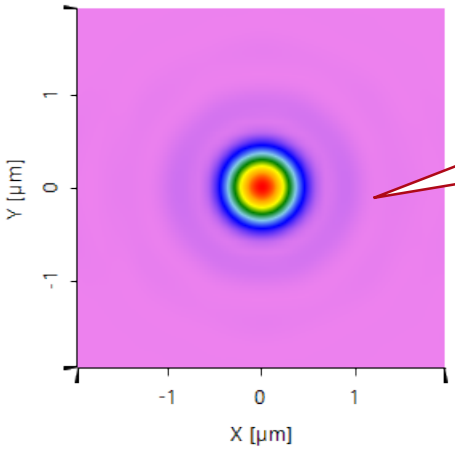
polarization: x-direction (0°)



intensity calculated with $|E_x|^2+|E_y|^2$



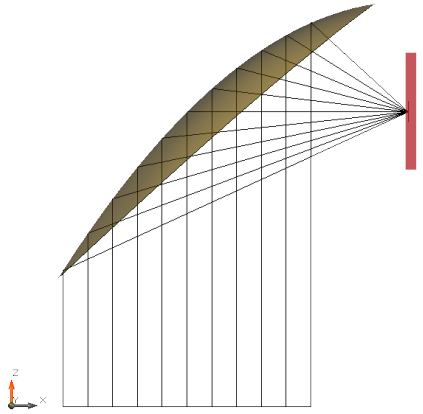
intensity calculated with $|E_x|^2+|E_y|^2+|E_z|^2$



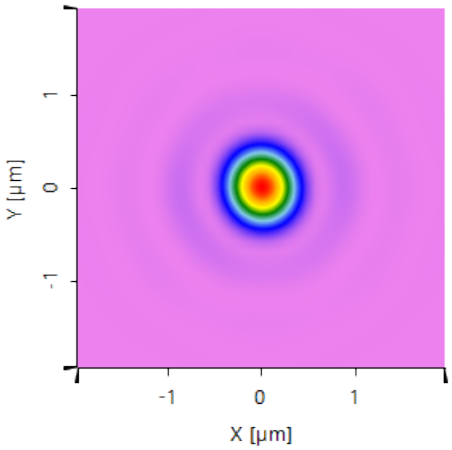
slightly asymmetric due to strong E_z component

Result: PSF calculation

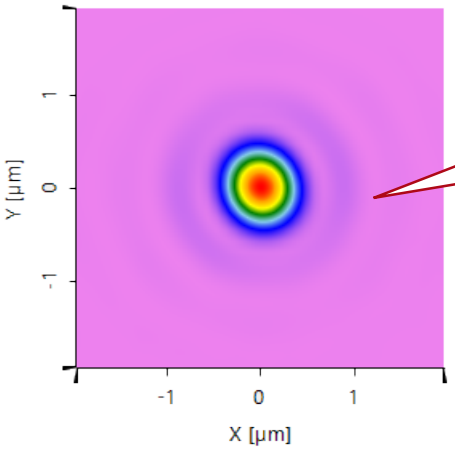
polarization: x-direction (45°)



intensity calculated with $|E_x|^2+|E_y|^2$



intensity calculated with $|E_x|^2+|E_y|^2+|E_z|^2$



PSF calculation includes polarization effects

Document & Technical Info

code	APM.0003
version of document	1.0
title	High-NA Focusing by Off-Axis Parabolic Mirror
category	Imaging Systems > Advanced PSF & MTF
created by	Roberto Knoth (LightTrans)
VL version used for simulations	7.0.0.28

Technical specifications of equipment where simulations were run	
Processor	i7-49010MQ (4 CPU cores)
RAM	32 GB
Operating System	Windows 10