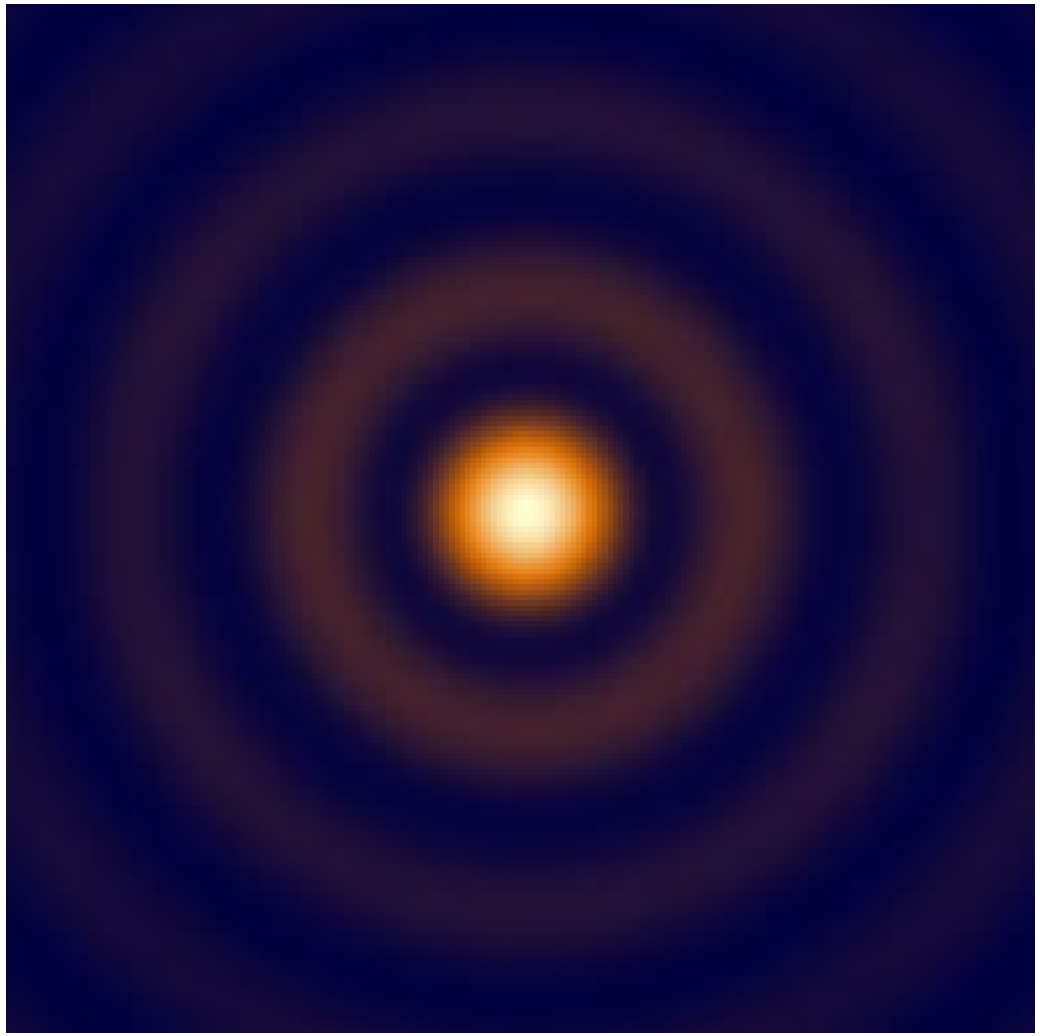
Tight Focusing of Variously Polarized Beams by an Ideal Lens

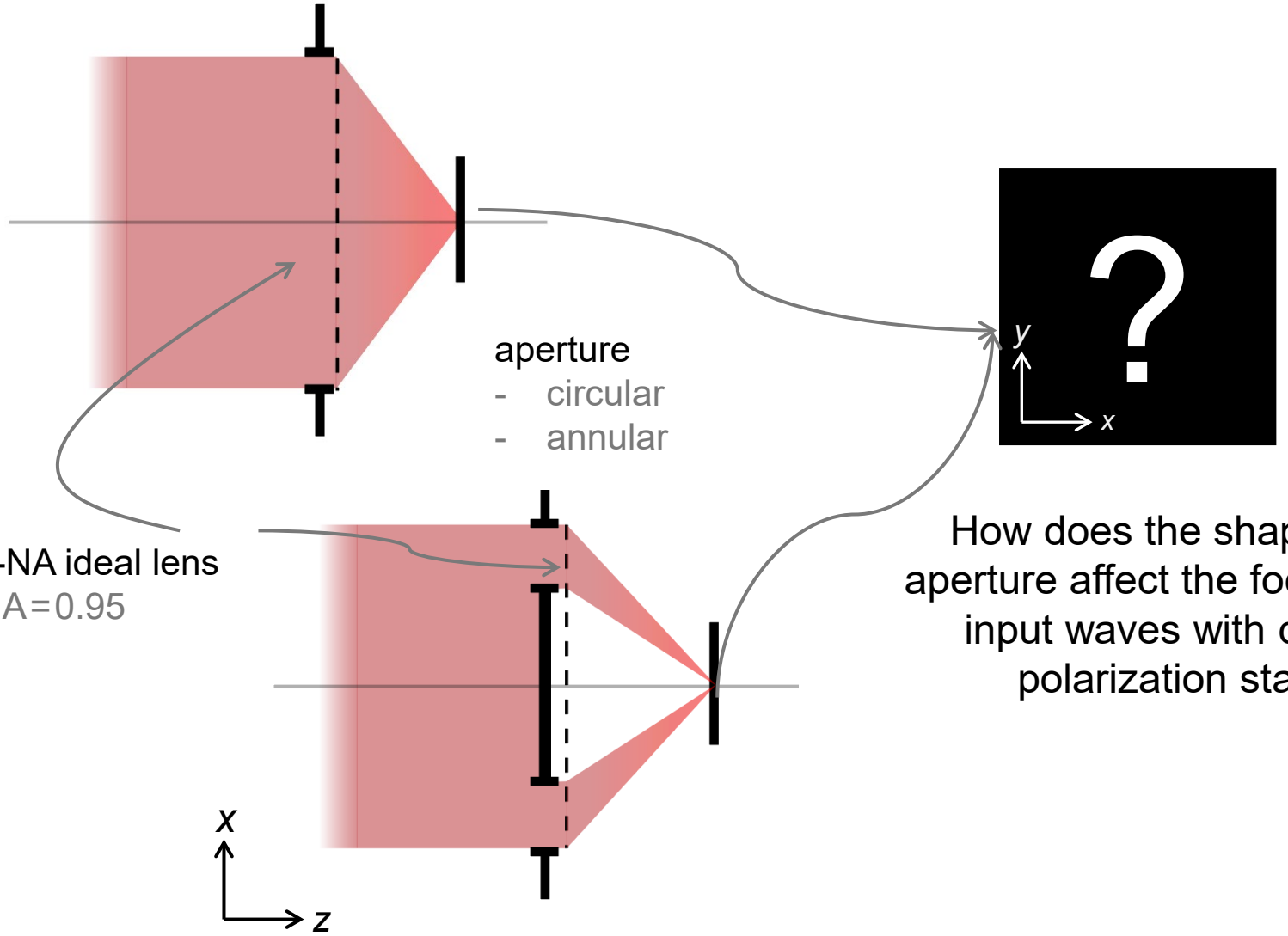
Abstract



Knowing the vectorial electric field distribution near the focus of a high-NA objective lens is of great importance for applications like microscopy, optical tweezers, laser machining, etc. The high-NA objective lens is often approximated as an ideal lens. We demonstrate the focusing of beams with various states of polarization, i.e. linearly, circularly and radially polarized beams, by an ideal lens in VirtualLab Fusion. We investigate the focal field with respect to different aperture shapes, like circular and annular.

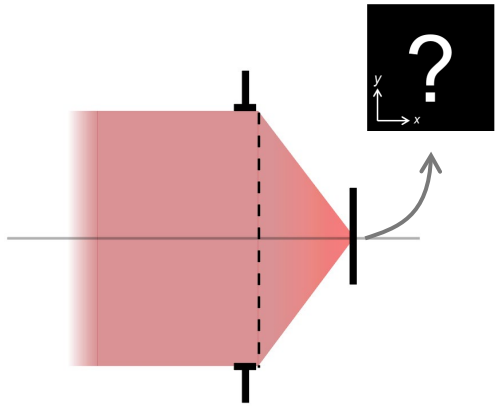
Scenario

input wave
- wavelength: 632.8 nm
- polarization: linearly polarized in *y* direction; right-hand circularly polarized; radially polarized;



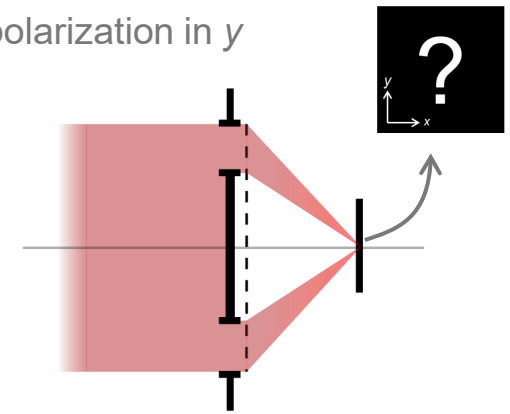
How does the shape of the aperture affect the focal spot for input waves with different polarization states?

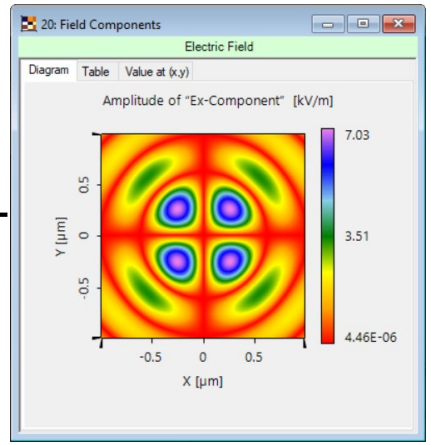
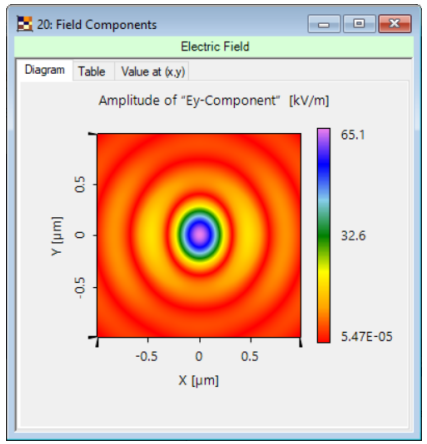
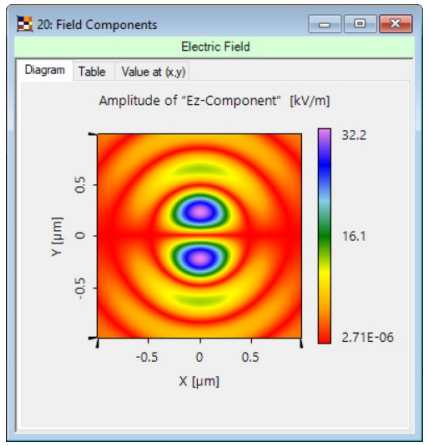
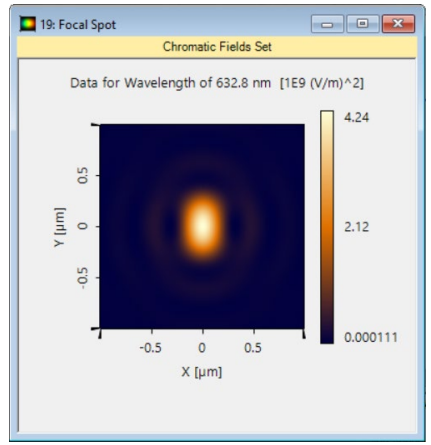
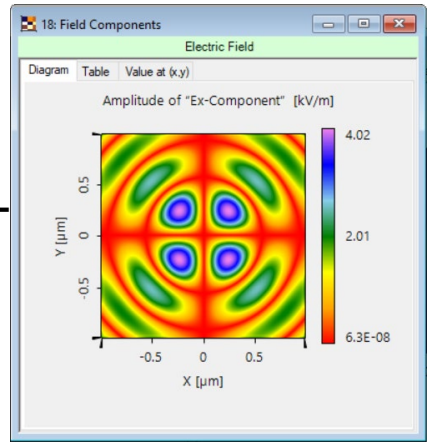
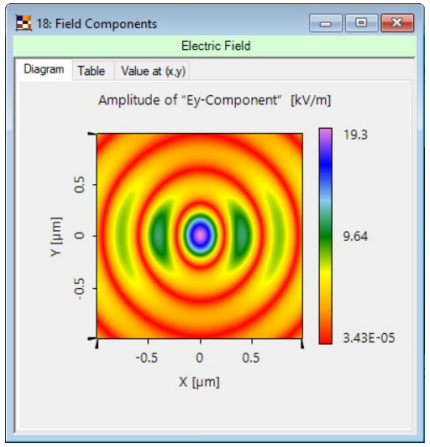
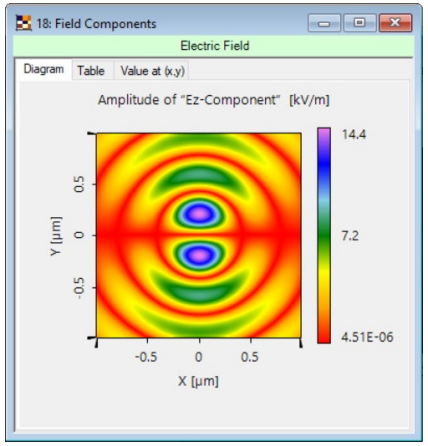
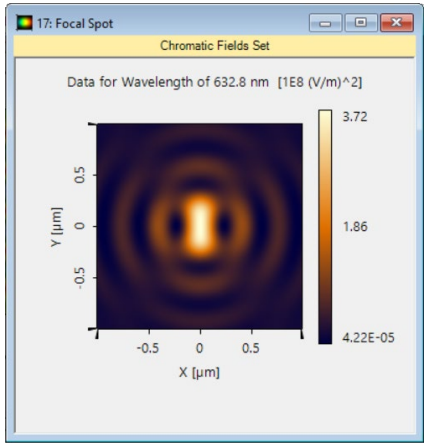
Influence on Focal Spot of Aperture Shape: Linearly Polarized



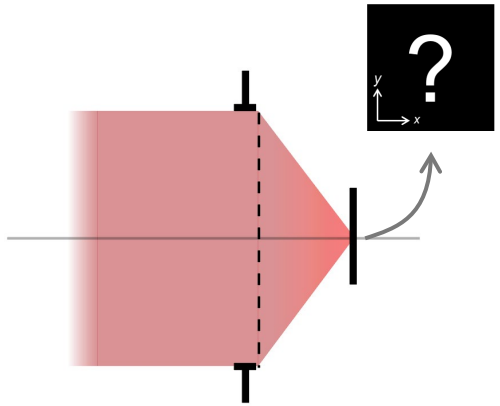
input wave

- Gaussian wave
- wavelength: 632.8nm
- fixed linear polarization in *y*

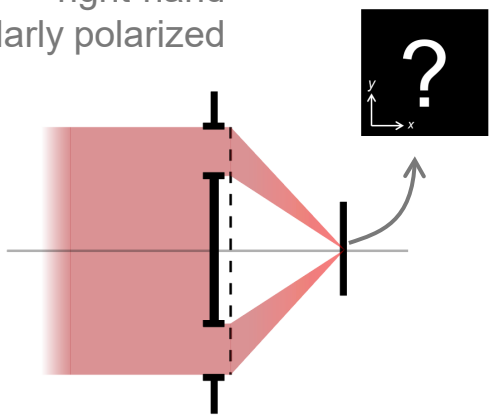


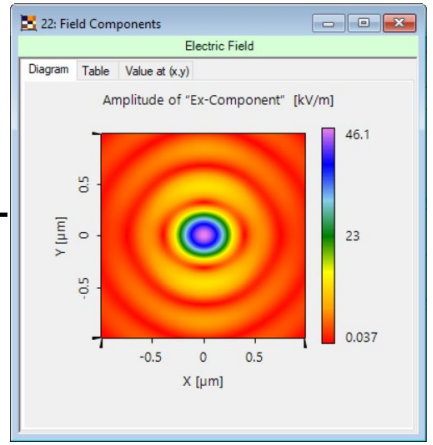
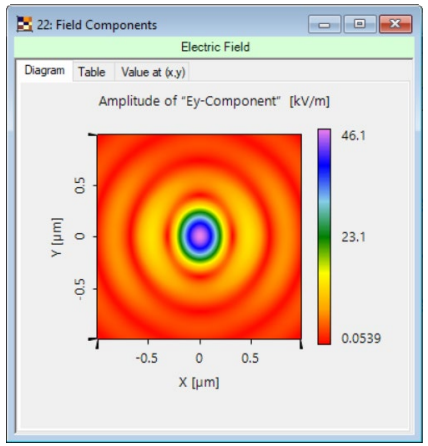
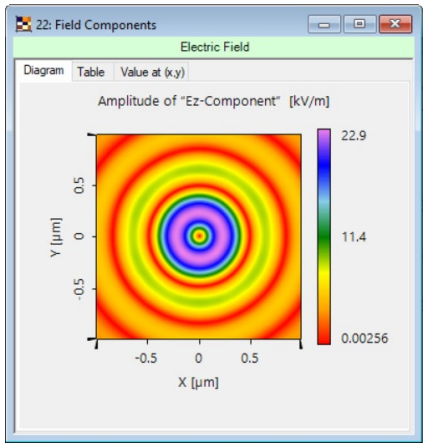
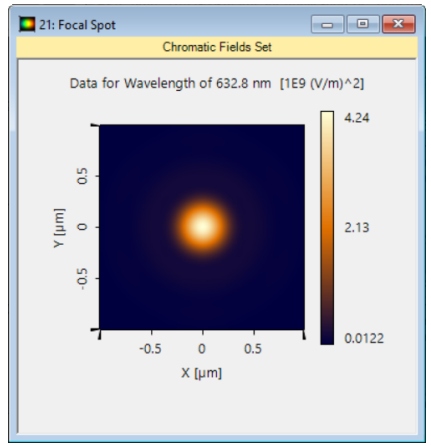
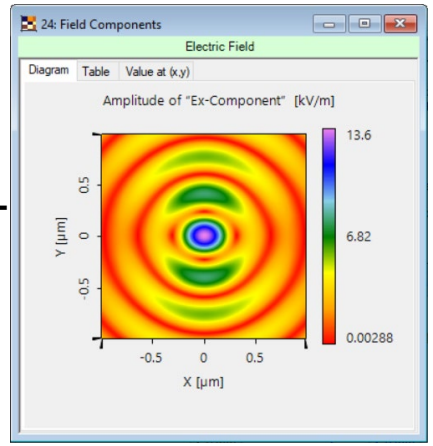
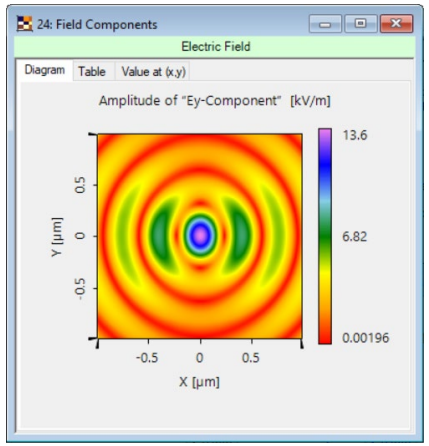
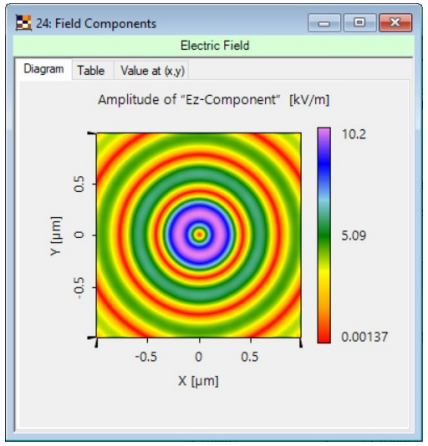
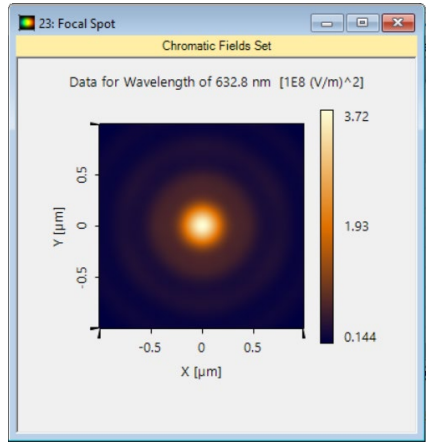
	$\lvert E_x \rvert$	$\lvert E_y \rvert$	$\lvert E_z \rvert$	$E_x^2 + E_y^2 + E_z^2$
circular apterture				
annular aperture				

Influence on Focal Spot of Aperture Shape: Circularly Polarized

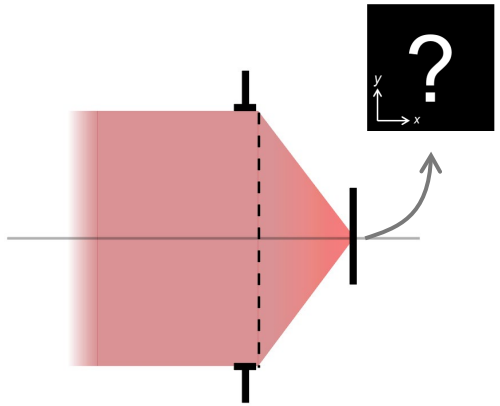


input wave
- Gaussian wave
- wavelength: 632.8nm
- right-hand circularly polarized



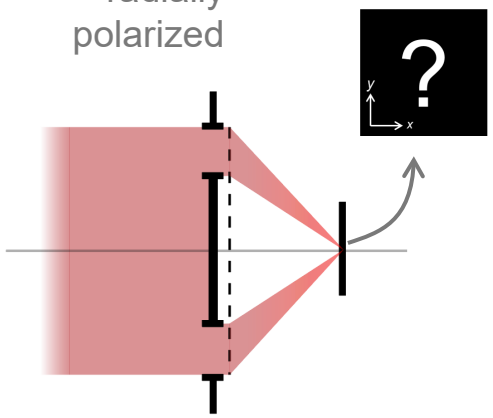
	$\lvert E_x \rvert$	$\lvert E_y \rvert$	$\lvert E_z \rvert$	$E_x^2 + E_y^2 + E_z^2$
circular apterture				
annular aperture				

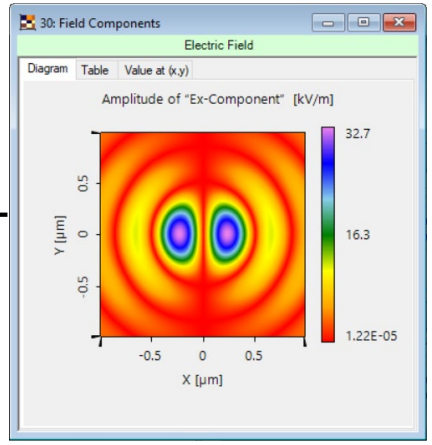
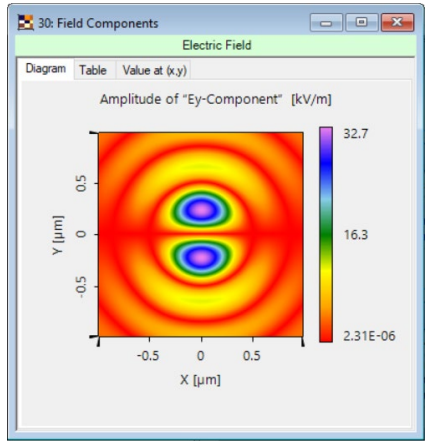
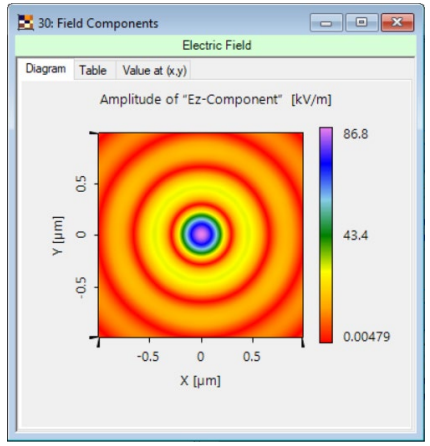
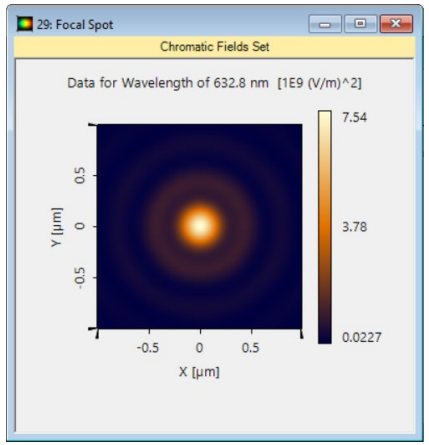
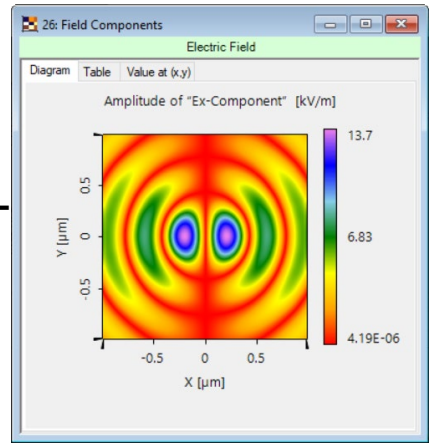
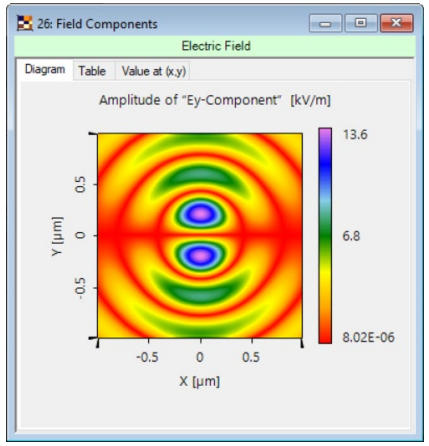
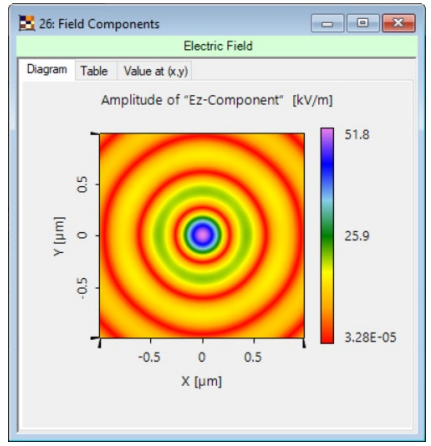
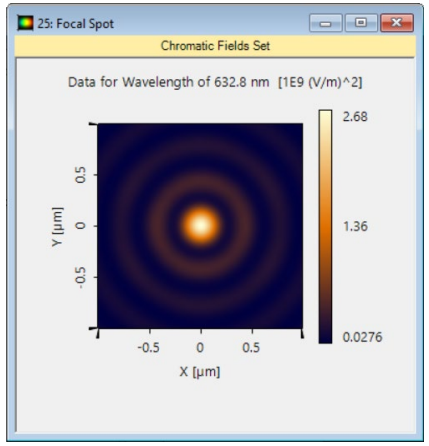
Influence on Focal Spot of Aperture Shape: Radially Polarized



input wave

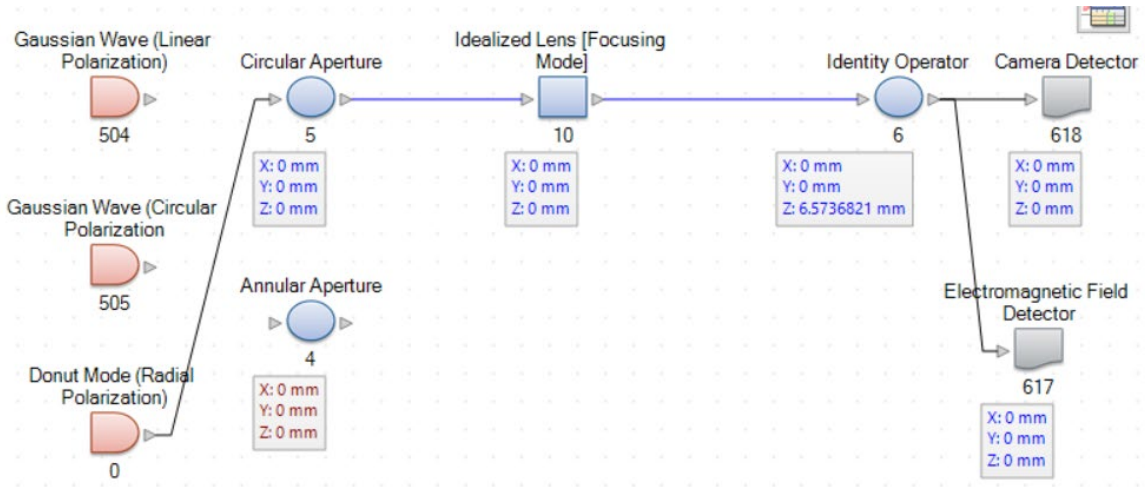
- Donut wave
- wavelength: 632.8nm
- radially polarized

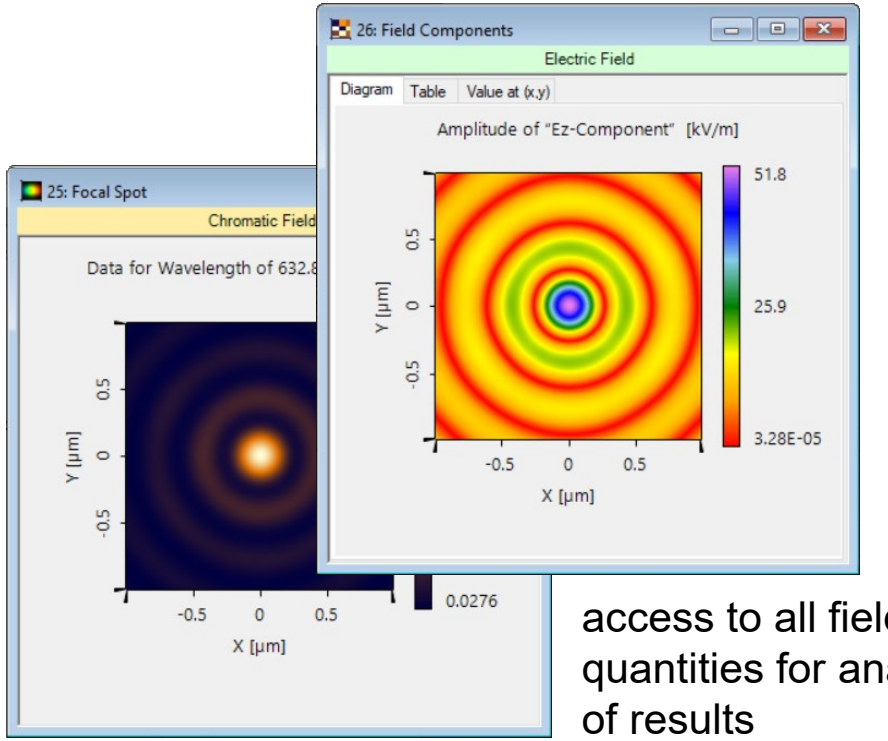


	$\lvert E_x \rvert$	$\lvert E_y \rvert$	$\lvert E_z \rvert$	$E_x^2 + E_y^2 + E_z^2$
circular apterture				
annular aperture				

Peek into VirtualLab Fusion

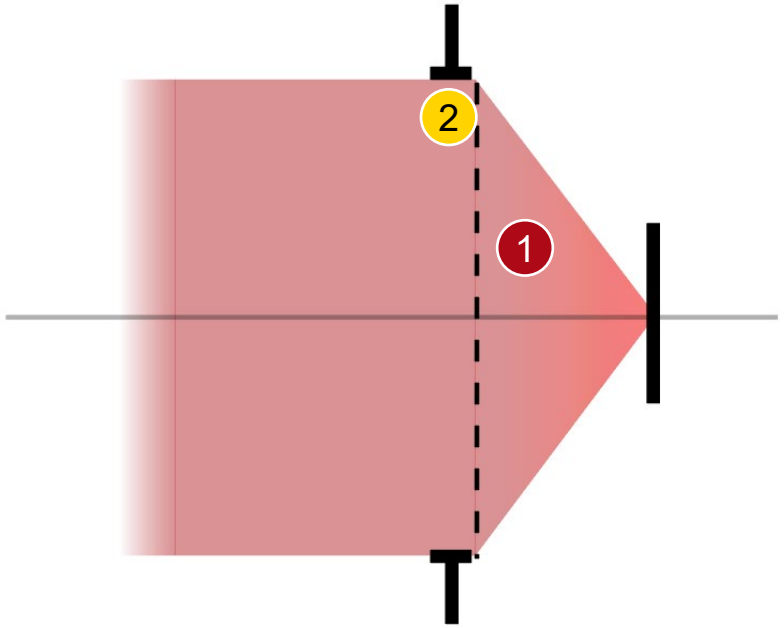
definition of variously polarized beams and different aperture shapes with ease

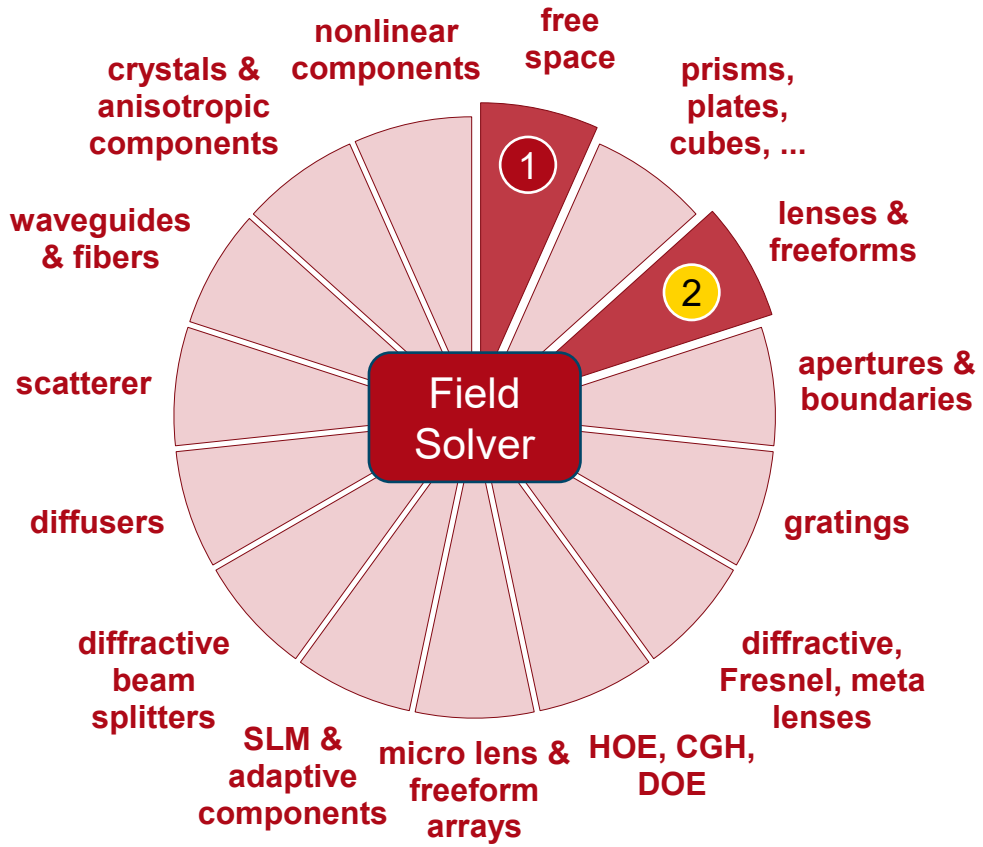




access to all field quantities for analysis of results

VirtualLab Fusion Technologies





Document Information

title	Tight Focusing of Arbitrary Beams by an Ideal Lens
document code	MIC.0005
version	1.1
toolbox(es)	VirtualLab Fusion Basic
VL version used for simulations	2020.2 (Build 2.18)
category	Application Use Case
further reading	- Analyzing High-NA Objective Lens Focusing