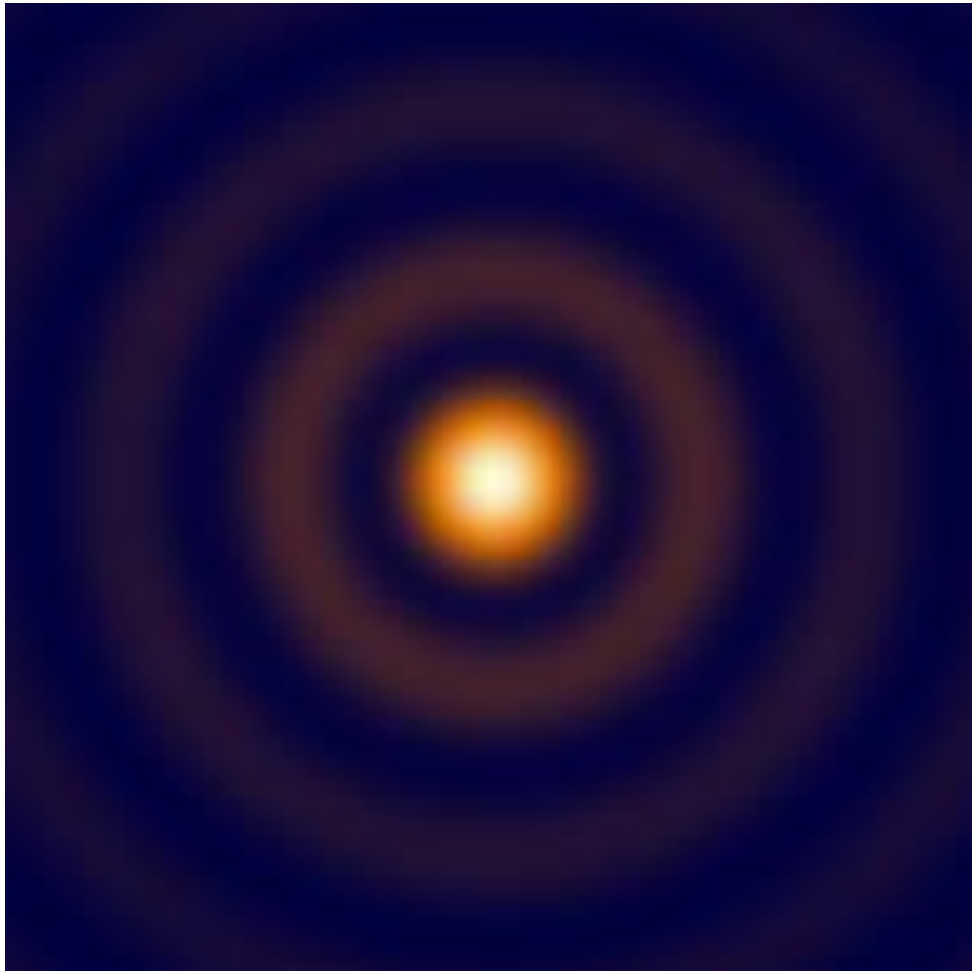
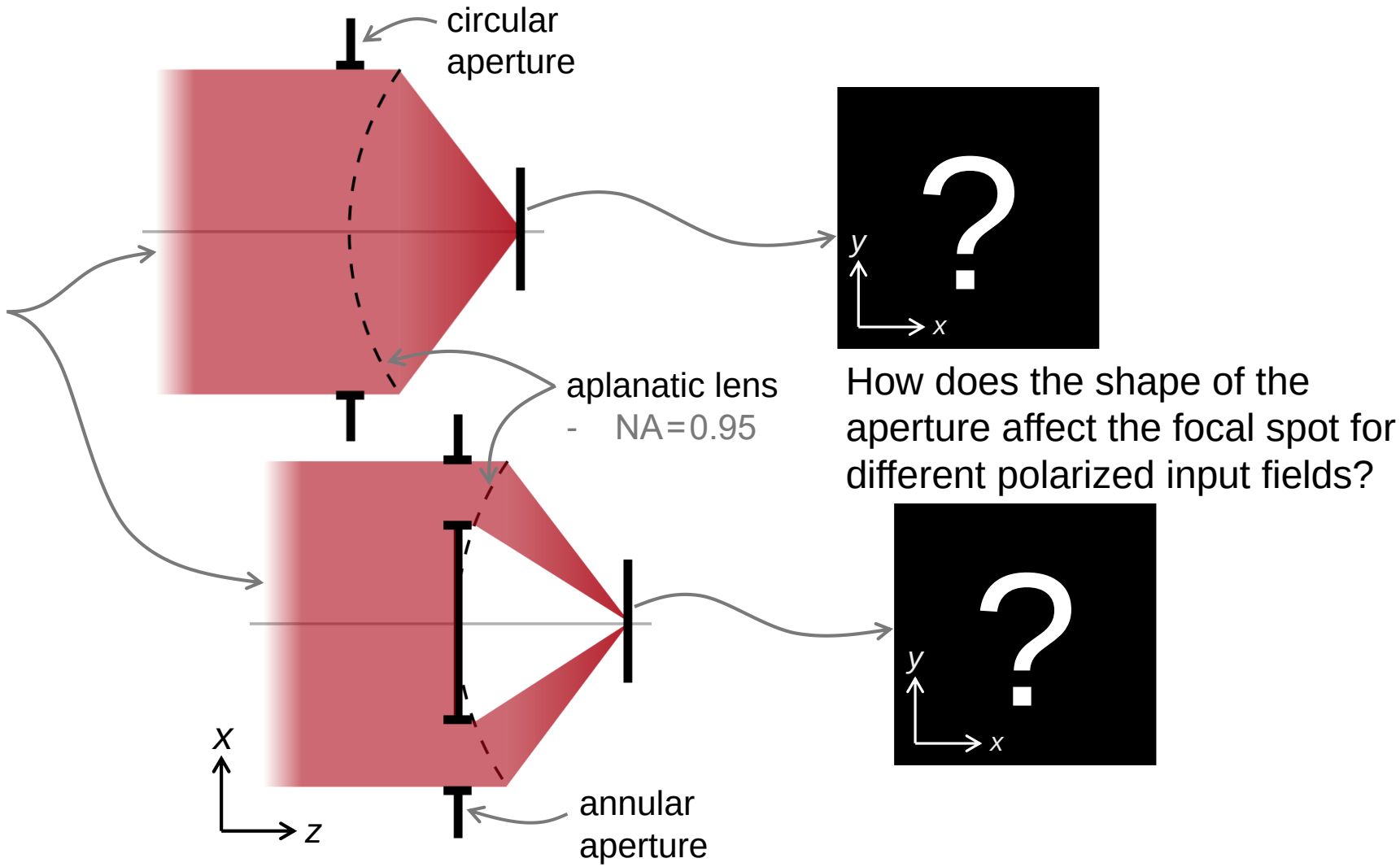
Tight Focusing of Variously Polarized Beams by an Aplanatic Lens

Abstract



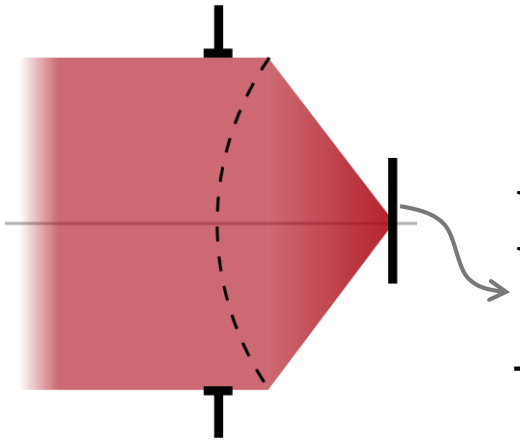
Knowing the vectorial electric field distribution near the focus of a high-NA objective lens is of great importance for applications e.g. microscopy, optical tweezer, laser machining, etc. The high-NA objective lens is often assumed as aplanatic lens. We demonstrate the focusing of variously polarized beams, e.g. linearly, circularly and radially polarized beams, by an aplanatic lens in VirtualLab Fusion. We investigate focal field with respect to different shapes of apertures, e.g. circular and annular.

Modeling Task



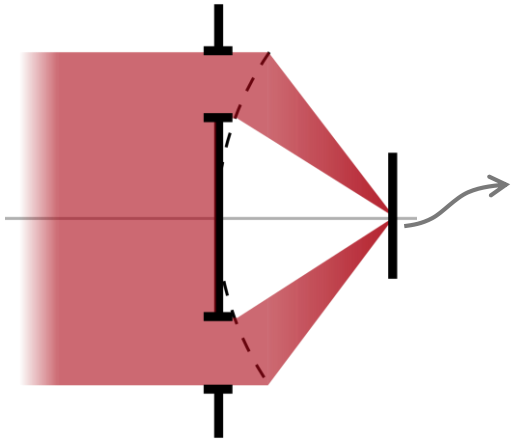
How does the shape of the aperture affect the focal spot for different polarized input fields?

Circular vs. Annular Aperture: Linearly Polarized Input



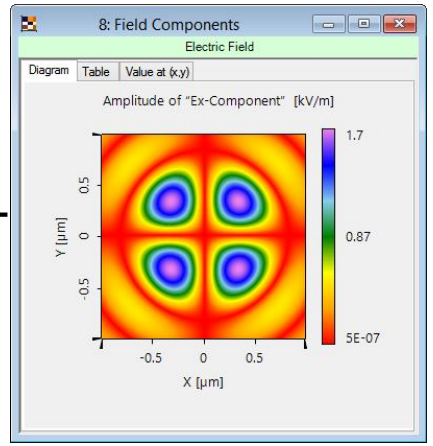
input wave

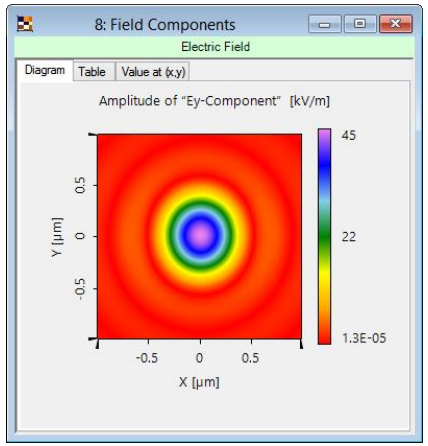
- linear polarization in *y* direction

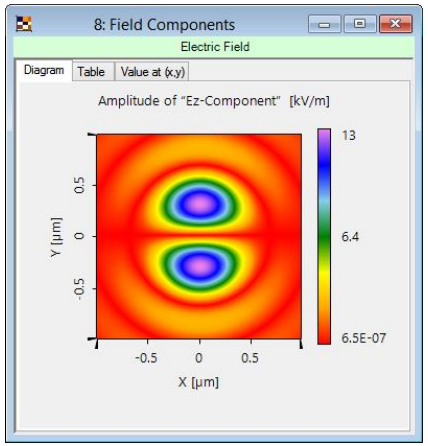


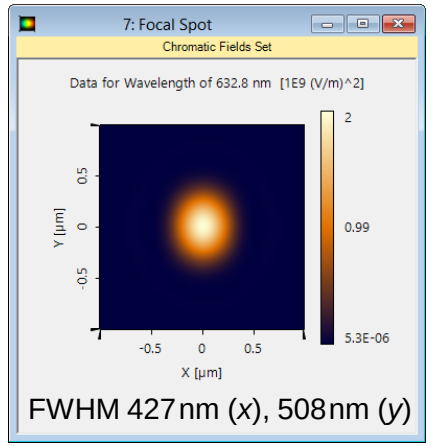
$|E_x|$ $|E_y|$ $|E_z|$ $\|\boldsymbol{E}\|^2$

circular apterture

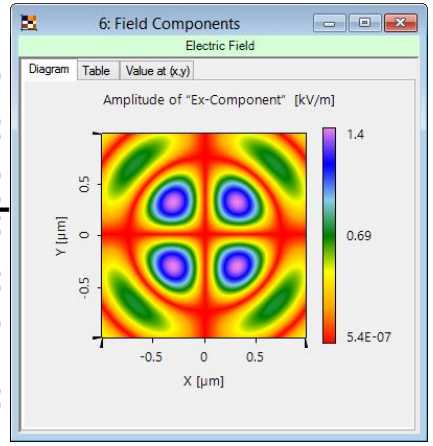


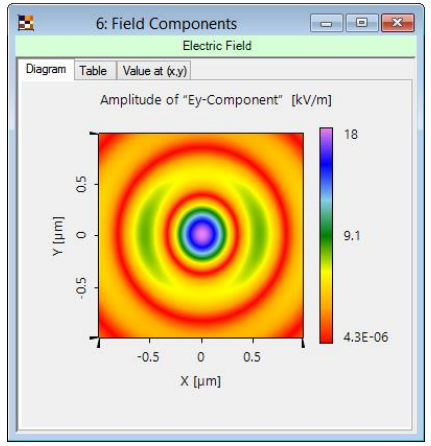


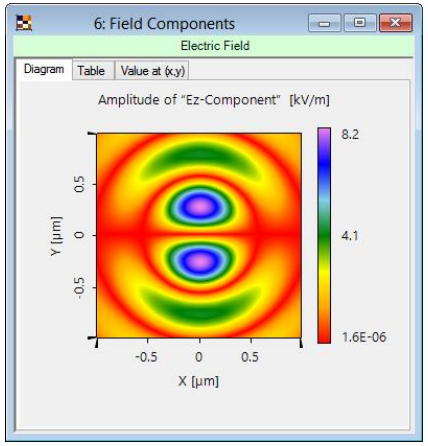


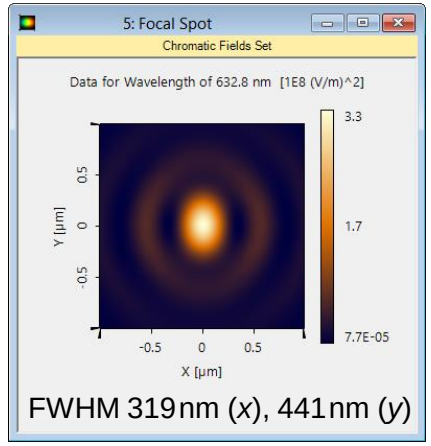


annular aperture

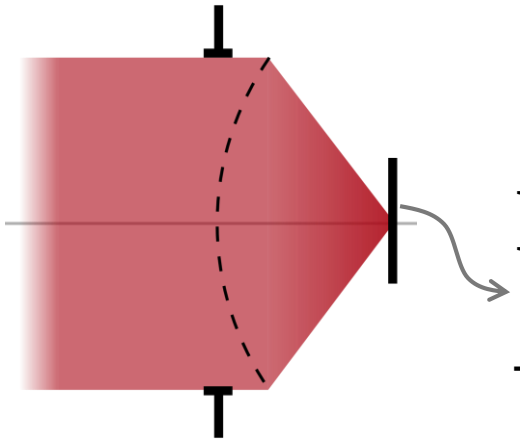






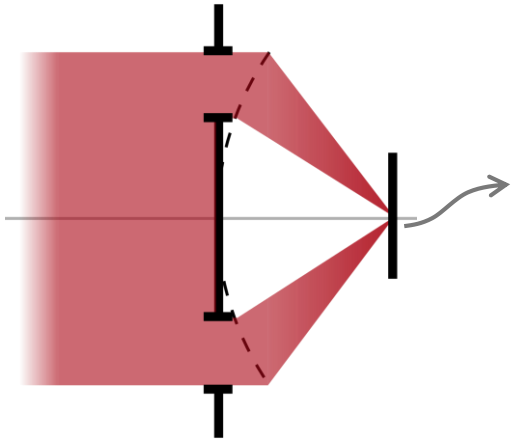


Circular vs. Annular Aperture: Circularly Polarized Input



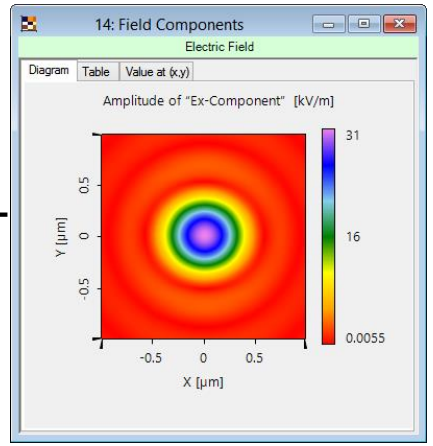
input wave

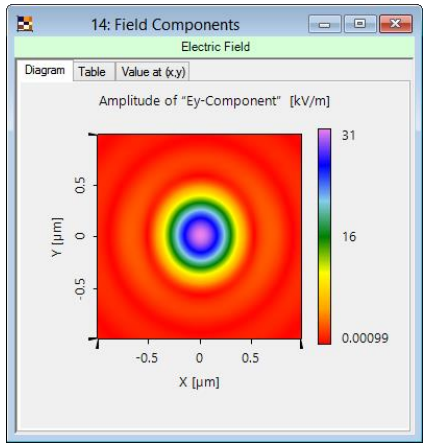
- circular polarization right-hand directly

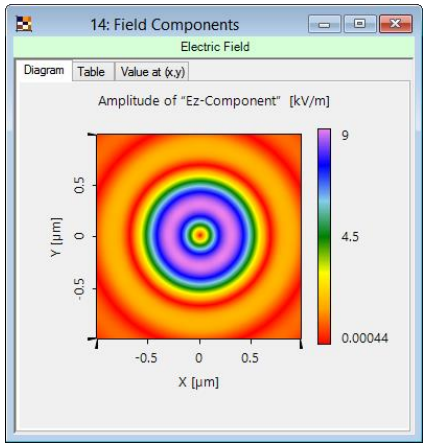


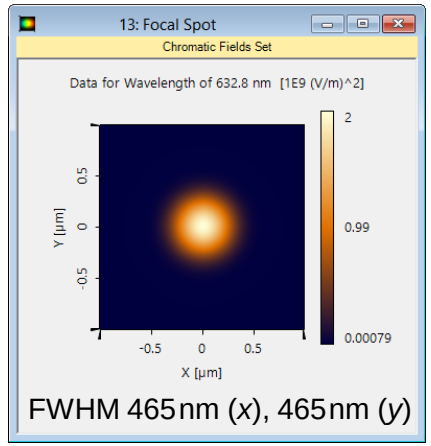
$|E_x|$ $|E_y|$ $|E_z|$ $\|\boldsymbol{E}\|^2$

circular apterture



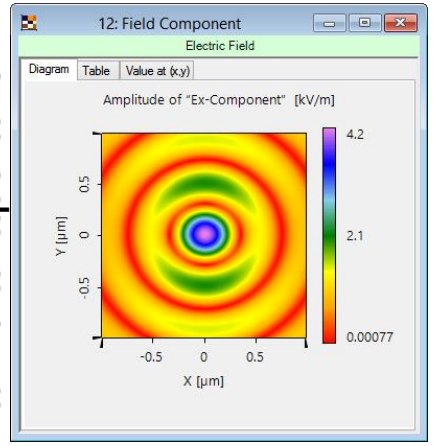


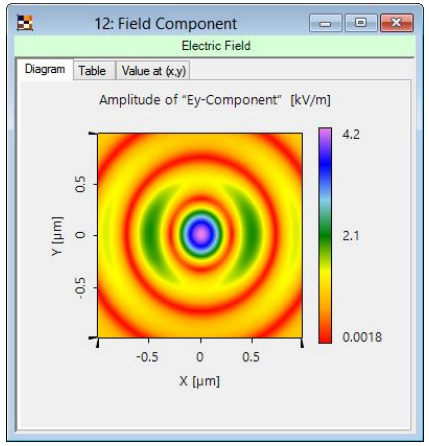


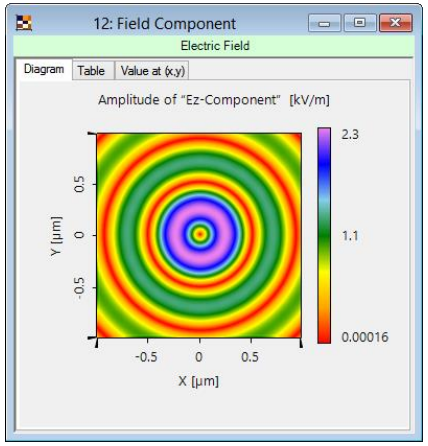


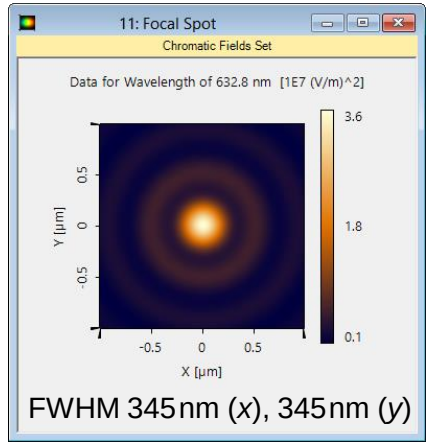
FWHM 465nm (*x*), 465nm (*y*)

annular aperture



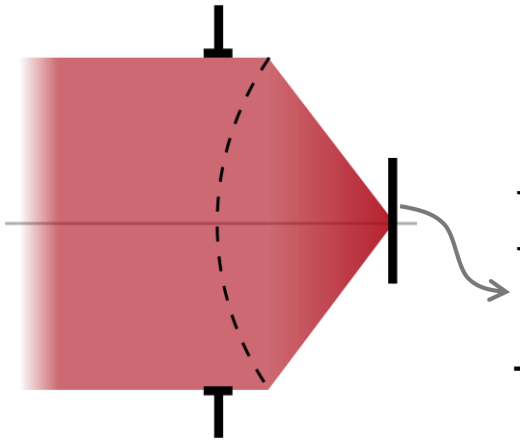






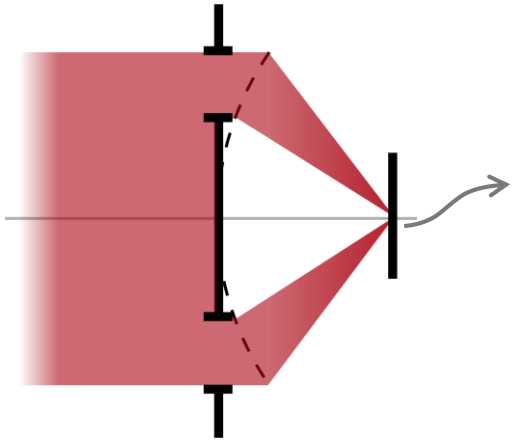
FWHM 345nm (*x*), 345nm (*y*)

Circular vs. Annular Aperture: Radially Polarized Input



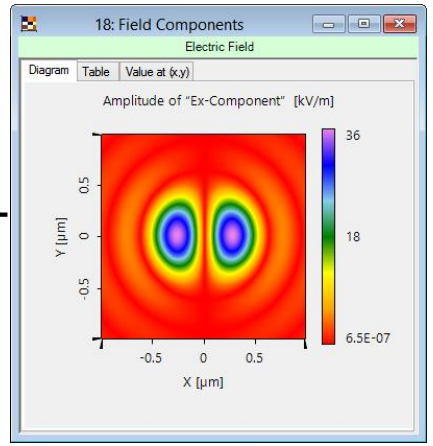
input wave

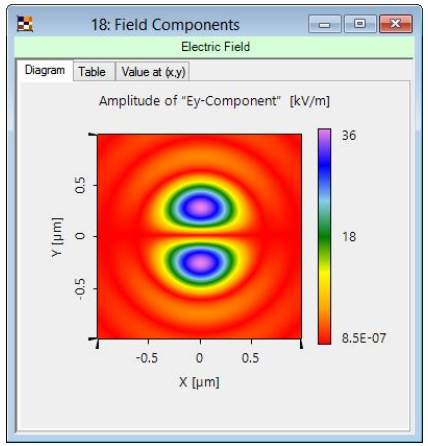
- radial polarization

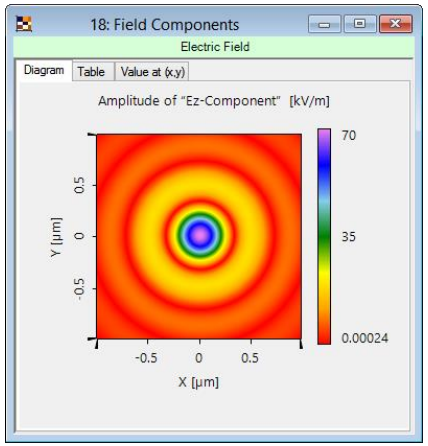


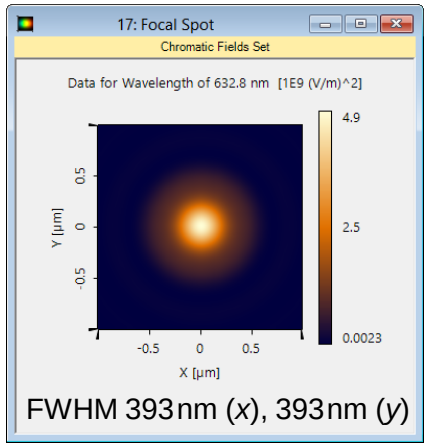
$|E_x|$ $|E_y|$ $|E_z|$ $\|\boldsymbol{E}\|^2$

circular apterture

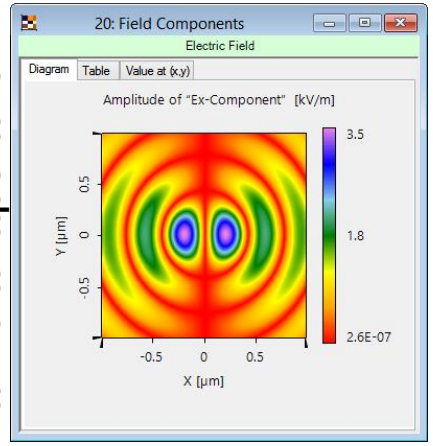


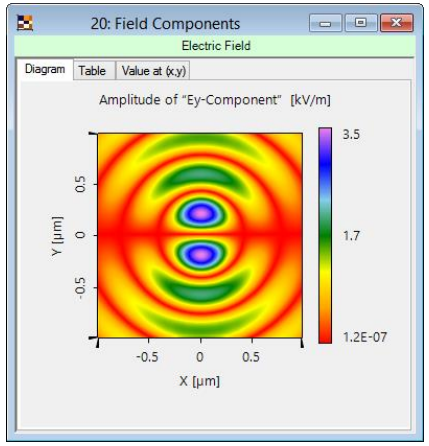


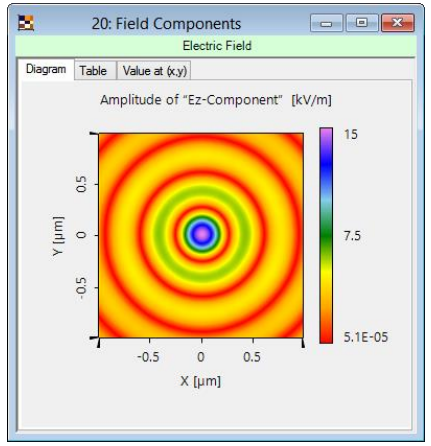


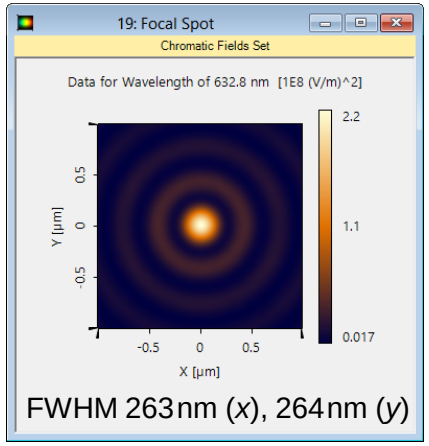


annular aperture



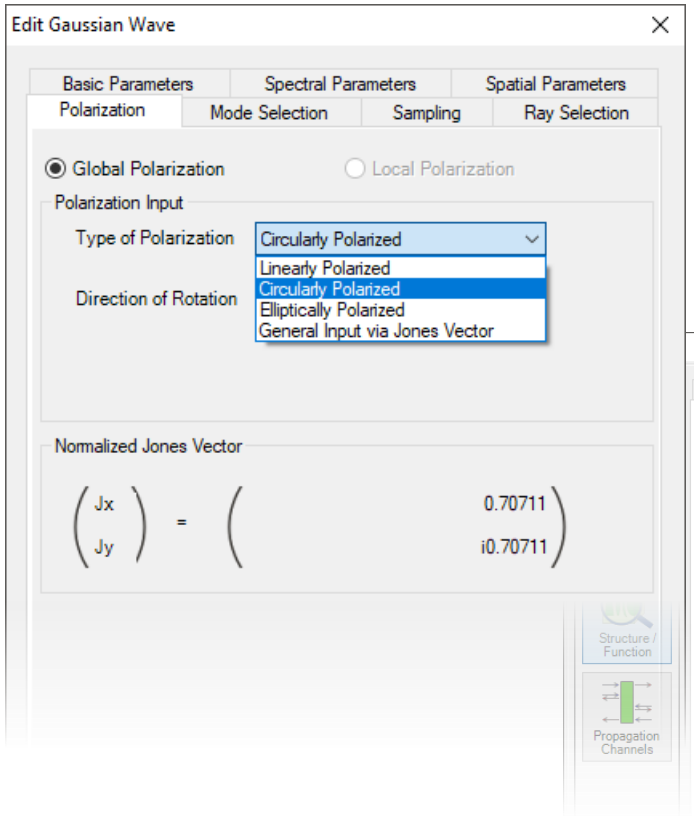




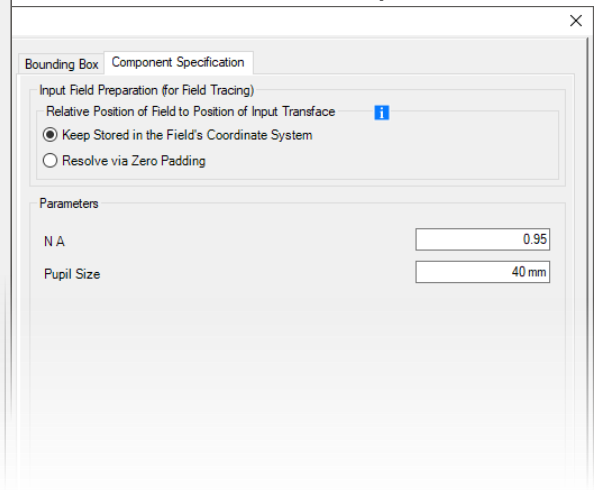


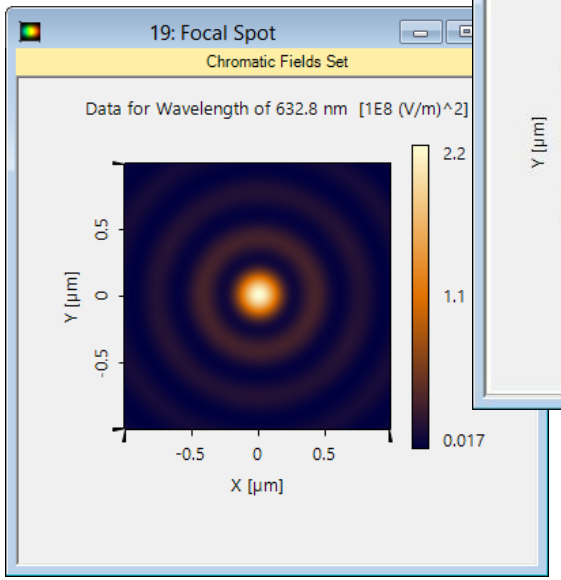
Peek into VirtualLab Fusion

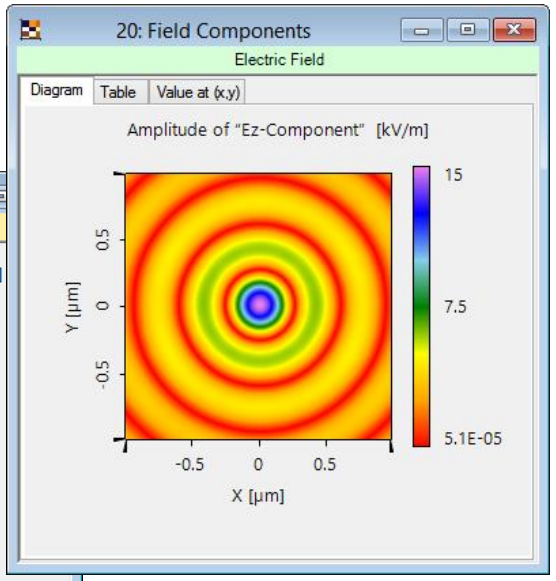
convenient definition of different polarization states



idealized model for aplanatic lens

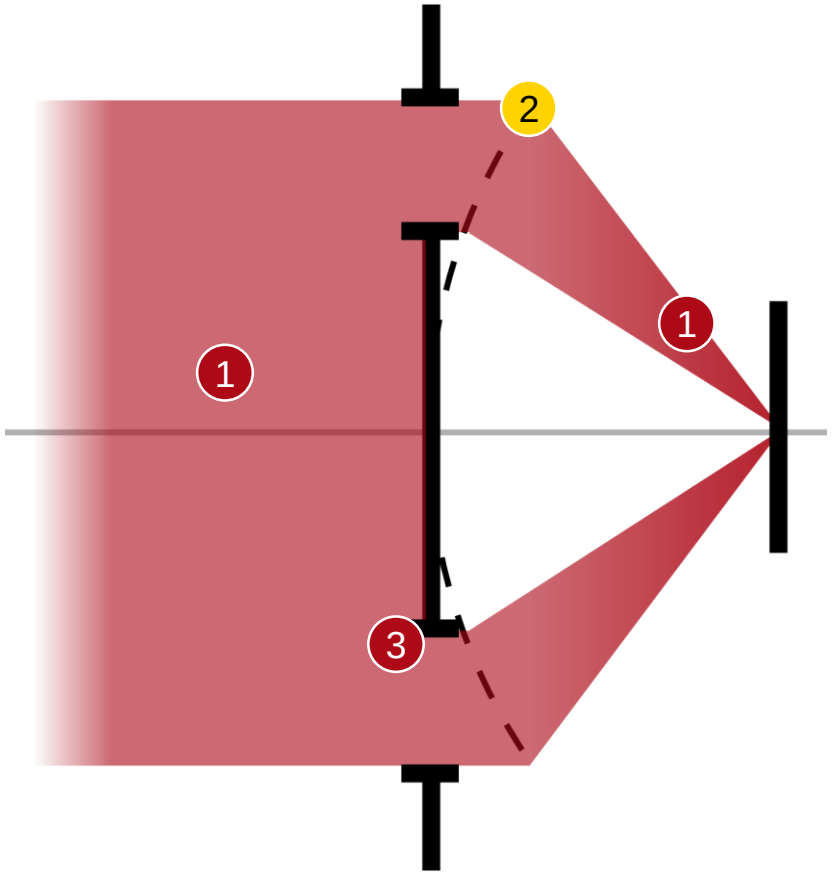


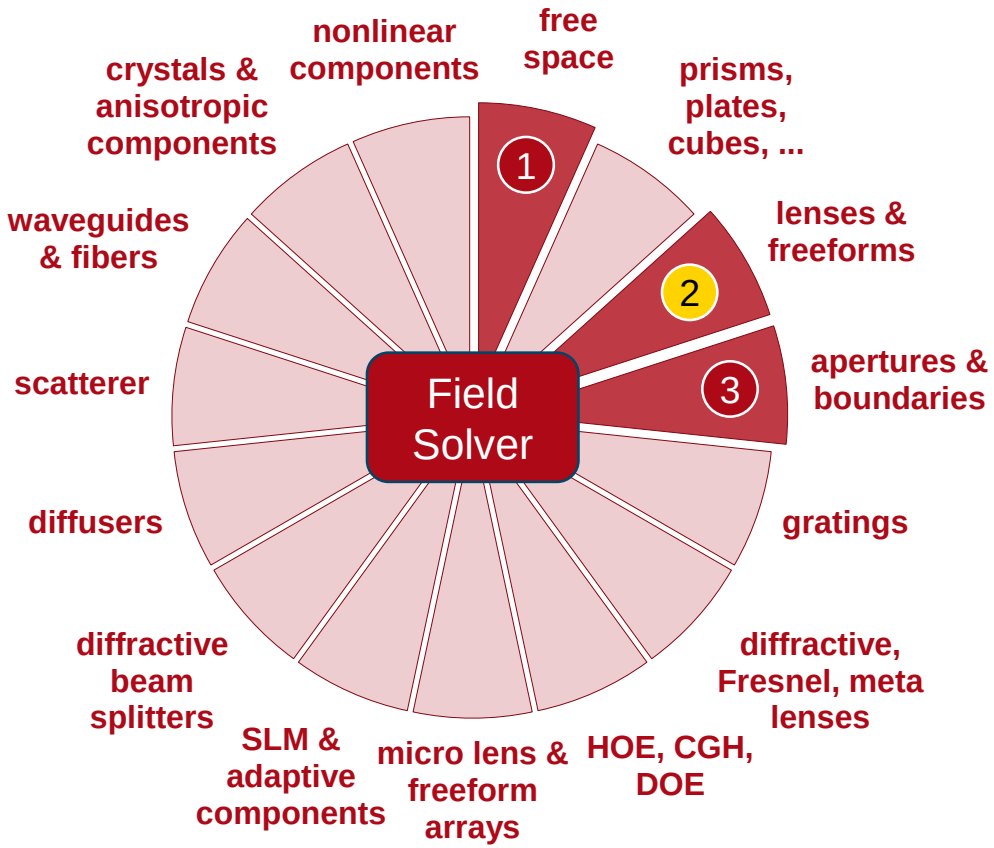




access to all vectorial field quantities for result analysis

VirtualLab Fusion Technologies





Document Information

title	Tight Focusing of Variously Polarized Beams by an Aplanatic Lens
document code	MIC.0005
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	VirtualLab Fusion Spring Release 2019
category	Application Use Case
further reading	- Analyzing High-NA Objective Lens Focusing - Investigation of Idealized Vectorial Focusing Situation Using Debye-Wolf Integral