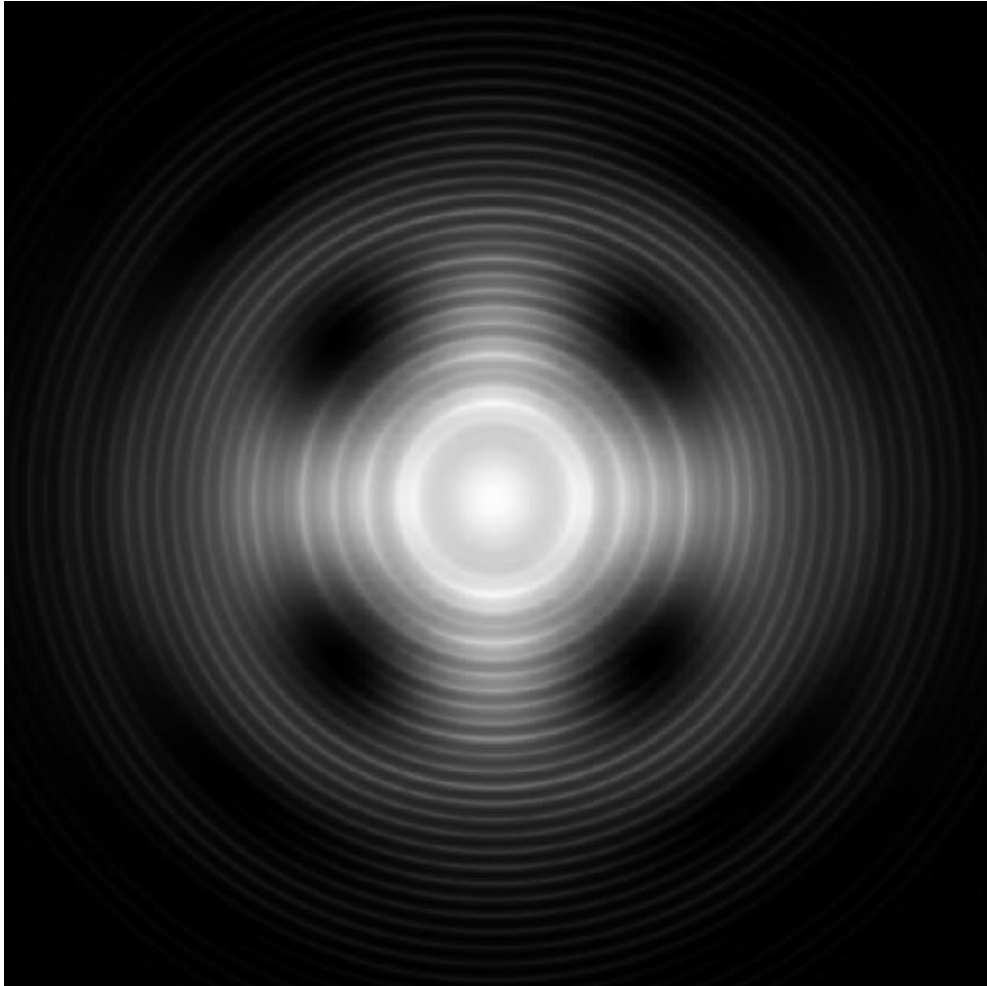


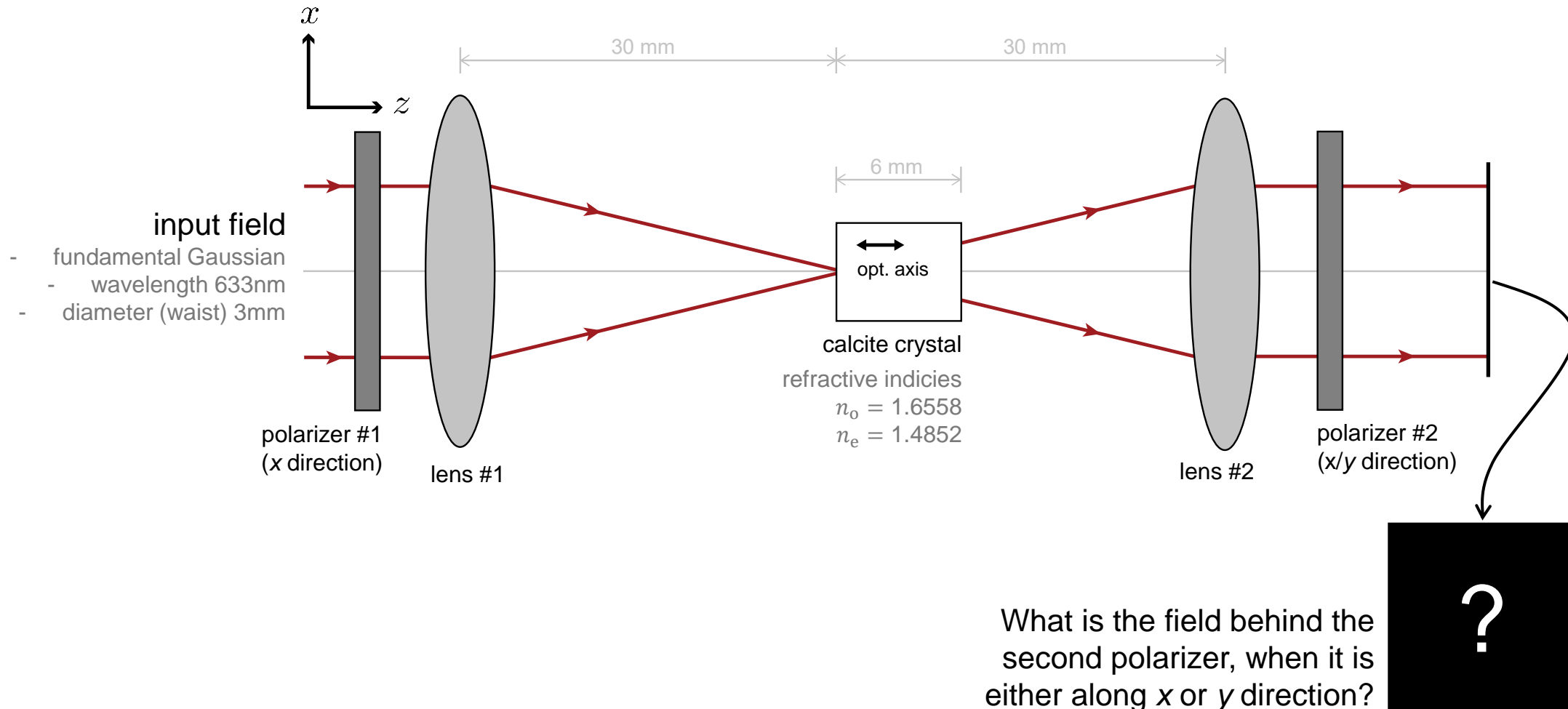
Polarization Conversion in Uniaxial Crystals

Abstract

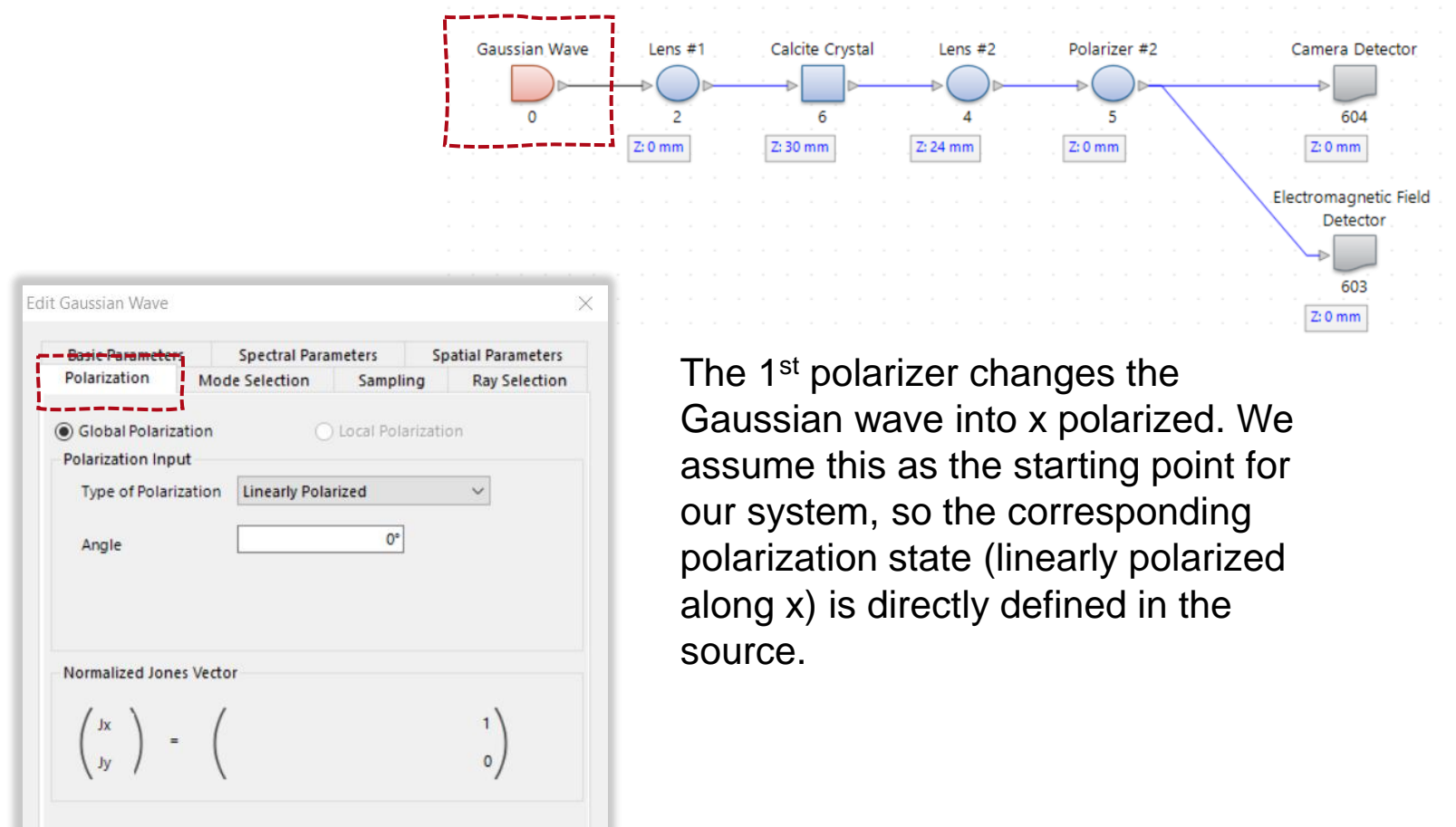
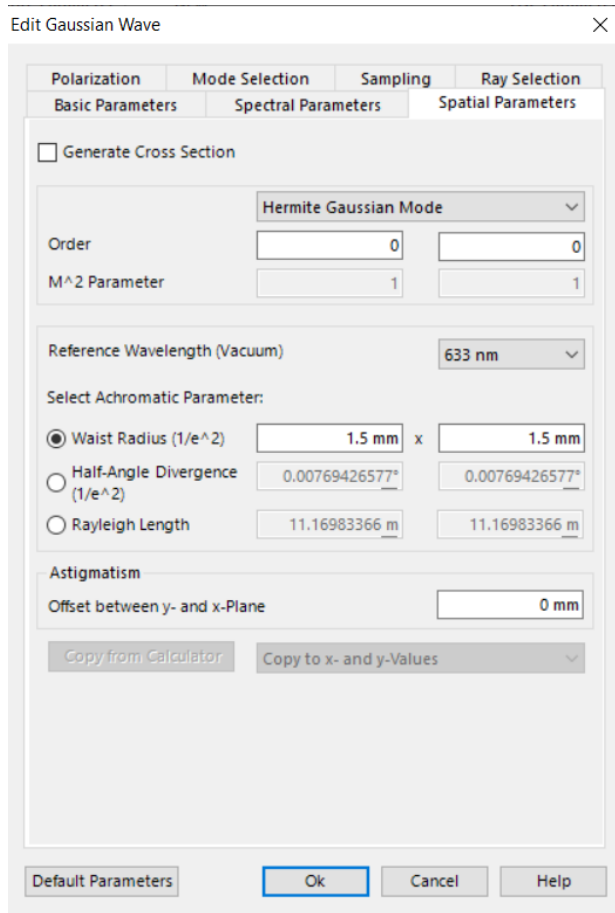


When a linearly polarized beam is focused and then propagated through a uniaxial crystal, even when along the optic axis, complicated conversions may take place between different polarization components. Such an effect can be utilized for e.g. generation of optical vortices. Taking calcite crystal as an example, the conversion of polarization in uniaxial crystals is demonstrated in VirtualLab Fusion. The optical vortices generated within the process are visualized.

Modeling Task

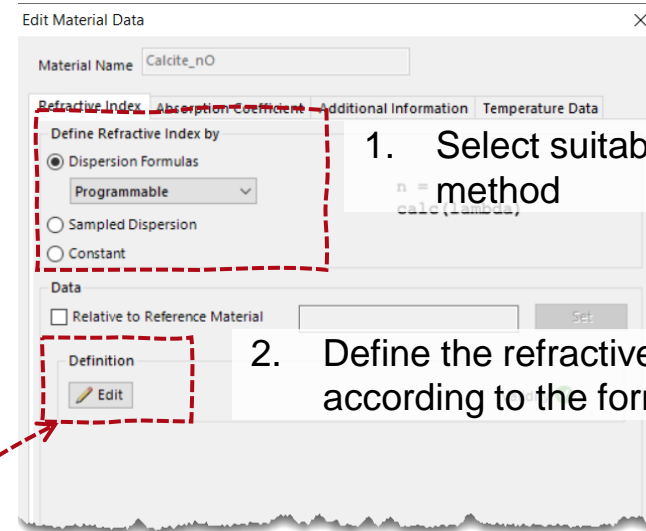
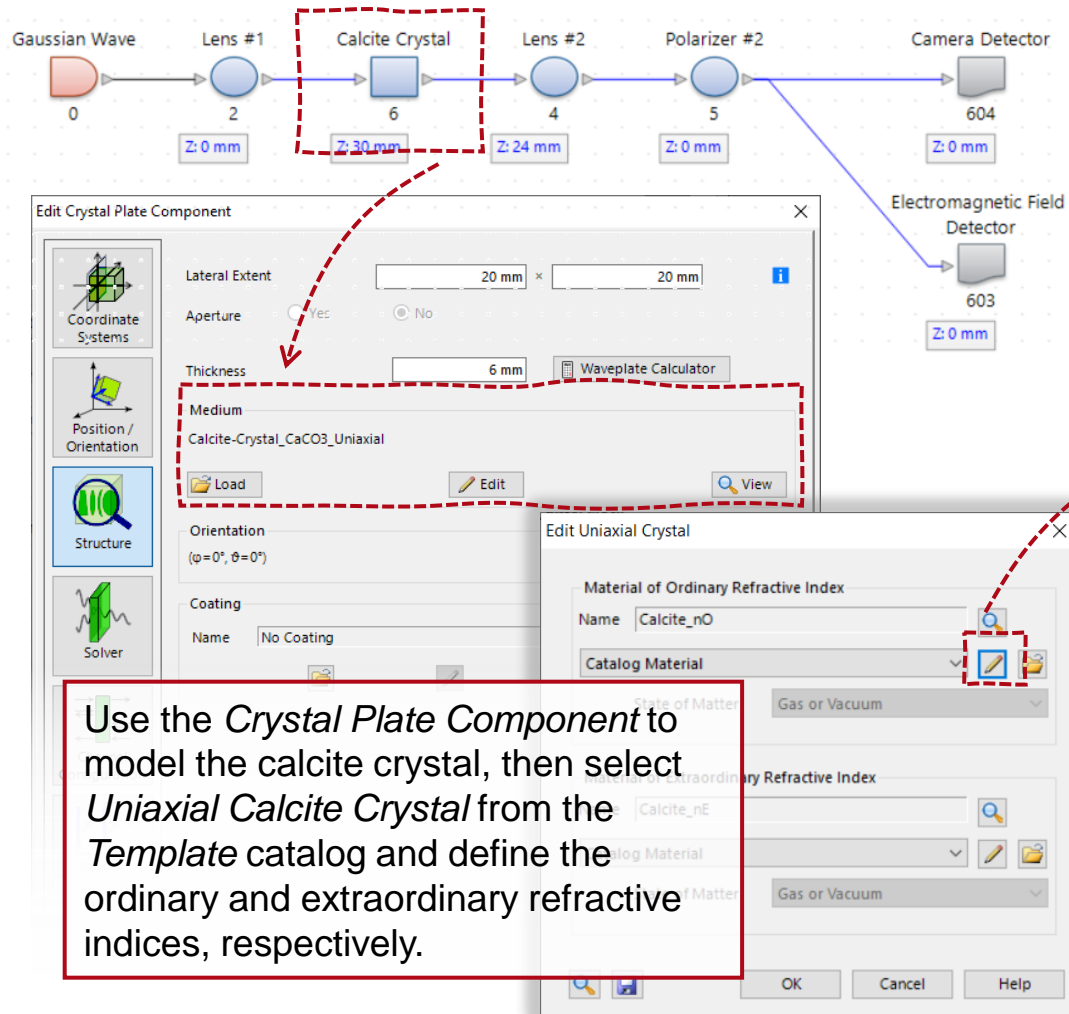


System Building Blocks – Source



The 1st polarizer changes the Gaussian wave into x polarized. We assume this as the starting point for our system, so the corresponding polarization state (linearly polarized along x) is directly defined in the source.

System Building Blocks – Uniaxial Calcite Crystal



1. Select suitable definition method

2. Define the refractive index according to the formula

Tips: after configuring the material, use the Save tab to save the new material to the *User Defined* material catalog and load it easily for the next simulation.

Uniaxial Calcite Crystal

- Thickness: 6mm
- Ordinary refractive index

$$n_o = \left(2.69705 + \frac{0.0192064}{\lambda^2 - 0.0182} - 0.0151624\lambda^2 \right)^{1/2}$$

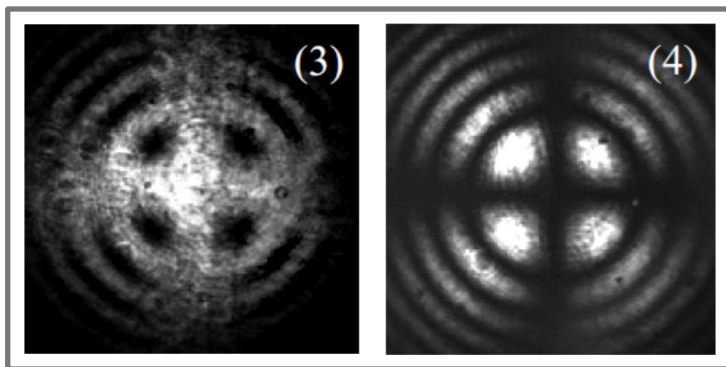
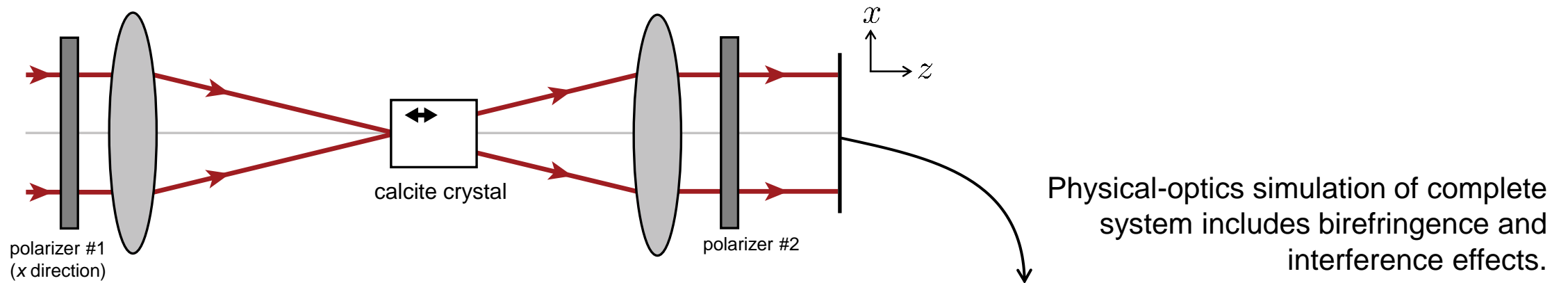
- Extraordinary refractive index

$$n_e = \left(2.18438 + \frac{0.0087309}{\lambda^2 - 0.01018} - 0.0024411\lambda^2 \right)^{1/2}$$

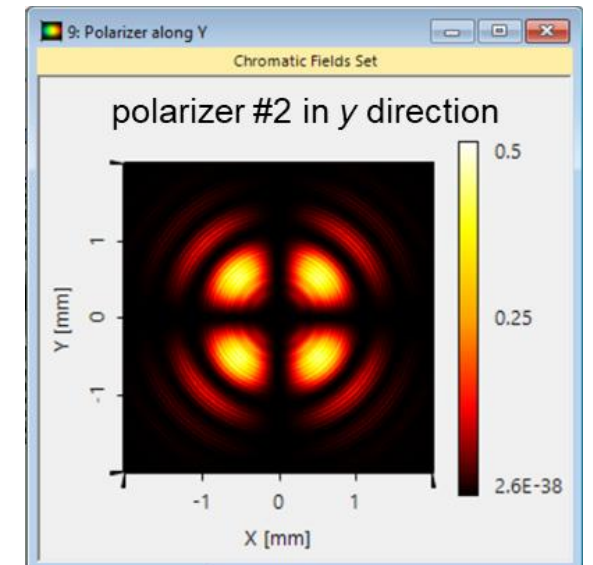
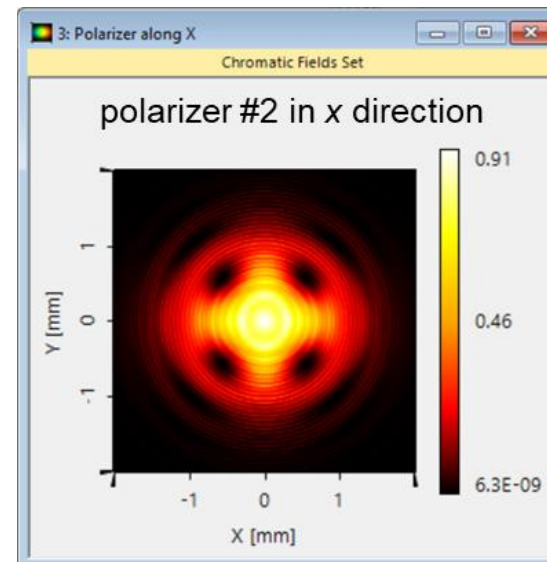
with λ in micrometers.

Parameters follow from Y. Izdebskaya *et al.*, Opt. Express **17**, 18196-18208 (2009)

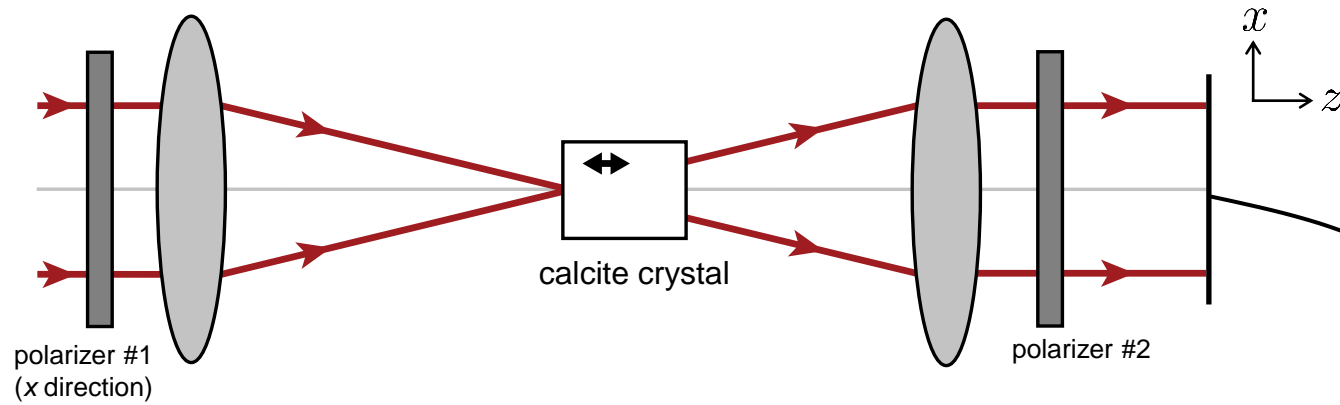
Results



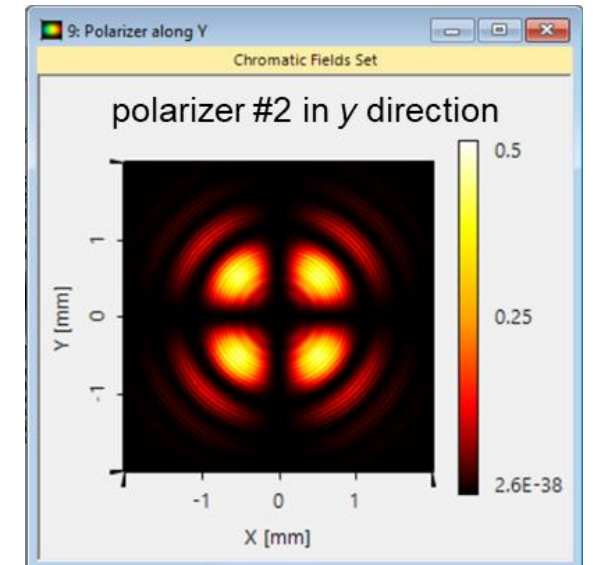
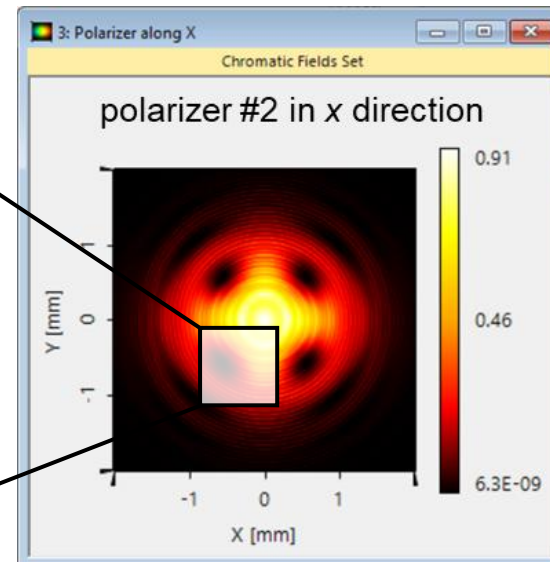
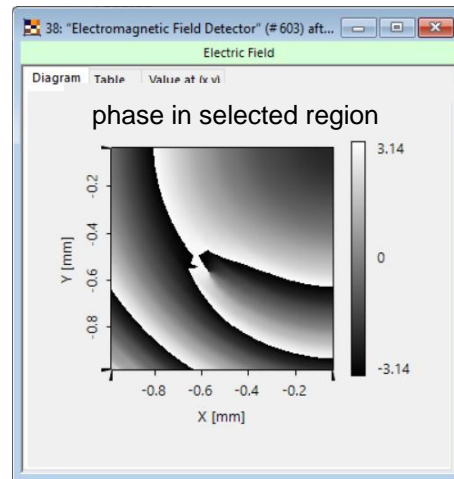
Experimental measurements from Y. Izdebskaya *et al.*, Opt. Express **17**, 18196-18208 (2009)



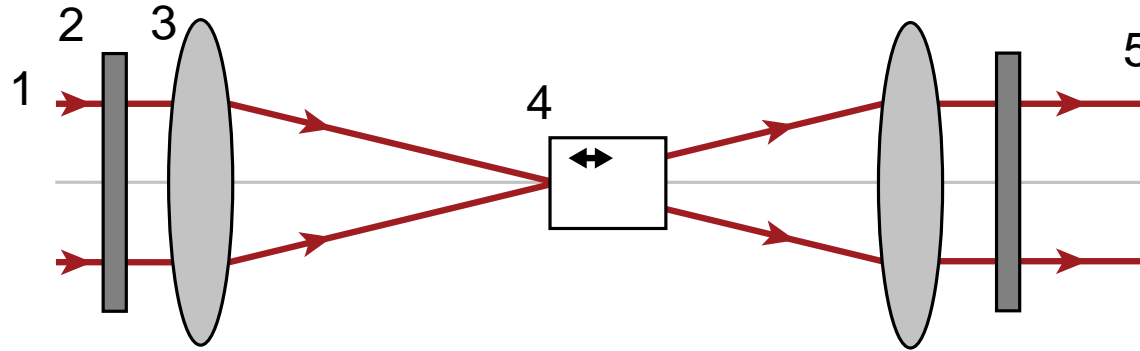
Results



Visualization of phase distribution reveals a phase dislocation/vortex phase.



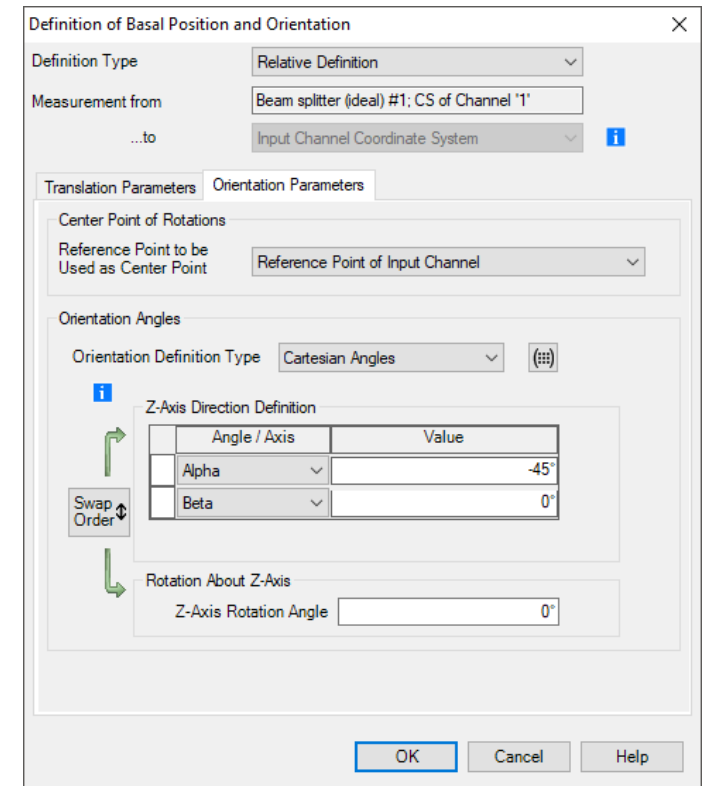
Summary – Components...



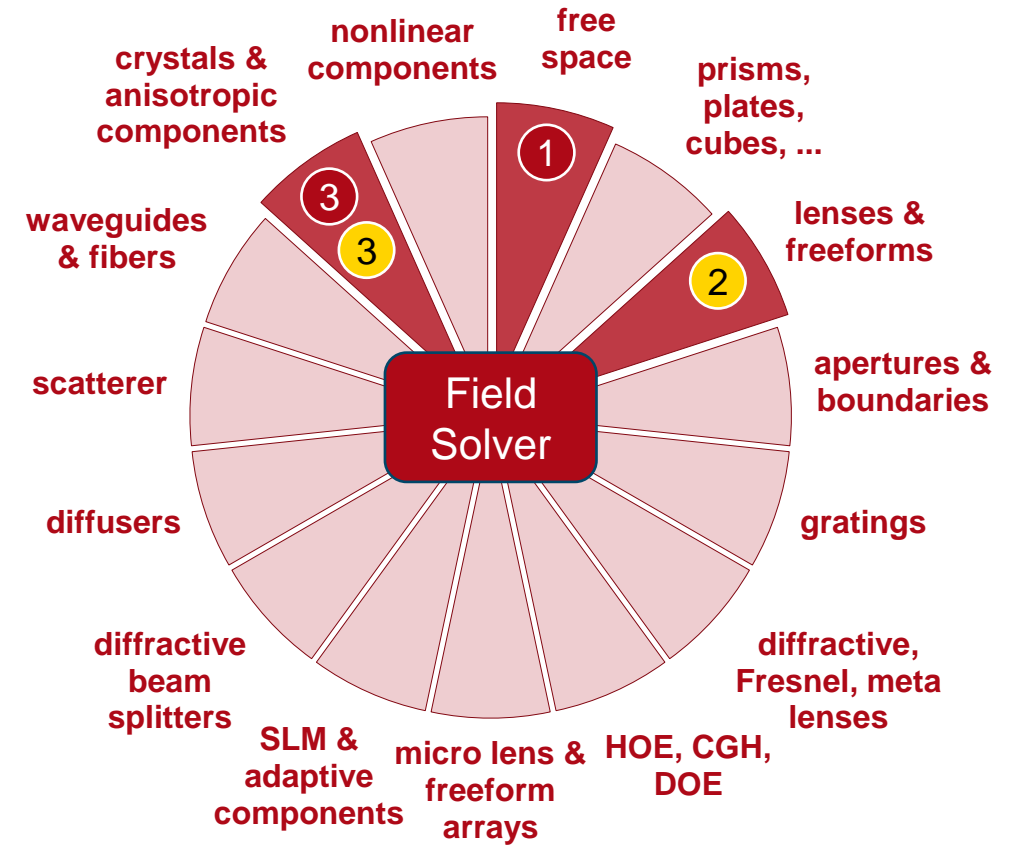
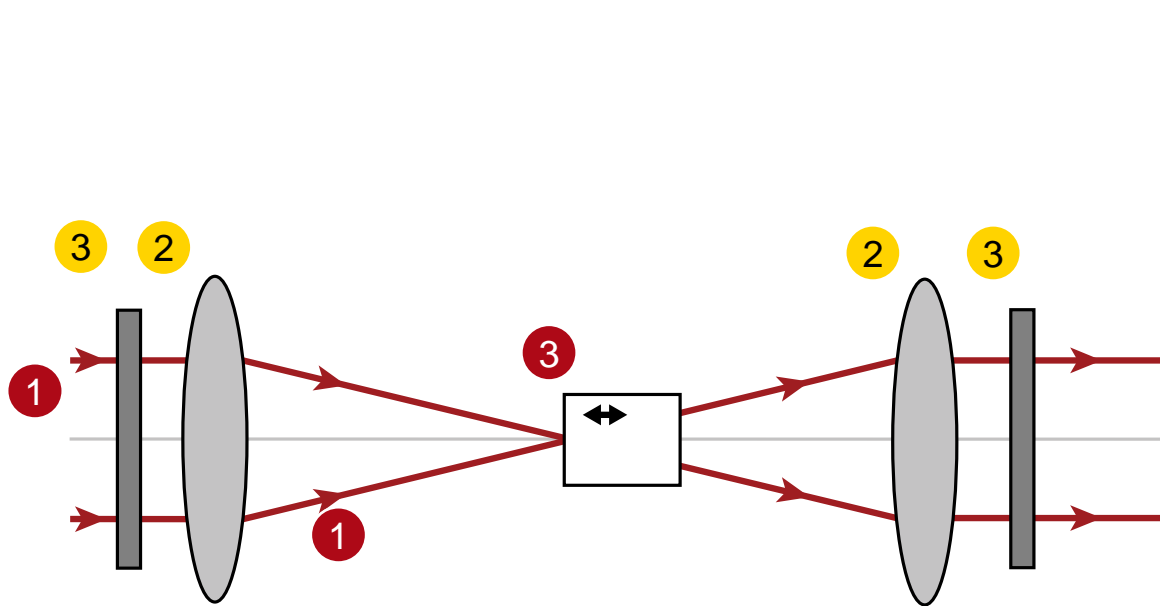
... of Optical System	... in VirtualLab Fusion	Source Model/Component Solver
1. Source	Gaussian Source	
2. Polarizer	Polarizer	-
3. Lens	Ideal Lens	
4. Calcite Crystal	Crystal Plate	Layer Matrix [S-Matrix]
5. Detector	Camera Detector	-

Workflow in VirtualLab Fusion

- Set up input field
 - [Basic Source Models](#) [Tutorial Video]
- Construct real components using surfaces
- Set up Uniaxial Calcite Crystal
 - [Optically Anisotropic Media in VirtualLab Fusion](#) [Use Case]
- Define position and orientation of components
 - [LPD II: Position and Orientation](#) [Tutorial Video]



VirtualLab Fusion Technologies



idealized component

Document Information

title	Polarization Conversion in Uniaxial Crystals
document code	USC.0203
version	1.0
edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.176)
category	Application Use Case
further reading	<ul style="list-style-type: none">- <u>Optically Anisotropic Media in VirtualLab Fusion</u>- <u>Conical Refraction in Biaxial Crystals</u>