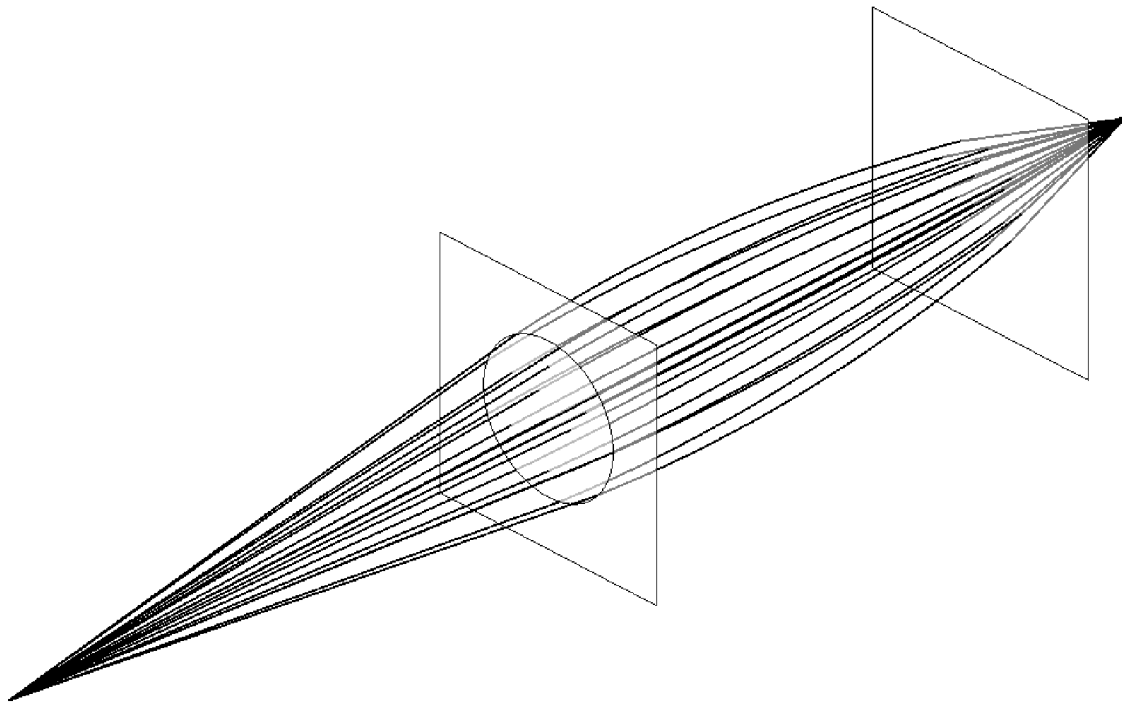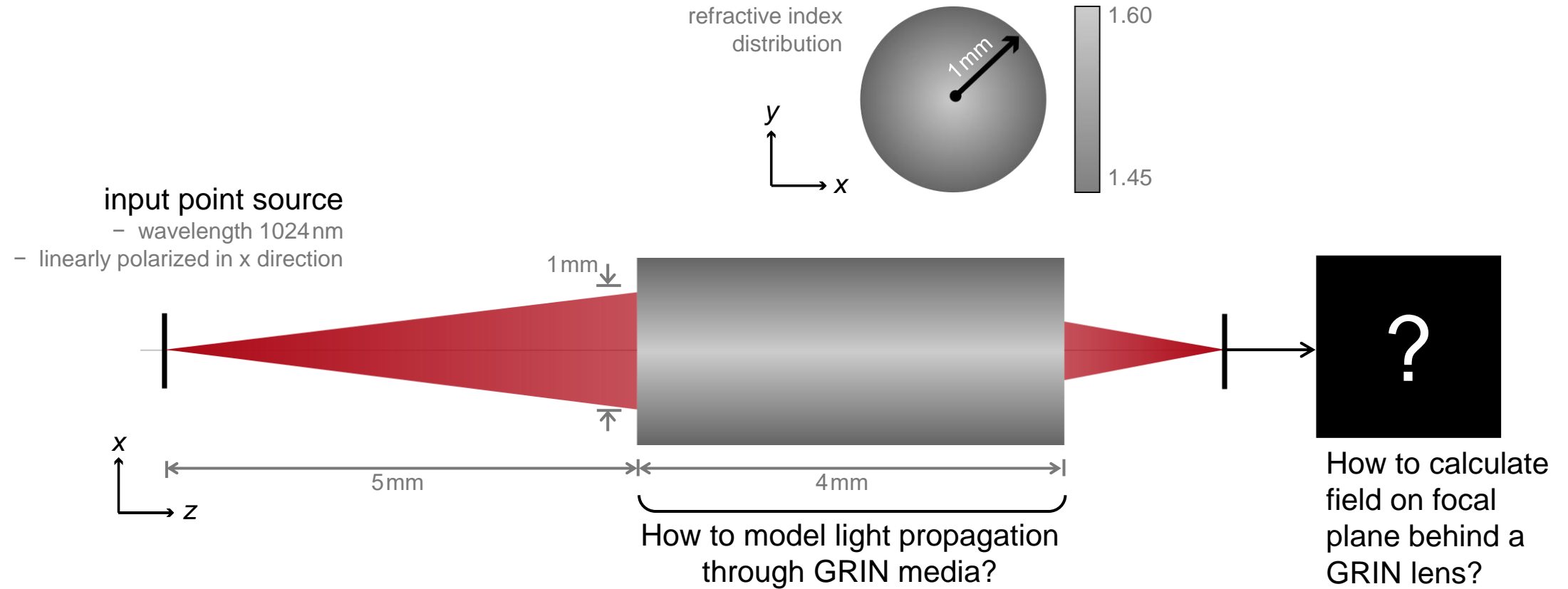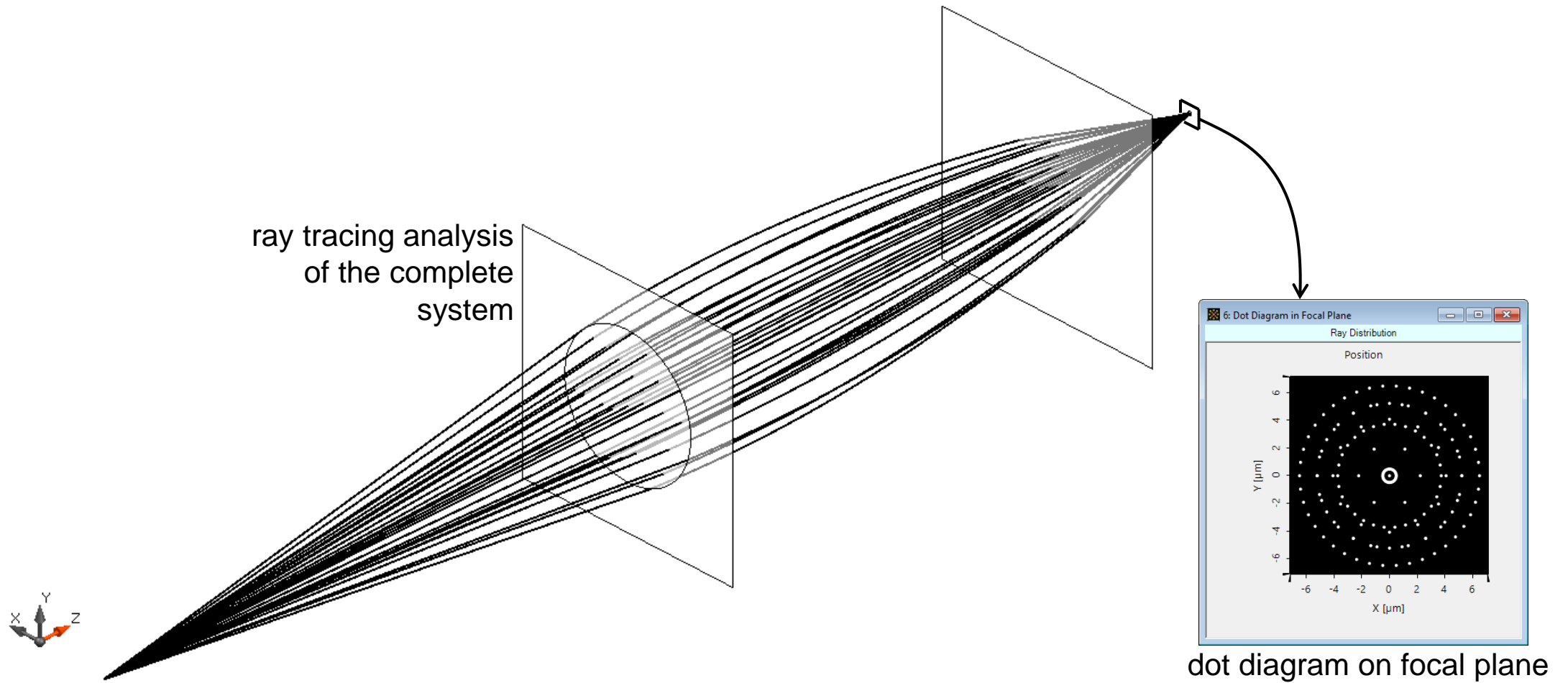# Modeling of Graded-Index (GRIN) Lens

Abstract

Graded-index (GRIN) media, with smooth variation of refractive indices, can be used to e.g. make a lens with flat surface, or reduce the aberrations. VirtualLab Fusion provides a physical-optics modeling technique for light propagation through GRIN media. With the same speed but far beyond ray tracing, the physical-optics modeling takes fully electromagnetic fields into consideration, which includes the polarization crosstalk effects.
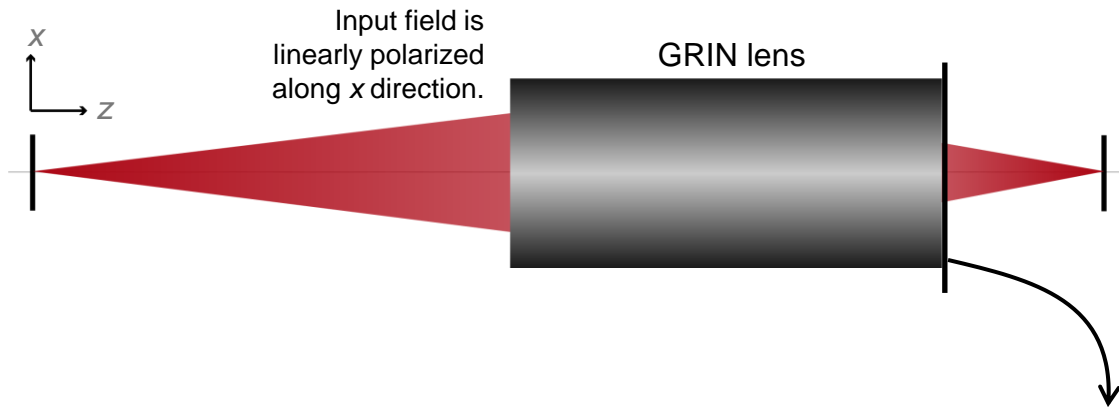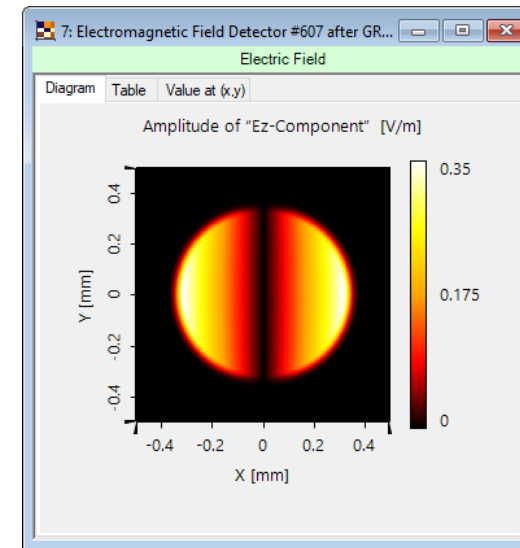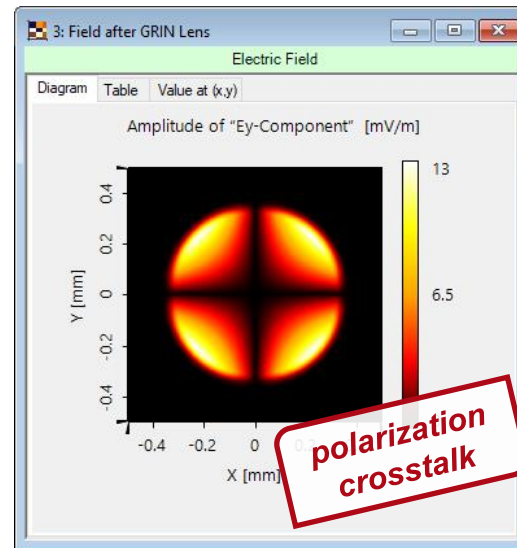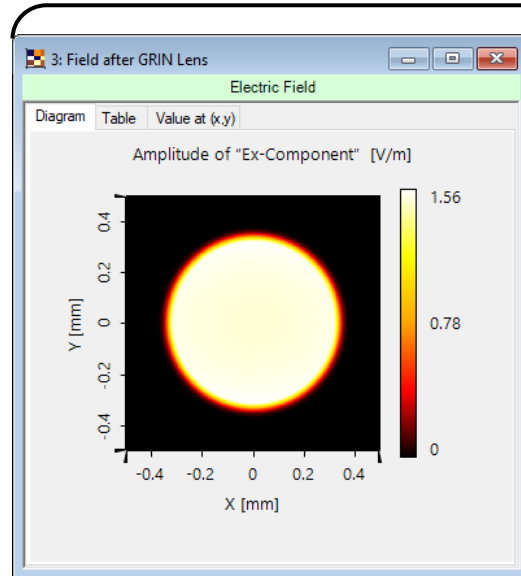
Modeling Task

refractive index distribution

1.60

1.45

input point source
– wavelength 1024 nm
– linearly polarized in x direction

1 mm

5 mm

4 mm

How to model light propagation through GRIN media?

?

How to calculate field on focal plane behind a GRIN lens?

Ray Tracing Results

ray tracing analysis
of the complete
system

dot diagram on focal plane

Field Tracing Results – behind GRIN Lens

x

z

Input field is linearly polarized along *x* direction.

GRIN lens

fully vectorial modeling of field propagation through the GRIN lens
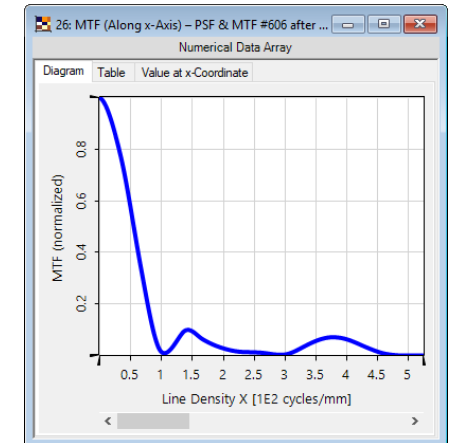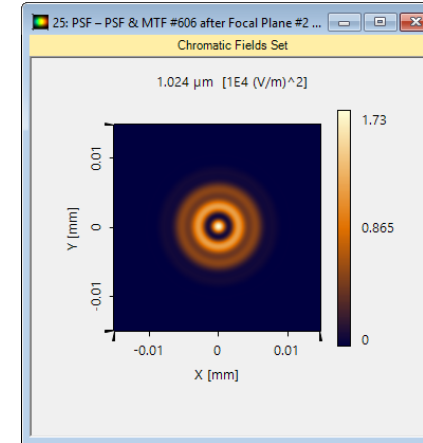
3: Field after GRIN Lens

Electric Field

Diagram   Table   Value at (x,y)

Amplitude of "Ex-Component" [V/m]

1.56

0.78

0

Y [mm]

0.4 0.2 0 -0.2 -0.4

X [mm]

-0.4 -0.2 0 0.2 0.4

3: Field after GRIN Lens

Electric Field

Diagram   Table   Value at (x,y)

Amplitude of "Ey-Component" [mV/m]

13

6.5

Y [mm]

0.4 0.2 0 -0.2 -0.4

X [mm]

-0.4 -0.2 0 0.2 0.4

polarization crosstalk

7: Electromagnetic Field Detector #607 after GR...

Electric Field

Diagram   Table   Value at (x,y)

Amplitude of "Ez-Component" [V/m]

0.35

0.175

0

Y [mm]

0.4 0.2 0 -0.2 -0.4

X [mm]

-0.4 -0.2 0 0.2 0.4

Field Tracing Results – Focal Plane

Input field is linearly polarized along *x* direction.

GRIN lens

polarization crosstalk
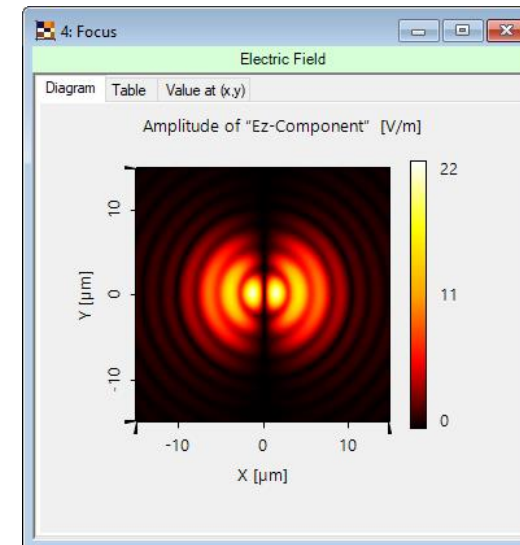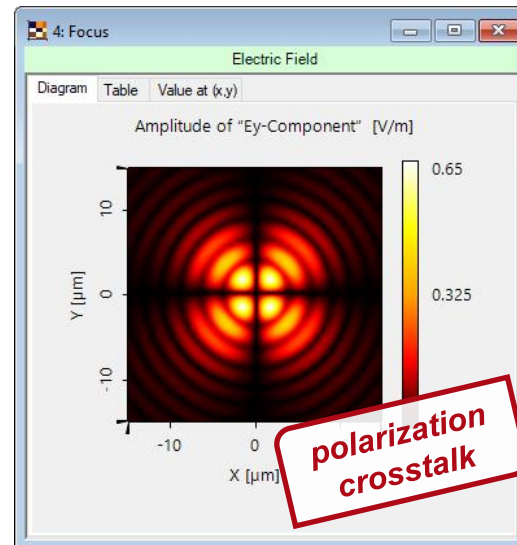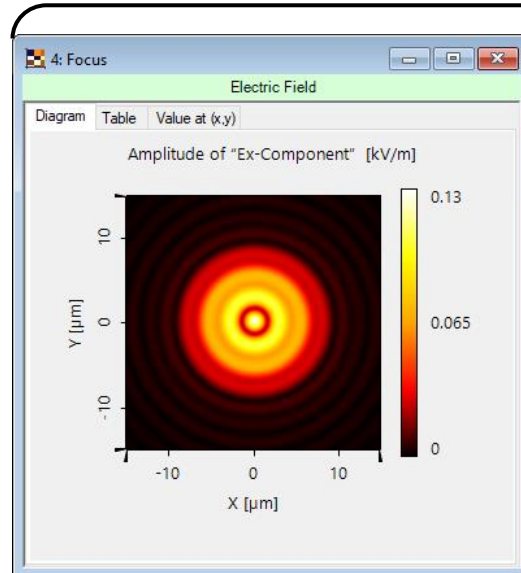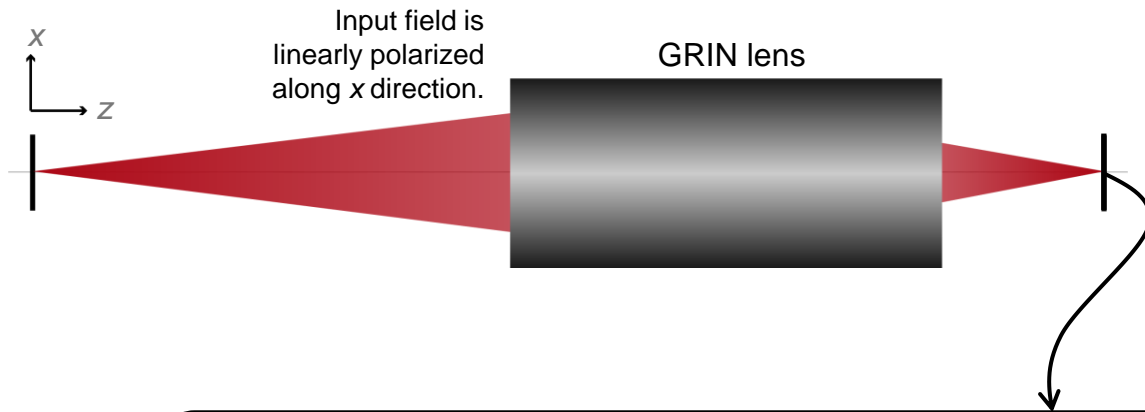
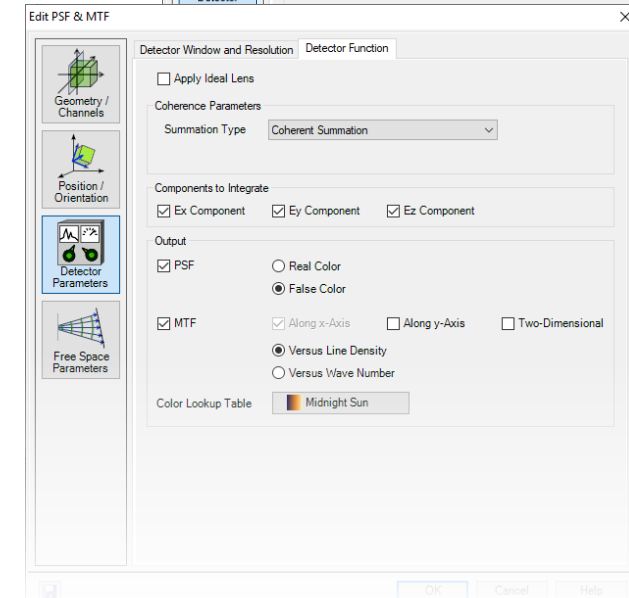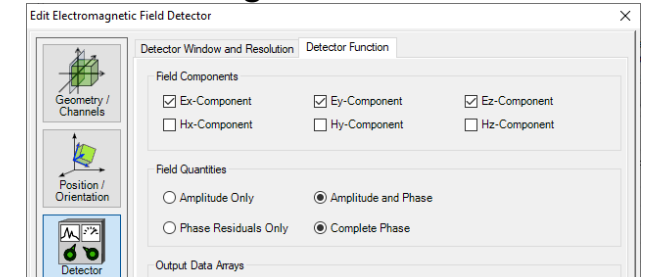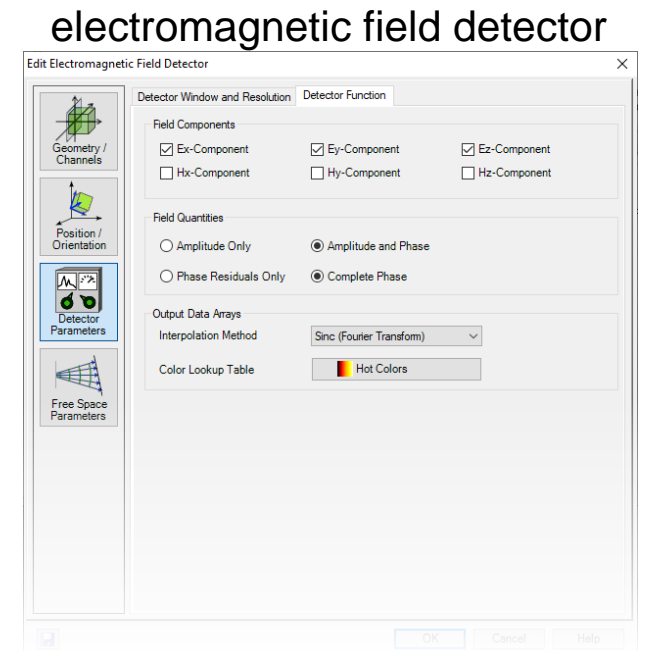# Peek into VirtualLab Fusion

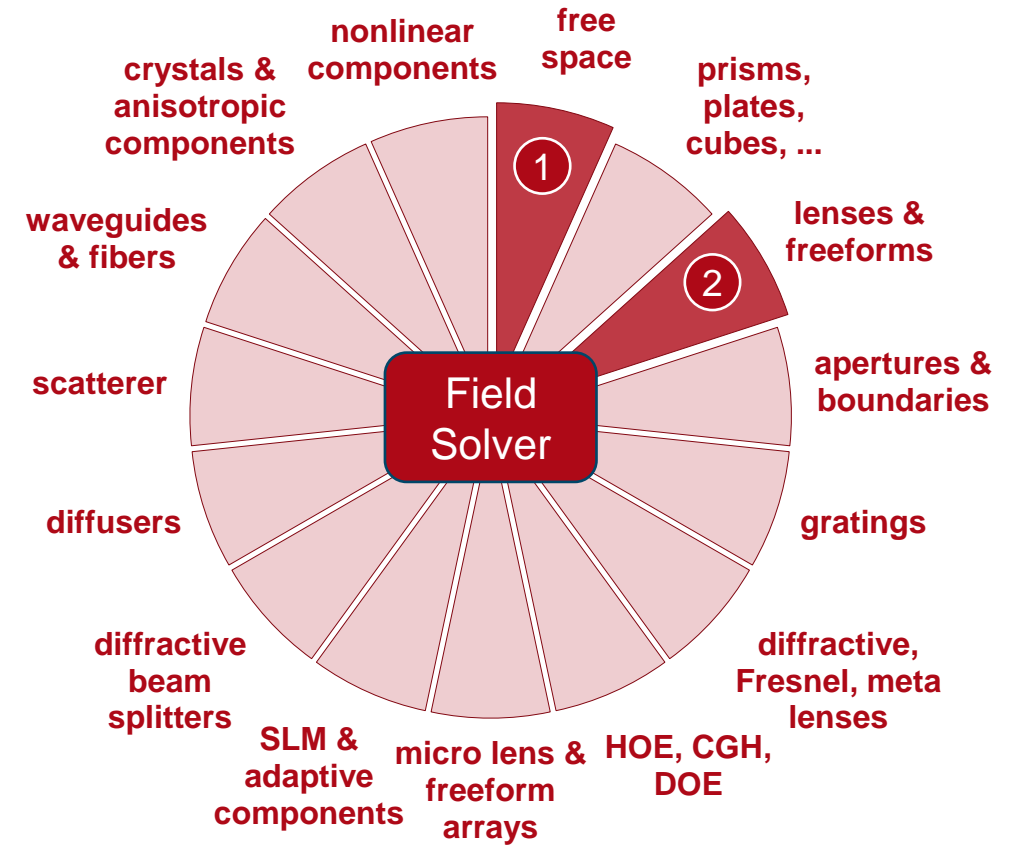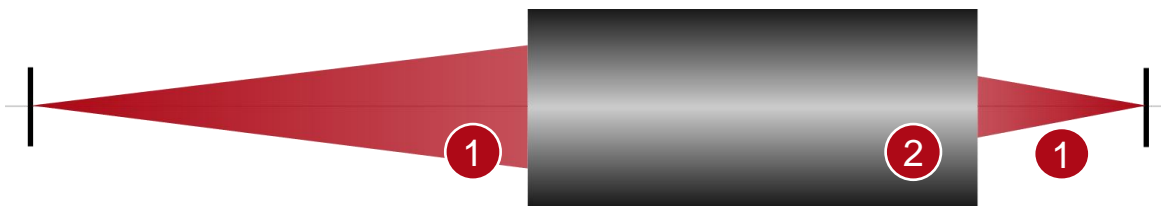ray tracing system analyzer
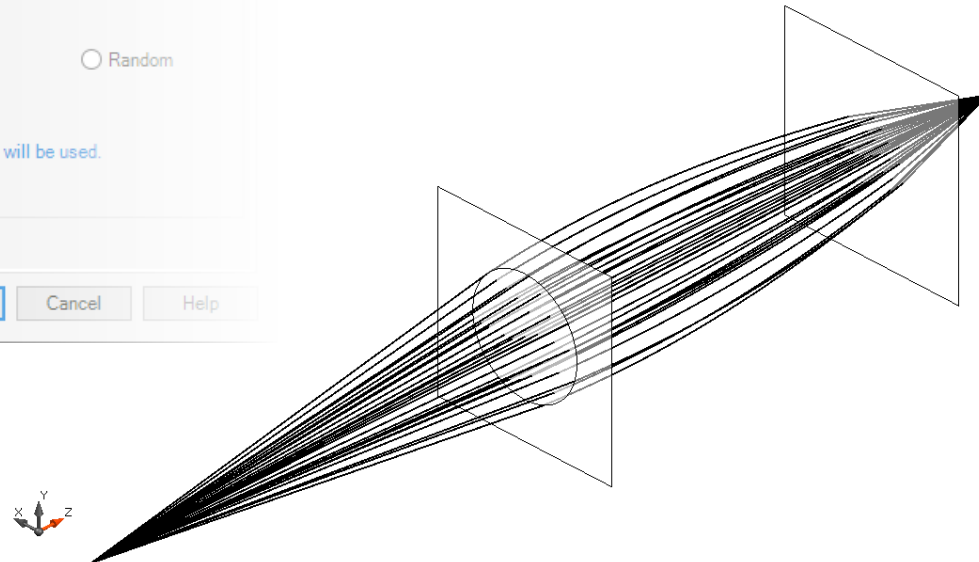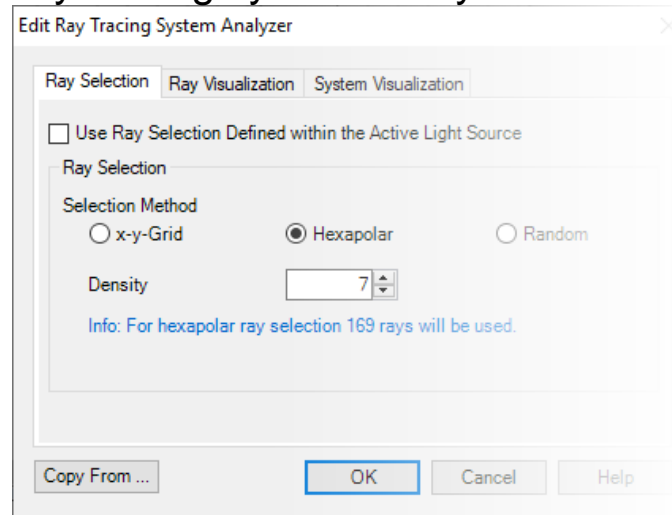
electromagnetic field detector

PSF & MTF detector

Workflow in VirtualLab Fusion

- Set up input point source
  - Basic Source Models [Tutorial Video]

- Construct a graded-index lens
  - Construction and Modeling of a Graded-Index Lens [Use Case]

- Configure a Detector
  - Usage of PSF & MTF Detector [Use Case]
  - Electromagnetic Field Detector [Use Case]

electromagnetic field detector

VirtualLab Fusion Technologies

Document Information

title	Modeling of Graded-Index (GRIN) Lens
document code	GRIN.0002
version	1.2
edition	VirtualLab Fusion Basic
software version	2020.1 (Build 1.202)
category	Application Use Case
further reading	- Construction and Modeling of a Graded-Index Lens - Gaussian Beam Focused by a Thermal Lens