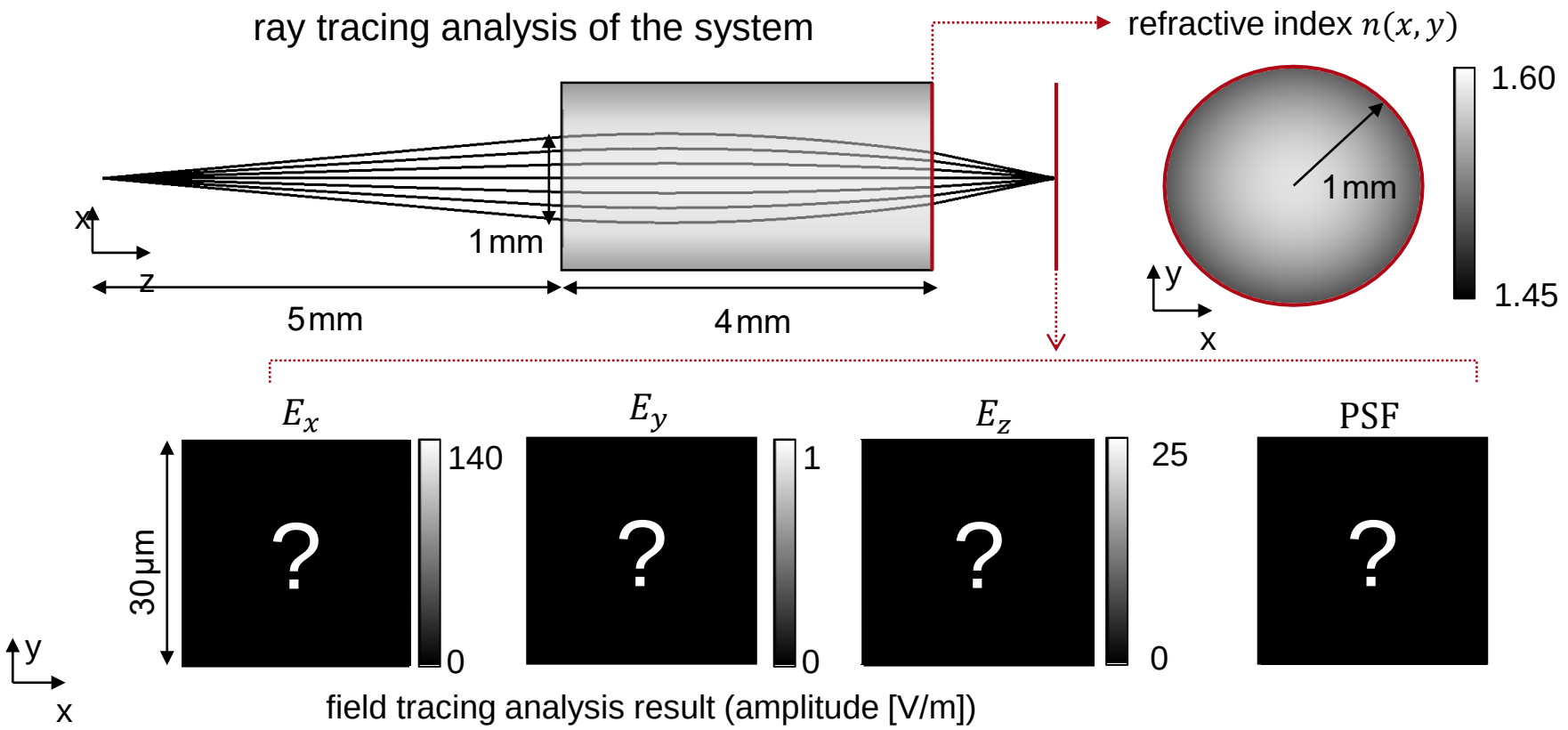
Imaging Systems > Advanced PSF Calculation

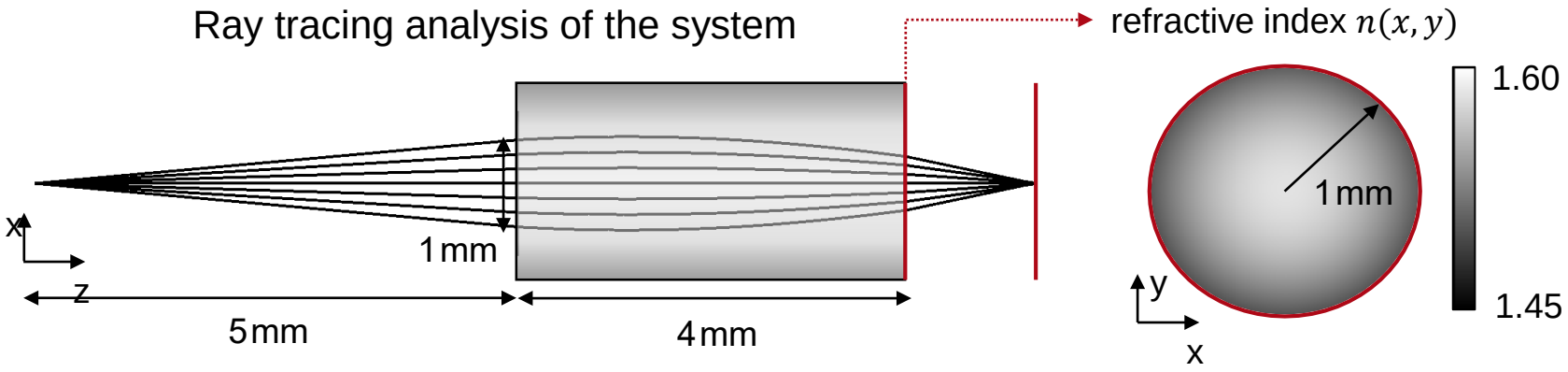
Construction and Modeling of Graded-Index (GRIN) Lens

Task Description

- How to construct a GRIN lens?
- How to perform both ray and field tracing analyses of it?

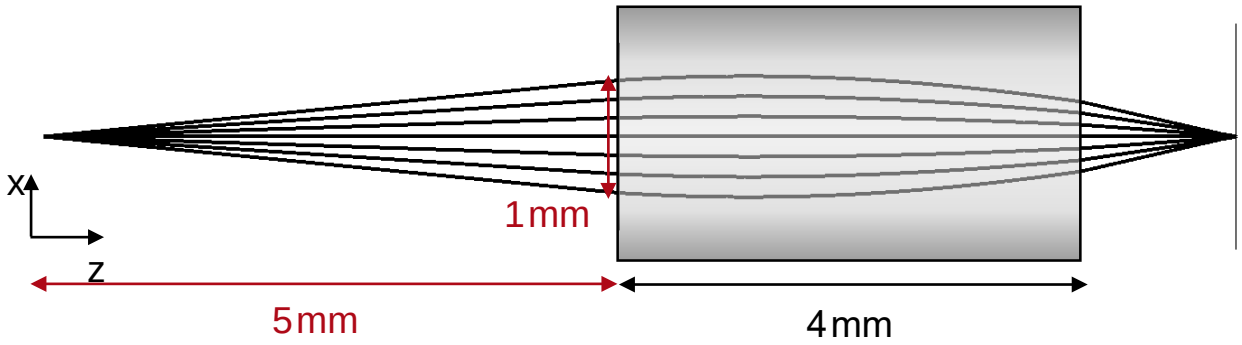


Highlights



- Switching between ray and field tracing is easily done.
- PSF of the imaging system is calculated fast and accurately.
- The polarization crosstalk introduced by the GRIN component is simulated.

Specification: Light Source



Parameter	Description / Value
type/name	spherical wave (point source)
distance between point source to input plane	5mm
beam diameter in input plane	1mm
polarization	linear in x-direction (0°)

Specifications: GRIN Lens

- refractive index $n(x, y)$

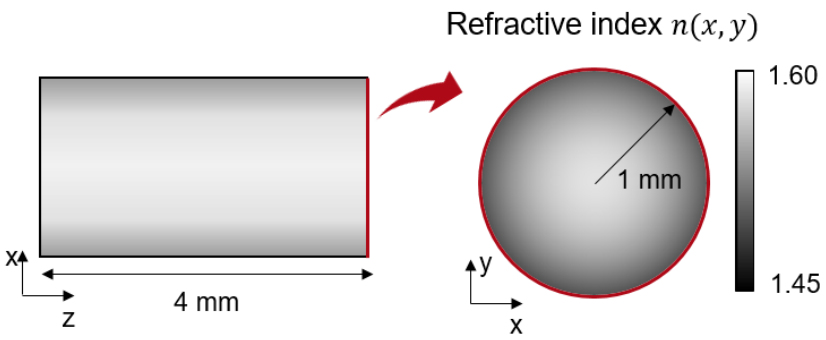
$$n(x, y) = n_0 \left(1 - \frac{g^2}{2} \cdot r^2\right)$$

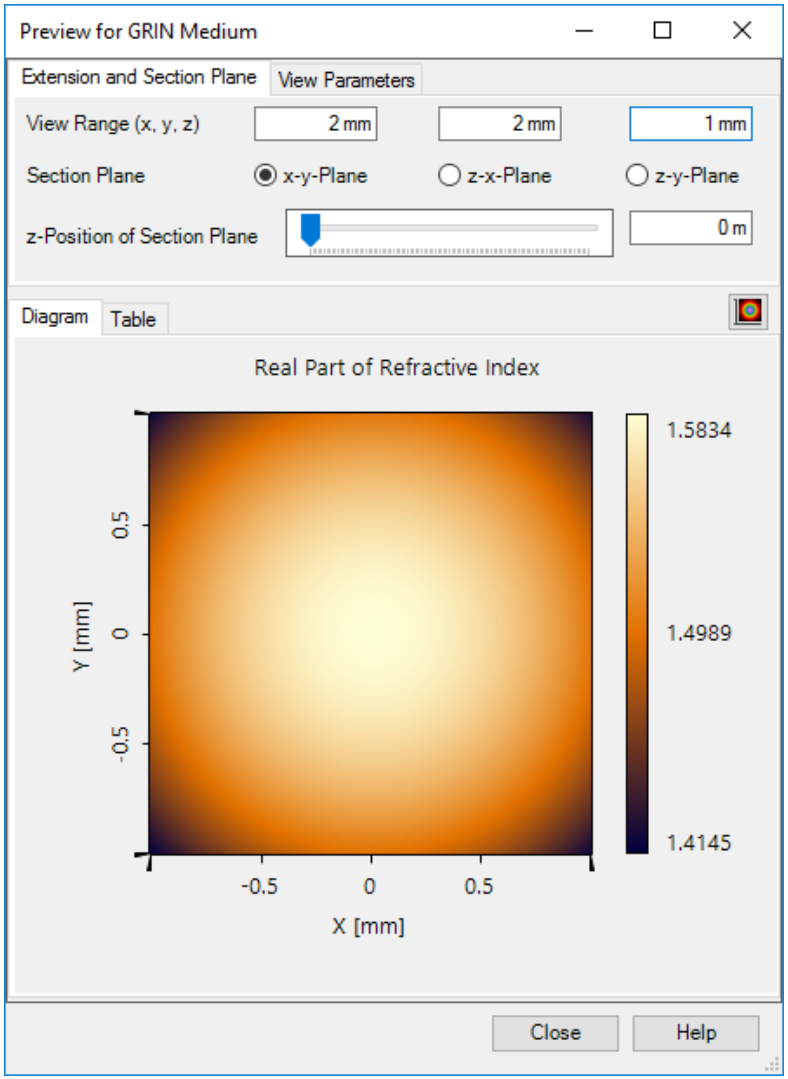
with $r = \sqrt{x^2 + y^2}$.

- according to [1] we use

$n_0 = 1.5834$

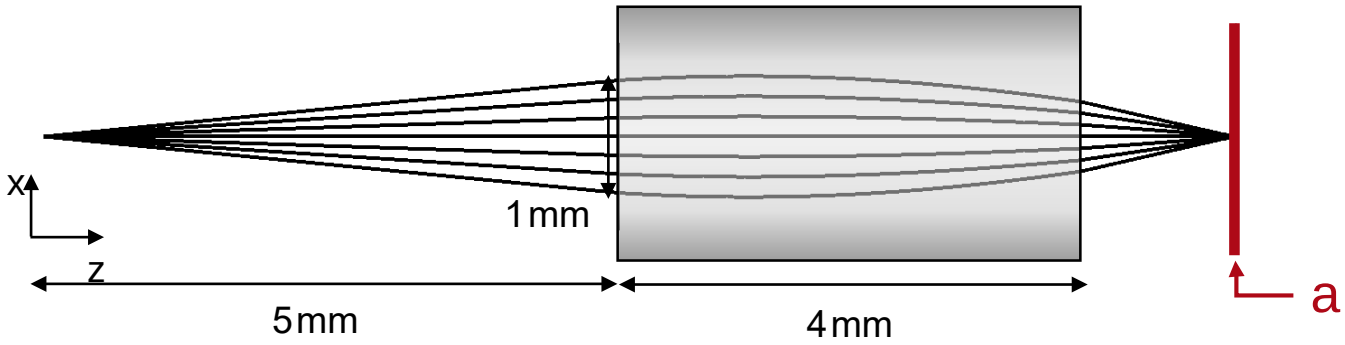
$g = 0.32665\ \text{mm}^{-1}$





[1] Riedl, M.J., *Optical Design Fundamentals for Infrared Systems*, SPIE Press (2001)

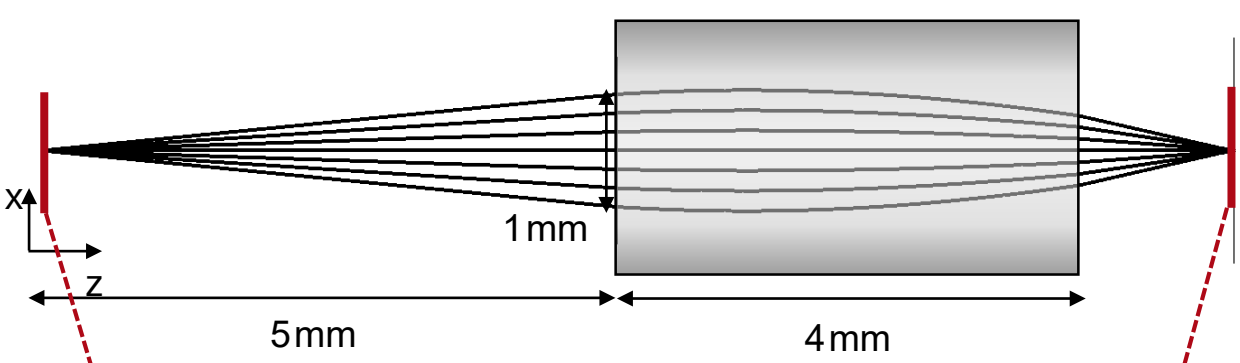
Specifications: Detector

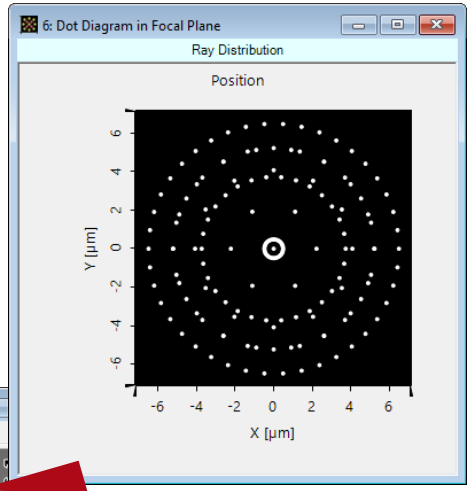


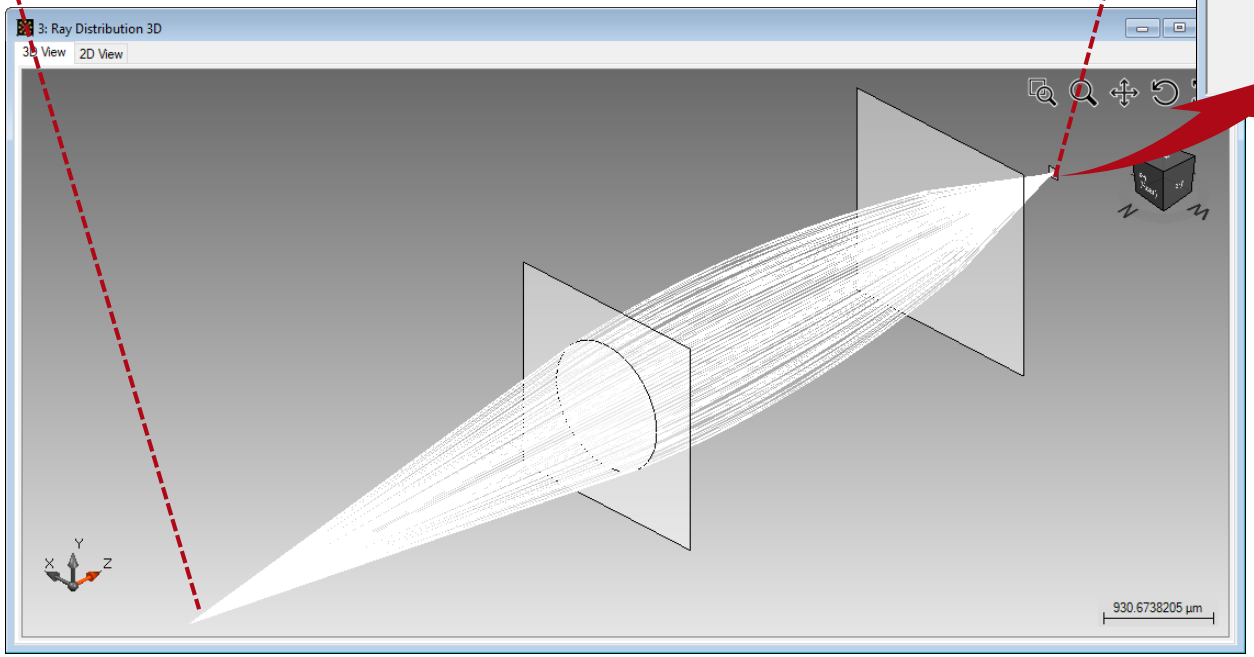
Position	Modeling Technique	Detector/Analyzer
full system	3D system ray tracing	general overview of light behavior in system
a	ray tracing	dot diagram
a	field tracing	point spread function (PSF)
a	field tracing	amplitude of E_x, E_y, E_z

Results: 3D System Ray Tracing

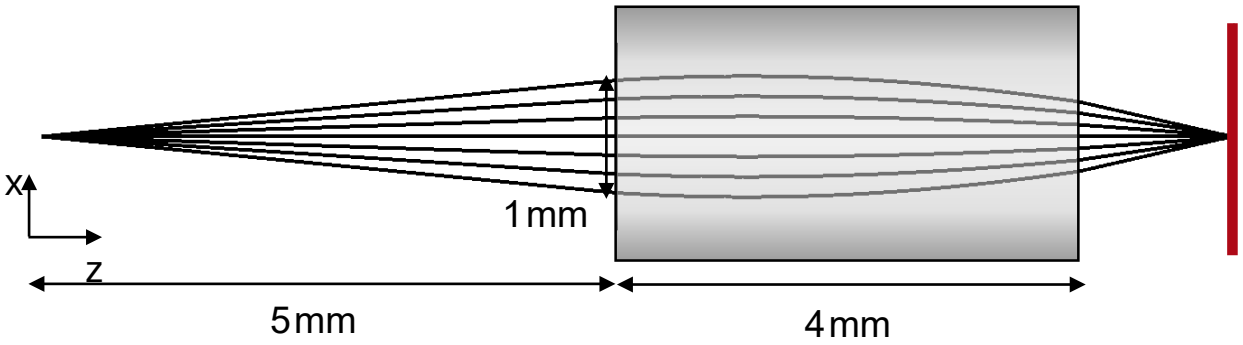
dot diagram



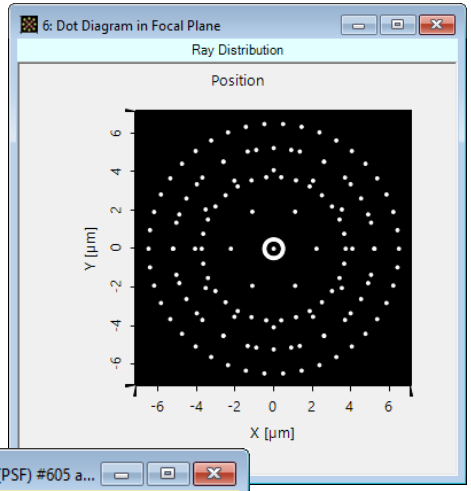




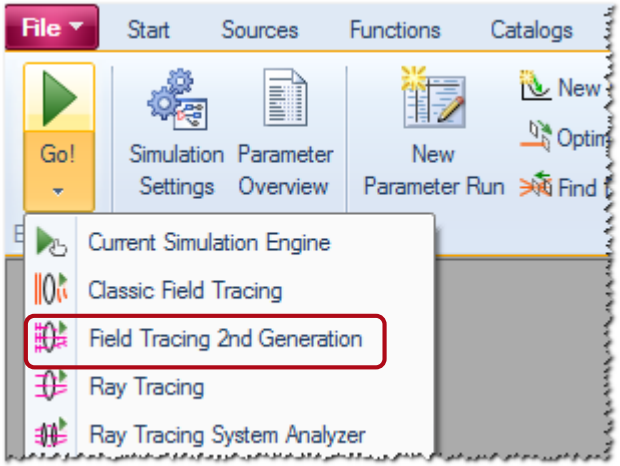
Results: PSF

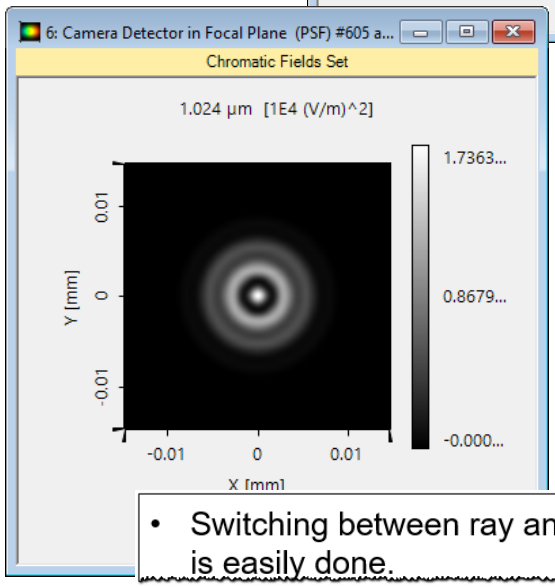


dot diagram



Switching from ray tracing to field tracing is just one button:



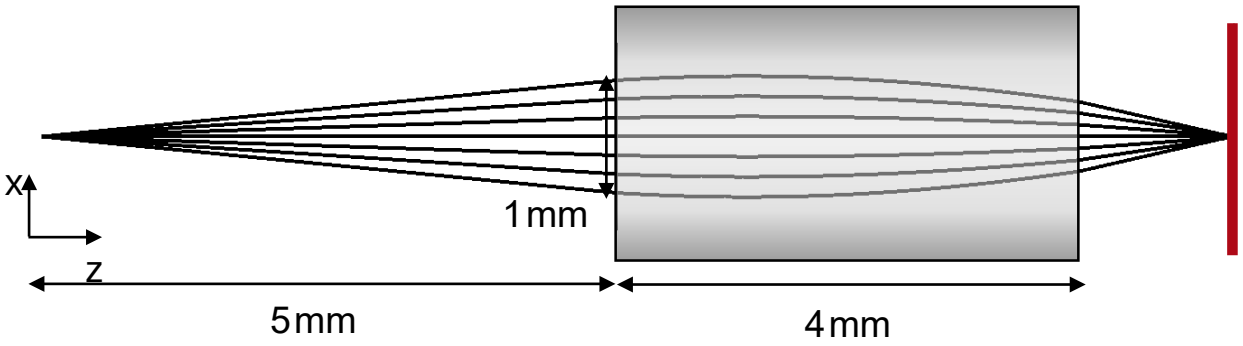


PSF

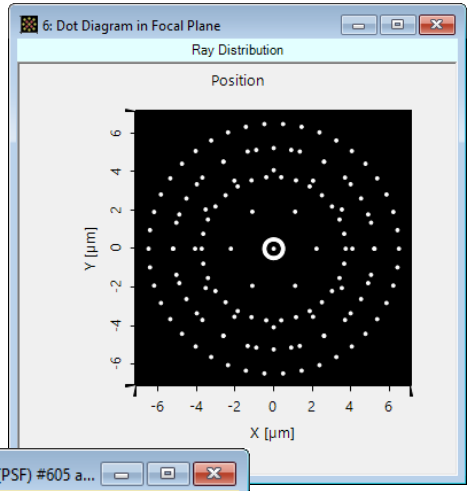
Highlight

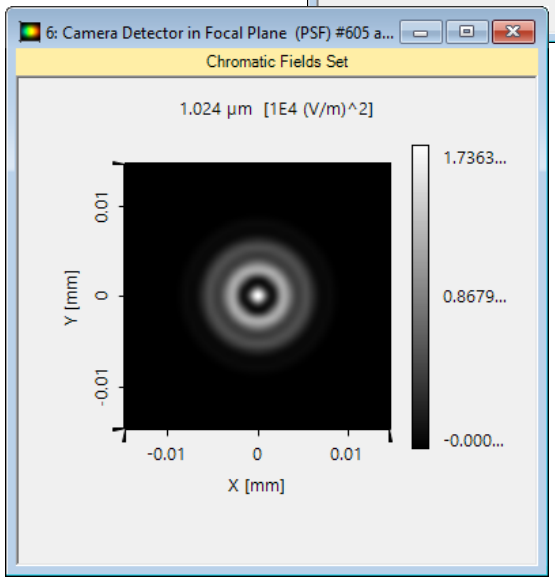
- Switching between ray and field tracing is easily done.

Results: PSF



dot diagram





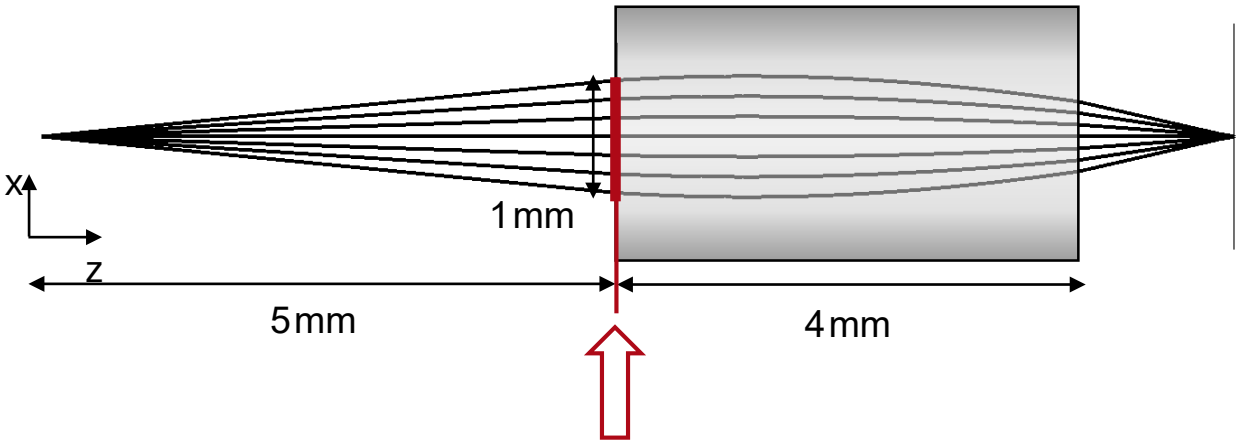
PSF

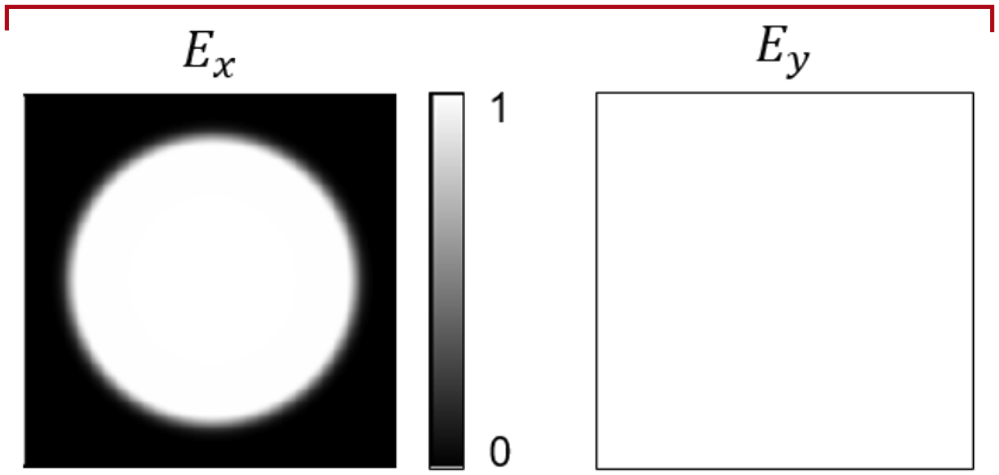
Ray Tracing ~2s
Field Tracing 2nd Gen. ~3s !!!

Highlight

- PSF of the imaging system is calculated fast and accurately.

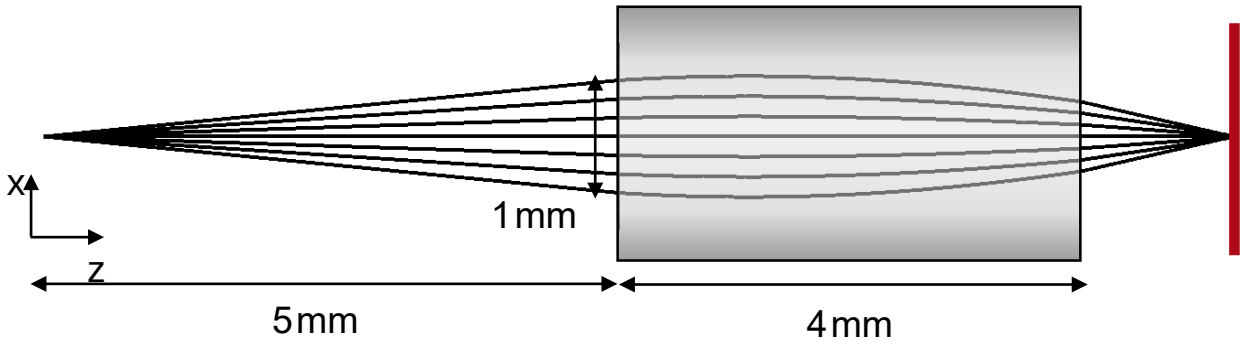
Results: Polarization Crosstalk



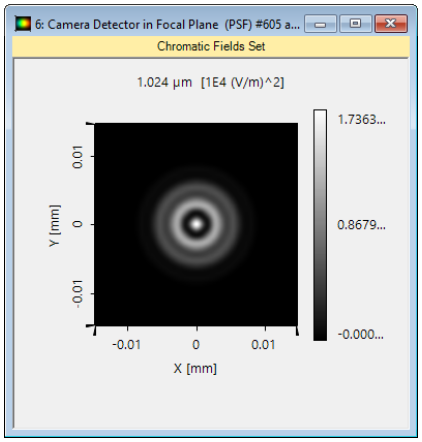


amplitudes of input field [V/m]

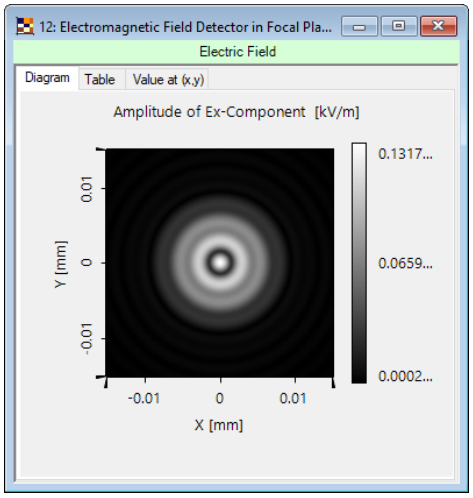
Results: Polarization Crosstalk



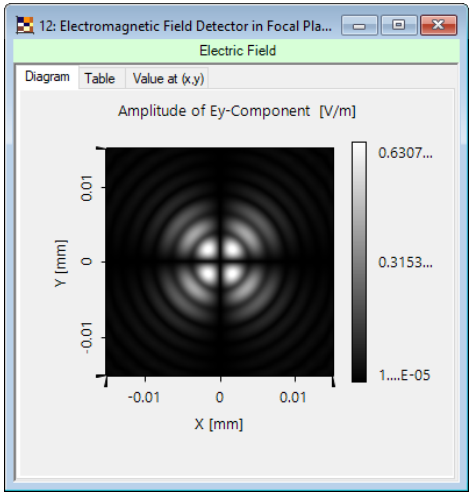
PSF



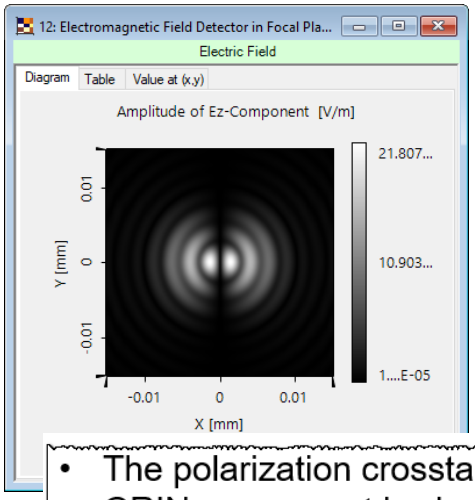
E_x



E_y



E_z



amplitudes of in target plane [V/m]

Highlight

- The polarization crosstalk introduced by GRIN component is simulated.

Document & Technical Info

code	APM.0004
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title	Construction and Modeling of a Graded-Index (GRIN) Lens
category	Imaging System > Advanced PSF & MTF (APM)
author	Huiying Zhong
used VL version	7.0.1.12

Specifications of PC Used for Simulation	
Processor	i7-5600U (2 CPU cores)
RAM	12 GB
Operating System	Windows 10