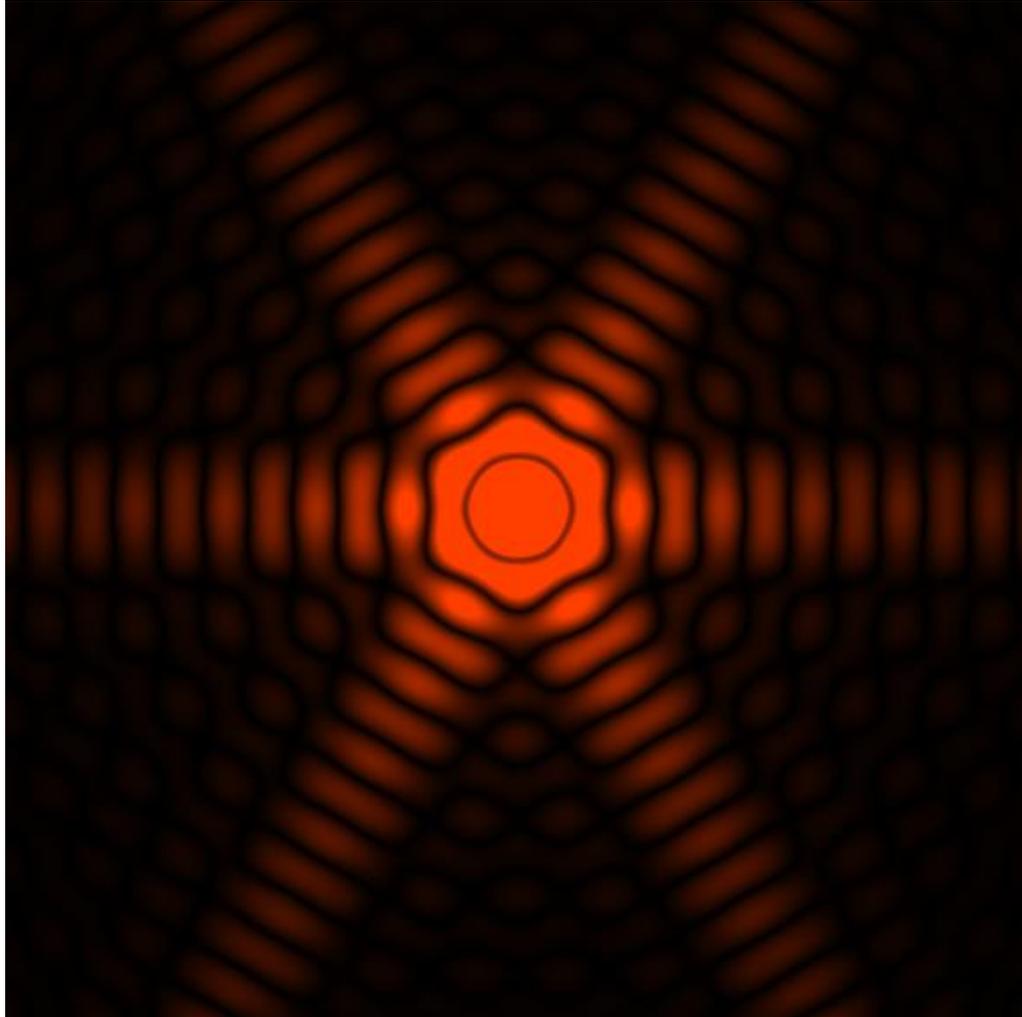


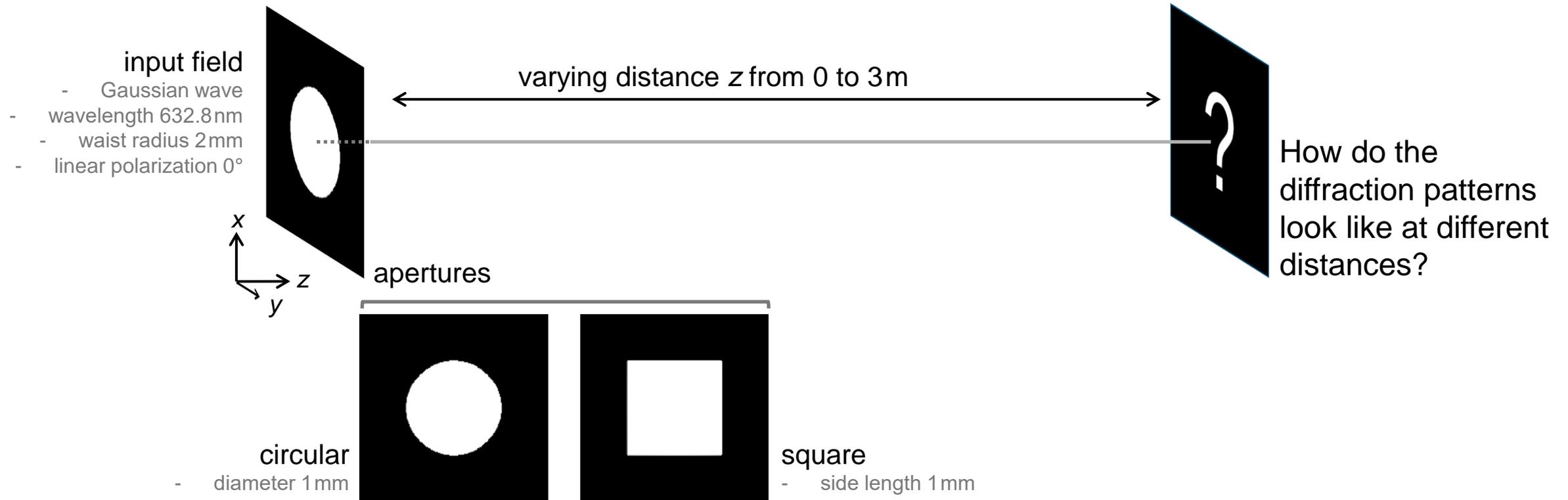
Diffraction Patterns behind Different Apertures

Abstract



As one of the most well-known phenomena in physical optics, diffraction plays a role in various cases. VirtualLab Fusion, with its advanced propagation technologies, can handle diffraction effects in optical systems automatically. In this example, we selected some regular apertures, such as circular (or elliptical) and square (or rectangular), as well as apertures in other shapes, like pentagon or hexagon ones. The diffraction patterns from them are calculated and the property of diffraction is studied.

Modeling Task for Symmetric Apertures

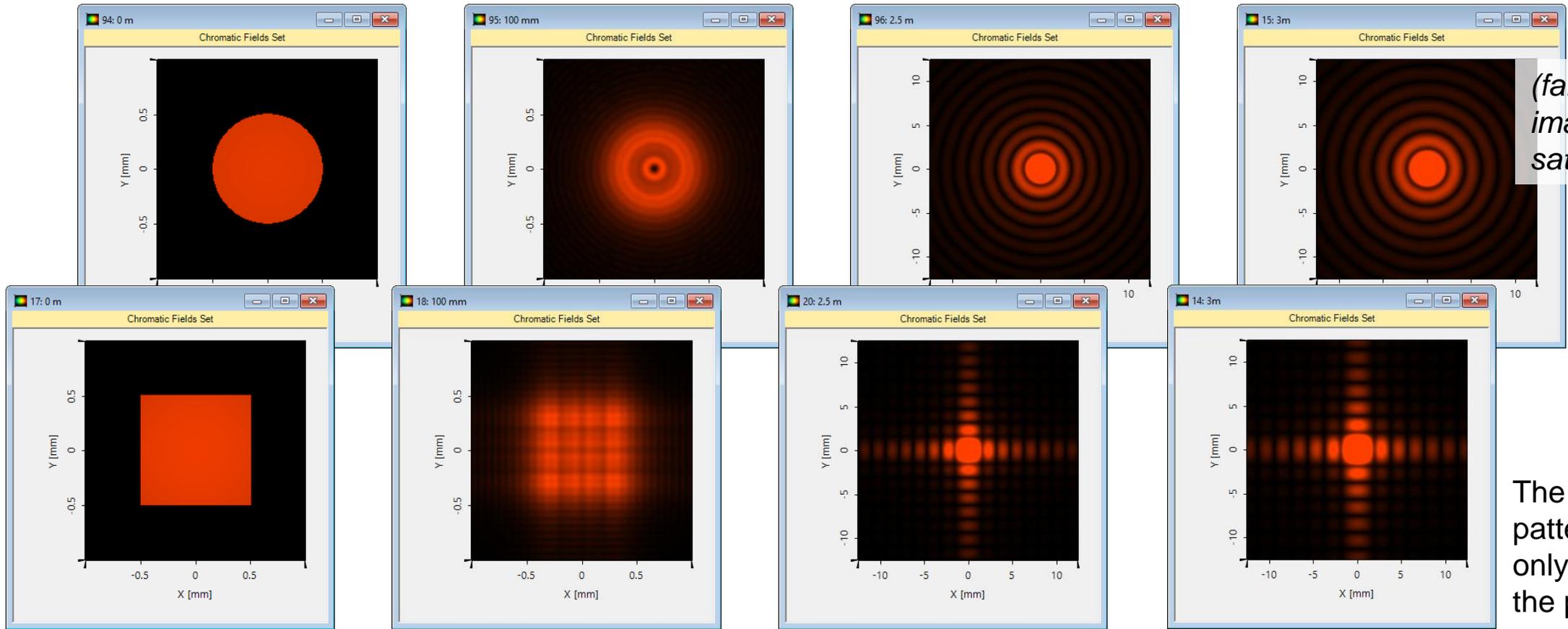


Fields after Symmetric Apertures

field behind aperture

near-field

far-field



(far-field result images are saturated.)

The far-field pattern changes only in size, but the profile keeps.

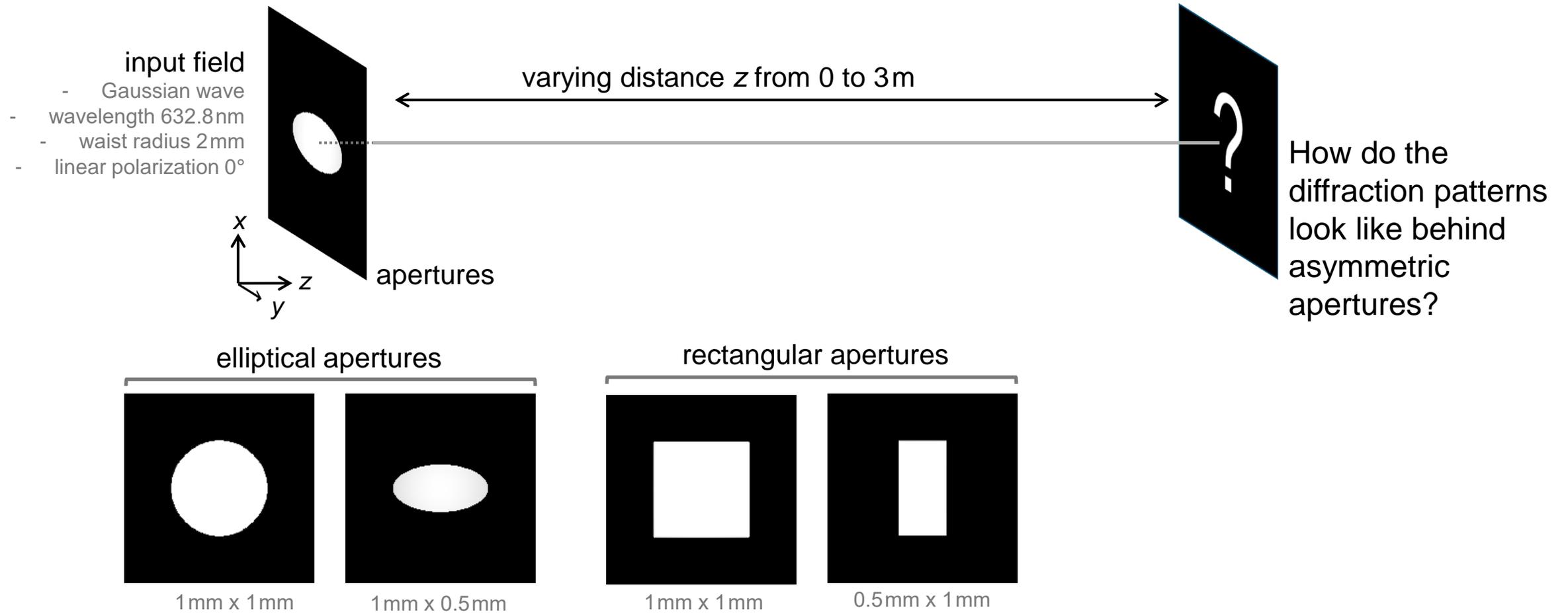
$z=0\text{m}$
window size 2 mm x 2 mm

$z=100\text{mm}$
window size 2 mm x 2 mm

$z=2.5\text{m}$
window size 25 mm x 25 mm

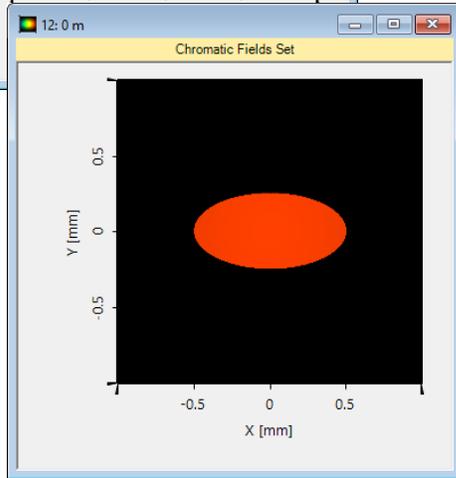
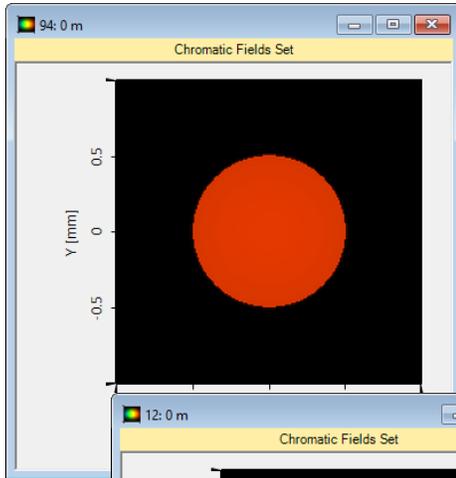
$z=3\text{m}$
window size 25 mm x 25 mm

Modeling Task for Asymmetric Apertures



Fields after Elliptical Apertures

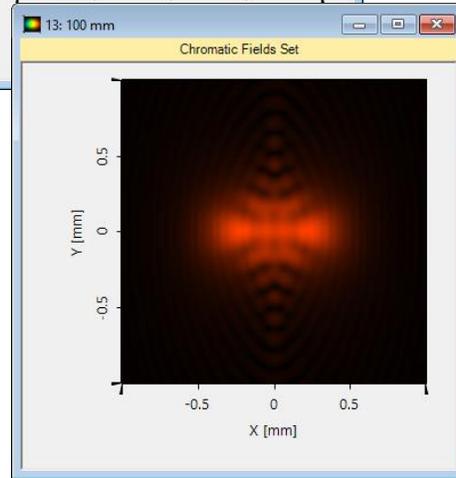
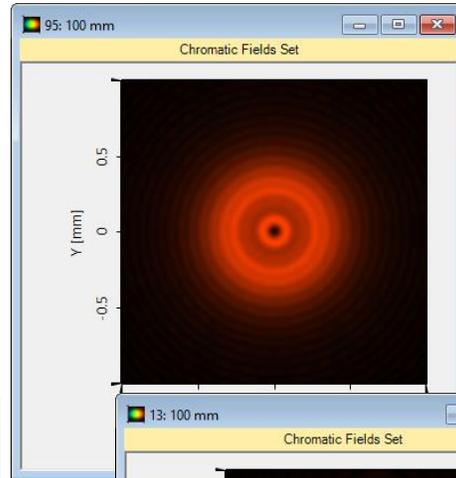
field behind aperture



elliptical aperture
compressed in y-
direction

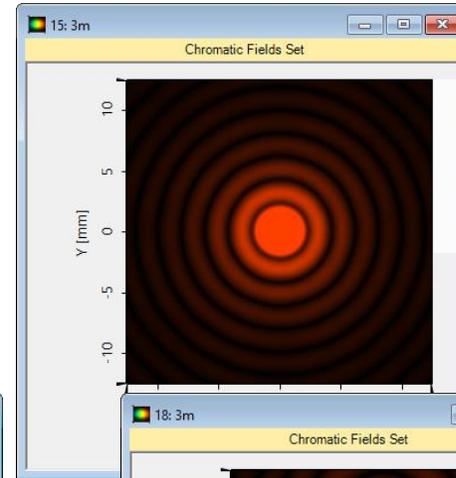
$z=0$ m

near-field

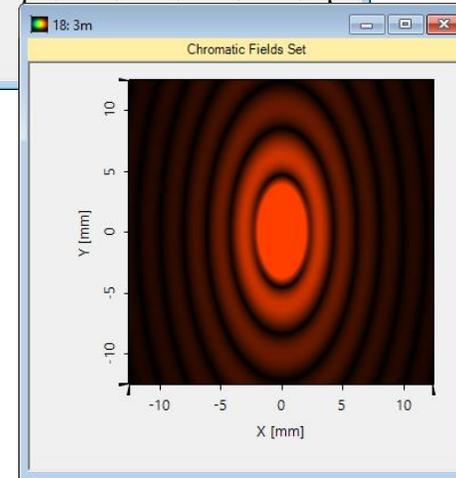


$z=100$ mm

far-field



(far-field result
images are
saturated.)

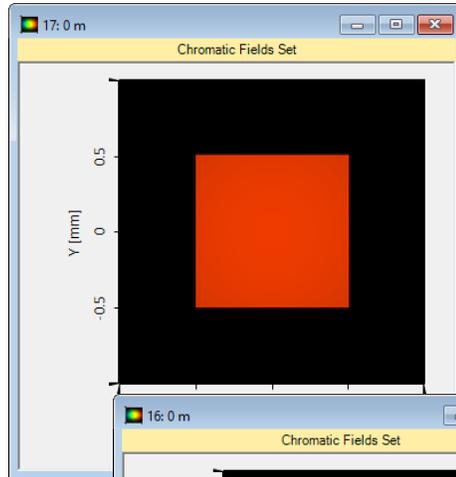


far-field pattern
stretched in y-
direction

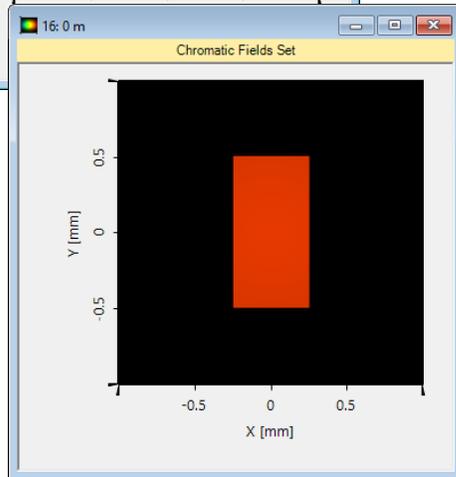
$z=3$ m

Fields after Rectangular Apertures

field behind aperture

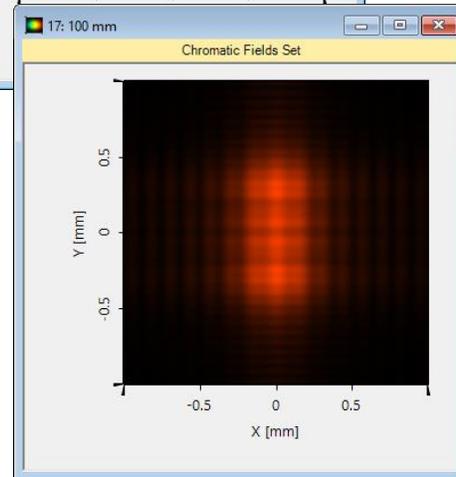
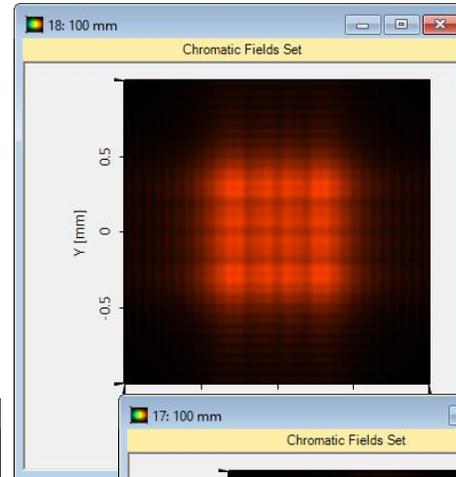


rectangular aperture
compressed in x -
direction



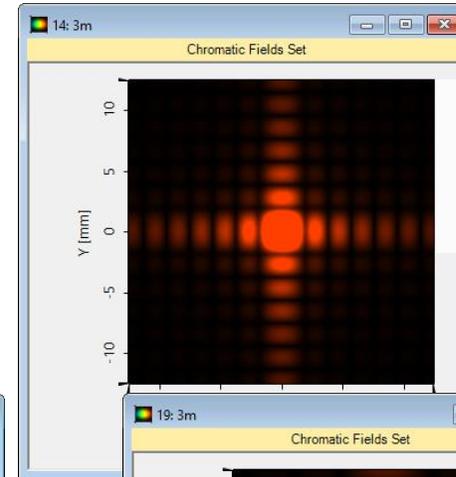
$z=0\text{m}$

near-field

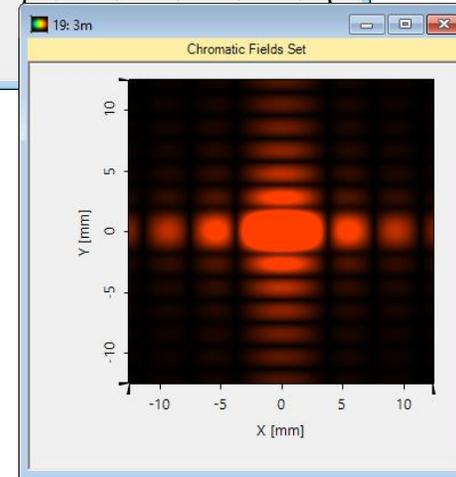


$z=100\text{mm}$

far-field



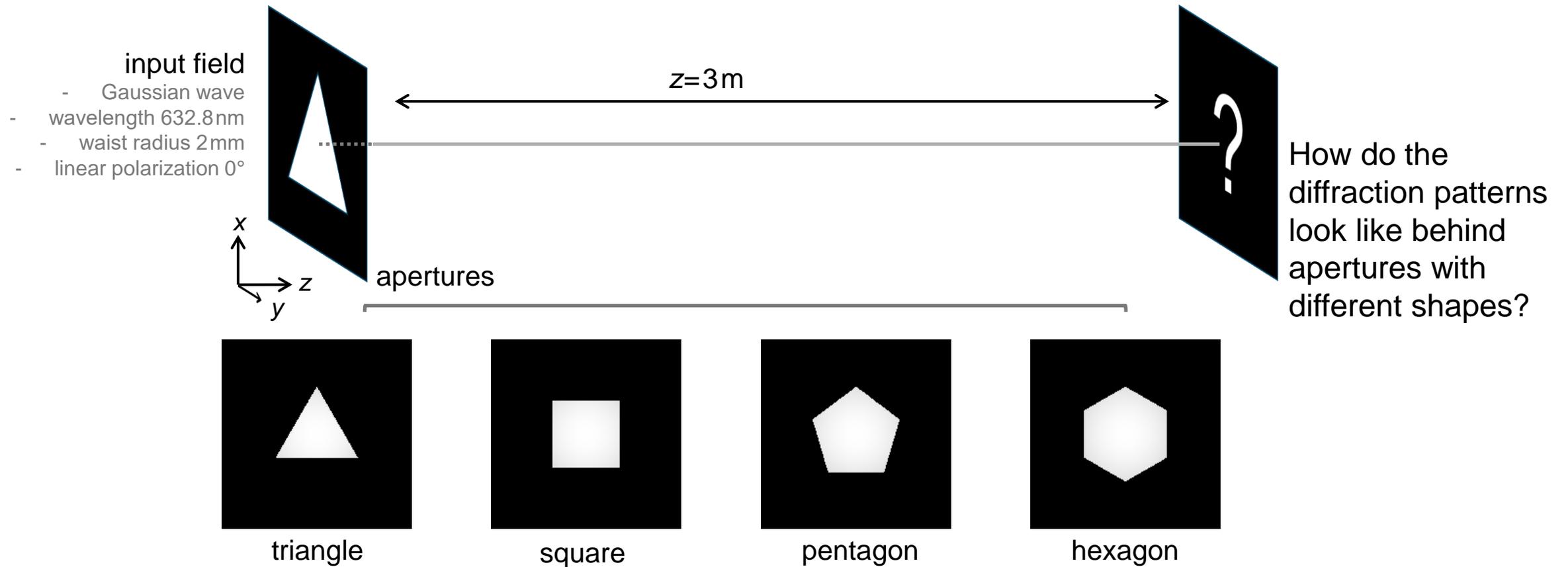
*(far-field result
images are
saturated.)*



far-field pattern
stretched in x -
direction

$z=3\text{m}$

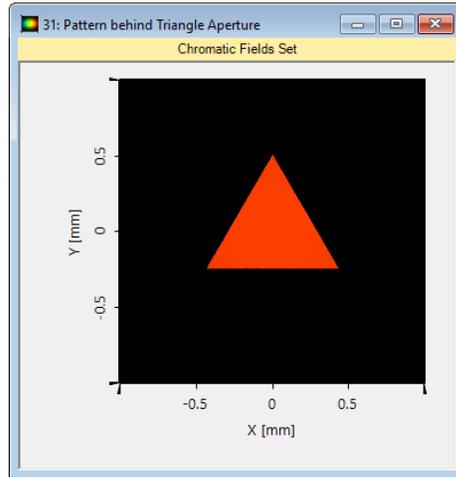
Modeling Task for Polygonal Apertures



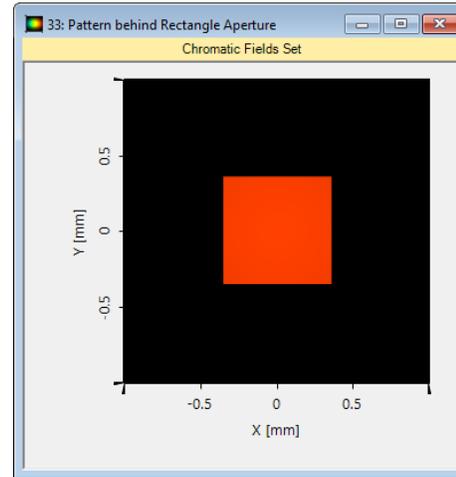
Fields after Polygonal Apertures

field behind aperture

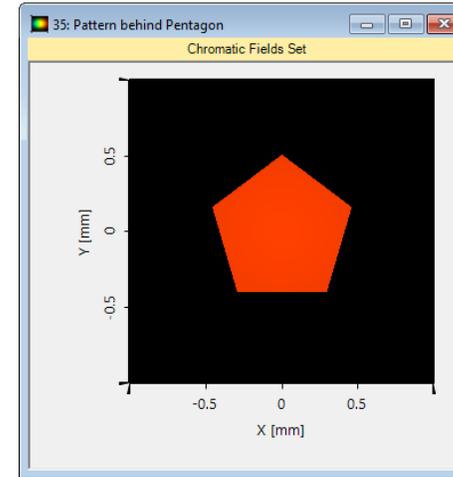
triangle



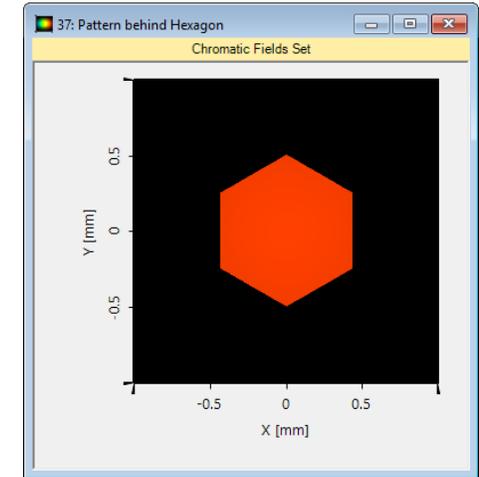
square



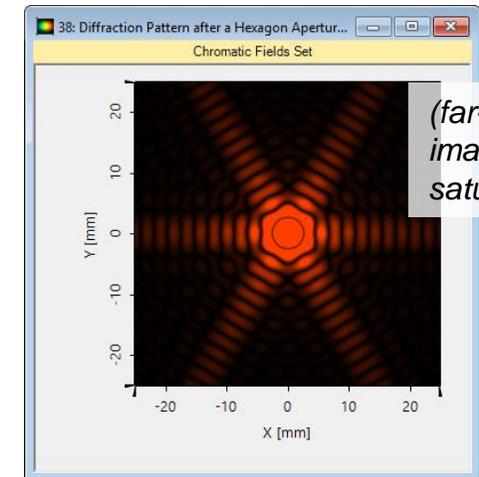
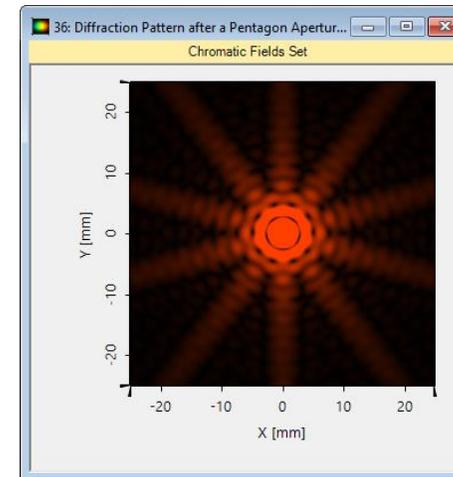
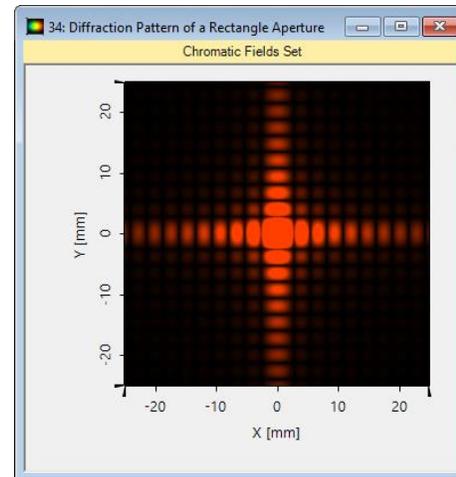
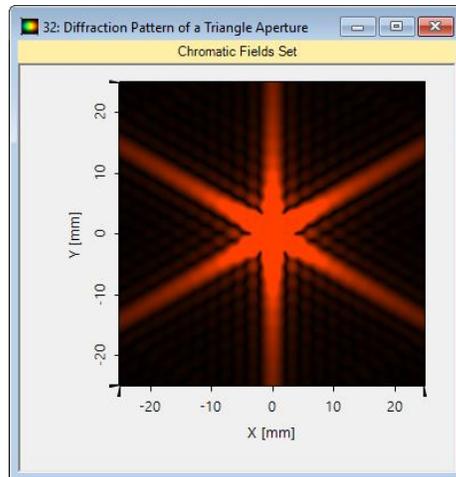
pentagon



hexagon



far-field



(far-field result images are saturated.)

Peek into VirtualLab Fusion

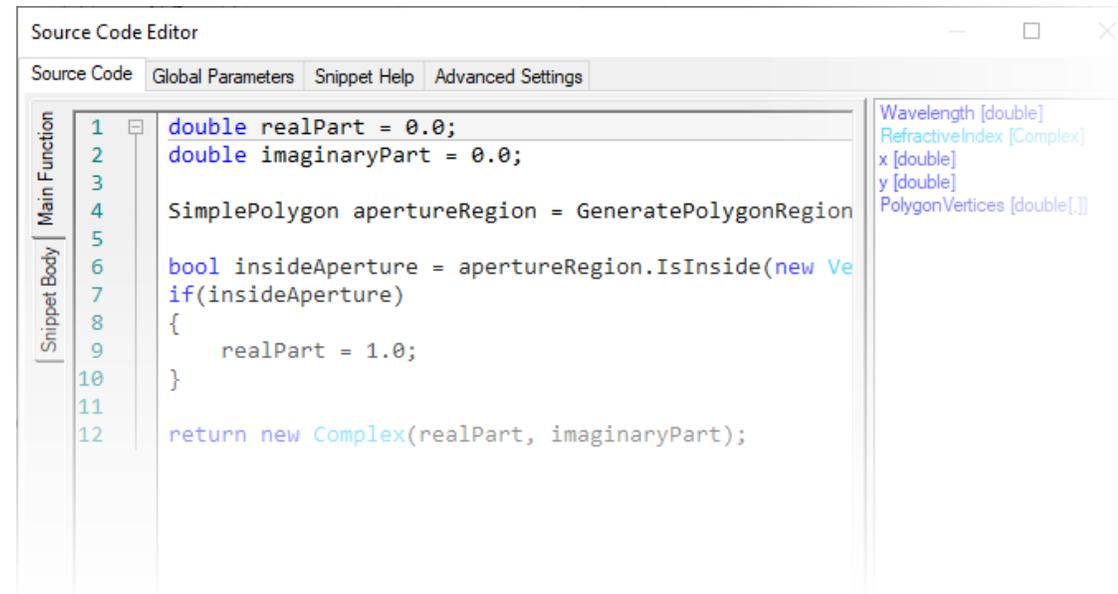
The screenshot displays the VirtualLab Fusion interface. The main workspace shows an optical setup with three components: a Gaussian Wave (0), a Square Aperture (1), and a Camera Detector (600). The Square Aperture is positioned at X: 0 mm, Y: 0 mm, and Z: 0 mm. The Camera Detector is positioned at X: 0 mm, Y: 0 mm, and Z: 3 m. A Rectangular Aperture (2) is also shown at X: 0 mm, Y: 0 mm, and Z: 0 mm. The Edit Aperture dialog box is open, showing the Basic Parameters tab with the Shape set to Rectangular and Diameter set to 500 μm x 1 mm. The far-field pattern calculation window (11: far-field) shows a Chromatic Fields Set with a diffraction pattern on a grid of X [mm] and Y [mm] axes, ranging from -10 to 10 mm.

convenient settings for aperture parameters

far-field pattern calculation with diffraction included

Workflow in VirtualLab Fusion

- Configure the Camera Detector
 - [Usage of Camera Detector](#) [Use Case]
- Specify or customize transmission functions
 - [How to Work with the Programmable Function & Example \(Cylindrical Lens\)](#) [Use Case]



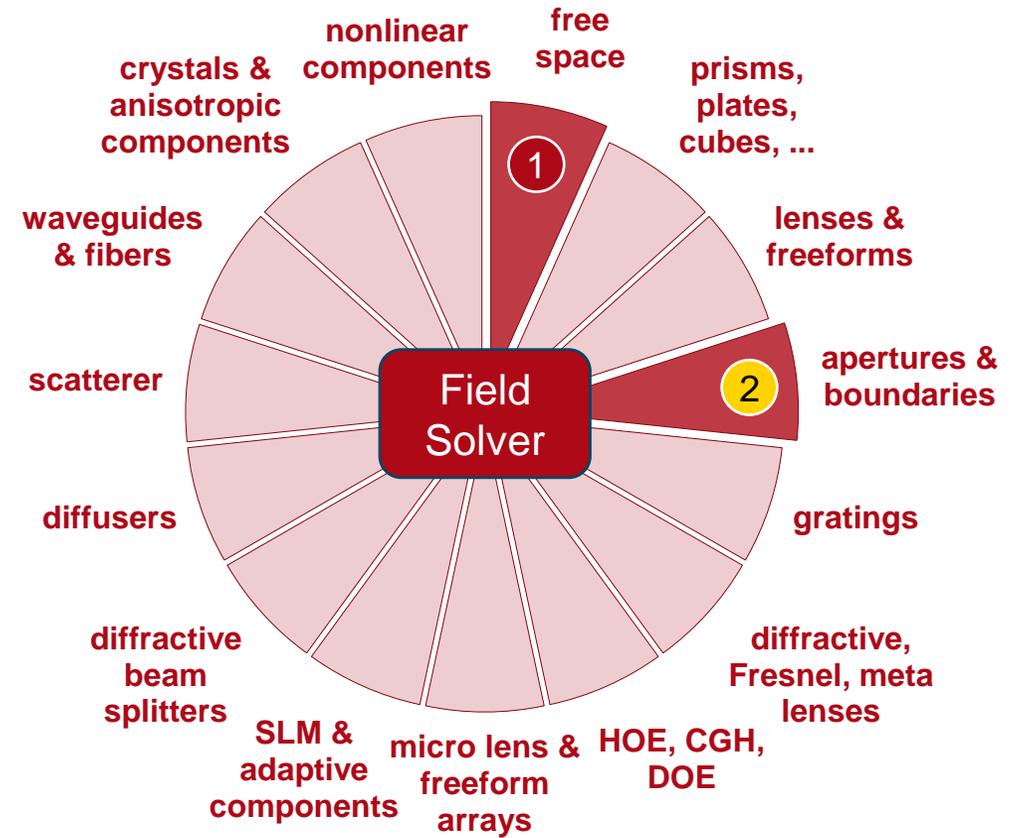
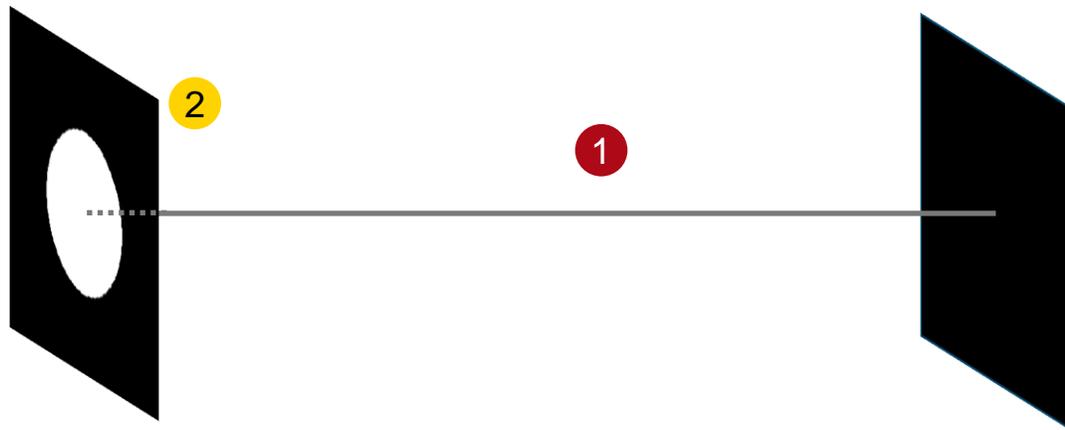
```
Source Code Editor
Source Code Global Parameters Snippet Help Advanced Settings

Main Function
Snippet Body

1 double realPart = 0.0;
2 double imaginaryPart = 0.0;
3
4 SimplePolygon apertureRegion = GeneratePolygonRegion
5
6 bool insideAperture = apertureRegion.IsInside(new Ve
7 if(insideAperture)
8 {
9     realPart = 1.0;
10 }
11
12 return new Complex(realPart, imaginaryPart);

Wavelength [double]
RefractiveIndex [Complex]
x [double]
y [double]
PolygonVertices [double[,] ]
```

VirtualLab Fusion Technologies



idealized component

Document Information

title	Diffraction Patterns behind Different Apertures
document code	MISC.0008
version	2.0
edition	VirtualLab Fusion Basic
software version	2020.1 (Build 1.202)
category	Application Use Case
further reading	<ul style="list-style-type: none">- Observation of Poisson Spot- Advanced PSF & MTF Calculation for System with Rectangular Aperture- Focal Spots for Different Aberrations