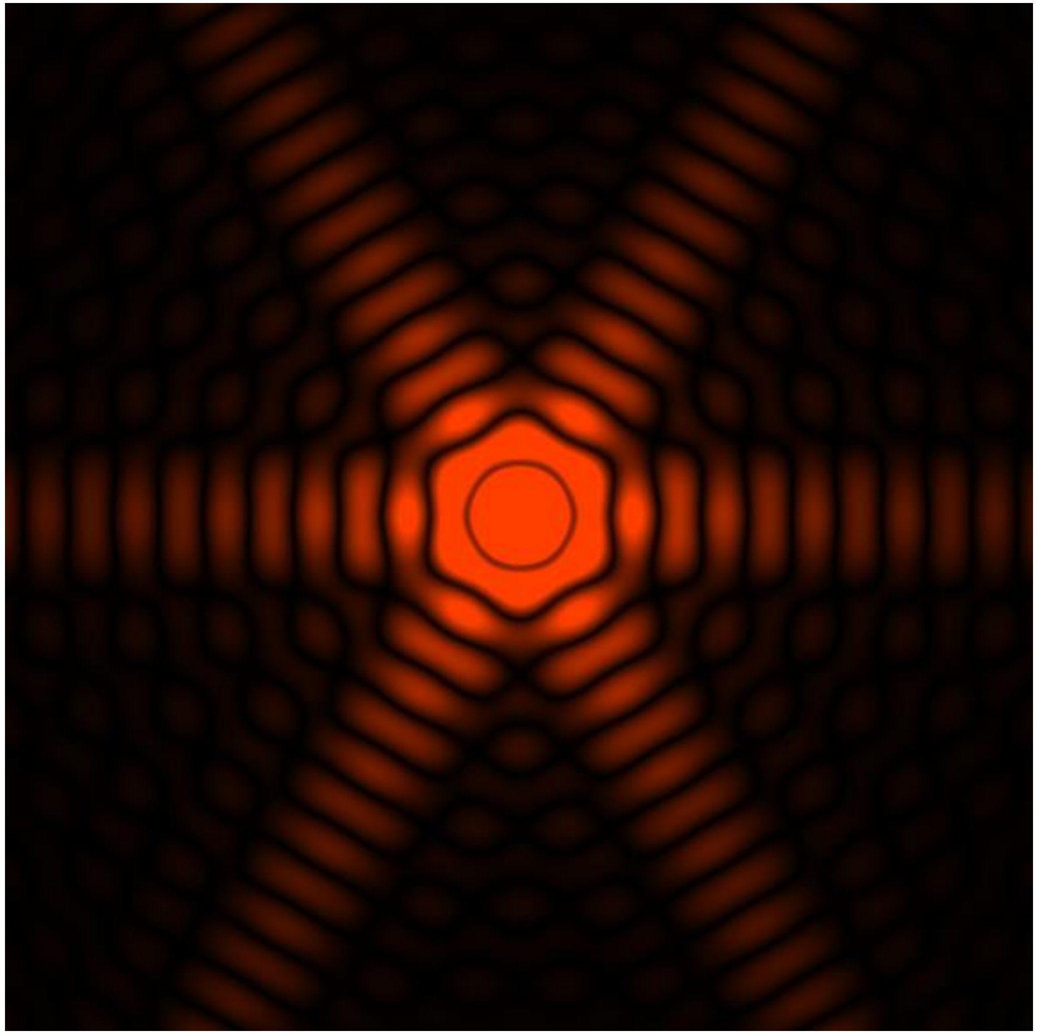
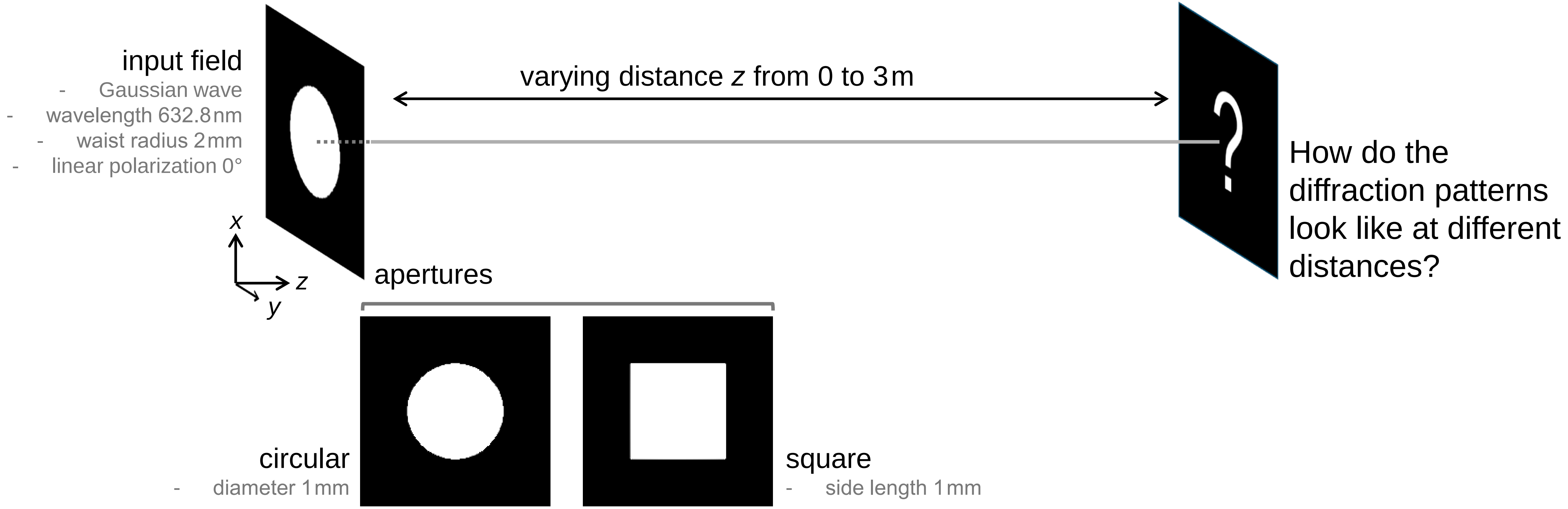
Diffraction Patterns behind Different Apertures

Abstract



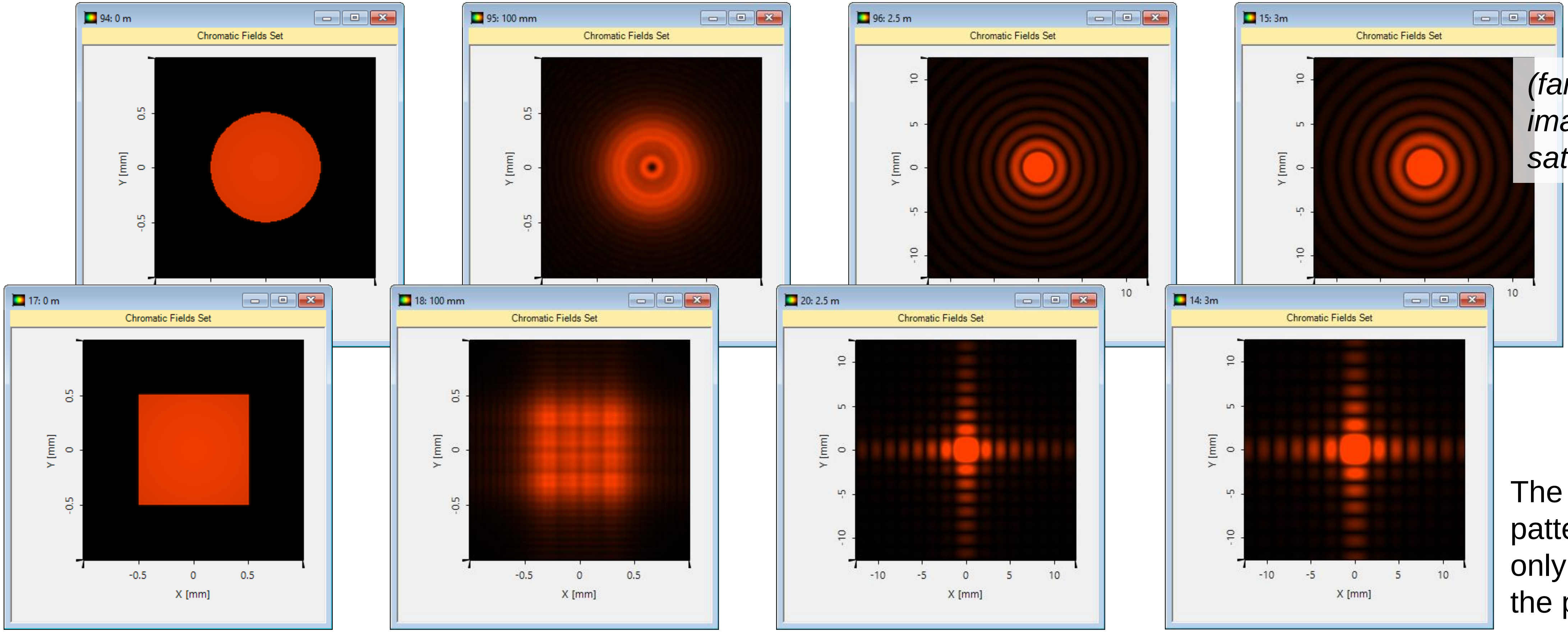
As one of the most well-known phenomena in physical optics, diffraction plays a role in various cases. VirtualLab Fusion, with its advanced propagation technologies, can handle diffraction effects in optical systems automatically. In this example, we selected some regular apertures, such as circular (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.)

z=0m
window size 2mm x 2mm

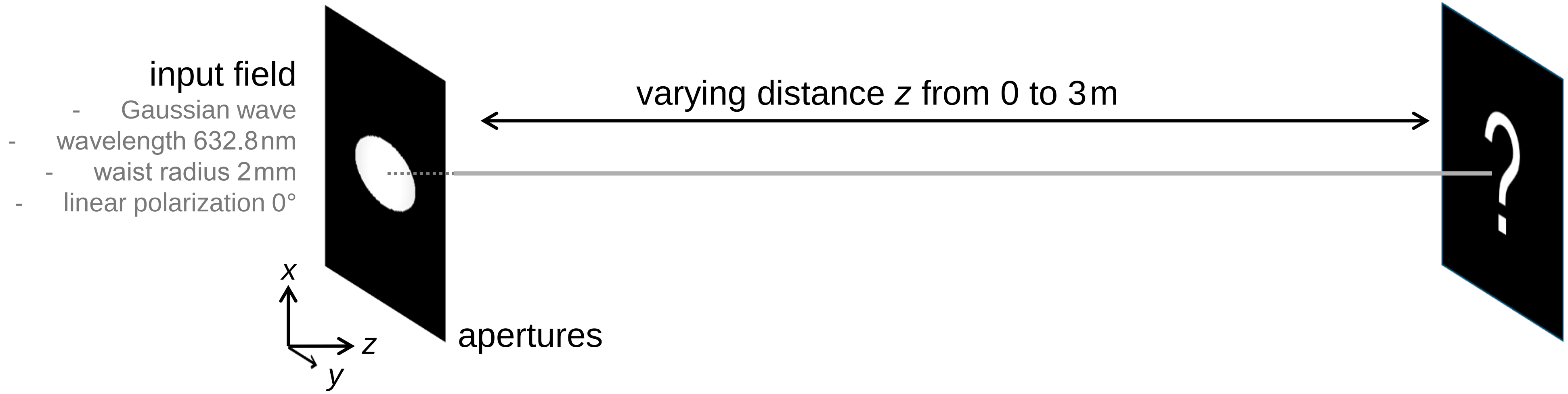
z=100mm
window size 2mm x 2mm

z=2.5m
window size 25mm x 25mm

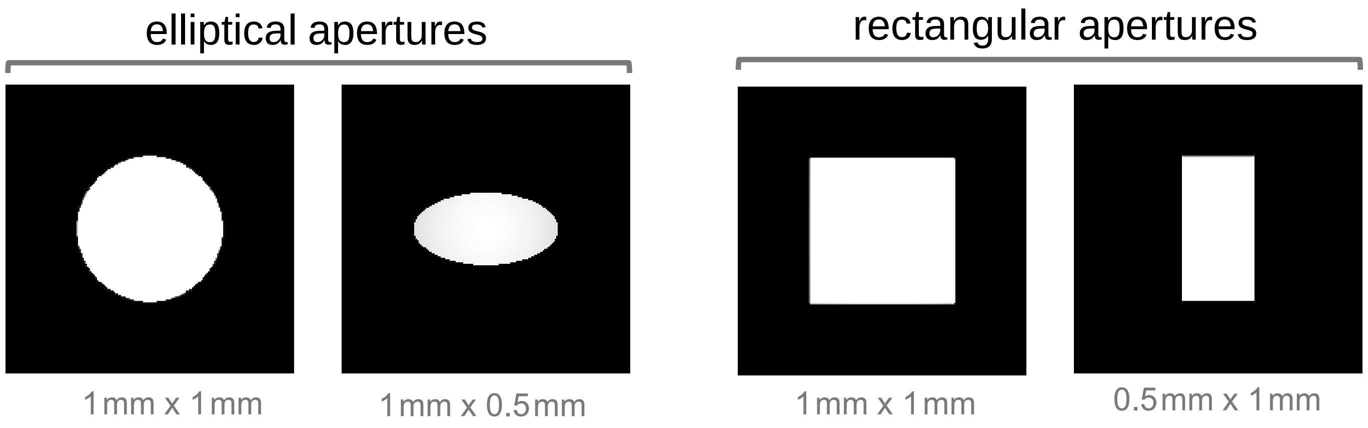
z=3m
window size 25mm x 25mm

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

Modeling Task for Asymmetric Apertures

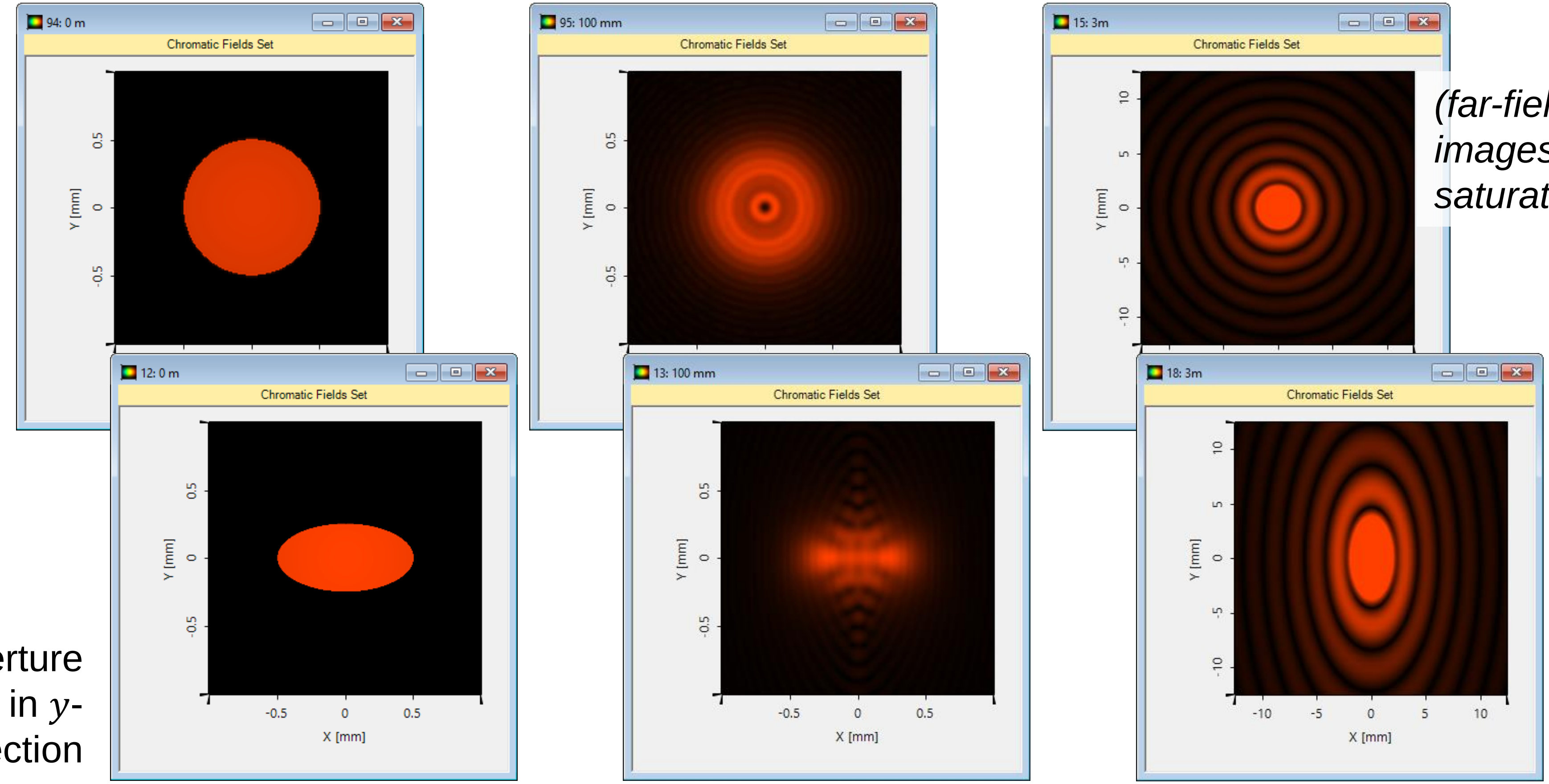


How do the diffraction patterns look like behind asymmetric apertures?



Fields after Elliptical Apertures

field behind aperture | near-field | far-field



(far-field result images are saturated.)

elliptical aperture compressed in y-direction

far-field pattern stretched in y-direction

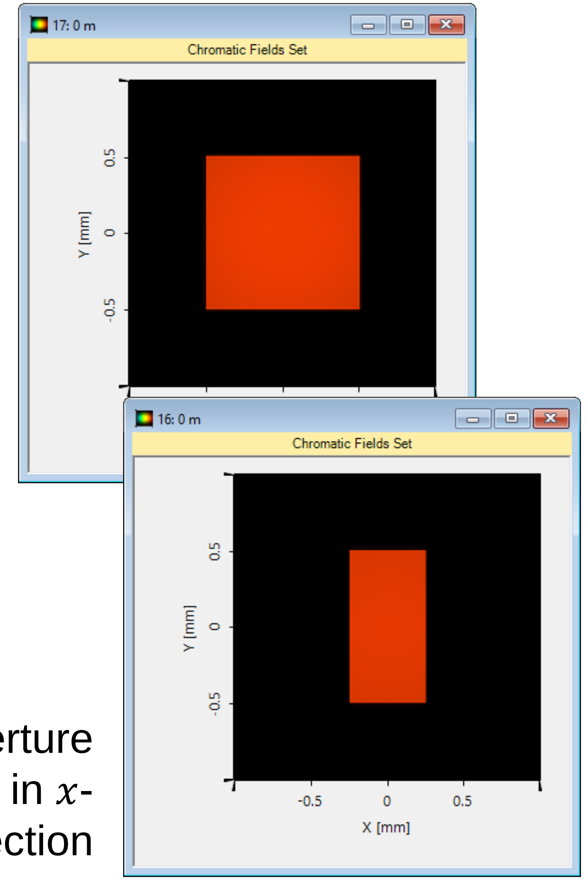
$z = 0\,\mathrm{m}$ | $z = 100\,\mathrm{mm}$ | $z = 3\,\mathrm{m}$

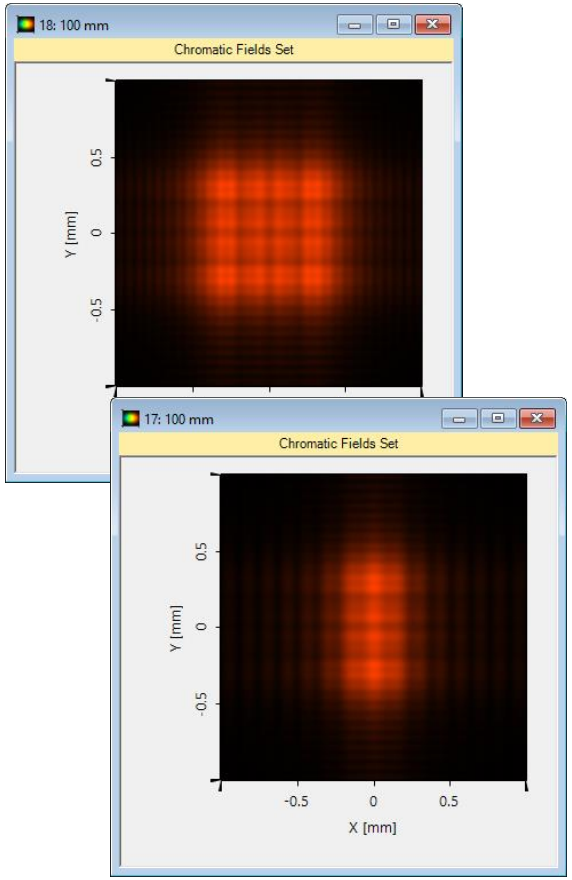
Fields after Rectangular Apertures

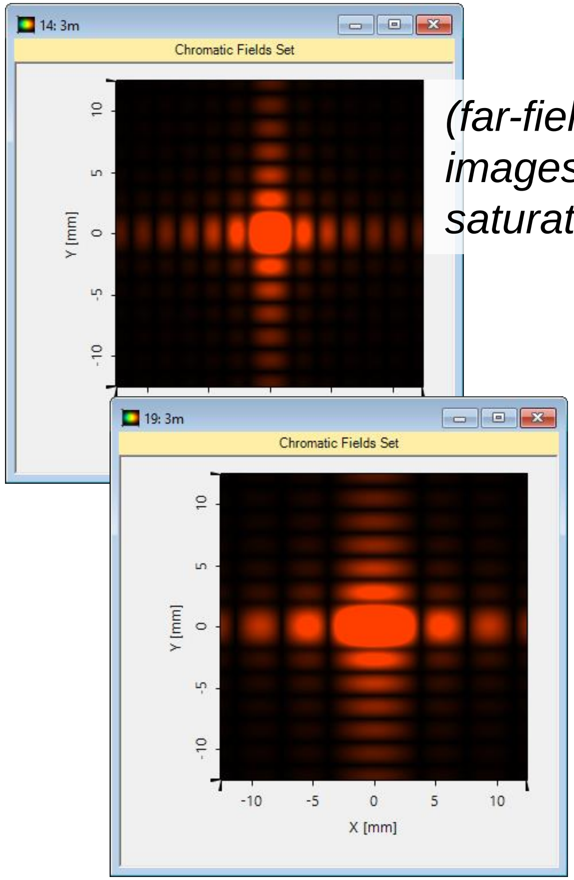
field behind aperture

near-field

far-field







(far-field result images are saturated.)

rectangular aperture compressed in x-direction

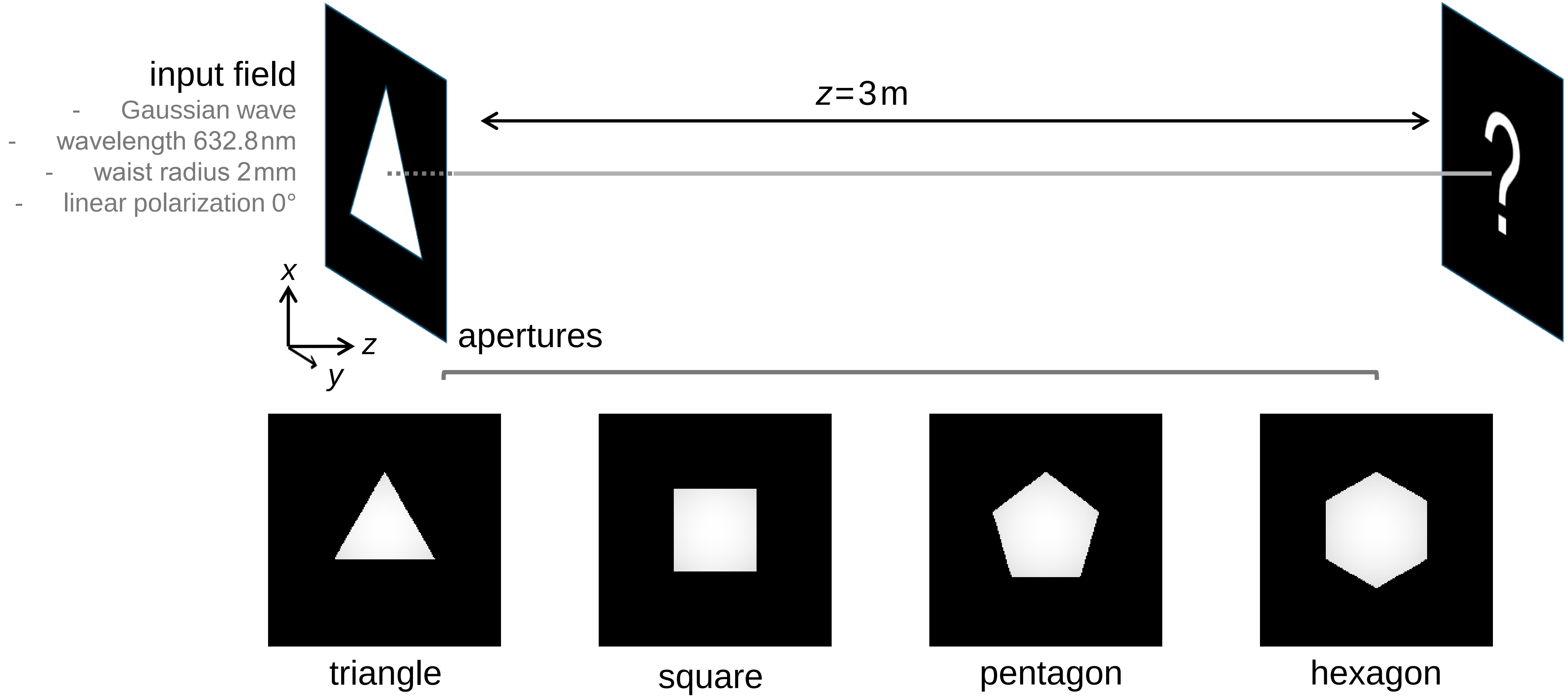
far-field pattern stretched in x-direction

z=0m

z=100mm

z=3m

Modeling Task for Polygonal Apertures



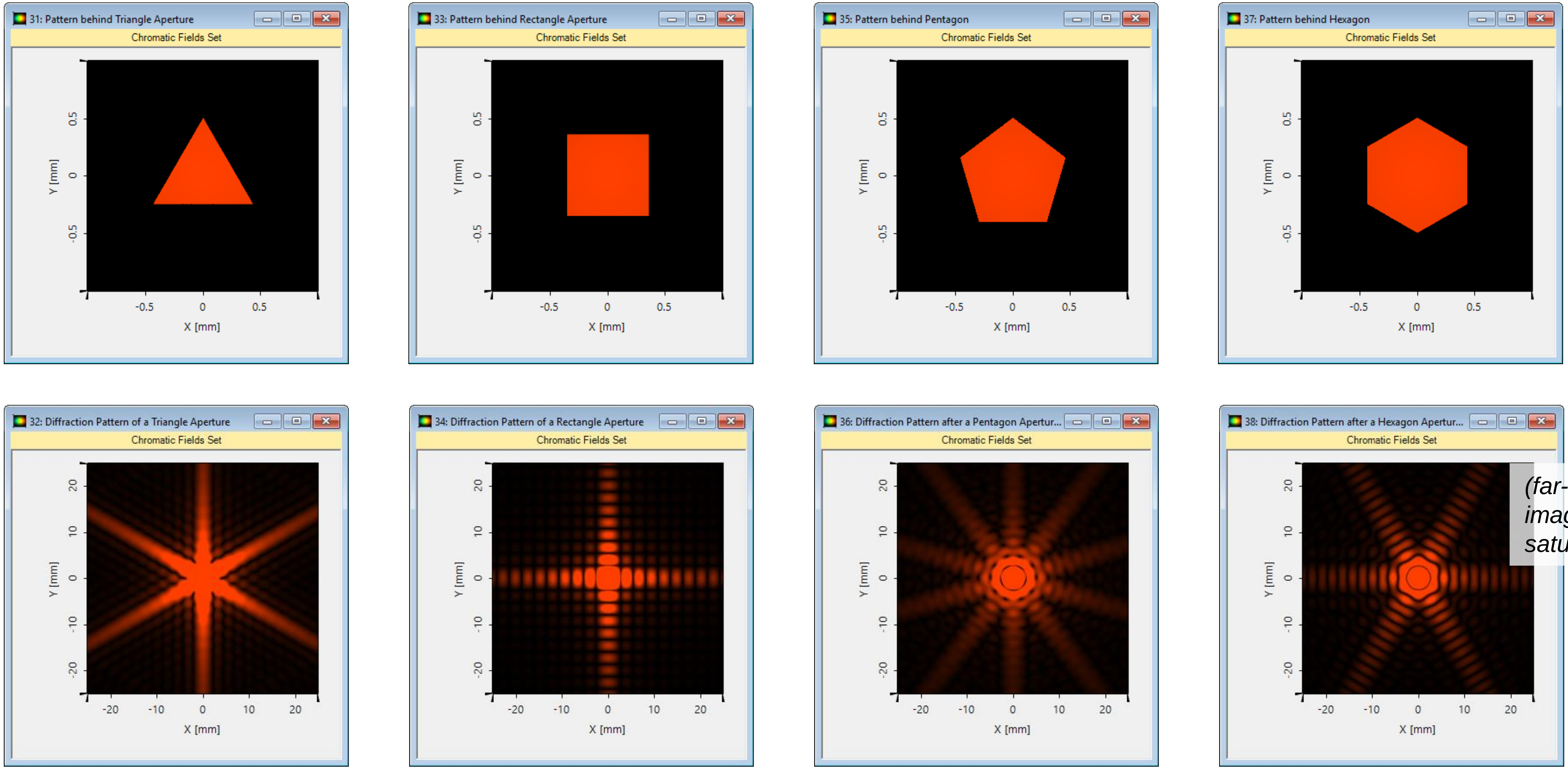
How do the diffraction patterns look like behind apertures with different shapes?

Fields after Polygonal Apertures

triangle | square | pentagon | hexagon

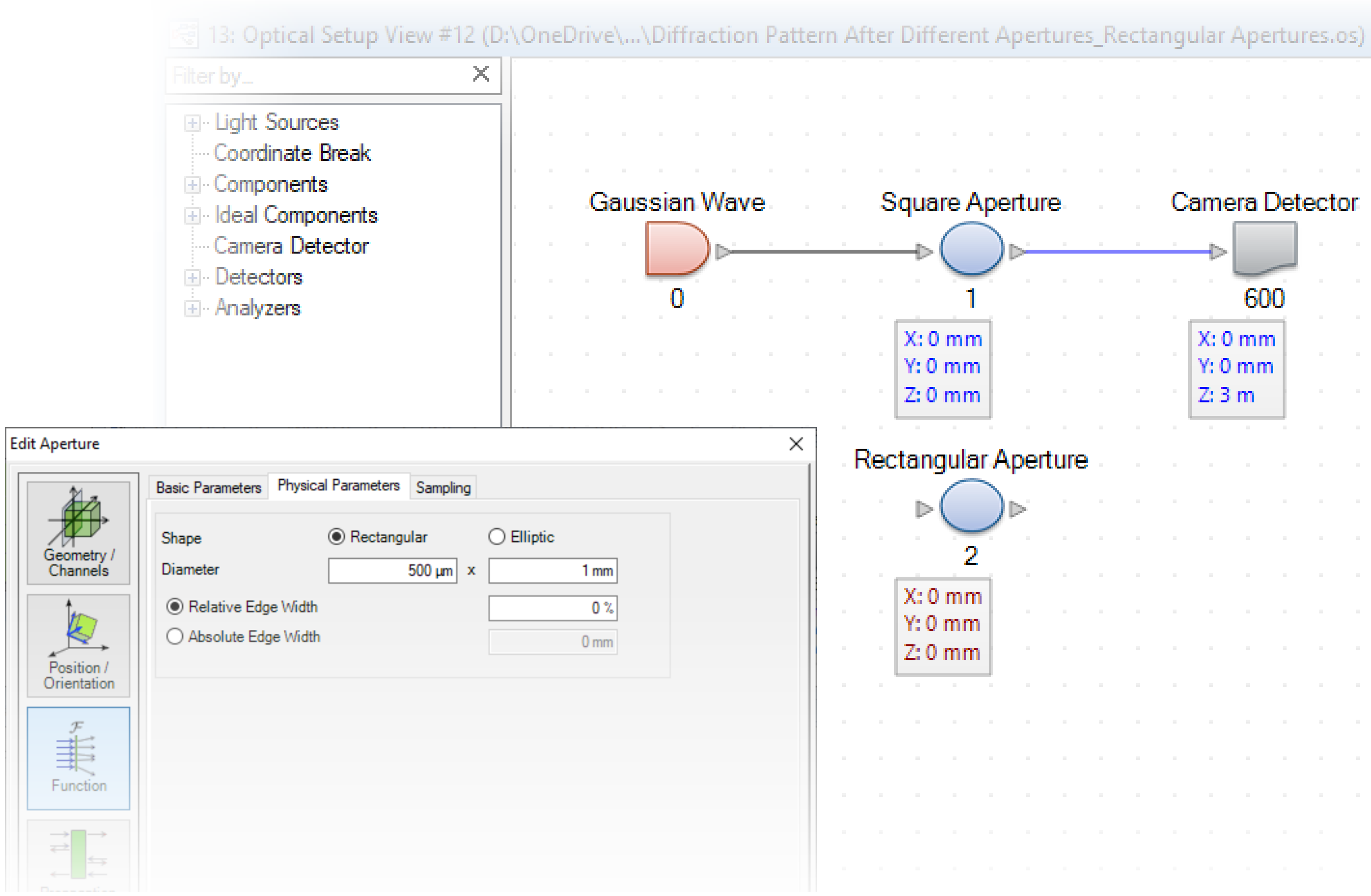
field behind aperture

far-field

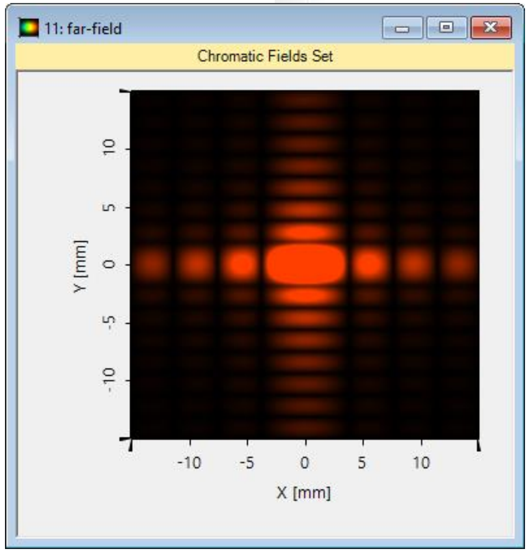


(far-field result images are saturated.)

Peek into VirtualLab Fusion



convenient settings for aperture parameters

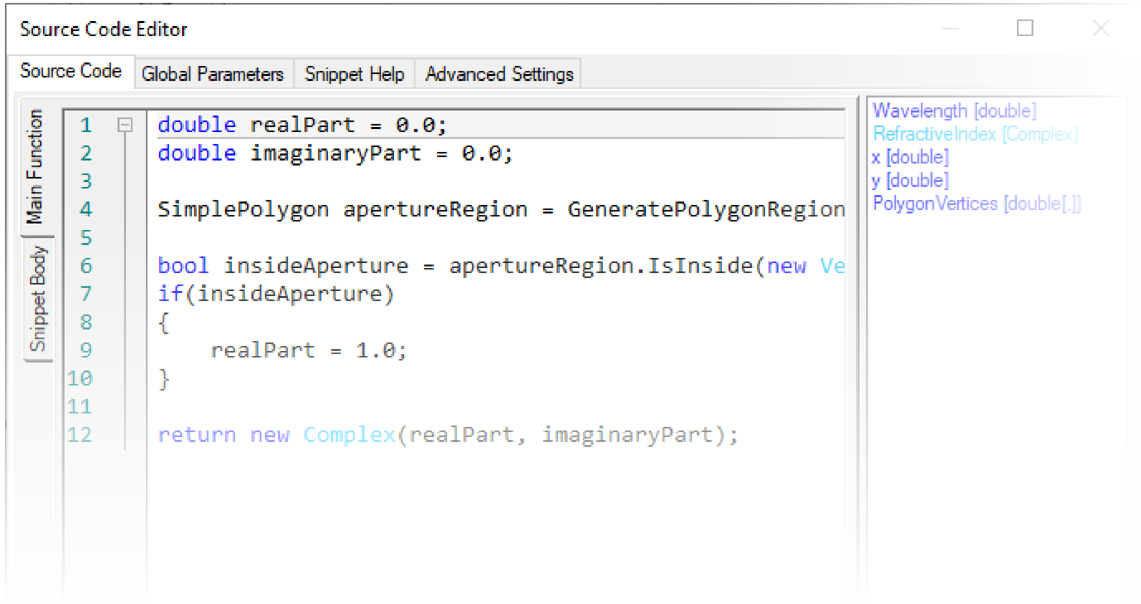


far-field pattern calculation with diffraction included

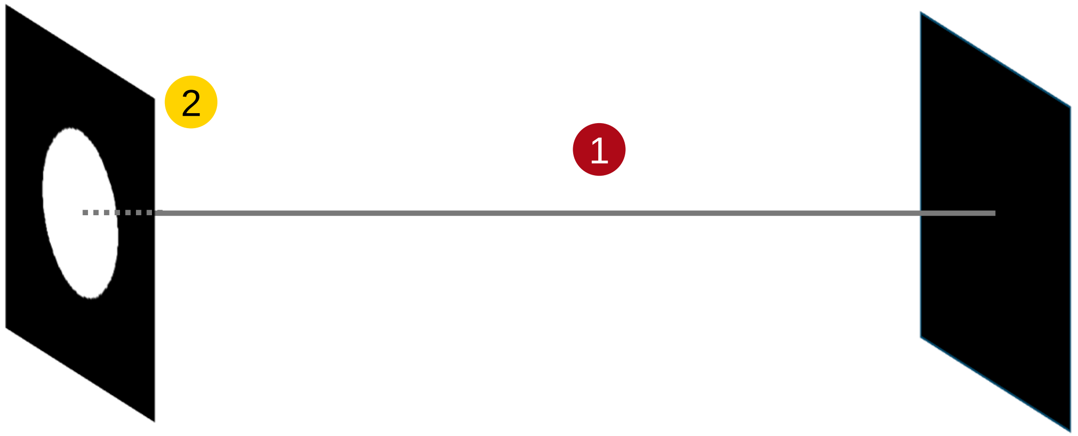
Workflow in VirtualLab Fusion

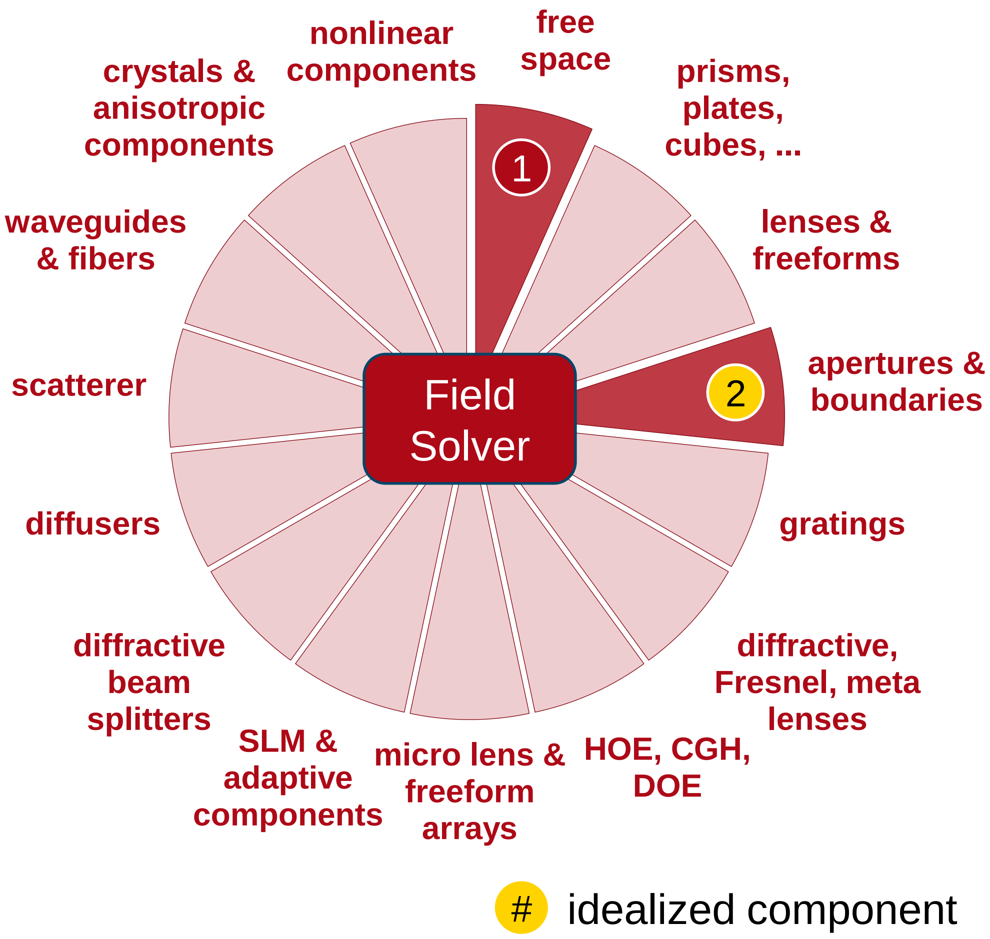
- Configure the Camera Detector
  - Usage of Camera Detector [Use Case]

- Specify or customize transmission functions
  - How to Work with the Programmable Function & Example (Cylindrical Lens) [Use Case]



VirtualLab Fusion Technologies





Document Information

title	Diffraction Patterns behind Different Apertures
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version	2.0
edition	VirtualLab Fusion Basic
software version	2020.1 (Build 1.202)
category	Application Use Case
further reading	- Observation of Poisson Spot - Advanced PSF & MTF Calculation for System with Rectangular Aperture - Focal Spots for Different Aberrations