Resolution Investigation for Microscope Objective Lenses by Rayleigh Criterion

Abstract


high-NA objective
USP 6519092B2
(NA=1.4)
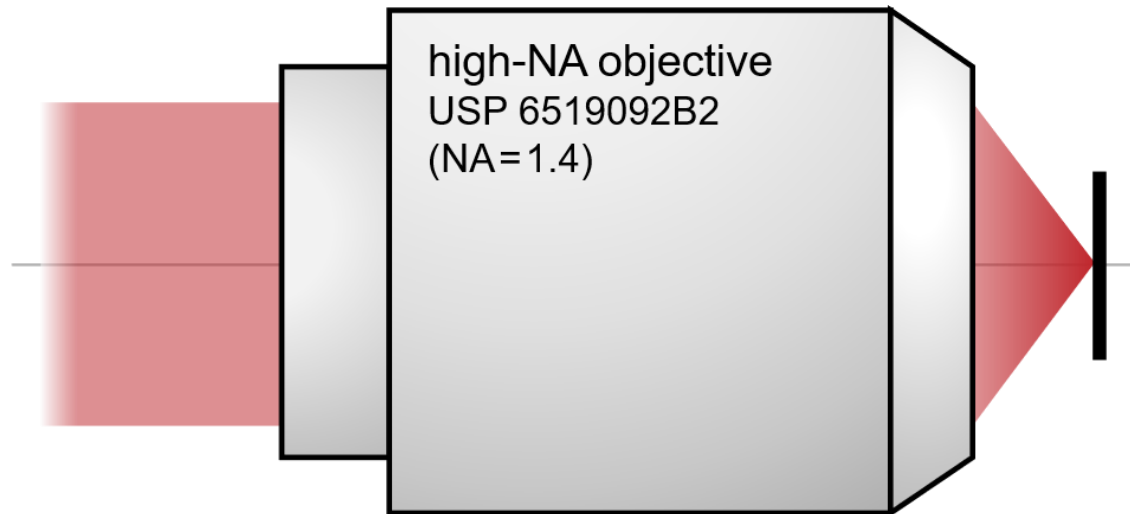
To characterize the resolution of a microscope, it is often practical to following the theory of "Rayleigh Criterion" which was invented by John William Strutt, 3rd Baron Rayleigh in 1896. The theory defines that when the center of one Airy pattern is just overlapped with the first minimum of another, then they can just be resolved. In this example, we follow Rayleigh's theory and check the resolution for microscopy objective lenses with different numerical aperture (NA) values.
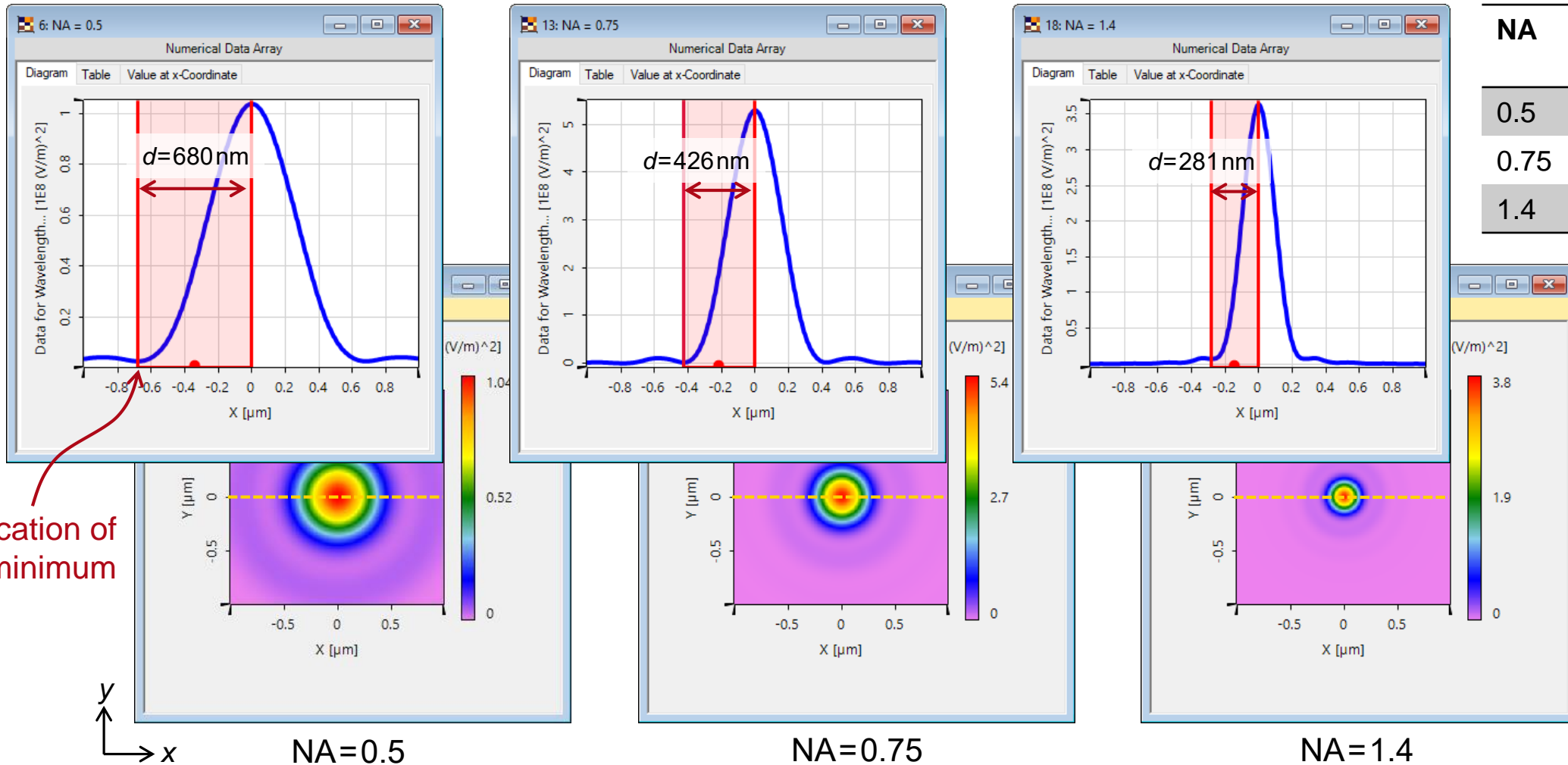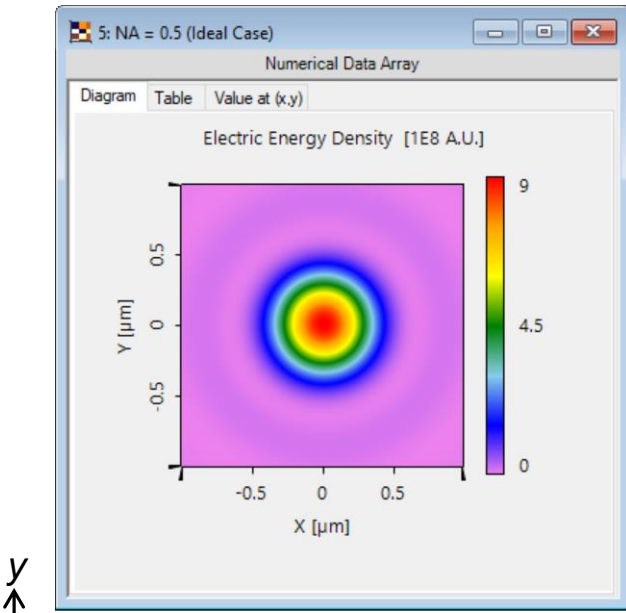
Modeling Task
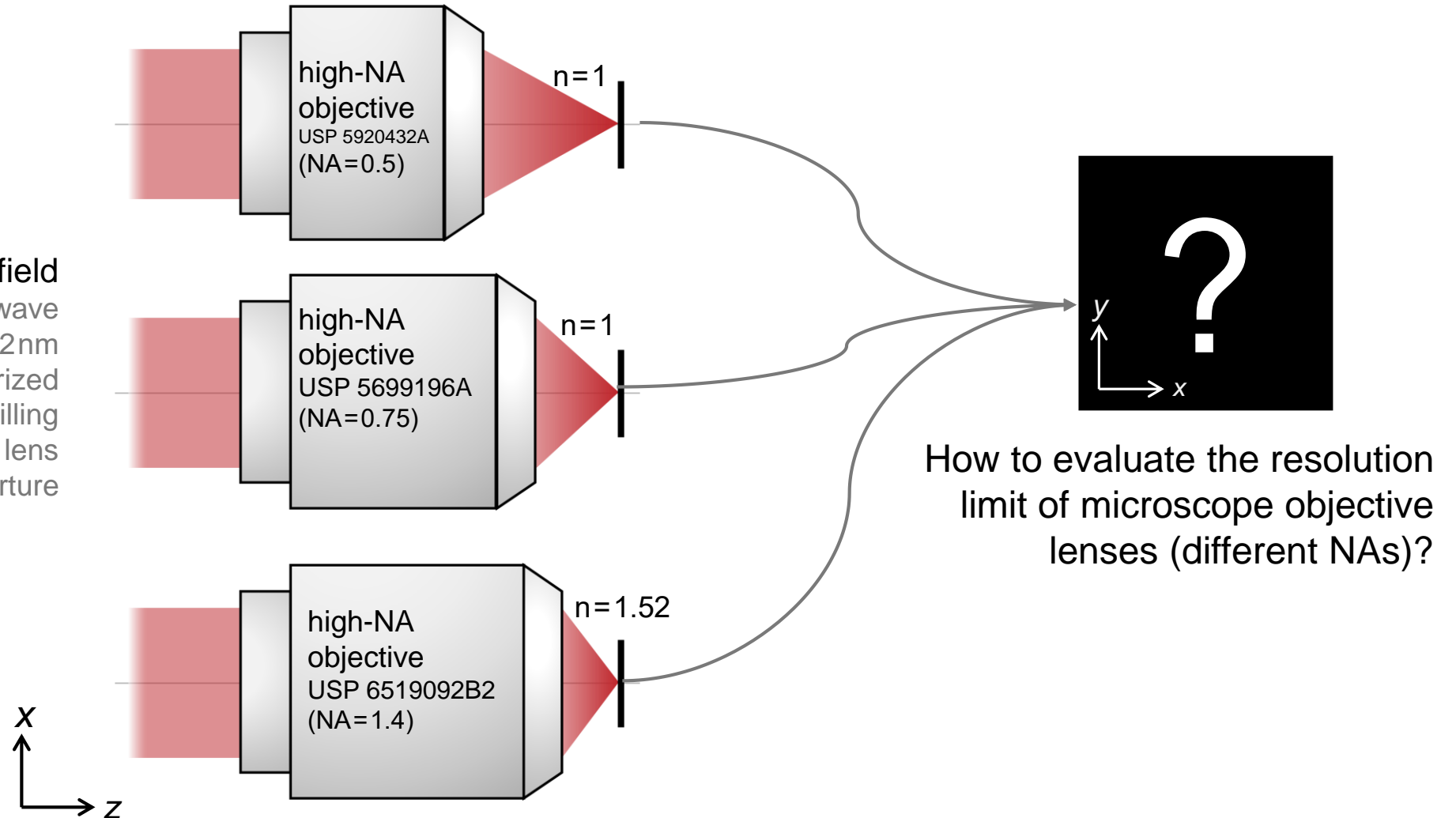
Evaluation of Real Objective Lenses
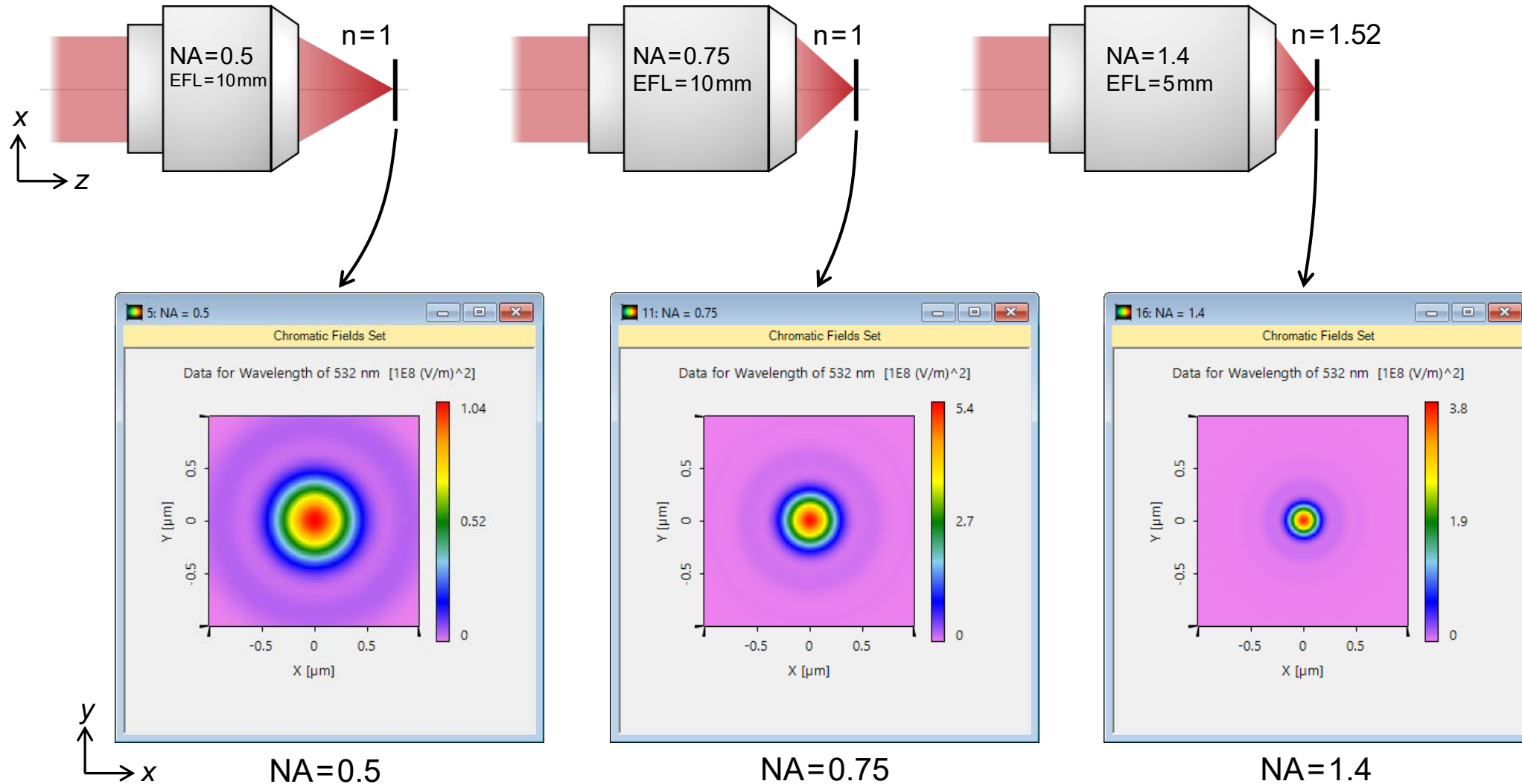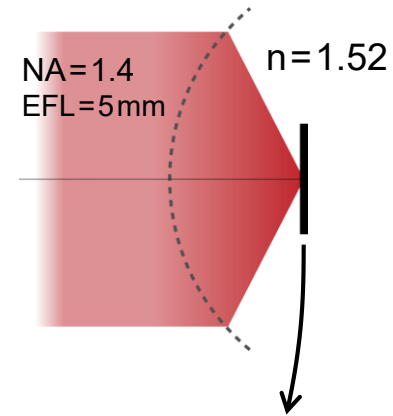

NA=0.5

NA=0.75

NA=1.4

Evaluation of Real Objective Lenses

NA	Rayleigh criterion D
0.5	649 nm
0.75	433 nm
1.4	232 nm

$$D = \frac{0.61\lambda}{\text{NA}}$$

location of first minimum

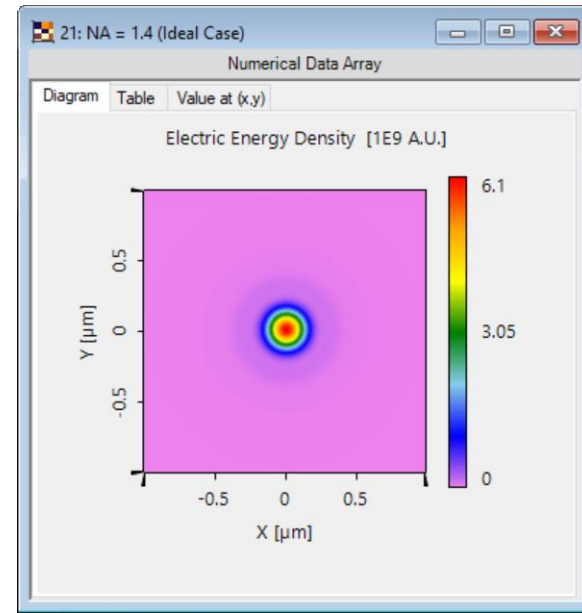NA=0.5   NA=0.75   NA=1.4

Evaluation of Idealized Lenses by Debye-Wolf Integral
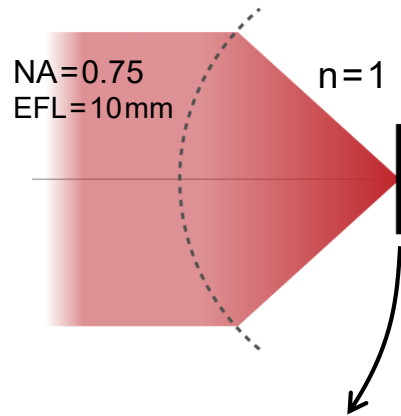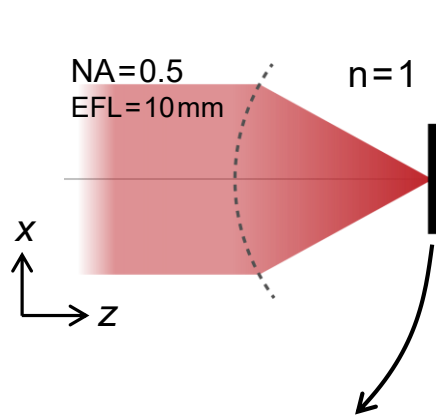
NA=0.5
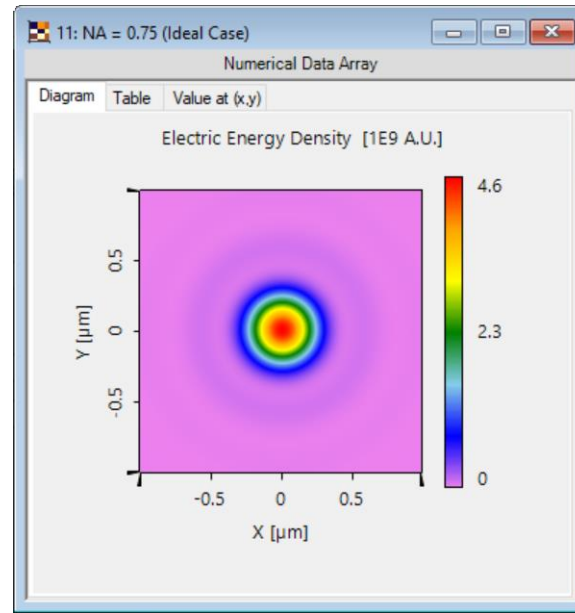
NA=0.75

NA=1.4

Evaluation of Idealized Lenses by Debye-Wolf Integral

NA	Rayleigh criterion D
0.5	649 nm
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NA = 1.4
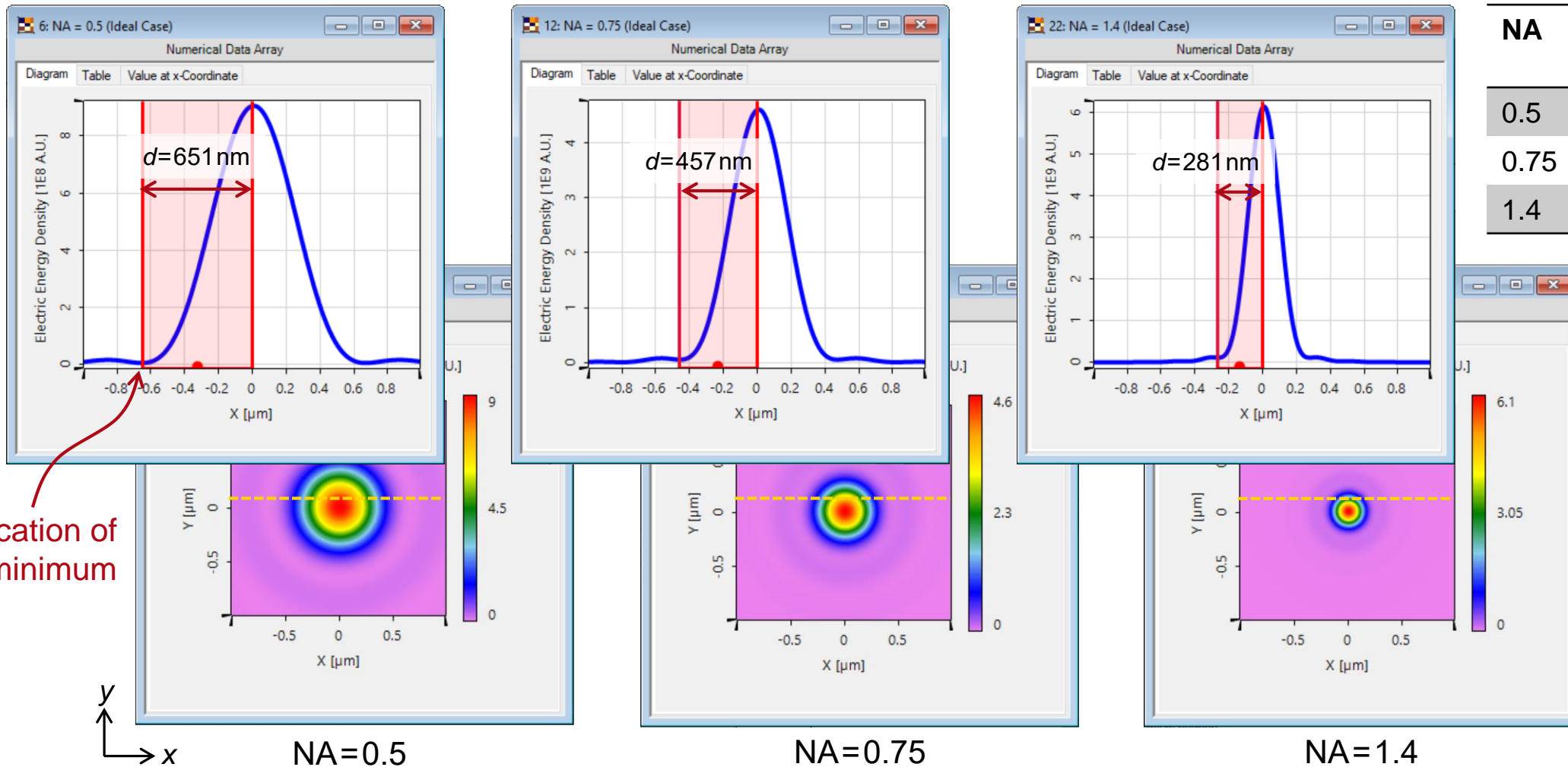
Peek into VirtualLab Fusion

import from Zemax OpticStudio®
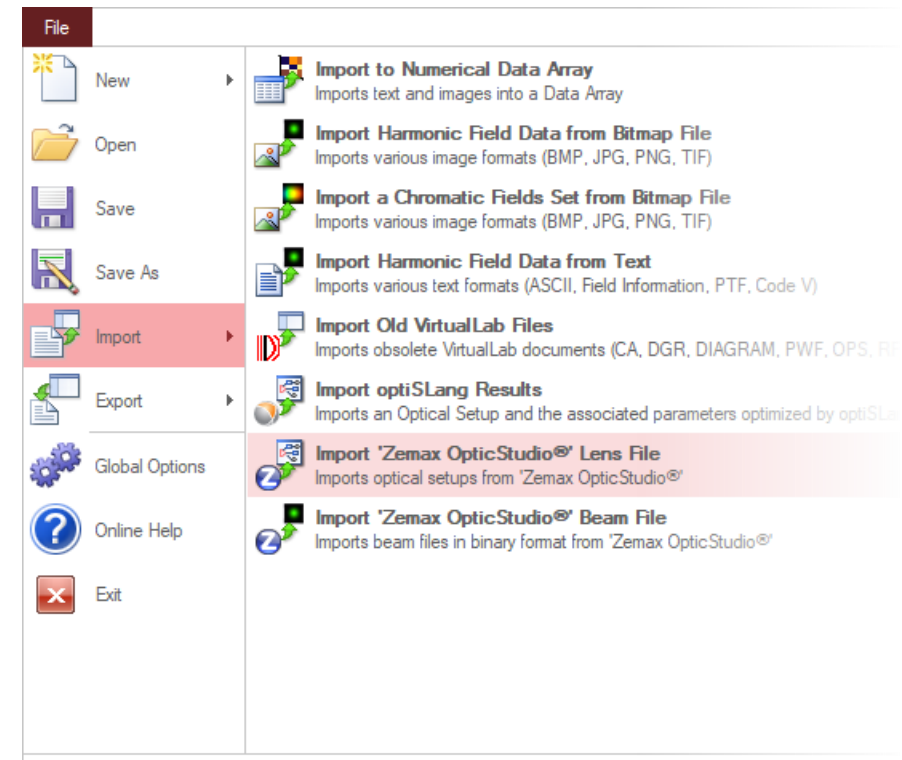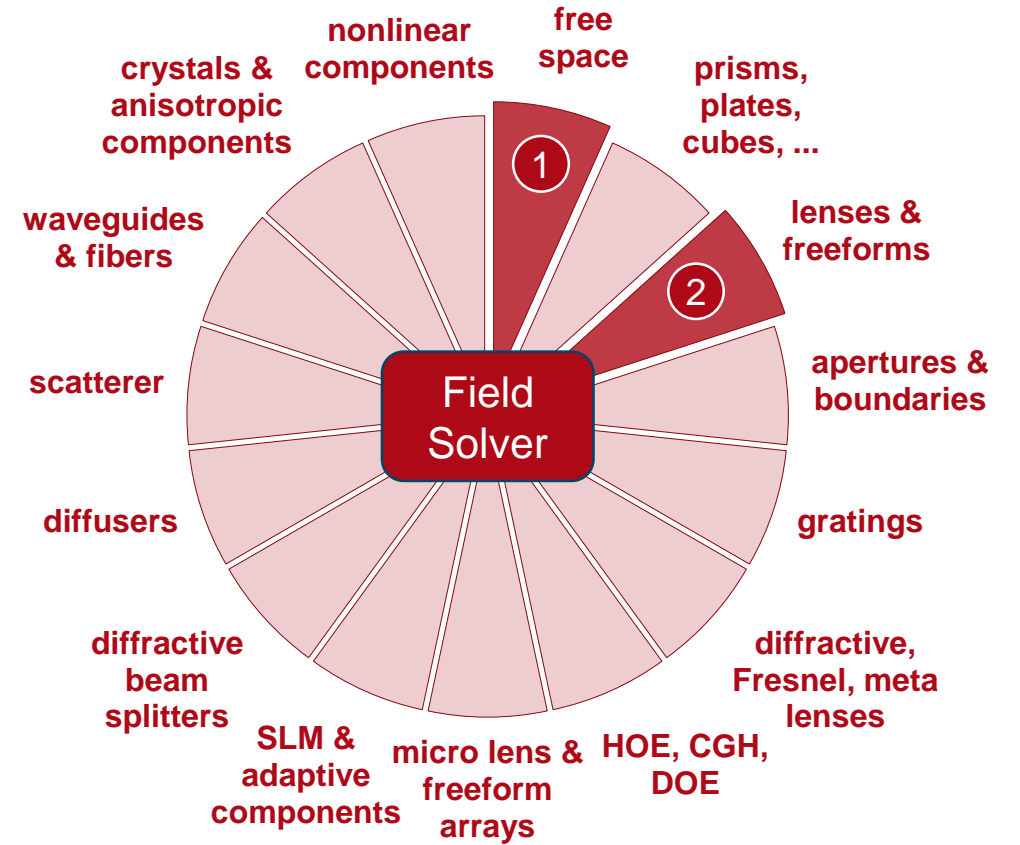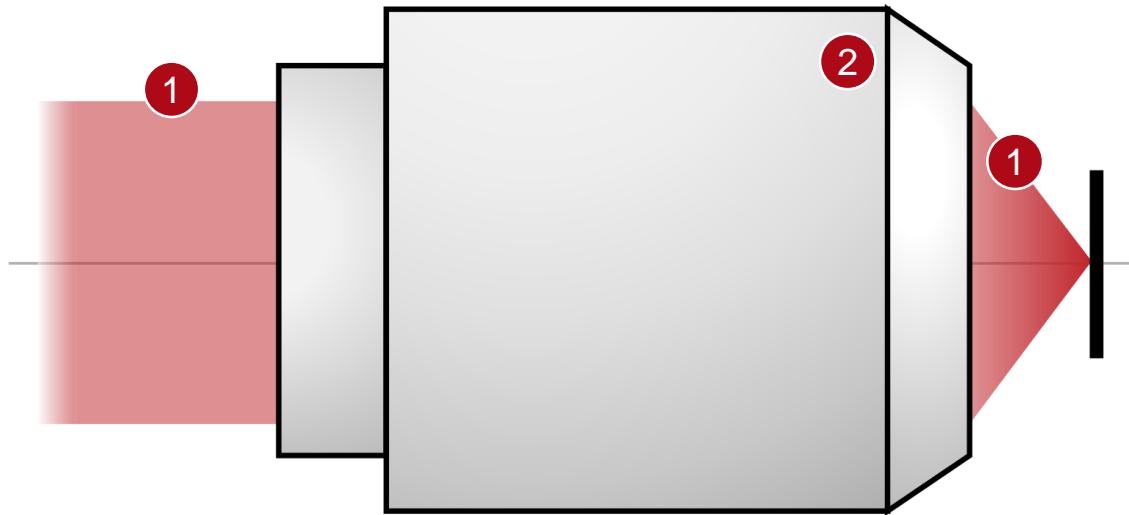
physical optics evaluation
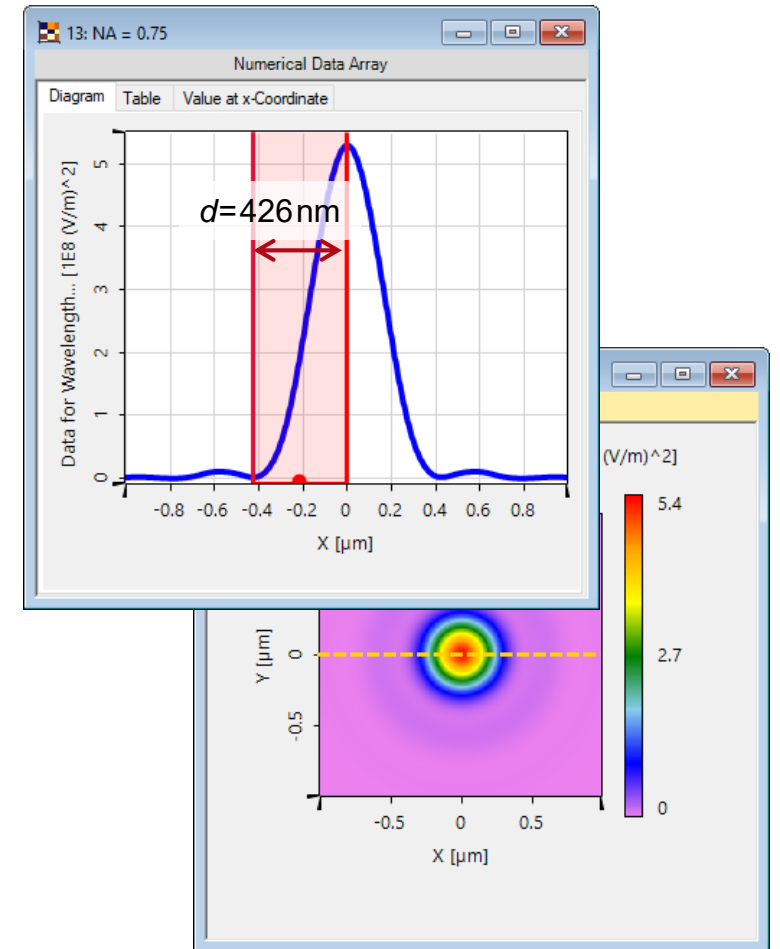
Workflow in VirtualLab Fusion

- Import lens systems from Zemax OpticStudio®
  - Import Optical Systems from Zemax [Use Case]

- Analyze imaging performance of real lens system
  - Analyzing High-NA Objective Lens Focusing [Use Case]

- Use Debye-Wolf integral as a reference
  - Debey-Wolf Integral Calculator [Use Case]

VirtualLab Fusion Technologies

Document Information

title	Resolution Investigation for Microscope Objective Lenses by Rayleigh Criterion
document code	MIC.0006
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	VirtualLab Fusion 2019 Summer Release (7.6.1.18)
category	Application Use Case
further reading	- Analyzing High-NA Objective Lens Focusing - Debye-Wolf Integral Calculator - Investigation of Idealized Vectorial Focusing Situation Using Debye-Wolf Integral