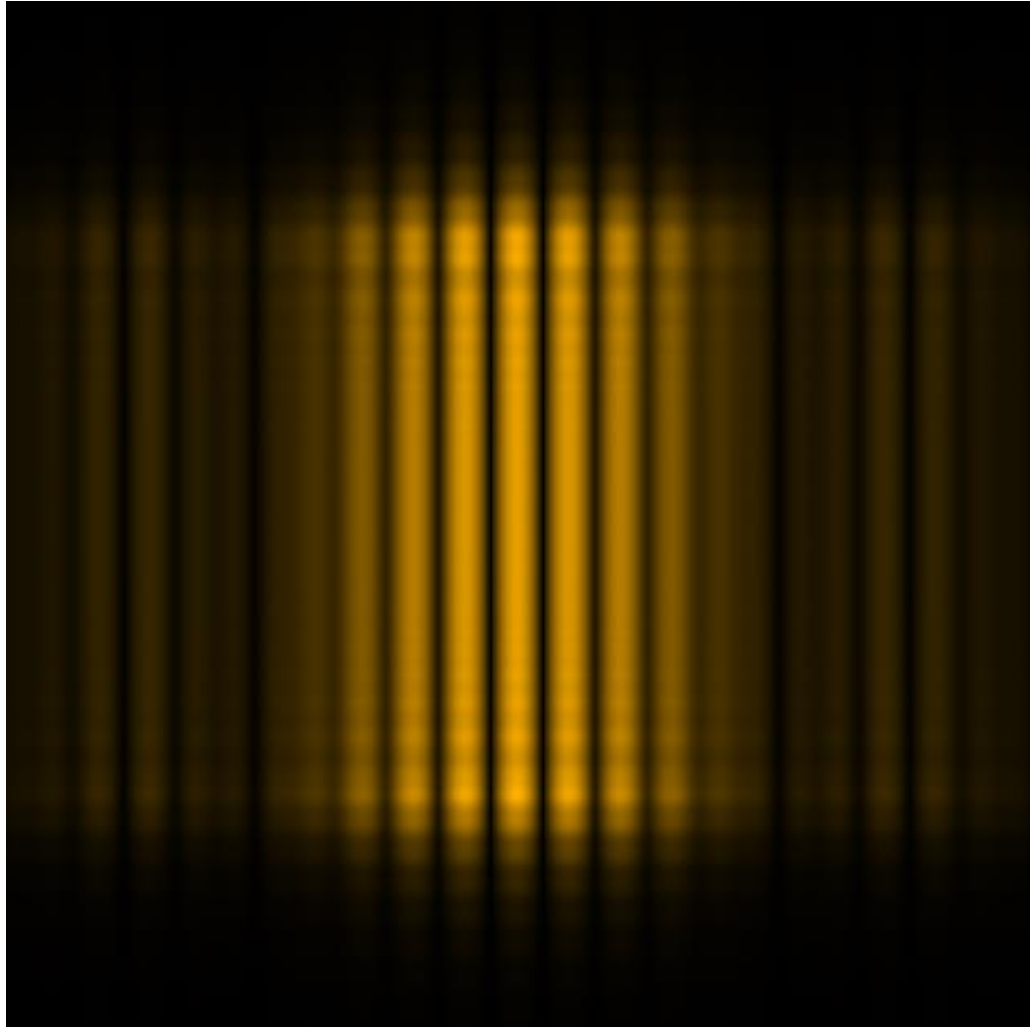


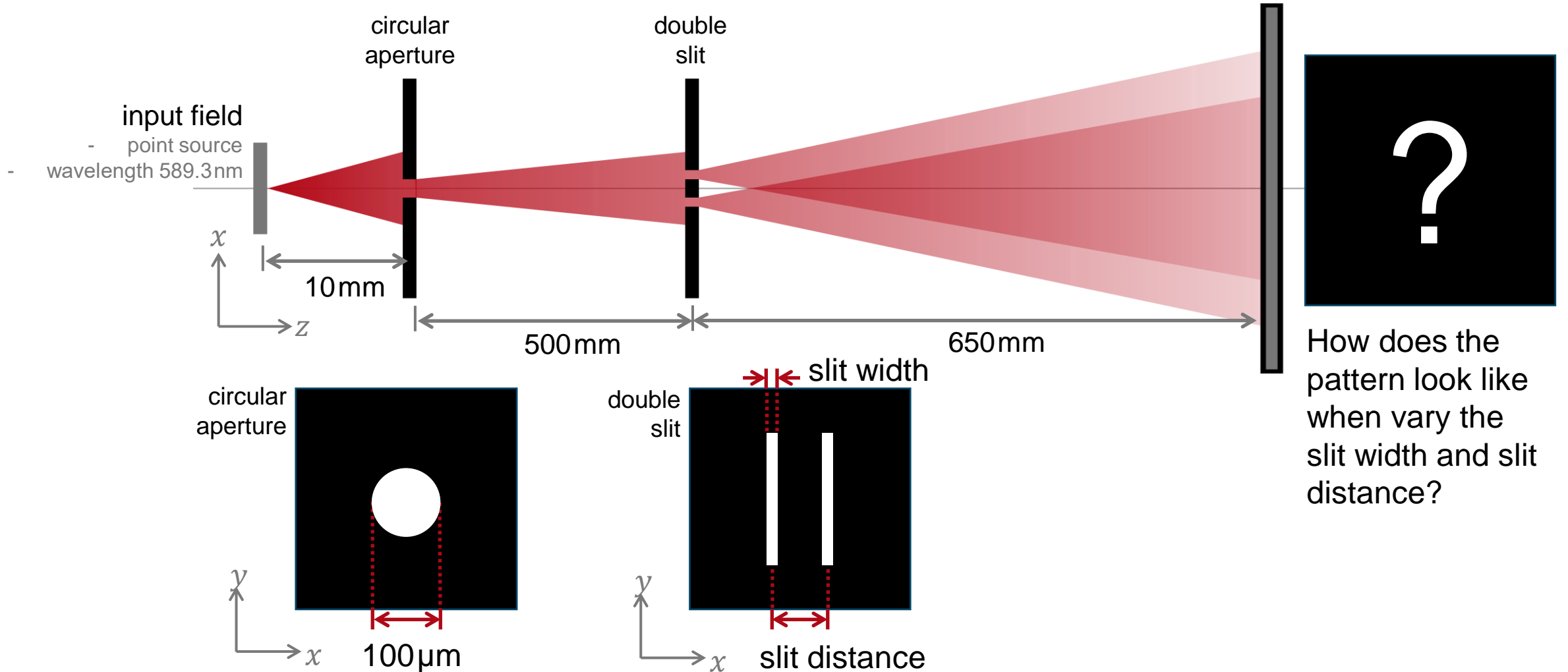
Young's Interference Experiment

Abstract

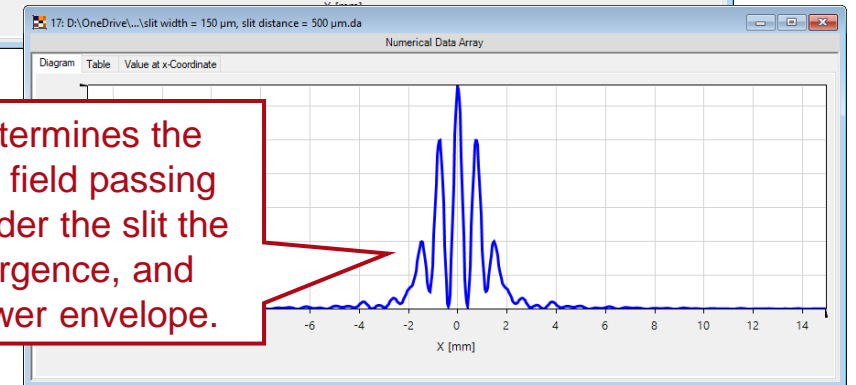
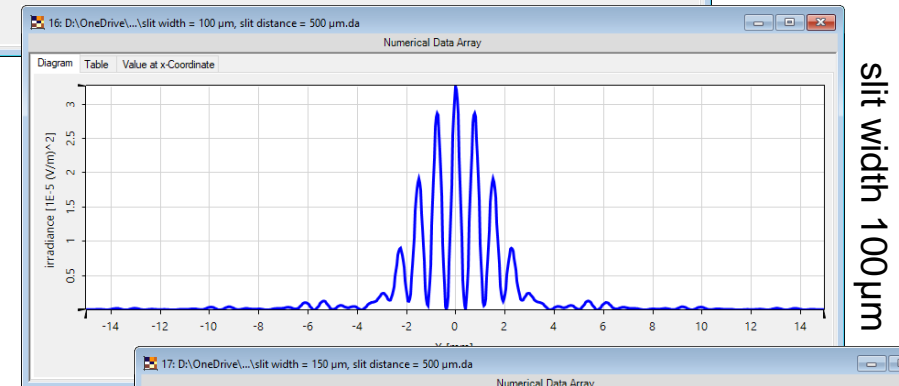
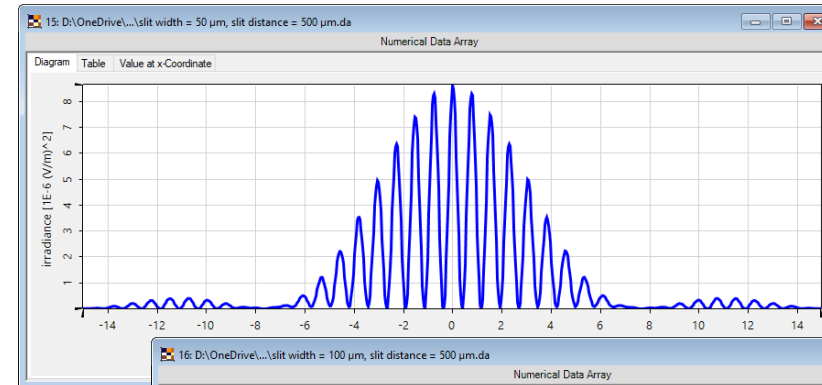
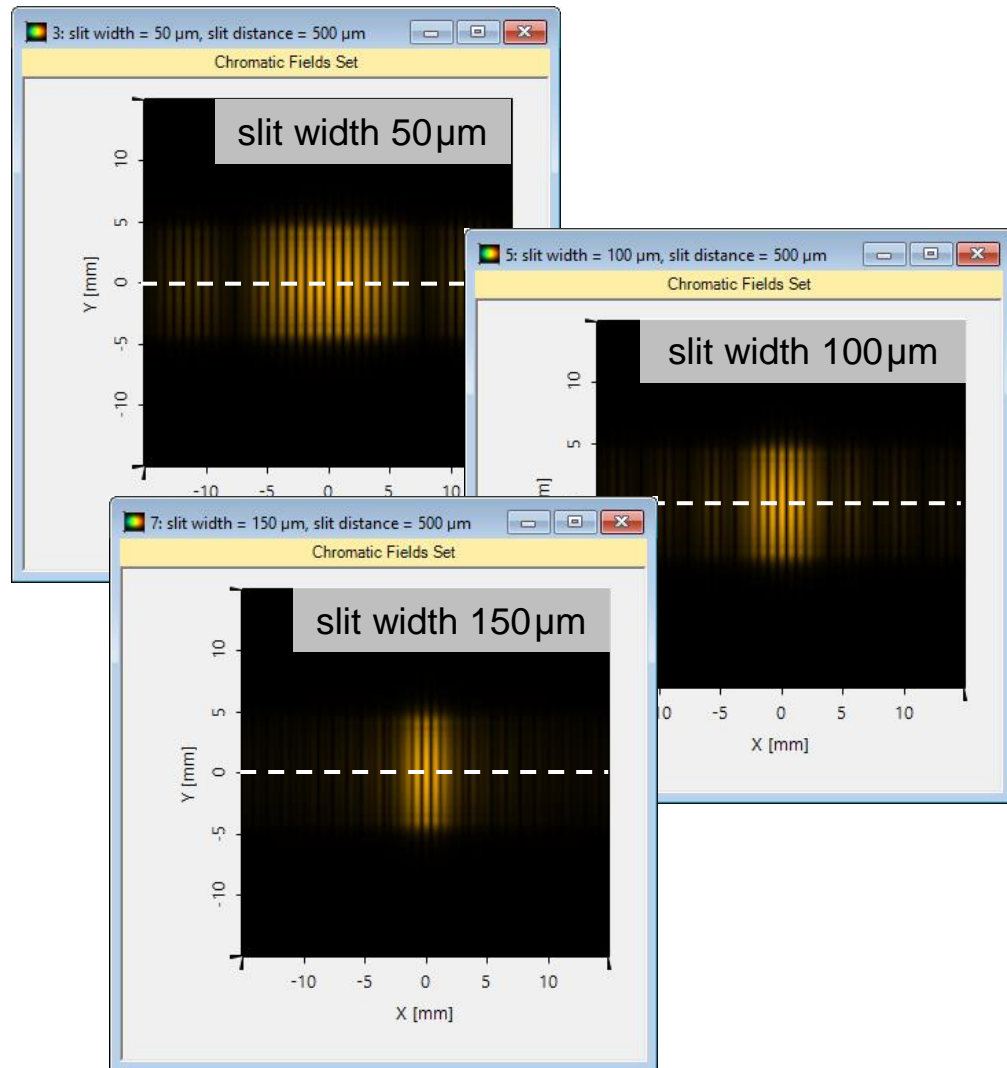


The Young's interference experiment was one of the well-known experiments that shows the wave nature of light. It is the fundamental of several quantum optics experiments nowadays. We reproduce this famous experiment in VirtualLab Fusion, by using a double slit with adjustable slit width and slit distance. With a single point source, we examine the influence from the slit width and the slit distance on the interference; then with an extended source we observe how the interference contrast changes with the lateral extension of the source.

Modeling Task – Single on-Axis Point Source

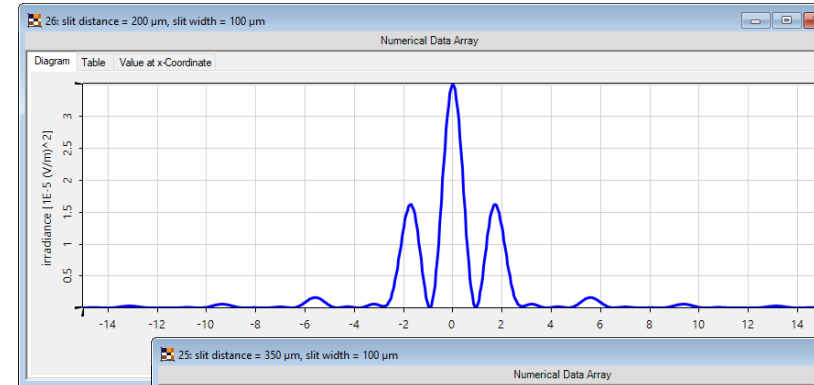
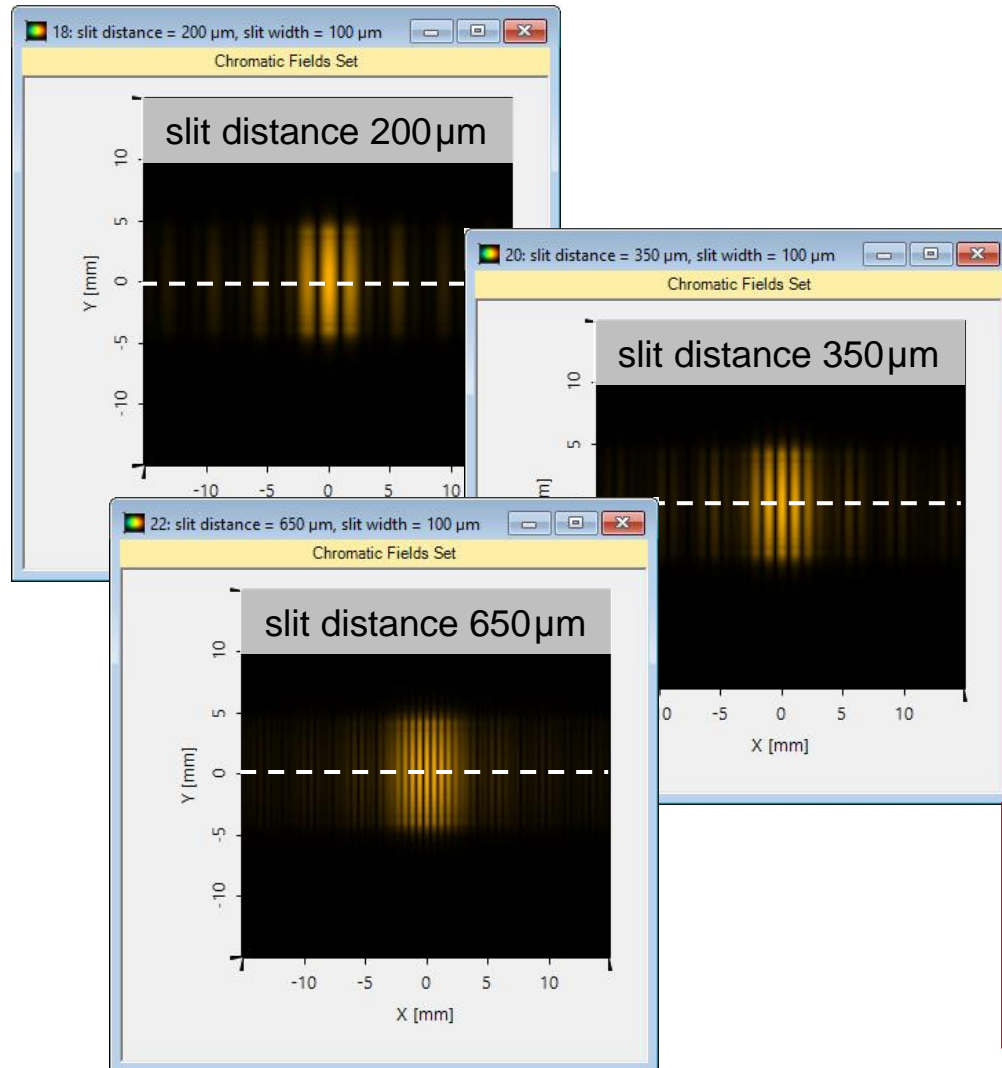


Fix Slit Distance ($500\ \mu\text{m}$) and Vary Slit Width

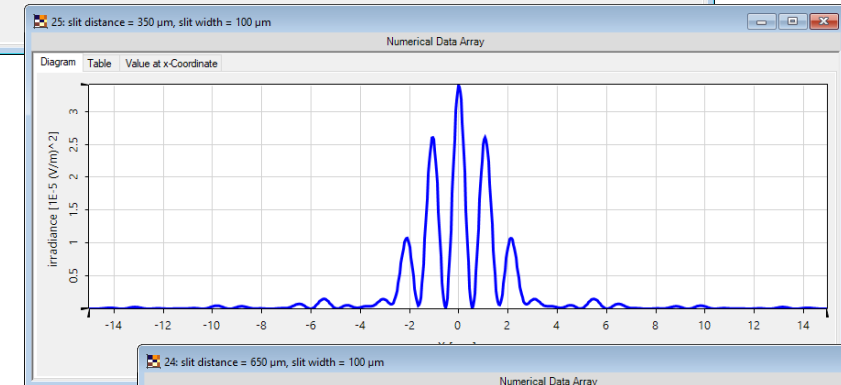


The slit width determines the divergence of the field passing through it – the wider the slit the smaller the divergence, and therefore a narrower envelope.

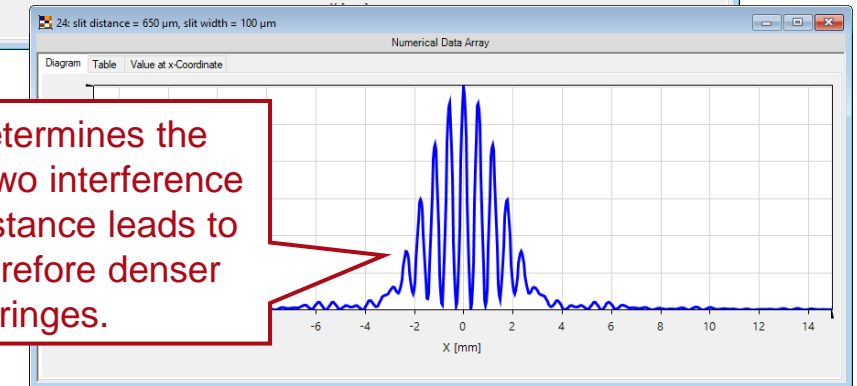
Fix Slit Width ($100\ \mu\text{m}$) and Vary Slit Distance



slit distance $200\ \mu\text{m}$



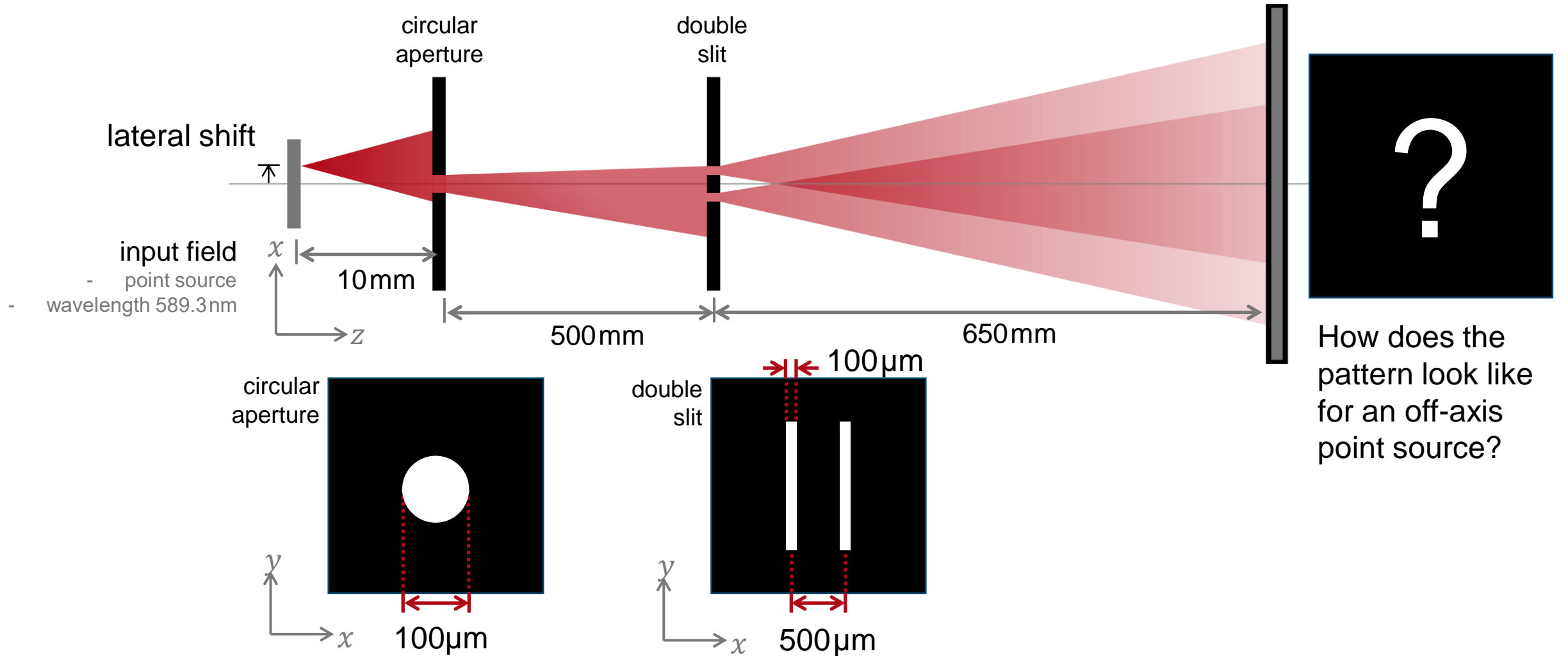
slit distance $350\ \mu\text{m}$



slit distance $650\ \mu\text{m}$

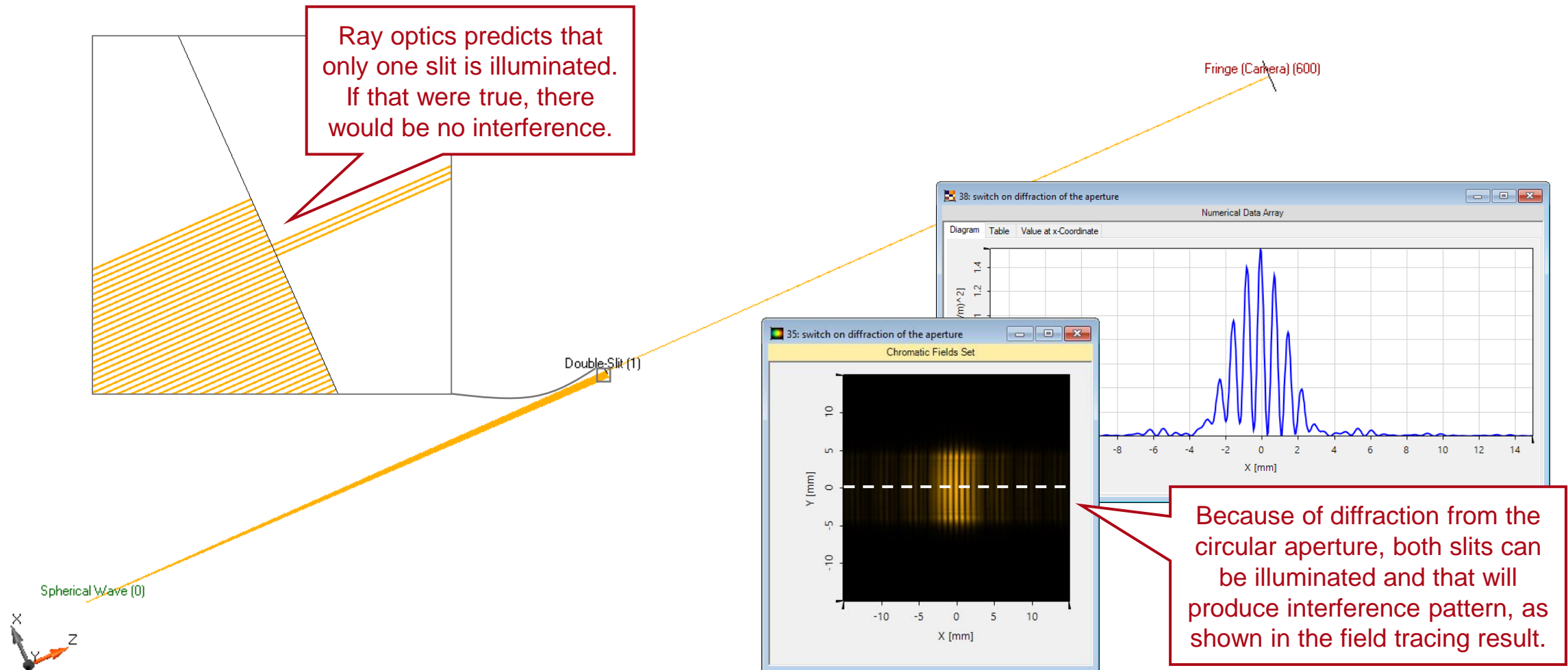
The slit distance determines the angles between the two interference beams. Larger slit distance leads to larger angle and therefore denser interference fringes.

Modeling Task – Single off-Axis Point Source

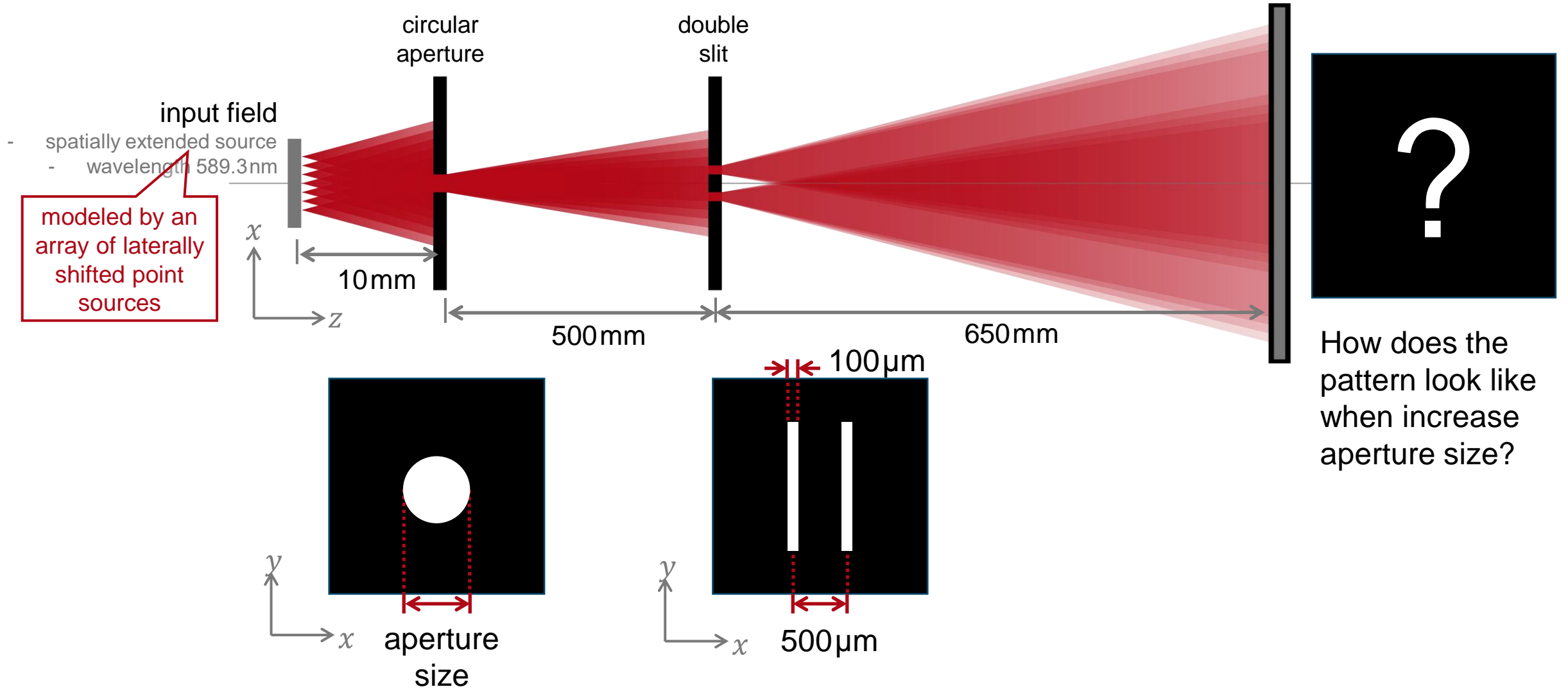


How does the pattern look like for an off-axis point source?

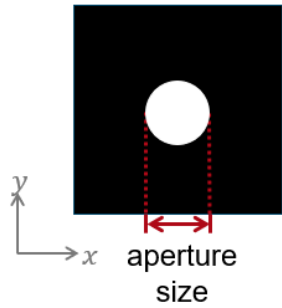
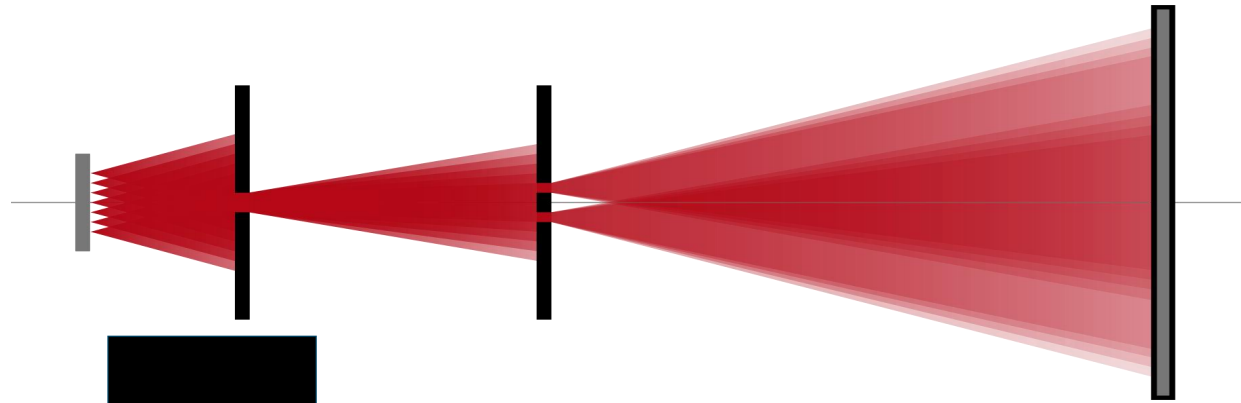
Result for an Off-Axis Point Source (Lateral Shift X 60 μm)



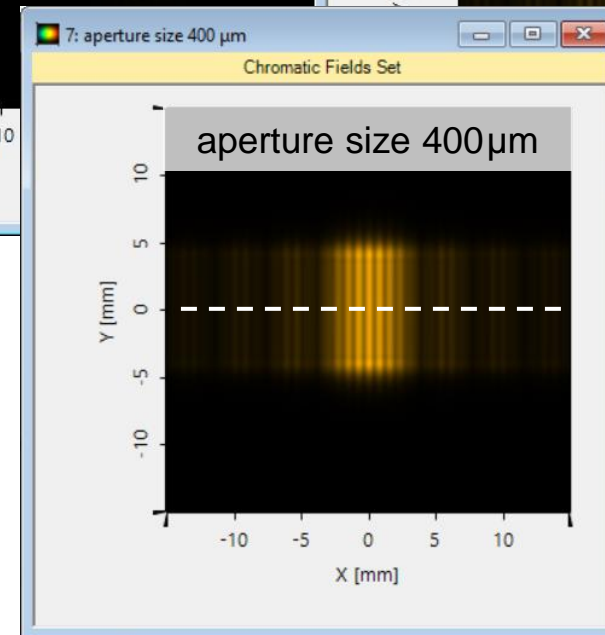
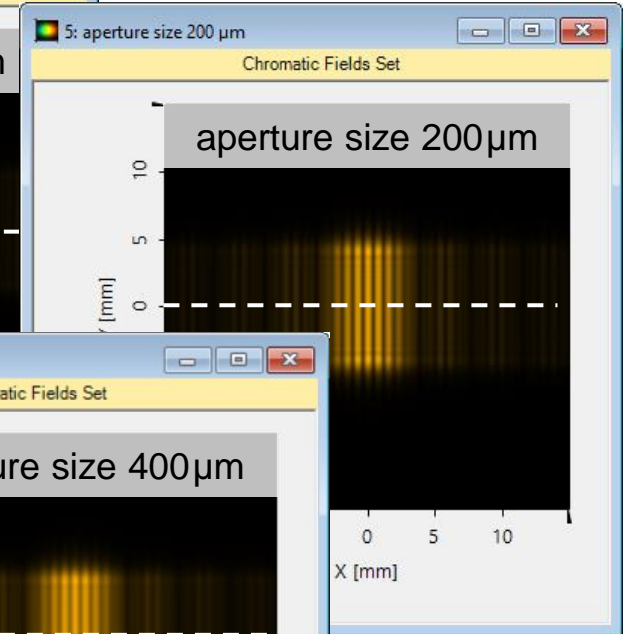
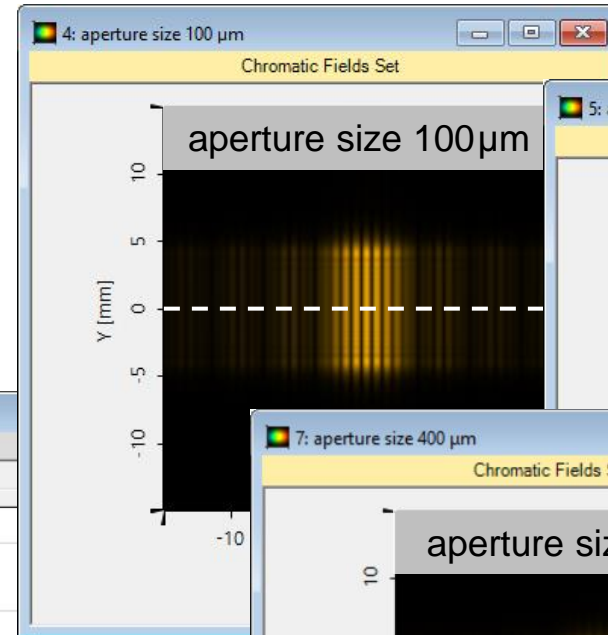
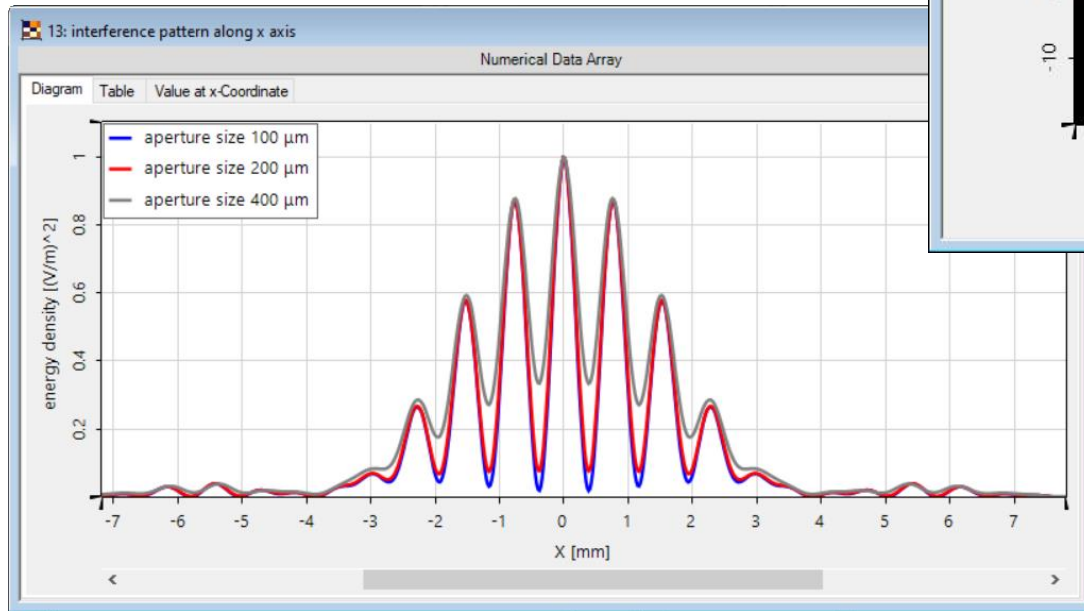
Modeling Task – Extended Source



Interference with Extended Source



The interference contrast decreases when aperture size increases.



Peek into VirtualLab Fusion

The image displays a screenshot of the VirtualLab Fusion software interface. The main window, titled "3: aperture size 400 μm^* ", shows a "Results" section with a "Go!" button and a checkbox for "Use Already Calculated Results for Next Run". Below this is a table with columns for "Subdetector", "Combined Output", and "Iteration Step".

Subdetector	Combined Output	Iteration Step	
		638	639
Lateral Offset X ("Spherical...	Data Array	368 μm	368 μm
Lateral Offset Y ("Spherical...	Data Array	16 μm	48 μm
a)" #600 aft...	2D Chromatic	Chromatic Fields Set	Chromatic F...
X-Axis (Ca...	1D Chromatic	Chromatic Fields Set 1D	Chromatic Fie...

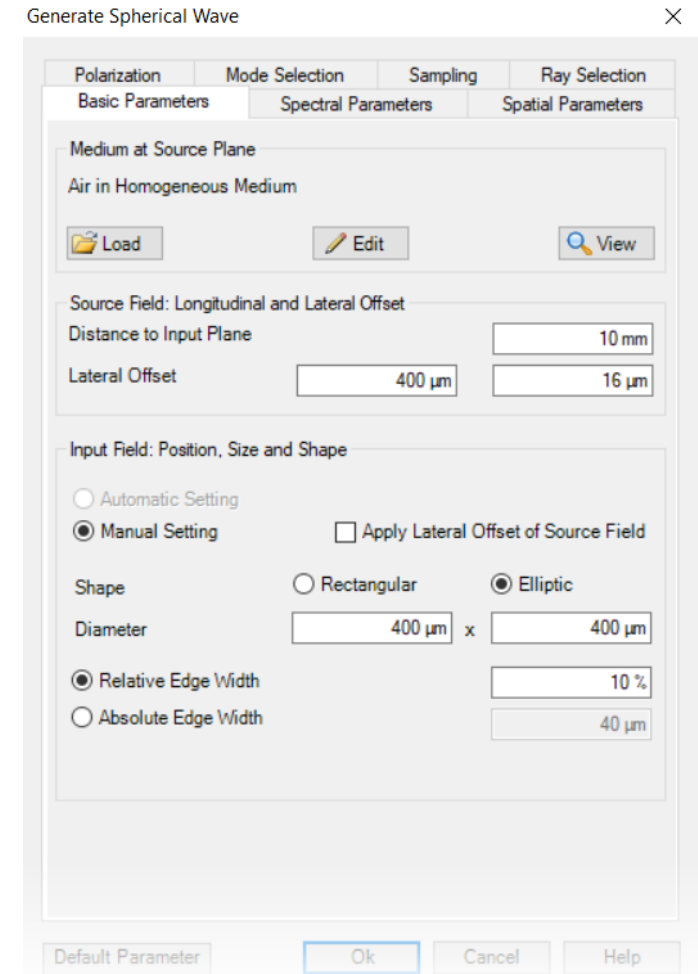
Overlaid on the left is a "Generate Spherical Wave" dialog box. It has tabs for "Polarization", "Mode Selection", "Sampling", and "Ray Selection". The "Basic Parameters" tab is active, showing "Medium at Source Plane" set to "Air in Homogeneous Medium". Under "Source Field: Longitudinal and Lateral Offset", "Distance to Input Plane" is 10 mm and "Lateral Offset" is 368 μm and 48 μm . Under "Input Field: Position, Size and Shape", "Automatic Setting" is unselected and "Manual Setting" is selected. "Shape" is set to "Elliptic" with a "Diameter" of 400 μm x 400 μm . "Relative Edge Width" is 10%.

On the right, a window titled "44: Fringe" displays a "Chromatic Fields Set" plot. The plot shows a fringe pattern with vertical lines of varying intensity, centered around X=0 mm. The Y-axis ranges from -10 to 10 mm, and the X-axis ranges from -10 to 10 mm. An arrow points from the "Chromatic Fields Set" entry in the table to this plot.

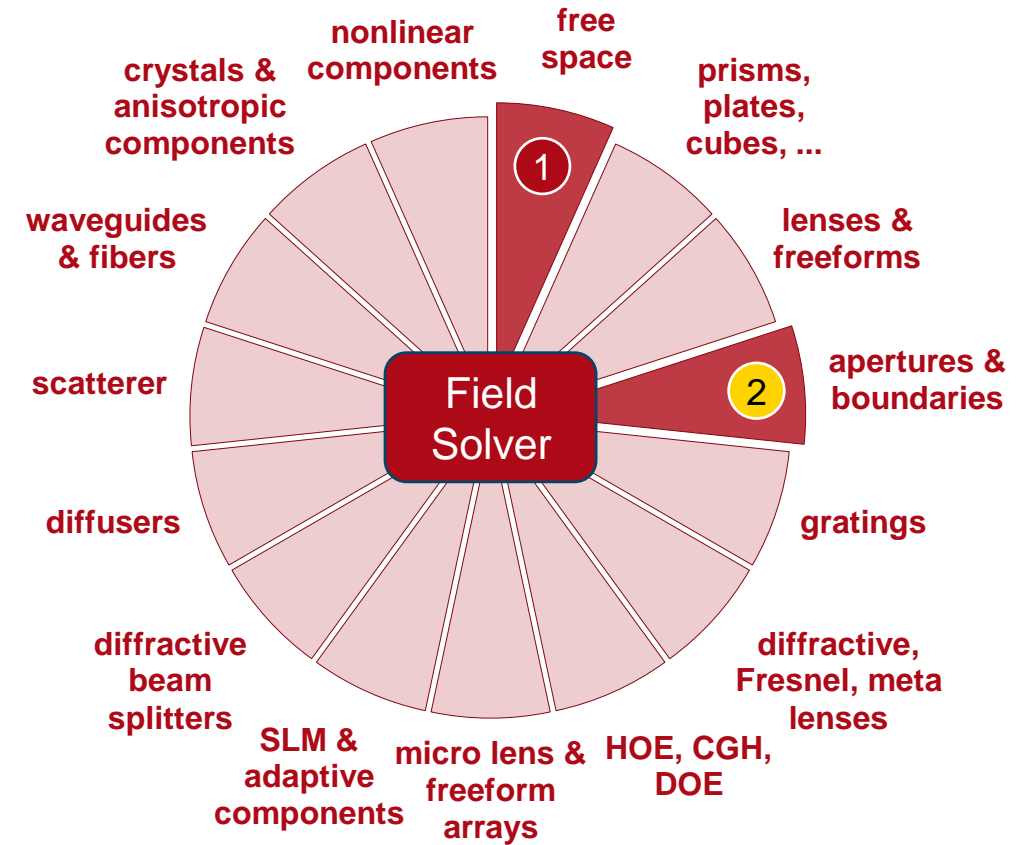
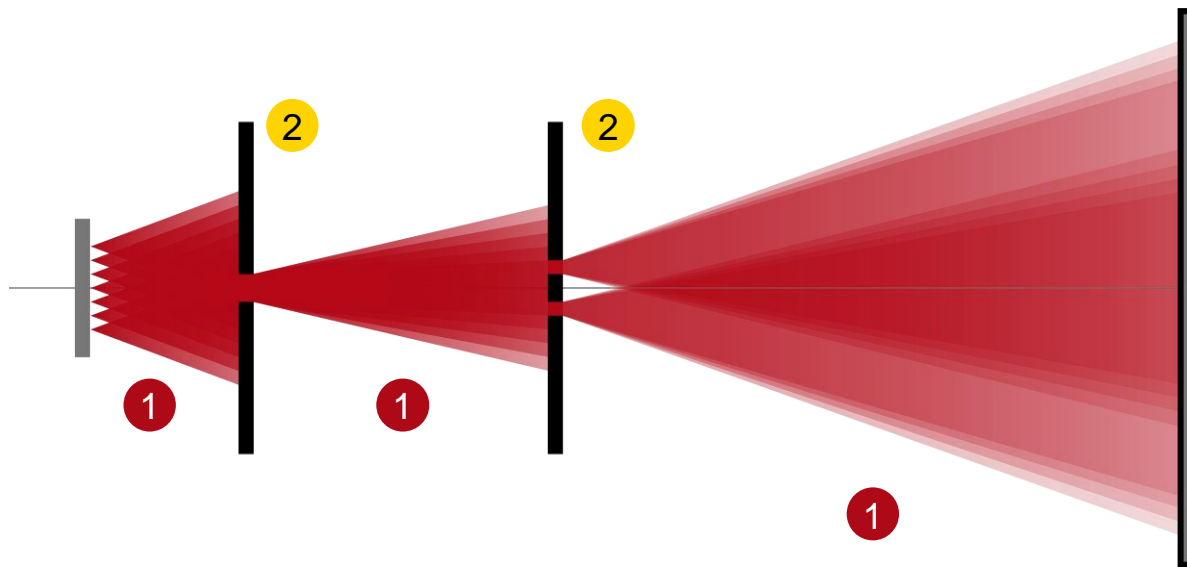
Text labels: "convenient settings for point source" (bottom left), "Parameter Run for different off-axis point source" (bottom center), and "result pattern" (top right).

Workflow in VirtualLab Fusion

- Programming a double-slit function
 - [Programming a Double-Slit Function](#) [Use Case]
- Check influence from different parameters with Parameter Run
 - [Usage of the Parameter Run Document](#) [Use Case]
 - [Scanning Mode of Parameter Run](#) [Use Case]
- Model partially coherent source by shifted elementary-field method



VirtualLab Fusion Technologies



idealized component

Document Information

title	Young's Interference Experiment
document code	IFO.0015
version	1.0
edition	VirtualLab Fusion Basic
software version	2020.1 (Build 3.4)
category	Application Use Case
further reading	<ul style="list-style-type: none">- <u>White-Light Michelson Interferometer</u>- <u>Mach-Zehnder Interferometer</u>