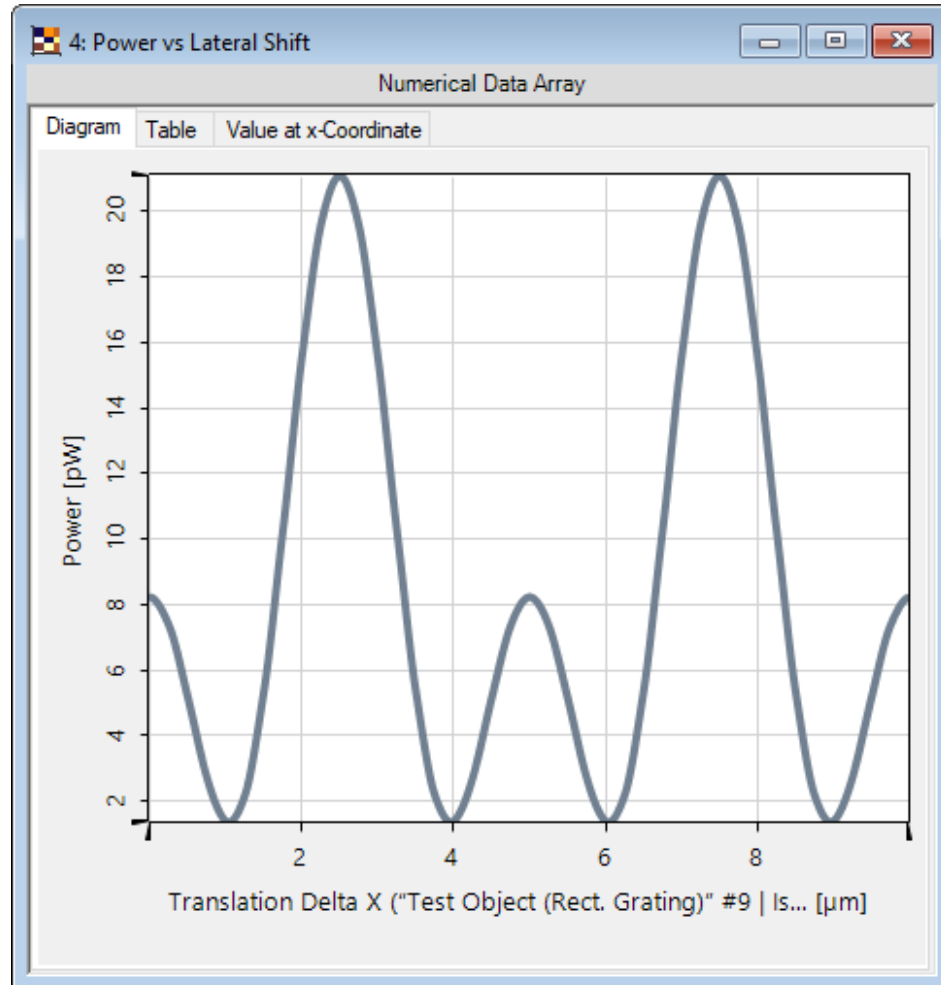


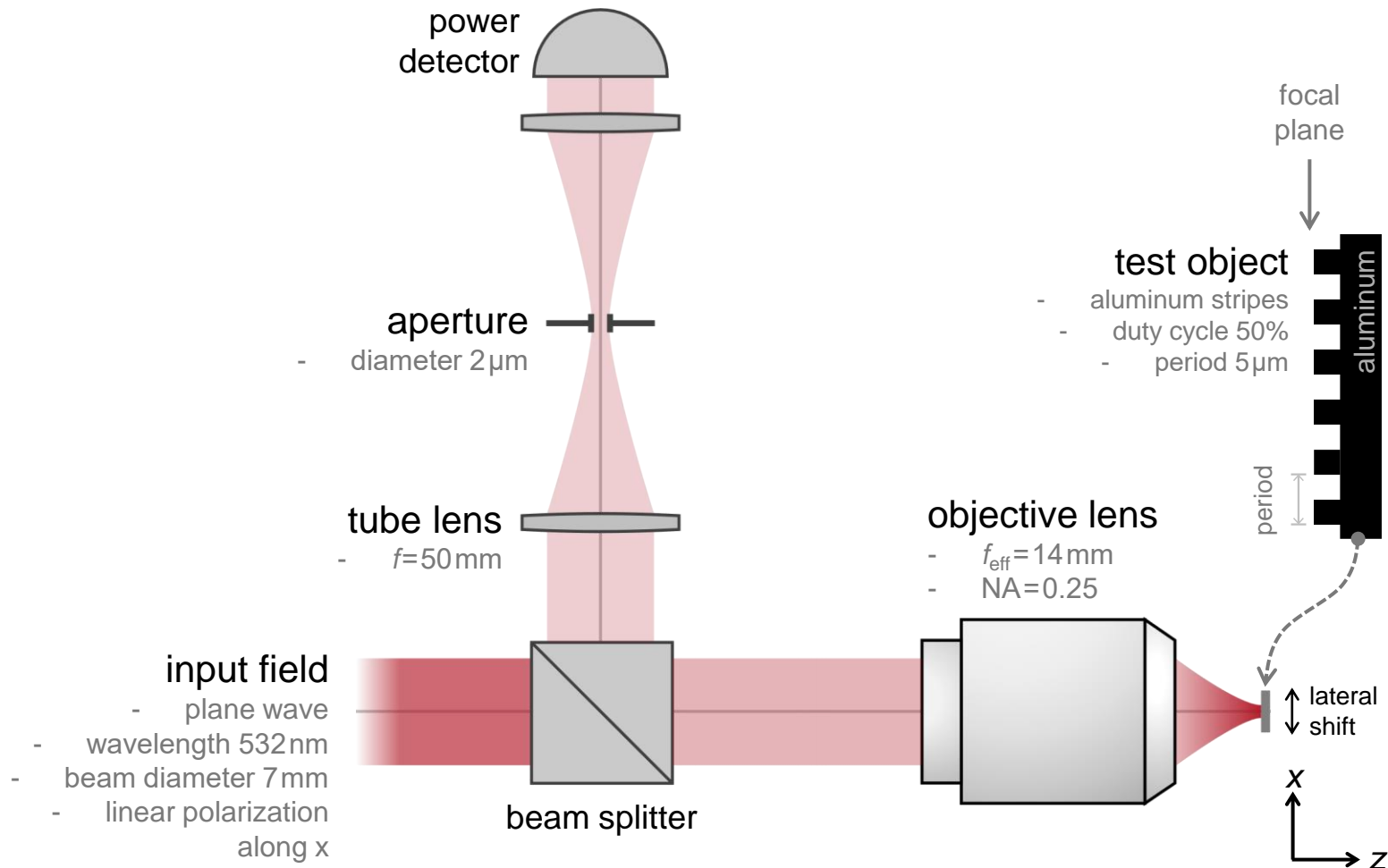
# **Working Principle of Confocal Scanning Microscopes**

# Abstract



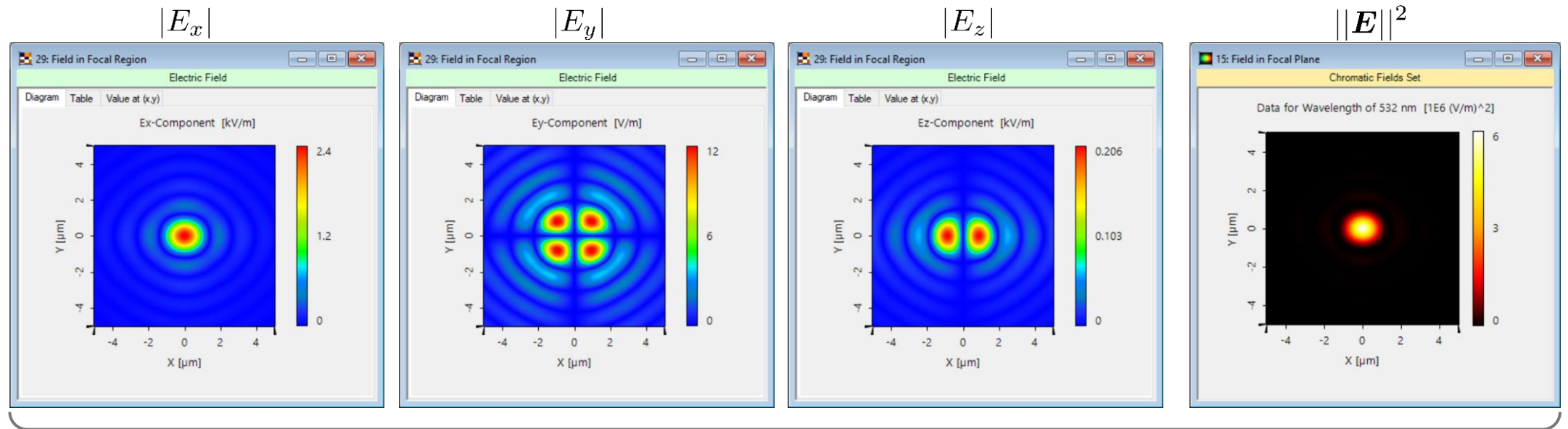
Confocal scanning microscopy, after its invention and patent by M. L. Minsky in the 1950s and later with the novelty of employing lasers as the source, has lent itself to widespread use. By using a spatial pinhole to block the light scattered or reflected from out-of-focus planes, it helps improve the longitudinal resolution and contrast. In this example, we build a confocal scanning microscope in VirtualLab Fusion, and use a metallic grating with alternating ridges and grooves as the test object to demonstrate its working principle.

# Modeling Task

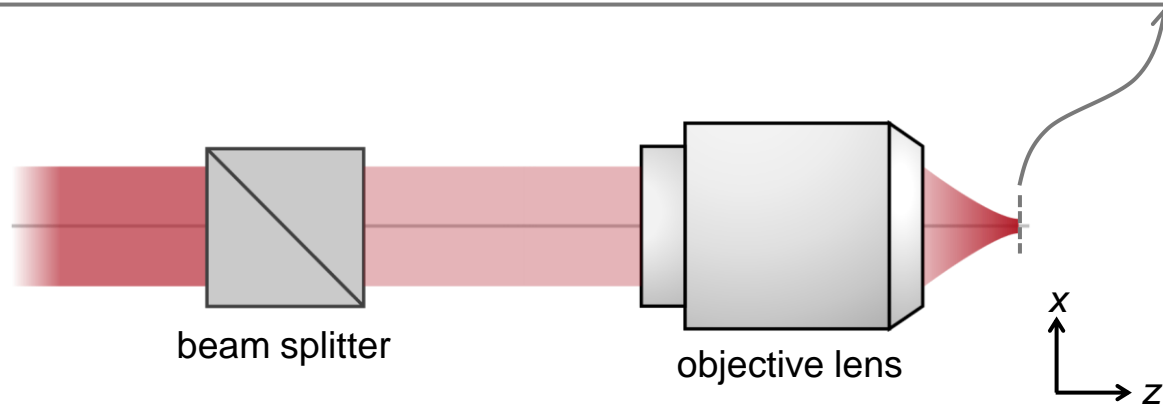


How does a confocal scanning microscope work, and how is it used to detect power changes with respect to the lateral shift of the object?

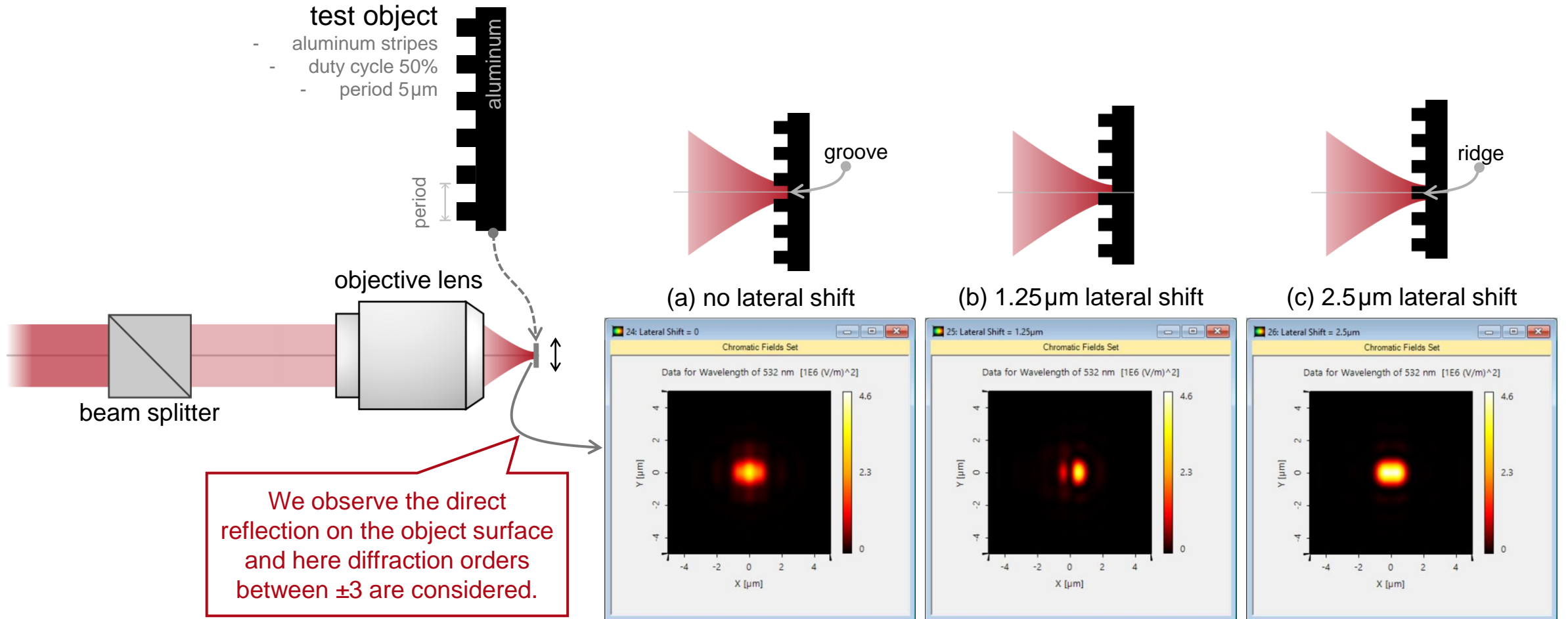
# Probe Field in Focal Region



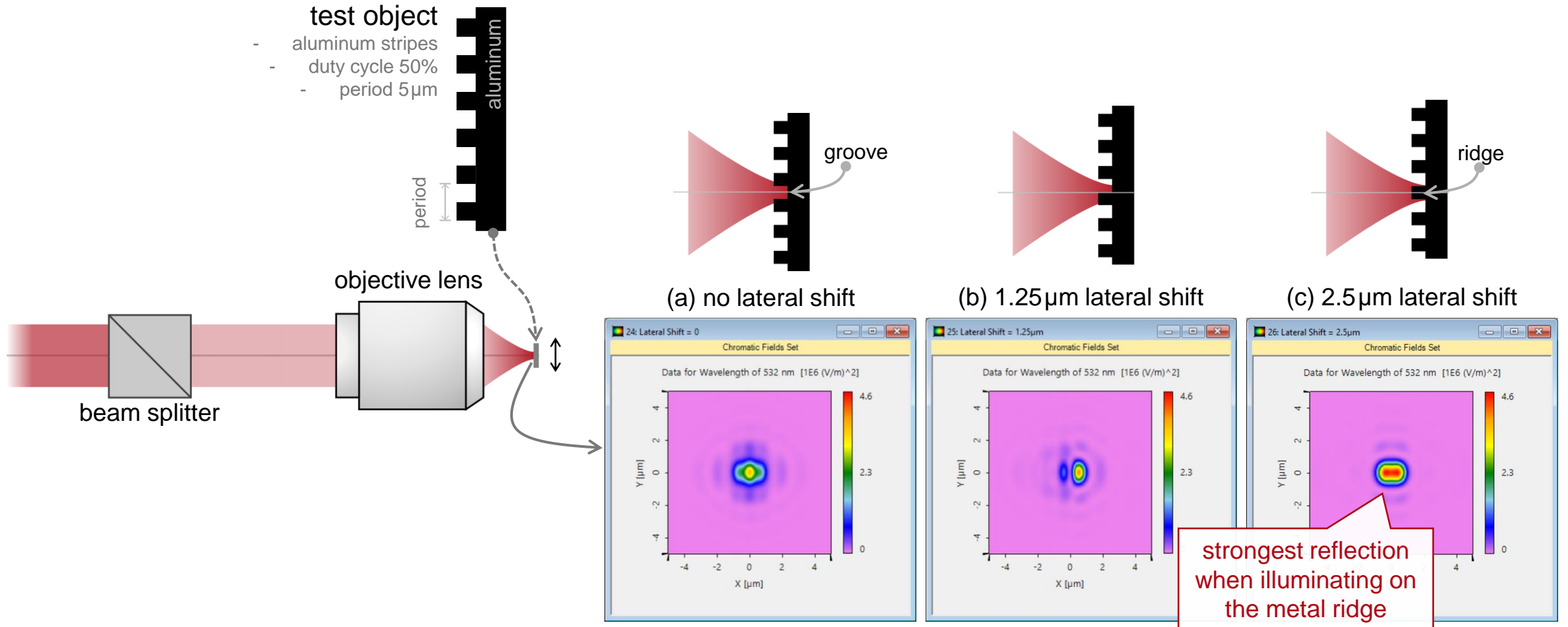
- input field
- plane wave
  - wavelength 532 nm
  - beam diameter 7 mm
  - linear polarization



# Direct Reflection from the Test Object

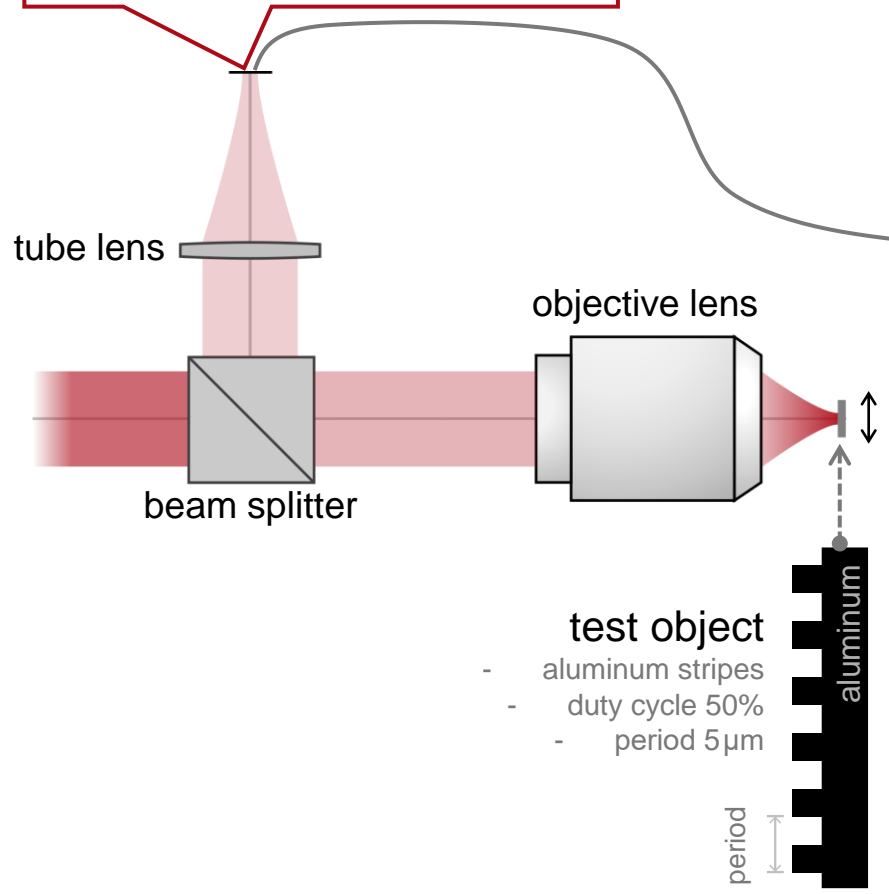


# Direct Reflection from the Test Object

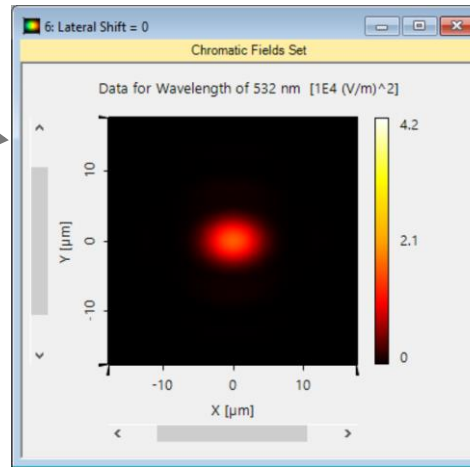


# Image of Test Object

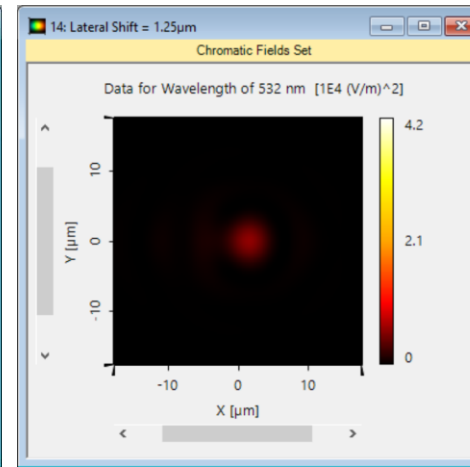
We observe the image behind the tube lens and only the diffraction orders within  $\pm 3$  contribute to the imaging.



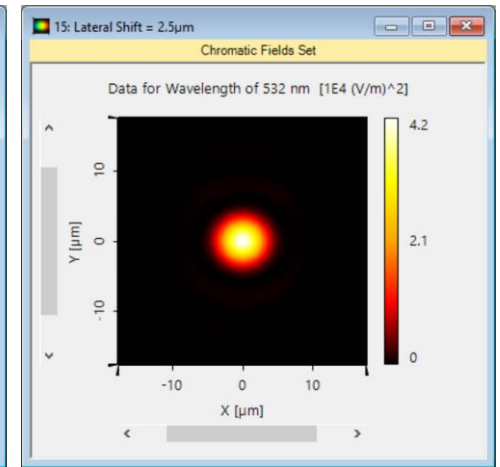
(a) no lateral shift



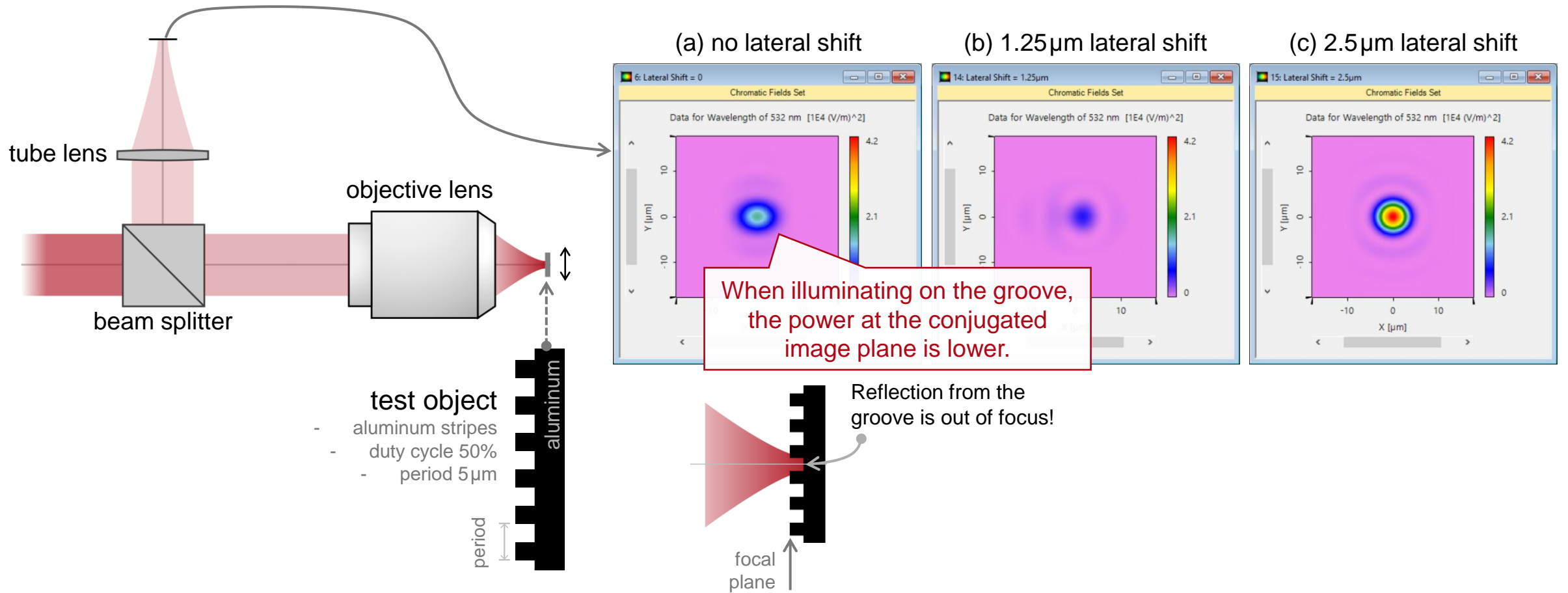
(b)  $1.25\mu\text{m}$  lateral shift



(c)  $2.5\mu\text{m}$  lateral shift

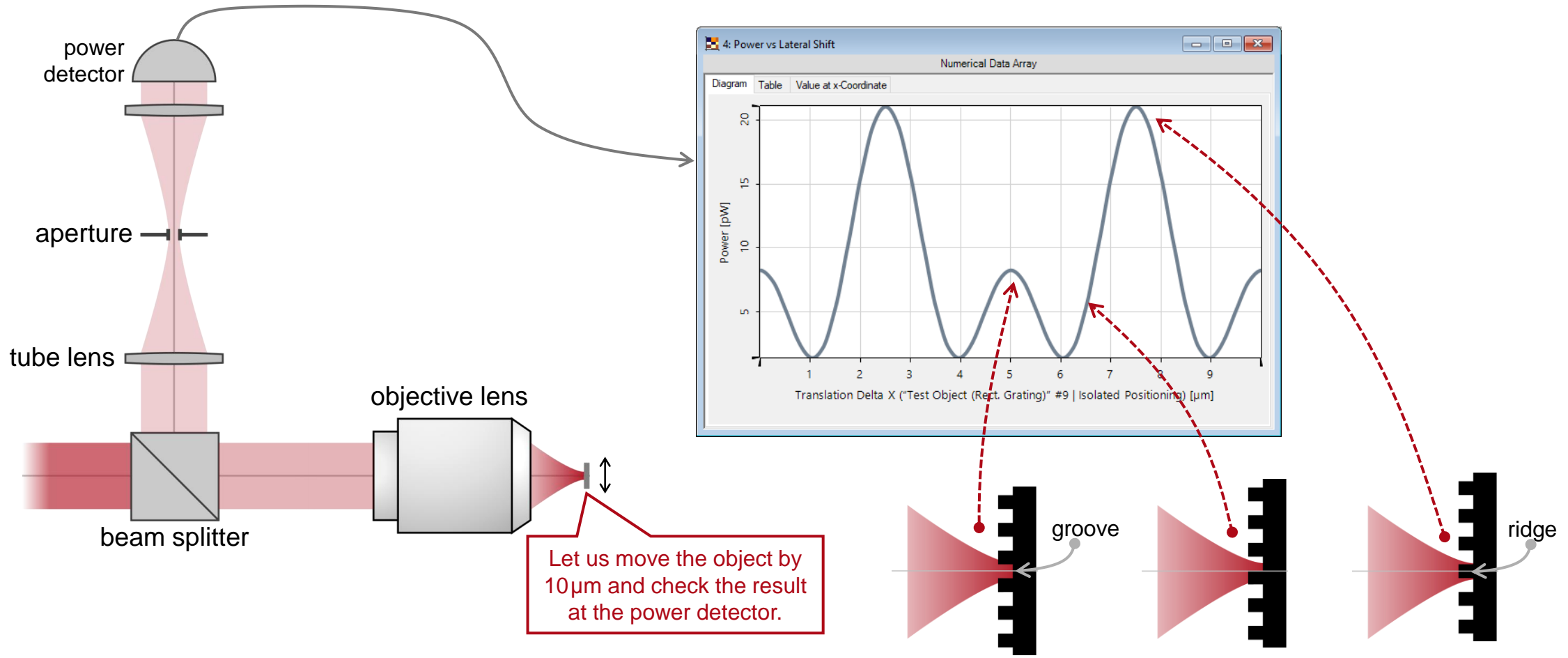


# Image of Test Object



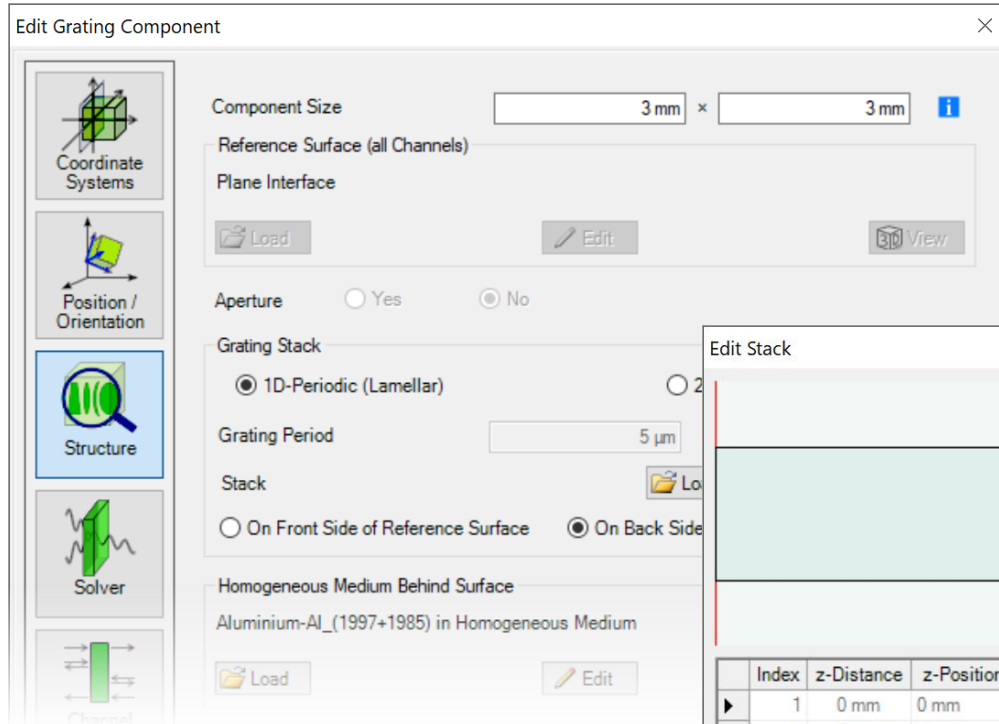


# Power Measurement vs Lateral Shift of Test Object



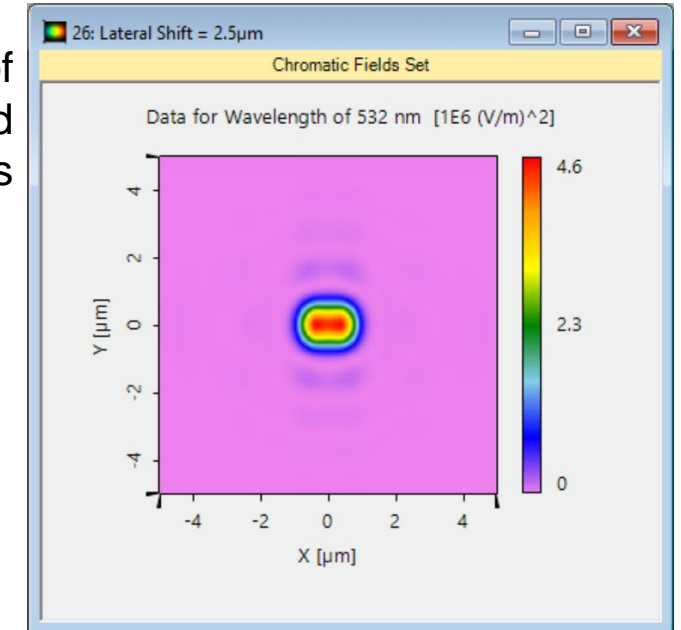
# Peek into VirtualLab Fusion

inclusion and configuration of gratings within system



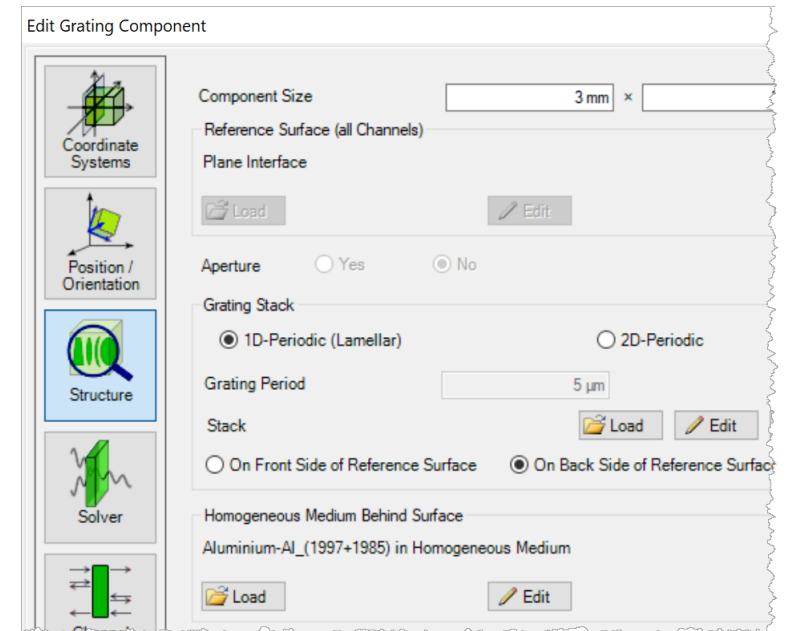
analysis/visualization of electromagnetic field interaction with gratings

Index	z-Distance	z-Position	Interface	Subsequent Medium	Com
1	0 mm	0 mm	Plane Interface	Aluminium-Al_(1997+1	Enter your commen
2	0 mm	0 mm	Rectangular Grating In	Air in Homogeneous M	Enter your commen
3	2.5 μm	2.5 μm	Plane Interface	Aluminium-Al_(1997+1	Enter your commen

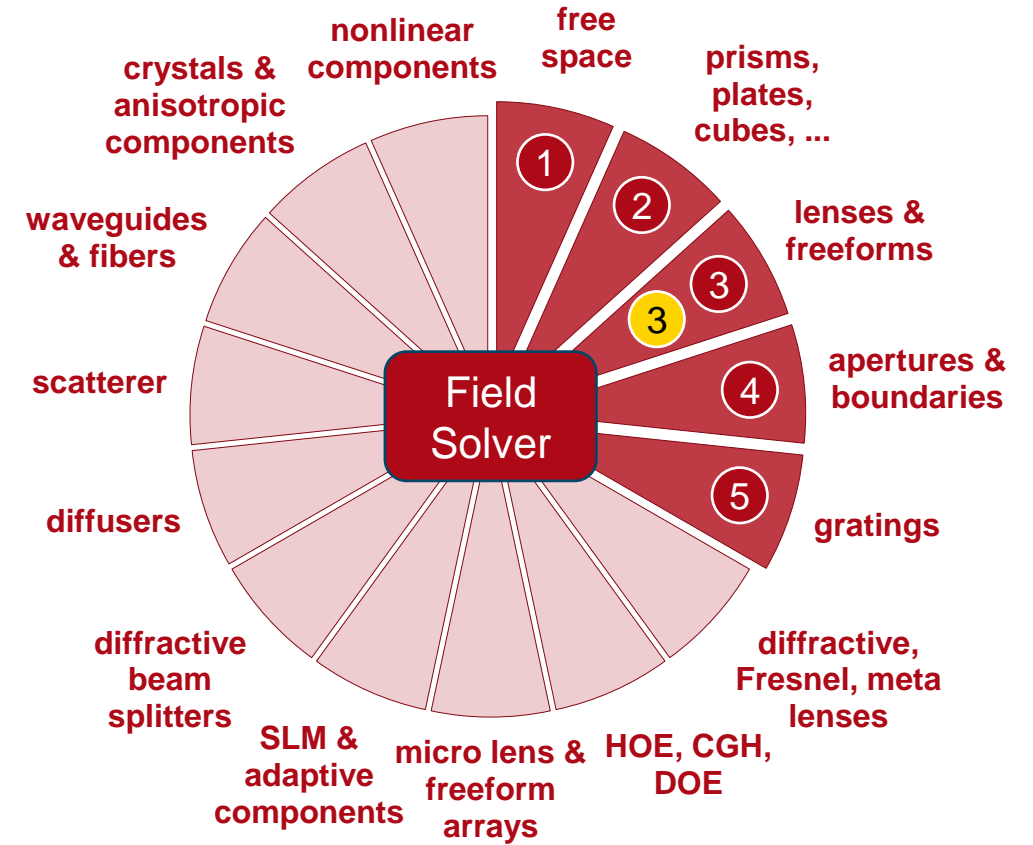
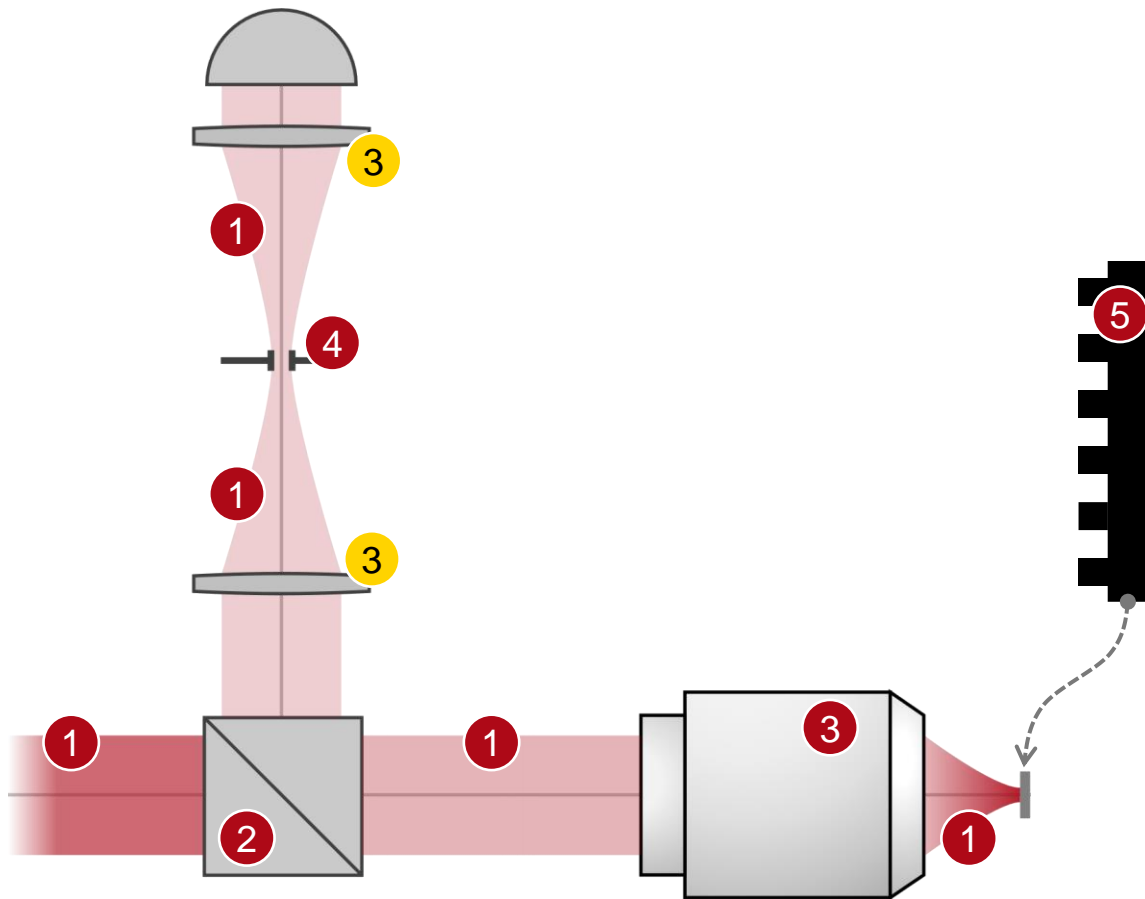


# Workflow in VirtualLab Fusion

- Construct grating structures using interfaces
  - [Configuration of Grating Structures by Using Interfaces](#) [Use Case]
- Grating modeling within complex system
  - [Modeling of Gratings within Optical System – Discussion at Examples](#) [Use Case]
- Set channels properly for multi-pass simulation
  - [Channel Configuration for Surfaces and Grating Regions](#) [Use Case]
- Use Parameter Run to check influence/changes
  - [Usage of the Parameter Run Document](#) [Use Case]



# VirtualLab Fusion Technologies



# idealized component

# Document Information

title	Working Principle of Confocal Scanning Microscopes
document code	MIC.0010
version	1.3
edition	VirtualLab Fusion Advanced
software version	2024.1 (Build 2.74)
category	Application Use Case
further reading	<ul style="list-style-type: none"><li>- <a href="#"><u>Demonstration of Abbe's Theory of Image Formation</u></a></li><li>- <a href="#"><u>Modeling of Gratings within Optical System - Discussion at Examples</u></a></li></ul>