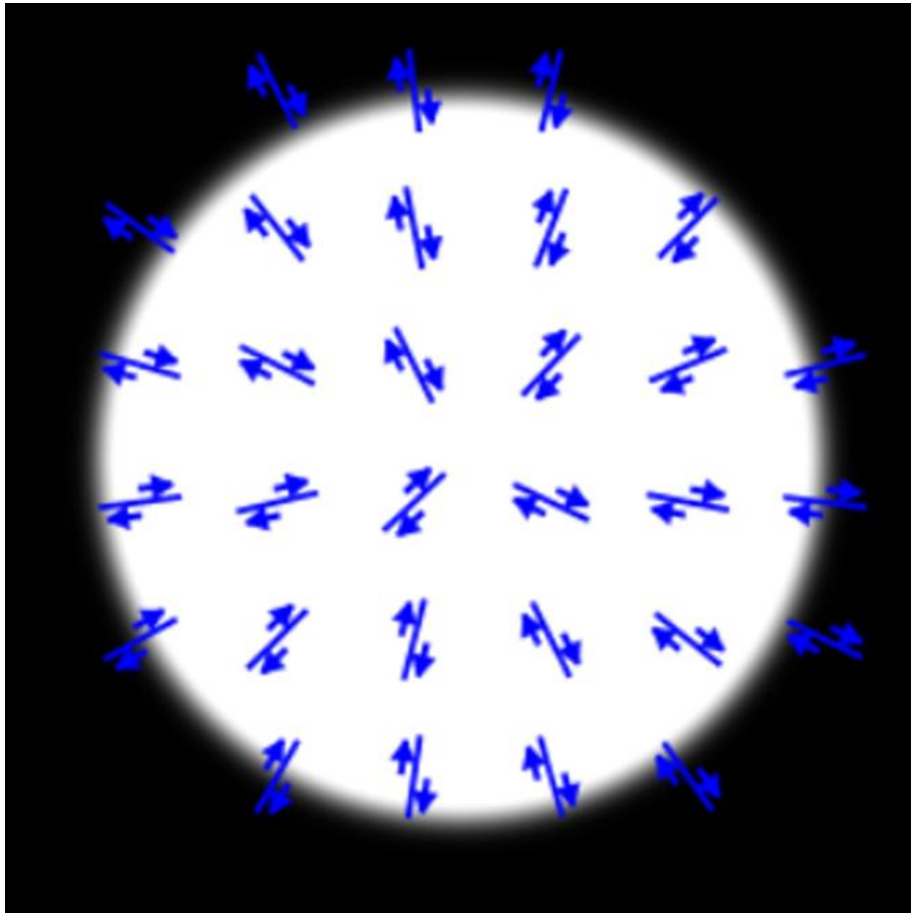
Imaging of Sub-Wavelength Gratings by Using Vector Beam Illumination

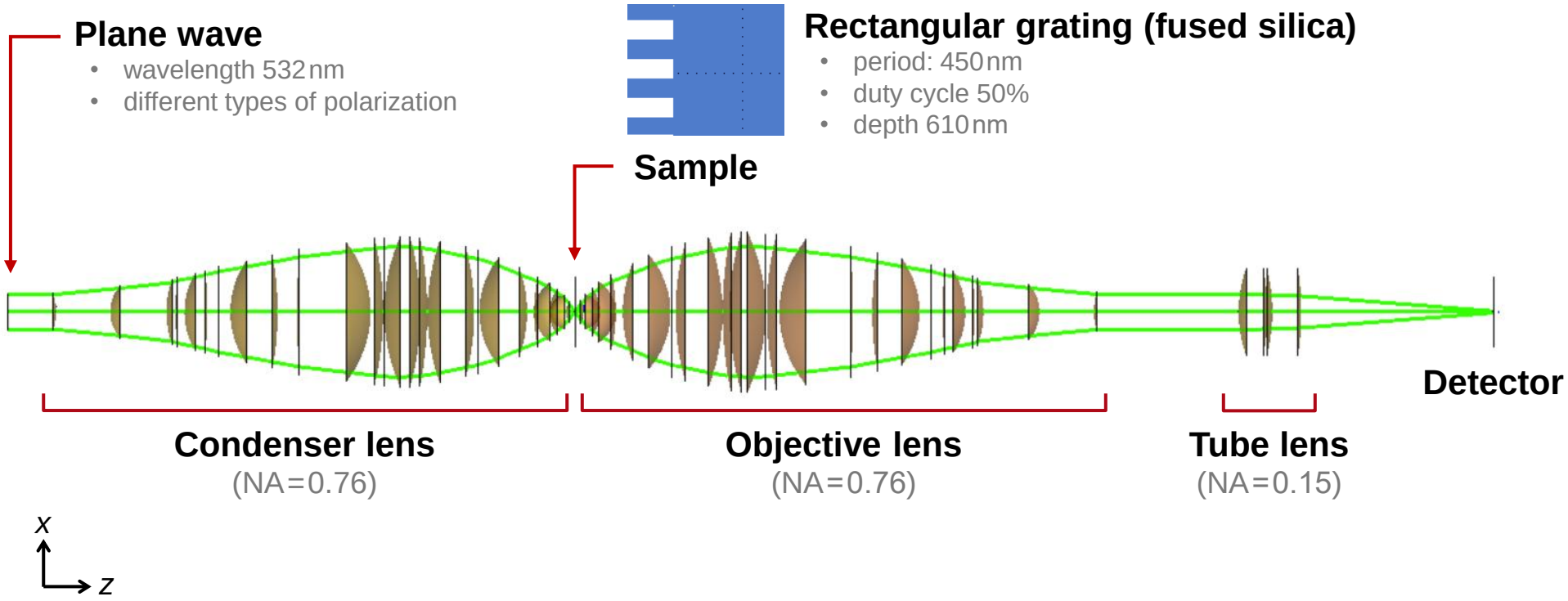
Abstract



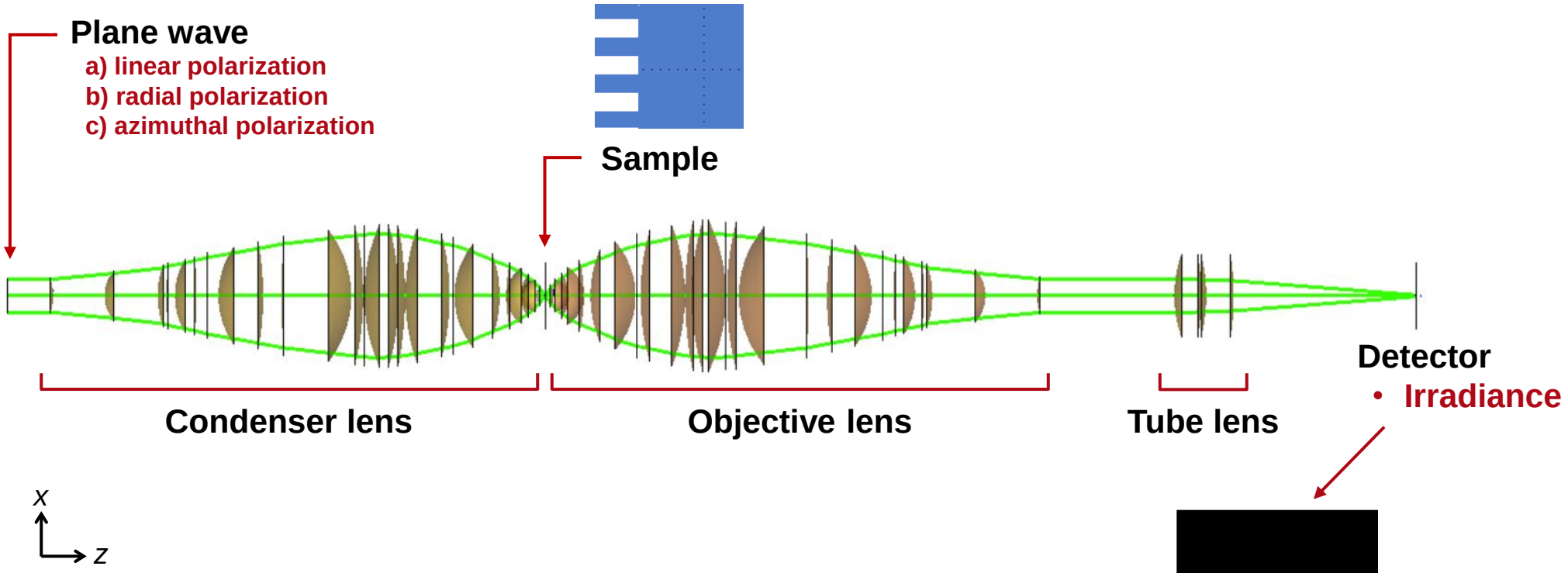
It has been shown that the polarization of light play an important role in the interaction with micro- and nanostructures. For example, different types of vector beams have been employed in microscopy. In this example, a high-NA microscope for imaging of sub-wavelength grating is build up, and the influences from illumination with linear, radial, and azimuthal polarizations is investigated.

Application Scenario

Scenario: System



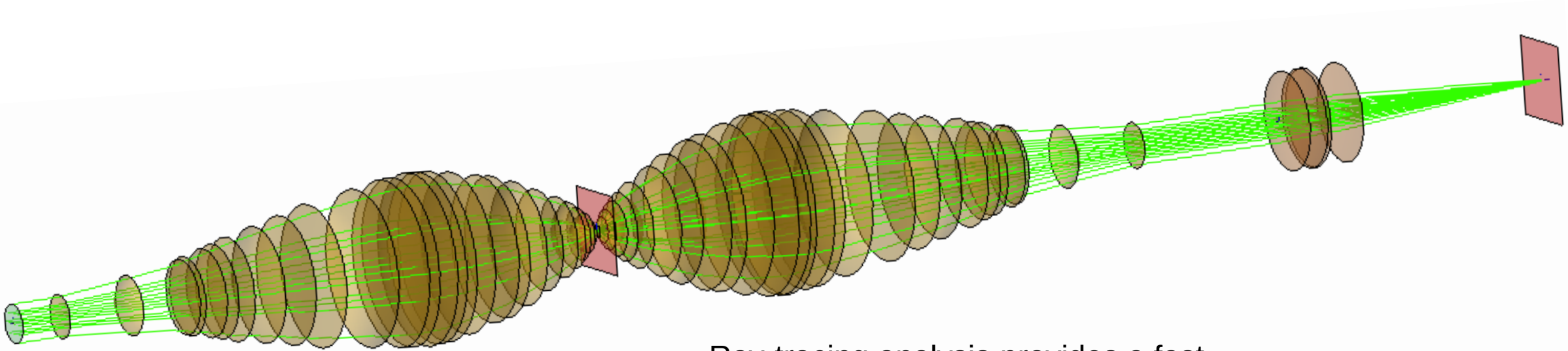
Scenario: Task



How to calculate the image of the sub-wavelength grating, under illumination with differently polarized light?

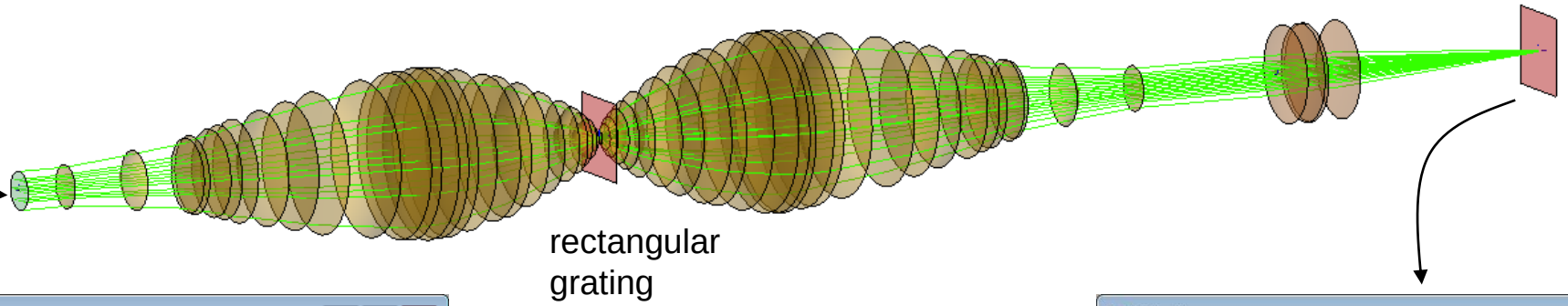
Simulation Results

3D System View

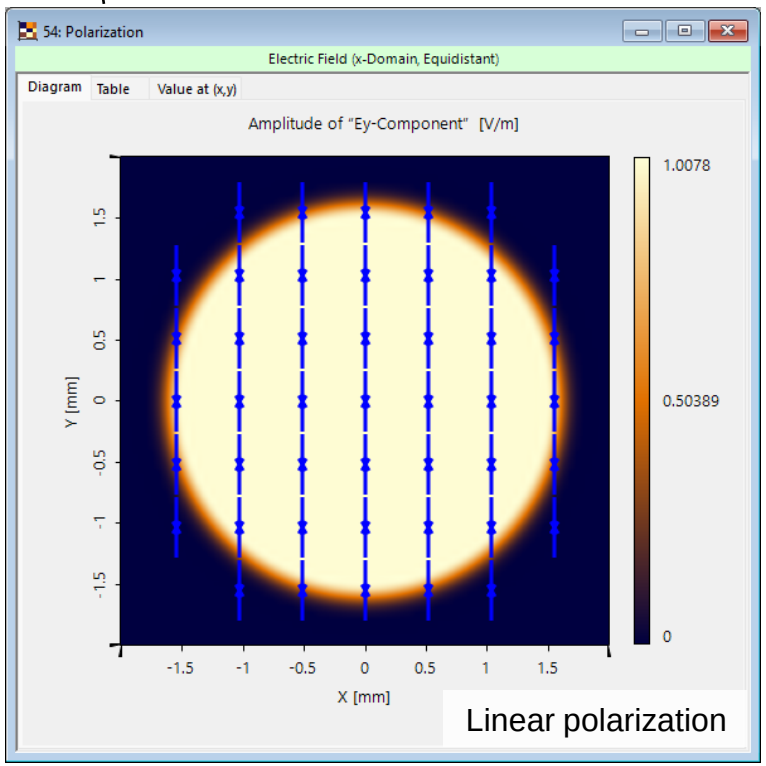


Ray-tracing analysis provides a fast overview of the complete system in space, including multiple diffraction orders.

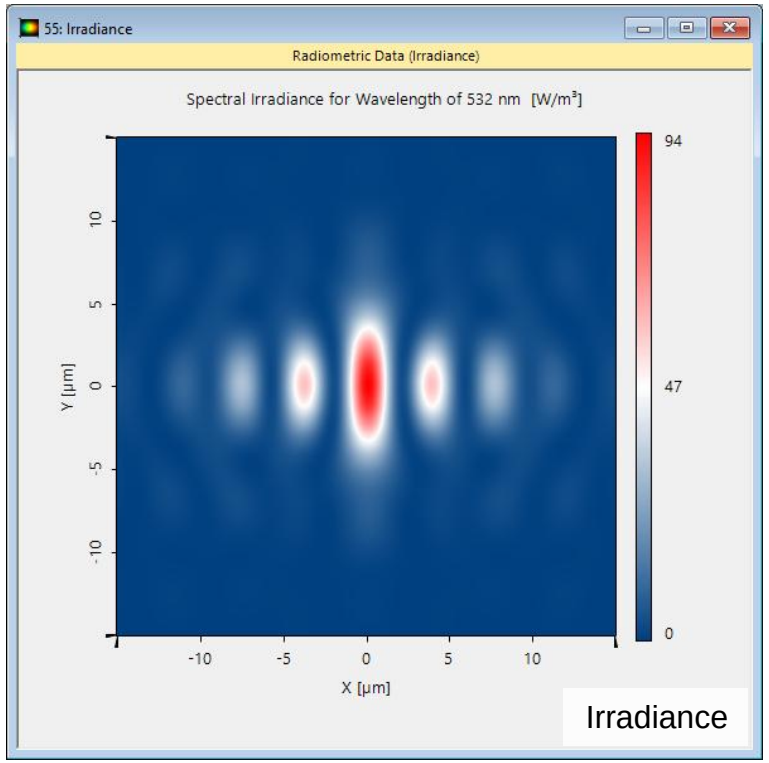
Imaging with Linearly Polarized Light



rectangular grating

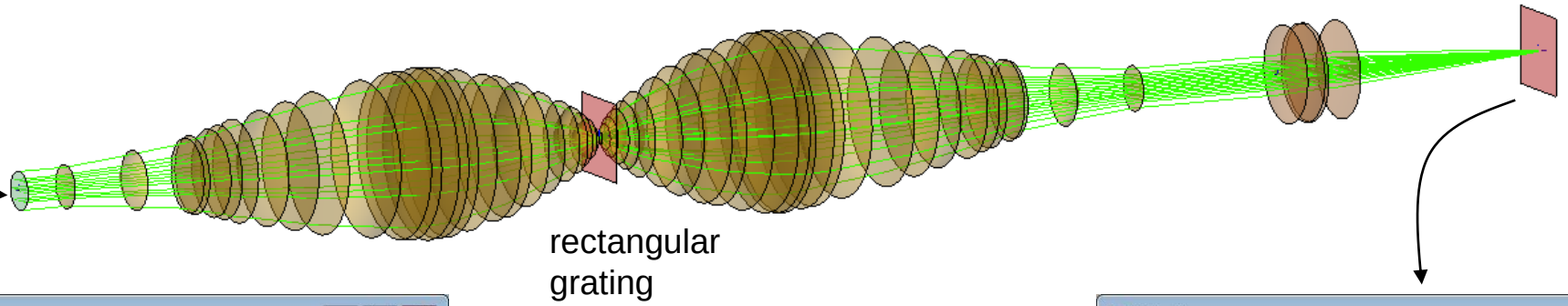


Linear polarization

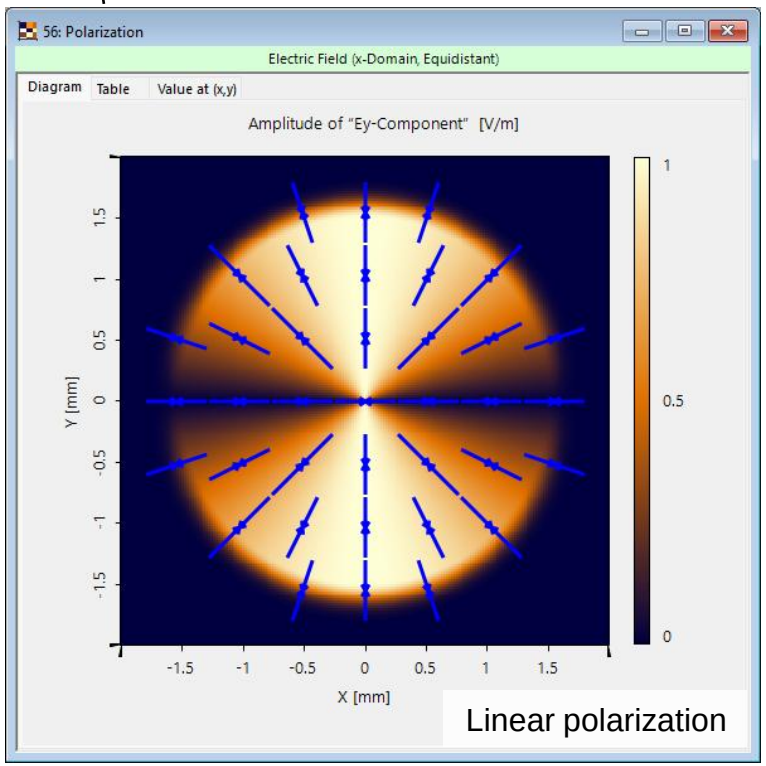


Irradiance

Imaging with Radially Polarized Light

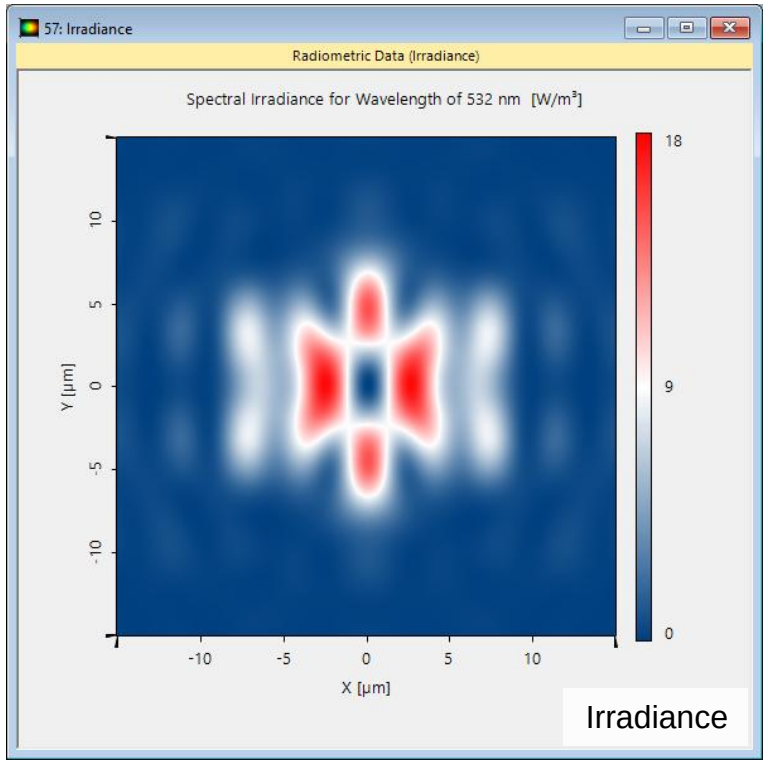


rectangular grating



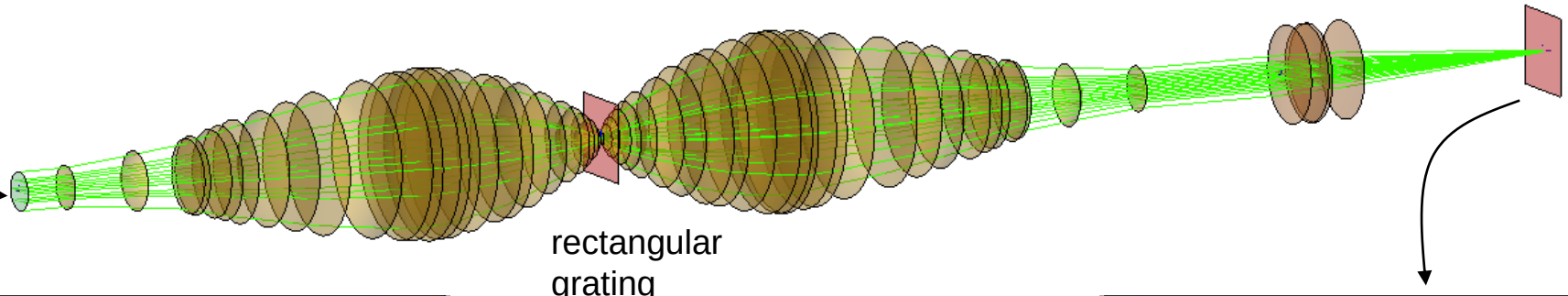
Linear polarization

Vector nature of light is taken into account, and interaction with grating is modeled by using Fourier modal method.

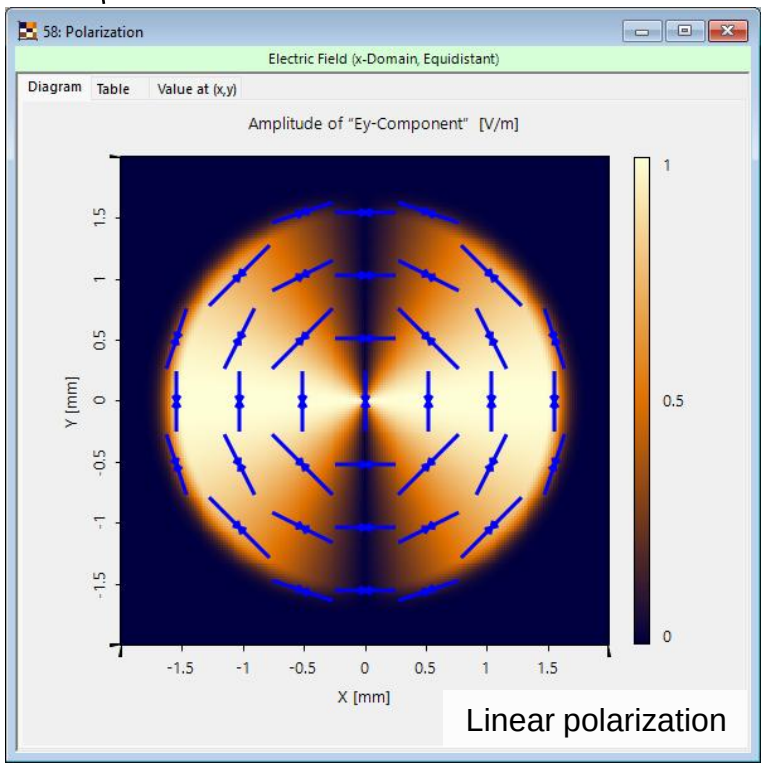


Irradiance

Imaging with Azimuthal Polarized Light

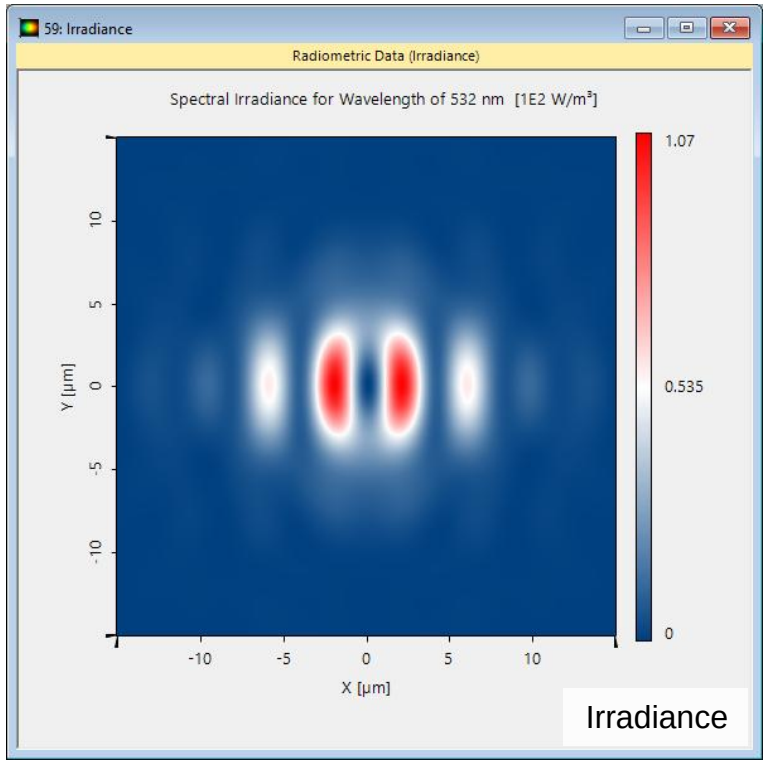


rectangular grating



Linear polarization

Vector nature of light is taken into account, and interaction with grating is modeled by using Fourier modal method.



Irradiance

Workflows

Basic Workflow Steps

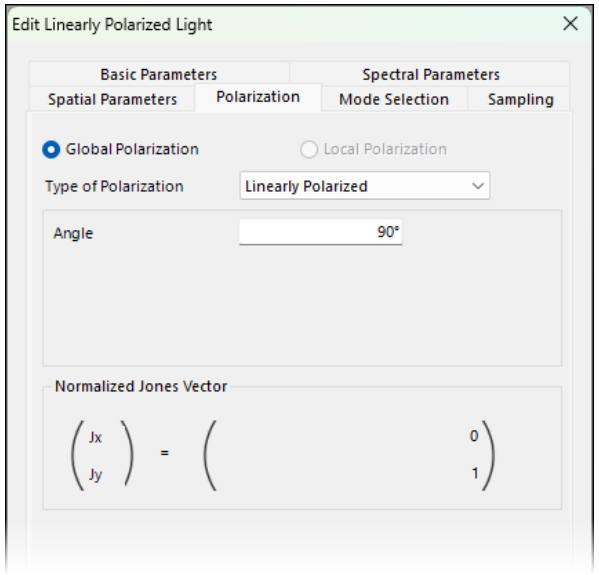
Source selection

System setup

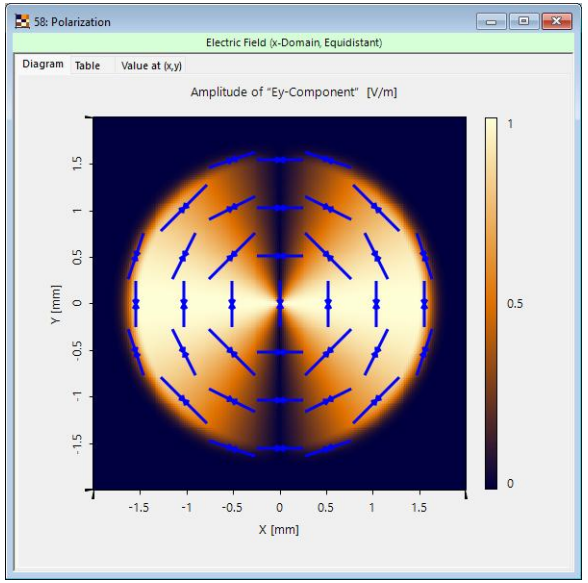
Detector selection

Getting it done in VirtualLab Fusion:

- Plane Wave
- Programmable Source for Radial and Azimuthal Field



Options for linear polarization



Azimuthal polarization

Basic Workflow Steps

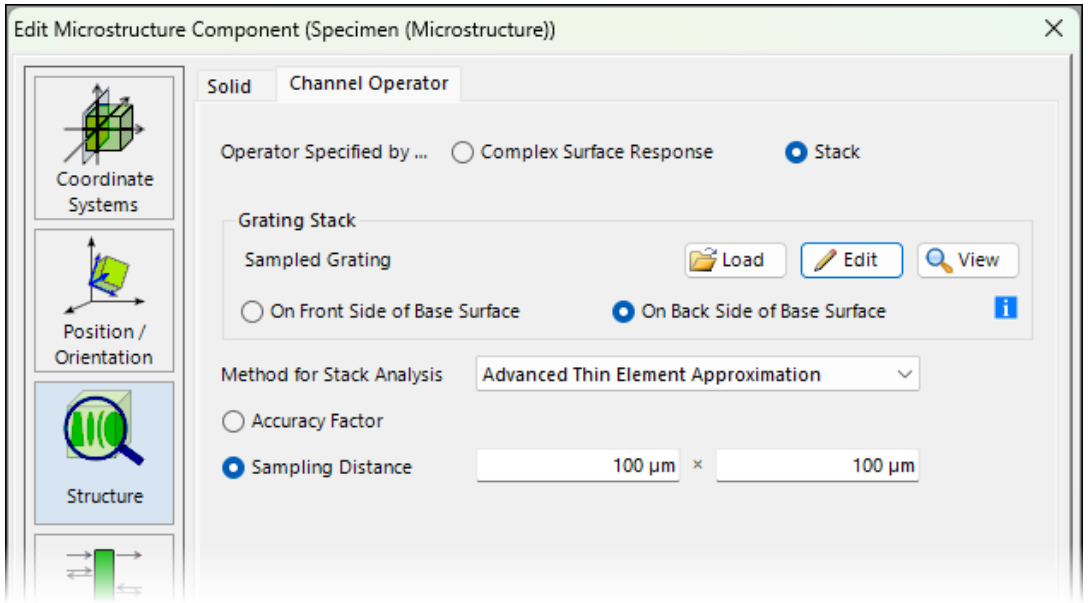
Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Zemax import of lens group
- Position and orientation of elements in the optical setup
- Use Grating Component to represent sample



Micro-structure component

Basic Workflow Steps

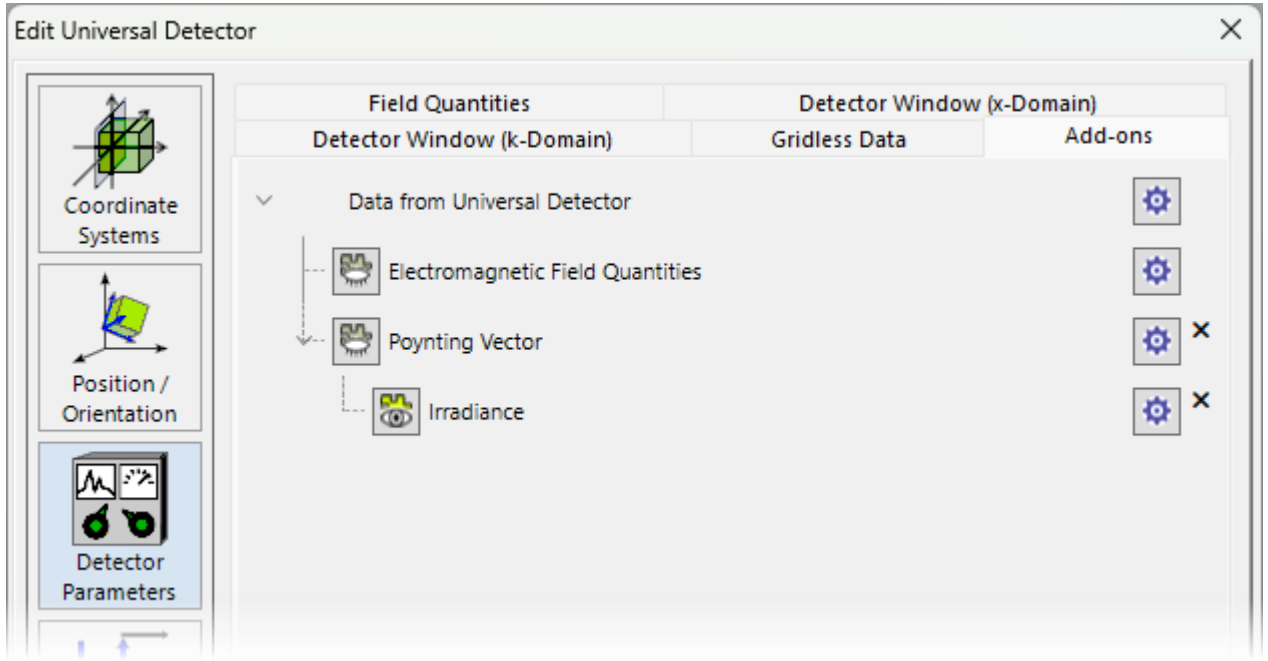
Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Irradiance Detector



Detector add-on selection

Document Information

Title	Imaging of Sub-Wavelength Gratings by Using Vector Beam Illumination
Document code	USC.0012
Publication date	31.07.2025
Required packages	-
Software version	2025.1 (Build 1.176)*
Category	Use Case
Further reading	• Reflecting Microscope System with very high Numerical Aperture • Single Molecule Imaging by High-NA Fourier Microscope

* *The files attached to this document require the specific version or later.*