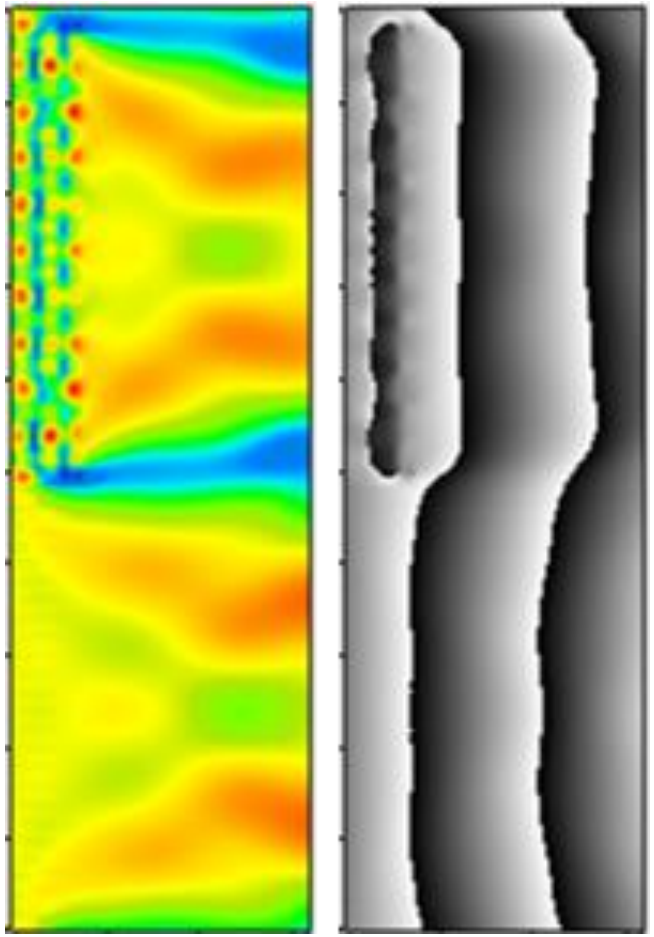
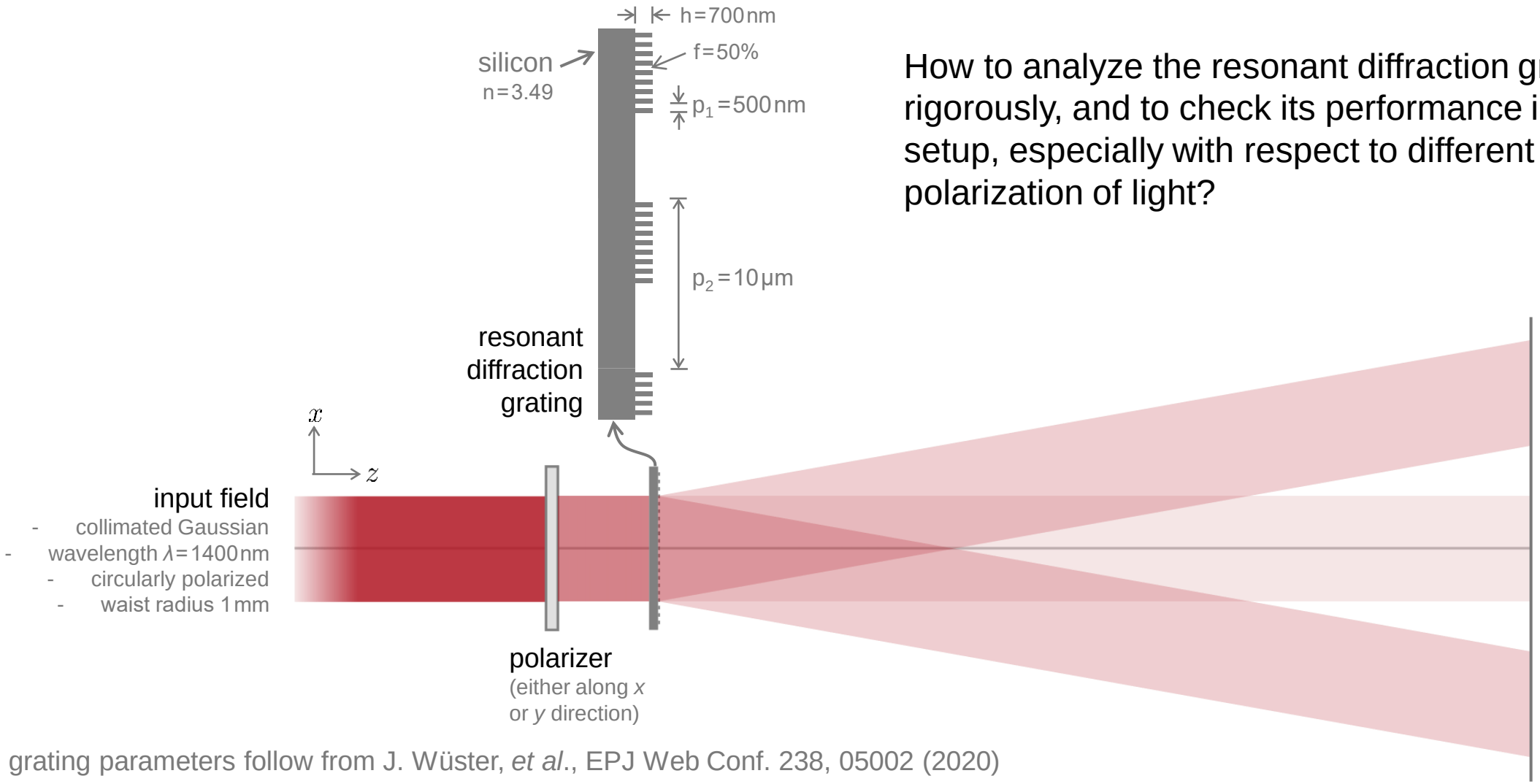
Polarization-Dependent Binary Resonant Gratings

Abstract



Polarization-dependent diffraction gratings are found helpful for certain optical metrology systems. According to the work of J. Wüster *et al*., we construct a grating with sub-wavelength structures following the principle of form birefringence. The grating has a super-period greater than the wavelength, and it shows clearly the polarization dependency: when illuminated with TE polarization, the zeroth order has high transmission efficiency; while for TM case, the ±1 orders have high efficiencies.

Modeling Task

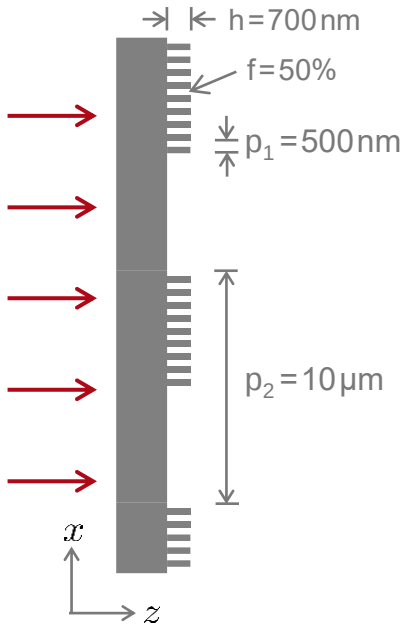


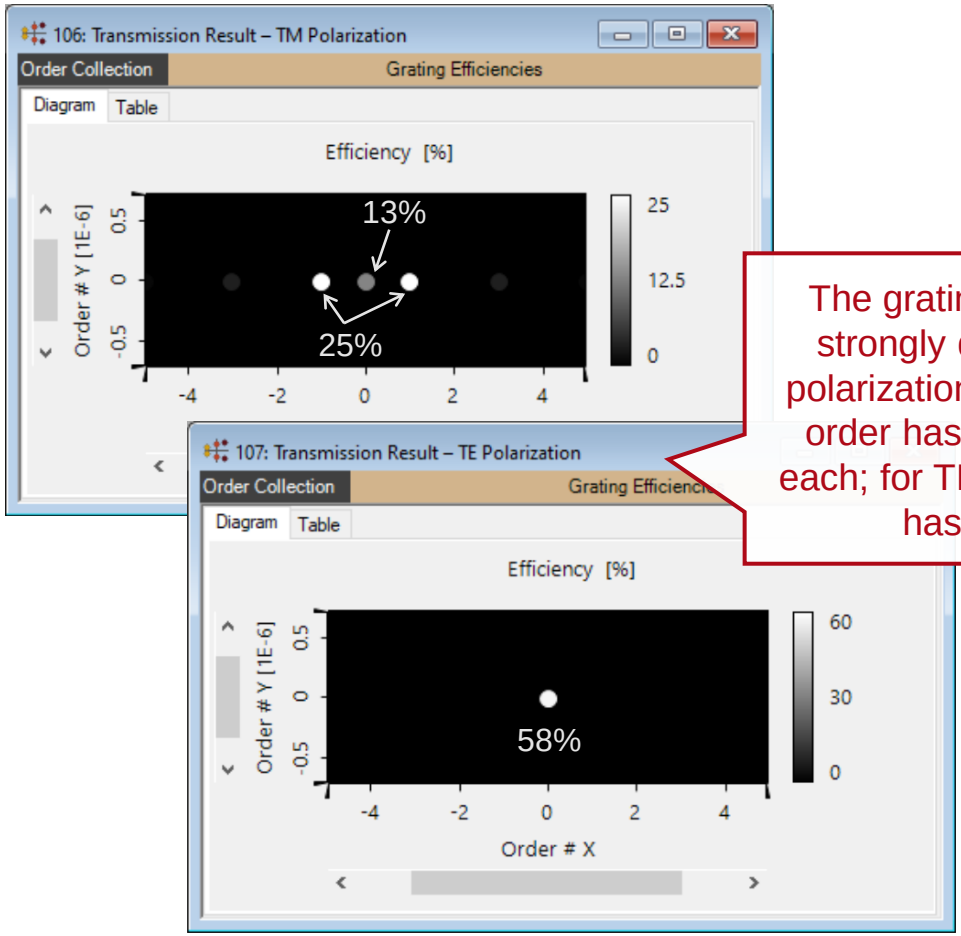
How to analyze the resonant diffraction grating rigorously, and to check its performance in the setup, especially with respect to different polarization of light?

grating parameters follow from J. Wüster, *et al*., EPJ Web Conf. 238, 05002 (2020)

Grating Property Analysis

input field
- plane wave
- wavelength $\lambda = 1400\,nm$
- normal incidence
- linearly polarized (TE or TM)

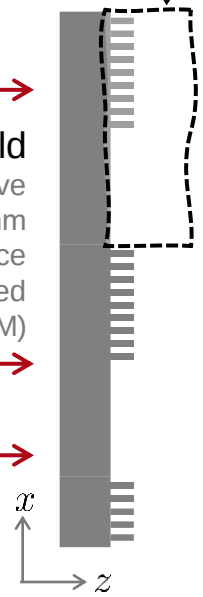




The grating diffraction property strongly depends on the input polarization: for TM case the ±1st order has the efficiency of 25% each; for TE case the zeroth order has 58% efficiency.

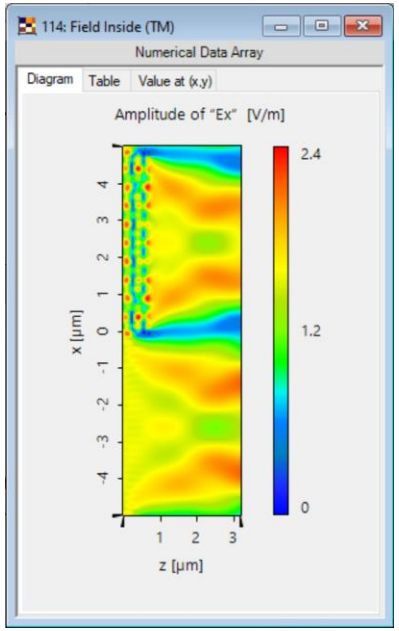
Field Inside Analysis

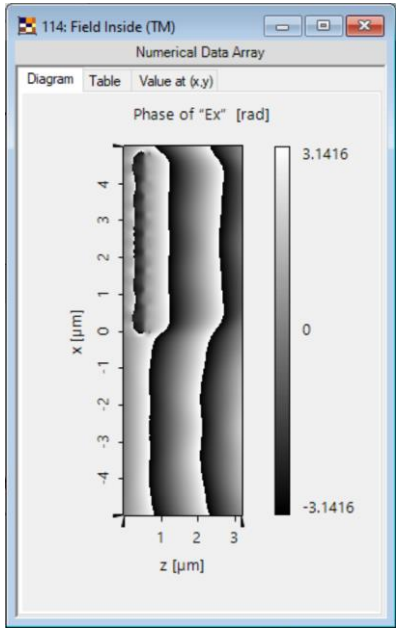
check the field distribution inside



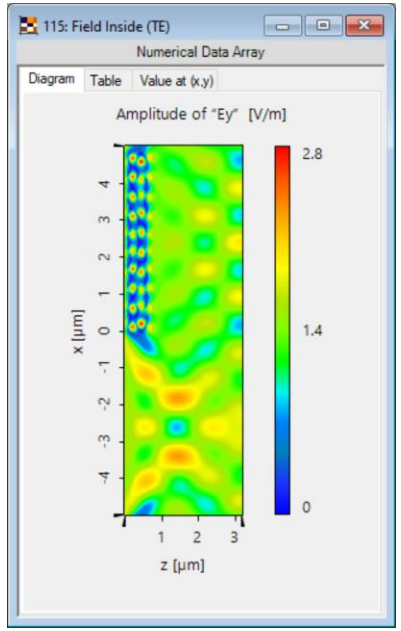
input field
- plane wave
- wavelength $\lambda = 1400\,nm$
- normal incidence
- linearly polarized (TE or TM)

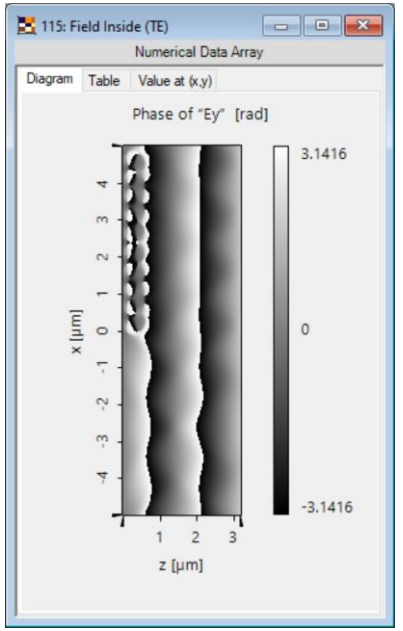
case with TM input polarization





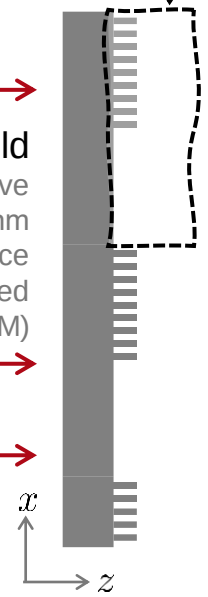
case with TE input polarization





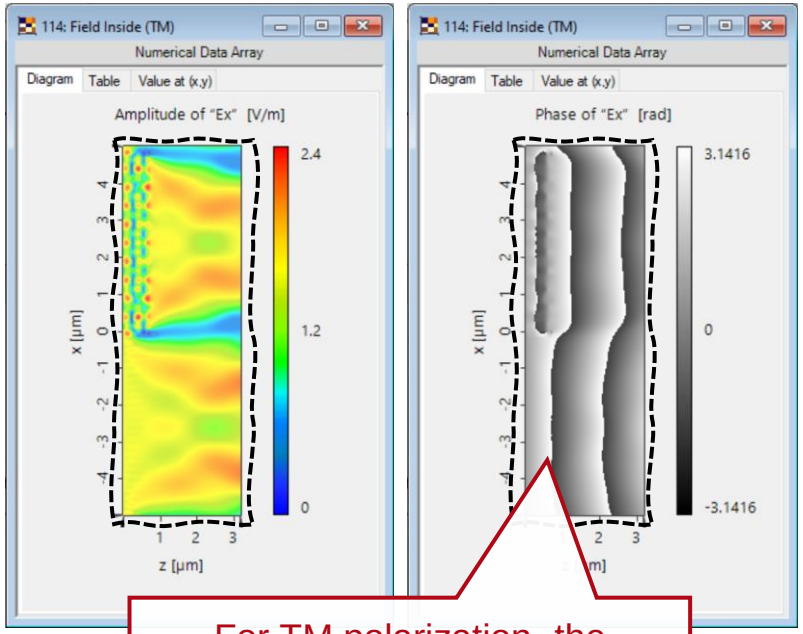
Field Inside Analysis

check the field distribution inside



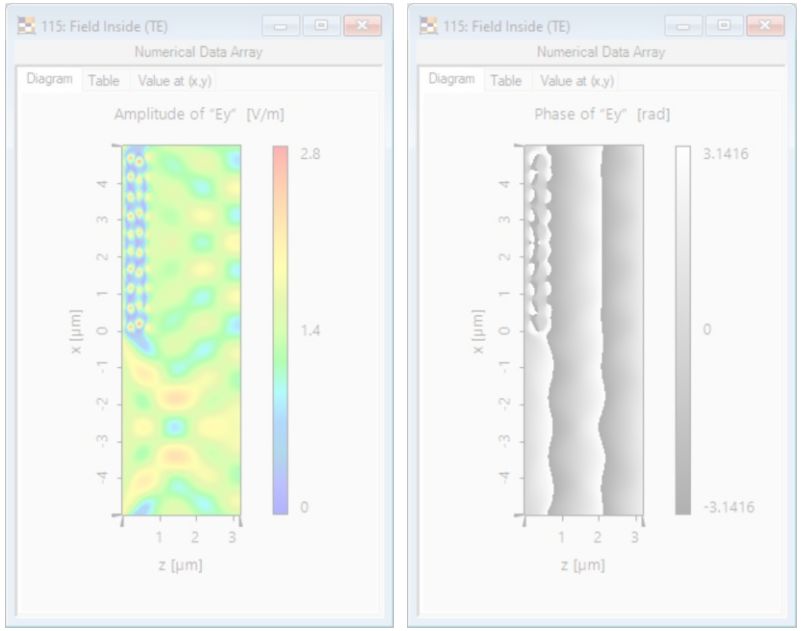
input field
- plane wave
- wavelength $\lambda = 1400\,nm$
- normal incidence
- linearly polarized (TE or TM)

case with TM input polarization



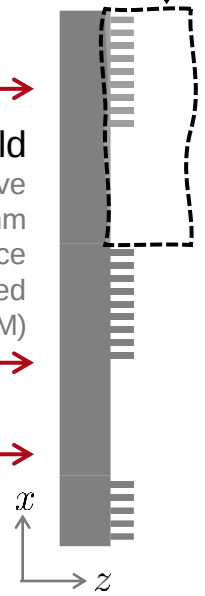
For TM polarization, the transmitted phase shows a π-shift between the modulated and unmodulated regions.

case with TE input polarization



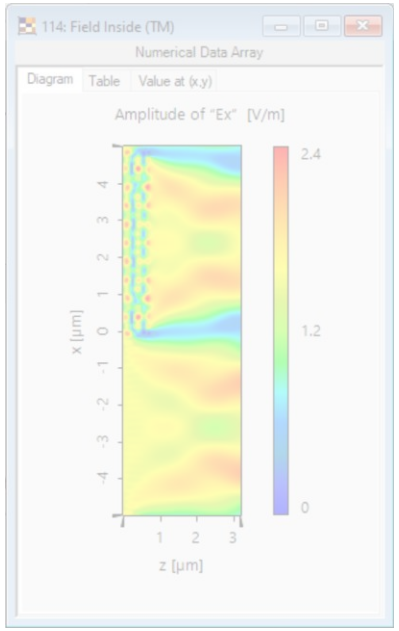
Field Inside Analysis

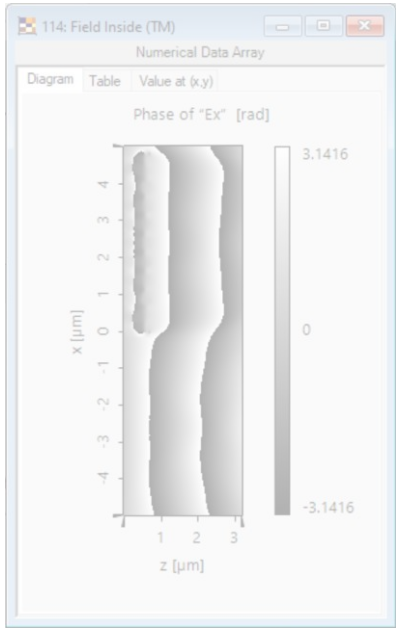
check the field distribution inside



input field
- plane wave
- wavelength $\lambda = 1400\,nm$
- normal incidence
- linearly polarized (TE or TM)

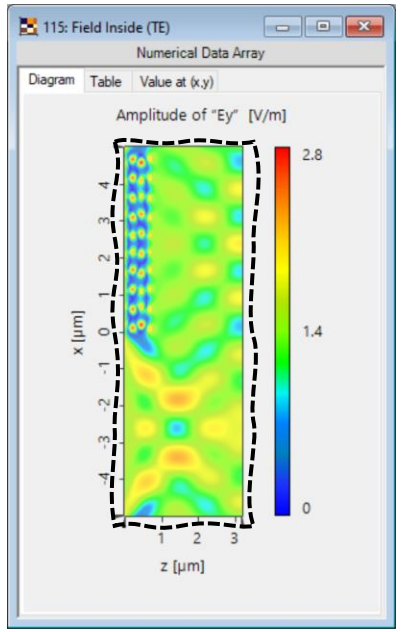
case with TM input polarization

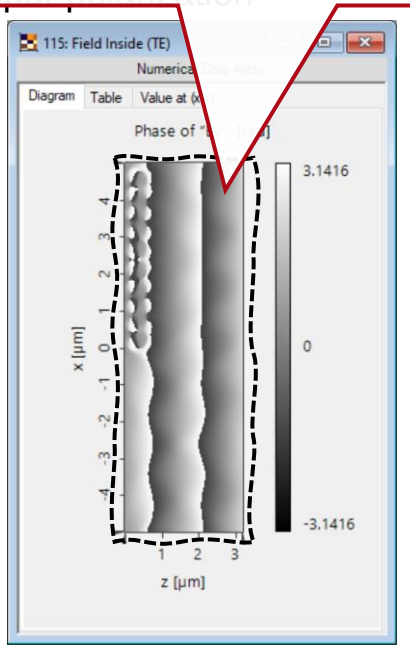




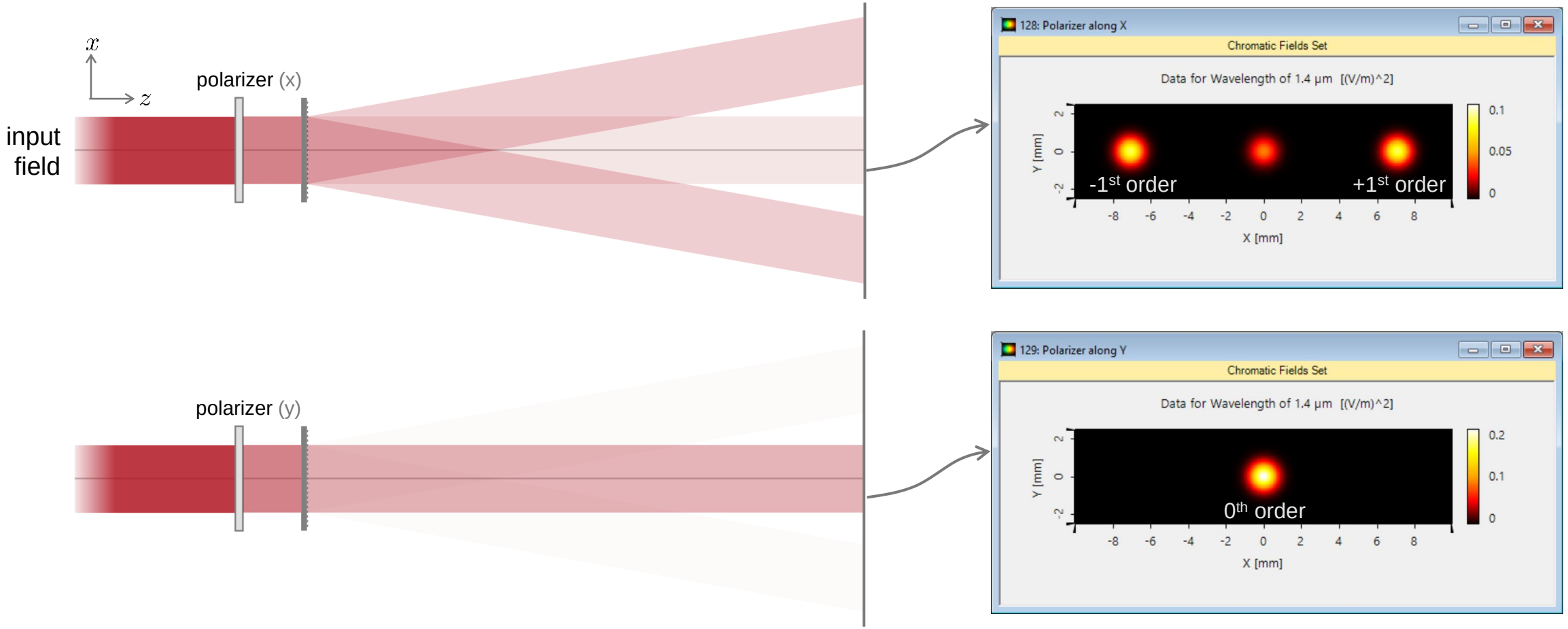
For TE polarization, there is not phase shift between the modulated and unmodulated regions.

case with TE input polarization



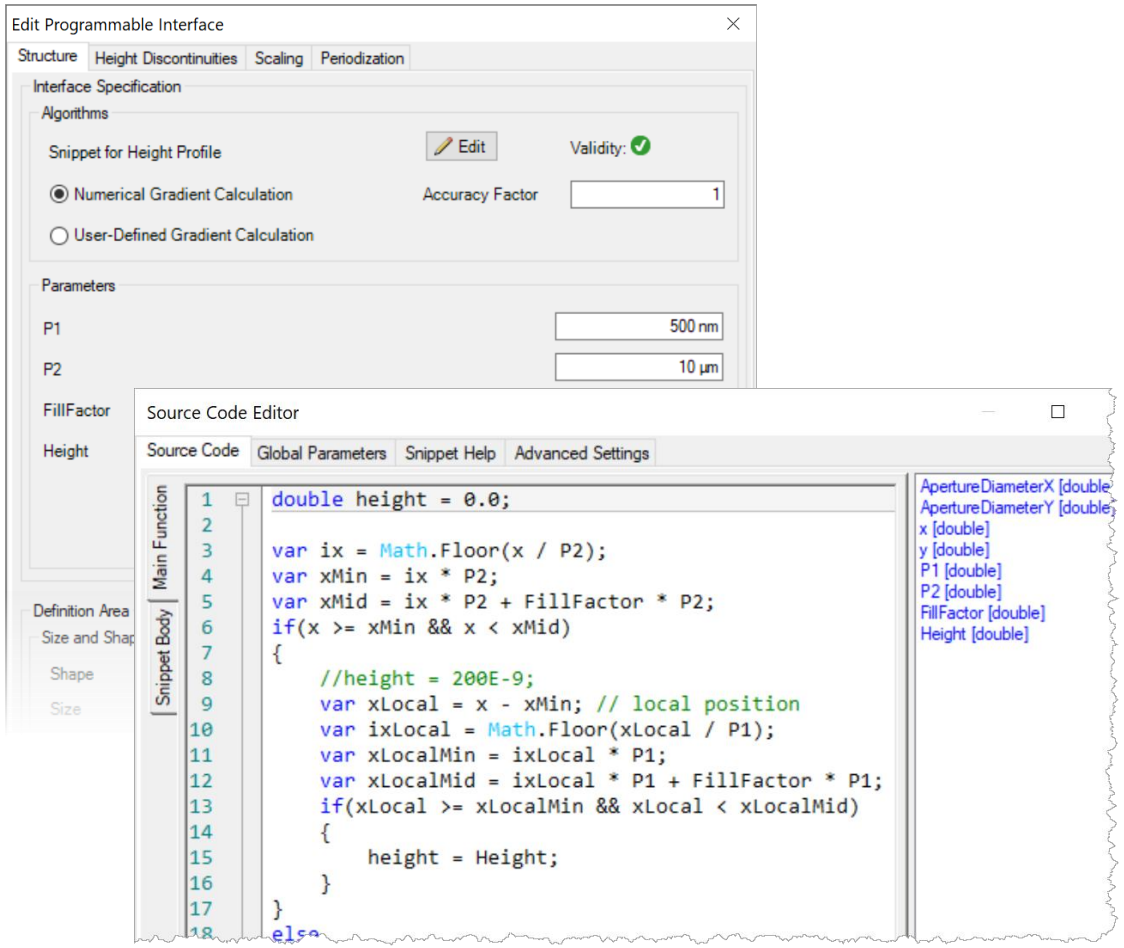


Experimental Test Setup

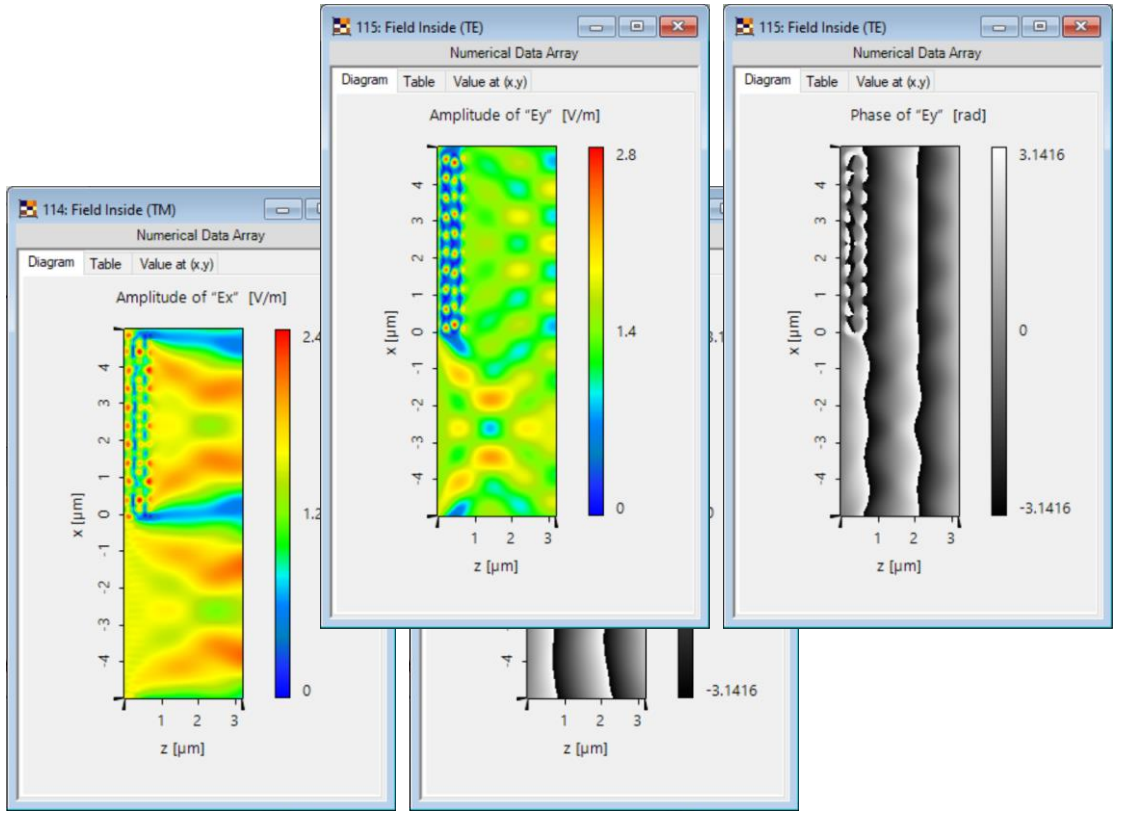


Peek into VirtualLab Fusion

flexible grating definition via programming



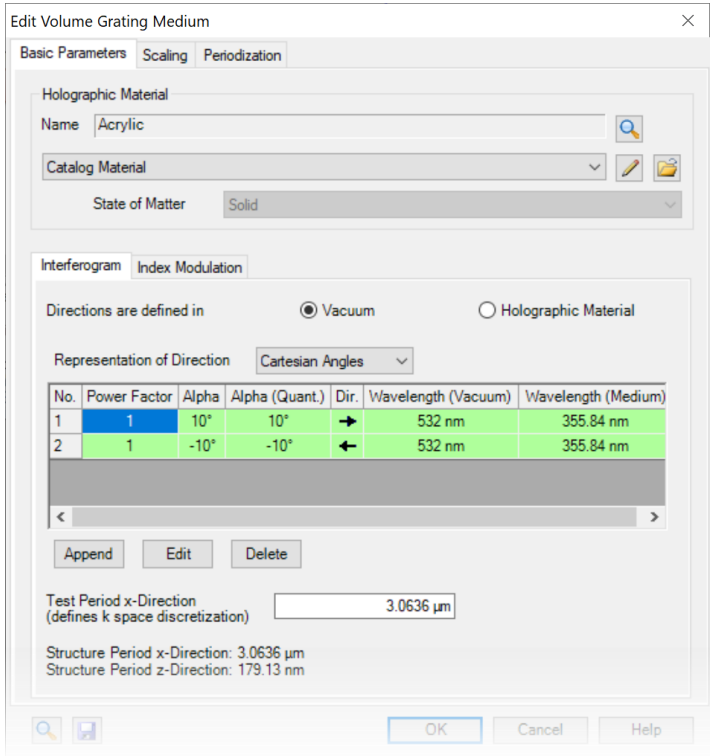
visualization of field inside grating structure



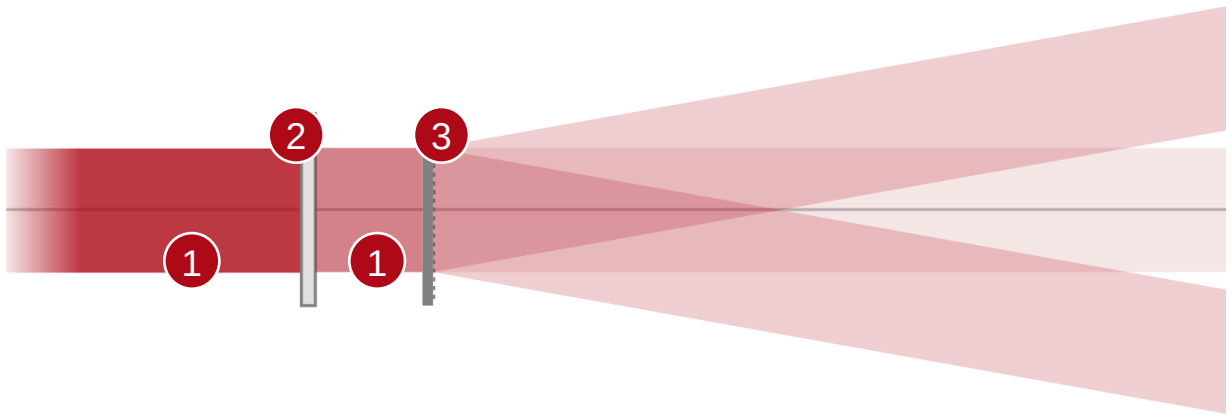
Workflow in VirtualLab Fusion

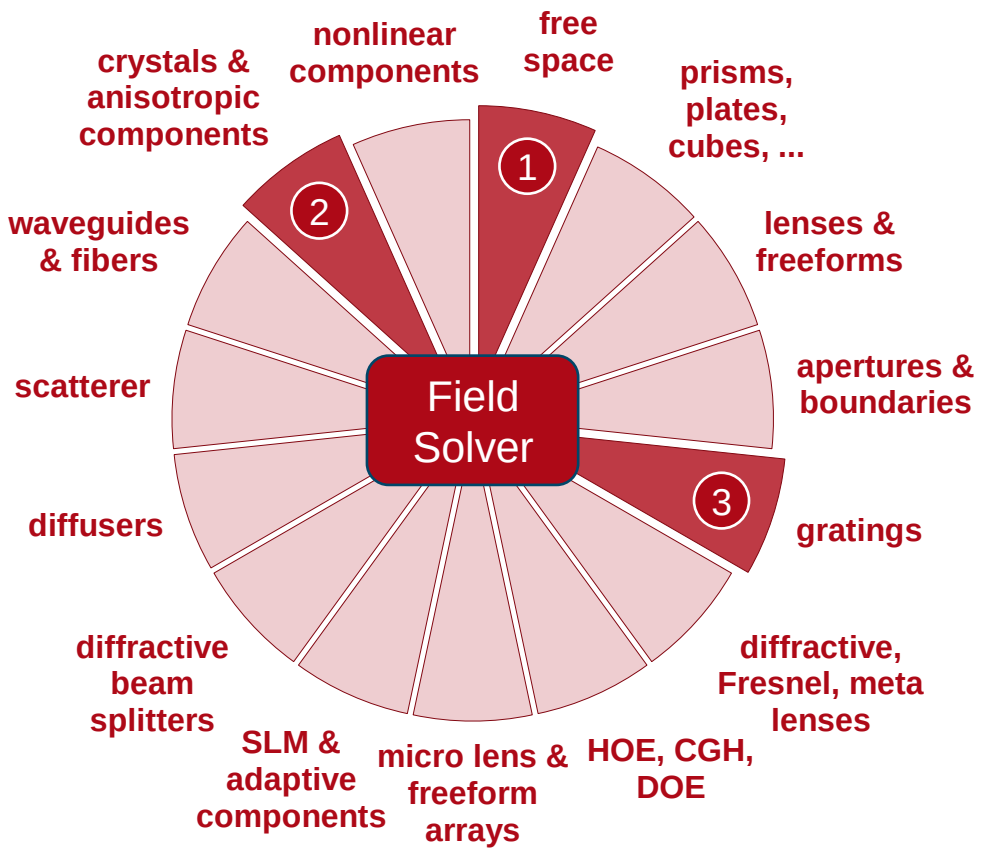
- Construct grating using customized interfaces
  - How to Work with the Programmable Interface & Example (Spherical Surface) [Use Case]
  - Configuration of Grating Structures by Using Interfaces [Use Case]

- Grating modeling within complex system
  - Modeling of Gratings within Optical System - Discussion at Examples [Use Case]



VirtualLab Fusion Technologies





Document Information

title	Polarization-Dependent Binary Resonant Gratings
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further reading	- Ultra-Sparse Dielectric Nano-Wire Grid Polarizers - Analysis and Design of Highly Efficient Polarization Independent Transmission Gratings