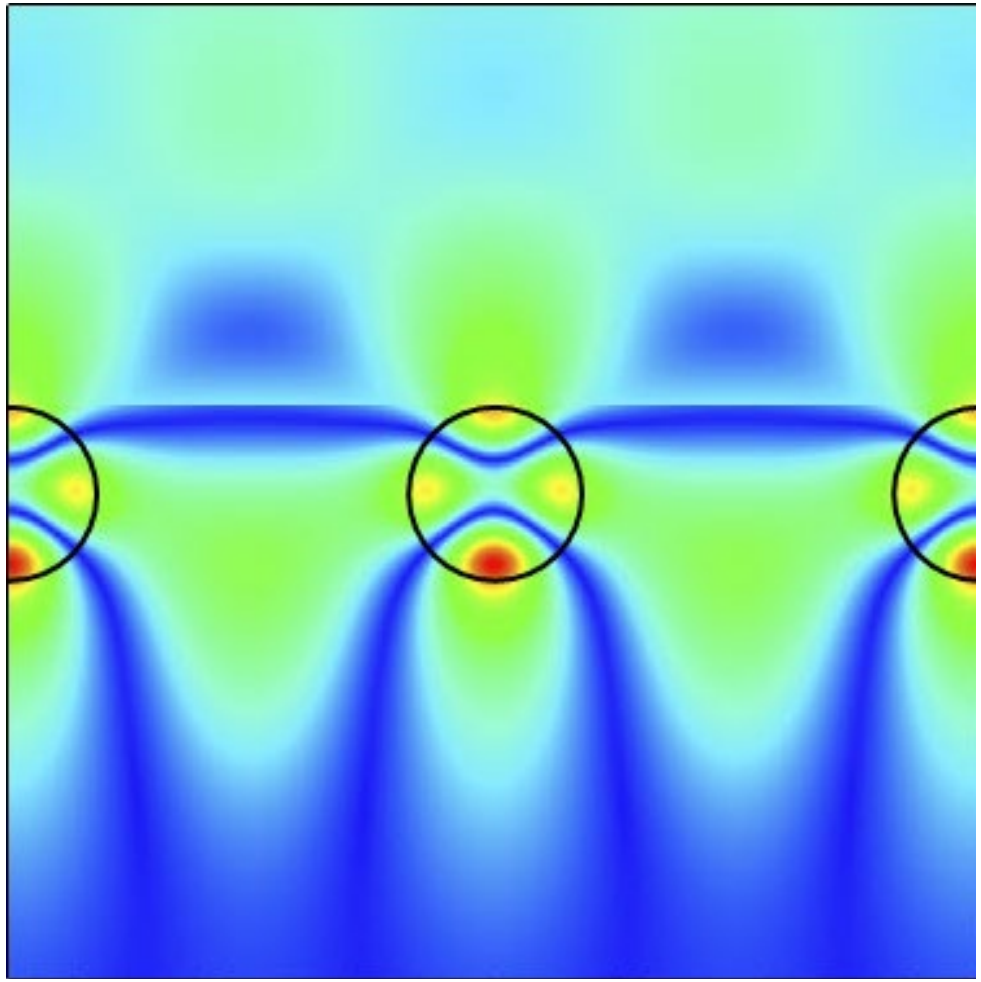
Resonant Photonic Lattices

Abstract



Resonant periodic nanostructures are a prime example to be calculated with Fourier Modal Method (FMM) – algorithms, due to their small periods. Hence, in this Use Case, we want to simulate a photonic lattice system with the in-build FMM solver of VirtualLab Fusion. There the wavelength dependend reflectivity, as well as the field in and around the structure for various point of interest will be analyzed.

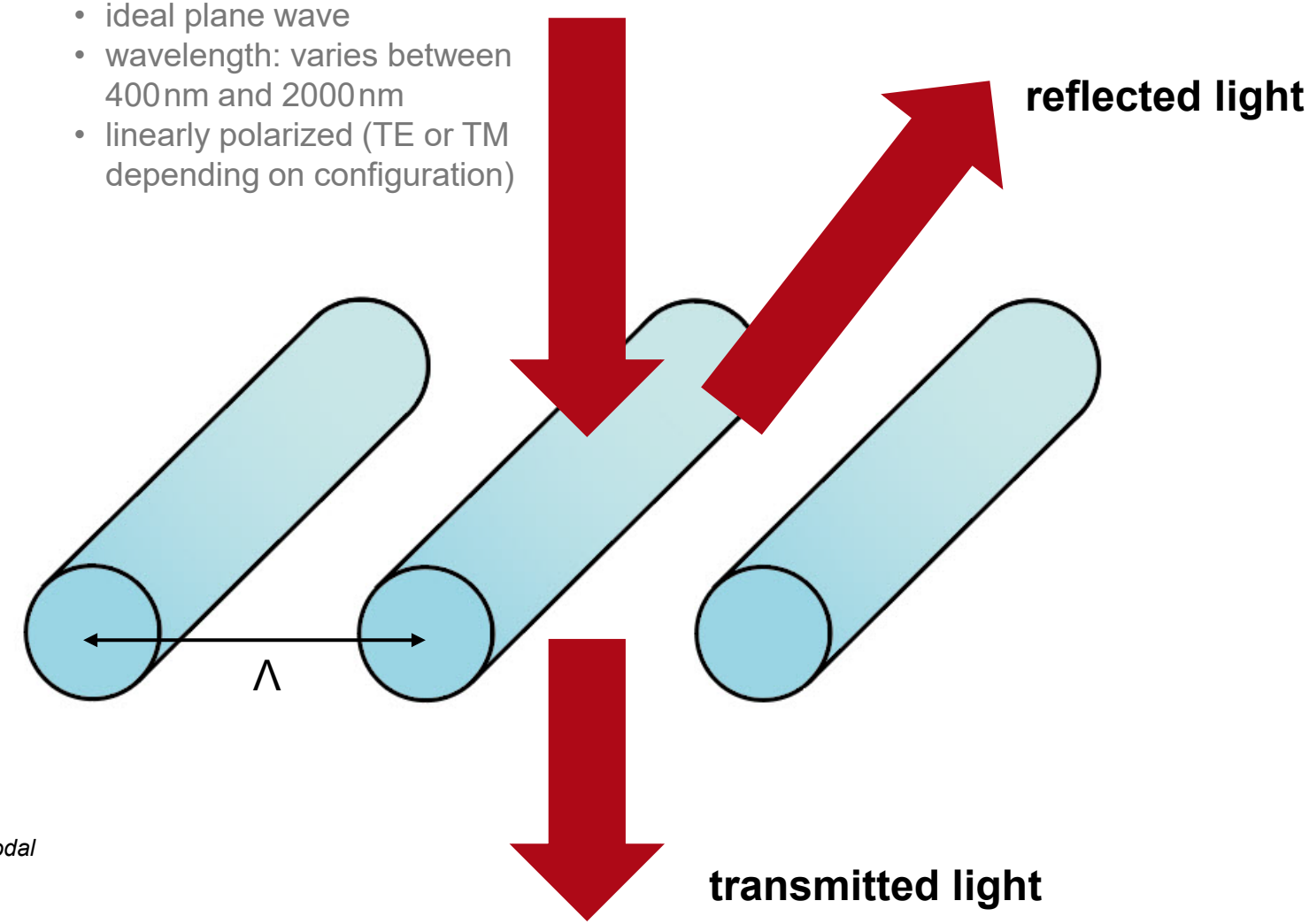
Modeling Scenario

source

- ideal plane wave
- wavelength: varies between 400 nm and 2000 nm
- linearly polarized (TE or TM depending on configuration)

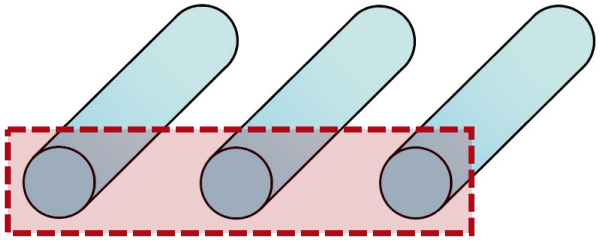
photonic lattices

- 1D lamellar grating
- invariant in y-direction
- refractive index of cylinders: 3.5
- 3 configuration with different period Λ: 500 nm, 700 nm and 1100 nm



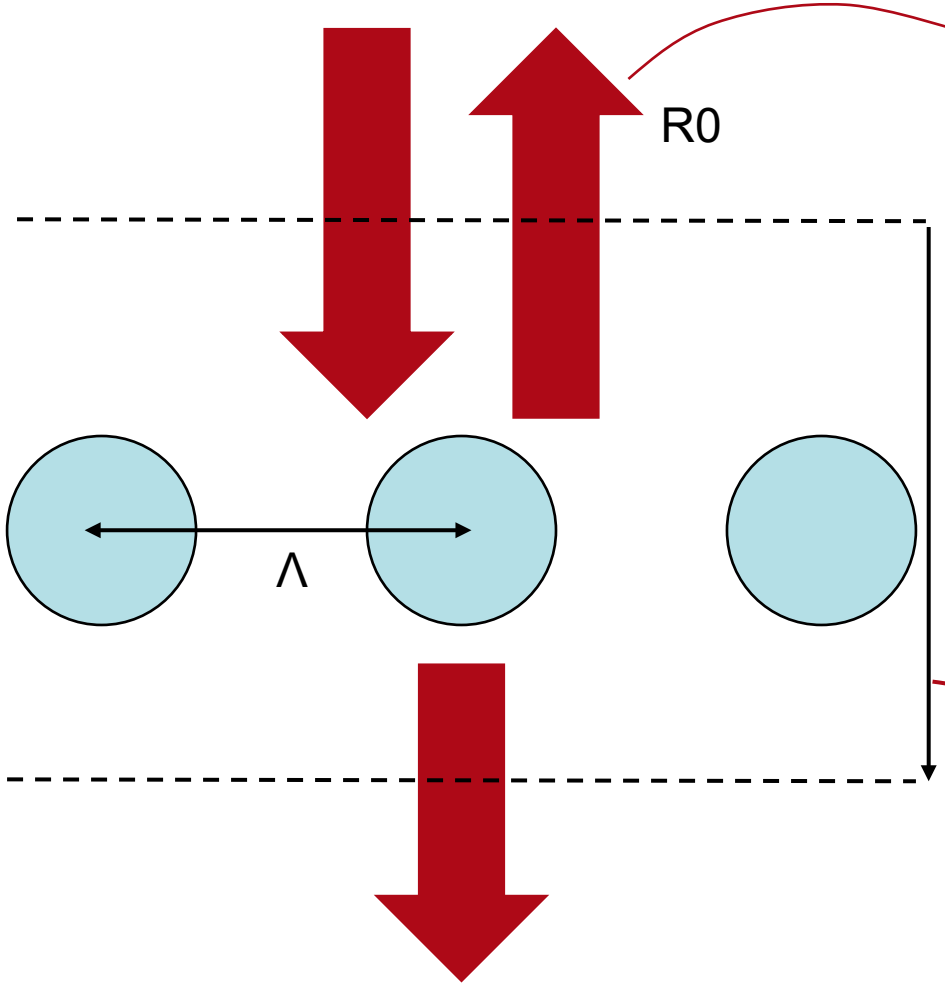
*Reference: Yeong Hwan Ko, Nasrin Razmjooei, Hafez Hemmati, and Robert Magnusson, "Perfectly-reflecting guided-mode-resonant photonic lattices possessing Mie modal memory," Opt. Express **29**, 26971-26982 (2021)*

Modeling Task



3 different configurations

a) TM-polarized source, 500 nm period
b) TE-polarized source, 1100 nm period
c) TE-polarized source, 700 nm period



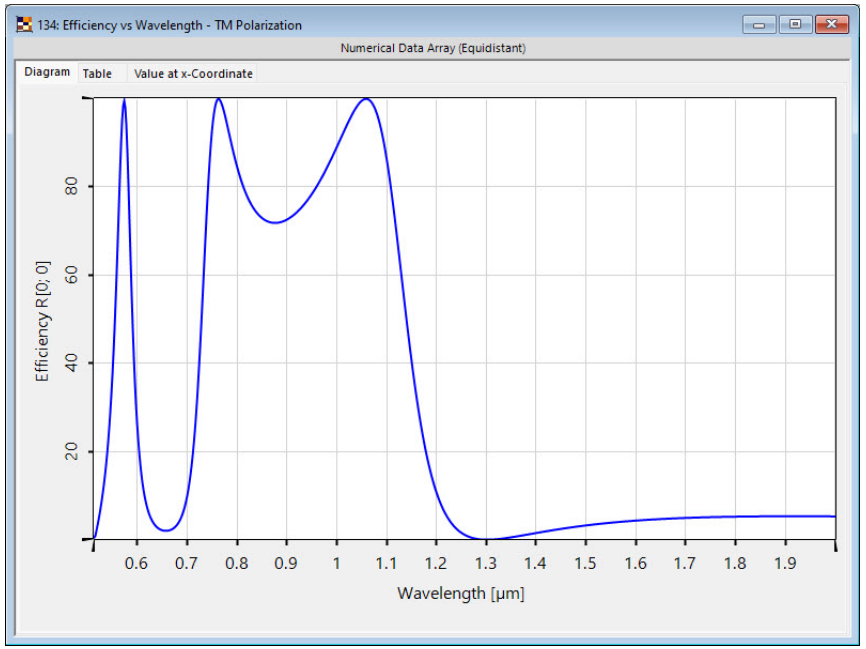
Task 1: wavelength dependency of the 0th reflection order for all 3 configurations

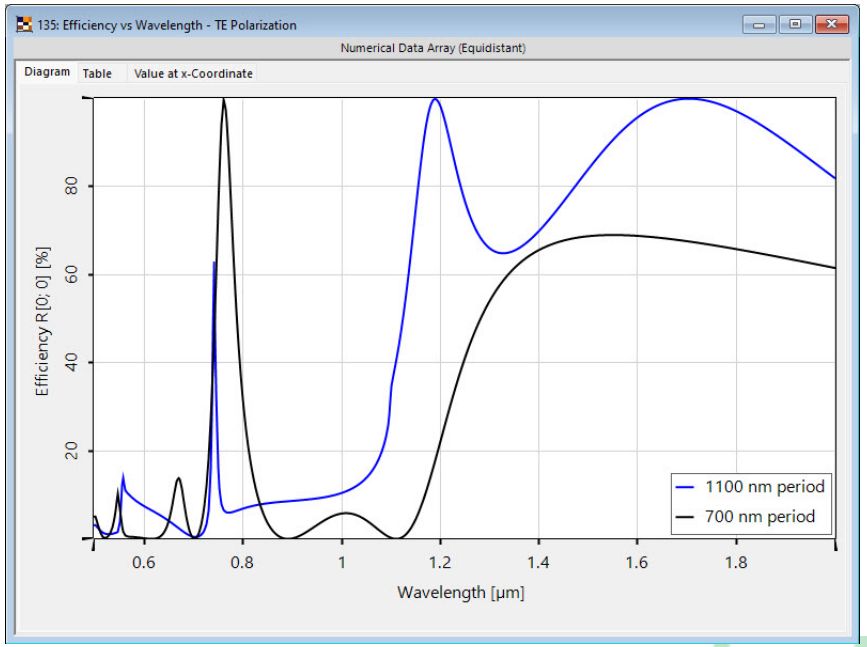
Task 2: detection of the field inside and near around the cylinders at wavelengths that provide high reflectivity.

Simulation Results

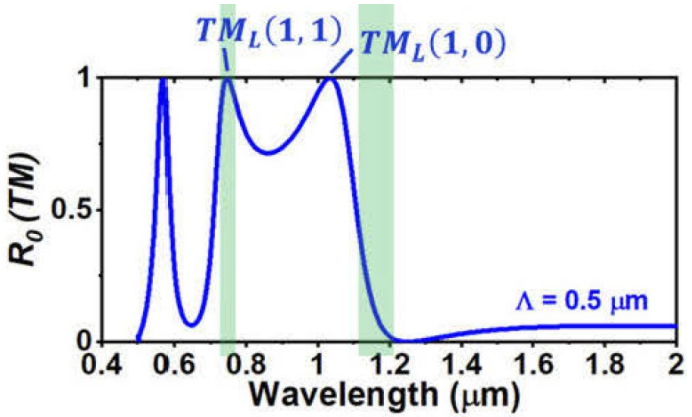
Task 1 – Wavelength Dependency of the Reflection

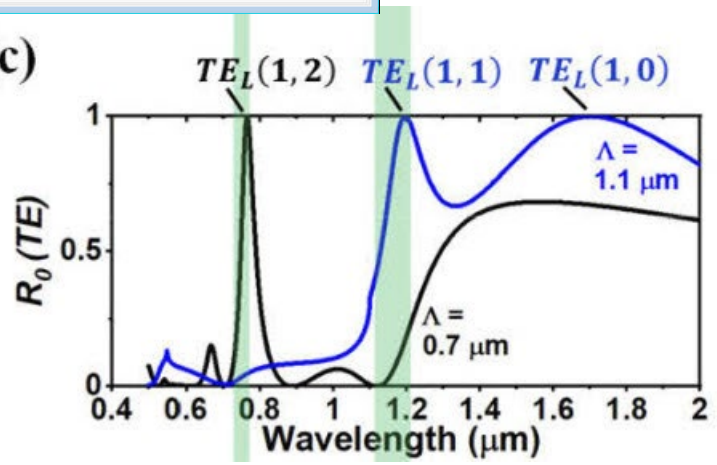
configuration a
TM-polarized source,
500 nm period





configuration b & c
TE-polarized source,
500 nm period &
1100 nm period





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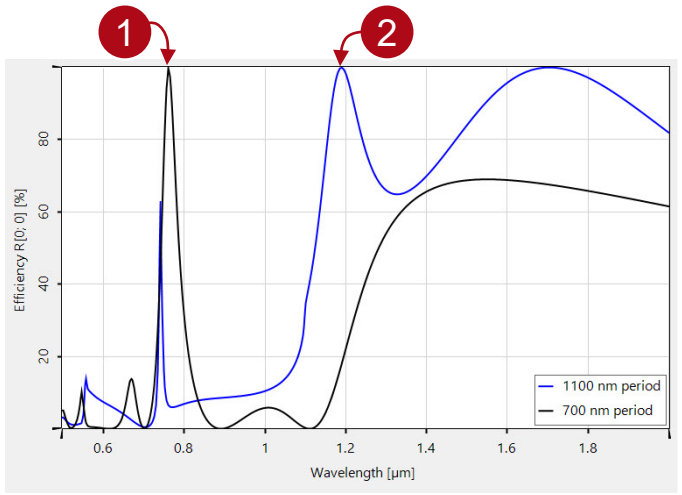
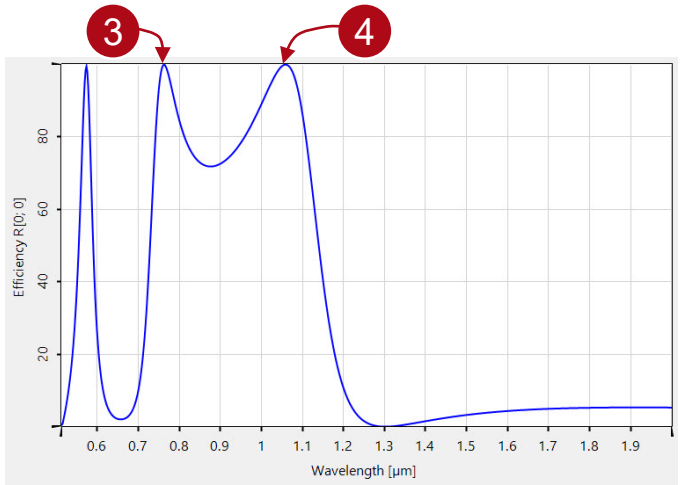
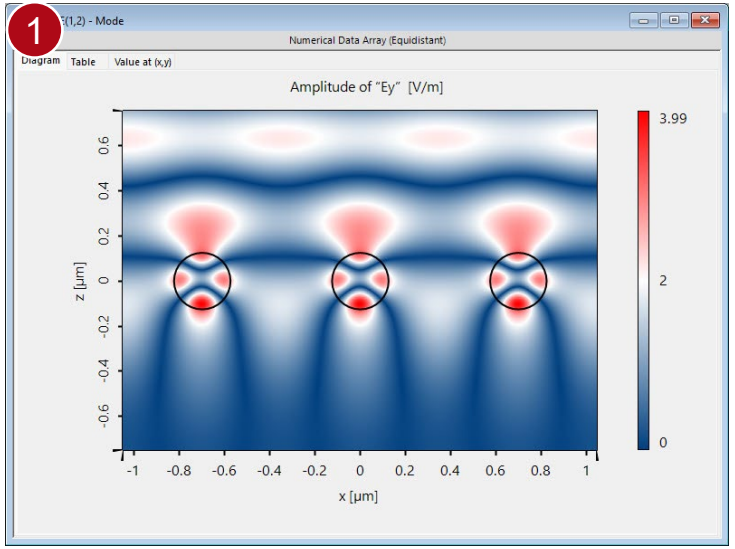
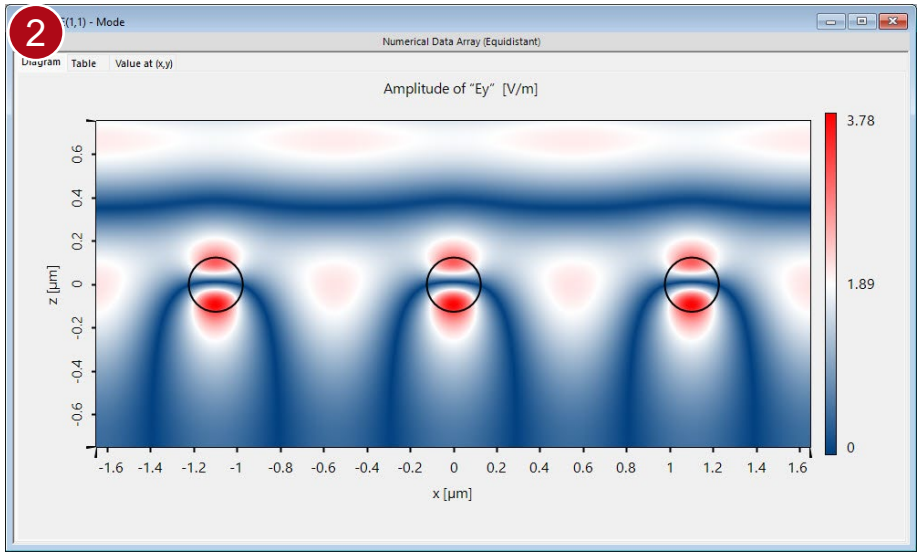
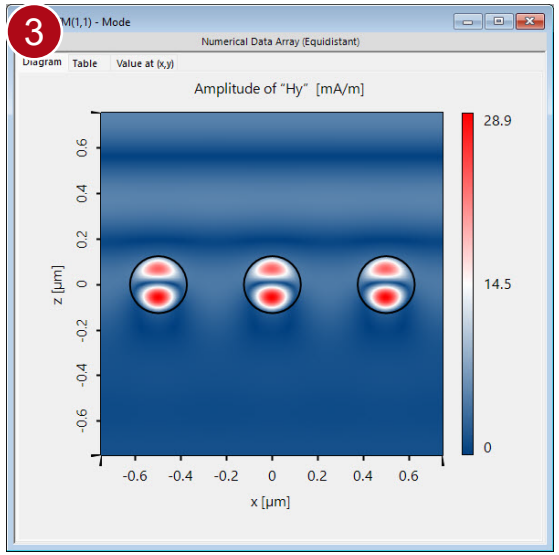
Task 2 – Field around the Structure

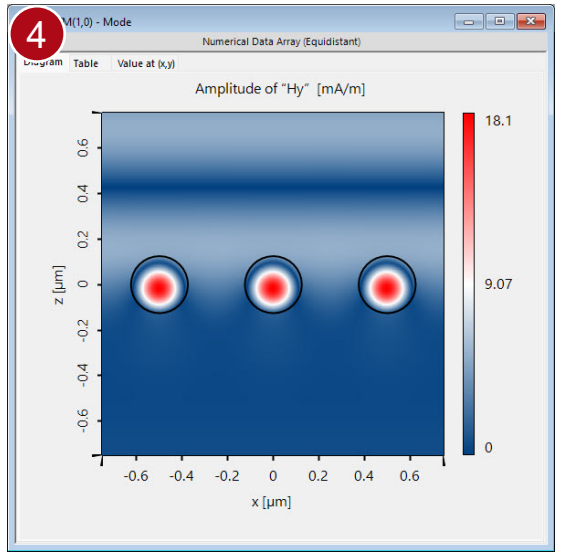




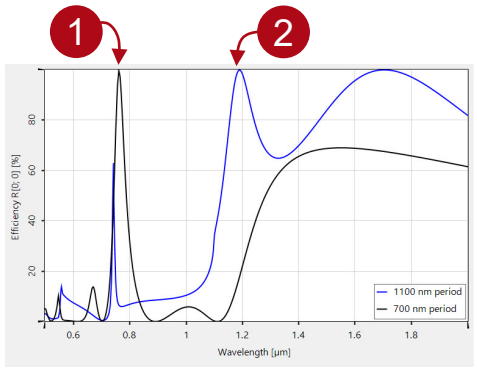


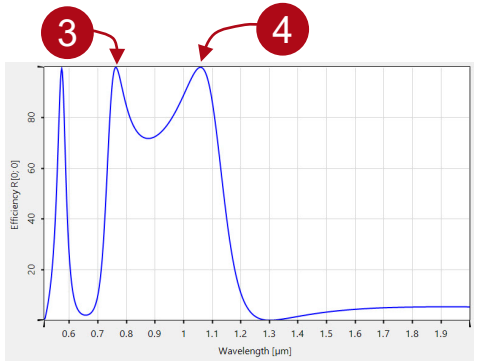


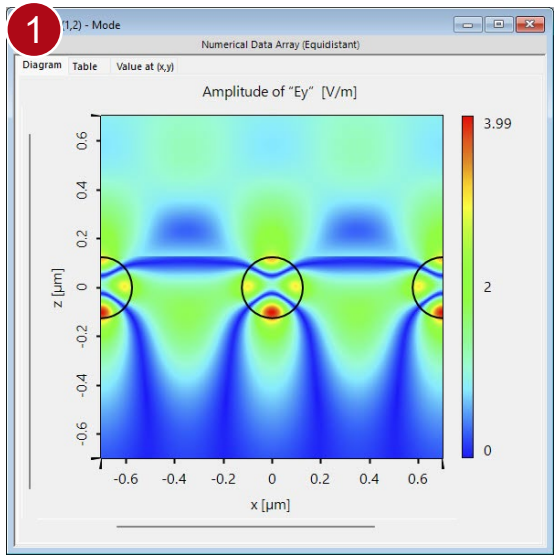


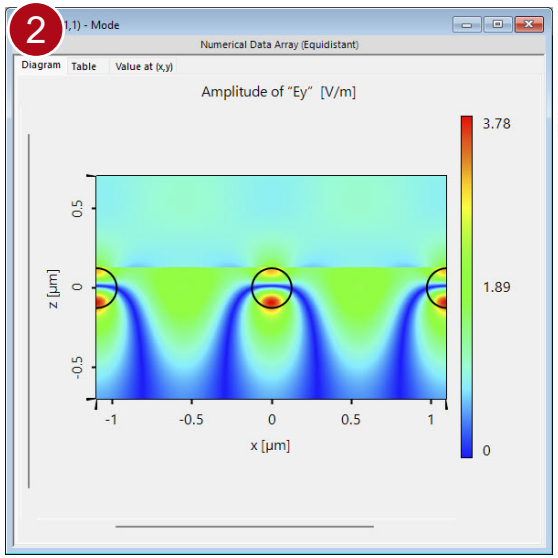


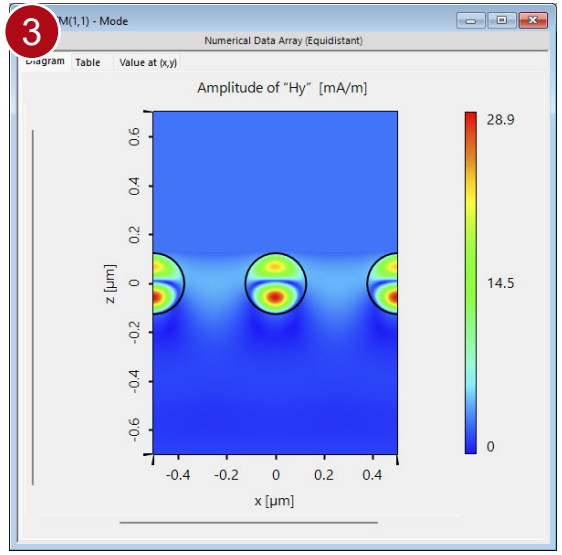
Task 2 – Comparison with Reference

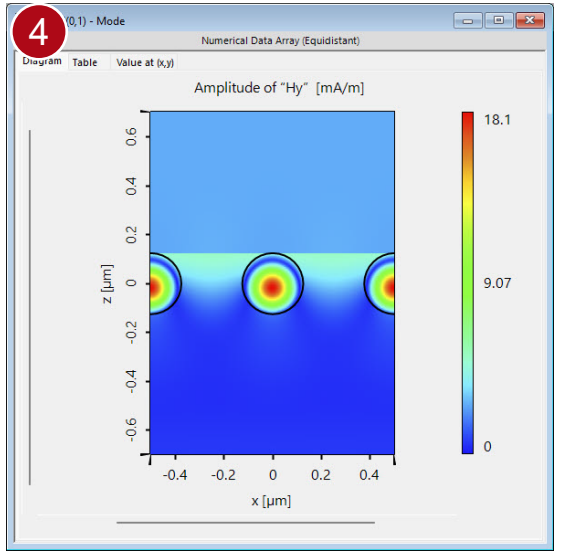


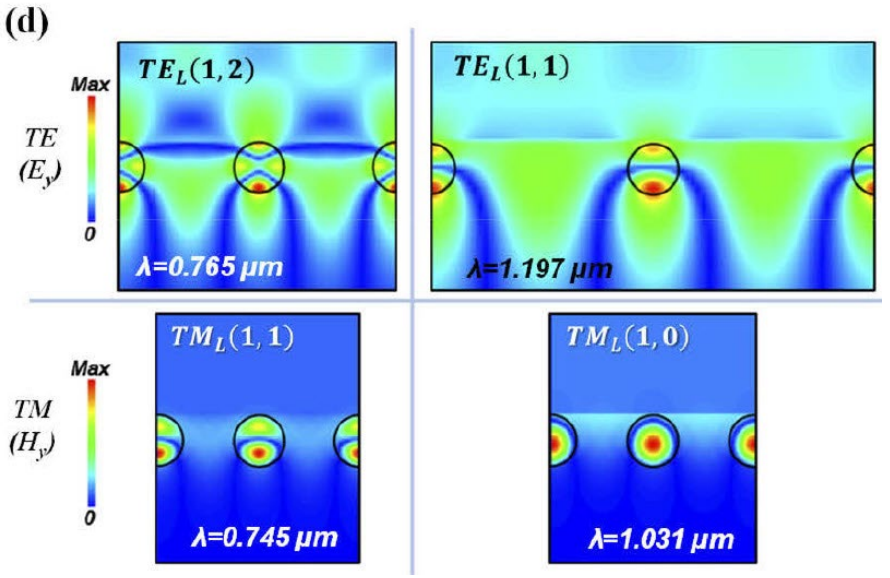












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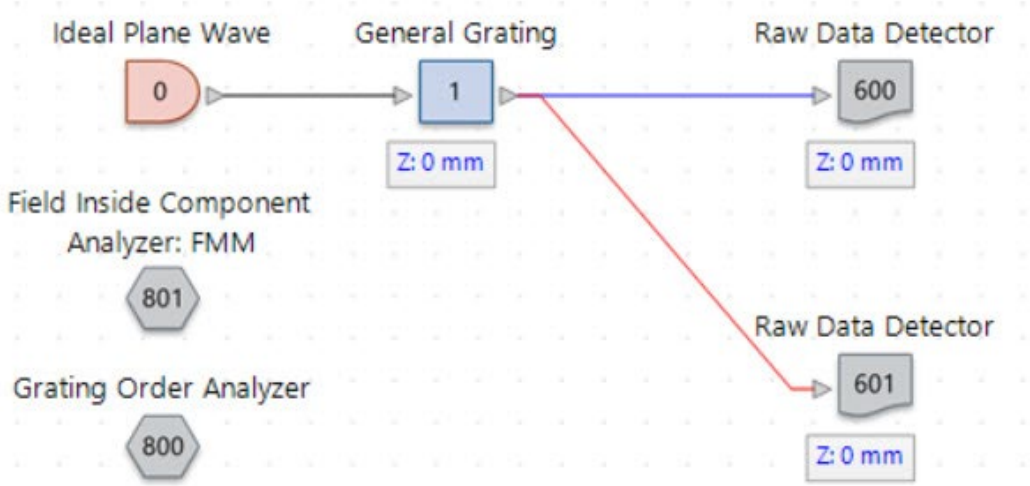
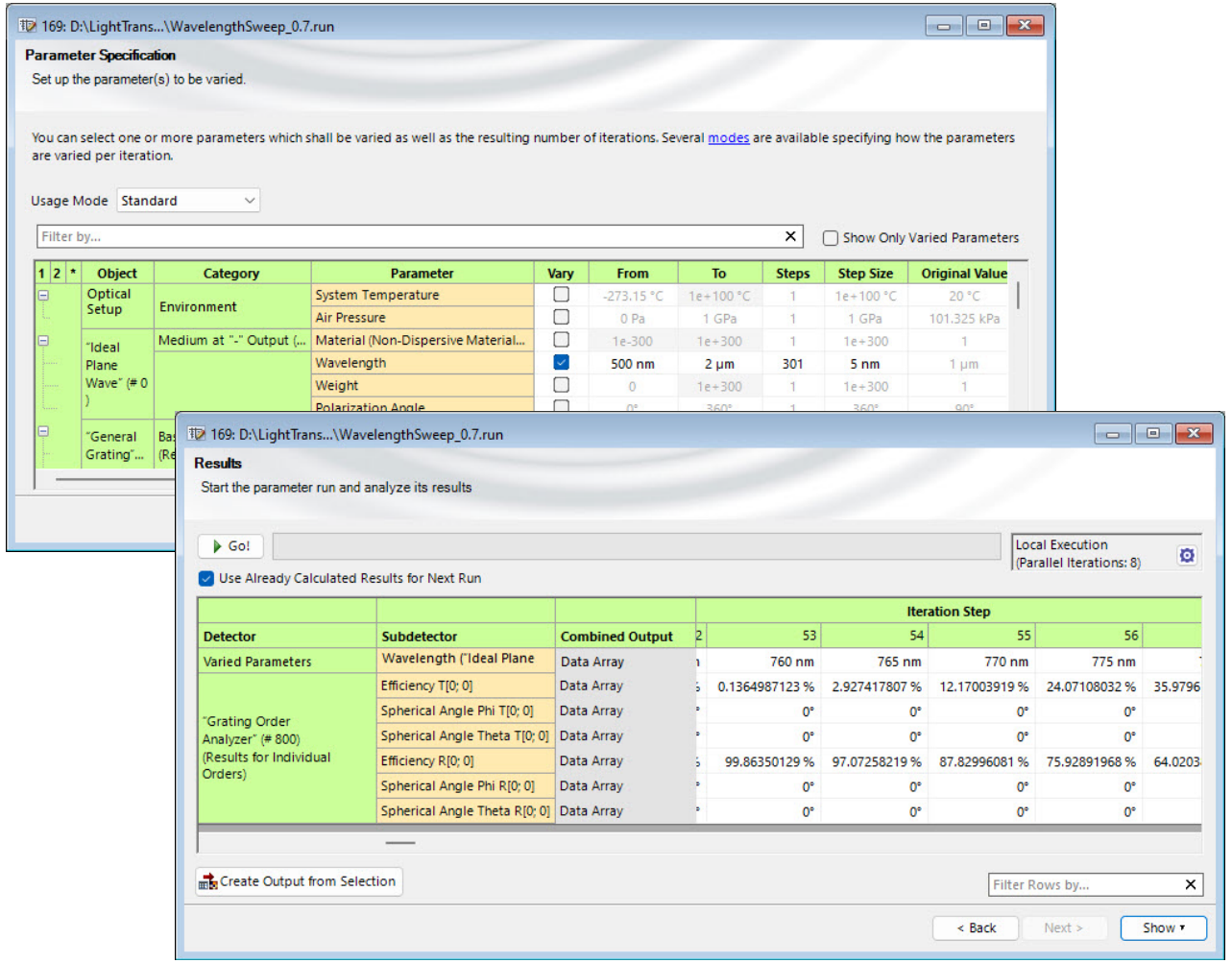
Workflows

Parameter Run

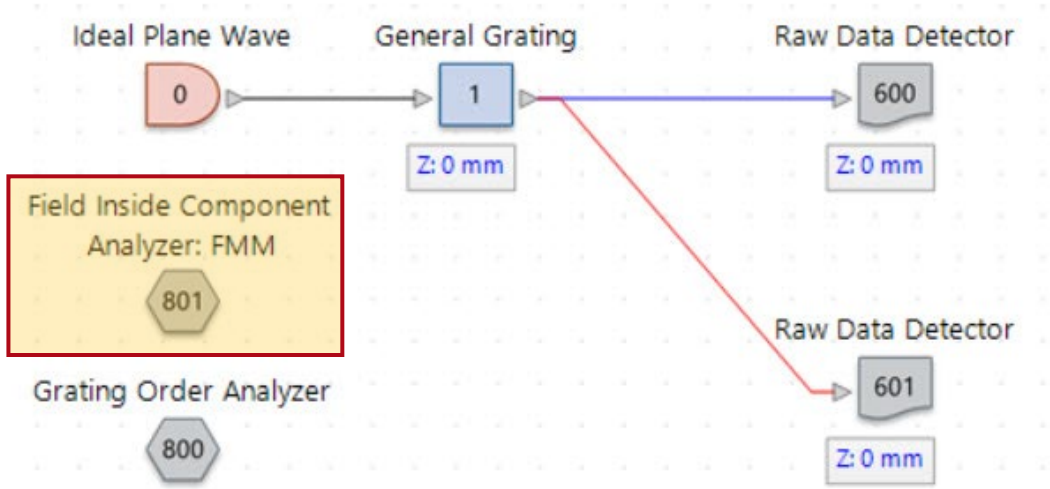


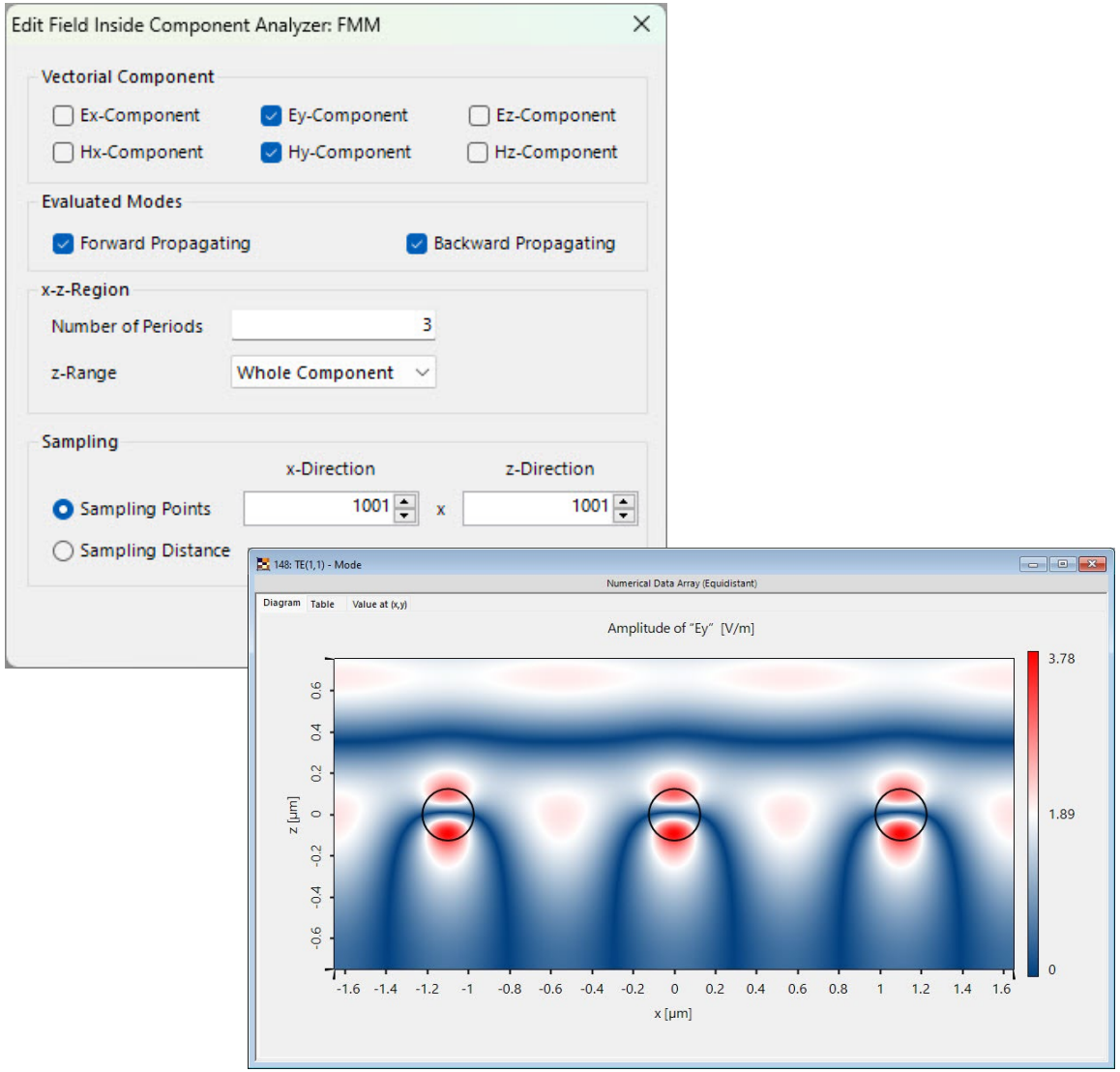


To analyze the wavelength dependency of the reflectivity of the device, a parameter sweep is performed with the Parameter Run document.

More information under:
Usage of the Parameter Run Document

Field Inside Component Analyzer: FMM





With the *Field Inside Component Analyzer: FMM*, the propagated field can be displayed for the various configurations. Find more information under:

Field Inside Component Analyzer: FMM

Post-Processing

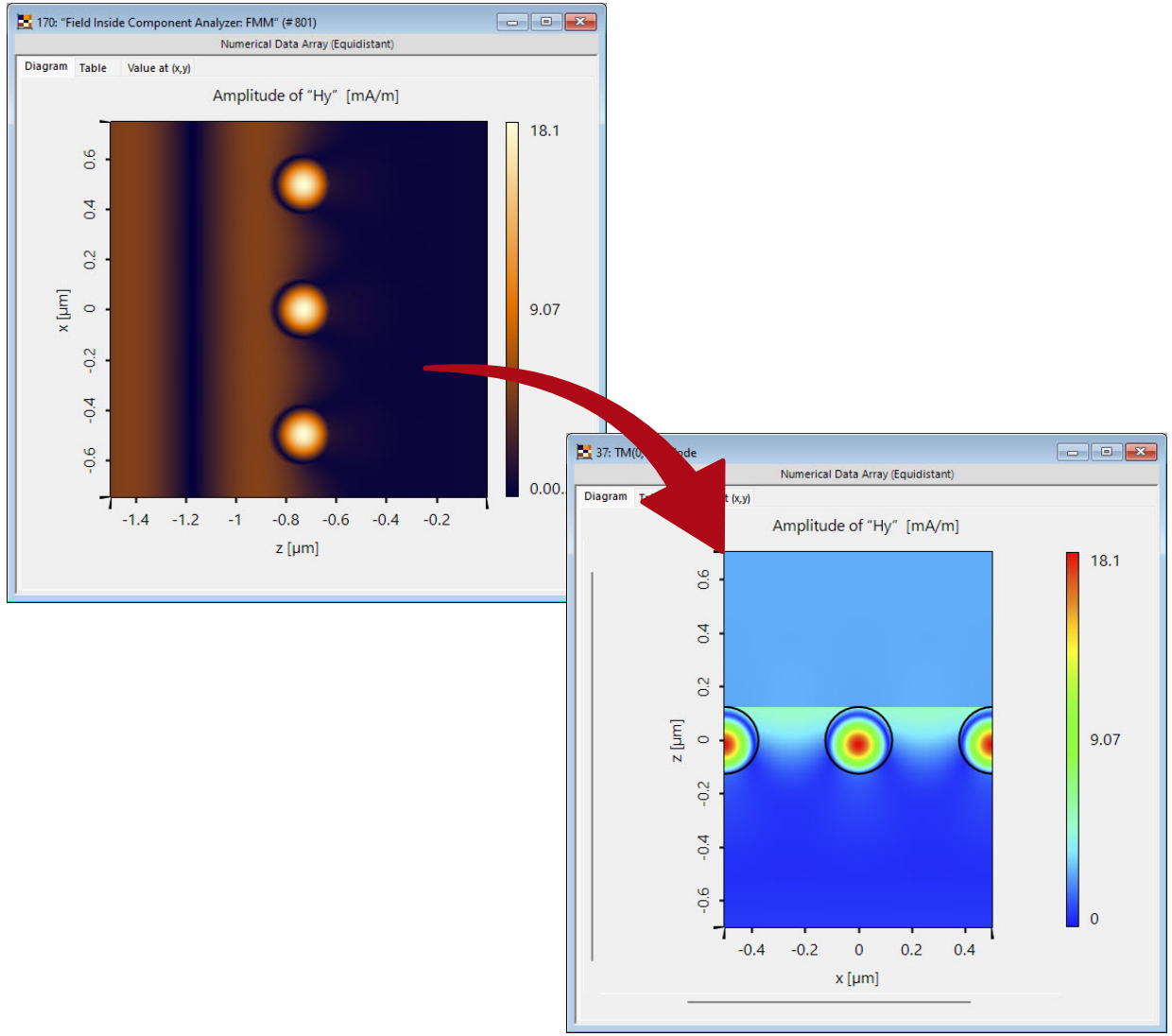
Workflow: How to Format VLF Results

Add Structure to Result:

- Flexible Region Configuration
- Graphics Add-ons
- Add Region to Data Array

Change Format of Data Array:

- General Manipulation Tools for Data Arrays
- View Settings for 2D Data Arrays



Document Information

title	Resonant Photonic Lattices
document code	GRT.0039
document version	1.0
required packages	-
software version	2024.1 (Build 1.132)
category	Use Case
further reading	Usage of the Parameter Run Document Field Inside Component Analyzer: FMM General Manipulation Tools for Data Arrays