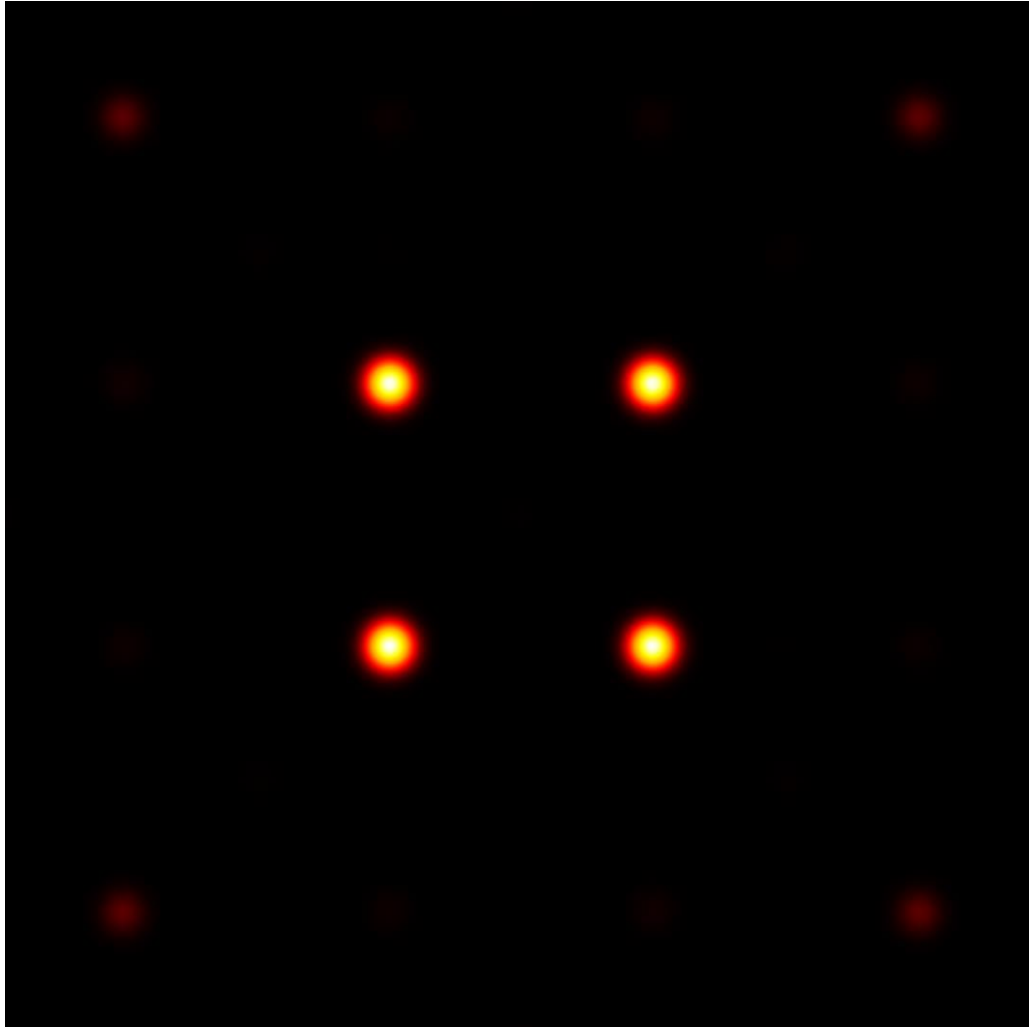


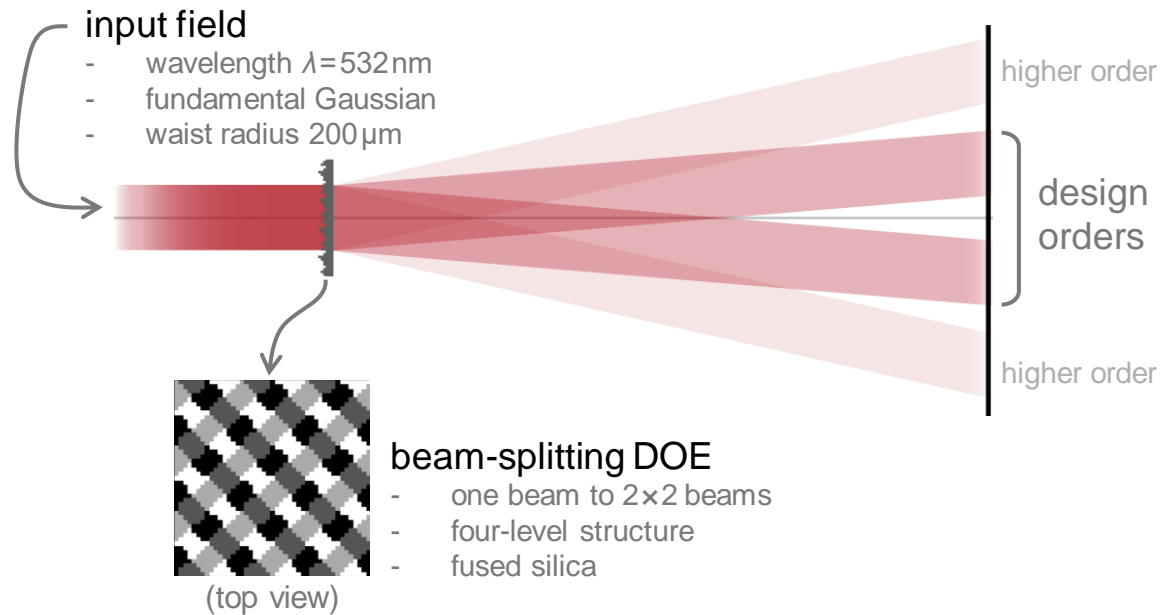
Angular-Filtering Volume Gratings for Suppressing Higher Diffraction Orders

Abstract



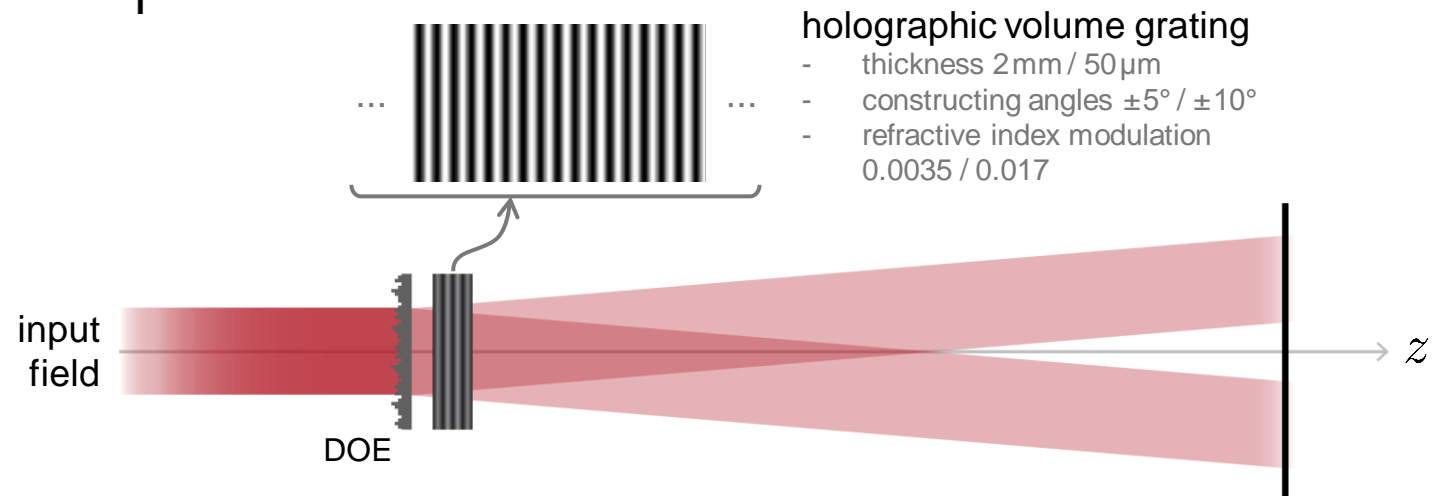
Holographic volume gratings, which are usually made by two-/mult-beam interference, are known for their wavelength and angle sensitivities. Because of that, they can be designed to work as angular stop filters. In this example, following the work of Bang *et al.*, construct volume gratings, analyze the angular sensitivities of them, and then use one of the grating as a angular filter in a beam-splitting DOE system. The suppression of the undesired higher diffraction orders are shown in the simulation.

Modeling Task



On the holographic volume grating, we show

- how to analysis its angular sensitivity, and
- how to use it as an angular filter in e.g. a DOE beam-splitting system to get rid of the undesired higher diffraction orders.

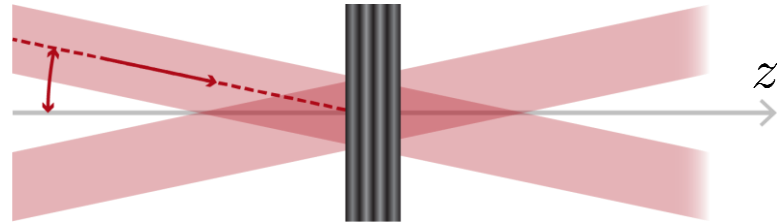


volume grating parameters from K. Bang, *et al.*, Opt. Lett. 44, 2133-2136 (2019)

Grating Angular Transmittance Analysis (5° Design)

input field

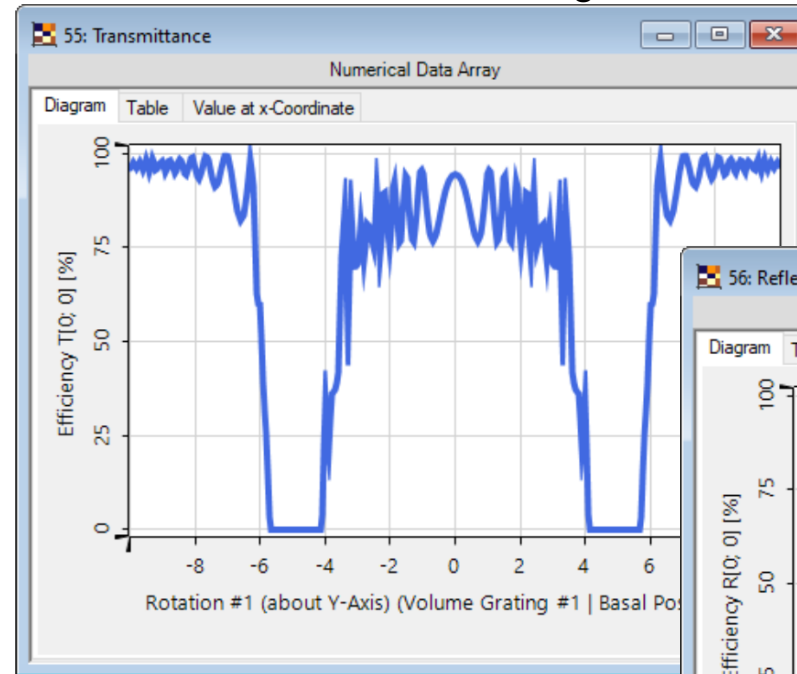
- wavelength $\lambda=532\text{nm}$
- plane wave
- incidence angle from -10 to $+10^\circ$



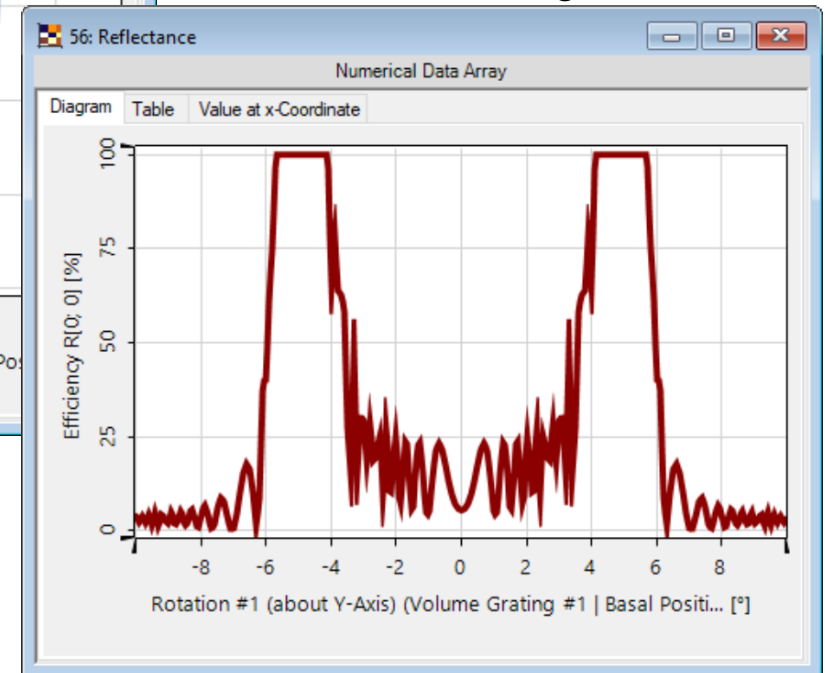
volume grating

- thickness 2mm
- constructing angle $\pm 5^\circ$
- refractive index modulation 0.0035

transmittance vs angle



reflectance vs angle

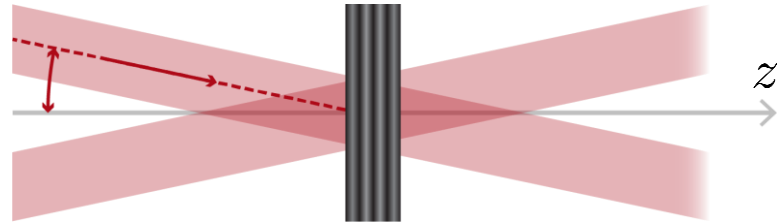


The FMM / RCWA is used to calculate the transmittance and reflectance of the holographic volume grating.

Grating Angular Transmittance Analysis (10° Design)

input field

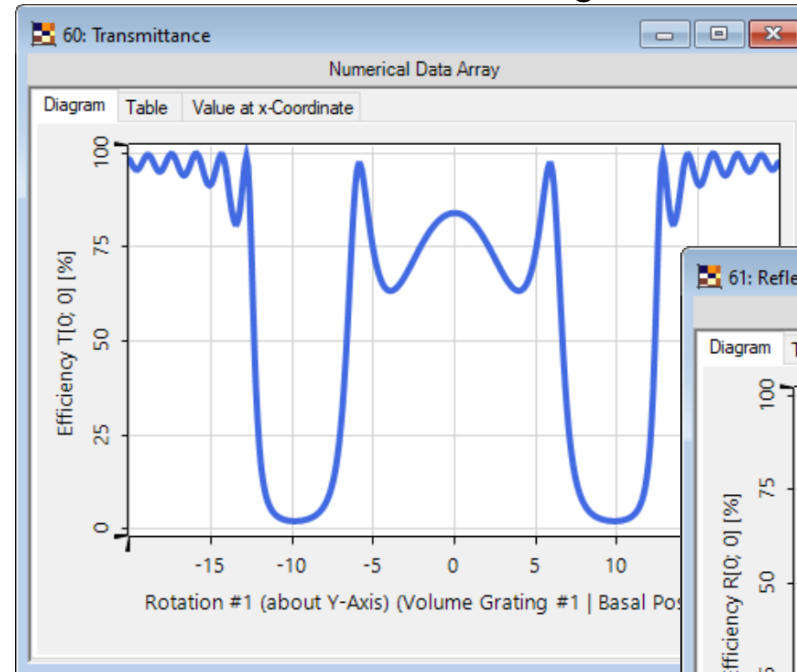
- wavelength $\lambda = 532\text{nm}$
- plane wave
- incidence angle from -20 to $+20^\circ$



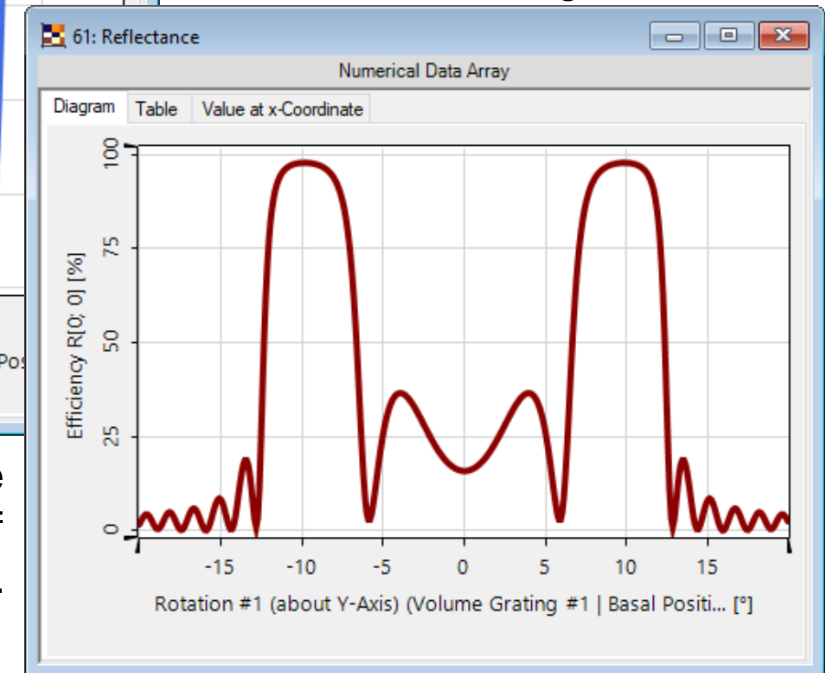
volume grating

- thickness $50\mu\text{m}$
- constructing angle $\pm 10^\circ$
- refractive index modulation 0.017

transmittance vs angle

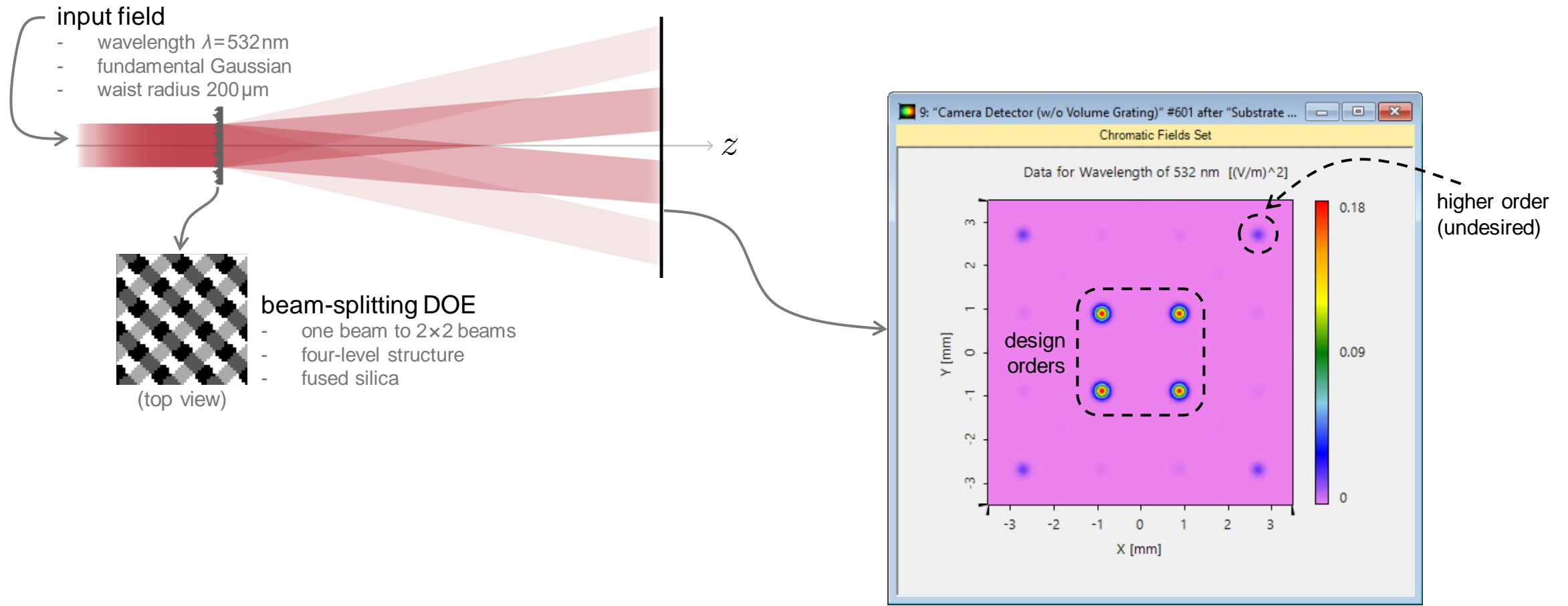


reflectance vs angle

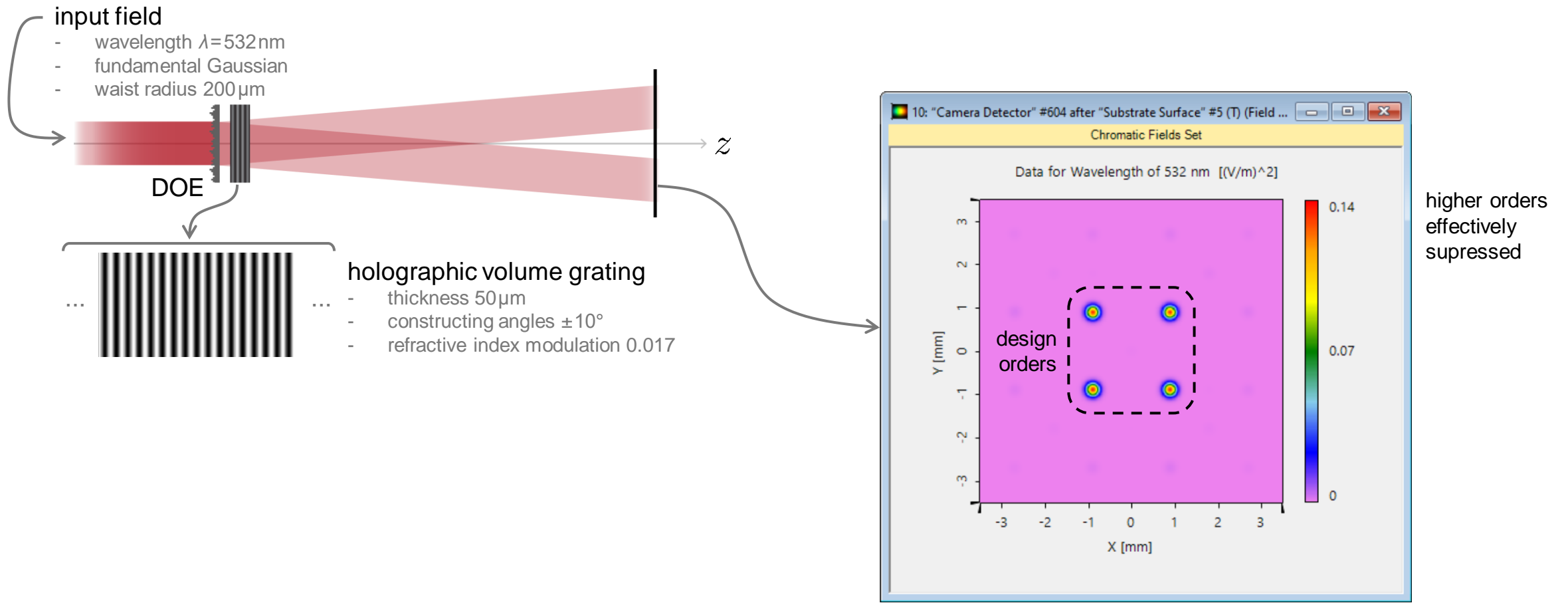


The FMM / RCWA is used to calculate the transmittance and reflectance of the holographic volume grating.

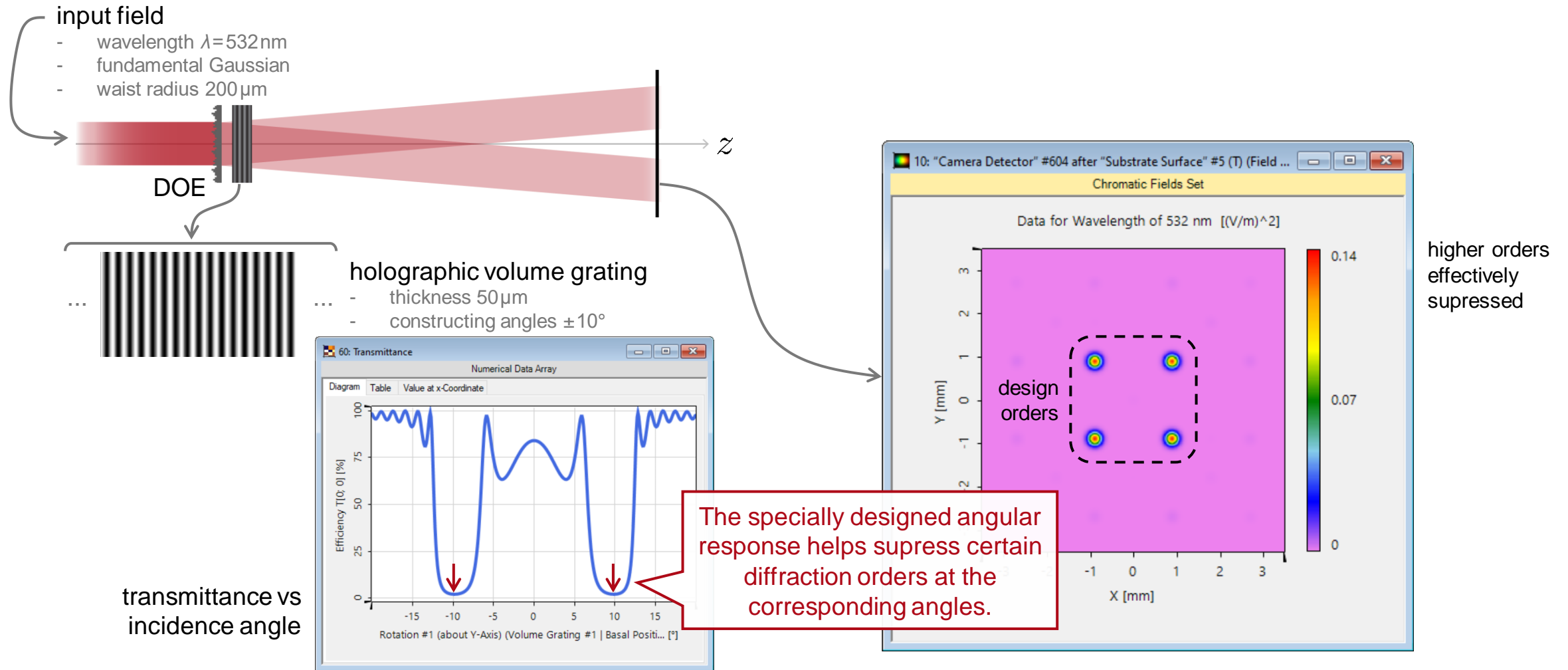
Original Beam-Splitting DOE System



Angular Filtering Effect of Volume Grating

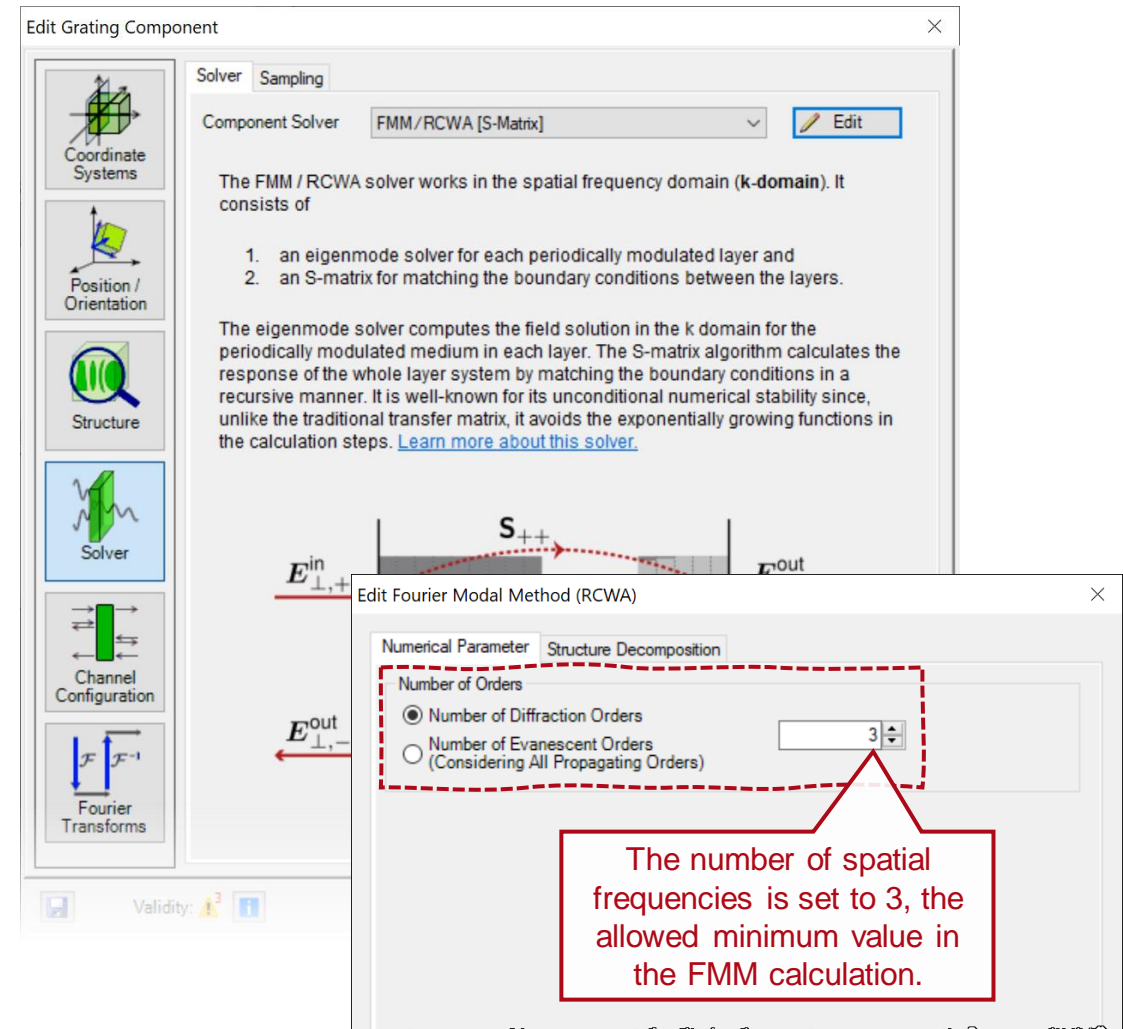
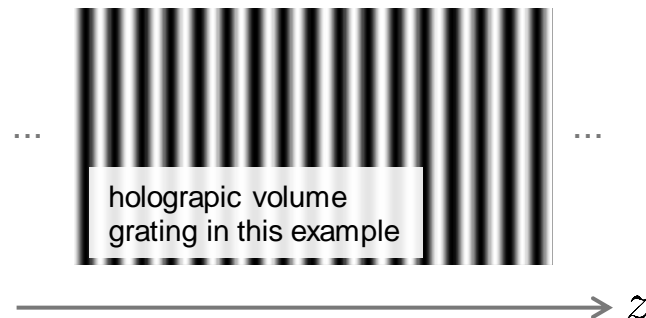


Angular Filtering Effect of Volume Grating



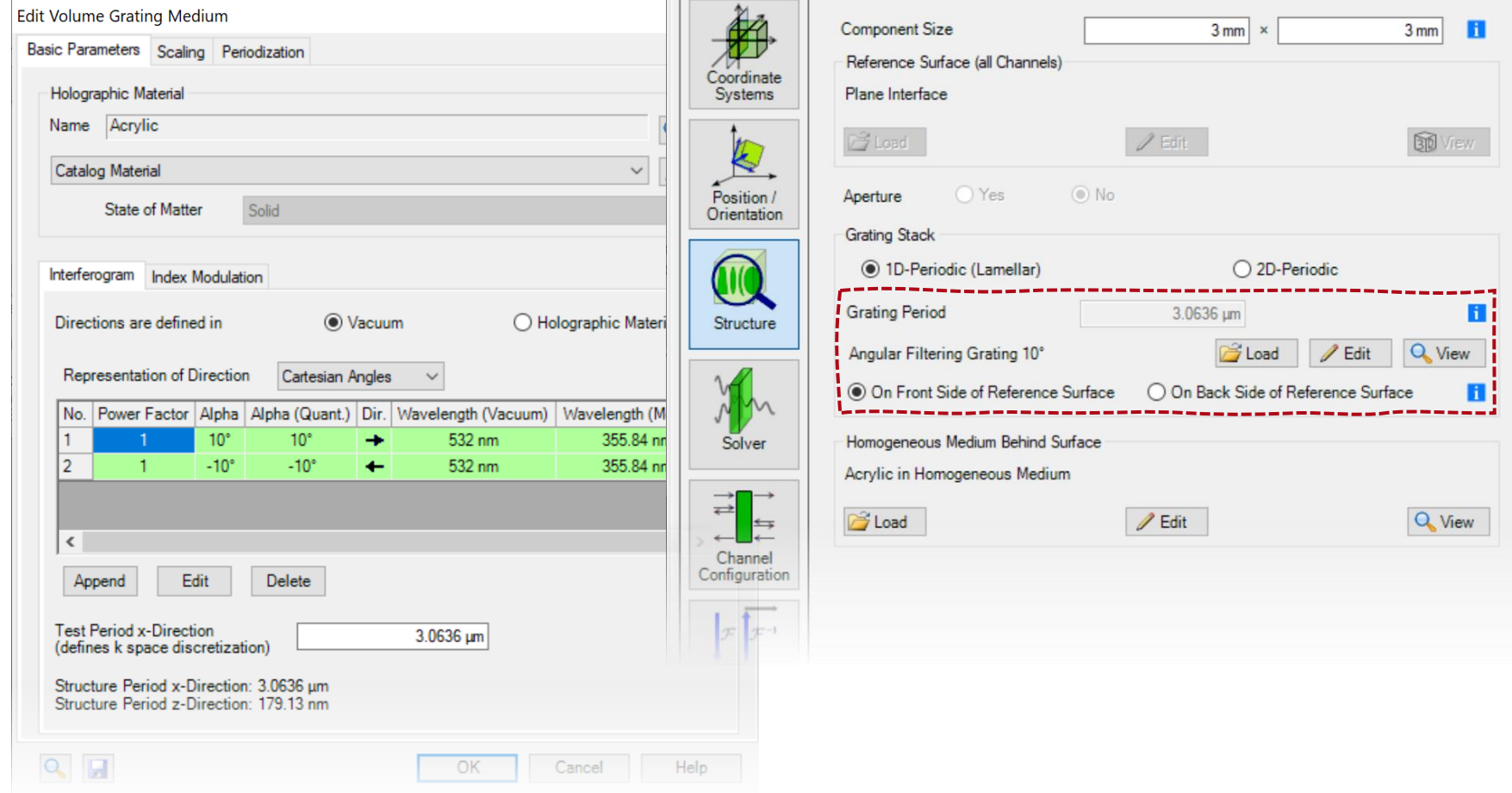
Note on Simulation Settings

- FMM / RCWA simulation setting
 - The refractive index of the holographic volume grating, in this example, varies only along the z-axis, but there is no transverse variation.
 - For such cases, there is no need to expand the electromagnetic field into multiple spatial frequency components in the FMM / RCWA calculation.



Peek into VirtualLab Fusion

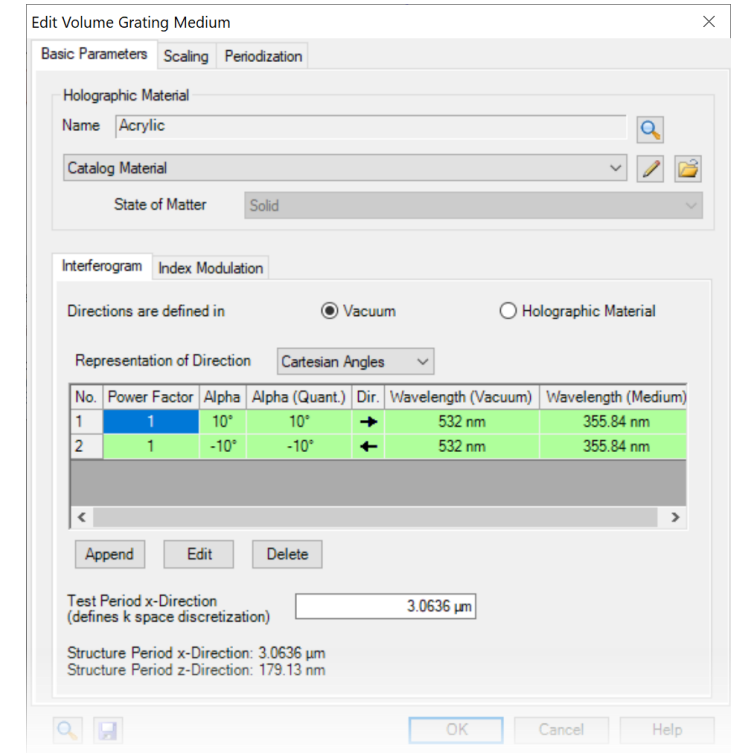
configuration of volume gratings



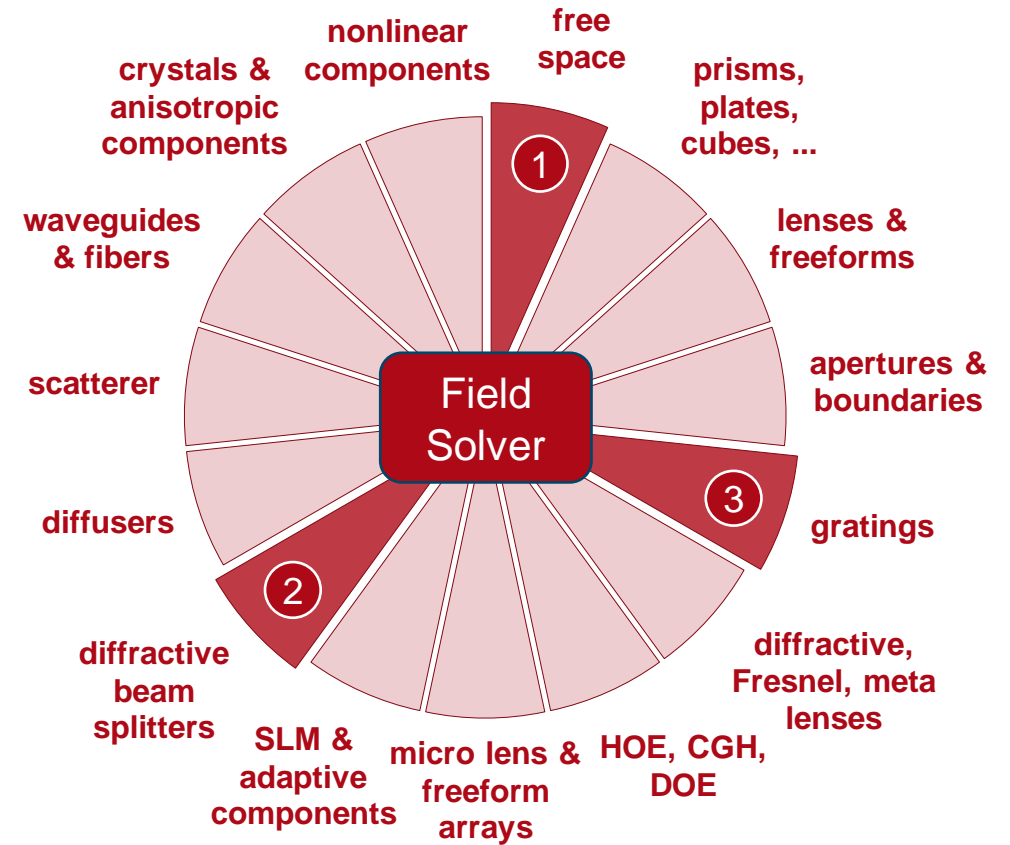
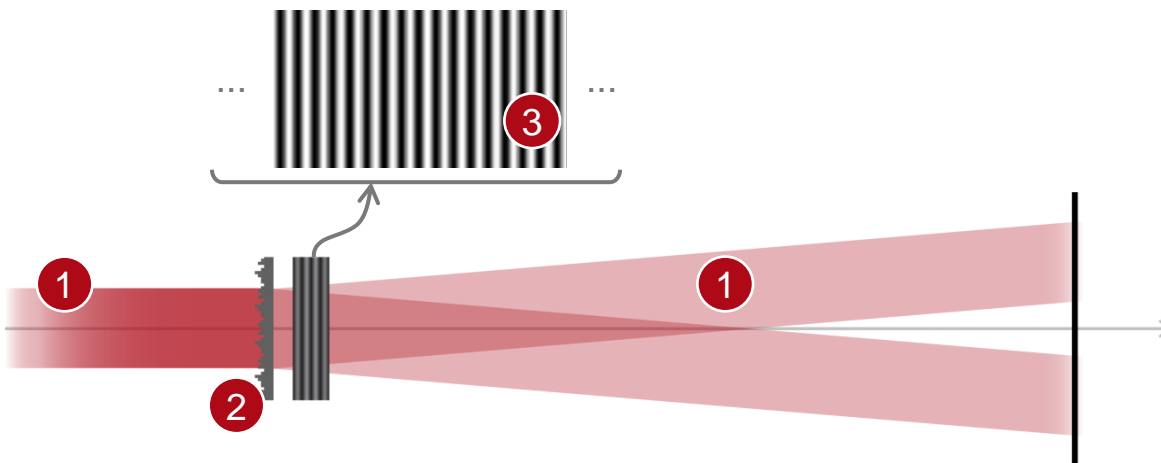
convenient inclusion of e.g. the volume grating into general system for further investigation

Workflow in VirtualLab Fusion

- Construct grating structures using special media
 - [Configuration of Grating Structures by Using Special Media](#) [Use Case]
- Rigorous analysis of holographic volume gratings
 - [Rigorous Simulation of Holographic Generated Volume Grating](#) [Use Case]
- Grating modeling within complex system
 - [Modeling of Gratings within Optical System - Discussion at Examples](#) [Use Case]



VirtualLab Fusion Technologies



Document Information

title	Angular-Filtering Volume Gratings for Suppressing Higher Diffraction Orders
document code	GRT.0025
version	1.0
edition	VirtualLab Fusion Advanced
software version	2020.1 (Build 3.4)
category	Application Use Case
further reading	<ul style="list-style-type: none">- Rigorous Simulation of Holographic Generated Volume Grating- Modeling of Gratings within Optical System - Discussion at Examples