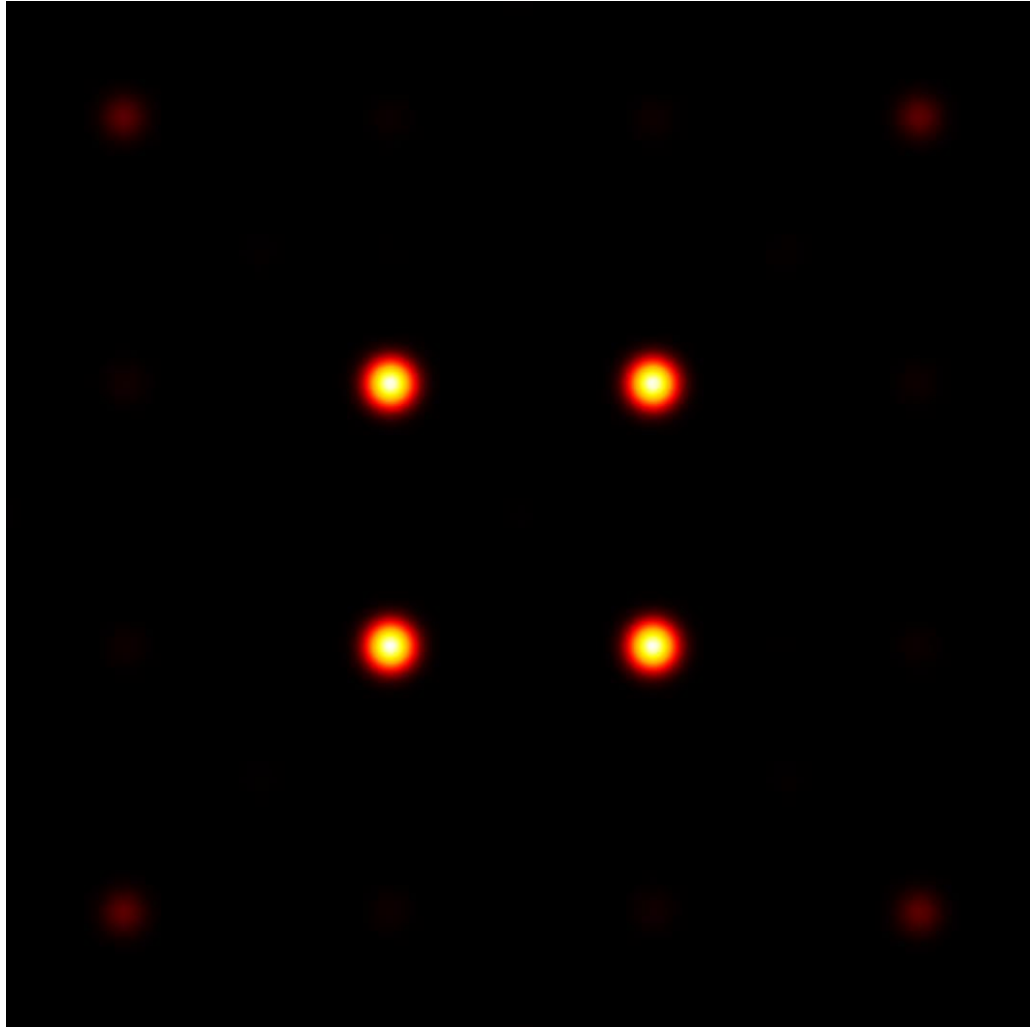


Angular-Filtering Volume Grating for Suppressing Higher Diffraction Orders

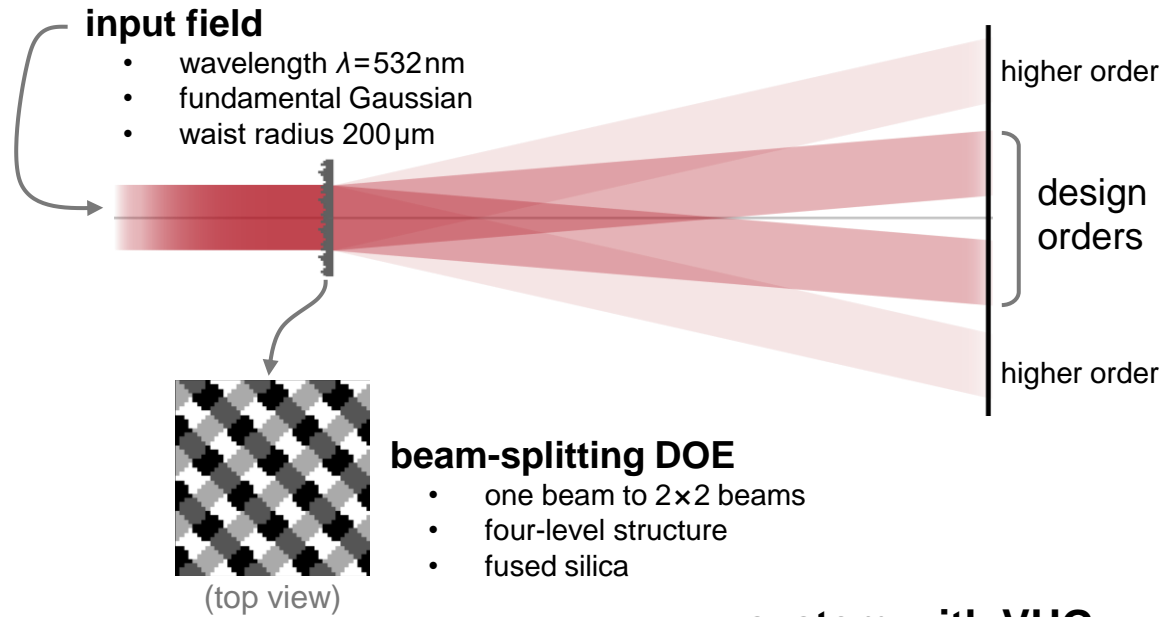
Abstract



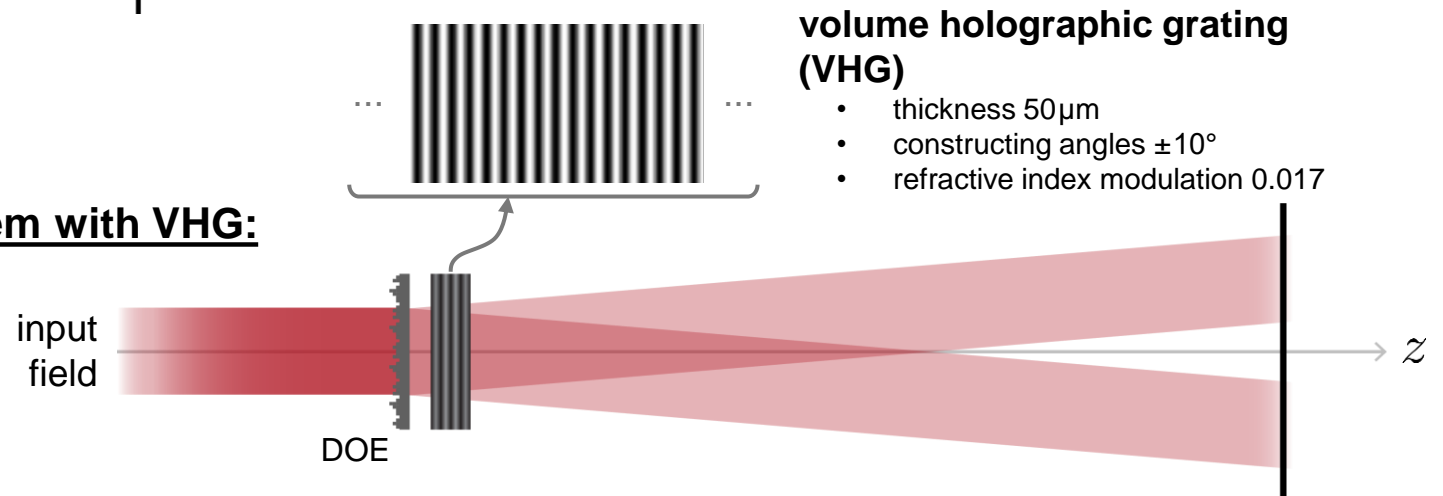
Holographic volume gratings, which are usually made by two-beam interference, are known for their wavelength and angle sensitivities. Because of that, they can be designed to work as angular stop filters. In this example, following the work of Bang *et al.*, a volume grating is constructed as angular filter in a beam-splitting DOE system in order to suppress undesired higher diffraction orders. For this purpose, the angular sensitivities of the volume grating is analyzed first. Finally, the suppression of the undesired higher diffraction orders are shown in the simulation by using VirtualLab Fusion.

Modeling Task

reference system:

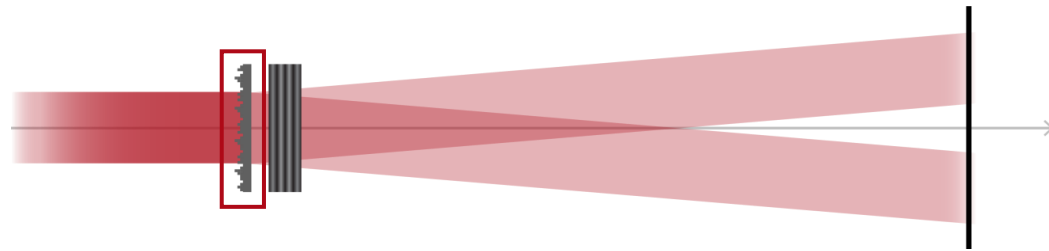


system with VHG:



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

Diffractive Optical Element (DOE)



The *Microstructure Component* allows for a modeling of diffractive structures by advanced TEA (thin element approximation). In our example the beam splitting DOE is given as a *Sampled Interface*. This interface can be converted into a *Stack* and then loaded into the *Microstructure Component*.

1

Index	z-Distance	z-Position	Surface	Subsequent Me
1	0 mm	0 mm	Sampled Interface	Fused_Silica in H

2

6: Sampled Height Profile

Numerical Data Array

Diagram Table Value at (x,y)

Height Values [μm]

0

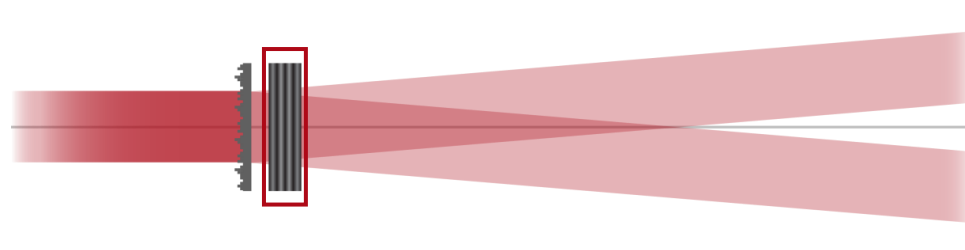
-0.433

-0.866

y [μm]

x [μm]

Volume Holographic Grating (VHG)



The grating components offer a specialized *Volume Grating Media* to model the VHG:

- Use the *General Grating Component* in the *General Grating Optical Setup* to investigate the properties of the VHG, such as the angle-dependence.
- Import the medium then to the *Grating Component* of the regular *Optical Setup* to simulate the entire system including the DOE.

More information under:

[Holographically Generated Volume Grating](#)

Edit Volume Grating Medium

Basic Parameters | Scaling | Periodization

Holographic Material

Name: Acrylic

Catalog Material: [Dropdown]

State of Matter: Solid

Interferogram | Index Modulation

Directions are defined in: Vacuum Holographic Material

Representation of Direction: Cartesian Angles

No.	Power Factor	Alpha	Alpha (Quant.)	Dir.	Wavelength (Vacuum)	Wavelength (Medium)
1	1	10°	10°	→	532 nm	355.84 nm
2	1	-10°	-10°	←	532 nm	355.84 nm

Append Edit Delete

Limit Period x-Direction (defines k space discretization): 3.0636 μm

Structure Period x-Direction: 3.0636 μm
Structure Period z-Direction: 179.13 nm

Edit Grating Component

Component Size: 3 mm x 3 mm

Reference Surface (all Channels): Plane Surface

Aperture: Yes No

Grating Stack: 1D-Periodic (Lamellar) 2D-Periodic

Grating Period: 3.0636 μm

Angular Filtering Grating 10°: [Load] [Edit] [View]

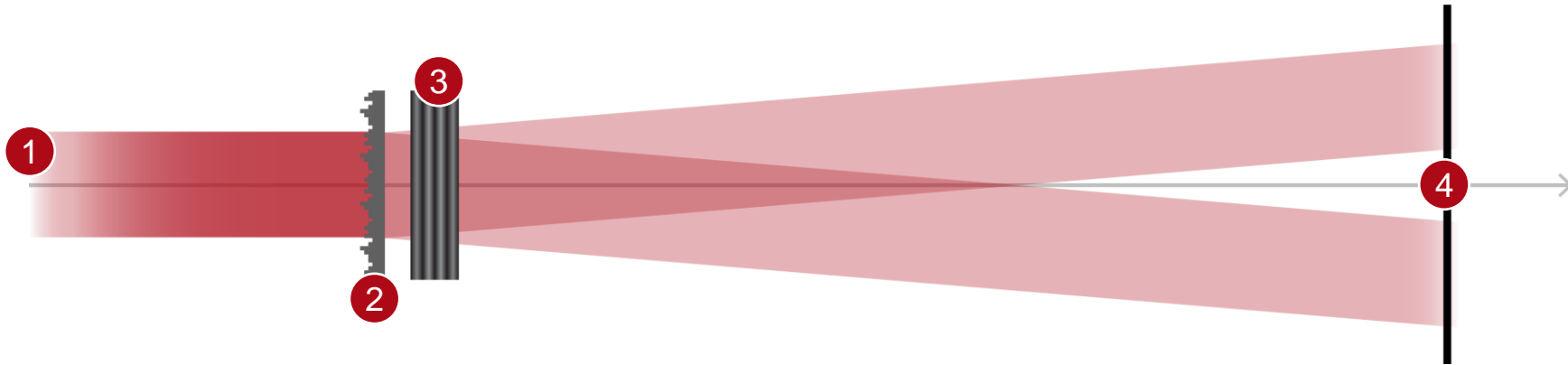
On Front Side of Reference Surface On Back Side of Reference Surface

Homogeneous Medium Behind Surface: Acrylic in Homogeneous Medium

[Load] [Edit] [View]

OK Cancel Help

Summary – Components...

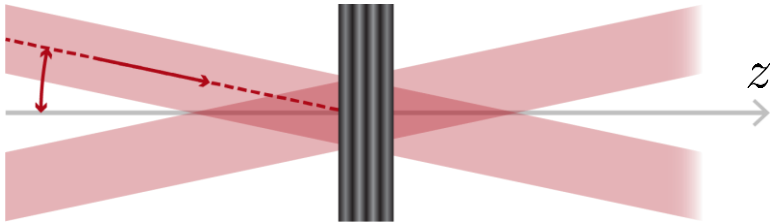


... of Optical System	... in VirtualLab Fusion	Model/Solver/Detected Value
1. source	<i>Gaussian Wave</i>	spatial gaussian function
2. DOE	<i>Microstructure Component</i>	Thin-Element Approximation (TEA)
3. volume grating	<i>Grating Component with Volume Grating Medium</i>	Fourier Modal Method (FMM)
4. detector	<i>Camera Detector</i>	energy density measurement

Analysis of Angular Transmittance

input field

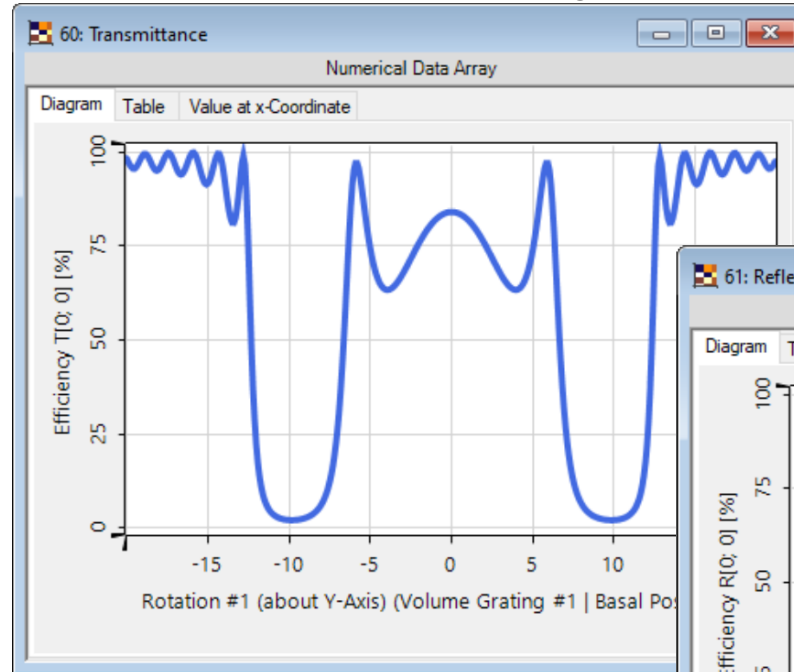
- wavelength $\lambda=532\text{nm}$
- plane wave
- incidence angle from -20 to $+20^\circ$



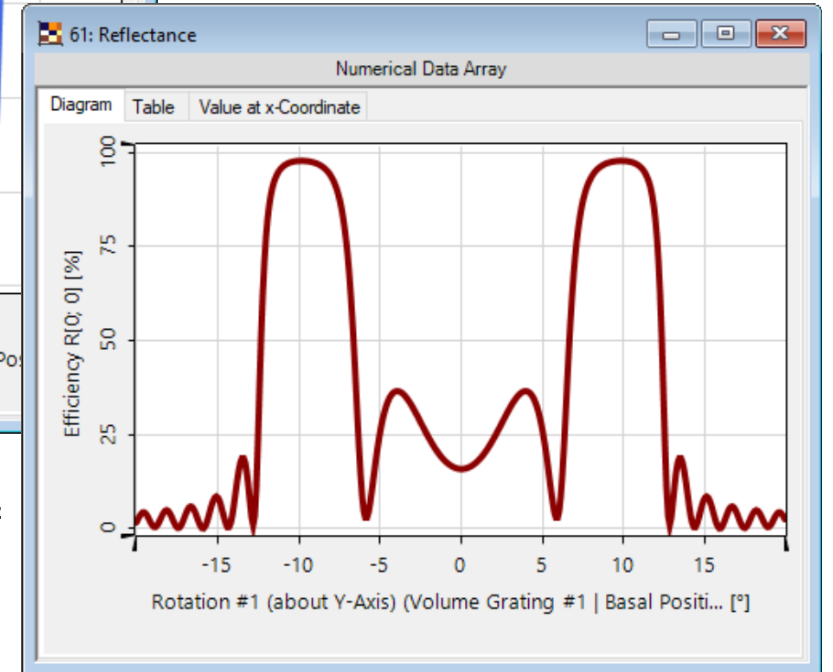
volume grating

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

transmittance vs angle

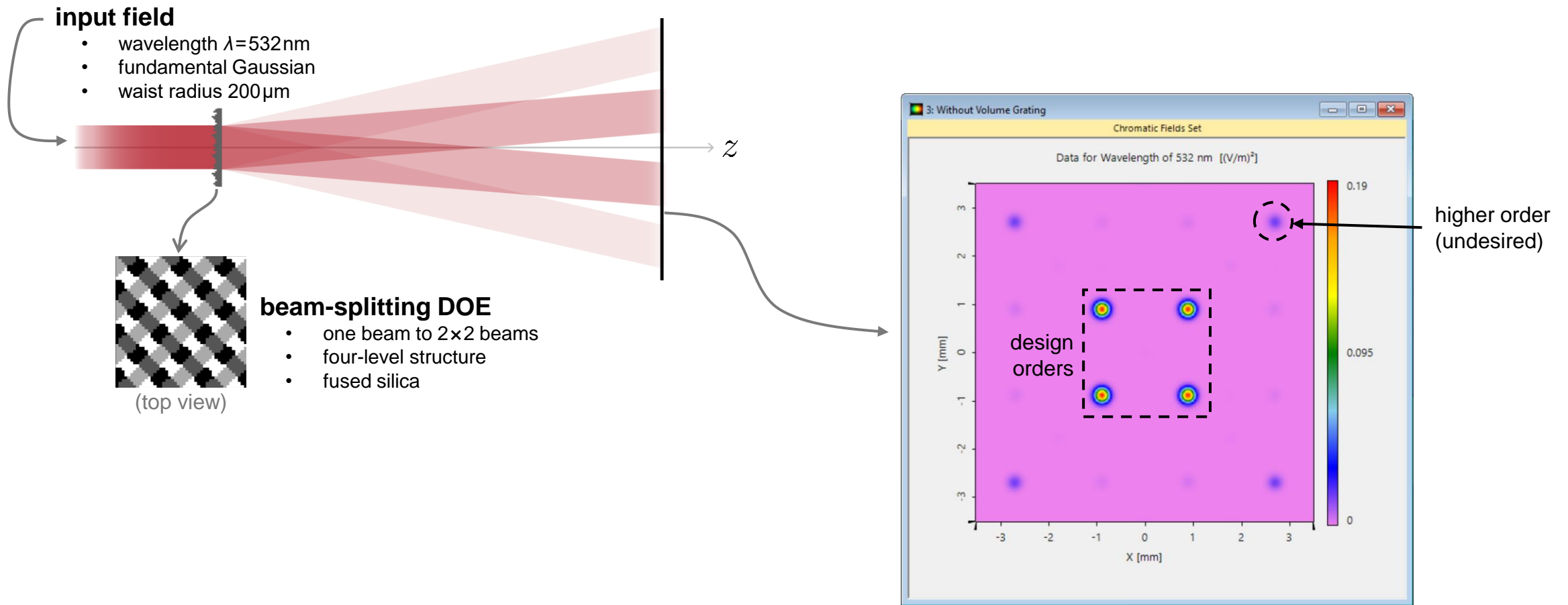


reflectance vs angle

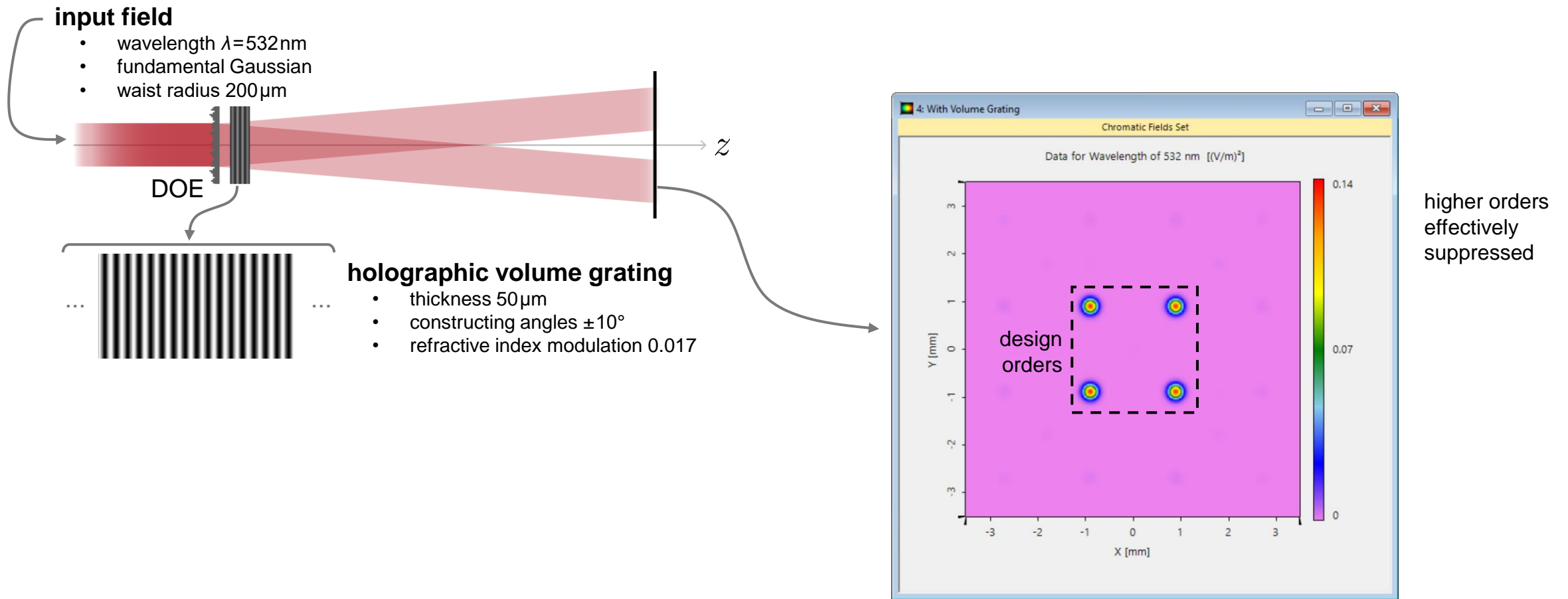


The FMM / RCWA is used to calculate the transmittance and reflectance of the holographic volume grating.

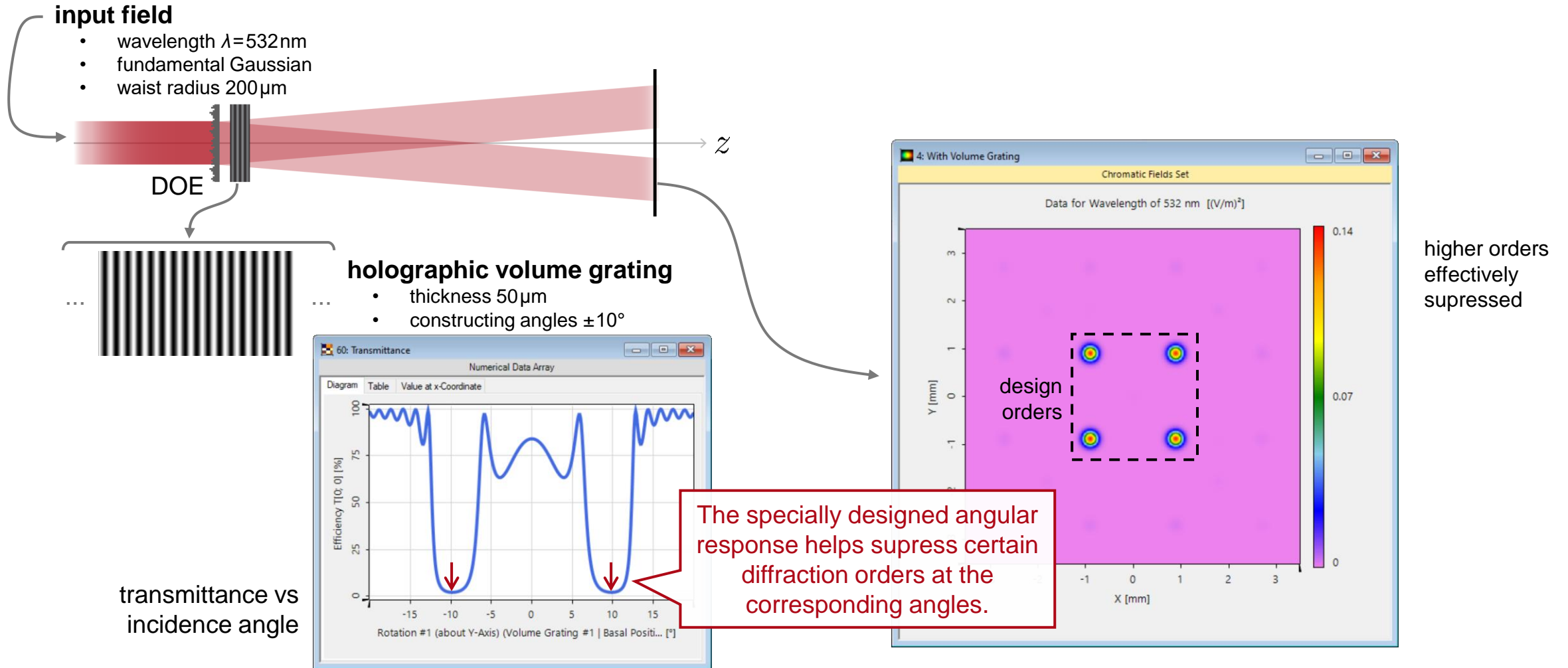
Analysis of Original Beam-Splitting System (without VHG)



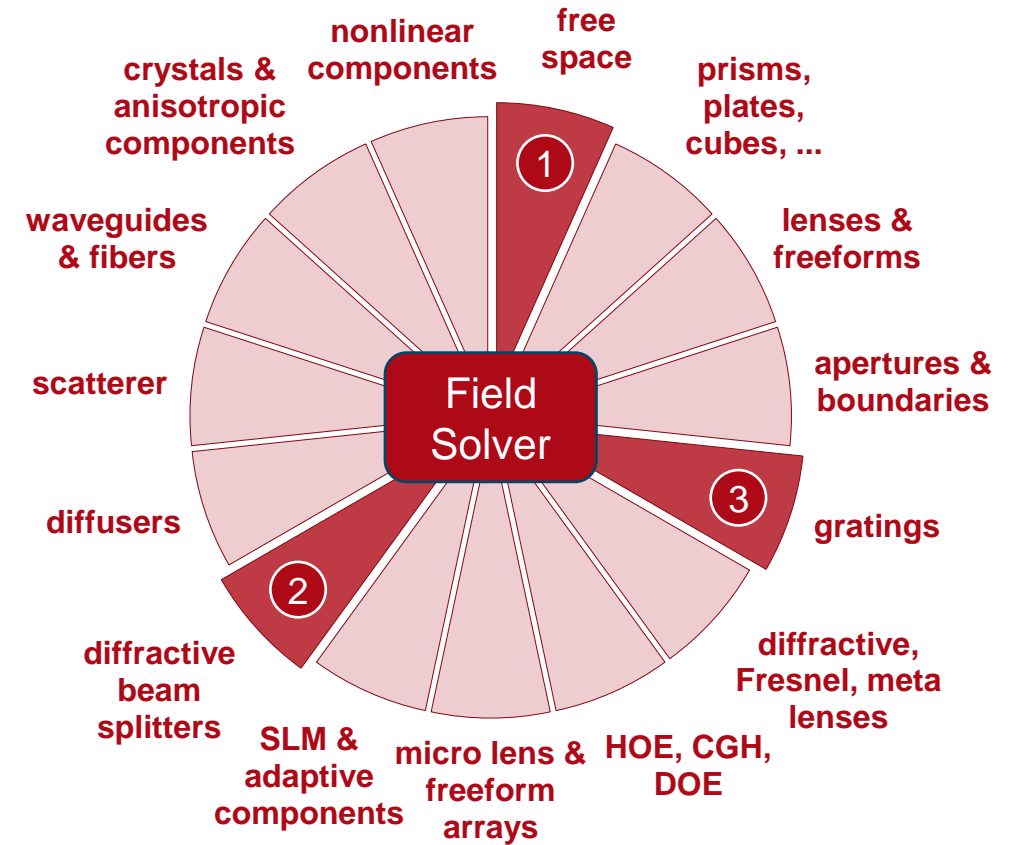
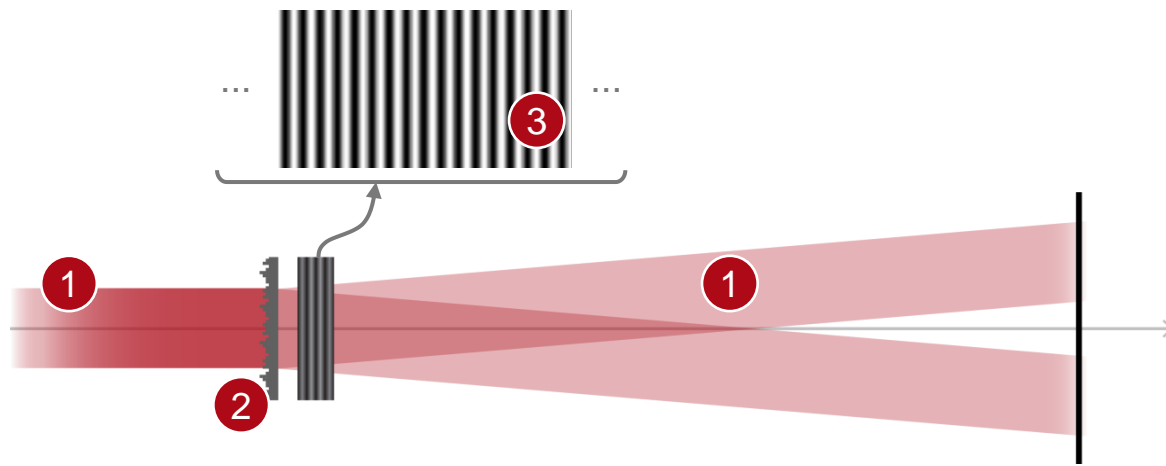
Analysis of Beam-Splitting System with VHG



Angular Filtering Effect of Volume Grating



VirtualLab Fusion Technologies



Document Information

title	Angular-Filtering Volume Gratings for Suppressing Higher Diffraction Orders
document code	GRT.0025
document version	1.2
software edition	VirtualLab Fusion Advanced
software version	2021.1 (Build 1.180)
category	Application Use Case
further reading	<ul style="list-style-type: none">- Holographically Generated Volume Grating- Modeling of Gratings within Optical System - Discussion at Examples