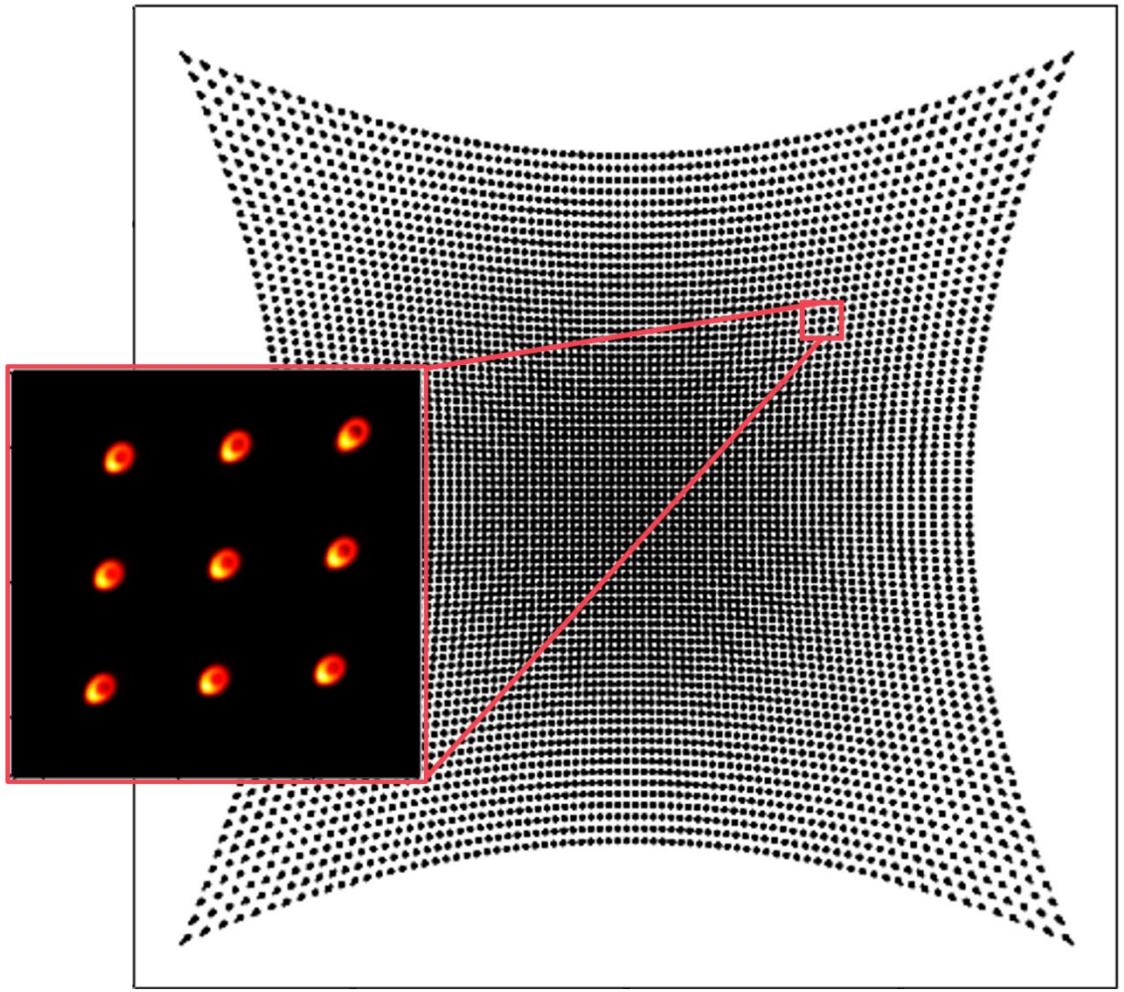
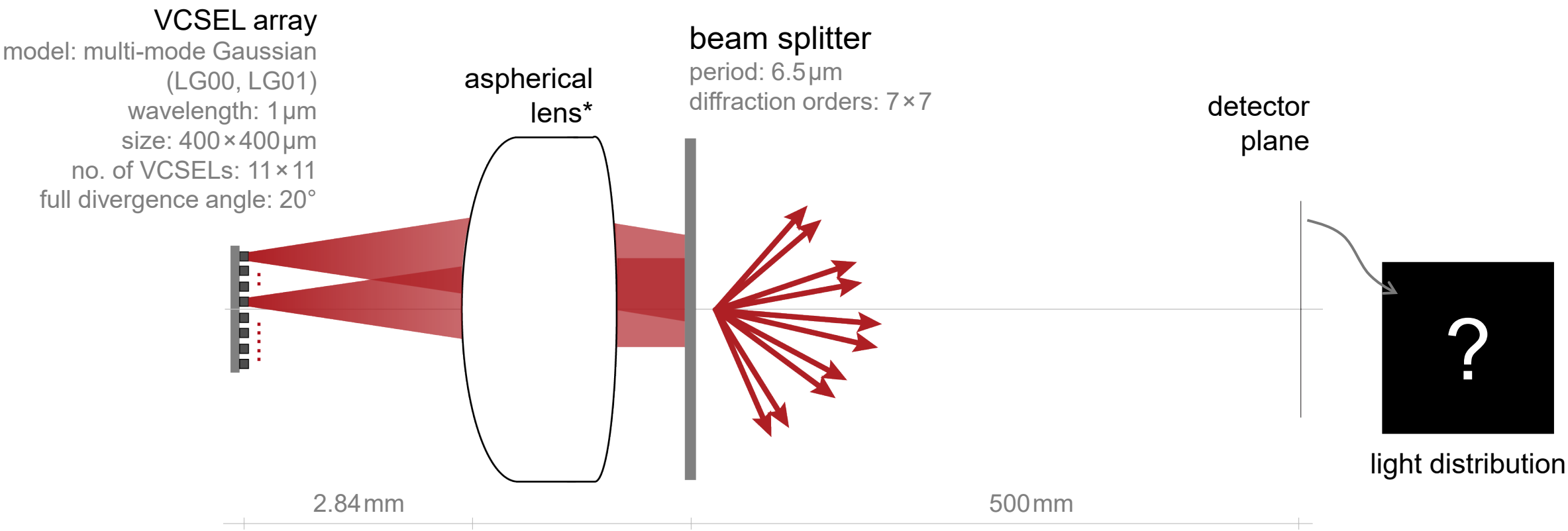
Working Principle Demonstration of the Dot Projector with Physical Optics Modeling

Abstract



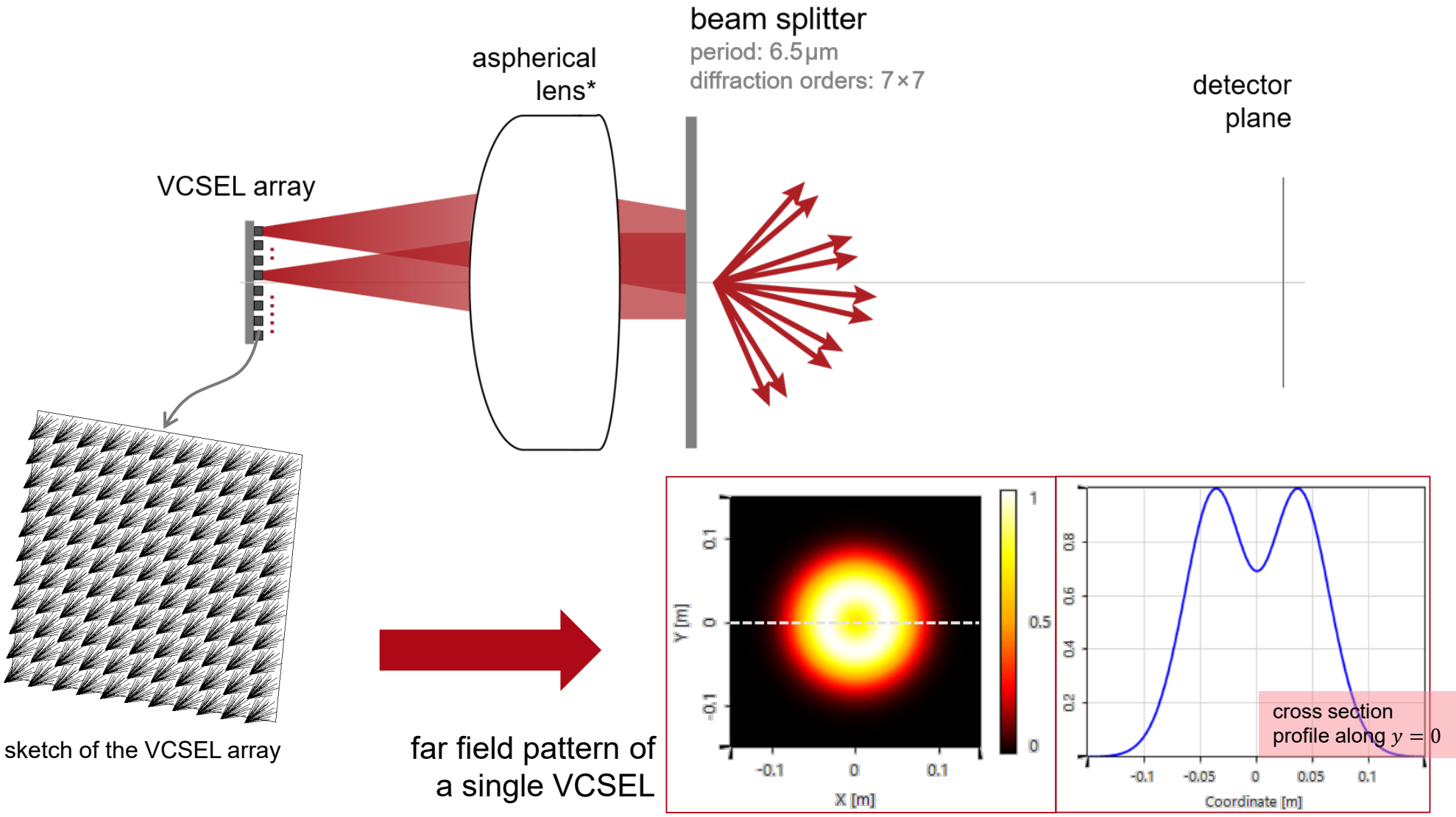
Dot projector is a key component that enables Apple‘s Face ID. The system usually consists of an array of light light emitting units, lenses, and beam splitting grating(s). The lens system together with the grating(s) will project and make several duplications of the array source pattern. In this example, we build up such a dot-projector system and demonstrate how it works. With VirtualLab Fusion, we perform both ray and field tracing for the system analysis.

Modeling Task

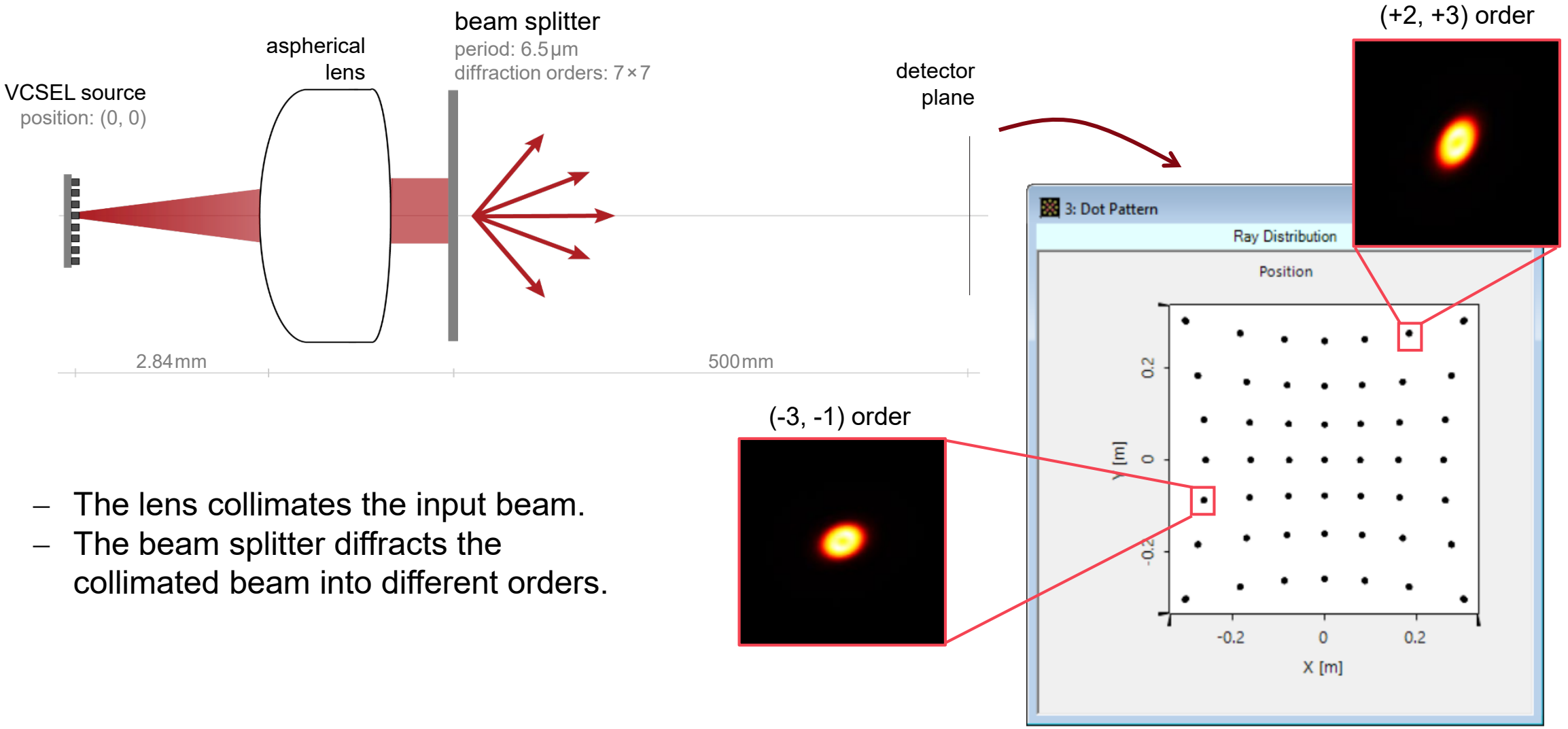


* The aspherical lens in the document is designed with Zemax OpticStudio®

Source Modeling

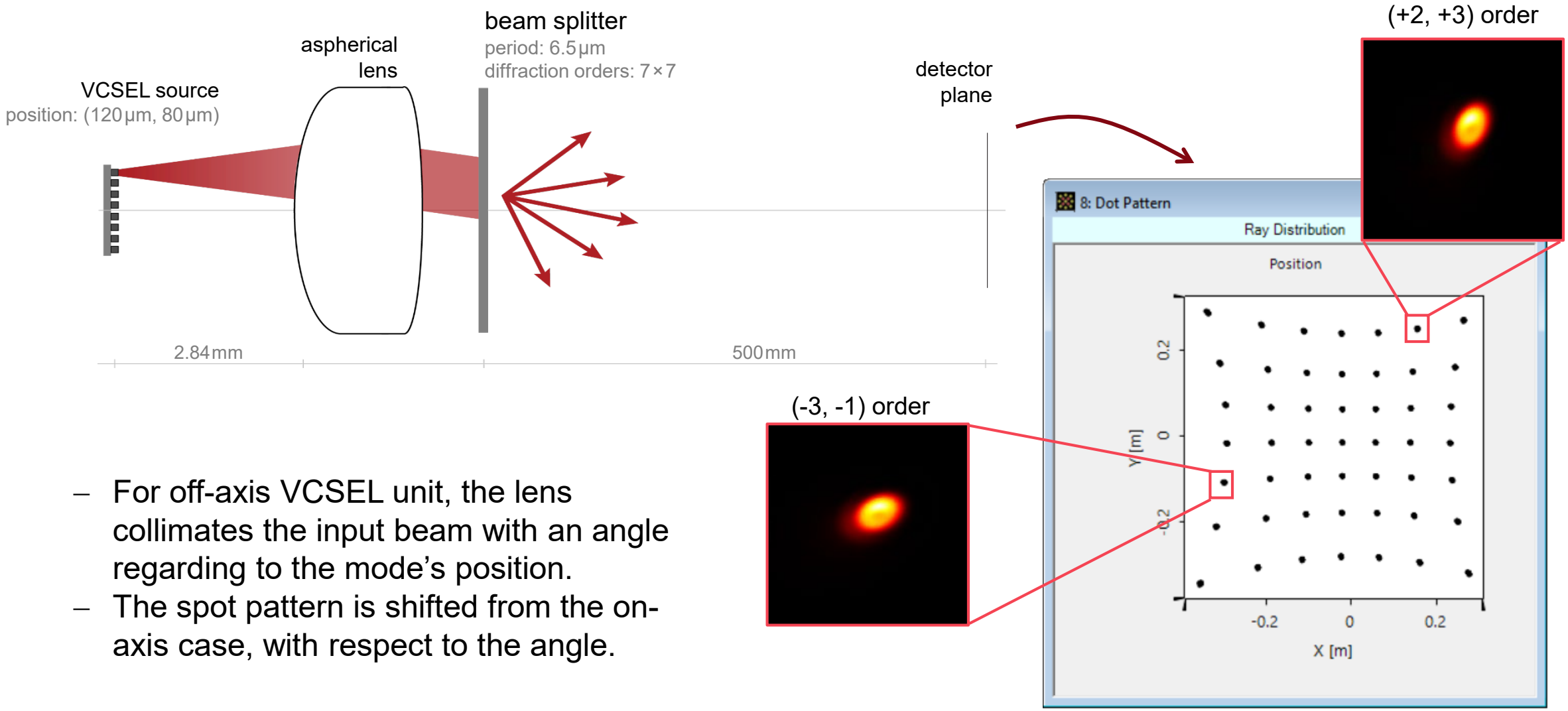


Simulation with the On-Axis VCSEL Unit



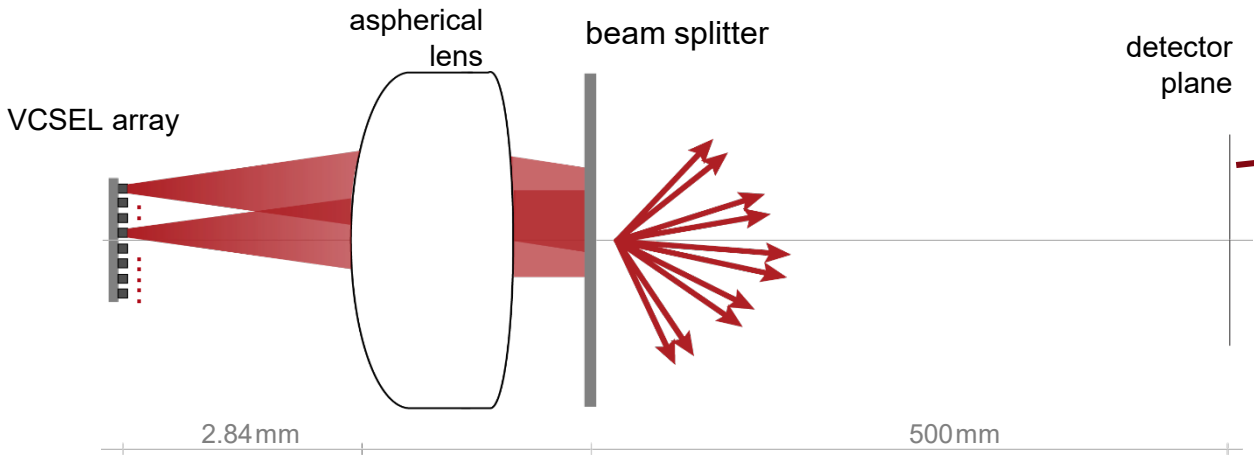
- The lens collimates the input beam.
- The beam splitter diffracts the collimated beam into different orders.

Simulation with an Off-axis VCSEL Unit



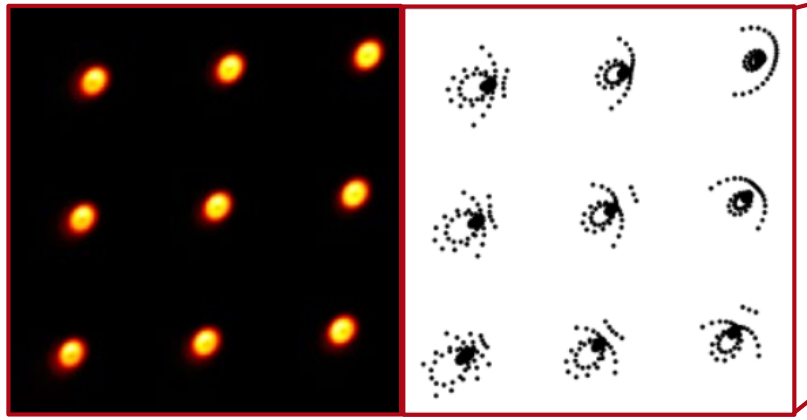
- For off-axis VCSEL unit, the lens collimates the input beam with an angle regarding to the mode's position.
- The spot pattern is shifted from the on-axis case, with respect to the angle.

Simulation with Complete VCSEL Array

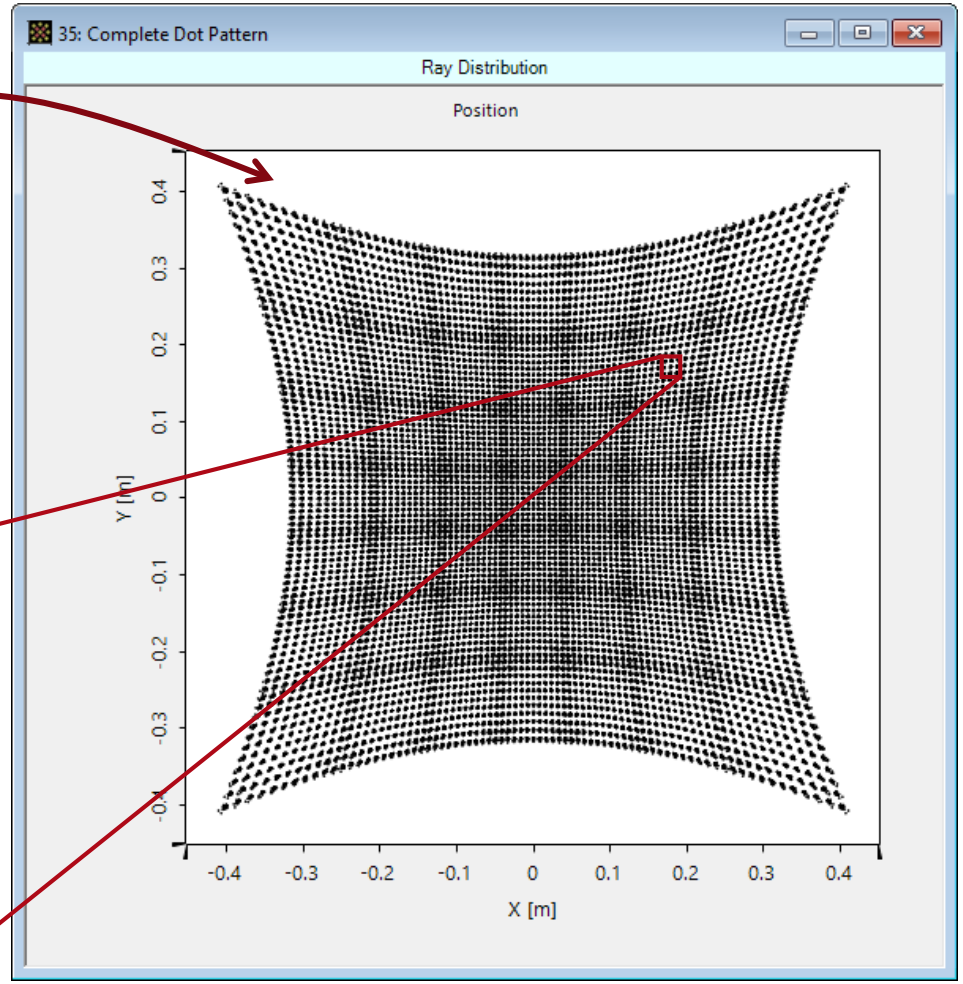


The beam splitter duplicates the pattern of the VCSEL array with lateral shifts on the detector plane.

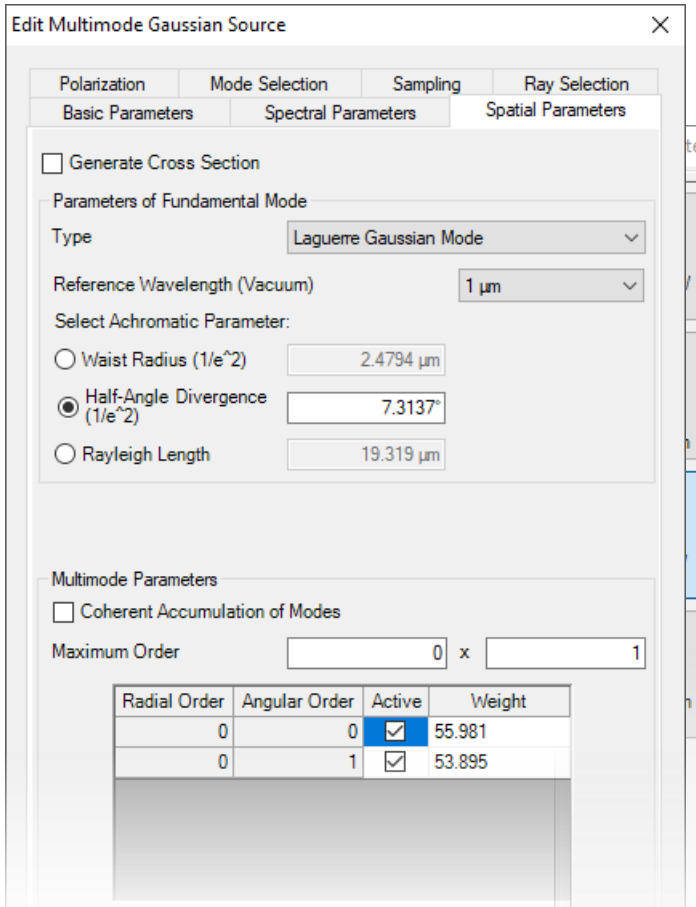
simulation results



field tracing ray tracing

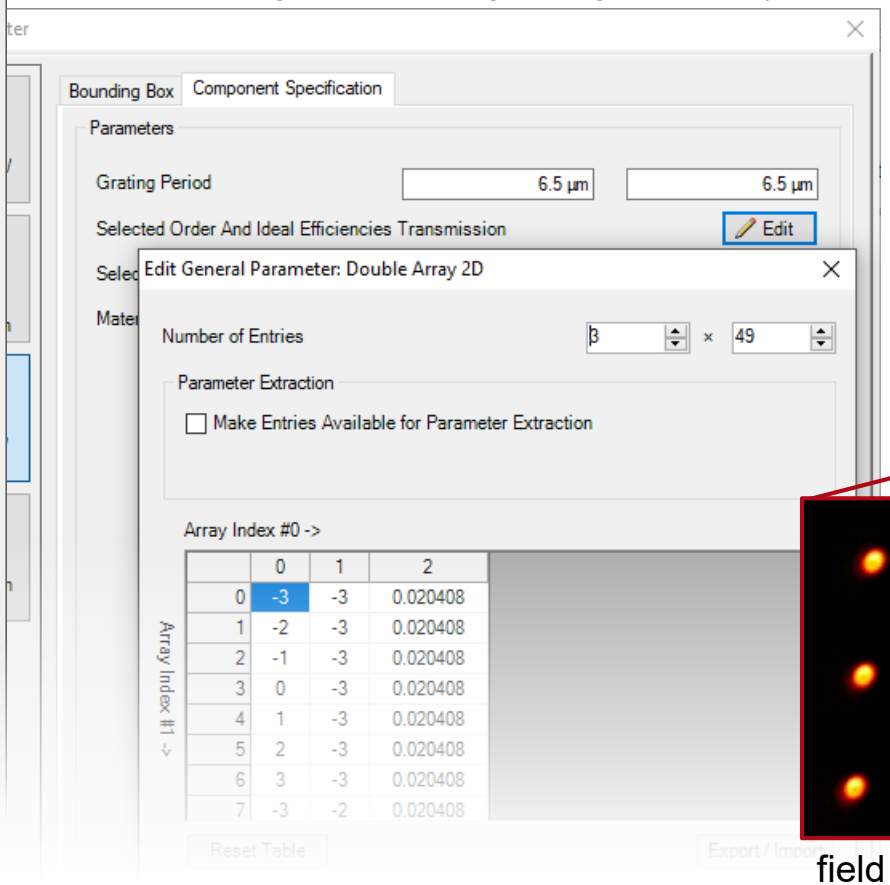


Peek into VirtualLab Fusion

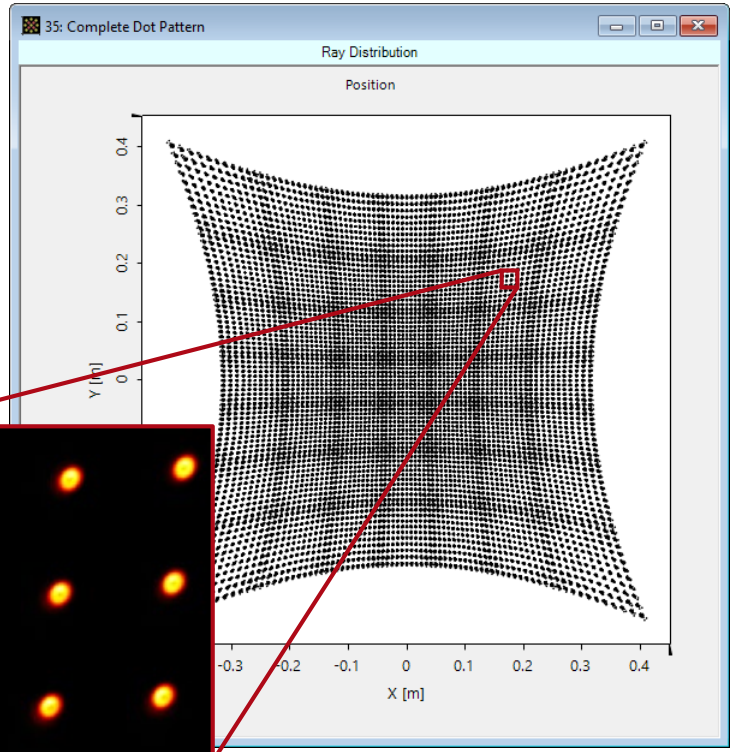


VCSEL model via multimode Gaussian source

configuration of grating in the system



ray tracing visualization

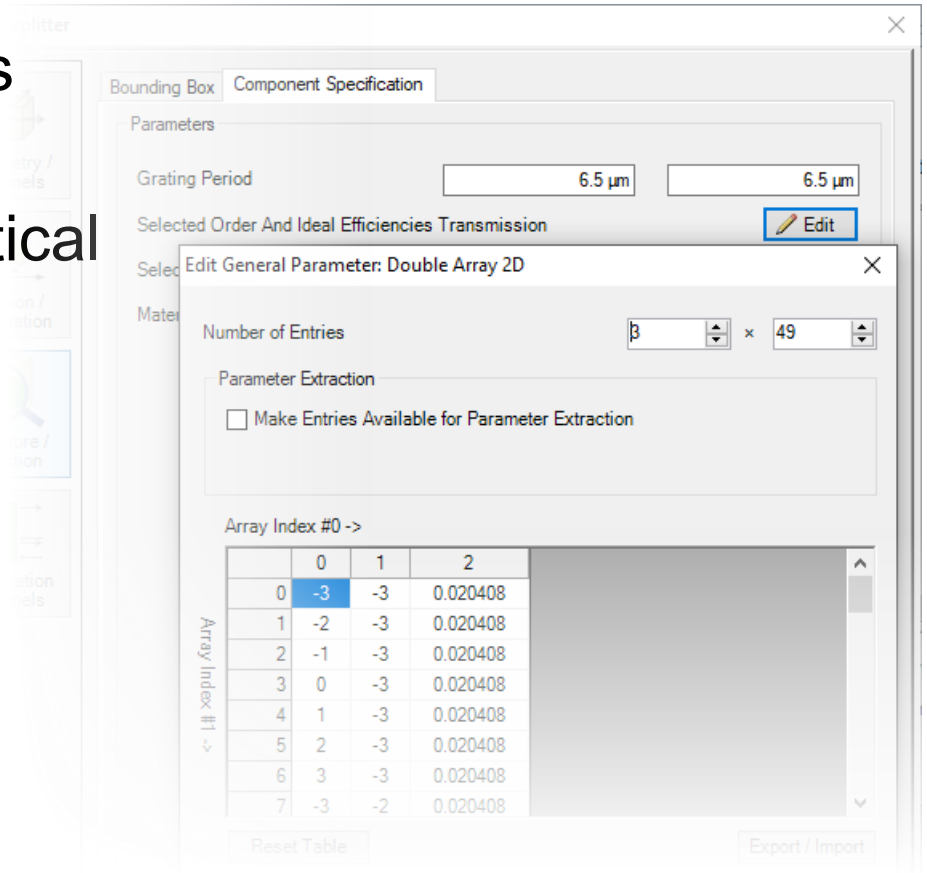


field tracing

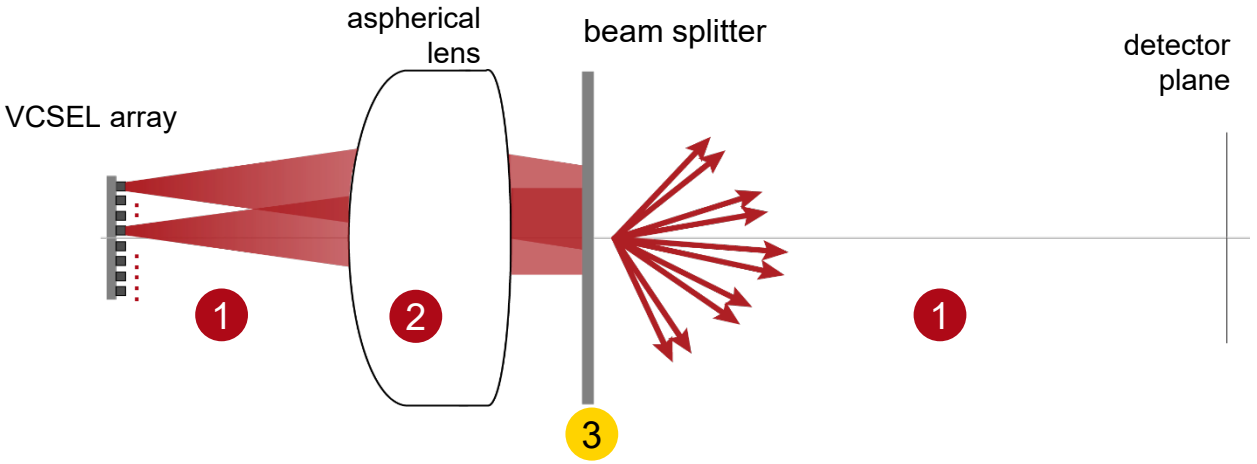
Workflow in VirtualLab Fusion

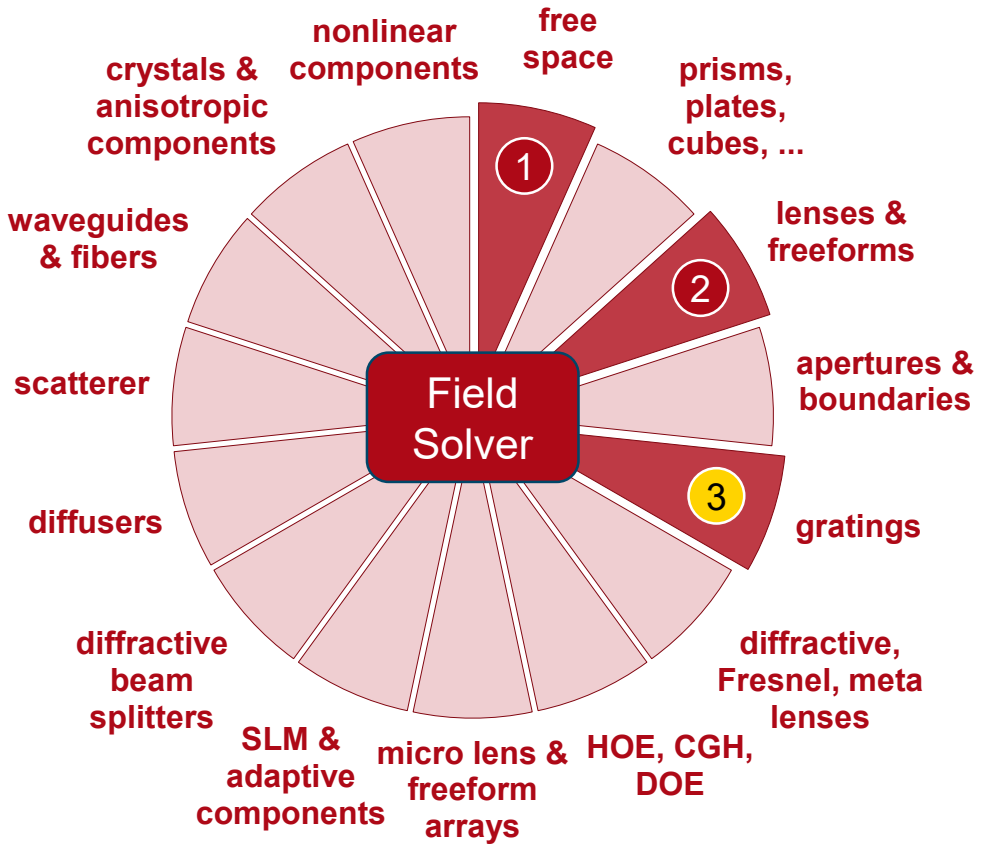
- Set up multimode source
  - Basic Source Models [Tutorial Video]
- Set the position and orientation of components
  - LPD II: Position and Orientation [Tutorial Video]
- Configure the grating component within an optical system

- Configuration of Parameter Run
  - Usage of the Parameter Run Document [Use Case]



VirtualLab Fusion Technologies





idealized component

Document Information

title	Working Principle Demonstration of the Dot Projector with Physical Optics Modeling
document code	MISC.0077
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	VirtualLab Fusion Summer Release 2019 (7.6.1.18)
category	Application Use Case
further reading	- Design and Rigorous Analysis of Non-Paraxial Diffractive Beam Splitter - Design of a High-NA Beam Splitter with 24000 Dots Random Pattern