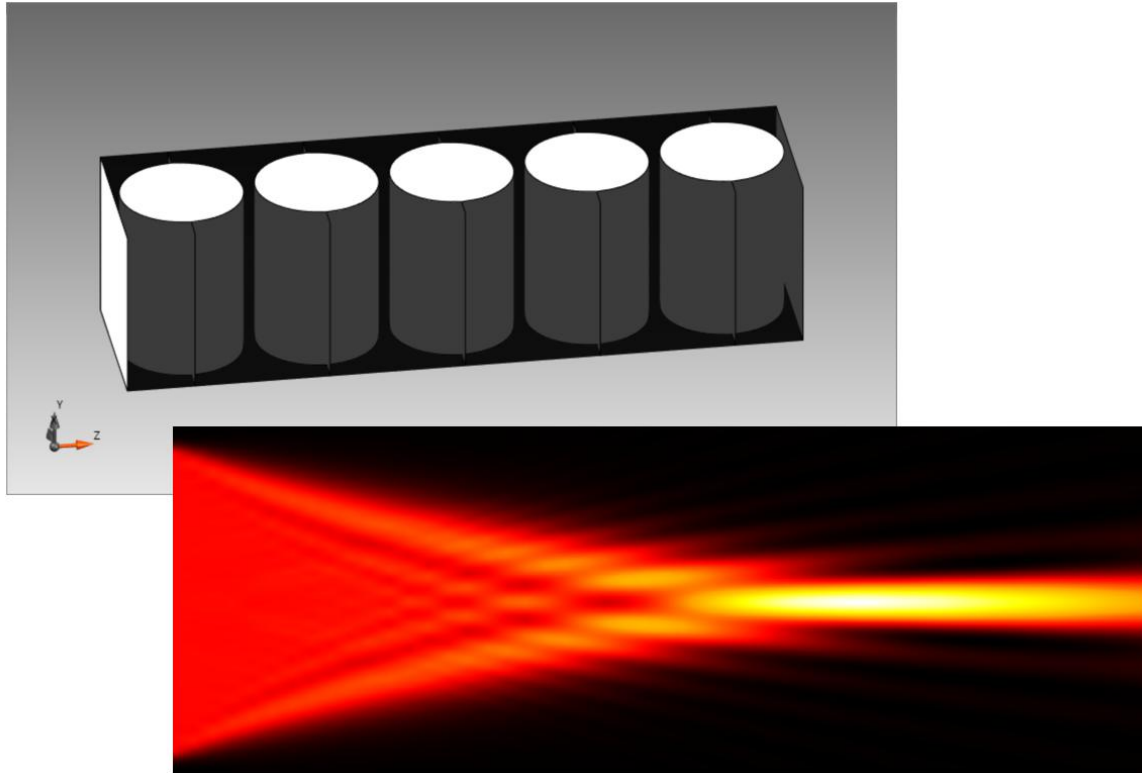


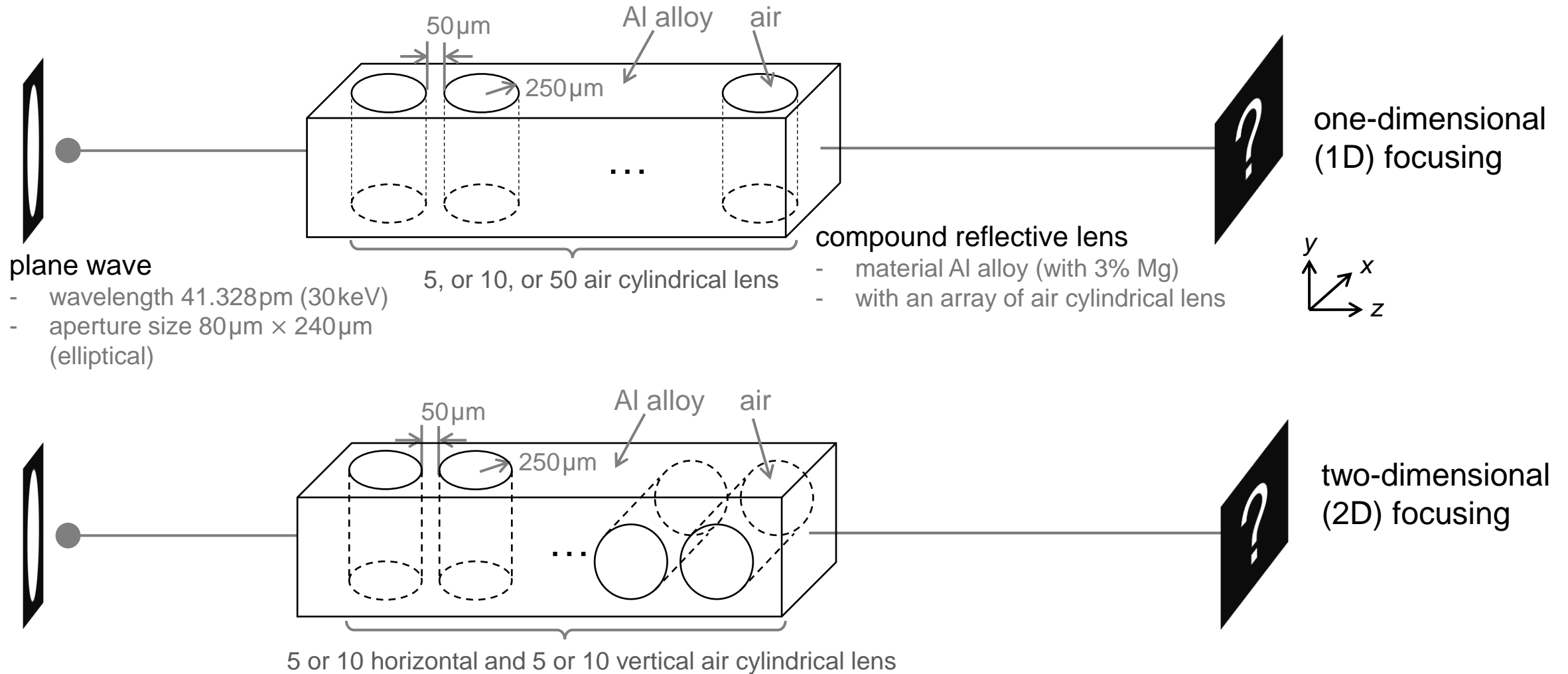
# Compound Refractive Lens for X-Ray Focusing

# Abstract



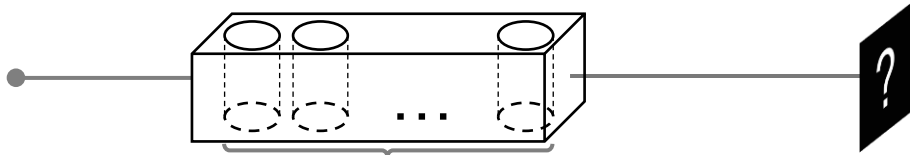
Refraction of x-rays by a single lens is usually small, but a compound lens (consisting of tens or hundreds of individual cylindrical lenses arranged in a linear array) can gradually focus x-rays one- or two-dimensionally. The focal length can be controlled by the number of the lenses, i.e., the more lenses are used, the shorter focal length is achieved. Following the paper of Snigirev *et al.* [Applied optics, 1998, 37(4): 653-662], this use case demonstrates 1D and 2D x-ray focusing by a compound refractive lens in VirtualLab Fusion.

# Modeling Task

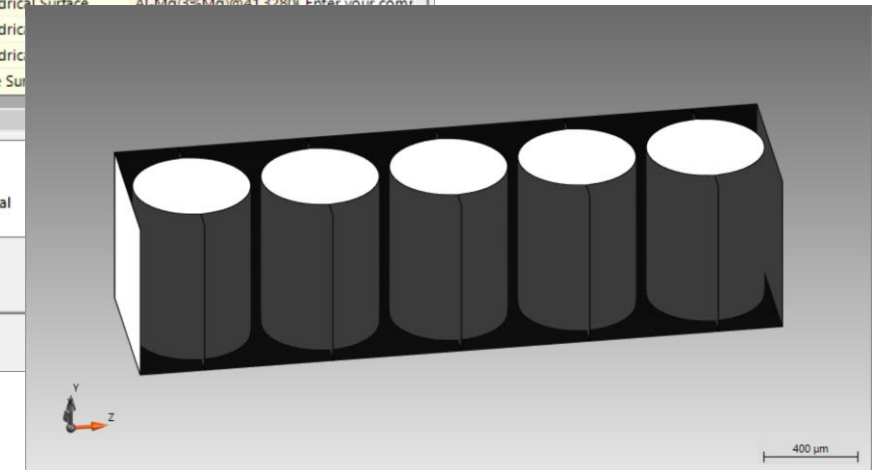
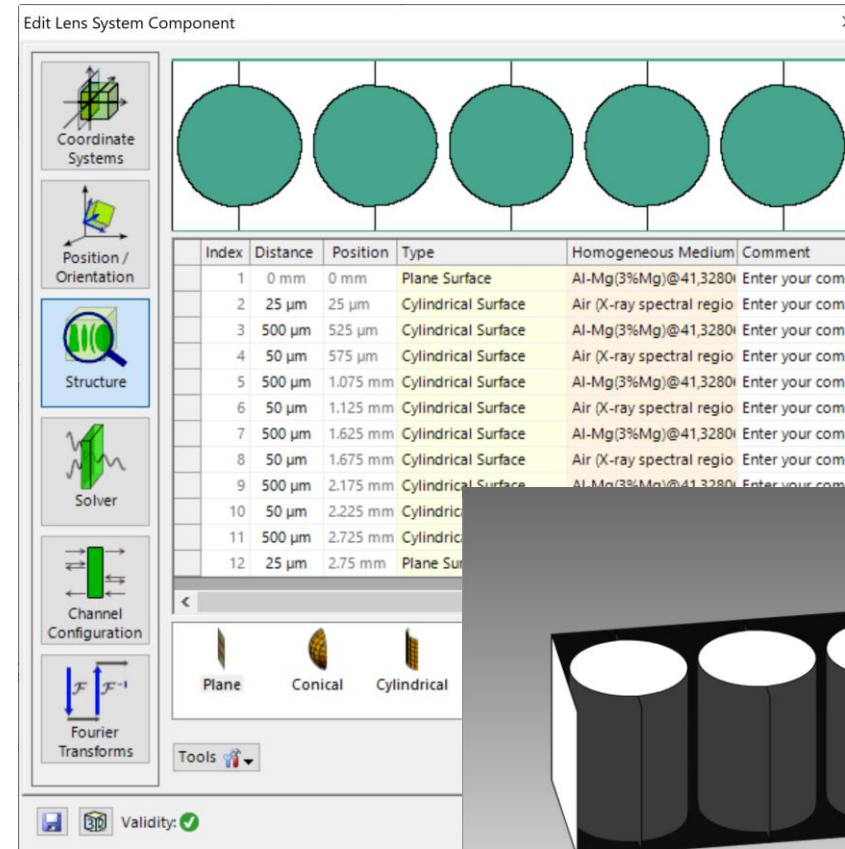


system parameters from Snigirev A, et al. Applied optics, 1998, 37(4): 653-662

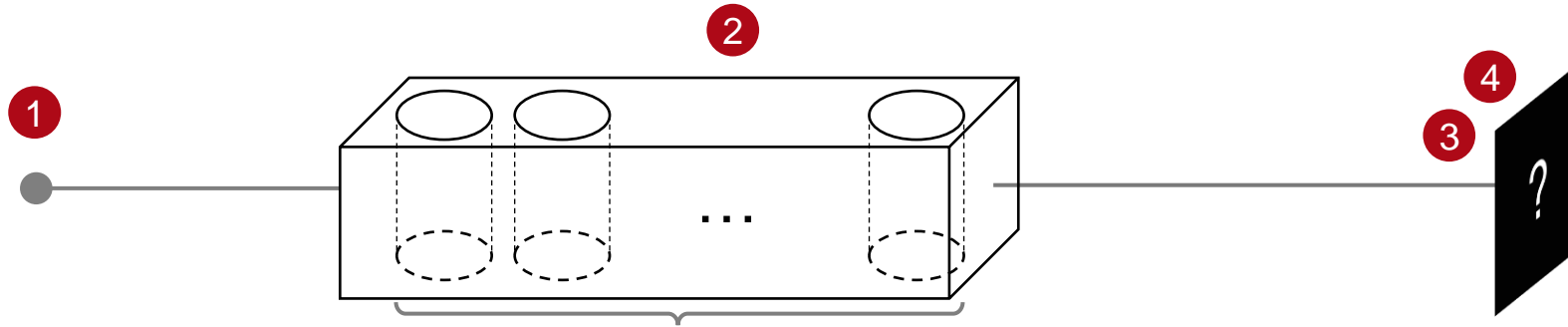
# System Building Blocks – Components



- The *Lens System Component* allows the definition of multiple surfaces and the media in between according to the user specifications. By setting two cylindrical surfaces with contrary sign on the *Radius of Curvature* it is possible to generate the cylindrical lenses used in this kind of component.
- This lens modeling is not apt for illumination of the full curvature (including the area where the surface becomes flat). But this is no limitation for this simulation at all, as only a small part of the lens curvature is illuminated.



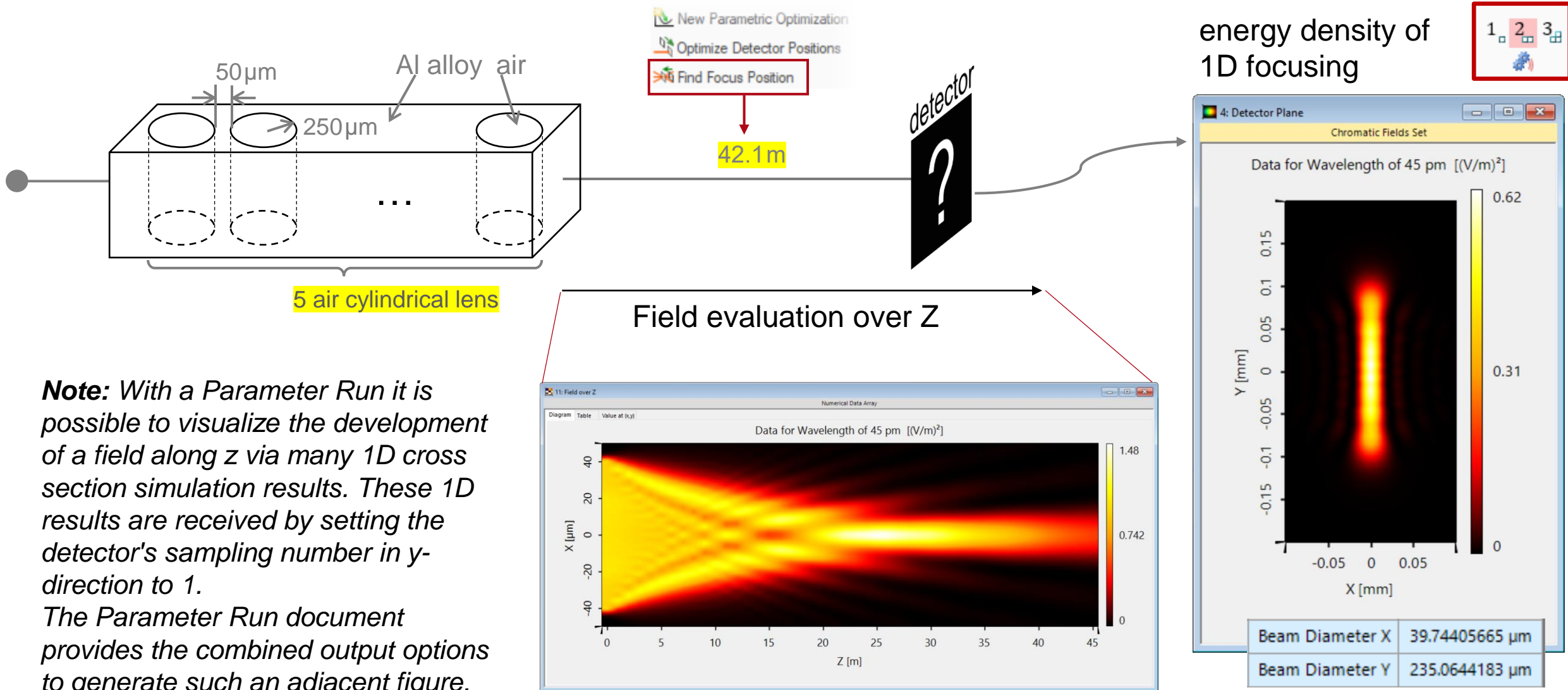
# Summary – Components...



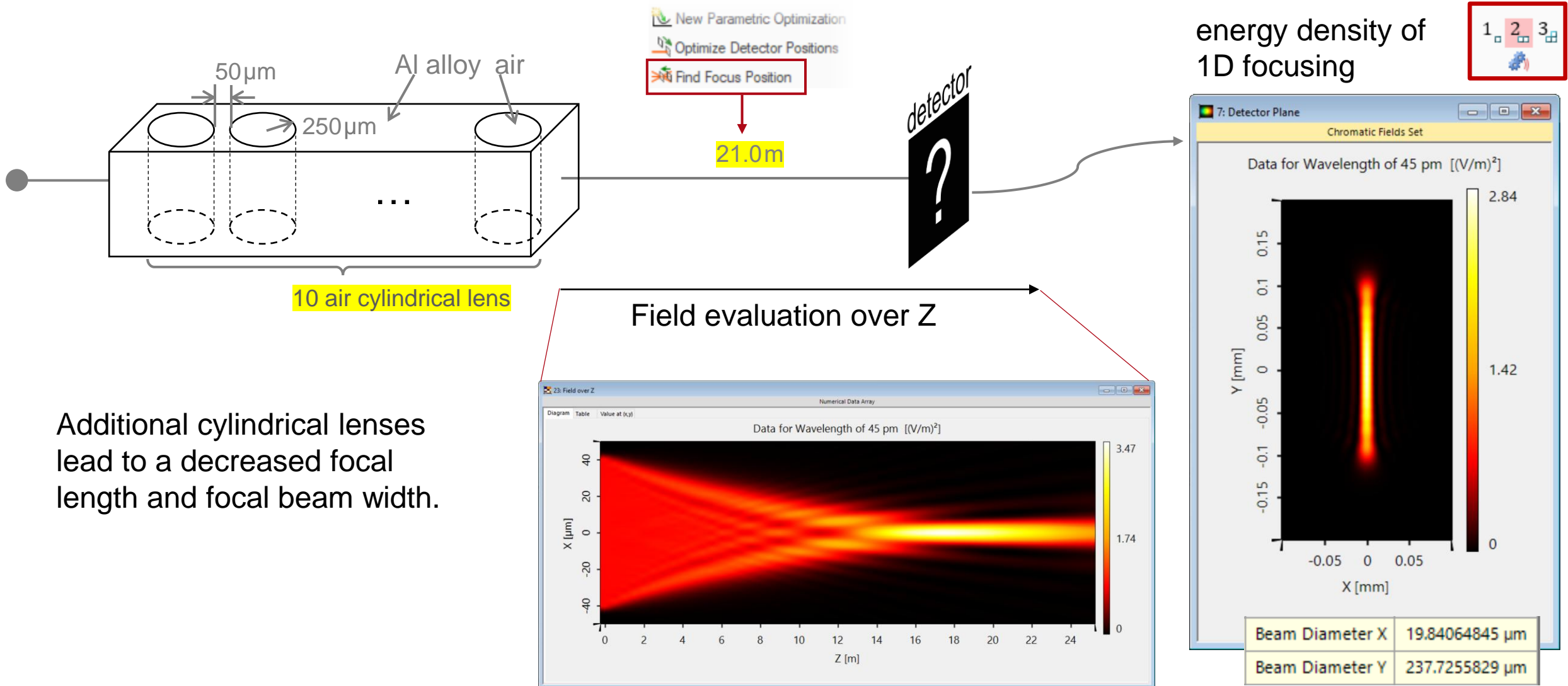
... of Optical System	... in VirtualLab Fusion	Model/Solver
1. Source	<i>Plane Wave Source</i>	Truncated Ideal Plane Wave
2. Compound lens	<i>Lens System Component</i>	Local Plane Interface Approximation (LPIA)
3. Detector	<i>Spot Size Detector</i>	Second-Momentum theory
4. Detector	<i>Camera Detector</i>	Energy density

## **Simulation Results**

# 1D-Simulation: 5 Cylindrical Lens



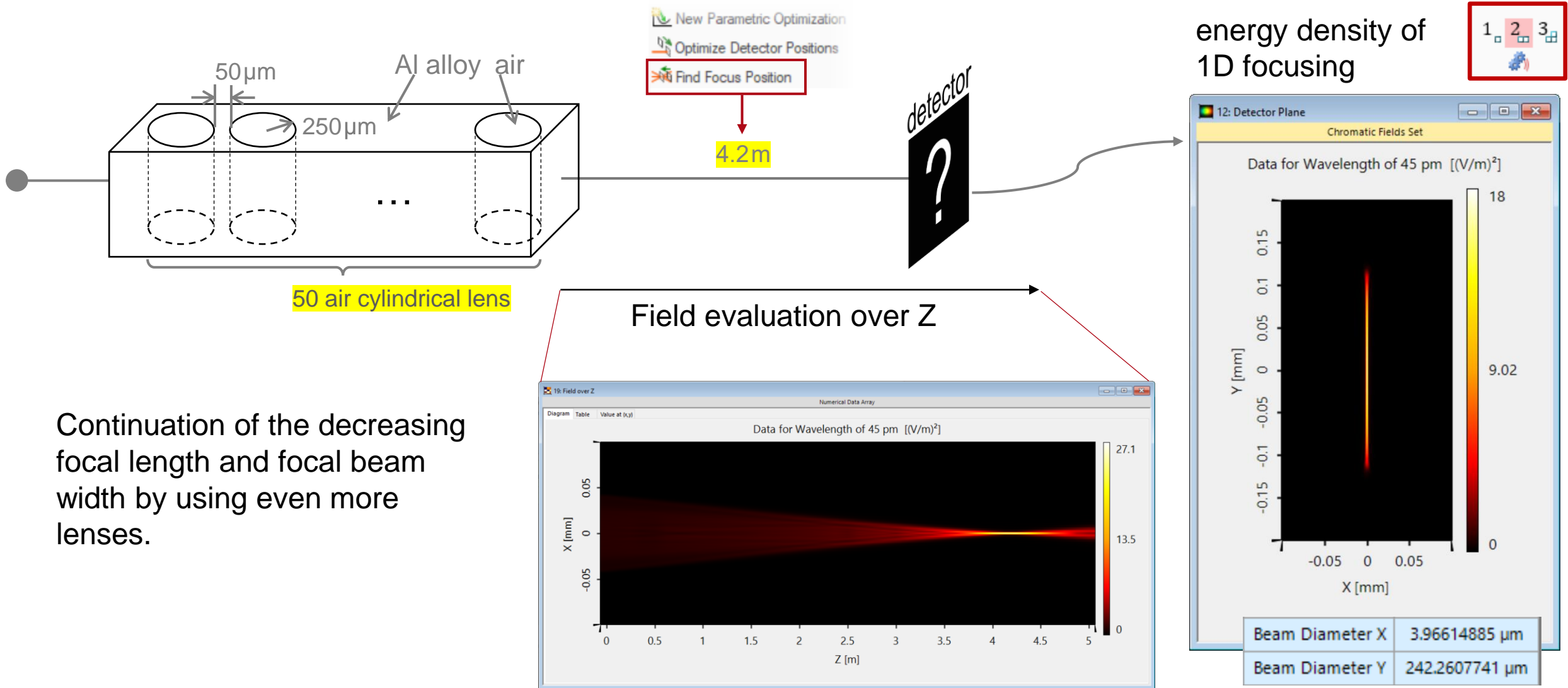
# 1D-Simulation: 10 Cylindrical Lens



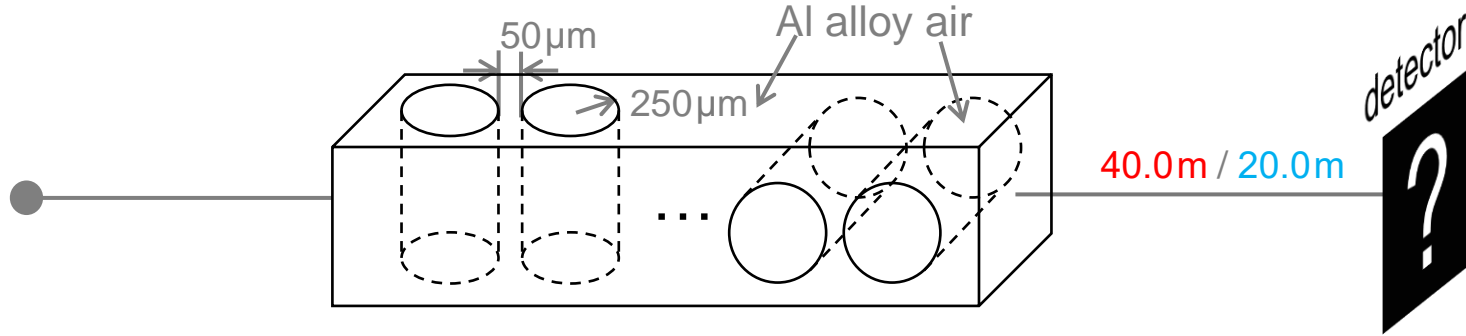
Additional cylindrical lenses lead to a decreased focal length and focal beam width.



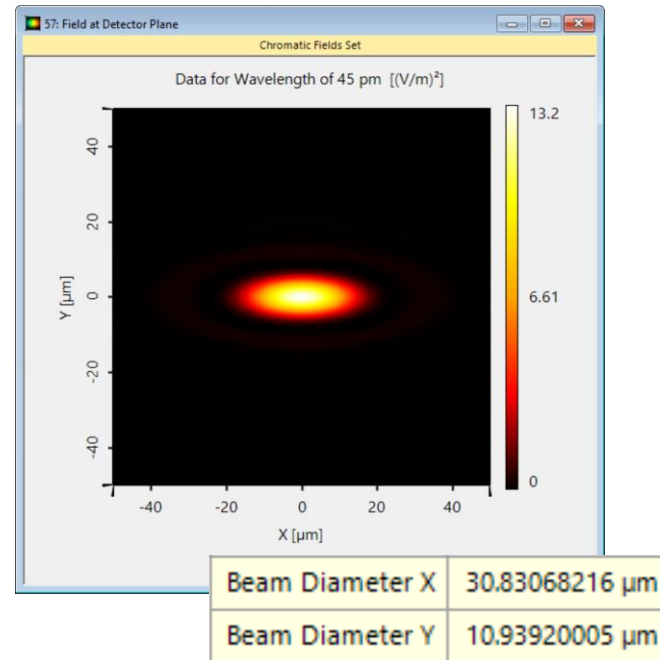
# 1D-Simulation: 50 Cylindrical Lens



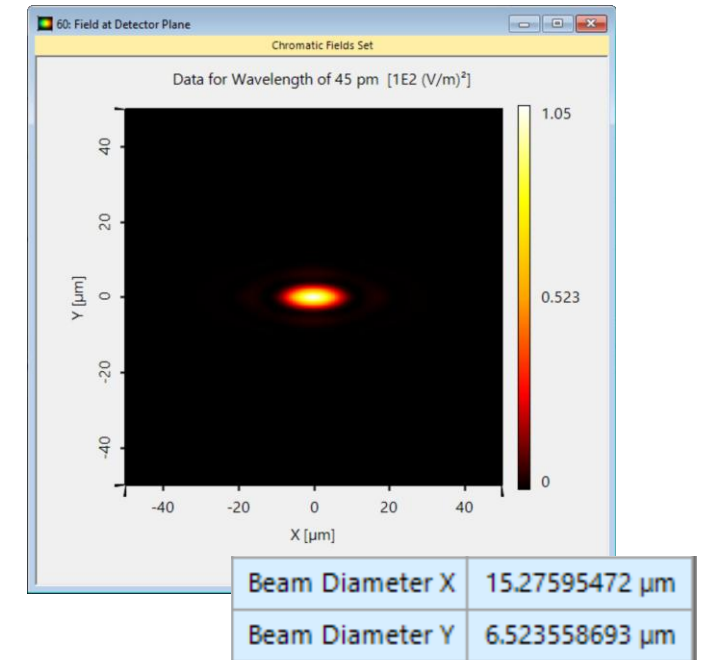
## 2D-Simulation: 5 Cylindrical Lens



- To focus the x-ray beam in both x- and y-direction the compound lens can be built up by an horizontally (H) and vertically oriented cylindrical lenses.
- Here we simulated an equal number of both types.

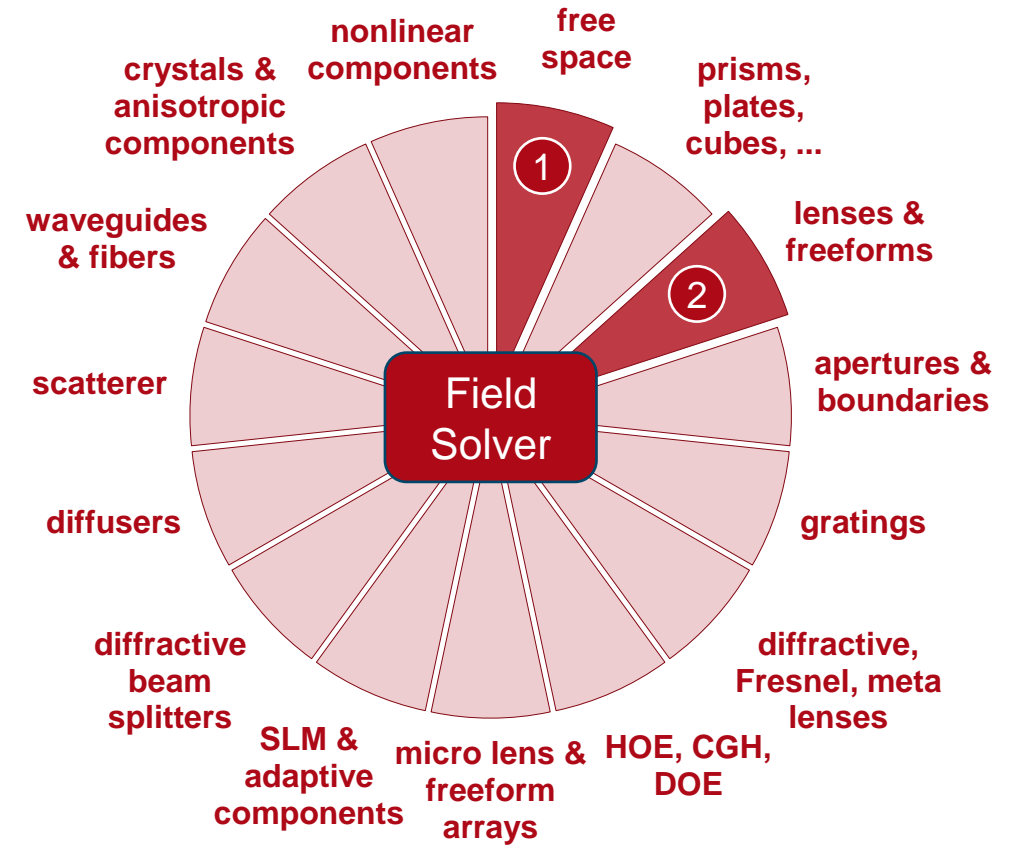
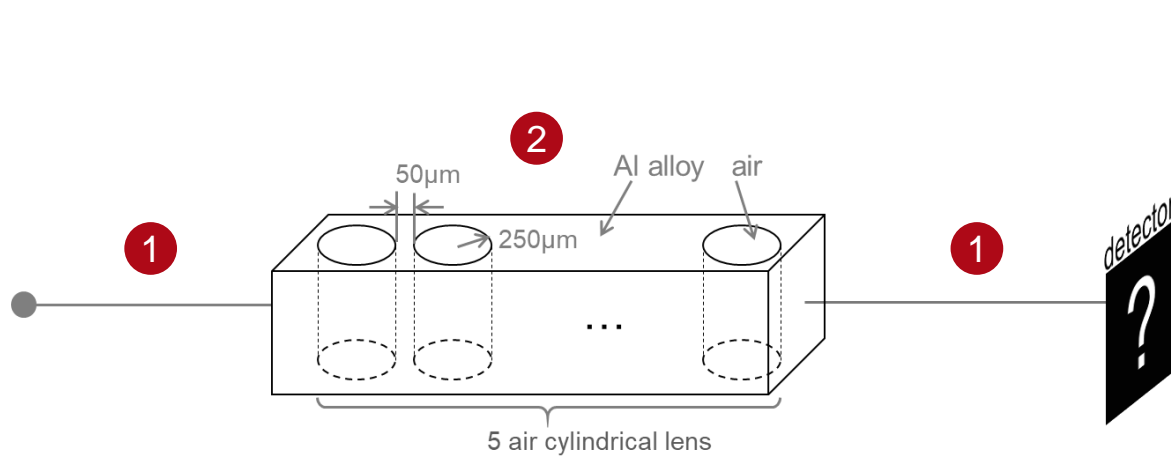


5 (H) and 5 (V) air cylindrical lens



10 (H) and 10 (V) air cylindrical lens

# VirtualLab Fusion Technologies



# Document Information

Title	Compound Refractive Lens for X-Ray Focusing
Document code	USC.0235
Publication date	17.02.2025
Required packages	-
Software version	2025.2 (Build 1.118)*
Category	Use Case
Further reading	<ul style="list-style-type: none"><li>• <a href="#">Single Grating Interferometer for X-Ray Imaging</a></li><li>• <a href="#">Grazing-Incidence Focusing Mirrors for X-Ray Beams</a></li></ul>

\* The files attached to this document require the specific version or later.