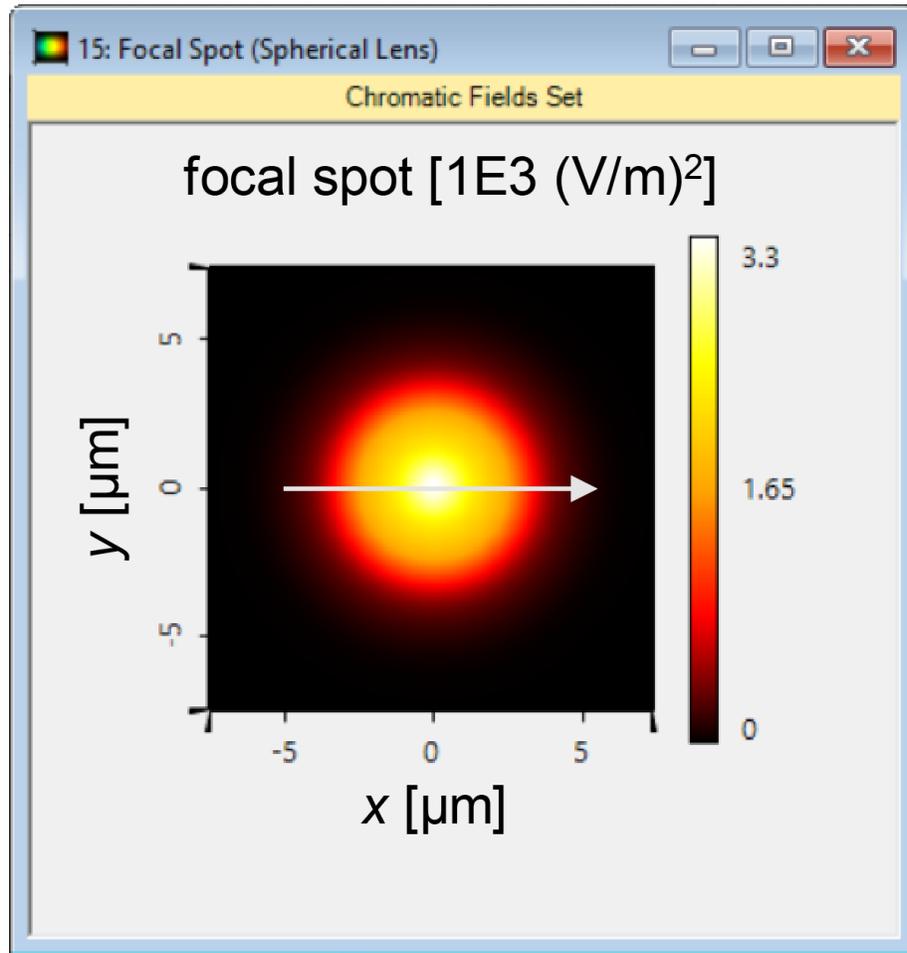


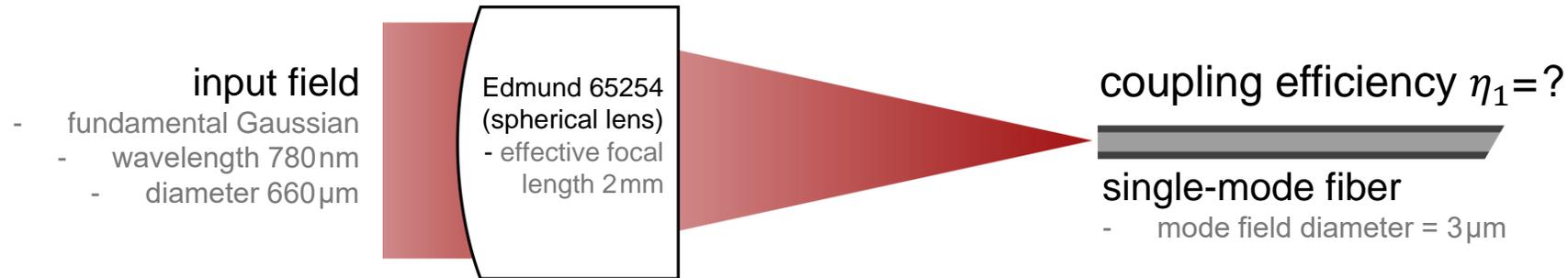
Comparison of Different Lenses for Fiber Coupling

Abstract

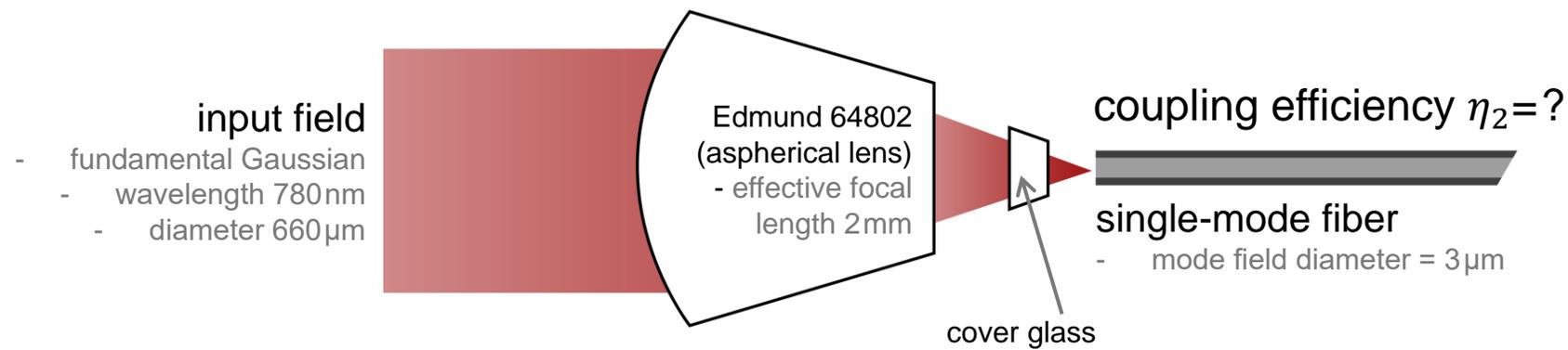


Optical fibers are widely used in different applications, and they play an important role in long-distance optical communication. In practice, launching light into optical fibers, especially to single-mode ones, can be a challenging task and the fiber coupling lens must be carefully chosen. In this example, we select two commercially available lenses, with the same effective focal length, but different surface types. They are evaluated, for the task of coupling light into a single-mode fiber, in terms of coupling efficiency which is calculated by using the overlap integral.

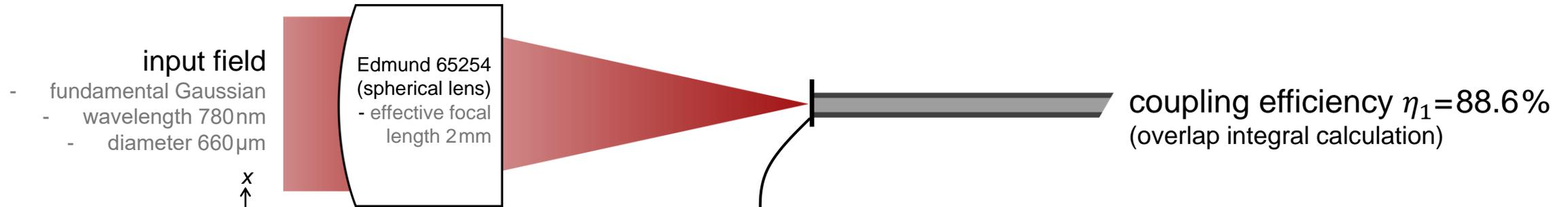
Modeling Task



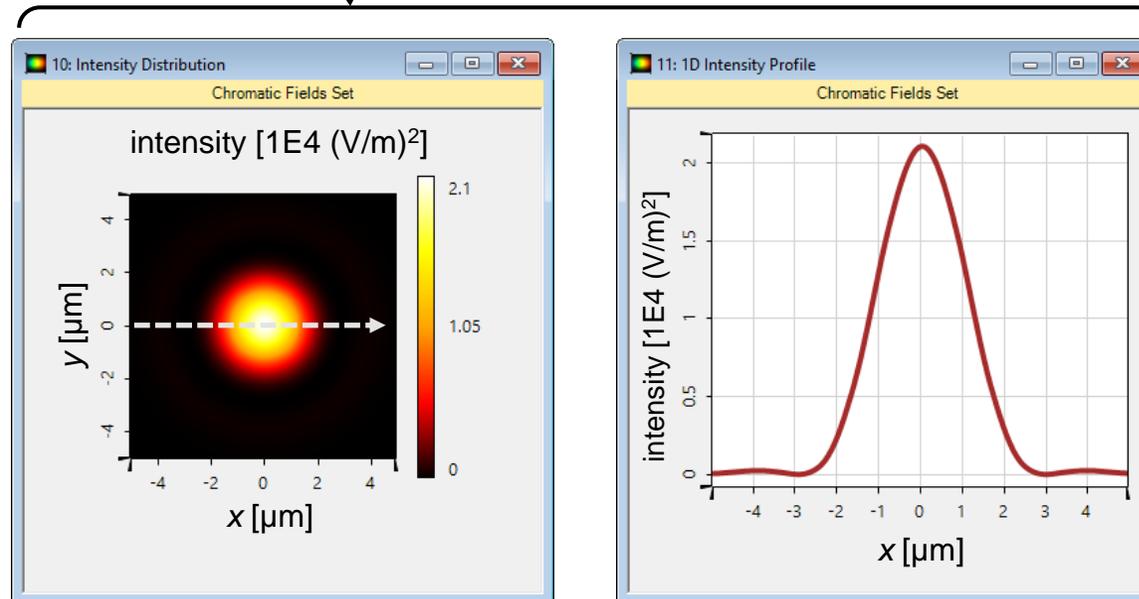
When two lenses with the same effective focal length are available for fiber coupling task, how to evaluate their performance in terms of coupling efficiency?



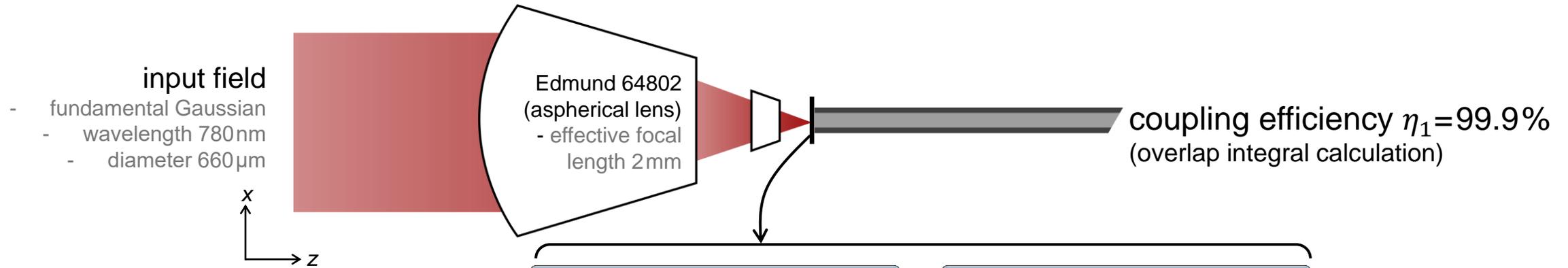
Simulation Results



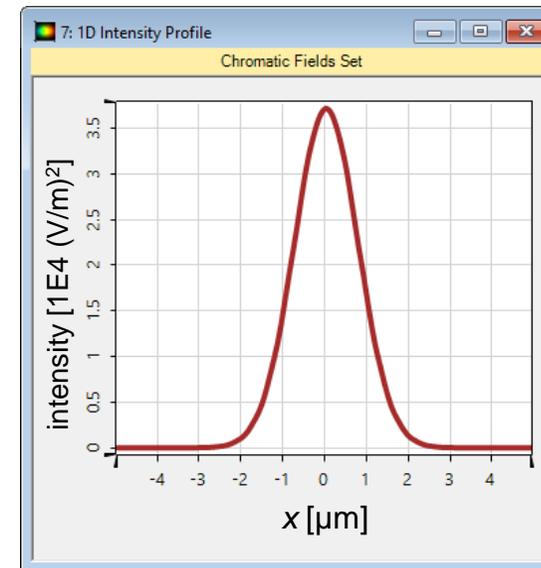
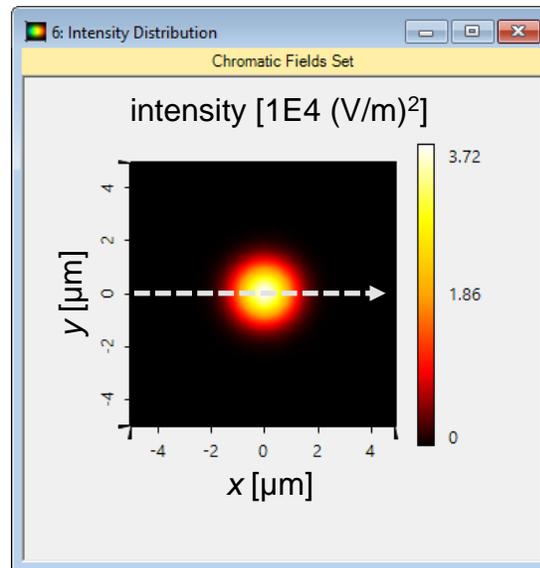
Due to aberrations from the spherical lens, the focal spot at the end of the fiber deviates from a Gaussian mode, and therefore it leads to poor coupling efficiency.



Simulation Results



Aspherical lens controls the aberrations well and that guarantees a focal spot in smaller size, and with Gaussian profile that fits to the fiber.



Field tracing simulation of the fiber coupling system takes only 2 seconds.

Peak into VirtualLab Fusion

The image shows a 3D visualization of a lens focusing a laser beam. The lens is a biconvex shape, and the beam is represented by a series of red lines converging to a focal point. Three software windows are overlaid on the scene:

- Edit Optical Interface Sequence:** A window showing a list of optical interfaces. The table below is a transcription of the data shown in this window.
- 6: Intensity Distribution:** A window showing a 2D intensity distribution plot. The plot is a heatmap with a central peak, and the axes are labeled y [μm] and x [μm]. The color scale ranges from 1.86 to 3.72 $10^4 \text{ (V/m}^2\text{)}$.
- Edit Fiber Coupling Efficiency:** A window showing detector parameters. The "Detector Function" tab is active, and the "Specify Gaussian Mode Field" option is selected. The "Mode Field Diameter ($1/e^2$)" is set to $3 \mu\text{m}$.

imported lens from Zemax file

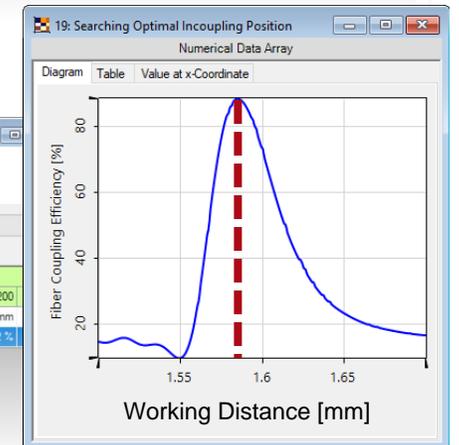
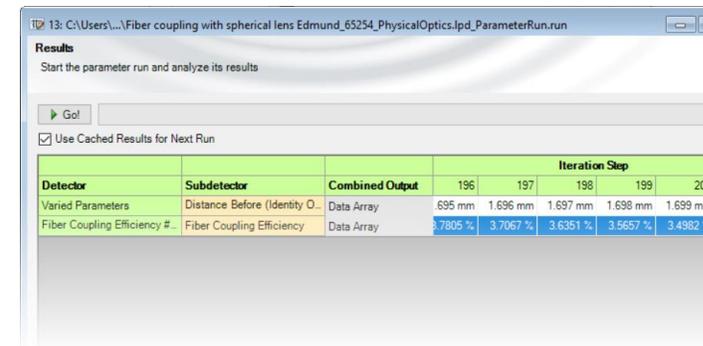
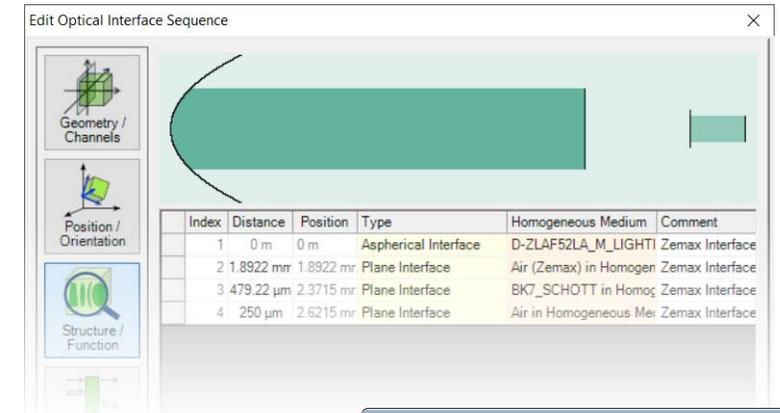
visualization and analysis

Index	Distance	Position	Type	Homogeneous Medium	Comment
1	0 m	0 m	Aspherical Interface	D-ZLAF52LA_M_LIGHTI	Zemax Interface
2	1.8922 mm	1.8922 mm	Plane Interface	Air (Zemax) in Homogen	Zemax Interface
3	479.22 μm	2.3715 mm	Plane Interface	BK7_SCHOTT in Homoç	Zemax Interface
4	250 μm	2.6215 mm	Plane Interface	Air in Homogeneous Mei	Zemax Interface

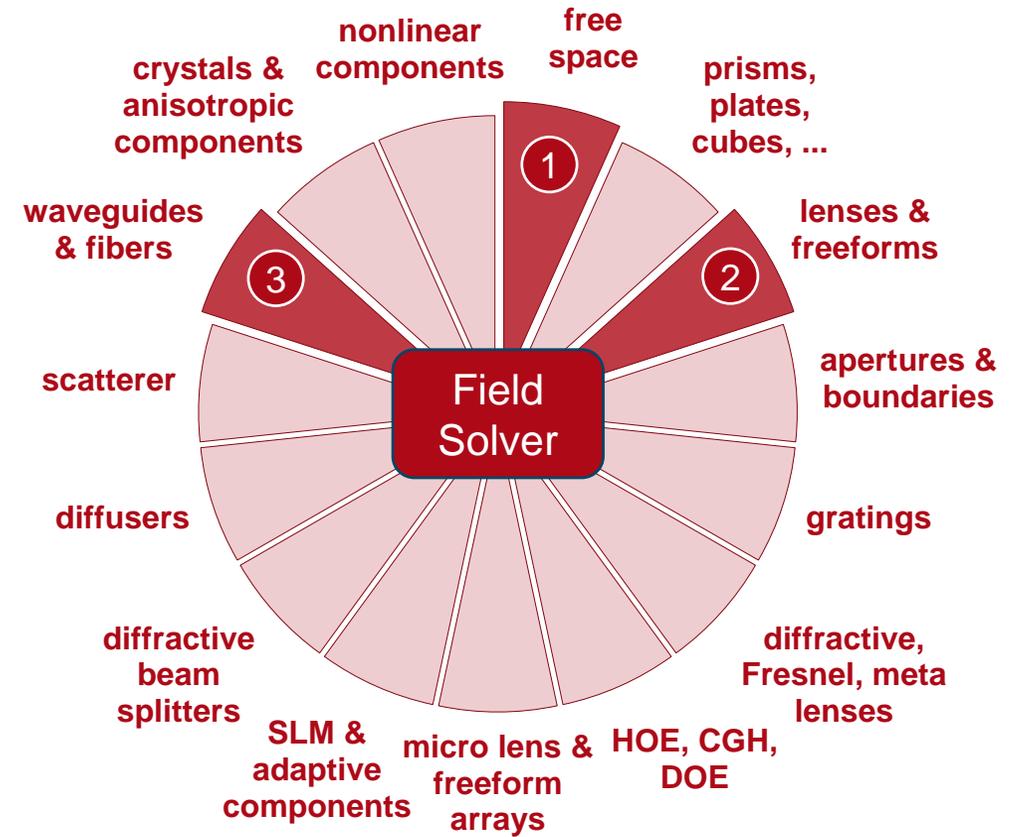
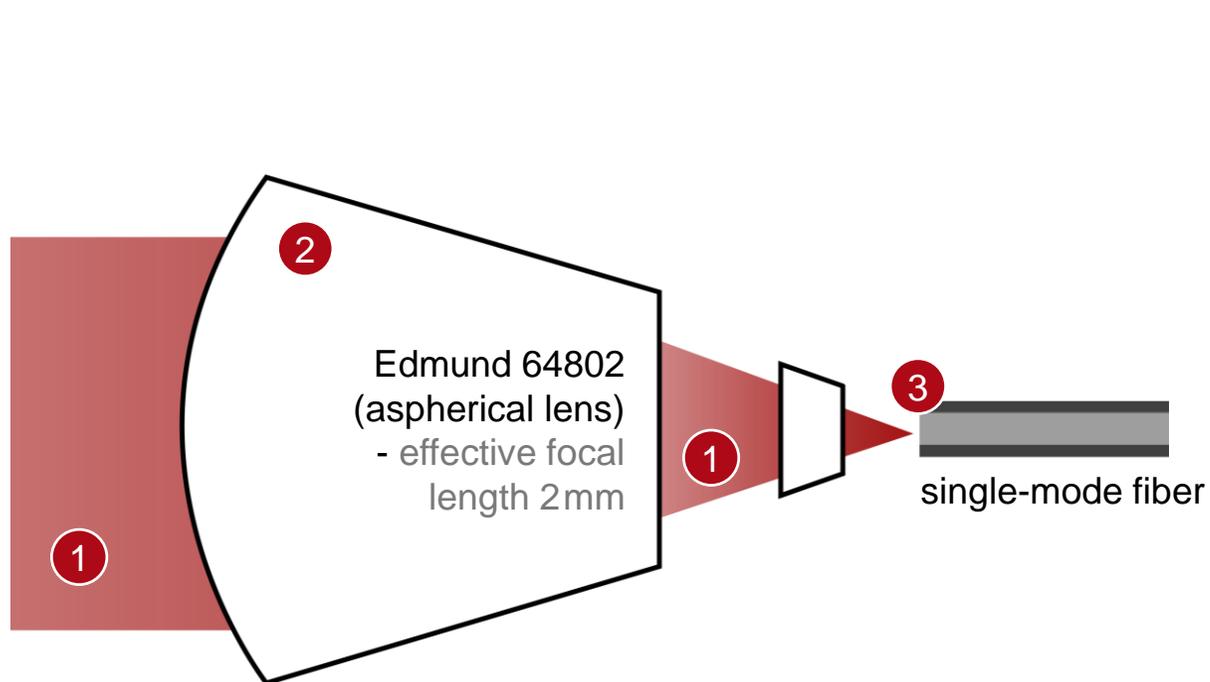
Workflow in VirtualLab Fusion

- Set up input Gaussian field
 - [Basic Source Models](#) [Tutorial Video]
- Load different coupling lenses from Zemax files
 - [Import Optical Systems from Zemax](#) [Use Case]
- Find optimal working distances for different lenses
 - [Optimal Working Distance for Coupling Light into Single-Mode Fibers](#) [Use Case]

and then compare their performance



VirtualLab Fusion Technologies



Document Information

title	Comparison of Different Lenses for Fiber Coupling
document code	FCP.0002
version	2.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.4.0.49
category	Application Use Case
further reading	<ul style="list-style-type: none">- Optimal Working Distance for Coupling Light into Single-Mode Fibers- Parametric Optimization of Fiber Coupling Lens