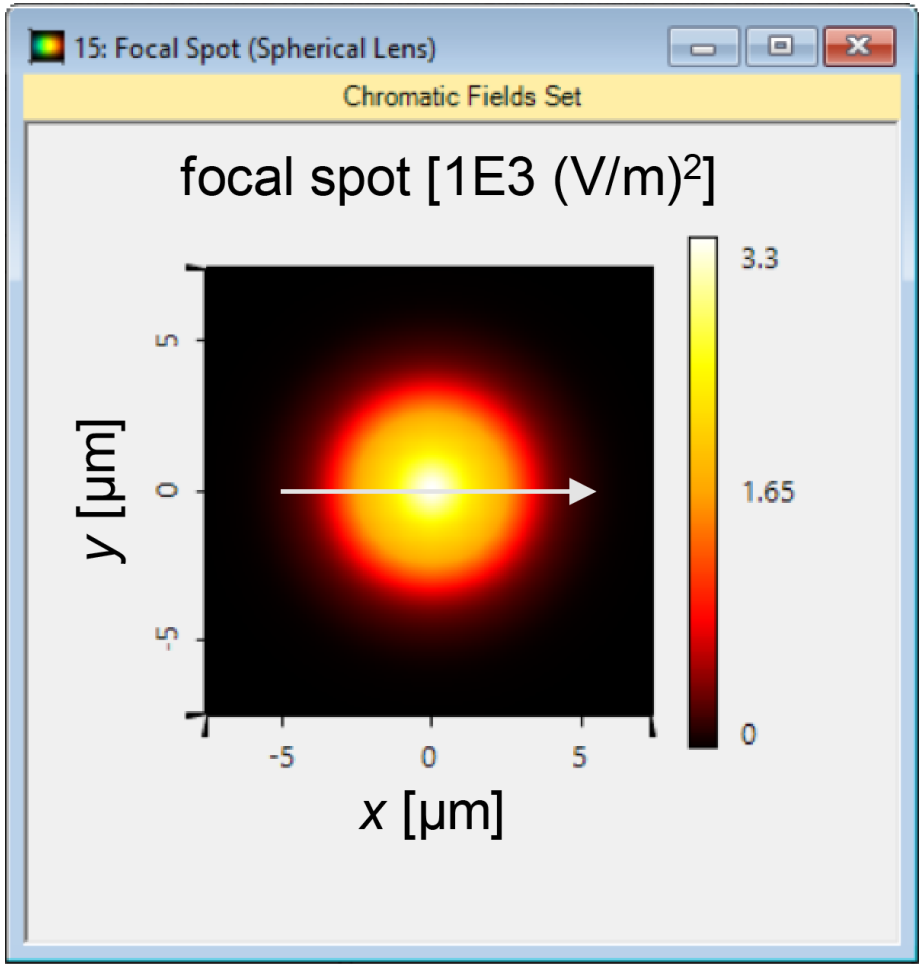
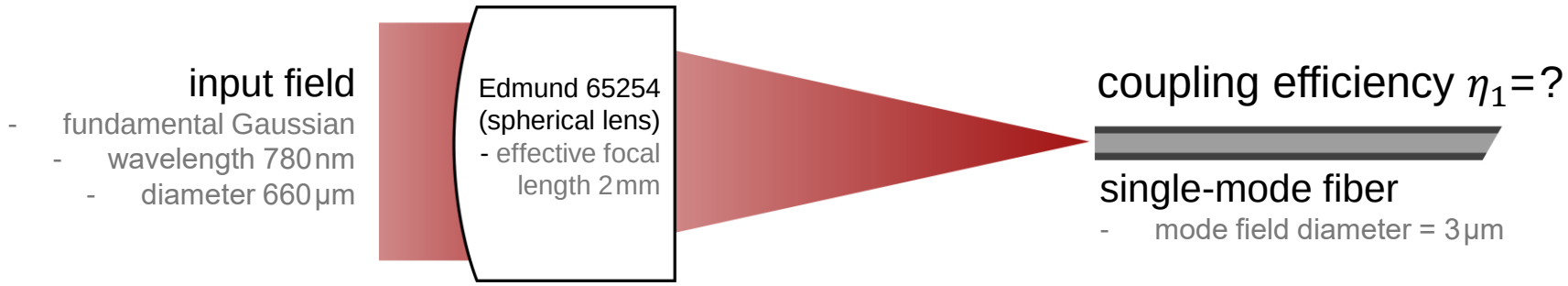
Comparison of Different Lenses for Fiber Coupling

Abstract

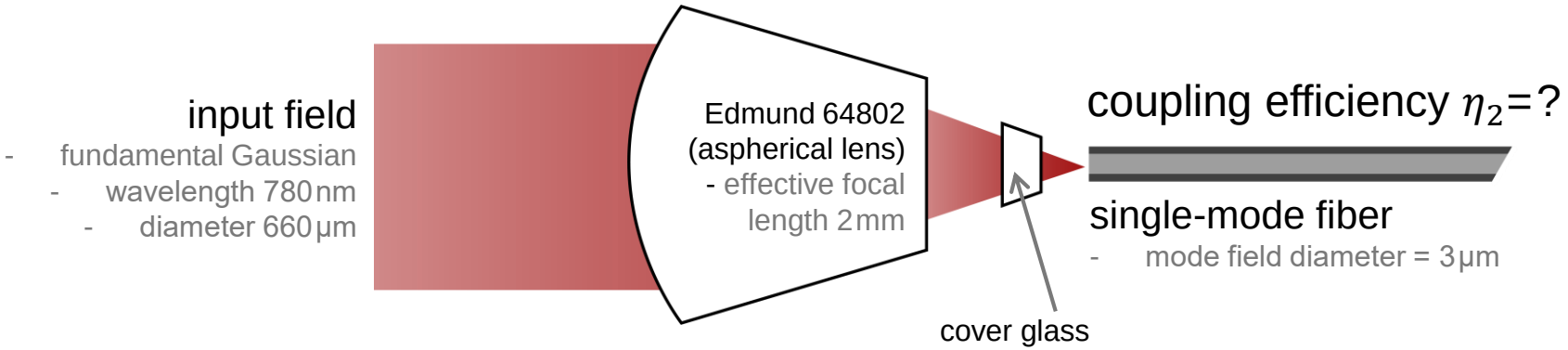


Optical fibers are widely used in different applications, and they play an important role in long-distance optical communication. In practice, launching light into optical fibers, especially to single-mode ones, can be a challenging task and the fiber coupling lens must be carefully chosen. In this example, 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

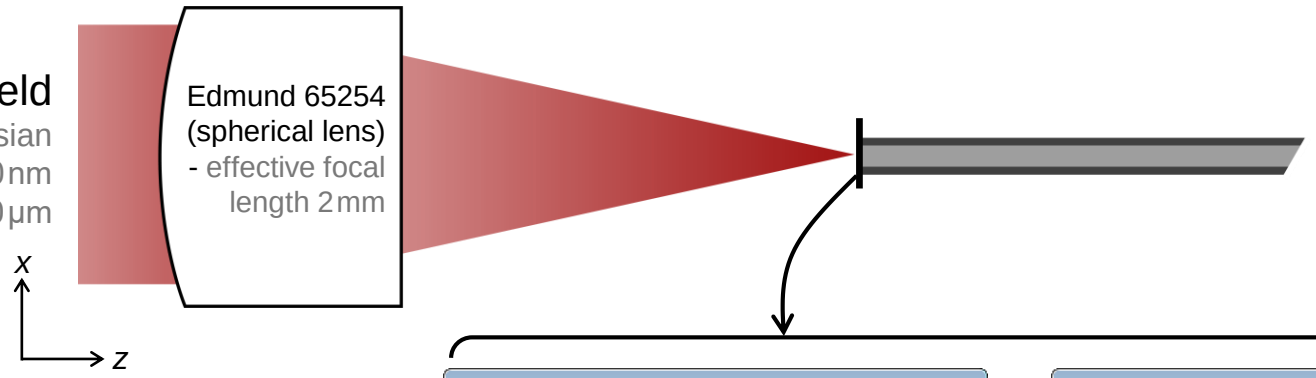


When two lenses with the same effective focal length are available for fiber coupling task, how to evaluate their performance in terms of coupling efficiency?



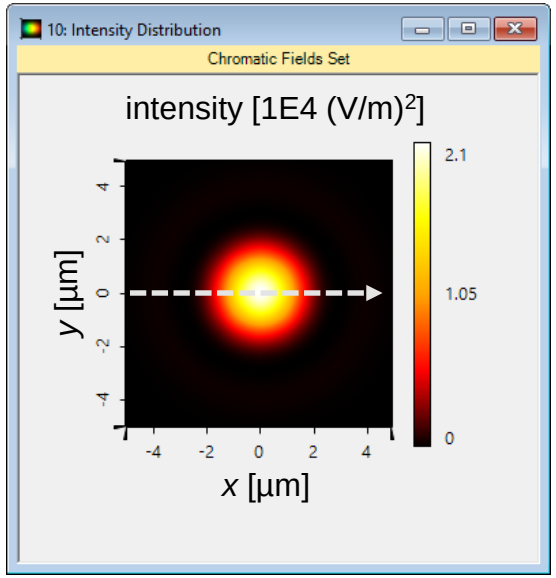
Simulation Results

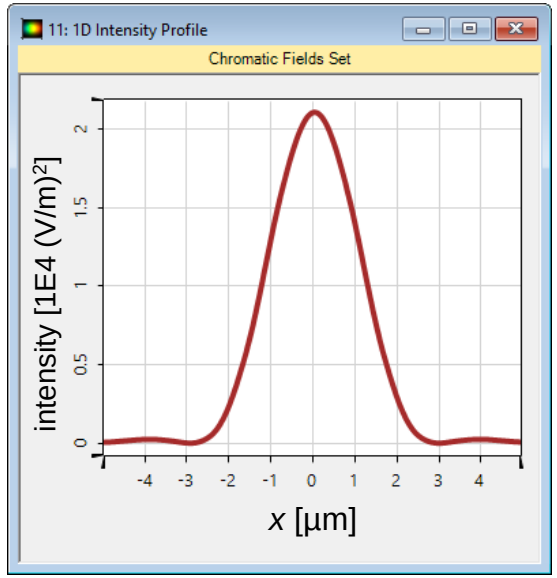
input field
- fundamental Gaussian
- wavelength 780 nm
- diameter 660 µm



coupling efficiency $\eta_1 = 88.6\%$
(overlap integral calculation)

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.





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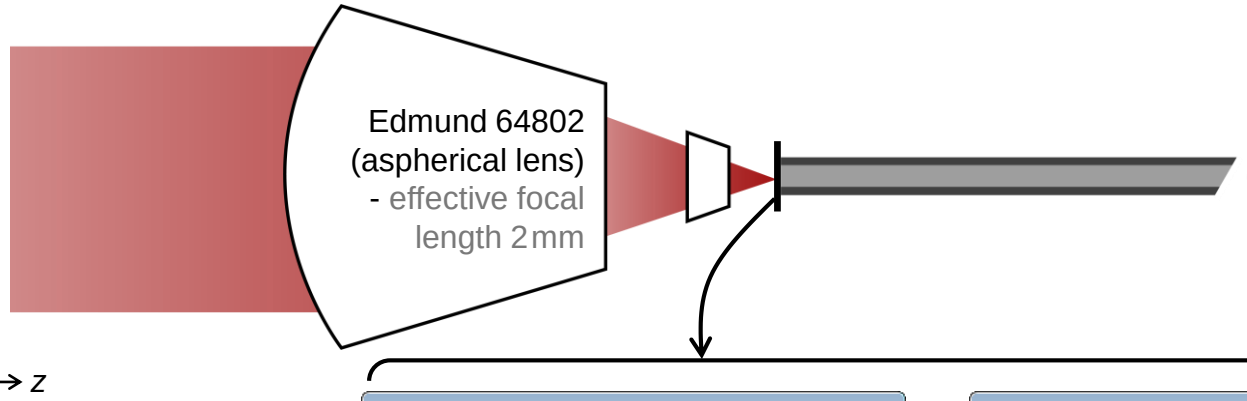
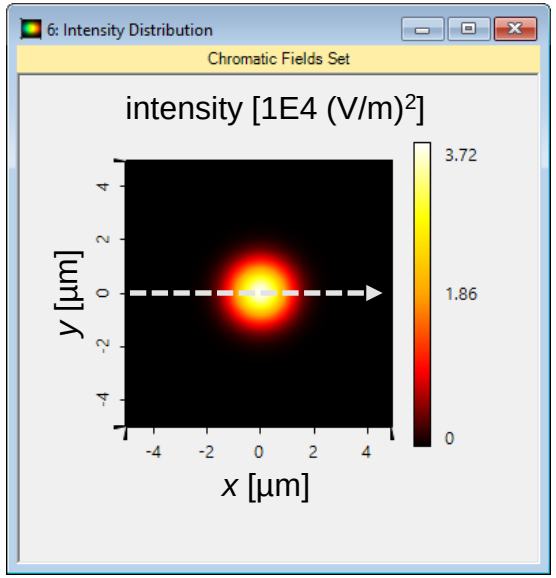
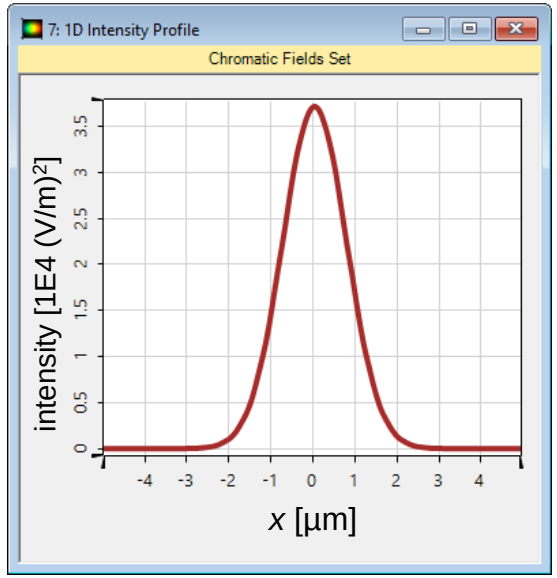


coupling efficiency $\eta_1 = 99.9\%$
(overlap integral calculation)

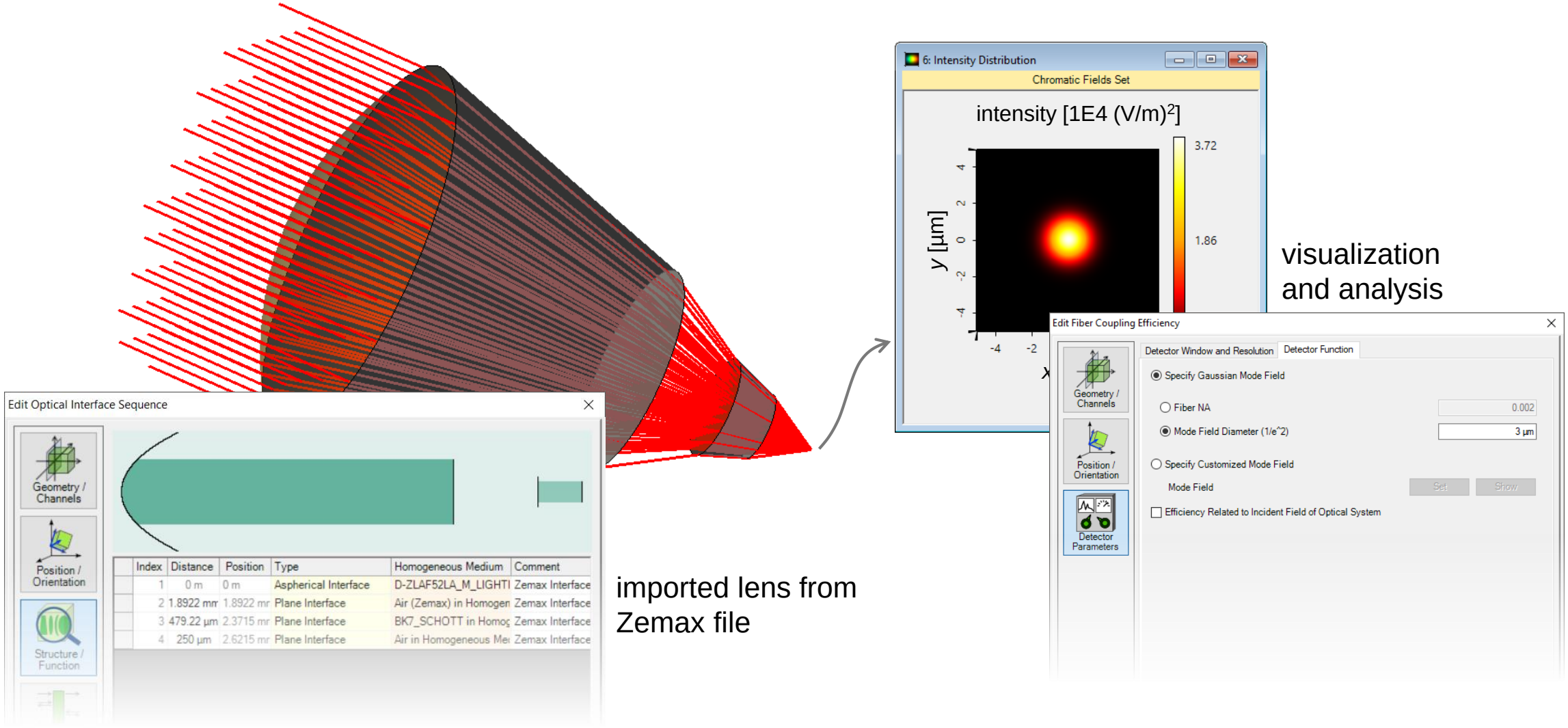




Field tracing simulation of the fiber coupling system takes only 2 seconds.

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

Peak into VirtualLab



visualization and analysis

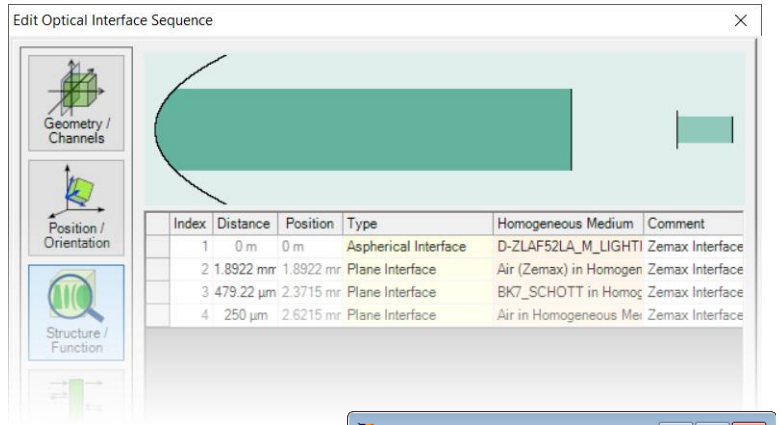
imported lens from Zemax file

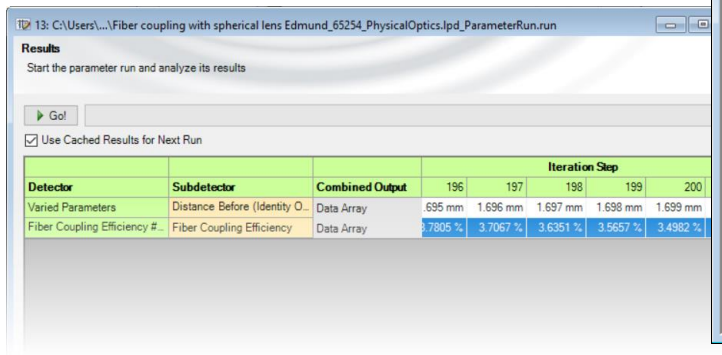
Workflow in VirtualLab

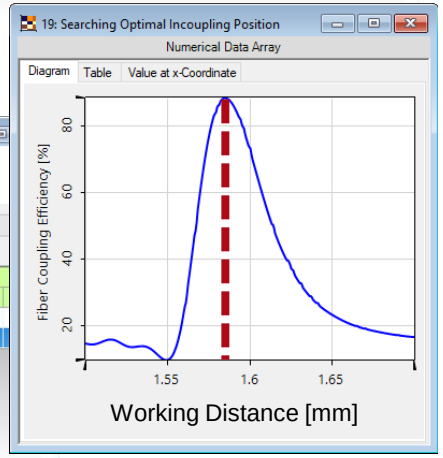
- Set up input Gaussian field

- Load different coupling lenses from Zemax files
  - Import Optical Systems from Zemax
- Find optimal working distances for different lenses
  - Optimal Working Distance for Coupling Light into Single-Mode Fibers

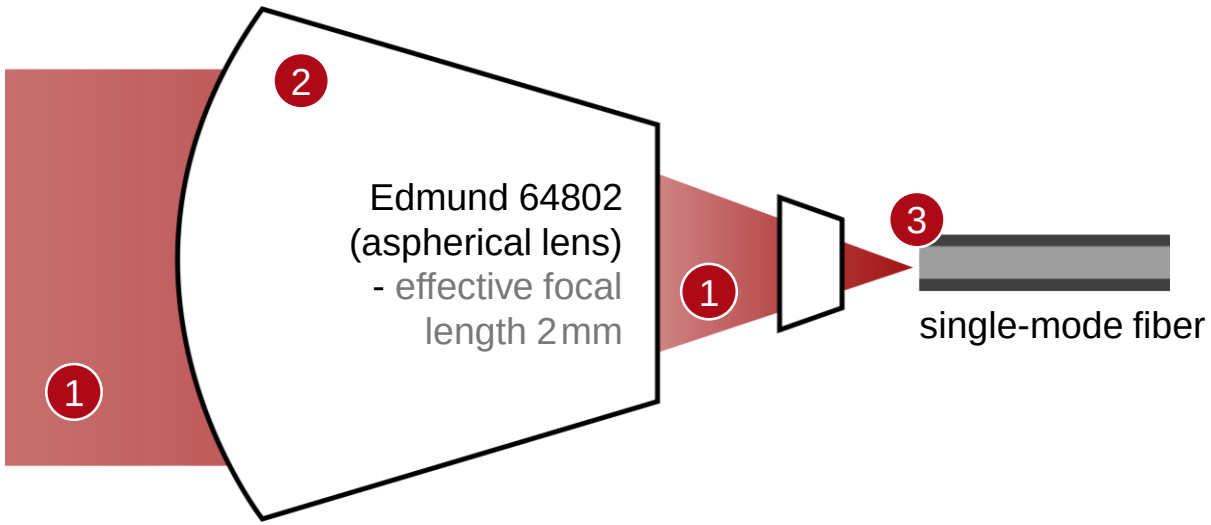
  and then compare their performance

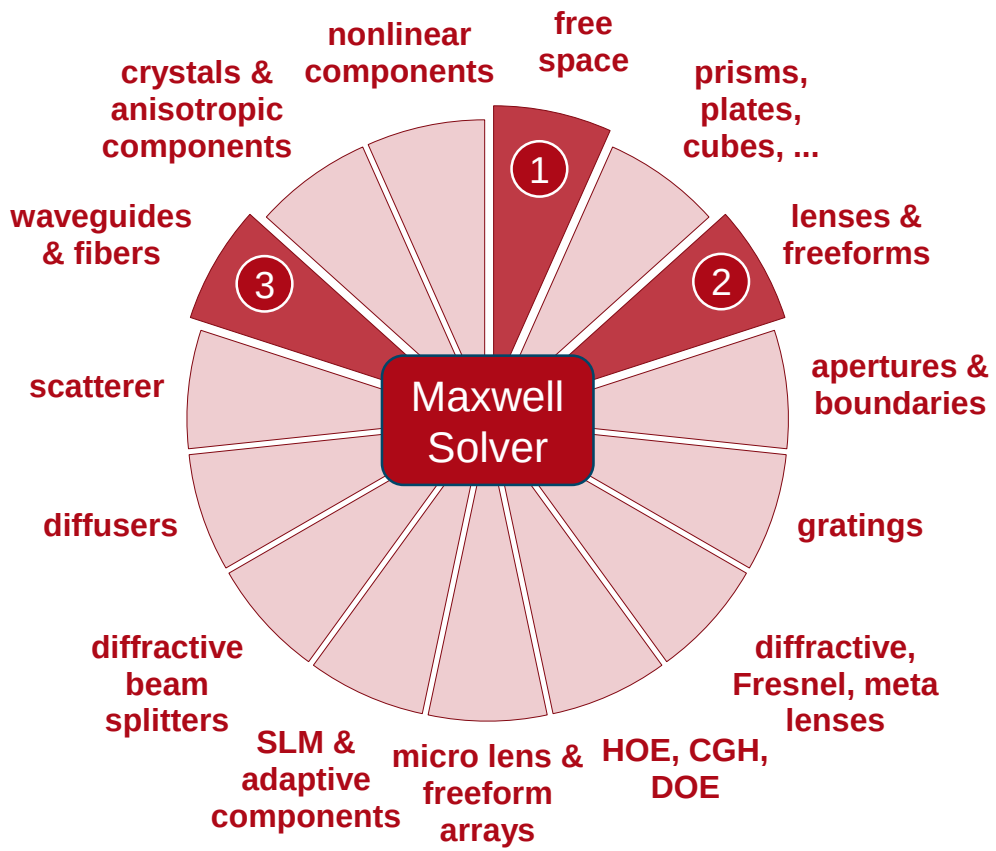






VirtualLab Technologies





Document Information

title	Comparison of Different Lenses for Fiber Coupling
document code	FCP.0002
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VL version used for simulations	7.4.0.49
category	Application Use Case
further reading	- Optimal Working Distance for Coupling Light into Single-Mode Fibers - Parametric Optimization of Fiber Coupling Lens