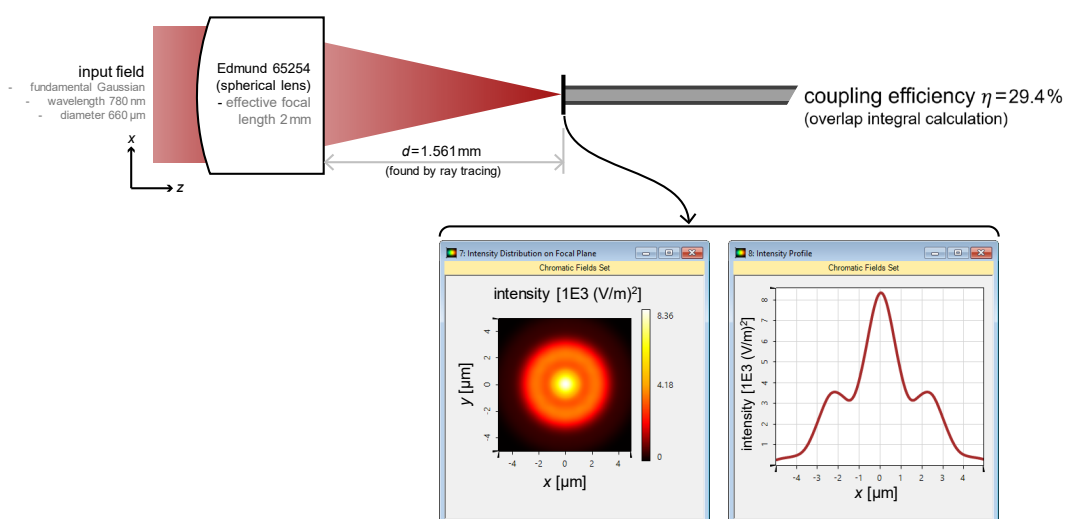


# Design of Fiber Coupling Systems and Tolerance Analysis

How to couple light into optical fibers with high efficiency is of great concern for many applications, e.g., in telecommunication, remote sensing, and lasers. For single-mode fibers with relatively high-NA, the coupling efficiency analysis requires a physical-optics consideration of the field in the focal region.

## Benefits in VirtualLab Fusion

- **All-in-one software platform** with ray tracing and field tracing (physical optics modeling)
- **Accurate calculation of field in focal region** and therefore also of the fiber coupling efficiency
- **Parametric design of coupling lens** or direct import from Zemax OpticStudio
- **Full tolerance analysis** including shift and tilt of fiber end position
- **Handling of special-cut/microstructured fiber end**



## Find Optimal Working Distance

- Instead of using pure ray-optics for predicting the optical working distance for fiber coupling, a full physical-optics model is used to calculate the field in the focal region.
- The fiber coupling efficiency is always calculated based on the accurately computed field in the focal region.
- Together with the Parameter Run, one can vary selected parameters and check their influence on the efficiency.

## Parametric Design of Fiber Coupling Lenses

- All system parameters are accessible via the parametric optimization tool in VirtualLab Fusion.
- With the parametric optimization, one can easily design fiber coupling lenses with various surface types.
- With each parametric optimization step, the coupling efficiency is calculated accurately based on physical optics modeling.

## Tolerance Analysis

- Fiber coupling setups, especially for single-mode fibers, are very sensitive to system misalignment.
- VirtualLab Fusion provides full tolerance analysis tools, including not just lateral and longitudinal shifts, but also possible tilt / rotation of fiber ends and other components in the system.
- Results of the analysis can be graphically visualized.

## Specially Cut/Structured Fiber End

- Modern optical applications often employ fibers with specially cut ends or even etched with microstructures.
- To correctly model such situations a proper model for such micro-/nanostructures is additionally required.
- VirtualLab Fusion connects different electromagnetic field solvers in one platform and therefore enables the modeling of such cases as well.

