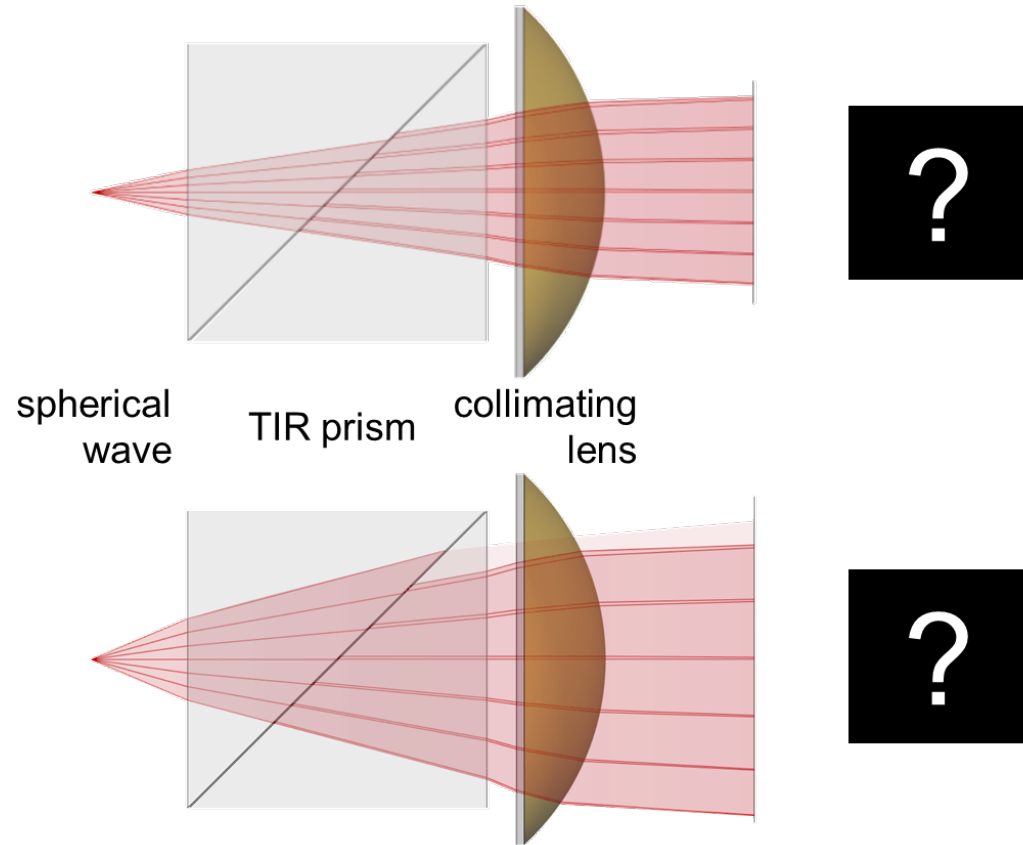


Modeling of Total Internal Reflection (TIR) Prism

Abstract



In this example, we illustrate the modeling of interference and vignetting effects at a total internal reflection (TIR) prism, where these effects are appearing especially for the transmitted part of the light. The discussed type of prism usually consist of two parts, which are glued together with a material of a slightly different refractive index. Dependent on the characteristics of the impinging light, vignetting as well as interference effects are appearing, which are introduced by the narrow gap between both prism parts.

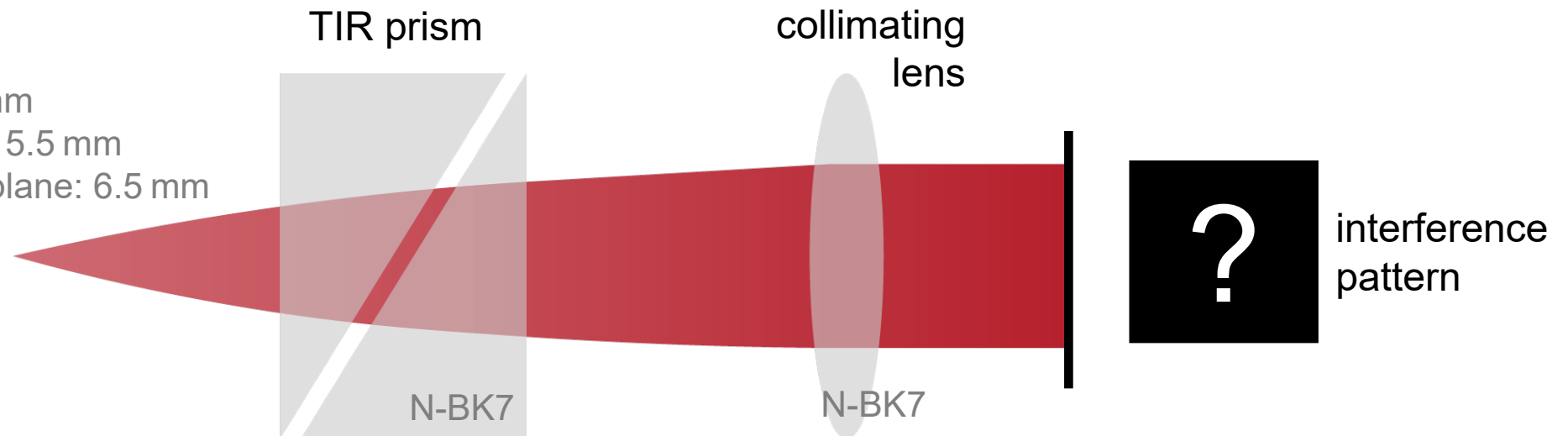
Task Description

An optical system, that contains a total internal reflection (TIR) prism, is modeled. Due to the gap of the prism, which exhibits a slightly different refractive index, interesting effects may appear:

- Multiple reflections occur at the prism gap. Hence an interference pattern can be observed for instance for transmitted part of the light.
- With larger divergence of the source or larger tilt angle of the prism gap, vignetting effect can be observed in addition.
- Of course, vignetting and interference can appear in combination.

spherical wave

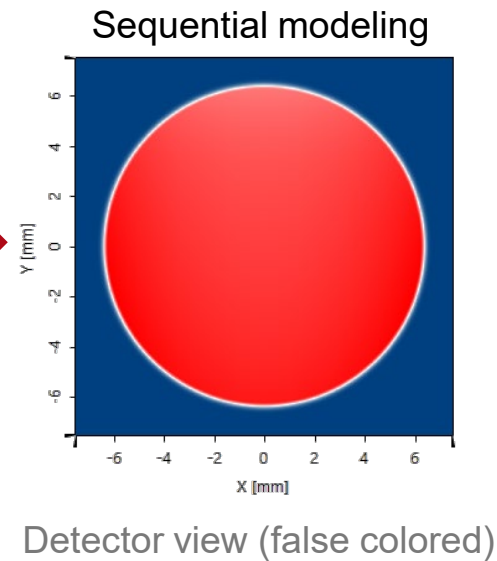
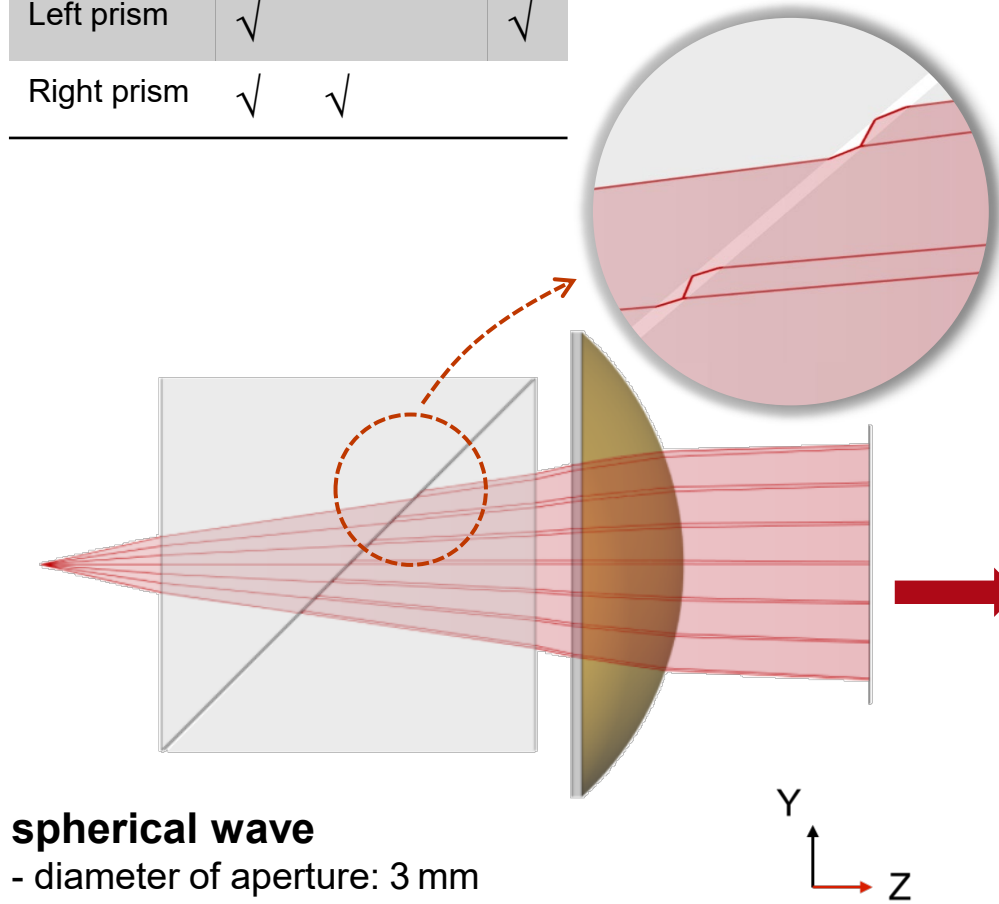
- Wavelength: 532 nm
- Diameter: 3 mm & 5.5 mm
- Distance to input plane: 6.5 mm



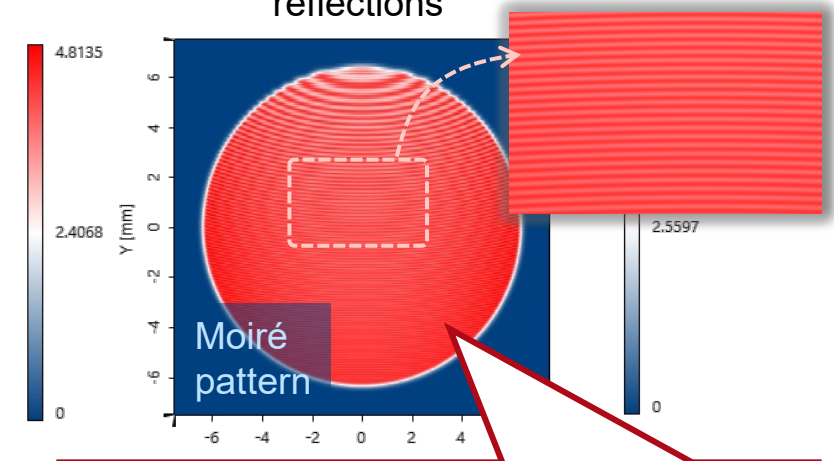
Interference Pattern Investigation with Multiple Reflections

Surface	+/+	+/-	-/-	-/+
Left prism	√			√
Right prism	√	√		

By enabling multiple reflections for the gap of the prism with a proper level of interactions, the fringe pattern can be observed due to the overlap of different light paths, very similar to the function of an etalon.



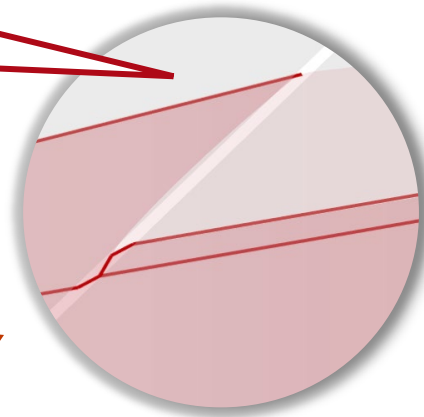
Interference pattern due to multiple reflections



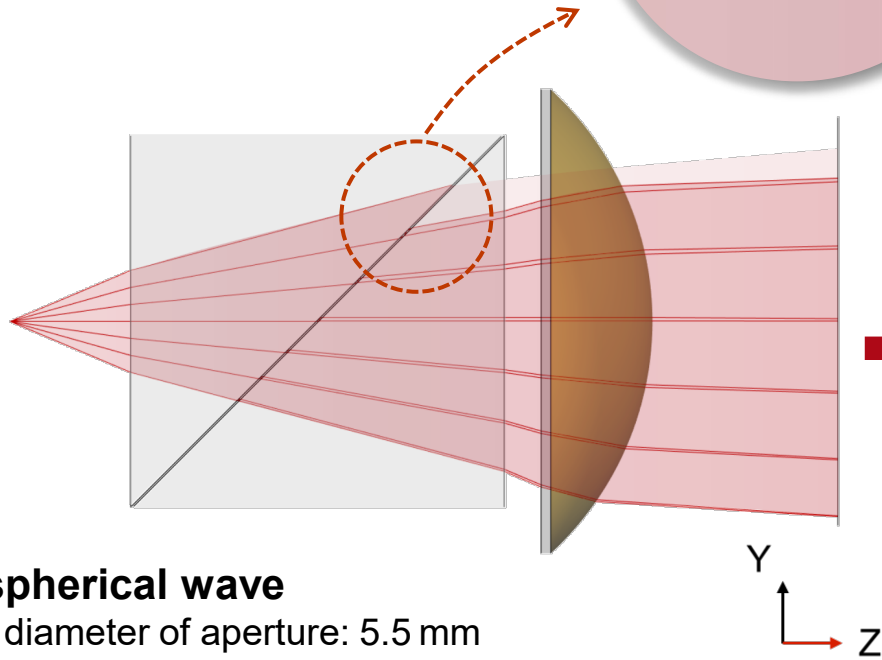
Be careful: aliasing effect due to low-resolution image

Vignetting Effect with Larger NA of the Beam

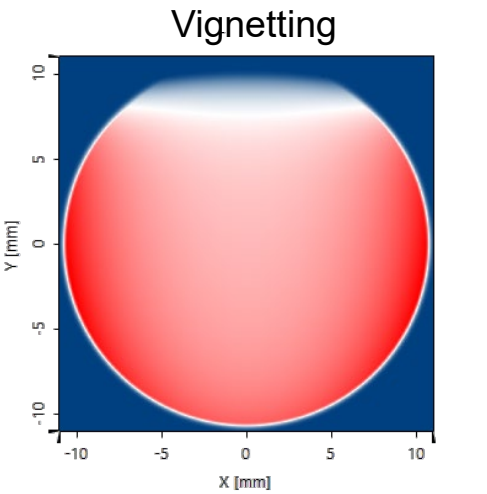
Total internal reflection
of the marginal rays



By increasing the aperture of the input field, the beam is truncated due to partial total internal reflection (TIR) at the gap and the vignetting effect appears. In addition, the etalon effect is still observable, if the regarding channels are enabled.

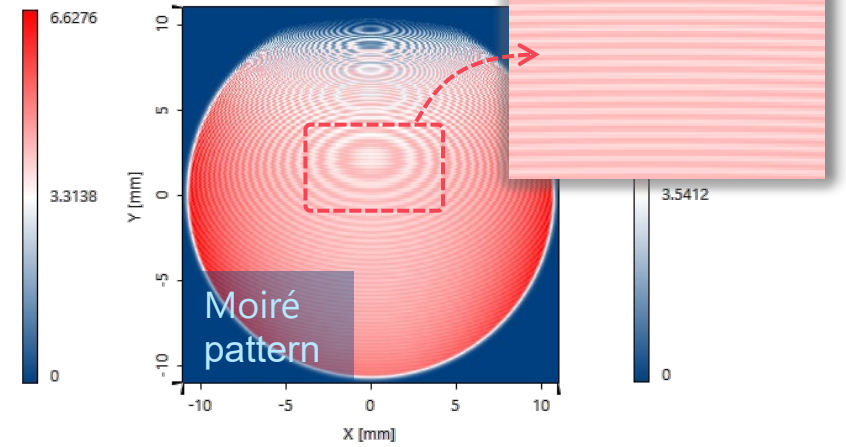


spherical wave
- diameter of aperture: 5.5 mm



Detector view (false colored)

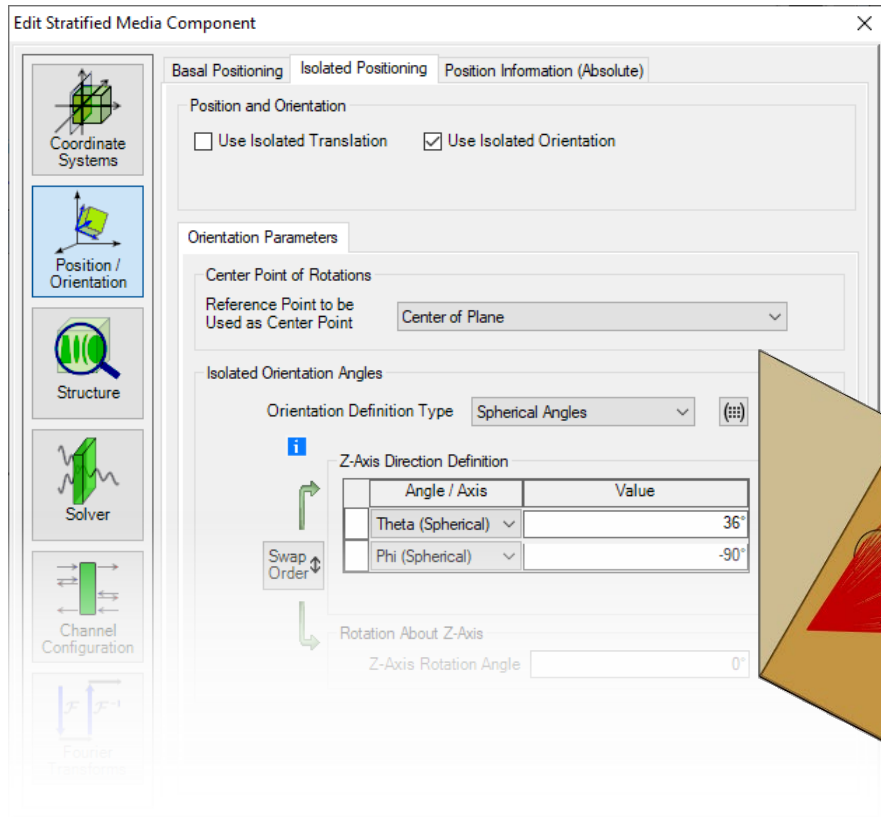
Vignetting + Interference



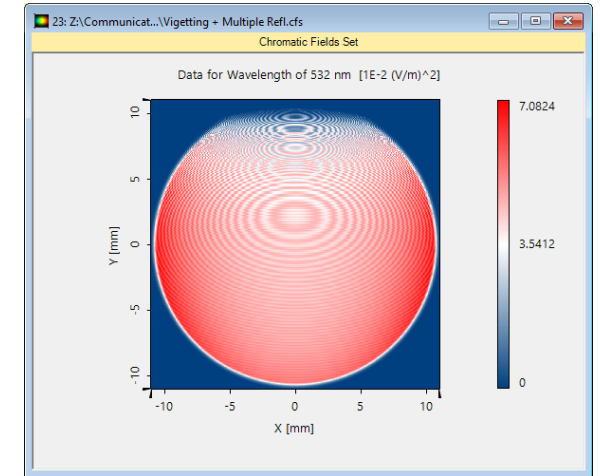
Moiré
pattern

Peek into VirtualLab Fusion

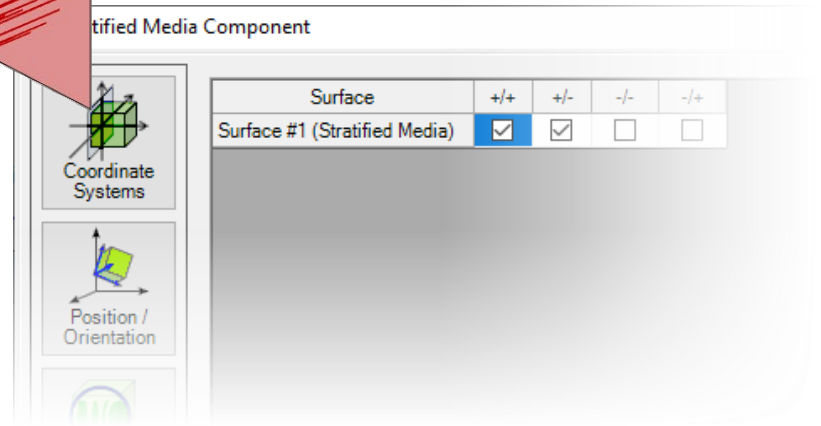
flexible position and orientation settings



direct observation of interference fringes

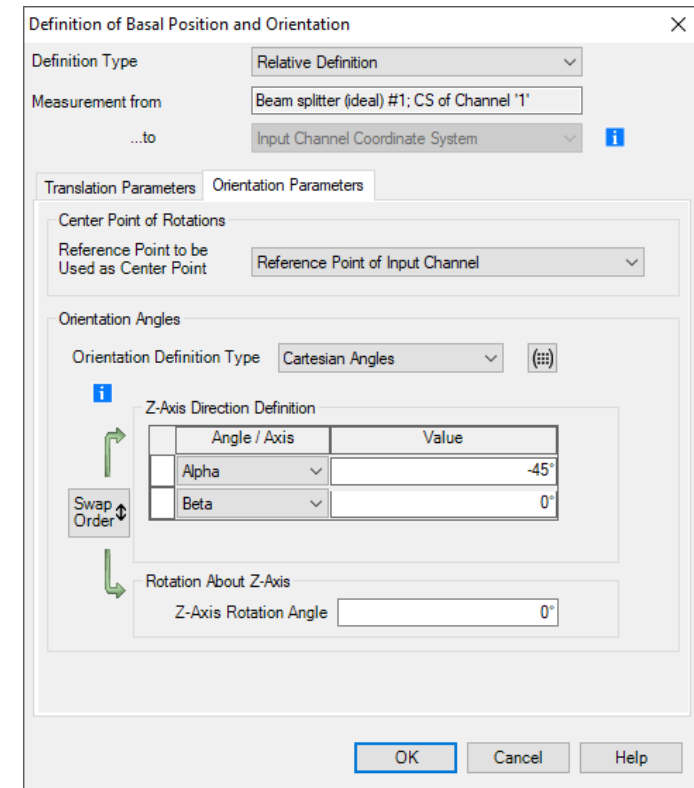


non-sequential ray tracing analysis

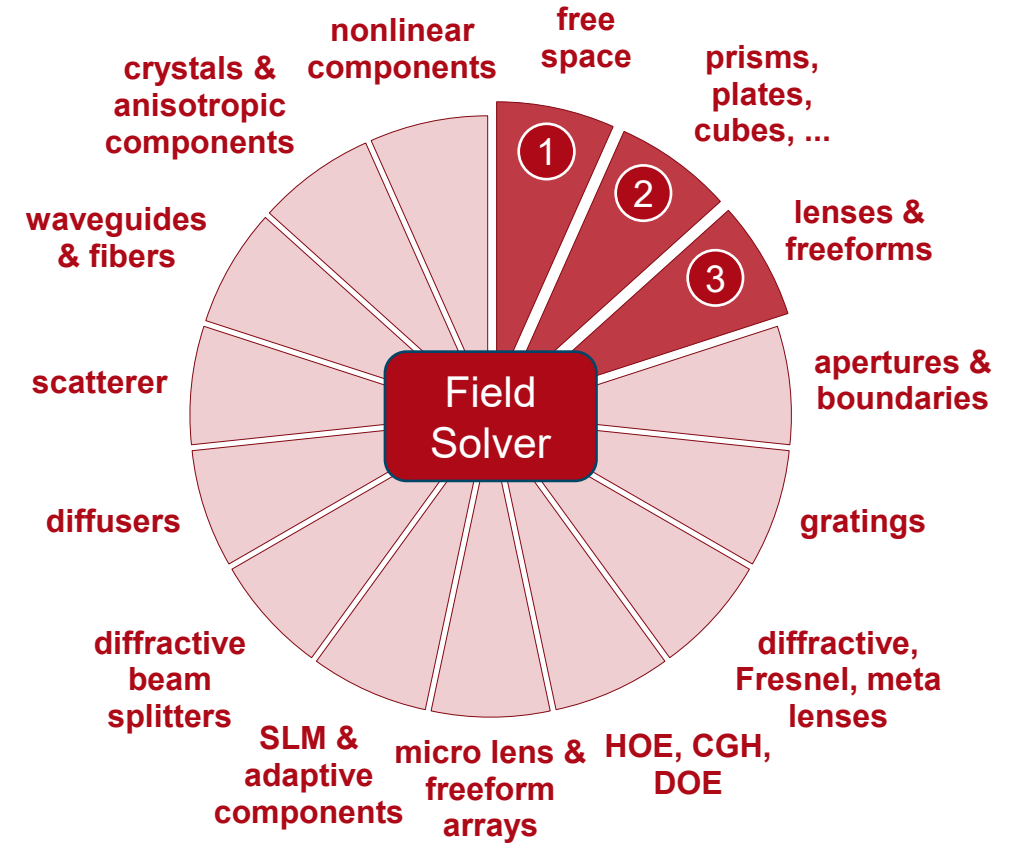
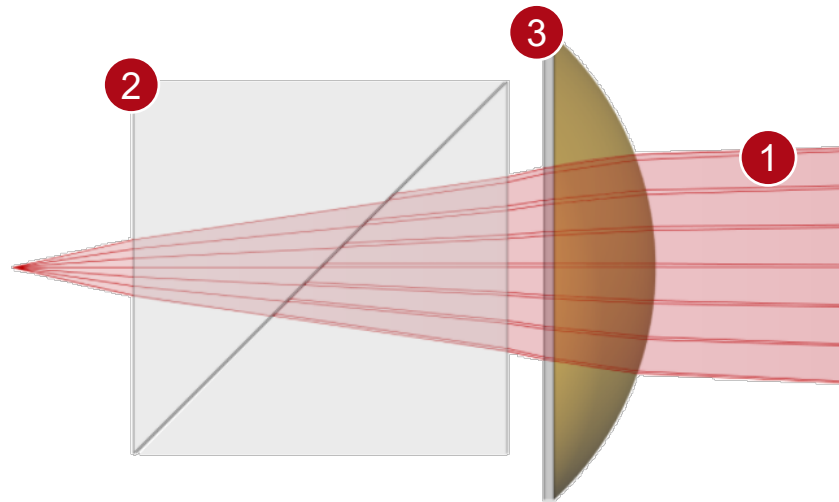


Workflow in VirtualLab Fusion

- Set up input field
 - [Basic Source Models](#) [Tutorial Video]
- Construct real components using surfaces
- Define position and orientation of components
 - [LPD II: Position and Orientation](#) [Tutorial Video]
- Set channels properly for non-sequential tracing
 - [Channel Setting for Non-Sequential Tracing](#) [Use Case]



VirtualLab Fusion Technologies



Document Information

title	Modeling of Total Internal Reflection (TIR) Prism
document code	IFO.0017
version	2.0
toolbox(es)	VirtualLab Fusion Basic
VL version used for simulations	2020.2 (Build 2.22)
category	Application Use Case
further reading	<u>Modeling of Etalon with Planar or Curved Surfaces</u>