Frustrated Total Internal Reflection (FTIR) on a Cube Beam Shaper
Optical beam splitter devices play a crucial part in many applications in the areas of spectrometry, interferometry and optical communication. A common type of beam splitter is based on the effect of Frustrated Total Internal Reflection (FTIR), and therefore consists of two glass prism which are separated by a very thin layer. If the layer is sufficiently thin, part of the light will transmit through the boundary due to evanescent waves tunnelling to the other side, while the rest will be reflected.
System Setup

input field
- fundamental Gaussian
- wavelength 500 nm
- TE/TM Polarization

beam splitter
- 2 glass prisms with a vacuum gap
- gap thickness: 0 - 500 nm

ideal mirrors

detectors
- energy density
With the channel configuration mode set to *Manual Configuration*, the user can specify which light paths are followed in the simulation, for each surface in the system individually. When the simulation is performed, the available light paths are determined by the so-called *Light Path Finder*. The field then is traced along these light paths through the configured setup.

**Channel Setting for Non-Sequential Tracing**
Frustrated Total Internal Reflection (FTIR)

The gap between the prisms is modeled by a Stratified Media Component. The reason for this is that the Stratified Media Component's S-matrix solver takes evanescent waves into account and thus enables the modeling of effects such as FTIR. More information about the Stratified Media Component under:

Stratified Media Component
Layer Matrix Solver

The Stratified Media Component uses the layer matrix electromagnetic field solver. This solver works in the spatial frequency domain (k-domain). It consists of

1. an eigenmode solver for each homogeneous layer and
2. an S-matrix for matching the boundary conditions at all the interfaces.

The eigenmode solver computes the field solution in the k-domain for the homogeneous medium in each layer. The S-matrix algorithm calculates the response of the whole layer system by matching the boundary conditions in a recursive manner.

This is a method well-known for its unconditional numerical stability since, unlike the traditional transfer matrix, it avoids the exponentially growing functions in the calculation steps.

For further information:
Layer Matrix [S-Matrix]
System Overview (Ray Results Profile: System 3D)
The ratio of reflectance and transmittance in an FTIR-based cube beam splitter strongly dependents on the thickness of the gap between the prisms. In this example, this effect is investigated for a thickness range between 0 nm and 500 nm.

VirtualLab Fusion Technologies

Field Solver

- prisms, plates, cubes, ...
- lenses & freeforms
- apertures & boundaries
- gratings
- diffractive, Fresnel, meta lenses
- HOE, CGH, DOE
- micro lens & freeform arrays
- SLM & adaptive components
- diffractive beam splitters
- scatterer
- waveguides & fibers
- free space
- nonlinear components
- crystals & anisotropic components

# idealized component
### Document Information

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- **Further Reading**
  - [Stratified Media Component](#)
  - [Channel Setting for Non-Sequential Tracing](#)
  - [Laser-Based Michelson Interferometer and Interference Fringe Exploration](#)
  - [Mach-Zehnder Interferometer](#)