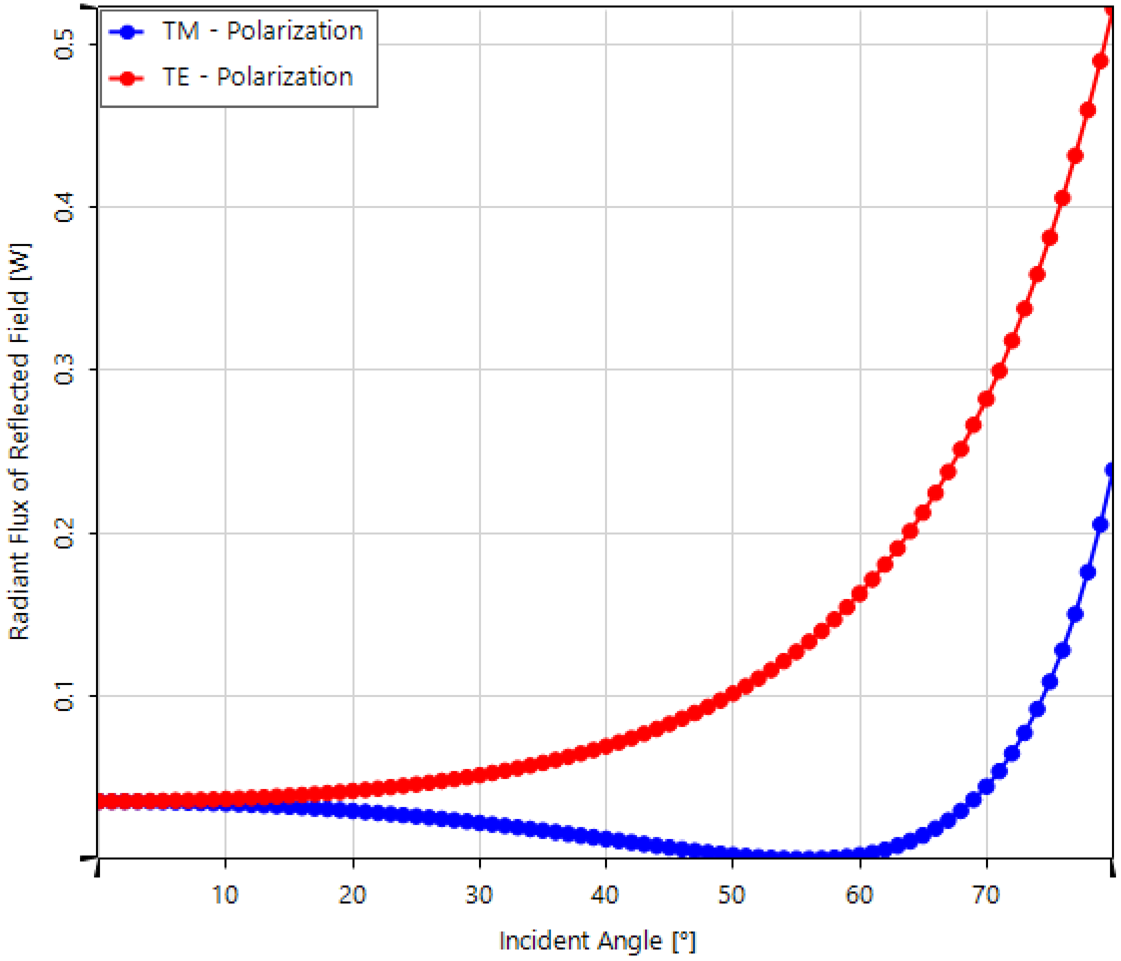
Polarization and Angle-Dependent Transmittance and Reflectance at a Plane Interface

Abstract



The Fresnel effect, which describes the behavior of transmittance and reflectance of light at an optical transition between two media, was one of the first historical observations to understand the vectorial nature of light. The deduced Fresnel equations enable to calculate the amount of energy being reflected or transmitted at such a material interface, depending on the polarization state and the angle of incidence of the impinging light. As a physical-optics based software, VirtualLab Fusion offers multiple tools to evaluate this, also for modern optics, crucial effect, such as the *Fresnel Effect Calculator* to calculate the Fresnel coefficients directly and the *Universal Detector* that measures the radiant flux of the transmitted and reflected light in an optical system.

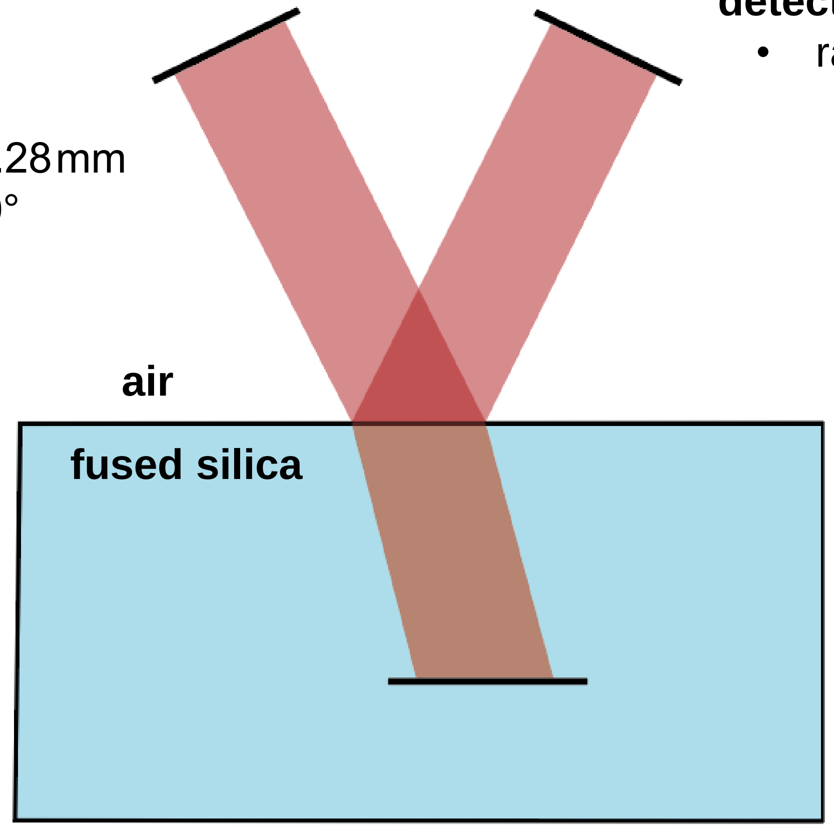
Task Description

plane wave (input)

- wavelength 532 nm
- TE/TM polarization
- diameter 1.28 mm × 1.28 mm
- incident angle: 0°- 80°
- power: 1 W

detector (reflection):

- radiant flux



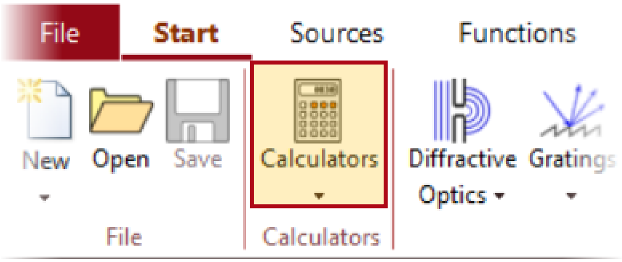
detector (transmission):

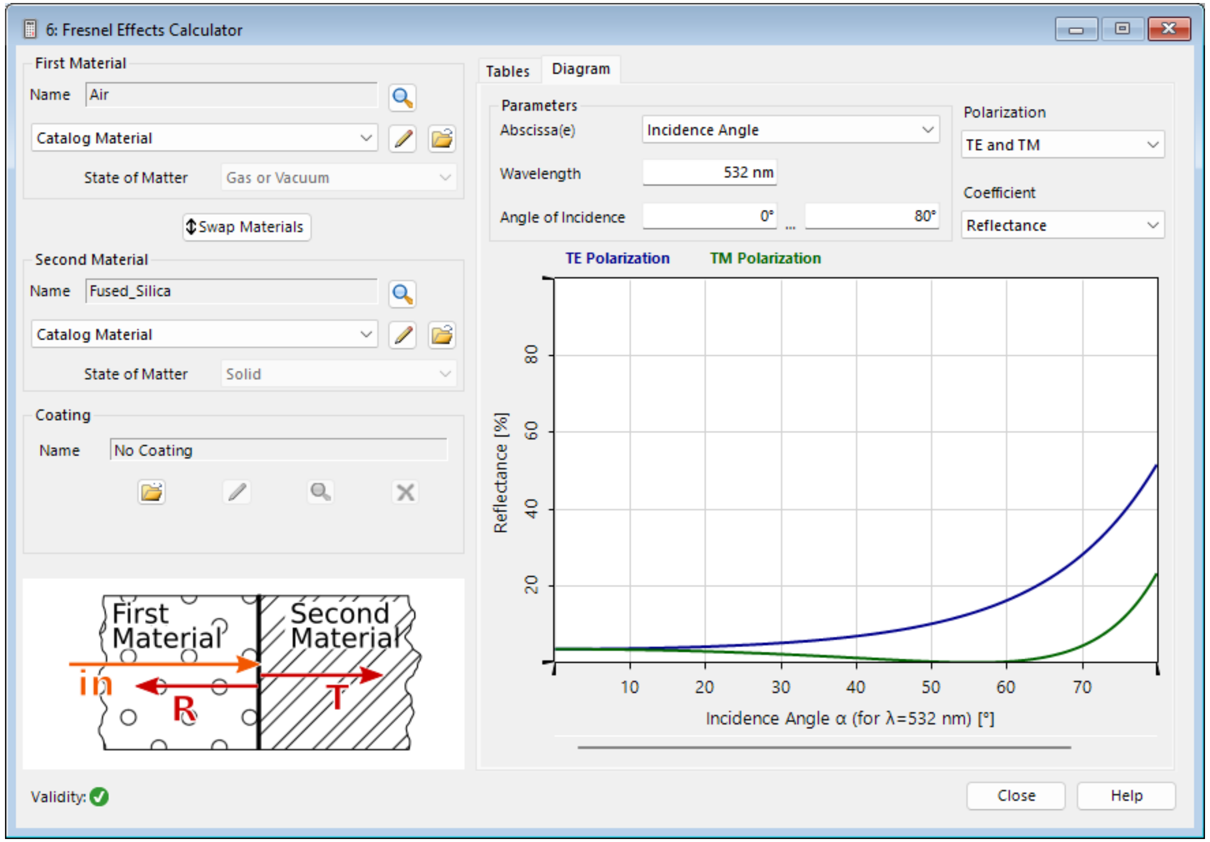
- radiant flux

Fresnel Effects Calculator

In order to assess the transmittance and reflectance upon an interface of two optical media, VirtualLab Fusion provides the *Fresnel Effect Calculator* found in the *Calculators* section of *Start* ribbon.

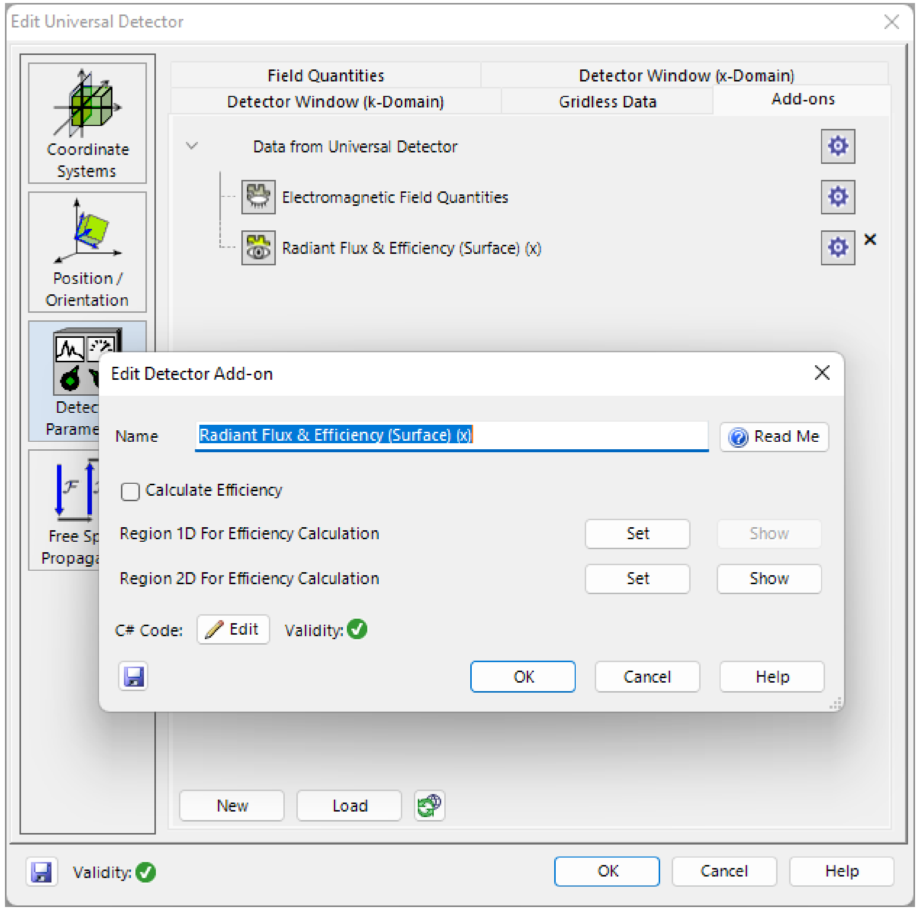
This calculator is based on the Fresnel equations and visualizes the curves of transmittance and reflectance over wavelength or angle of incidence. The material transition can be defined by materials provided in the catalog or by manually entered indices of refraction. Moreover, a coating, which can comprise multiple layers, can be added to the interface.

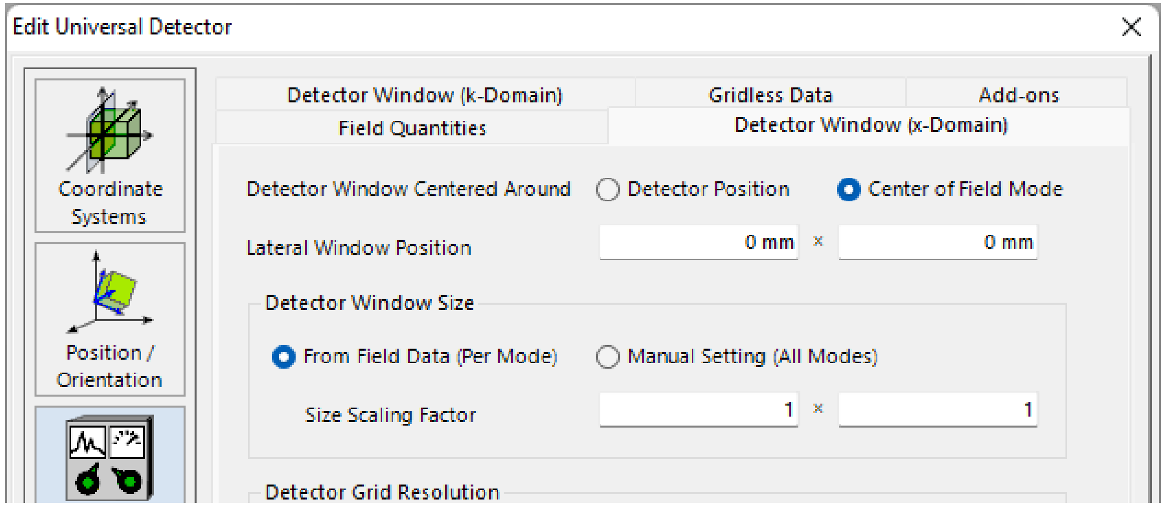


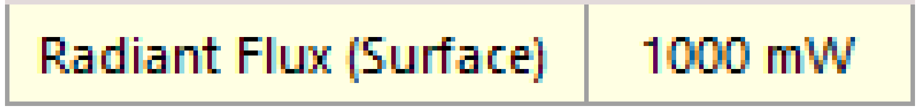


Universal Detector & Detector Add-ons

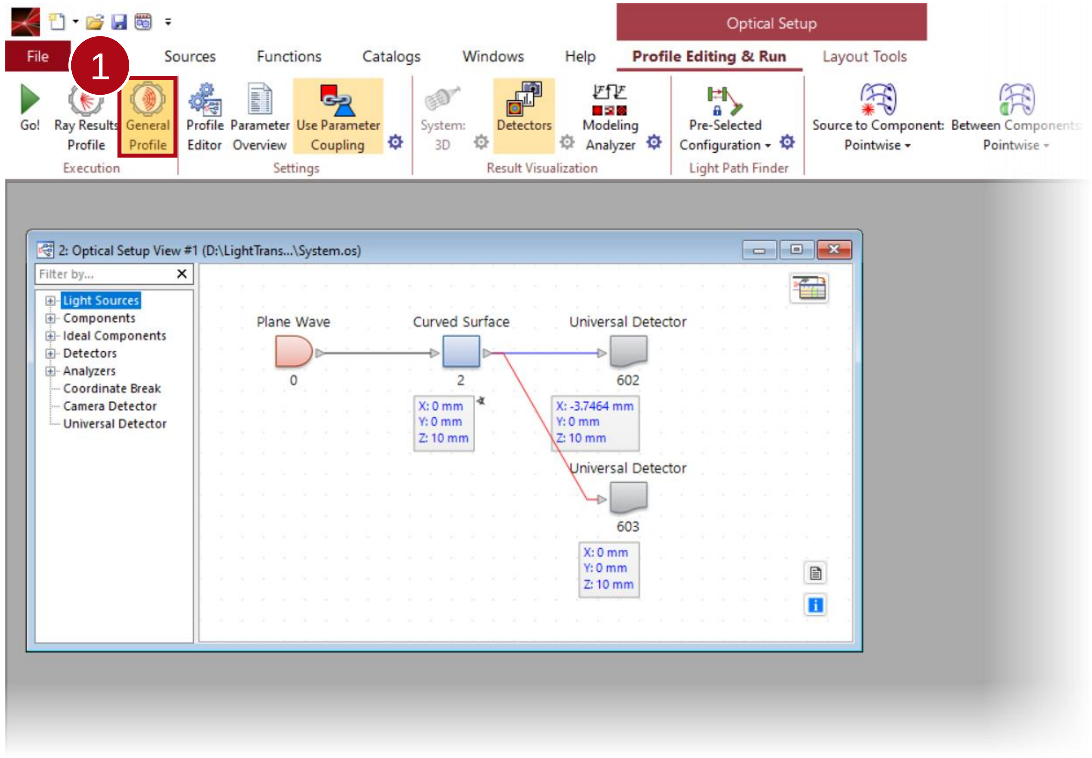
The *Universal Detector* allows to evaluate the impinging field and to calculate various physical quantities by using so-called *Add-ons*. One of the provided *Add-ons* enables to assess the radiant flux in space domain. The detectors size and position can also be specified manually or set to center around the impinging field. For more information, see: Universal Detector

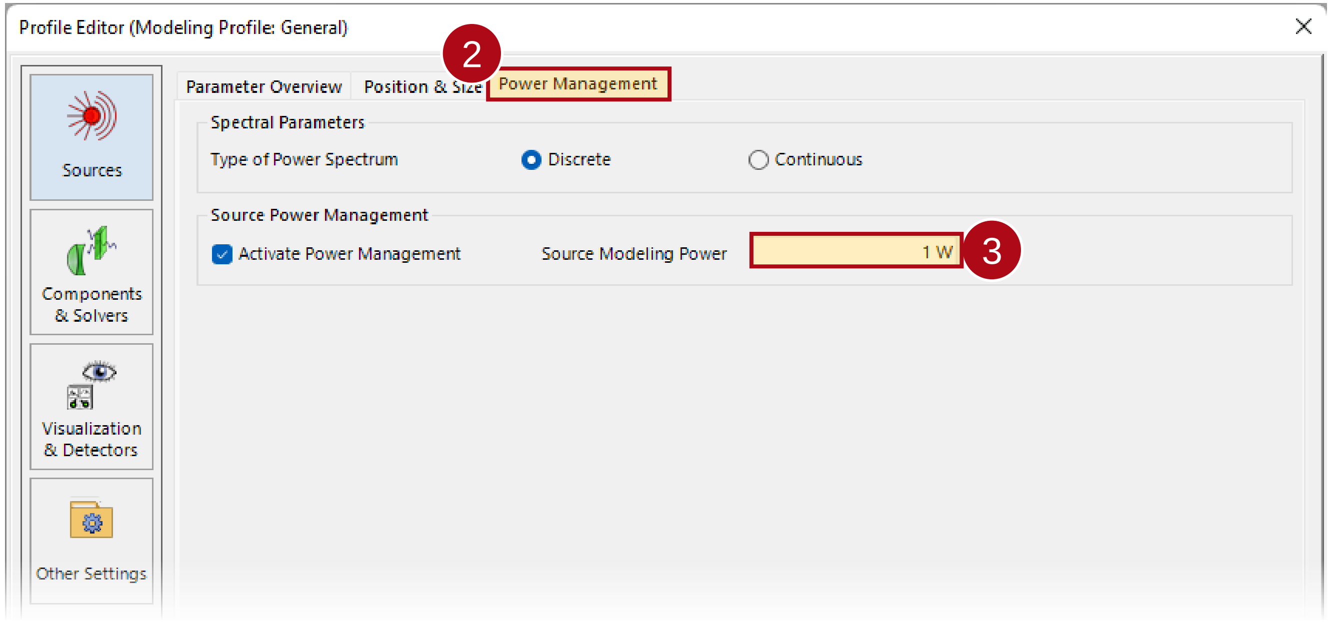






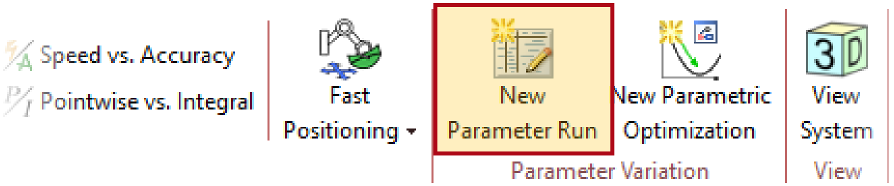
Power Management

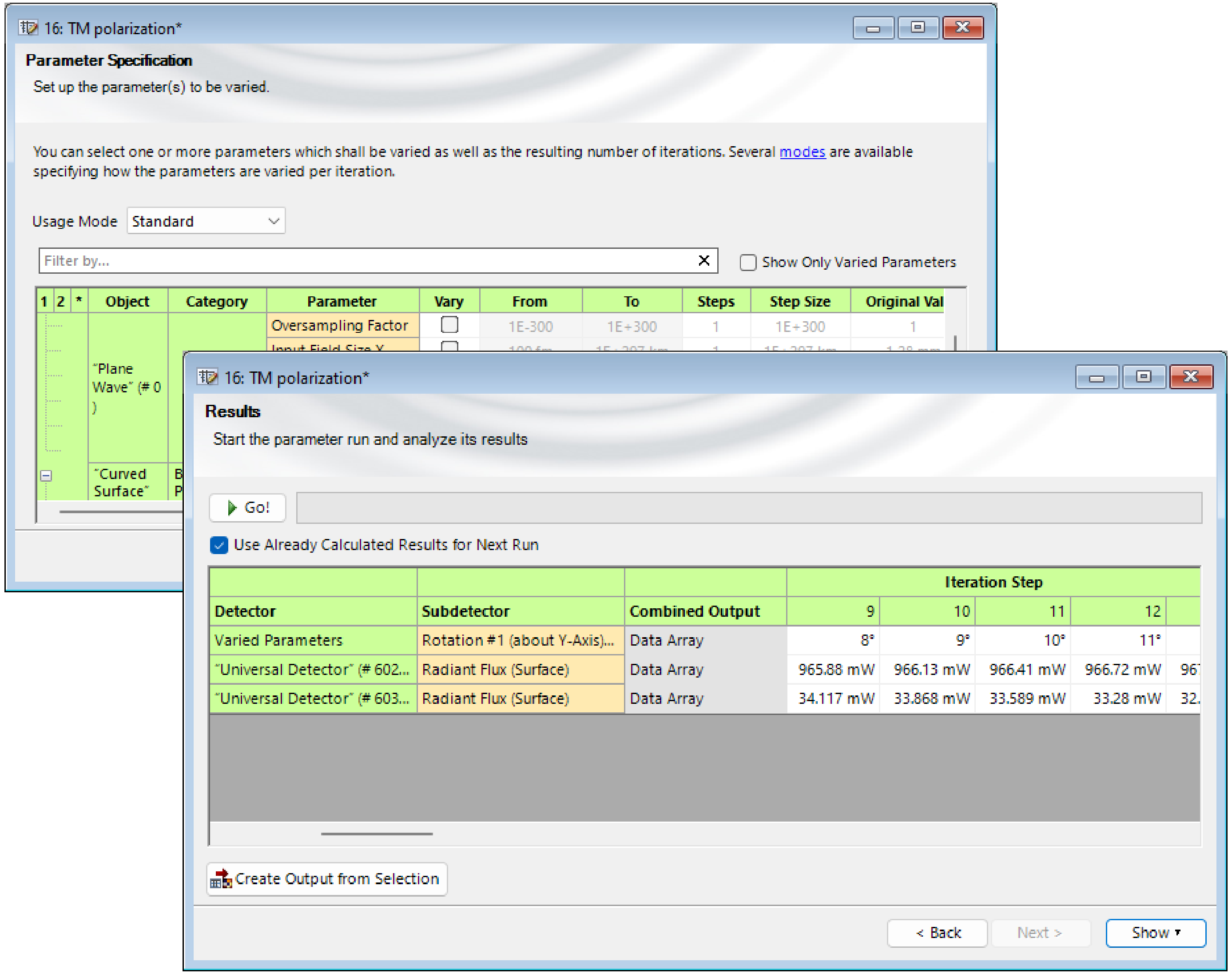




In VirtualLab Fusion any source can be configured with a desired emitting power (*Source Modeling Power*). Physically, the power of the source is defined as the flux of light through the aperture of the source (measured directly behind the source). The corresponding amplitude of the electromagnetic field emitted by the source will be adjusted accordingly.

Parameter Run



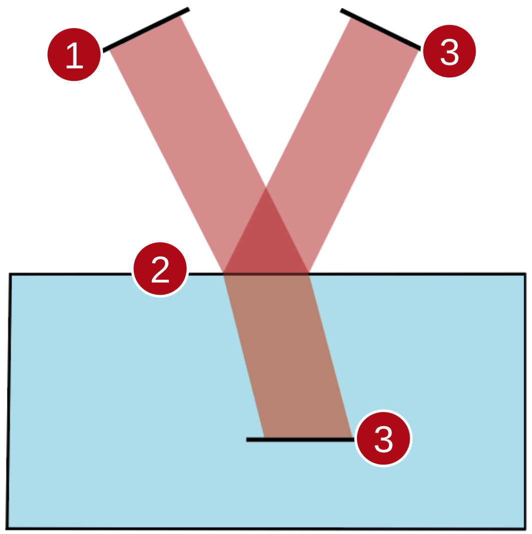


The *Parameter Run* feature can be used to show the dependence of the result on certain parameters of the system. In this use case ,the radiant flux of the transmitted and reflected wave depending is measured as function of angle of incidence (measured with respect to the interface normal).

More information about the *Parameter run* under:

[Usage of the Parameter Run Document]

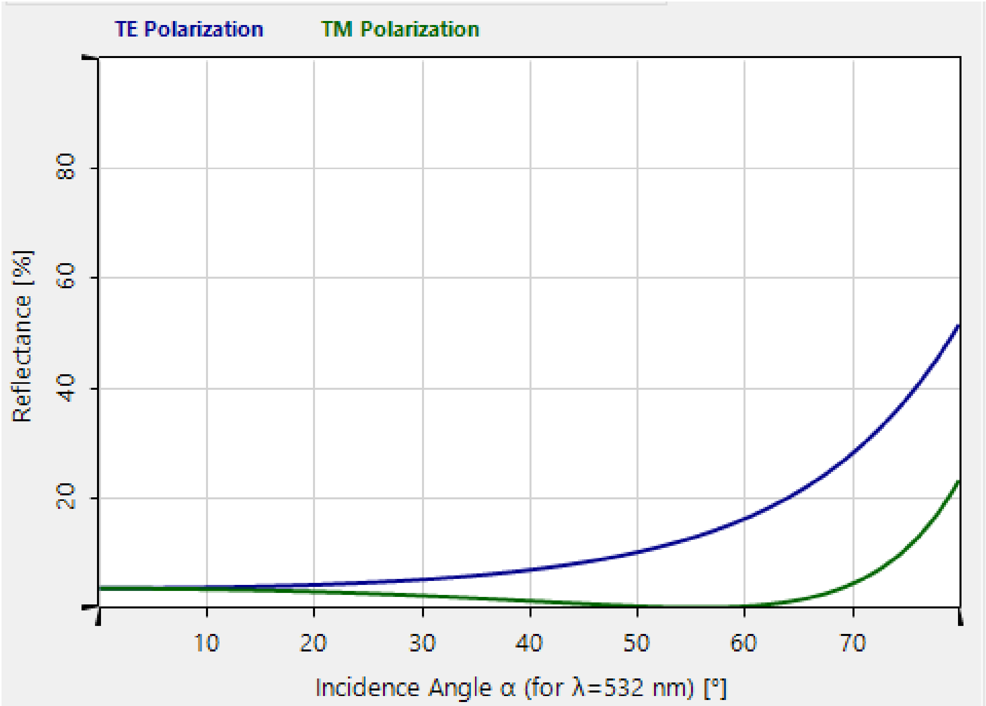
Summary – Components...



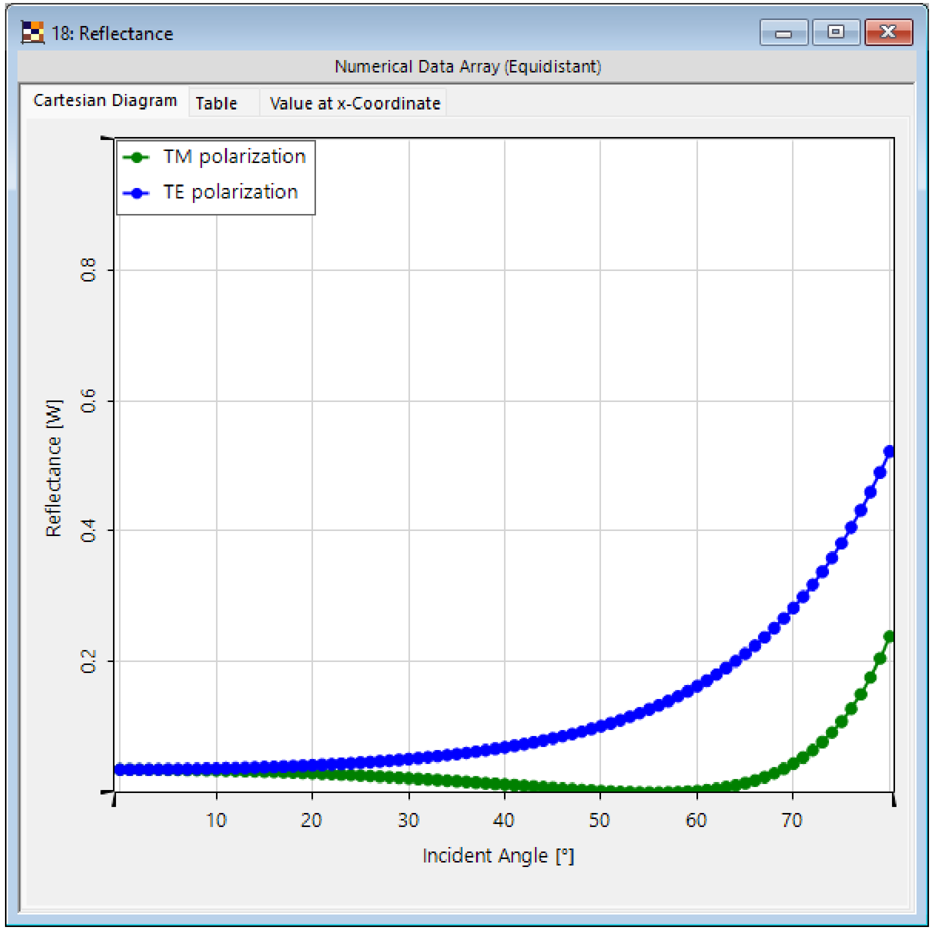
… of Optical System	… in VirtualLab Fusion	Model/Solver/Detected Magnitude
1. source	*Plane Wave*	truncated Ideal Plane Wave
2. surface	*Curved Surface Component*	Local Plane Interface Approximation (LPIA)
3. detector	*Universal Detector* with *Radiant Flux (Surface) Add-on*	Radiant Flux

Result: Reflectance for TE and TM polarized light

Now, the results of the reflectance determined by the Fresnel equation and the measured reflectance obtained by evaluation of the radiant flux are compared. The results show a perfect agreement, as well as exhibiting the expected dependencies.



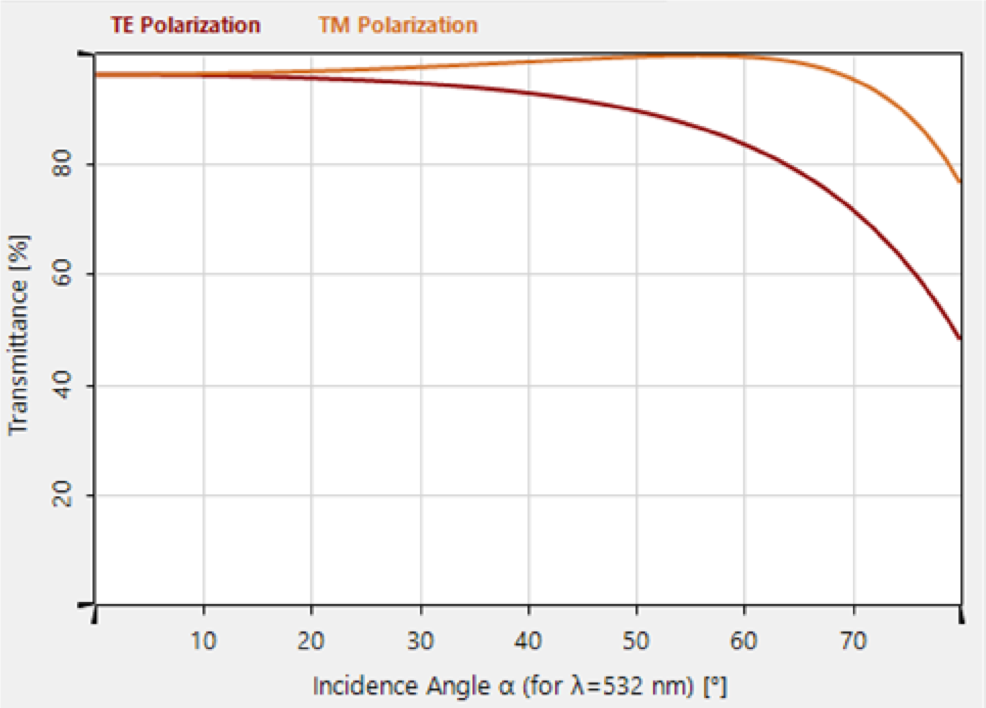
result of the calculator



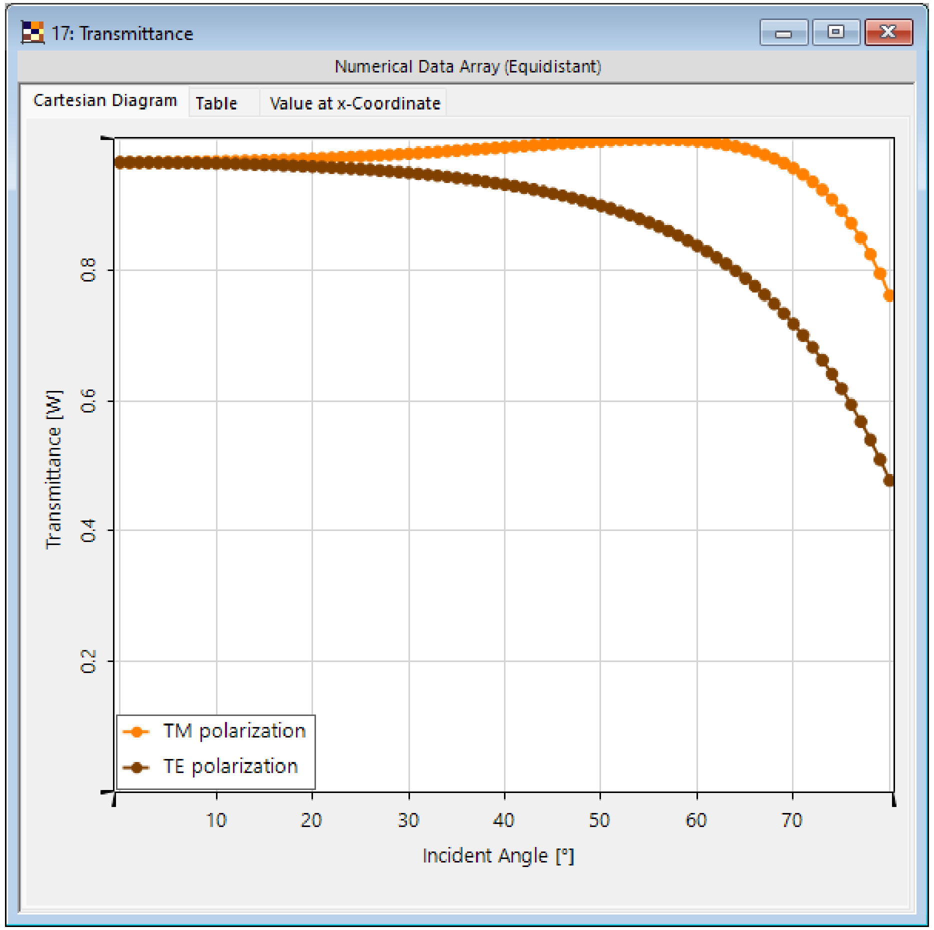
measured reflectance by radiant flux evaluation

Result: Transmittance for TE and TM polarized light

Here, the results of the transmittance stated by the Fresnel equation and the measured values obtained by evaluation of the radiant flux are compared. Again, the results are identical, and show the expected characteristics.

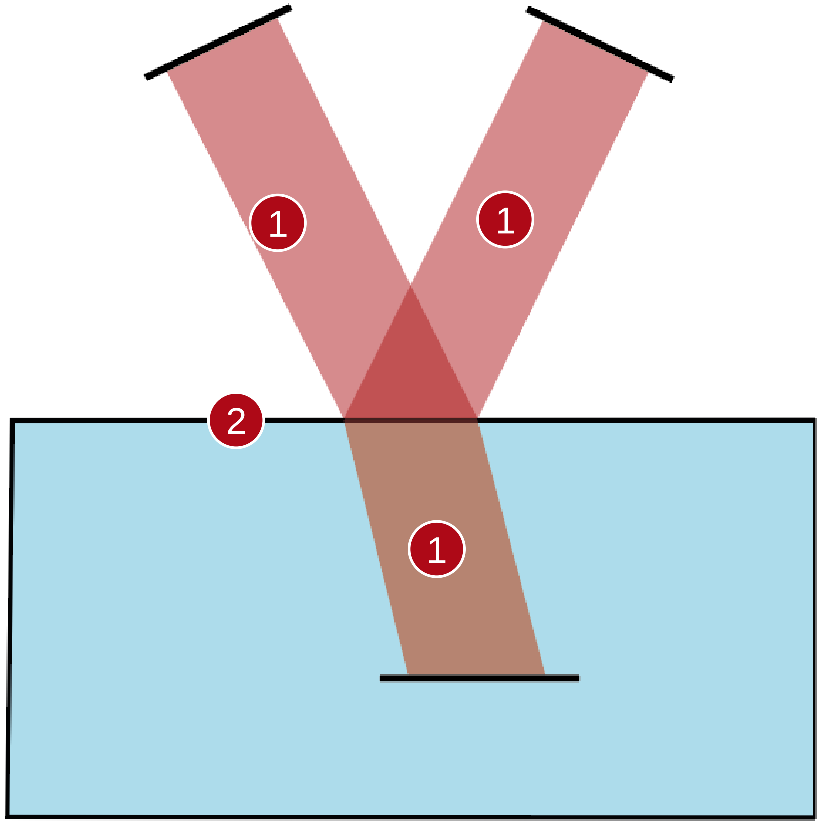


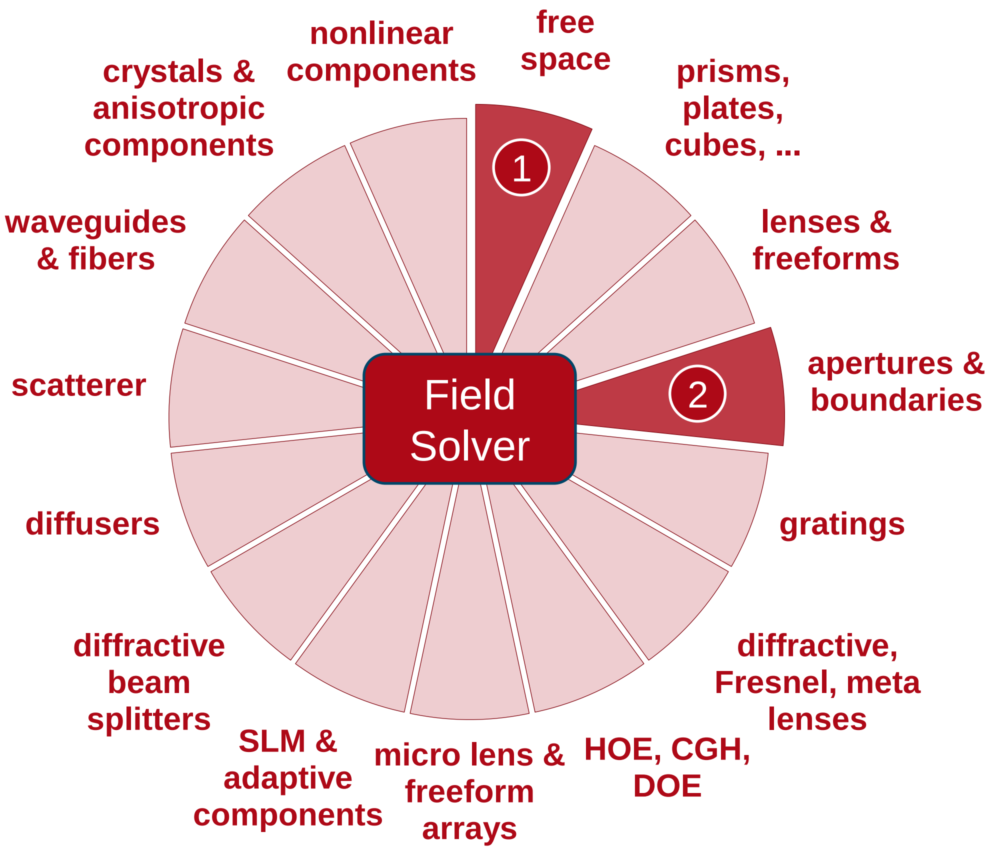
result of the calculator



measured transmittance by radiant flux evaluation

VirtualLab Fusion Technologies





Document Information

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