VirtualLab Fusion 2021.1 – Release Notes

Overview of Features and Changes

General Information

Version	2021.1 (Build 1.180)
Update Service	2nd quarter of 2021 is required.
Install Type	Installation (It is not necessary to uninstall previous versions of VirtualLab Fusion)

New Applications and Features in VirtualLab Fusion 2021.1

The new version 2021.1 provides our users with solutions for more applications:

- A new **Microlens Array (MLA) Component** enables accurate and fast modeling of the ever-increasing number of applications of MLA.
- Any type of crystals can be included in system modeling by the new **Crystal Plate Component.**
- **Anisotropic layers** can be added to all surfaces to exploit the extra freedom of polarization control and multiplexing in optical systems.
- We provide a **Fiber Mode Calculator** to analyze and investigate LP Bessel and LP Laguerre modes for step index and parabolic index fibers.
- LP modes are also used in the new **Multimode Fiber Coupling Efficiency Detector**, which evaluates the overlap integral of the incident beam with the LP modes.
- The new **LP Mode Source** allows the propagation of LP modes through any optical system.
- With the new **Multiple Source Component,** we make the first step to significantly extend the source modeling in VirtualLab Fusion by enabling the use of different and shifted sources.
- In version 2021.1 we come with a new workflow which enables a **seamless transition from ray to full physical-optics modeling**. This way we simplify the usage of the amazing modeling features in VirtualLab Fusion.

Linearly-Polarized (LP) Fiber Modes

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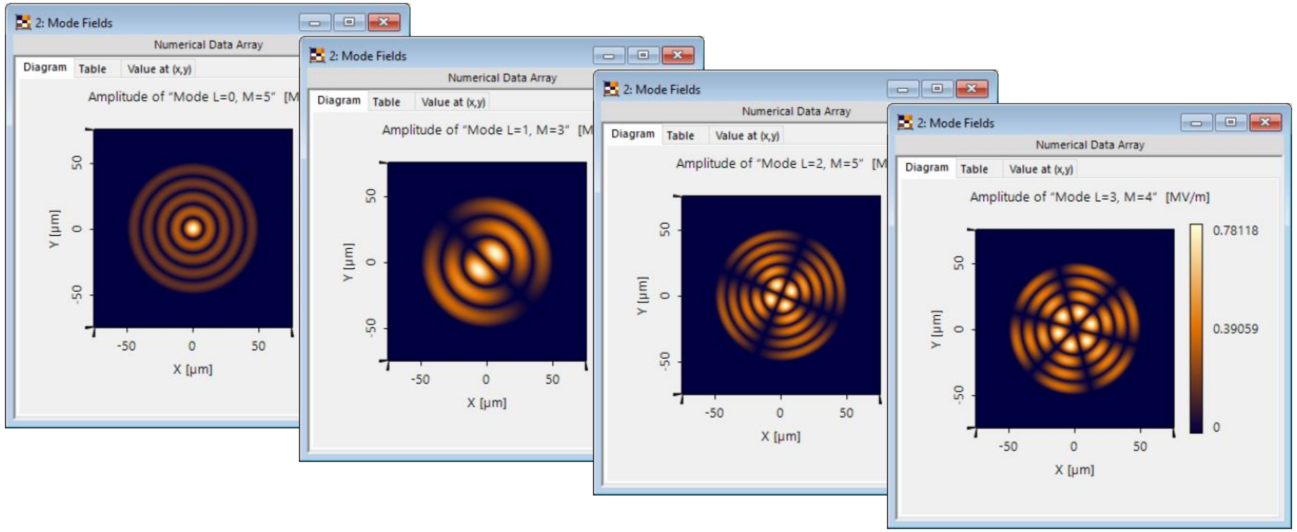
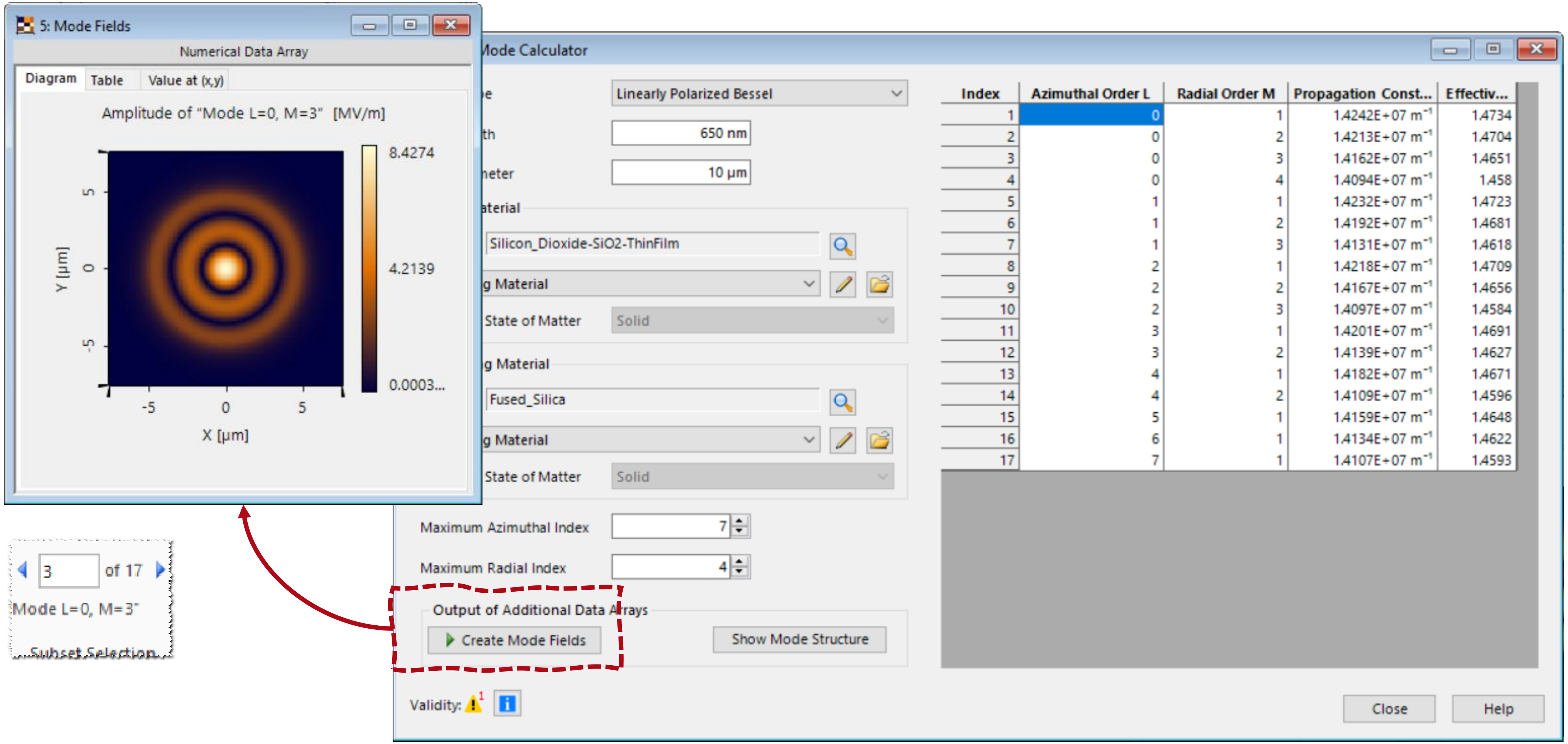
- The new **LP Mode Source** allows the propagation of LP modes through any optical system.

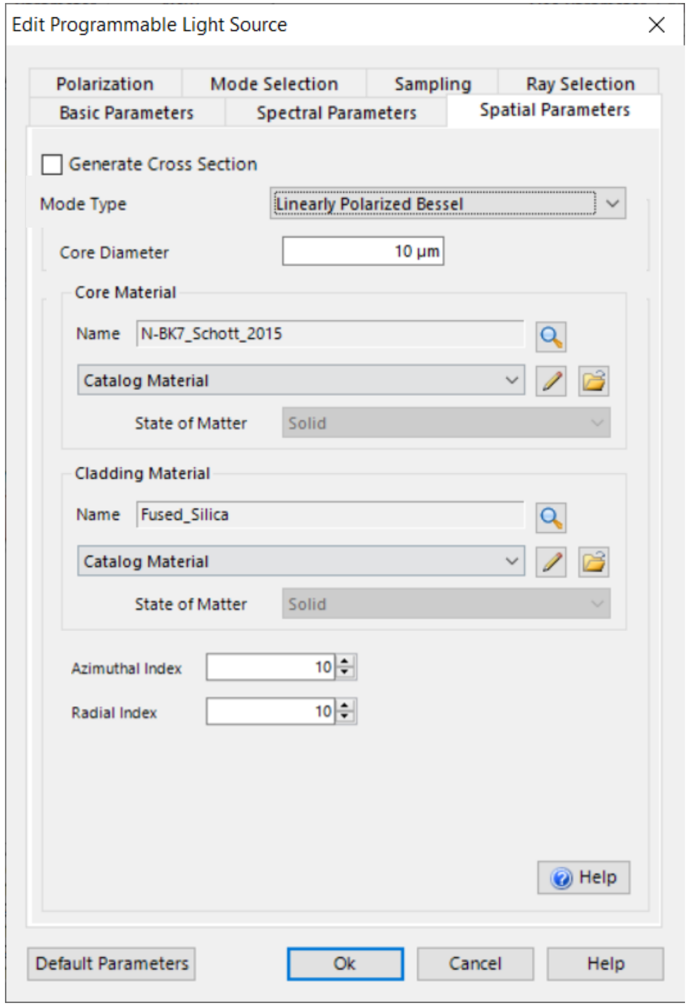


Fiber Mode Calculator



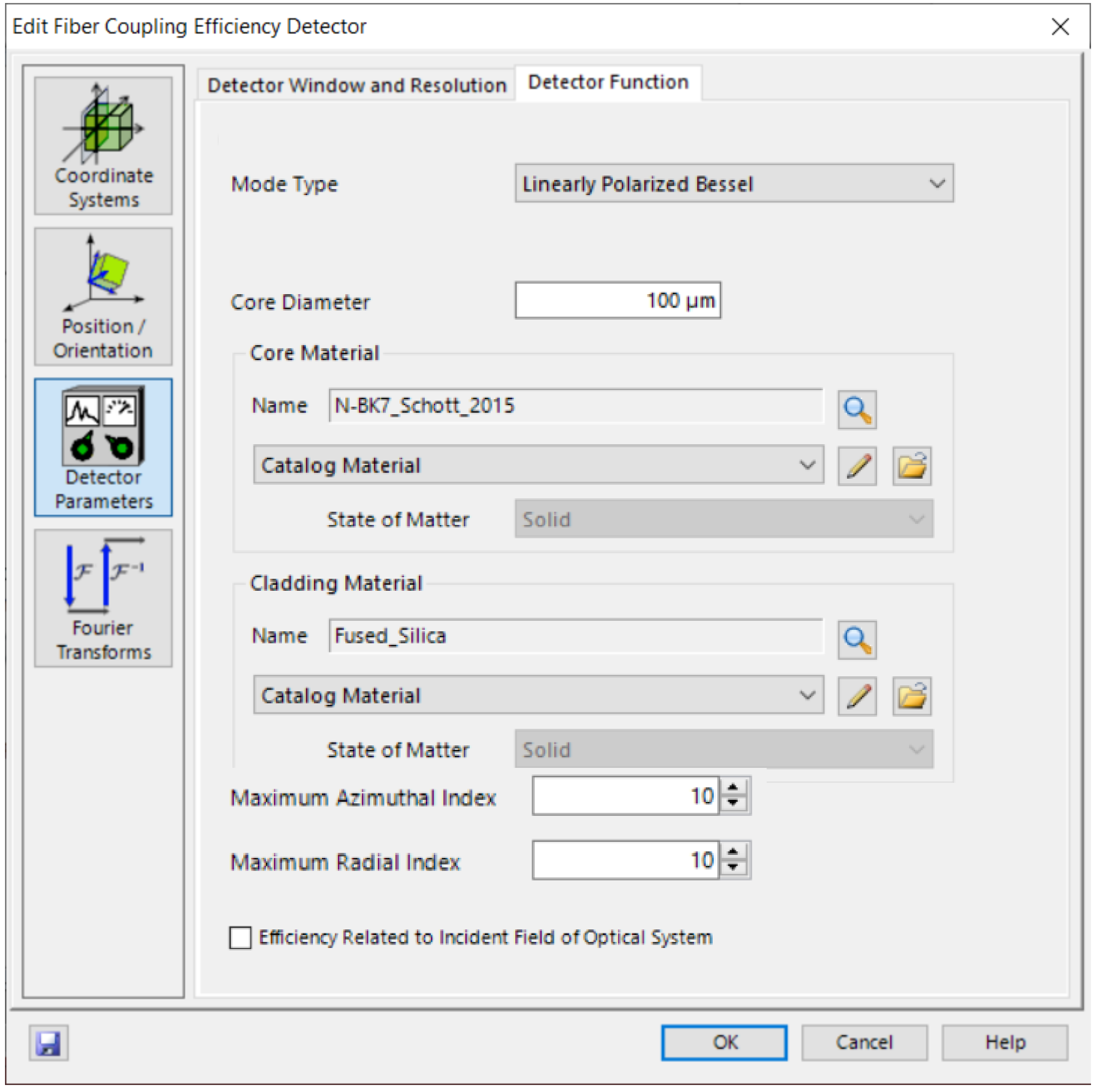
LP Mode Source

- Single fiber mode can be generated, after users set
  - the working wavelength, and
  - the fiber structure
    - step-index fiber
      - core diameter $2\rho_0$
      - core material
      - cladding material
    - graded-index fiber
      - core diameter $2\rho_0$
      - core material
      - gradiant constant Δ



Multimode Fiber Coupling Efficiency Detector

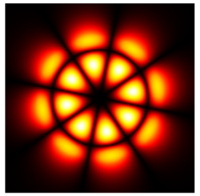
- Coupling efficiency can be calculated, after users configure the fiber structure
  - step-index fiber
    - core diameter $2\rho_0$
    - core material
    - cladding material
  - graded-index fiber
    - core diameter $2\rho_0$
    - core material
    - gradiant constant Δ



Linearly-Polarized (LP) Fiber Mode Solver – Related Use Cases

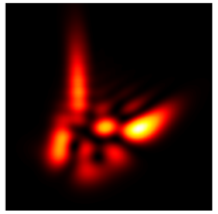
- LP Fiber Mode Calculator
- Investigation Aberration Effects on LP Fiber Modes in Focal Region
- Few-Mode Fiber Coupling under Atmospheric Turbulence

Fiber Mode Calculator



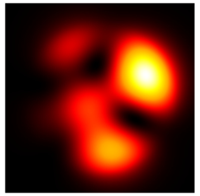
The Fiber Mode Calculator can be used to calculate linearly polarized (LP) propagation modes in a cylindrically symmetric fiber, either step-index with a single core or graded-index with an infinite parabolic profile. The corresponding polynomials to describe these modes are Bessel for step-index fibers and Laguerre for graded-index fibers. This use case shows how to use the calculator and the configuration of the sampling parameters of mode fields.

Investigation Aberration Effects on Fiber Modes in Focal Region



Fibers are widely used as sources in optical systems. Investigating the effects of the aberrations of the optical system on the propagation of the fiber modes is therefore worthwhile. In this use case, we employ a specific fiber, either step- or graded-index, as a source to generate a couple of propagating modes, and evaluate the diffraction pattern after the propagation of said modes through an aberrated optical system.

Few-Mode Fiber Coupling under Atmospheric Turbulence

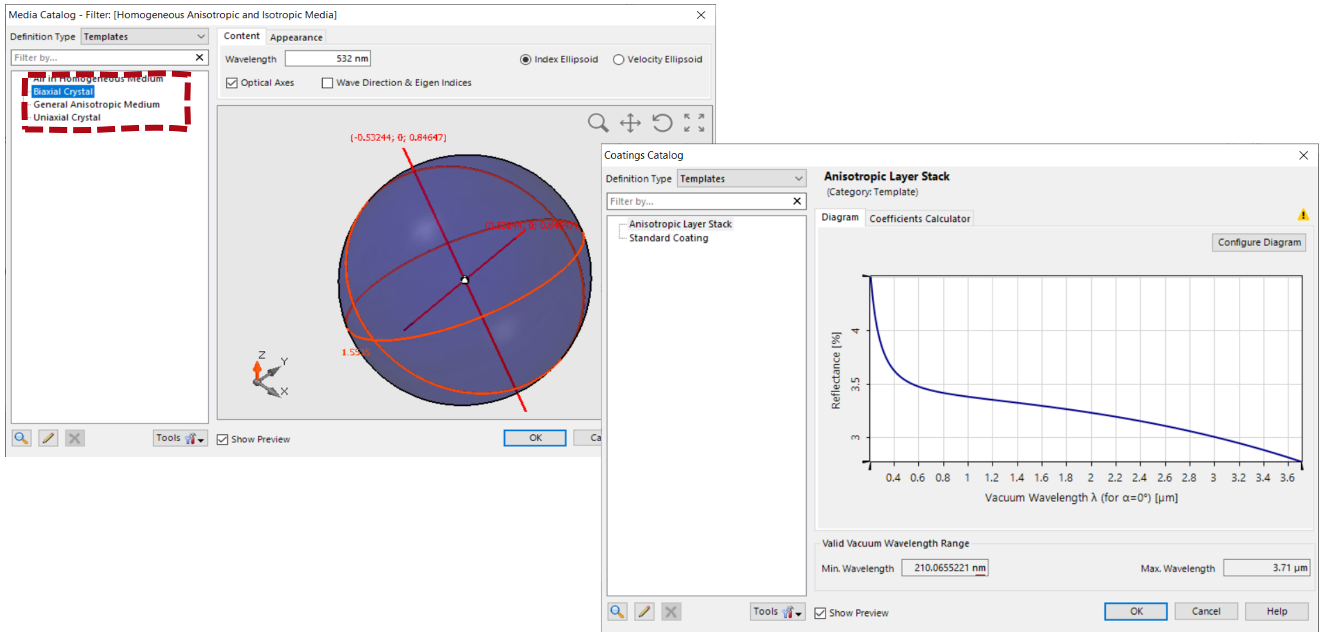


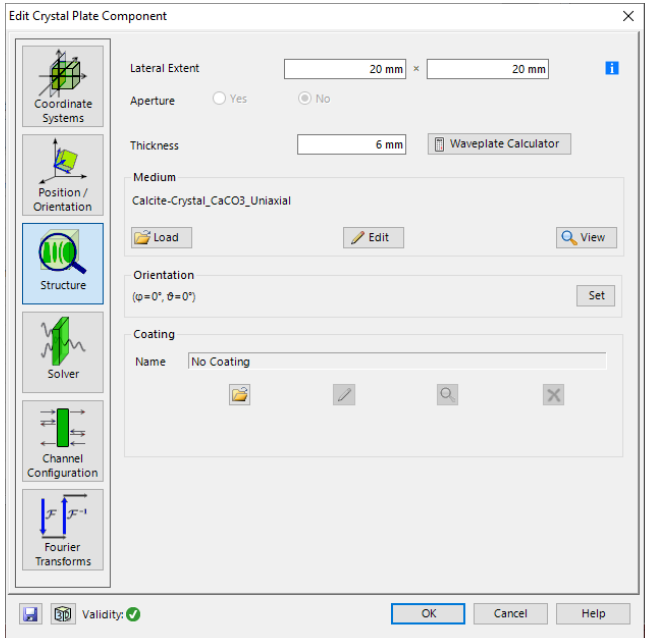
Free-space optical communication uses free space as a medium between transceivers, e.g., fibers. For longer propagation distances of the optical beam in free space, the atmospheric turbulence effects cannot be ignored. In this use case, we reproduce the experiments of Zheng et al. [Opt. Express 24 (2016)] to explore the atmospheric turbulence effects on the coupling efficiency between the free-space optical beam and few-mode fibers.

Anisotropic Media & Coatings

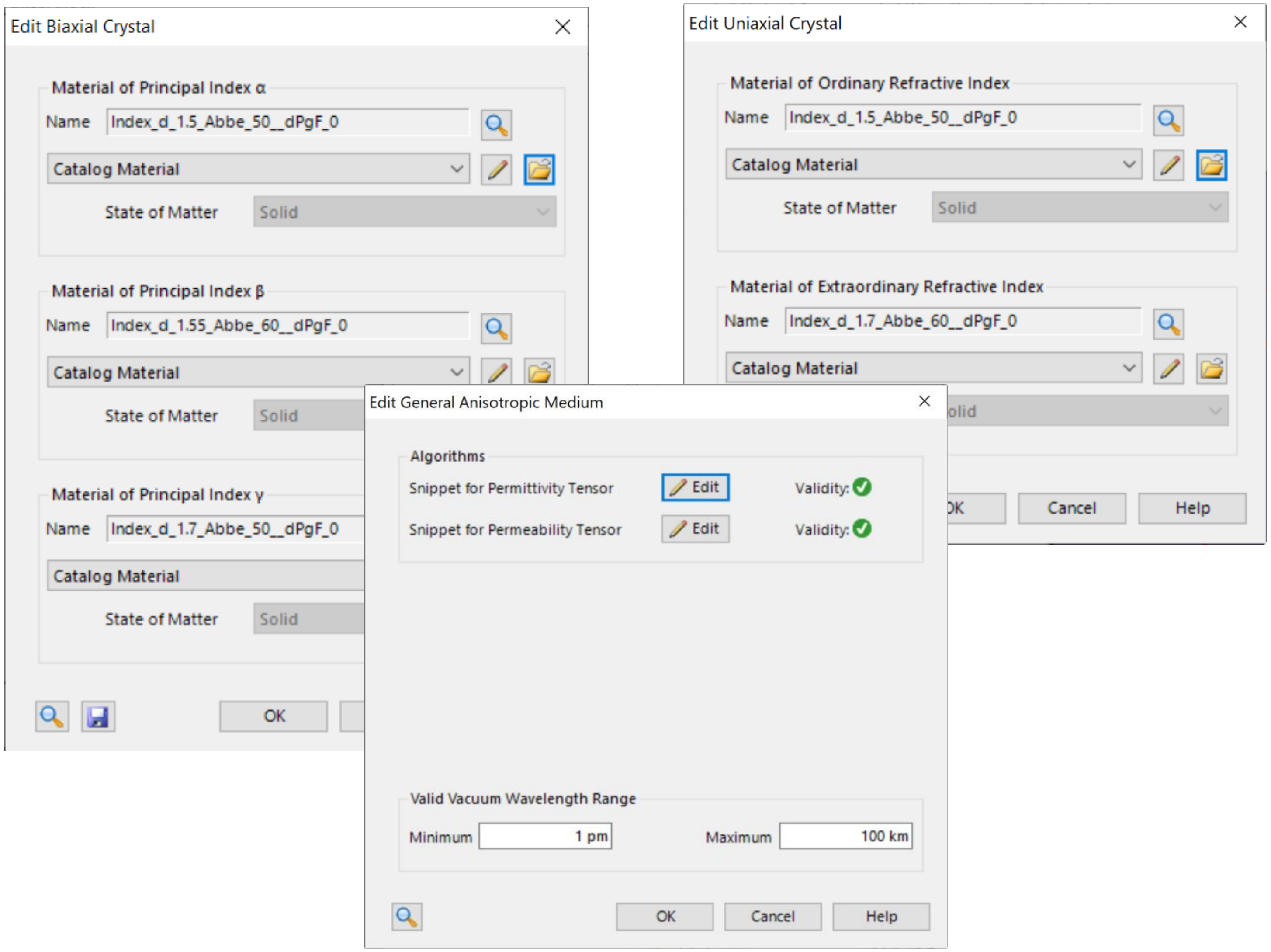
Anisotropic Media & Coatings

- Any type of crystals can be included in system modeling by the new **Crystal Plate Component.**
- **Anisotropic layers** can be added to all surfaces to exploit the extra freedom of polarization control and multiplexing in optical systems.





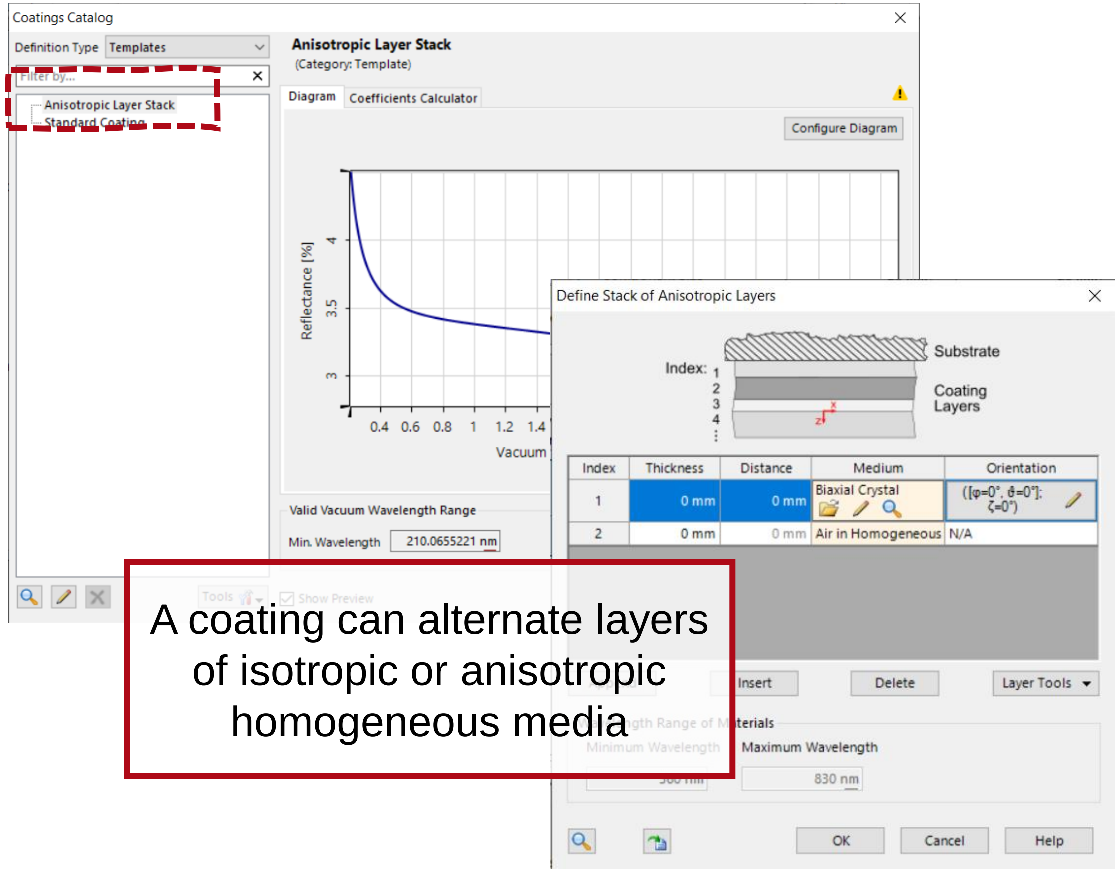
Anisotropic Media in VirtualLab Fusion



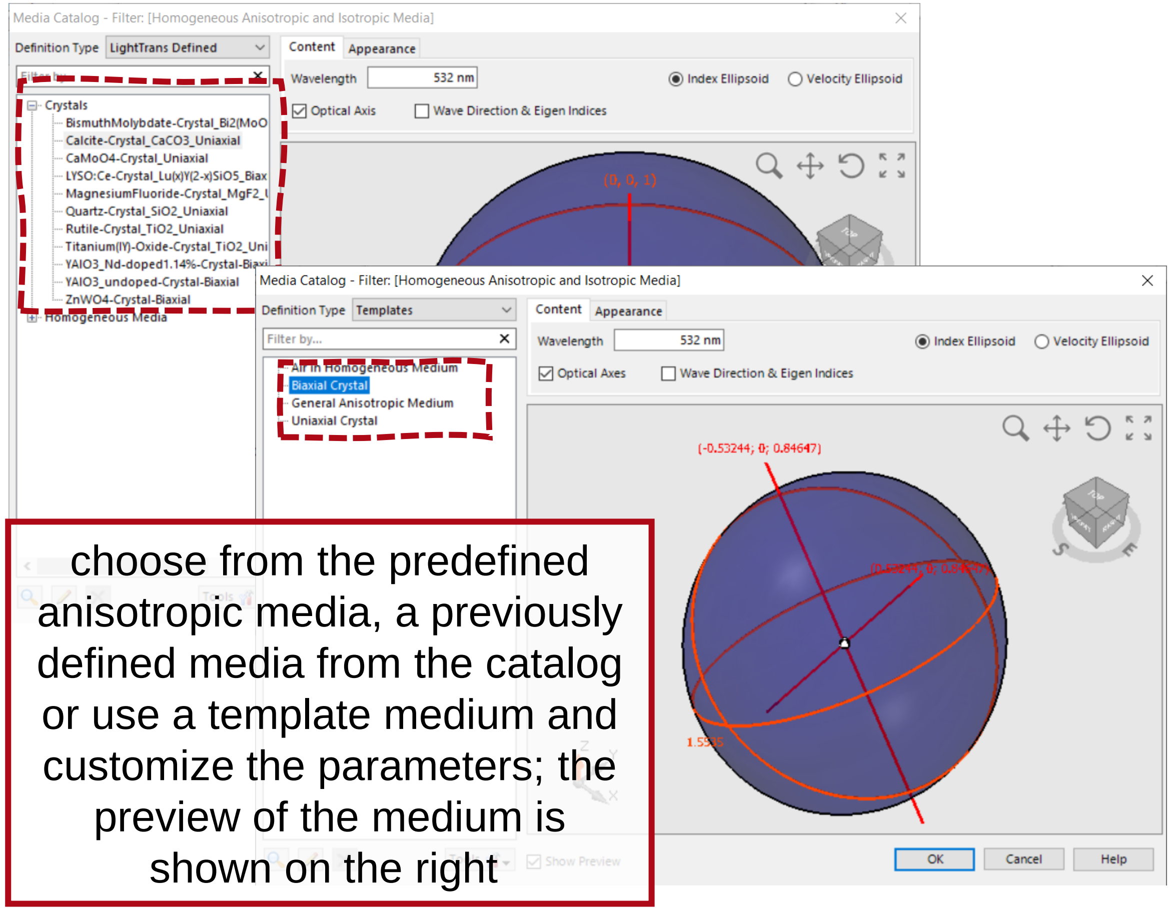
- The Biaxial Crystal is defined by the principal indices of three directions
- The Uniaxial Crystal is defined by the ordinary and extraordinary refractive indices
- General Anisotropic Media can be set up by directly defining the permittivity tensor

Anisotropic Coatings in VirtualLab Fusion

Anisotropic coatings can be found in the coating catalog and applied to all optical surfaces in VirtualLab Fusion.

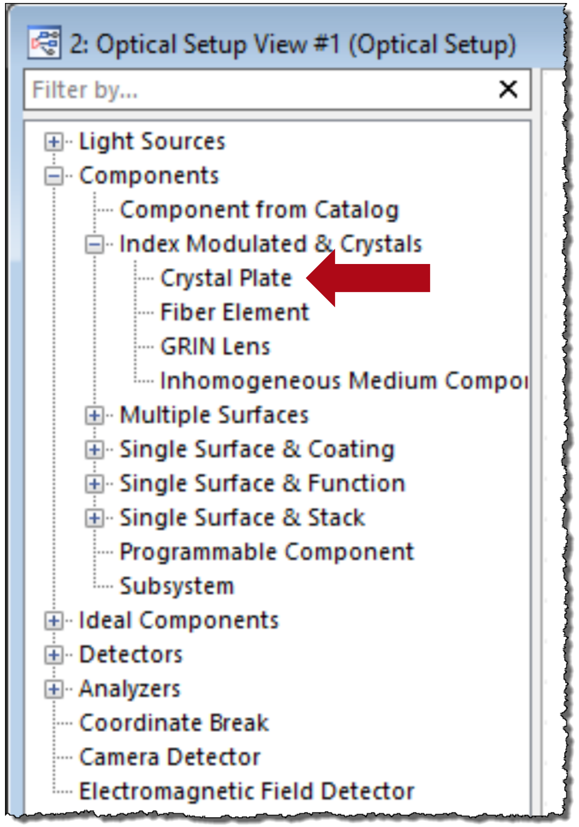


A coating can alternate layers of isotropic or anisotropic homogeneous media

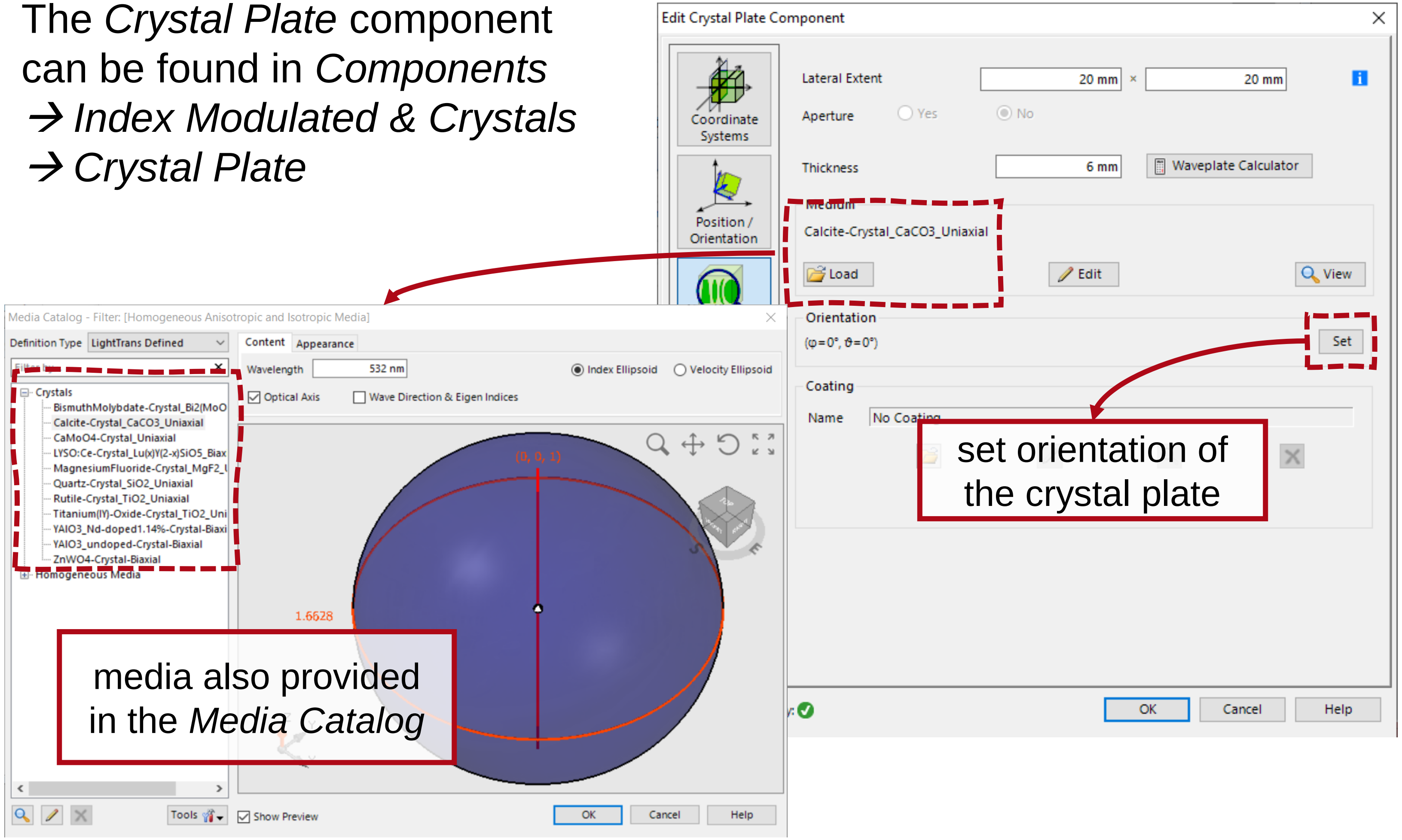


choose from the predefined anisotropic media, a previously defined media from the catalog or use a template medium and customize the parameters; the preview of the medium is shown on the right

Anisotropic Crystal Plate

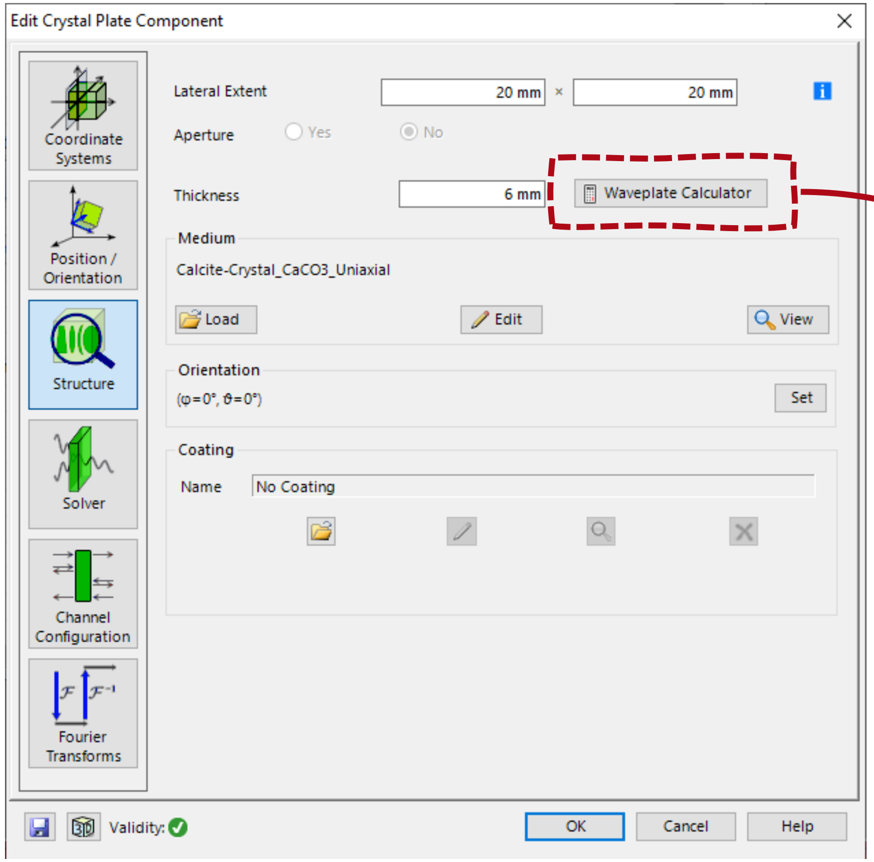


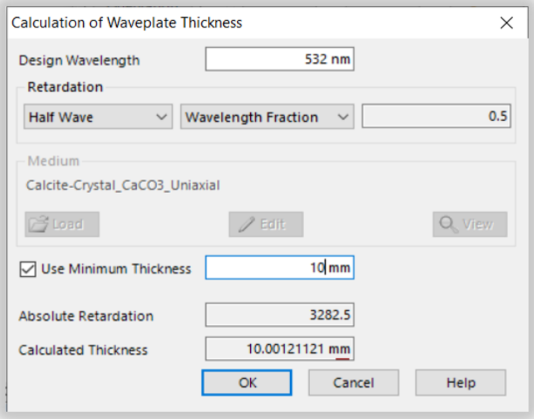
The *Crystal Plate* component can be found in *Components*
→ *Index Modulated & Crystals*
→ *Crystal Plate*

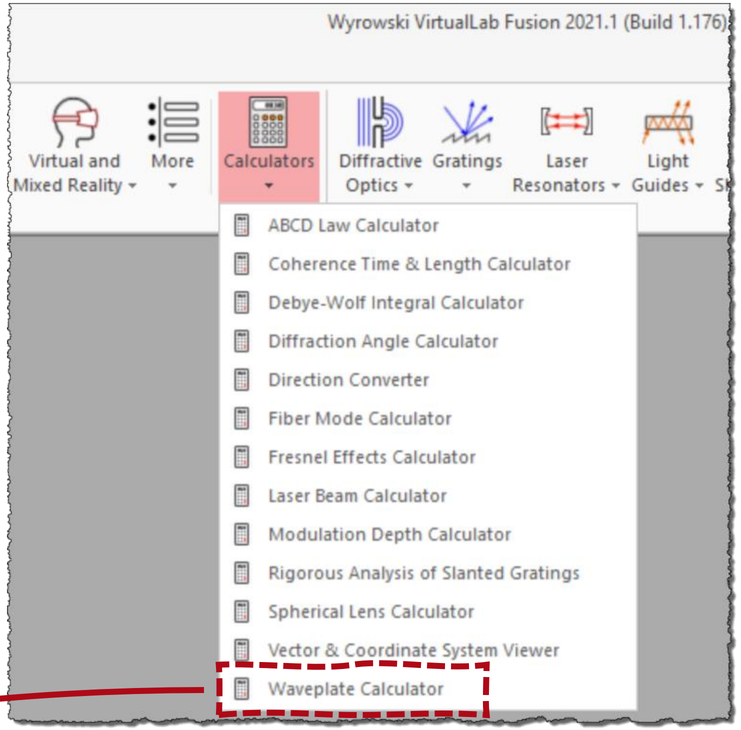


Waveplate Calculator

The *Crystal Plate Component* as well as the *Calculator* Section of the Main Window allows access to the *Waveplate Calculator* which can be used to determine the thickness and retardation of a waveplate with given characteristics.

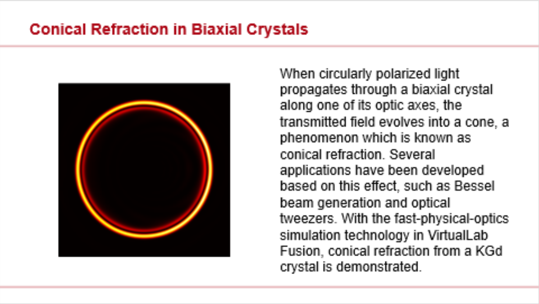




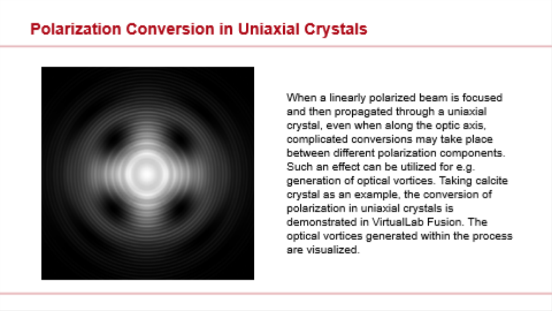


Anisotropic Media & Coatings– Related Use Cases

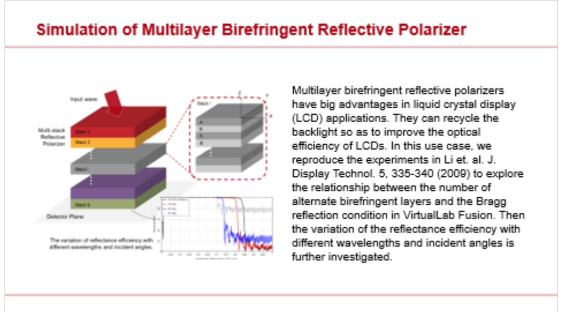
- Conical Refraction in Biaxial Crystals



- Polarization Conversion in Uniaxial Crystals



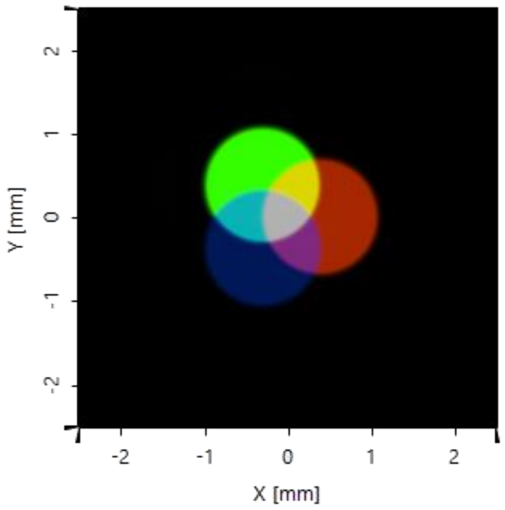
- Simulation of Multilayer Birefringent Reflective Polarizer

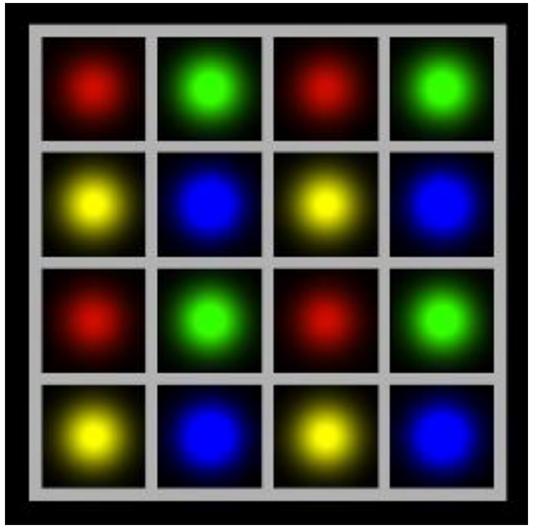


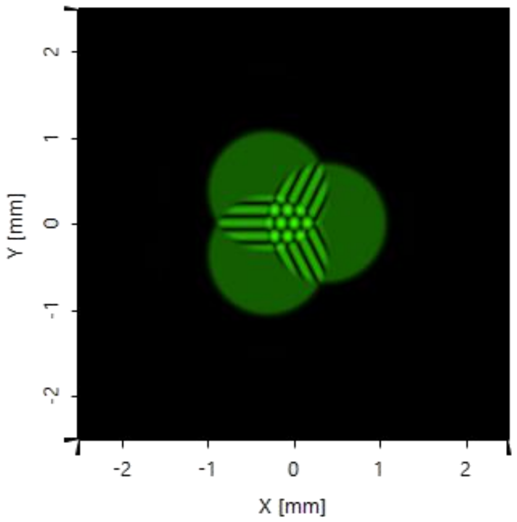
Multiple Source Component

Multiple Source Component

- With the new **Multiple Source** Component, we make the first step to significantly extend the source modeling in VirtualLab Fusion by enabling the use of different and shifted sources.

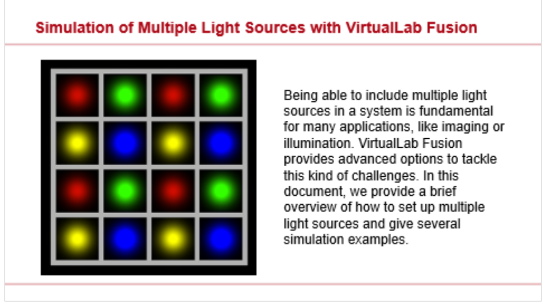




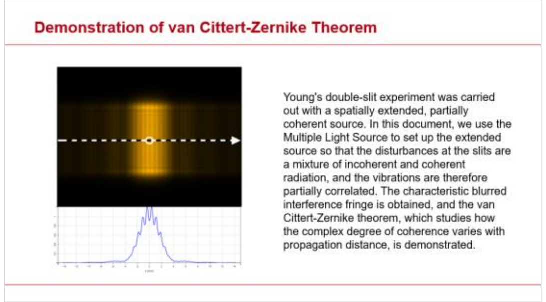


Multiple Source Component – Related Use Cases

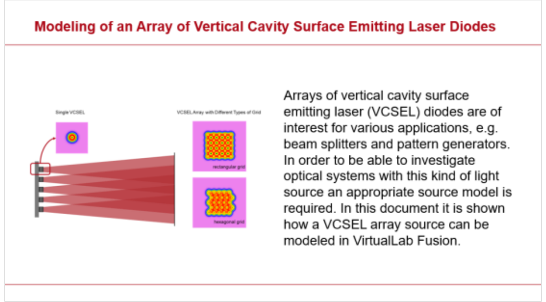
- [Simulation of Multiple Light Sources with VirtualLab Fusion]()



- [Demonstration of van Cittert-Zernike Theorem]()

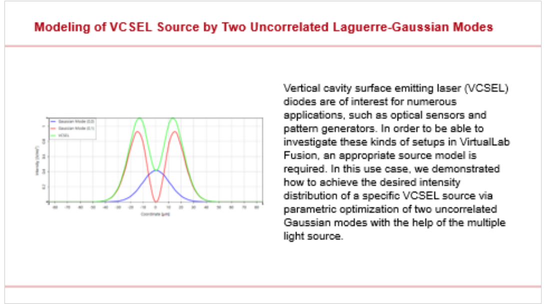


- [Modeling of an Array of Vertical Cavity Surface Emitting Laser Diodes]()



Multiple Source Component – Related Use Cases

- Modeling of VCSEL Source by Two Uncorrelated Laguerre-Gaussian Modes



Advanced Simulation of Micro Lens Array

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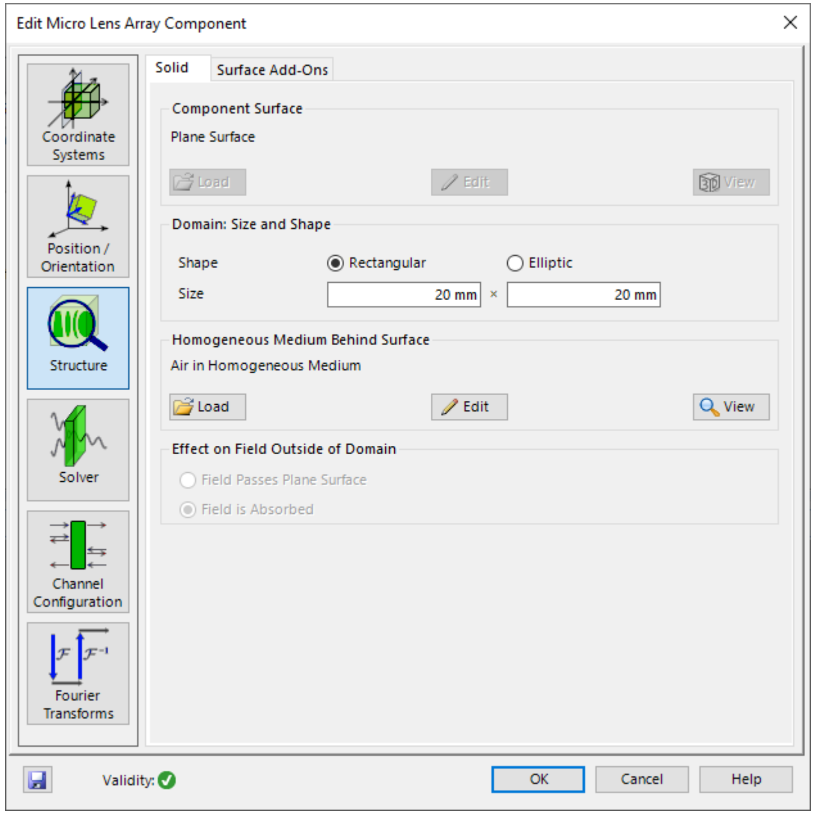
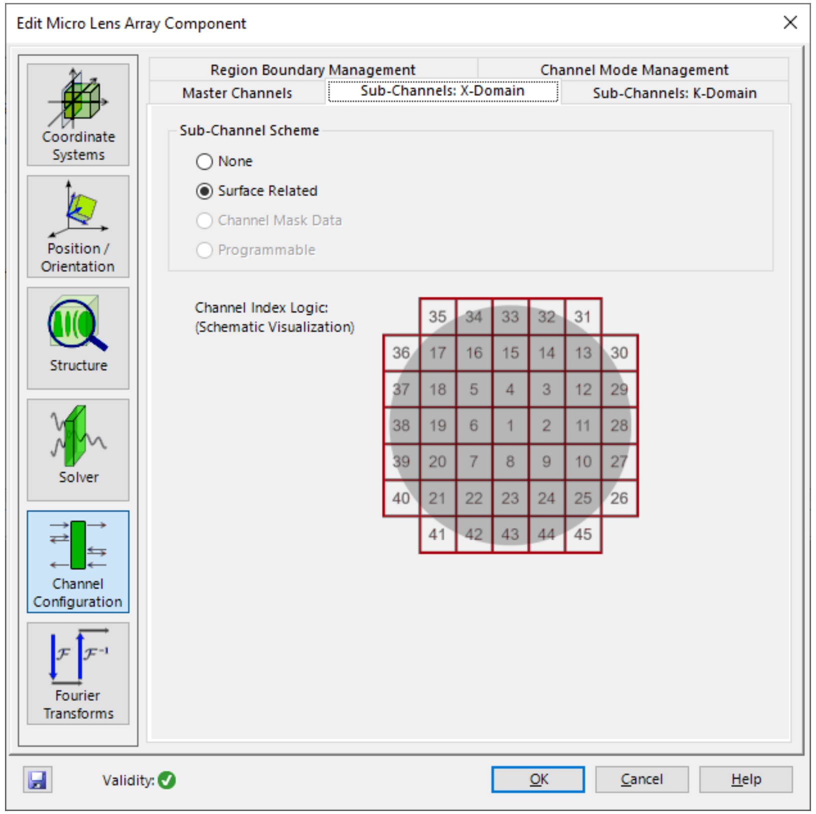
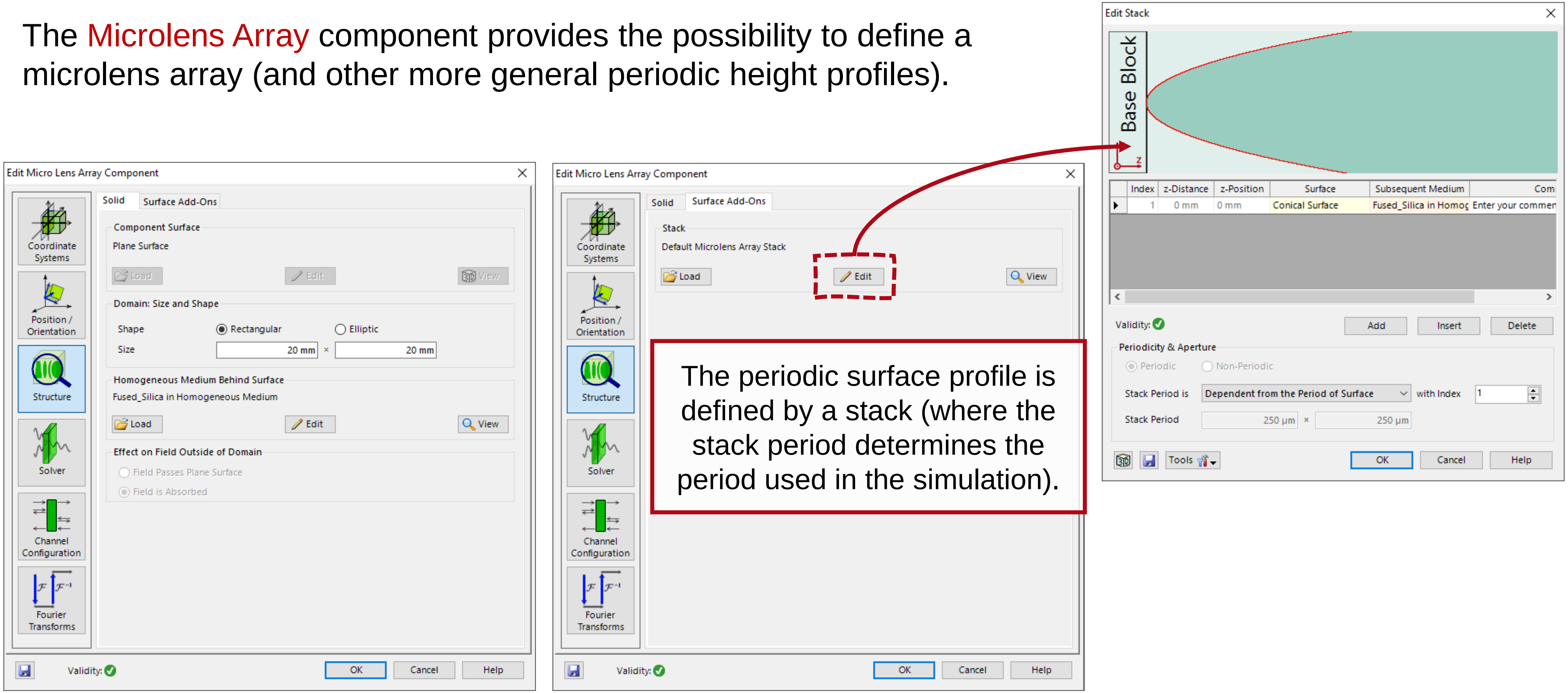
- A new **Microlens Array (MLA) Component** enables accurate and fast modeling of the ever-increasing number of applications of MLA.





Micro Lens Array - Component

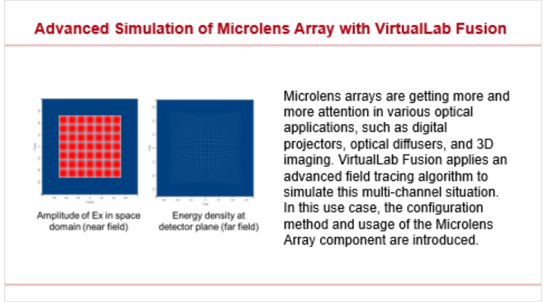
The Microlens Array component provides the possibility to define a microlens array (and other more general periodic height profiles).



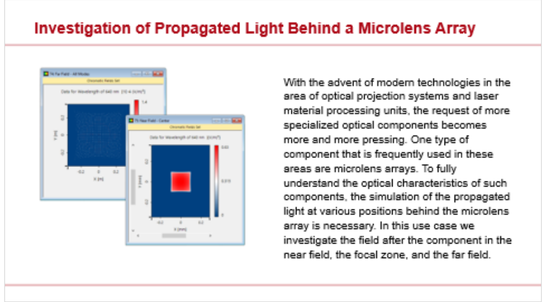
The periodic surface profile is defined by a stack (where the stack period determines the period used in the simulation).

Advanced Simulation of Micro Lens Array – Related Use Cases

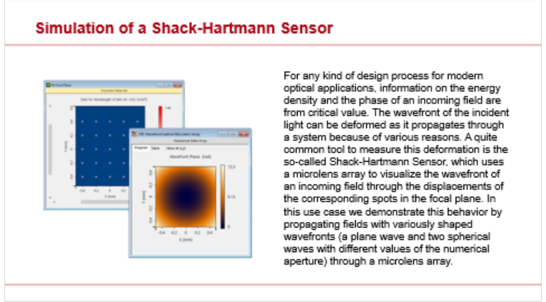
- **Advanced Simulation of Microlens Array with VirtualLab Fusion**



- **Investigation of Propagated Light Behind a Microlens Array**



- **Simulation of a Shack-Hartmann Sensor**



Modeling Workflow & Accuracy Control

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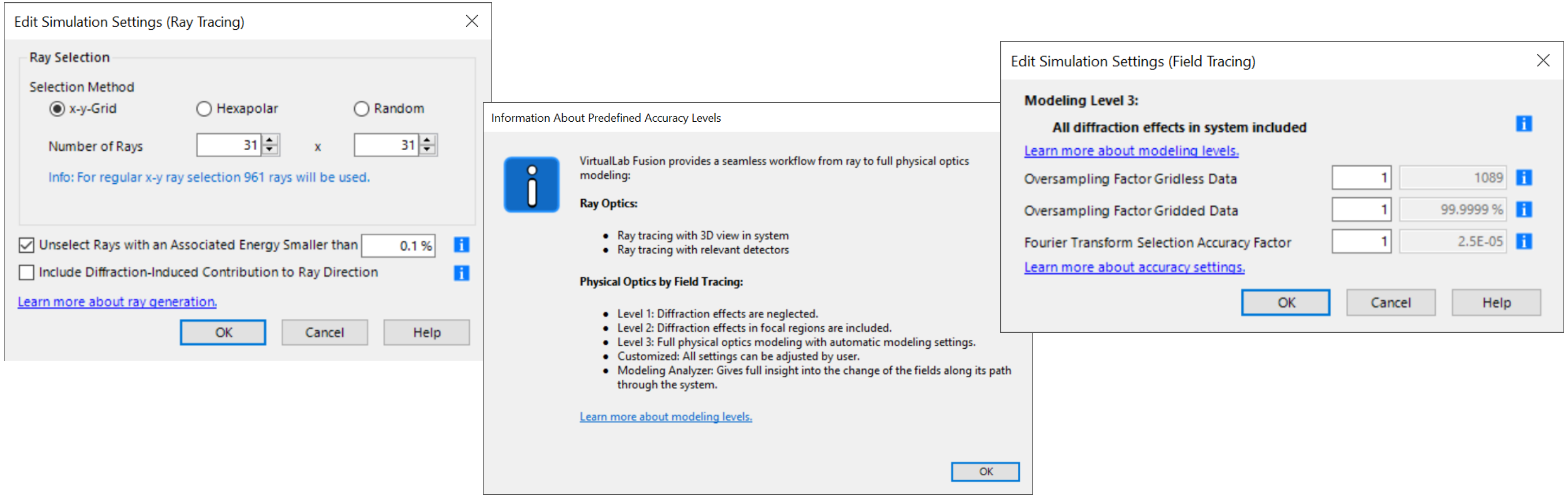
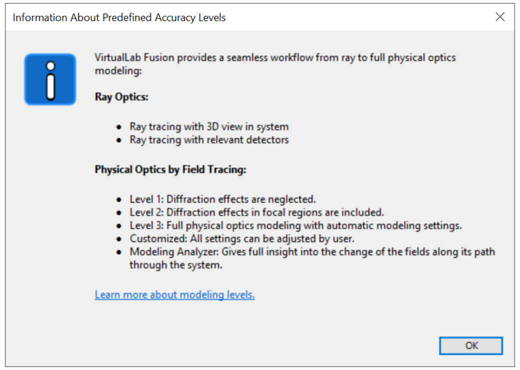
- In version 2021.1 we come with a new workflow which enables a **seamless transition from ray to full physical-optics modeling**. This way we simplify the usage of the amazing modeling features in VirtualLab Fusion.

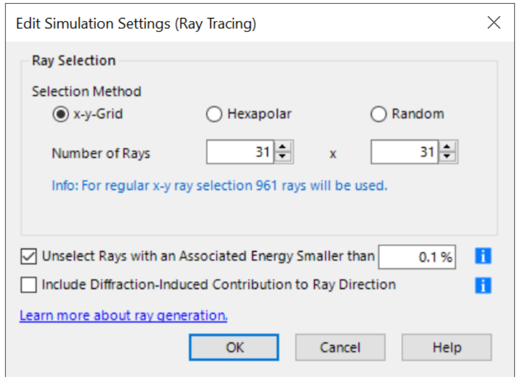


Modeling Workflow & Accuracy Control – Related Documents

- [Seamless Transition from Ray to Physical Optics]

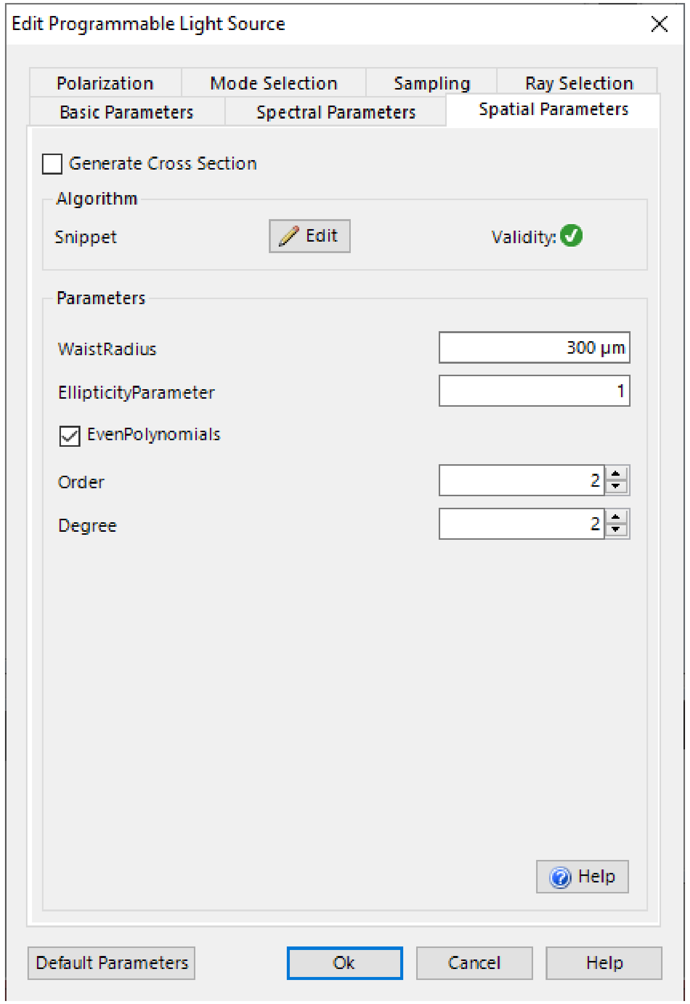


- [Generation of Rays for Ray Tracing]



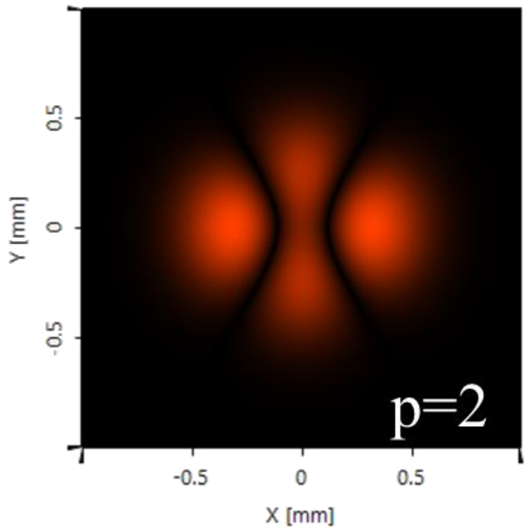
New Features & Updates – System Building Blocks

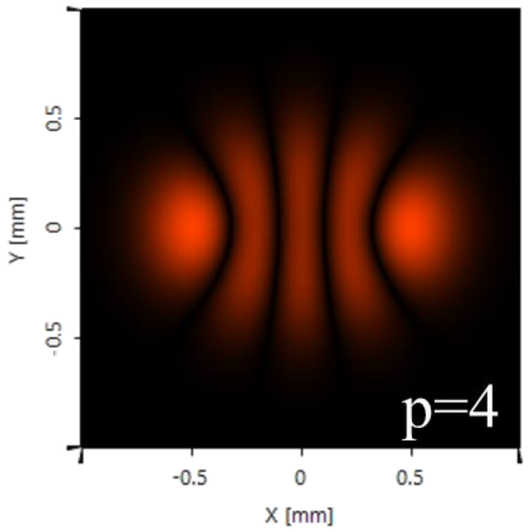
Ince Gaussian Source



The Ince-Gaussian source can be found in the tree of the optical setup, which is able to be controlled by

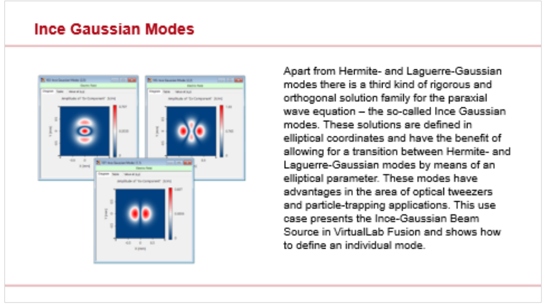
- Waist radius
- Ellipticity parameter
- Order of mode polynomial
- Degree of mode polynomial



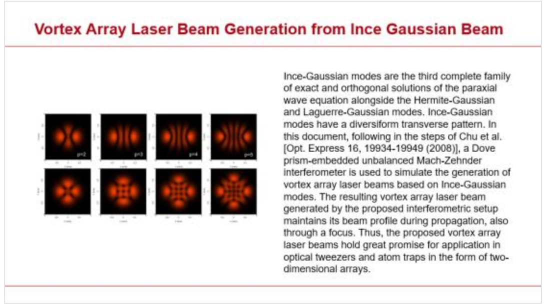


Ince Gaussian Source – Related Use Cases

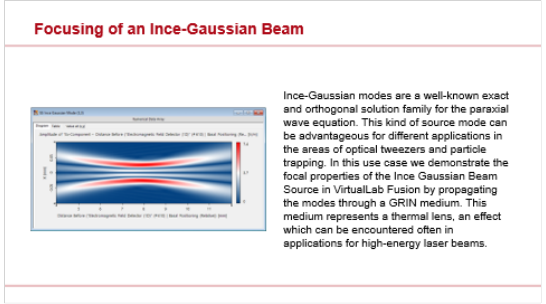
- Ince Gaussian Modes



- Vortex Array Laser Beam Generation from Ince Gaussian Beam

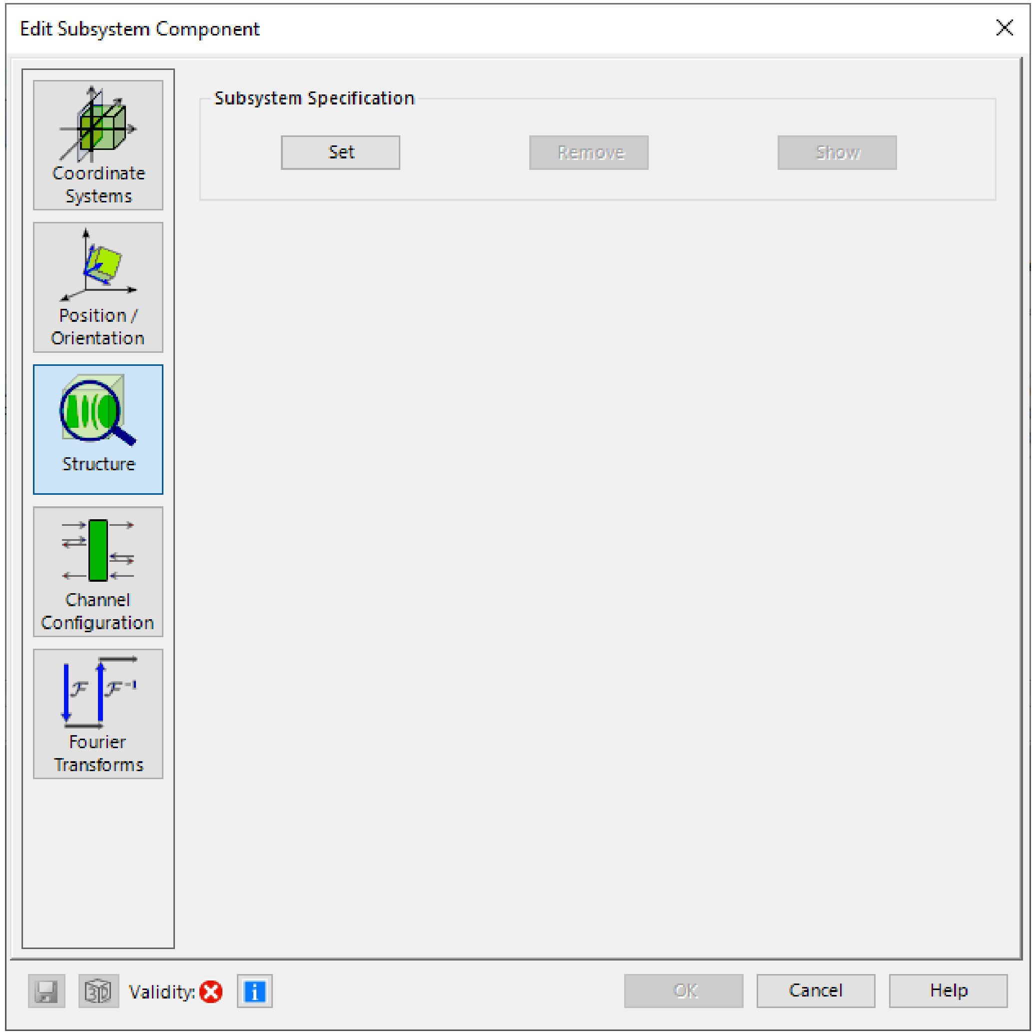


- Focusing of an Ince-Gaussian Beam



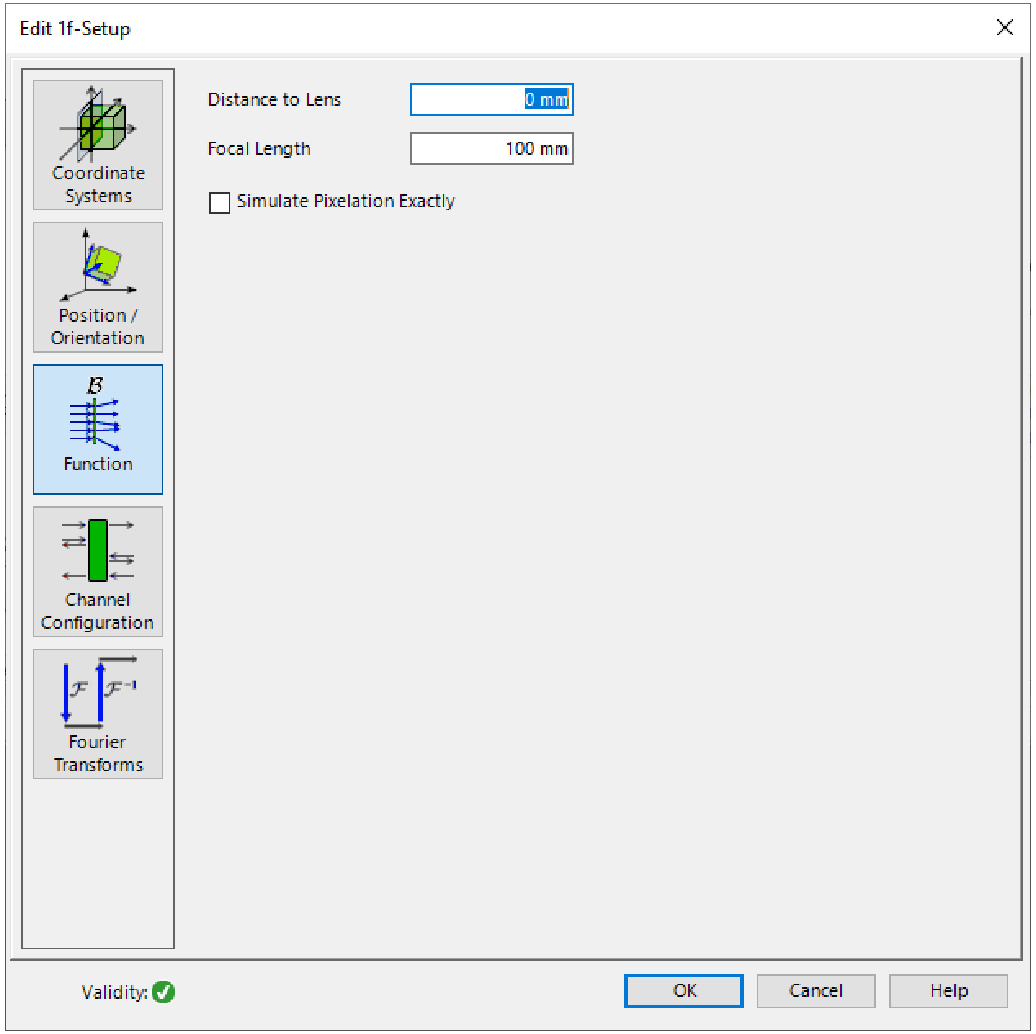
Real Components

Subsystem components now expose the geometry of the subsystem to the parent Optical Setup.
As a result, the complete subsystem is now visible in the 3D view and such components now work for Field Tracing and Ray Tracing.



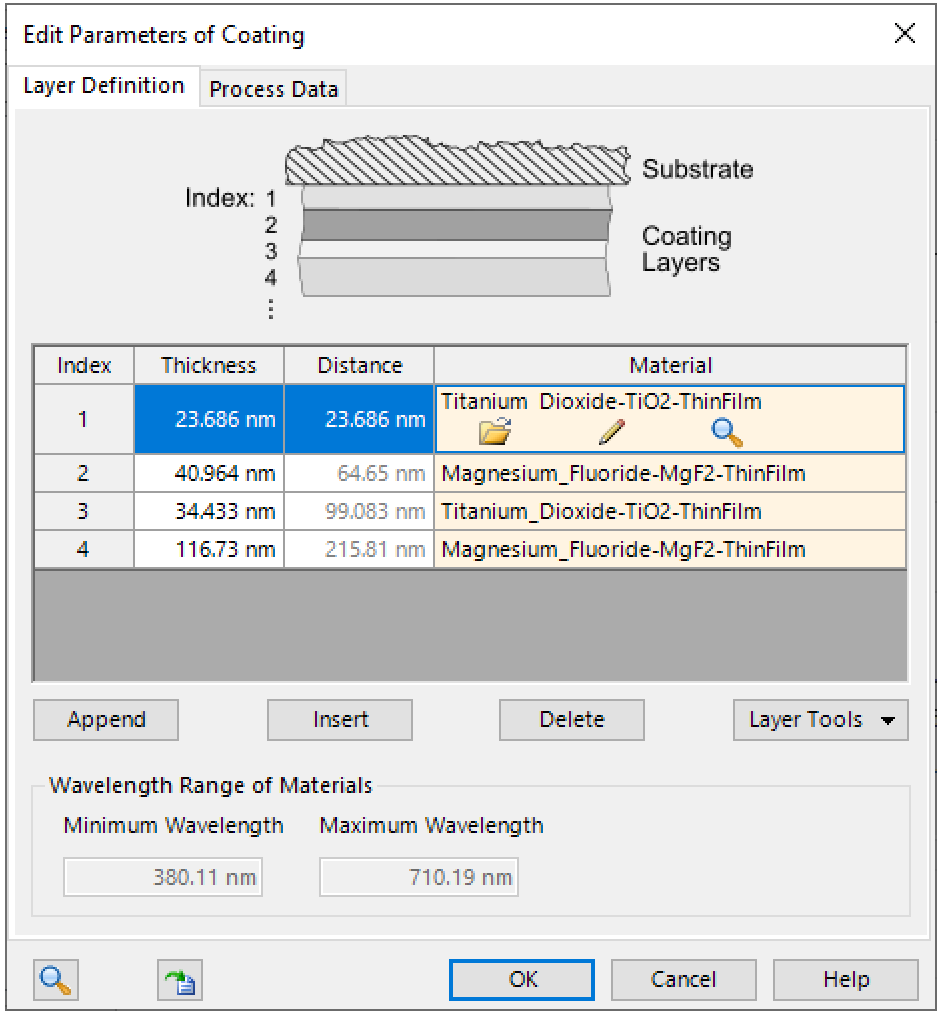
Ideal Components

- 1f-Setup, 2f-Setup now work for both Ray and Field Tracing.
- For Field Tracing the operation is realized as in integratal operator.
- Within Ray Tracing we use ABCD operator to calculate the effect on the incident rays.



Coatings

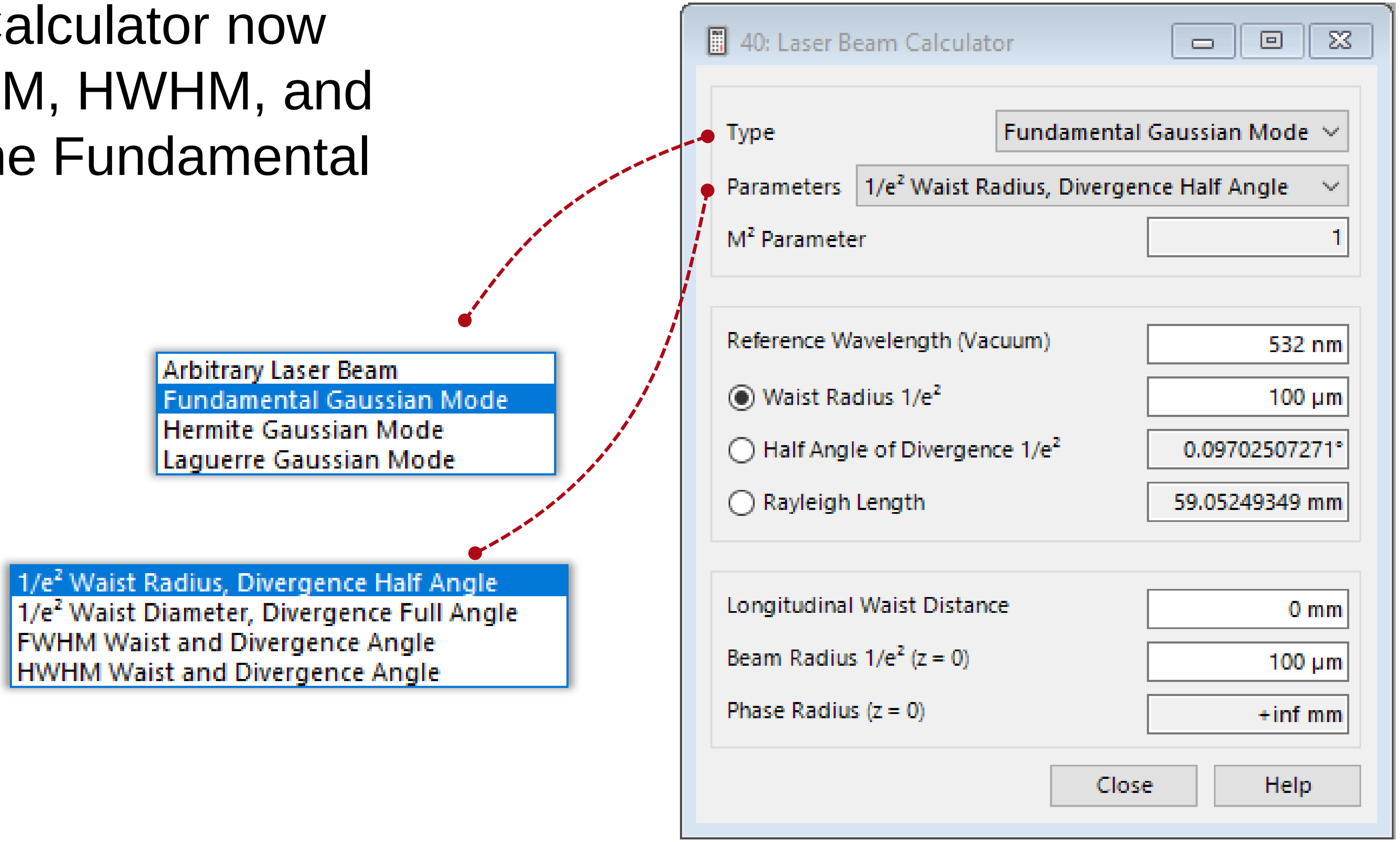
- Several performance improvements for coatings with extremely many layers.
- Coatings now consist of a sequence of materials, not homogeneous media anymore. This is easier to use and more performant.



New Features & Updates – Handling & User Interface

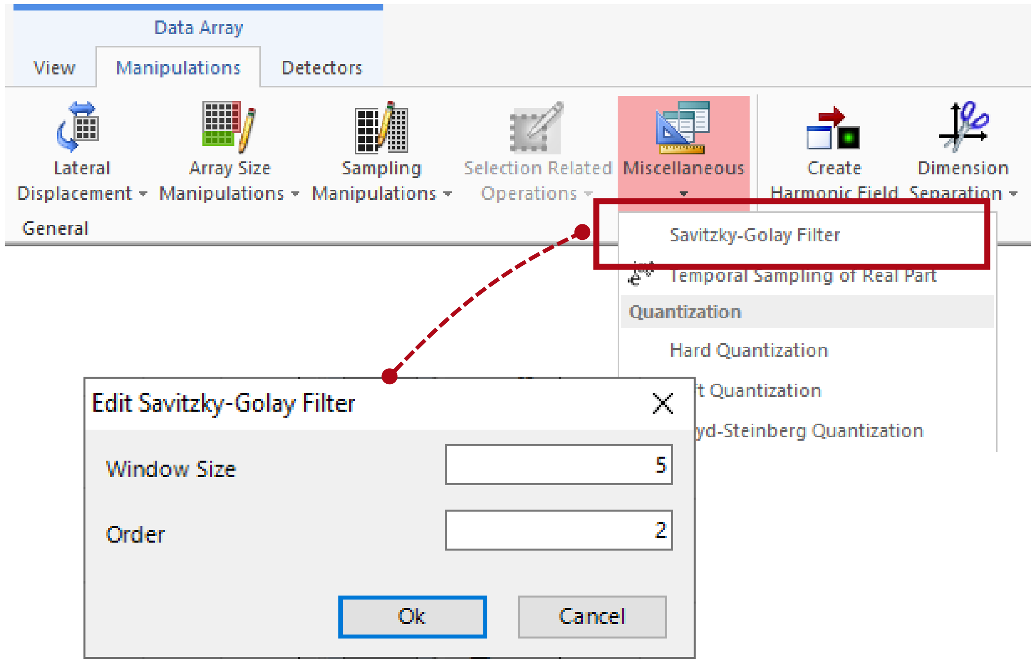
Laser Beam Calculator

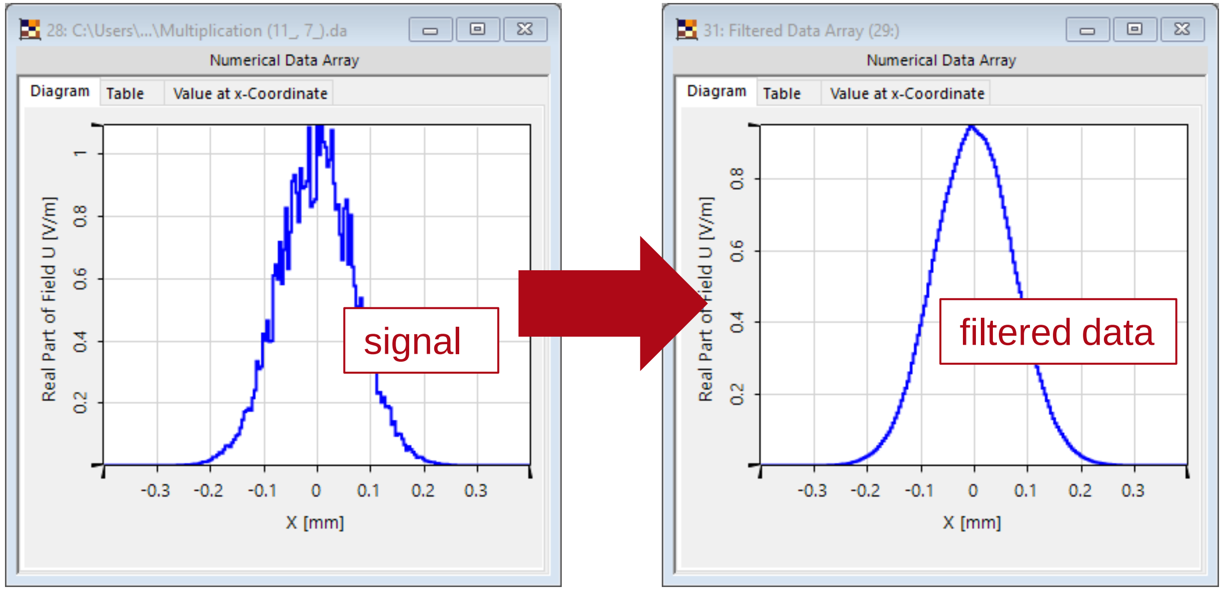
The Laser Beam Calculator now allows to use FWHM, HWHM, and 1/e² diameter for the Fundamental Gaussian Mode.



Savitzky-Golay Filter

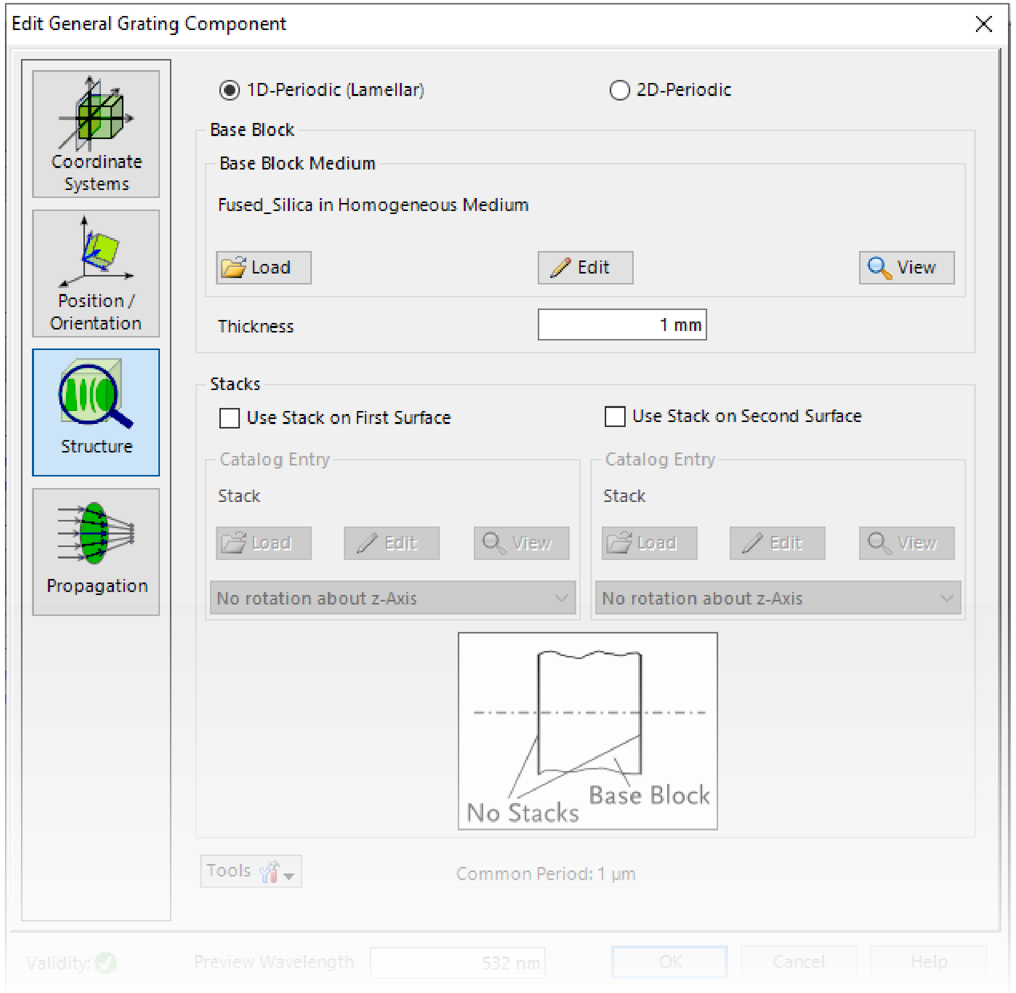
Savitzky-Golay filter for real-valued data arrays to remove local signal noise while preserving the original shape.





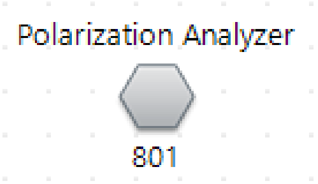
Grating Workbench

- In a *Grating Optical Setup*, you can now switch the grating components between 1D-Periodic (Lamellar) and 2D-Periodic mode. You don't need to setup a whole new optical system just to change this.
- Renamings:
  - Renamed “2D Gratings” to “1D-Periodic (Lamellar) Gratings” and “3D Gratings” to “2D-Periodic Gratings”.
  - Renamed “Test Period” to “Limit Period” for Volume Grating Medium.



Grating Workbench

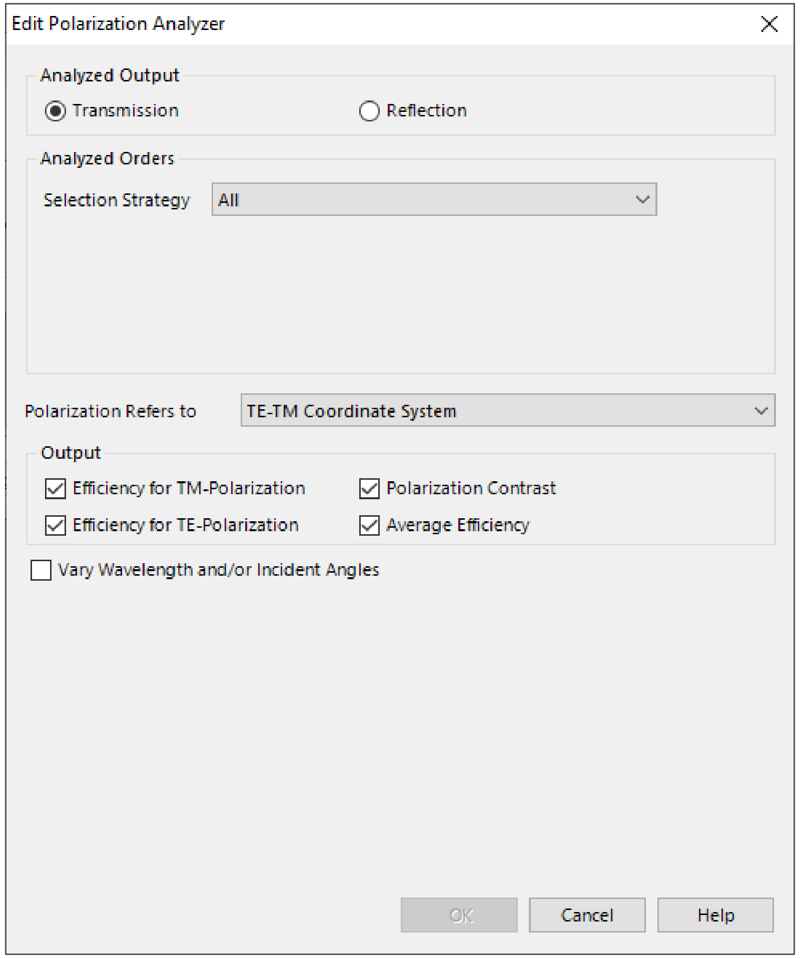
Polarization Analyzer now supports also TE and TM polarization.



Detector Results

	Date/Time	Detector	Sub - Detector	Result
4	04/07/2021 22:03:56	"Polarization Analyzer" (# 801)	Efficiency for TM-Polarization	96.49458751 %
3			Efficiency for TE-Polarization	96.49458751 %
2			Polarization Contrast	1
1			Average Efficiency	96.49458751 %

Detector Results | Messages



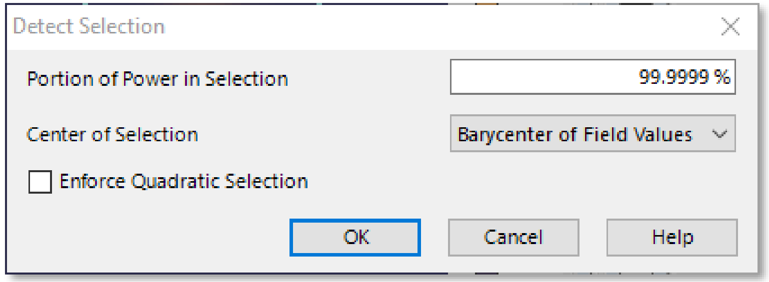
Miscellaneous Changes

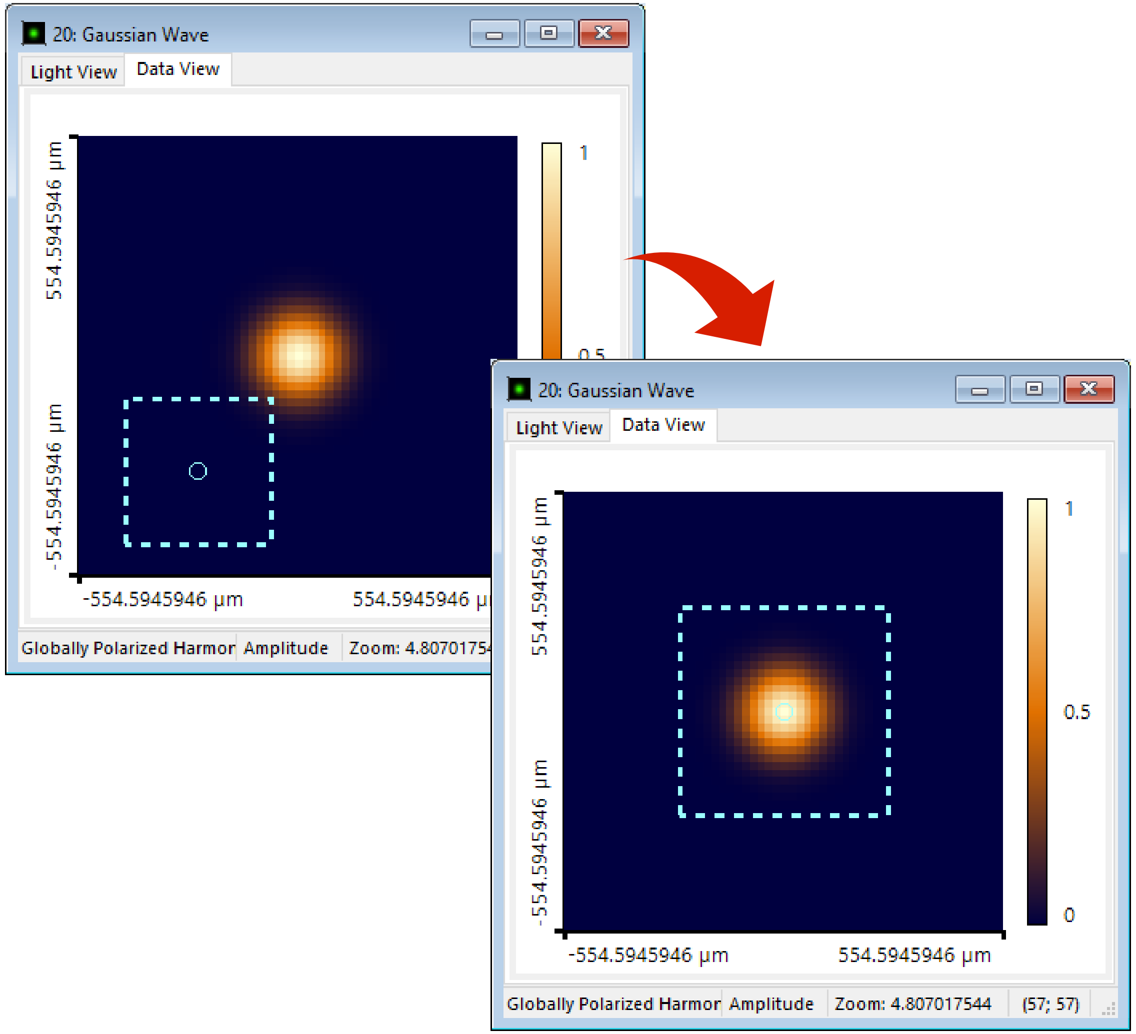
Performance

- Sometimes you have a configuration with very many parameters for Parameter Extraction which can decrease performance very much. For such cases there is now the new Optical Setup tool **Configure Parameter Extraction** where you can exclude such performance critical objects from Parameter Extraction:
  - A Surface Layout of a Light Guide with many regions. This was available before as a special implementation.
  - Coatings with many layers.
  - For a Pillar Medium (General) with very many pillars, the pillar distribution parameters can be excluded.
  - After creation of (large) Harmonic Fields, VirtualLab now becomes responsive again much faster.
- There is a performance optimization for short lasting iterations in VirtualLab. However, it turned out that this optimization slowed down certain simulations. Thus, it is now disabled by default and can be turned on in the Global Options Dialog (Performance > Multi-Core) if needed.

Barycenter of the Field Value

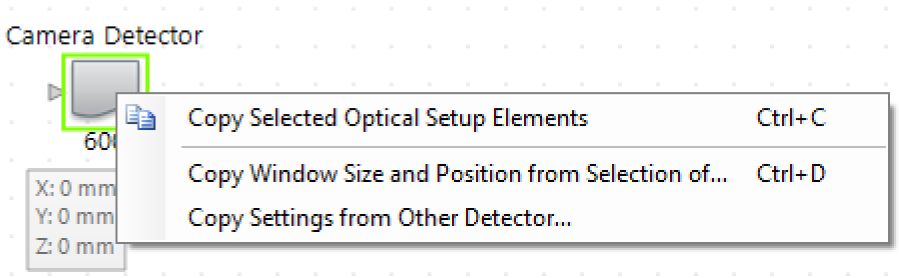
For the Detect Selection algorithm, you can now choose the barycenter of the field values as center of the resulting selection.

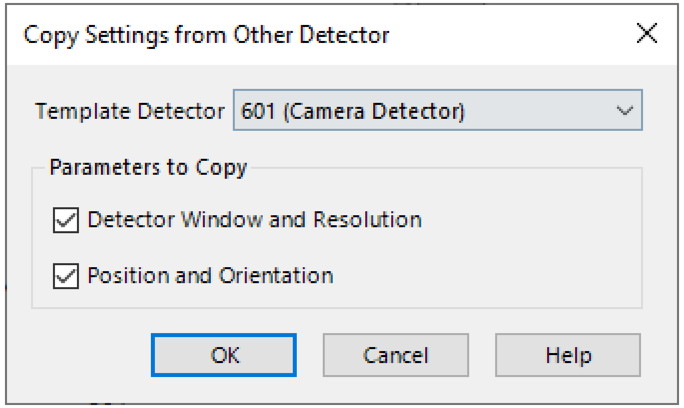




Convenience Tool – Copy Detector Settings

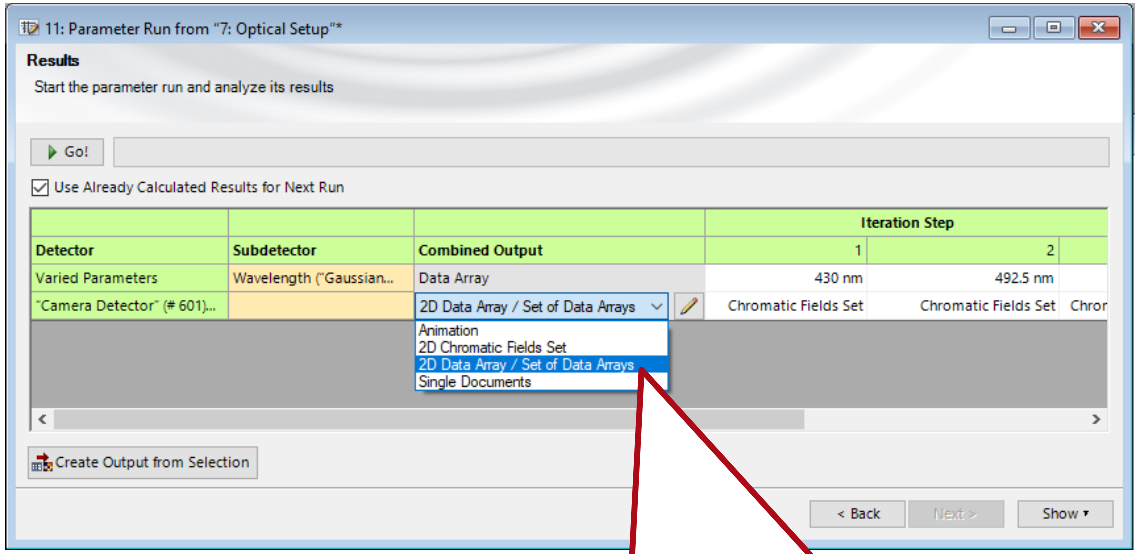
- New tool available to copy several parameters of a detector from another detector.
- The tool provides the selection for copying
  - Detector window and resolution
  - Position and orientation





Combined Output of Chromatic Fields Sets to Data Array

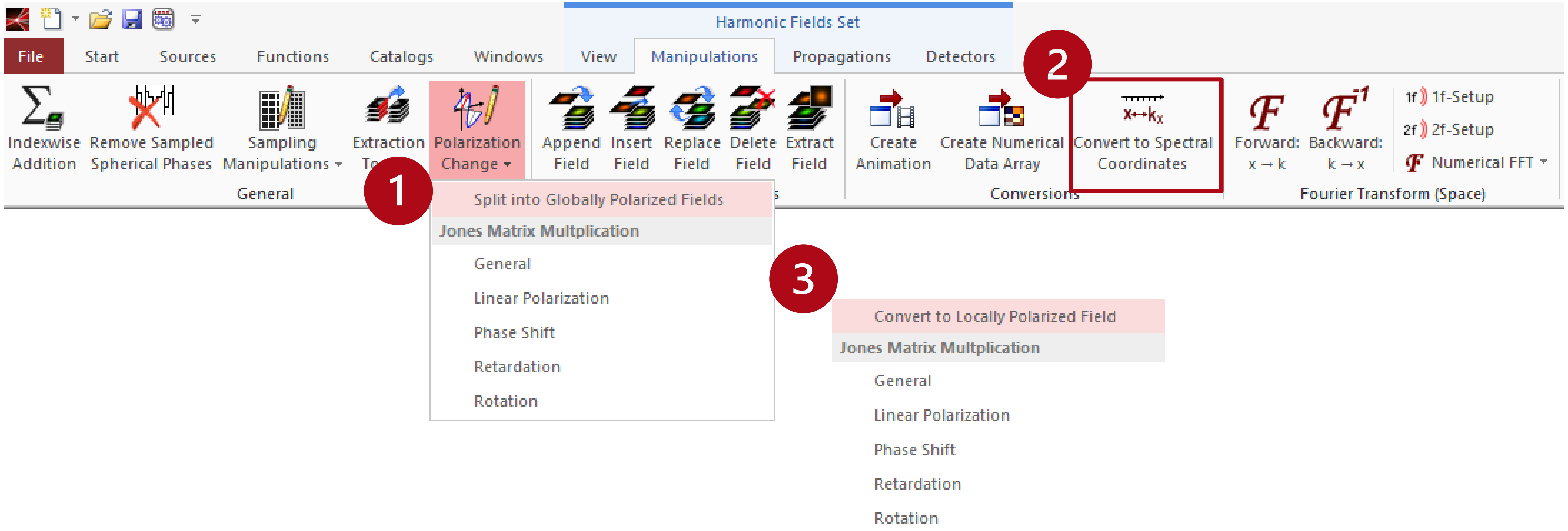
- For the Combined Output of Chromatic Fields Sets to an Animation, in case of “False Color” and “All Wavelengths” now the summed amplitude of all wavelengths is shown in a frame, instead of one frame per wavelength.
- If desired the old behavior can be restored via the new Combined Output to Data Arrays.



New Combined Output of Chromatic Fields Sets to a 2D Data Array.

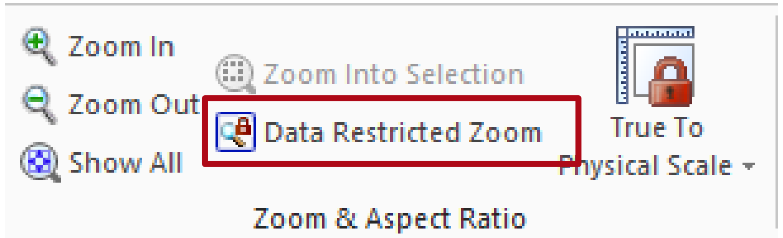
New Manipulations for Harmonic Fields Sets

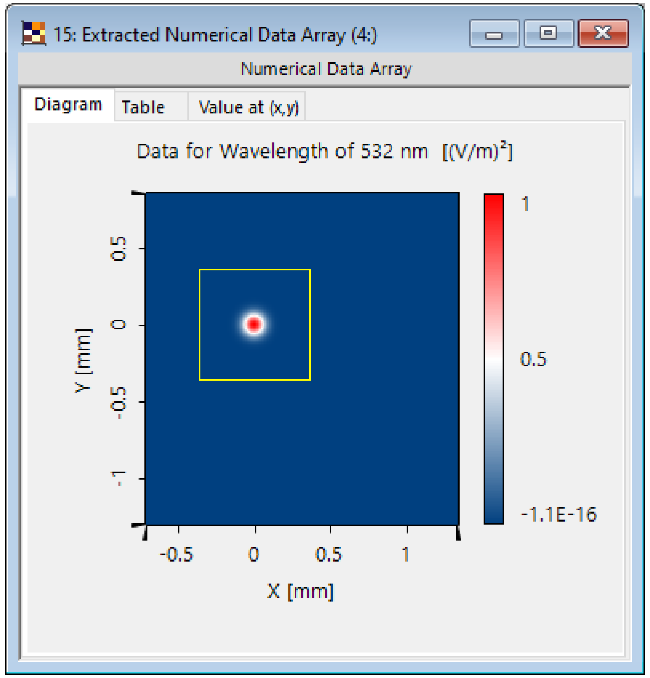
- New manipulations for Harmonic Fields Sets: Split into Globally Polarized Fields, Convert to Locally Polarized Field, Convert to Spatial / Spectral Coordinates.



Views

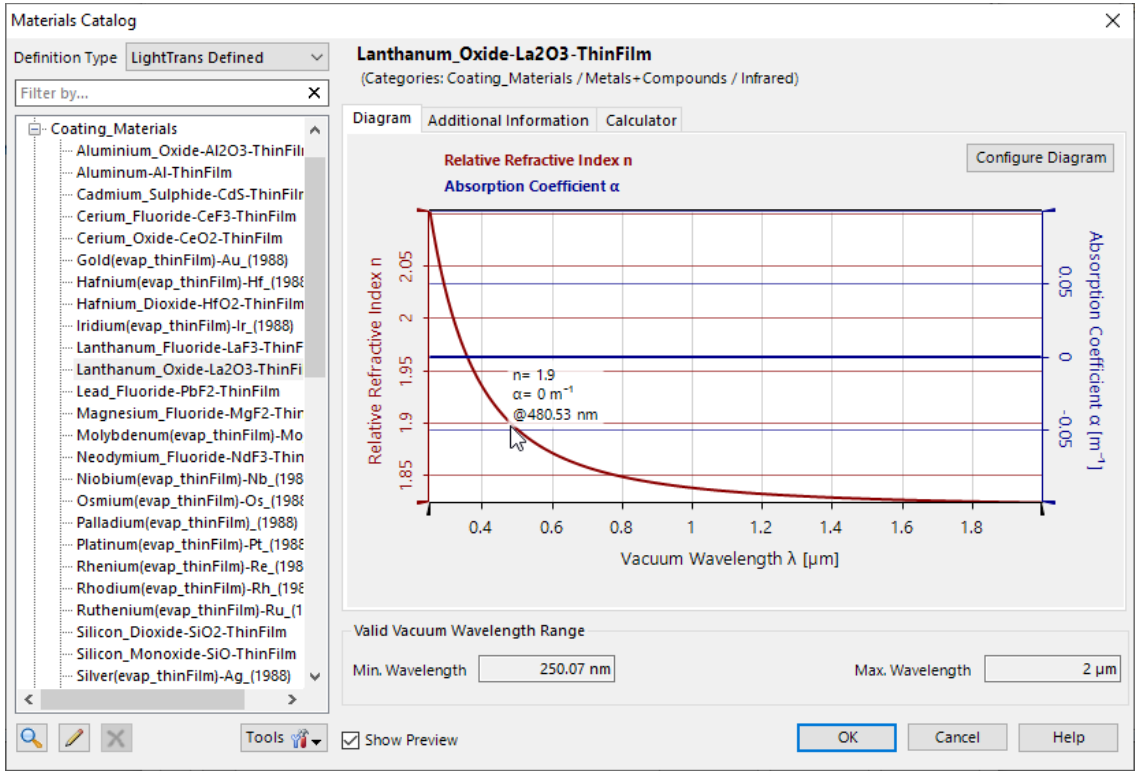
- Periodicity is better supported for Data Arrays and related objects now.
- For data arrays you can now zoom out of the current data.





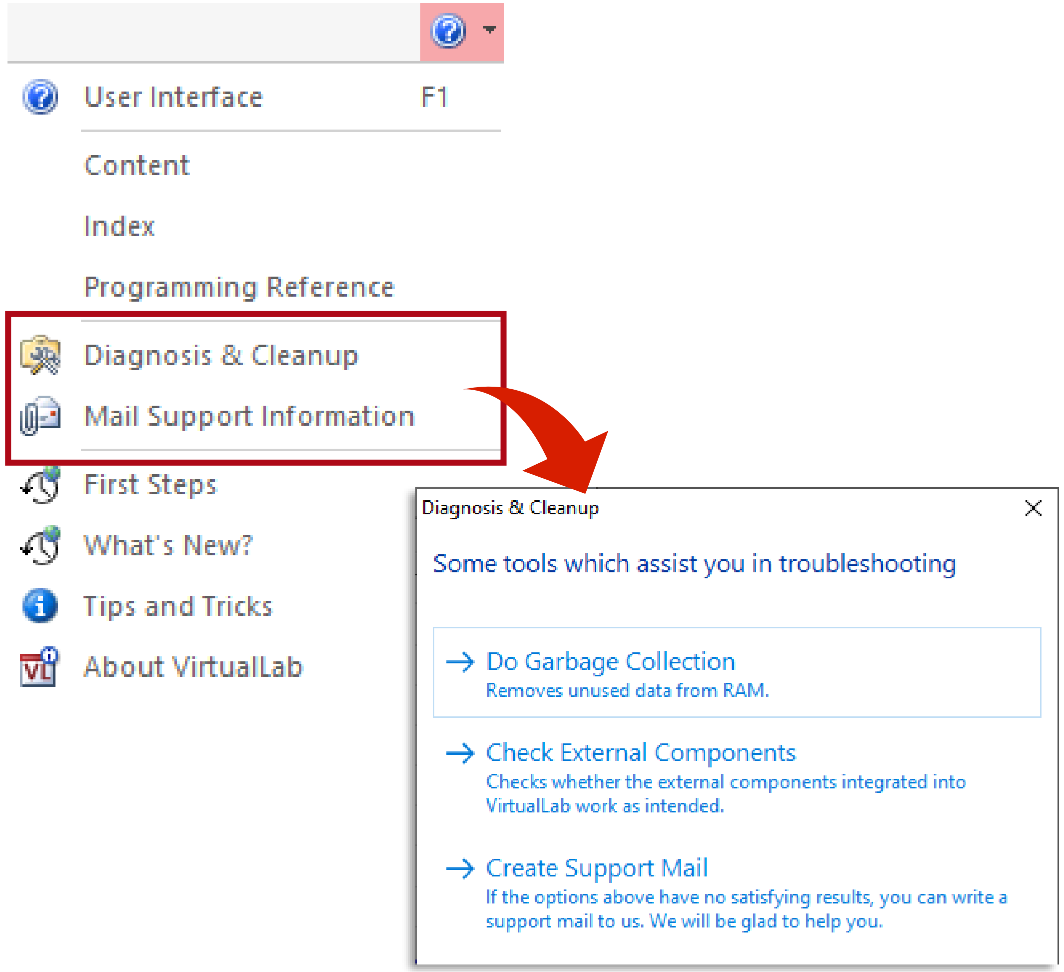
Material View Tooltip

- For the material view there is now a tooltip showing the values at the current mouse position. To activate this feature, hold the ⇧Shift key while moving the mouse.



Support

- The help menu now contains a “Diagnosis & Cleanup” item where you can cleanup your RAM and check whether external components work correctly.
- Also, via the help menu you can now generate a preconfigured support email.
- If you generate a c2v file, automatically an email is generated to send it to LightTrans.

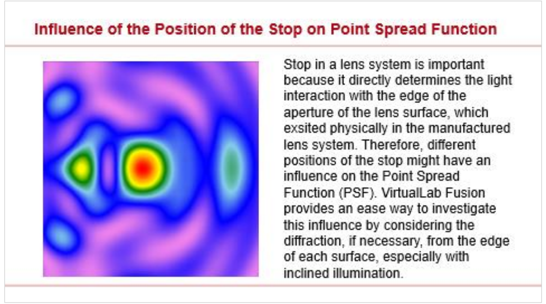


Improvements of Zemax Import

The Zemax import was improved, so that there is a clear indication and correct configuration of the stop (aperture) after the import into a VirtualLab optical system.

Related Use Case:

- **Influence of the Position of the Stop in a Lens System on Point Spread Function**



XML Export of Optical Setups

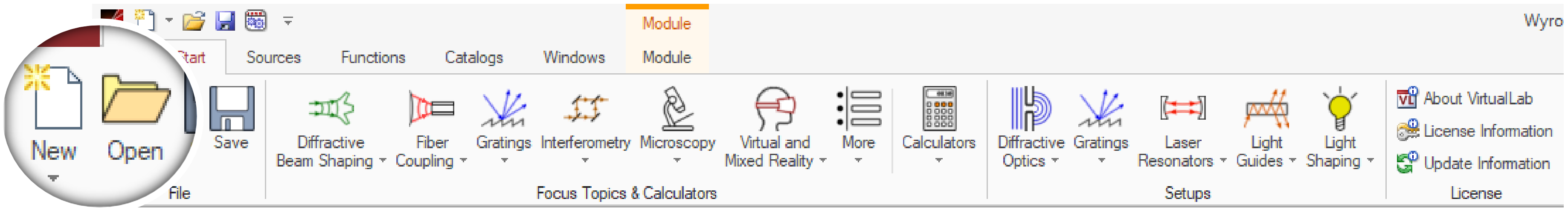
The XML format for export of Optical Setups has been unified, before there were two different variants for exporting all parameters via Export as XML and for exporting variable parameters via batch mode / optiSLang export. This enables the following features:

- Output of physical values is now more machine readable and less human readable. This avoids errors when the XML file is imported into other programs like optiSLang or MATLAB.
- New ID tag enables re-import of parameters even when their name has changed.
- String and Boolean variables of snippets are now available in batch mode. You can change them in external programs and then process the altered data in VirtualLab.
- You can import the values of matching parameters from an XML file back to the currently open Optical Setup.
- The XML file now contains the active simulation engine.

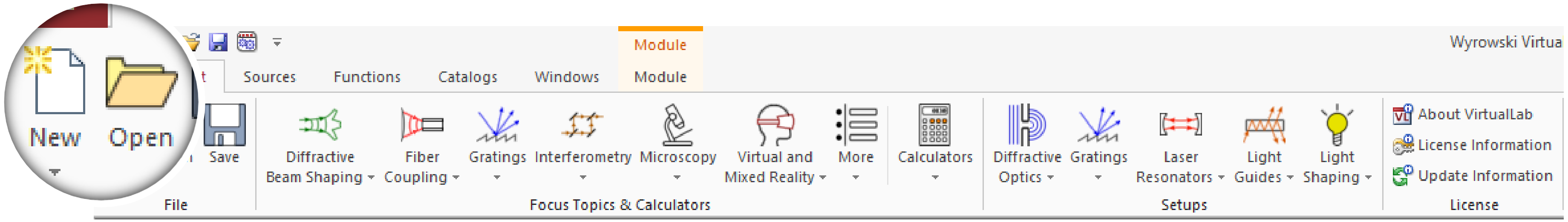
New Default Font

- Changed the default font because the old one had many issues e. g. with kerning and Greek letters. Via the Global Options dialog you still can restore the old one if required.

Old font



New font



Others

- Black Box component has been removed. But old Optical Setups containing such a component will still work.
- Empty Harmonic Fields Sets can no longer be generated.
- We now always use the “Uncompressed” codec for video export. No edit dialog anymore which offers not or poorly working codecs.