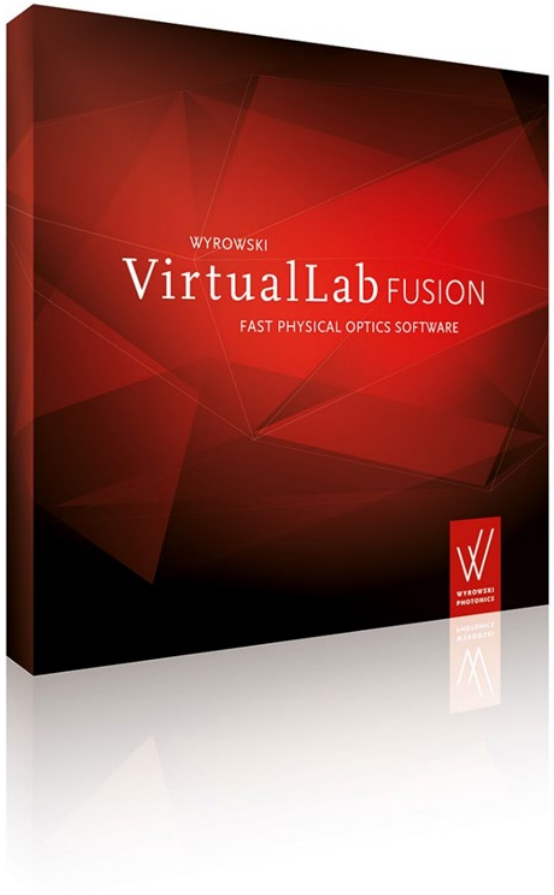
December 2022, Release of VirtualLab Fusion 2023.1

The New VirtualLab Fusion 2023

Overview of new features of version 2023.1

General Information

Software Version	2023.1 (Build 1.556)
Update Service	4th quarter of 2022 is required; contact your distributor for more information
Install Type	• Standalone Installation • VirtualLab 2023.1 is installed in addition to any other VirtualLab installations on your PC.
Release Notes	December 22, 2022

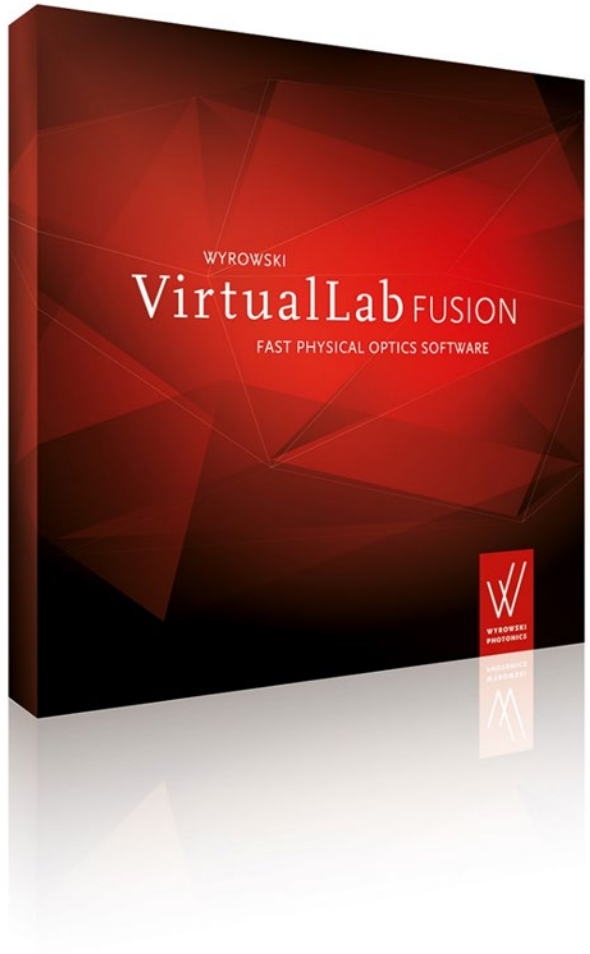


The New VirtualLab Fusion 2023.1

Major development directions

Major Development Directions of VirtualLab Fusion 2023.1

- VirtualLab Fusion enables physical optics modeling through its amazing fast physical optics technology.
- The development of VirtualLab Fusion never stops. VLF 2023.1* provides:
  - Higher Speed
  - Easier Use
  - More Physics
  - Deeper Transparency
  - Better Control



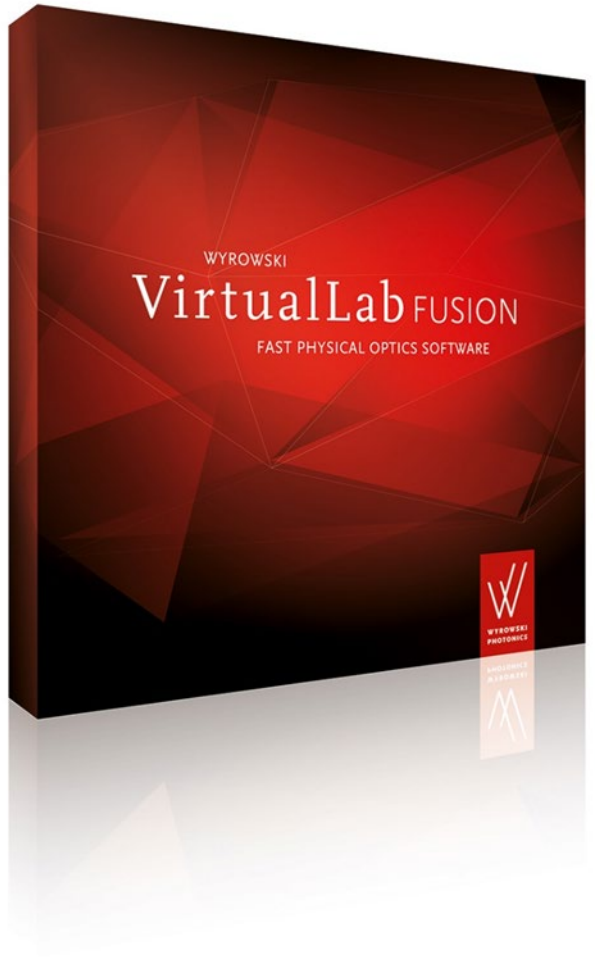
*Our customers often refer to VirtualLab Fusion as VLF. Thus, in this feature overview we use VLF 2023.1 for VirtualLab Fusion 2023.1 .

Higher Speed

Major development directions of VirtualLab Fusion 2023.1

Higher Speed by VirtualLab Fusion 2023.1

- VirtualLab Fusion achieves **fast physical optics*** system modeling by two key technologies:
  - Connecting specialized modeling techniques per optical component.
  - Applying pointwise modeling techniques wherever possible.
- The algorithms of both technologies are further optimized in VLF 2023.1 and deliver **higher modeling speed**.
- VLF 2023.1 makes better use of multicore processors for parallel computing.
- The new modeling **Profile Editor** and **Profile Editing Tools** enable excellent balancing of accuracy vs. speed.
- The new **Universal Detector** significantly saves modeling steps and time by evaluating multiple detector signals from the electromagnetic field.



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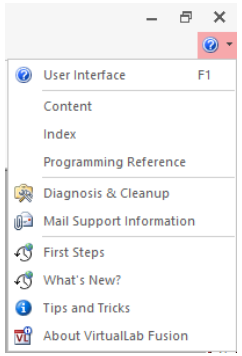
Easier Use

Major development directions of VirtualLab Fusion 2023.1

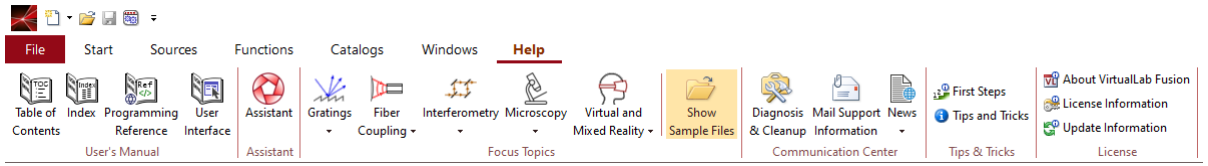
Easier Use of VirtualLab Fusion 2023.1

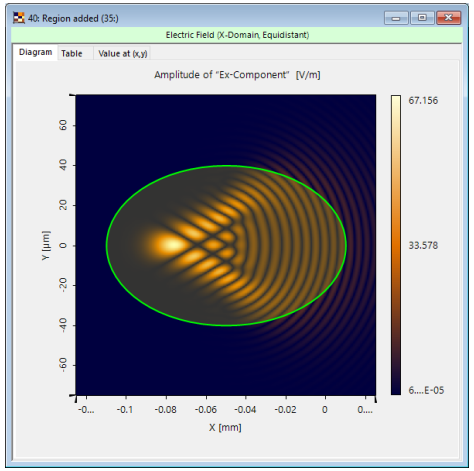
- Till recently VirtualLab Fusion provided a small button with basic help functions only.
- With VLF 2023.1 we introduce a **comprehensive help and assistant concept**, with content added steadily.
- The new **VLF Assistant** explains features on demand in a special window inside VLF 2023.1.
- VLF 2023.1 comes with a new modeling **Profile Editor** and **Profile Editing Tools.**
- These tools facilitate a smooth getting started with VLF 2023.1 physical optics modeling.
- The **Data Views** in VLF 2023.1 are further unified and received additional features, which make them easier to use.
- The **VLF Calculators** are helpful tools. VLF 2023.1 provides more of these helpers.

Before



Now in VLF 2023.1



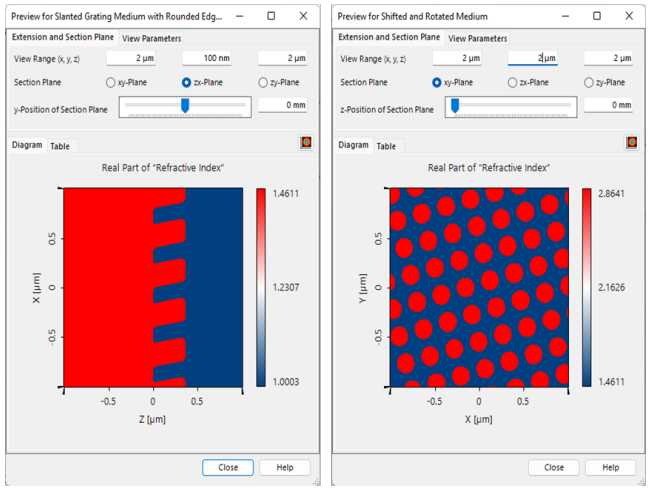


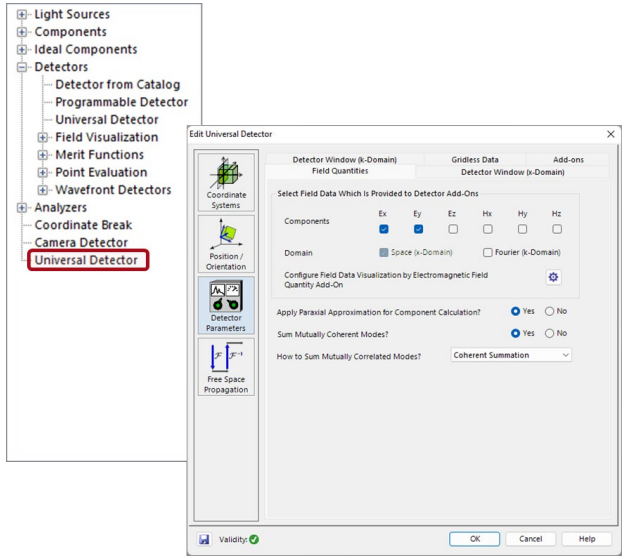
More Physics

Major development directions of VirtualLab Fusion 2023.1

More Physics in VirtualLab Fusion 2023.1

- VirtualLab Fusion provides an ever-growing number of physical optics models with emphasis on:
  - Sources with models for light radiation
  - Components with models for light interaction
  - Detectors with models for light evaluation
  - Models for propagation of light from sources to components and to detectors
- VLF 2023.1 introduces a **source power management** to the source models.
- **Components** come with various new features.
- The new **Universal Detector** means a quantum leap forward in detector modeling with VLF. Missing a detector in VLF? Not anymore!
- VirtualLab Fusion is famous for its **seamless control of the inclusion of diffraction in physical optics modeling**.* With VLF 2023.1 we make this even better!





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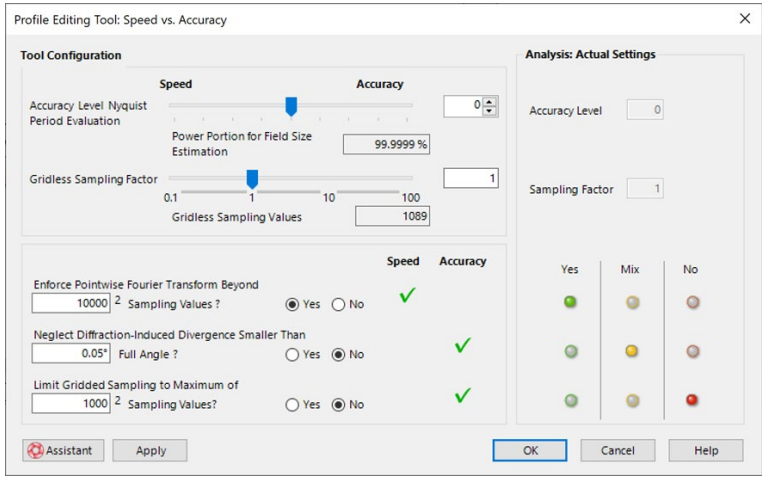
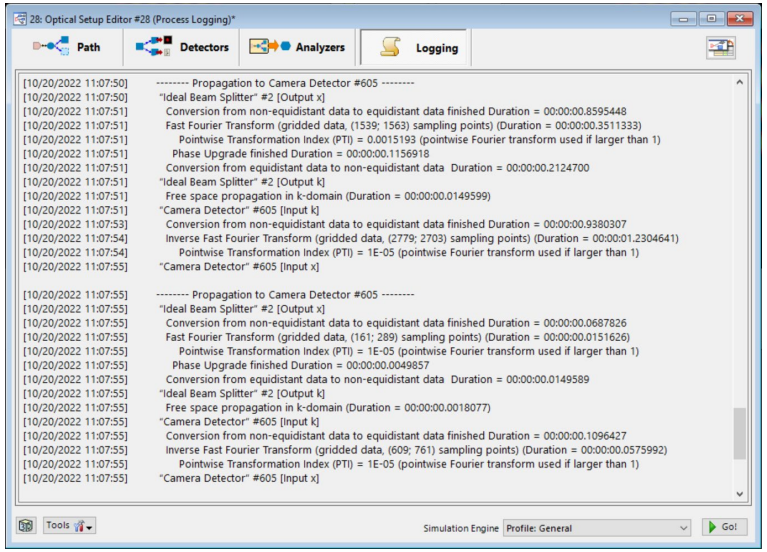
Deeper Transparency

Major development directions of VirtualLab Fusion 2023.1

Deeper Transparency of VirtualLab Fusion 2023.1

- The **VLF Assistant** provides insight into the concepts, the features, the usage, some typical troubleshooting, and further development plans. By that it deepens the transparency of VLF technology.
- The new modeling **Profile Editor** and **Profile Editing Tools** facilitate getting a full and transparent overview of system and modeling parameters.
- The **Process Logging** in VLF 2023.1 provides more and more detailed information about the performance of algorithms, data sampling, process parameters, and cpu time per modeling step. The logging brings great transparency, which is to your benefit.
- New features of the **System Modeling Analyzer** strengthen its functionality and give better insight into the effects of the modeling steps.



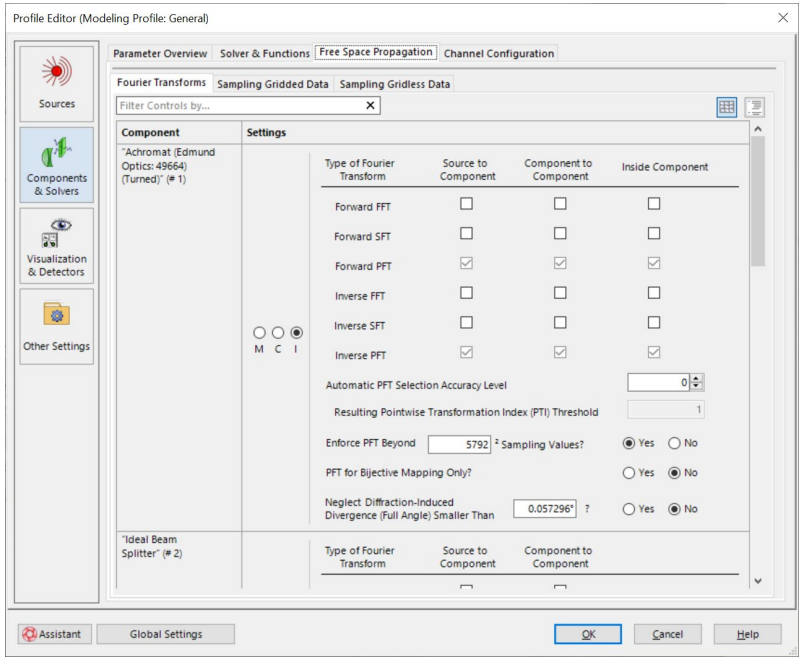


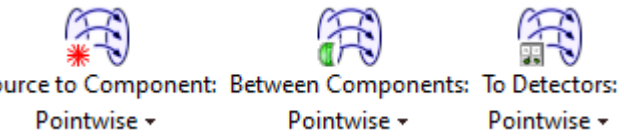
Better Control

Major development directions of VirtualLab Fusion 2023.1

Better Control of VirtualLab Fusion 2023.1

- The new **Profile Editor** provides full insight and full control of all system and modeling parameters. It functions as your modeling and design control center.
- The editor offers a well-structured access to all relevant parameters and comes with smart features for fast editing.
- To further simplify the work with the Profile Editor, VLF 2023.1 introduces **Profile Editing Tools** to configure modeling parameters in the Profile Editor automatically.
- The new **Expert Modus** of VLF 2023.1 enables a wider range of numerical manipulations of data objects.





The New VirtualLab Fusion 2023.1

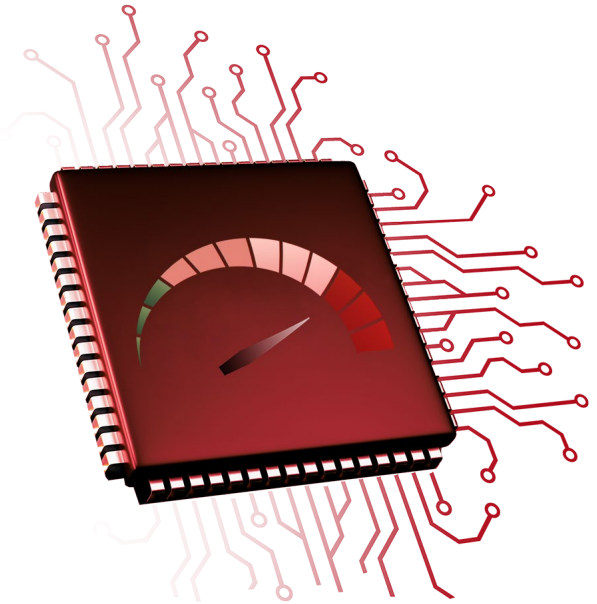
Feature Overview

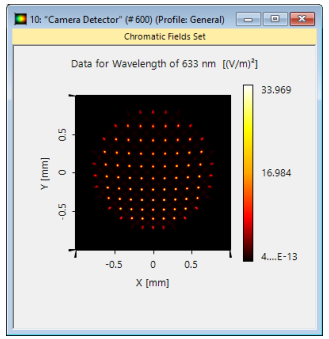
Higher Modeling Speed

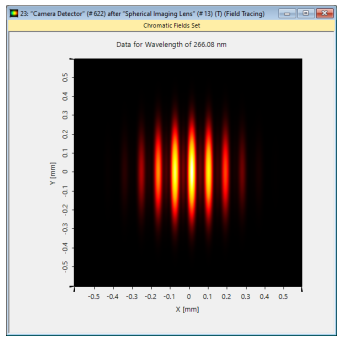
VirtualLab Fusion 2023.1 feature overview

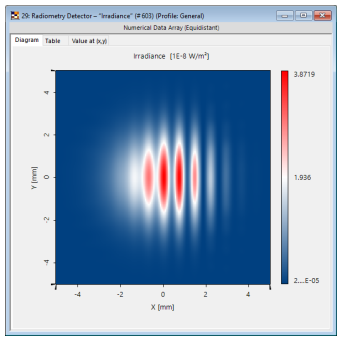
Higher Modeling Speed in VLF 2023.1

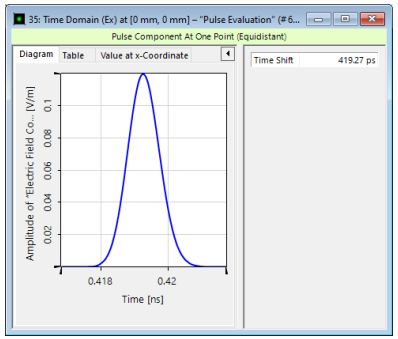
- The modeling algorithms in VLF 2023.1 are further optimized and deliver higher modeling speed.
- VLF 2023.1 makes better use of multicore processors for parallel computing.
- At five examples we demonstrate the increase of computational speed which ranges from a factor 1.5 to 3 times faster calculation.
- Dependent on the specific task the increase in speed can be even higher.

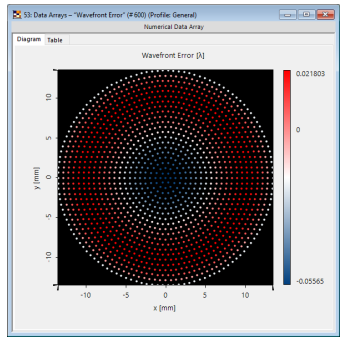




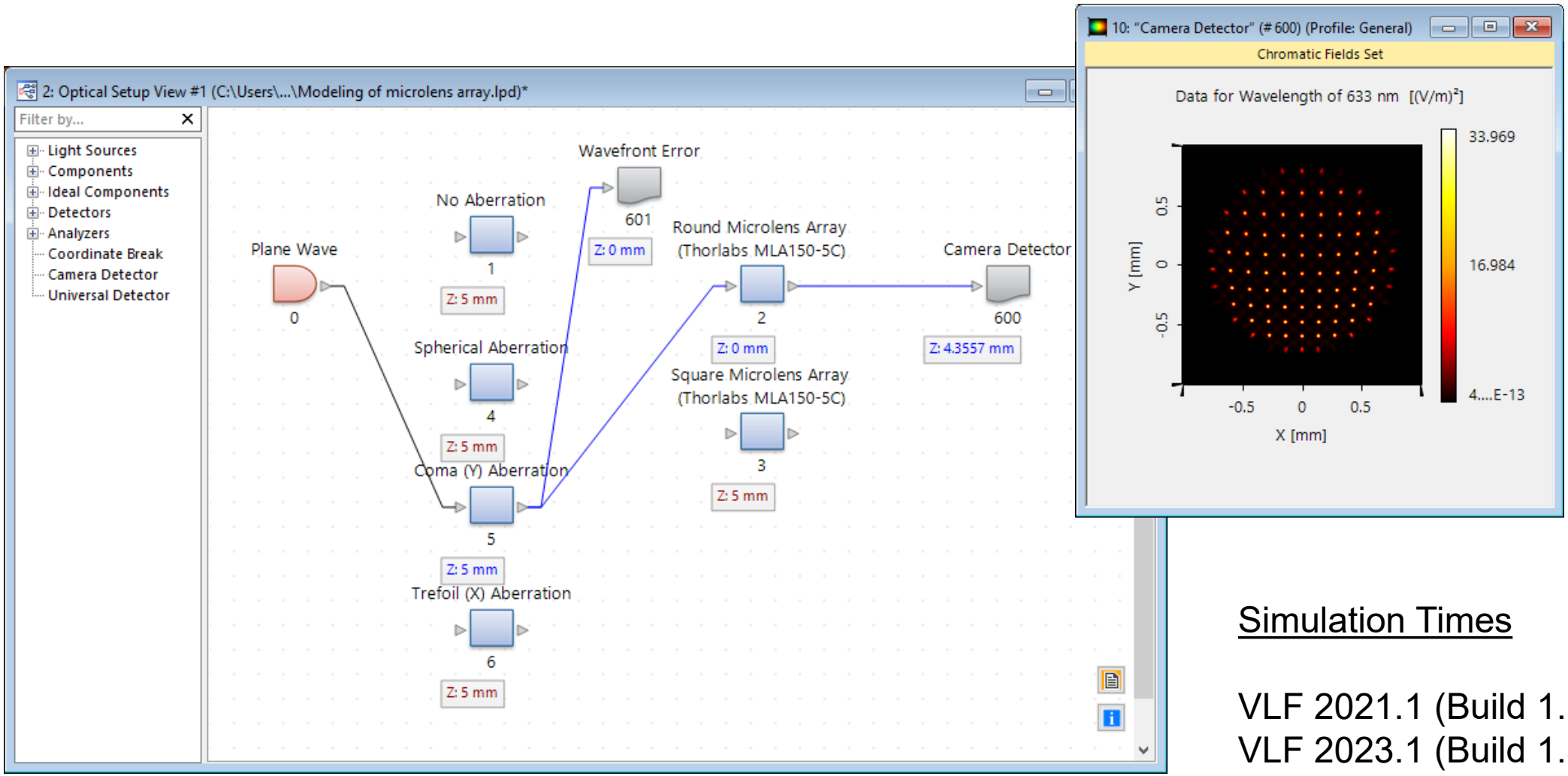








Example 1: Modeling of Microlens Arrays

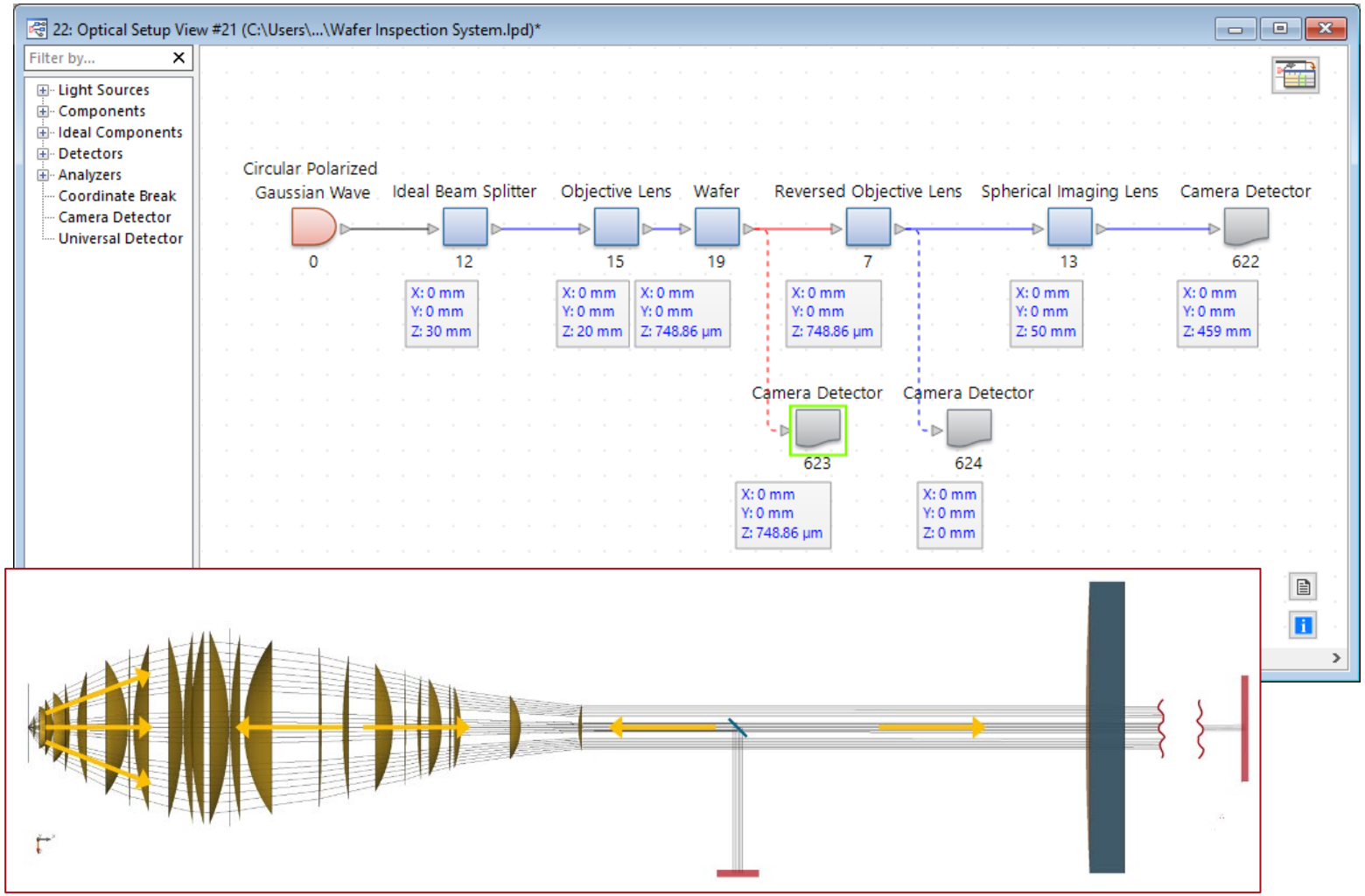


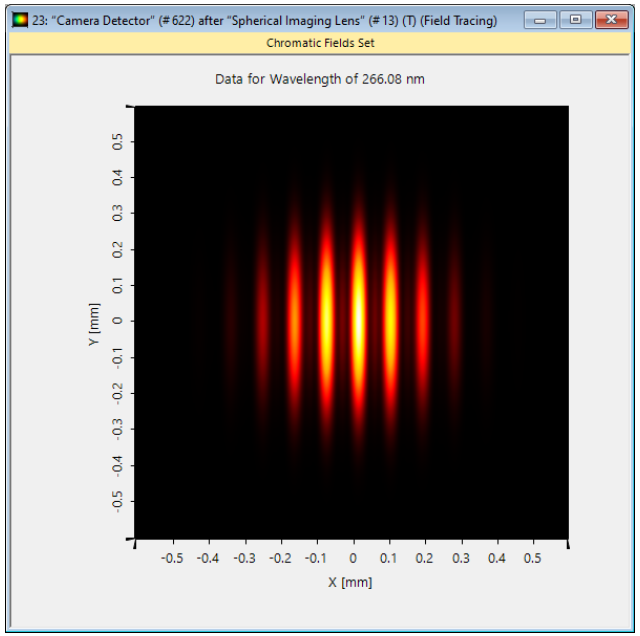
Use Case: Modeling of Microlens Arrays with Different Lens Shapes

Simulation Times

VLF 2021.1 (Build 1.180): 16 sec
VLF 2023.1 (Build 1.554): **11 sec**

Example 2: Waver Inspection System





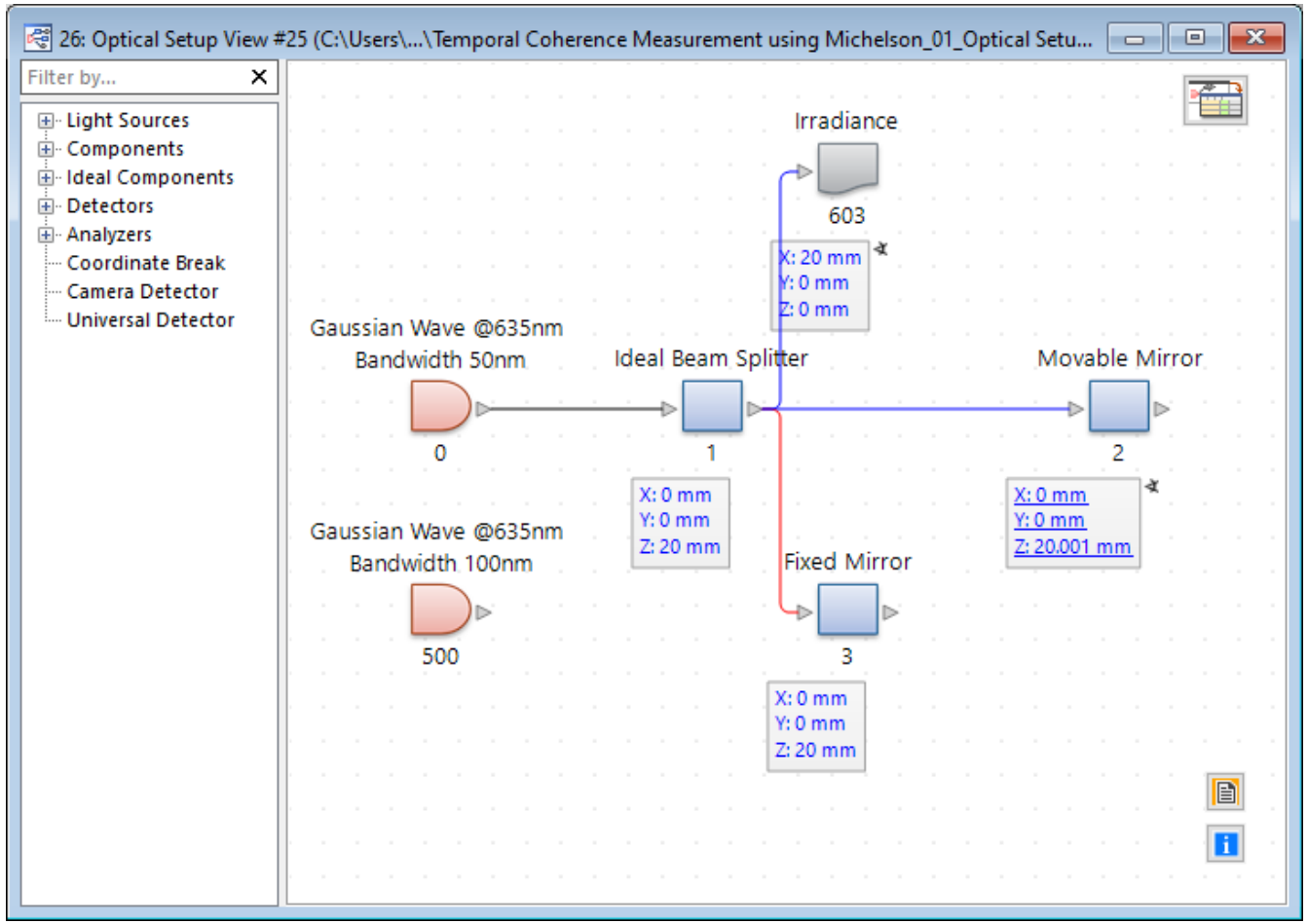
Use Case: Optical System for Inspection of Micro-Structured Wafer

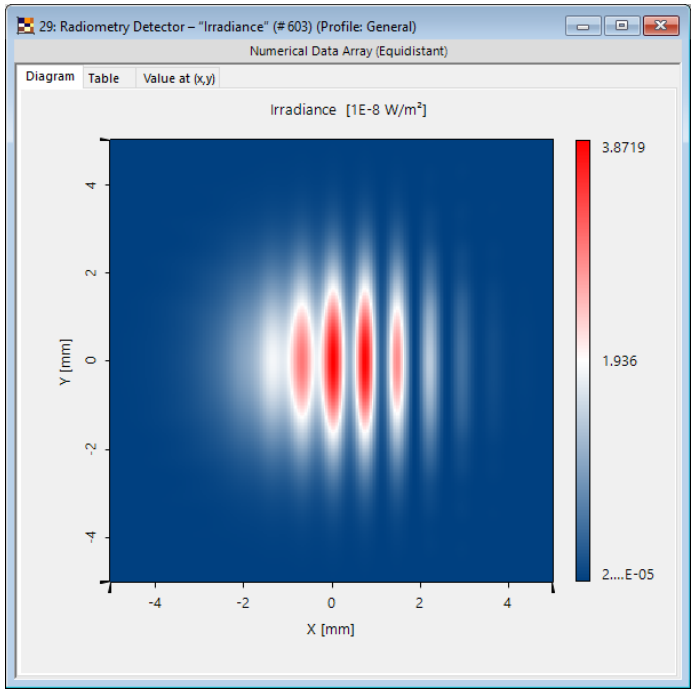
Simulation Times

VLF 2021.1 (Build 1.180): 19 sec
VLF 2023.1 (Build 1.554): **8 sec**

Example 3: Coherence Measurement

Use Case: Coherence Measurement Using Michelson Interferometer and Fourier Transform Spectroscopy

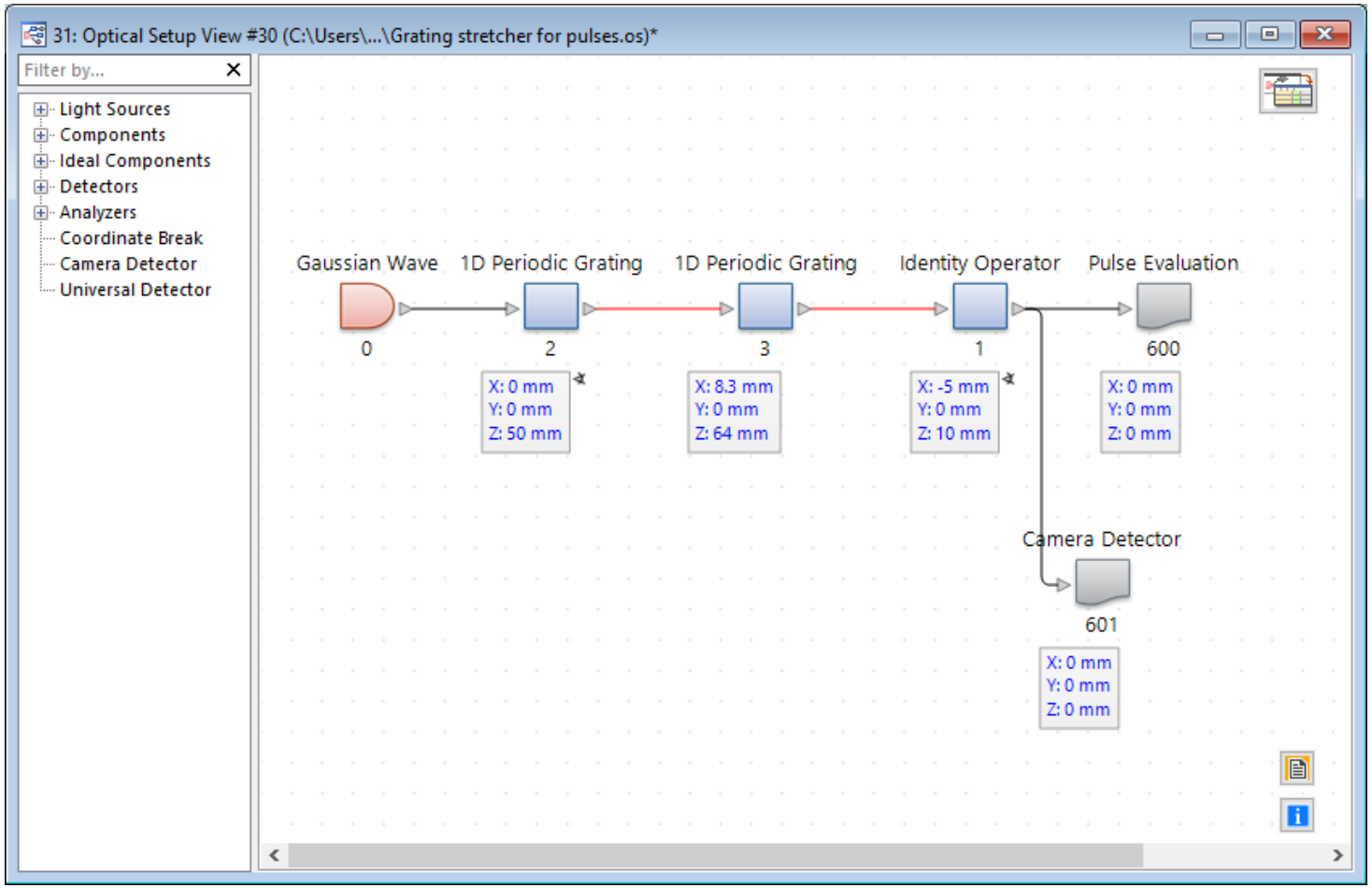


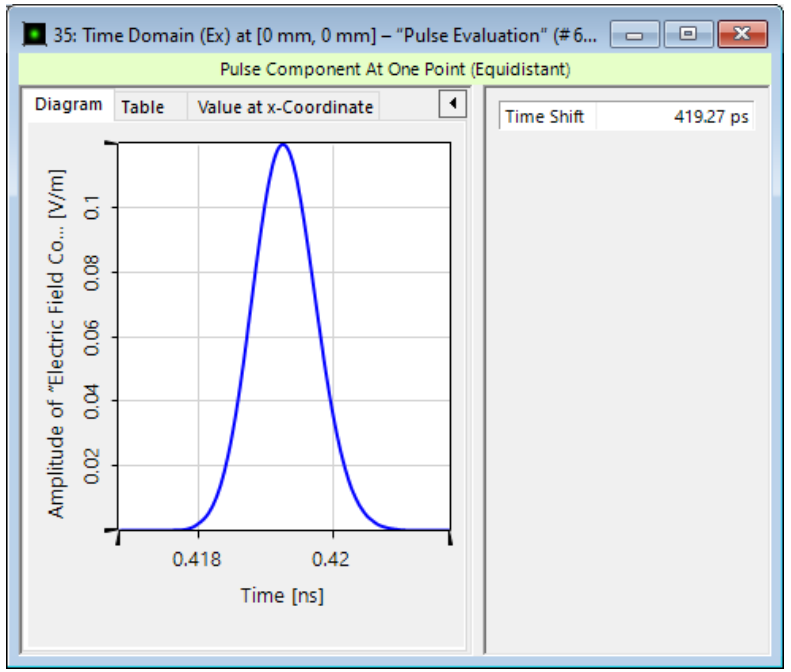


Simulation Times

VLF 2021.1 (Build 1.180): 52 sec
VLF 2023.1 (Build 1.554): **25 sec**

Example 4: Grating Stretcher



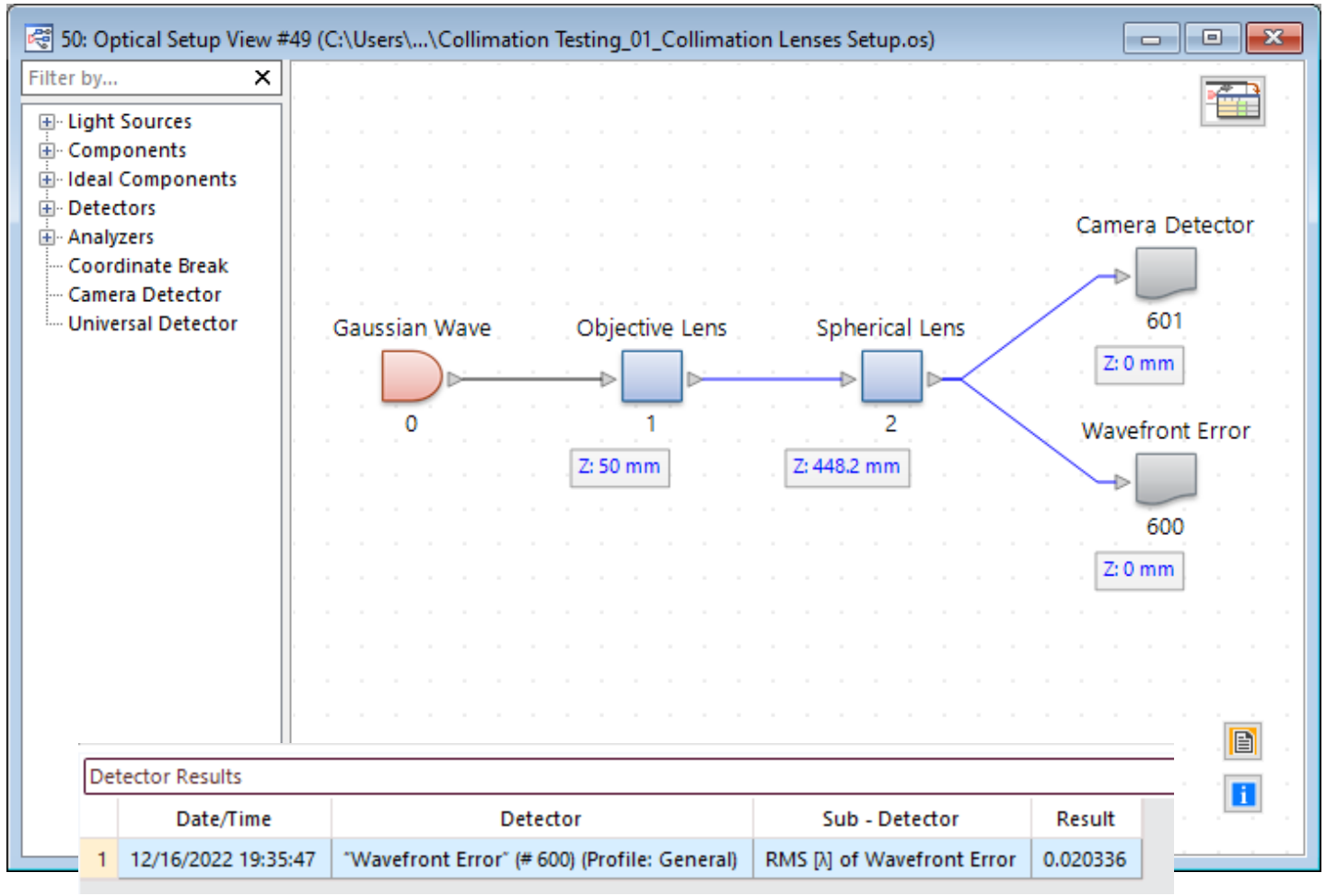


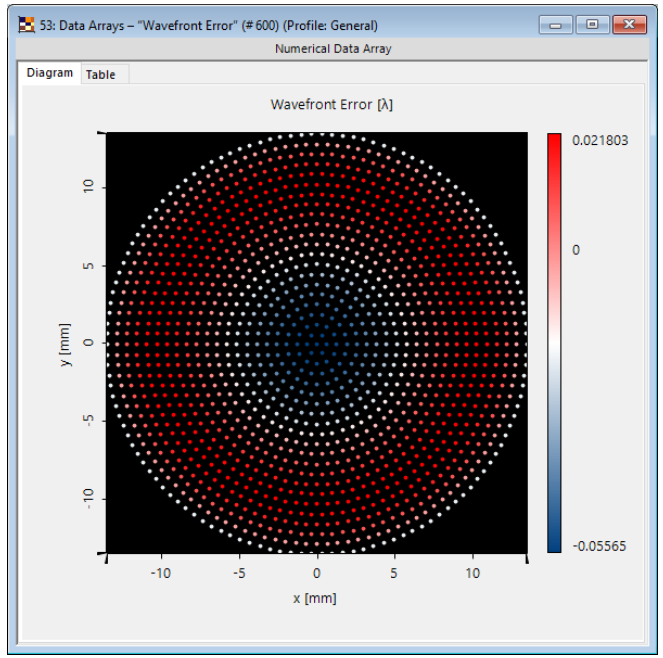
Use Case: Grating Stretcher for Ultrashort Pulses

Simulation Times

VLF 2021.1 (Build 1.180): 74 sec
VLF 2023.1 (Build 1.554): **33 sec**

Example 5: Analysis of Collimation System





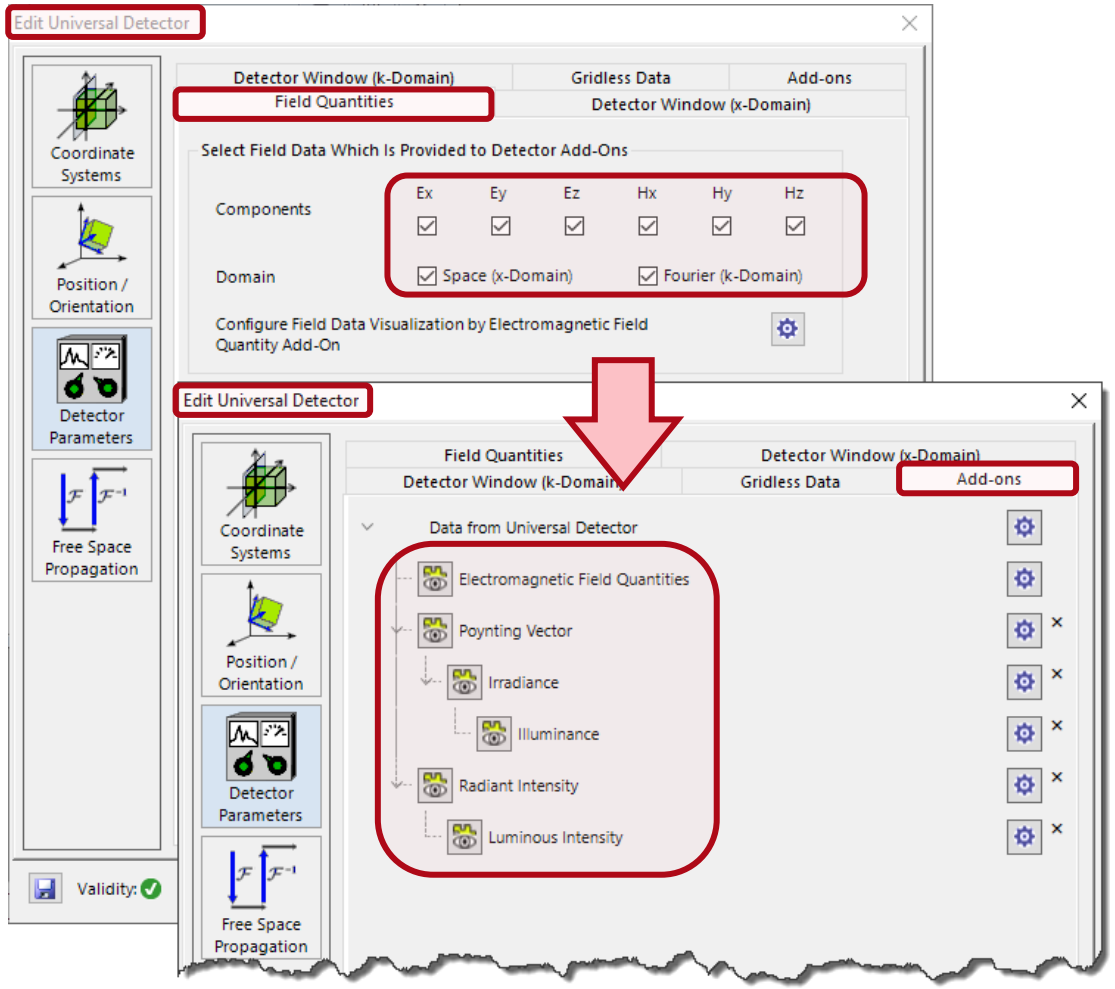
Use Case: Collimation Testing with Shearing Interferometry

Simulation Times

VLF 2021.1 (Build 1.180): 14 sec
VLF 2023.1 (Build 1.554): **5 sec**

Higher Modeling Speed in VLF 2023.1

- The new **Universal Detector** allows the calculation of any detector signal from the electromagnetic field.
- The field is calculated once in the detector plane and all detector signals are obtained from the same electromagnetic field data.
- This significantly increases the modeling speed by avoiding multiple calculations of field data.
- Figure: In the example the Poynting vector, radiant intensity, luminous intensity, illuminance and irradiance is calculated from the field data.

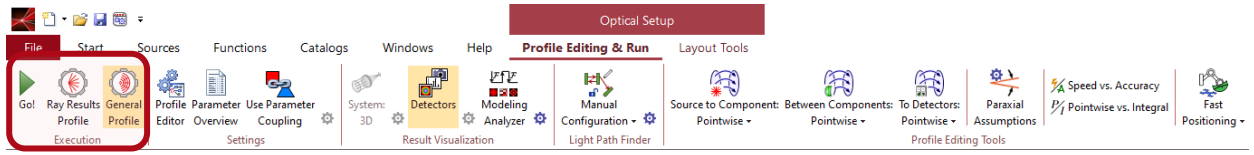


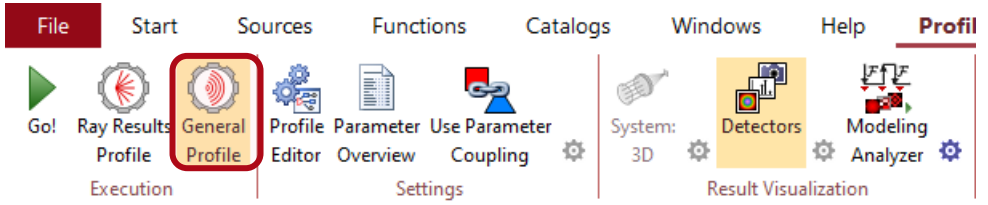
Profile Editor

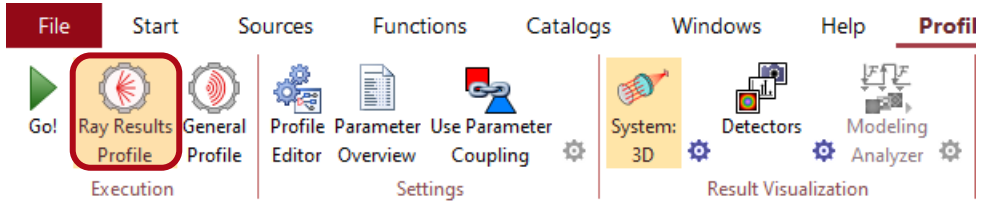
VirtualLab Fusion 2023.1 feature overview

Modeling Profiles

- VirtualLab Fusion stores optical systems in .os files. These files include all parameters about the system layout, sources, components, and detectors.
- VLF 2023.1 introduces the concept of Modeling Profiles which are also stored in the .os files.
- The Modeling Profiles allow the configuration and storage of the modeling settings.
- Optical systems come with the General Profile, which enables an unrestricted editing of the modeling settings.
- The additional Ray Results Profile is pre-configured to enable fast access to results known from ray optics.
- The profiles enable a **seamless control of the inclusion of diffraction in physical optics modeling.***







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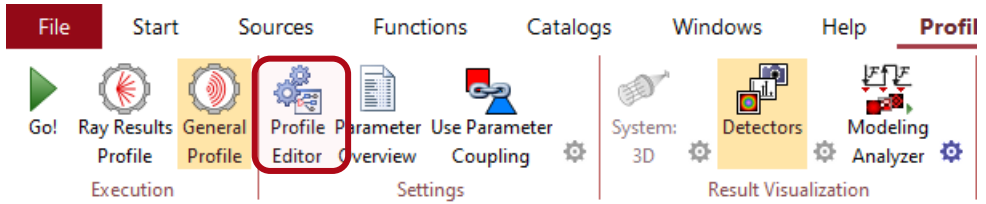
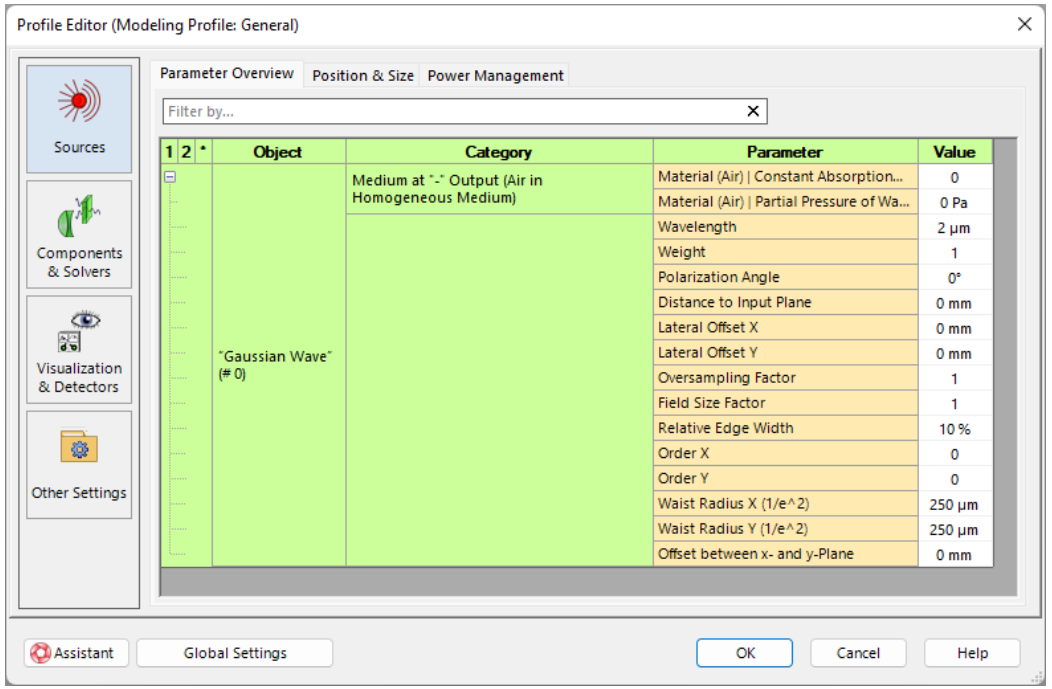
Profile Editor

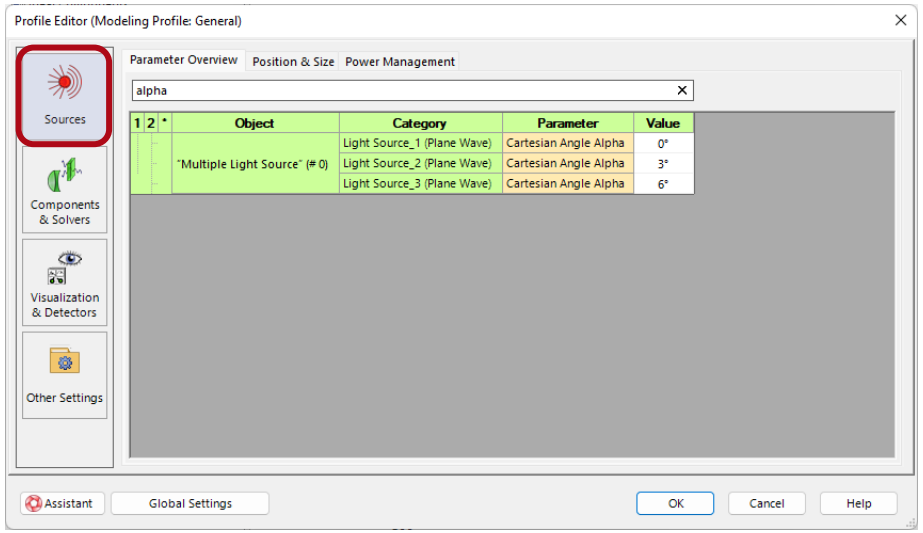
- VLF 2023.1 drastically improves the access to all relevant parameters in an optical system and its modeling (.os file).
- The center for modeling control is the Profile Editor. It gathers parameters from all other places and dialogues and systematically present them in one dialogue.
- The first version of the Profile Editor is released with VLF 2023.1 and combines a parameter overview and an easy parameter access with smart internal editing tools.
- This Profile Editor offers a new and *additional* user interface for system and modeling configuration. No other dialogues were removed.

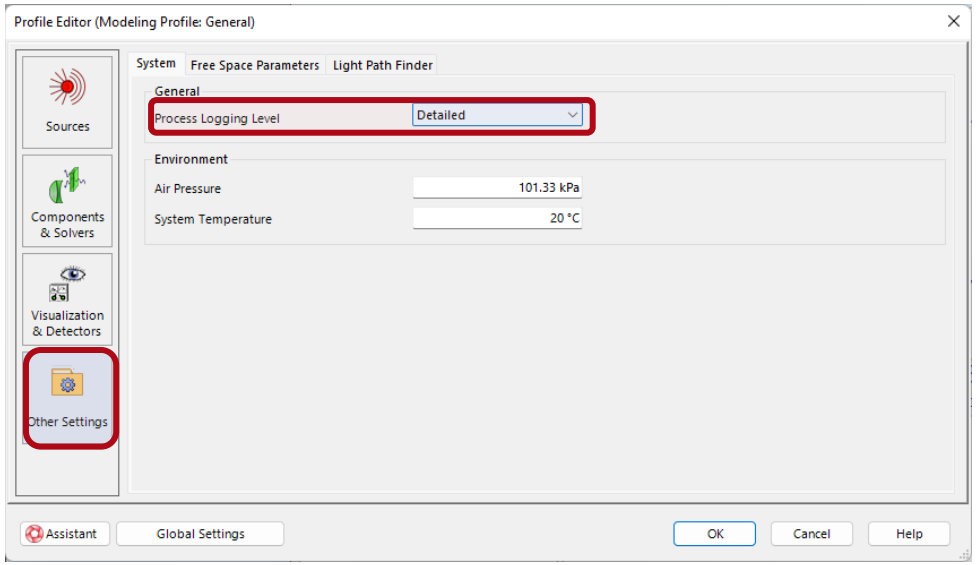




Profile Editor

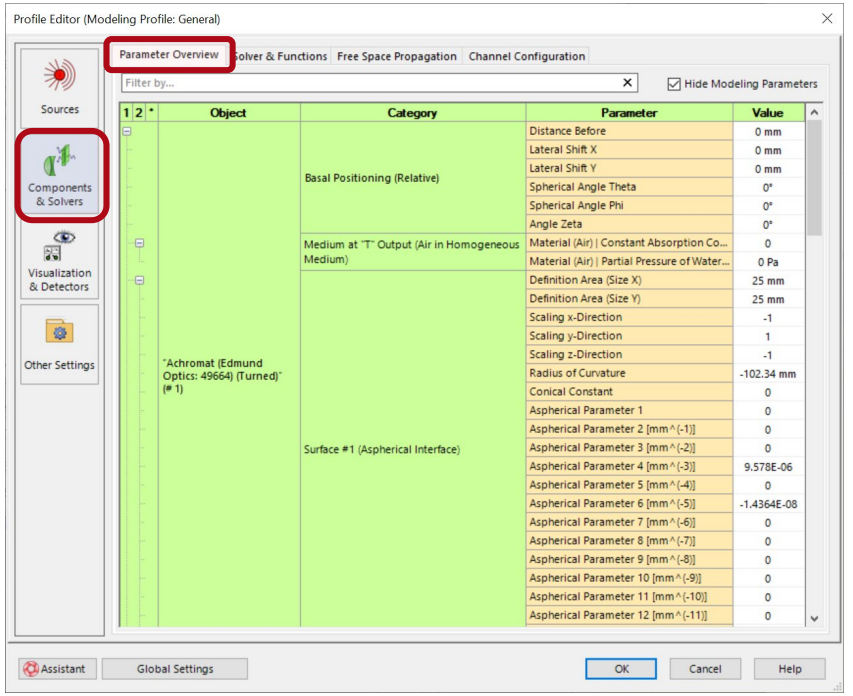
- The basic categories of the Profile Editor are:
  - Sources
  - Components & Solvers
  - Visualization & Detectors
  - Other Settings
- The source tab gives access to all source parameters. VLF 2023.1 is still restricted to one major source. But the Multiple Light Source provides already a great way to work with a collection of sources in one system.
- Each system requires some basic settings which can be set in Other Settings.
- **Process Logging** provides deep insight into the modeling and its performance. While initializing a system we recommend normal/detailed logging. For simulation series and optimization, logging should be switched off to save, though small, contribution to cpu time.

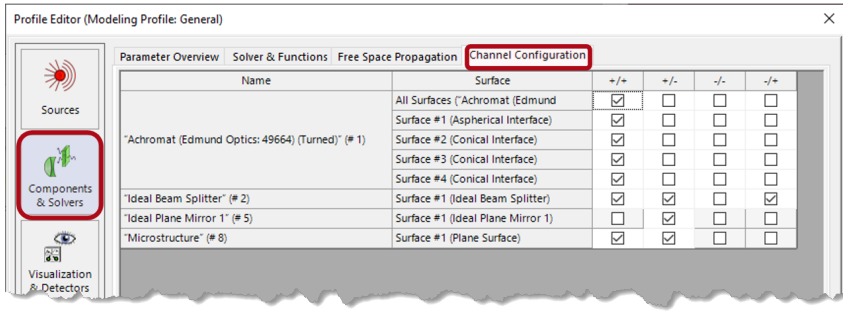




Profile Editor – Components & Solver

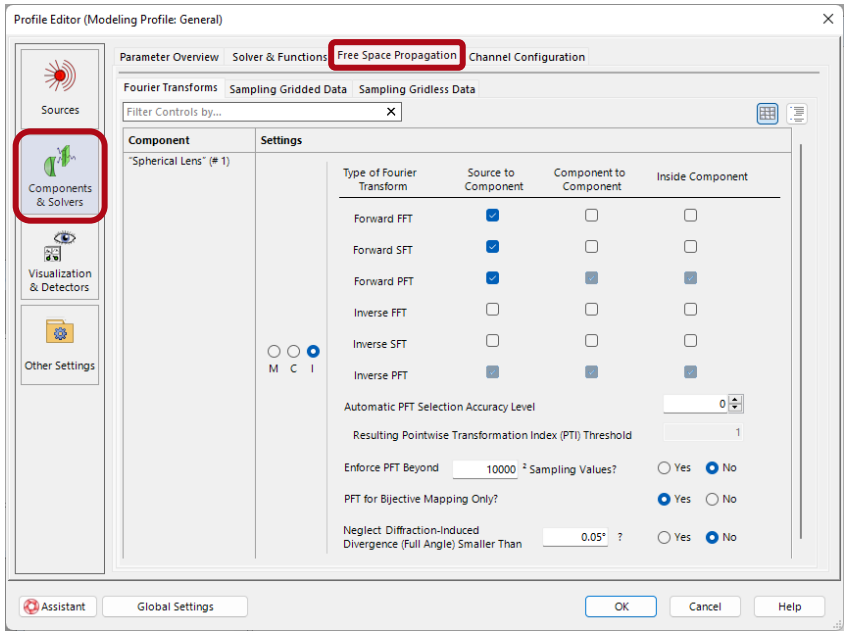
- The tab Components & Solver gives access to the categories
  - Parameter Overview
  - Solver & Function
  - Free Space Propagation
  - Channel Configuration
- The Parameter Overview provides an excerpt of the System Parameter Overview per component.
- The Solver & Function tab will give access to all related parameters per component. However, in the first editor version which comes with VLF 2023.1, most of these parameters are not yet gathered from the component dialogues.
- The Channel Configuration tab enables easy configuration of non-sequential modeling per component.

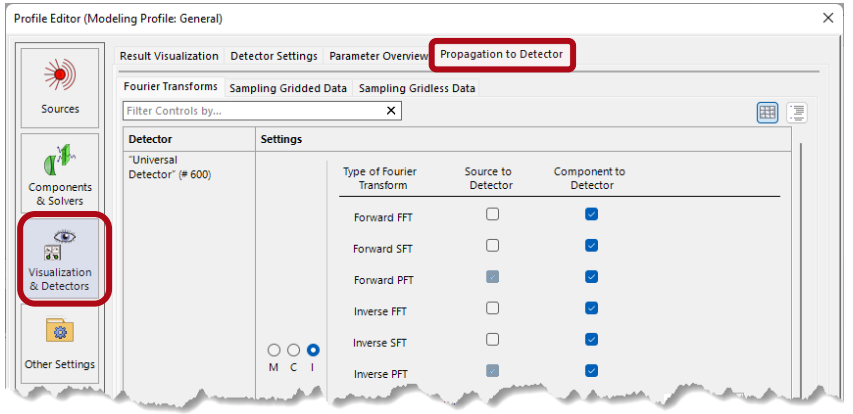




Profile Editor – Free Space Propagation

- The propagation from sources to components and detectors as well as between components constitutes the key technology for connecting the sources with the component solvers and with the detectors.*
- It is controlled by the tab Free Space Propagation for components and Propagation to Detectors for detectors.
- The Profile Editor enables detailed settings of the Fourier transforms in the modeling and by that a seamless control of the inclusion of diffraction in physical optics modeling.*
- VLF 2023.1 provides various **tools** to help with these settings together with technical background information to master this key technology easily.





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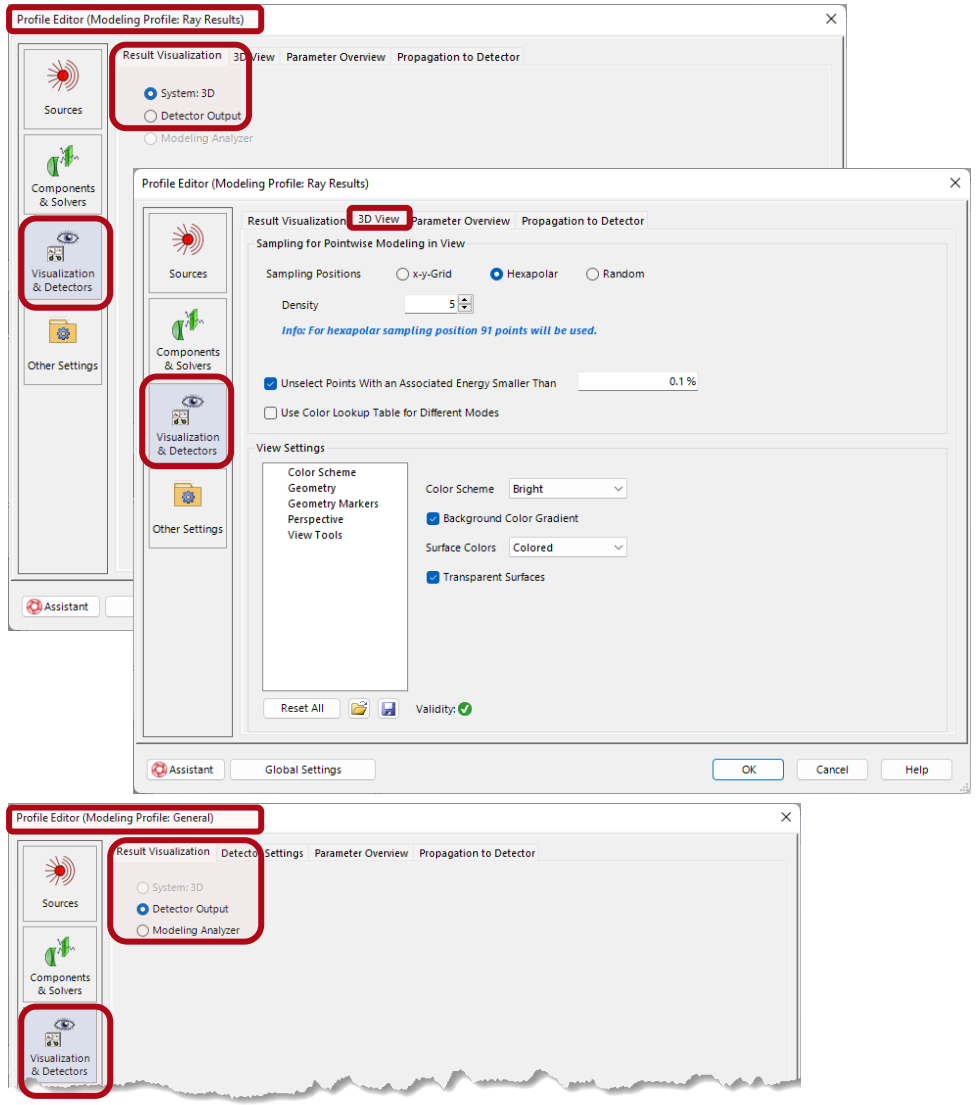
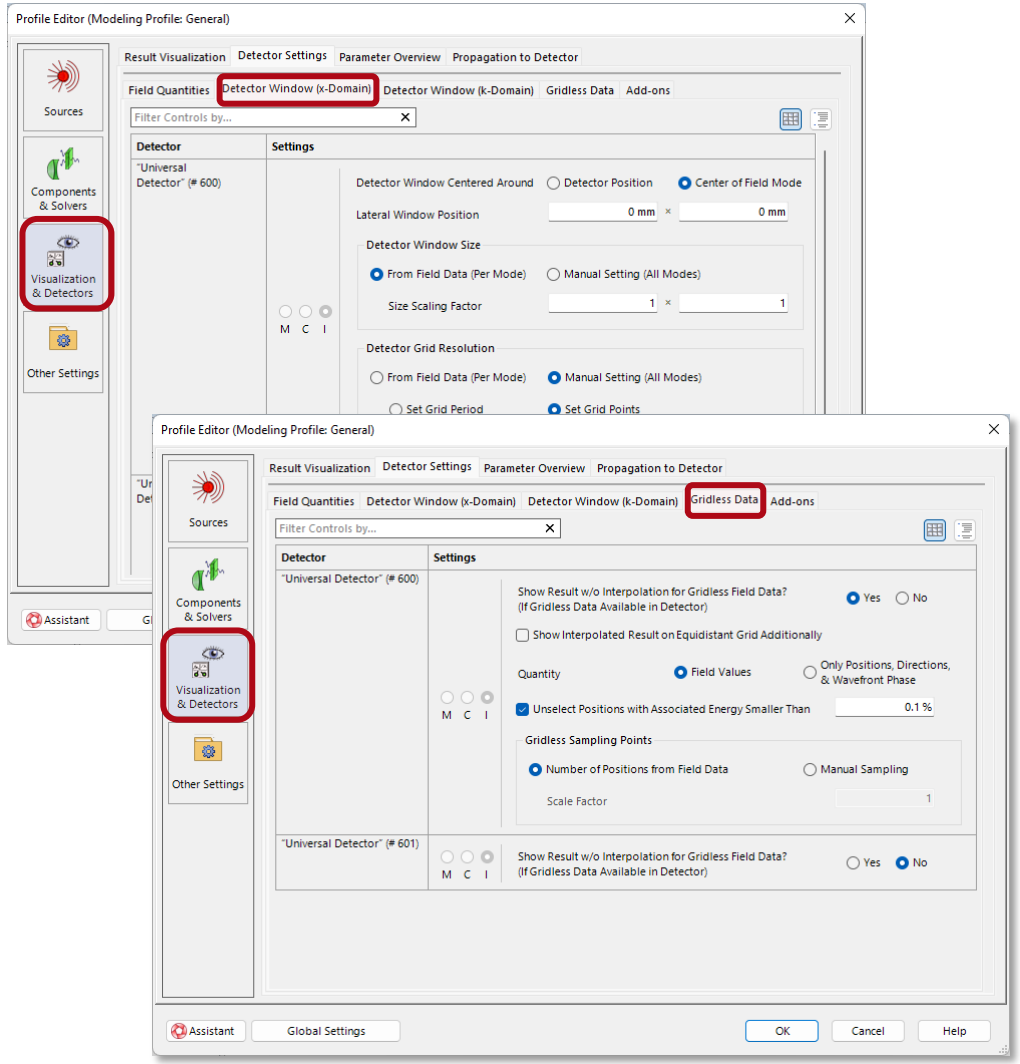
Profile Editor – Detectors & Visualization

- Results can be visualized by:
  - System 3D illustrations
  - Data views from detectors
  - Data views from Modeling Analyzer
- Since light propagation in 3D systems is illustrated by rays, VLF 2023.1 provides the selection of 3D System visualization in the Ray Results Profile only.
- Detector outputs can be generated in both profiles. In the Ray Results Profile, they are restricted to dot diagrams, direction diagrams, and visualization of wavefront phase/OPL.
- The General Profile enables the selection of the **Modeling Analyzer** also.



Profile Editor – Detectors & Visualization

- The first version of the Profile Editor provides all parameters of the new **Universal Detector**.
- The parameters include the Propagation to Detector settings and by that seamless control of the inclusion of diffraction in the propagation to detectors.
- The Detector Settings allow the selection of field quantities to be evaluated in x- and k-domain, and the specification of the detector windows with respect to size and sampling.
- If the last step in the modeling of propagation to the detector is pointwise, the field values reach the detector in form of gridless data. VLF 2023.1 allows the display of this point cloud with field values or positions only.
- This provides direct access to dot diagrams known from ray optical modeling.



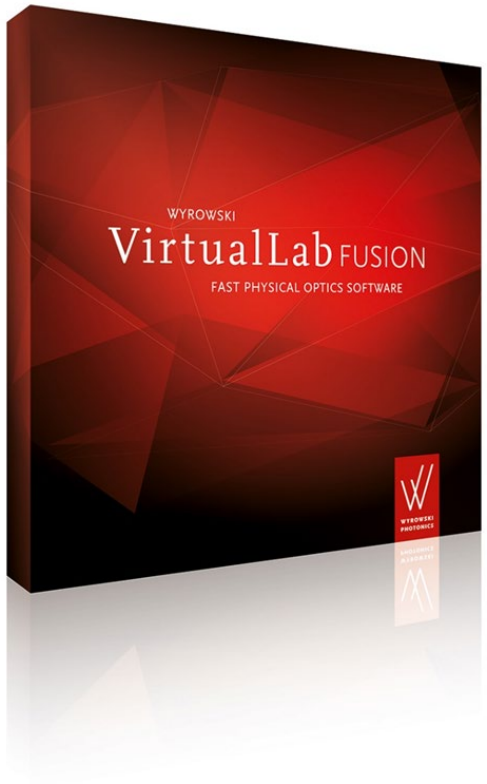
Learn More About Profile Editor

Videos

- Modeling Profile Editor
- Parameter Overview
- Source - Position & Size
- Source - Power Management
- Component - Solvers

Use Cases

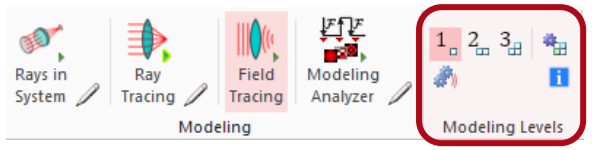
- Profile Editor
- Configuring Your Simulation in VirtualLab Fusion
- Free Space Propagation Settings



Profile Editing Tools

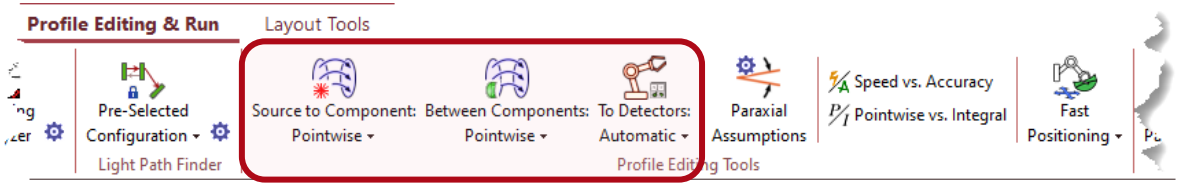
VirtualLab Fusion 2023.1 feature overview

Profile Editing Tools: Control Inclusion of Diffraction



Before

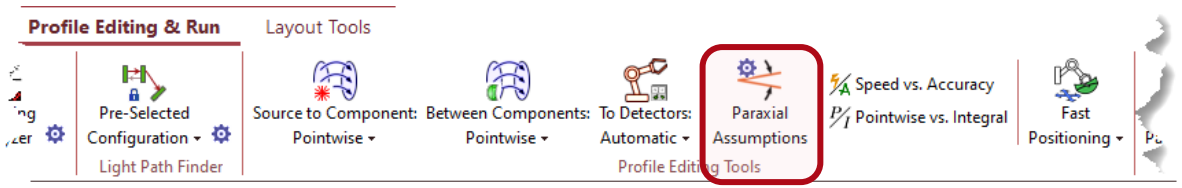
New in VLF 2023.1

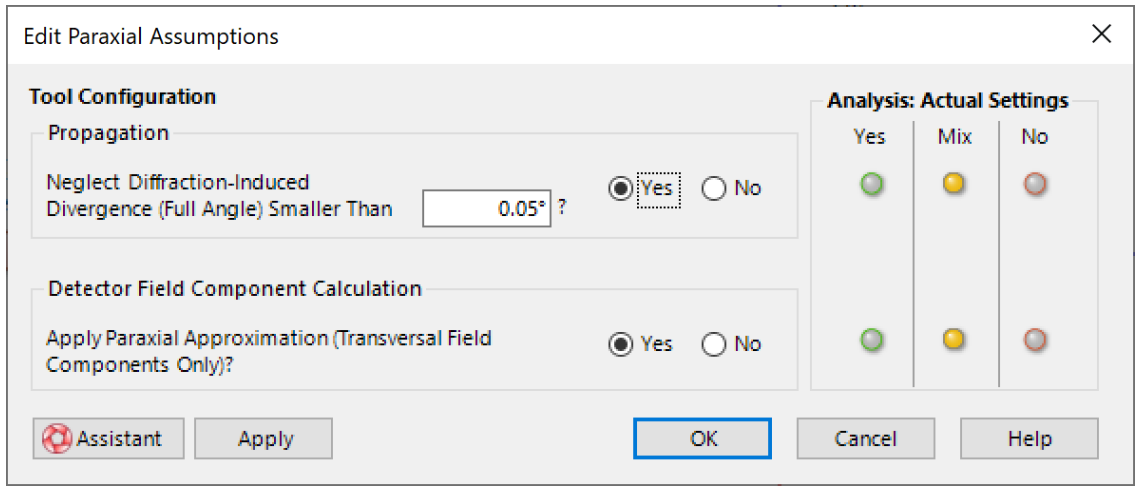


- The seamless control of the inclusion of diffraction in physical optics modeling constitutes one of the key technologies in VirtualLab Fusion.*
- Before VLF 2023.1, this control was simplified by the introduction of modeling levels. With VLF 2023.1, this concept is further developed and becomes more transparent.
- The new tool allows selecting pointwise propagation and by that diffraction is neglected independent of the magnitude of diffraction.
- In the automatic propagation mode of operation VLF 2023.1 evaluates the magnitude of diffraction for each propagation step.
- If the magnitude of diffraction is smaller than a preselected threshold, VLF 2023.1 switches from integral to pointwise propagation.

 *Register for webinar series on VLF 2023 now.

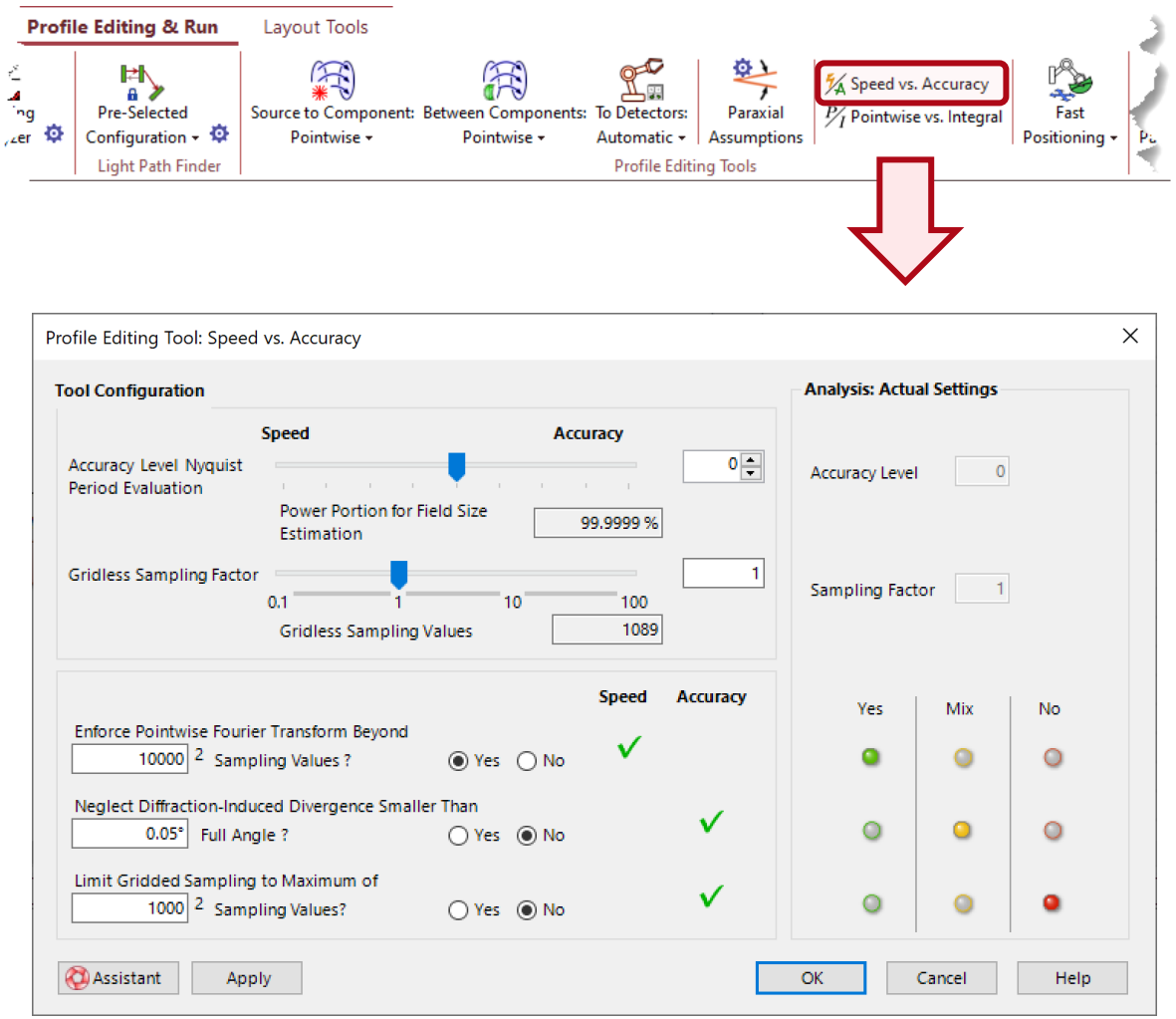
Profile Editing Tools - Paraxial Assumptions





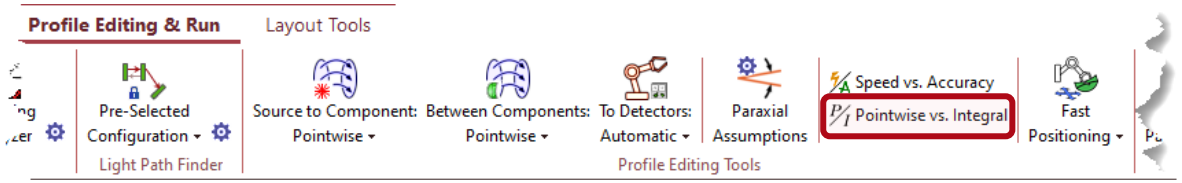
- The development of diffraction effects by propagation of paraxial light can be very slowly.
- That means, the diffraction-induced divergence of the paraxial beam is small.
- In VLF 2023.1 small diffraction effects of paraxial beams can be neglected to further accelerate the modeling or for other reasons.
- VirtualLab Fusion applies vectorial physical optics in all modeling steps.
- By that the results show vectorial effects when they occur.
- It is well known, that for paraxial light, vectorial effects are predominantly confined to the transversal field components.
- VLF 2023.1 enables the active restriction to vectorial effects of the transversal field components to further accelerate simulations.

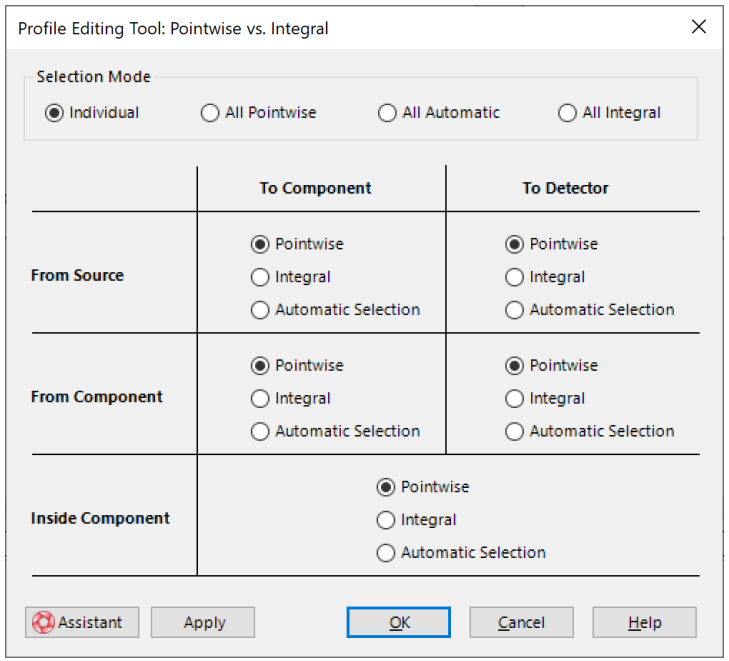
Profile Editing Tools - Speed vs. Accuracy



- VLF 2023.1 provides a tool for a compact and direct control of balancing modeling speed and modeling accuracy.
- The sampling of field data has a significant effect on modeling speed and accuracy. The tool provides access to control equidistant and gridless sampling of field data.
- The pointwise Fourier transform (PFT) algorithm uses significantly less sampling points than the FFT and is therefore often much faster. Enforcing the PFT comes at the cost of less accuracy in inclusion of diffraction effects.
- The use of automatic sampling algorithms sometimes leads to oversampling and by that too high PC memory demand. VLF 2023.1 allows a general limitation of sampling. This comes together with a **new calculator for PC memory evaluation**.

Profile Editing Tools – Pointwise vs. Integral Propagation





- Because of the importance of field propagation in homogeneous media, e.g., air, VLF 2023.1 provides a new tool for its control.
- This tool allows a detailed selection of different propagation methods:
  - Pointwise: diffraction *neglected* independent of magnitude of diffraction
  - Integral: diffraction *included* independent of magnitude of diffraction
  - Automatic Selection: diffraction *included* dependent on the magnitude of diffraction.
- These selections can be independently done for propagation from and to sources, components, and detectors.
- An even more detailed access to these settings is provided on the propagation tabs in the Profile Editor.

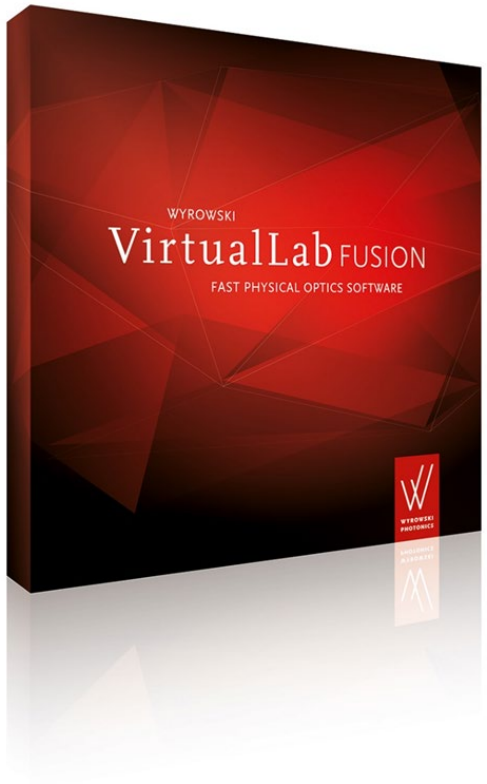
Learn More About Profile Editing Tools

Videos

- Propagation from Source to Component
- Propagation Between and Inside Components
- Propagation to Detectors
- Optional Paraxial Assumptions in Modeling
- Balance Modeling Speed vs. Accuracy
- Pointwise vs. Integral Operations

Use Cases

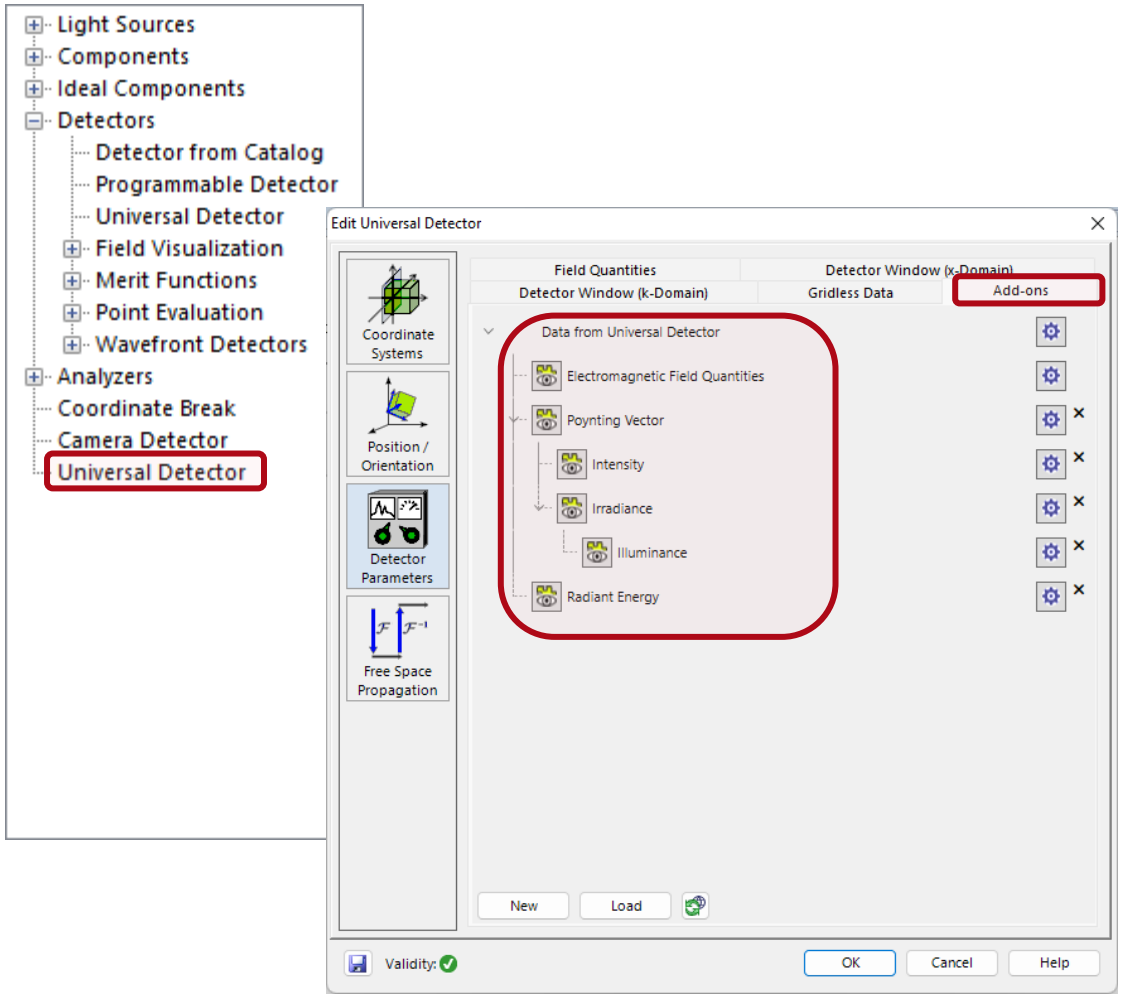
- Profile Editor
- Paraxial Assumptions Tool
- Speed vs Accuracy Tool
- Free Space Propagation Settings



Universal Detector

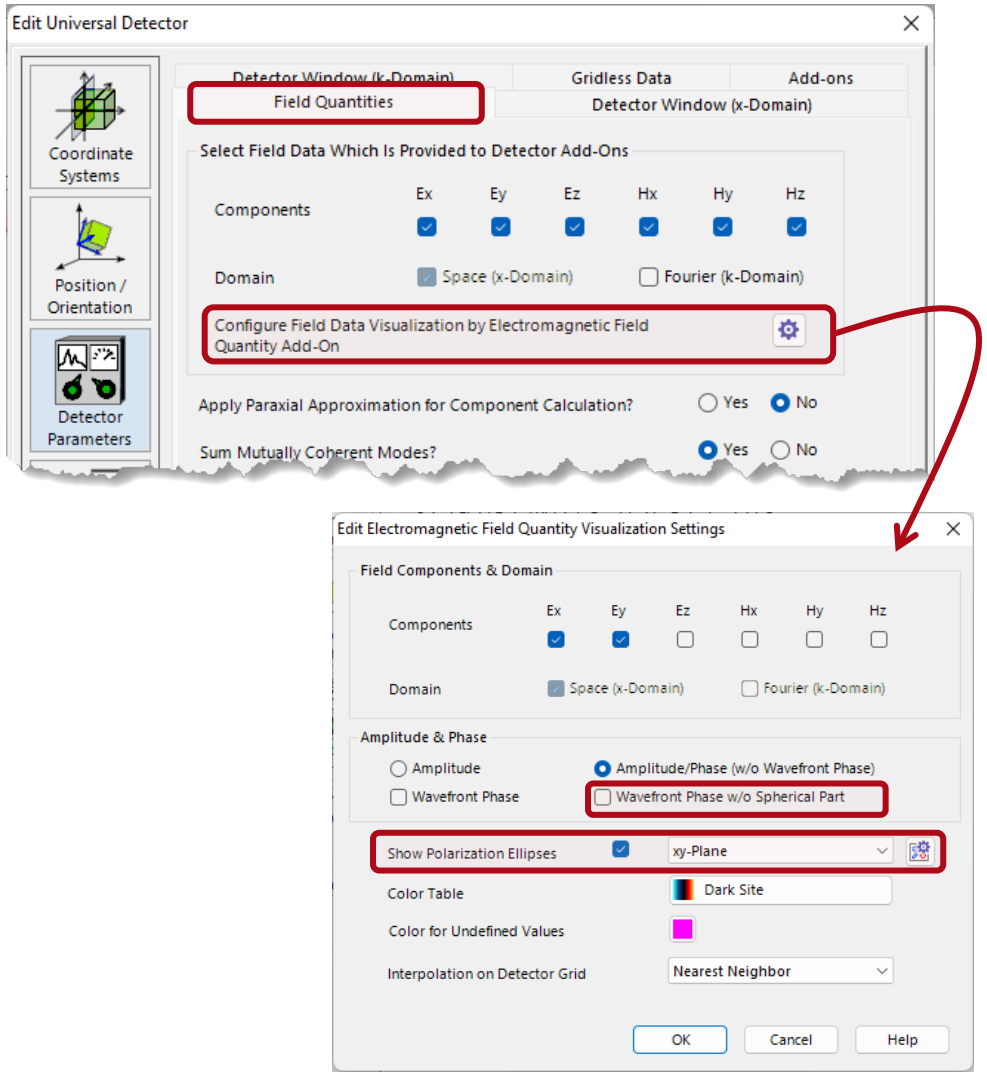
VirtualLab Fusion 2023.1 feature overview

The Detector Revolution



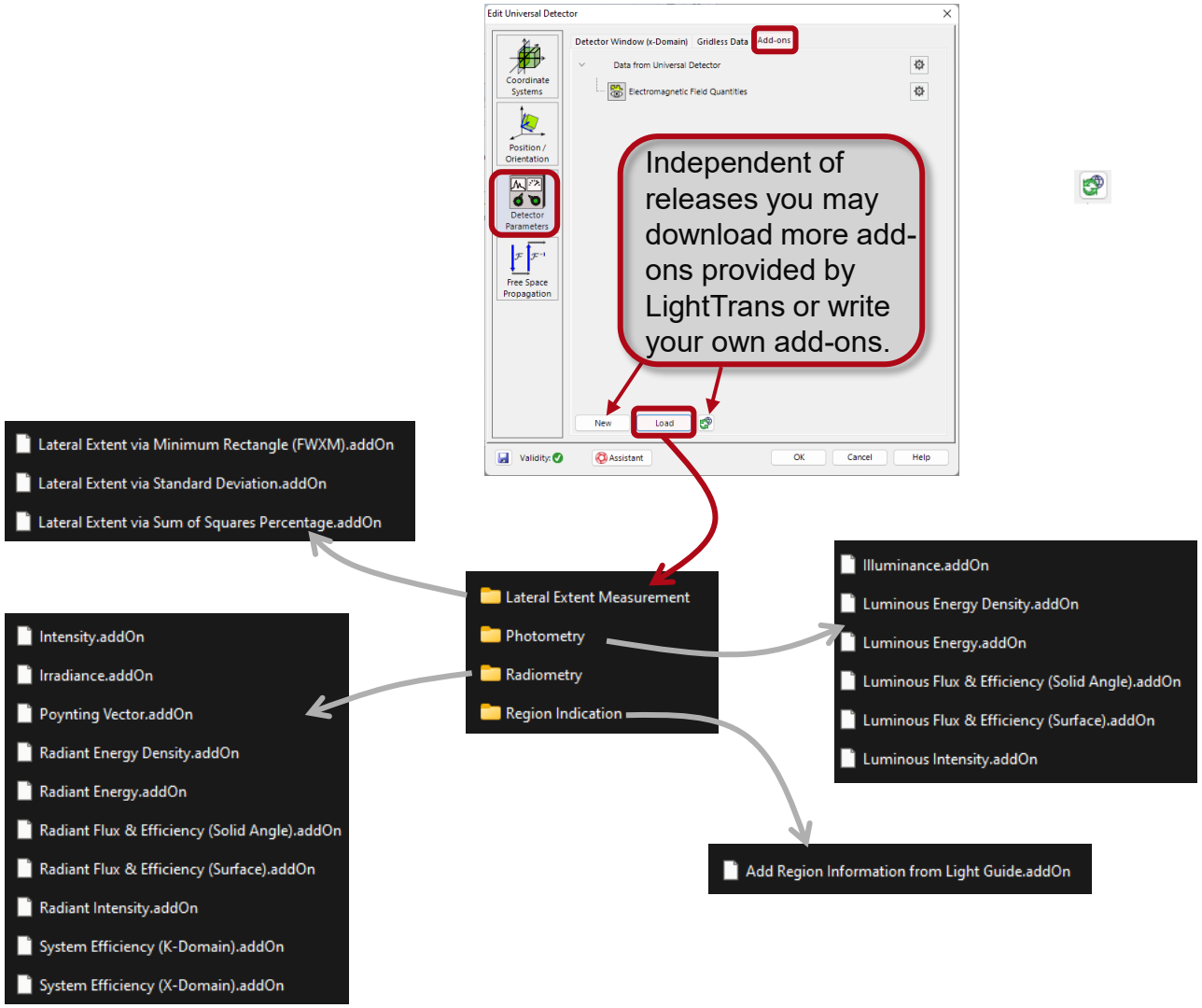
- Light is fully described by electromagnetic fields. Physical optics modeling provides electromagnetic fields and by that unrestricted access to all light quantities.
- Before VLF 2023.1 fields had to be propagated to any selected detector. With VLF 2023.1 we change that drastically by fully exploiting the power of physical optics.
- Any detector function can be applied to light which is propagated to the new Universal Detector.
- This is done by add-ons in the detector which enables an ever-growing number of detector functions, e.g., spot size, aberrations, M^2, radiometry and photometry quantities.
- And the best of it: any missing detector function can be delivered quickly on customer request without a new software release.

Universal Detector – Field Quantities and Their Visualization



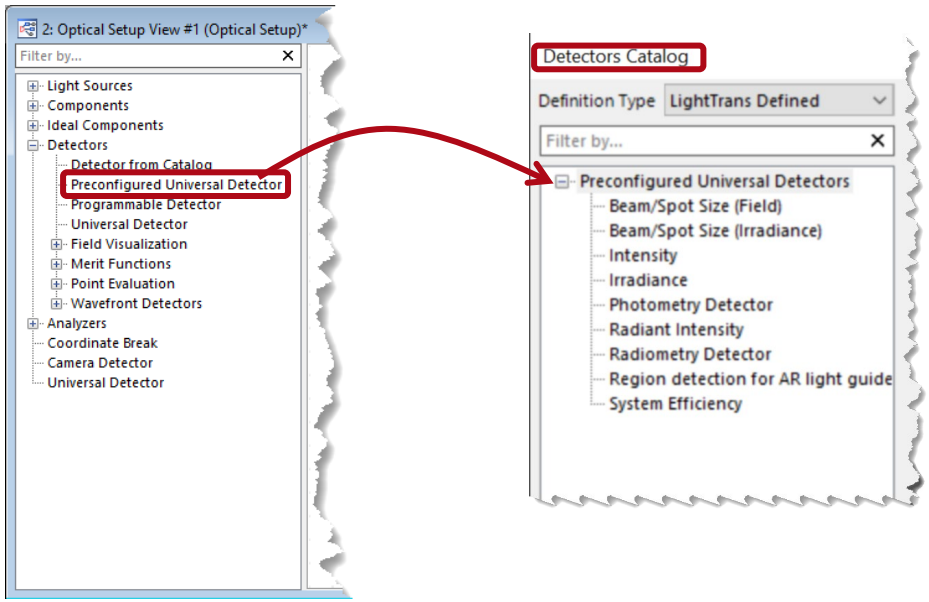
- The Field Quantity settings allow the selection of the field quantities which are needed for further processing by detector add-ons.
- The field visualization can be configured in the Field Quantity Add-on.
- It enables the selection of the field components to be visualized.
- For the selection of amplitude and phase VLF 2023.1 offers the extra feature to show the wavefront phase without the spherical part and by that the aberrations only.
- The Universal Detector enables the display of polarization ellipses as **Graphics Add-ons**.

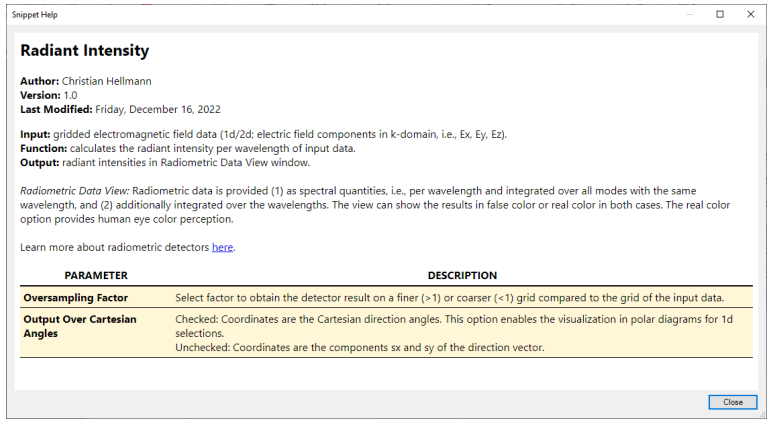
Universal Detector: Add-ons With Release of VLF 2023.1



- With the release VLF 2023.1 comes with detector add-ons for
  - Extent measurements for any lateral signal, e.g., beam size
  - Radiometry
  - Photometry
  - Region indication in detector outputs
- More detector add-ons are provided steadily and independent of further releases.
- If you miss a detector, send a mail to support@lighttrans.com.
- LightTrans' support team will contact you and make sure that you will get the missing detector soon.

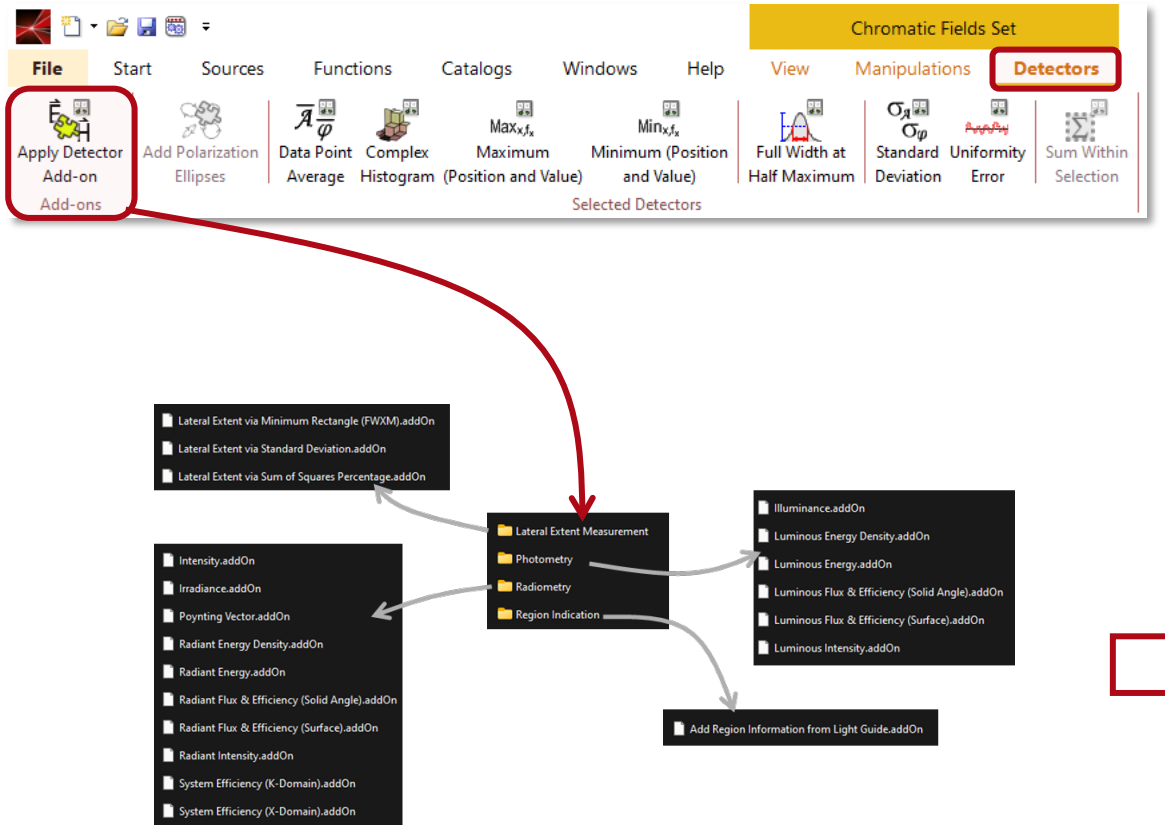
Preconfigured Universal Detectors



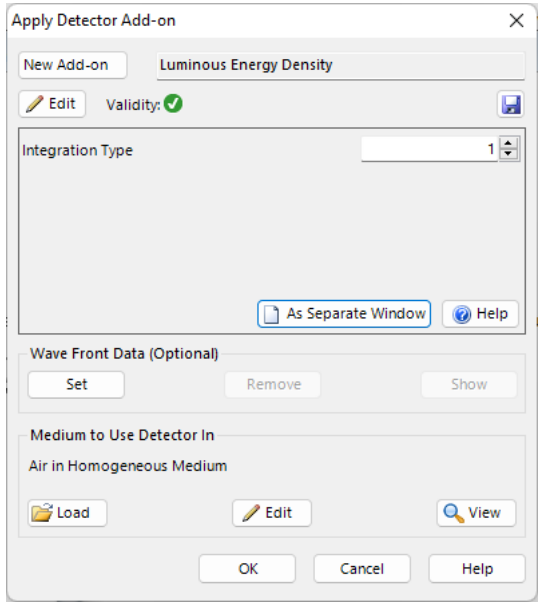


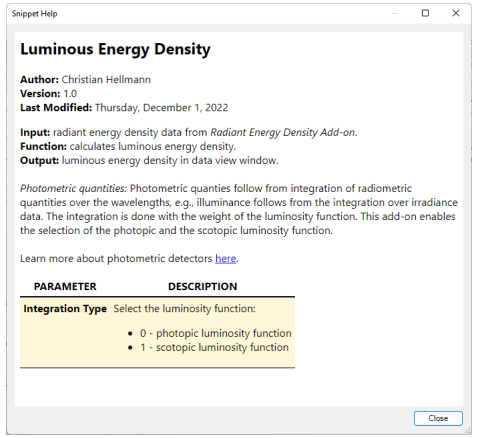
- Users can configure the universal detector by selecting and combining add-ons.
- This concept provides an amazing flexibility to obtain the detectors which you need.
- As examples preconfigured universal detectors are added in the catalog:
  - Irradiance
  - Intensity
  - Radiant intensity
  - Radiometry
  - Photometry
  - Beam/Spot size (electromagnetic field)
  - Beam/Spot size (irradiance)
  - Region detection for AR light guide glasses
  - System efficiency

Post-Processing: Application of Detector Add-Ons

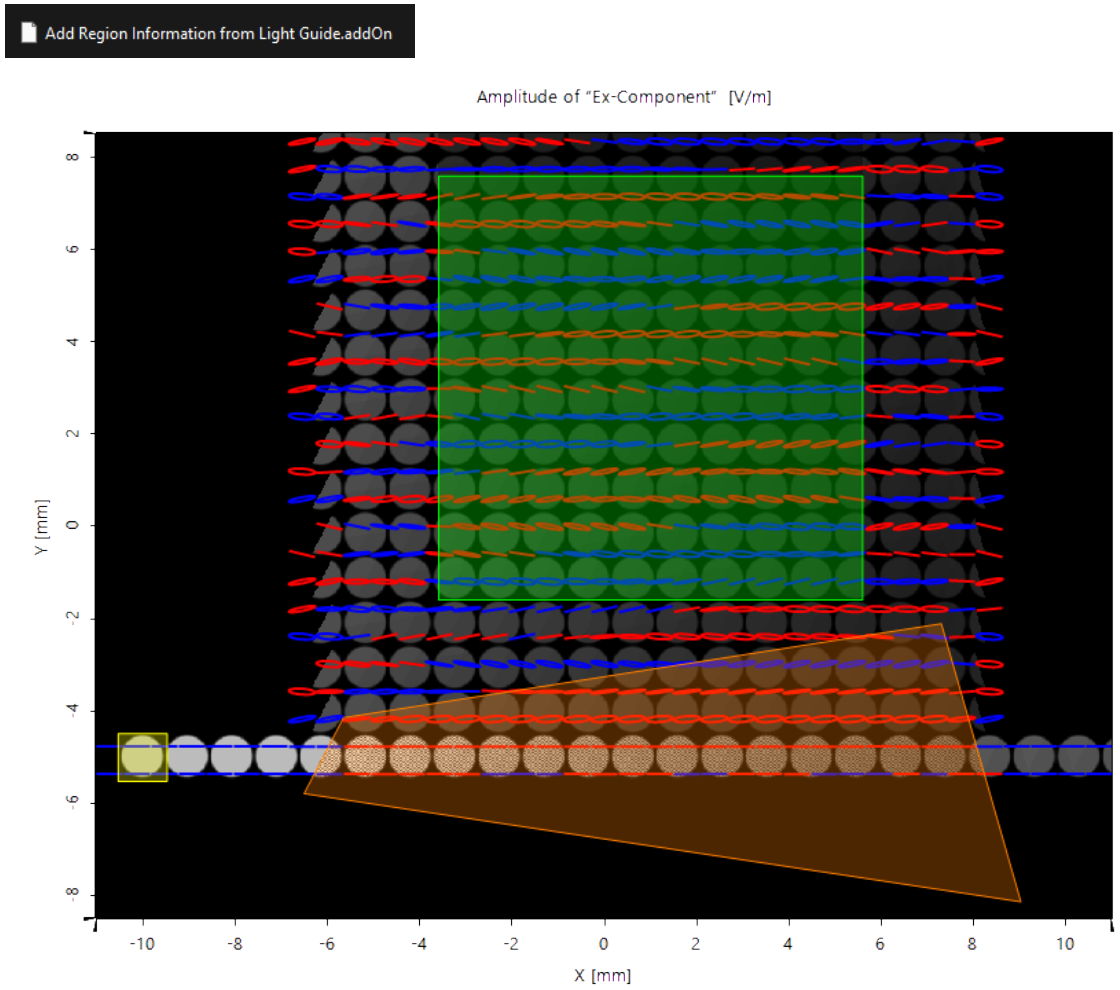


- The application of detector add-ons must not be done in the universal detector already but can be performed in a post-processing as well.



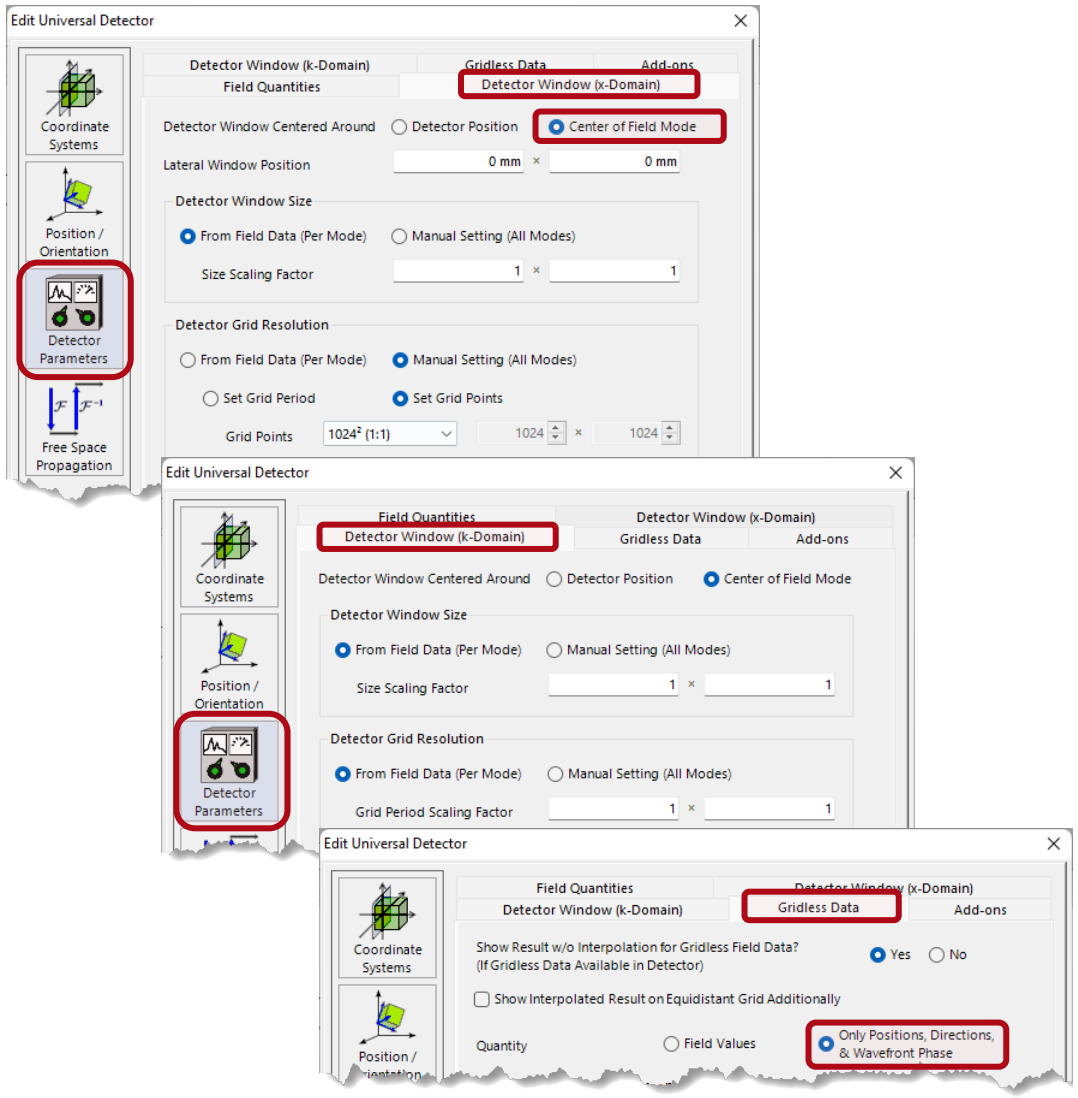


Universal Detector – Usage of Graphics Add-ons



- The Universal Detector add-on concept offers more flexibility to provide detector results.
- The detector add-ons can be combined with graphics add-ons.
- The display of the polarization ellipses in a detector result is an example of this new technique.
- With VLF 2023.1 this concept is further extended and applied to the indication of regions as well.
- The figure shows the example of the three grating regions of an AR glass layout together with the field inside the light guide.
- The green region indicates the outcoupling grating.

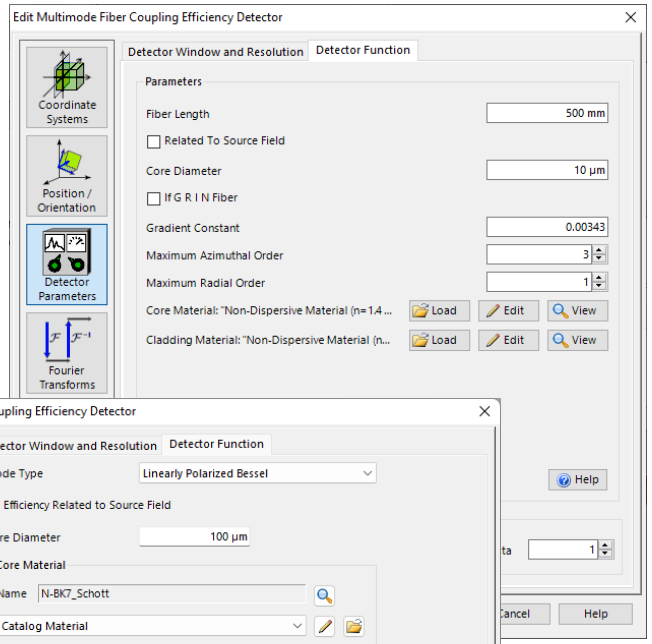
Universal Detector – Window Specifications



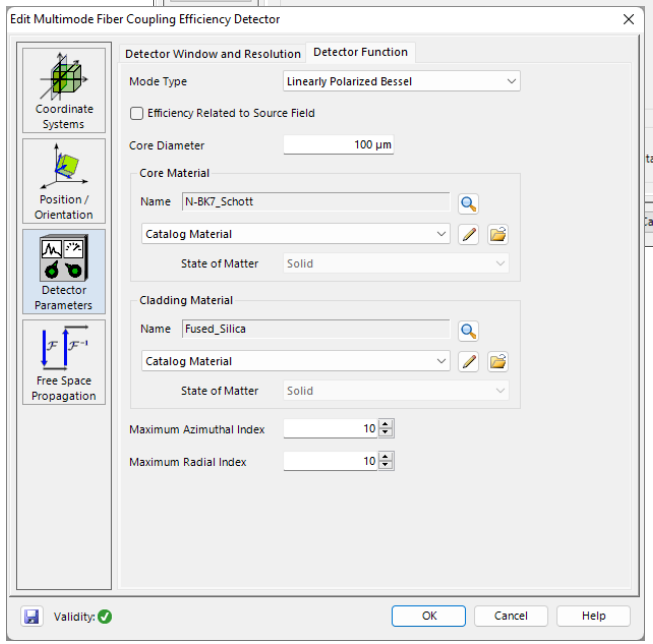
- The new Universal Detector enables an independent specification of the detector window in x- and k-domain.
- Often physical optics modeling leads to a set of correlated and uncorrelated field modes in the detector plane.
- VLF 2023.1 allows the display of all modes in the same window and coordinate system or alternatively in windows with the center of the individual modes.
- If field values reach the detector by a pointwise operation, gridless data is obtained.
- VLF 2023.1 allows the display of the field values, the phase values, the local directions, and the data positions at the gridless positions with and without lateral interpolation.

Multimode Fiber Coupling Efficiency Detector

VLF 2021:

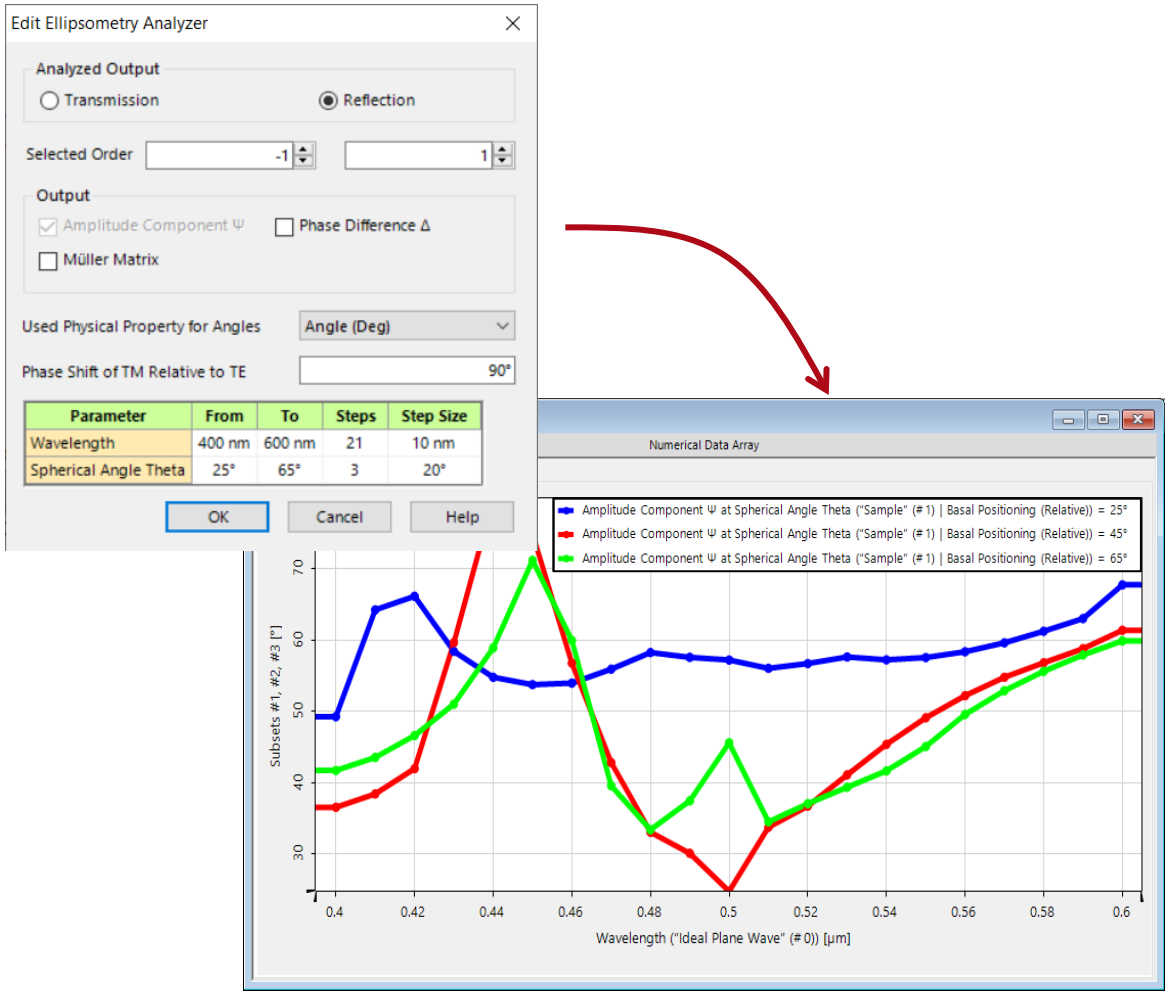


VLF 2023.1:



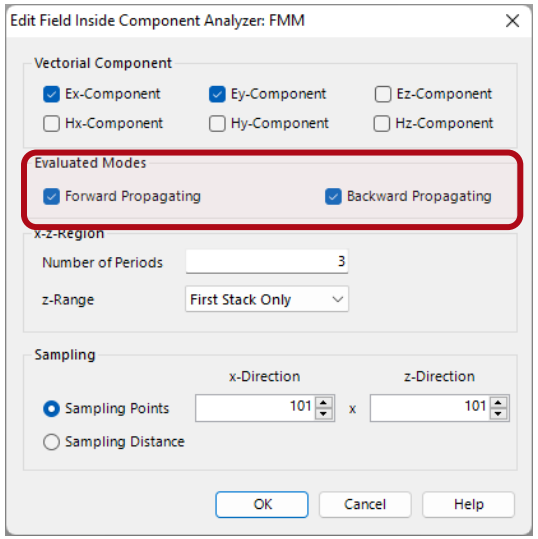
- The Multimode Fiber Coupling Efficiency Detector comes in a new version in VLF 2023.1.
- It provides a more user-friendly interface and an easier use.

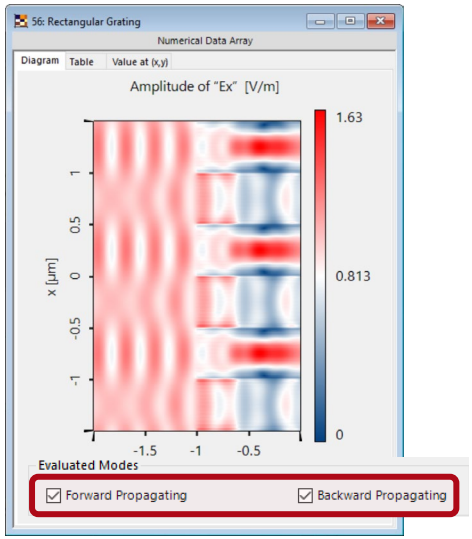
New Ellipsometry Analyzer

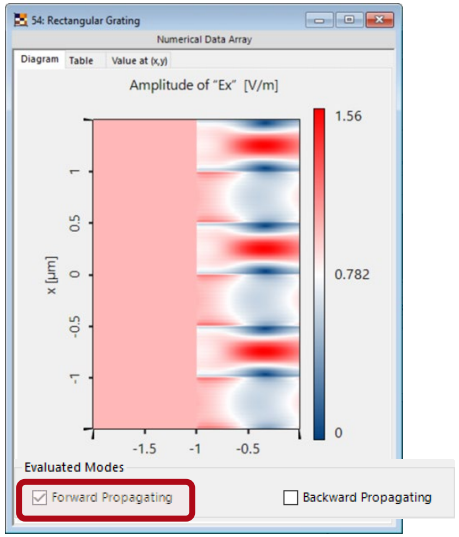


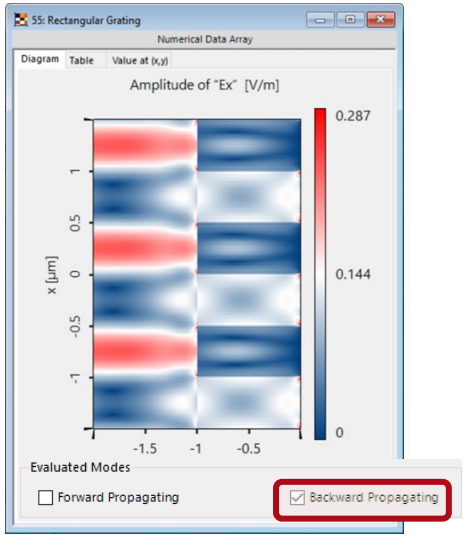
- VLF 2023.1 provides a new analyzer for ellipsometry evaluations of systems.
- It enables a full analysis of ellipsometry quantities like phase difference and Mueller Matrix.

New Feature @ Field Inside Analyzer









- The Field Inside Analyzer for the analysis of gratings with the Fourier Modal Method (FMM) shows the electromagnetic field inside the grating.
- VLF2023.1 allows the separate or superimposed investigation of forward and backward propagated fields inside the grating.

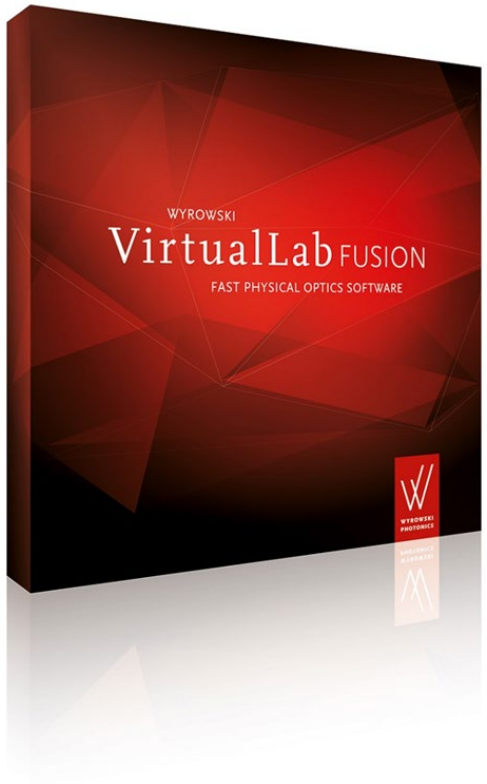
Learn More About Universal Detectors

Videos

- General Modeling Profile
- Source - Power Management
- Polarization Ellipses in Data Array Views
- Visualize Positions in View Windows

Use Cases

- Universal Detector
- Fresnel Curves on a Plane Surface
- Add Point Cloud to Data Array

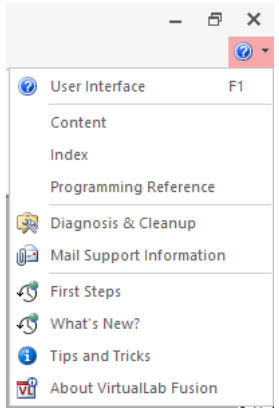


Help Center

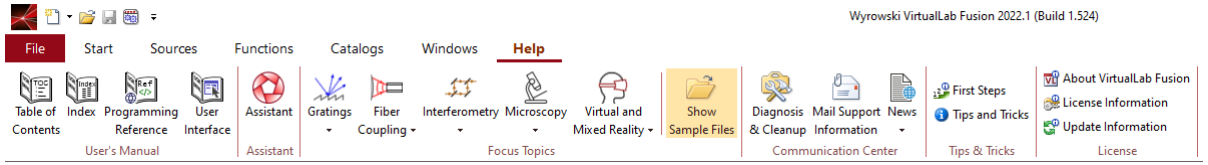
VirtualLab Fusion 2023.1 feature overview

Comprehensive Help and Assistant Concept

Before

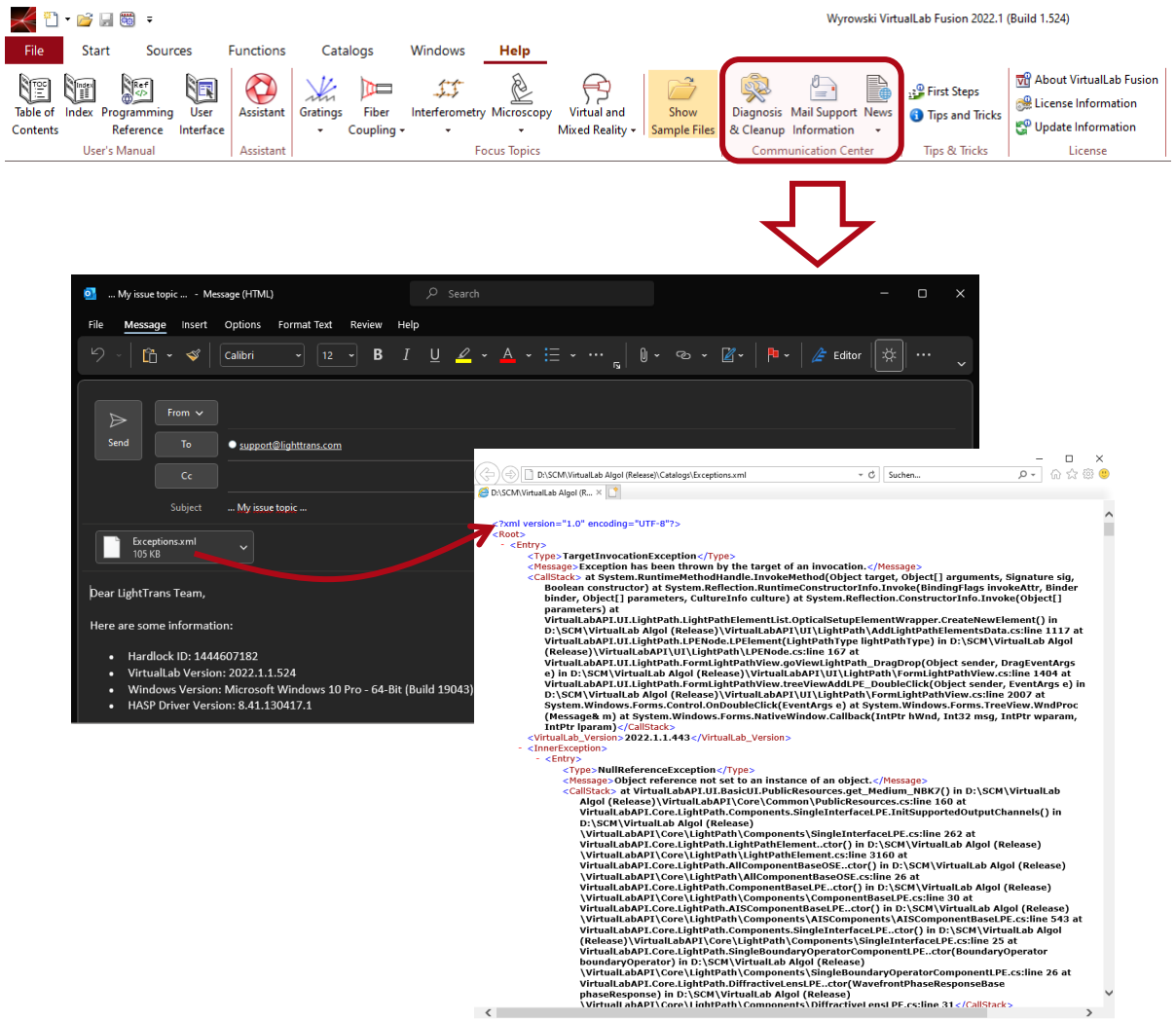


VLF 2023.1:



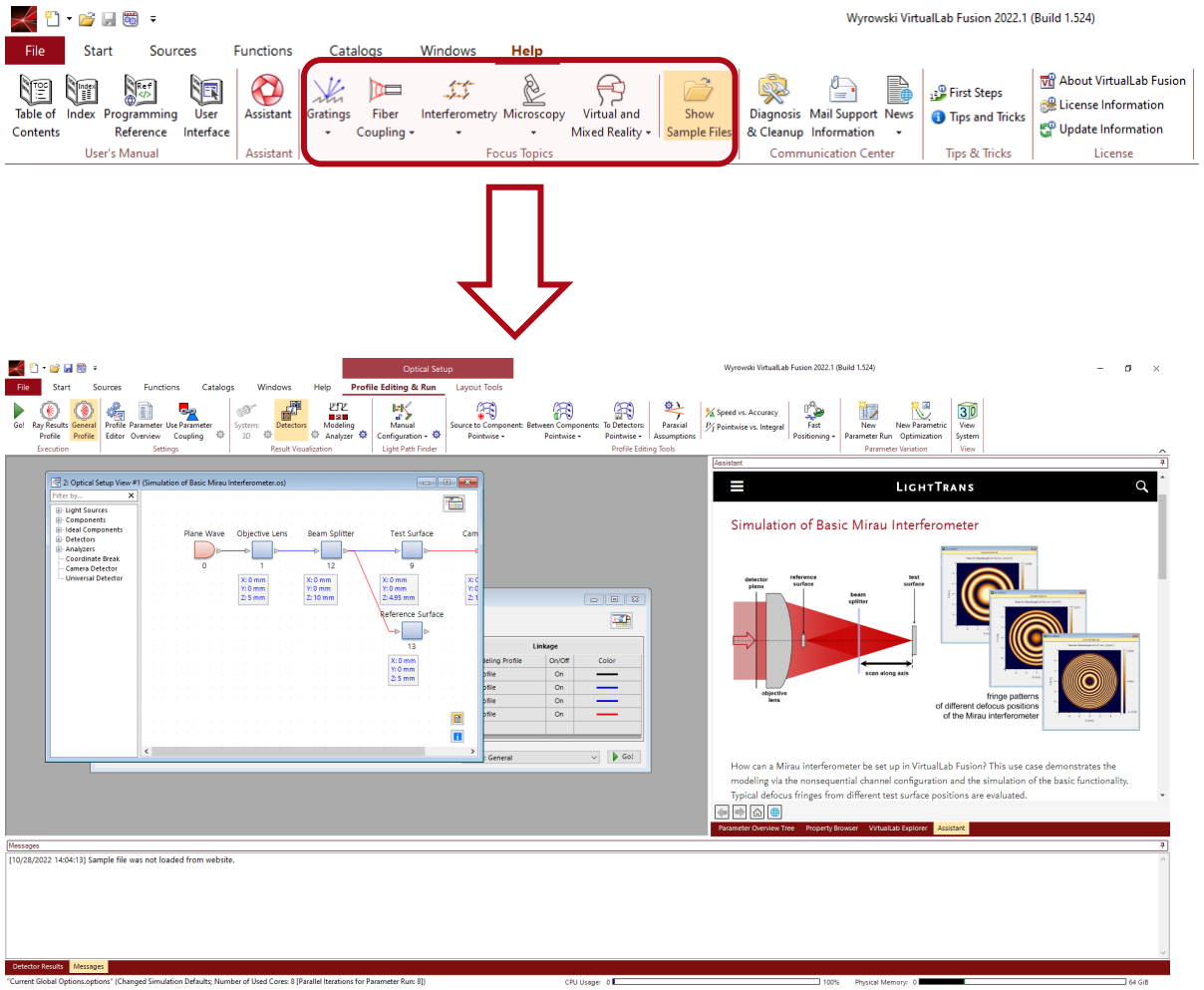
- VLF 2023.1 raises the help and assistant workflow to a new level.
- A new ribbon leads to the comprehensive help center.
- It gives access to the User's Manual, which provides all information about the meaning of objects and parameters of the user interface in VLF.
- Then we have the additional categories:
  - License information
  - Tips & Tricks
  - Communication Center
  - Focus Topics
  - Assistant

Communication Center



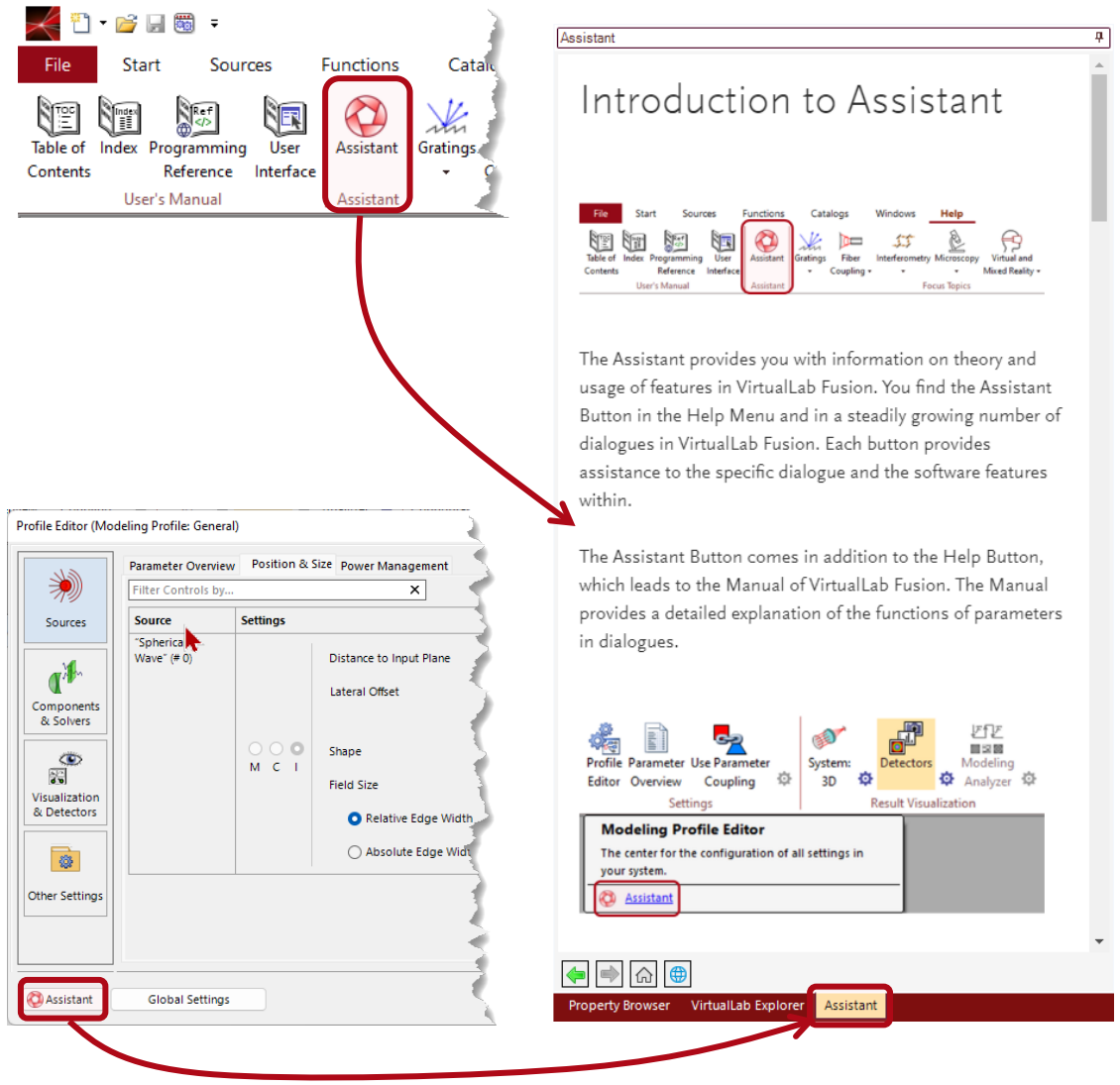
- VLF users appreciate the direct help through our support team.
- VLF 2023.1 facilitates the direct contact with the LightTrans team via the communication center.
- By clicking on *Mail Support Information* an email is generated, which includes all important information for the team to get to the core of your request fast.
- The ribbon *News* enables us to provide you with information of new developments, innovations, and other issues around VirtualLab Fusion in a timely manner.
- In short: VLF 2023.1 provides a more direct communication line between you and us.

Focus Topics



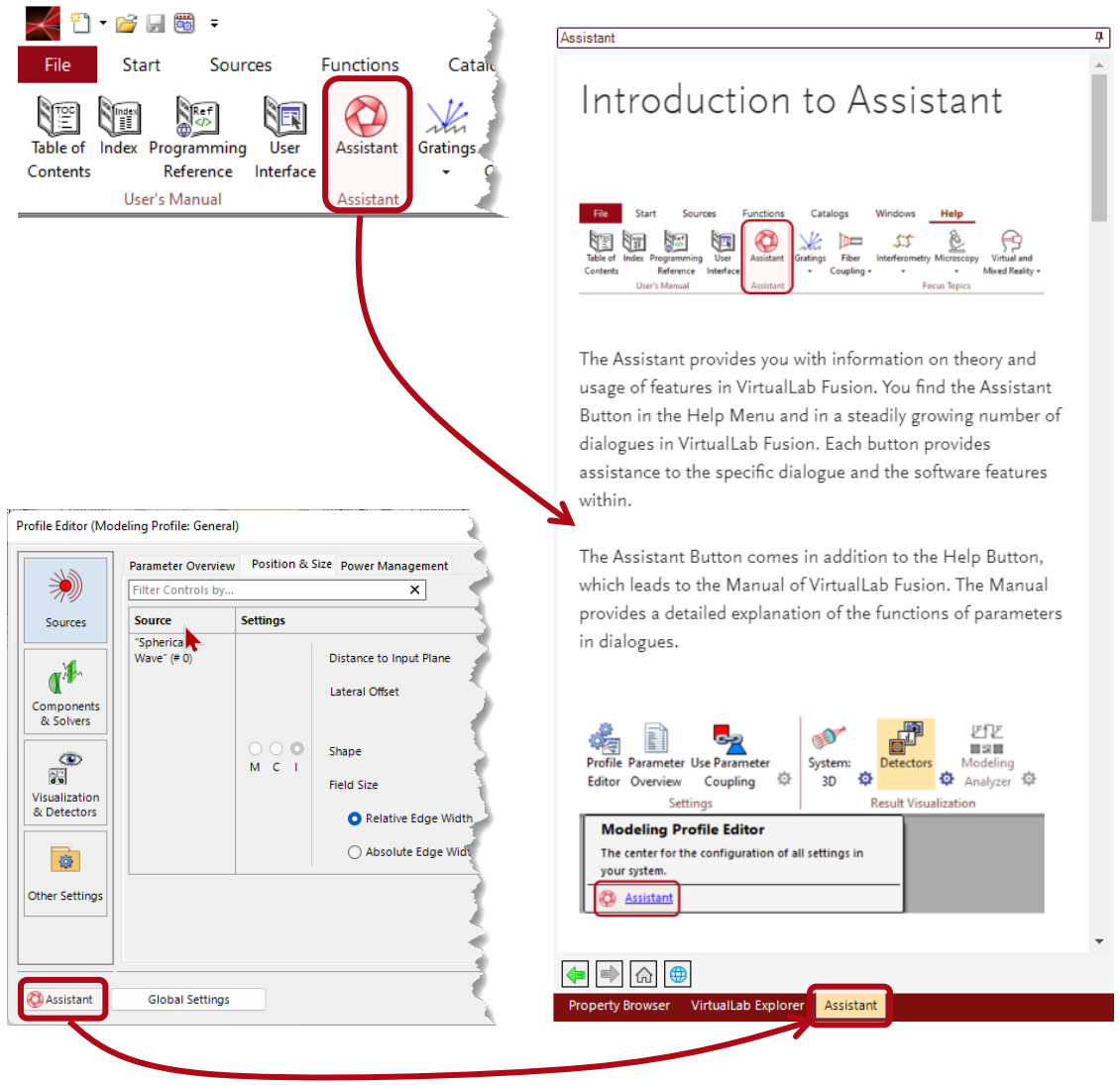
- *Focus Topics* provides the user with a collection of selected use cases.
- Focus Topics provides the user with a collection of selected use cases.
- LightTrans can update this collection independent of the release. That provides us with a dynamic way to inform you about hot topics evolving in the market.
- Clicking on a use case example opens the *Assistant* window in VLF 2023.1 to give you basic information and links to a full use case description.
- You also have the option to open the use case VLF file together with the Assistant window and running it yourselves.

VirtualLab Fusion Assistant



- VLF 2023.1 introduces the new VirtualLab Fusion Assistant.
- You may access it via the Assistant button in the Help Menu or via Assistant buttons in an ever-increasing number of dialogues.
- While the Help button in dialogues provides access to the User's manual, the Assistant button opens the new Assistant window.
- There, the Assistant offers useful information on the theory and the usage of related software features.
- The content of the Assistant is dynamically updated also between software releases.

VirtualLab Fusion Assistant



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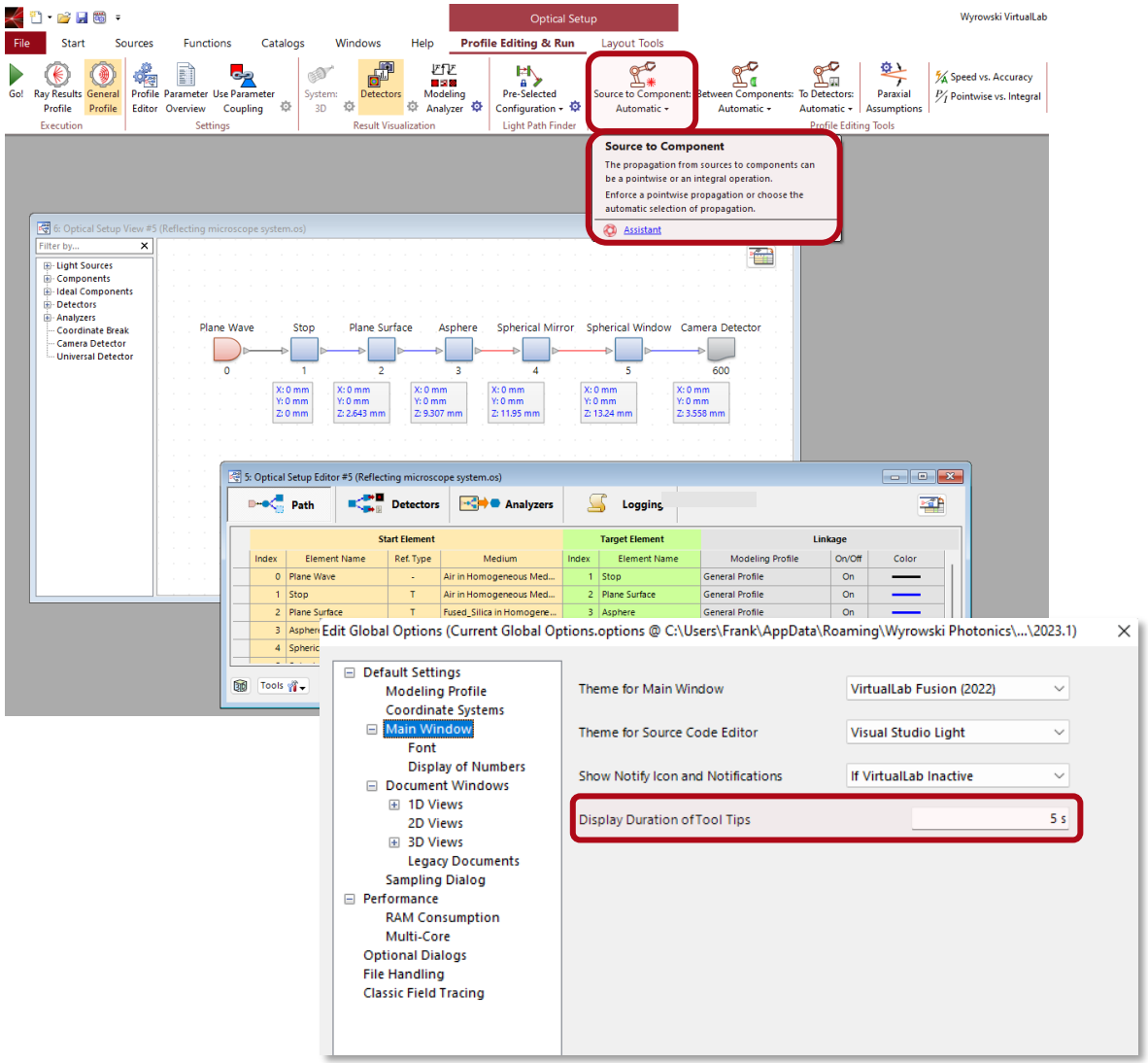
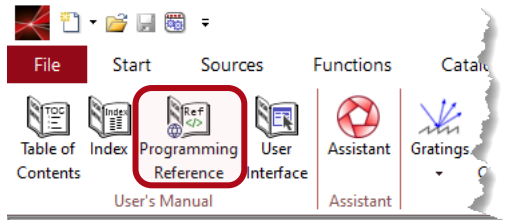
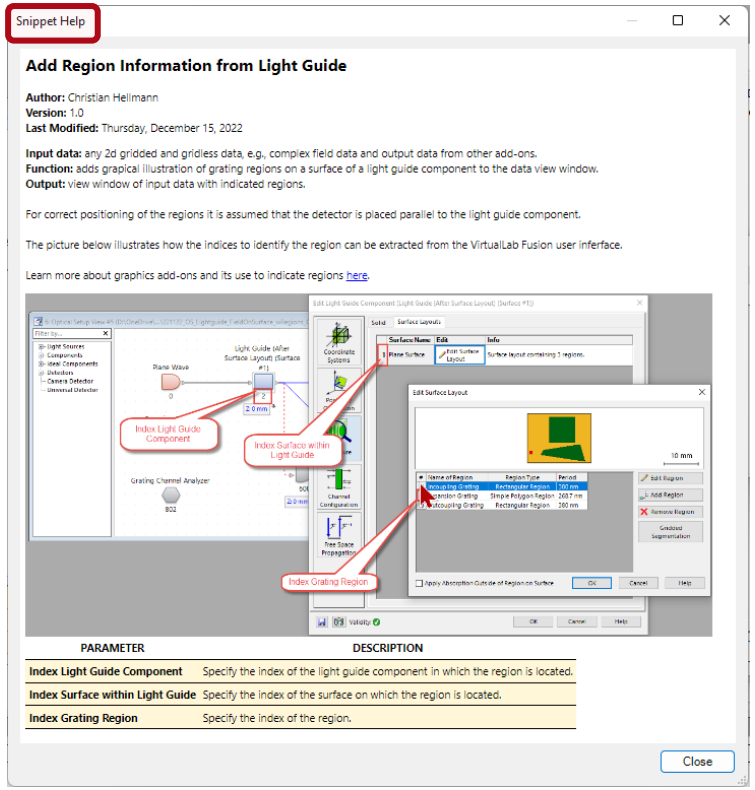
Tool Tips



- In VLF2023.1 we considerably strengthen the Tool Tips concept.
- Most important ribbons have now a Tool Tip with an additional link to an Assistant entry on the function of the ribbon.
- Because of the software technique which is used for the Tool Tip implementation in VLF, the Tool Tip behavior is as follows:
  - Each time you move the mouse pointer over a ribbon triggers the Tool Tip to be visible for a time duration, which can be adjusted in Global Options | Main Window.
  - The Tool Tips are not displayed, if you select 0 seconds in *Display Duration of Tool Tips.*

Customized Programming



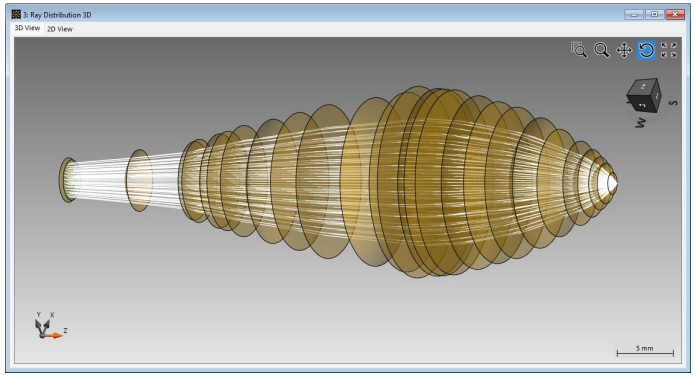


- More experienced users massively benefit from the programming features which come with VirtualLab Fusion.
- The snippet help document can now include a picture to help visualizing of what the snippet is about.
- The Programming Reference provides all relevant information to get the maximum out of VLF 2023.1.
- The following methods have been added:
  - Acos and Asin in VL_Math (both for complex numbers)
  - Centroid and CreateDetectorResult in VL_Detectors
  - ExtractSummedSquaredAmplitudes in VL_Fields
  - CalculateBitmapFromDataArray2D and ClaculateBitmapFromChormaticFieldsSet2D in VL_Files
- More parameters are added to their corresponding programmable items:
  - Complete data of the varied parameters to Programmable Parameter Run

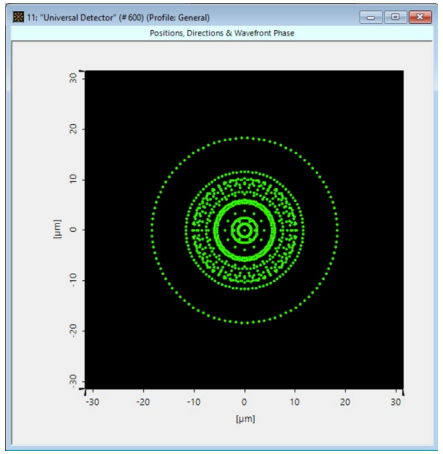
Data Views

VirtualLab Fusion 2023.1 feature overview

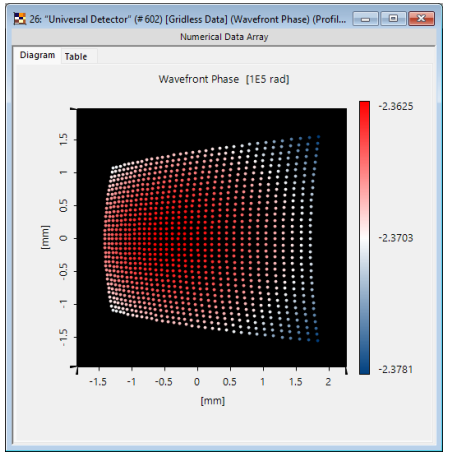
Selected Data Views in VirtualLab Fusion 2023.1



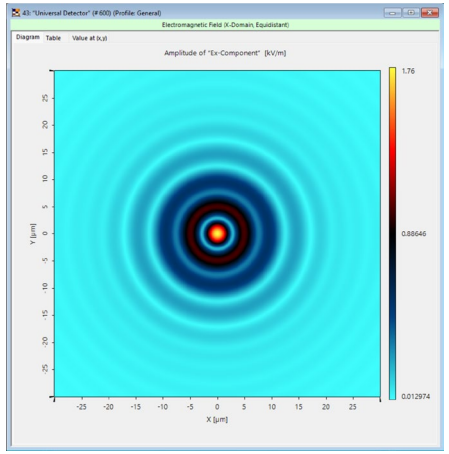
3D System View



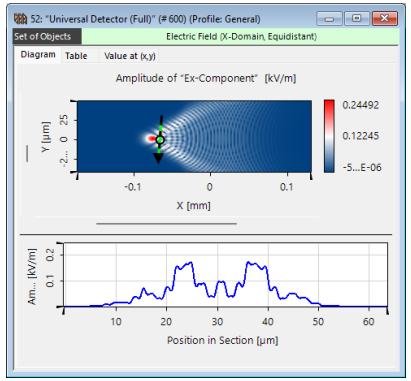
Data Array (gridless): Positions only



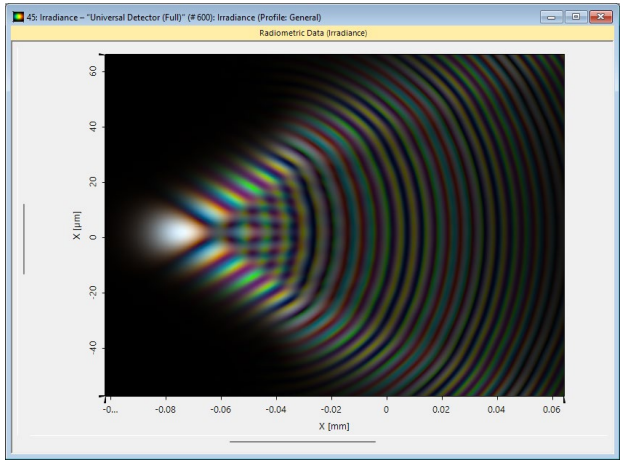
Data Array (gridless): Field Values



Data Array (gridded): Field Values

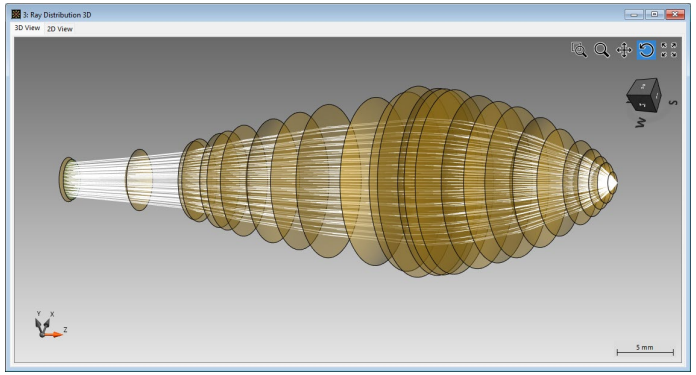


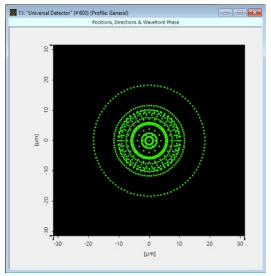
Set of Data Arrays (gridded): Field Values

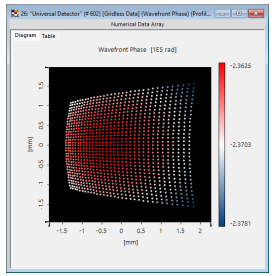


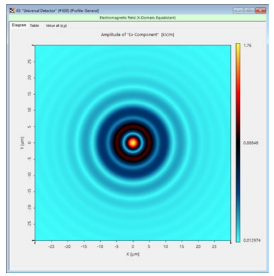
Radiometric Data View

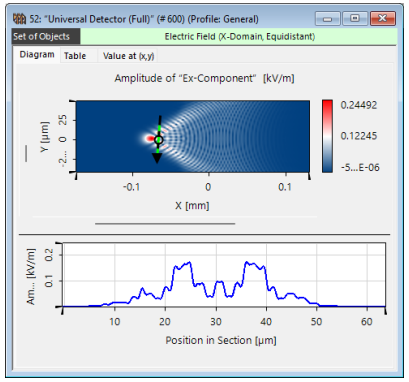
Selected Data Views in VirtualLab Fusion 2023.1

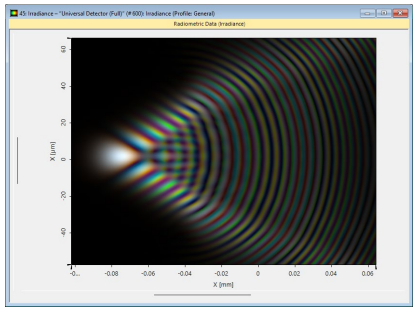






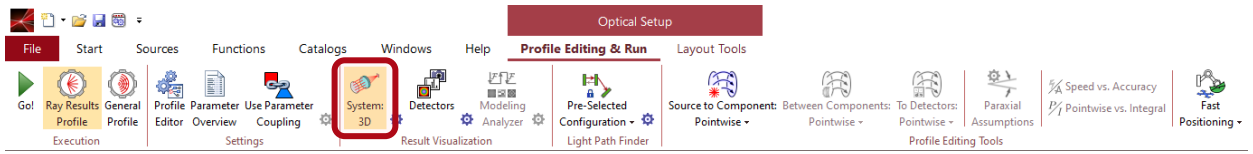


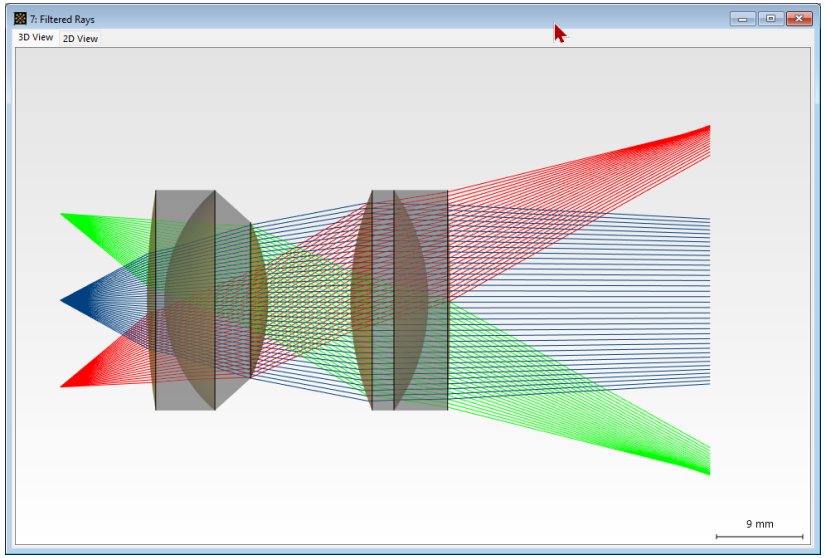




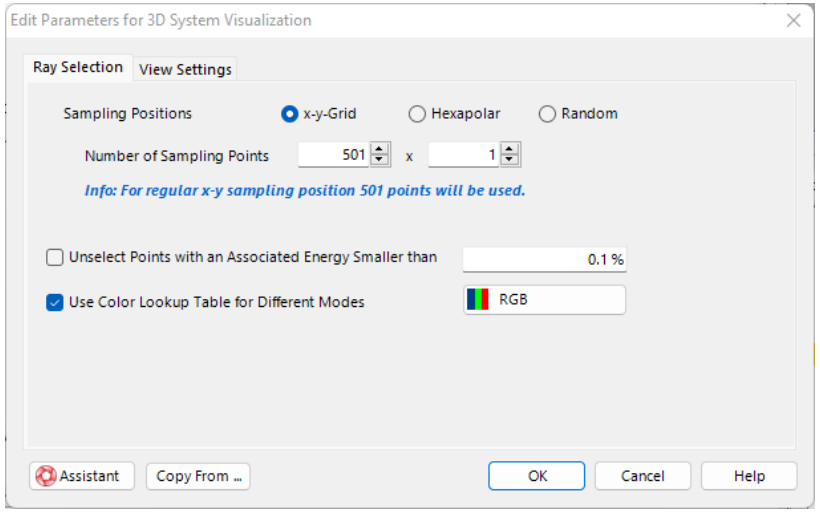
- Optical simulations most often generate 2d or 1d result data. VLF 2023.1 applies data view windows to provide the results to the user.
- **System 3D**: used to illustrate the coordinate mapping of pointwise physical optics modeling, which provides the results known from ray optics.
- **Data Array**: the universal visualization tool for 2d and 3d gridded and gridless data.
- **Set of Data Arrays**: In modeling we often deal with multiple modes and wavelengths. Then, several data arrays are combined in a set of data arrays.
- **Radiometric Data**: Energy quantities, e.g., irradiance, can be visualized according to the human eye color perception by the concepts of colorimetry.

System 3D View: New Dialogue and Configuration Options

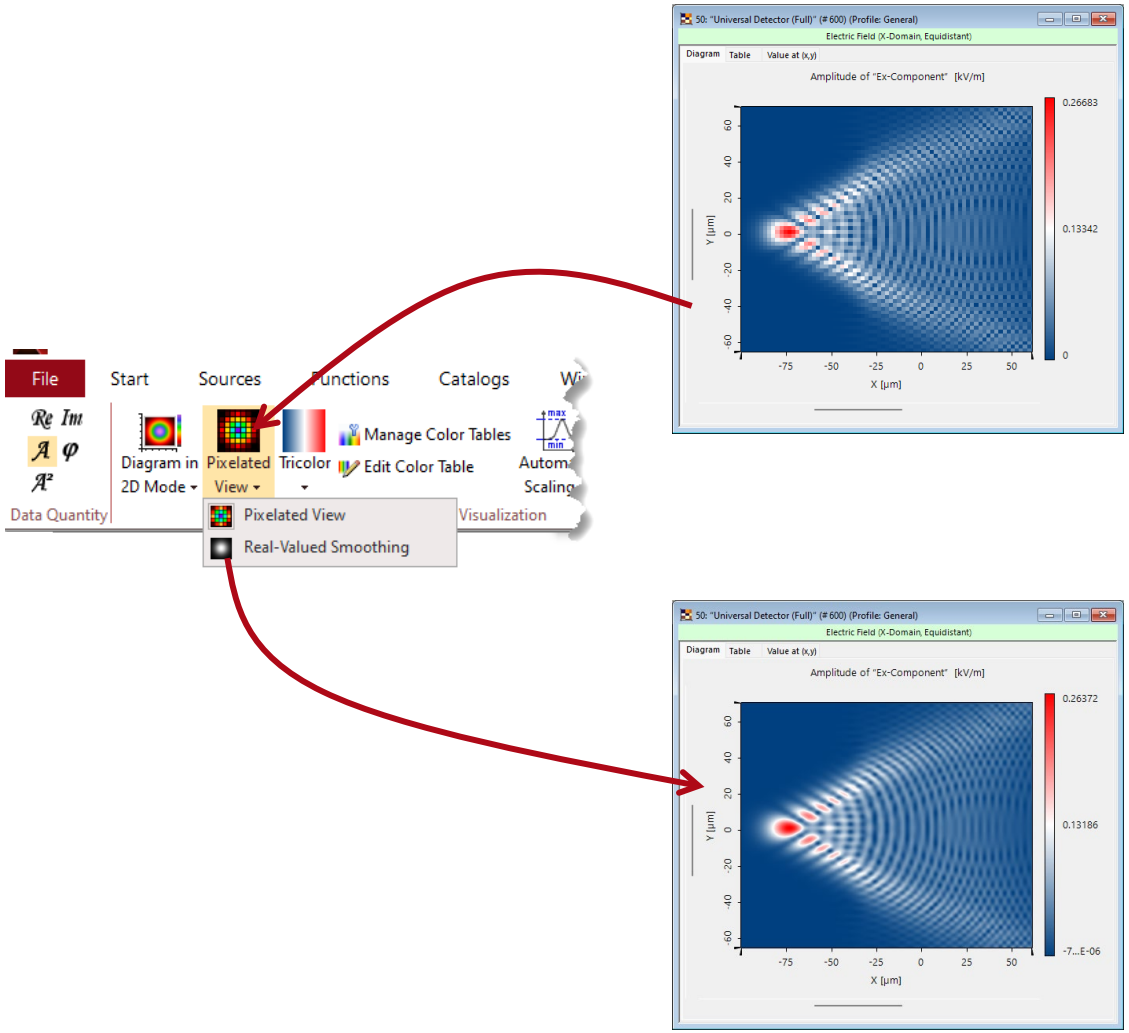




- VLF 2023.1 provides a new dialogue to control the System 3D view.
- It simplifies the use of the 3D System view and adds new configuration features.
- The use of color tables to customize the appearance of different modes is available in the new dialogue.



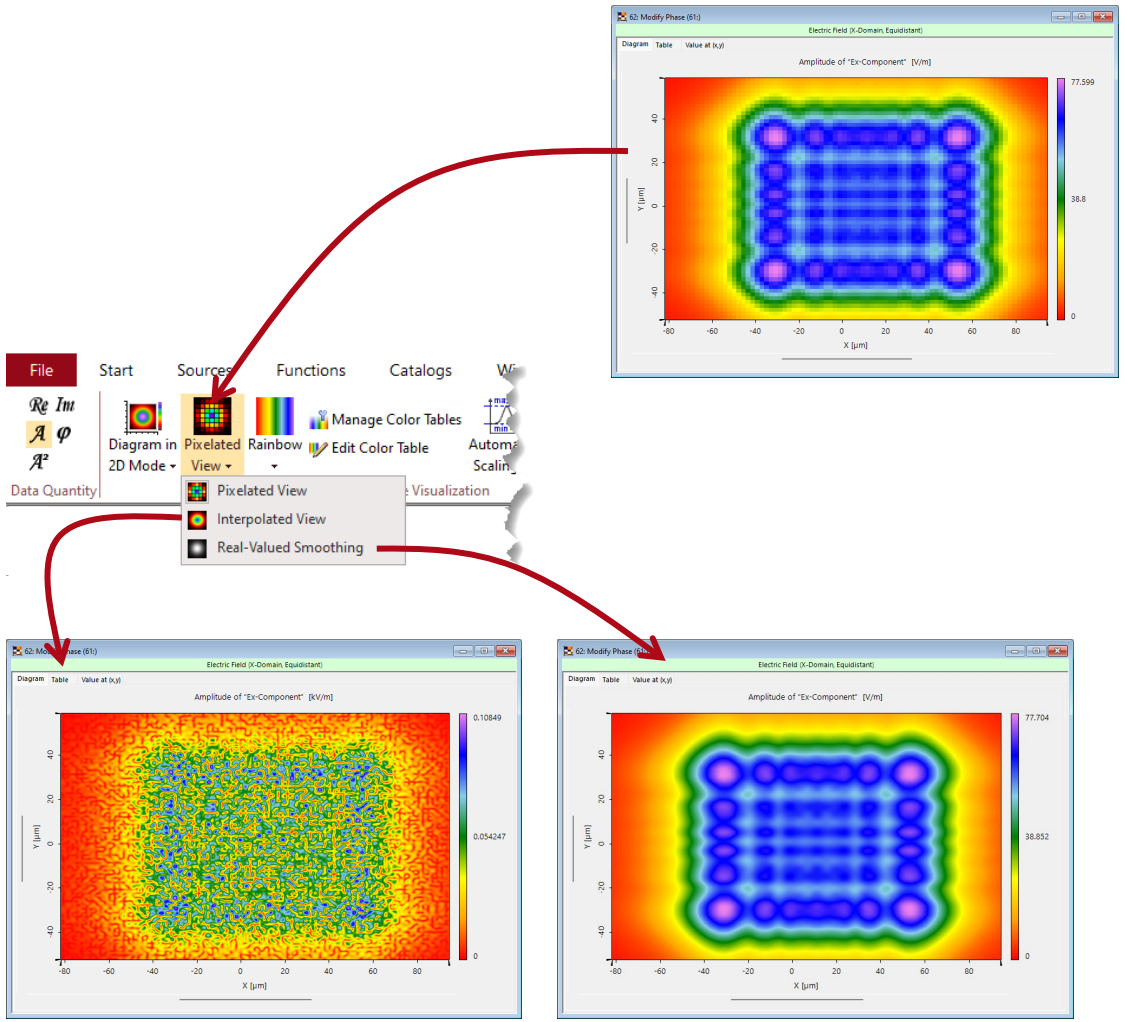
Data Array View: Smoothing of Pixelated Data



- The speed of detector evaluation is the higher the smaller the selected number of pixels in the detector.
- However, then complex data is typically undersampled and leads to artifacts in the interpolated data.
- In VLF 2023.1 we add an option to obtain a smoother visualization of data without demanding more sampling points for complex interpolation.

Example 1: Field data with nearest neighbor interpolation setting, i.e., pixelated view only. The new option allows a smoothing without changing the interpolation via Manipulations.

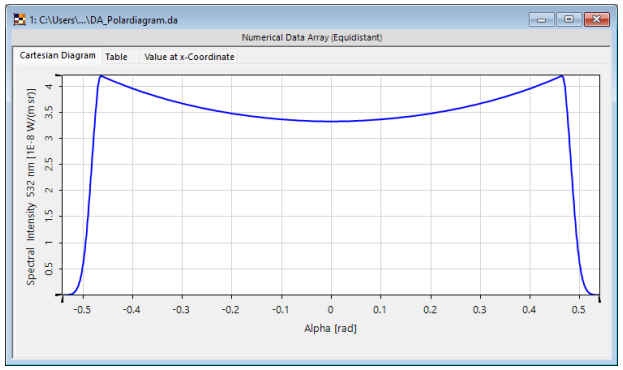
Data Array View: Smoothing of Pixelated Data

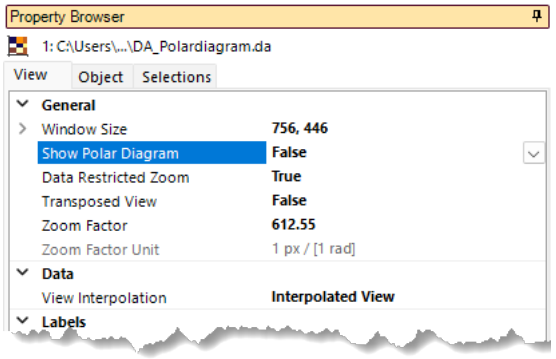


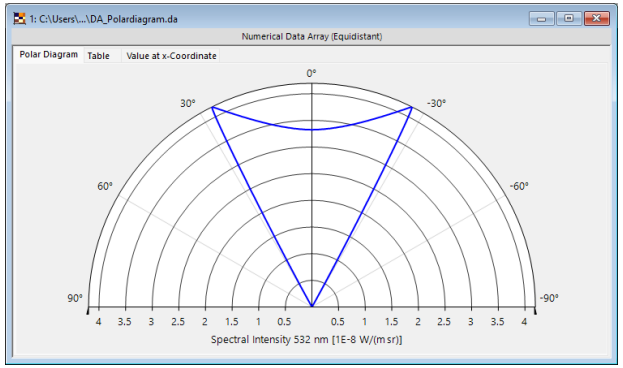
- Complex data is typically undersampled and leads to artifacts in the interpolated data.
- In VLF 2023.1 we add an option to obtain a smoother visualization of data without demanding more sampling points for complex interpolation.

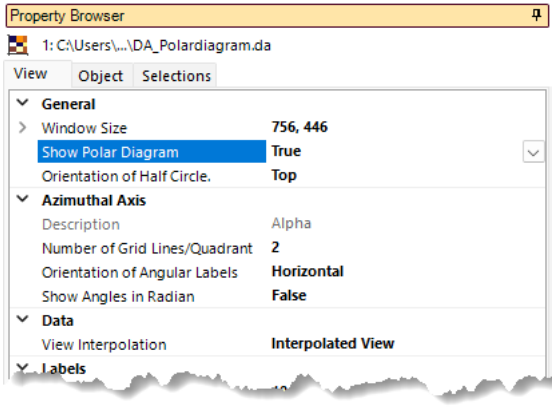
Example 2: Complex field data with cubic interpolation setting, which enables the interpolated view. Because of a random phase the complex interpolation leads to speckles. The new option allows a smoothing of the real-valued amplitude only.

Data Array View: Polar Diagrams



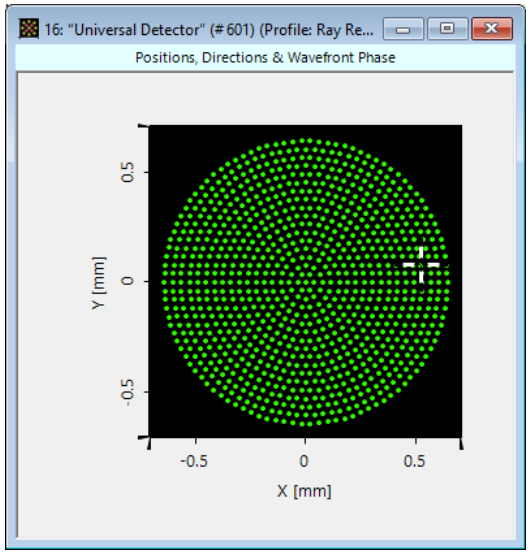


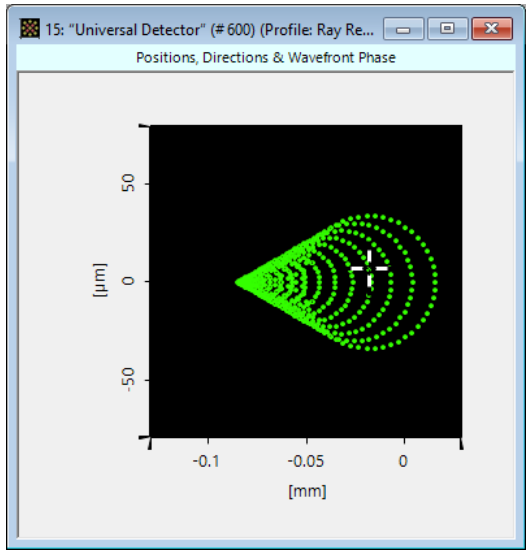


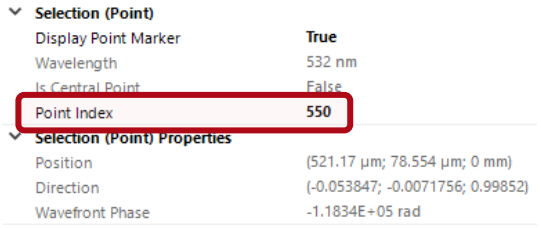


- One-dimensional (1d) data may be generated by detectors directly or are obtained by extracting 1d lines from 2d data.
- VLF 2023.1 adds the option of polar diagram views for all cases, in which the 1d data depends on an angle.
- Switch between a Cartesian and a polar diagram visualization via the Property Browser.
- This new feature can be directly applied to the new angle dependent radiometric and photometric detector add-ons!

Data Array View: Find and Mark Points by Index

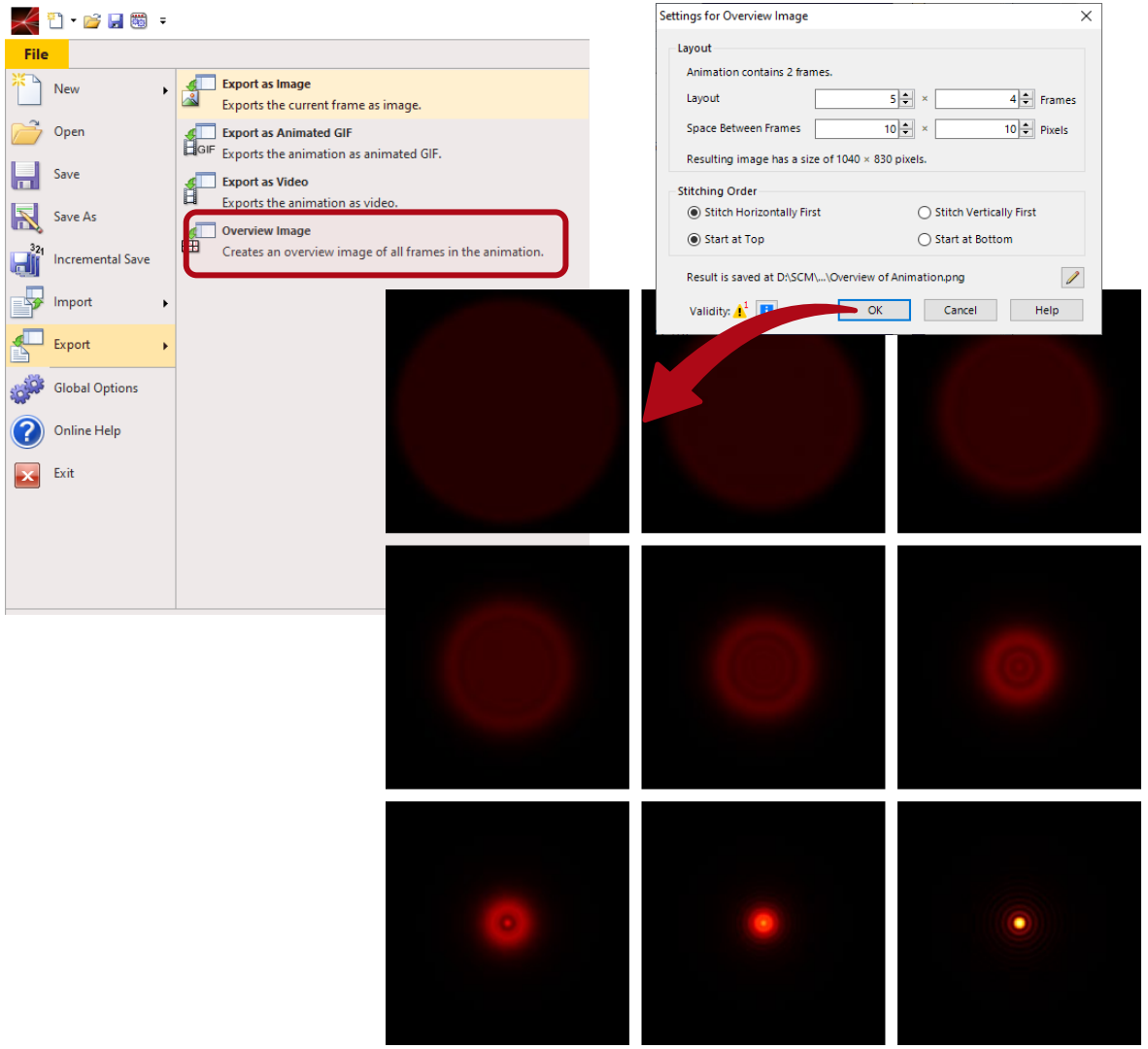






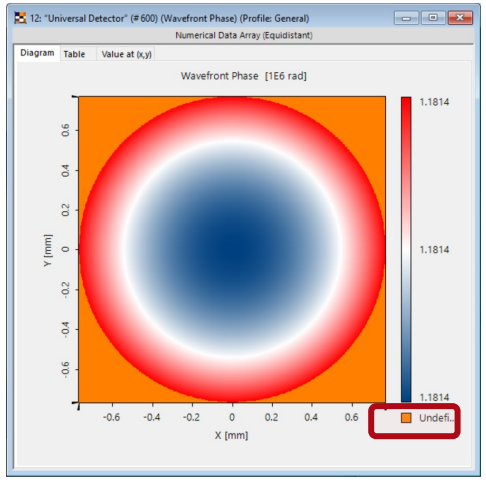
- For pointwise operations it is interesting to follow the mapping of selected points.
- Hence, VLF 2023.1 enables the visual indication of a selected point index in the data view.
- In a typical workflow the user checks the index of the point of interest in a data view close to the source. Then, VLF 2023.1 allows the visual indication of the same index point in all other views of the same system modeling.

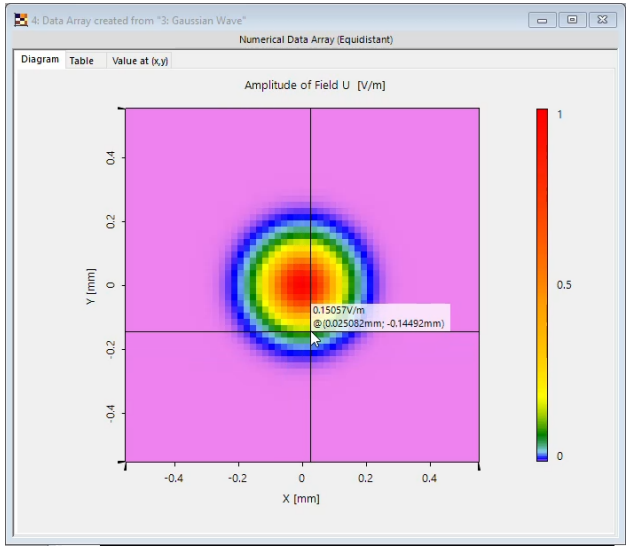
Export to Overview Bitmap



- The flexible illustration of data is essential for a fast result documentation.
- VLF 2023.1 introduces a new feature to enable the convenient layout of arrays of result figures.
- The workflow uses the generation of a bitmap sequence from a set of data arrays, from which then the Overview Image is composed.

Data Array View: More New Features

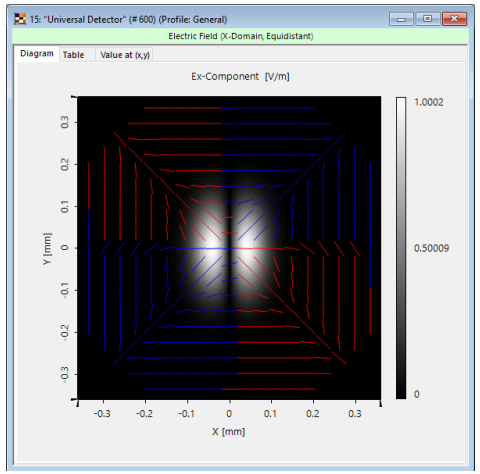


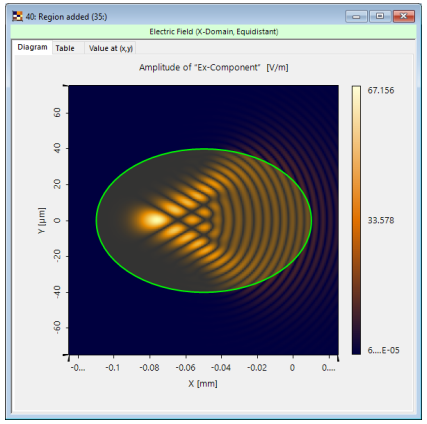


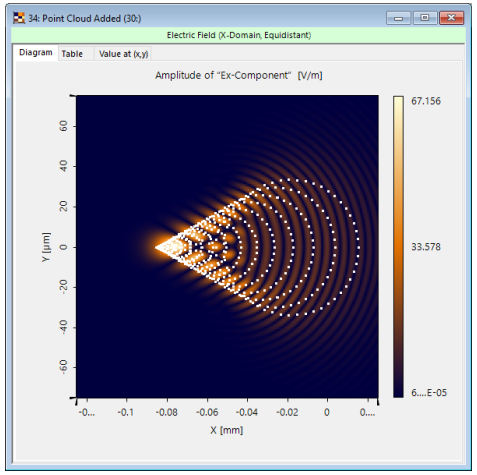
- VLF 2023.1 enables the selection of the color to illustrate undefined values in a view.

- VLF2023.1 provides the value of the position and the data at the mouse position.

More Options in Data Views by Graphics Add-ons

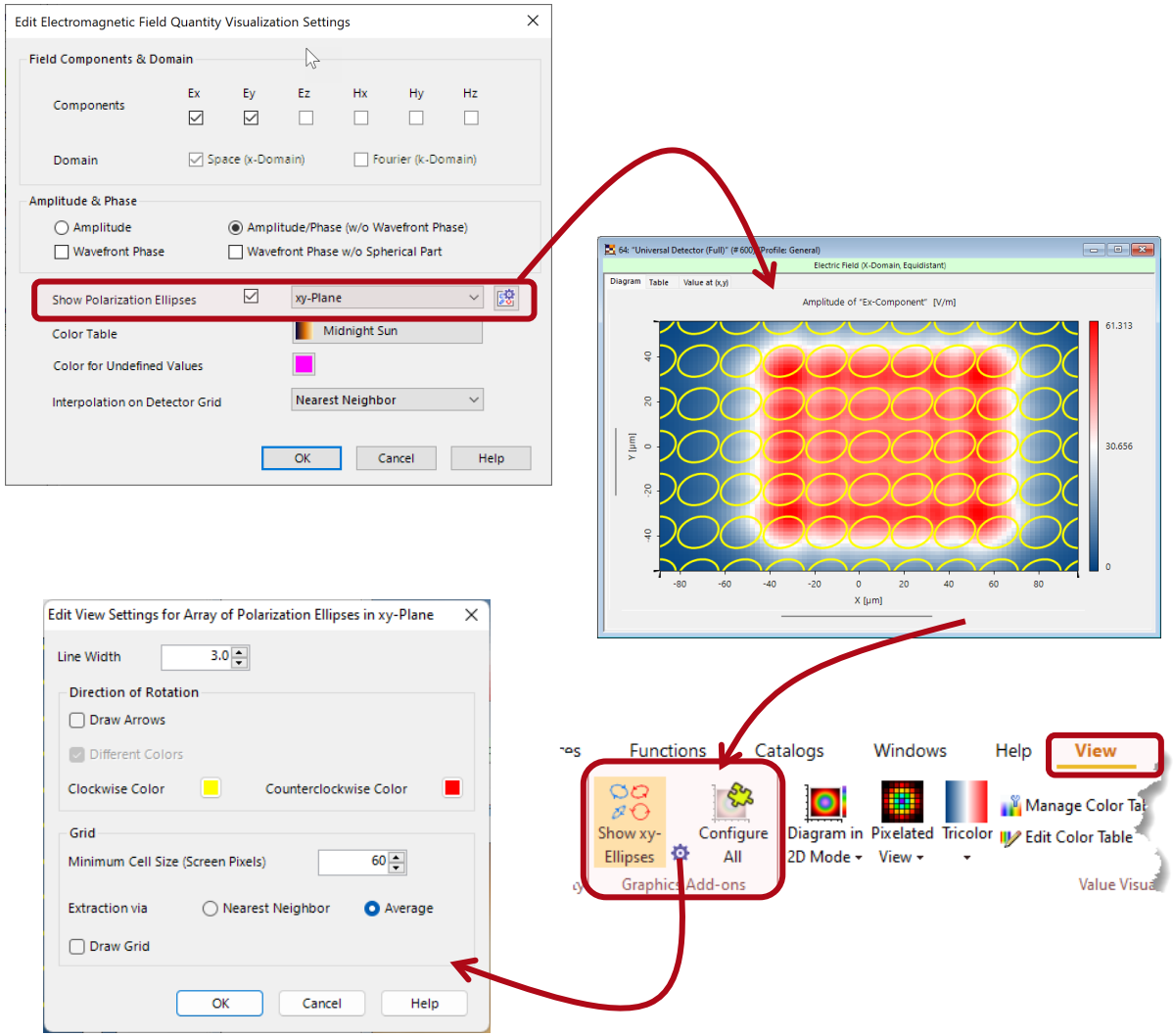






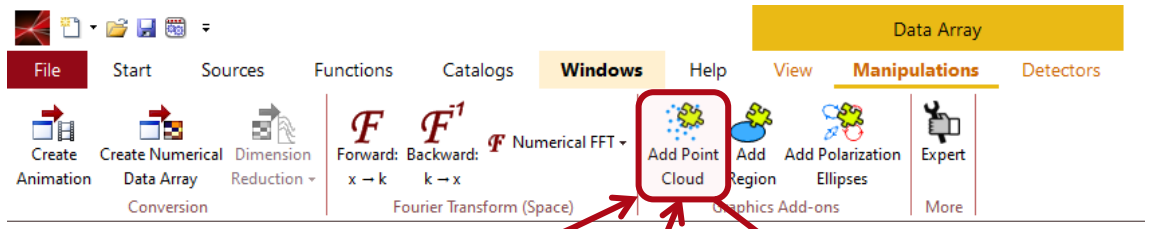
- In addition to the visualization of the data about the light itself, e.g., amplitude, phase, and irradiance, other information should be added to the data view.
- VLF 2023.1 introduces the concept of graphics add-ons, which enable to add such additional information to data array views.
- This concept can be universally applied to include a growing number of geometric objects into a data view.

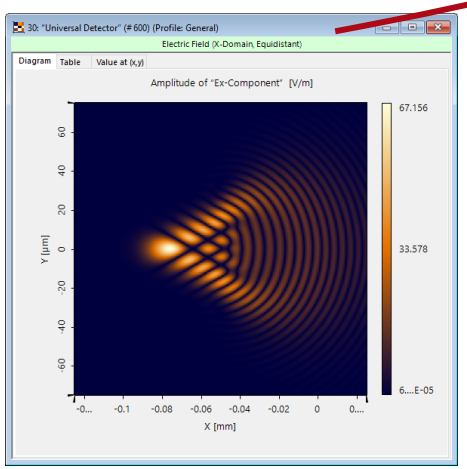
Graphics Add-ons: Polarization Ellipses

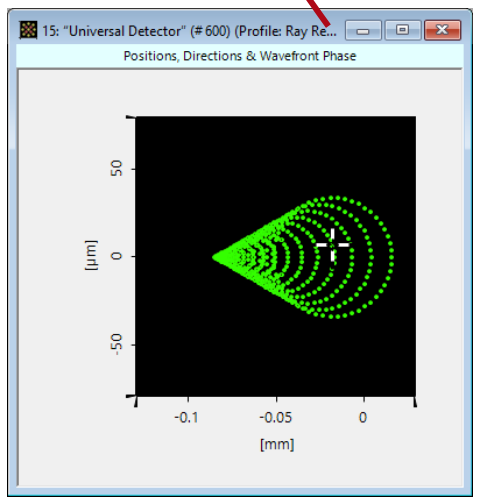


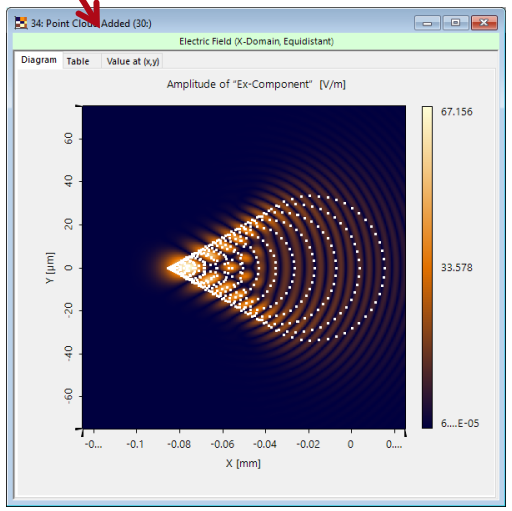
- VLF 2023.1 applies the new graphics-add on concept to optionally add polarization ellipses to the field data output of the universal detector.
- Once added to the data view, the ellipses can be configured via the View ribbon.
- Graphics add-ons provide a great variety of configuration options

Graphics Add-ons: Add Point Cloud





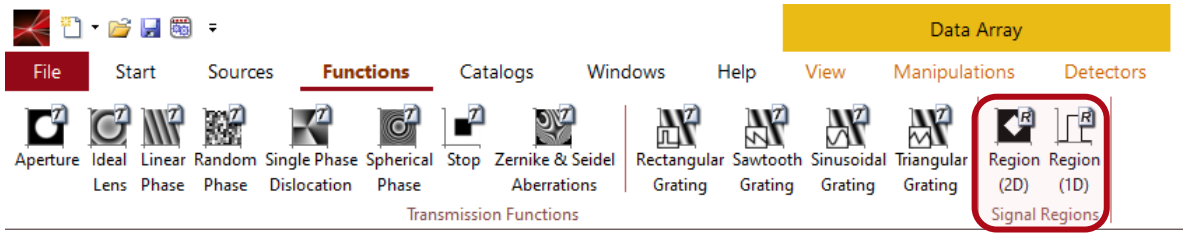


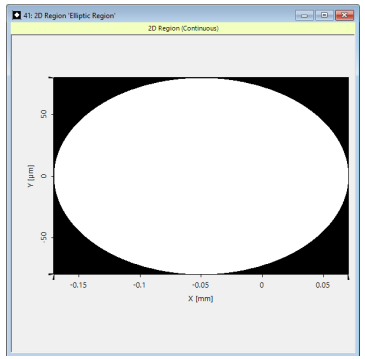


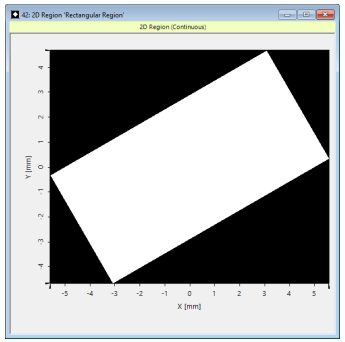
- The seamless transition between physical and geometrical optics modeling concepts in VirtualLab Fusion enables the generation of different types of results by using different modeling configurations.
- VLF2023.1 applies the graphics add-on concept to enable the combination of different results.

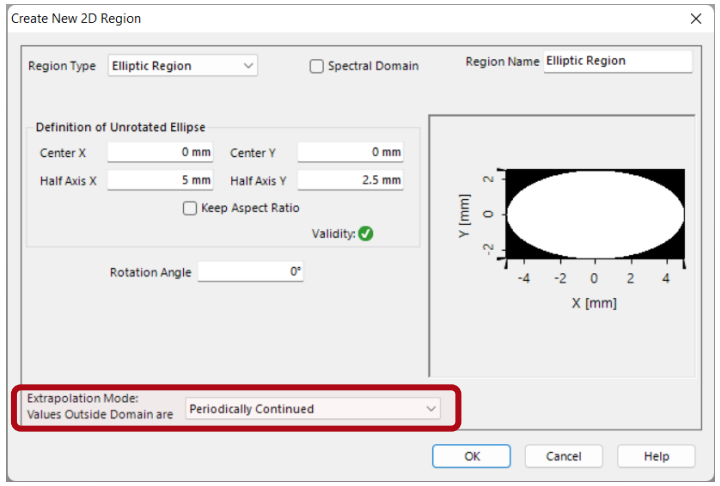
Combination of spot diagram and PSF calculation in one data array view.

Regions in VirtualLab Fusion



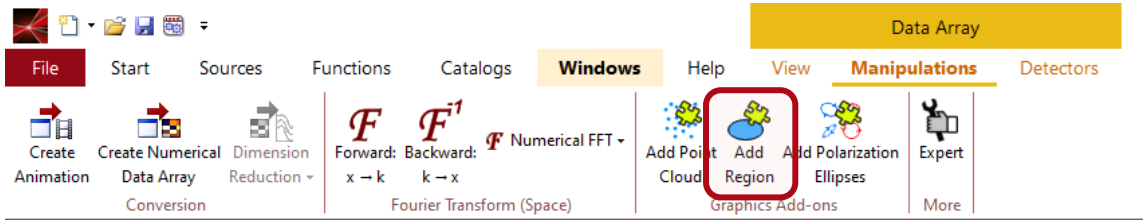




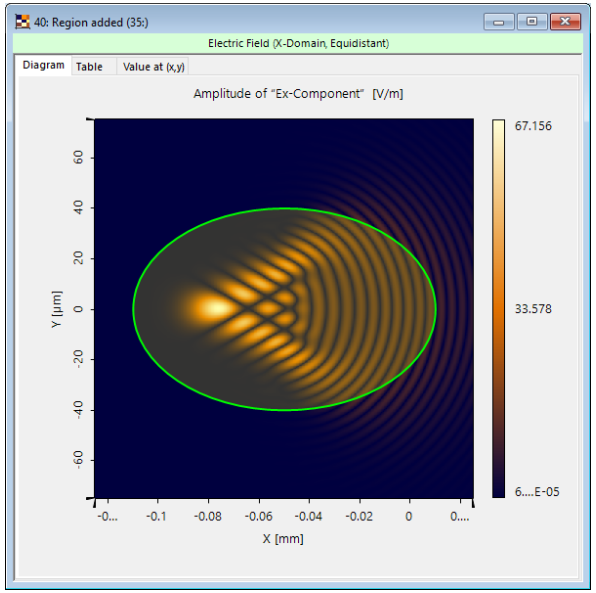


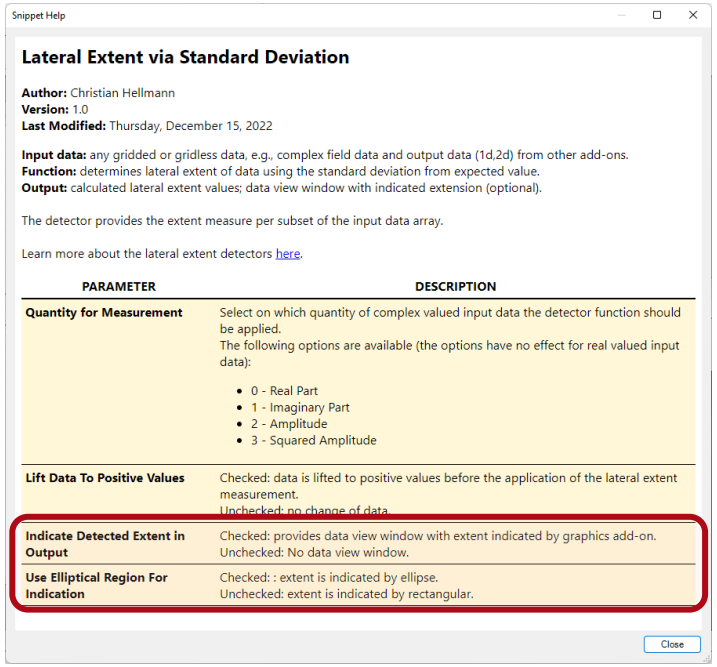
- Regions are used in VirtualLab Fusion, e.g., for some time to define signal windows in diffractive optics designs.
- In VLF 2023.1 we start to apply the region concept in many more scenarios.
- Regions define 1d and 2d domains in which specific operations should be performed, e.g., a detector should be evaluated, or a grating should be defined.
- We steadily extent the usability of the region concept. VLF 2023.1 adds the periodical extension of regions.

Graphics Add-ons: Add Region



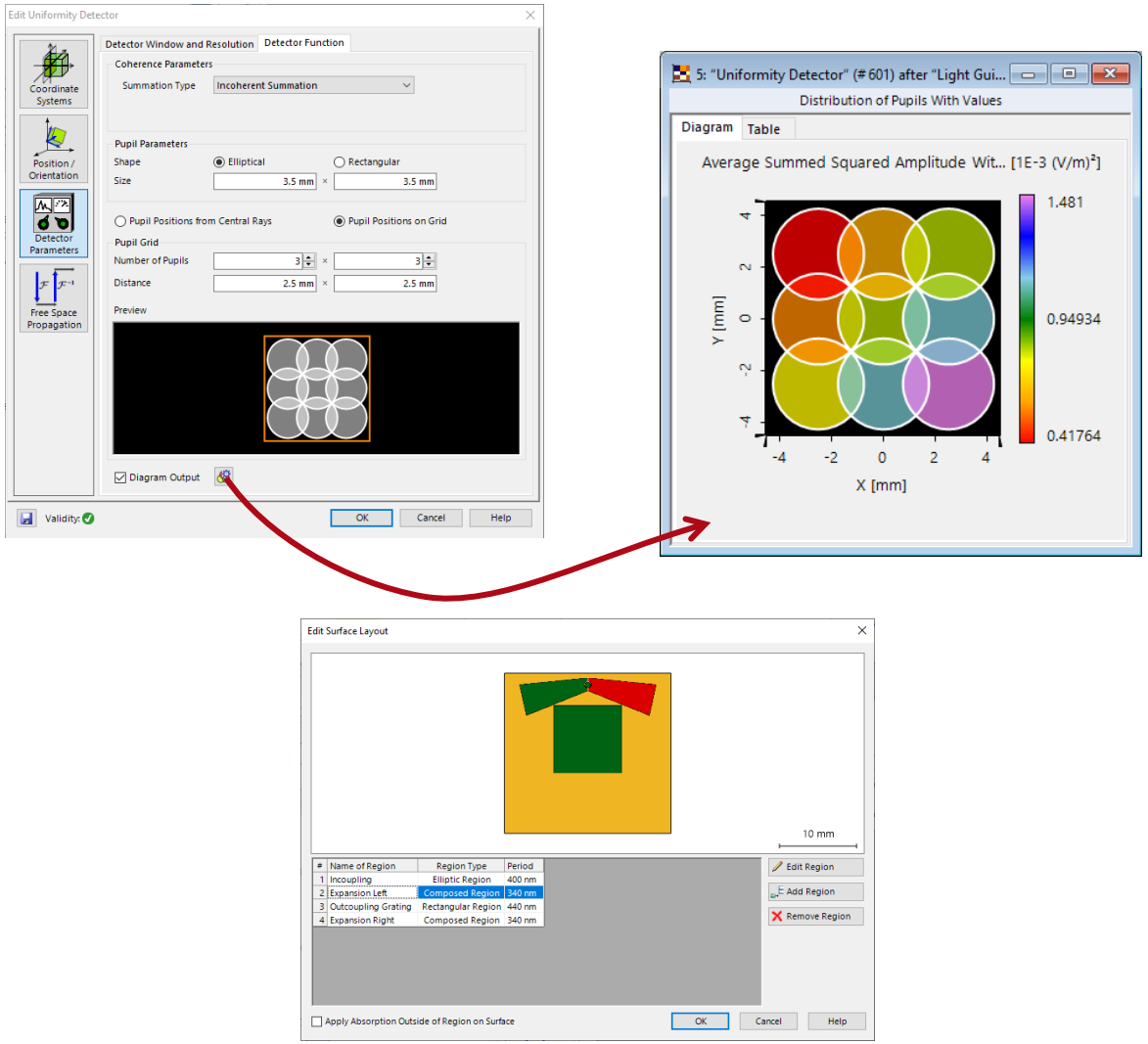
- Regions define geometric objects, which can be included in data arrays by graphics add-ons.
- VLF 2023.1 enables this concept in a direct way via the Manipulation ribbon.





- The concept can be also used in add-ons of the universal detector, e.g., to indicate the measured extent of a function.

Light Guide Toolbox: New View Features



- The VirtualLab Fusion Light Guide Toolbox provides a power workflow for the design of light guides for AR/VR.
- We steadily improve the tools for the design.
- VLF 2023.1 adds new features to some specialized views:
  - Visualization of the regions in detectors behind light guides (see here) .
  - Direct visualization of the uniformity in the exit pupil.
  - Improved and interactive preview of the grating regions layout in a light guide for faster access and control of regions and grating parameters.

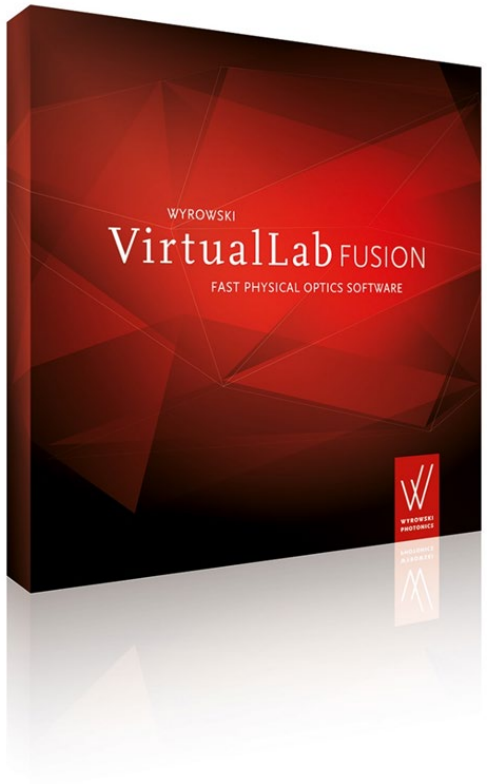
Learn More About VirtualLab Fusion Views

Videos

- Optical System
- Data Arrays
- Positions, Directions & Wavefront Phase
- Interpolation and Smoothing
- Graphics Add-ons
- Polarization Ellipses in Data Array Views
- Visualize Positions in View Windows
- Visualize Region Boundaries in View Windows

Use Cases

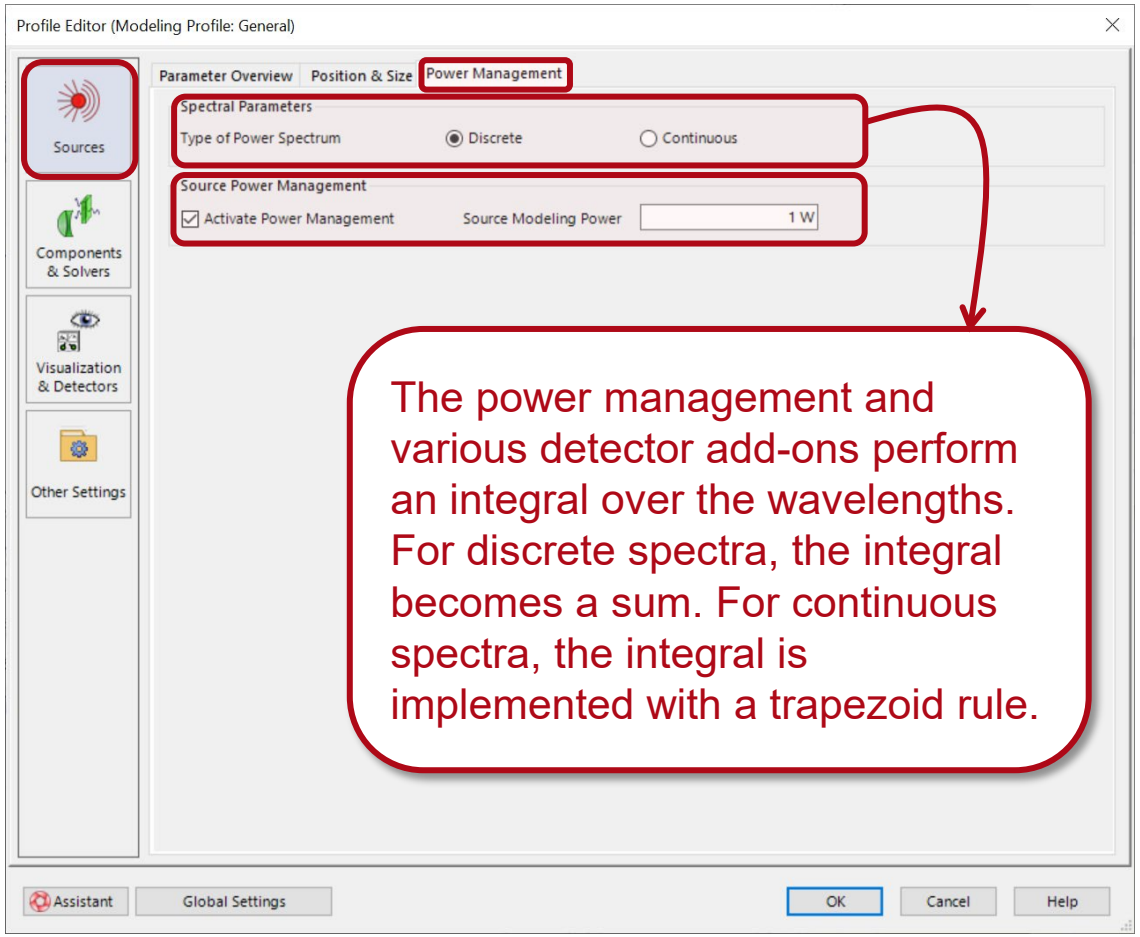
- 3D Visualization of the Optical Setup
- Universal Detector
- View Settings for 2D Data Arrays
- Graphics Add-on
- Add Region to Data Array
- Add Point Cloud to Data Array



Source Power Management

VirtualLab Fusion 2023.1 feature overview

Source Power Management



- With the introduction of radiometric and photometric detector add-ons in VLF 2023.1, the need for a source power management became pressing.
- Thus, VLF 2023.1 provides a source power management. The user have access to it via the Profile Editor in Sources.
- Activating the power management and specifying the source power leads VLF 2023.1 to perform
  - an evaluation of the source power for the given specifications in the source,
  - and a subsequent scaling of the amplitude of all field modes in the source before propagating the modes through the system to produce the specified source power for modeling.

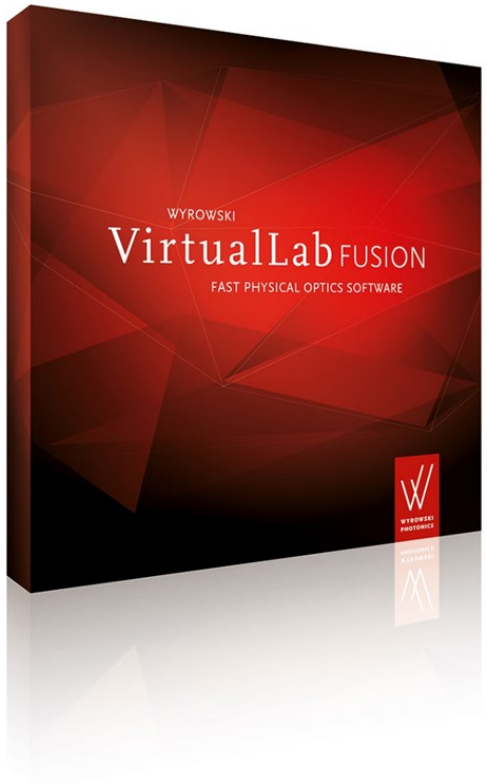
Learn More About Source Power Management

Videos

- General Modeling Profile
- Source - Power Management

Use Cases

- Universal Detector
- Fresnel Curves on a Plane Surface

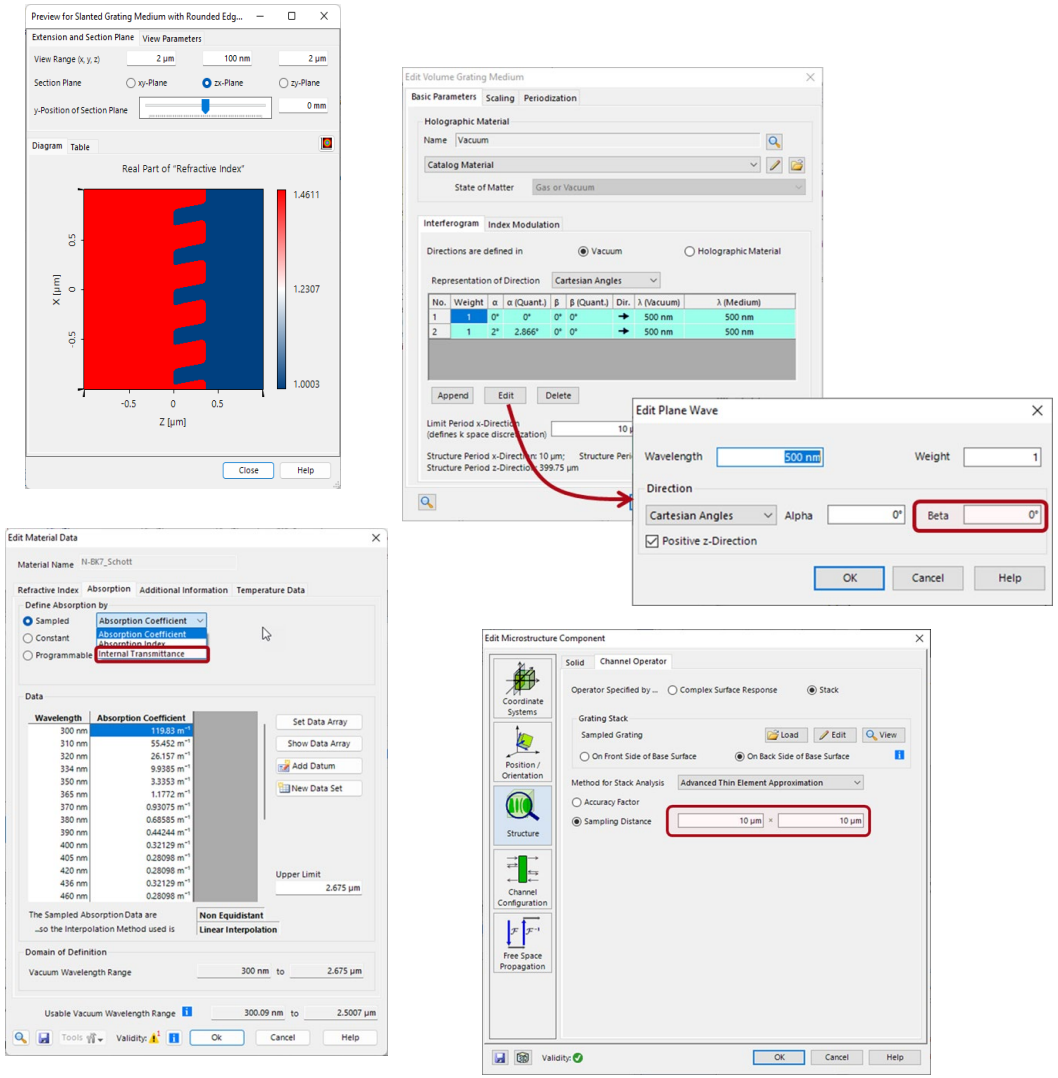


Components

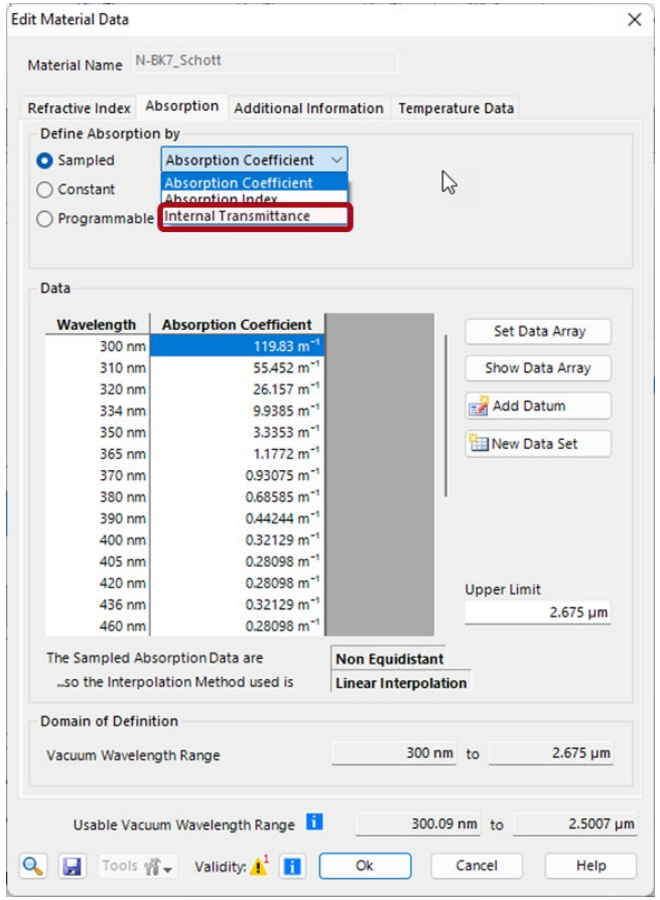
VirtualLab Fusion 2023.1 feature overview

New Features of Components in VirtualLab Fusion

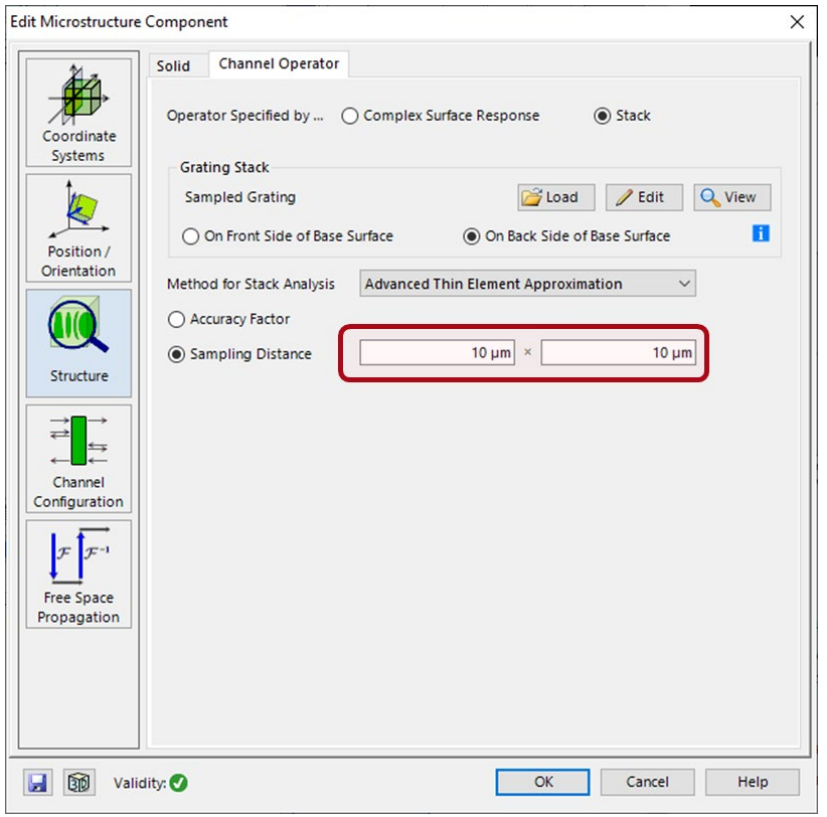
- VirtualLab Fusion combines sources, components and detectors to configure optical systems.
- Components are constructed by surfaces, stacks on surfaces, and media in between surfaces.
- Media can describe any spatial refractive index modulation, including jumps in the modulation of the index.
- The wavelength dependency of the refractive index is described in the materials.
- Components come with a specific solver for modeling.
- VLF 2023.1 provides some new features for components.



New Features of Components in VirtualLab Fusion I

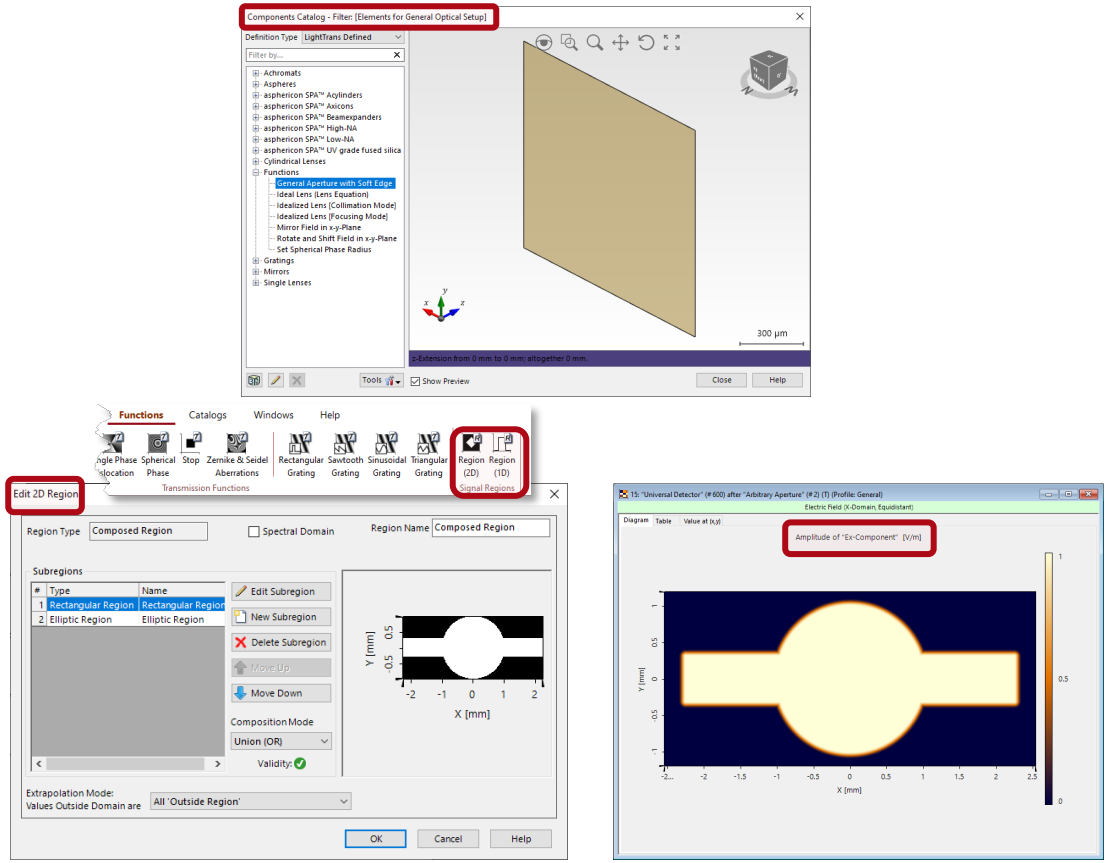


Absorption can now also be defined using sampled data representing Absorption Indices and Internal Transmittance.

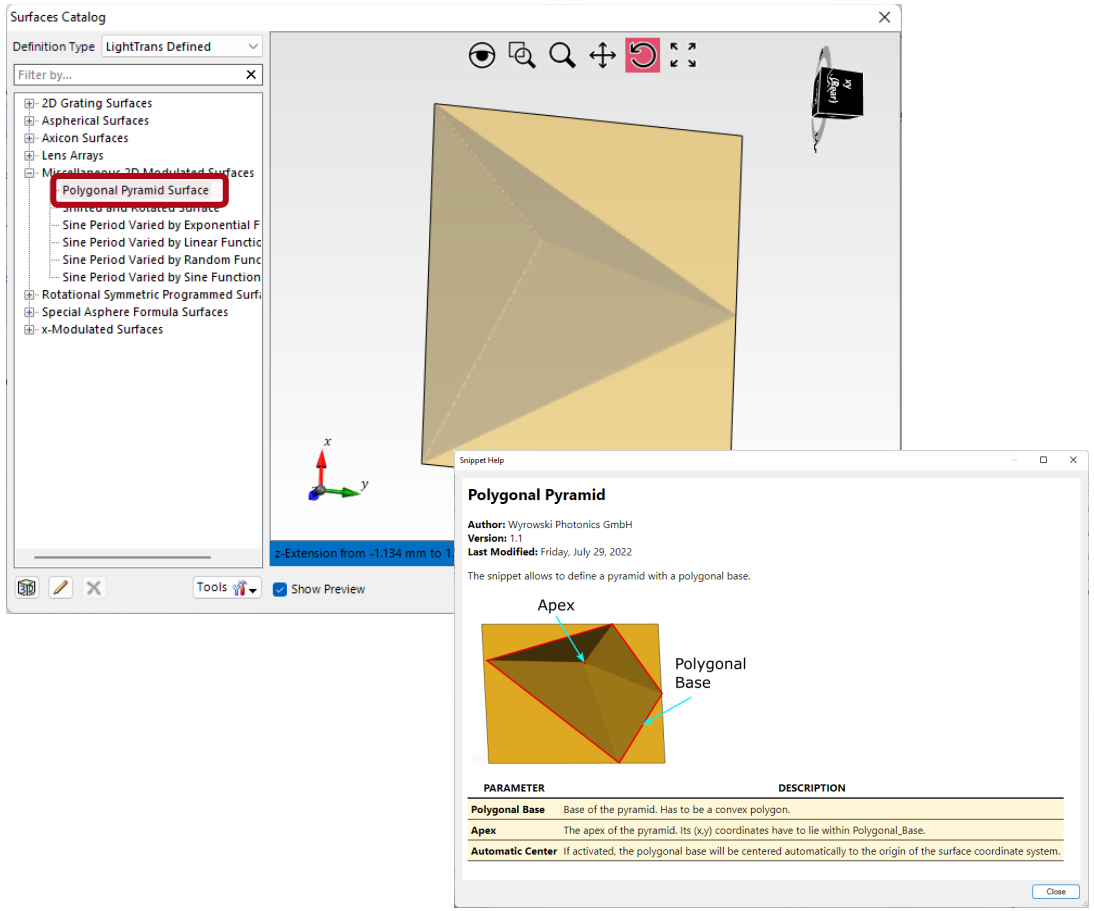


The proper sampling of the field behind a microstructure component is crucial. VLF 2023.1 gives direct access to this sampling.

New Features of Components in VirtualLab Fusion II

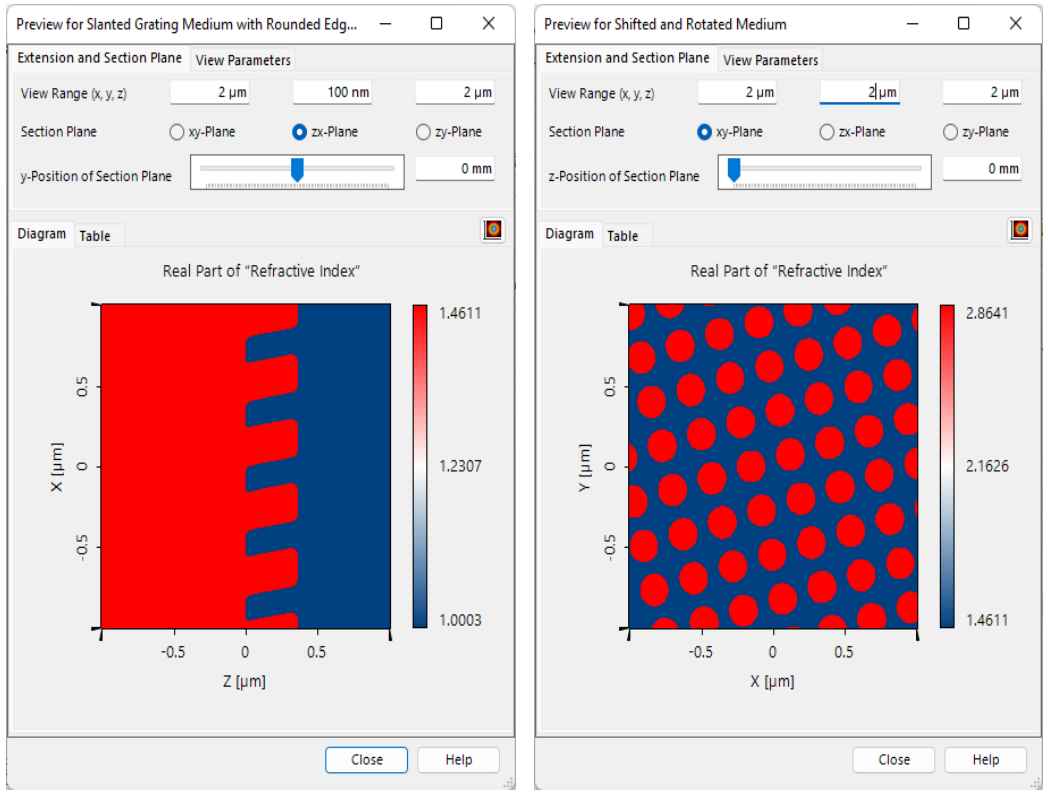


The new General Aperture with Soft Edge combines the creation of general 2d regions with the concept of soft edges to ensure correct sampling of fields passing through such apertures.



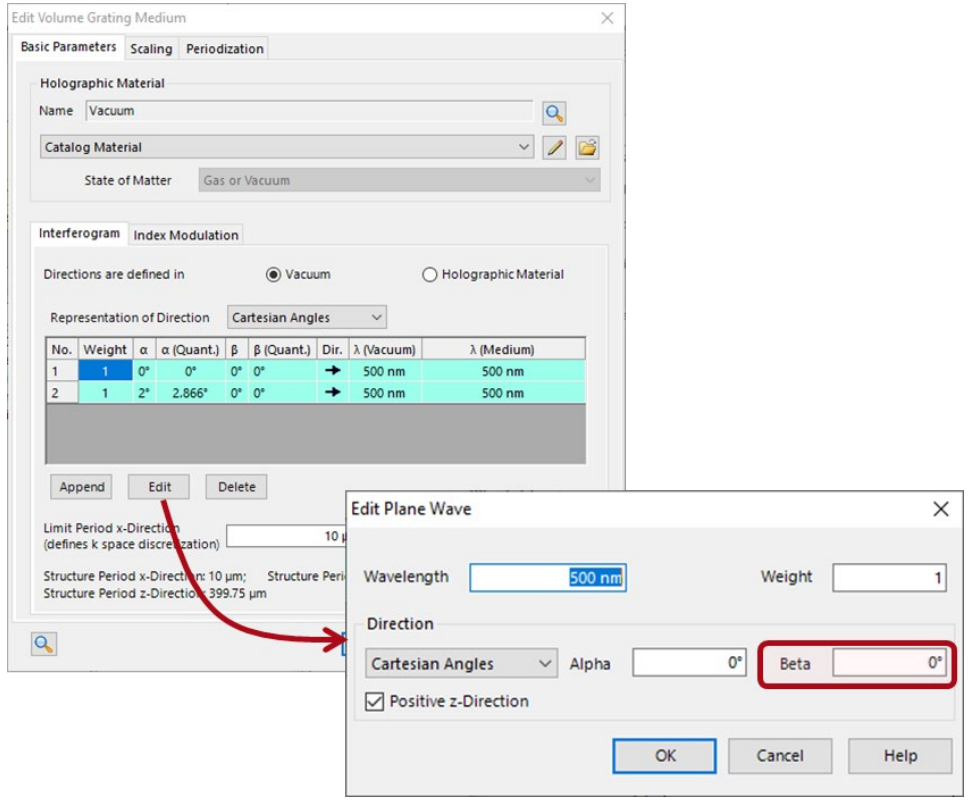
A new pyramid surface, defined by polygonal region as base, is added in VLF 2023.1

New Features of Components in VirtualLab Fusion III



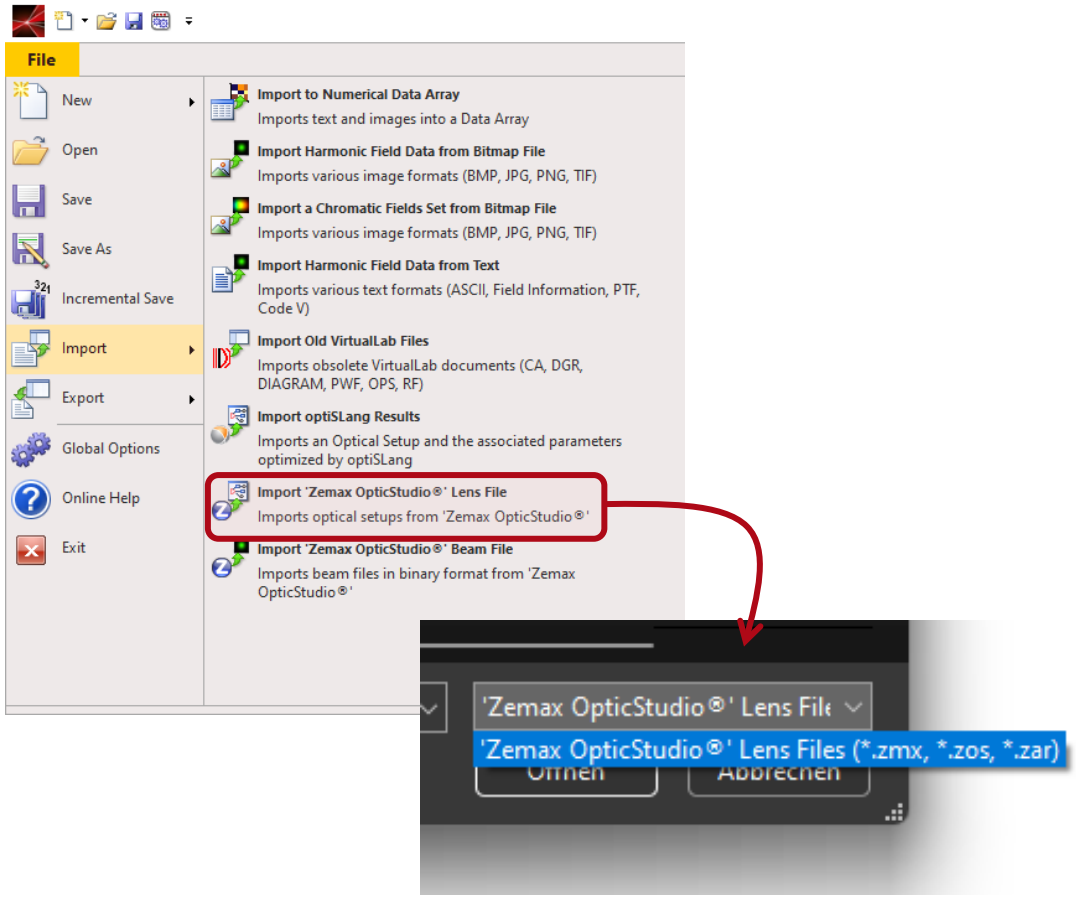
New media in VLF 2023.1:

- Slanted Grating with rounded edges
- Medium to shift and rotate another medium



More options to configure the volume grating medium.

New Features of Components in VirtualLab Fusion IV



More types of Zemax OpticStudio® Lens Files can be imported.

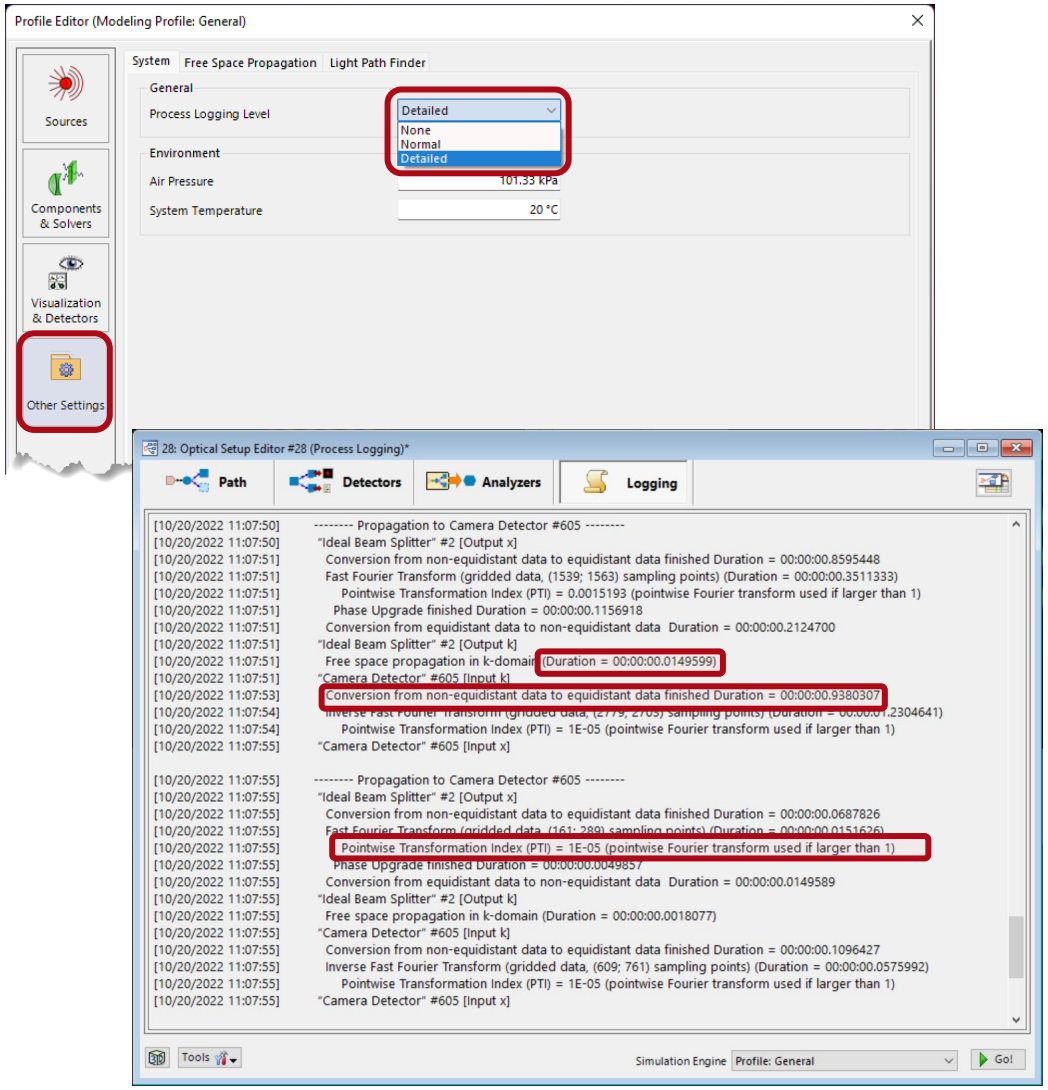
The following parameters are now available for Parameter Extraction in Parameter Run and Optimization:

- **Materials**: Parameter of the dispersion formulas
- **Crystal Plate Component**: Orientation
- **Pillar Medium (z-Independent)**: constant refractive index
- **Light sources**: Jones vector
- **Microstructure Component**: Accuracy Factor
- **Periodic Aperture**: Aperture settings

Process Logging

VirtualLab Fusion 2023.1 feature overview

Extended Process Logging

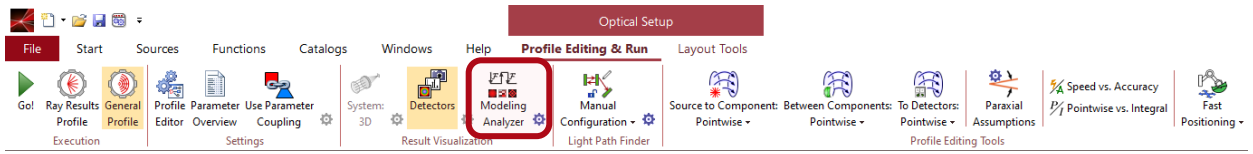


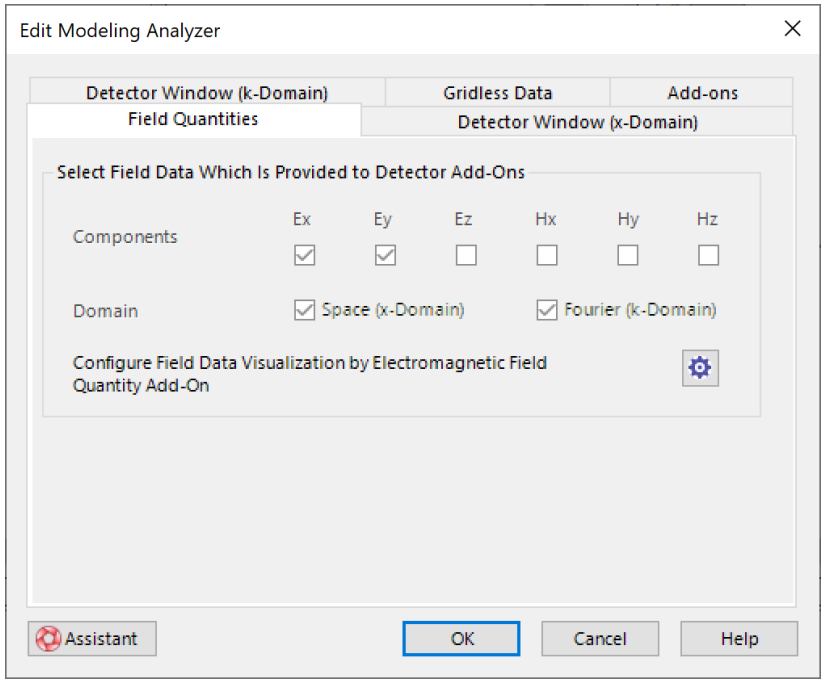
- Process logging delivers transparency in optical modeling and design.
- The more modeling steps are included in the logging the more modeling characteristics and behavior can be understood.
- VLF 2023.1 adds more operations in the logging, e.g., data conversions which can be sometimes time consuming.
- The automatic selection of the pointwise Fourier transform algorithm constitute a key technology in VirtualLab Fusion.
- We introduce with VLF 2023.1 a new criterion, the Pointwise Transformation Index (PTI) to judge the switching point between FFT and PFT algorithms. The logging provides the PTI values to provide maximum flexibility.

System Modeling Analyzer

VirtualLab Fusion 2023.1 feature overview

System Modeling Analyzer





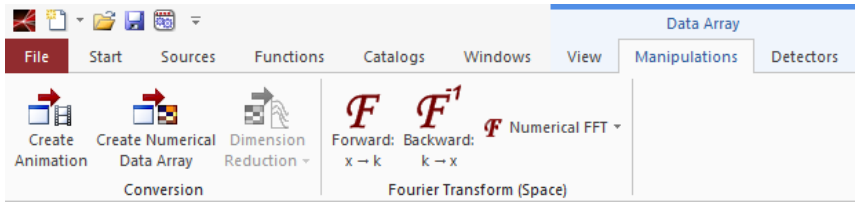
- Besides the process logging, the System Modeling Analyzer provides deep insight into the modeling steps by generating a set of data arrays with all modeling results per step.
- In VLF 2023.1 the Universal Detector is used to provide the fields per step. That gives access to the fields in x- and k domain.
- Dependent on the modeling settings in the profile the Modeling Analyzer now also provides gridless field data without interpolation on demand.

Expert Modus

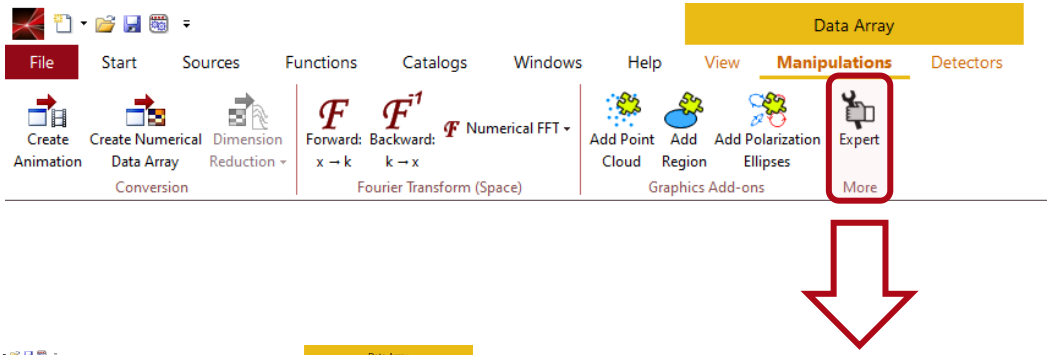
VirtualLab Fusion 2023.1 feature overview

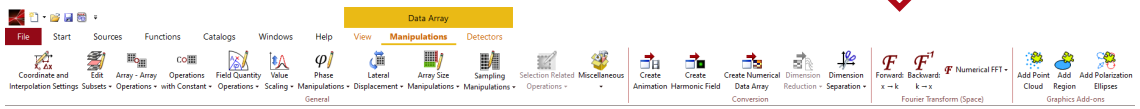
Manipulations of Data Arrays in Expert Modus

VLF 2021.1:



VLF 2023.1.1:



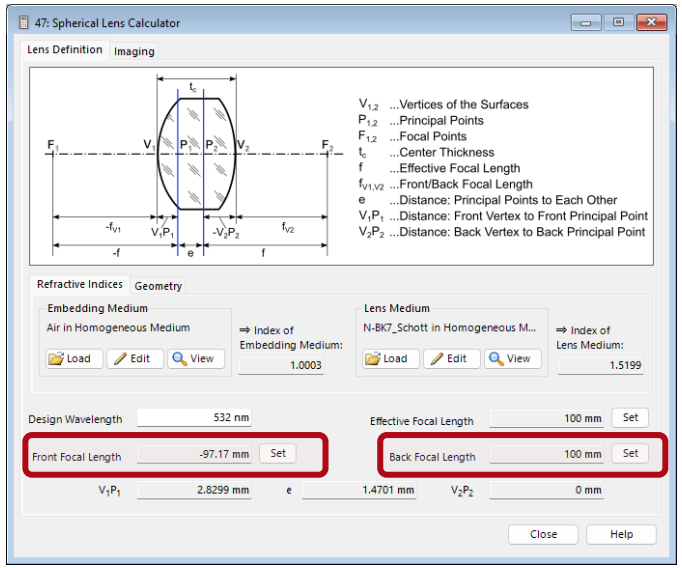


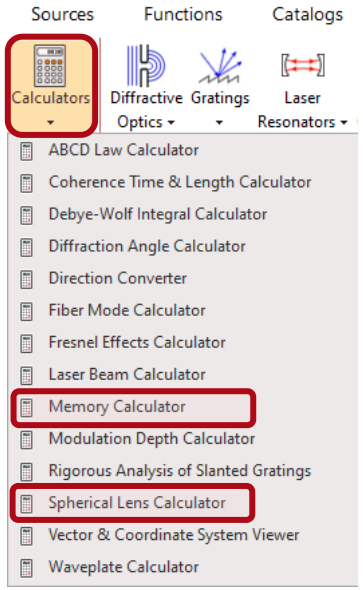
- With VLF 2023.1 we change our concept of the availability of ribbons.
- Dependent of the type of data in a data array view selected ribbons are available. That helps to reduce the number of ribbons to the most important ones for the special type of data.
- However, it also limits the manipulations which are available for the data type.
- In VLF 2023.1 we give this restriction up to offer our users the maximum flexibility for data manipulations.
- To this end VLF 2023.1 offers the Expert Modus which provides all available manipulations independent of the data type.

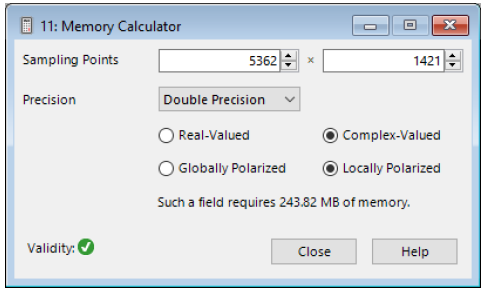
VLF Calculators

VirtualLab Fusion 2023.1 feature overview

The Small Helpers: New Calculators







- Our customers appreciate the Calculators in VirtualLab Fusion.
- We add new calculators with most major releases.
- VLF 2023.1 adds a new feature to the Spherical Lens Calculator for lens design with the lens maker's formula.
- Then VLF 2023.1 adds a Memory Calculator to give a fast understanding of the usage of memory in your PC dependent of the data type and the number of sampling points.

VirtualLab Fusion 2023.1 – The Feature Firework

- VirtualLab Fusion 2023.1 provides amazing new features for:
  - Higher Speed
  - Easier Use
  - More Physics
  - Deeper Transparency
  - Better Control
- Do not miss the webinar series on VLF 2023.1!

Register Now!