HSL.002 Homogenization of Excimer Laser Beam by Diffractive Diffuser.

Shows the simulation of a homogenization system for an excimer laser beam using a diffractive diffuser. The diffuser is optimized to generate a circular top hat.

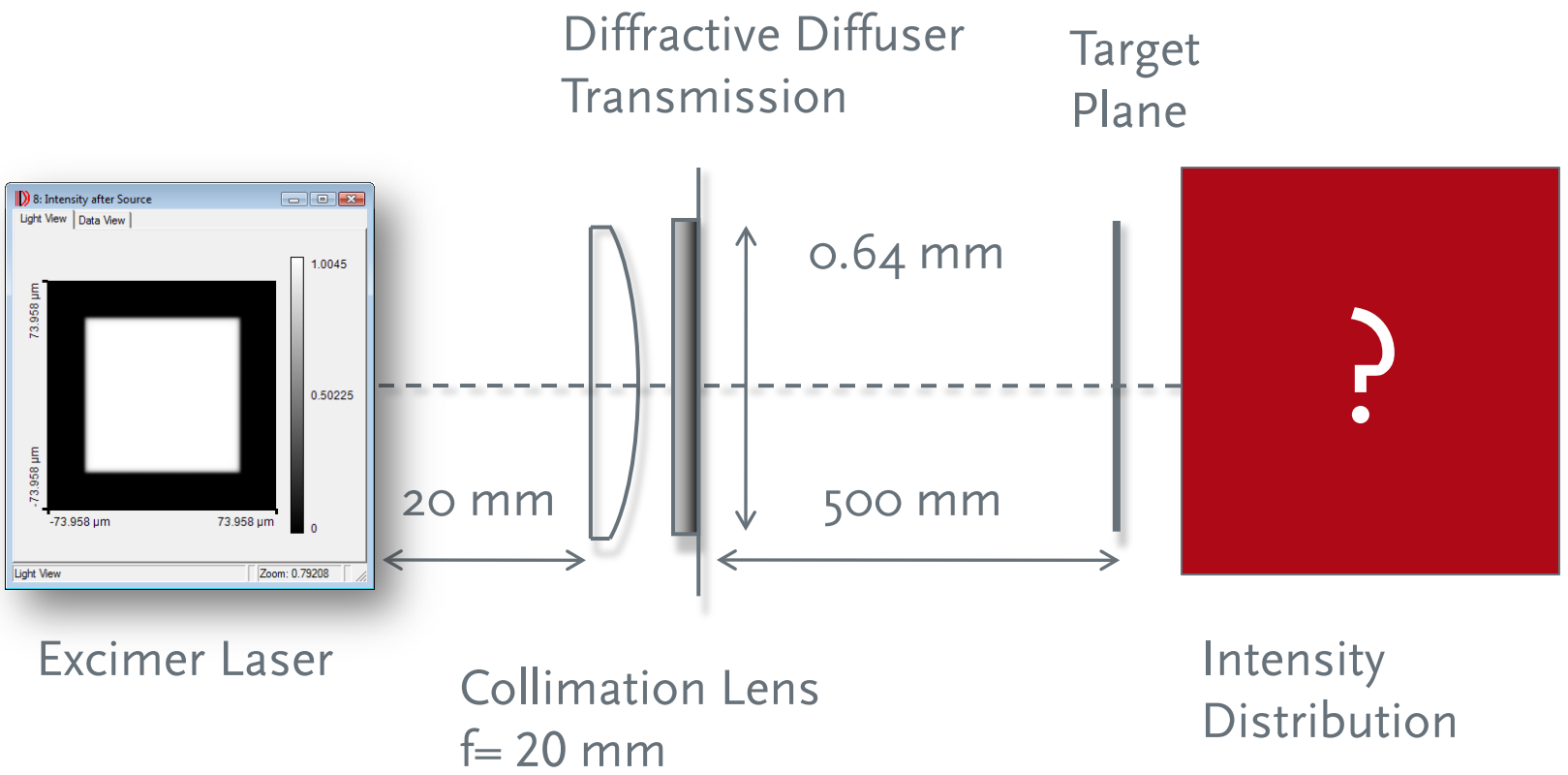
Keywords: Diffractive Optics, Diffractive Optical Elements, Homogenization, Diffuser, Excimer Laser, Partial Coherence

Required Toolboxes: Starter Toolbox Premium

Related Tutorials: HSL.1, DO.2

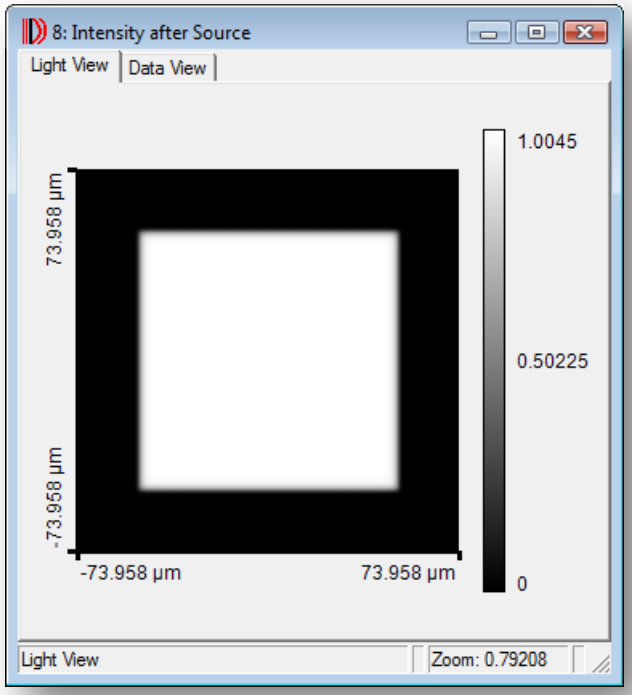
LightTrans

Modeling Task



Modeling Task

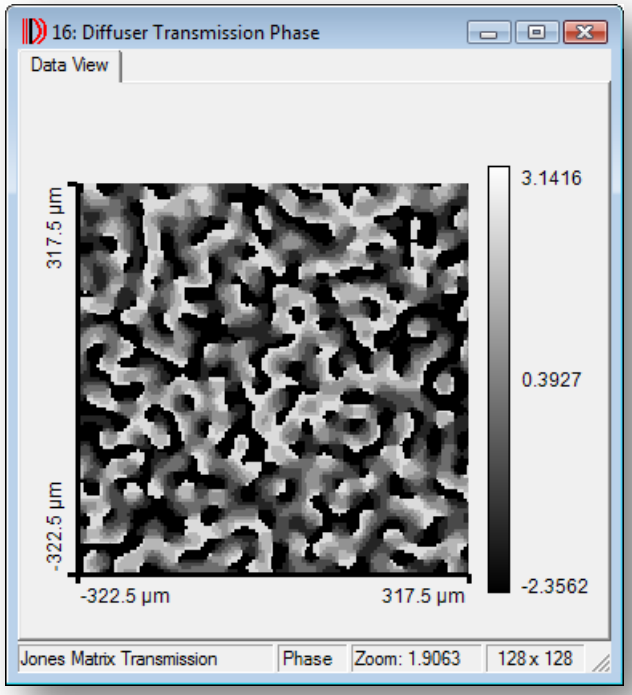
Illuminating Beam Parameters



- Source Plane Diameter: 100 x 100 µm
- Divergence Angle (HWHM): 0.89 x 0.89°
- Spatial Coherence Length: 3 x 3 µm
- Wavelength: 351 nm

Modeling Task

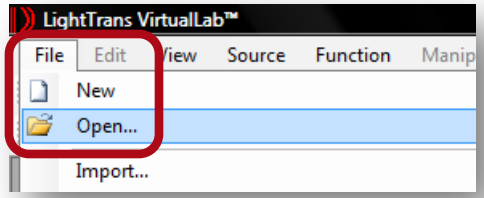
Diffractive Diffuser

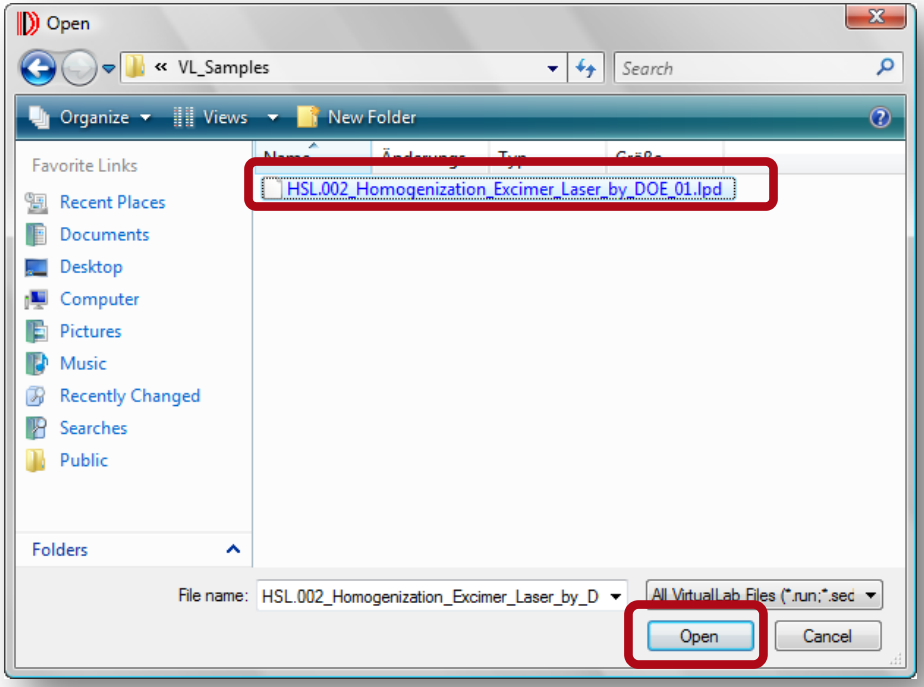


Diffuser Transmission Phase

- Sampling Distance: 5 µm
- Diameter: 640 x 640 µm
- Phase Levels: 8

Loading of Light Path Diagram

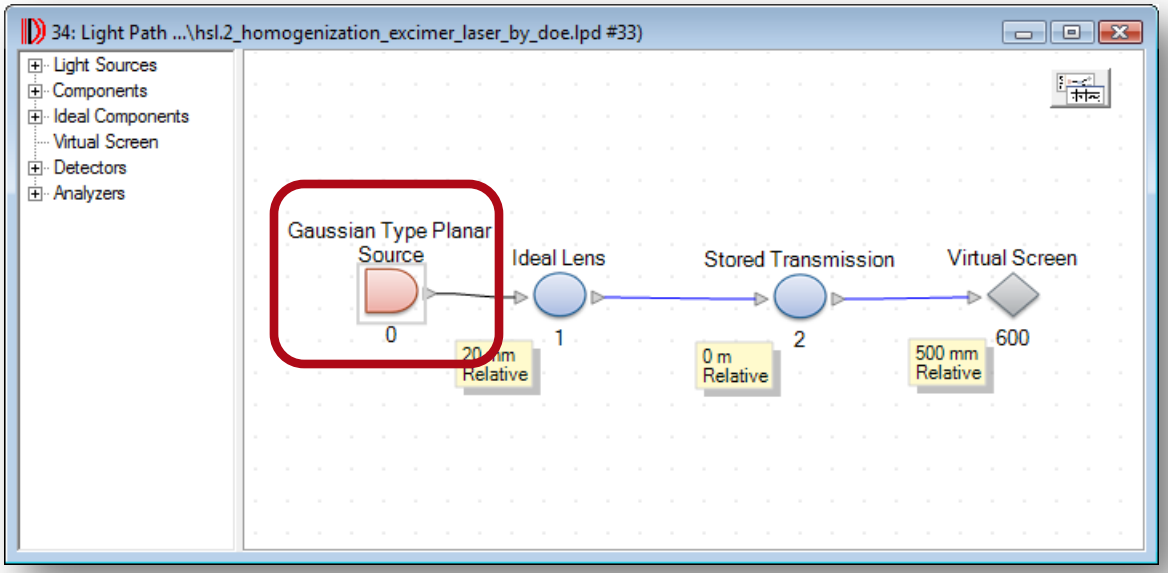




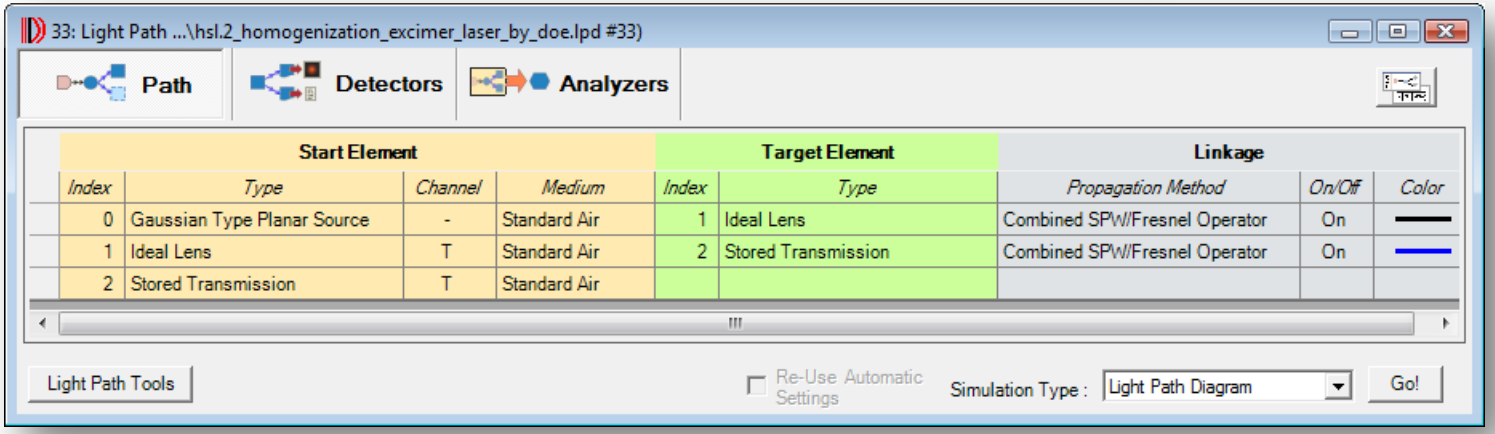
- Load the file HSL.002_Homogenization_Excimer_Laser_by_DOE_01.lpd.
- The file can be found in the VL_Samples folder of this tutorial.

Results in

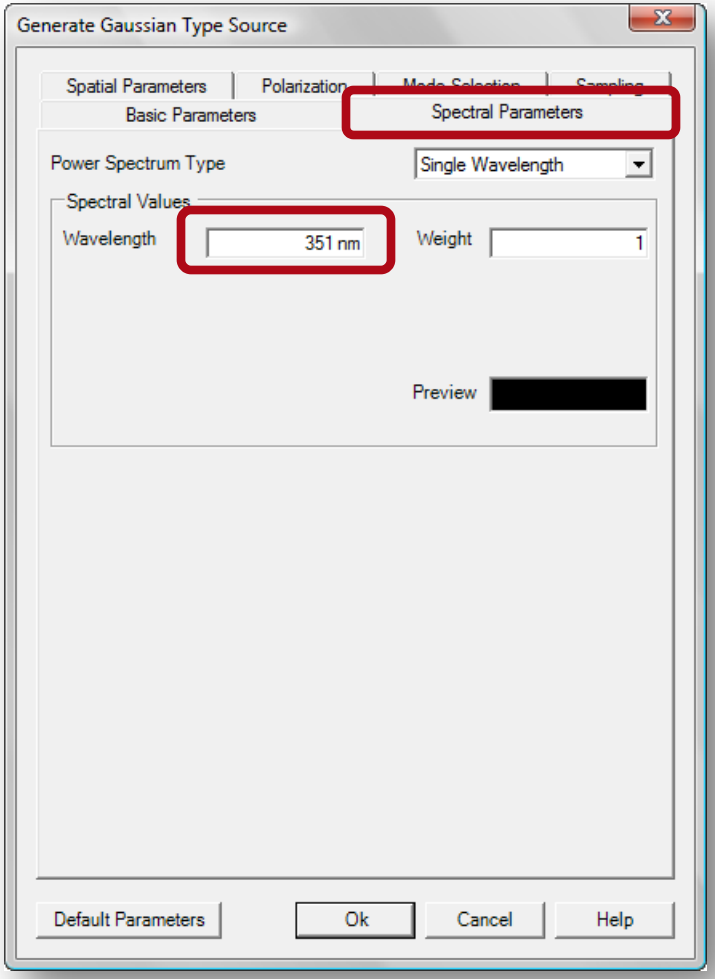
Gaussian Type Planar Source



- Double click *Gaussian Type Plane Source* to open edit dialog.

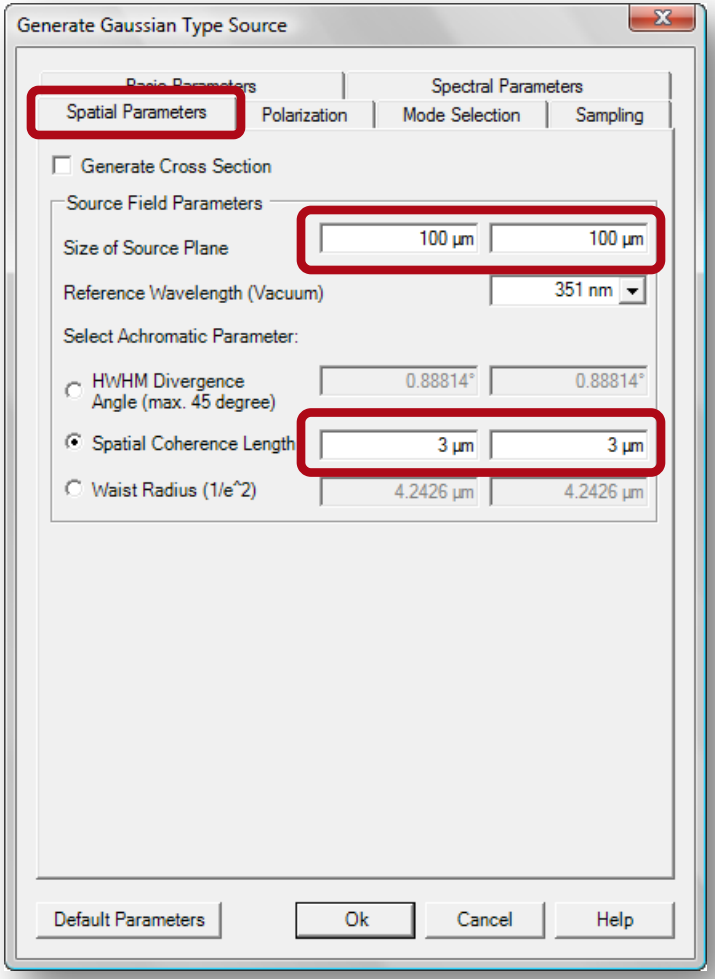


Gaussian Type Planar Source



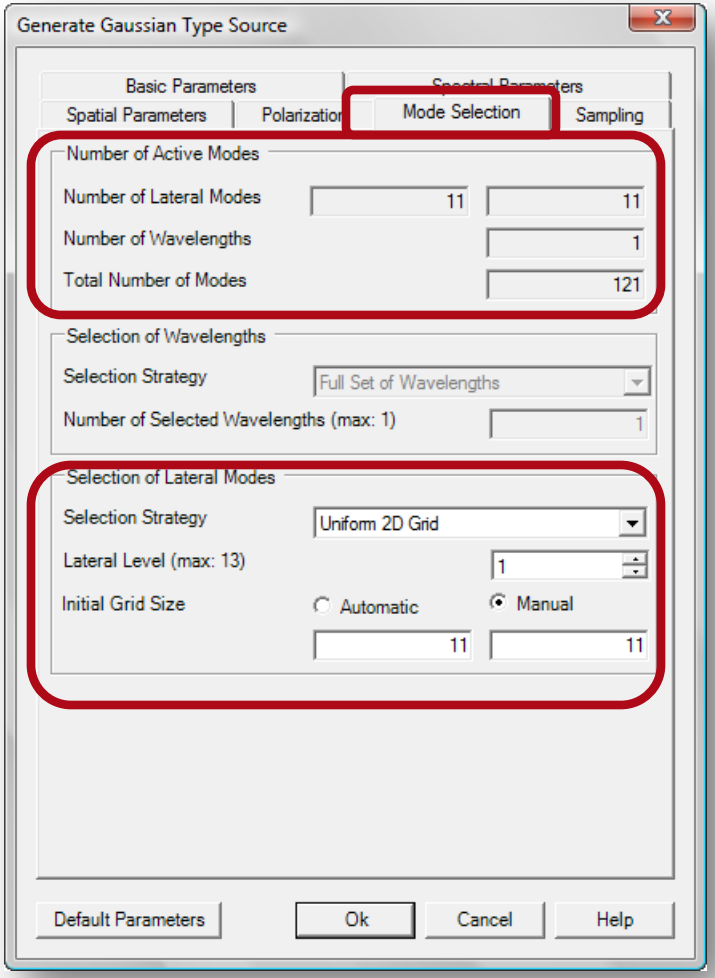
- The *Gaussian Type Plane Source* simulates a partial coherent source by several Gaussian modes that are incoherent to each other.
- This source will be used in the following to model an Excimer laser.
- As a first step the wavelength should be set to 351 nm.
- Just a single wavelength will be used for simulation. (VirtualLab™ supports also the simulation of multiple wavelength.)

Gaussian Type Planar Source



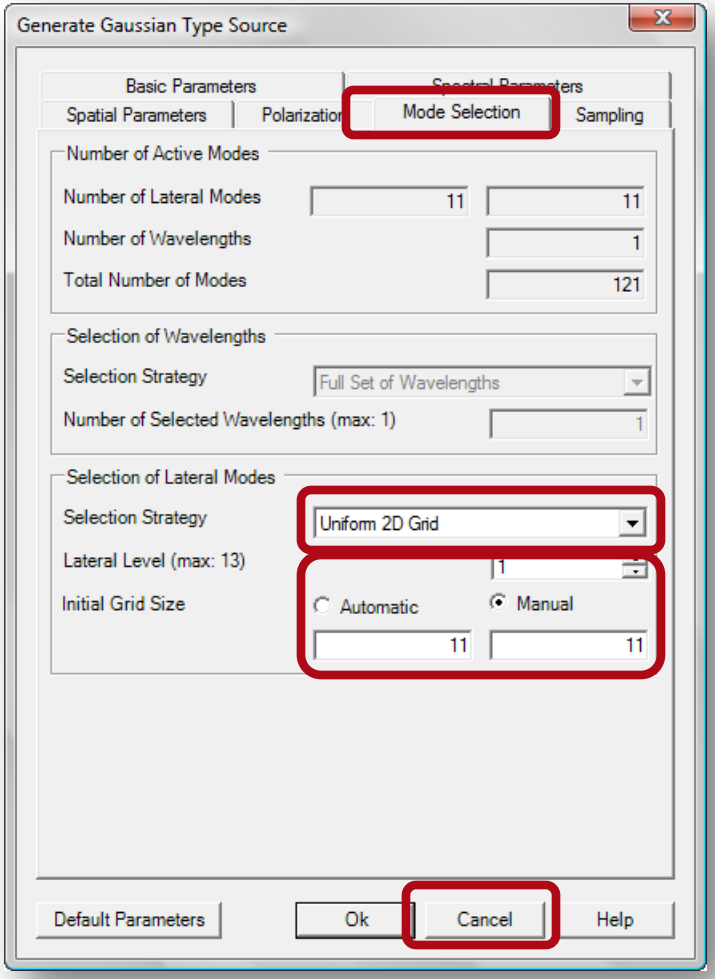
- Switch to the *Spatial Parameters* page to change the radiation characteristic of the source.
- The source is defined by the *Size of Source Plane* and *Divergence* angle or *Spatial Coherence Length* or *Waist Radius* of a mode. The last three parameters can't be change independent on each other since they depend on each other.
- Enter the *Size of Source Plane* and the *Spatial Coherence Length* as shown in the screen shot.

Gaussian Type Planar Source



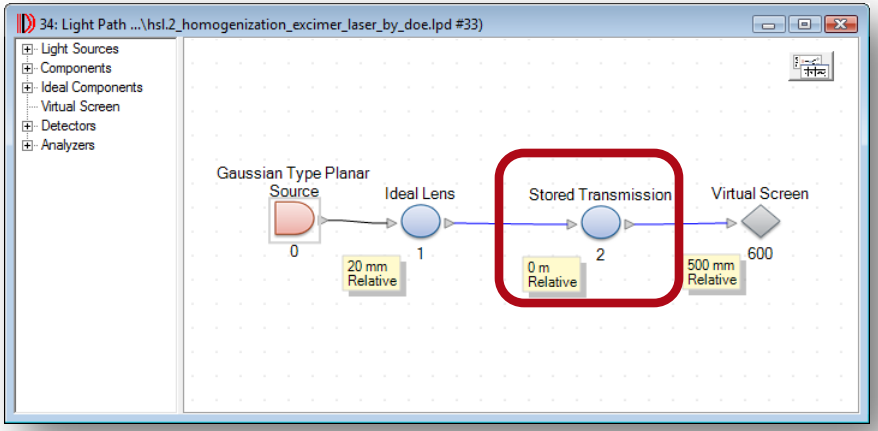
- Change to the *Mode Selection* page.
- This page allows to control the number of modes used for simulation of spatial and temporal coherence (the temporal coherence is simulated by power spectrum).
- On top of the page you will see the total number of modes.
- The lower part allows to control the number of lateral modes used for simulation of spatial coherence.

Gaussian Type Planar Source



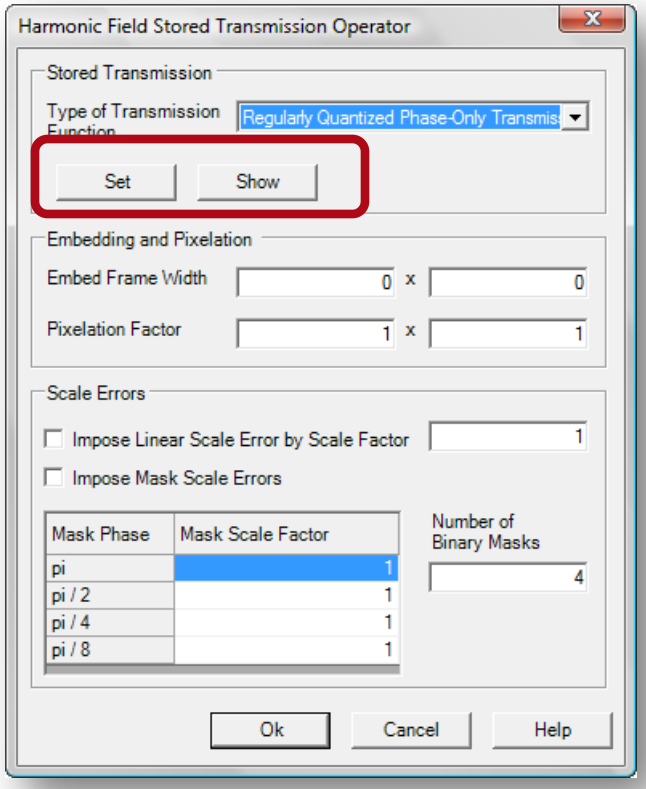
- Lateral modes can start at *Uniform 2D Grid* positions or at *Random* positions.
- In case of Uniform 2D Grid the number of modes is determined by a *Initial Grid Size* and a *Lateral Level* that helps to easily increase the number of modes.
- The larger the number of modes the more accurate is the simulation result but the more memory and computational time is required.
- Click *Cancel* button.

Stored Transmission



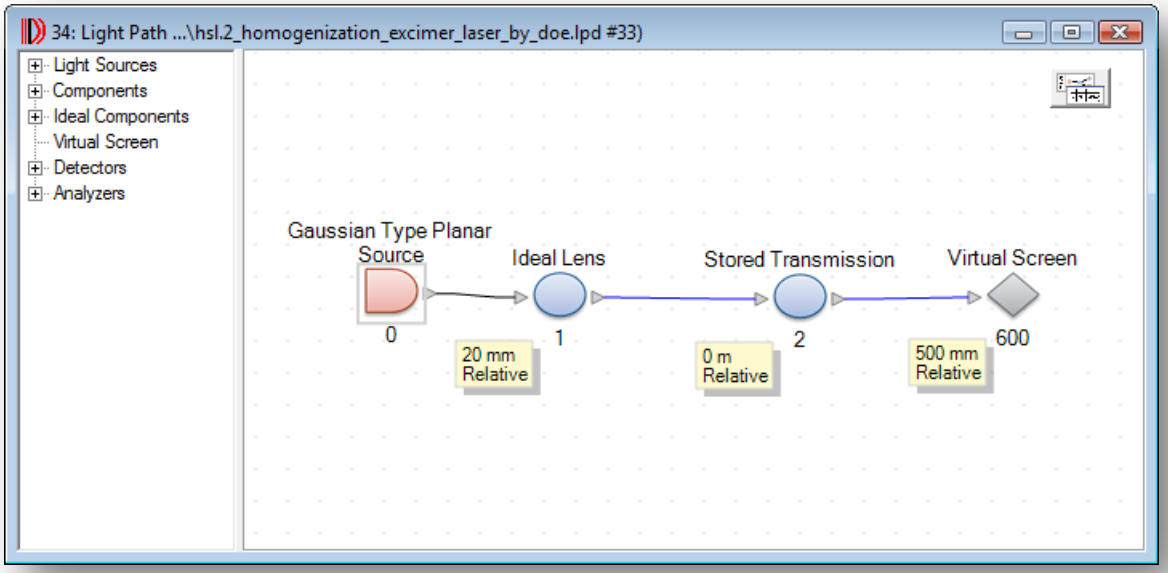
- After the light source follows a ideal lens component in a distance of 20 mm. It is used to collimate the light of the source.
- A *Stored Transmission* is used to simulate the effect of the diffractive diffuser.
- Double click *Stored Transmission* to display edit dialog.

Stored Transmission

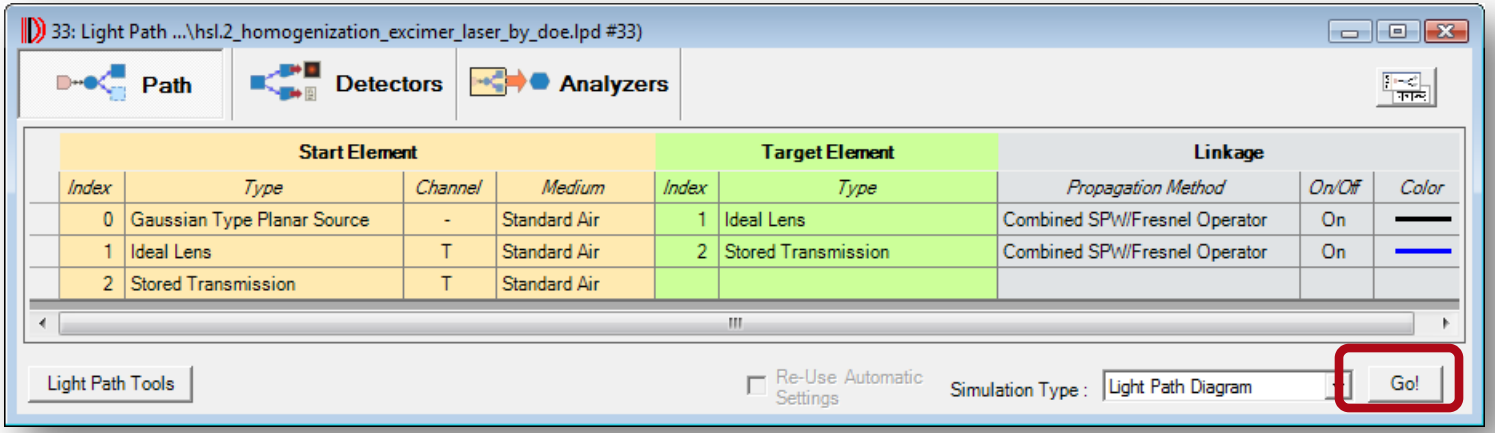


- The Stored Transmission contains the transmission function of the diffractive diffuser. The diffuser was optimized using the Diffractive Optics Toolbox Basic. See tutorial DO.2 for more details.
- The *Set* and *Show* buttons allow to set and display the transmission used for simulation.

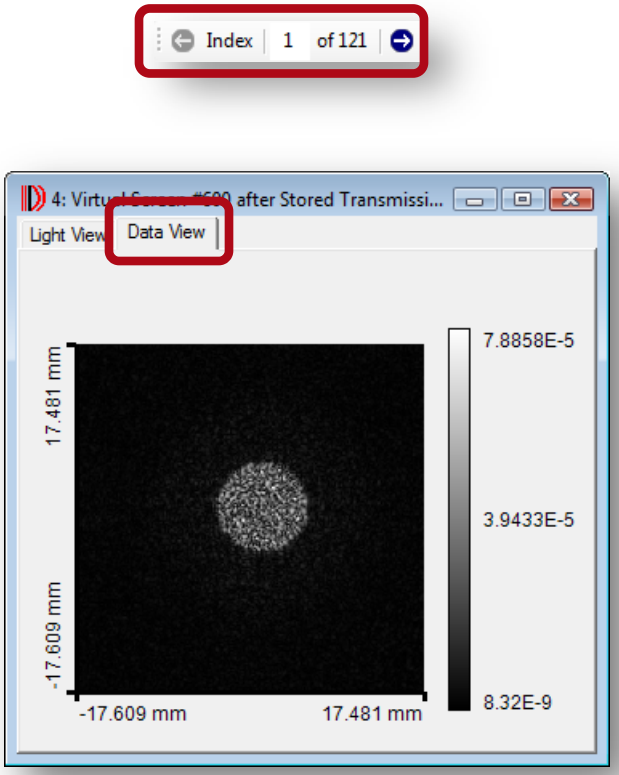
Gaussian Type Planar Source



- Click *Go!* button to start simulate of system.
- The simulation requires around three minutes.

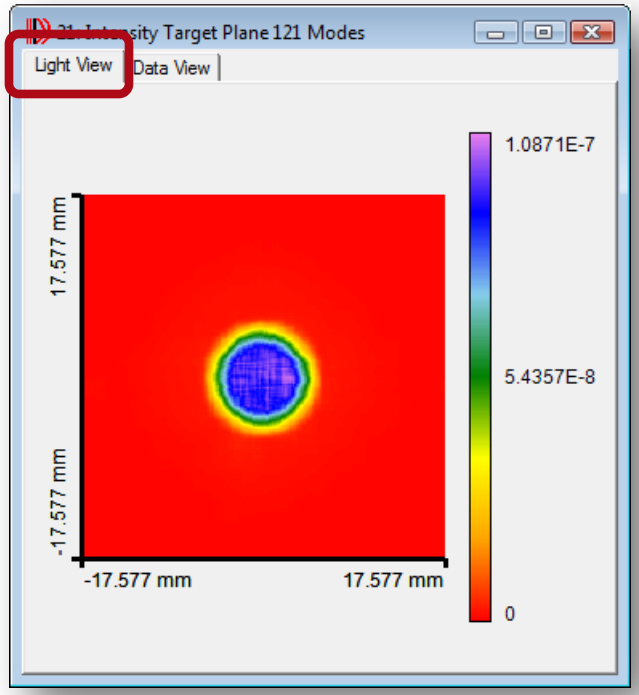


Harmonic Field Sets



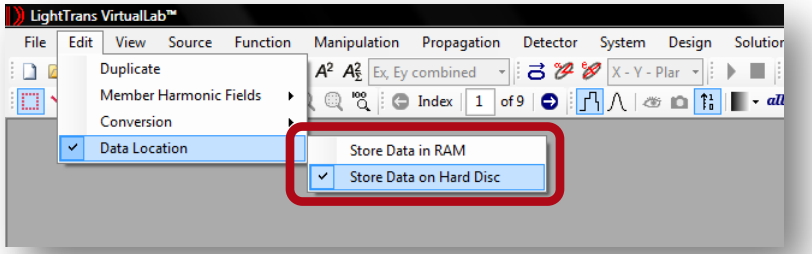
- As a simulation result a *Harmonic Field Set* is returned. It contains the complex amplitudes of the different modes in the target plane.
- The window of the harmonic field set contains as in case of harmonic fields a *Data View* and a Light View.
- The *Data View* shows one mode out of the set of modes. It is possible to switch to another mode using the toolbar (see upper screen shot)

Harmonic Field Sets



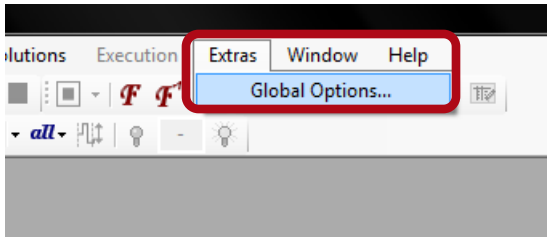
- The *Light View* shows the superposition of $E_x^2+E_y^2$ of all modes.
- Depending on the number of modes the calculation of the *Light View* may take a signification time.

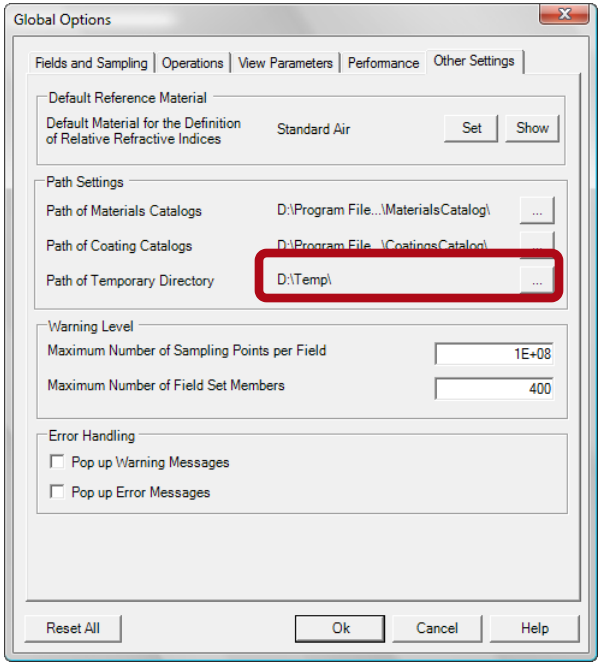
Harmonic Field Sets



- Since harmonic field sets may contain hundreds of modes the amount of data can be too large for the RAM memory. Because of this the modes are stored on the hard disc.
- If a user likes to keep the data in the RAM memory is possible to change the data location of the current harmonic field set as shown in the screen shot.

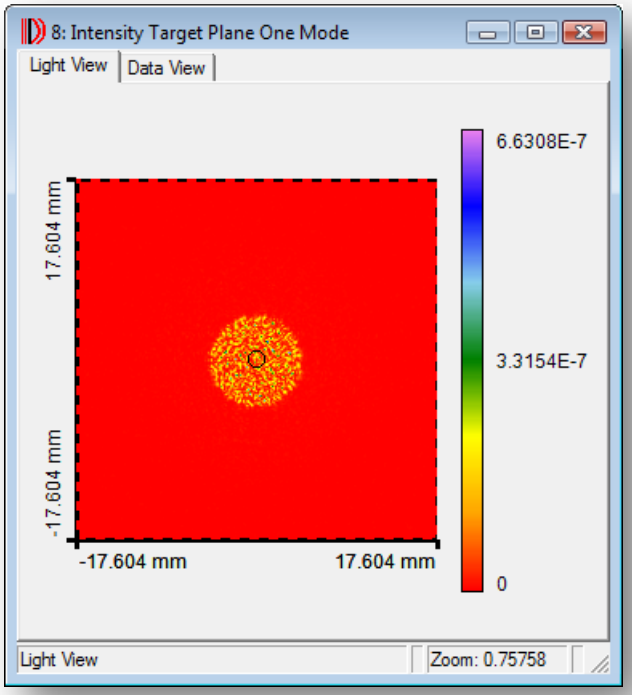
Harmonic Field Sets



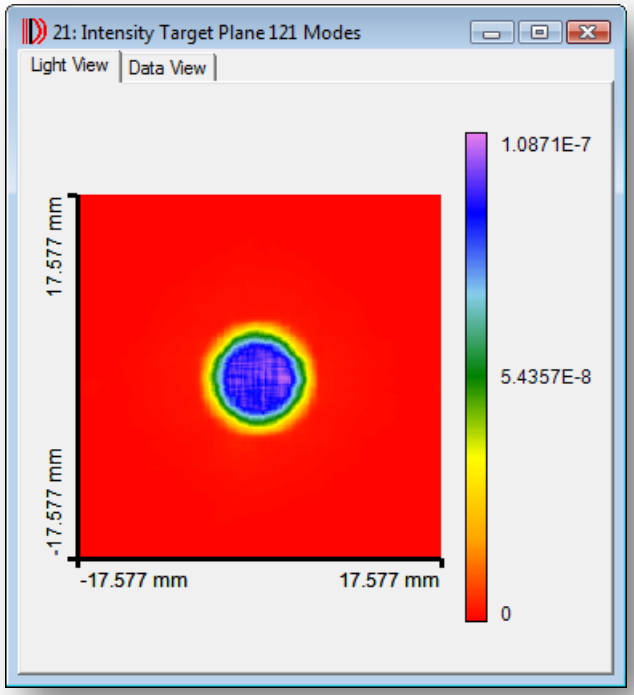


- Depending on the number of modes and the number of sampling points per mode a huge amount of hard disc space can be required to store a single harmonic field set.
- This may require to move the location of the folder used for temporary storage to another location.
- The *Global Options* allows to change the *Temporary Directory*.
- It is recommended to have more than 100 GB free hard disc space.

Simulation Results



Intensity Target Plane of One Mode



Intensity Target Plane 11 x 11 Modes

Conclusion

- VirtualLab™ enables the simulation spatial partial coherence of light sources.
- Different source models can be used: Multimode Gaussian Source, Gaussian Type Planar Source, Customized Mode Plane Source.
- Simulation of homogenization systems using diffractive diffusers is possible.