

UseCase.0012 (1.0)

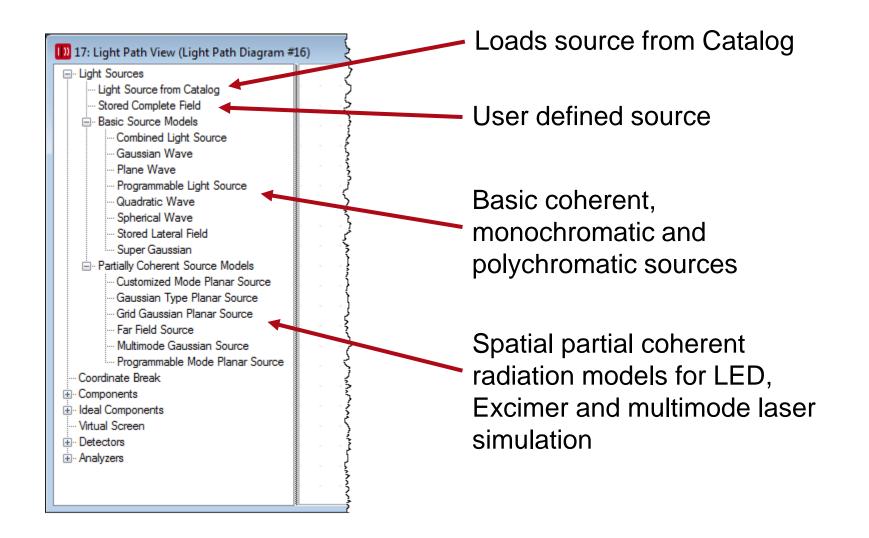
# **Configuration of Light Sources**

**Keywords:** LED, laser, harmonic fields, harmonic fields set, spectra, pulses, polarization

### **Description**

- This use case explains how light sources are configured to simulate different radiation in a plane.
- In general VirtualLab distinguishes between basic and partial coherent sources models.
- The lateral and spectral radiation can be defined by
  - Pre-defined formulas
  - Measurement data
  - User-defined formulas
- Light sources have no input and just one output channel.
- Apart from the Laser Resonator Toolbox in VirtualLab the processes inside of sources are not simulated.

# **Light Sources in Light Path Diagram**



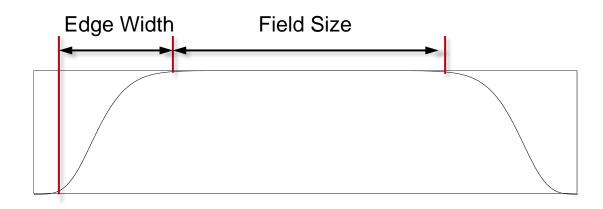
## **Light Sources – Basic Parameters**

Edit S	Super Gau	issian V	Vave	;	×
	Selection Spectral Para	Samp ameters	ling	Ray Selection Spatial Parameters	
Medium at Source Plane Standard Air in Homogeneo	ous Medium				
🚰 Load	🥒 Edi	t		Q View	]
Source Field: Longitudinal a Distance to Input Plane	nd Lateral Of	fset		0 m	
Lateral Offset		0 m		0 m	
Input Field: Position, Size an     O Automatic Setting     Manual Setting	Fie	<b>ld Size Fa</b> oply Later		1 iset of Source Field	
Shape	Rectan	gular		Elliptic	
Diameter	2	49.15 µm	x	249.15 µm	
Relative Edge Width			[	10 %	
O Absolute Edge Width				24.915 µm	
Default Parameter	Ok		Can	cel Help	

- The basic parameters tab can be configured for all light sources alike.
- It allows to enter the lateral offset and distance from source plane.
- The user defines the medium directly after the source plane.
- Supports in addition the configuration of
  - Field size
  - Field shape (rectangular, elliptical)
  - Edge width (apodization)

# Light Sources – Field Size and Shape

- Most analytical light distributions have infinite extension.
- For the computer all light distributions must have a finite extension.
- VirtualLab introduces the concept of field size, field shape and edge width (apodization).
- A Gaussian like apodization is used on the edges of the field in order to reduce numerical errors.
- The field size can be defined automatically (for some sources) or manually.
- In addition the suggested field size can be changed by a Field Size Factor.



# **Light Sources – Spatial Parameters**

	Edit Super Gau	issian Wave		×
Polarization Basic Parameters	Mode Selection Spectral Para	Sampling	Bay Selection Spatial Parameters	)
Type 💿 Isot	ropic (RotSymm.)	<ul> <li>Separable</li> </ul>	(RectSymm.)	
Waist Radius Radius defined at	1/(e^2) 🔿 50%	100 µm O Fraction	13.534 %	
Edge Steepness / O Edge Width Edge Maximum Edge Minimum Order Percentage Values I		26.917 µm 90 % 10 % 10 ude (S	i	
Default Parameter	Ok	Cance	el Help	

- On the spatial parameters page the user can define additional parameters of the lateral distribution.
- The content of the spatial parameters depend on the light source which is configured.

# **Light Sources – Polarization**

Ec	dit Super Gau	ssian Wave	5	×
Pagio Parameters	Spectral Para	meters	Spatial Parameters	
Polarization Mo	de Selection	Sampling	Ray Selection	
Global Polarization     Polarization Input		Local Polariz	ation	
Type of Polarization	Linearly Polari Circularly Pola Elliptically Pola	zed rized	tor	
Normalized Jones Vector $\begin{pmatrix} Jx \\ Jy \end{pmatrix}$ =			1 0	
Default Parameter	Ok	Car	ncel Help	

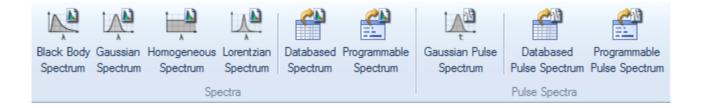
- On the polarization tab the user can define the global polarization of the source.
- The following polarization types are available:
  - Linear (input of angle to xaxis)
  - Circular (left or right rotation of polarization)
  - Elliptical (define polarization ellipses)
  - General (input of Jones vector)
- Resulting Jones vector is displayed.

# **Light Sources – Spectral Parameters**

Edit Super Gaussian Wave				
Polarization Mode Sale Basic Parameters Sp	ection ectral Paramete	Sampling ars	Ray Selection Spatial Parameters	
Power Spectrum Type		Triplet of V Single Way	Vavelengths v	l
Spectral Values			Vavelengths	
Wavelength 1	473 nm	Weight	0.8	
Wavelength 2	532 nm	Weight	0.62	]
Wavelength 3	635 nm	Weight	1.05	
Default RGB Values		Preview		
Default Parameter	Ok	Cano	el Help	

- The user can select between three different spectral modes
  - Single wavelength (monochromatic simulation)
  - Triple wavelength (three wavelength and weights have to be defined)
  - List of wavelength (list of wavelength with weights, import from diagram or ASCII)
- Resulting color is displayed if visible, otherwise black.

#### **Light Sources – Spectra Gererators**



- Within the source ribbon several generators for the definition of spectra for sources and pulses are available.
- The generated data arrays representing the spectrum can be imported into the light source.

# **Light Sources – Sampling**

Manual Sampling Sampling Points Sampling Distance Array Size Embedding Size of Embedding Frame (Sampling Points)	101 2.9602 µm 298.98 µm	ctor	Ray Selection 1 meters from 101 2.9602 μm 298.98 μm
<ul> <li>Automatic Sampling Overs</li> <li>Manual Sampling</li> <li>Sampling Points</li> <li>Sampling Distance</li> <li>Array Size</li> <li>imbedding</li> <li>ize of Embedding Frame (Sampling Points)</li> </ul>	Сору Activ 101 2.9602 µm 298.98 µm Points)	xx	meters from 101 2.9602 μm 298.98 μm
Manual Sampling         Sampling Points         Sampling Distance         Array Size         imbedding         ize of Embedding Frame (Sampling Points)	Сору Activ 101 2.9602 µm 298.98 µm Points)	xx	meters from 101 2.9602 μm 298.98 μm
Sampling Points Sampling Distance Array Size mbedding ize of Embedding Frame (Sampling P	101 2.9602 µm 298.98 µm ?oints)	x	101 2.9602 μm 298.98 μm
Sampling Distance     Array Size Embedding Size of Embedding Frame (Sampling P	2.9602 μm 298.98 μm Points)	x	2.9602 μm 298.98 μm
Array Size Embedding Size of Embedding Frame (Sampling P	298.98 µm Points)		298.98 µm
Array Size Embedding Size of Embedding Frame (Sampling P Total Sampling Points	Points)	x	
ize of Embedding Frame (Sampling P			10
otal Array Size	358.18 µm	x	358.18 µm

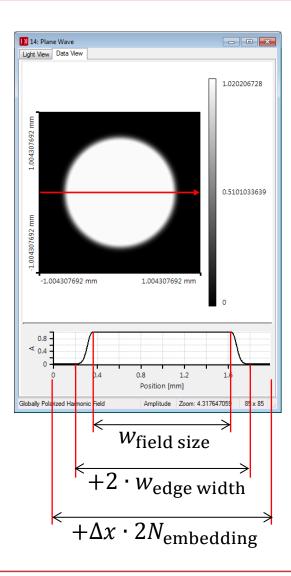
- On the sampling tab the user can define the sampling parameters that shall be used for the generation of the field.
- By default VirtualLab provides the user an automatic sampling mode which is for most cases sufficient.

# **Light Sources – Sampling**

- The automatic sampling suggestion can be modified using the Sampling Factor.
- If wanted, the user can also define the sampling manually.
- In manual mode the user can select whether to specify the number of data points or the sampling distance.
- The embedding factor is used to introduce zero padding around data points.
- Thus the total array size for the light representation in the input plane is defined by

 $w_{\text{array}} = w_{\text{field size}} + 2 \cdot w_{\text{edge width}} + \Delta x \cdot 2N_{\text{embedding}}$ 

# **Light Sources – Sampling**



The array size is defined by:

- $w_{array} \rightarrow Array size$
- $w_{field \ size} \rightarrow Field \ Size$
- w<sub>edge width</sub> → Absolute Edge Width
- $\Delta x \rightarrow$  Sampling distance
- N<sub>embedding</sub> → Embedding frame width in sampling points

# **Light Sources – Ray Selection**

	Edit Super Gau	ussian Wave	×
Basic Parameter	s Spectral Par	ameters	Soatial Parameters
Polarization	Mode Selection	Sampling	Ray Selection
the source.	y Tracing r Ray Tracing are spec e soherical phase is Infi		ical phase part of
Ray Selection			
Method to use fo	or ray selection		
🔿 x-y-Grid		oolar	O Random
Density	5	1 ≑	
Info: For hex	apolar ray selection 2	977 rays will be u	used.
Default Parameter	Ok	Cance	el Help

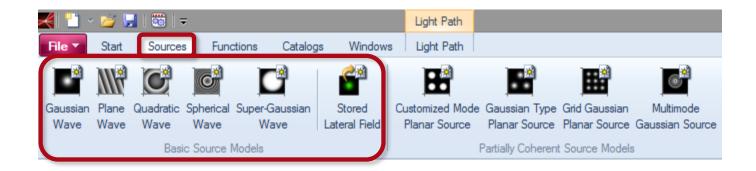
- The user can define the number and the mode for the generation of rays (used for ray tracing)
- The following modes are supported:
  - x-y Grid (equidistant grid in x and y)
  - Hexapolar (definition of the density of the rays)
  - Random (number of rays which will be distributed randomly, including seed)

## **Light Sources – Mode Selection**

Edit Su	per Ga	ussian Wa	ve	×
Polarization Mode Sel	ectral Par	ameters Sampling	Spatial Parame Ray Selec	
Selection of Active Modes Selection Strategy Number of Spectral Modes (m Number of Lateral Modes (ma	a) Full Sel Spectra	of Spectral a al Selection O	nd Lateral Modes nd Lateral Modes rdered by Index niform in Index yn	~
Number of Active Modes				
Number of Spectral Modes				1
Total Number of Modes				1
Default Parameter	<u>O</u> k	<u><u> </u></u>	ancel <u>H</u>	elp

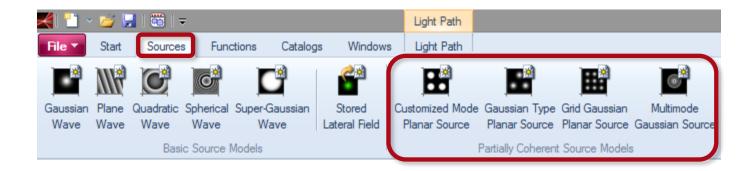
- For partial coherent modes the modes' positions and weights are defined on the mode selection tab.
- For all light sources the user can specify the modes to be generated.
- The selection can be used to generate only a subset of modes to check the general performance of the light source and the system.

## **Light Source Generation in Main Window**



- Source generators can also be triggered within the main menu to generate harmonic field (s sets).
- For basic sources different coherent light sources can be specified as mono- or polychromatic.

# **Light Source Generation in Main Window**



- For partially coherent models also generators are available in the main window.
- These sources can be used e.g. to simulate LEDs, Excimer or multi-mode lasers.



- The light source generators of VirtualLab allow a very flexible and user-friendly way to define source fields that can be used for further simulations or manipulations.
- The standardized way to specify a light source with all its parameters enable the user to get familiar with the usage concept and to be able to configure all sources in the same way.
- The simulation of basic sources (e.g. spherical, plane or Gaussian fields) as well as simulations of partial coherent sources (LED, Excimer or multi-mode lasers) can be done with VirtualLab.