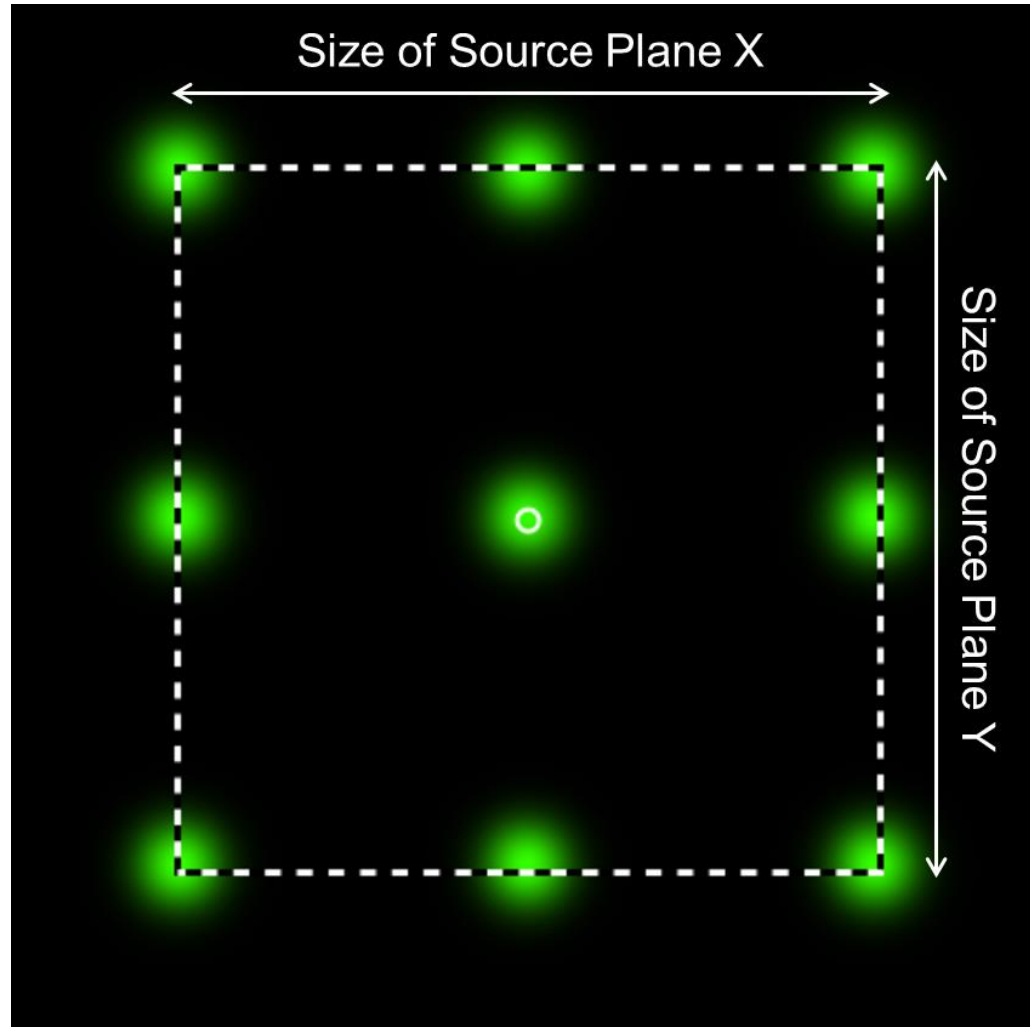# How to Customize the Position of Source Modes Via Programming and Example (Along a Line)

Abstract

Providing maximum versatility for your optical simulations is one of our most fundamental objectives. The source concept employed in VirtualLab Fusion follows this spirit of customizability: not only can the user manipulate at will the temporal spectrum of the source and the functional shape of the base mode, but also the position and weight of the laterally shifted modes used to replicate the spatial coherence characteristics of the source. This document shows how to configure the latter two source properties (position and weight of the modes) via a piece of user-defined programming code.

Where to Find Programmable Mode Positioning: Catalog

Where to Find Programmable Mode Positioning: Optical Setup

All the highlighted source types allows for customization of mode position via programming!

Writing the Code

Source Code Editor

Tabs: Source Code | Global Parameters | Snippet Help | Advanced Settings

```
1    double xPosition = 0.0;
2    double yPosition = 0.0;
3
4    /************************************
5     ********** INSERT YOUR CODE HERE *************
6     ************************************/
7
8    //Attention: The index of the modes is zero-based for
9
10   return new VectorD(xPosition, yPosition);
```

SizeOfSourcePlaneX [double]
SizeOfSourcePlaneY [double]
NumberLateralModes [int]
Index [int]

Hint: the Global Parameters, Snippet Help, Advanced Settings tabs and other aspects of the interface work equivalently to those of other programmable elements in VirtualLab.

Check Consistency   Validity: ✓   OK   Cancel   Help
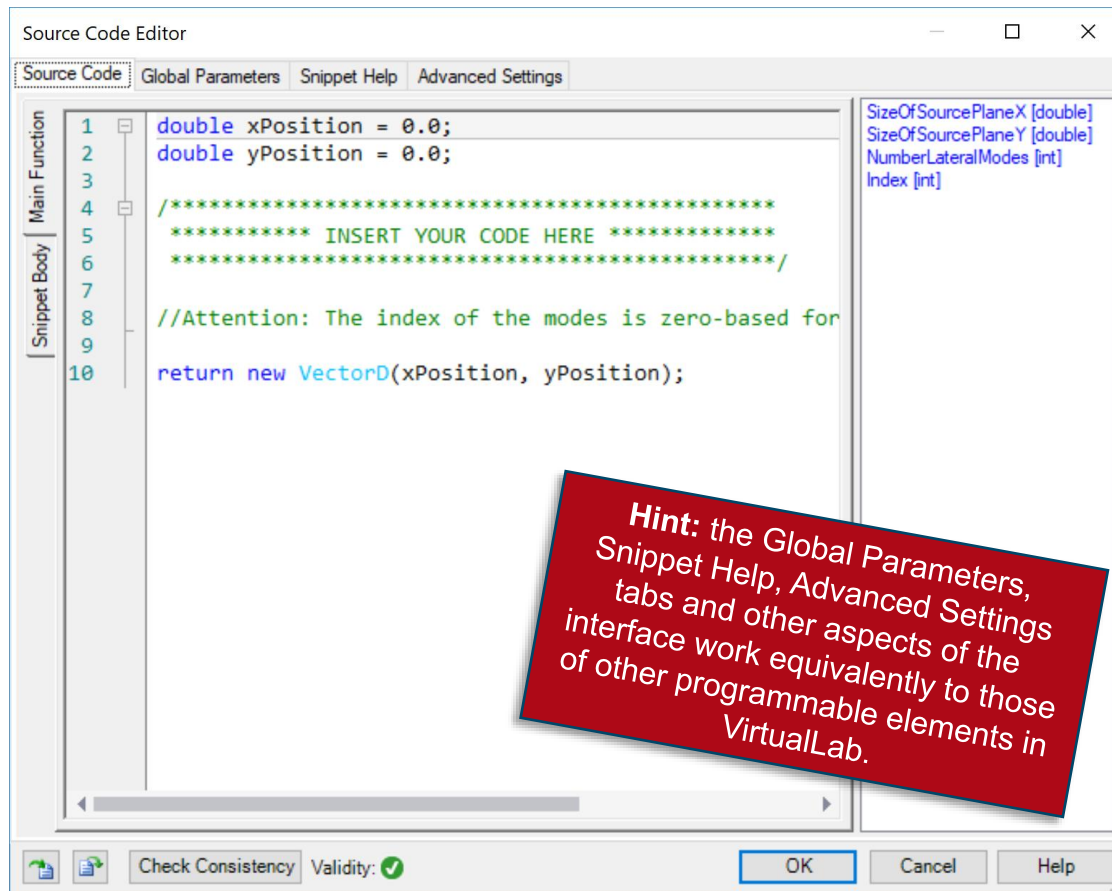
- The panel on the right shows a list of available independent parameters.
- `SizeOfSourcePlaneX` and `SizeOfSourcePlaneY` are user-determined parameters whose value can be accessed in the code and changed in the Spatial Parameters tab of the source configuration dialog.
- `NumberOfLateralModes` gives the total number of laterally shifted modes. The value of this parameter can be modified in the configuration dialog of the source, in the Mode Selection tab.
- The parameter `Index` identifies each of the individual lateral modes.
- The code in the Main Function must return a `VectorD` value (representing the position of the mode in the *x, y* plane) per `Index`.
- Use the Snippet Body to group parts of the code in support functions.

A Comment on the Size of Source Plane
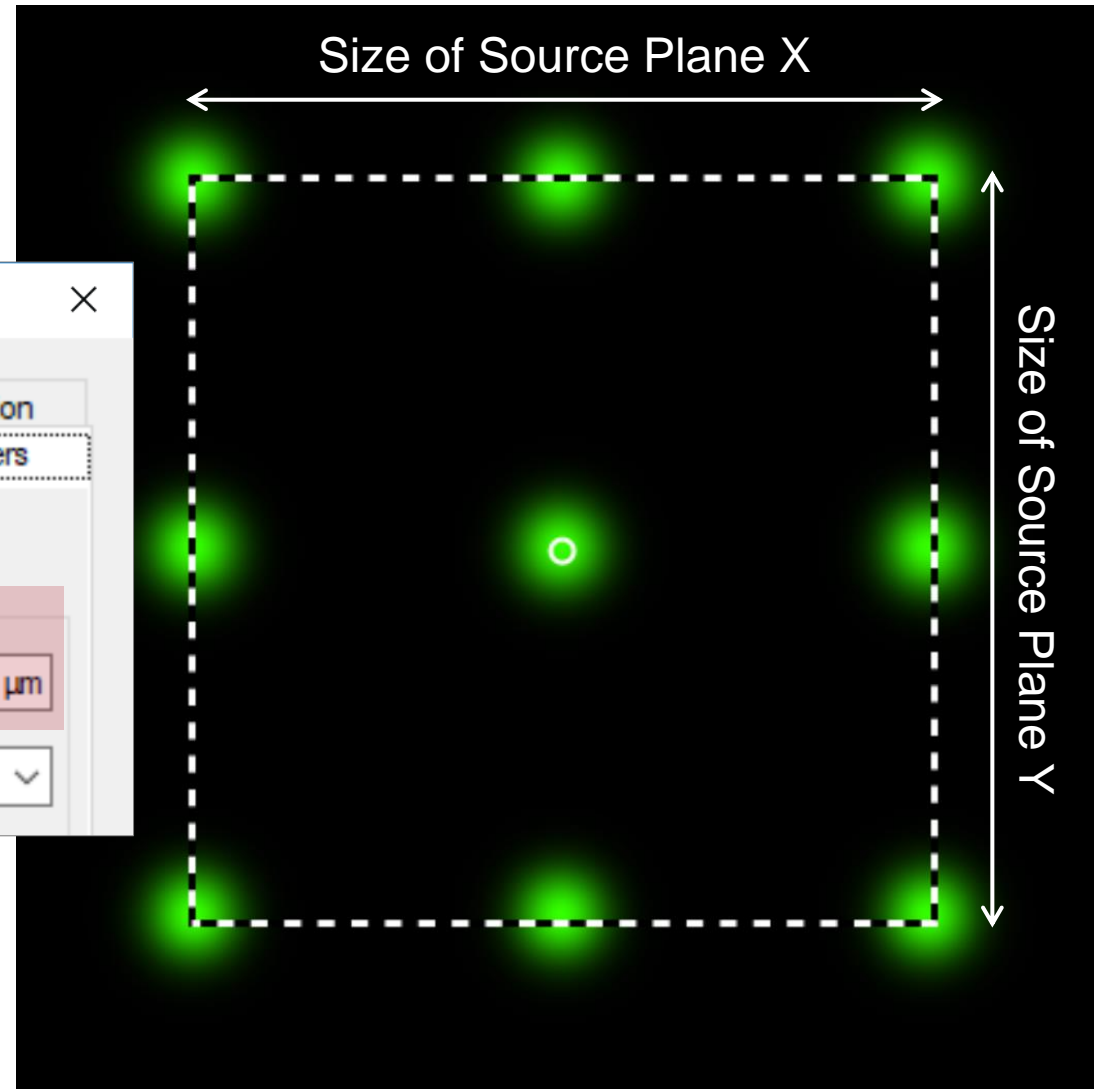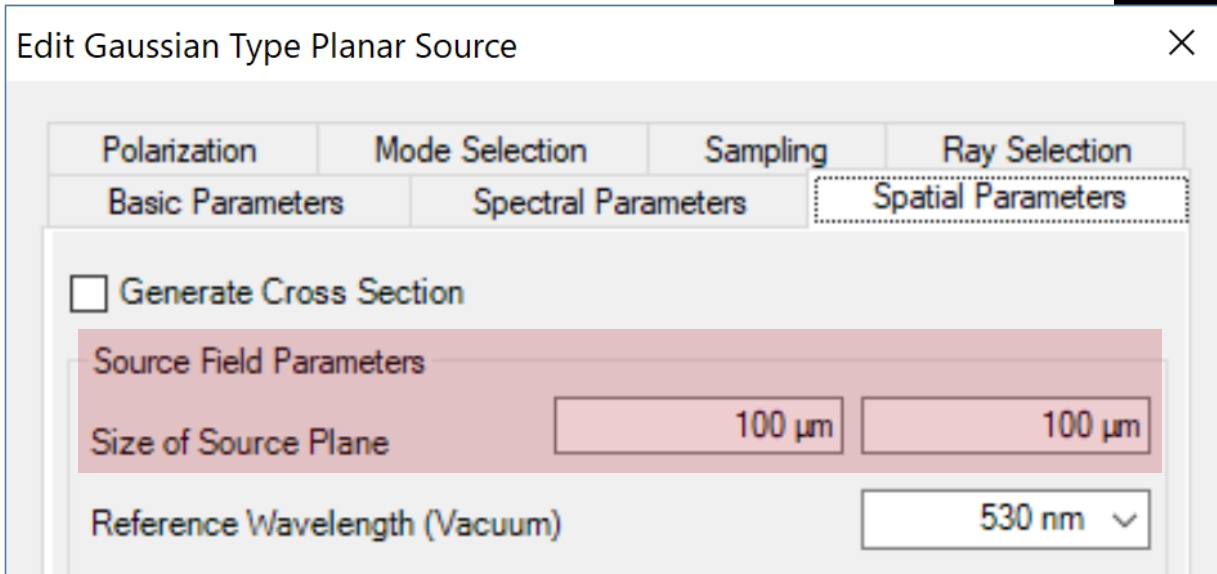
Output

- The different replicas of the base mode will be placed according to the positions defined in the snippet.

- The actual functional shape of the base mode depends on the specific type of source selected (for instance, Gaussian for the Gaussian Type Planar Source, or user-defined for the Programmable Mode Planar Source).

- For preliminary simulations it is recommended to select a sub-set of all the modes which define the actual source in the Mode Selection tab before running the simulation. This means fewer modes will be traced through the system and consequently less time will be required.

- For more final simulations the entire set of modes can be selected again easily.

- Algorithmically, all the modes are grouped together in data types of an array nature, which have been designed for the purpose. In any programmable element which the field encounters subsequently in the system, it is possible to access each of the individual modes.
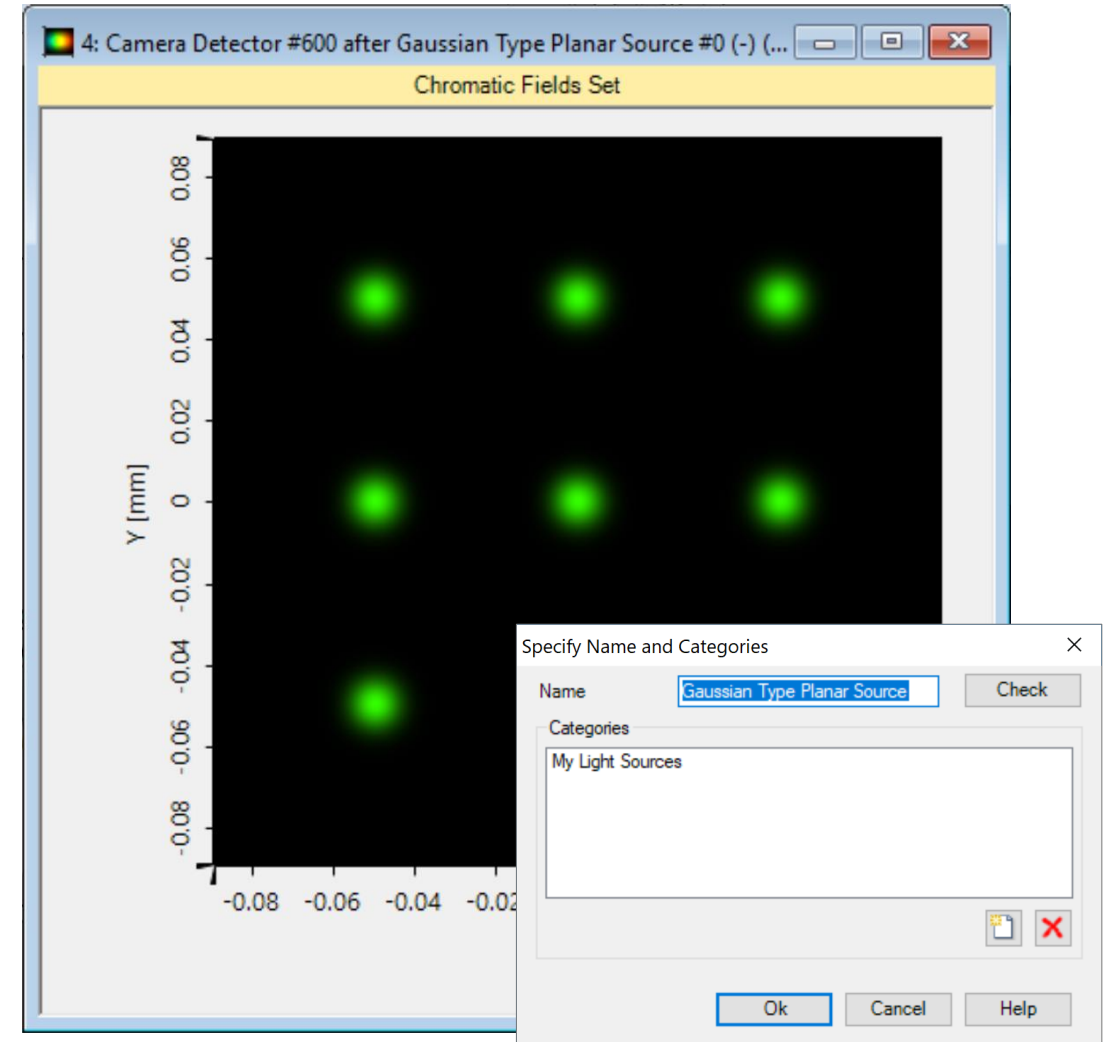
Positioning Modes Along a Line

Positioning Base Modes Along a Line with Angle α

$$\text{position}\,(\text{mode}_i) = \left(-\frac{\Delta x}{2}, -\frac{\Delta y}{2}\right) + i \cdot (\delta x, \delta y) \qquad (1)$$

- $N \rightarrow$ Number of modes.

- $\Delta x \rightarrow$ Size of source plane in x.

- $\Delta y = \Delta x \tan \alpha$.

- $\delta x = \frac{\Delta x}{N-1}$.

- $\delta y = \delta x \tan \alpha$.

Where to Find Programmable Mode Positioning: Optical Setup

All the highlighted source types allows for customization of mode-position via programming!

Where to Find Programmable Mode Positioning: Catalog

All the highlighted source types allows for customization of mode-position via programming!

Custom Source Mode Positioning: Global Parameters

- Once you have triggered open the Edit dialogue, go to the Global Parameters Tab.

- There, Add and Edit a global parameters:
  - `double` `Angle = 45 deg (0 deg, 180 deg)`: the angle formed by the straight line along which the modes are positioned and the *x* axis.

Hint: it is possible to add some clarifying text to each global parameter to facilitate use of the snippet for other users!
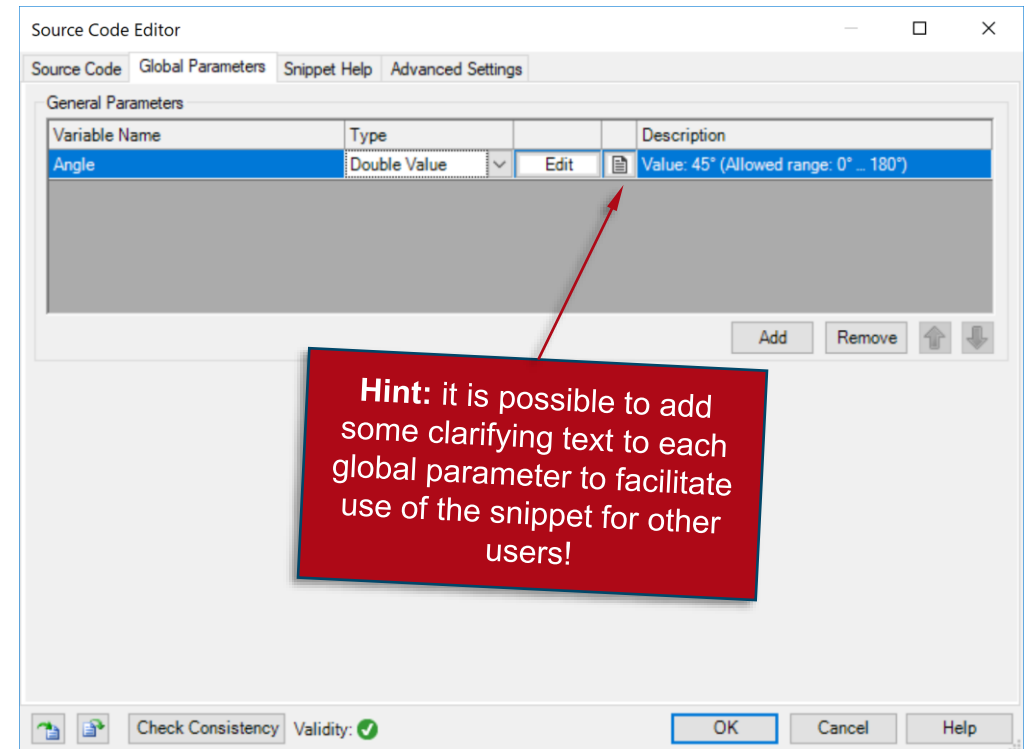
Custom Source Mode Positioning: Writing the Code

Declaration of output variable given by default

Are there errors in your code?

Export Snippet to save your work!

Default global parameters/variables

Global parameter defined by user in Global Parameters tab

Compute result using Eq. (1).

Source Code Editor

Source Code | Global Parameters | Snippet Help | Advanced Settings

Main Function | Snippet Body

```
1    // Declare output:
2    double xPosition = 0.0;
3    double yPosition = 0.0;
4
5    // Declare and compute the step size in X direction:
6    double deltaX = SizeOfSourcePlaneX / (NumberLateralModes - 1);
7
8    // Compute the X position of the mode with index Index:
9    xPosition = -(SizeOfSourcePlaneX / 2) + (Index * deltaX);
10
11   // Compute the Y position of the mode with index Index,
12   // taking into account inclination (Angle):
13   yPosition = -(Math.Tan(Angle) * SizeOfSourcePlaneX / 2) +
14       (Index * Math.Tan(Angle) * deltaX);
15
16   // Deliver output:
17   return new VectorD(xPosition, yPosition);
```

SizeOfSourcePlaneX [double]
SizeOfSourcePlaneY [double]
NumberLateralModes [int]
Index [int]
Angle [double]

Check Consistency   Validity: ✓   OK   Cancel   Help

Custom Source Mode Positioning: Mode No. and Size of Source Plane

Edit Gaussian Type Planar Source   ✕

| Basic Parameters | Spectral Parameters | Spatial Parameters |
| Polarization | Mode Selection | Sampling | Ray Selection |

Definition of Lateral Modes

Definition Strategy   [User Defined   ▼]

Number of Lateral Modes (max: 2147483647)   [9]

                                                   [Edit]

Weight Function

Specification Type   ◉ Constant Weight   ○ User-Defined Weight

              Weight Value   [1]

Selection of Active Modes

Selection Strategy   [Full Set of Spectral and Lateral Modes   ▼]

Number of Spectral Modes (max: 1)   [1]

Number of Lateral Modes (max: 9)   [9]

Number of Active Modes

Number of Lateral Modes   [9]

Number of Spectral Modes   [1]

Total Number of Modes   [9]

[Default Parameter]   [Ok]   [Cancel]   [Help]

Edit Gaussian Type Planar Source   ✕

| Polarization | Mode Selection | Sampling | Ray Selection |
| Basic Parameters | Spectral Parameters | Spatial Parameters |

☐ Generate Cross Section

Source Field Parameters

Size of Source Plane   [100 µm]   [100 µm]

Reference Wavelength (Vacuum)   [530 nm ▼]

Select Achromatic Parameter:

◉ HWHM Divergence
   Angle (max. 45 degree)   [1°]   [1°]

○ Spatial Coherence Length   [4 µm]   [4 µm]

○ Waist Radius (1/e^2)   [5.7 µm]   [5.7 µm]

[Default Parameter]   [Ok]   [Cancel]   [Help]

The size of the source plane also has to be defined separately, in the Spatial Parameters tab

The total number of lateral modes must be defined in the configuration dialog of the source, in the Mode Selection tab
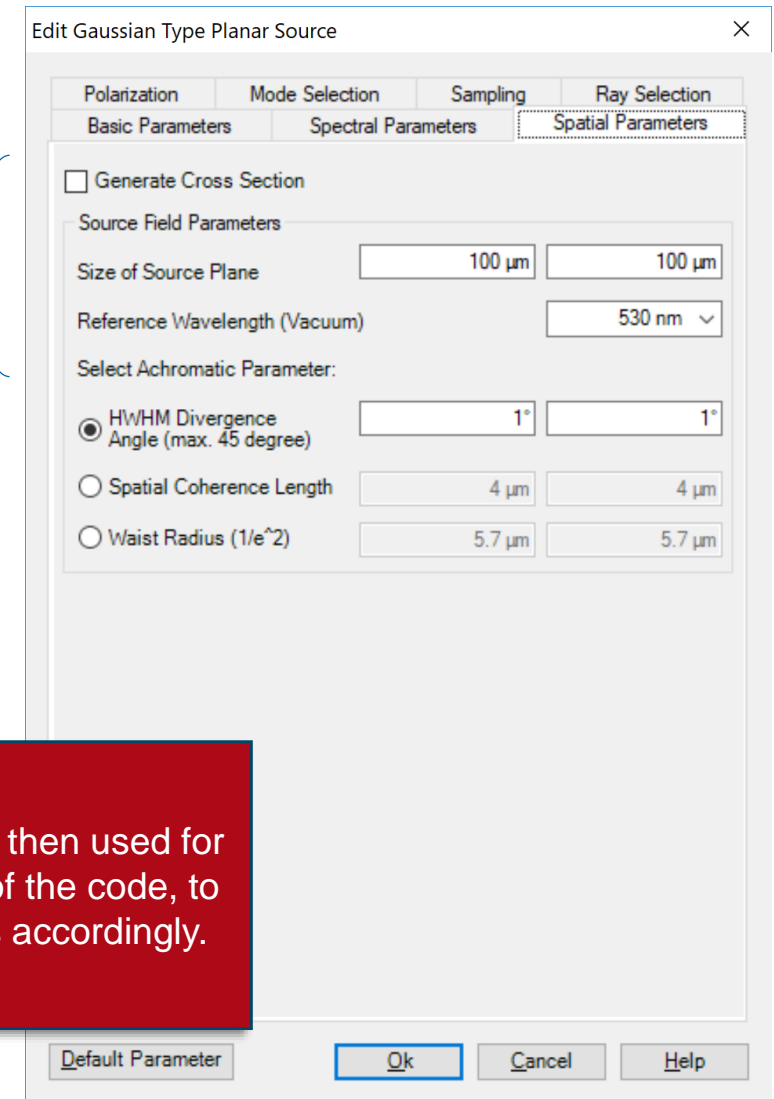
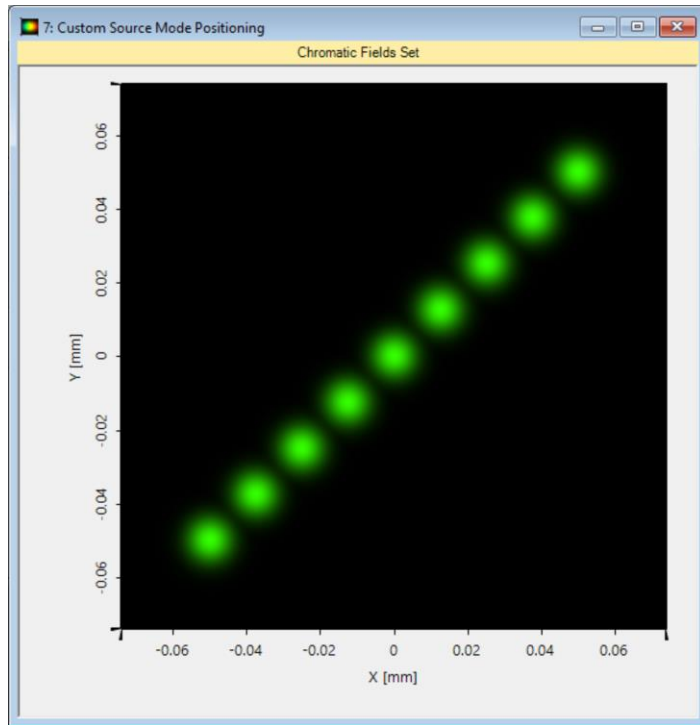These values are then used for the calculations of the code, to place the modes accordingly.

Custom Source Mode Positioning: Using Your Snippet

Configure the spectral make-up of the source independently in the Spectral Parameters tab

Change the size of the source plane in the Spatial Parameters tab

Change the total number of modes here

Modify your snippet and the value of the global parameters you defined here

Out of all the modes composing the source, select which shall be used in the next simulation.

Test the Code!

Main Function

```
// Declare output:
double xPosition = 0.0;
double yPosition = 0.0;

// Declare and compute the step size in X direction:
double deltaX = SizeOfSourcePlaneX / (NumberLateralModes - 1);

// Compute the X position of the mode with index Index:
xPosition = -(SizeOfSourcePlaneX / 2) + (Index * deltaX);

// Compute the Y position of the mode with index Index,
// taking into account inclination (Angle):
yPosition = -(Math.Tan(Angle) * SizeOfSourcePlaneX / 2) +
    (Index * Math.Tan(Angle) * deltaX);

// Deliver output:
return new VectorD(xPosition, yPosition);
```

Document Information

title	How to Customize the Position of Source Modes Via Programming and Example (Along a Line)
document code	CZT.0106
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.4.0.49
category	Feature Use Case
further reading	- How to Work with the Programmable Light Source And Example (Gaussian Beam)