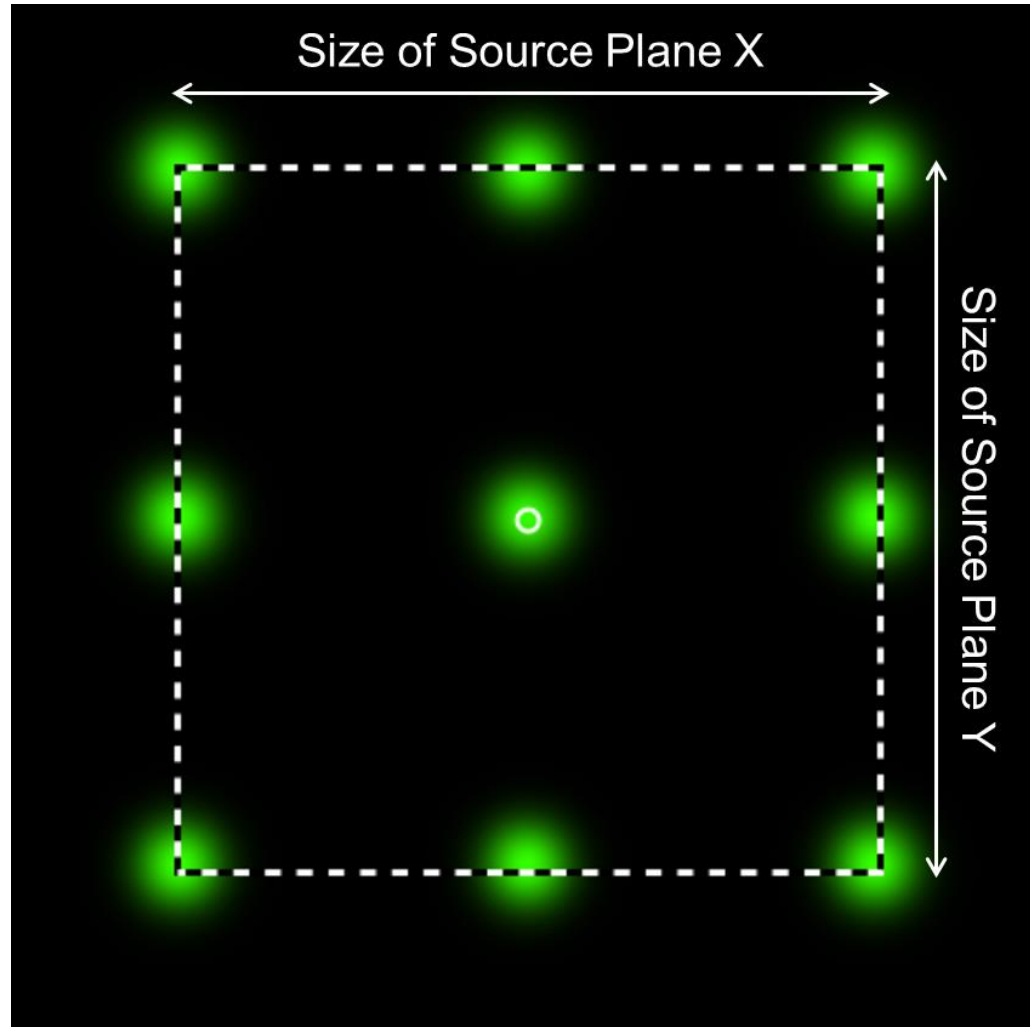


How to Customize the Position of Source Modes Via Programming and Example (Along a Line)

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

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

The image shows a software interface with several windows and dialog boxes. A red callout box in the top left contains the text: "All the highlighted source types allows customization of mode position via programming!".

The main window is the "Light Sources Catalog". It has a "Definition Type" dropdown set to "Templates". A list of source types is shown on the left, with "Gaussian Type Planar Source" highlighted. A red hand icon with the number "2" points to this source type. A red hand icon with the number "3" points to the search icon at the bottom left. A red arrow points from the callout box to the "Light Sources" icon in the top toolbar, which has a red hand icon with the number "1".

The "Edit Gaussian Type Planar Source" dialog box is open. It has tabs for "Basic Parameters", "Spectral Parameters", and "Spatial Parameters". The "Mode Selection" sub-tab is active. The "Definition Strategy" dropdown is set to "User Defined", with a red hand icon and the number "4" pointing to it. The "Number of Lateral Modes (max: 2147483647)" field is set to "9", with a red hand icon and the number "5" pointing to it. The "Weight Function" section has "Constant Weight" selected, with a red hand icon and the number "6" pointing to it. The "Weight Value" field is set to "1". A red arrow points from the "Edit" button in this dialog to the "Edit Positions for Mode Selection" dialog.

The "Edit Positions for Mode Selection" dialog box is open. It has a "Specification Type" section with "Programmable Input" selected. The "Definition" section has an "Edit" button, with a red hand icon and the number "7" pointing to it. A "Validity" indicator shows a green checkmark.

The "Source Code Editor" window is open, showing a code snippet for the "Main Function". The code is as follows:

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

A red arrow points from the "Edit" button in the "Edit Positions for Mode Selection" dialog to the "Source Code Editor" window.

Where to Find Programmable Mode Positioning: Optical Setup

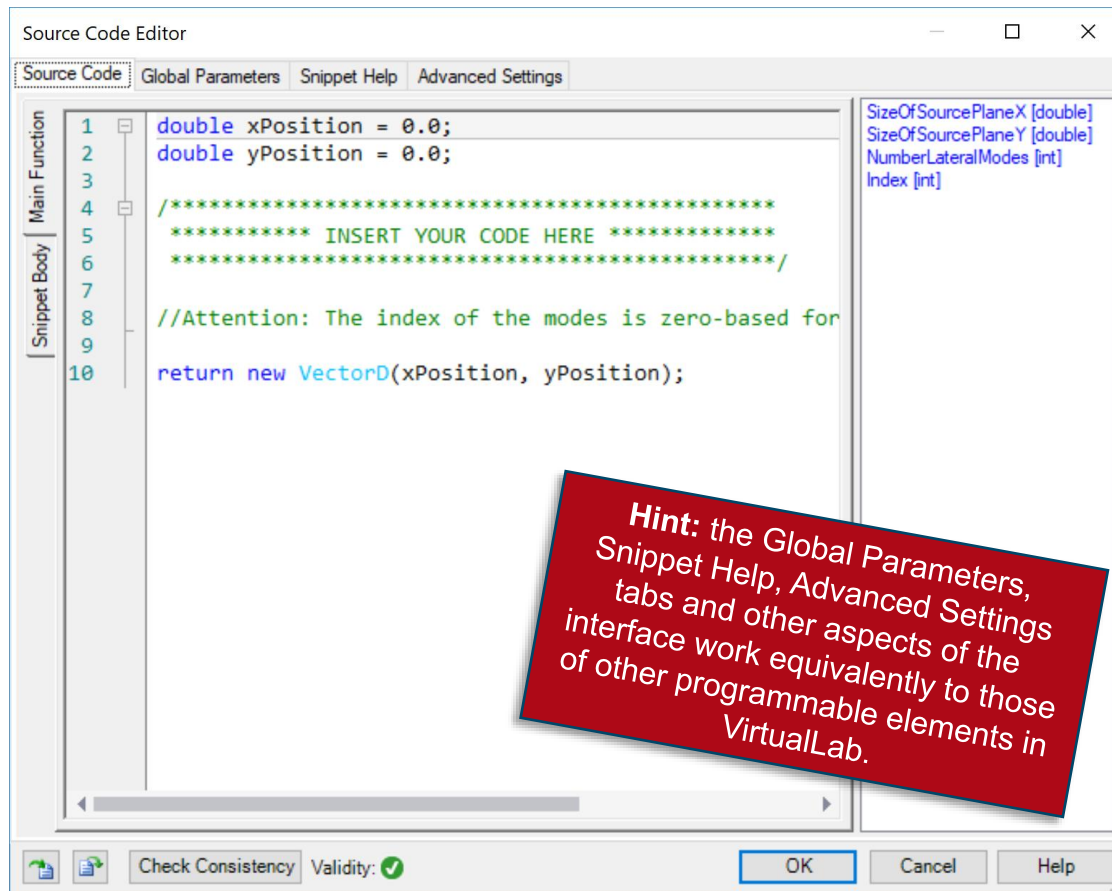
All the highlighted source types allows for customization of mode position via programming!

The image illustrates the workflow for configuring a programmable mode position in an optical setup. It consists of several interconnected windows:

- Source Model List:** A tree view on the left containing various source models. The 'Programmable Mode Planar Source' is highlighted with a red box and a red arrow labeled '1' pointing to the 'Gaussian Type Planar Source' icon.
- Gaussian Type Planar Source:** A central icon representing the selected source type, with a red arrow labeled '2' pointing to the 'Edit Gaussian Type Planar Source' dialog box.
- Edit Gaussian Type Planar Source:** A dialog box with multiple tabs. The 'Mode Selection' tab is active, showing:
 - 'Definition of Lateral Modes' set to 'User Defined' (indicated by red arrow '3').
 - 'Number of Lateral Modes' set to 9 (indicated by red arrow '4').
 - 'Weight Function' set to 'Constant Weight' (indicated by red arrow '5').
 - 'Edit' button (indicated by red arrow '5').
- Edit Positions for Mode Selection:** A dialog box that opens from the 'Edit' button in the previous dialog. It shows:
 - 'Specification Type' set to 'Programmable Input' (indicated by red arrow '6').
 - 'Edit' button (indicated by red arrow '6').
- Source Code Editor:** A window that opens from the 'Edit' button in the 'Edit Positions for Mode Selection' dialog. It contains a code snippet for defining mode positions:

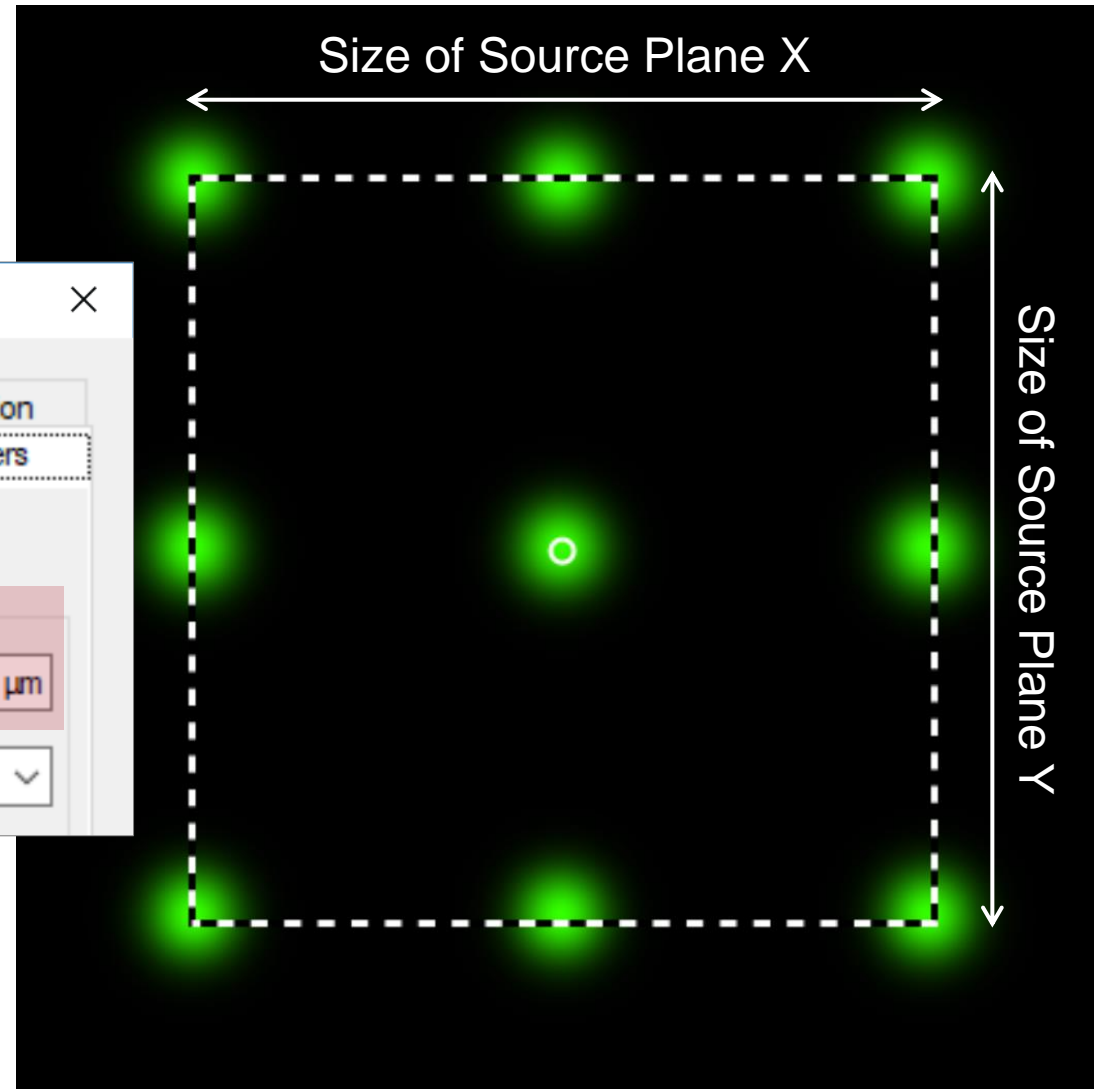
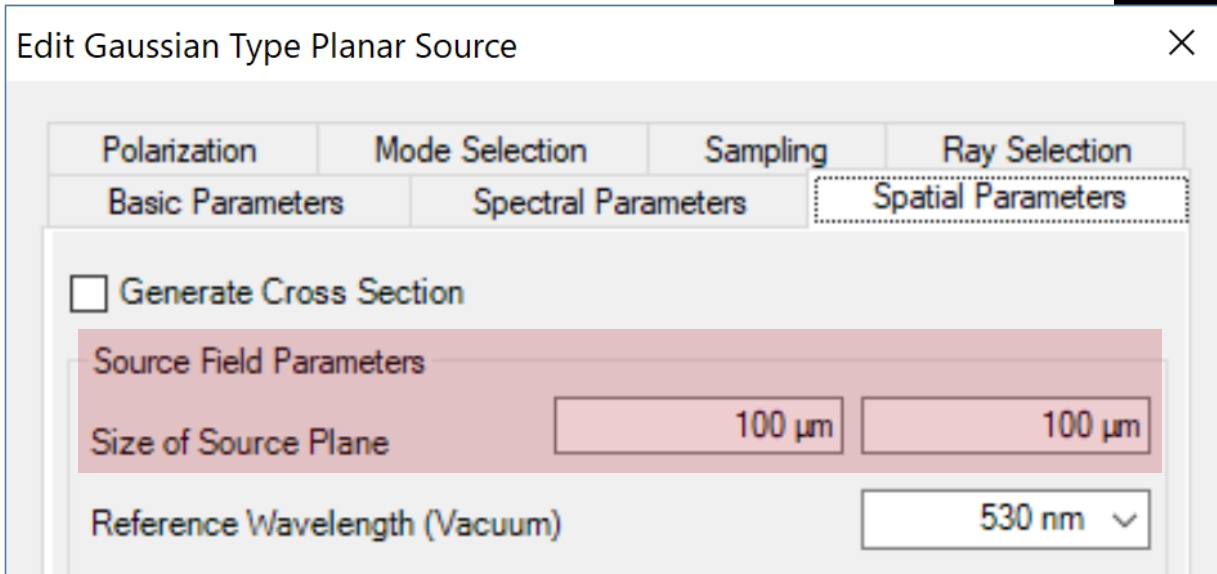
```
1 double xPosition = 0.0;
2 double yPosition = 0.0;
3
4 /***** INSERT YOUR CODE HERE *****/
5
6 //Attention: The index of the modes is zero-based for
7
8 return new VectorD(xPosition, yPosition);
9
10
```

Writing the Code



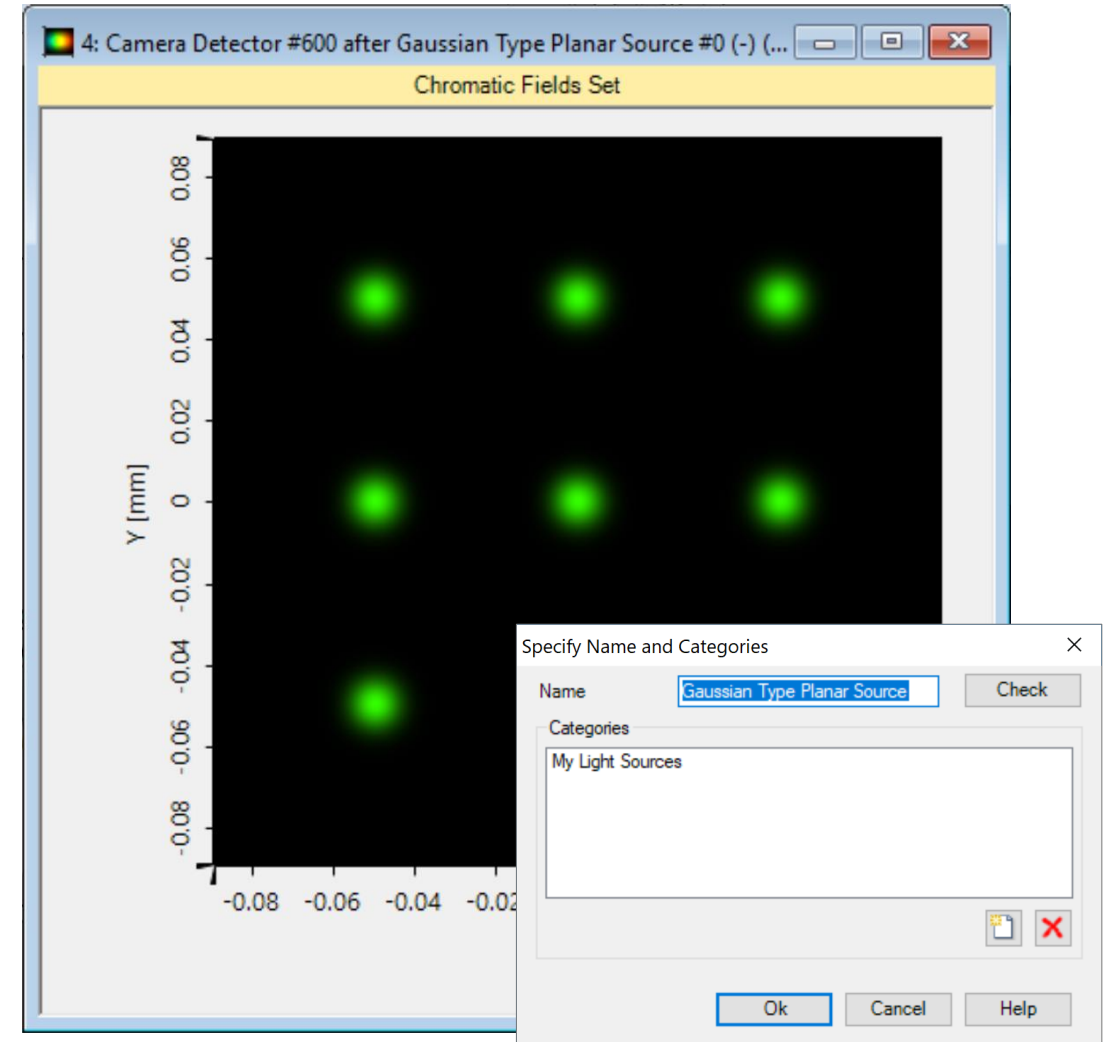
- The panel on the right shows a list of available independent parameters.
- `SizeOfSourcePlaneX` and `SizeOfSourcePlaneY` are user-determined parameters whose value can be accessed in the code and changed in the Spatial Parameters tab of the source configuration dialog.
- `NumberOfLateralModes` gives 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.

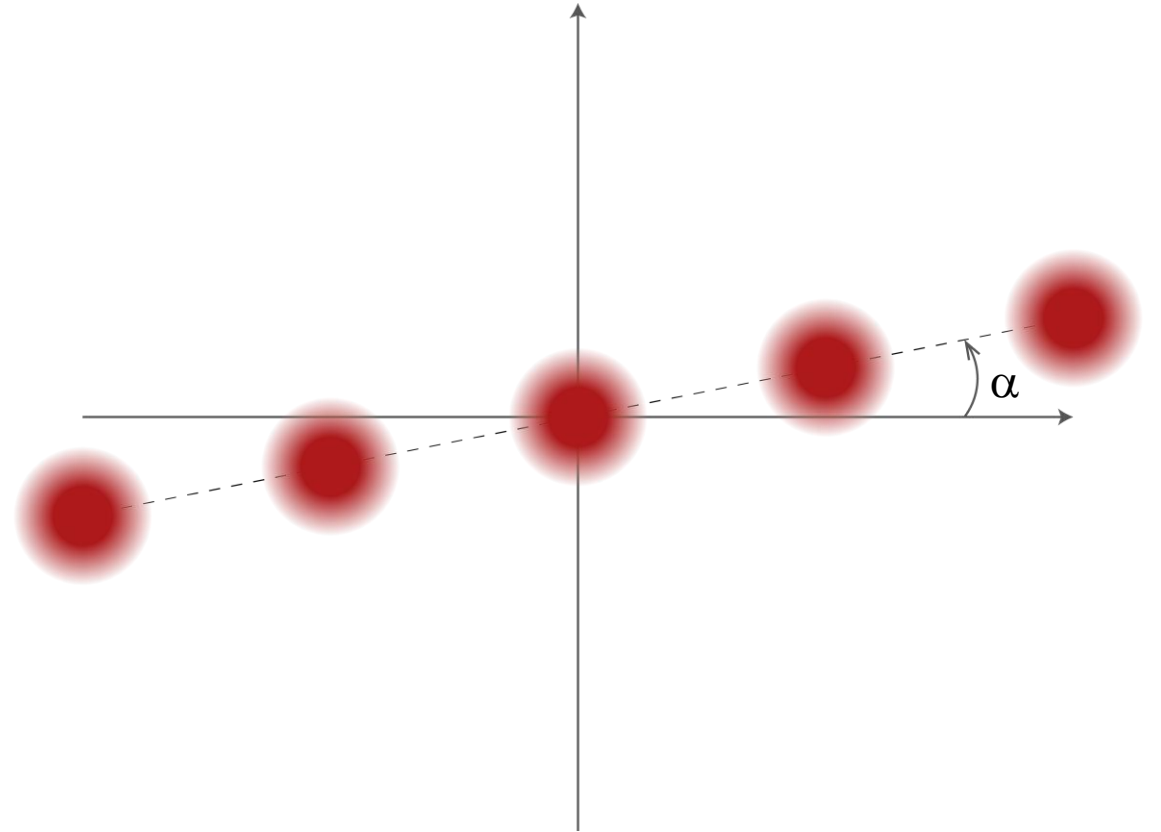


Positioning Modes Along a Line

Positioning Base Modes Along a Line with Angle α

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

- $N \rightarrow$ 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!

The image illustrates the workflow for configuring a programmable mode position in an optical setup. It shows the following steps:

- 1**: Selecting a source type from the 'Coherent Source Models' list, specifically 'Gaussian Type Planar Source'.
- 2**: Clicking on the 'Gaussian Type Planar Source' icon in the workspace.
- 3**: Opening the 'Edit Gaussian Type Planar Source' dialog box.
- 4**: Setting the 'Definition Strategy' to 'User Defined'.
- 5**: Clicking the 'Edit' button in the 'Edit Gaussian Type Planar Source' dialog.
- 6**: Opening the 'Edit Positions for Mode Selection' dialog box, where the 'Programmable Input' option is selected.

The 'Edit Gaussian Type Planar Source' dialog box contains the following parameters:

- Basic Parameters**: Polarization, Mode Selection, Sampling, Ray Selection.
- Definition of Lateral Modes**: Definition Strategy (User Defined), Number of Lateral Modes (max: 2147483647), Weight Function.
- Specification Type**: Constant Weight (selected), User-Defined Weight.
- Weight Value**: 1.
- Selection of Active Modes**: Selection Strategy (Full Set of Spectral Modes), Number of Spectral Modes (max: 1), Number of Lateral Modes (max: 9), Number of Active Modes, Number of Lateral Modes, Number of Spectral Modes, Total Number of Modes.

The 'Edit Positions for Mode Selection' dialog box contains the following parameters:

- Specification Type**: Programmable Input (selected), Databased Input.
- Definition**: Edit button, Validity: ✓.

The 'Source Code Editor' window shows the following code:

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

Where to Find Programmable Mode Positioning: Catalog

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

Light Sources Catalog

Definition Type: **Templates**

Filter by...

- Combined Light Source
- Customized Mode Planar Source
- Far Field Source
- Gaussian Type Planar Source**
- Gaussian Wave
- Grid Gaussian Planar Source
- Multimode Gaussian Source
- Panel Type Source
- Plane Wave
- Programmable Light Source
- Programmable Mode Planar Source
- Quadratic Wave
- Scanning Source
- Spherical Wave
- Stored Complete Field
- Stored Lateral Field
- Super-Gaussian Wave

Y [mm] vs X [mm] plot showing a grid of green spots.

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**

Weight Function

Specification Type: Constant Weight User-Defined Weight

Weight Value: **1**

Selection of Active Modes

Selection Strategy: **Full Set of Spectral Modes**

Number of Spectral Modes (max: 1): **1**

Number of Lateral Modes (max: 9): **9**

Number of Active Modes: **9**

Number of Lateral Modes: **9**

Number of Spectral Modes: **1**

Total Number of Modes: **9**

Edit Positions for Mode Selection

Specification Type: Programmable Input Databased Input

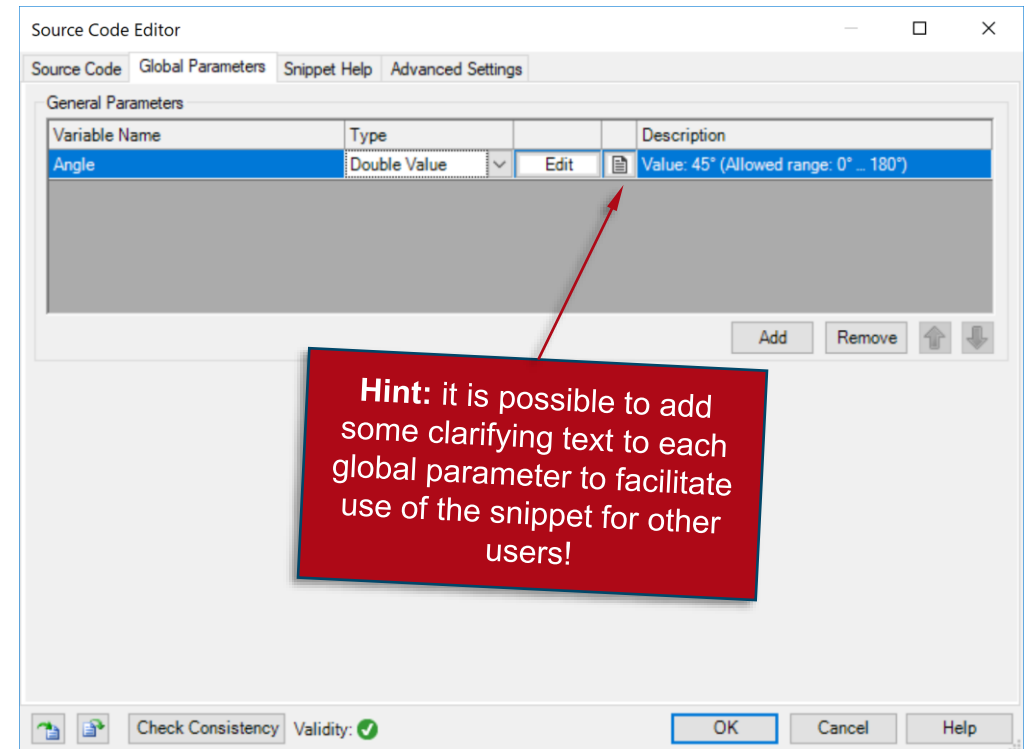
Definition: **Edit** (Validity:)

Source Code Editor

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

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.



Custom Source Mode Positioning: Writing the Code

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]

Declaration of output variable given by default

Default global parameters/variables

Global parameter defined by user in Global Parameters tab

Compute result using Eq. (1).

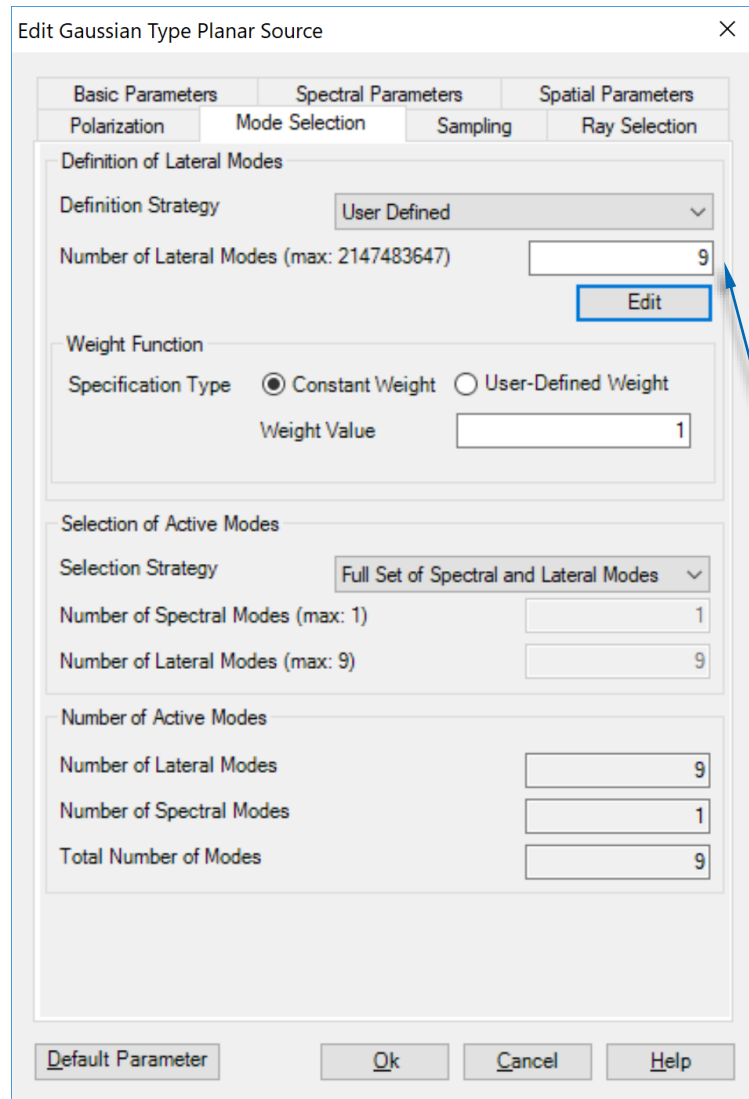
Are there errors in your code?

Export Snippet to save your work!

Check Consistency Validity:

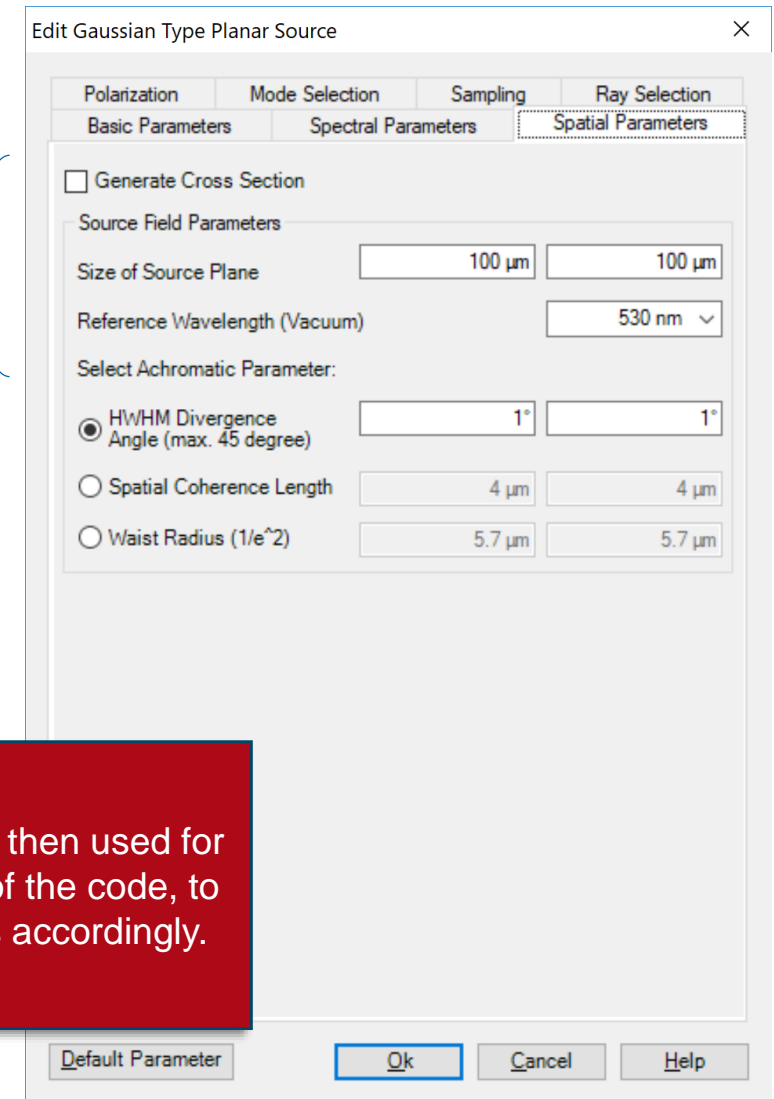
OK Cancel Help

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



The total number of lateral modes must be defined in the configuration dialog of the source, in the Mode Selection tab

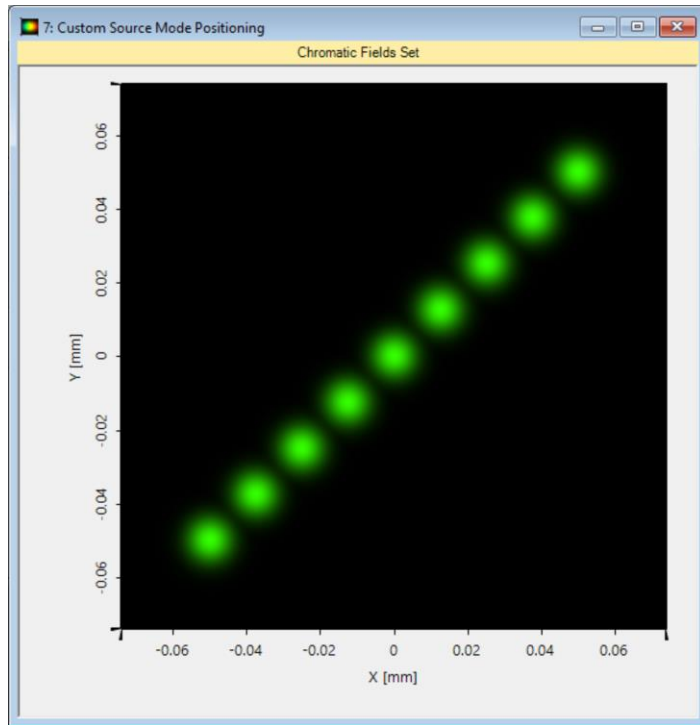
The size of the source plane also has to be defined separately, in the Spatial Parameters tab



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



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

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

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

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category	Feature Use Case
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