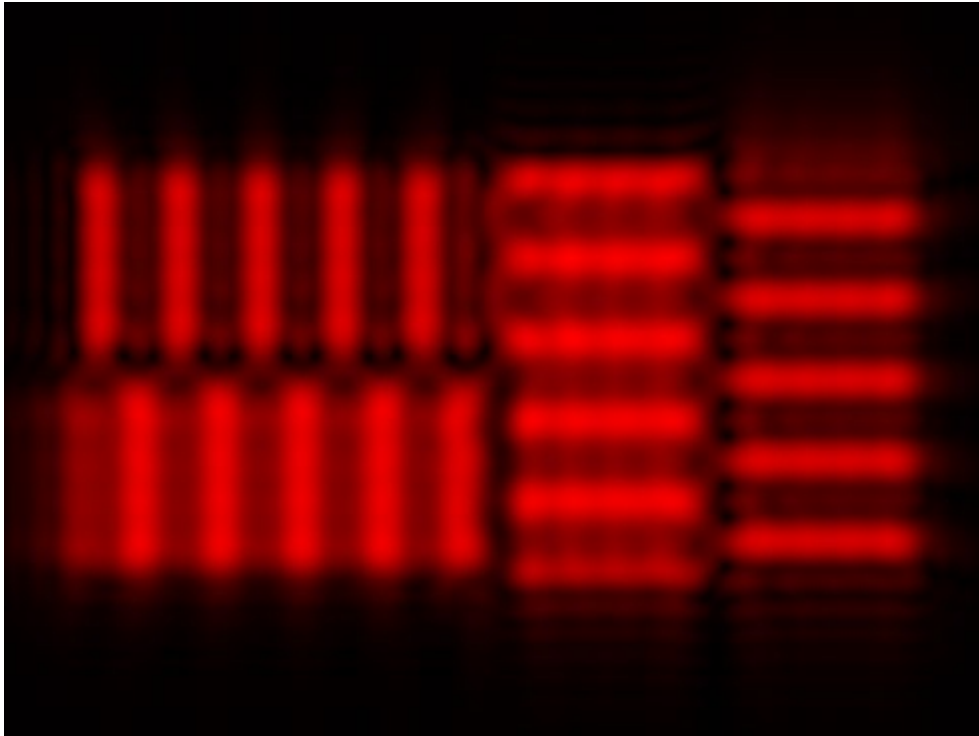


# Imaging of Grating Patterns Positioned on Each Side of a Wafer

# Abstract

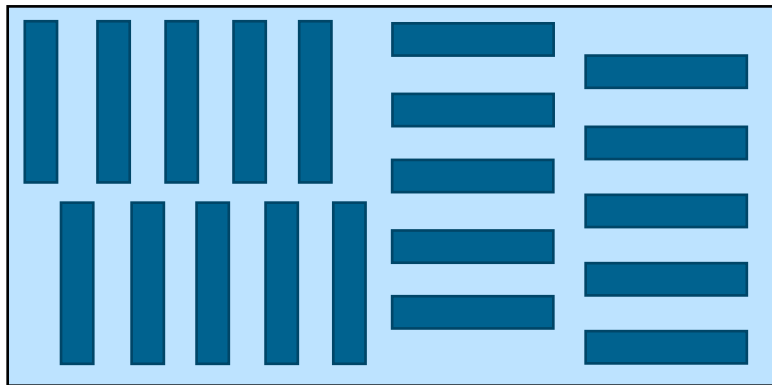


Simulating aperiodic structures commonly found in semiconductor testing systems is notoriously challenging: feature sizes of the structures fall between the capabilities of rigorous Maxwell solvers and ray-based solvers. VirtualLab Fusion's field decomposition technique addresses this by dividing the structure into regular subsections, allowing for individual calculation. Its flexible detection concept then enables light recombination at the detector, allowing for automatic calculation of radiometric quantities like irradiance.

# Modeling Scenario – Imaging System

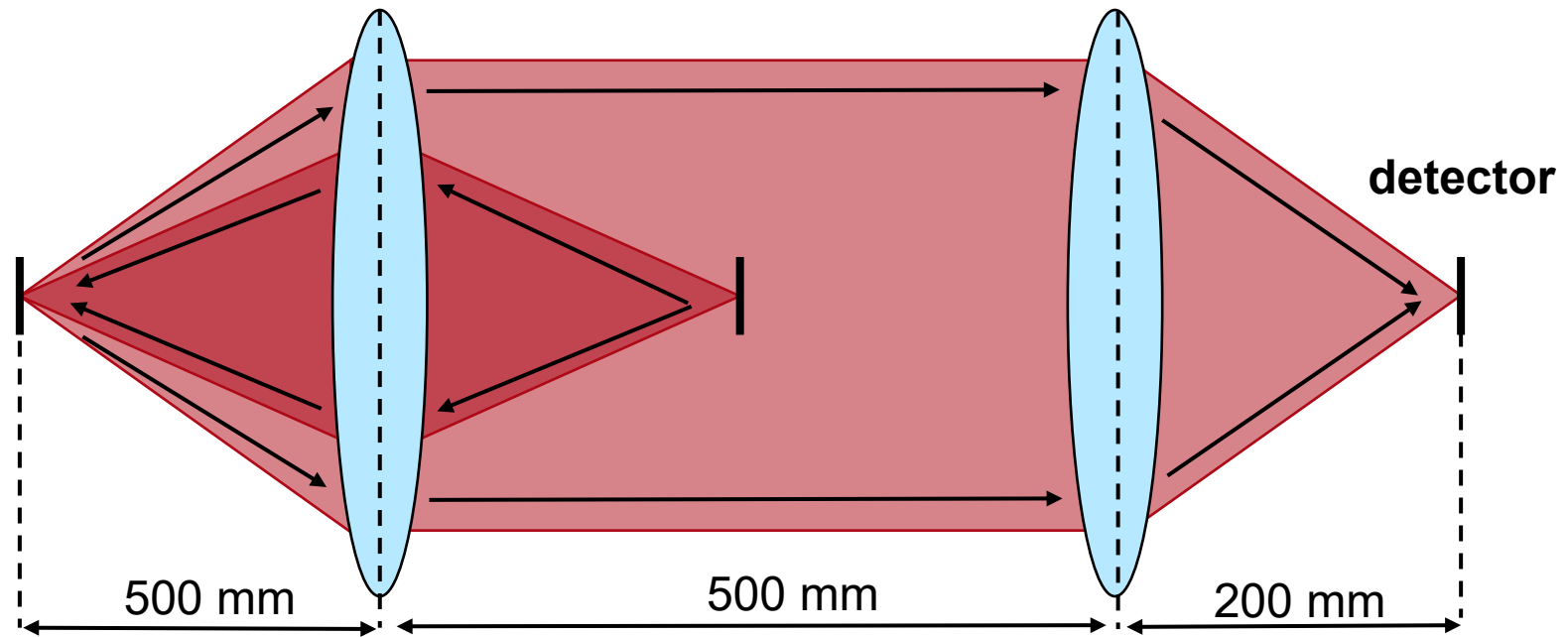
## aperiodic test structure

- assemble of multiple rectangular gratings
- period:  $8\ \mu\text{m}$
- grating material: silicon dioxide
- substrate: silicon (details see next page)



## Gaussian source

- wavelength:  $800\ \text{nm}$
- linearly polarized in x



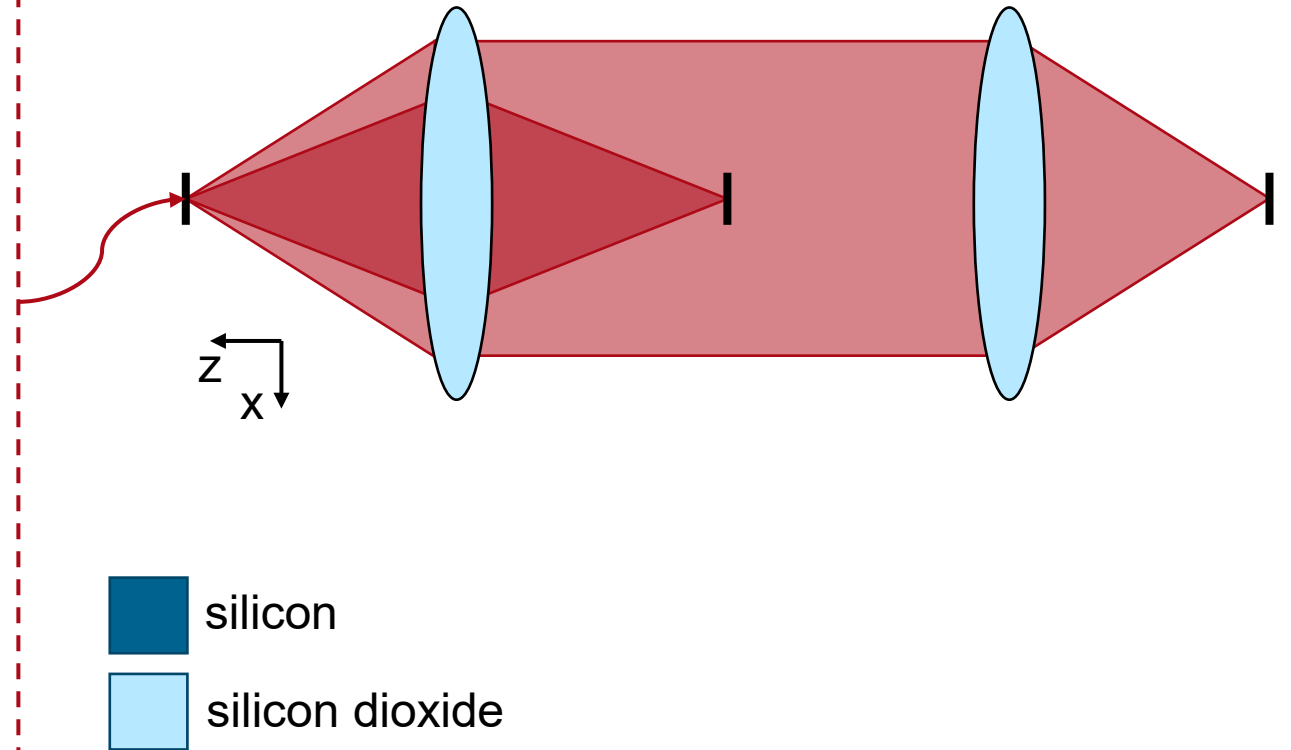
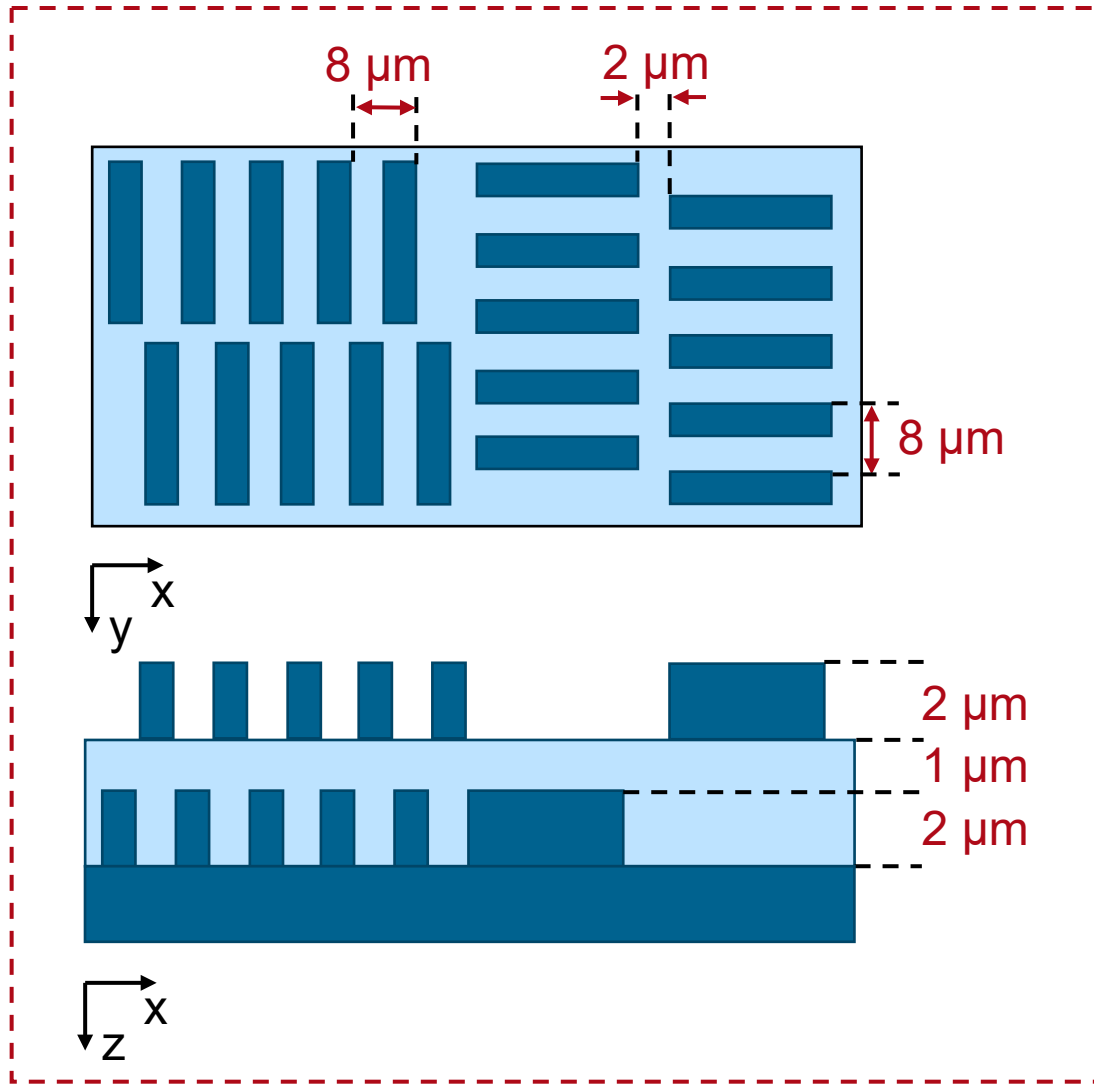
## objective lens

- focal length:  $500\ \text{mm}$
- functional lens

## imaging lens

- focal length:  $200\ \text{mm}$
- functional lens

# Modeling Scenario – Multi-Layer Grating



# Modeling Task

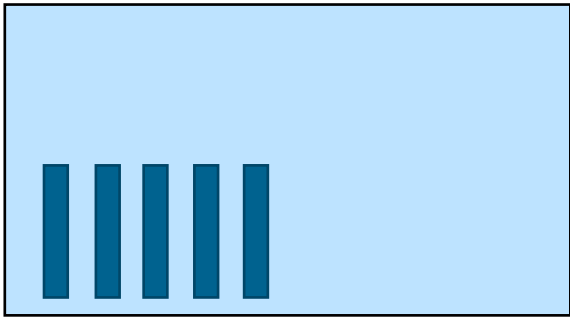
configuration 1



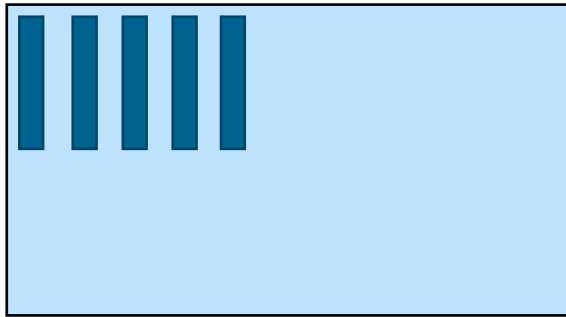
configuration 2



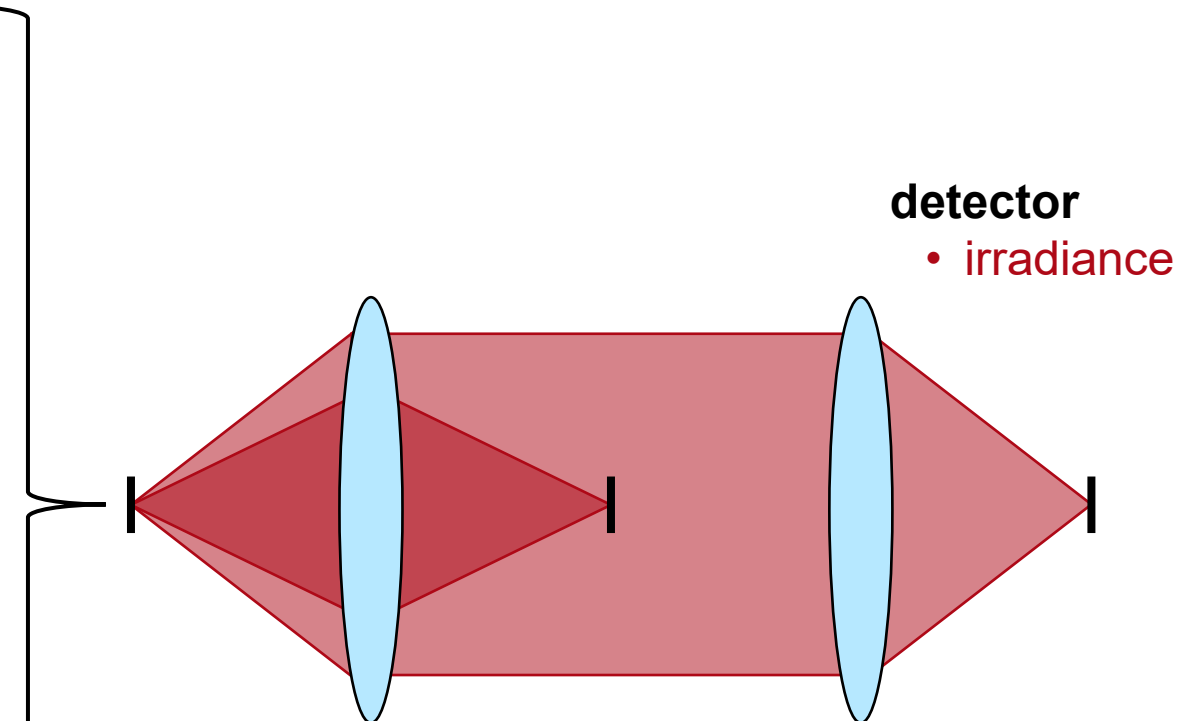
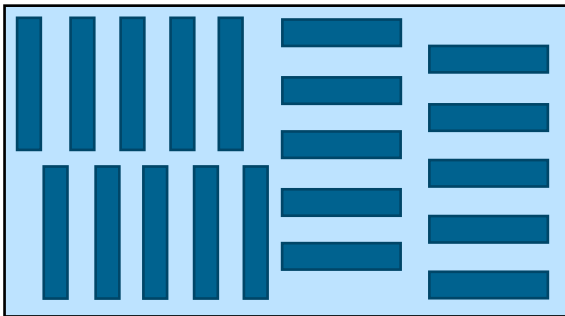
configuration 3



configuration 4



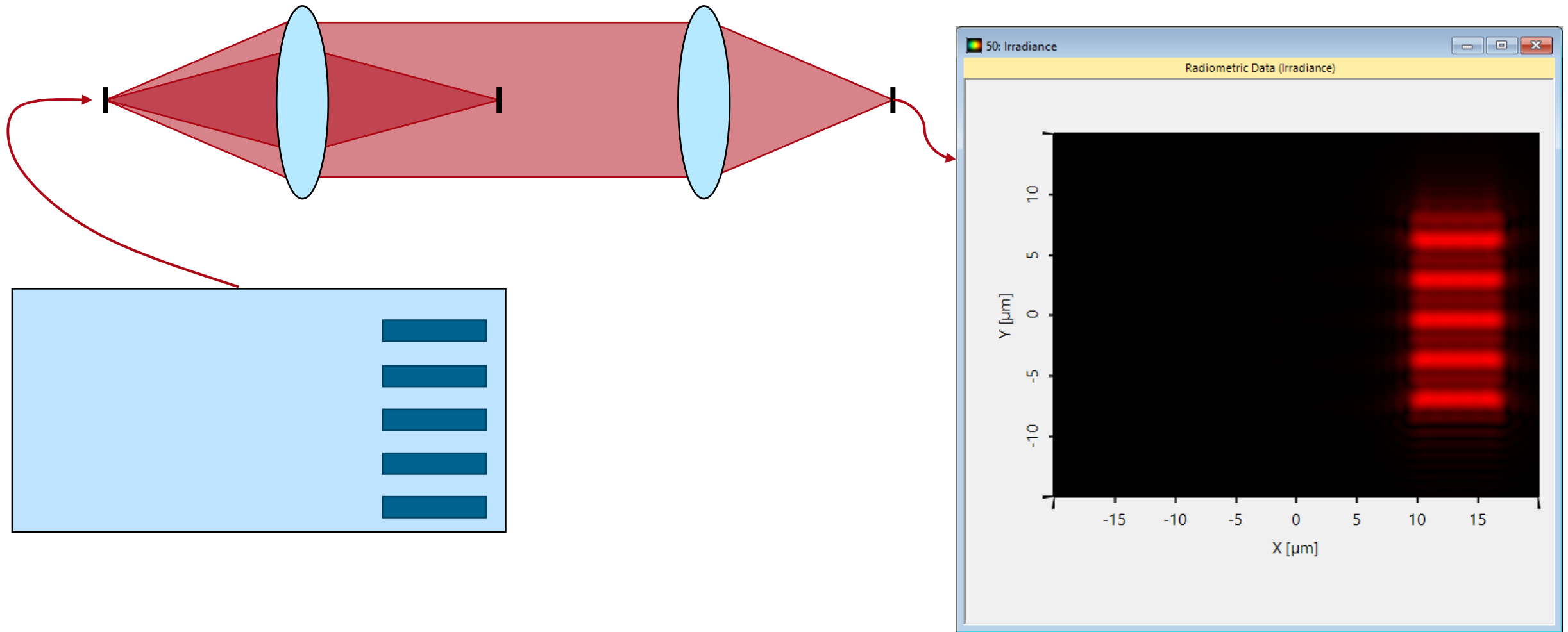
configuration 5



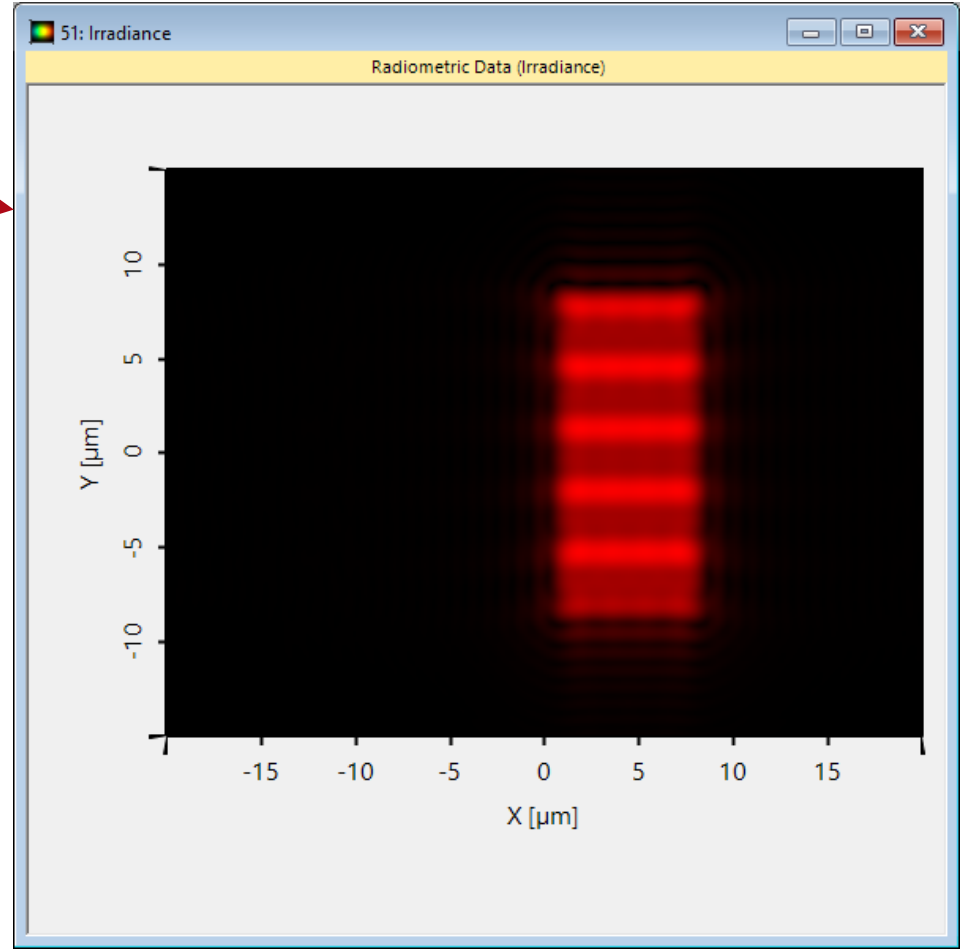
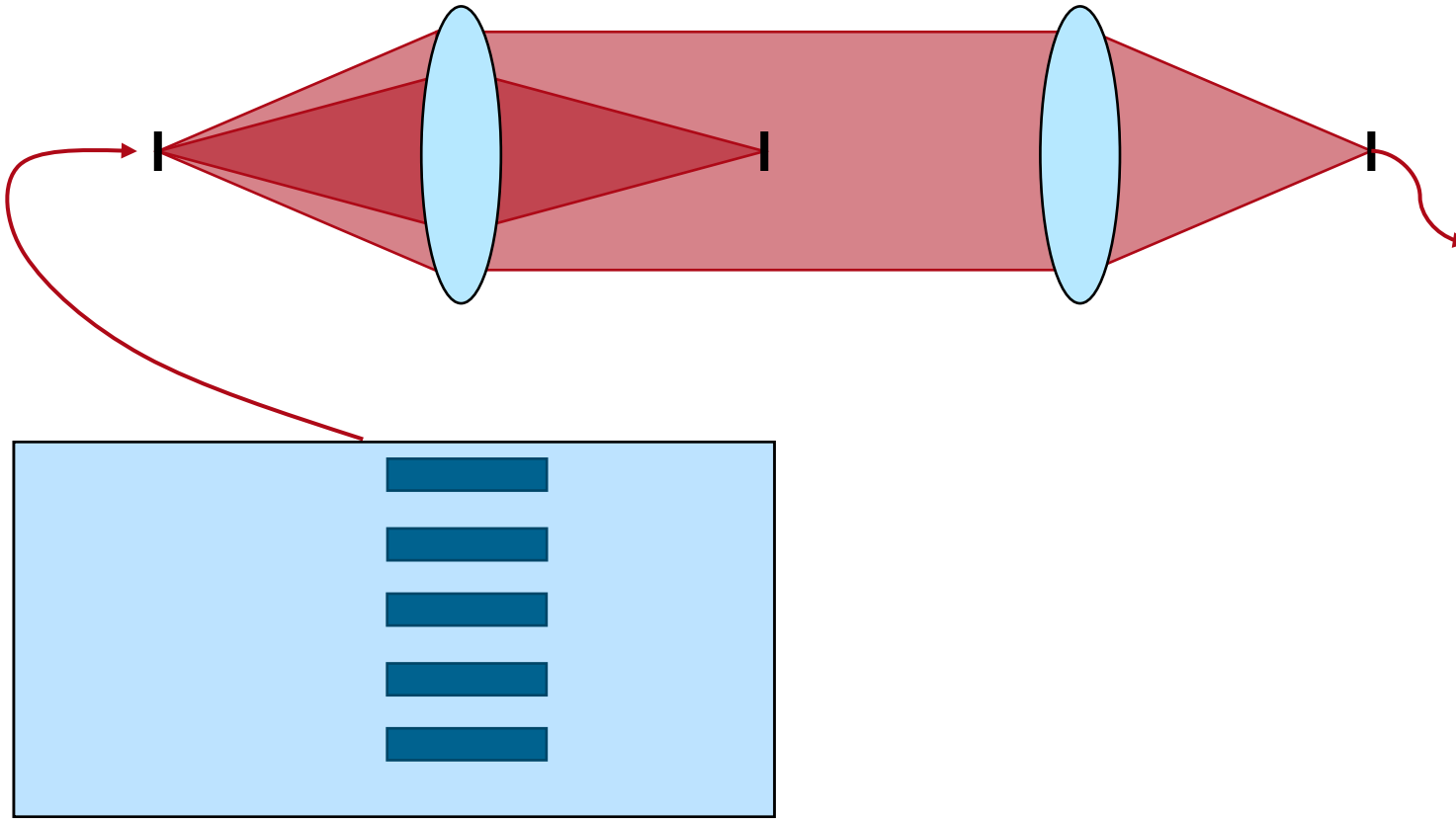
**detector**  
• irradiance

Task: Calculate imagine of various grating configurations.

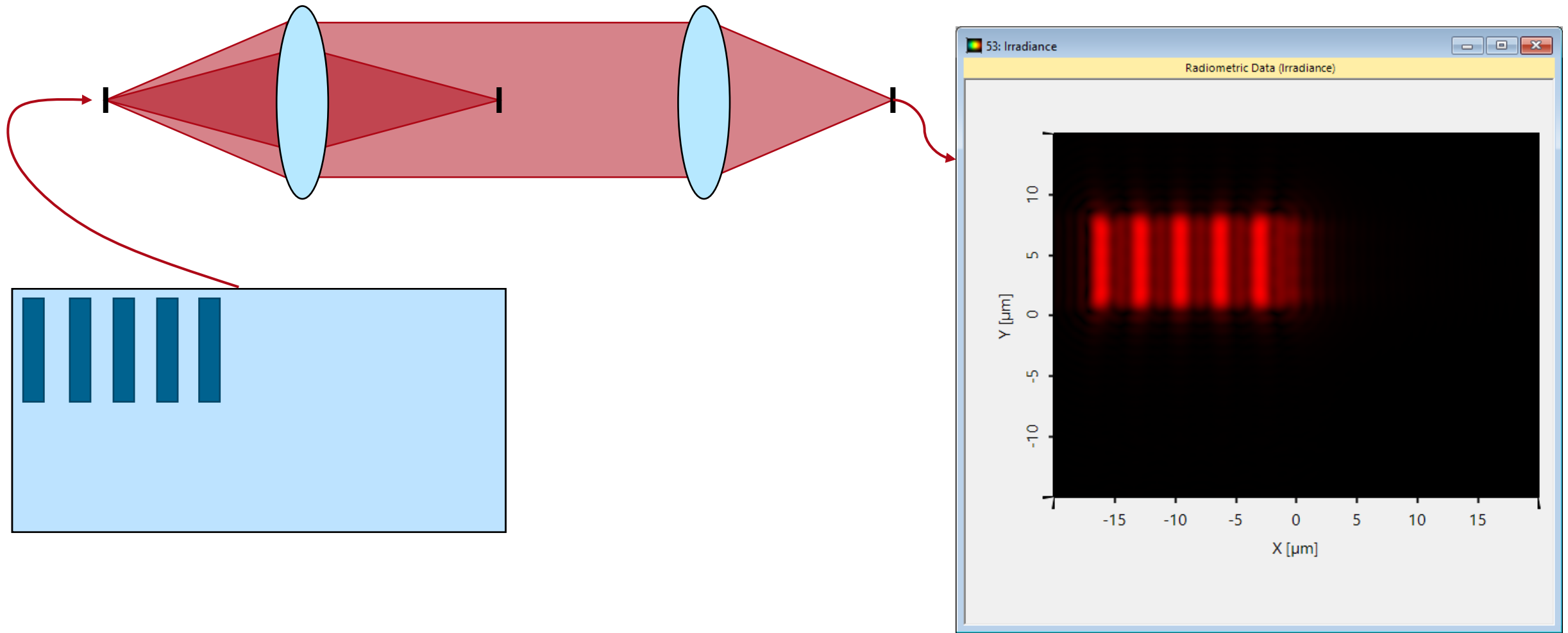
# Configuration 1



# Configuration 2

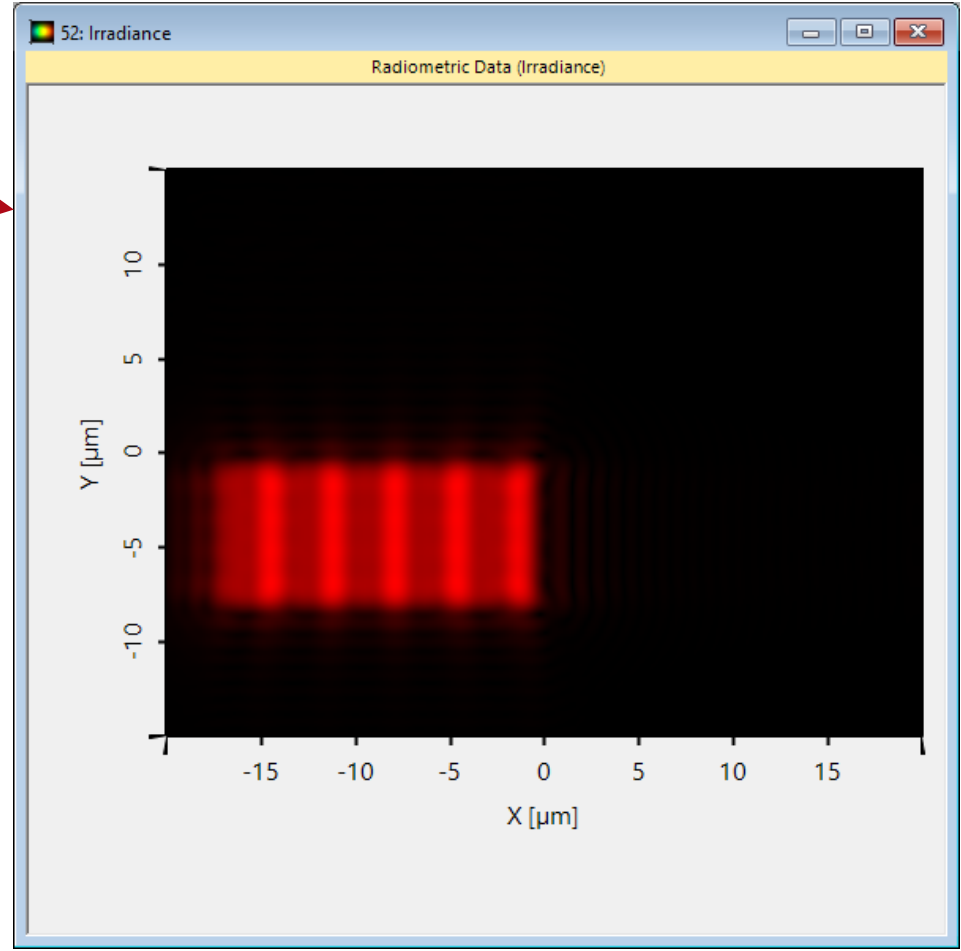
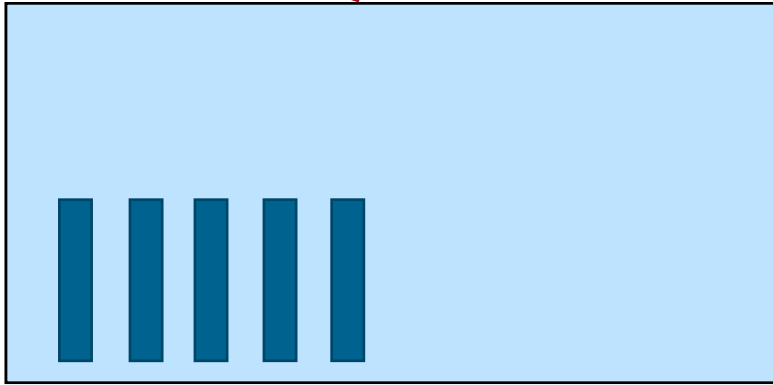
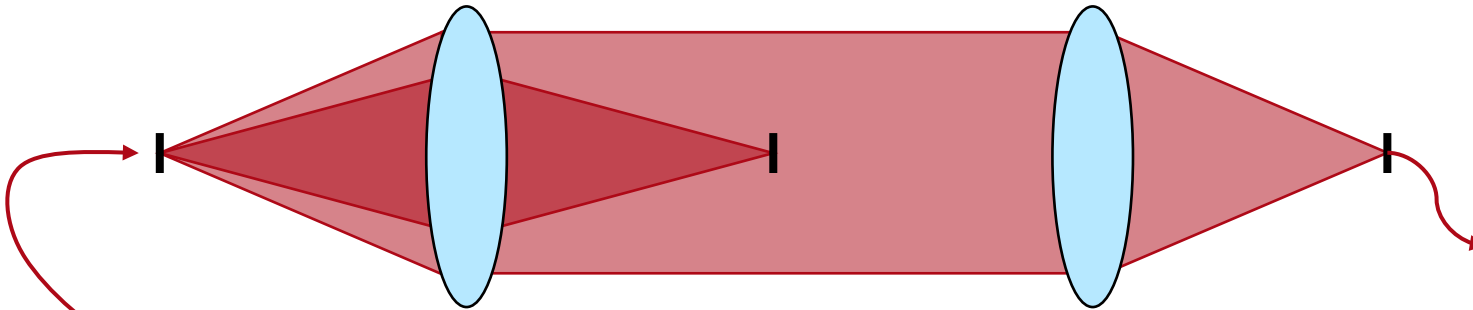


# Configuration 3

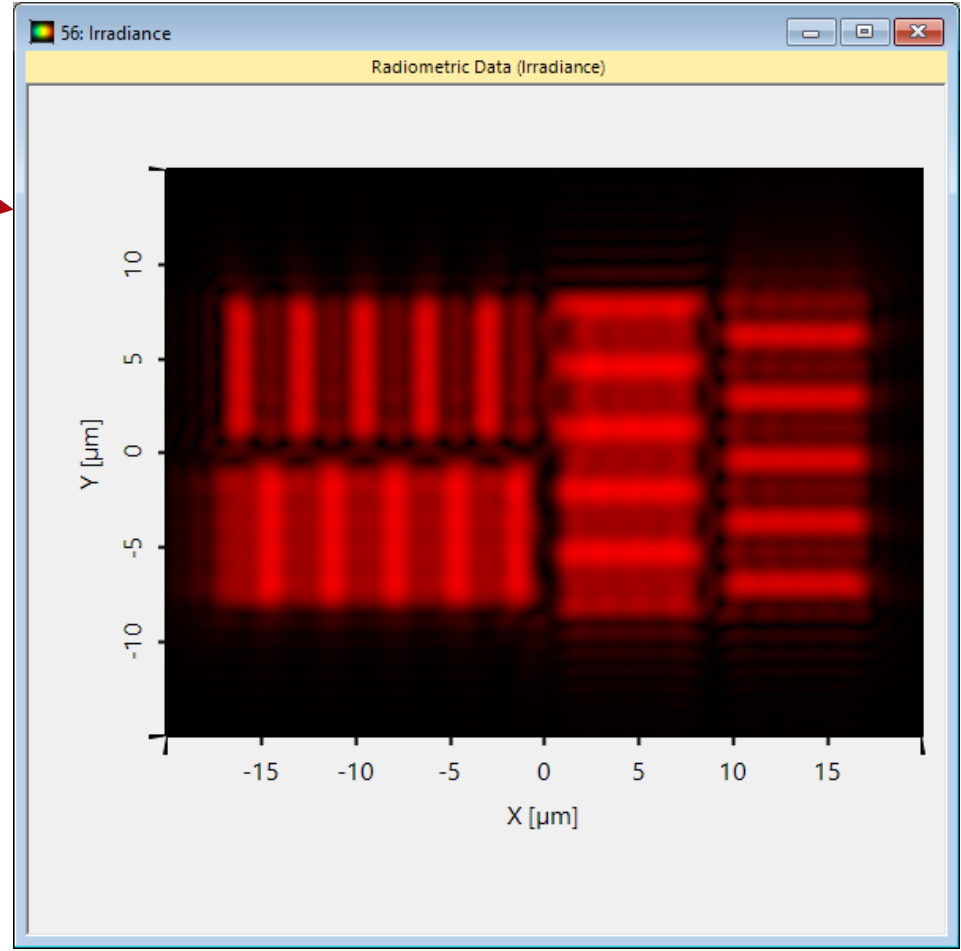
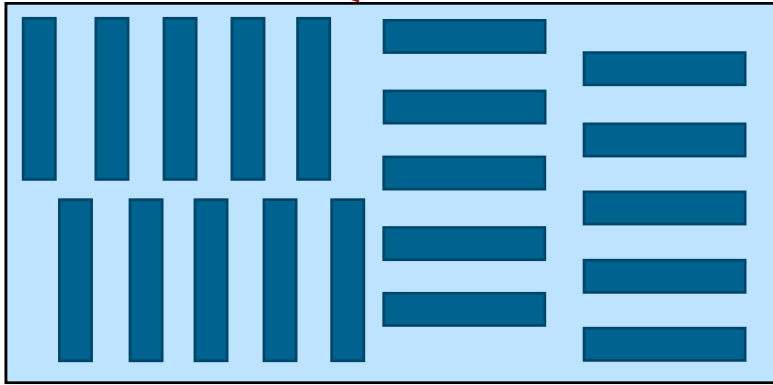
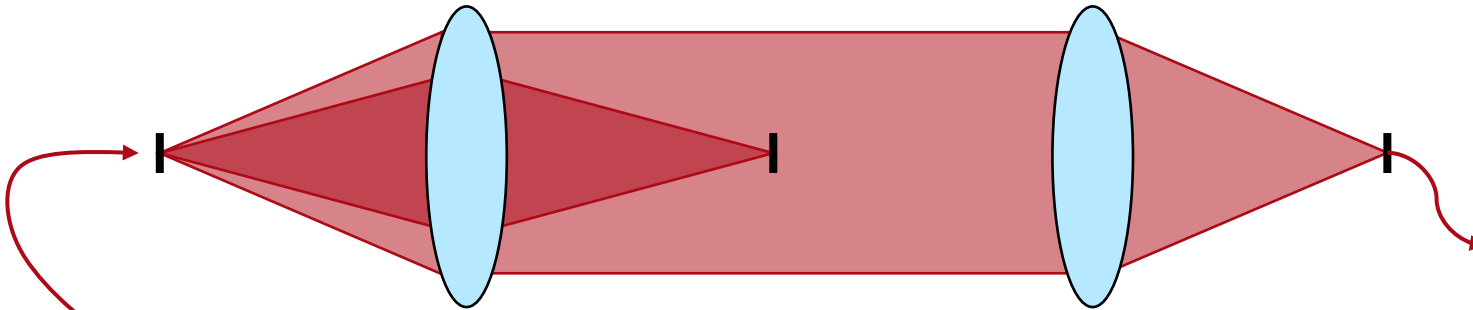




# Configuration 4



# Configuration 5



# Workflows

# Parameter Variation Analyzer

Using field decomposition techniques, the structure is simulated piece by piece, with final results recombined through the *Parameter Variation Analyzer*. For more information, see:

## [Parameter Variation Analyzer](#)

The screenshot displays the Parameter Variation Analyzer software interface, which is used for configuring and running simulations with varying parameters. It consists of several overlapping windows:

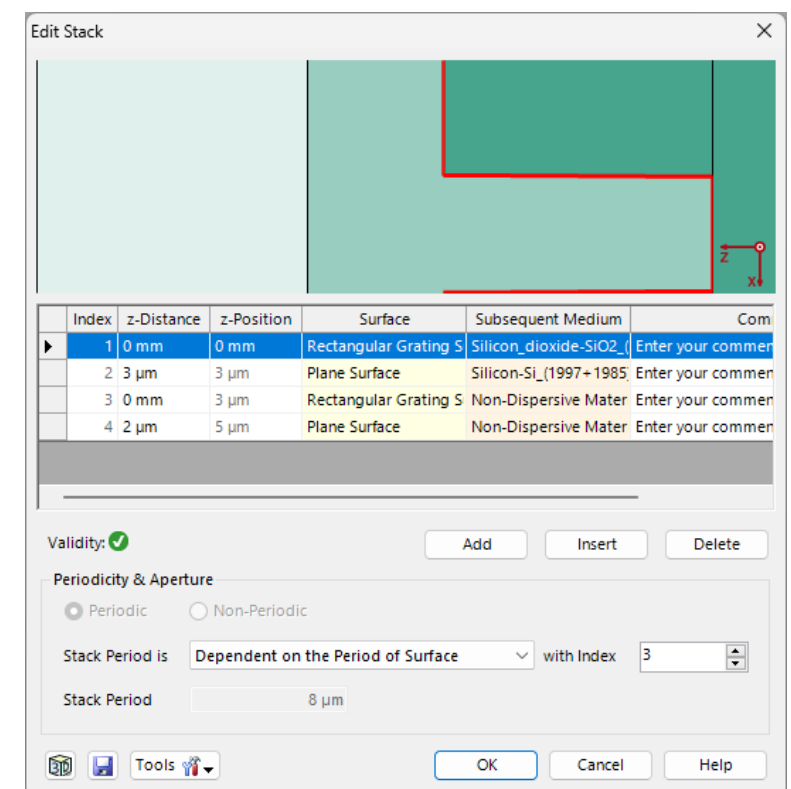
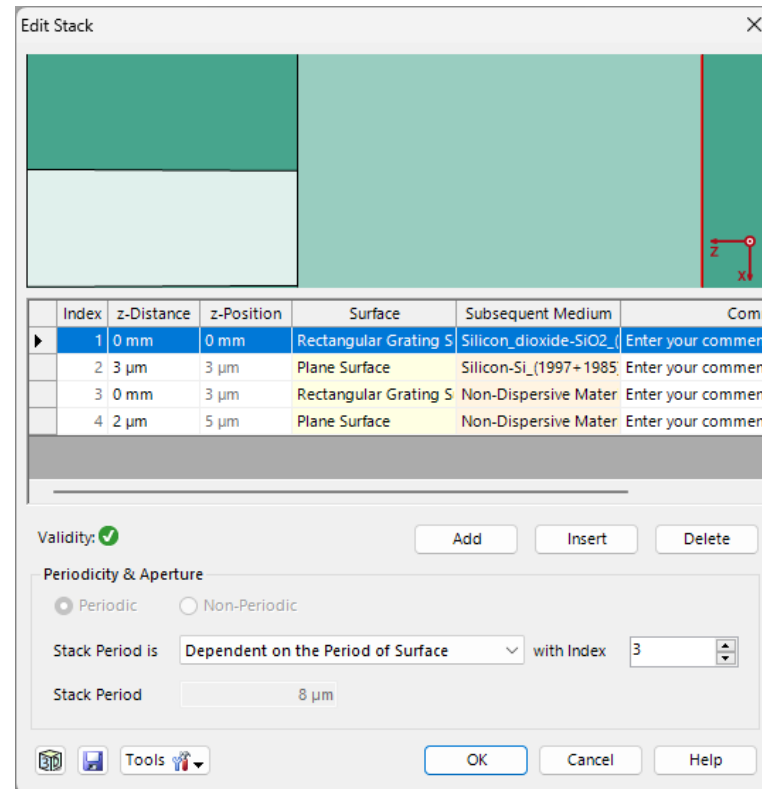
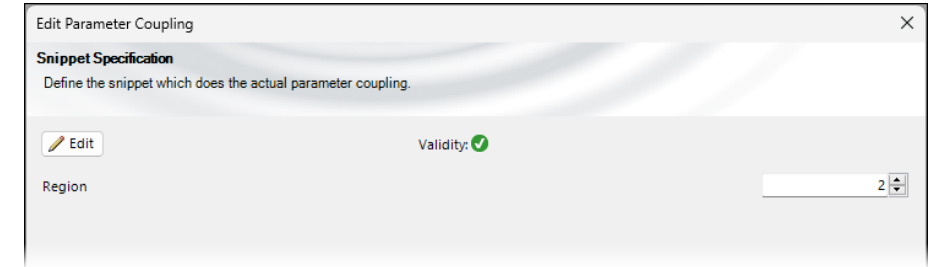
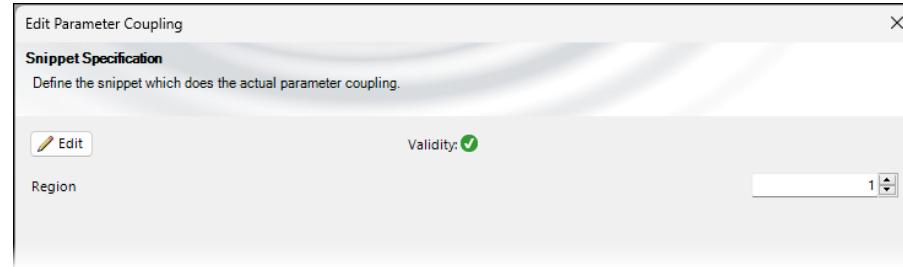
- 4: Edit Parameter Variation**: A window for configuring parameter variations. It includes a "Parameter Specification" section with instructions to "Set up the parameter(s) to be varied." Below this, there is a "Usage Mode" dropdown set to "Standard" and a "Filter by..." search box. A table lists parameters to be varied, with columns for "Vary", "From", "To", "Steps", "Step Size", and "Original Value".
- Edit Parameter Variation Analyzer**: A window for configuring the parameter variation process. It includes a "Configure Parameter Variation" button and displays "Used Engines: Profile: General" and "Indices of Used Detecting Devices: 602".
- Evaluate Results**: A window showing the results of the simulation. It includes a "Snippet" button, an "Edit" button, and a "Validity: ✓" indicator. The main area displays "No global parameters defined / necessary".
- Source Code Editor**: A window for editing the source code. It shows a C# code snippet for a class named `VLModule` that implements the `ISnippet_Pro` interface. The code includes a `GetData` method that uses the `ParameterVariation` class to run simulations and retrieve results.

1	2	*	Parameter	Vary	From	To	Steps	Step Size	Original Value
			System Temperature	<input type="checkbox"/>	-273.15 °C	1e+100 °C	1	1e+100 °C	20 °C
			Air Pressure	<input type="checkbox"/>	0 Pa	1 GPa	1	1 GPa	101.33 kPa
			Global Parameters of Coupling Snippet						
			Region	<input checked="" type="checkbox"/>	1	4	4	1	1
			Gaussian Wave* (#0)						
			Medium at "-" Output (Non-Dispersive Material (n=1) in Homogeneous Medium)						
			Material (Non-Dispersive Material (n=1)) Constant Refractive Index	<input type="checkbox"/>	1e-300	1e+300	1	1e+300	1

```
1  Preset using directives
29
30 #region Additional using directives
31
32 #endregion
33
34 Base Class to handle Global Parameters
87
88 public class VLModule : VLBaseModule, VirtualLabAPI.Core.Modules.ISnippet_Pro
89
90     public List<DetectorResultObject> GetData(ParameterRun ParameterVariation
91
92     #region Main method
93
94     ParameterVariation.StartParameterRun();
95
96     string searchString_detectorName = "Detector"; // enter detect
97
98     searchString_detectorName = searchString_detectorName.ToLower();
99
100     int IDDetector = -1;
101     for (int runDetectorResults = 0; runDetectorResults < ParameterVariat
102         string currDetectorName = ParameterVariation.ResultMatrix.NameOfR
```

# Parameter Coupling

We use *Parameter Coupling* to generate the different configurations. The parameter Region is used to control this. A value of 1 or 3 represents the “upper grating”, while 2 and 4 correspond to the “lower gratings”.



# Document Information

---

title	Imaging of Grating Patterns Positioned on Each Side of a Wafer
document code	USC.0413
document version	1.0
required packages	Grating Package
software version	2024.1 (Build 1.132)
category	Use Case
further reading	<ul style="list-style-type: none"><li>• <a href="#"><u>Parameter Variation Analyzer</u></a></li><li>• <a href="#"><u>Optical System for Inspection of Micro-Structured Wafer</u></a></li></ul>