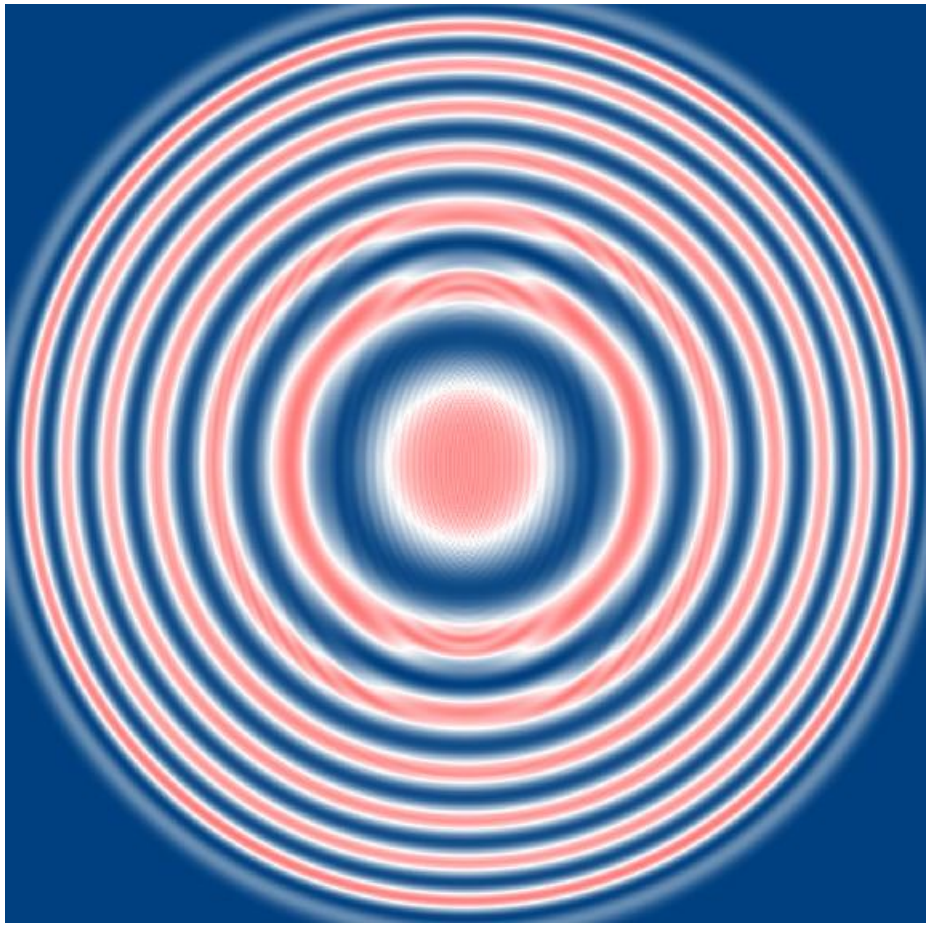
Mach-Zehnder Interferometer with Laterally-Varying Beam Splitter Cube

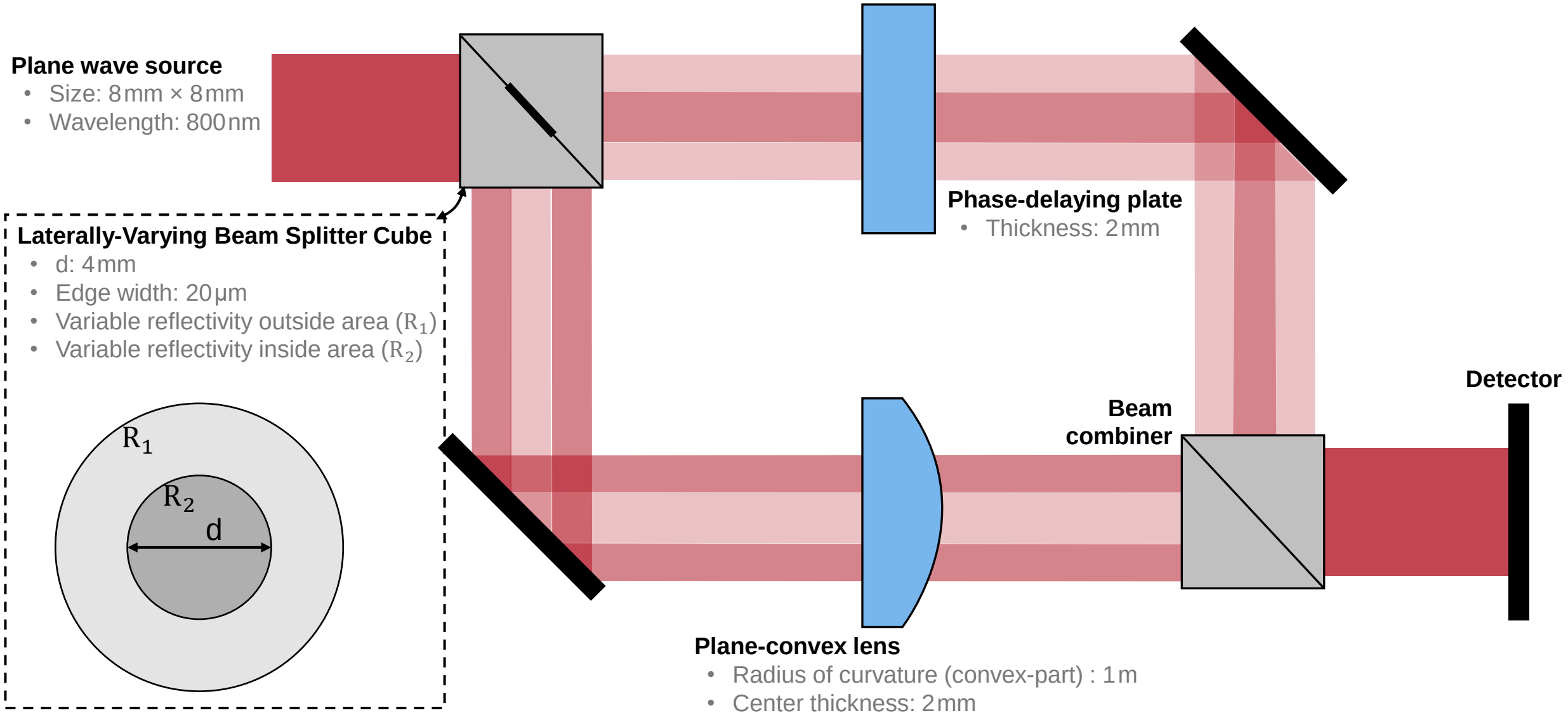
Abstract



We simulate a Mach–Zehnder interferometer using a beam splitter with independently adjustable inner and outer regions. A lens in one arm produces interference pattern, while diffraction from the edges of the beam-splitter regions influence these effects. By varying the reflectivity, the resulting interference pattern changes according to the configuration.

Application Scenario

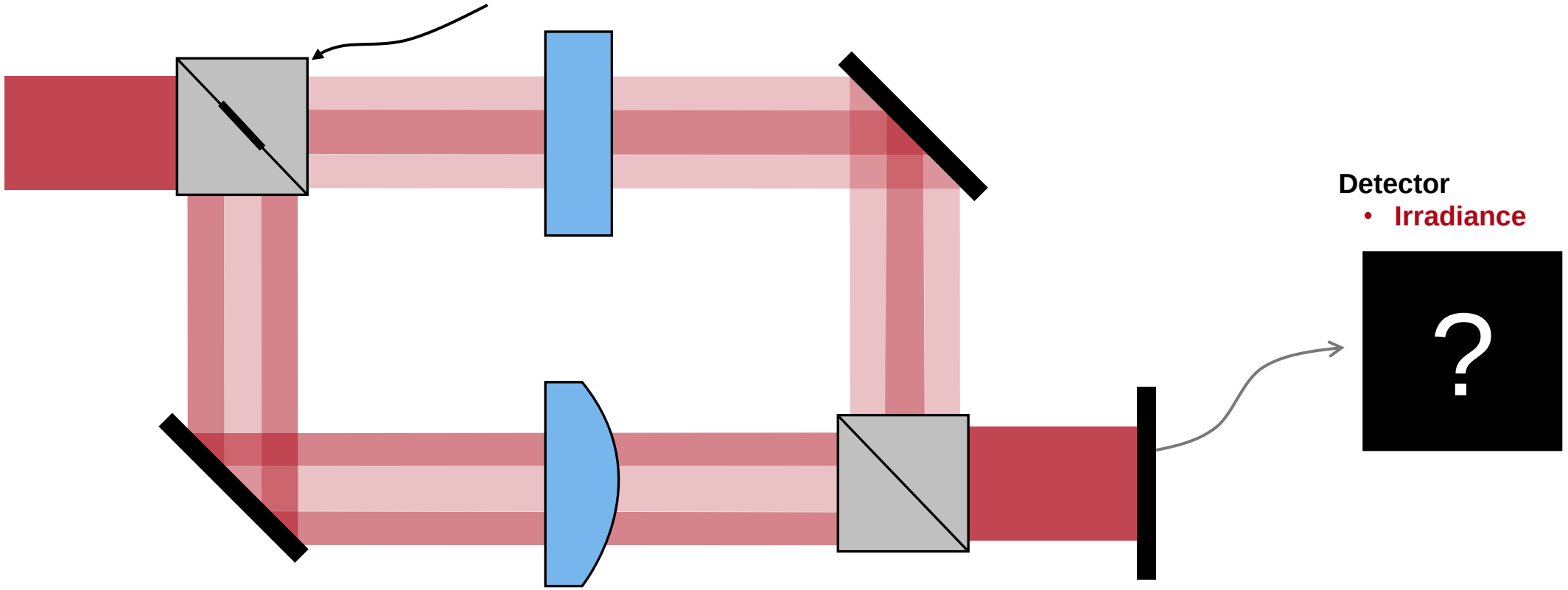
Application Scenario: System



Application Scenario: Task

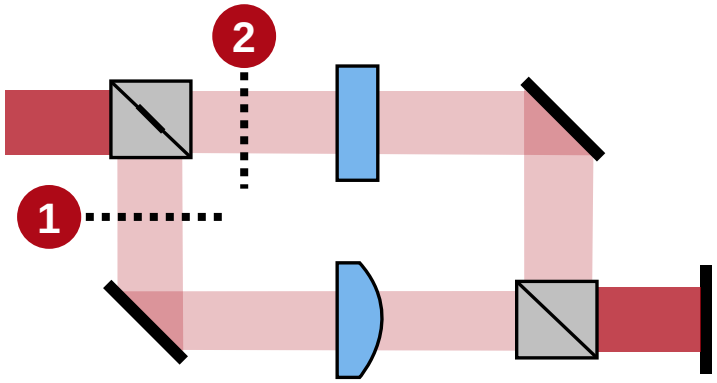
Reflectivity …	Conf. 1	Conf. 2	Conf. 3
… outside area (R_1)	50%	100%	70%
… inside area (R_2)	50%	0%	30%

Task: Measure irradiance patterns across beam splitter configurations.



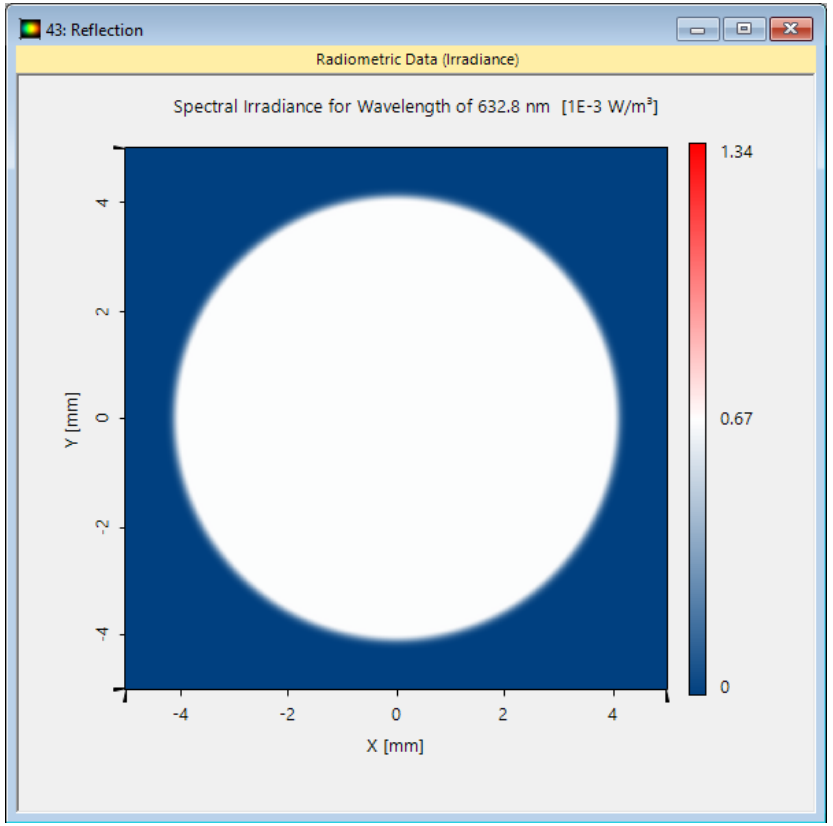
Results

Configuration 1: Field after Beam Splitter

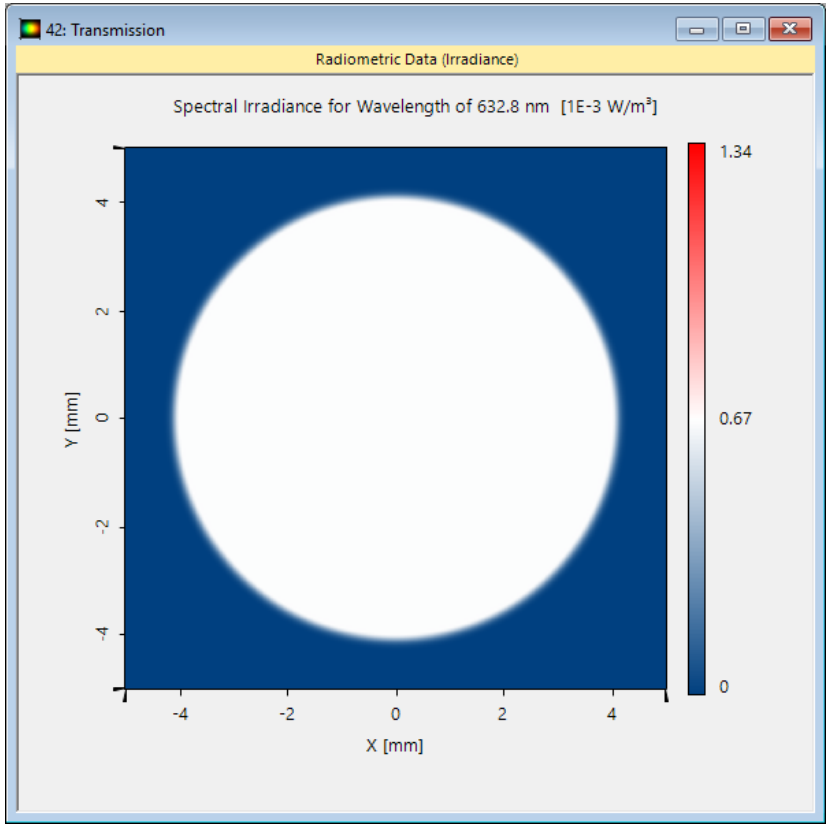


Reflectivity …	Conf. 1
… outside area (R_1)	50%
… inside area (R_2)	50%

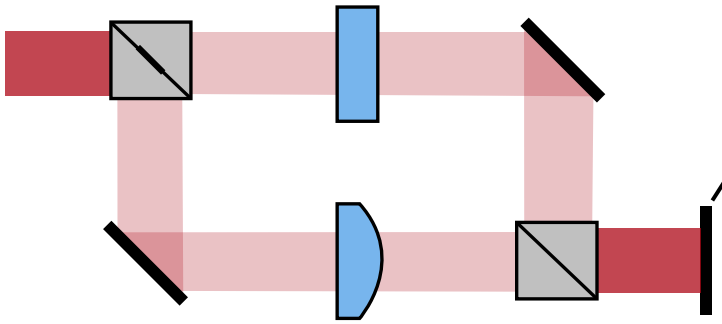
1 Reflection



2 Transmission

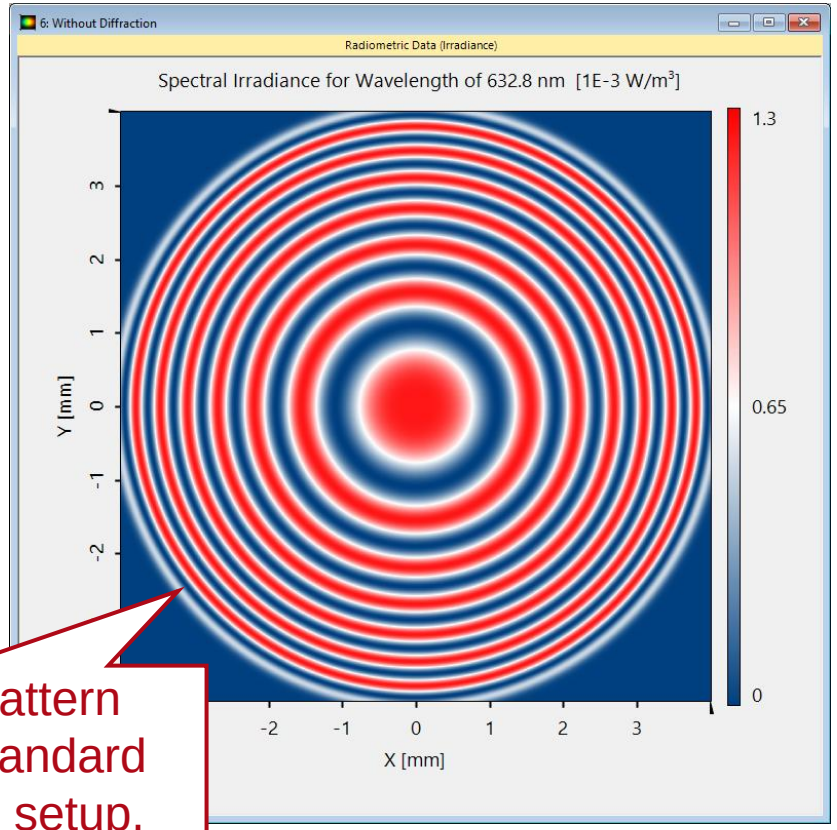


Configuration 1: At Detector Plane

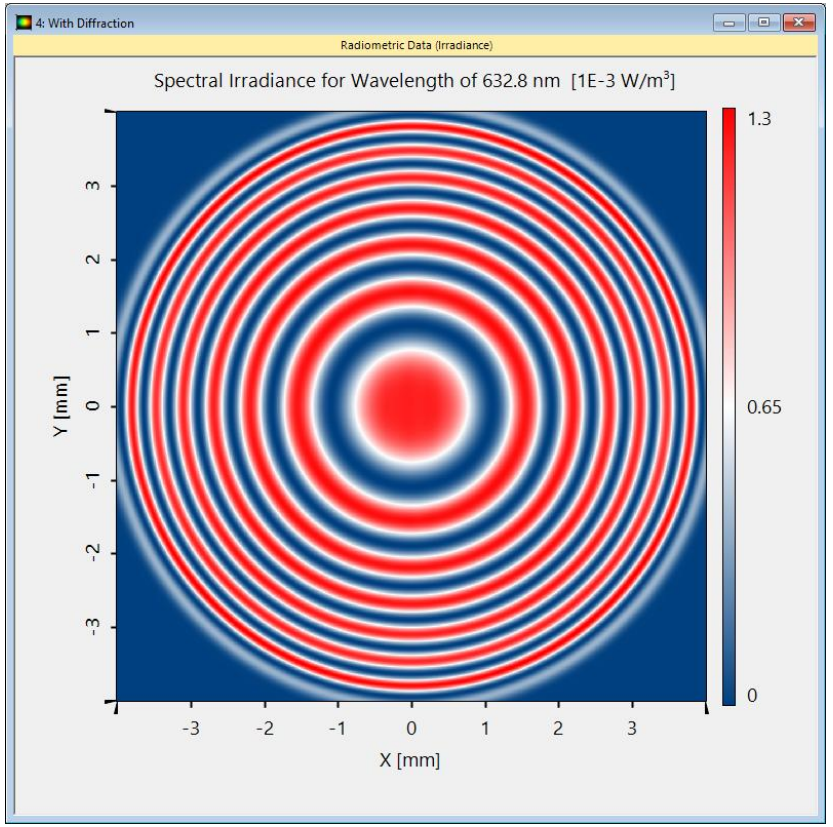


Reflectivity …	Conf. 1
… outside area (R_1)	**50%**
… inside area (R_2)	**50%**

Without inclusion of diffraction effects

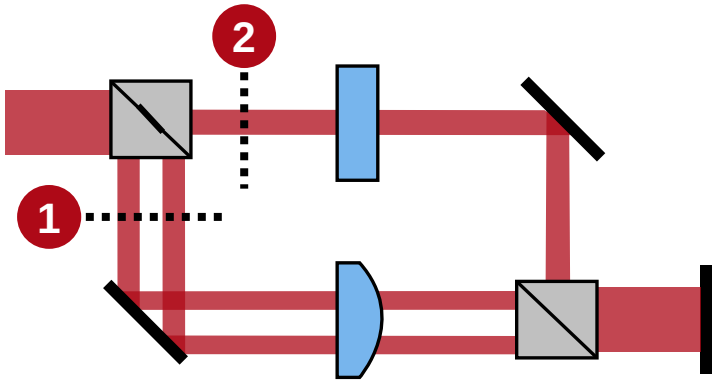


With inclusion of diffraction effects



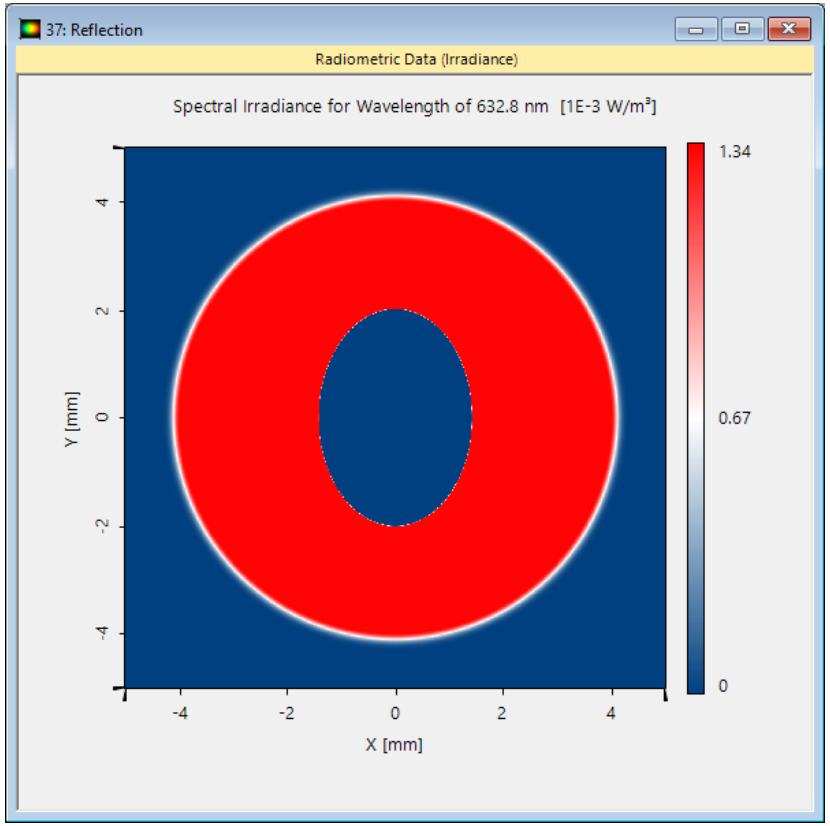
Interference pattern identical to a standard Mach–Zehnder setup.

Configuration 2: Field after Beam Splitter

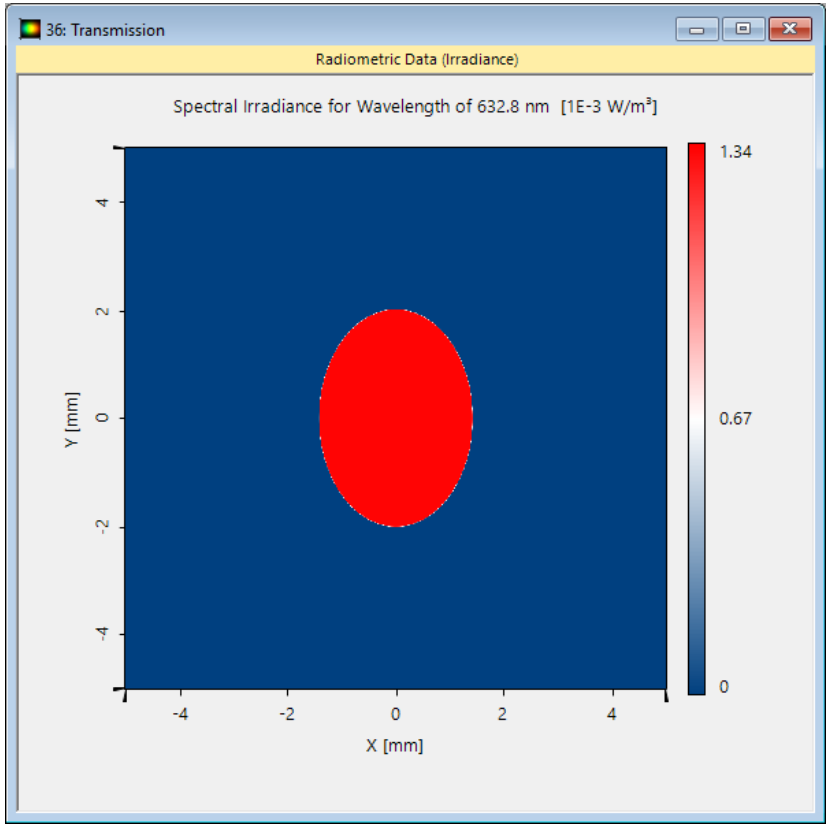


Reflectivity …	Conf. 2
… outside area (R_1)	100%
… inside area (R_2)	0%

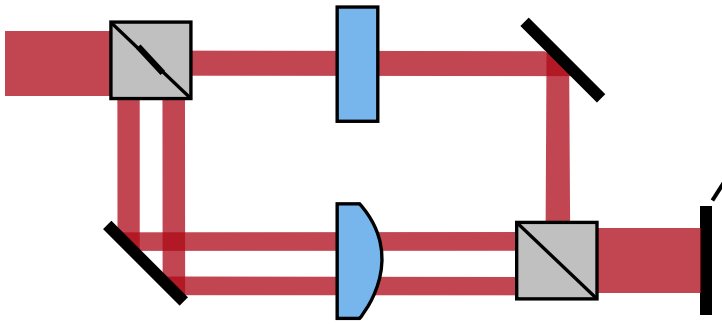
1 Reflection



2 Transmission

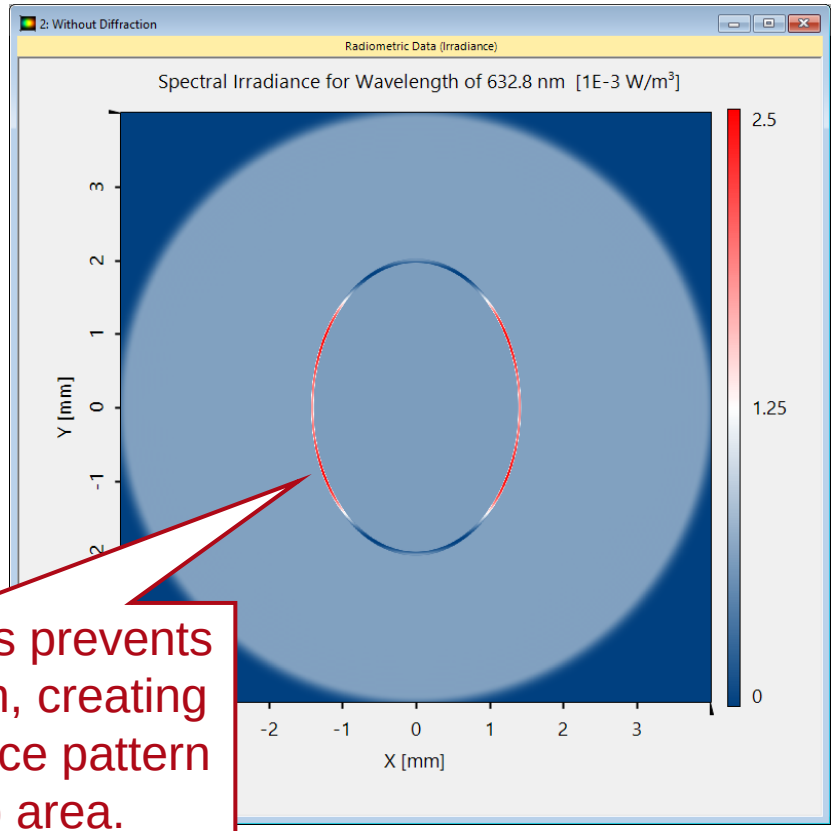


Configuration 3: At Detector Plane

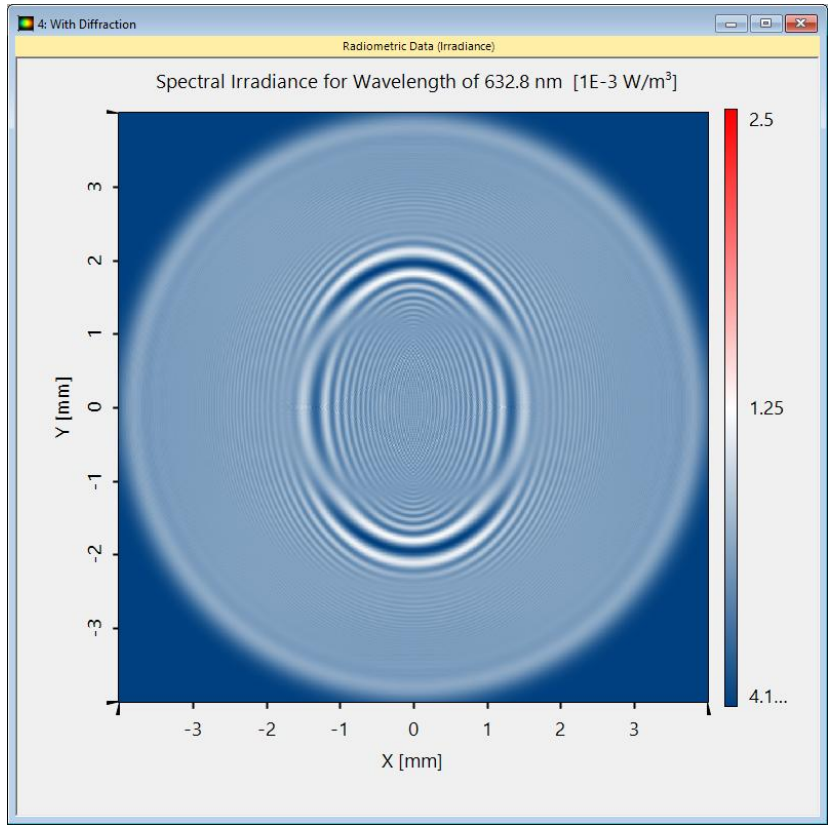


Reflectivity …	Conf. 2
… outside area (R_1)	**100%**
… inside area (R_2)	**0%**

Without inclusion of diffraction effects

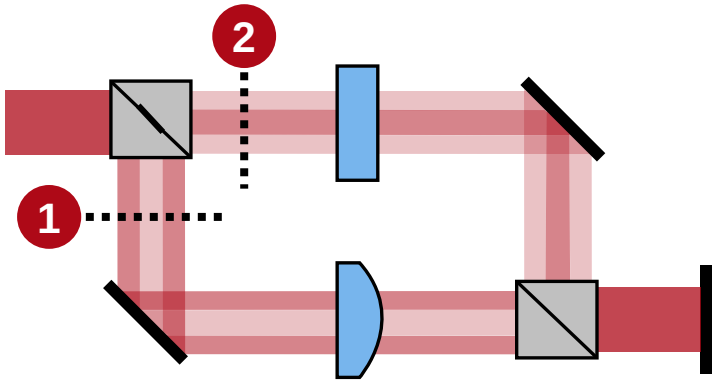


With inclusion of diffraction effects



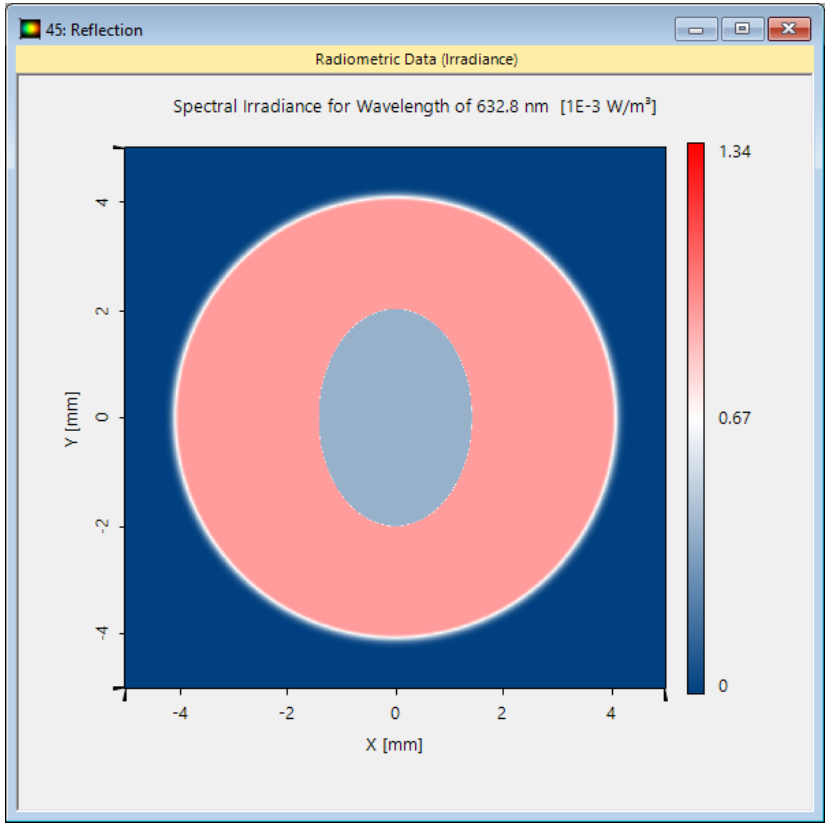
The spherical lens prevents full recombination, creating a small interference pattern in the overlap area.

Configuration 3: Field after Beam Splitter

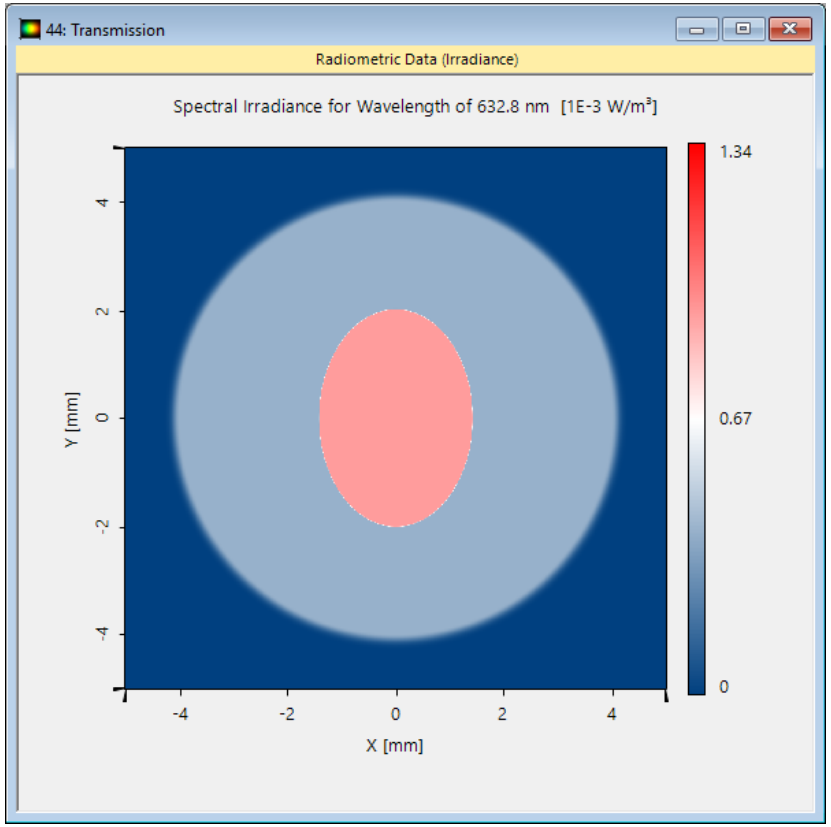


Reflectivity …	Conf. 3
… outside area (R_1)	70%
… inside area (R_2)	30%

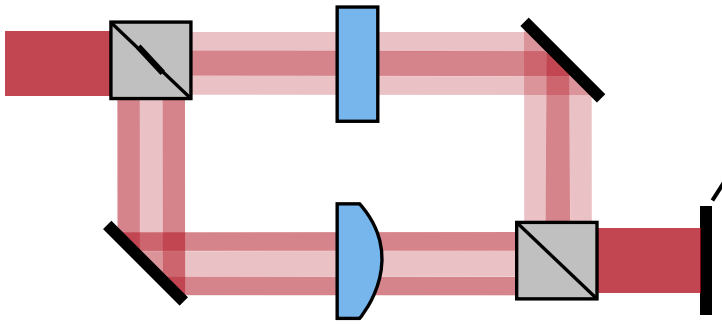
1 Reflection



2 Transmission

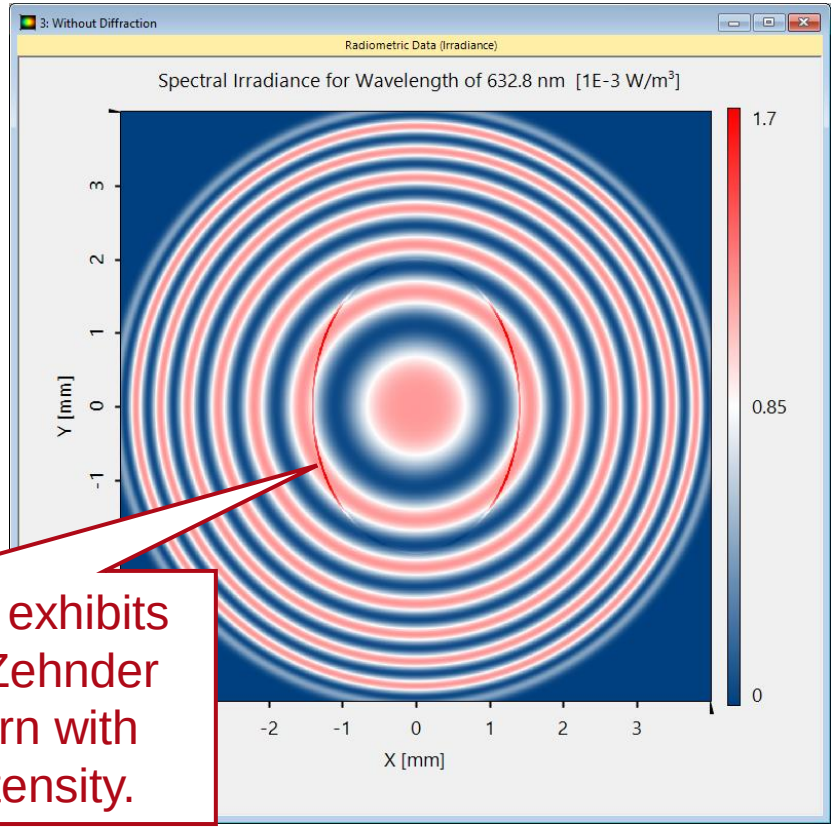


Configuration 3: At Detector Plane

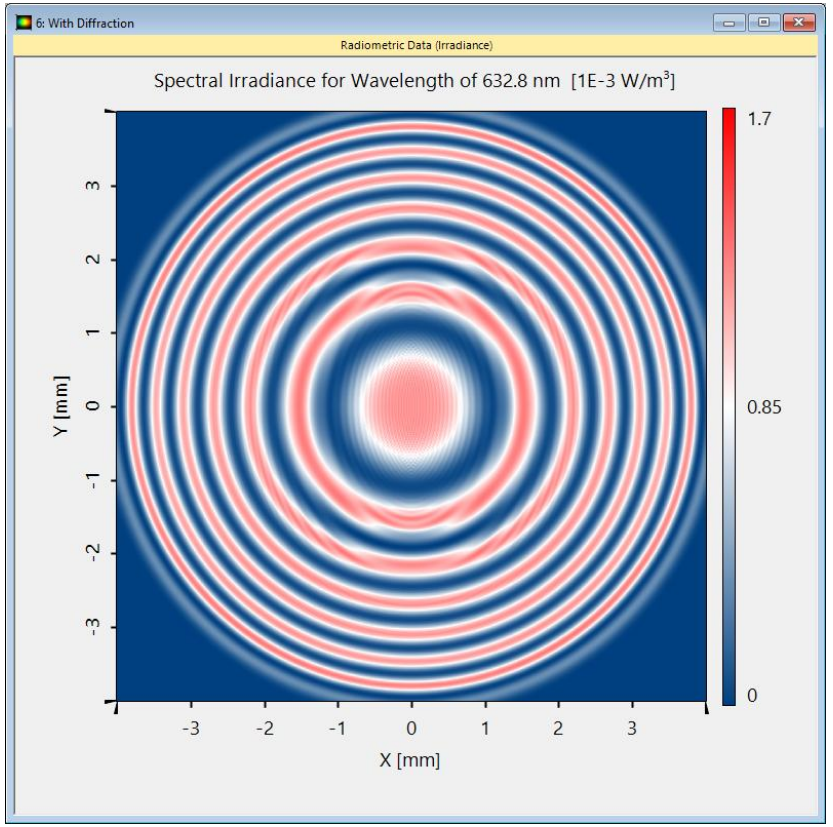


Reflectivity …	Conf. 3
… outside area (R_1)	**70%**
… inside area (R_2)	**30%**

Without inclusion of diffraction effects



With inclusion of diffraction effects



The overlap region exhibits the known Mach–Zehnder interference pattern with increased field intensity.

Workflows

LP Mode Source

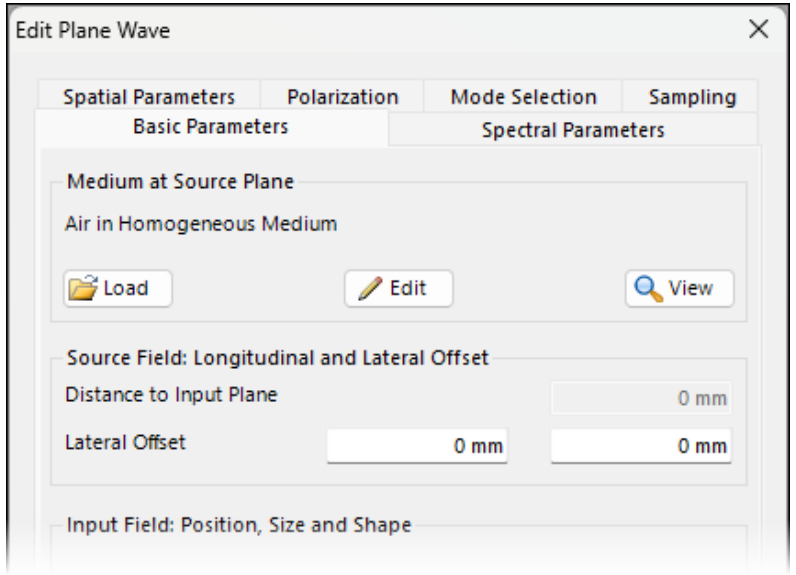
Source selection

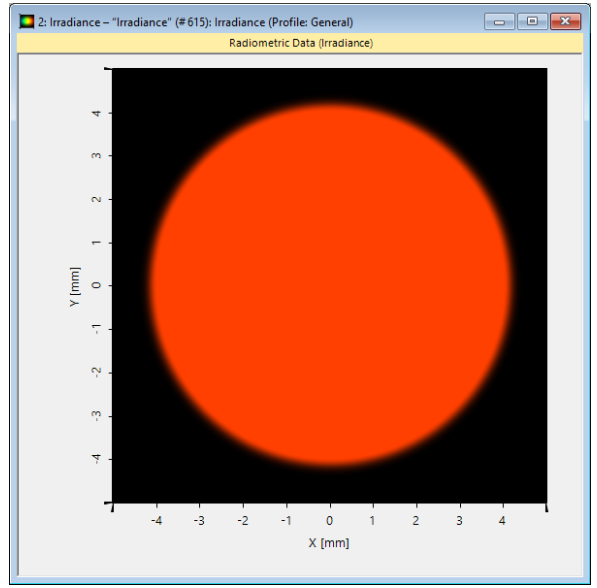
System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Plane Wave





System Setup

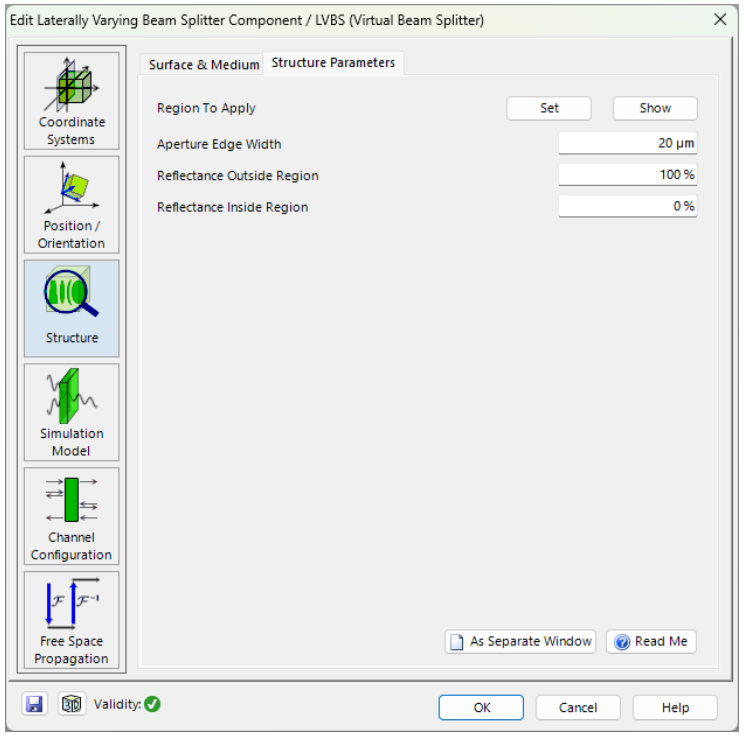
Source selection

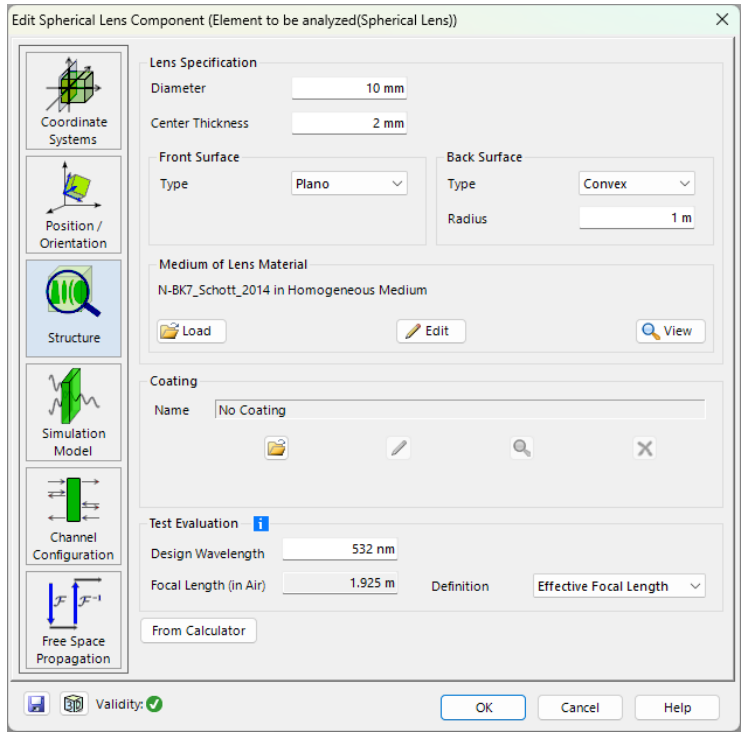
System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Model lens by Spherical Lens component
- Load Laterally-Varying Beam Splitter Cube from Catalog





Detector Selection

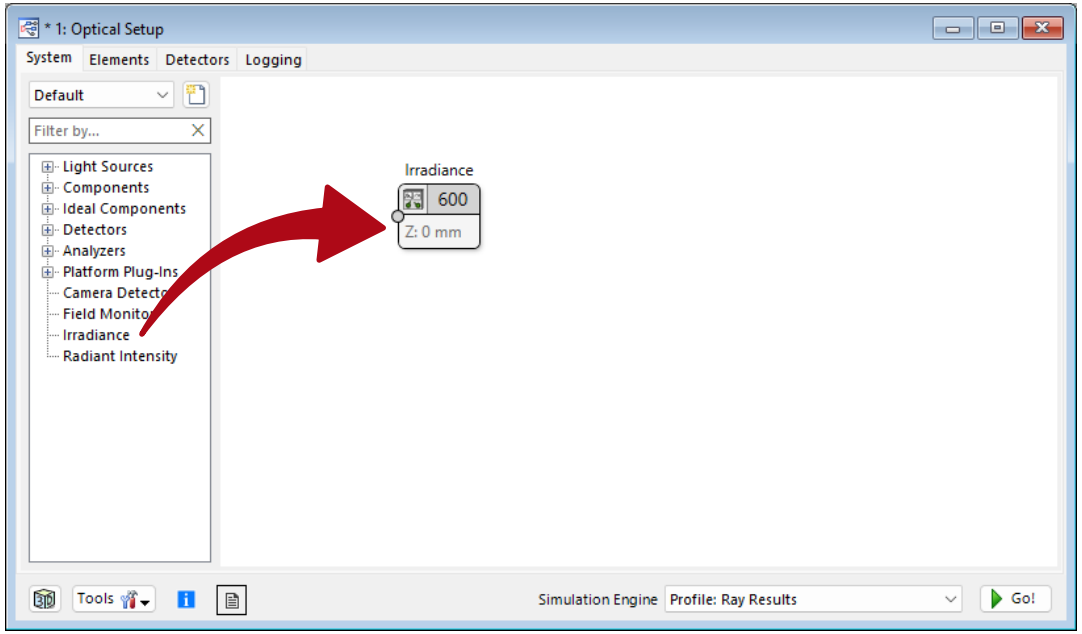
Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Add Irradiance detector to your system.



Document Information

Title	Mach-Zehnder Interferometer with Laterally Varying Beam Splitter Cube
Document code	USC.0467
Publication date	23.09.2025
Required packages	-
Software version	2025.2 (Build 1.118)*
Category	Use Case
Further reading	- Laser-Based Michelson Interferometer and Interference Fringe Exploration - Fizeau Interferometer for Optical Testing

* *The files attached to this document require the specific version or later.*

Marketing Picture