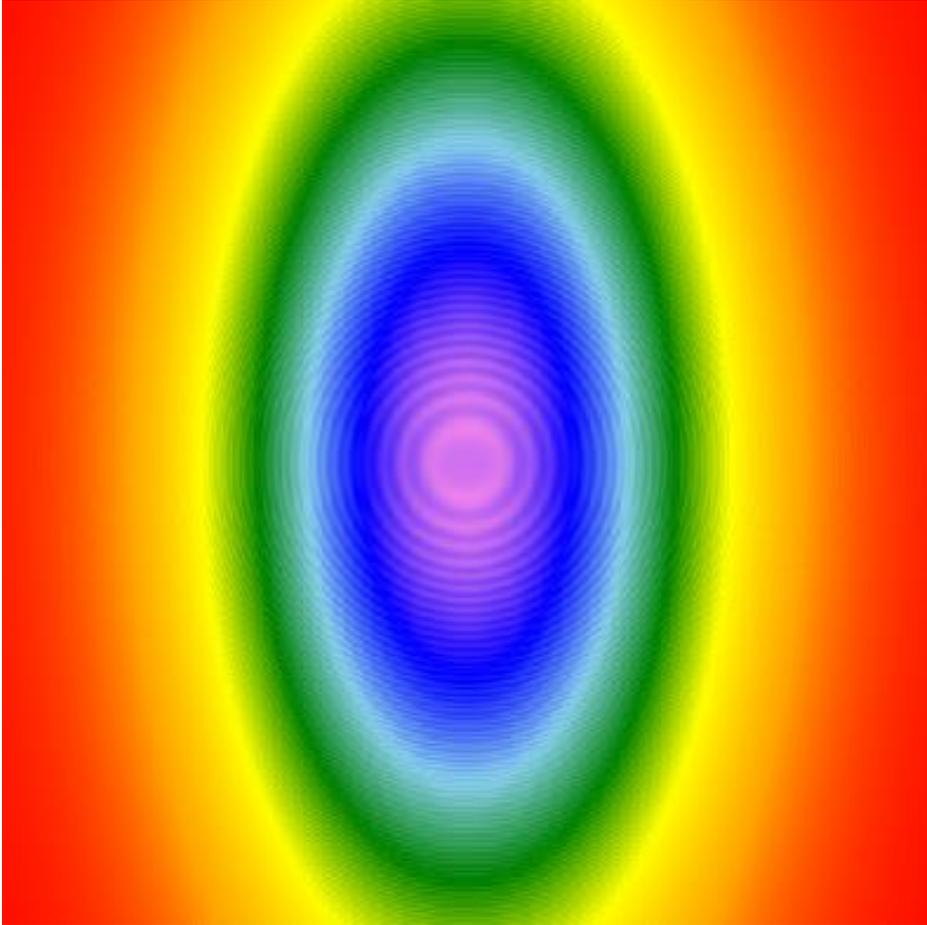# Investigation of Ghost Imaging Effects in Collimation System
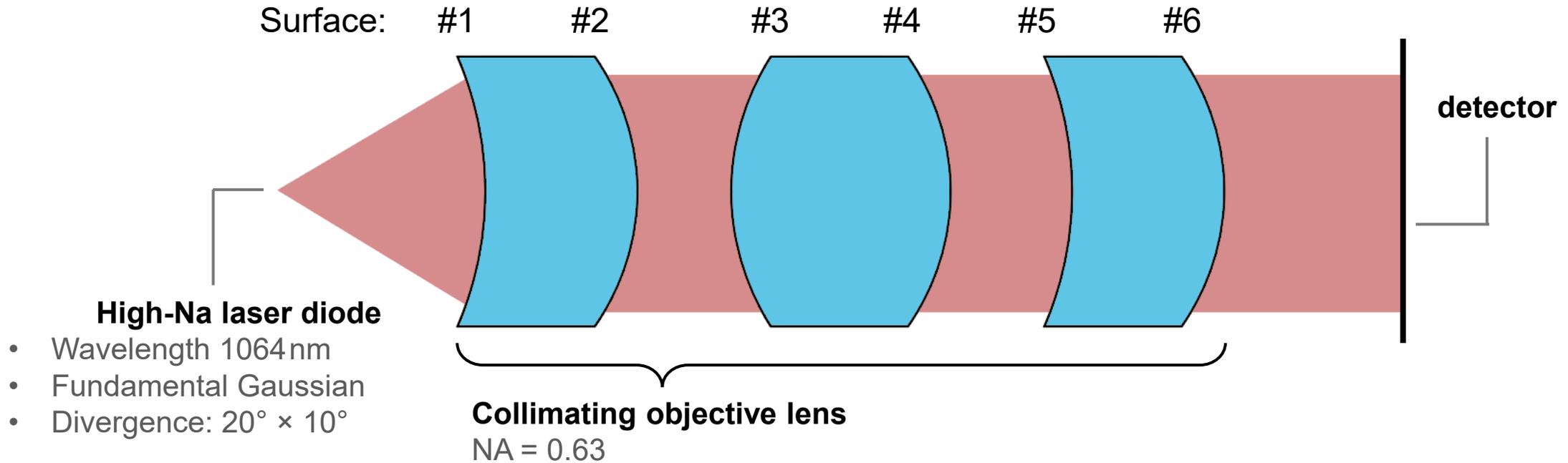
Abstract

Simulation is commonly used to evaluate system performance prior to manufacturing. This use case analyzes stray light from internal reflections in a collimation lens for a high-NA laser diode. Also, the resulting ghost-image interference pattern in the detected field or modeled.

Application Scenario

Application Scenario: System

Surface: #1   #2   #3   #4   #5   #6

detector

High-Na laser diode

- Wavelength 1064 nm
- Fundamental Gaussian
- Divergence: 20° × 10°

Collimating objective lens
NA = 0.63

surface	#1	#2	#3	#4	#5	#6
Radius of Curvature	-6.8 mm	-3.9 mm	21.1 mm	-8.7 mm	-5.0 mm	-7.1 mm
material behind surface	N-SF6	air	N-BK7	air	N-BK7	air

Application Scenario: Task

Surface: #1   #2   #3   **#4**   **#5**   #6
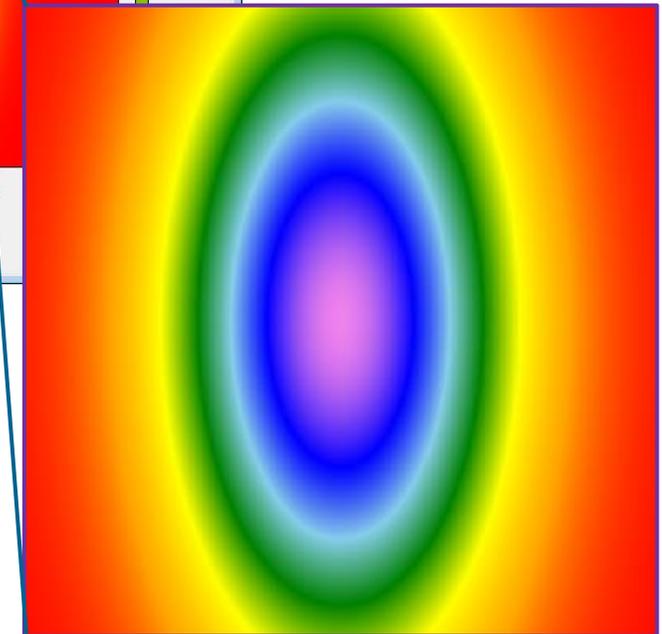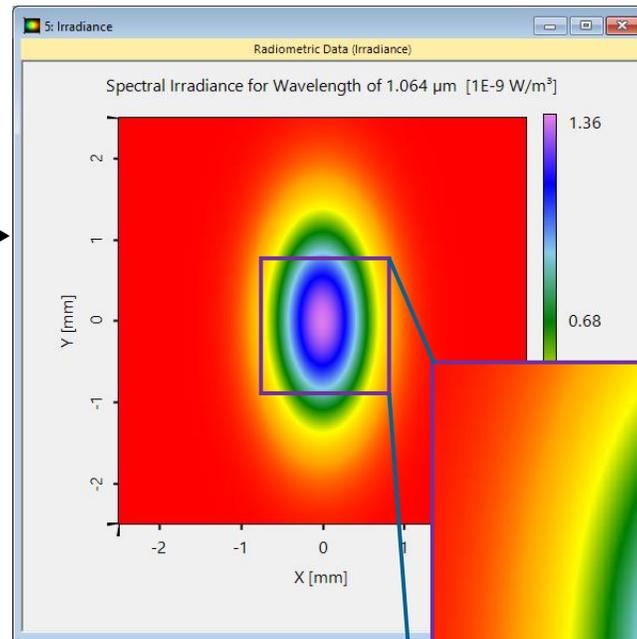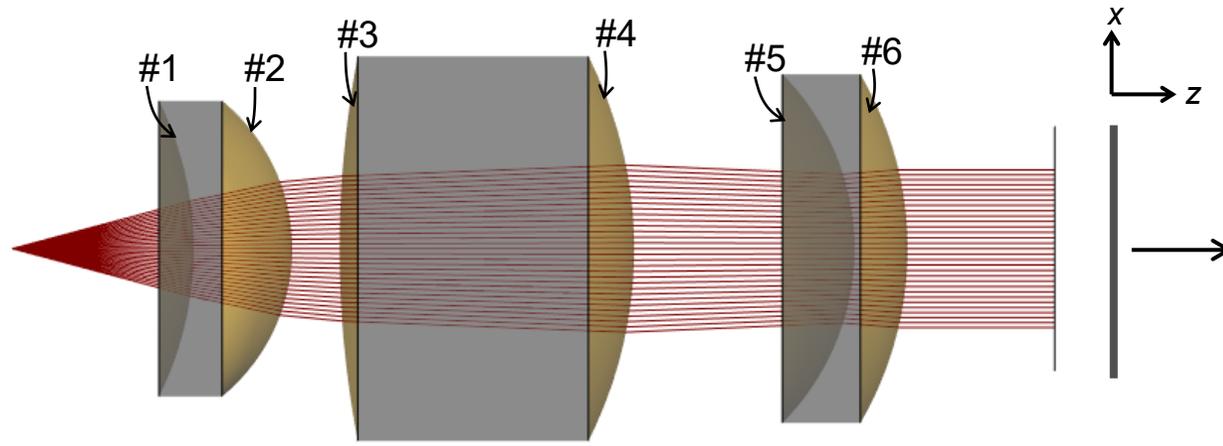
Detector
- Irradiance
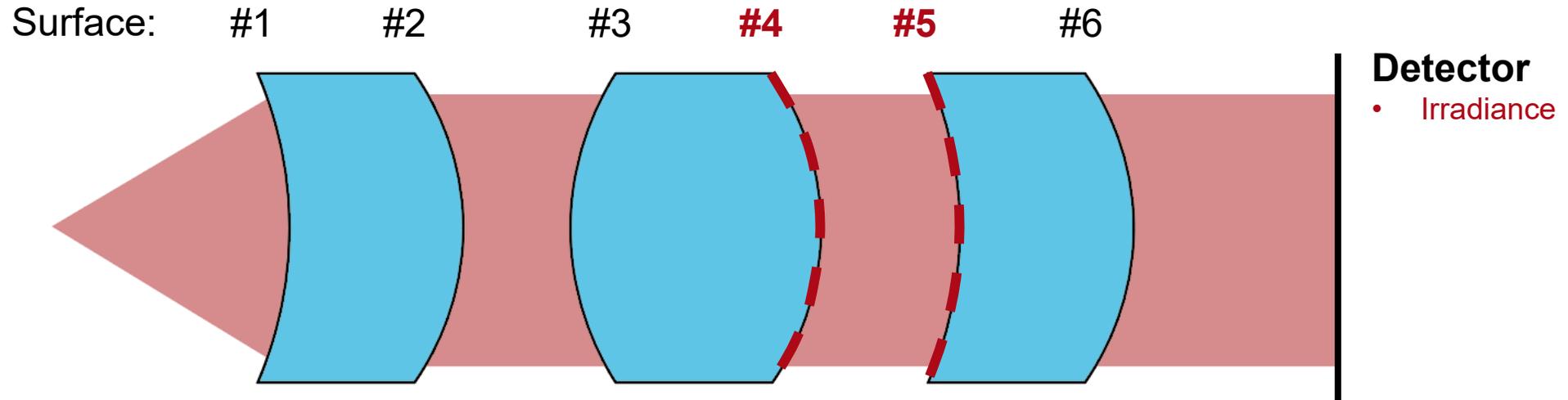
Task 1: Calculate irradiance at detector when all surfaces have perfect anti-reflection coatings
Task 2: Calculate irradiance at detector when surface #4 and #5 are uncoated (including multi-reflections).
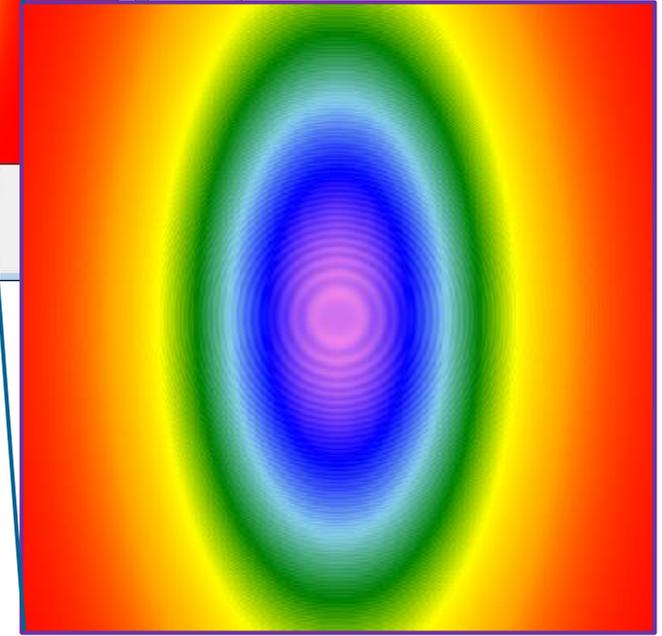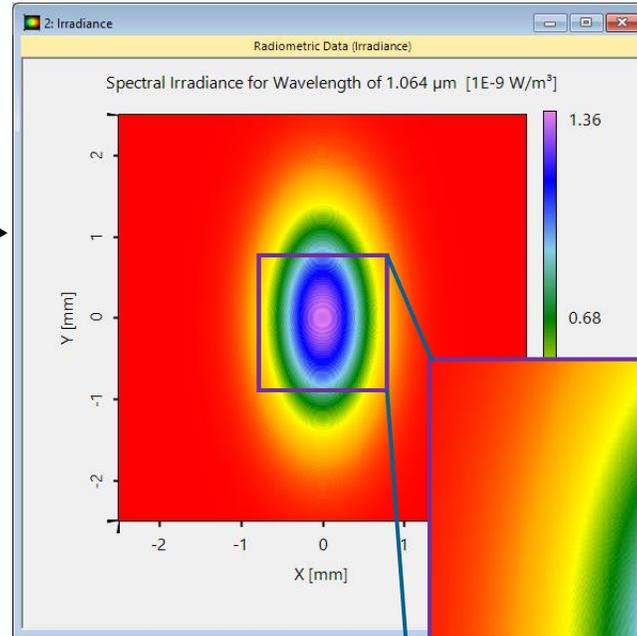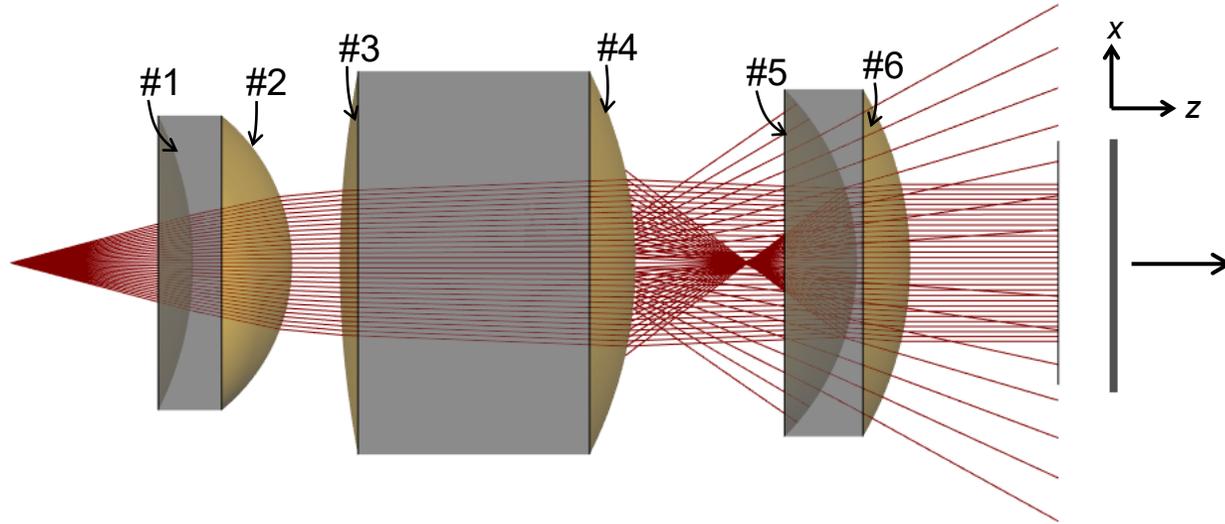
Simulation Results

Task 1: Perfect Antireflection (AR) Coating

Surface	+/+	+/-	-/-	-/+
1	✔	X	X	X
2	✔	X	X	X
3	✔	X	X	X
4	✔	X	X	X
5	✔	X	X	X
6	✔	X	X	X

The perfect AR coating is modeled by configuring the surface channels for non-sequential tracing so, that only the straight-through (main) light path is allowed. As a result, no interference pattern appears.

Task 2: With Internal Reflections

Surface	+/+	+/-	-/-	-/+
1	✓	X	X	X
2	✓	X	X	X
3	✓	X	X	X
4	✓	X	X	✓
5	✓	✓	X	X
6	✓	X	X	X

When the reflection channels for the surfaces of interest are opened, the multiple internal reflections will create the interference pattern – the ghost images – which appear in the result.
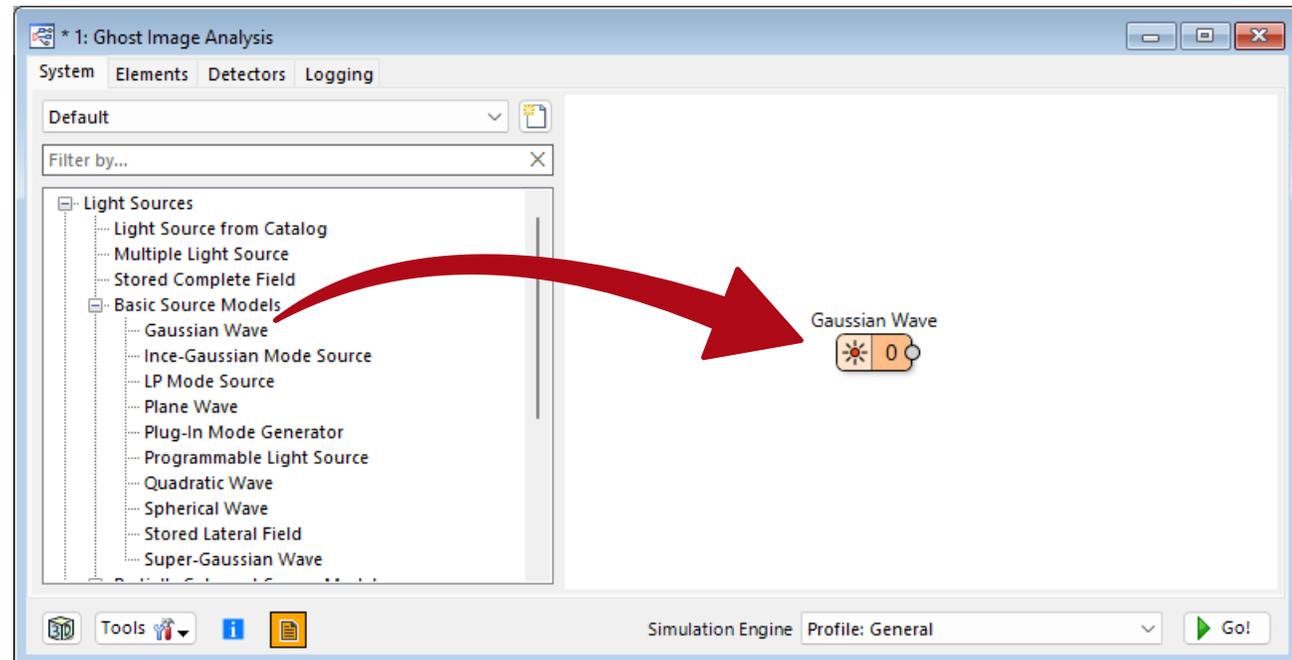
Workflow Steps

Basic Workflow Steps

Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

➢ Include <u>Gaussian Wave</u> to system
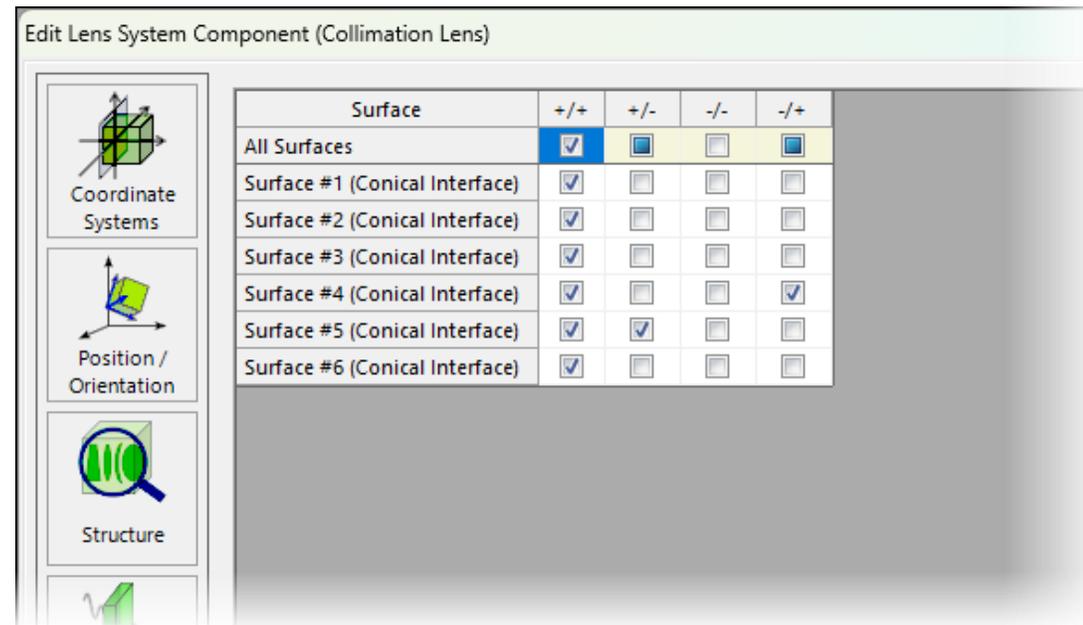
Basic Workflow Steps

Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

➢ Set up collimation lens
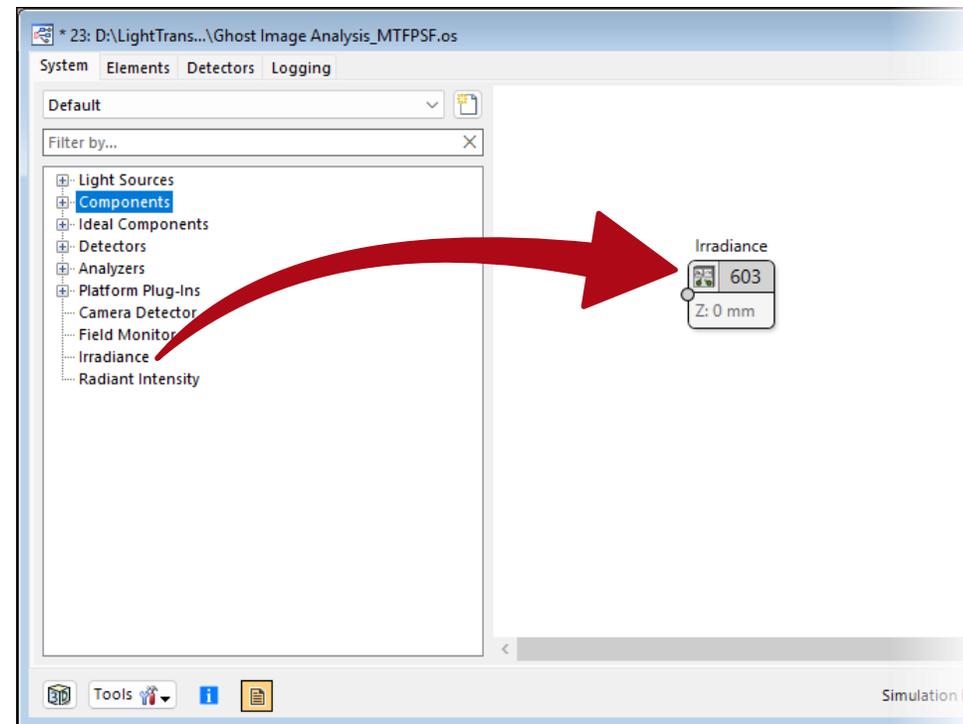➢ Channel configuration for surfaces

Basic Workflow Steps

Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

➢ <u>Irradiance Detector</u>

Document Information

Title	Investigation of Ghost Imaging Effects in Collimation System
Document code	USC.0019
Publication date	15.01.2026
Required packages	-
Software version	2025.2 (Build 1.118)*
Category	Use Case
Further reading	• Modeling of Etalon with Planar or Curved Surfaces • Channel Setting for Non-Sequential Tracing • Catadioptric Imaging System Based on Pancake Lenses

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