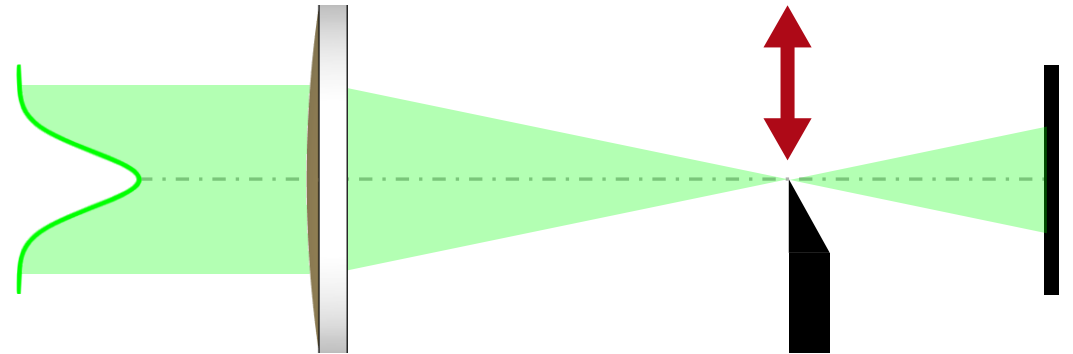


Knife-Edge Beam Size Measurement

via Knife Edge Twin

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Author	LightTrans International GmbH
SW Package:	VirtualLab Fusion Platform
SW Version:	2026.2 (Build 3.30)



Scenario

Demo System

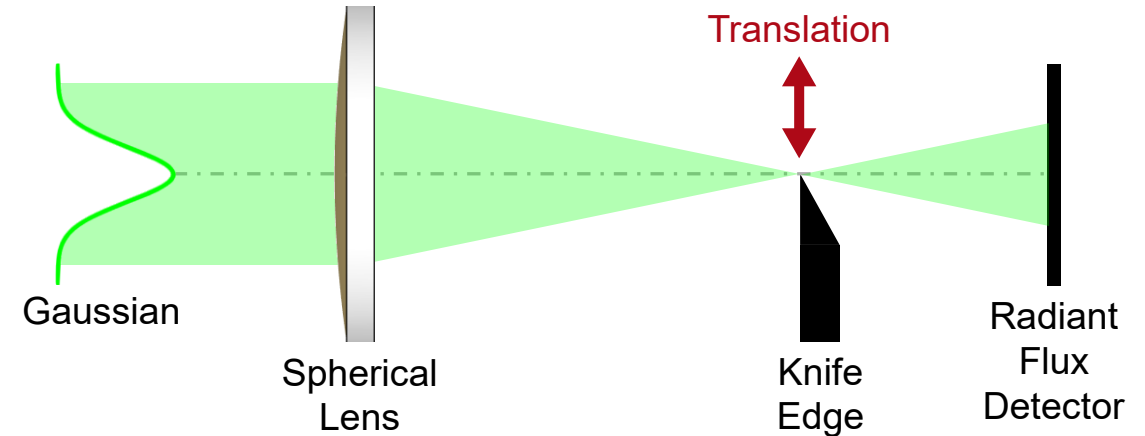
A collimated Gaussian beam at 532 nm is focused by a plano-convex fused-silica lens (Thorlabs LA4102-AB). A knife edge is positioned in the beam waist and translated across the focused beam.

Measurement Principle

For each knife-edge position, the transmitted radiant flux is recorded by a downstream detector. The resulting S-shaped radiant-flux-versus-position curve represents the classical knife-edge measurement.

Objective

Determine the focused beam size from the virtual measurement and compare it with the beam size obtained directly from the simulated field.



Knife-Edge Beam Evaluation

Extracting the Beam Size from the Knife-Edge Scan

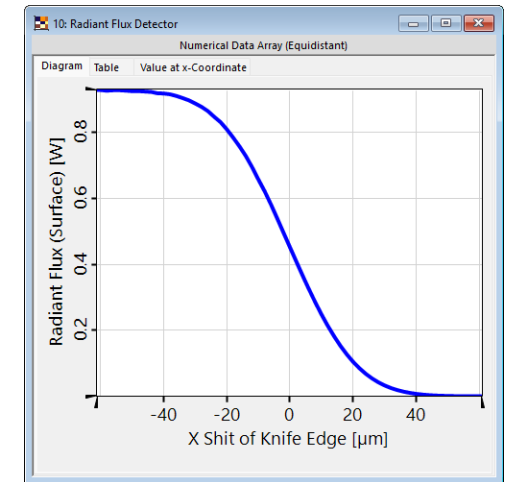
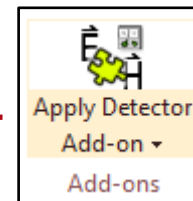
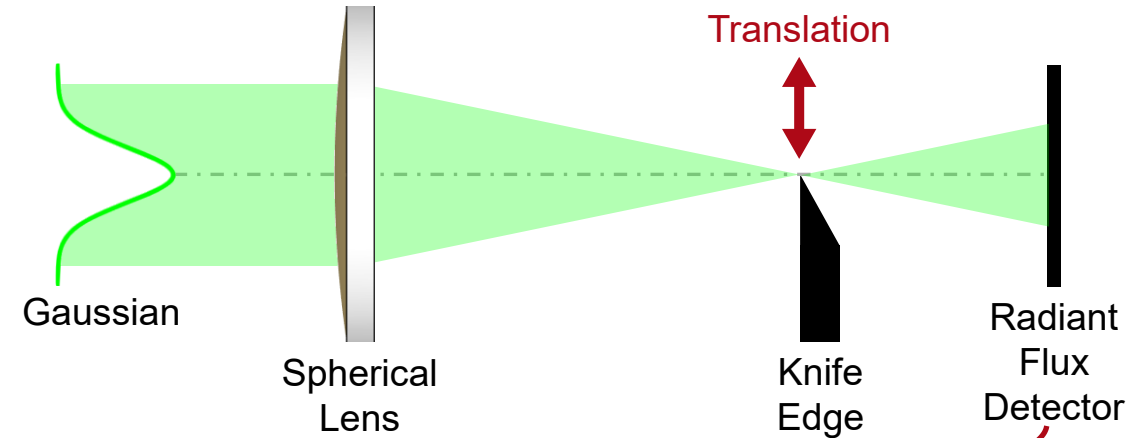
Sweeping the knife edge across the beam generates the characteristic **S-shaped radiant-flux curve**.

A dedicated **Detector Add-on** fits an error-function model to this curve.

From the fit, the Detector Add-on determines and reports:

- **Beam Center** x_0
- **$1/e^2$ Irradiance Radius** w
- **Irradiance FWHM**

$$\text{FWHM} = w\sqrt{2 \ln 2}$$



Radiant flux vs knife-edge position

Virtual Measurement and Validation

From Optical Simulation to Virtual Experiment

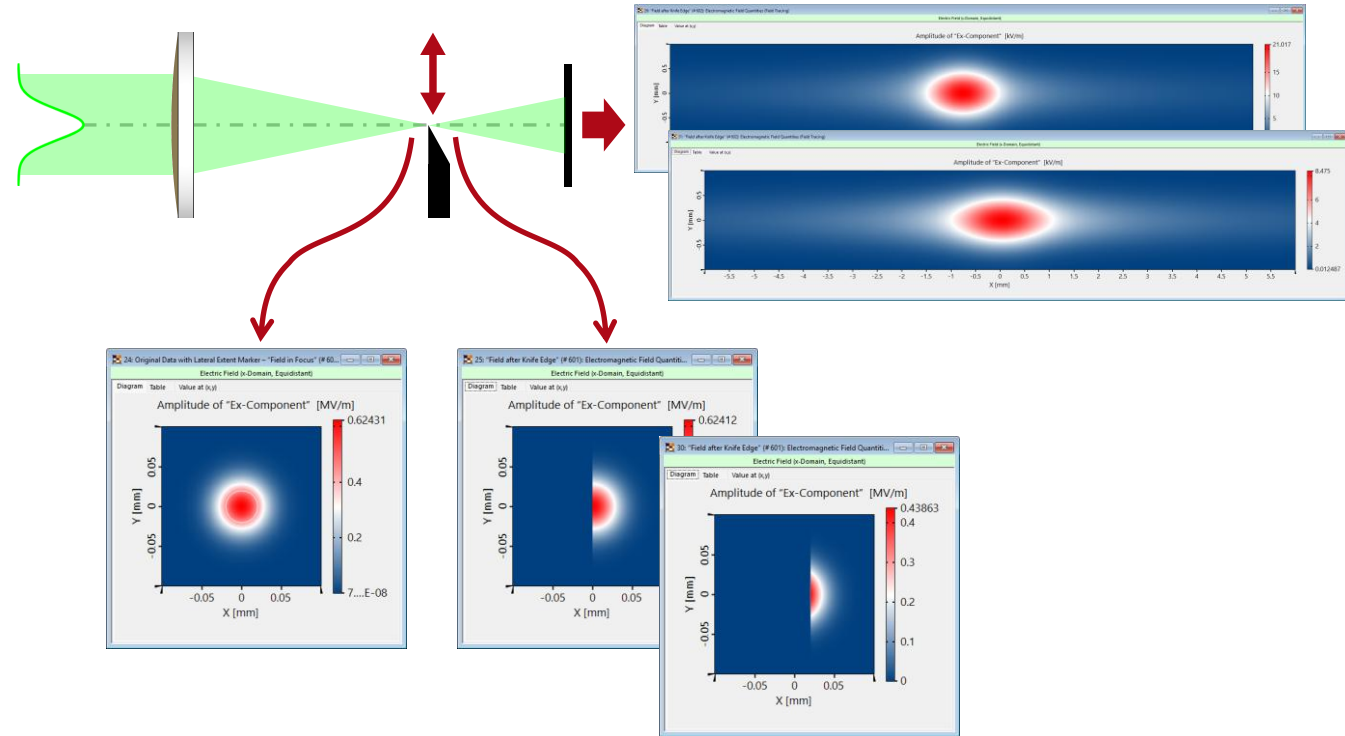
The optical system provides the complete field information.

The knife-edge scan intentionally evaluates the beam indirectly, exactly as in a laboratory measurement.

This makes it possible to compare:

- **direct field evaluation**, and
- **virtual experimental characterization**.

The virtual knife-edge measurement reproduces the beam size obtained from direct field evaluation.



Agreement of Beam FWHM

Direct Field Evaluation
 $\text{FWHM}_{\text{Irrad.}} \approx 39.96 \mu\text{m}$

Knife-Edge Measurement
 $\text{FWHM}_{\text{Irrad.}} \approx 40.02 \mu\text{m}$

Workflow

What the User Does

1. **Open the optical setup** containing the Gaussian source, focusing lens, knife edge, and detector.
2. **Run the simulation**, inspect the focused beam, and evaluate its FWHM.
3. **Run a parameter sweep** to translate the knife edge across the beam.
4. **Generate the radiant-flux-versus-position curve** from the combined sweep results.
5. **Apply the Detector Add-on(*)** to evaluate the curve and determine the beam parameters.
6. **Compare the reconstructed beam size** with the direct field evaluation.

