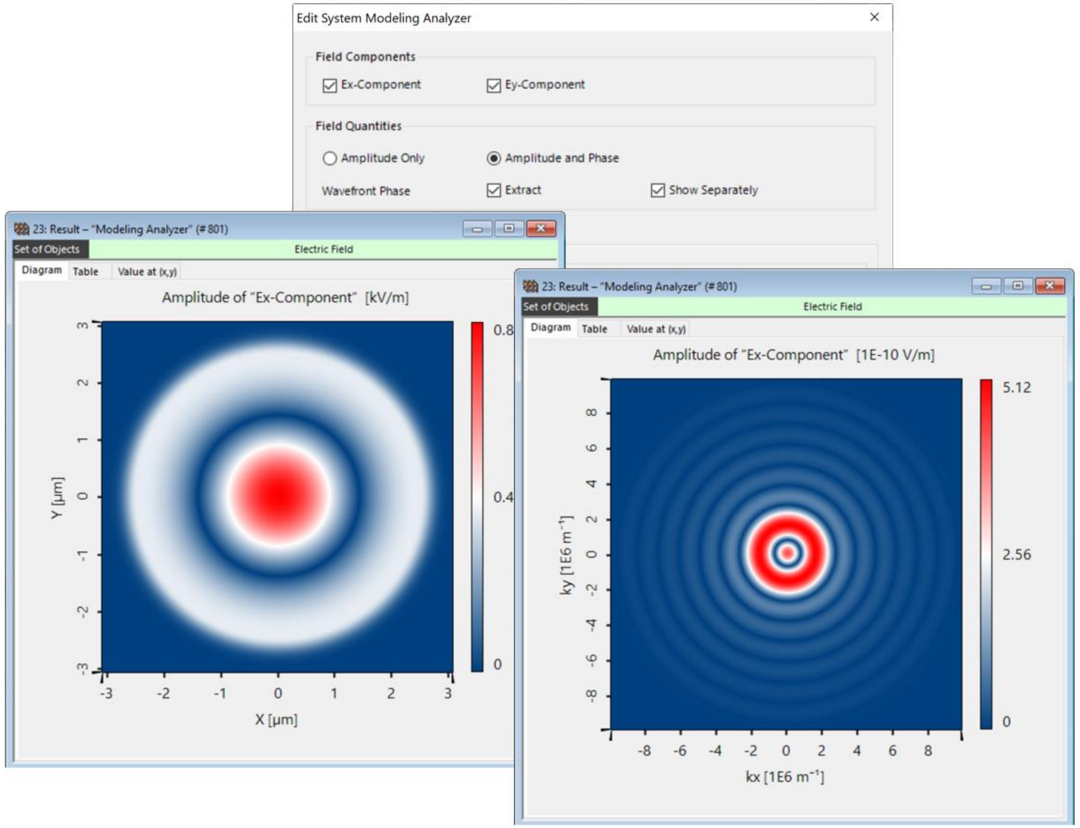
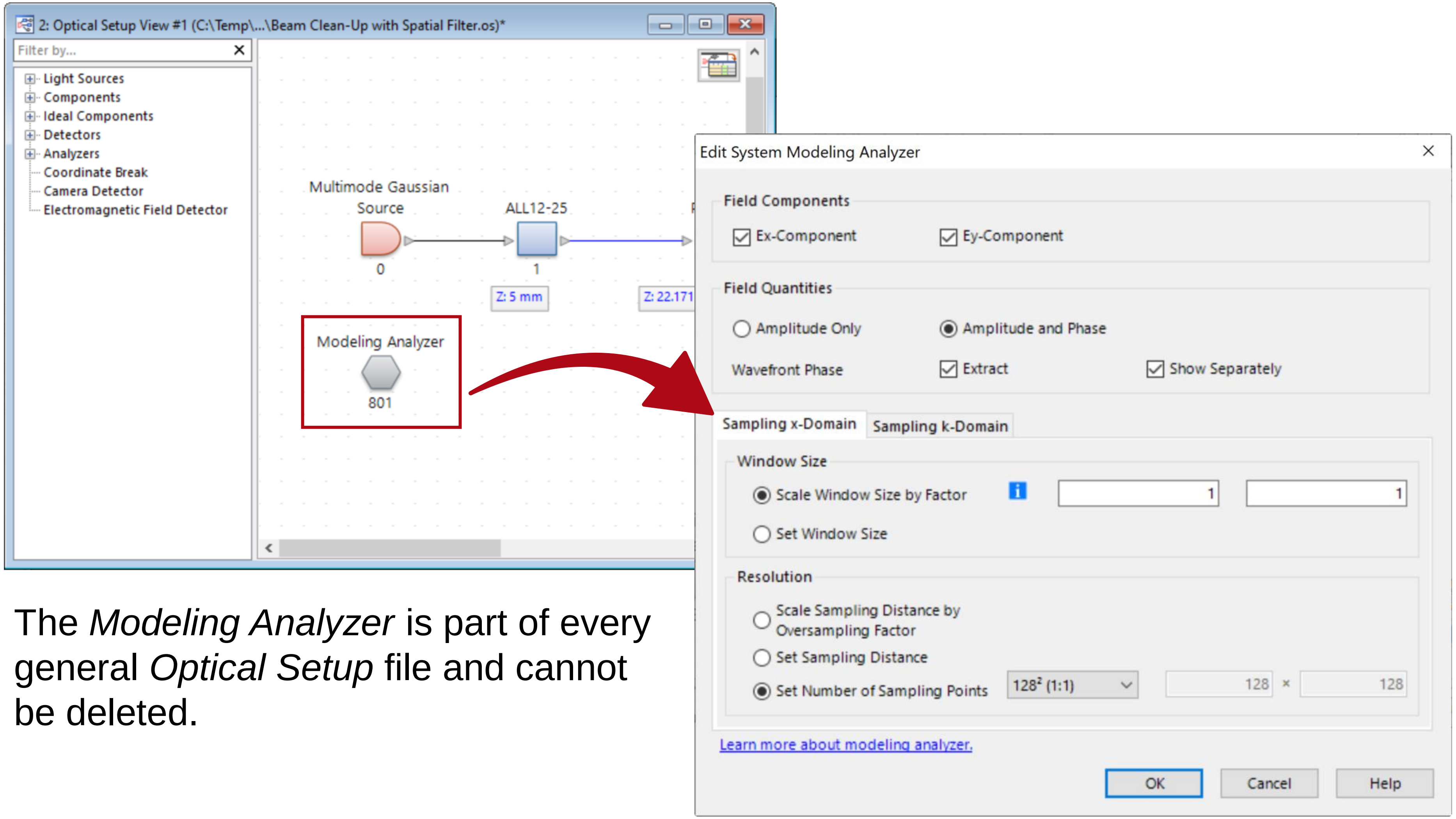
System Modeling Analyzer

Abstract



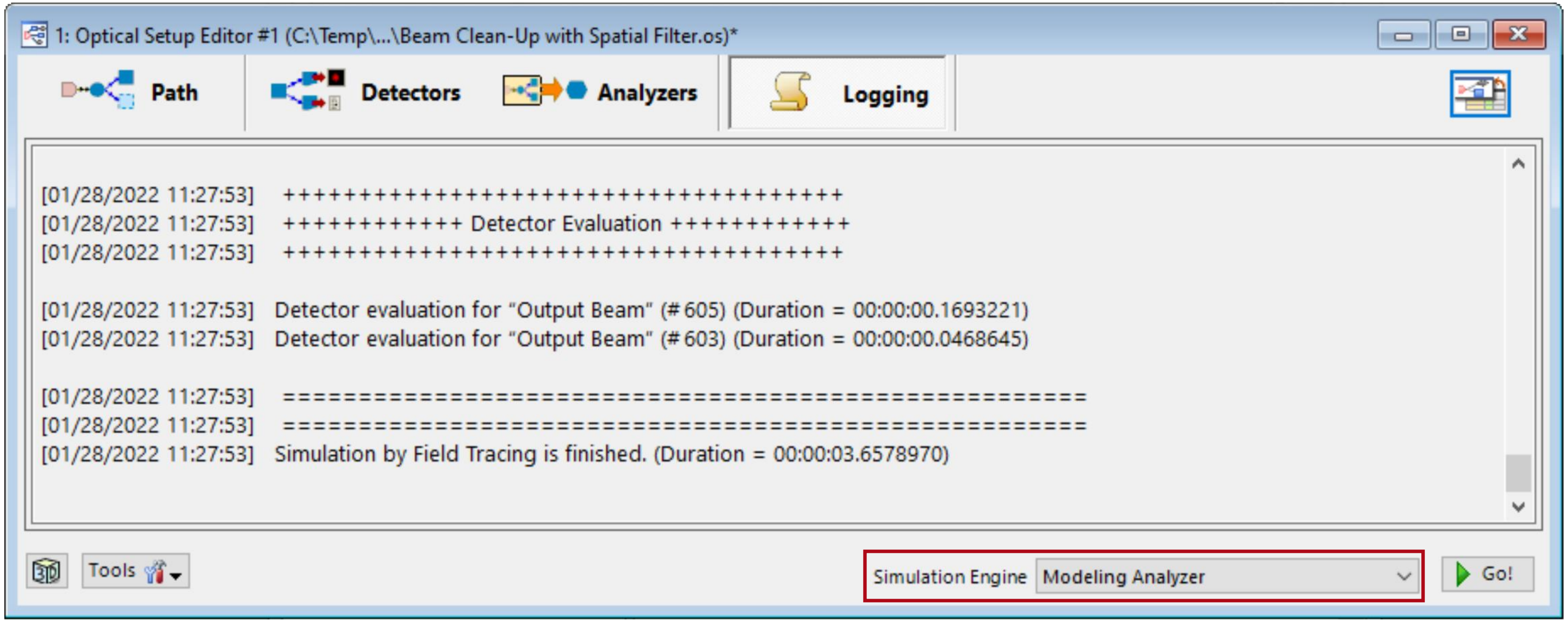
In physical optics, Fourier transforms are one of the most basic tools required for propagating light through complex optical systems. These operations allow us to switch between the different domains available for the representation of light fields (like the space and frequency domain) and facilitate the efficient application of specific solvers for various kinds of optical components. Most of these solvers usually work in a specific domain, which means that a constant back-and-forth between domains is essential for an accurate and fast simulation. In order to provide the optical engineer with a comprehensive overview of the different stages of the field as it propagates through the system, VirtualLab Fusion is equipped with a powerful tool, the *System Modeling Analyzer*. In this document, the usage of this tool is presented.

System Modeling Analyzer



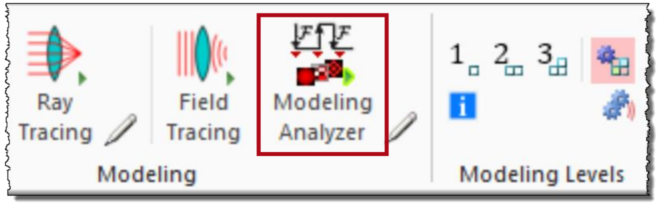
The *Modeling Analyzer* is part of every general *Optical Setup* file and cannot be deleted.

How to Run the Modeling Analyzer

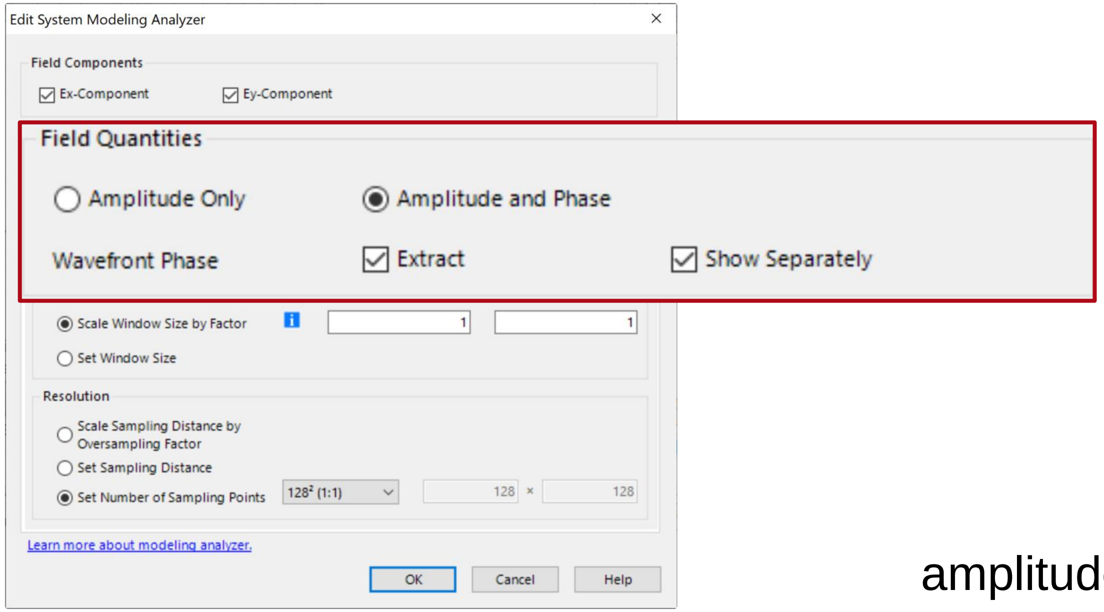


Like the *Ray Tracing System Analyzer*, the *Modeling Analyzer* can be configured as a *Simulation Engine* in the *Optical Setup Editor.*

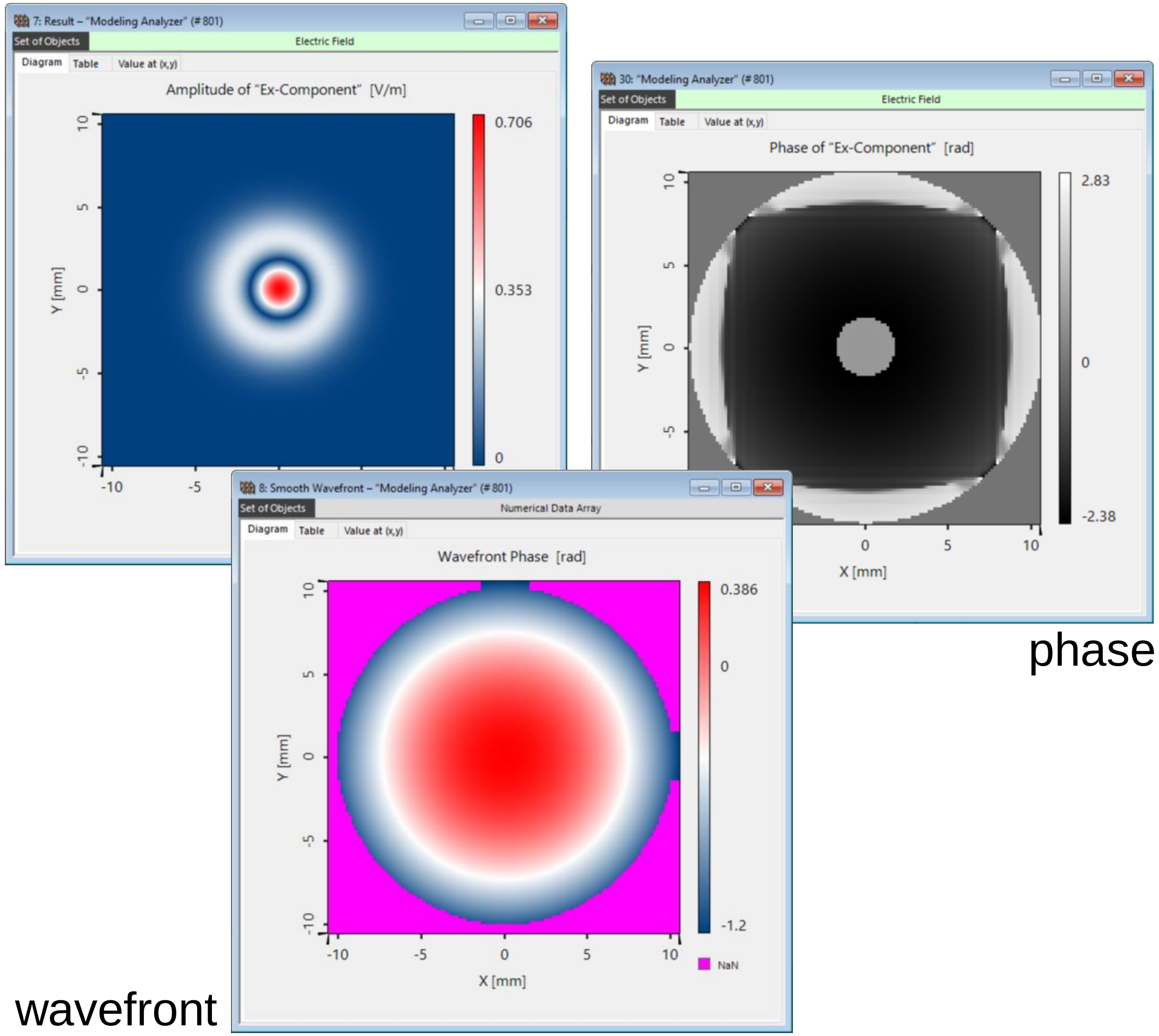
There is also the possibility to directly run the analyzer from the main menu. The corresponding button can be found in the *Optical Setup* tab.



System Modeling Analyzer



The settings of the analyzer allow us to select certain components of the electromagnetic field and which *Field Quantities* the analyzer is going to provide, with the options *Amplitude only* and *Amplitude & Phase*, the latter also offering the choice to extract the wavefront phase and show it as a separate document.



amplitude

phase

wavefront

Example 1: Beam Clean-Up Filter

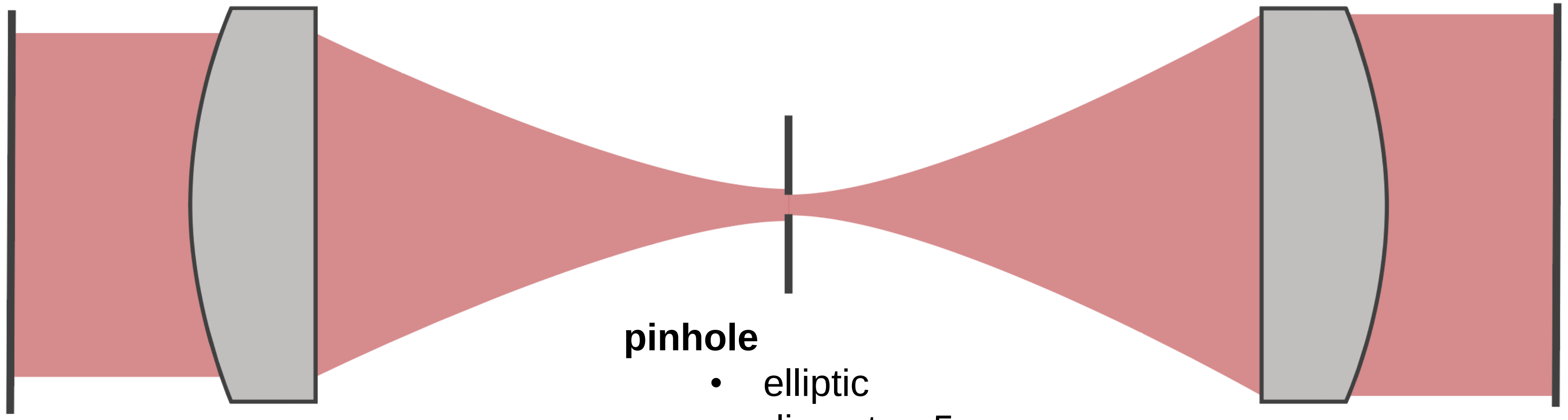
Example – Beam Clean Up Filter

focusing lens

- focal length: 25 nm
- thickness: 12.5 mm

collimation lens

- focal length: 25 nm
- thickness: 12.5 mm



pinhole

- elliptic
- diameter: 5 µm

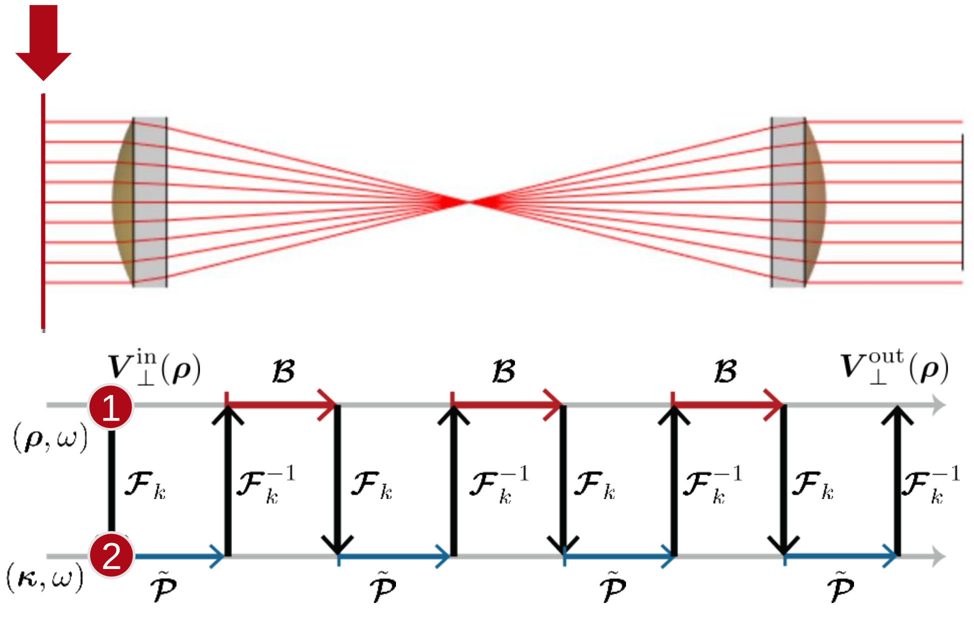
gaussian wave

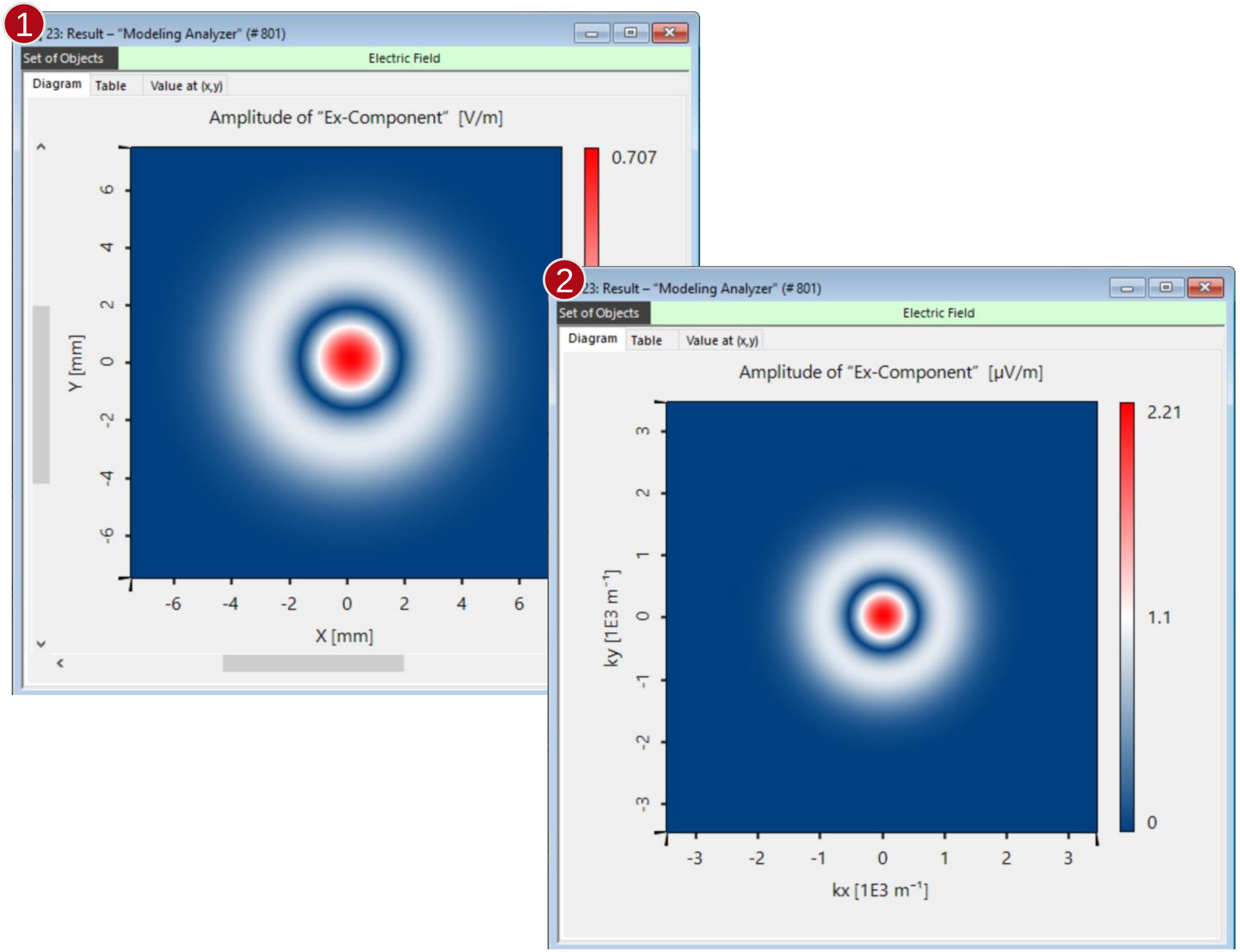
- wavelength: 632.8 nm
- waist: 2.5 mm × 2.5 mm diameter
- order: (1,0)

See the full Use Case:

Laser Beam “Clean-Up” with Spatial Filter

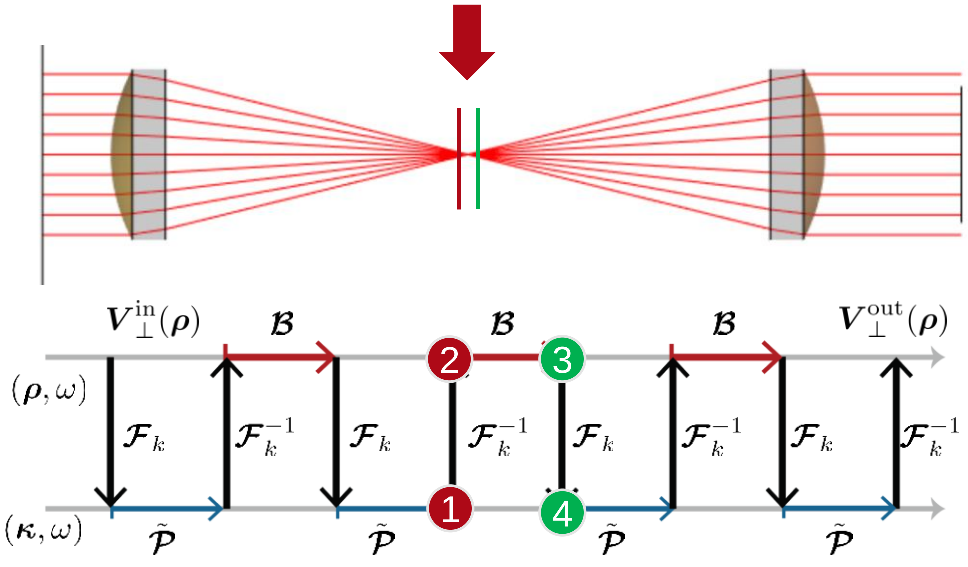
Beam Clean-Up Filter – Source

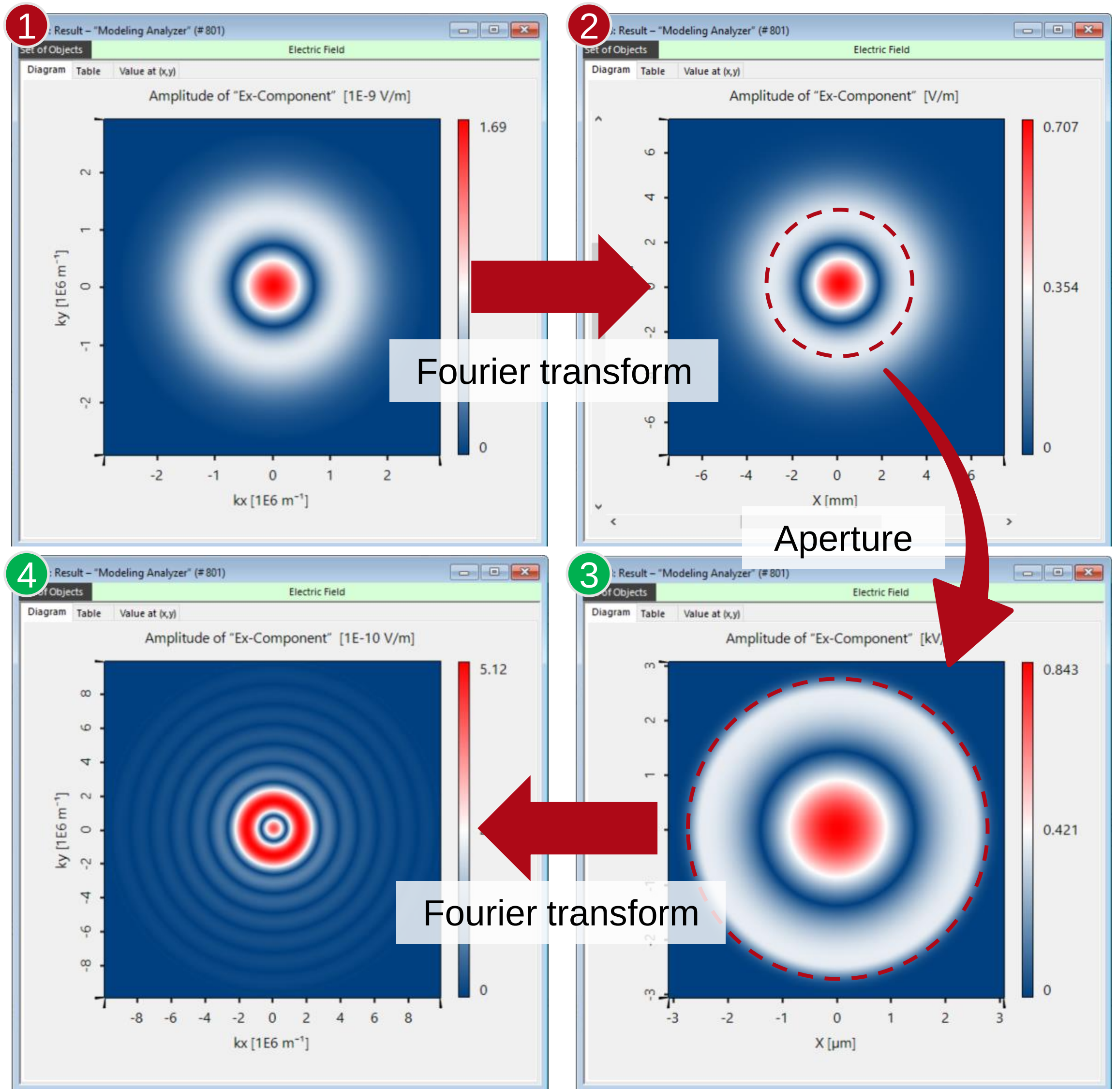




For complex optical systems, a full in-depth investigation of the light propagation requires information from both the x- and k-domains. The *Modeling Analyzer* provides this data at every interface of the system, here for example at the source.

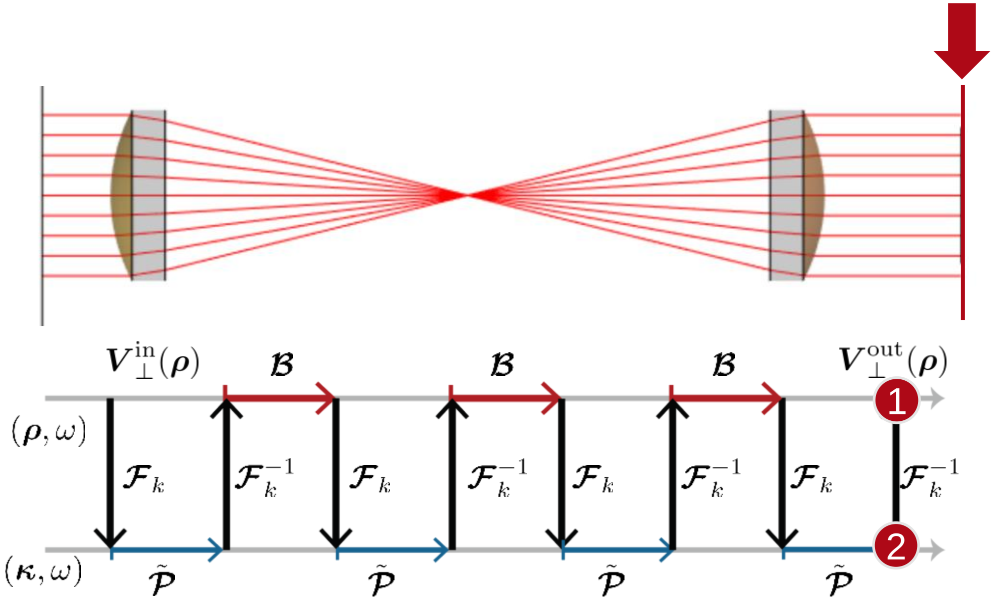
Beam Clean-Up Filter – Aperture

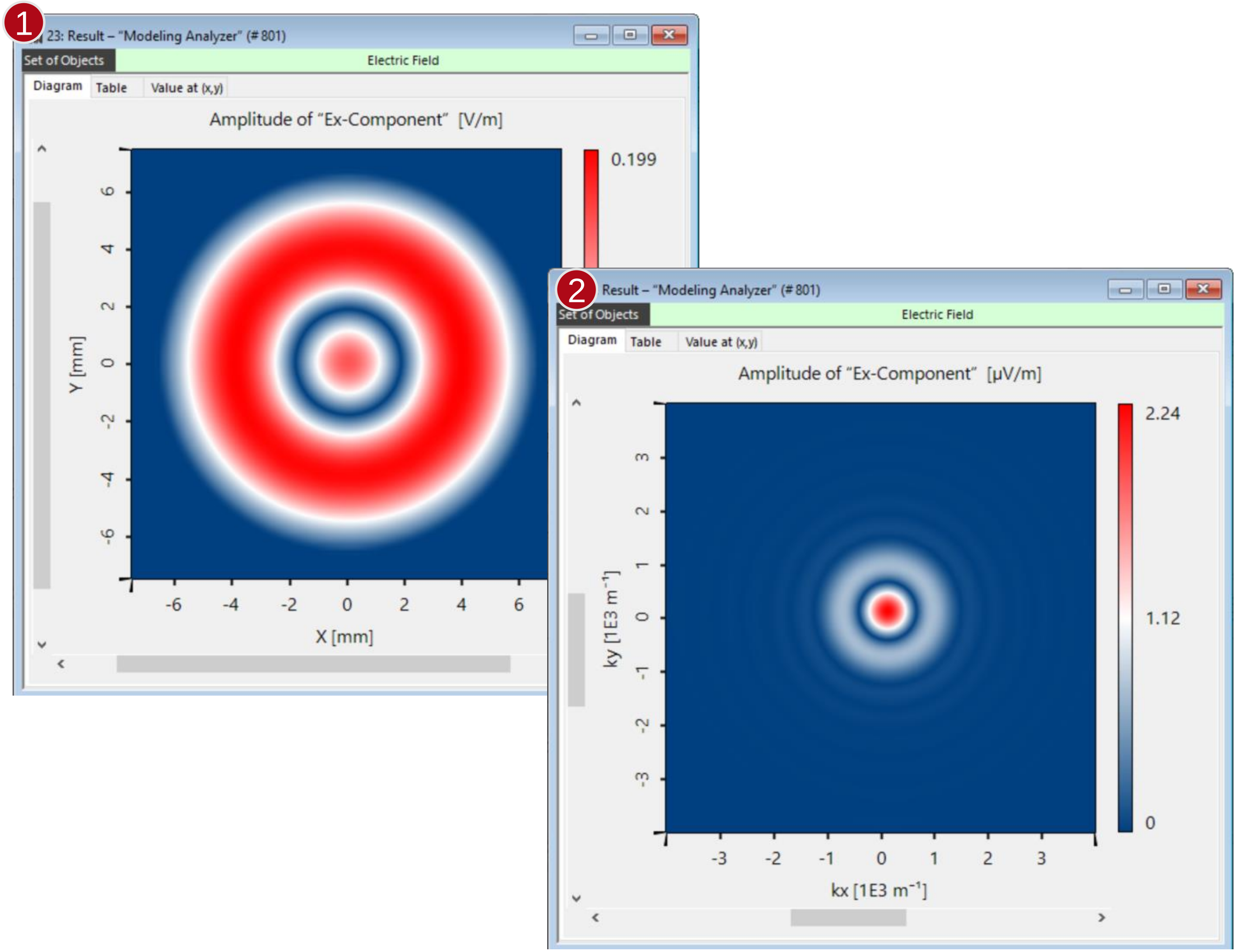




This allows the user to directly investigate effects at crucial locations in the system, such as the truncation of the field by an aperture and the resulting higher frequencies in k-domain.

Beam Clean-Up Filter – Detector





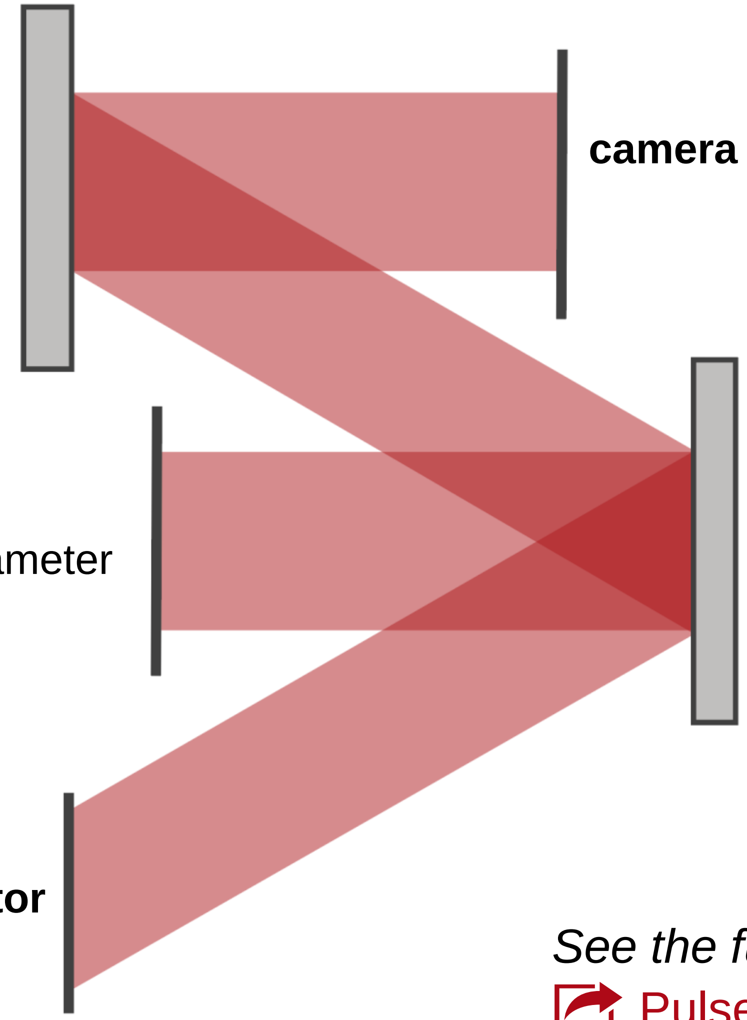
The *Modeling Analyzer* also provides the electromagnetic field data at each detector plane, allowing for a quick analysis of the resulting field.

Example 2: Reflective Grating

Reflective Grating Pair – System Setup

grating
- Ideal grating
- Period: 1.667 µm
- ± 1 order,
  10% efficiency

camera detector



gaussian wave
- wavelength: 710 nm
- waist: 2.5 mm × 2.5 mm diameter

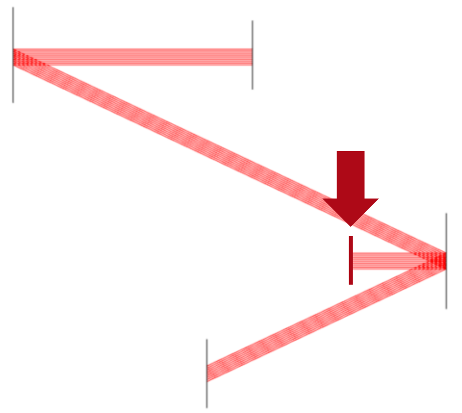
grating
- Ideal grating
- Period: 1.667 µm
- - 1 order,
  10% efficiency

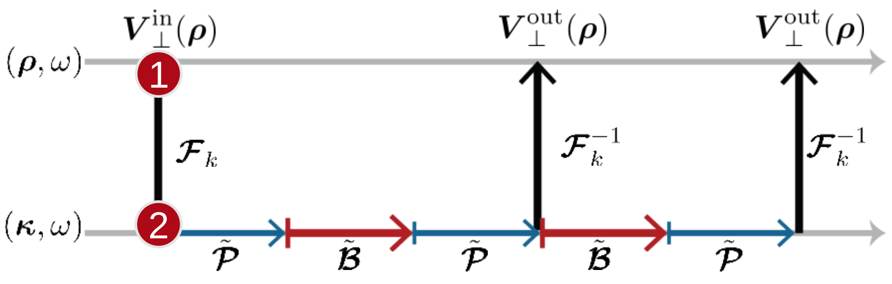
camera detector

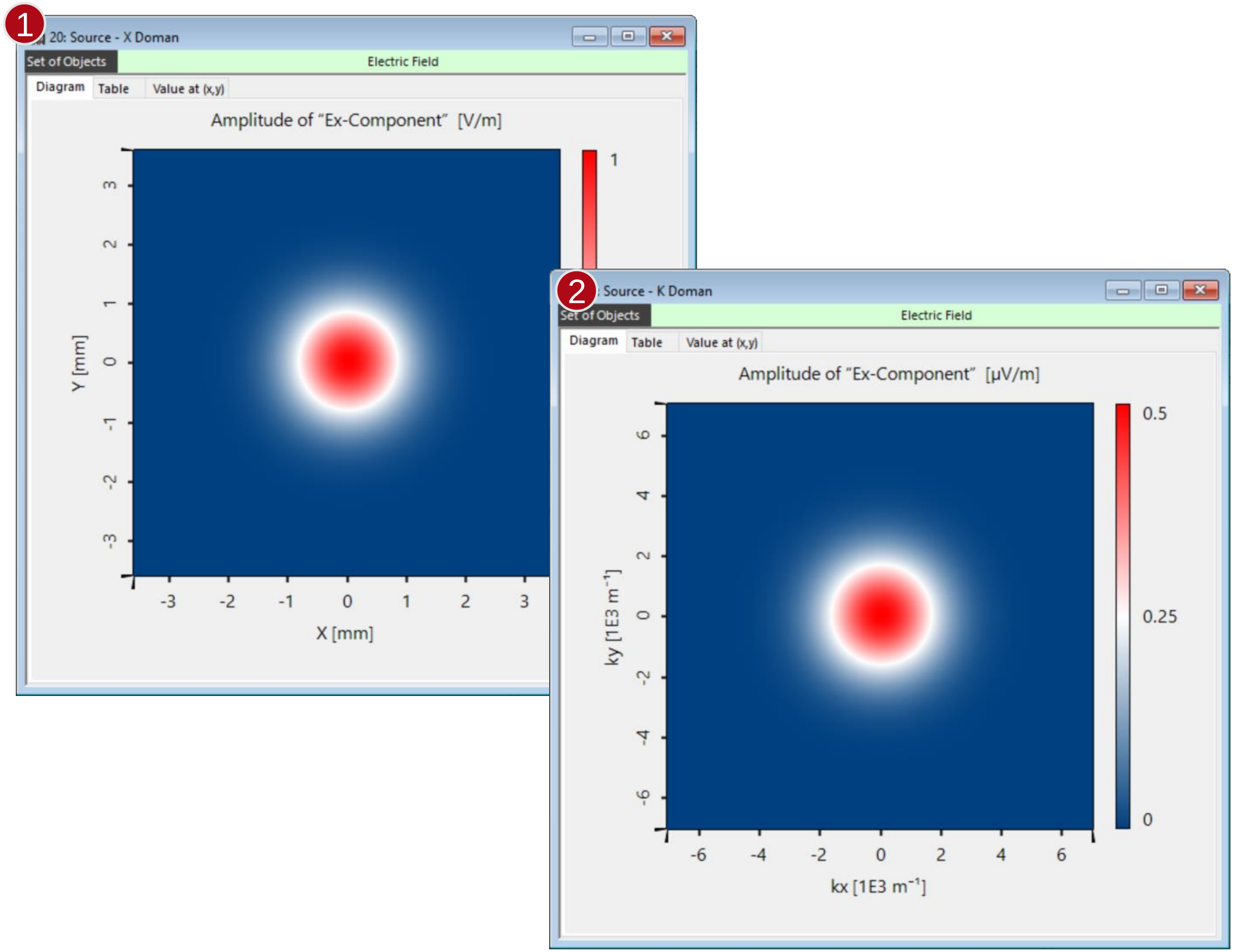
See the full Use Case:

Pulse Front Tilt in SSTF – Setups

Reflective Grating Pair – Source

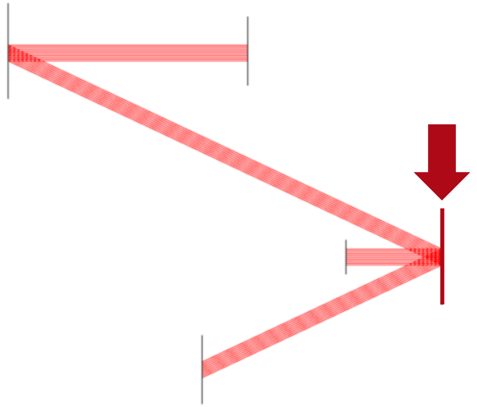


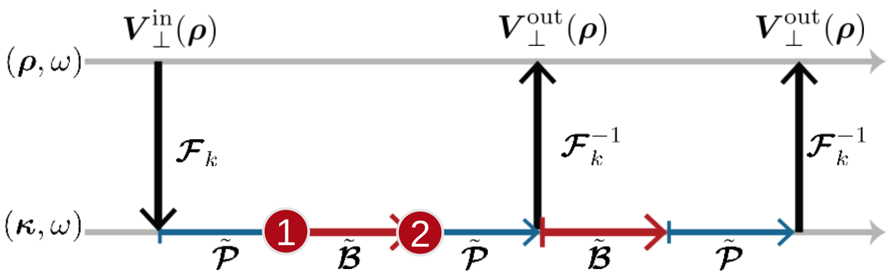




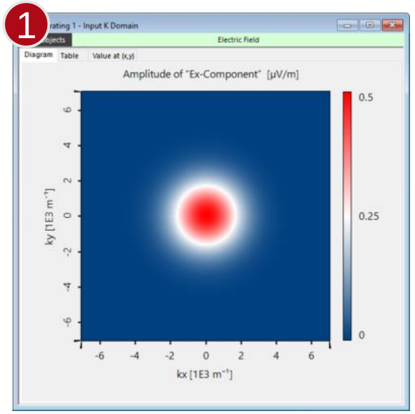
The *Modeling Analyzer* can also be used for non-sequential models, or if the field is split by gratings or beam splitters.

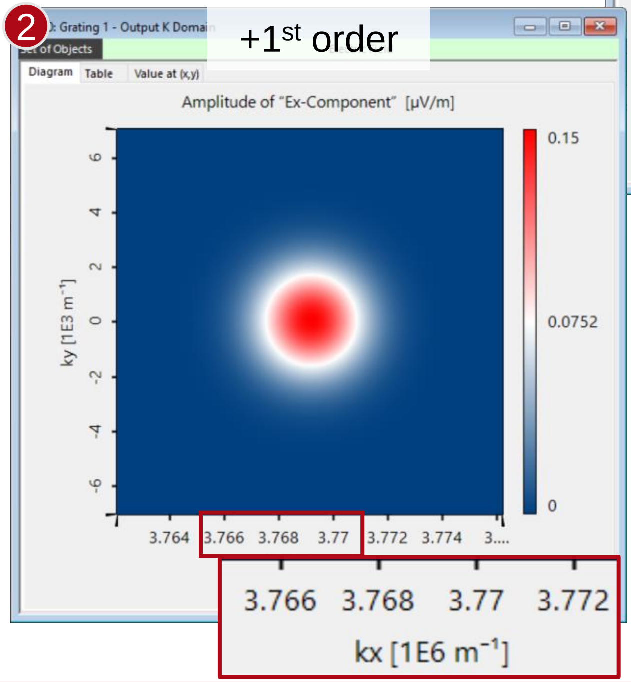
Reflective Grating Pair – Grating

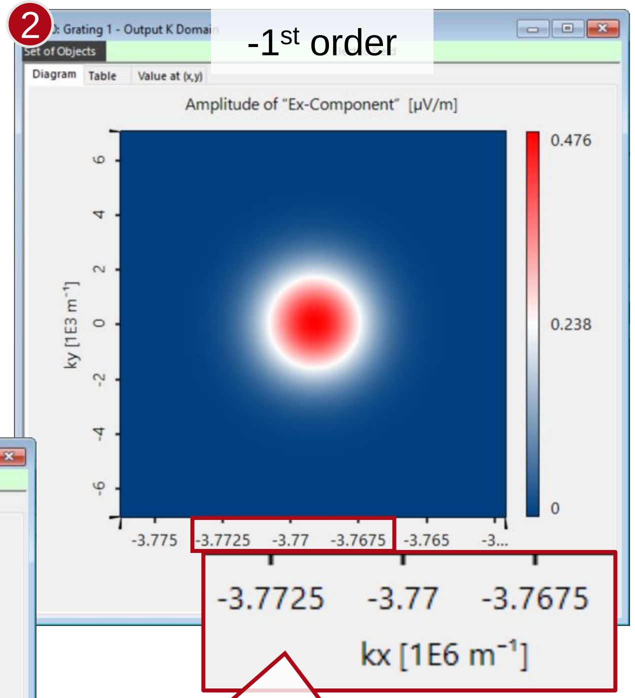




In case that the solver of the specific element (so-called ***B***-operator) is applied in the k-domain (e.g. for gratings) the *Modeling Analyzer* will only provide the according k-domain result.

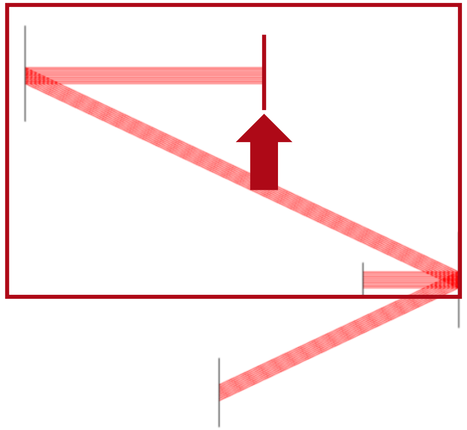


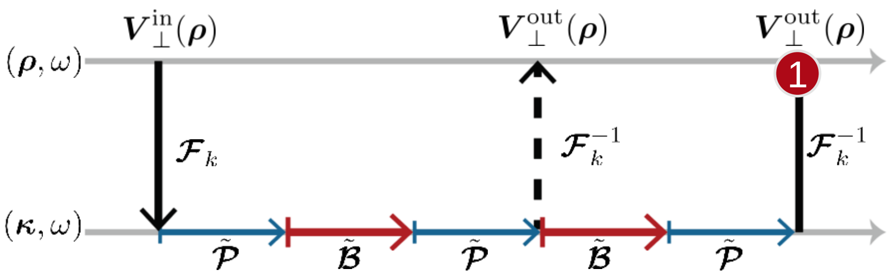




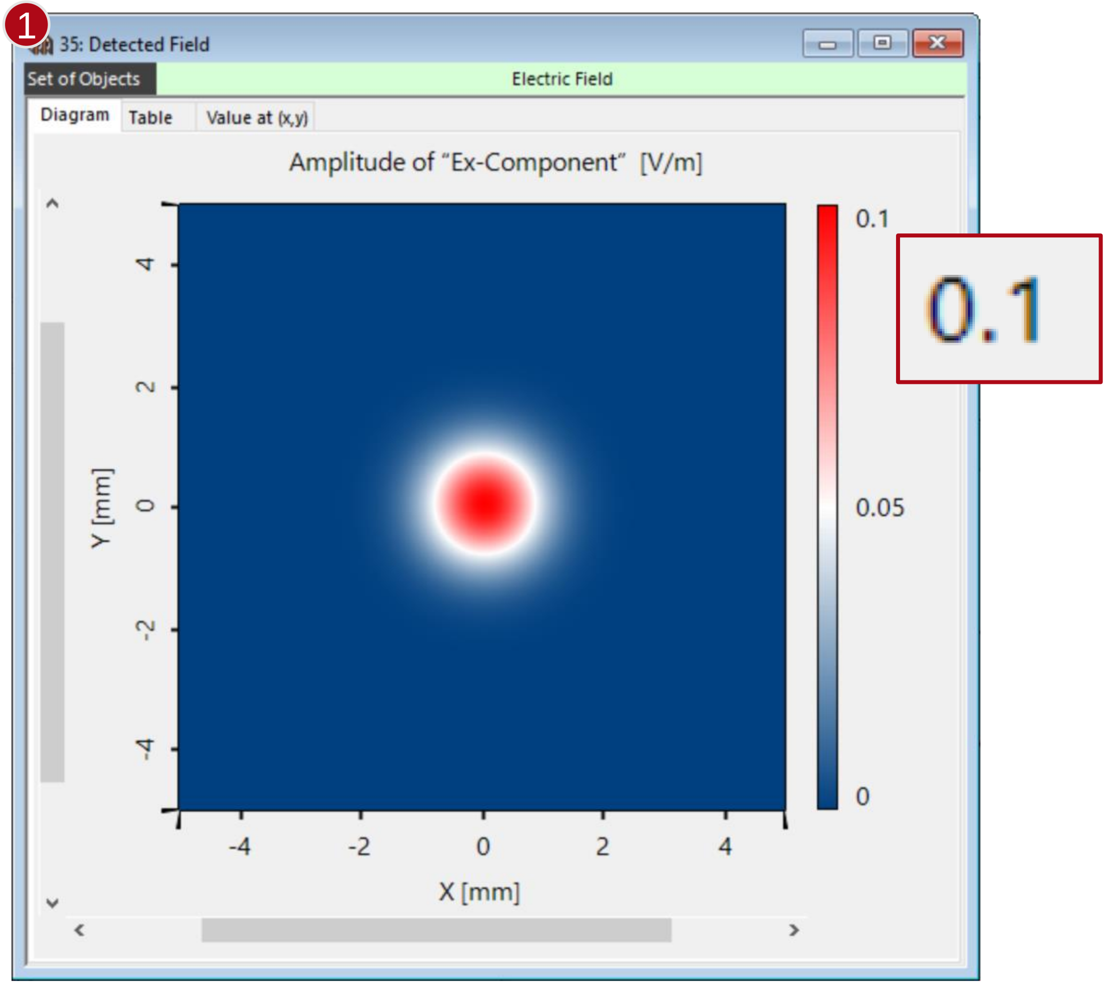
The diffraction orders introduced by the grating can be identified by their different positions or values in the k-domain. In particular, the ±1st orders are shown.

Reflective Grating Pair – Upper Arm

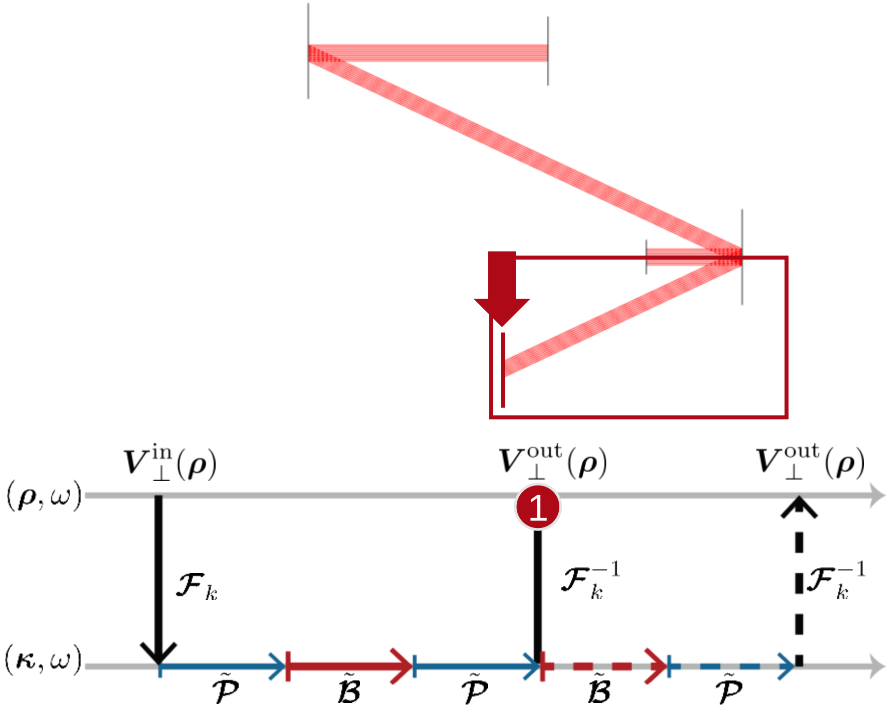




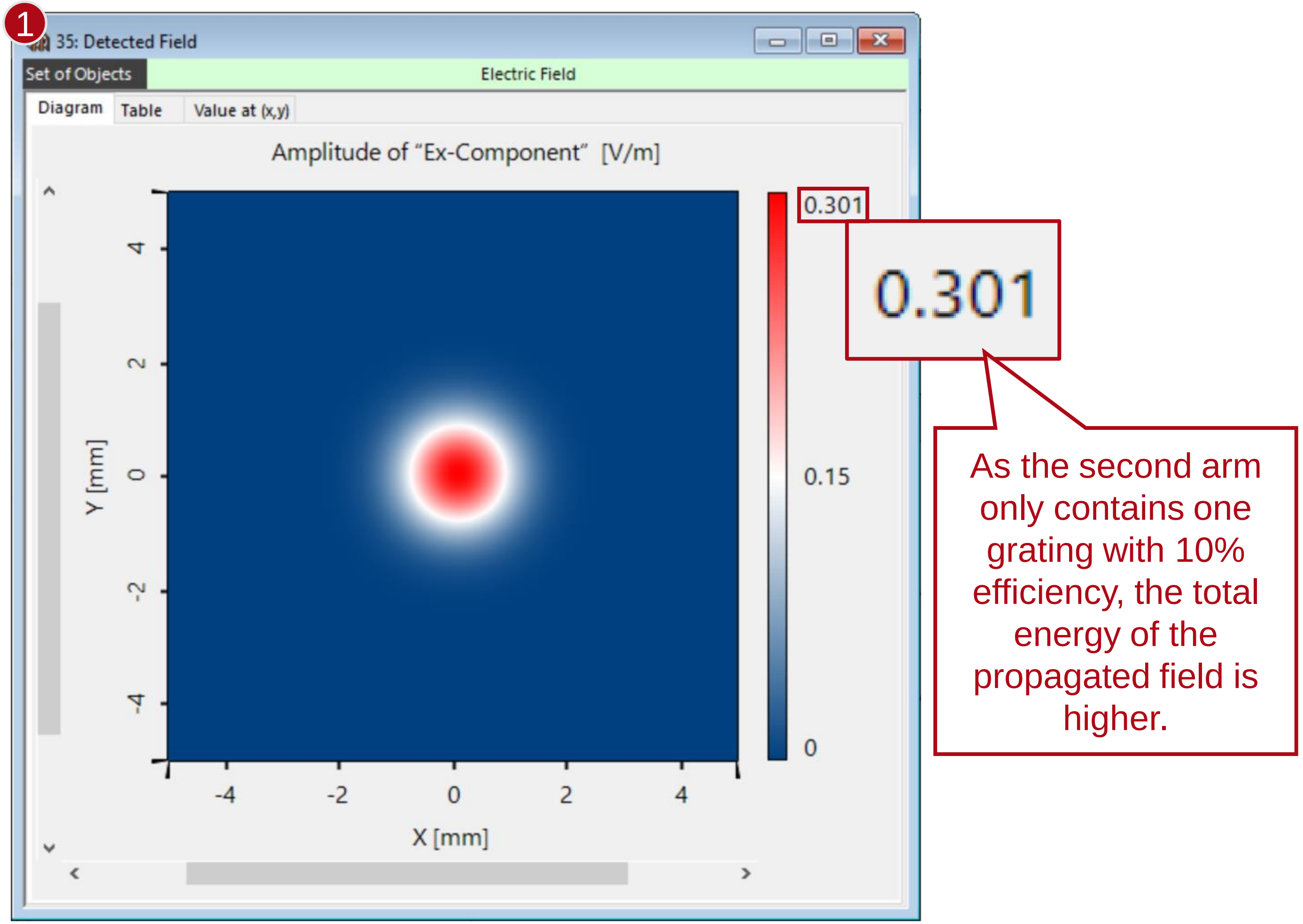
If more than one path is available, the *Modeling Analyzer* will output all results of the corresponding component first, and afterwards follow each individual path until the light reaches a detector.



Reflective Grating Pair – Lower Arm



Then the analyzer continues with the next path, and so on.



Document Information

title	System Modeling Analyzer
document code	SWF.0043
document version	1.0
software edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.180)
category	Feature Use Case
further reading	- Pulse Front Tilt in SSTF – Setups - Laser Beam “Clean-Up” with Spatial Filter - Automatic Selection of Fourier Transform Techniques in Free-Space Propagation Operator