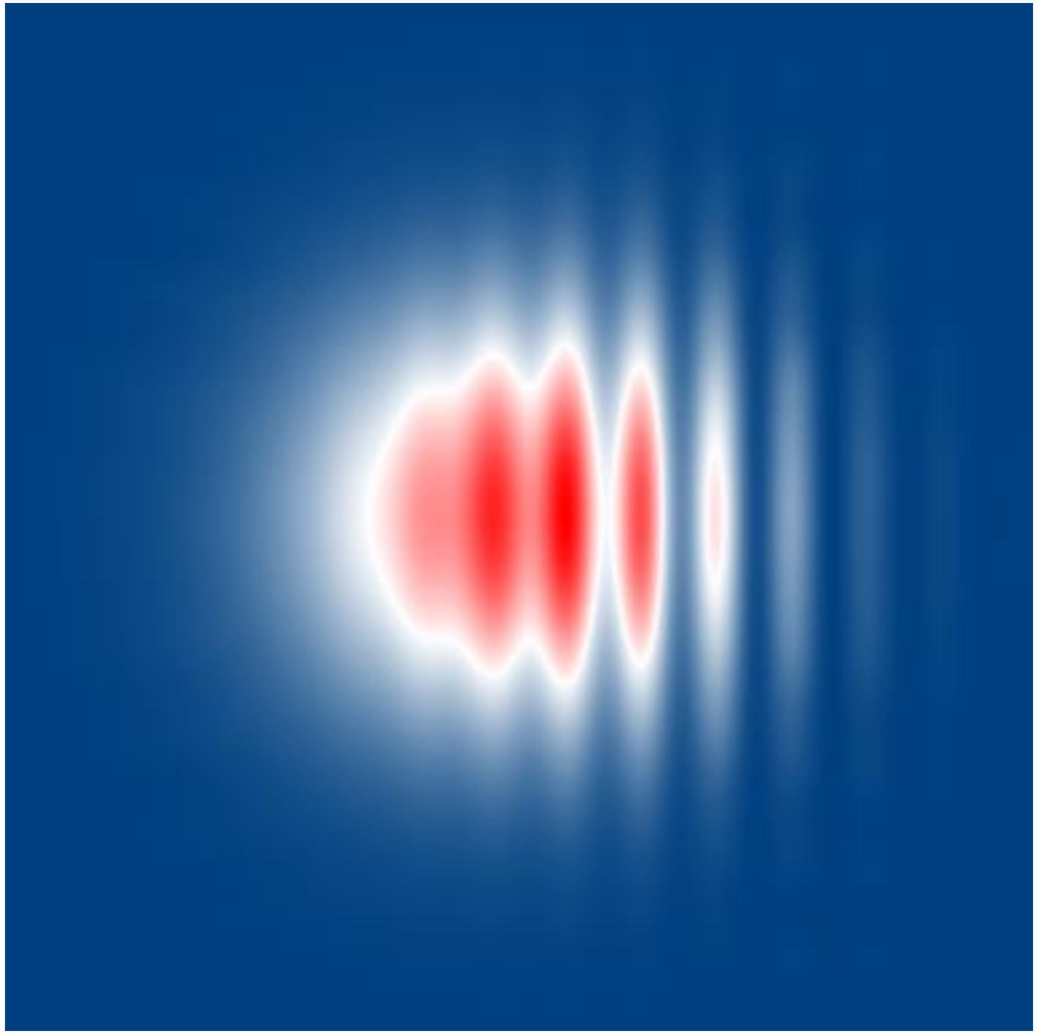
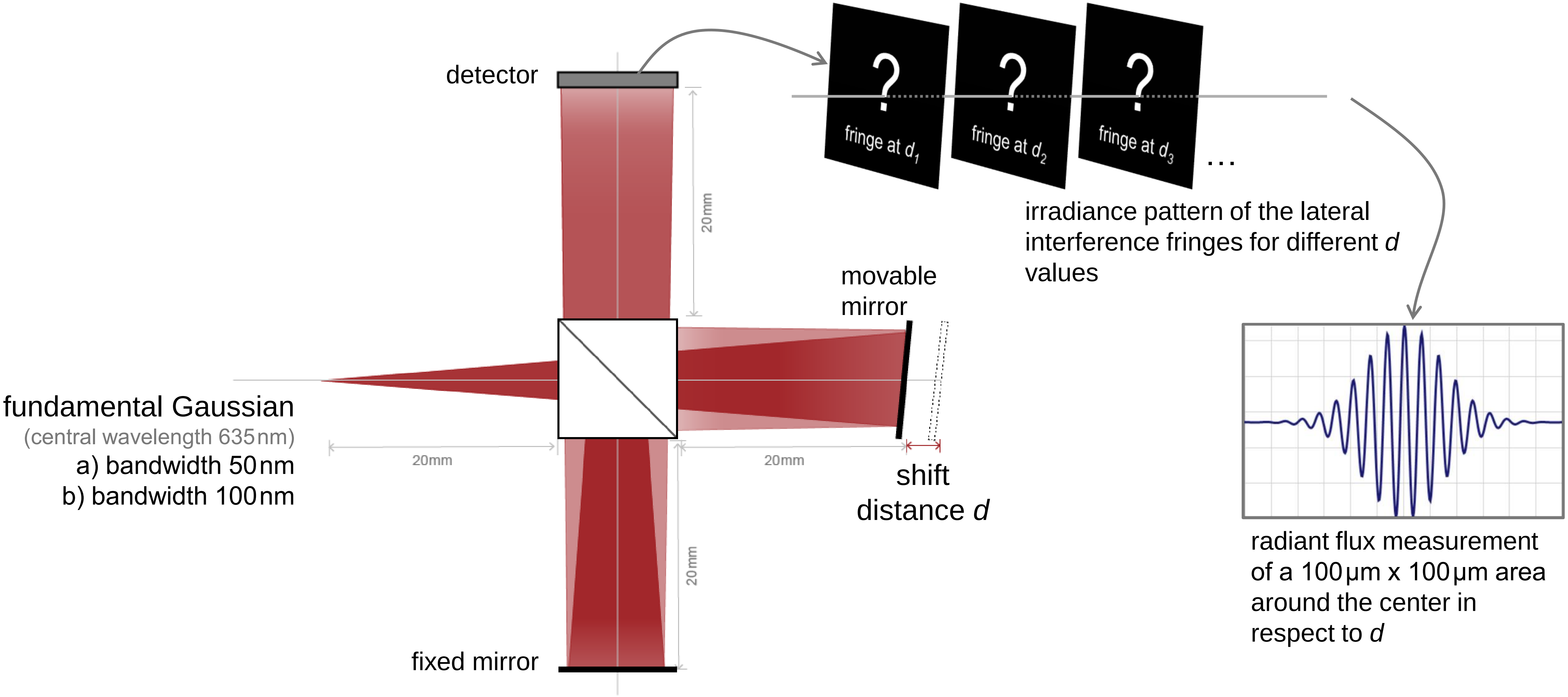
Coherence Measurement Using Michelson Interferometer and Fourier Transform Spectroscopy

Abstract

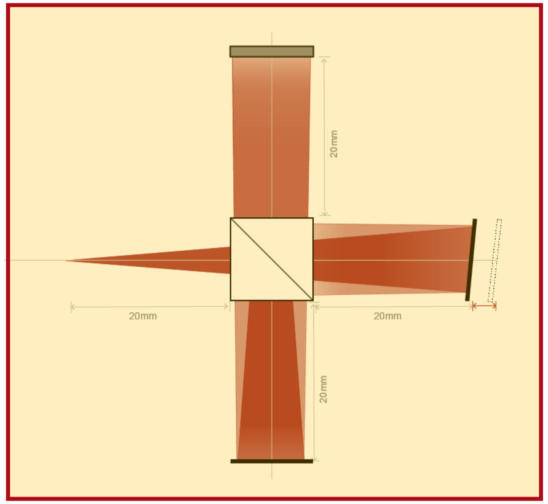


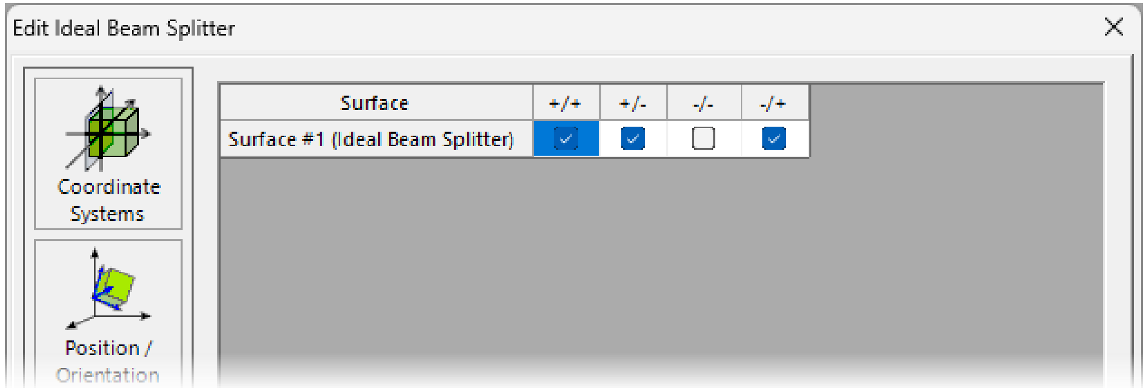
It is known that, in an interferometer, the fringe contrast may depend on the coherence of the light source. For example, in a Michelson interferometer with a source of a certain bandwidth, the interference fringe contrast decreases as the optical path difference between the two arms increases. By measuring the interferogram contrast at different positions of the movable mirror, the coherence length of the source can be concluded. Typical Fourier-transform spectroscopy is usually based on optical setups of this kind.

Modeling Task

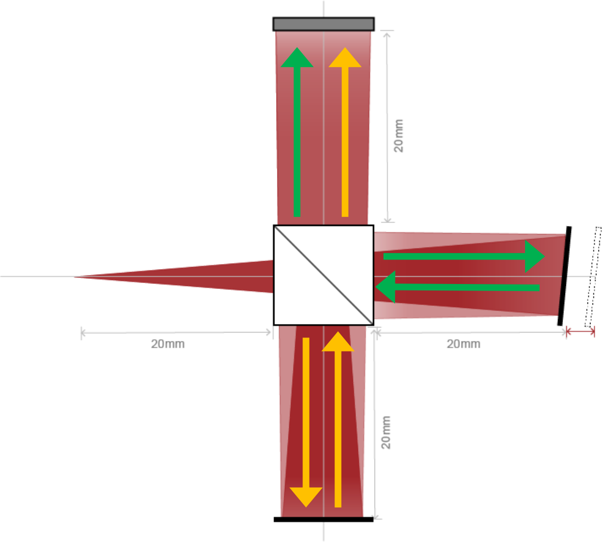


Non-Sequential Tracing



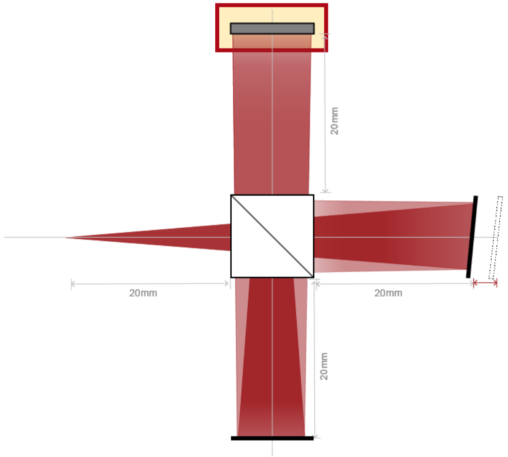


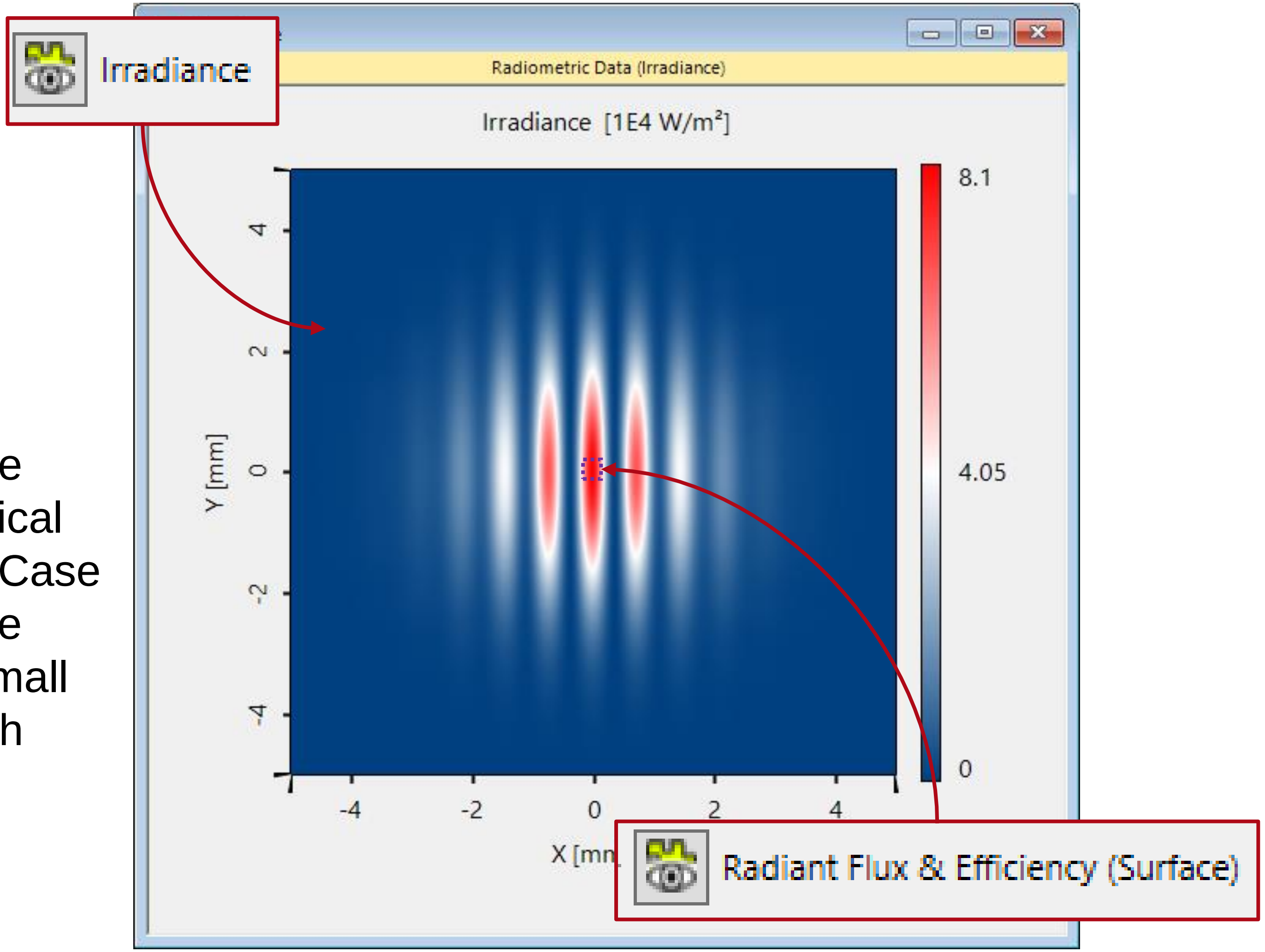
With the channel configuration mode toggle set to *Manual Configuration*, the user can specify, for each surface in the system, which channels to open for the simulation. When the simulation is run, a preliminary analysis of the active light paths will be performed (by the so-called *Light Path Finder*). The field will then be traced along these light paths by the engine, to the detectors present in the system.



Channel Setting for Non-Sequential Tracing

Detector Add-On

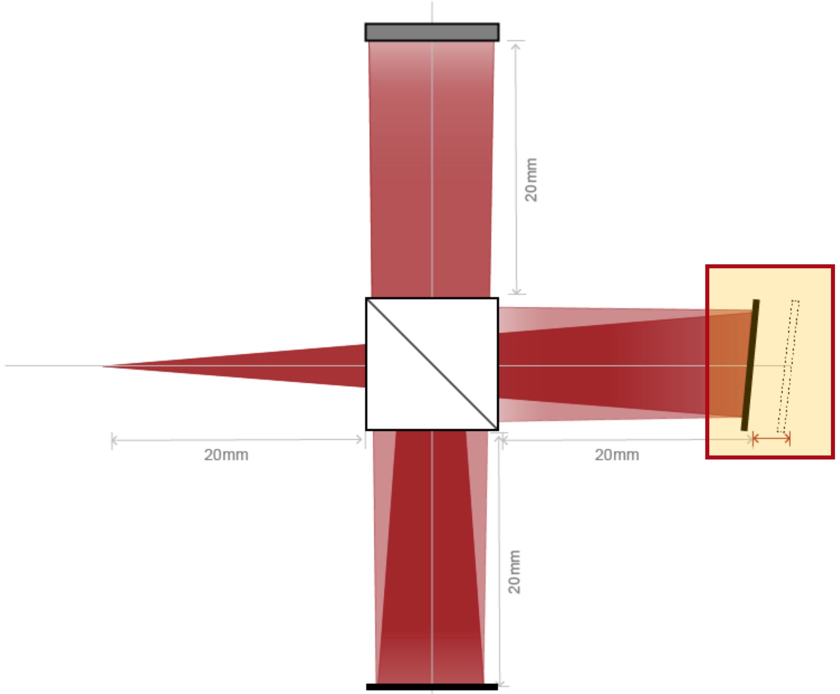


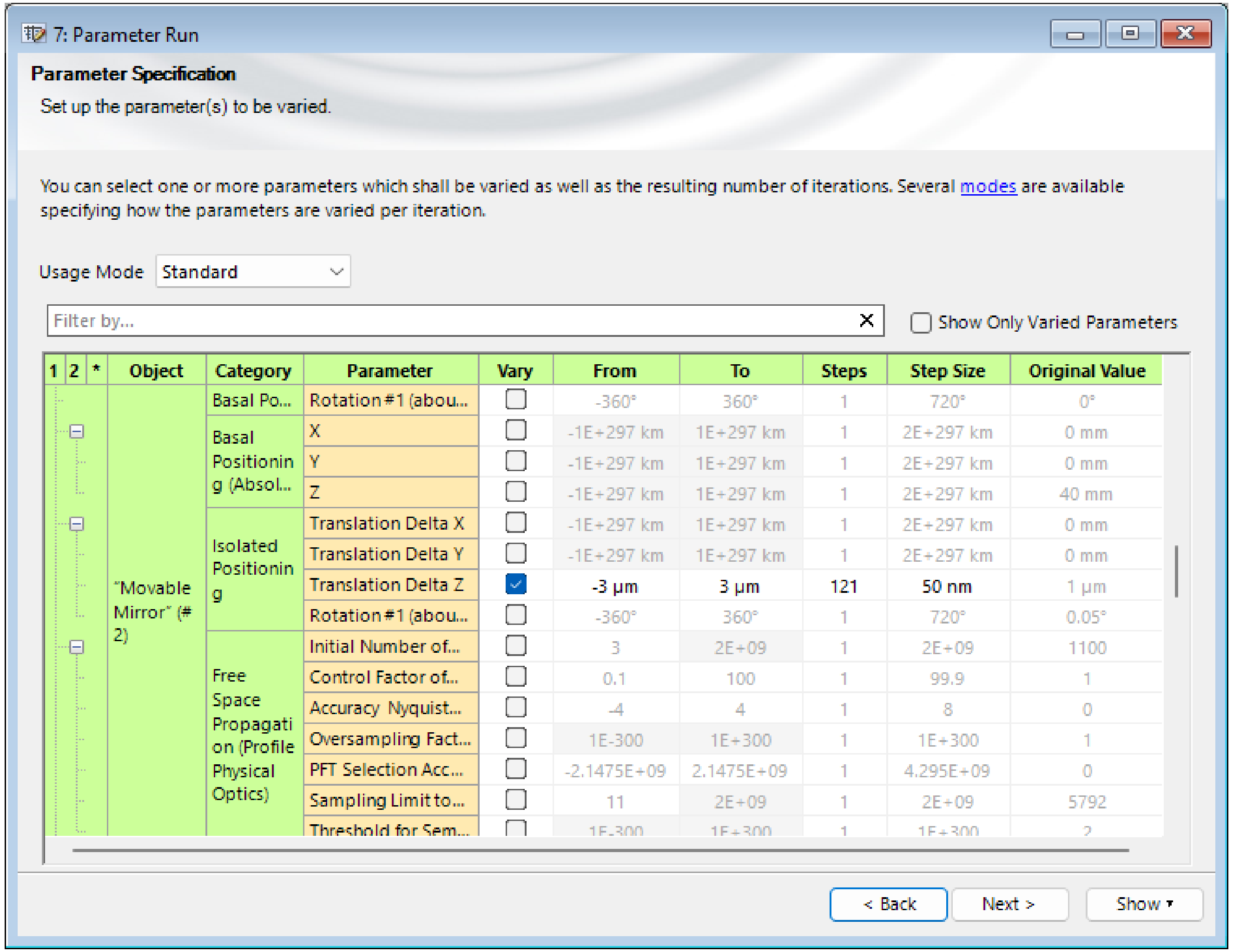


The *Universal Detector* allows the evaluation of the impinging field and the calculation of various physical quantities through so-called *Add-Ons*. In this Use Case specifically we calculate the Irradiance of the entire pattern. We then measure the *Radiant Flux* in a small region around the center to visualize the bandwidth dependency. For more information, see:

Universal Detector

Parameter Run

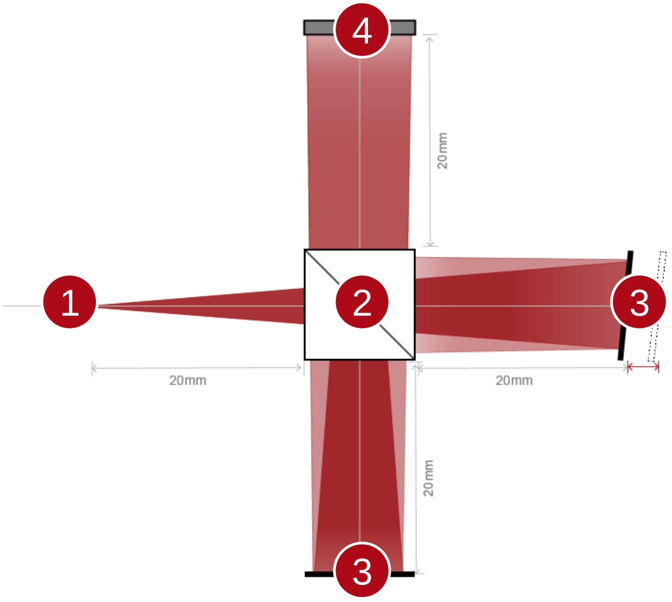




The actual coherence measurement is performed by varying the position of the tilted mirror. Such a variation of parameters can be achieved by a *Parameter Run.*

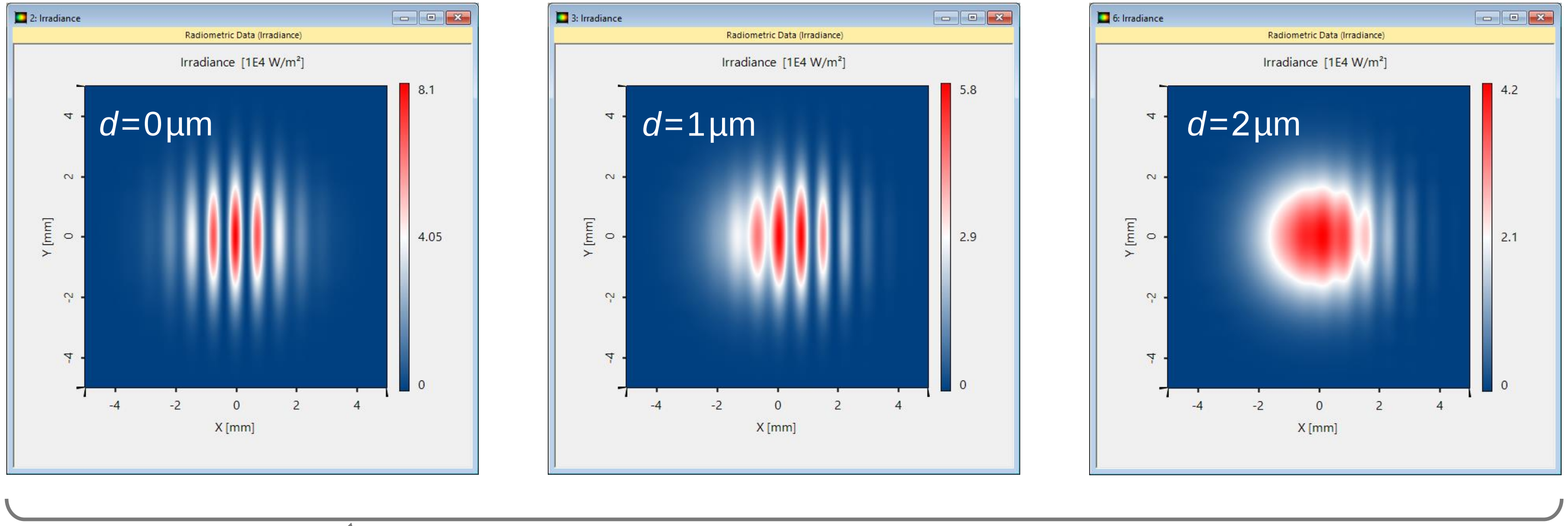
Usage of the Parameter Run Document

Summary – Components...

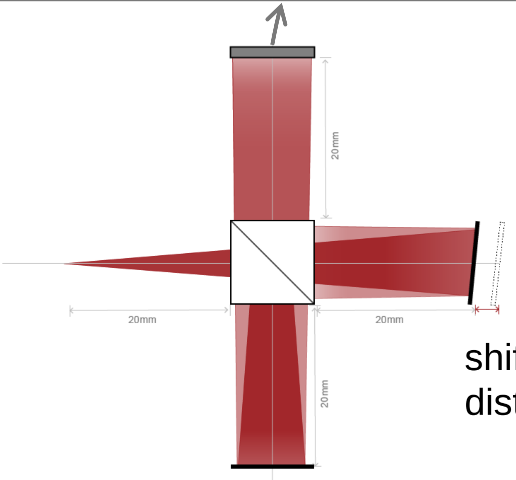


… of Optical System	… in VirtualLab Fusion	Model/Solver/Detected Value
1. Source	Gaussian Wave	spatial Gaussian formula
2. Beam Splitter	Ideal Beam Splitter	transmission function
3. Mirror	Ideal Mirror	Local Plane Interface Approximation
6. Detector	Universal Detector	Irradiance/radiant flux

Lateral Interference Fringes – 50 nm Bandwidth



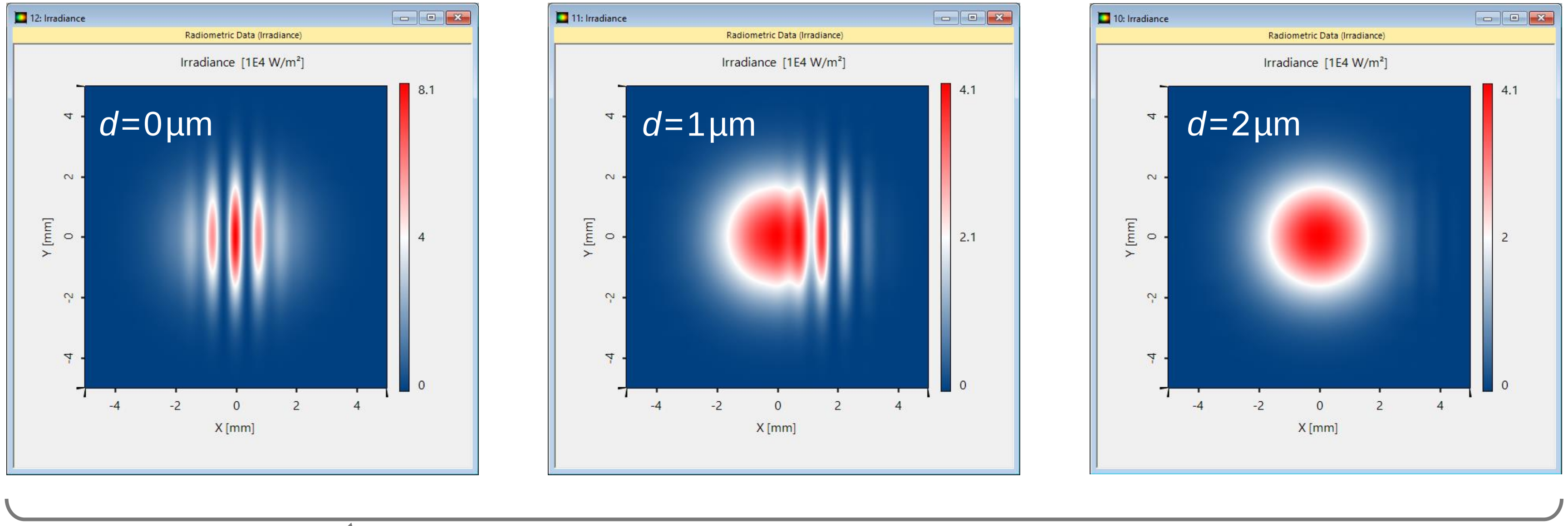
fundamental Gaussian
(central wavelength 635 nm)
a) bandwidth 50 nm



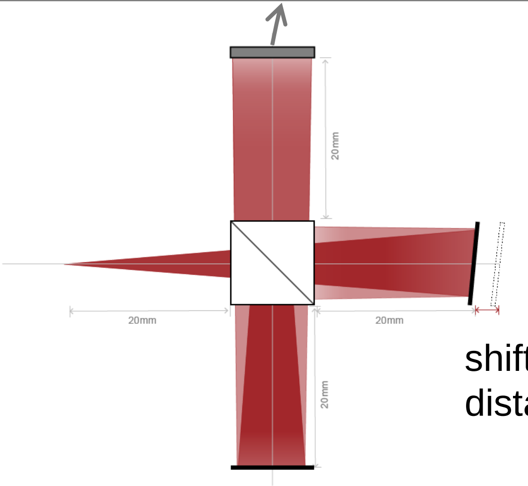
shift
distance *d*

The interference pattern is only visible when the two arms are the same length, with the contrast of the fringes decreasing as the path difference increases. The region where the fringes remain visible represents the *coherence length*. The asymmetry is caused by the mirror tilt.

Lateral Interference Fringes – 100 nm Bandwidth



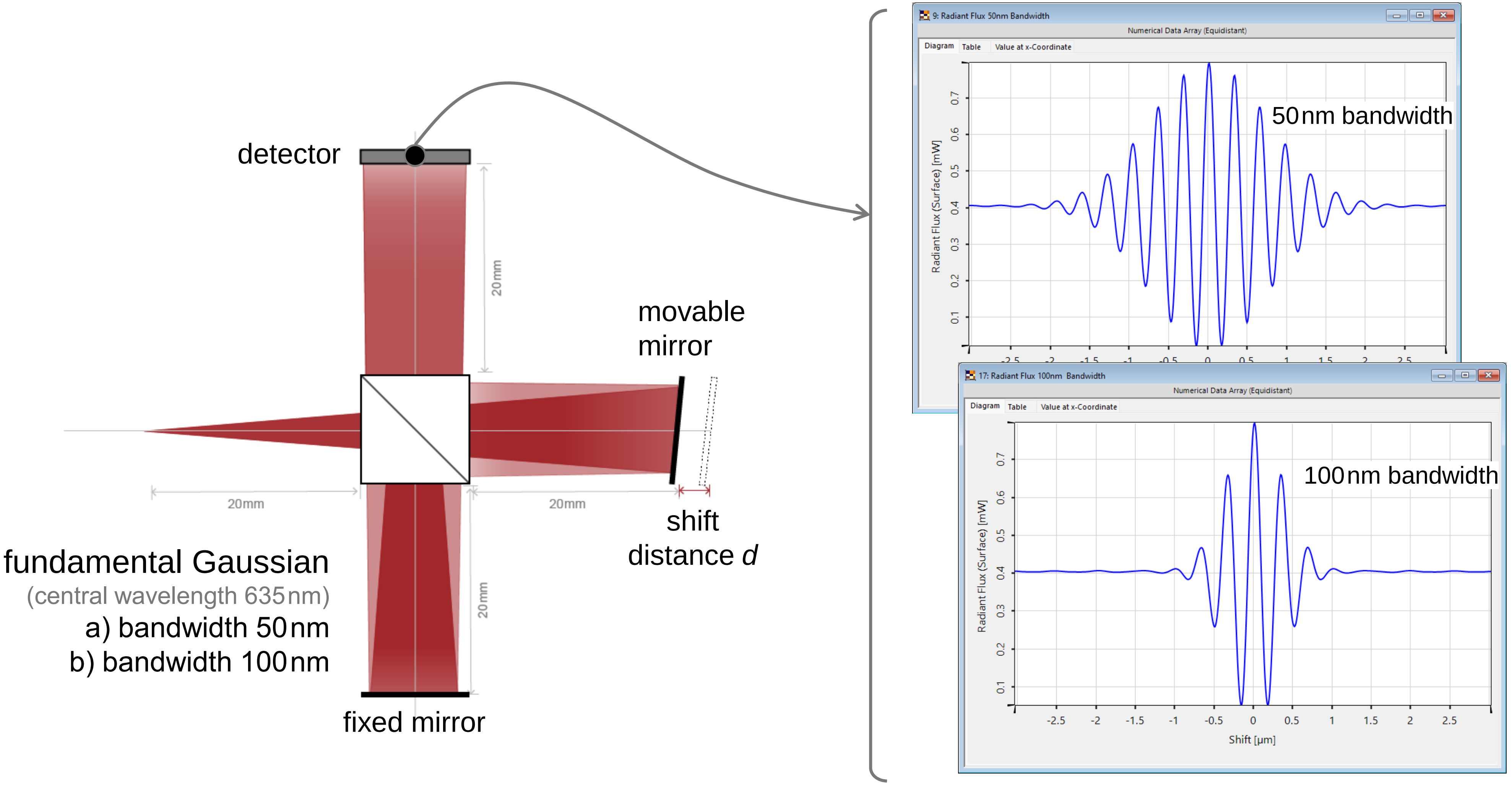
fundamental Gaussian
(central wavelength 635 nm)
b) bandwidth: 100 nm



shift
distance *d*

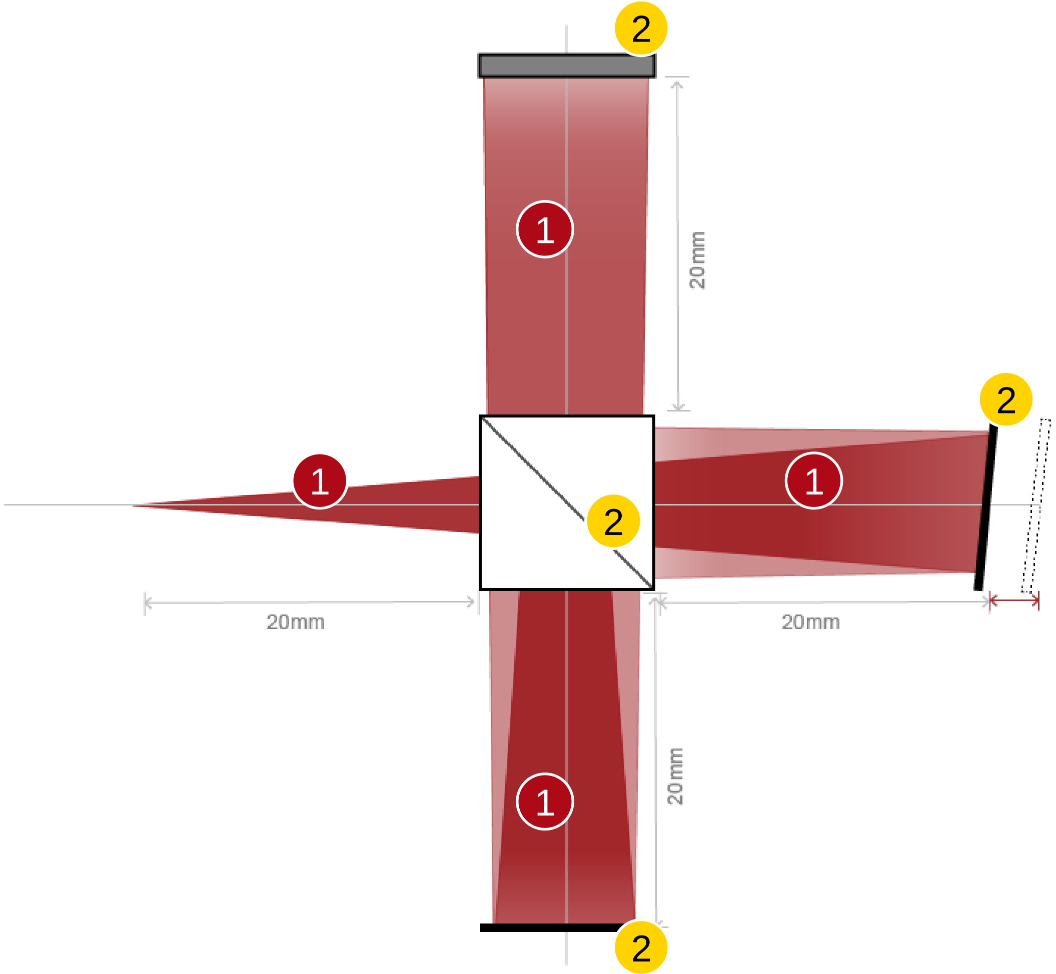
Broader spectral bandwidth leads to a shorter coherent length; therefore the interference fringe starts to vanish sooner in comparison to the case with narrower bandwidth.

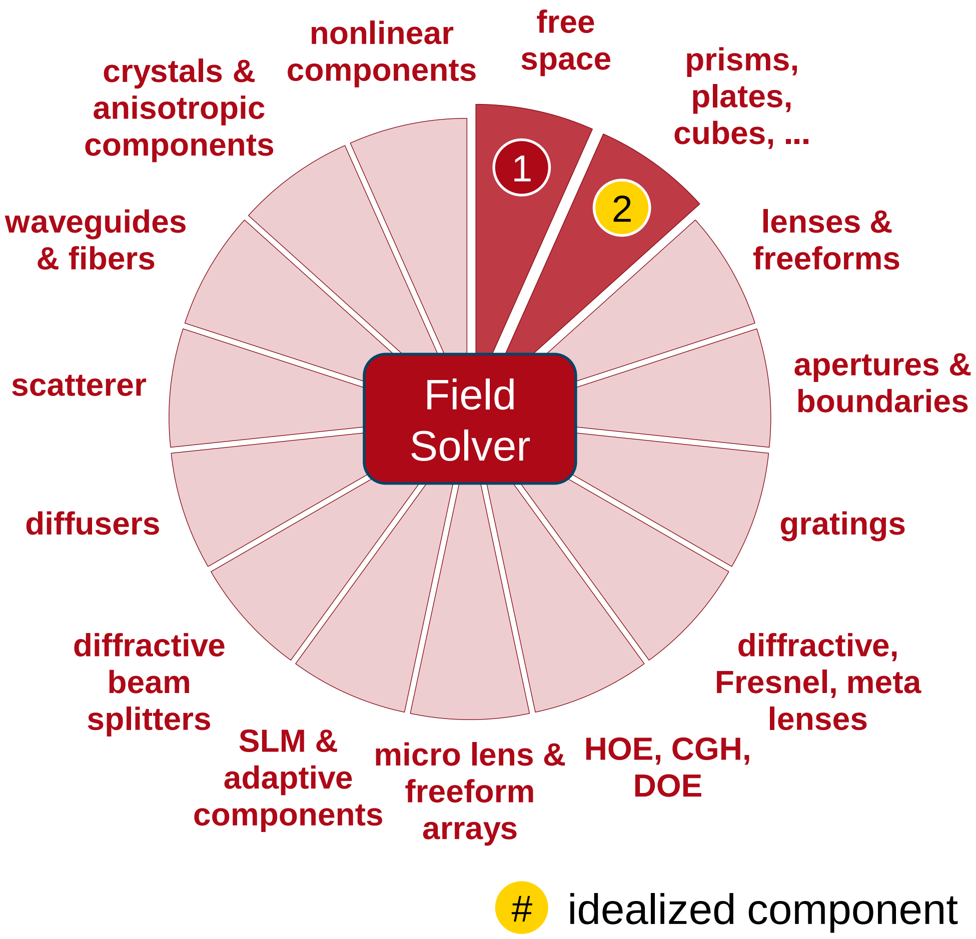
Radiant Flux Measurements of the On-Axis Point



When measuring the radiant flux on axis the coherence length can be directly visualized. It is quite clear that it is inversely proportional to the bandwidth of the incoming light.

VirtualLab Fusion Technologies





Document Information

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