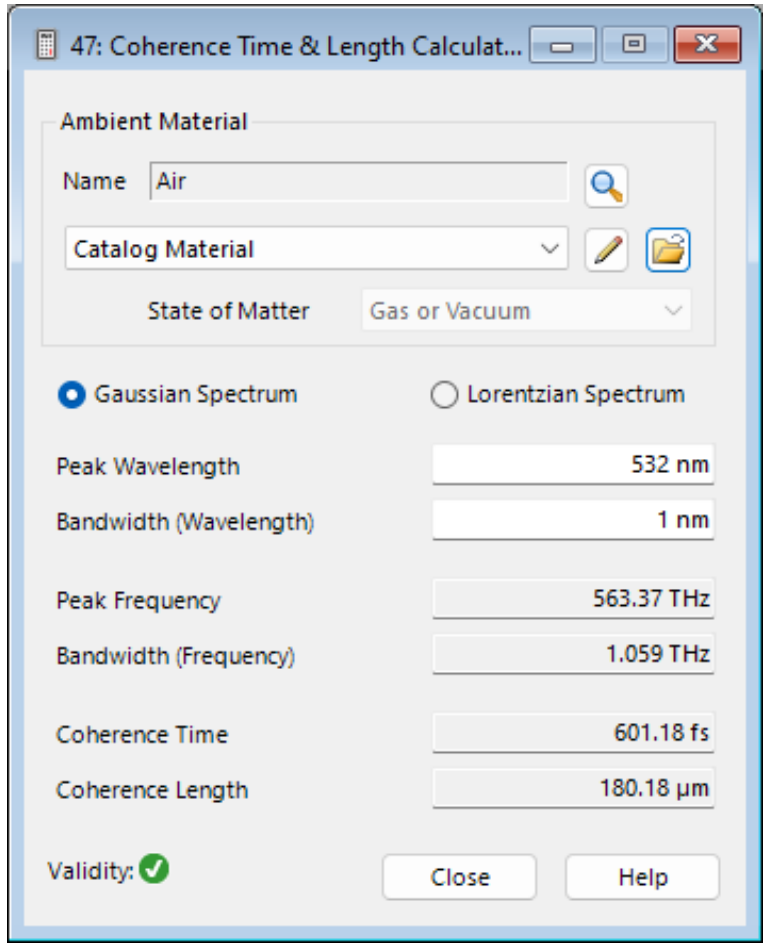
Coherence Time & Length Calculator

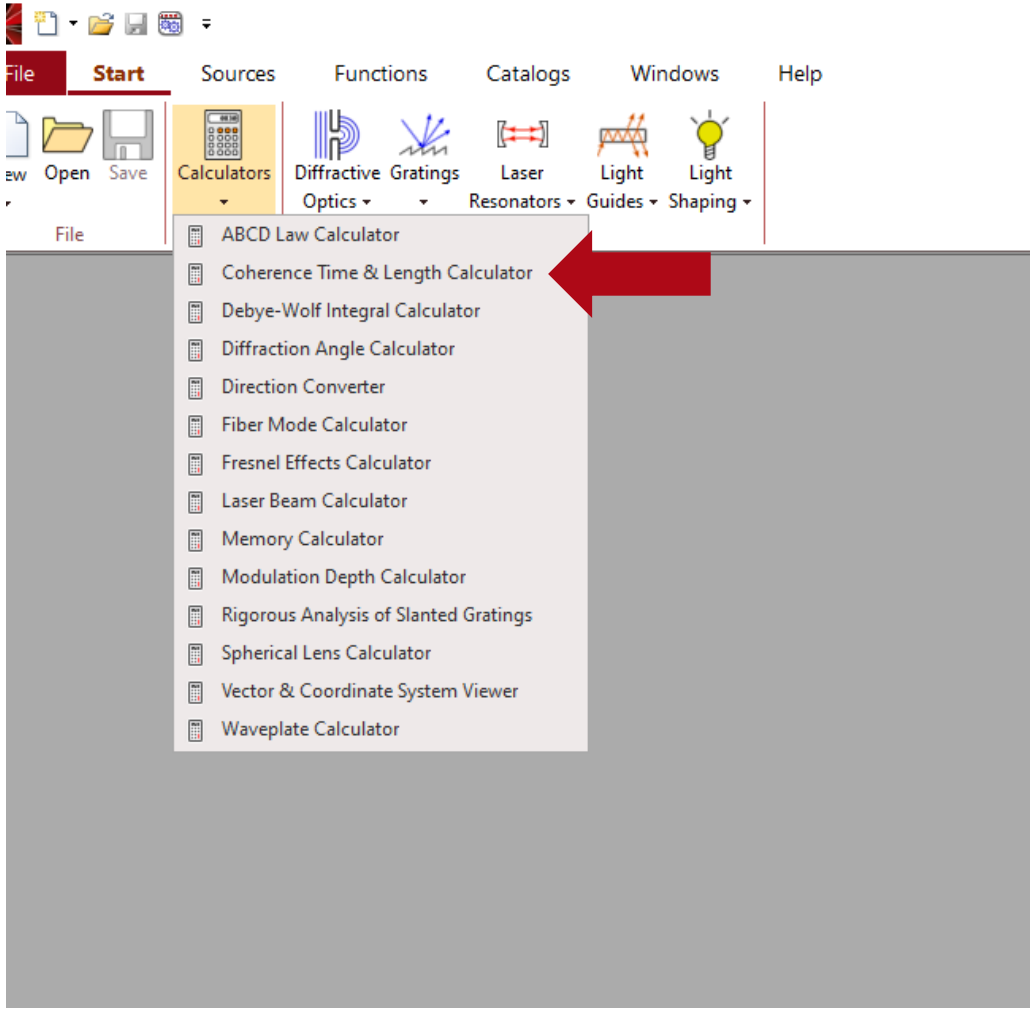
Abstract



In this use case we introduce a calculator that provides a quick estimate of the temporal coherence properties of a given source based on information about its wavelength spectrum. The results of this calculator can then be copied automatically into a Universal Detector, in order to apply an approximate approach to the consideration of temporal coherence that does not require sampling the wavelength spectrum of the source.

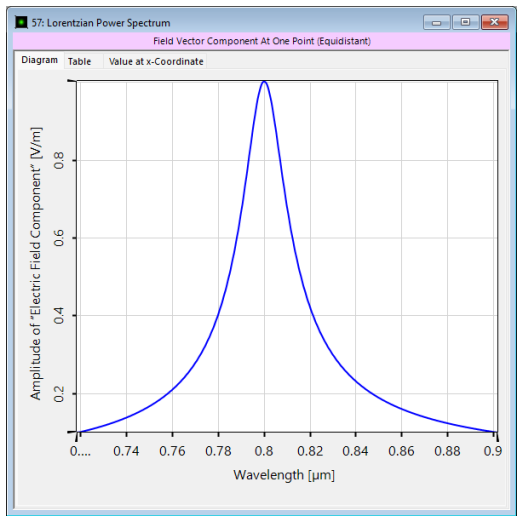
Open the Coherence Length & Time Calculator

The *Coherence Time & Length Calculator* can be accessed through the *Calculators* drop-down list under the *Start* ribbon.

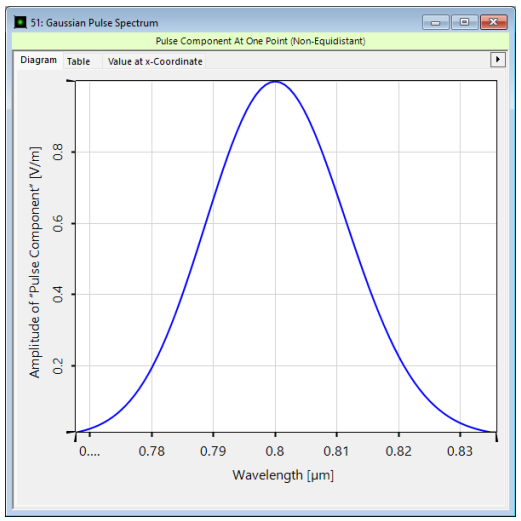


Input Values

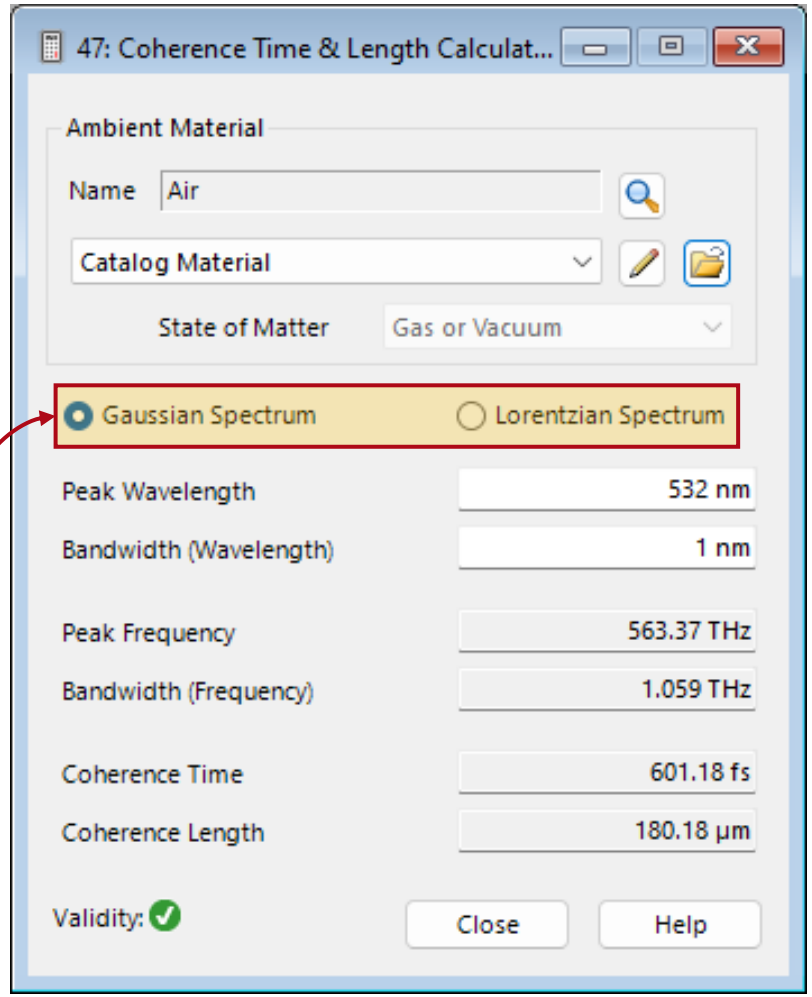
The calculator allows for the specification of the medium, the type of spectrum as well as the *Peak Wavelength* and the *Bandwidth*. All other coherence related quantities will be automatically calculated.



Lorentzian Spectrum



Gaussian Spectrum



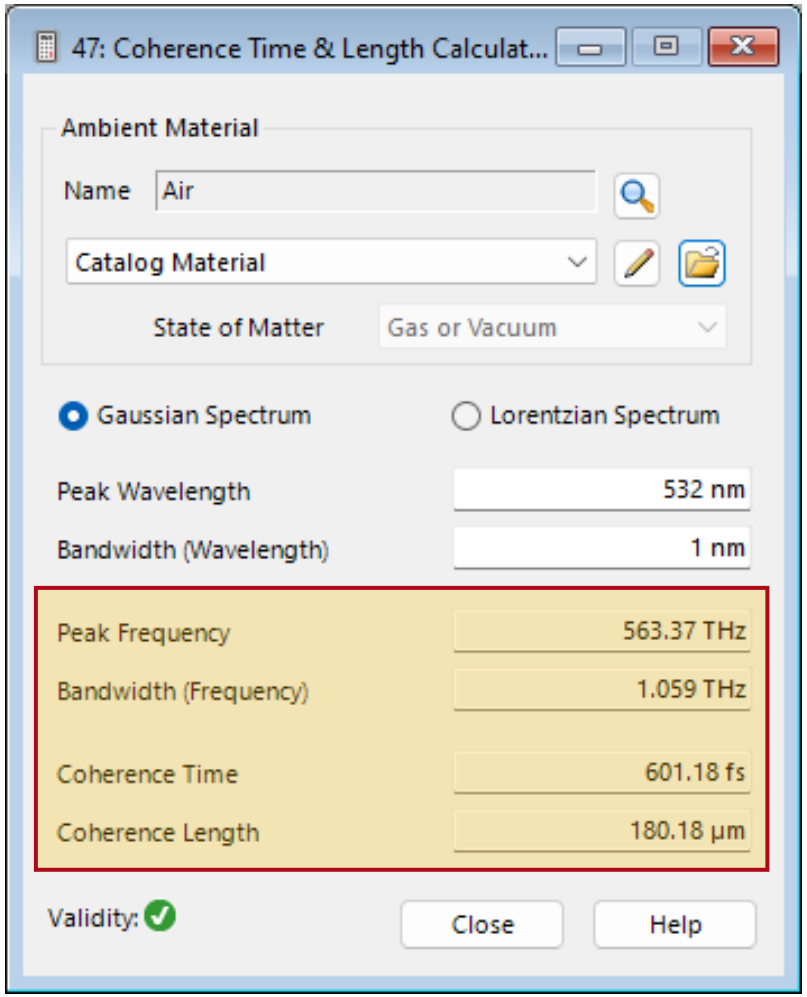
Output Values

Peak Frequency: $\nu_p = \frac{2\pi c}{\lambda_p}$, with c the speed of light in the *Ambient Material* and λ_p the *Peak Wavelength*

Bandwidth (Frequency): $\Delta\nu = \frac{2\pi c}{\Delta\lambda}$, with c the speed of light in the *Ambient Material* and $\Delta\lambda$ the *Bandwidth (Wavelength)*

Coherence Time: $\tau = \frac{s}{\pi\Delta\nu}$, where s is 2 for a *Gaussian Spectrum* and 1 for a *Lorentzian Spectrum*

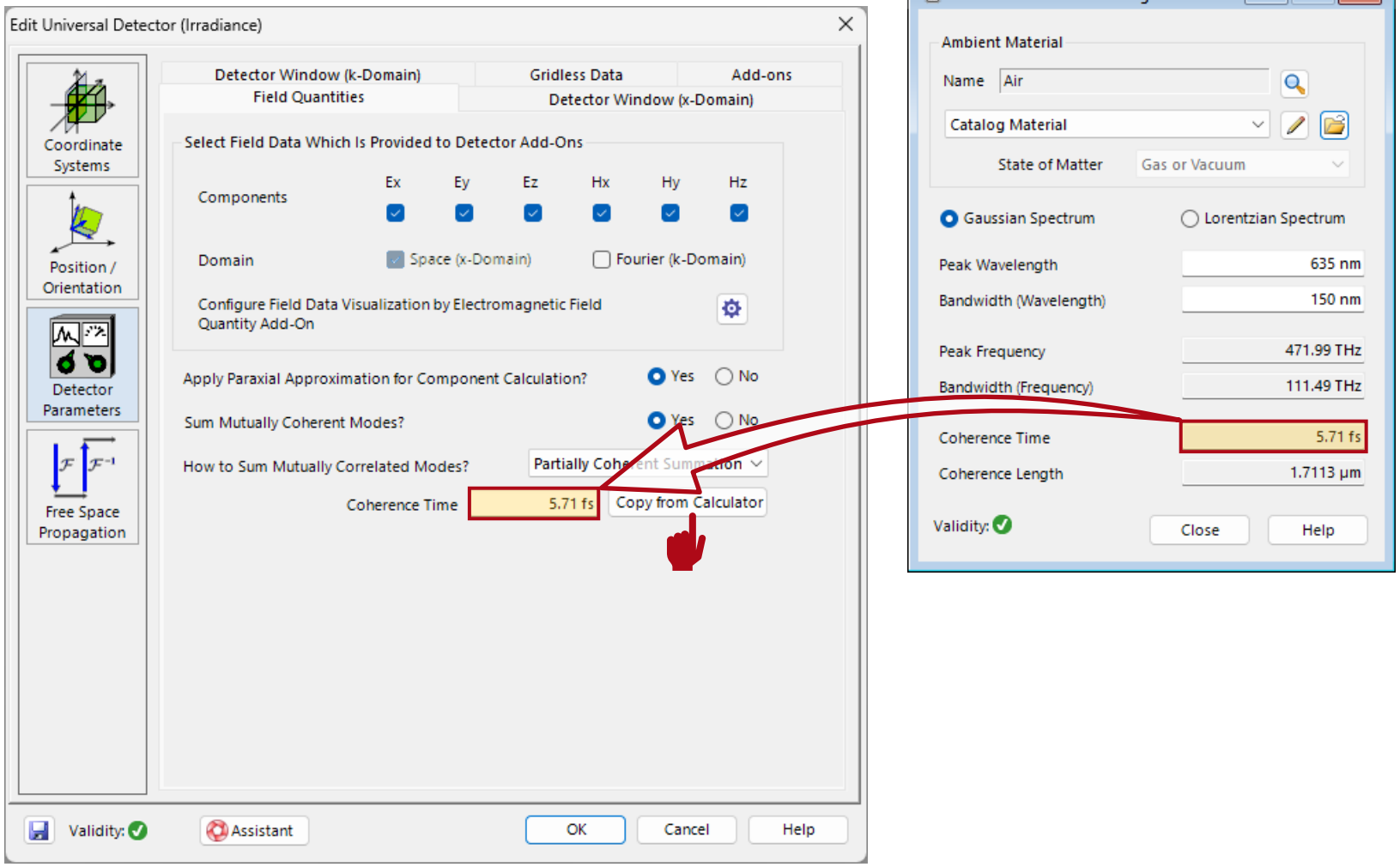
Coherence Length: $l = c\,\tau$, with c the speed of light in the *Ambient Material*



Connection to Universal Detector

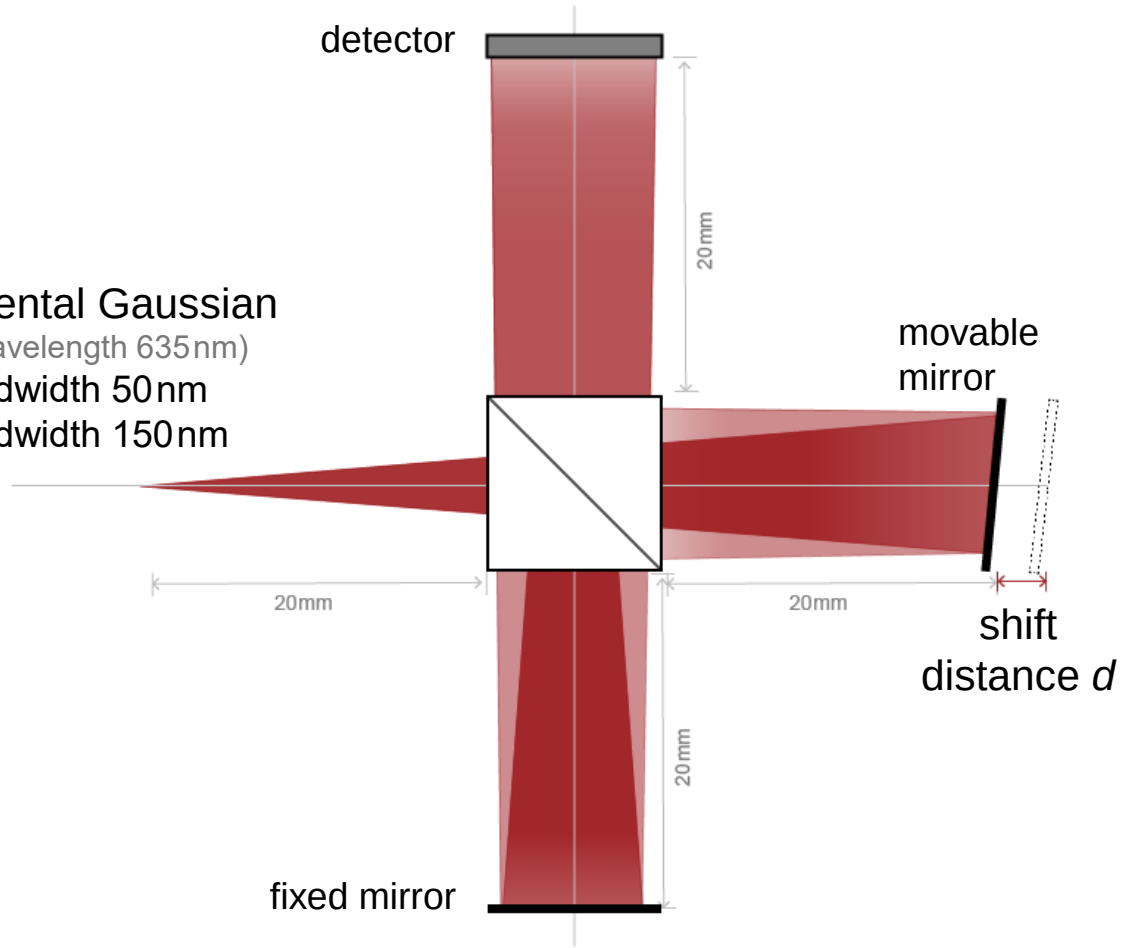
If a *Universal Detector* is part of an *Optical Setup*, the result from this calculator can easily be transferred to said detector through the *Copy from Calculator* function, when the option *Partially Coherent Summation* for *How to Sum Mutually Correlated Modes* is selected.

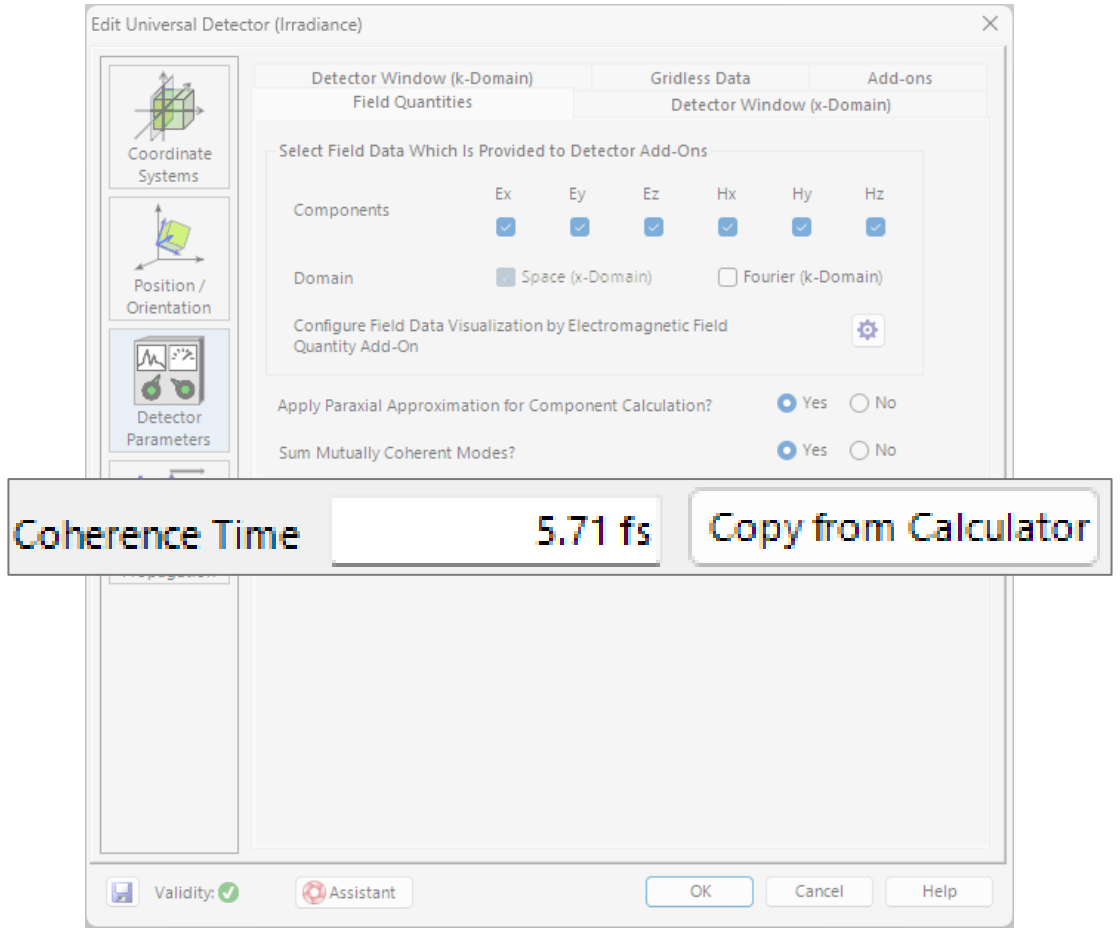
In the following example we use this trick to investigate the coherence properties of a source in a Michelson interferometer.



Example Task

fundamental Gaussian
(central wavelength 635nm)
a) bandwidth 50nm
b) bandwidth 150nm



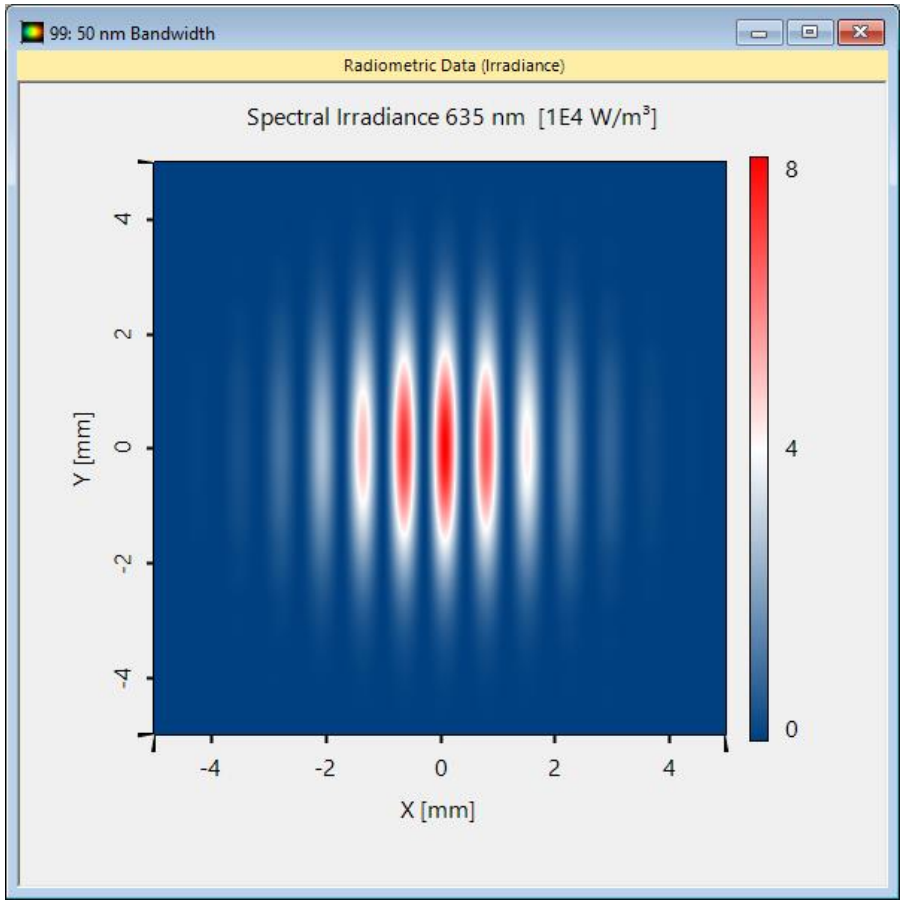


Irradiance at Detector Plane

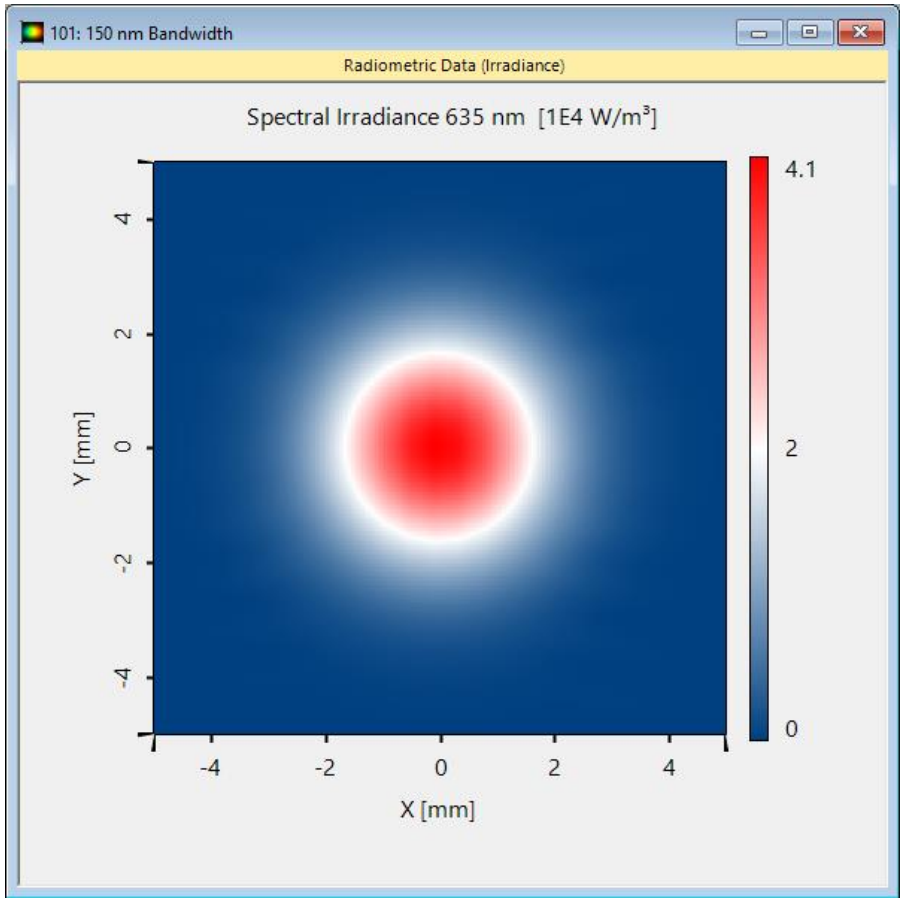
See the full Use Case: Temporal Coherence Measurement Using Michelson Interferometer

The system with 50 nm bandwidth shows a clear interference pattern which disappears for higher bandwidths.

Both results are taken with the same path difference of 2 µm.



50 nm bandwidth



150 nm bandwidth

Document Information

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further reading	