

Coherence Time & Length Calculator

Abstract

47: Coherence Time & Length Calculat...

Ambient Material

Name: Air

Catalog Material

State of Matter: Gas or Vacuum

Gaussian Spectrum Lorentzian Spectrum

Peak Wavelength: 532 nm

Bandwidth (Wavelength): 1 nm

Peak Frequency: 563.37 THz

Bandwidth (Frequency): 1.059 THz

Coherence Time: 601.18 fs

Coherence Length: 180.18 μm

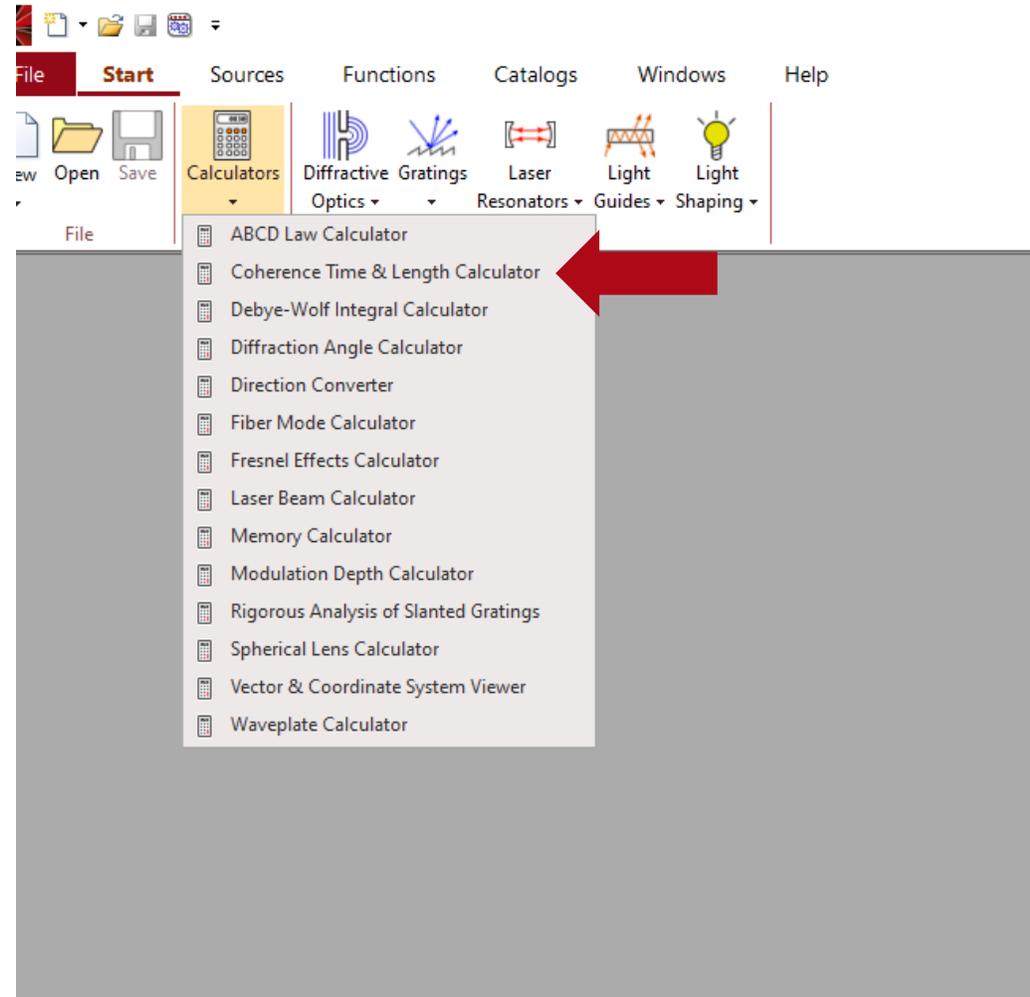
Validity:

Close Help

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.

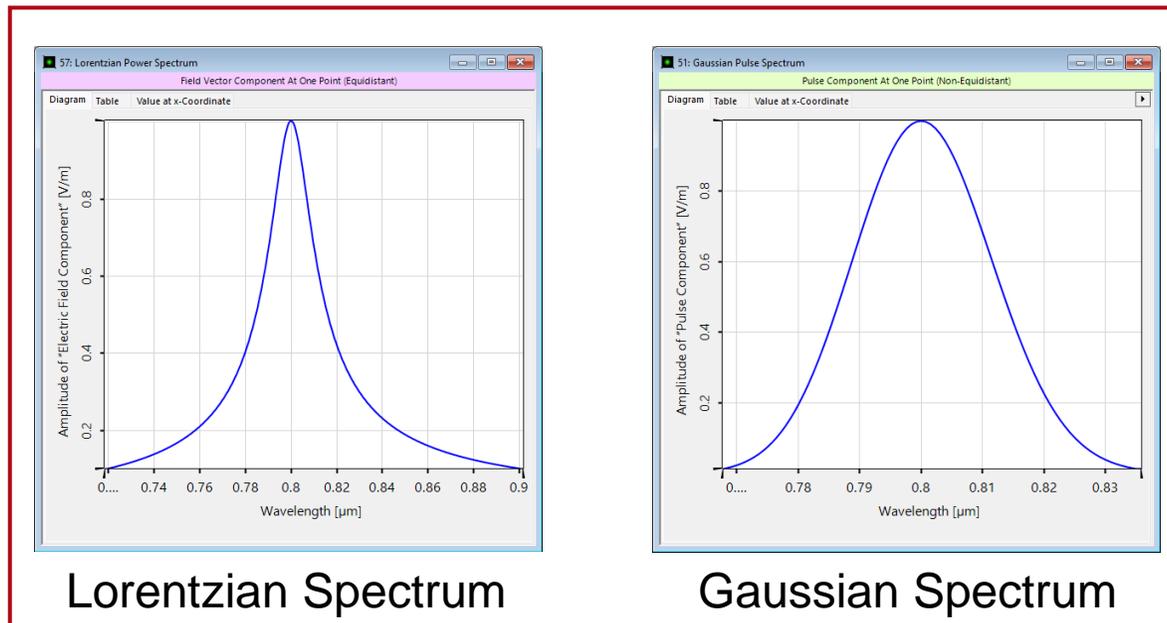
Open the Coherence Length & Time Calculator

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.



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Bandwidth (Frequency) 1.059 THz

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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*

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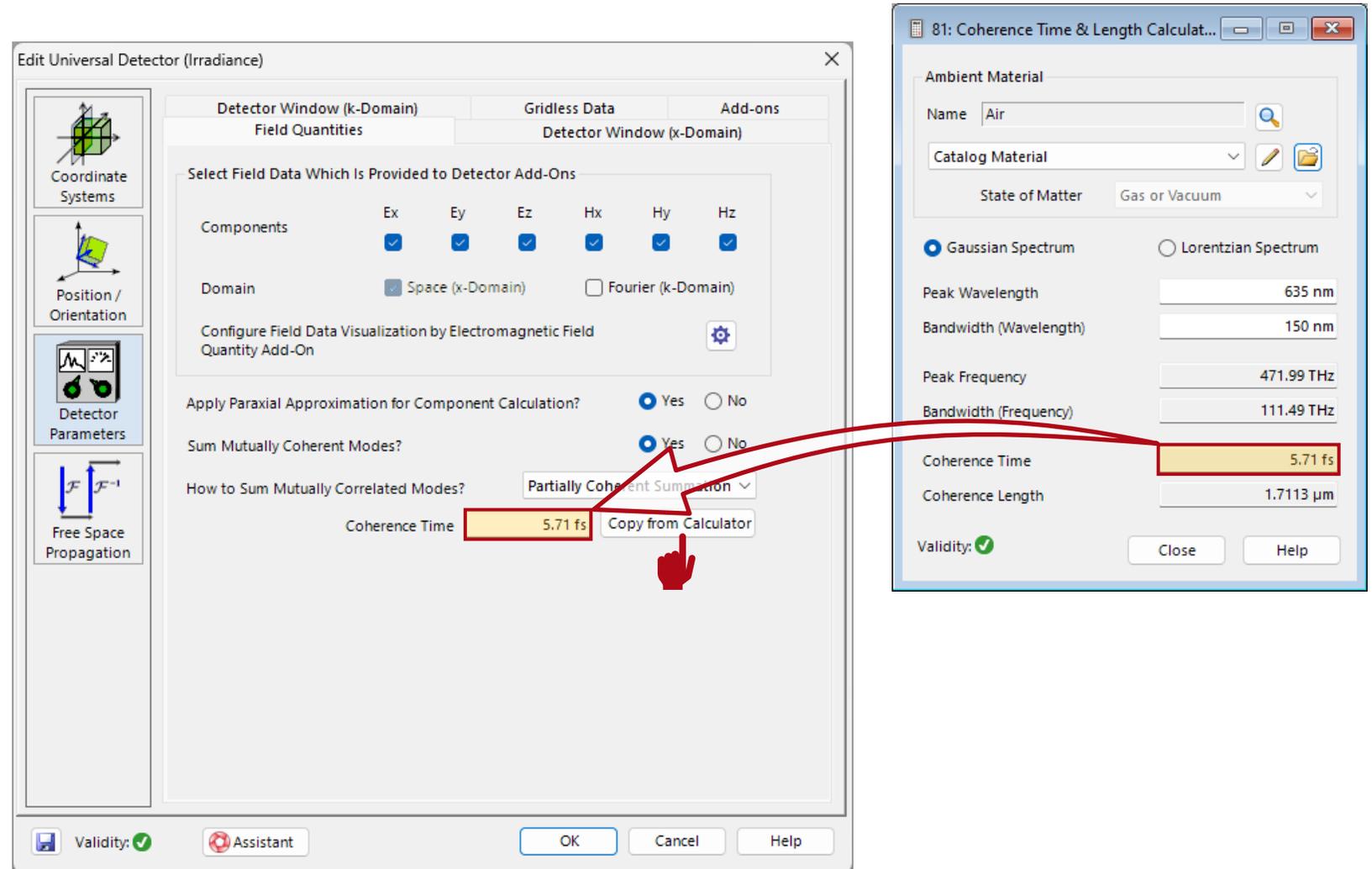
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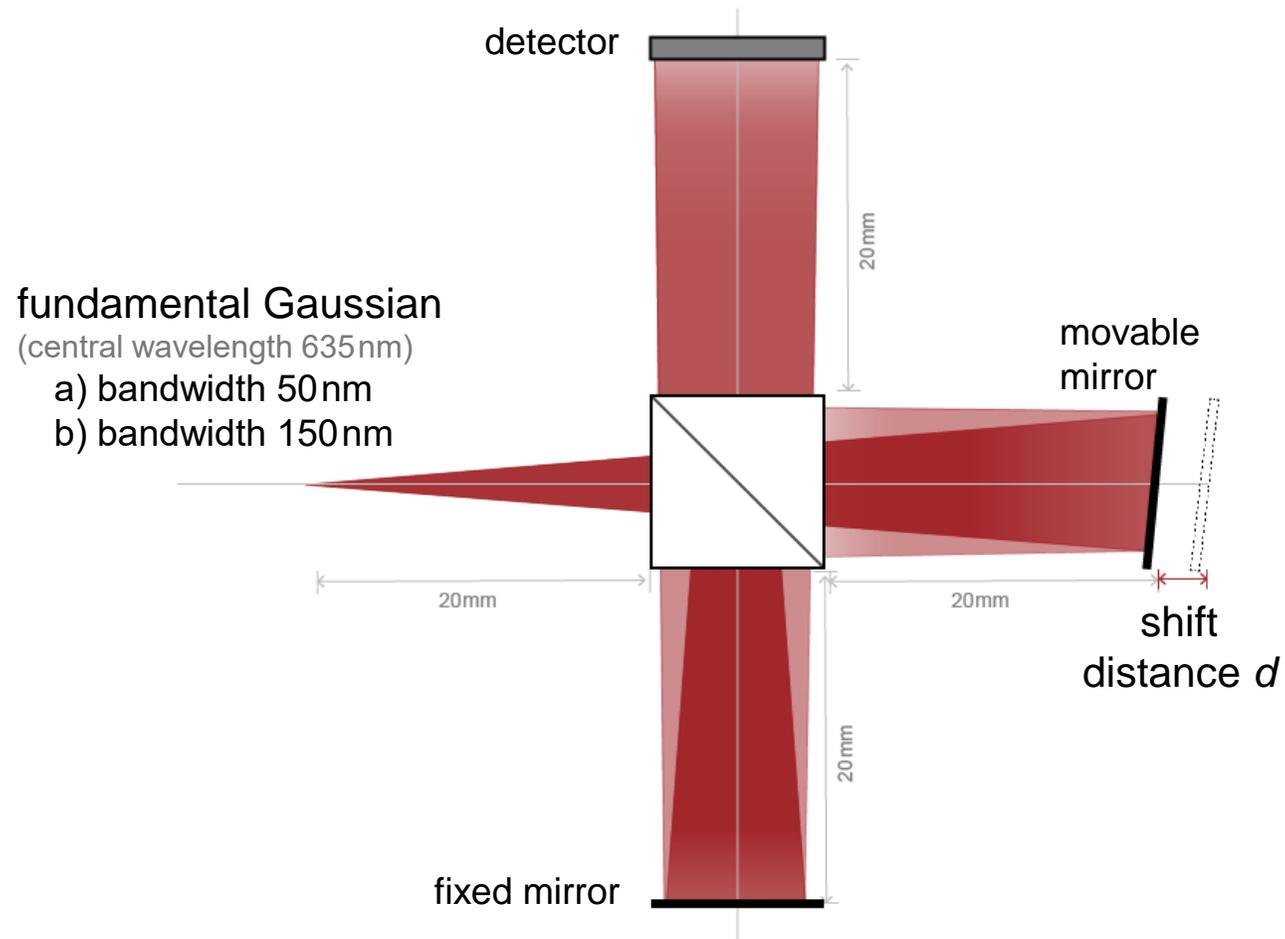
Connection to Universal Detector

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



Edit Universal Detector (Irradiance)

Detector Window (k-Domain) | Gridless Data | Add-ons

Field Quantities | Detector Window (x-Domain)

Select Field Data Which Is Provided to Detector Add-Ons

Components	Ex	Ey	Ez	Hx	Hy	H _z
	<input checked="" type="checkbox"/>					

Domain: Space (x-Domain) Fourier (k-Domain)

Apply Paraxial Approximation for Component Calculation? Yes No

Sum Mutually Coherent Modes? Yes No

Validity: Assistant

OK Cancel Help

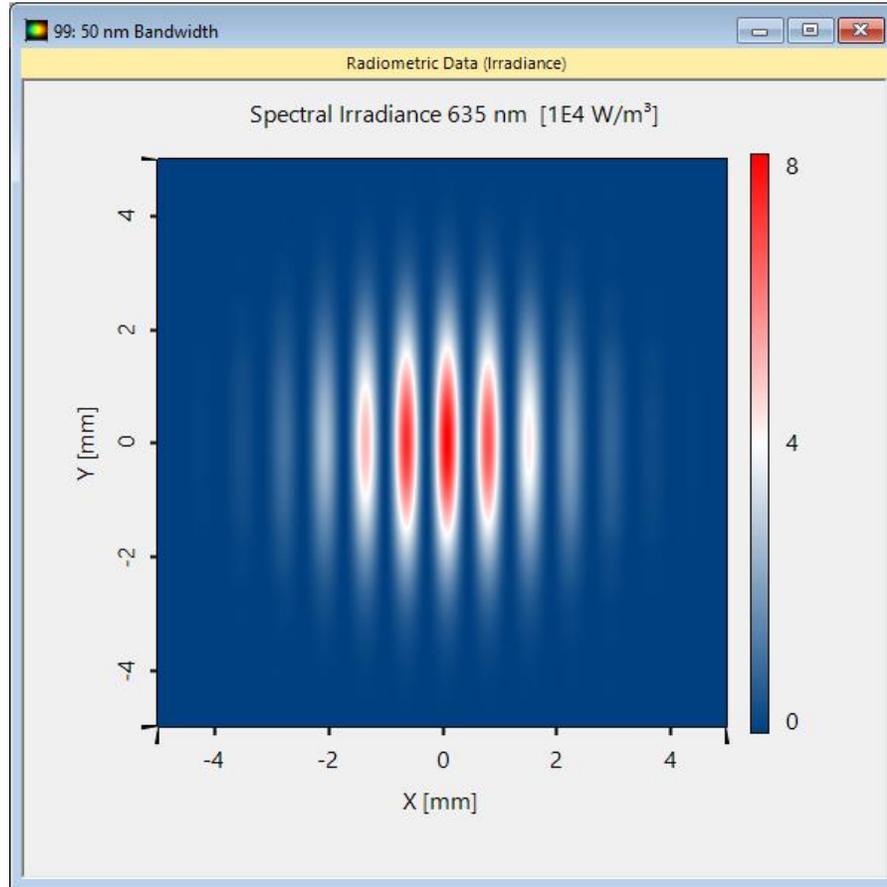
Coherence Time 5.71 fs Copy from Calculator

Irradiance at Detector Plane

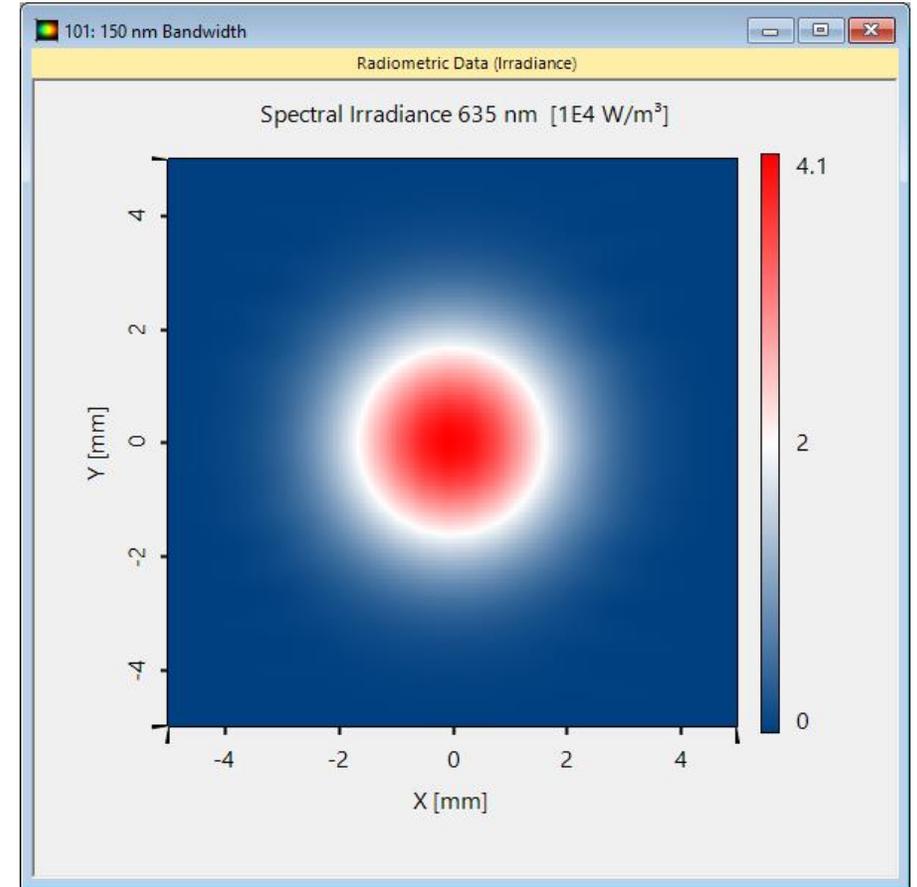
See the full Use Case: [Temporal Coherence Measurement Using Michelson Interferometer](#)

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

Both results are taken with the same path difference of $2\mu\text{m}$.



50nm bandwidth



150nm bandwidth

Document Information

title	Coherence Time & Length Calculator
document code	SWF.0038
version	1.3
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category	Feature Use Case
further reading	