

# 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  $\mu\text{m}$

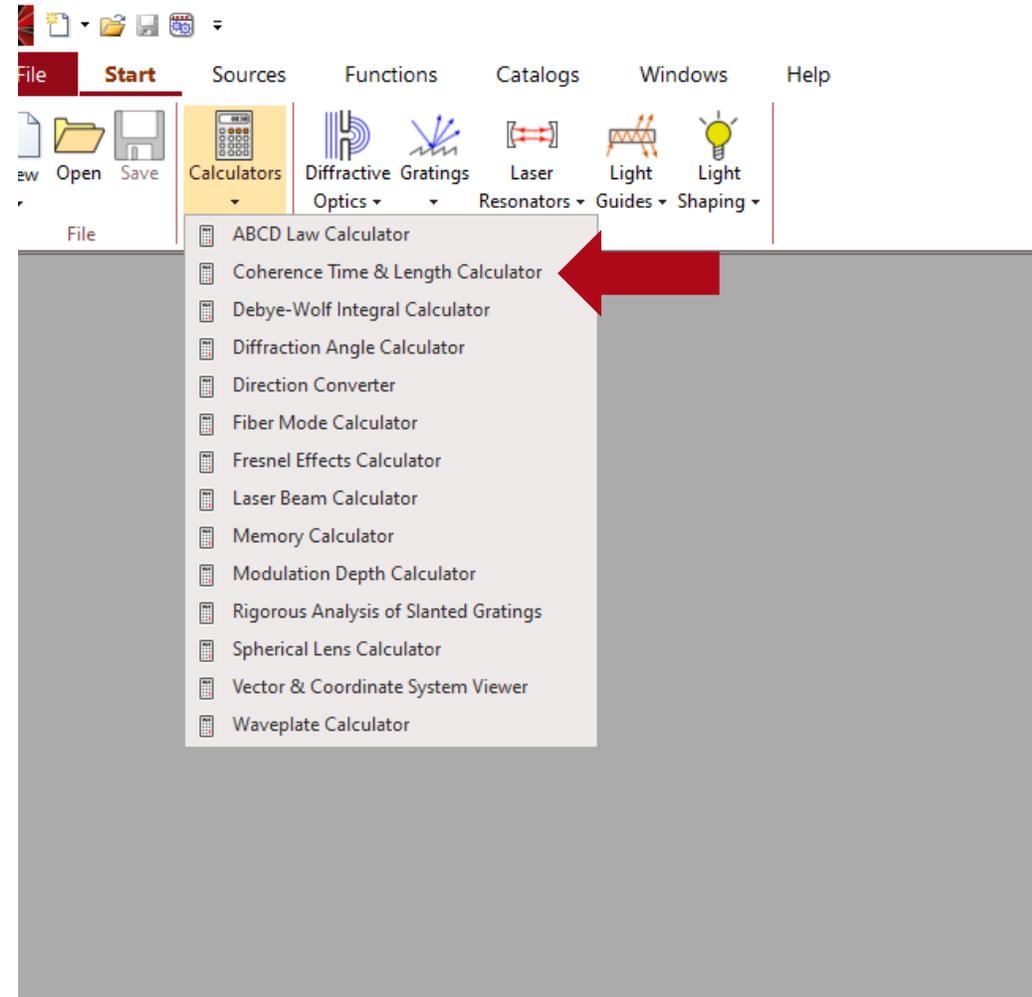
Validity:

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.

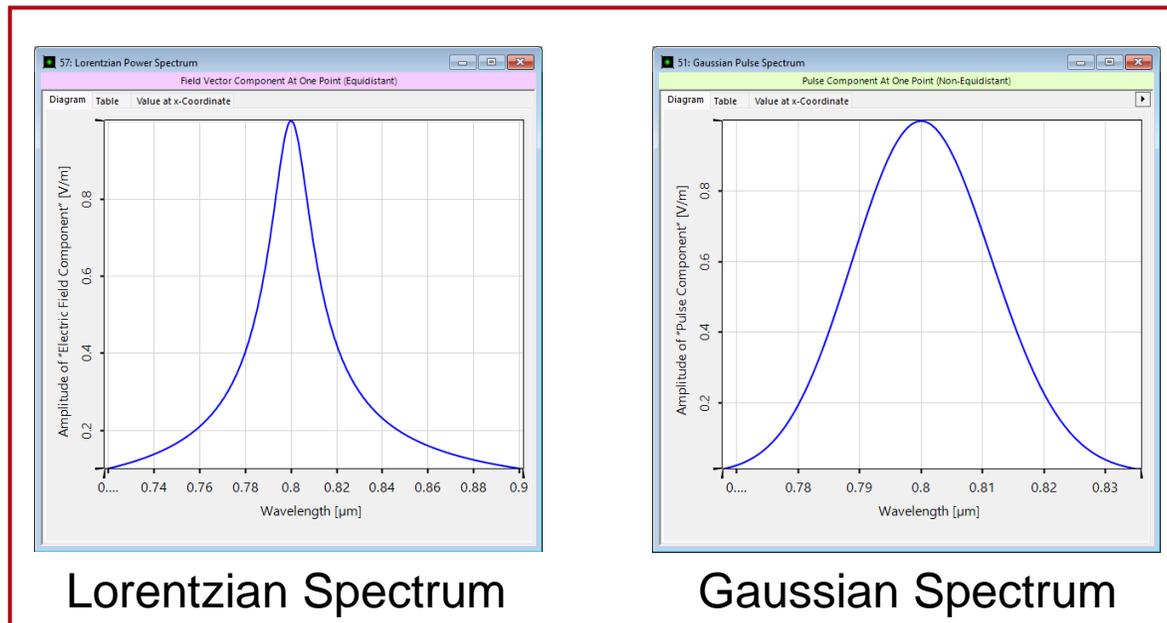
# Open the Coherence Length & Time Calculator

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

Coherence Time 601.18 fs

Coherence Length 180.18  $\mu\text{m}$

Validity:

Close Help

# Output Values

**Peak Frequency:**  $\nu_p = \frac{2\pi c}{\lambda_p}$ , with  $c$  the speed of light in the *Ambient Material* and  $\lambda_p$  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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Peak Frequency	563.37 THz
Bandwidth (Frequency)	1.059 THz
Coherence Time	601.18 fs
Coherence Length	180.18 μm

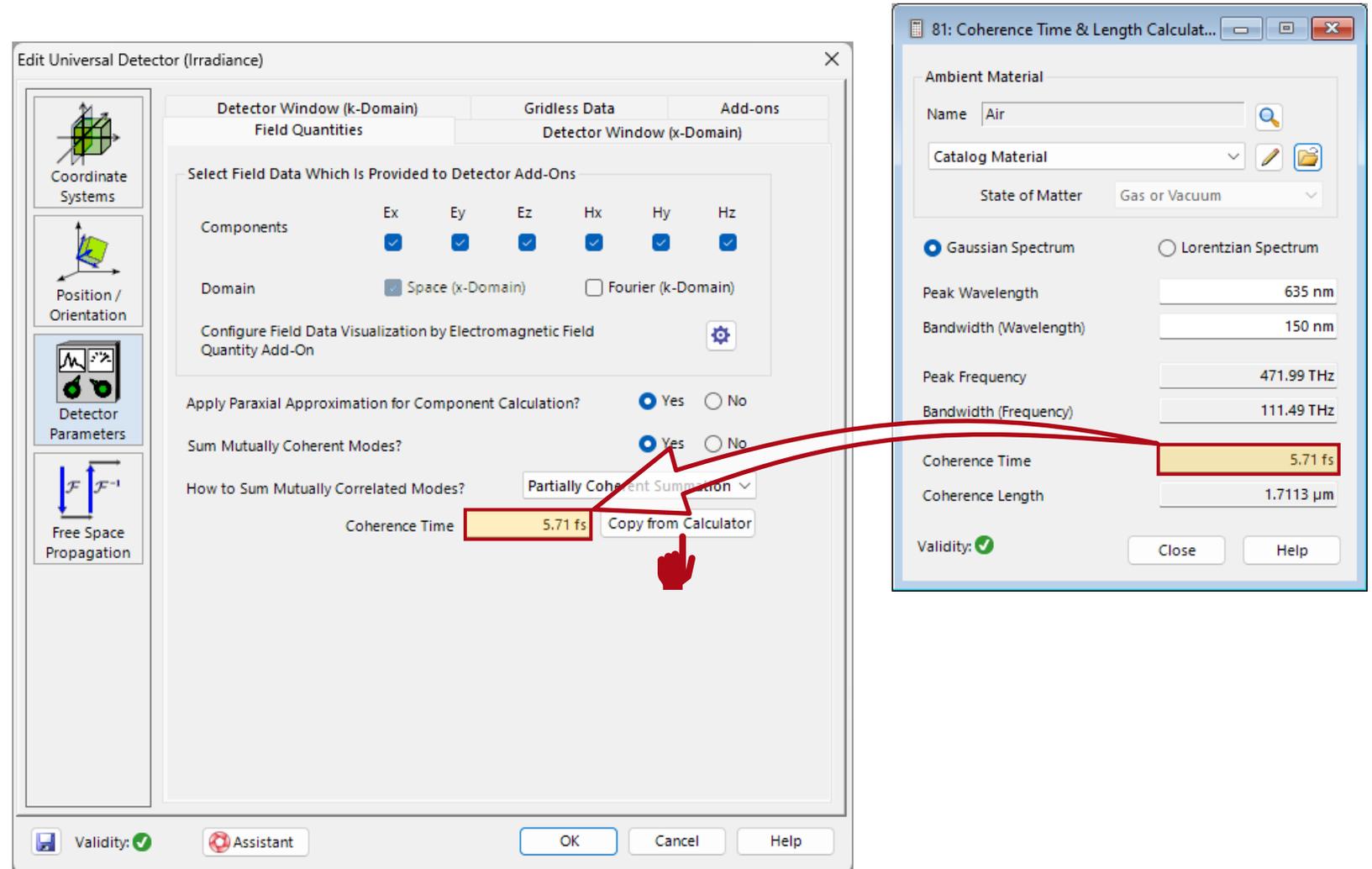
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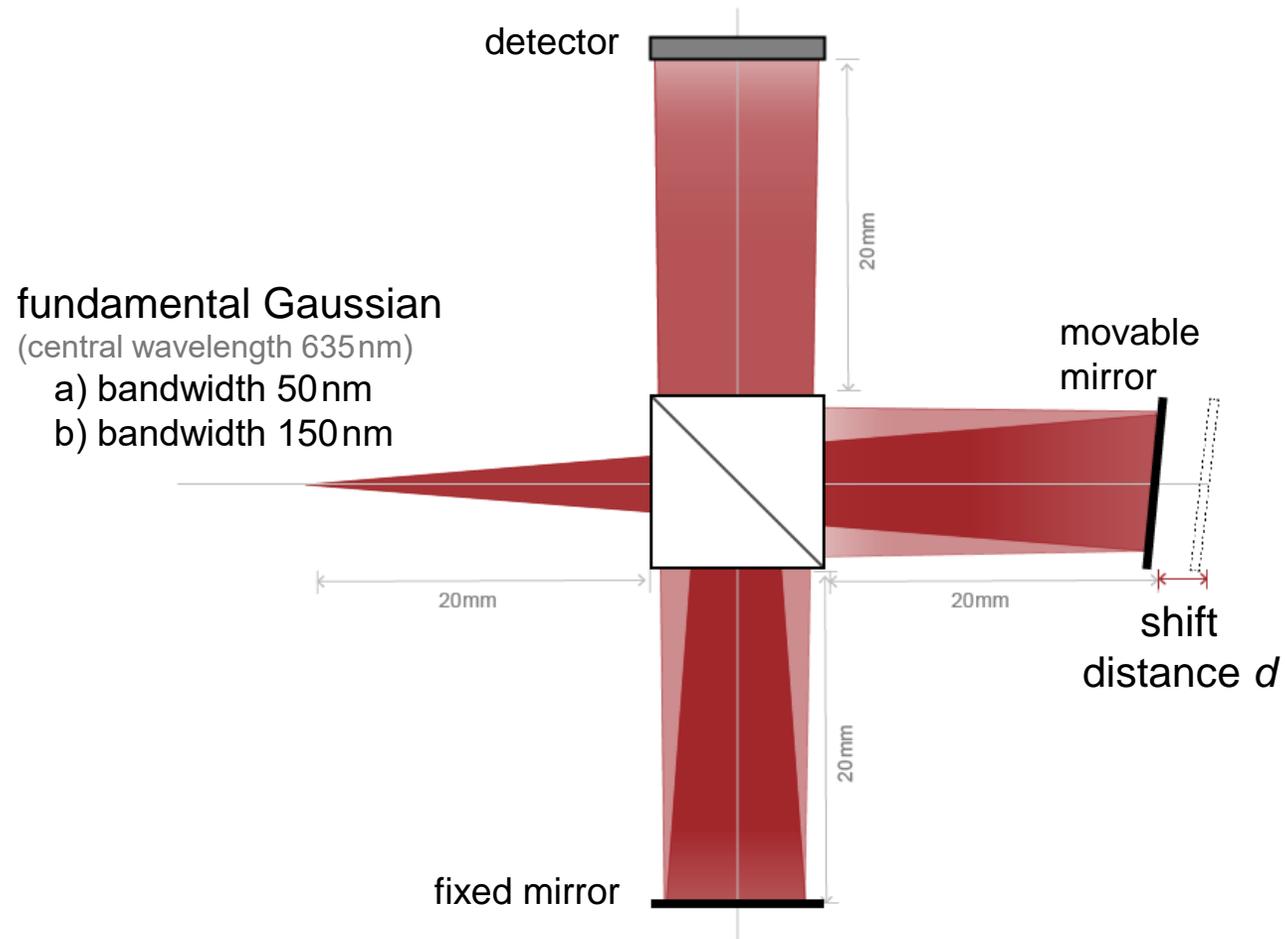
# Connection to Universal Detector

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 <sub>z</sub>
	<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

Coherence Time: 5.71 fs

Copy from Calculator

Validity: Assistant

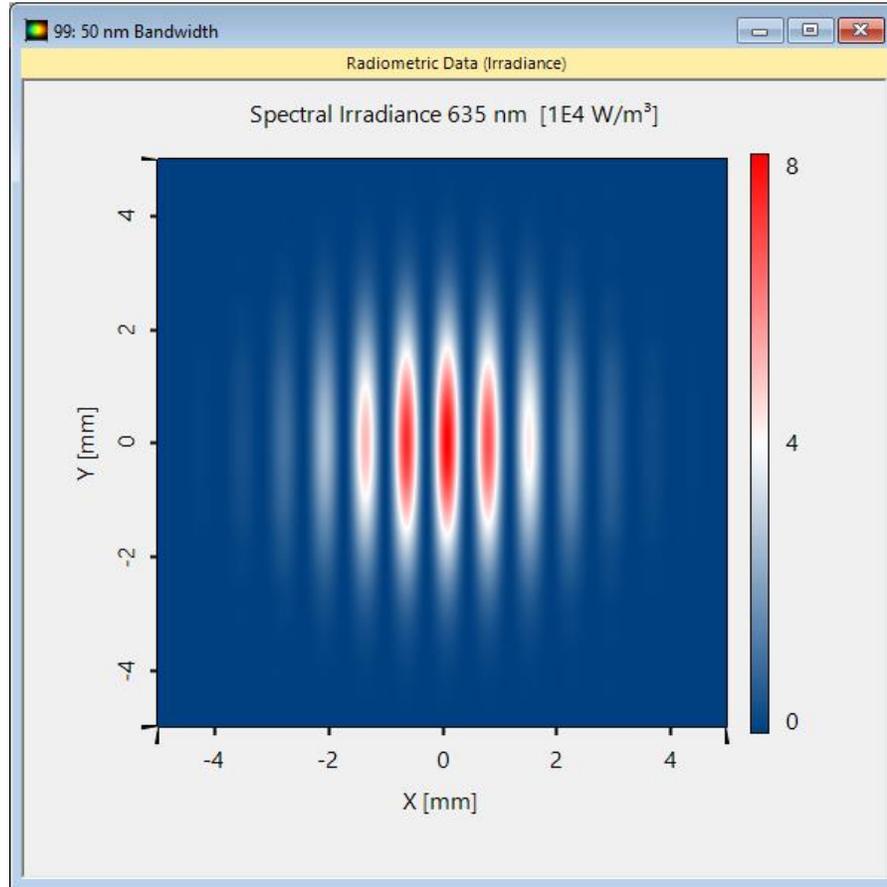
OK Cancel Help

# Irradiance at Detector Plane

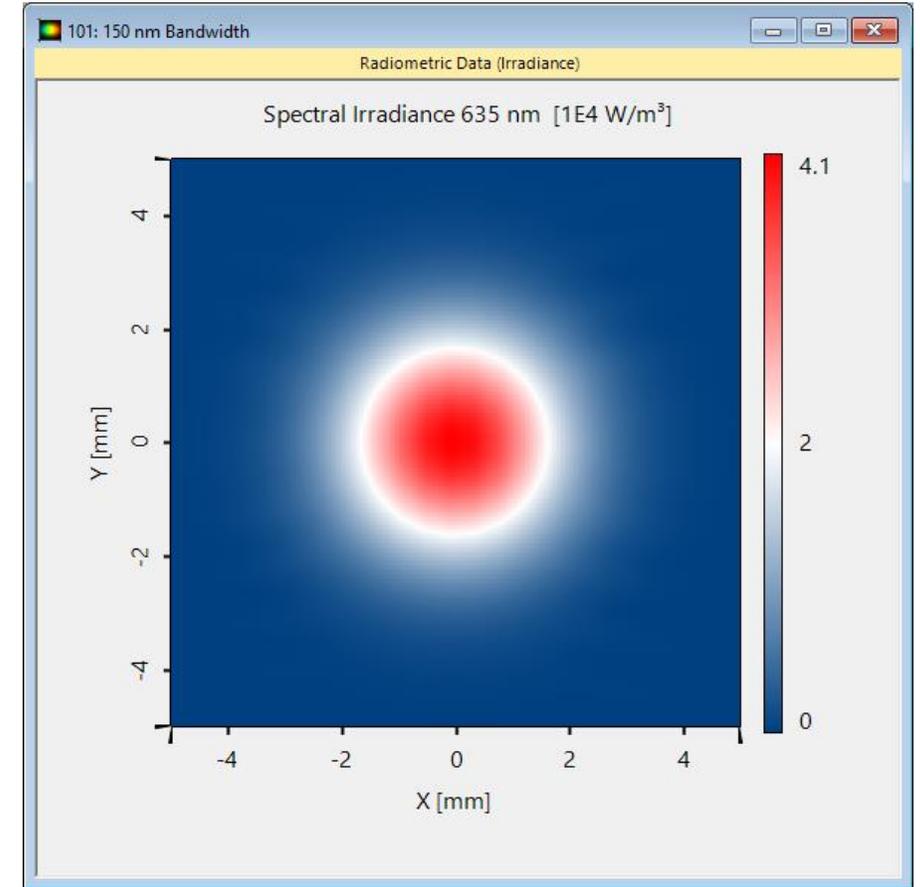
See the full Use Case: [Temporal Coherence Measurement Using Michelson Interferometer](#)

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

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title	Coherence Time & Length Calculator
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further reading	