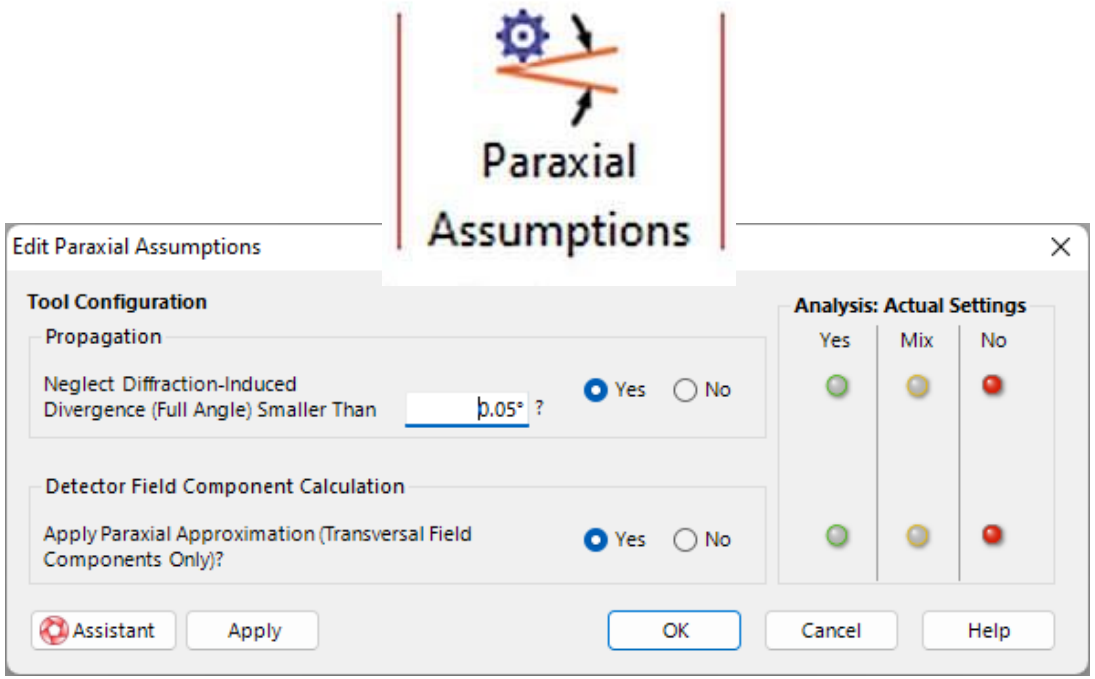
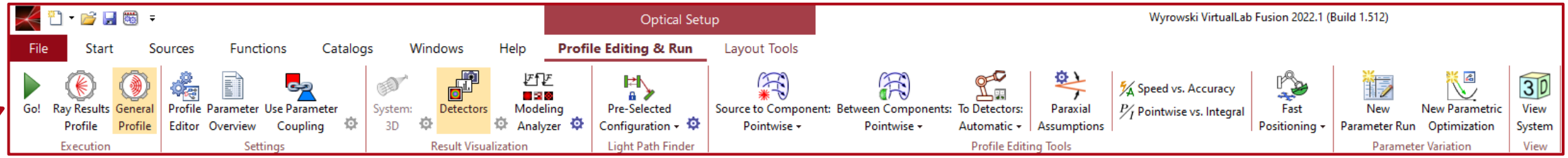
Paraxial Assumptions Tool

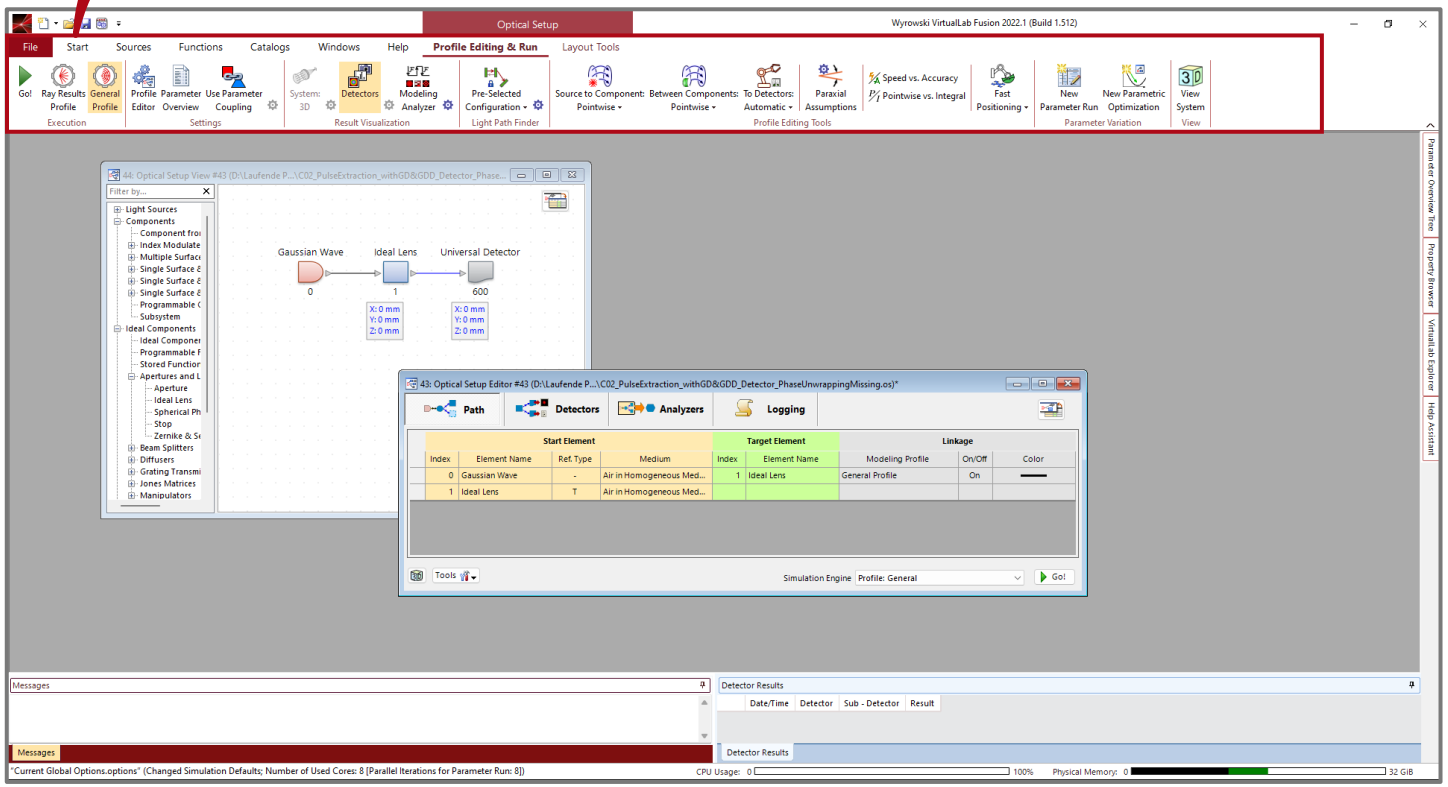
Abstract



Both because of the practical role that paraxial behavior plays in countless optical systems, and due to the drastic simplification of the mathematics and numerics involved that an assumption of paraxiality often entails, it makes sense to offer users of physical optics software the possibility of benefiting from these advantages. That is precisely what VirtualLab Fusion does: in a control panel specifically designed for the purpose, the user can both get an overview at a glance of the current status of the configuration of the system regarding the paraxial assumptions, and also modify that configuration for the whole system in a convenient, easy-to-use tool.

The Profile Editing & Run Tab

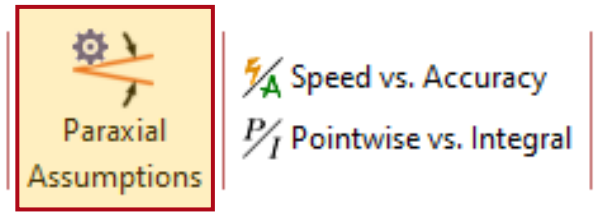




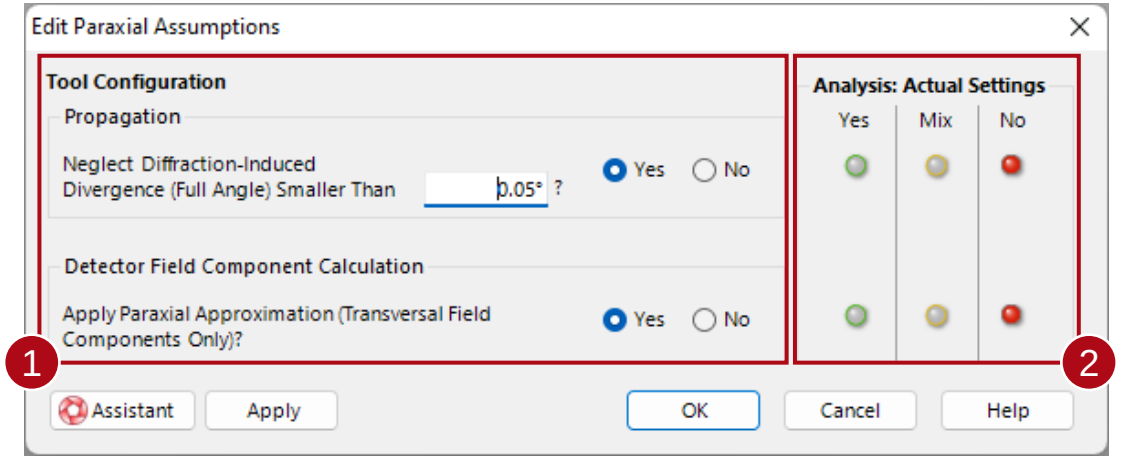
When an *Optical Setup* document is active, a new ribbon, *Profile Editing & Run*, will automatically be available in the menu.

In this use case we want to focus on the control of the application of paraxial assumptions in your simulation.

Paraxial Assumptions



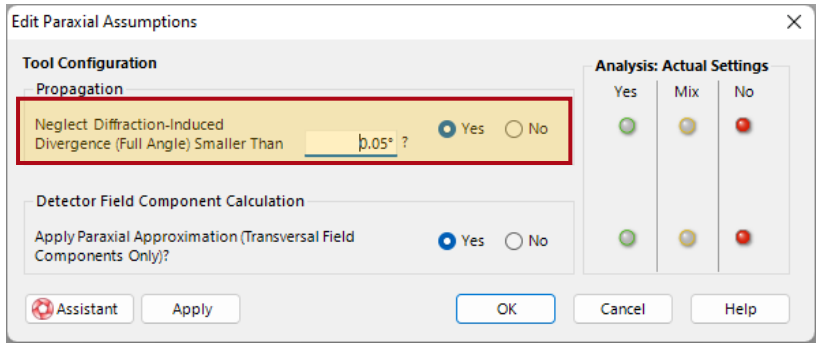
The tool *Paraxial Assumptions* provides an overview and allows users to control two different approximations related to paraxial behavior: first, whether diffraction effects in paraxial beams causing a divergence smaller than the given threshold are ignored, and second, whether the longitudinal component of the electromagnetic field will be assumed negligible.



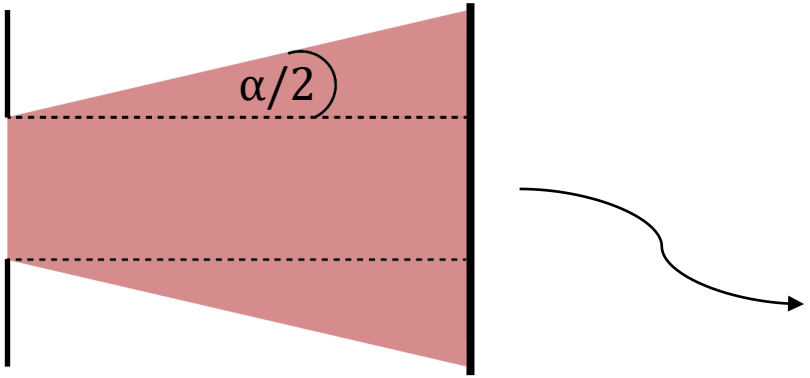
1 The fast configuration part can overwrite all settings in the entire system for a given approximation (which can be edited in detector settings, the *Profile Editor*, …). The two buttons (*Yes*/*No*) **do not** necessarily indicate the current status of said approximation, that is done by the analysis (2) part on the right.

2 The panel on the right provides condensed information about all current system settings related to those two approximations and reports its findings in the form of a traffic light system. Here, red (*No*) means that there is no component or detector in the system for which the corresponding approximation is active, green (*Yes*) means that for all components and detectors the corresponding approximation is active, and yellow (*Mix*) stands for the cases where the approximation is active for some elements of the system but not others.

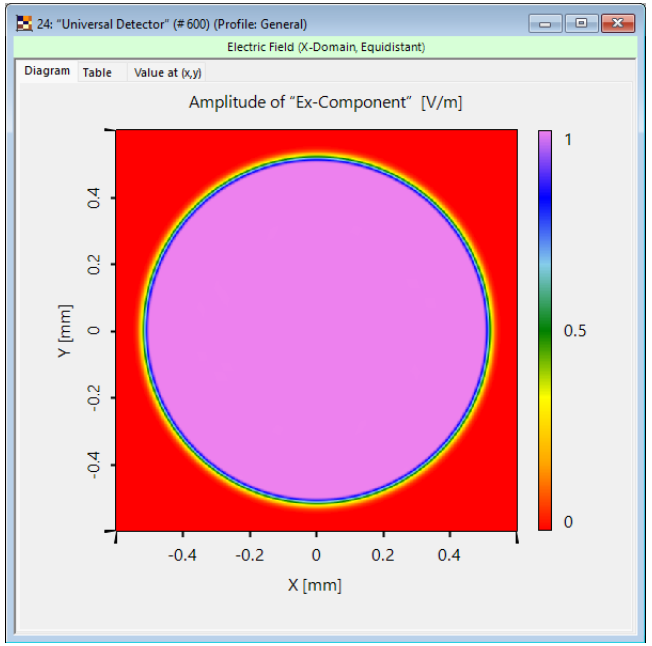
Physical Definition – Neglect Diffraction-Induced Divergence



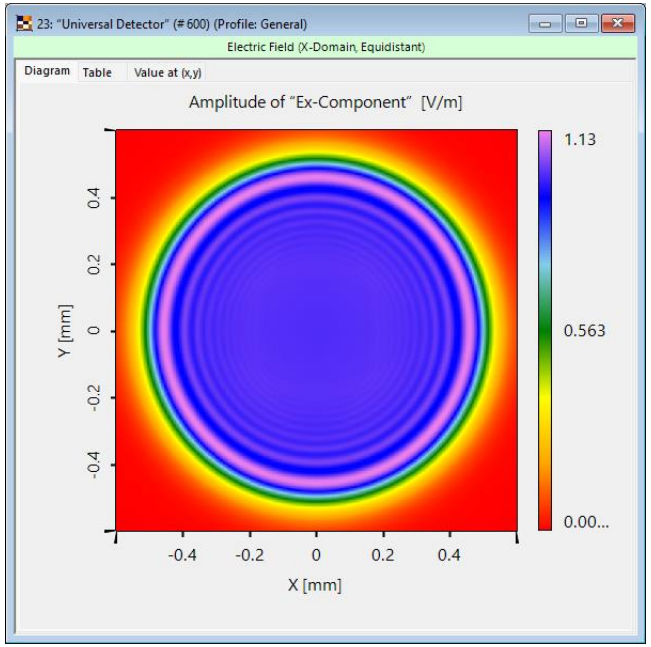
If this parameter is set to active, VirtualLab Fusion will automatically check how strong of a divergence diffraction effects will cause on the field. If the calculated divergence is below the given threshold, the corresponding Fourier transform operation will use the Pointwise algorithm, causing diffraction to be neglected in the simulation.



Illustrative sketch of propagating plane wave. The diffraction generates a divergence of $\alpha = 0.0165°$. Depending on the settings the diffractive effect will be included or not.

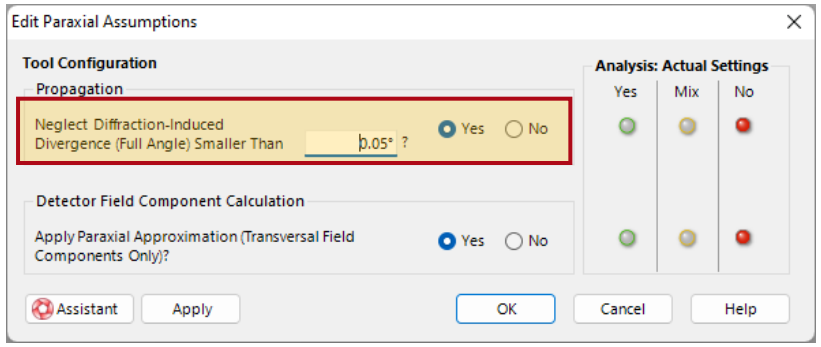


Approximation active and threshold > 0.0165°

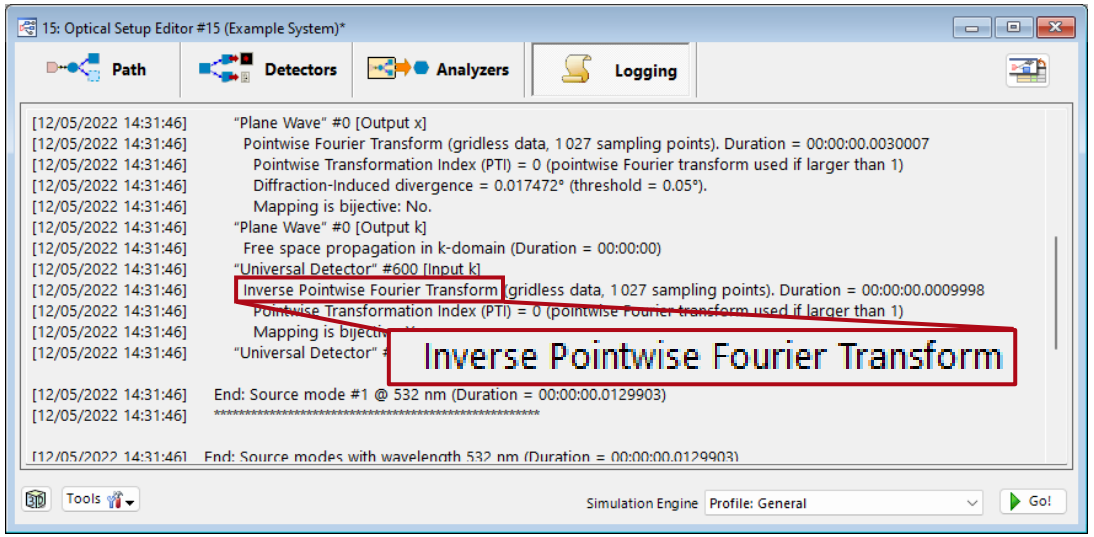


Approximation inactive or threshold < 0.0165°

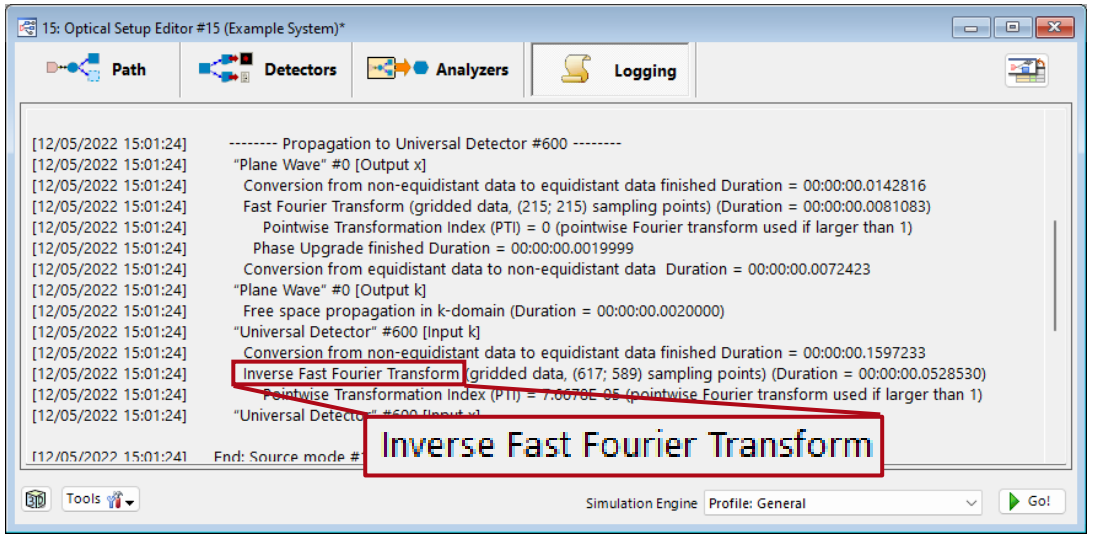
Physical Definition – Paraxial Approximation



The inclusion of diffraction effects in the propagation operator is controlled by changing the corresponding Fourier transform algorithm.

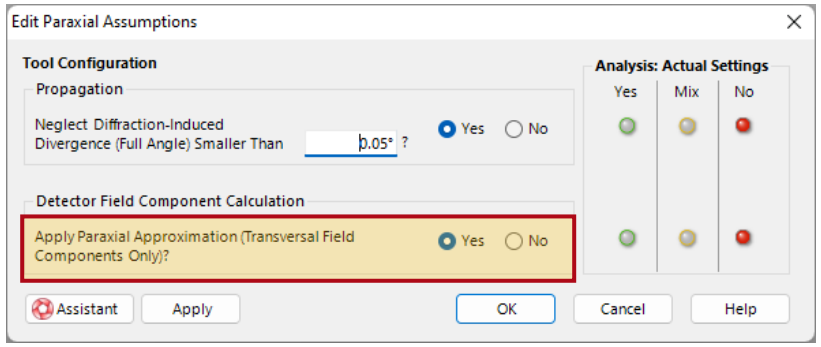


Approximation active and threshold > 0.0165°

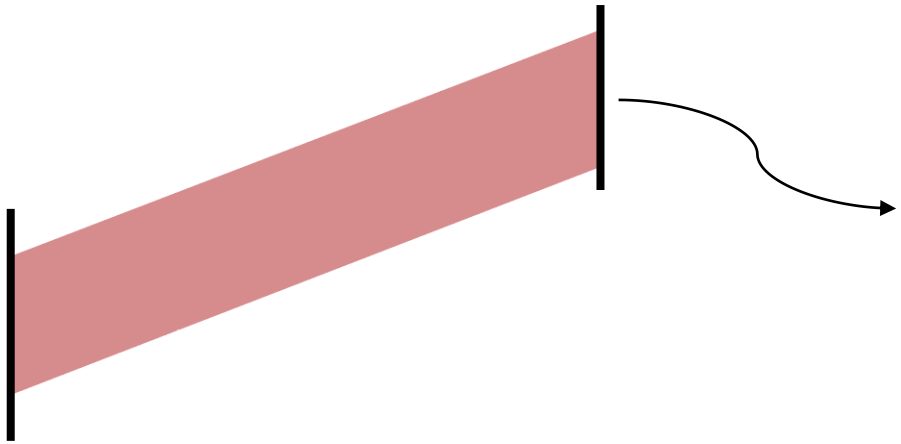


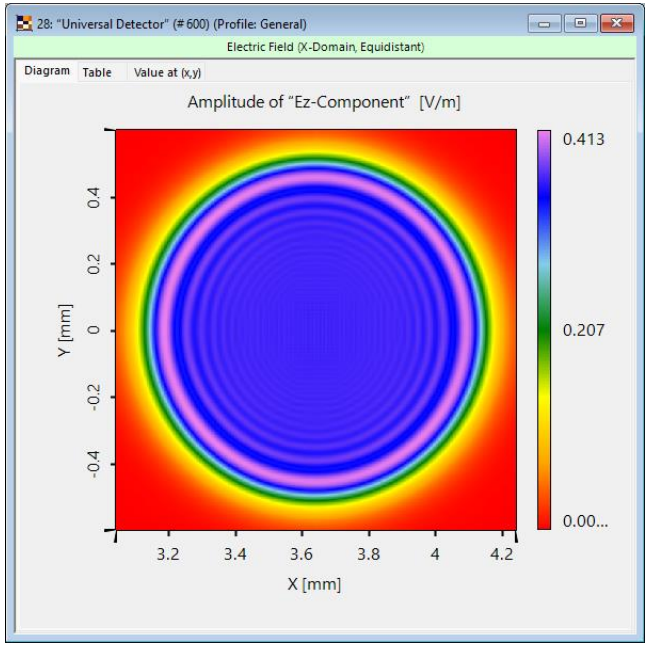
Approximation inactive or threshold < 0.0165°

Physical Definition – Paraxial Approximation

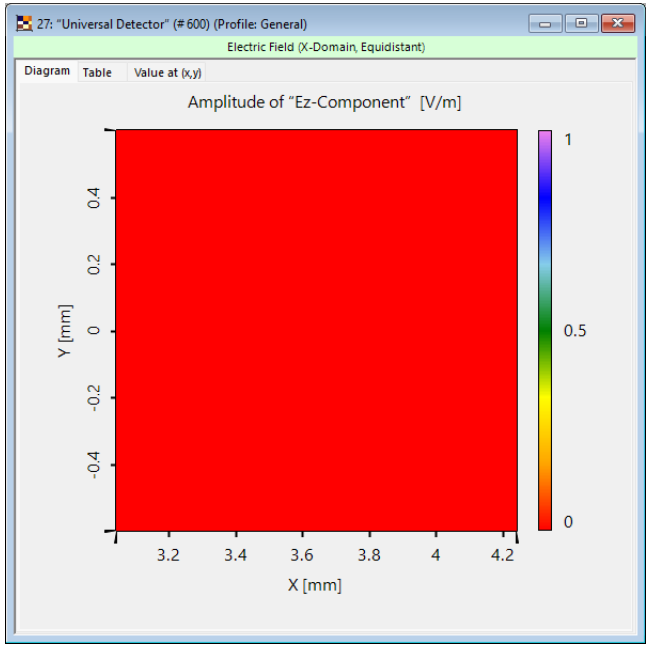


The option to assume *Paraxial Approximation* is only given for *Universal Detectors*. If active, the *Ez* component of the field will be assumed negligible.





Without Paraxial Approximation



With Paraxial Approximation

Document Information

title	Paraxial Assumption Tool
document code	SWF.0012
document version	1.0
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software version	2023.1 (Build 1.554)
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further reading	