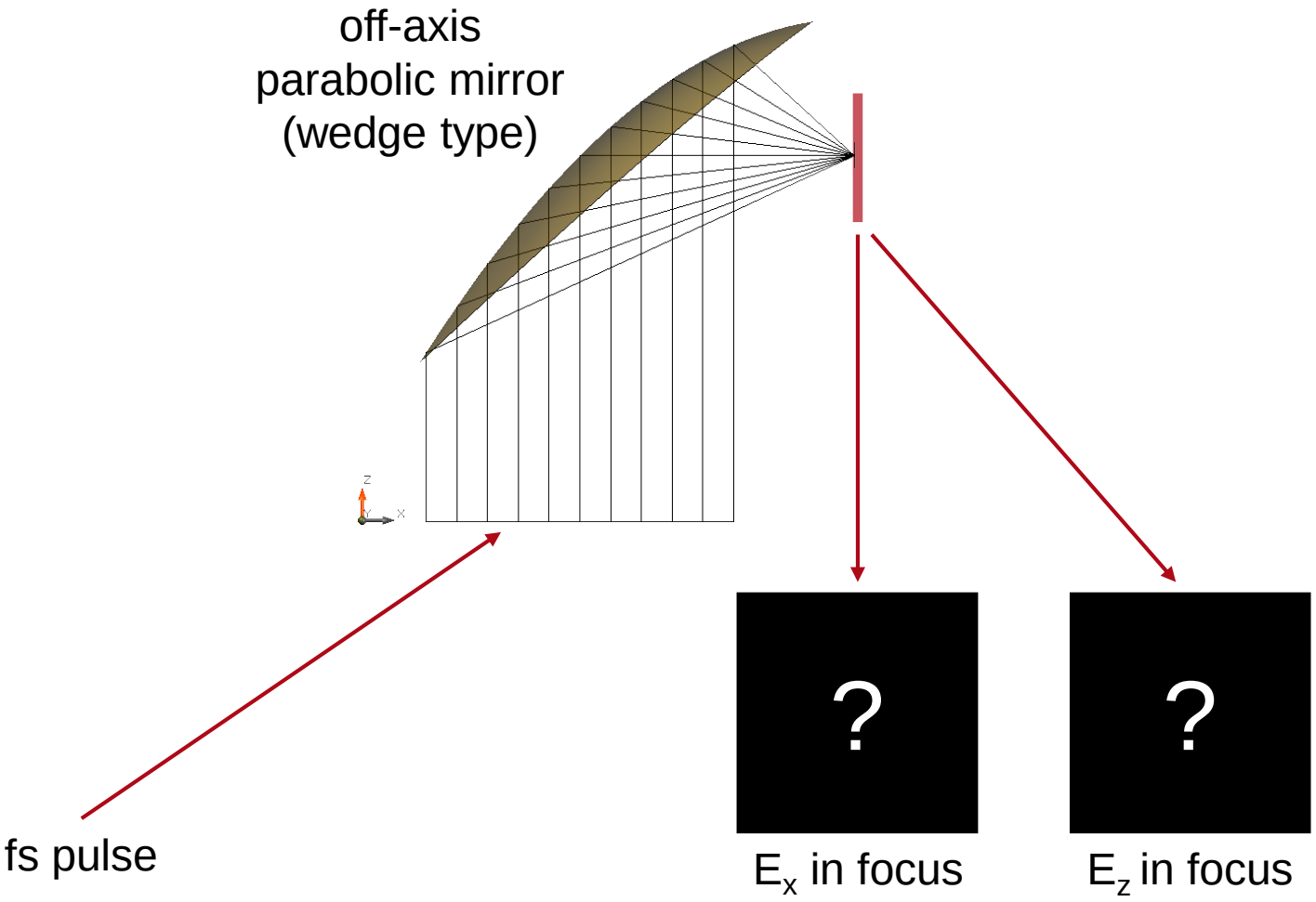
LightTrans

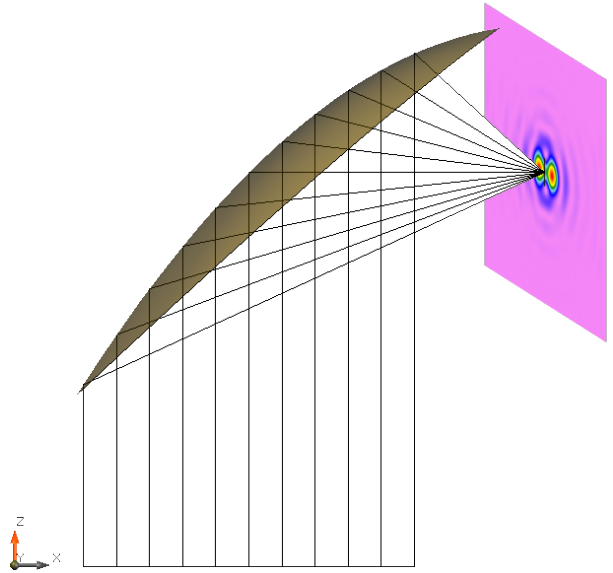
Laser Systems > Femtosecond Pulse Modeling

Focusing of Femtosecond Pulse by using a High-NA Off-Axis Parabolic Mirror

Task/System Illustration

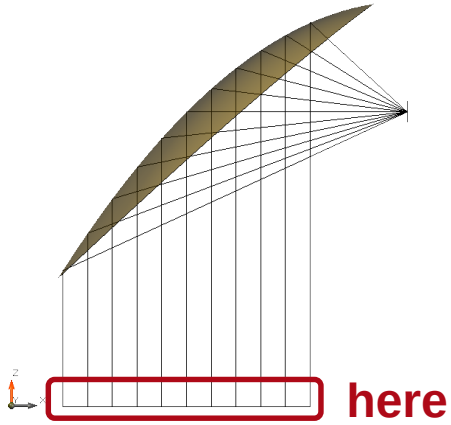


Highlights



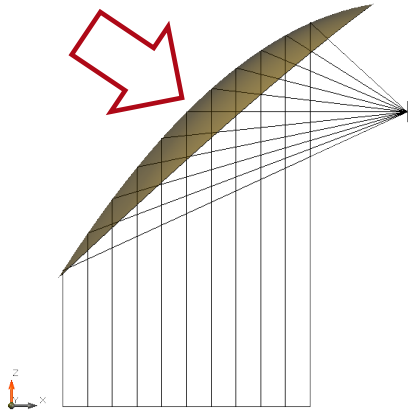
- fast simulation of femtosecond pulse propagation
- full vectorial analysis (e.g. calculation of E_z)

Specification: Light Source



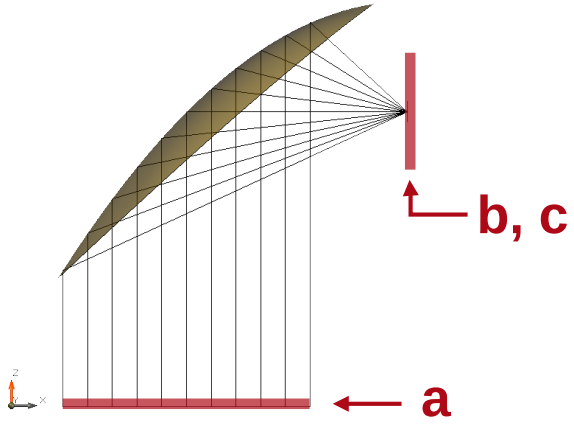
Parameter	Description / Value & Unit
type	plane wave pulse
mode	single Hermite Gaussian (0,0) mode
center wavelength	800 nm
pulse duration (FWHM)	10 fs (FWHM)
spectral sampling points	29
diameter	7 mm (round)
polarization	linear in x-direction (0°)

Specification: Off-axis Parabolic Mirror



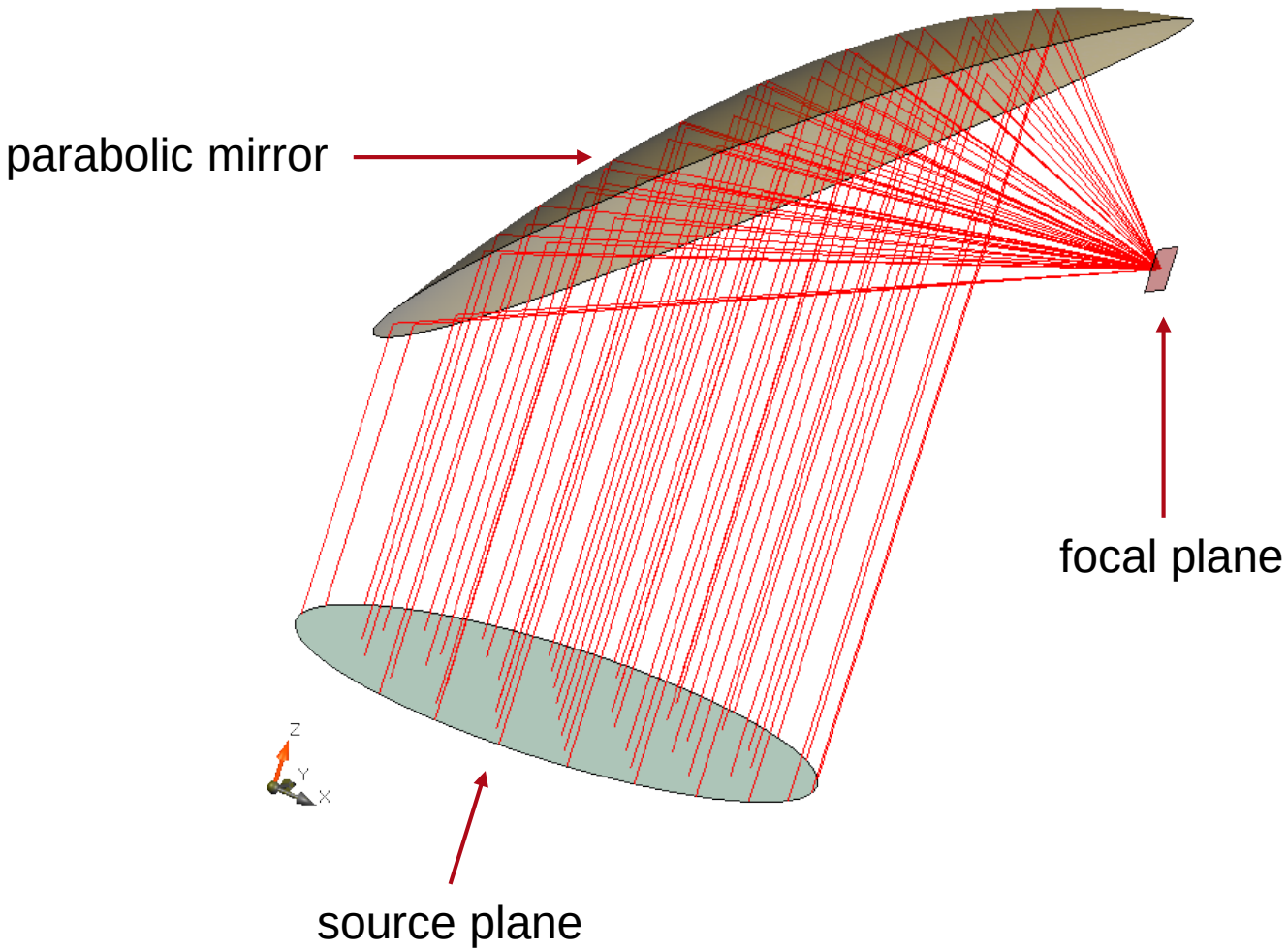
Parameter	Description / Value & Unit
type	off-axis parabolic mirror (wedge type)
off-axis angle	90°
numerical aperture (NA)	~0.47
focal length	7.5mm
material	ideal mirror

Specification: Detectors



Position	Modeling Technique	Detector/Analyzer
full system	3D ray tracing	3D ray tracing system visualization
a	field tracing	pulse evaluation directly behind source
b	field tracing	pulse evaluation in focal plane

Result: 3D Ray Tracing



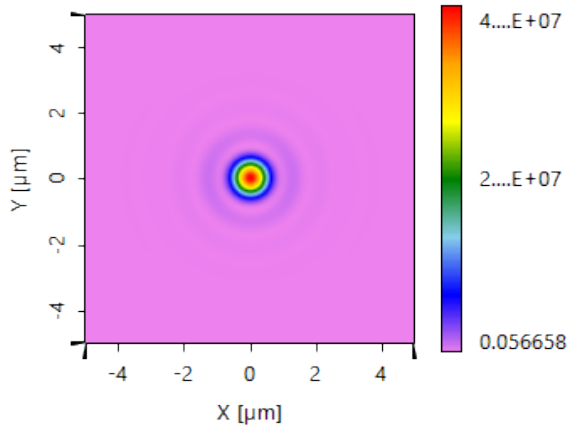
Result: Evaluation of Full Vectorial Light Field

Due to focusing with high numerical aperture initially negligible field components exhibit significant contributions.

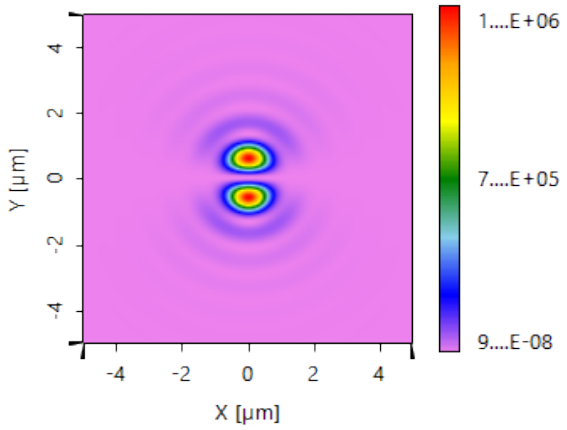
for carrier wavelength (800 nm):

Highlight

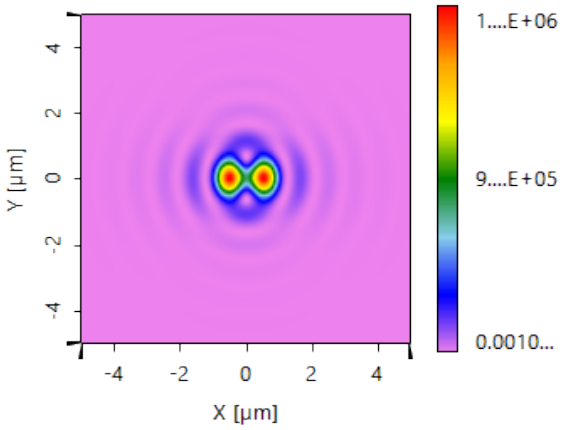
- fast simulation of femtosecond pulse propagation
- full vectorial analysis



$E_x \stackrel{\text{def}}{\cong} 100\%$

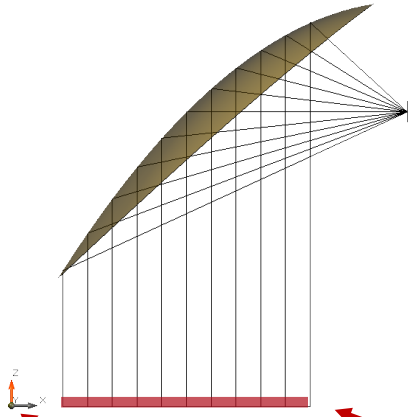


$E_y \cong 3\%$



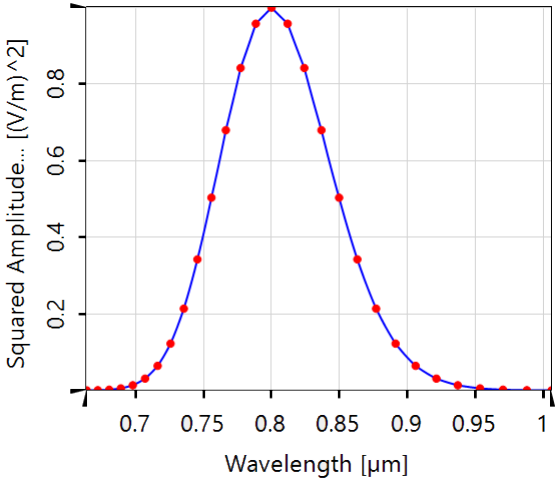
$E_z \cong 4\%$

Result: Pulse Evaluation in Source Plane

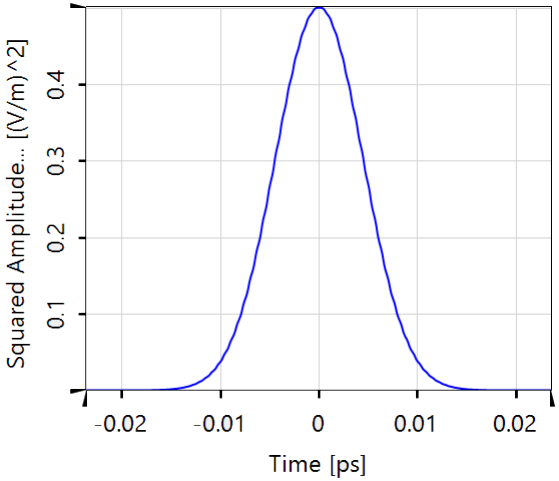


negligible E_z component

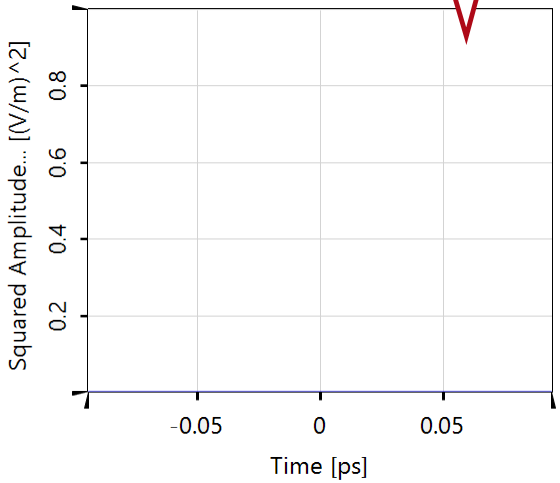
E_x wavelength domain



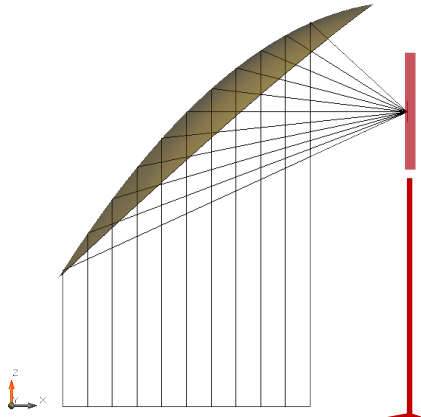
E_x time domain



E_z time domain



Result: Pulse Evaluation in Focal Plane

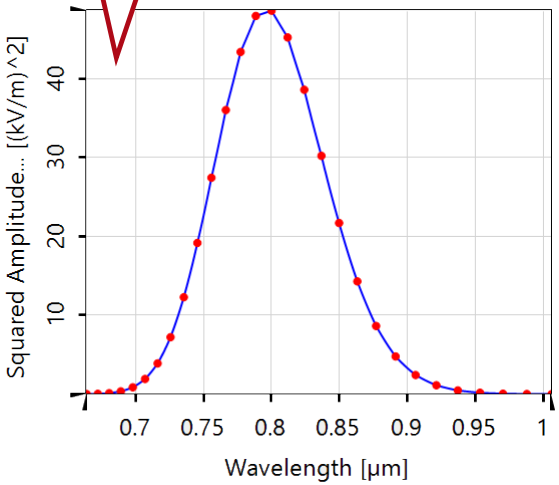


calculation time: 4 sec

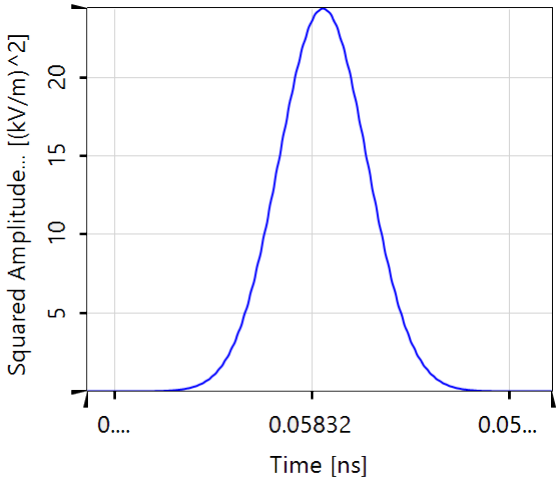
slight changes of spectrum's weights due to different wavelength's focus size

significant E_z component, due to high NA focusing

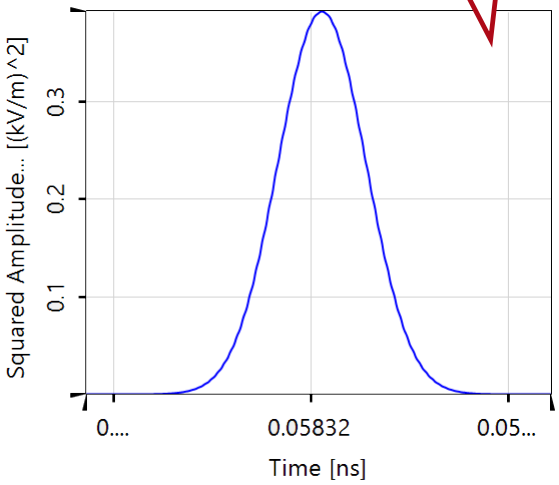
E_x wavelength domain



E_x time domain



E_z time domain



Document & Technical Info

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author	Stefan Steiner (LightTrans International UG)
VL version used for simulations	7.0.0.29

Specifications of PC Used for Simulation	
Processor	i7-4910MQ (4 CPU cores)
RAM	32 GB
Operating System	Windows 10