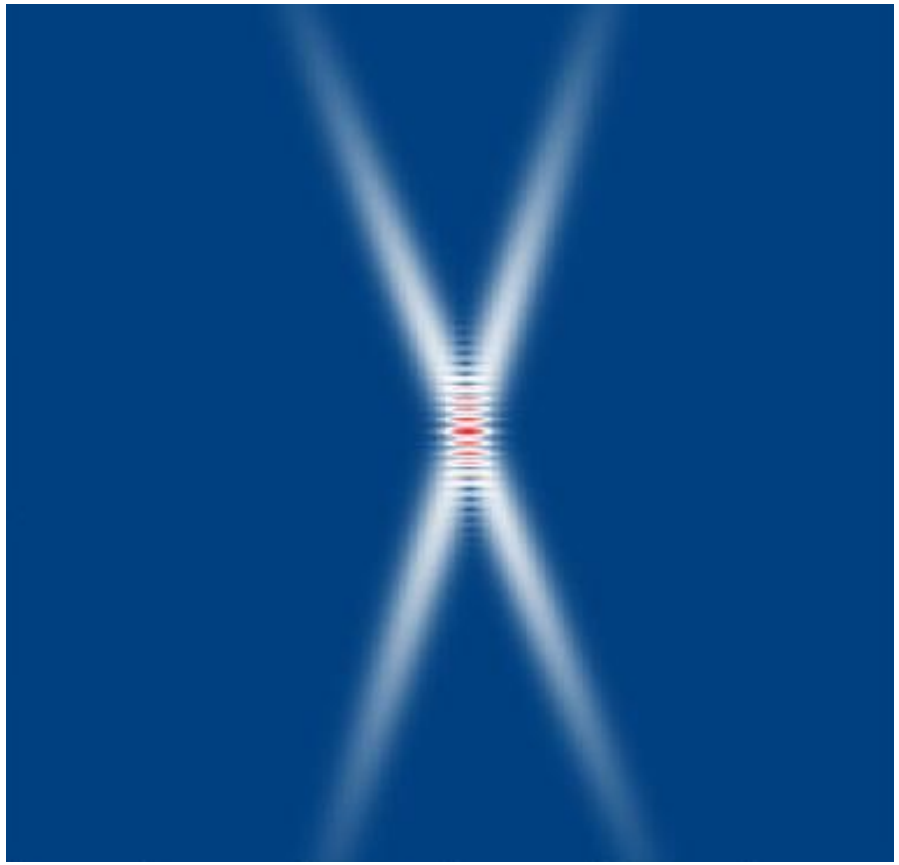
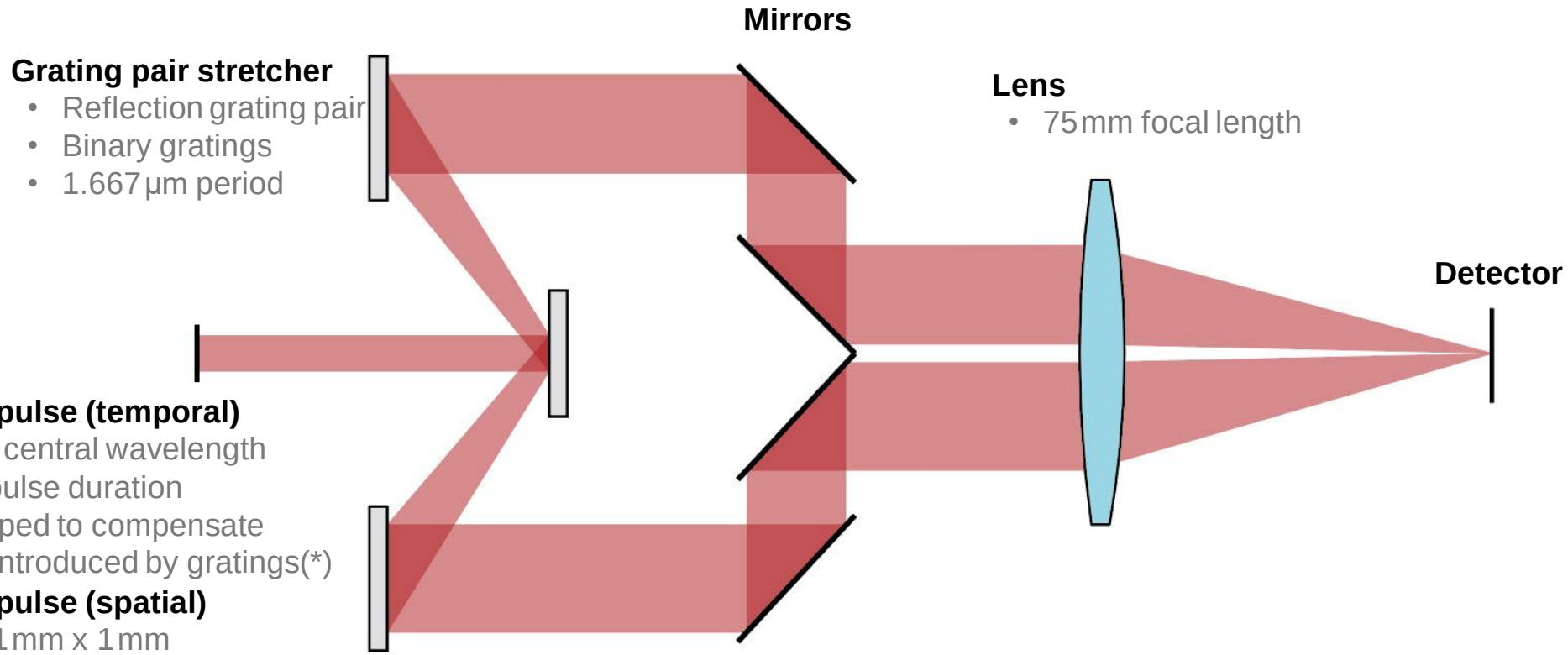
Interference Effects for Symmetric SSTF-Setups

Abstract



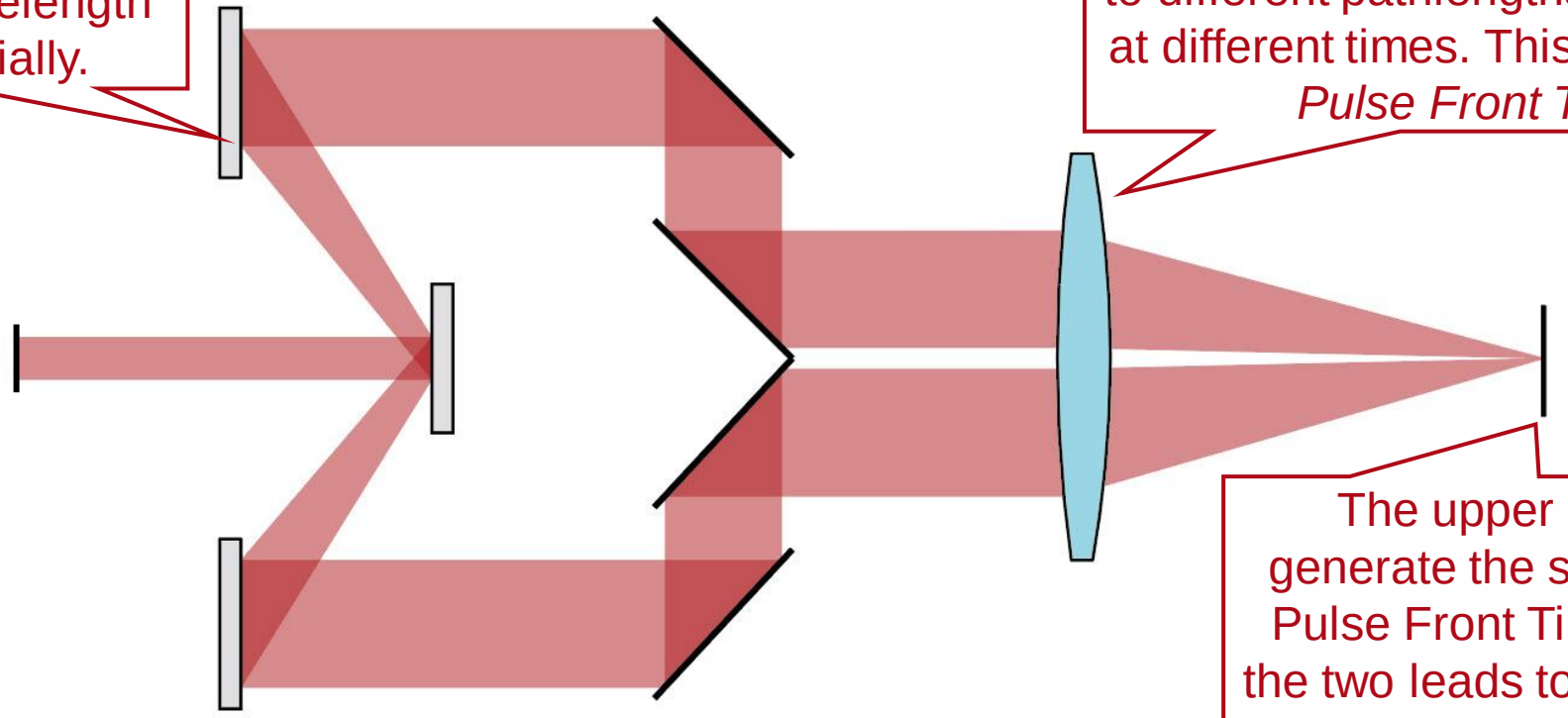
“Simultaneous spatial and temporal focusing” (SSTF) is a well known approach where light is spectrally widened with a stretcher setup and is then focused with a lens to get a focal spot that has a minimal size in space and time domain. This approach however, leads to a tilt of the pulse front, creating an asymmetric field distribution in the focus. To correct this behavior a symmetrized approach is show, utilizing two mirrored paths and the resulting interference effects are analyzed.

Application Scenario: System



Application Scenario: System

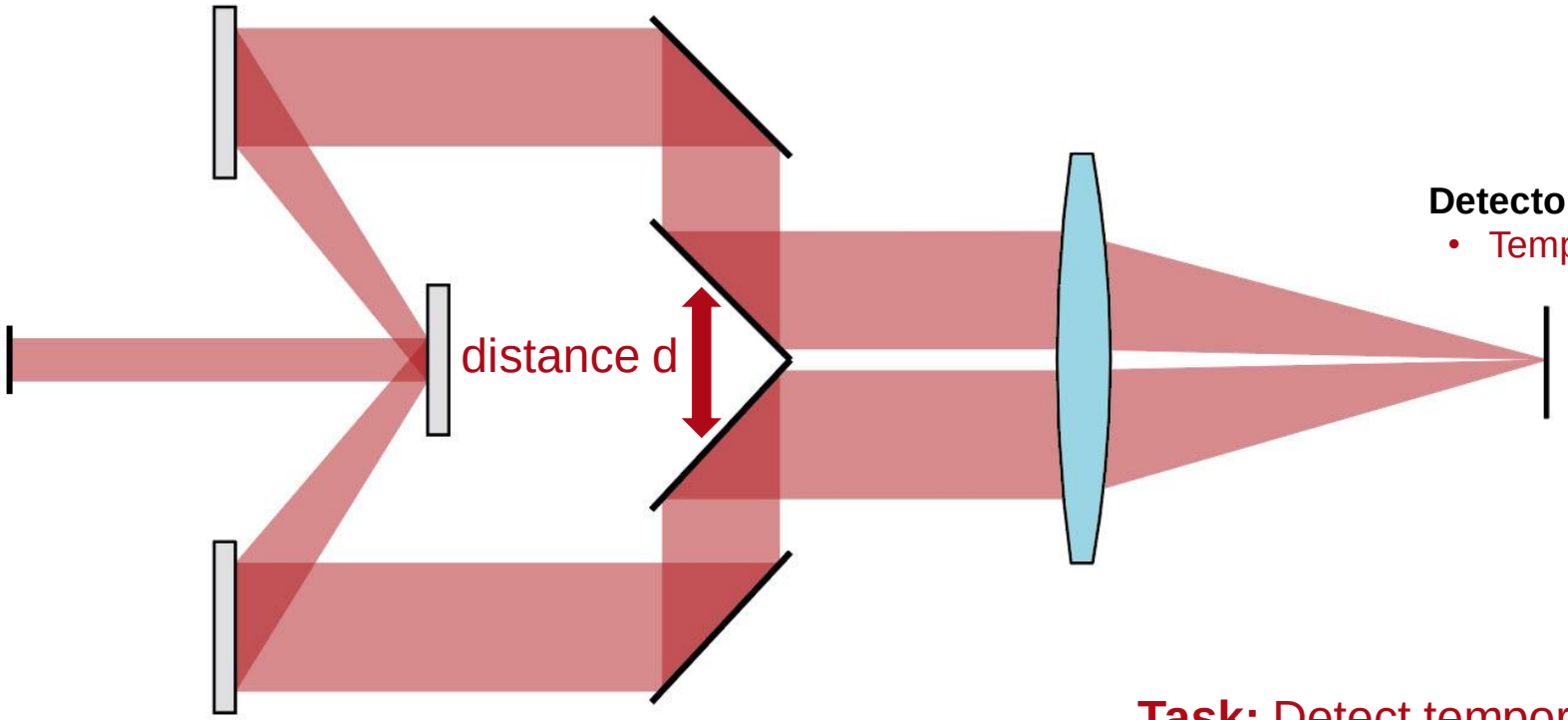
The grating pair separates wavelength modes spatially.



The lens focusses all wavelength modes to the same spot, but due to different pathlengths they arrive at different times. This results in a *Pulse Front Tilt*.

The upper and lower arm generate the same but mirrored Pulse Front Tilt. Superimposing the two leads to an symmetrical x-shaped pulse.

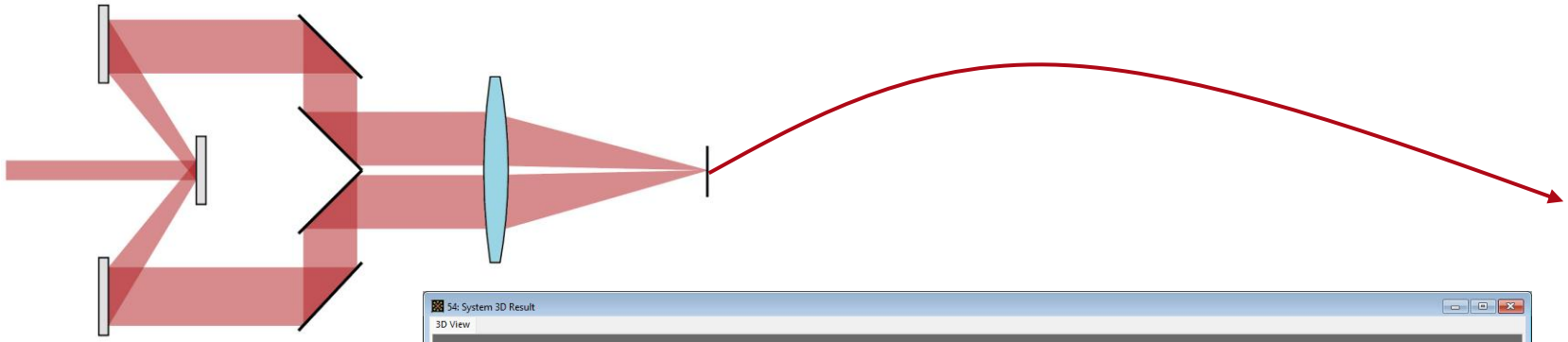
Application Scenario: Task

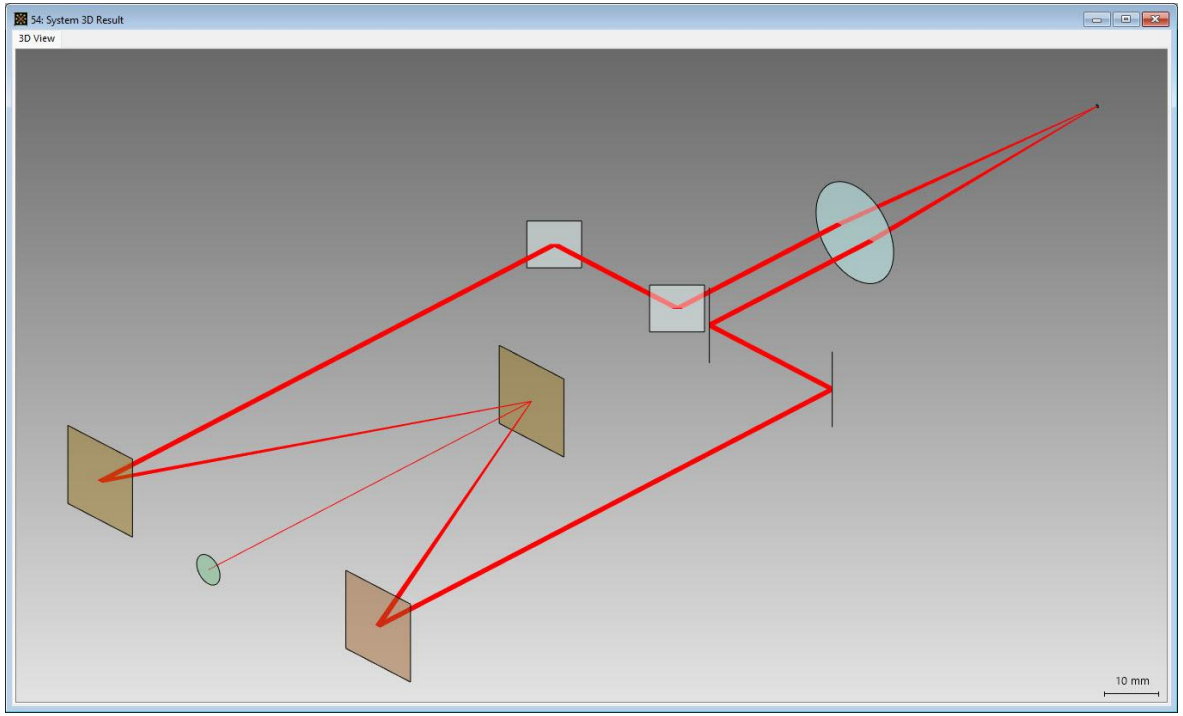


Task: Detect temporal envelope at focal spot for various distances d.

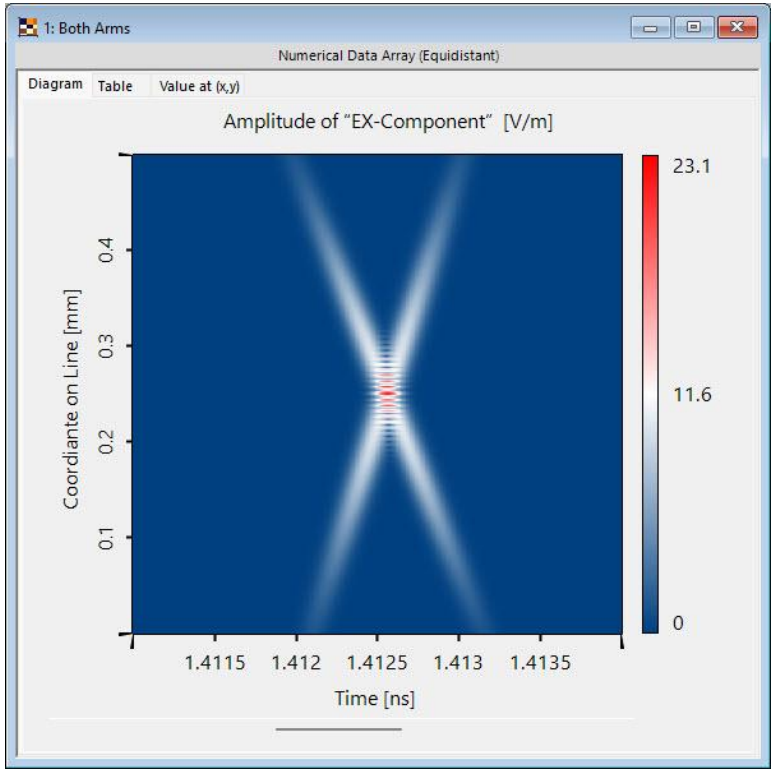
Simulation Results

System Impressions



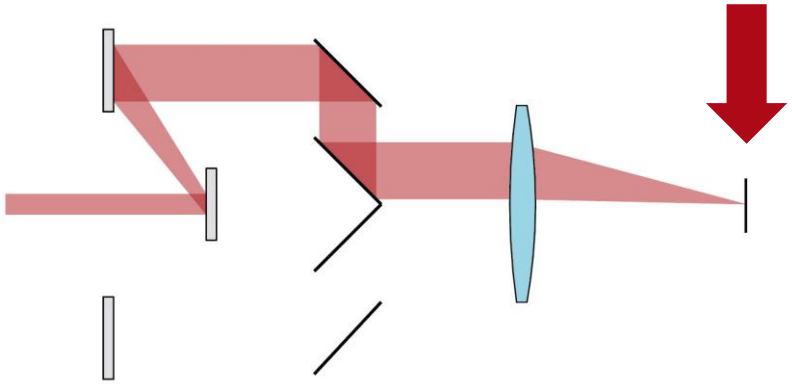


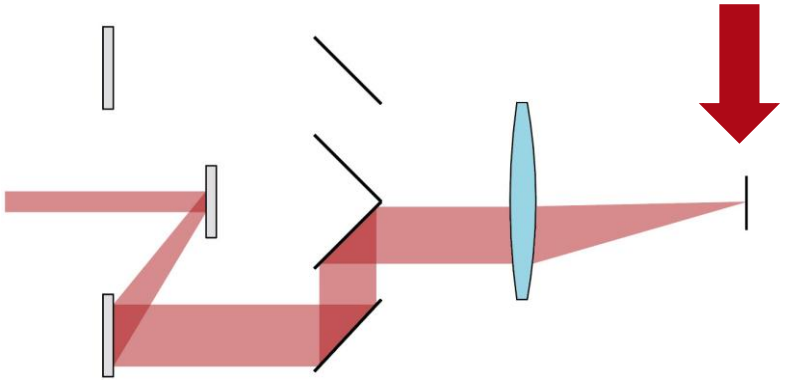
System 3D view (only center ray of central wavelength is shown for better visibility)

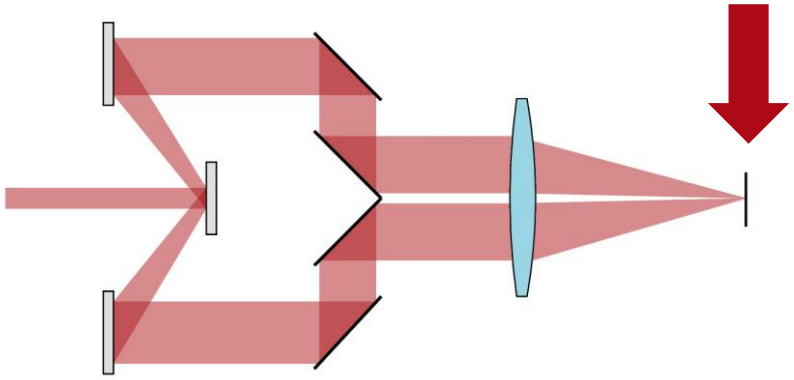


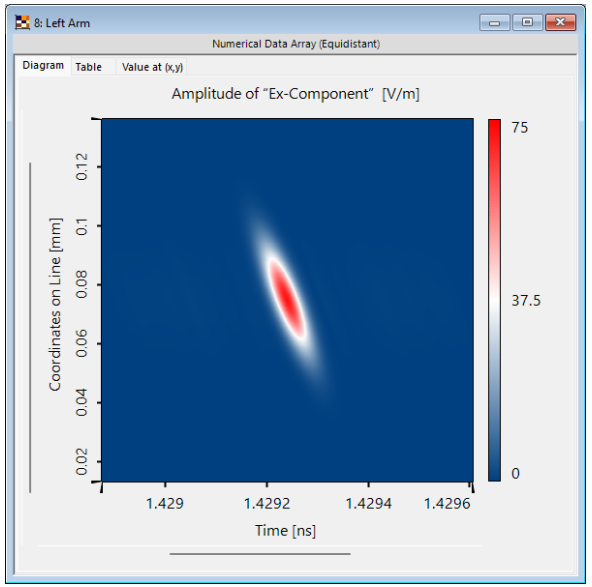
Temporal envelope at detector

Creation of a Cross-Pulse

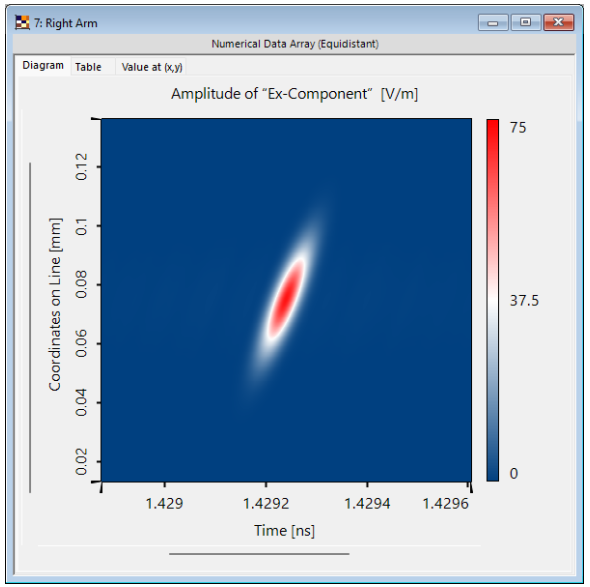




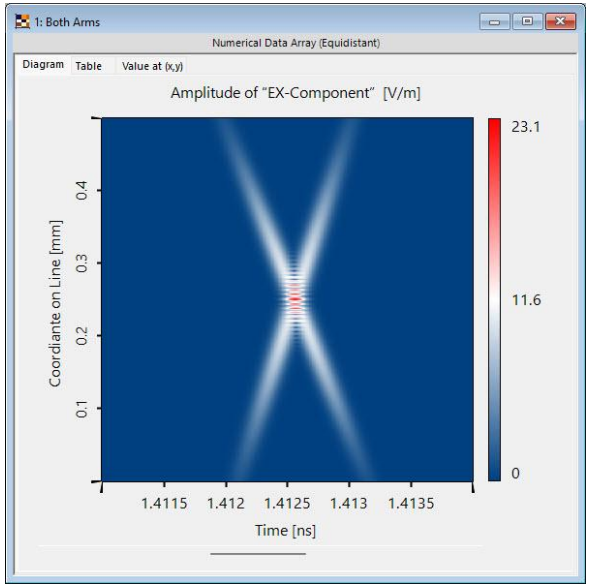




Temporal envelope over time for upper arm



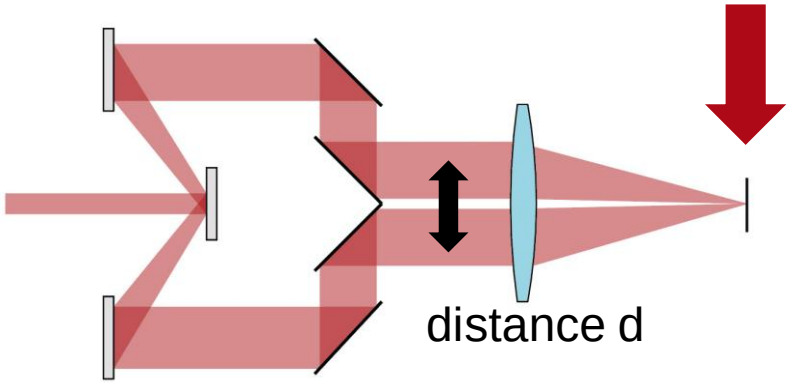
Temporal envelope over time for lower arm



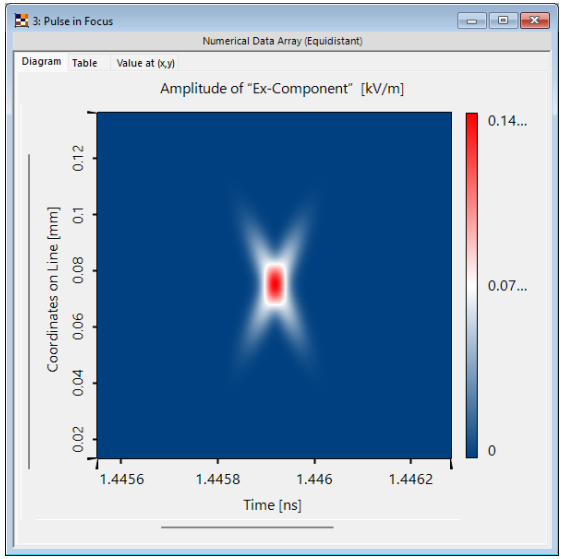
Temporal envelope over time for both arms

Interference in the Focal Region

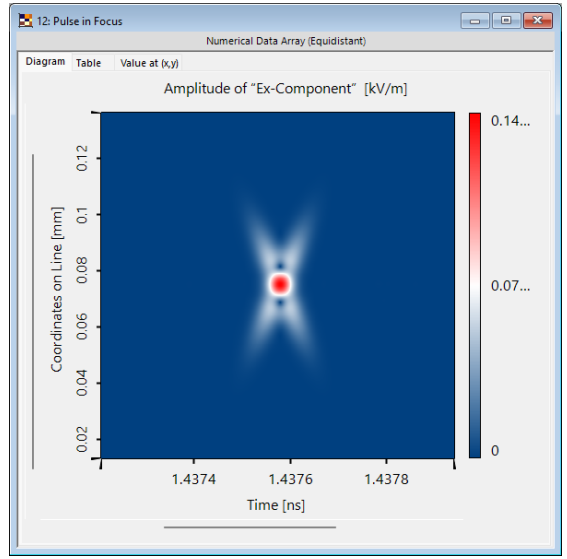
When the two orders are combined again, interference effects appear. The period of the lines along x-axis is directly proportional to the angle in which the two beams are focused and hence the distance of the two beams before they hit the focusing lens.

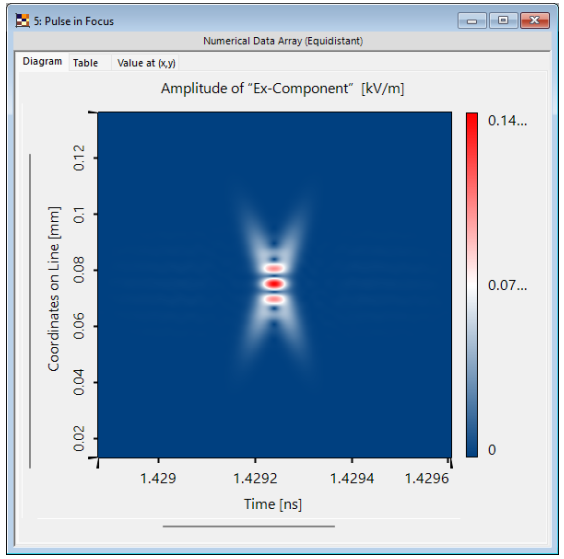


d = 0 mm

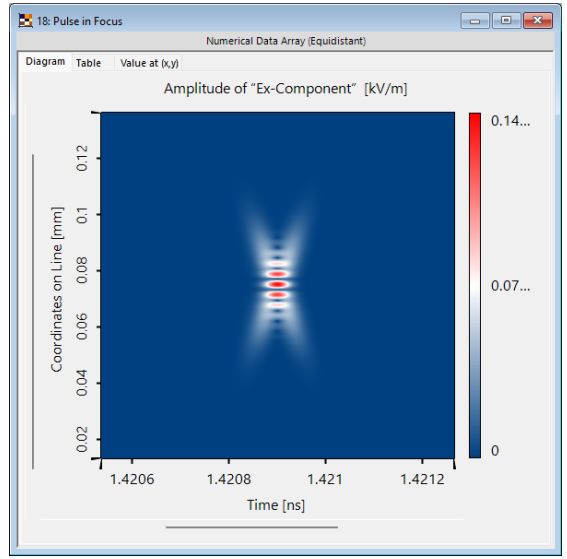


d = 5 mm





d = 10 mm



d = 15 mm

Workflow Steps

Basic Workflow Steps

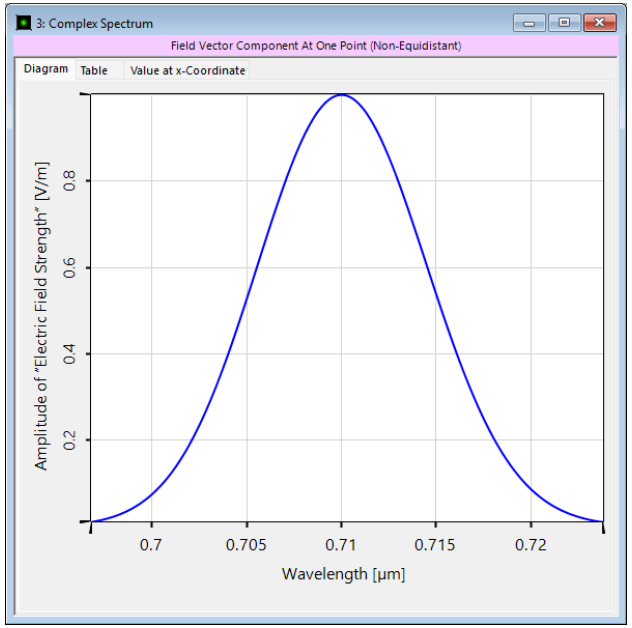
Source selection

System setup

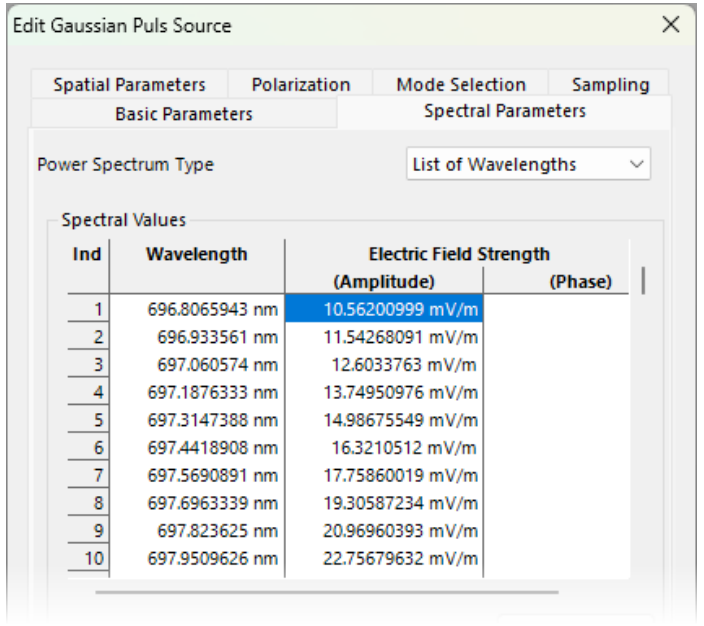
Detector selection

Getting it done in VirtualLab Fusion:

- Gaussian Wave
- Inclusion of spectra to source



Spectrum



Source settings

Basic Workflow Steps

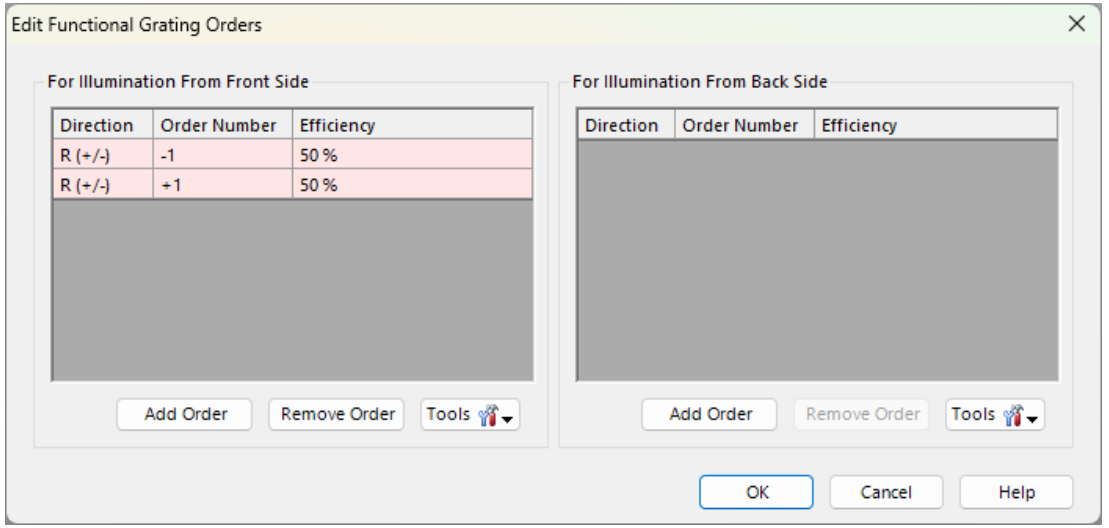
Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Functional Grating component
- Position and orientation of elements in the optical setup
- Channel configuration for surfaces and grating regions



Grating Channels

Basic Workflow Steps

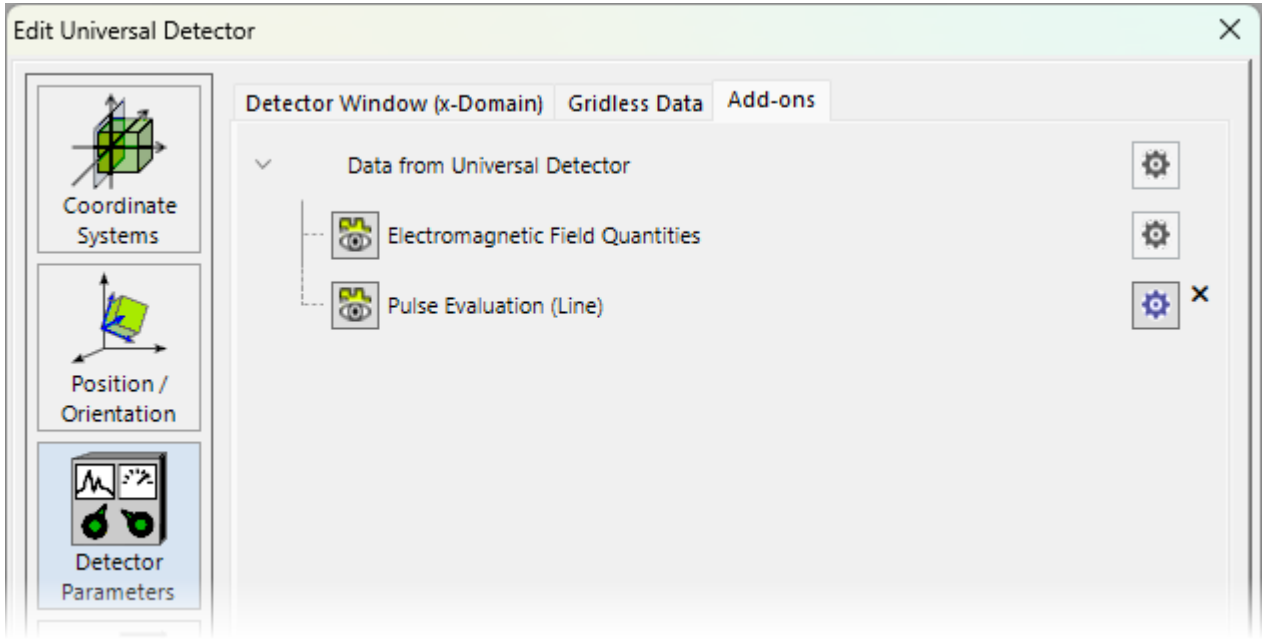
Source selection

System setup

Detector selection

Getting it done in VirtualLab Fusion:

- Universal Detector



Detector add-on selection

Document Information

Title	Interference Effects for Symmetric SSTF-Setups
Document code	USC.0441
Publication date	07.04.2025
Required packages	-
Software version	2024.1 (Build 2.74)*
Category	Use Case
Further reading	- Grating Stretcher for Ultrashort Pulses - Pulse Focusing with High-NA Lens

* *The files attached to this document require the specific version or later.*