

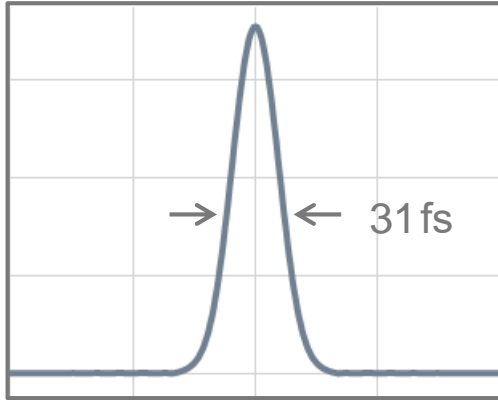
# **Grating Stretcher for Ultrashort Pulses**

# Abstract



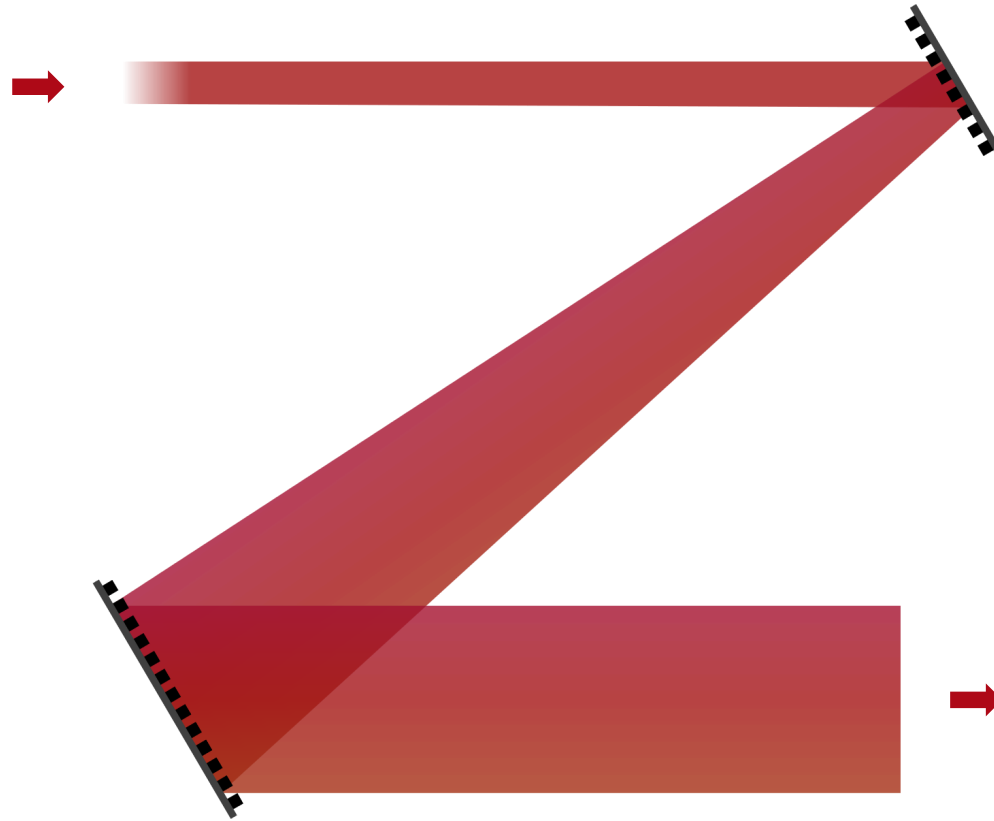
The role of ultrashort pulses is growing in modern optical applications. For example, they can be found in the fields of laser material processing, medical imaging, optical communication and so on. Prisms and gratings are typical optical components that are used for manipulating the temporal behavior of optical pulses. In this example, a pulse stretcher consisting of two diffractive gratings are constructed and the pulse broadening effect after propagation through them is demonstrated.

# Modeling Task



input pulse

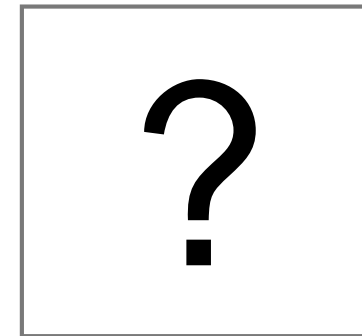
- carrier wavelength 619nm
- temporal duration 31 fs
- Gaussian spatial profile  
[collimated]



gratings pair

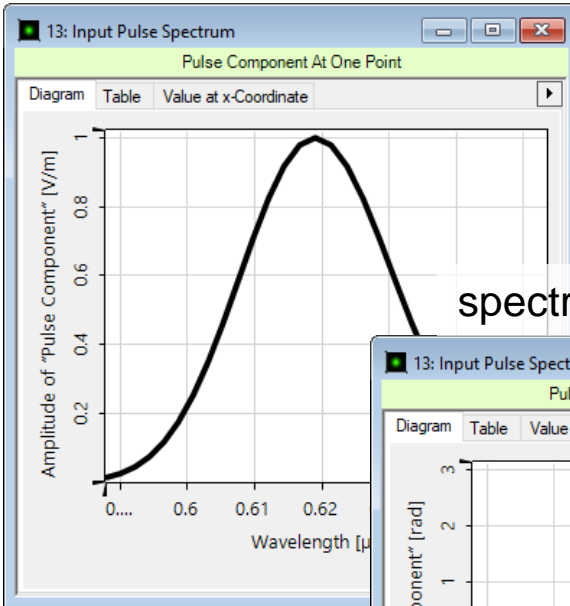
- period  $1.667\mu\text{m}$
- rotation angle  $30^\circ$
- diffraction order  $R+1$
- distance between two gratings 64 mm

How does the two diffraction gratings changes the ultrashort pulse that propagates through them?

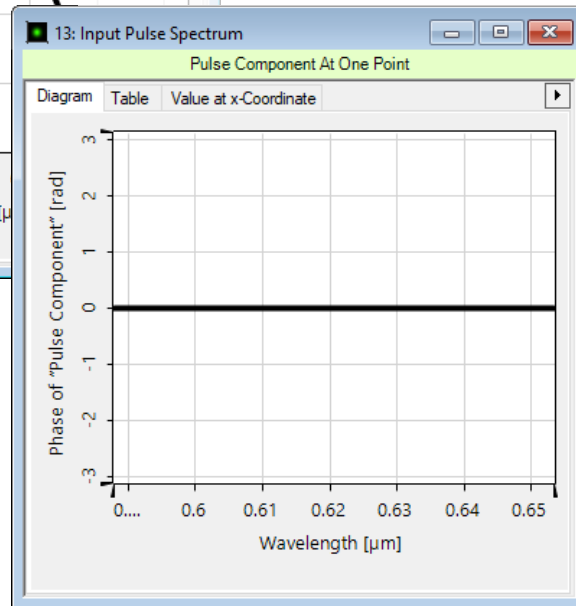


# Input Pulse in Both Domains

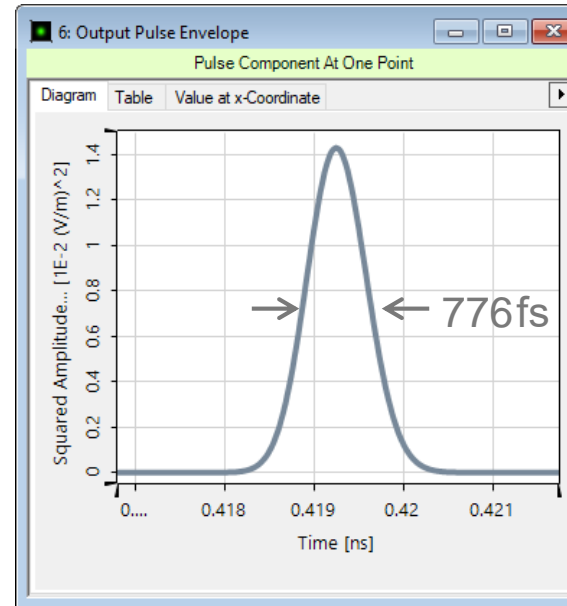
spectrum domain (amplitude)



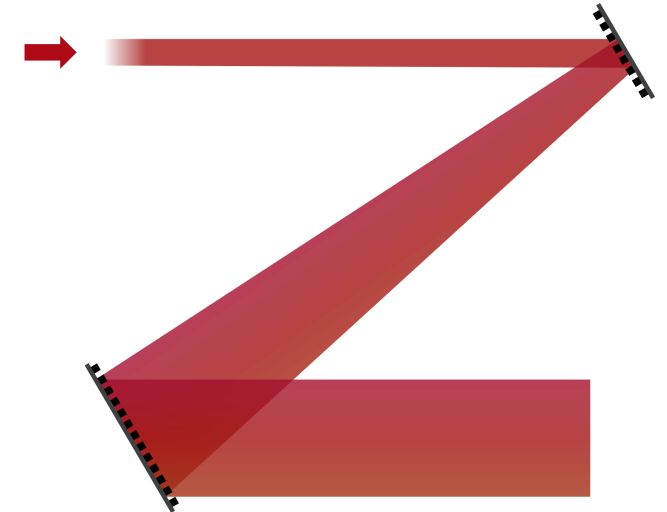
spectrum domain (phase)



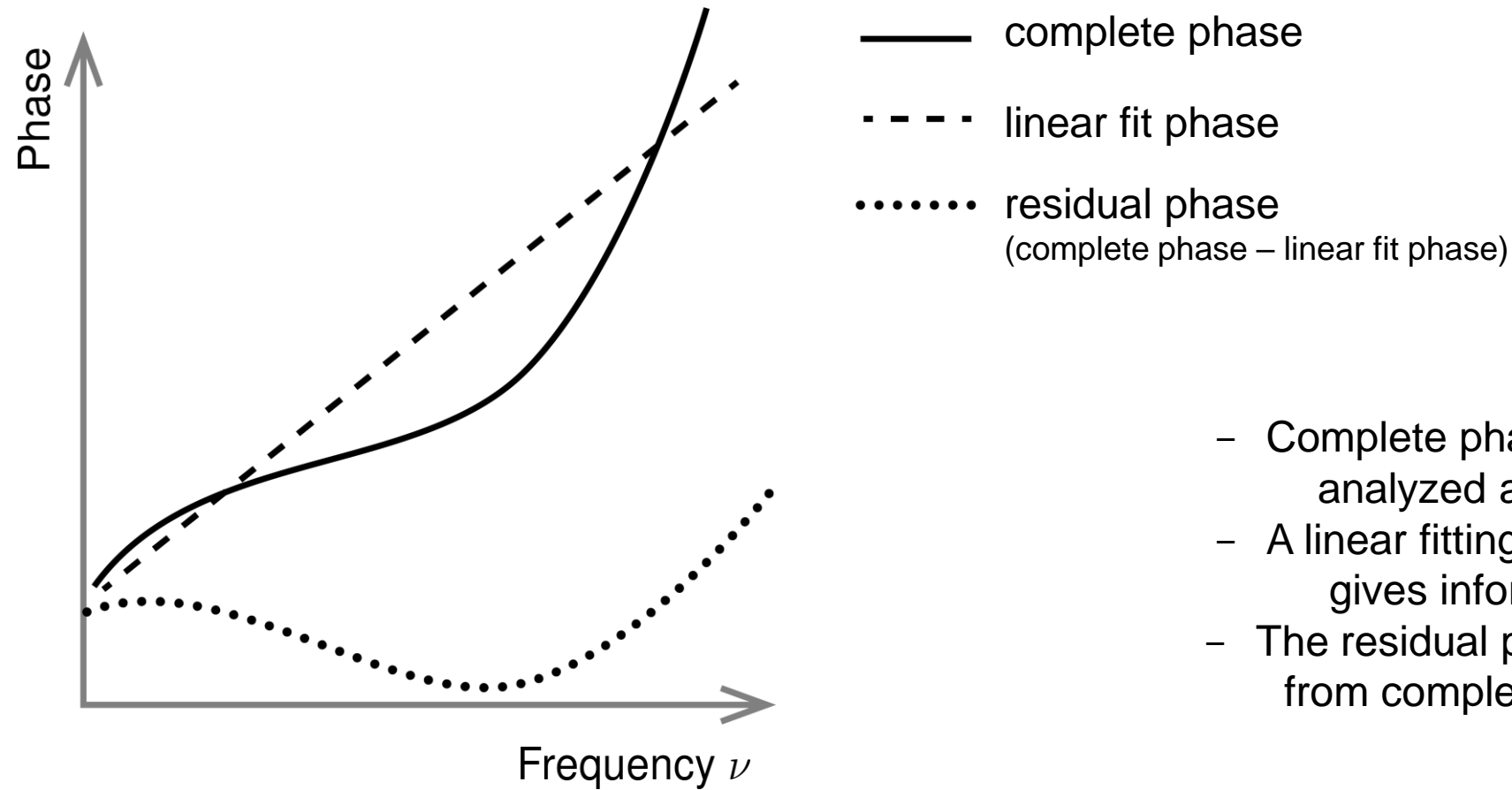
time domain  
(squared amplitude)



Nonlinear spectral phase leads to broadening of the temporal pulse envelope.

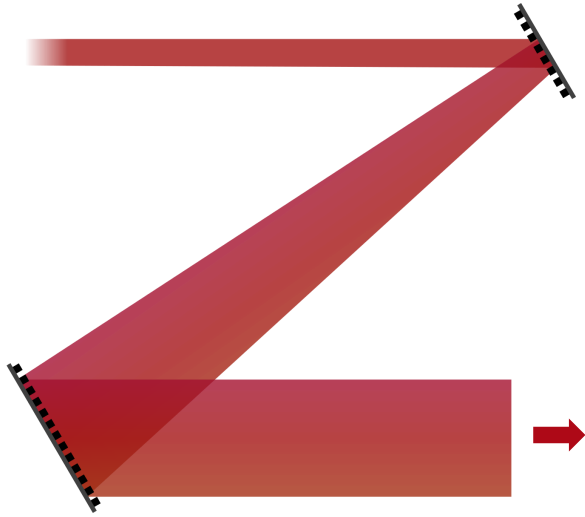


# Analysis of Phase over Frequency

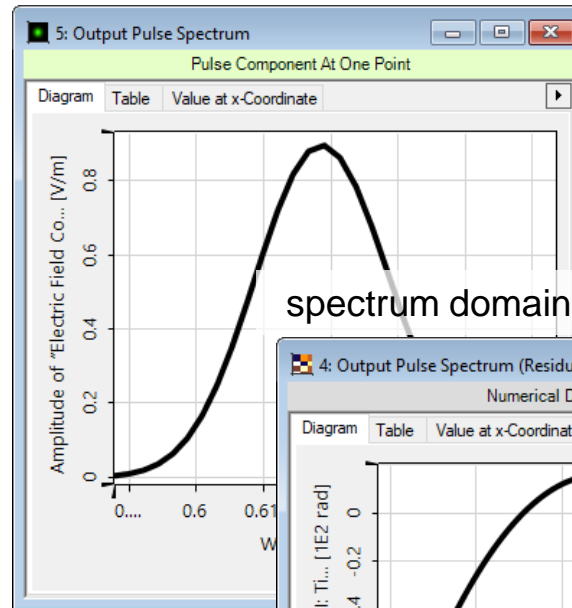


- Complete phase v.s. frequency can be analyzed at a given spatial position.
- A linear fitting of phase over frequency gives information on temporal shift.
- The residual phase (extracting linear fit from complete phase) determines the temporal pulse profile.

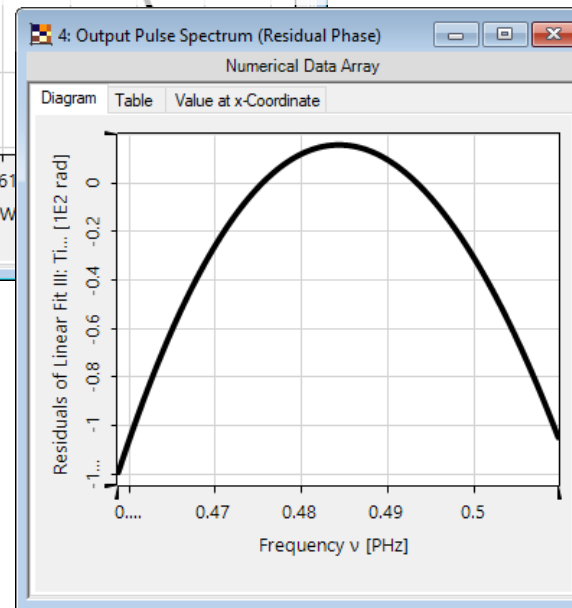
# Output Pulse in Both Domains



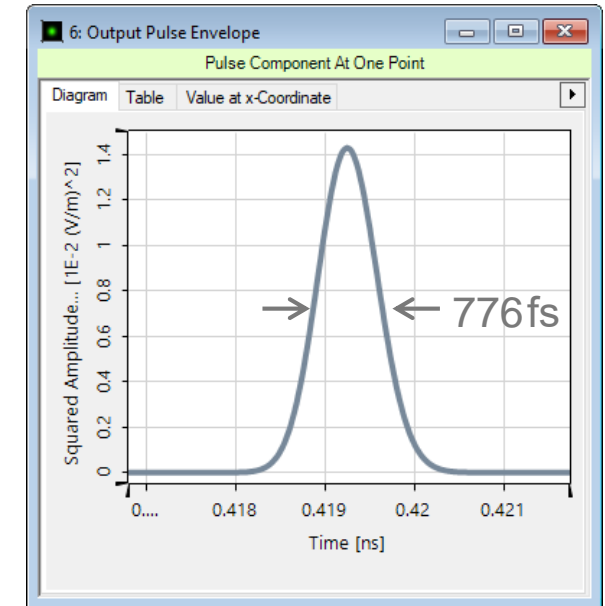
spectrum domain (amplitude)



spectrum domain (residual phase)

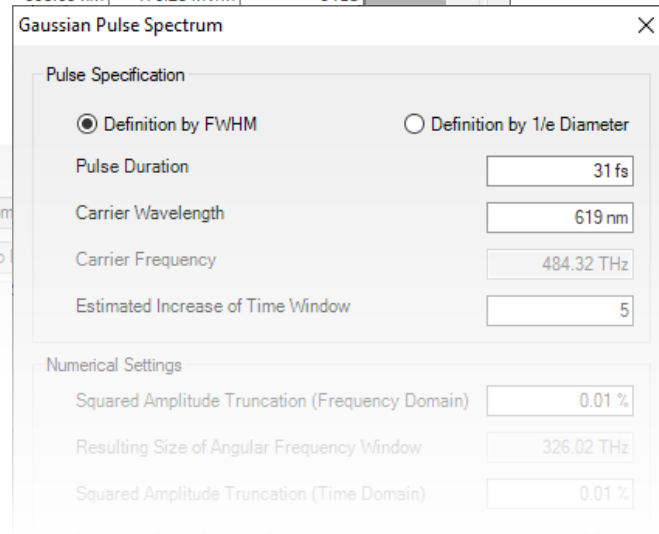
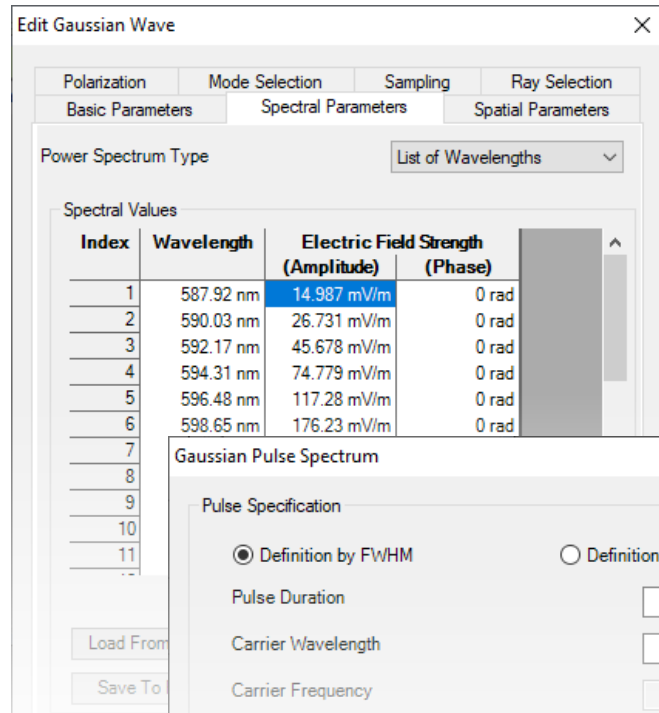


time domain  
(squared amplitude)

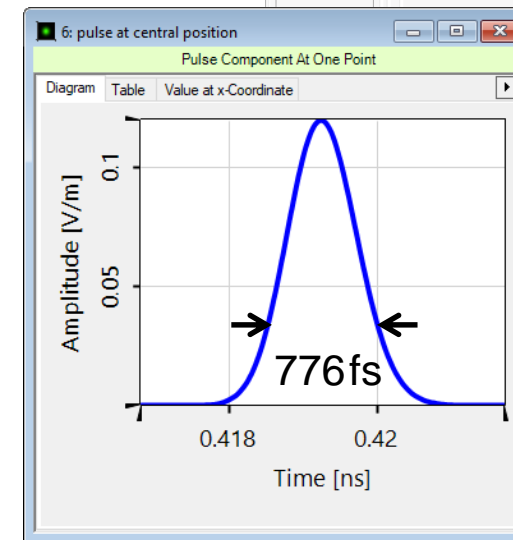
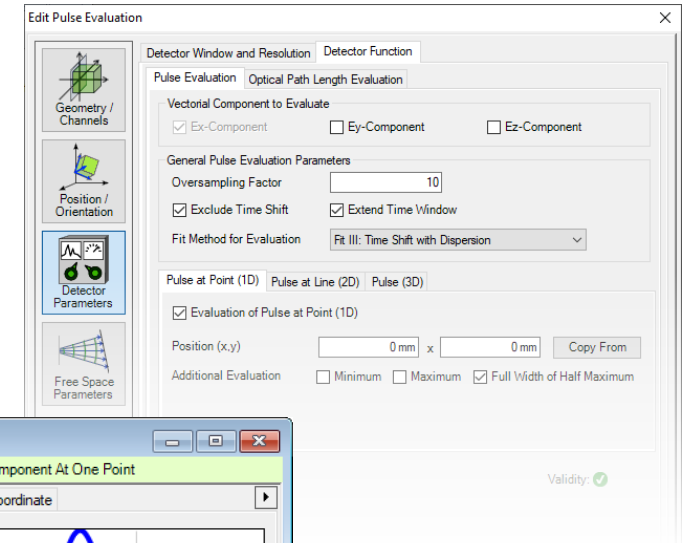
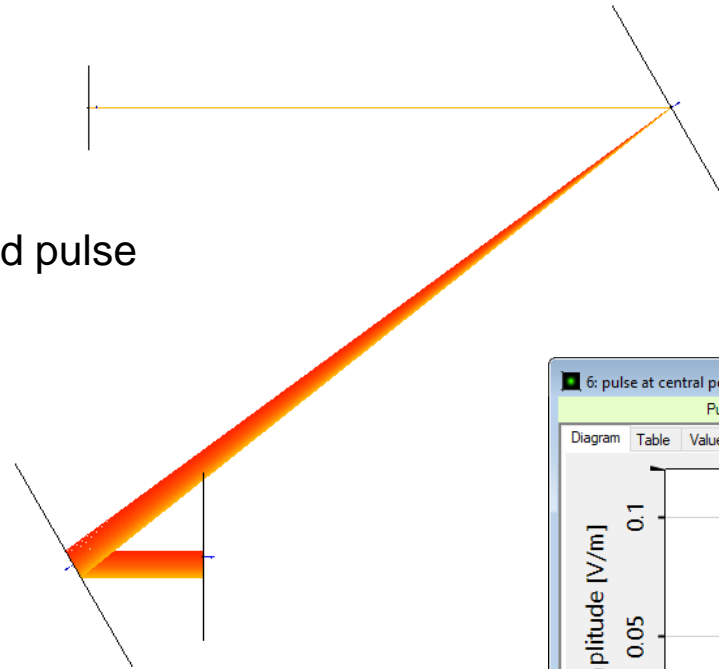


Higher-order spectral phase  
leads to broadening of the  
temporal pulse envelope.

# Peek into VirtualLab Fusion



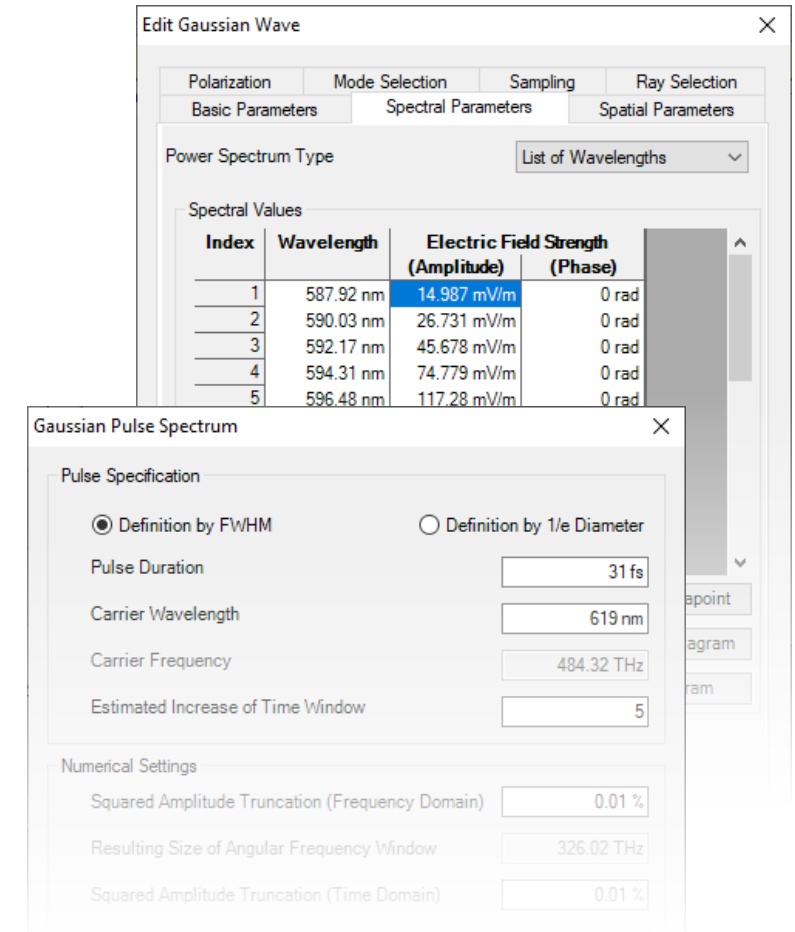
customized pulse spectrum



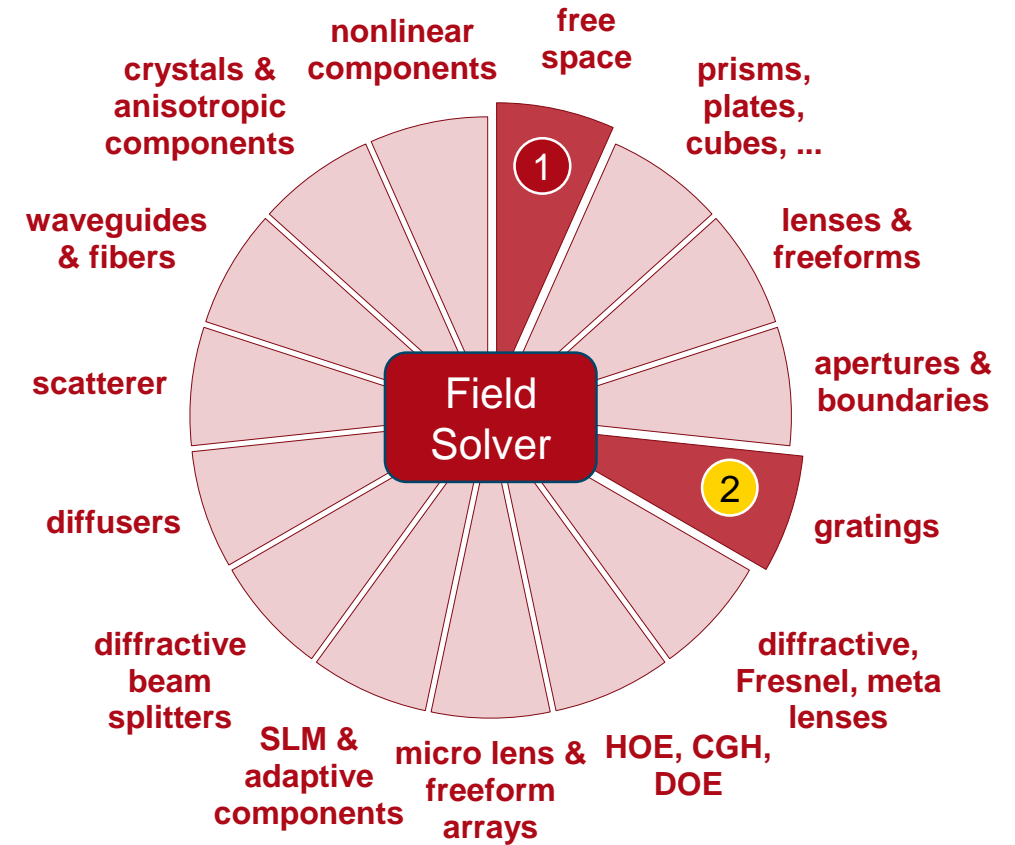
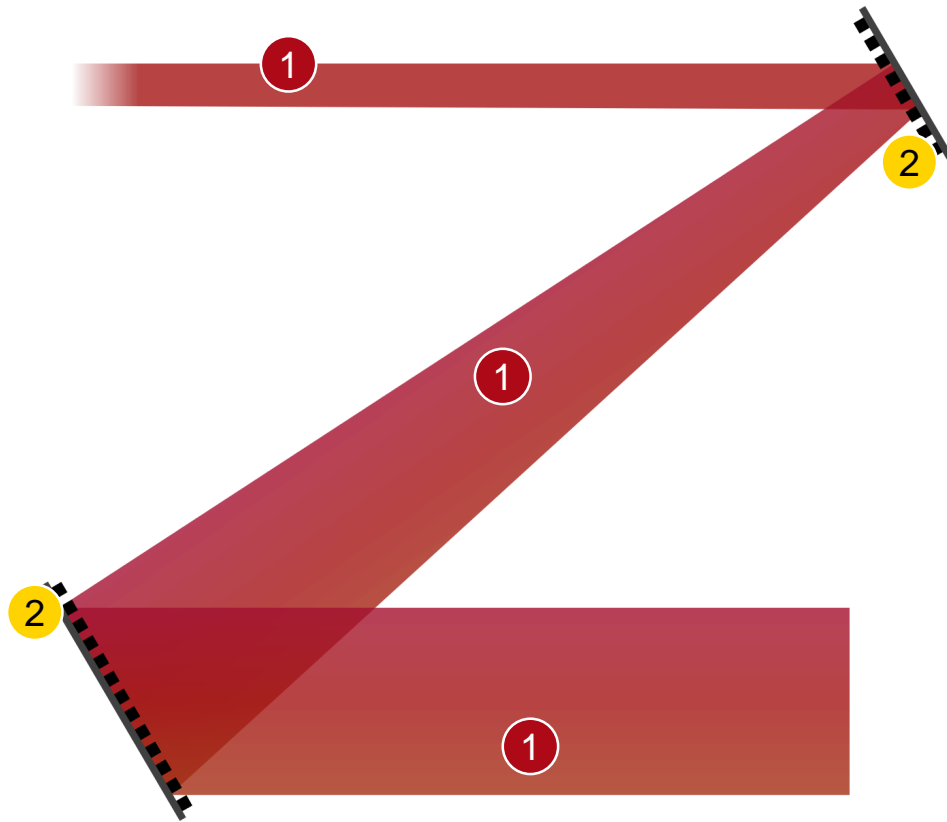
pulse evaluation detector

# Workflow in VirtualLab Fusion

- Set up input Gaussian field
  - [Basic Source Models](#) [Tutorial Video]
- Set up an ideal grating and select the working diffraction order
- Select and set up the pulse evaluation detector



# VirtualLab Fusion Technologies



# idealized component

# Document Information

title	Grating Stretcher for Ultrashort Pulses
document code	MISC.0076
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	VirtualLab Fusion Spring Release 2019
category	Application Use Case
further reading	<ul style="list-style-type: none"><li>- <a href="#">Focusing of Femtosecond Pulse by using a High-NA Off-Axis Parabolic Mirror</a></li><li>- <a href="#">Pulse Focusing with High-NA Lens</a></li><li>- <a href="#">Pulse Broadening in Dispersive Media</a></li></ul>