

fiberdesk

nonlinear pulse propagation

fiberdesk – graphical user interface (GUI)



fiberdesk – NLSE parameter setup

Parameter access in detail:

$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2}A + \int_{-\infty}^{\infty} \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega T} d\omega + \sum_{n \geq 1} \beta_n \frac{i^{n+1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \cdot \left(1 + i\tau_{shock} \frac{\partial}{\partial T} \right) \left(A(T) \int_{-\infty}^{\infty} R(\tau) |A(T-\tau)|^2 d\tau \right)$$

Propagation parameter

Load Save

standard propagation Setup >

general

define free parameters

☒ measure and parse 100 >

☐ write file

waveguide

loss 0.0 1/m

gain 0 1/m

mode diameter 3 μm

gamma 0.035555555 1/(W m)

effects

☒ dispersion

☒ SPM / TPA

☒ Raman

☒ self-steepening

☐ LLE

numerics

steps 7500

Gain

steady state gain (long pulses to cw)

☐ saturate gain with Esat = 1e-9 J $g = g_0 / (1 + \frac{E}{E_{sat}})$

profile

gain profile

Center 1060 nm Width 40 nm

shape const

add second peak

Center 1060 nm Width 40 nm

shape const

ratio of second to first peak (set to zero for only one peak): 0

user defined gain file

☐ use ASCII file for gain profile given in g(1/m) vs. wavelength (separator TAB)

file ...

temporal gain saturation (pulses shorter than population relaxation time)

☐ use temporal gain saturation instead of steady state gain and profiles, with

saturation fluence F 30 J/cm²

saturation energy with current MFD: J

$g(T) = g_0 \exp\left(-\frac{1}{E_{sat}} \int_{-\infty}^T |A(t)|^2 dt\right)$ with $E_{sat} = F \cdot A_{eff}$

Back

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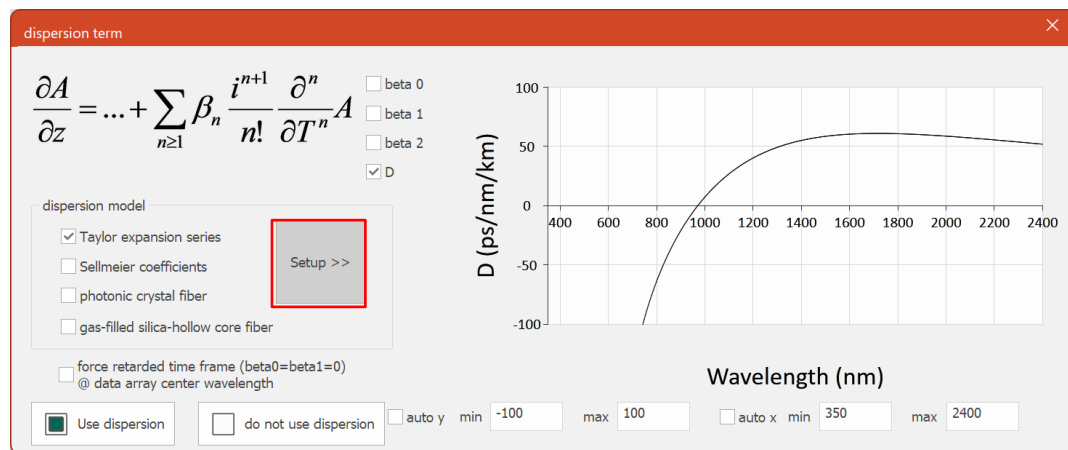
☒ dispersion

☒ SPM / TPA

☒ Raman

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☐ LLE



Dispersion Setup

Taylor Series @ 1060 nm predefined more ...

Beta	Value	Unit	Compensate at	Value	Unit
Beta1	0	ps/m	compensate at:	800	nm
Beta2	-0.01185	ps ² /m	D	19.8658517912	ps/(nm*km)
Beta3	7.995e-5	ps ³ /m	S	0.187213	ps/(nm ² *km)
Beta4	0.0				
Beta5	1.21005e-10				
Beta6	4.0347e-14				
Beta7	0				
Beta8	0				
Beta9	0				
Beta10	0				
Beta11	0				
Beta12	0				
Beta13	0				
Beta14	0				

Trust region from 0 nm to 20000 nm

☐ force retarded time frame (beta0=beta1=0)
@ data array center wavelength

grating compressor >>

OK Cancel Save Load

copy dispersion ([nm], D[ps/nm/km], b2[ps²/m])

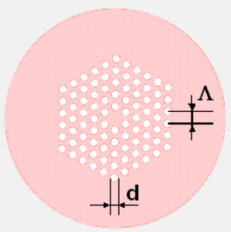
copy beta2 + group delay [nm], b2 [ps²/m], GD[ps/m]

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PCF Parameter



pitch5.0μm

hole diameter d0.5μm

d/L2.9209714

Copy values to clipboard

lambda = pitch/10 .. pitch * 2.0

V and W parametern_eff

dispersion D[ps/nm/km]

Material dispersion

$$n = \sqrt{A + \frac{B_1 \lambda^2}{\lambda^2 - C_1} + \frac{B_2 \lambda^2}{\lambda^2 - C_2} + \frac{B_3 \lambda^2}{\lambda^2 - C_3}}$$

predefinedmore...

A1

B10.696166C10.00467915μm²

B20.407943C20.0135121μm²

B30.897479C397.934μm²

OK

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loss0.01/m

gain01/m

mode diameter3μm

gamma0.0355555551/(W m)

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☐ LLE

dispersion term

$$\frac{\partial A}{\partial z} = \dots + \sum_{n \geq 1} \beta_n \frac{i^{n+1}}{n!} \frac{\partial^n}{\partial T^n} A$$

☐ beta 0

☐ beta 1

☐ beta 2

☒ D

dispersion model

☒ Taylor expansion series

☐ Sellmeier coefficients

☐ photonic crystal fiber

☐ gas-filled silica-hollow core fiber

Setup >>

☐ force retarded time frame (beta0=beta1=0) @ data array center wavelength

☒ Use dispersion

☐ do not use dispersion

☐ auto y

Gas filled silica hollow core fiber (fundamental mode)

predefinedmore...

$$n = \sqrt{A + \frac{B_1 \lambda^2}{\lambda^2 - C_1} + \frac{B_2 \lambda^2}{\lambda^2 - C_2} + \frac{B_3 \lambda^2}{\lambda^2 - C_3}}$$

T00K

P00Pa

B10C10

B20C20

B30C30

actual

T273.15K

P101325Pa

fiber

inner structure thickness100nm

core diameter 2*R80μm

OK

Dielectric dispersive medium

$$n = \sqrt{A + \frac{B_1 \lambda^2}{\lambda^2 - C_1} + \frac{B_2 \lambda^2}{\lambda^2 - C_2} + \frac{B_3 \lambda^2}{\lambda^2 - C_3}}$$

predefinedmore...

A1

B10.696166C10.00467915μm²

B20.407943C20.0135121μm²

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self phase modulation / two photon absorption term

$$\frac{\partial A}{\partial z} = \dots + i\gamma(1 - f_R)|A(T)|^2 A(T)$$

$$\gamma = \frac{\omega_0}{c} \frac{n_2}{A_{\text{eff}}} \text{ and } A_{\text{eff}} = \frac{\pi}{4} MFD^2$$

n2 3.2e-20 m²/W

f R 0.18

TPA 0.0 m/W

TPA is experimental so far

☐ saturate SPM

saturation power 1.0 GW/cm²

☒ use SPM and TPA

☐ exclude SPM

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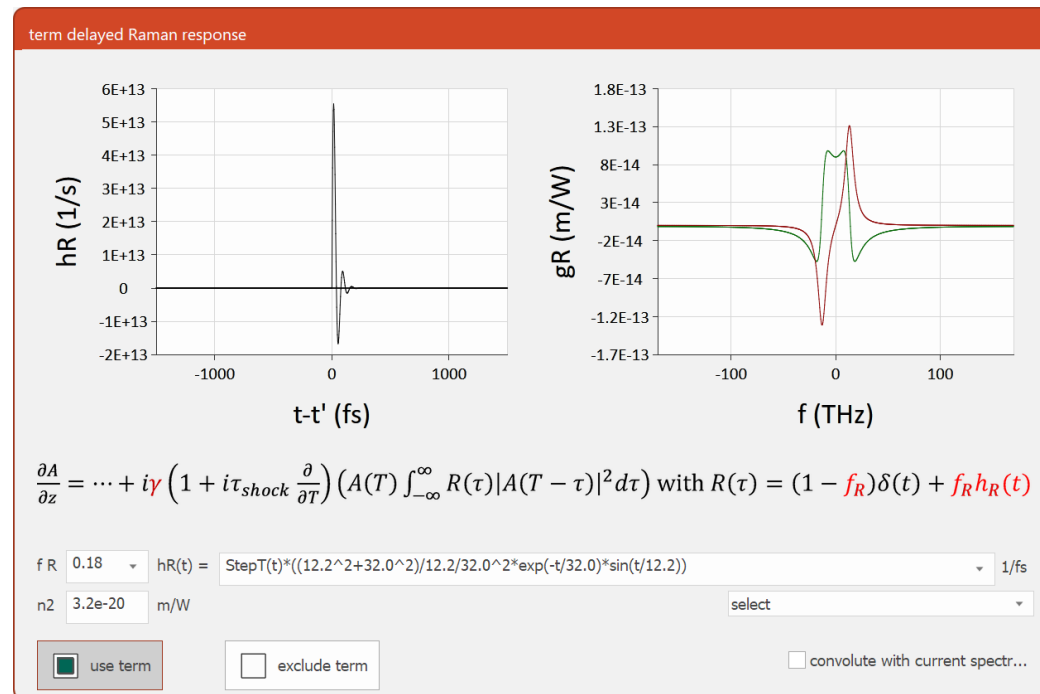
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☐ LLE

term self steepening

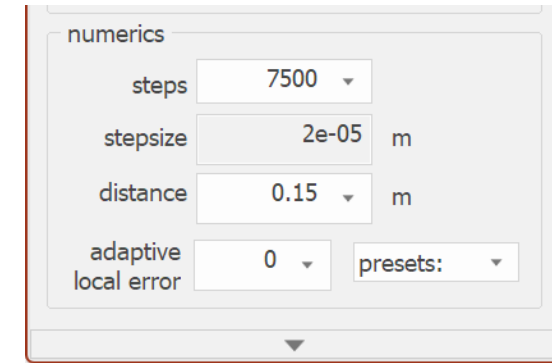
$$\frac{\partial A}{\partial z} = \dots + i\gamma \left(1 + i\tau_{shock} \frac{\partial}{\partial T} \right) \left(A(T) \int_{-\infty}^{\infty} R(\tau) |A(T-\tau)|^2 d\tau \right)$$
$$\tau_{shock} = \tau_0 + \tau_A = \frac{1}{\omega_0} - \left[\frac{1}{n_{eff}} \frac{dn_{eff}(\omega)}{d\omega} \right]_{\omega_0} - \left[\frac{1}{A_{eff}} \frac{dA_{eff}(\omega)}{d\omega} \right]_{\omega_0}$$

additional shock time 0.0 fs

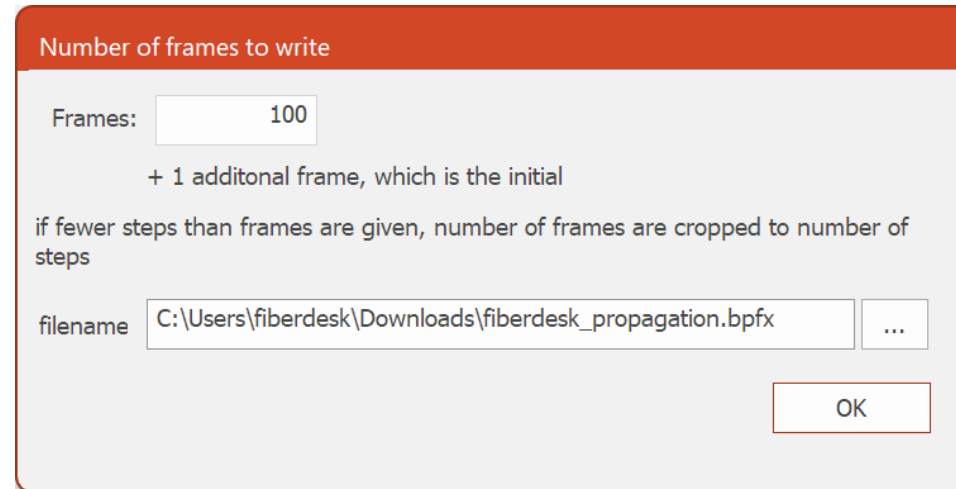
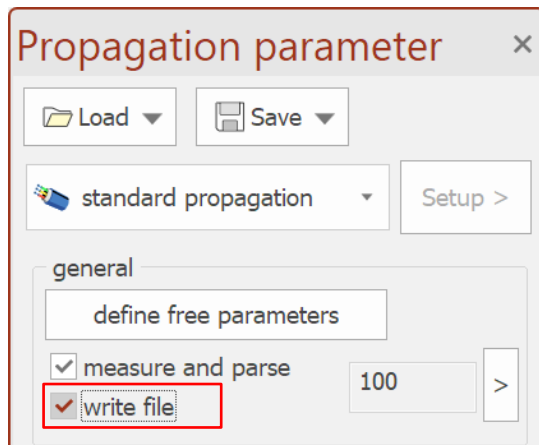
☒ use self steepening term ☐ exclude self steepening

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Propagation setup: distance, stepsize, numerical accuracy etc.



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file contains the initial field plus 100 fields from the calculated propagation for later analysis

file extension: ***.bpfx**