

fiberdesk

nonlinear pulse propagation

fiberdesk – graphical user interface (GUI)

The screenshot displays the fiberdesk GUI with several callout boxes highlighting key features:

- Ribbon control:** Located at the top of the window, containing various tool icons for simulation and analysis.
- Measured values:** A box pointing to the 'Measurements' panel on the left, which lists parameters such as (M0) index = 100, (M1) current position = 0.000 m, and (M2) accumulated distance = 0.000 m.
- Propagation parameter:** A box pointing to the 'Propagation parameter' panel on the left, showing settings for waveguide loss, gain, mode diameter, and effects like dispersion and SPM/TPA.
- Main View:** A central box pointing to the four main plots: 'Temporal Field' (Power / kW vs Time / ps), 'Temporal Propagation' (Distance / a.u. vs Time / ps), 'Spectrum' (Power / W ps² vs Wavelength / μm), and 'Spectral Propagation' (Distance / a.u. vs Wavelength / μm).
- Measured graphs:** A box pointing to the 'Measured Graphs' panel on the left, which shows a plot of 'Temporal Field energy / J' vs 'Position.index'.
- view setup:** A box pointing to the 'View Properties' panel on the right, which allows for customizing the display of project information, view content, and data scaling.
- Output:** A box pointing to the 'Message Output' panel at the bottom, which displays system messages like 'Welcome to fiberdesk 8.00'.

fiberdesk – NLSE parameter setup

Parameter access in detail:

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

The screenshot displays the 'Propagation parameter' and 'Gain' configuration windows in fiberdesk. In the 'Propagation parameter' window, the 'gain' field is highlighted in yellow. The 'Gain' window is open, showing the 'steady state gain (long pulses to cw)' model. The gain is defined as $g = g_0 / (1 + \frac{E}{E_{sat}})$. The saturation fluence F is set to 30 J/cm². The gain profile consists of two peaks, both centered at 1060 nm with a width of 40 nm. The ratio of the second peak to the first is set to 0. The 'temporal gain saturation' section is also visible, with the equation $g(T) = g_0 \exp\left(-\frac{1}{E_{sat}} \int_{-\infty}^T |A(t)|^2 dt\right)$ and $E_{sat} = F \cdot A_{eff}$.

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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 0.03555555 1/(W m)

effects

dispersion

SPM / TPA

Raman

self-steepening

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 **Setup >>**

Sellmeier coefficients

photonic crystal fiber

gas-filled silica-hollow core fiber

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

Use dispersion do not use dispersion

auto y min -100 max 100 auto x min 350 max 2400

Dispersion Setup

Taylor Series @ 1060 nm predefined more ...

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 >>

Save Load

OK Cancel

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

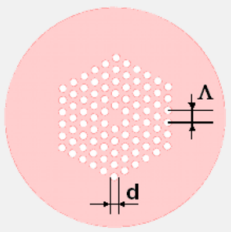
copy beta2 + group delay [nm],b2 [ps²/m], GD[ps/m]

fiberdesk – NLSE parameter setup

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PCF Parameter



pitch 5.0 μm
 hole diameter d 0.5 μm
 d/Λ 2.9209714

Material dispersion

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

Copy values to clipboard
 lambda = pitch/10 .. pitch * 2.0
 V and W parameter n_eff
 dispersion D[ps/nm/km]

predefined more...

A	1		
B1	0.696166	C1	0.00467915 μm ²
B2	0.407943	C2	0.0135121 μm ²
B3	0.897479	C3	97.934 μm ²

OK

Propagation parameter

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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

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

Use dispersion do not use dispersion auto y

Setup >>

Gas filled silica hollow core fiber (fundamental mode)

predefined more...

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

T0 0 K p0 0 Pa

B1 0 C1 0

B2 0 C2 0

B3 0 C3 0

actual

T 273.15 K p 101325 Pa

fiber

inner structure thickness 100 nm

core diameter 2*R 80 μm

OK

Dielectric dispersive medium

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

predefined more...

A	1		
B1	0.696166	C1	0.00467915 μm ²
B2	0.407943	C2	0.0135121 μm ²
B3	0.897479	C3	97.934 μm ²

OK

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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

fiberdesk – NLSE parameter setup

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self-steepening

LLE

term delayed Raman response

$\frac{\partial A}{\partial z} = \dots + i\gamma \left(1 + i\tau_{shock} \frac{\partial}{\partial T} \right) \left(A(T) \int_{-\infty}^{\infty} R(\tau) |A(T-\tau)|^2 d\tau \right)$ with $R(\tau) = (1 - f_R)\delta(\tau) + f_R h_R(\tau)$

f R 0.18 hR(t) = StepT(t)*((12.2^2+32.0^2)/12.2/32.0^2*exp(-t/32.0)*sin(t/12.2)) 1/fs

n2 3.2e-20 m/W select

use term exclude term convolute with current spectr...

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Propagation parameter

Load Save

standard propagation Setup >

general

define free parameters

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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

term self steepening

$$\frac{\partial A}{\partial z} = \dots + i\gamma \left(1 + i\tau_{shock} \frac{\partial}{\partial T} \right) \left(A(T) \int_{-\infty}^{\infty} R(\tau) |A(T-\tau)|^2 d\tau \right)$$

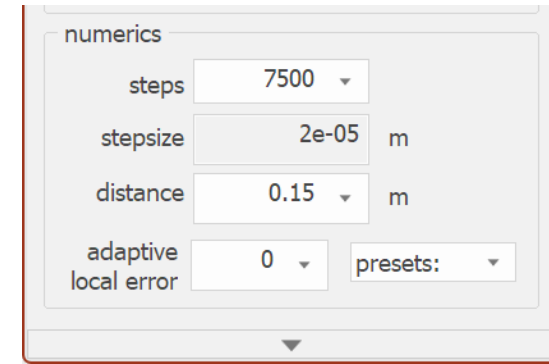
$$\tau_{shock} = \tau_0 + \tau_A = \frac{1}{\omega_0} - \left[\frac{1}{n_{eff}} \frac{dn_{eff}(\omega)}{d\omega} \right]_{\omega_0} - \left[\frac{1}{A_{eff}} \frac{dA_{eff}(\omega)}{d\omega} \right]_{\omega_0}$$

additional shock time 0.0 fs

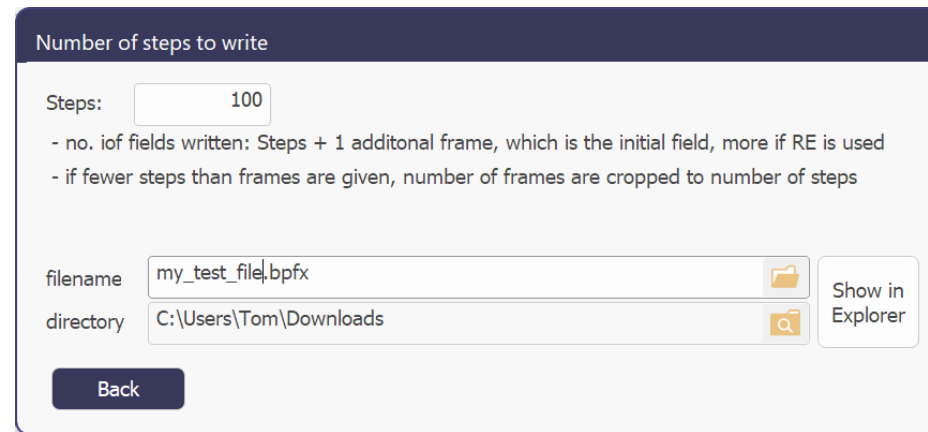
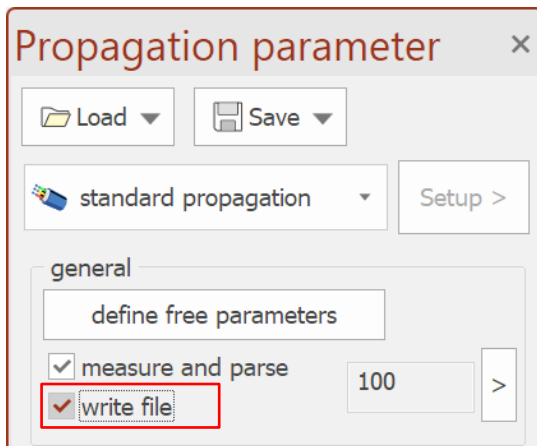
use self steepening term exclude self steepening

fiberdesk – NLSE parameter setup

Propagation setup: distance, stepsize, numerical accuracy etc.



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

file extension: ***.bpfx**