

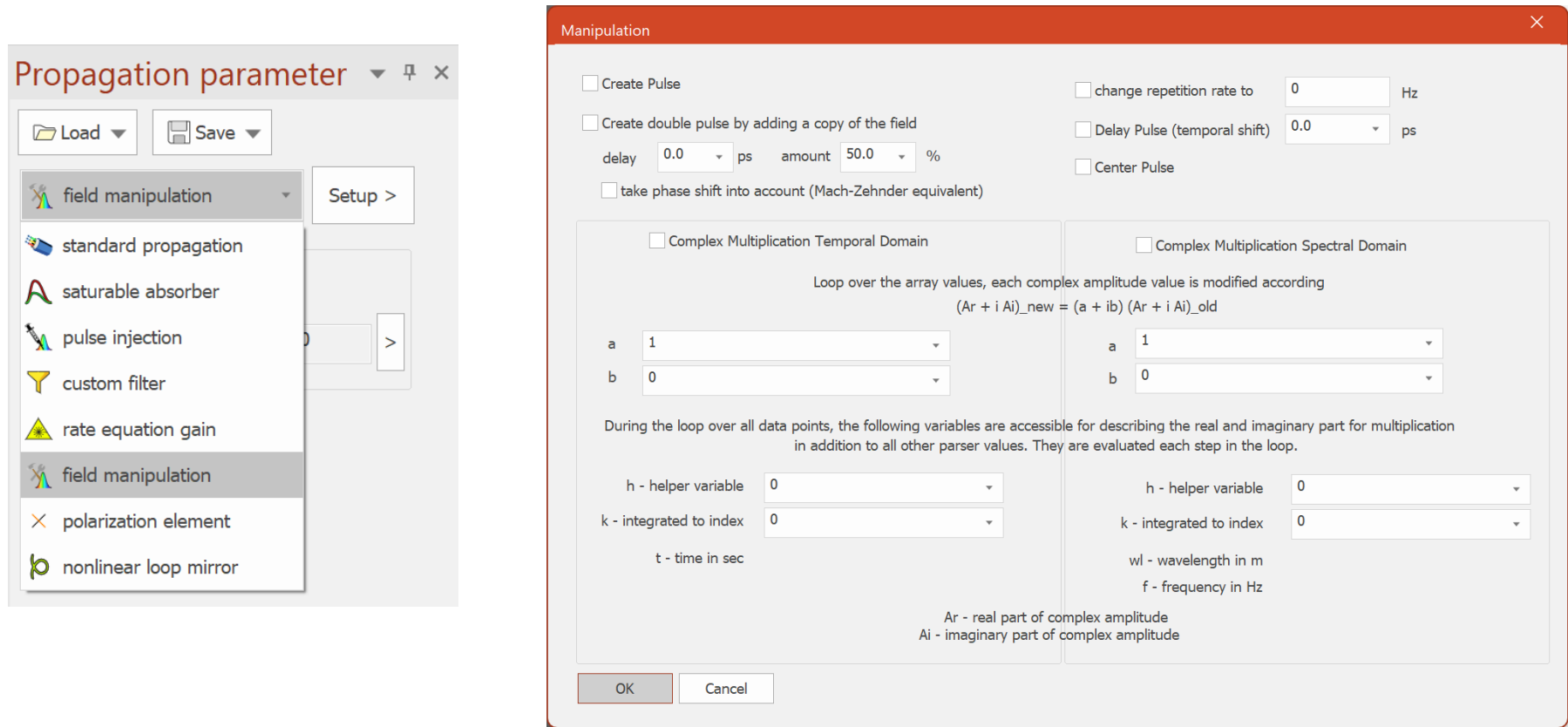
Lecture 7: Field manipulation

- (1) Introduction
- (2) A simple spectral filter function
- (3) Example: Phase modulation



Lecture 7: Field manipulation

Field manipulation:
Access the setup as shown here:



Lecture 7: Field manipulation

Field manipulation:

- Example: A simple spectral filter function

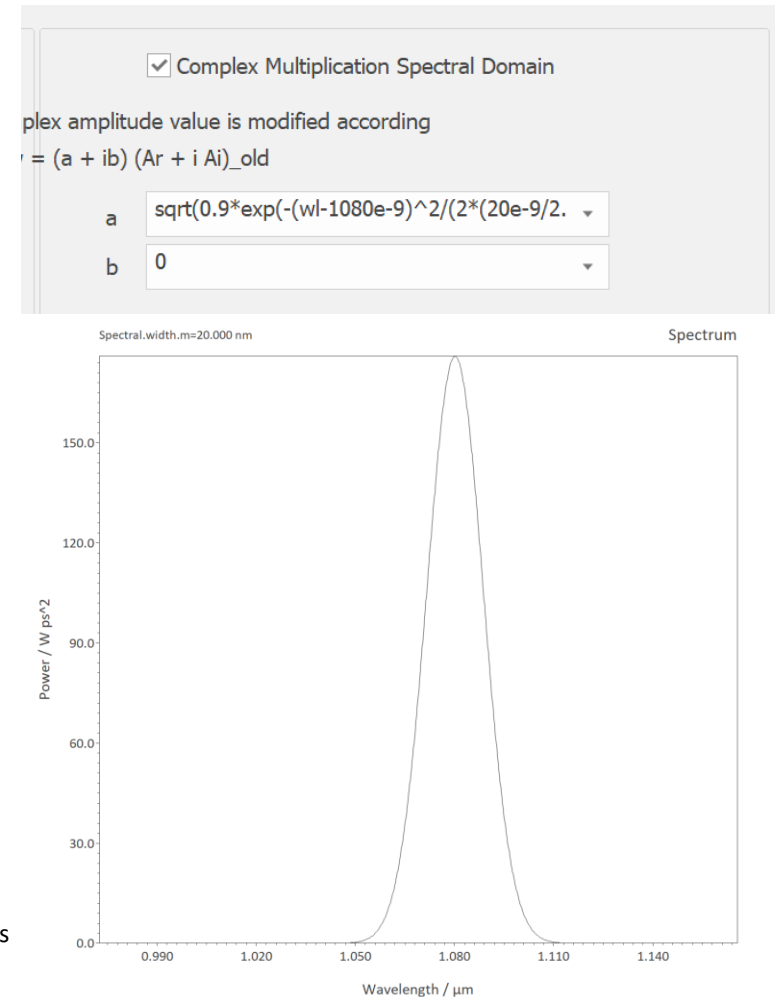
The complex multiplications in the temporal and spectral domain allow for direct manipulation of the data array values of the field. As the field $A(T)$ or $A(w)$ is complex, the terms to multiply can be complex, but need to be scripted as real and imaginary parts. As in the dialog, this multiplication given by a loop over each value in the array:

$$(A_{real} + iA_{imag})_{new} = (a + ib)(A_{real} + iA_{imag})_{old}$$

To make a 90% transmission filter at 1080 nm with a FWHM width of 20 nm ($1/e^2$), the equation needs to be for the real part only*:

$$a = \text{sqrt}(0.9 * \exp(-(wl - 1080e-9)^2 / (2 * (20e-9 / 2.355)^2)))$$

*See https://en.wikipedia.org/wiki/Full_width_at_half_maximum, for simplicity, the equation is done using a wavelength scaled axis



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Field manipulation:

- Example: **Phase modulation**

In phase modulation, the phase of the electric field is changed (for instance, by an optical phase modulator) to acquire an additional phase. Mathematically, this phase $\varphi(t)$ is added to the current phase of the field and the outcome expressed by:

$$E_{out} = E_{in} e^{i\varphi(t)}$$

Because this is a complex multiplication in the time domain, the setup in fiberdesk for an example signal of

$$\varphi(t) = 5 * \cos(2\pi * 6 * 10^9 \text{ Hz} * t)$$

needs to be taken in Euler form, see dialog entries.

☒ Complex Multiplication Temporal Domain
$\cos(5 * \cos(2 * 3.1415 * 10^9 * t))$
i $\sin(5 * \cos(2 * 3.1415 * 10^9 * t))$

