lecture 6

Rate-equation gain

(1) Simple cw oscillators
(2) Nonlinear fiber amplifiers (in preparation)

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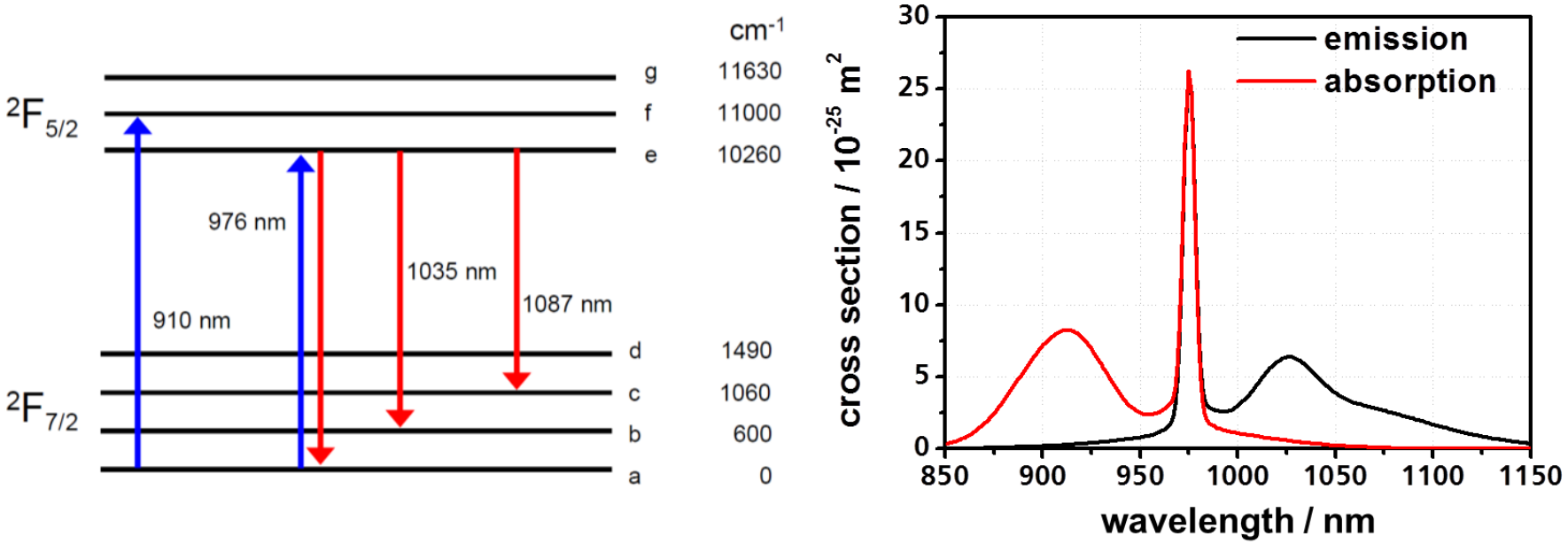
Rate-equation gain

Solution of stationary rate-equation (effectivly two level system) to describe pump- and signal powers as well as inversion in lasers and amplifiers.



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Rate-equation gain

Solution of stationary rate-equation (effectivly two level system) to describe pump- and signal powers as well as inversion in lasers and amplifiers.

$$\frac{dP_{P/S}^{\pm}}{dz} = \pm\left(\sigma_{P/S}^{em} n_2 \mp \sigma_{P/S}^{abs} n_1 + \alpha_{P/S}\right)\cdot \Gamma_{P/S} \cdot P_{P/S}^{\pm} \overbrace{\mp \sigma_{P/S}^{em} n_2 \cdot 2 \cdot h\upsilon_{P/S} \cdot \Delta\upsilon}^{ASE}$$

$$n_2 = \frac{\sum_{i=P,S} \frac{\sigma_i^{abs} \cdot n_0}{h\upsilon_i} \Gamma_i P_i}{\sum_{i=P,S} \frac{\left(\sigma_i^{abs} + \sigma_i^{em}\right)\cdot n_0}{h\upsilon_i} \Gamma_i P_i + \frac{1}{\tau}}$$

$n_0=n_1+n_2$ is the sum of upper and lower population density

$\alpha_{P/S}$ is an additional loss (background loss)

τ as the upper state lifetime

assumed that the pump absorption can be described by a simple overlap factor Γ_p, which is the ratio of doped core area to pump core area.

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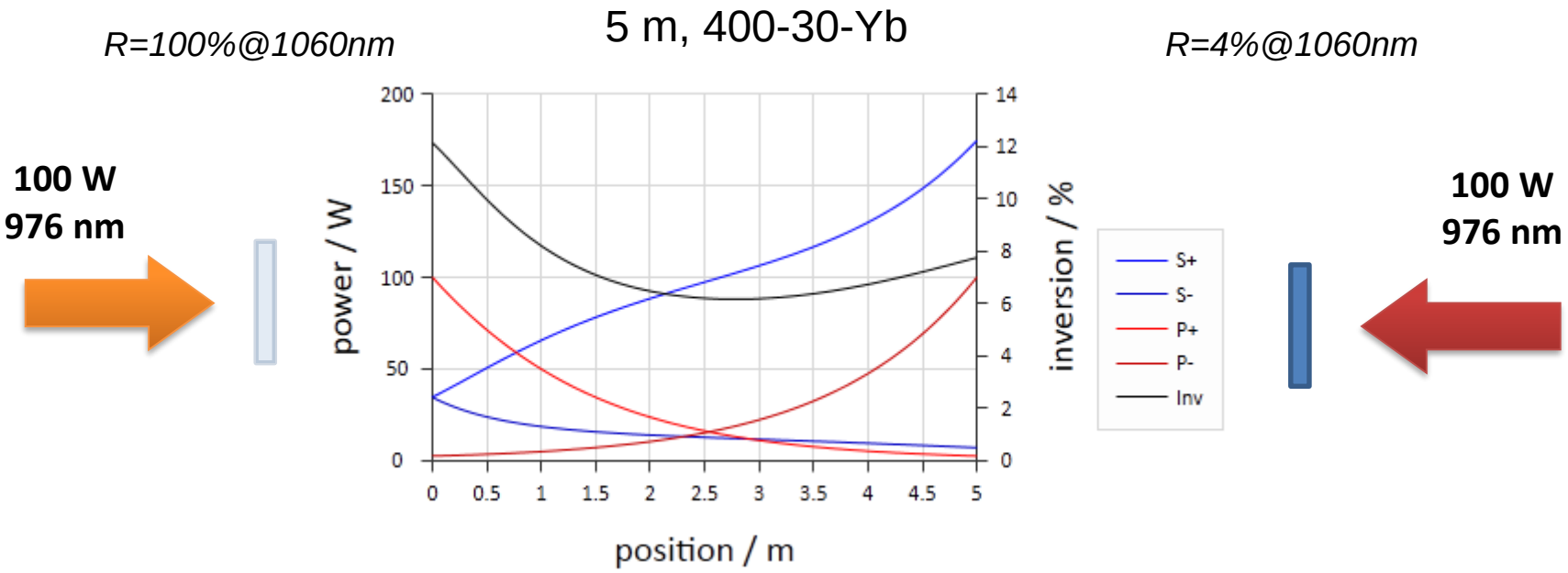
Simple cw fiber laser – pumped from both sides



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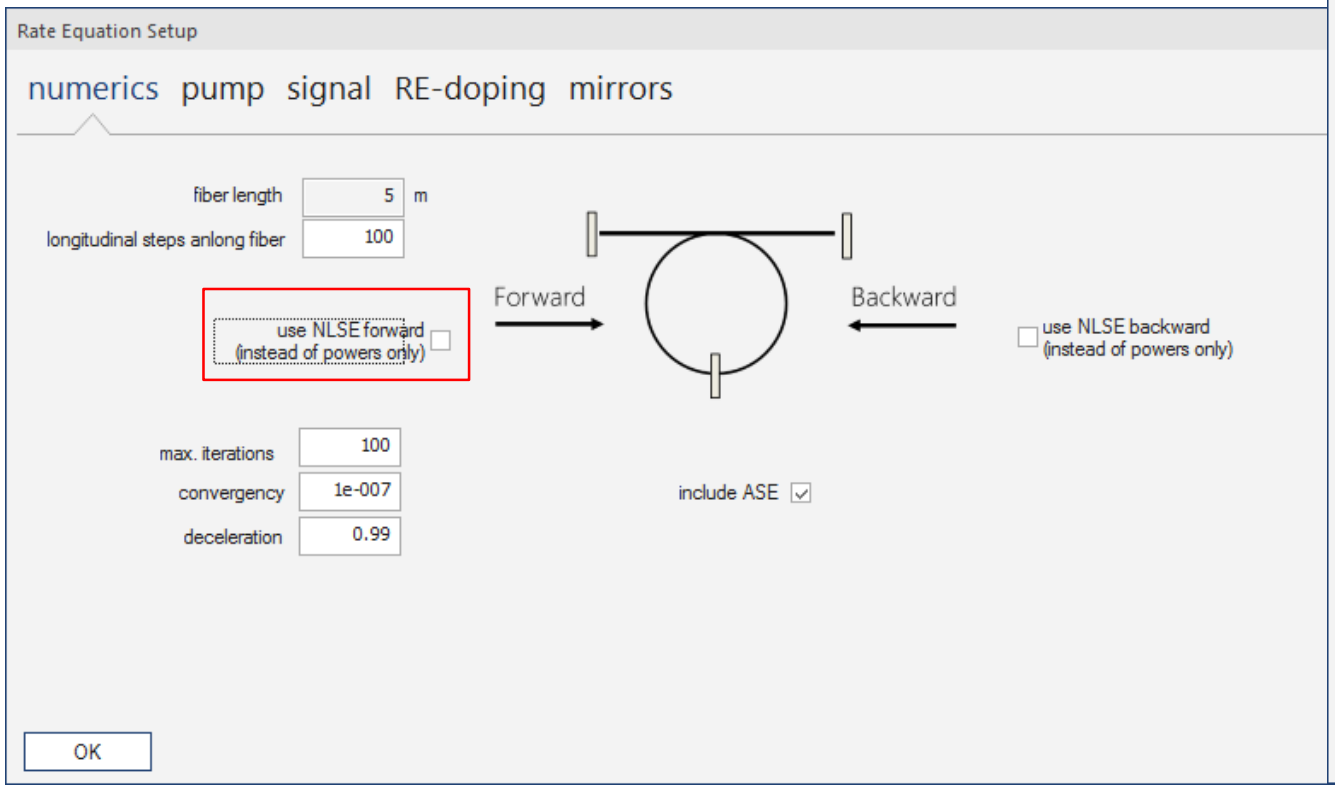
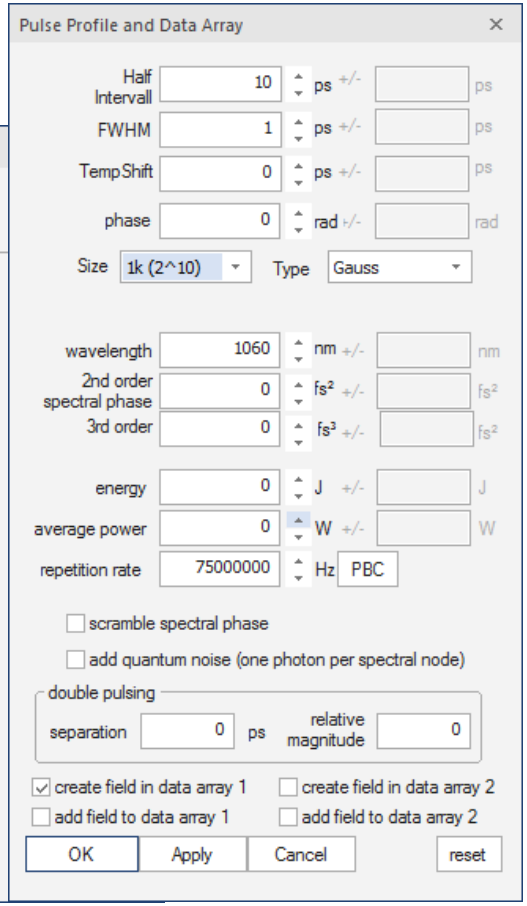
Simple cw fiber laser – pumped from both sides

empty field and numerics first





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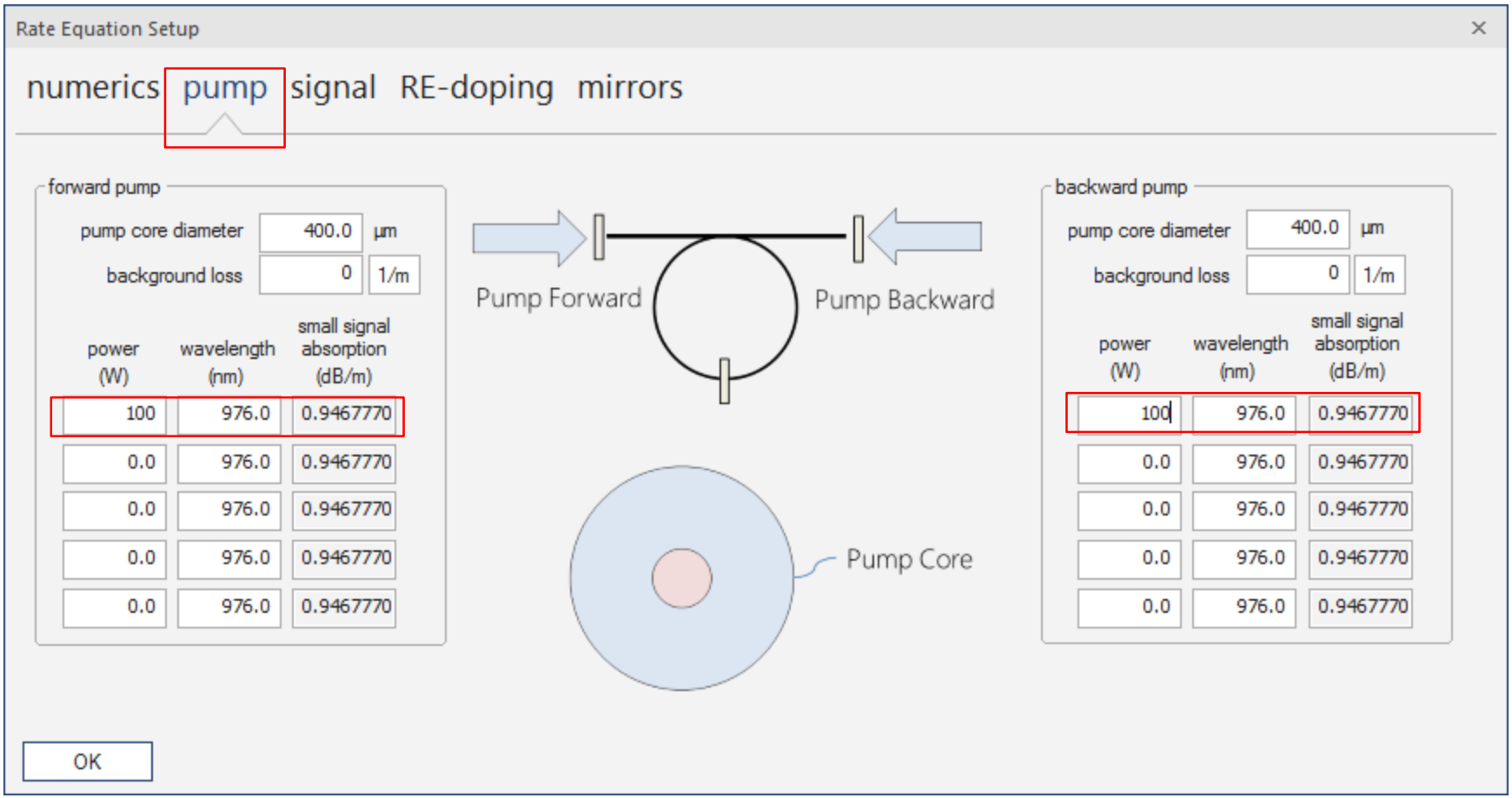
Simple cw fiber laser – pumped from both sides



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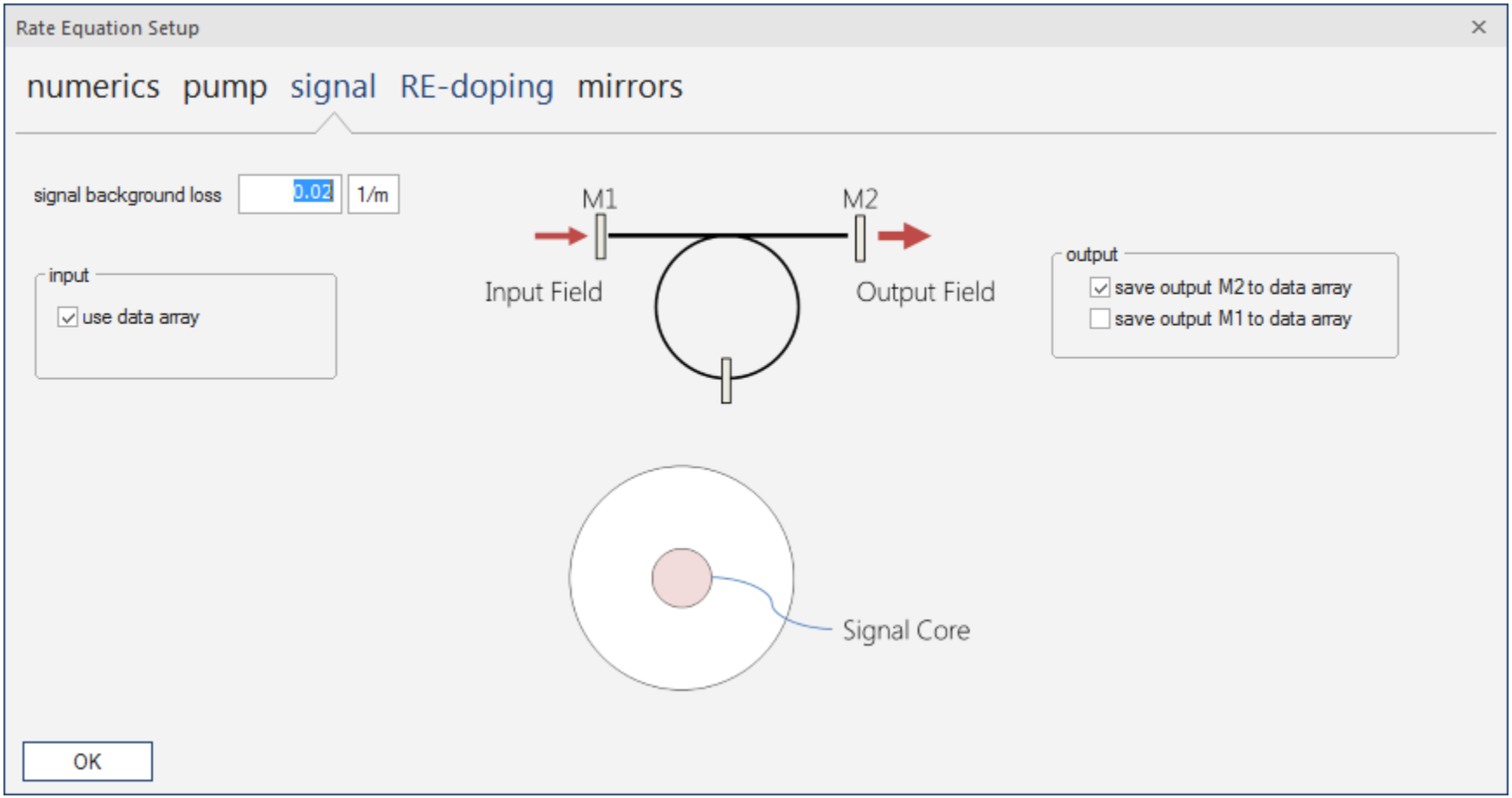
Simple cw fiber laser – pumped from both sides



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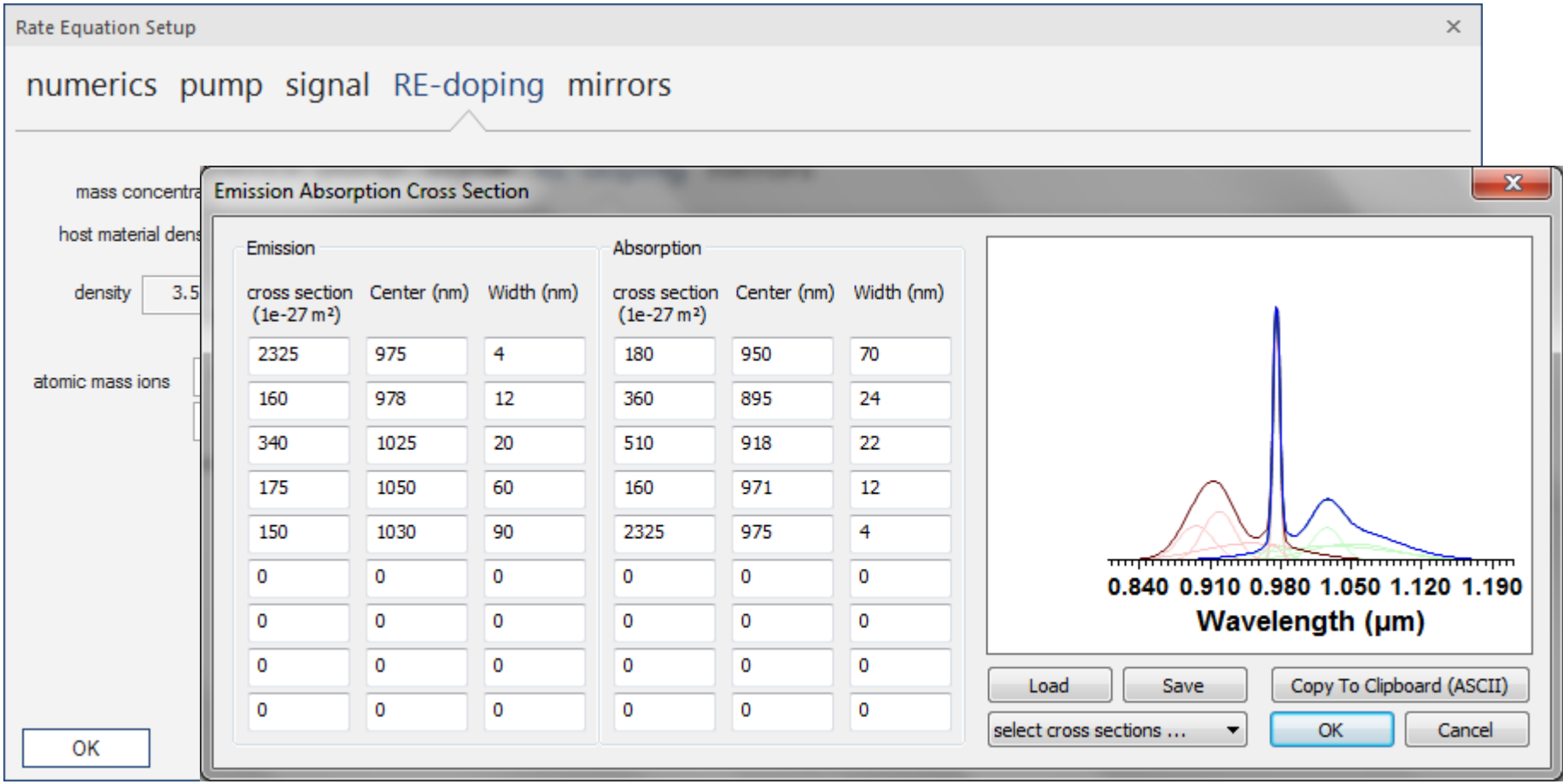
Simple cw fiber laser – pumped from both sides



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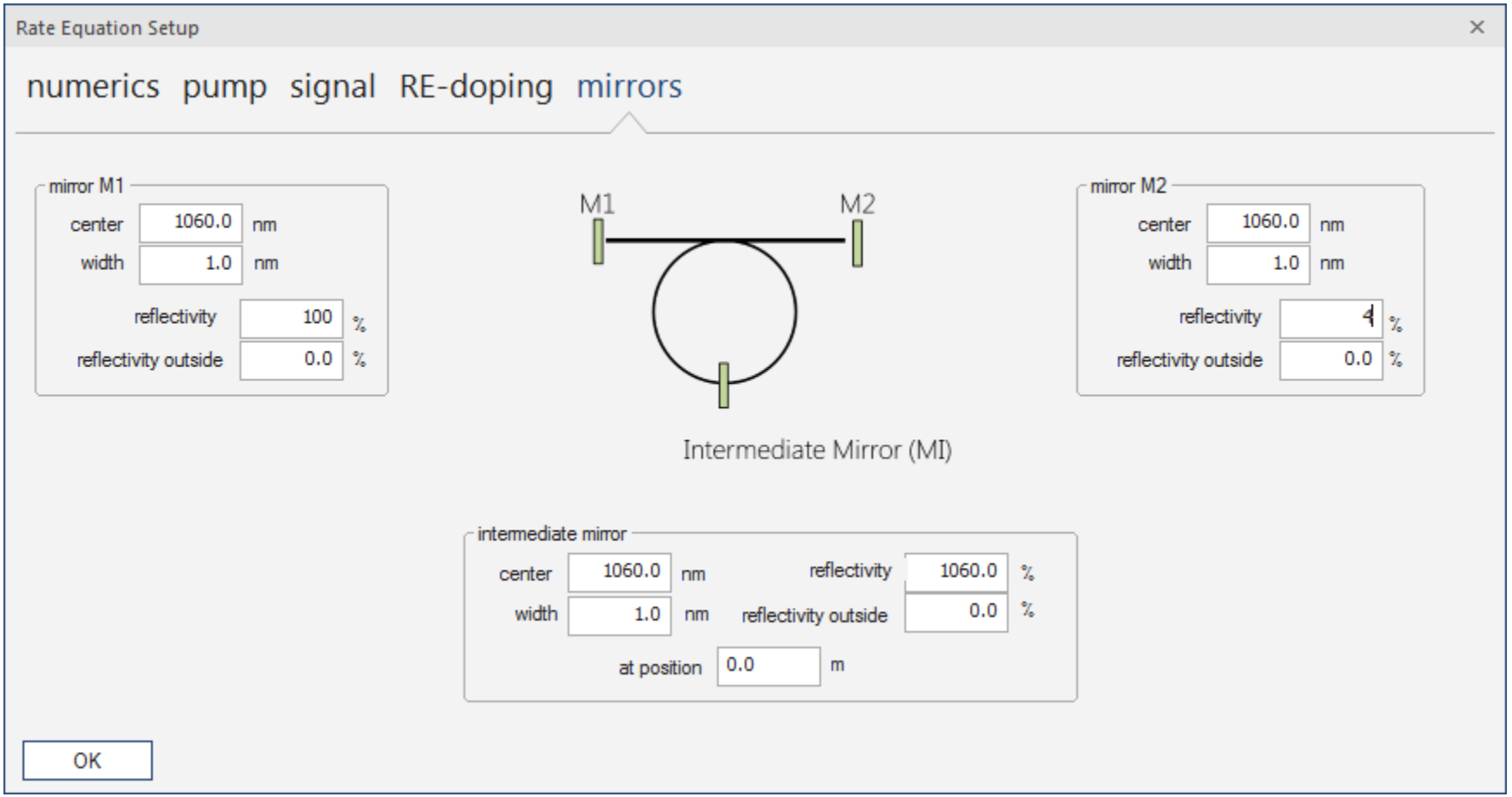
Simple cw fiber laser – pumped from both sides



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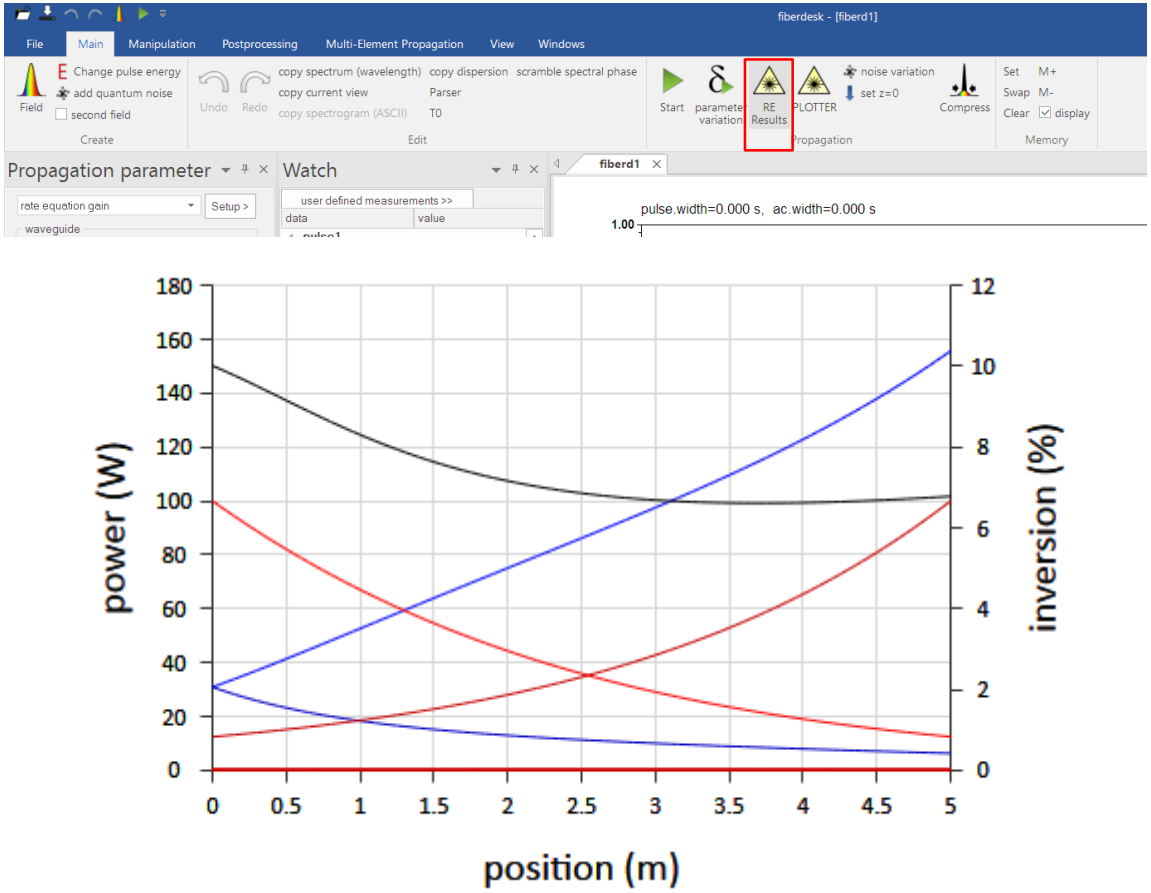
Simple cw fiber laser – pumped from both sides

Results:



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