THEORETICAL STUDIES OF PICOSECOND PULSE GENERATION IN GAIN-SWITCHED DFB LASERS

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During recent years, picoseconds optical pulses find different applications in free-space communications, bio-analytics, sensing, distance measurements, material processing, and spectroscopy. Such pulses can be generated by diode lasers. Moreover, diode lasers in addition with other types of lasers as solid state and fibre lasers can improve the pulse energy and peak power of pulses. Therefore, the theoretical and experimental efforts have been performed to improve the performance of pulsed diode lasers [1-3].

We consider in this paper the generation of picosecond pulses by gain-switching of distributed feedback ridge-waveguide laser diode shown in Fig. 1.

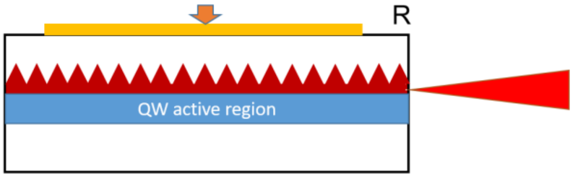

Figure 1. DFB laser.

The model investigated in this paper aims to simulate the mode competition between the Bragg-mode and the residual Fabry-Pérot modes during switch-on of a DFB laser [4]. The rate equation model for Fabry-Perot modes FP and Bragg mode B are treated separately coupled with one equation for charge carriers *n*

$$\frac{\mathrm{d}S_B}{\mathrm{d}t} = \frac{g_B(n)\Gamma S_B}{1+\varepsilon S_B} - \frac{S_B}{\tau_{S_B}} + K_B n^2, \qquad \frac{\mathrm{d}S_{FP}}{\mathrm{d}t} = \frac{g_{FP}(n)\Gamma S_{FP}}{1+\varepsilon S_{FP}} - \frac{S_{FP}}{\tau_{S_{FP}}} + K_{FP} n^2,$$

$$\frac{\mathrm{d}n}{\mathrm{d}t} = J - R - \frac{g_B(n) S_B}{1+\varepsilon S_B} + \frac{g_{FP}(n) S_{FP}}{1+\varepsilon S_{FP}}.$$

We integrate numerically the above equations by studying the influence of different parameters on dynamics of pulses. We investigate the impact of the gain-compression factor on peak power, pulse energy and pulse width. Figure 2 shows a typical temporal behaviour of the optical power at the front facet of laser and the evolution of curriers (black line) under the influence of pulse current (red line).

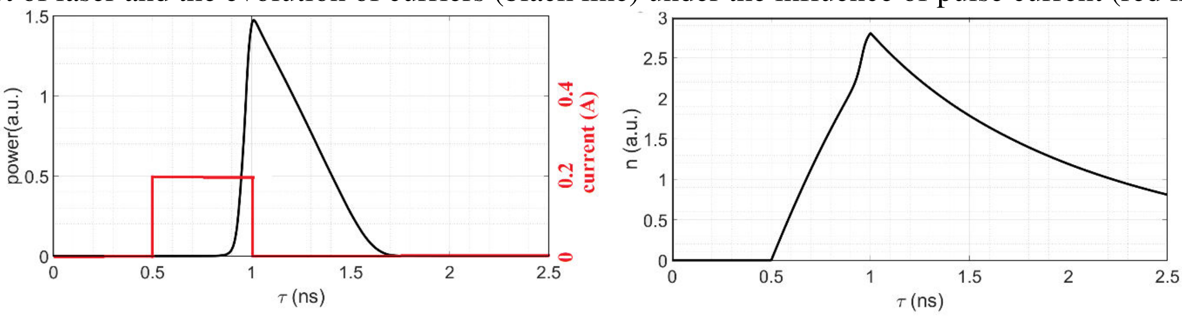

Figure 2. Pulse generation.

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[2] A. Klehr, T.Prziwarka, A.Liero, T.Hoffmann, J.Pohl, J.Fricke, H.J.Wünsche, H.Wenzel, W.Heinrich and G.Erbert G Proc. SPIE 9767 (2016) 976705
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