CMT 3 P THEORY OF ANTICIPATED SYNCHRONIZATION OF DFB LASER WITH PASSIVE DISPERSIVE REFLECTOR

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We discuss the phenomena of anticipated synchronization in a DFB lasers with a passive dispersive reflector. A rate equation model is proposed. It is shown that under certain conditions the system of two lasers coupled in unidirectional configuration displays anticipated synchronization. Finally, the possibility of detection of this phenomenon in experiment is presented.

During recent years the phenomena of synchronization of different systems has been the subject of significant studies due to its fundamental and applied interests in physical and biological sciences [1]. In the last decade Voss [2] proposed a new scheme of synchronization so called “anticipated synchronization”. The idea of anticipated synchronization is that two identical dynami-cal systems coupled in a master-slave configuration can exhibit anticipated synchronization when the slave system is subject to a delayed self-feedback [3]. There have been theoretical predictions of anticipated synchronization in different systems [2-4], and in some cases these predictions have been supported by experimental observation [5]. We believe that passive dispersive reflector lasers (PDRL) [6] could be a good candidacy for observation of anticipated synchronization. In this paper we report studies on the anticipated synchronization of single mode PDRL coupled in master-slave configuration shown in Figure 1. It consists of two DFB lasers coupled in unidirectional configuration. The slave laser is adjusted to an external optical circuit with a delay time τ .

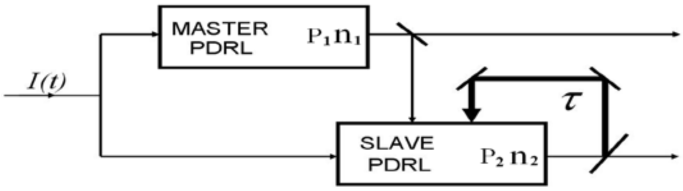

Figure 1. *Schematic diagram of two passive dispersive reflector lasers coupled in unidirectional configuration.*

We start from the rate equations used in [5] for devices with an active DFB reflector

$$\frac{dP_1}{dt} = TG(n)P_1 + I(t), \qquad \frac{dn_1}{dt} = J - n_1 - (1+n_1)\Gamma(n_1)P_1, \tag{1}$$

$$\frac{dP_2}{dt} = TG(n)P_2 + I(t) + K(P_1(t) - P_2(t-\tau)), \qquad \frac{dn_2}{dt} = J - n_2 - (1+n_2)\Gamma(n_2)P_2, \tag{2}$$

where T is the ratio between the carrier and photon life times, and J is the relative excess injection rate. The rate equations functions $\Gamma(n_i)$ and $G(n_i)$ for $i = 1,2$ have the form (for more detail see [5])

$$\Gamma(n_i) = \Gamma_0 + \frac{AW^2}{4(n_i - n_0)^2 + W^2} \quad \text{and} \quad G(n_i) = n_i + \alpha\,\Delta n \tanh\frac{n_i}{\Delta n} \tag{3}$$

We have studied the regime of anticipated synchronization of coupled DFB lasers with passive dispersive reflector. We have shown that, under appropriate conditions, the slave laser can anticipate the behavior of the master.

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