CHAOS BASED COMMUNICATIONS WITH QUANTUM DOTS LASERS UNDER THE INFLUENCE OF MULTIPLE FEEDBACKS

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It is well known that semiconductor lasers have a great importance in our daily life. We can't imagine a day without our computer or without sending and receiving messages. Semiconductor lasers have wide applications in communications, medicine, industry, etc. Under the influence of external feedback such lasers can generate a chaotic behavior appropriate for chaos based communication (CBC). In this paper we present the new scheme of a semiconductor laser with active medium quantum dots and a feedback which comes from five external mirrors (see Fig. 1). The first mirror is placed at distance L from the back facet of laser. The distance between mirrors is chosen also L.

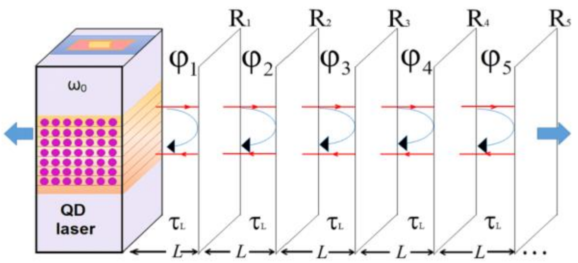

Figure 1. Setup

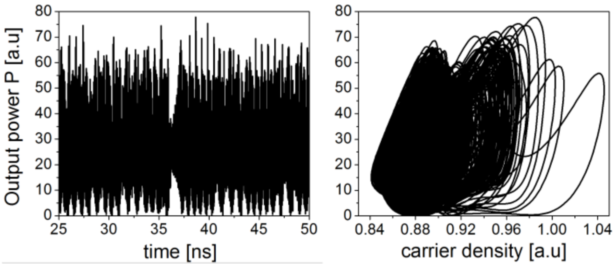

Figure 2. Chaotic dynamics of a semiconductor laser

We analyzed the dynamics of a semiconductor laser with active medium quantum dots using the following model [1], [2]

$$\frac{dE}{d\tau}=\frac{1}{2}(1+i\alpha)\left[-\gamma_{np}+g(2\rho-1)\right]E+\sum_{n=1}^{5}\gamma_n\exp\left(-i\sum_{k=1}^{n}\varphi_k\right)E(\tau-n\tau_L), \quad (1)$$

$$\frac{d\rho}{d\tau}=-\gamma_{ns}\rho-(2\rho-1)|E|^2+(CN^2+BN)(1-\rho), \quad (2)$$

$$\frac{dN}{d\tau}=J-N-2\left[(CN^2+BN)(1-\rho)\right], \quad (3)$$

where E is the complex amplitude of the electric field, ρ the occupation probability in the quantum dot, and N the density of carriers.

Figure 2 shows the evolution in time of output power (left) and the portrait phase (right) in the chaotic regime. Thus, in this paper, we studied the dynamics behavior of a semiconductor laser with active medium quantum dots under the influence of a optical feedback from external multiple cavities. We show the advantage of this scheme compared to that of conventional optical feedback. The appearance of a chaotic behavior appropriate for CBC takes place at low values of cavity length, which makes the device more compact.

[1] G. Huyet, et al Physica status solidi (a) **201**(2004)345 - 352
[2] Lang R. Lang, K. Kobayashi, IEEE J Quantum Electron **16**(1980)347- 355