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Directed Modulation of Quantum Dash Semiconductor Laser

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Abstract :

A numerical study of the effect of injection current modulation on the dynamics of a quantum dash semiconductor laser is presented . The control parameters chosen to affect the temporal intensity variation are the gain , the dc and ac parts of the injection current , the modulation frequency , carrier escape rate and ratio of carrier to photon decay rates . Various output ranging from single pulses to chaotic one produced.

Key words: Quantum dash semiconductor laser, Injection current modulation, Chaotic dynamics.

Introduction:

It is well understood today that the direct modulation of the semiconductor laser SCL adds the necessary degree of freedom (since SCLs belong to the class B lasers because the polarization relaxation rate is much larger than those of electric field and population inversion) that makes possible the occurrence of instabilities that leads to chaos [1]. The modulation response of SCLs has been studied [2]. The relaxation - oscillation frequency of SCLs usually fall in the GHz frequency domain and they show maximum response to modulation in these regimes[3] . SCLs have a good modulation bandwidth in the order of 10 GHz which makes them useful in the optical communication of ultra high bit

rates . Quantum dash Q Dash SCLs dynamics needs more study on the effect of injection current modulation since they offer many advantages over the traditional double heterostructure (DH) and the quantum well (QW) lasers such as large characteristic temperature (T_0) , low threshold current , small line- width enhancement factor , resistance to optical feedback , high modulation bandwidth, and ultrafast operation [4] . Their structure exhibits clear linear polarization , which is an advantage to reduce the bit rate error in device operation [5] .

Our attempt in this article is to understand the response of a Q Dash SCL by direct injection current modulation.