# Multi-Dynamics in Silicon-Based Quantum Dot Laser Through Optoelectronic Feedback Technique

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The near-zero linewidth enhancement factor and the high-gain active region permit narrow linewidth quantum dot (QD) lasers to emerge in Lidar, coherent communications, and non-classical optical applications [1-3]. The high insensitivity of QD lasers to optical feedback significantly improves the integration and process stability of photonic integrated circuits [4]. However, this also makes it difficult to obtain multiple dynamics of QD lasers under optical feedback compared to quantum well (QW) lasers. Investigating the nonlinear dynamics of QD lasers can extend its application to more scenarios. In this paper, we investigate the nonlinear dynamic process of the optoelectronic feedback of the QD Fabry-Perot laser at different temperatures. The QD laser exhibits rich dynamic characteristics from steady state variations to, square wave, and mixed fast and slow states. A comparison with QW lasers reveals that QD lasers are more sensitive to optoelectronic feedback and more prone to dynamics. The integrodifferential delay equation (iDDE) model results matched with the laser parameters are in good agreement with the experimental results. The saturation effect of the QD laser carriers leads to a faster dynamic change of the QD laser to the optoelectronic feedback. This is beneficial for future QD lasers to be used in directions such as multi-dynamics and quantum signal generation.

**References**

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