Broadband Amplitude Squeezing in Electrically Driven Quantum Dot Lasers at Room Temperature

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The advancement of optical information technology necessitates high-performance light sources with reduced noise levels for applications in classical optics (*e.g.* LIDAR, optical communications) and quantum photonics (*e.g.* CV-QKD, quantum computing, quantum sensing) [1–4]. For these quantum applications, it is crucial to suppress noise below the standard quantum limit (SQL), also known as the shot noise level (SNL) [5]. Conventional methods employ nonlinear effects, such as the Kerr effect and four-wave mixing, in nonlinear crystals and even integrated photonics platforms [6, 7]. Quiet pump-driven semiconductor lasers [8, 9], particularly quantum dot (QD) lasers, are promising to achieve squeezed states and facilitate optical quantum integration. In this work [10], we demonstrate single-mode amplitude squeezed state using a QD distributed feedback (DFB) laser under quiet pumping condition, achieving 1.0 dB amplitude-squeezing level and around 9 GHz squeezing bandwidth at room temperature as shown in Figure 1. After the noise-correction, the amplitude-squeezing level can be up to 3.1 dB. The results confirm the potential of QD lasers for quantum technologies.

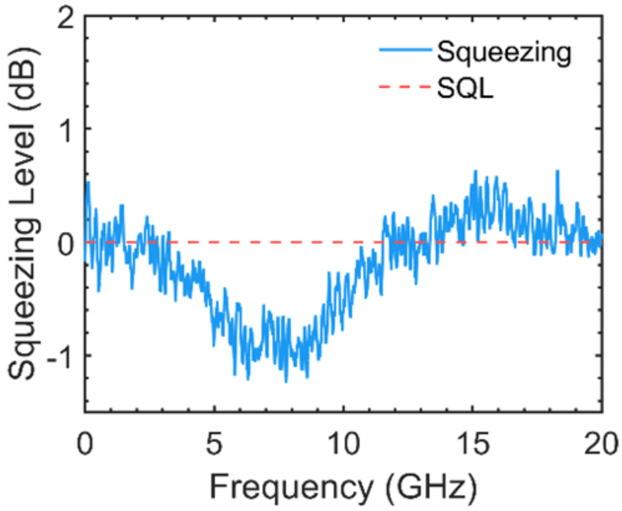

Figure 1: Squeezing level spectrum for QD laser at 4.5 times threshold current. The noise spectrum was measured using a self-homodyne detection system, with the QD laser driven by a quiet pump (ILX Lightwave LDX-3620), which provides an average 10 dB suppression in carrier noise compared to the normal pump (Keithley 2400)

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