Intrinsically low intensity noise pulse train from a nonlinear amplifying loop-mirror based mode-locked laser at 1.5 μm

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Optical frequency combs are one of important frequency sources that can link optical clocks in different frequency. As a precise transfer oscillator, optical frequency combs need to convert their frequency in desired frequency bands using nonlinear frequency conversion. Since the nonlinear effect highly relies on intensity, intrinsically low-intensity noise can improve the signal-to-noise ratio (SNR) of the generated light, which can improve the phase-locked loop with clock lasers. In this work, we achieve an intrinsically low-intensity noise pulse train from a nonlinear amplifying loop mirror (NALM)-based mode-locked laser (MLL) at 1550 nm. In order to achieve low intensity noise, we compare the performance by changing output coupling method, coupling ratio of NALM and tap in a fiber loop, intracavity dispersion, and pump power. The MLL shows its best intensity noise performance when pumped at 300 mW. The net-cavity dispersion is +0.004 ps^2 at 1567 nm. The coupling ratio of NALM and the additional coupling ratio at a fiber loop is 30 %. Fig. 1 shows the comparison of intensity noise when the pump power is adjusted. The relative intensity noise is improved over broadband. The integrated rms intensity noise of the optimized MLL is 0.009 % [1 Hz – 10 MHz].

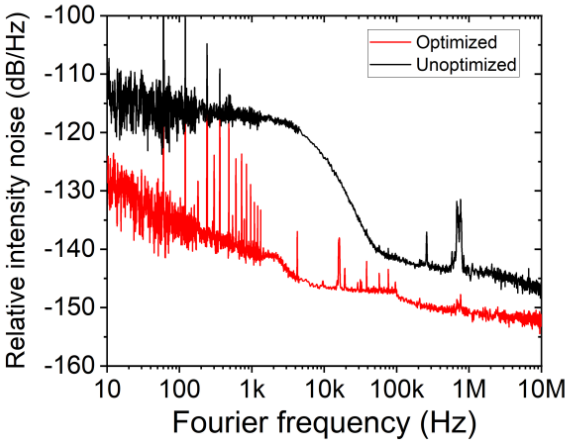

Fig. 1: Relative intensity noise measurement of the optimized MLL (red line) and unoptimized MLL (black line)