



Digital auto-locking ultra-stable laser at 1.5 μm for optical frequency transfer

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An ultra-stable laser with high stability and low phase noise is widely used in many fields, such as gravity wave detection, fundamental physics tests, frequency metrology, optical atomic clock and coherent transfer of optical frequency. Since the 1.5 μm laser is the transmission window of CW optical frequencies through optical fiber networks, the 1.5 μm ultra-stable laser is widely used in high-precision coherent phase transfer through fiber. In order to meet the needs of Engineering applications in optical frequency transfer, we demonstrate an automatic-locking ultra-stable laser. The locking time is about 16 seconds, including the automatic locking time of about 10.6 seconds and the parameter optimization time of about 5.5 seconds. When the laser is stabilized, the most probable linewidth obtained by 1000 measurements is 1.0 Hz and the best linewidth is 0.81 Hz. The Fractional frequency instability is about 4.3×10^{-15} at 1 s averaging time. This ultra-stable laser is used as the laser source for the 112 km urban fiber frequency transfer link, a frequency transfer instability of 2.3×10^{-15} at 1 s averaging time and 7.3×10^{-19} at 10000 s averaging time were achieved, which is about one order of magnitude higher than that with free-running laser.