125. Title: Coherent sampling of active mode-locked terahertz quantum cascade lasers and frequency synthesis

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Abstract: Terahertz quantum cascade lasers are compact, electrically pumped semiconductor laser sources that are capable of delivering tens of milliwatts of power in continuous wave. Here, we demonstrate that these devices can be operated in a regime of active mode-locking by modulating their bias current with a radiofrequency synthesizer. Detection of the emitted pulse train is made possible by phase-locking the quantum cascade laser repetition rate and carrier frequency to a harmonic of the repetition rate of a mode-locked femtosecond fibre laser. This technique allows coherent sampling of the terahertz electric field, showing that the terahertz pulses are transform-limited. In addition, our technique allows control of the carrier-envelope phase shift of the quantum cascade laser.