5ps-long terahertz pulses from an active mode-locked quantum cascade laser

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We report the active mode-locking of a 2.5THz Quantum Cascade Laser (QCL) emitting in free running over a bandwidth of ~300GHz [1]. The QCL was driven in mode-locking regime by modulating its current at the cavity roundtrip frequency with a low power Radio-Frequency (RF) wave. Therefore the effect of the RF modulation is solely that of mutually locking the phases of the existing modes, without affecting the modes amplitudes. This is in striking contrast with previous reports of active mode-locking where multimode emission was the direct consequence of the RF modulation [2,3]. As shown in the Figure, by measuring the THz electric field amplitude vs time we find a double-pulse structure at twice the cavity free-spectral range. The emitted pulses are transform-limited, with durations of ~6ps and ~5ps respectively, the shortest achieved to date with active mode-locked THz QCLs [1,2,3]. Such short pulses were obtained thanks to the use of a metal-metal waveguide, which favors lasing over a broader spectral bandwidth compared to previously employed single-plasmon waveguides.

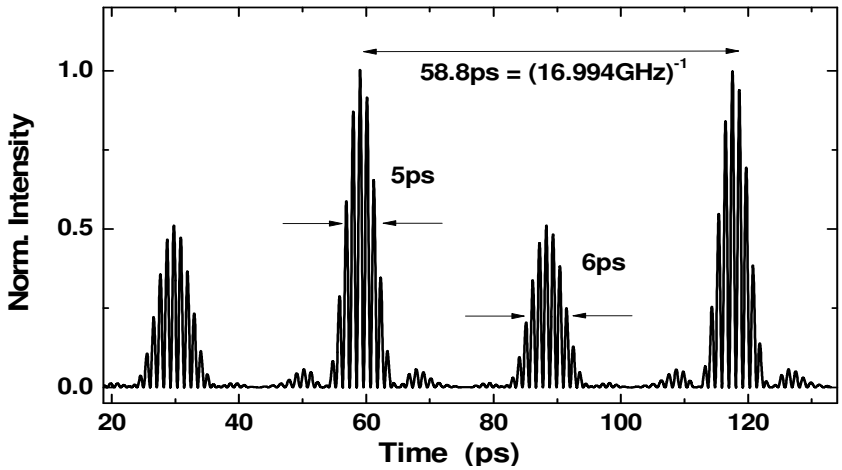

Fig.1. Electro-optically sampled pulse train emitted by the actively mode-locked QCL (normalised intensity).

References

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