Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Robust, frequency-stable and accurate mid-IR laser spectrometer based on frequency comb metrology of quantum cascade lasers upconverted in orientation-patterned GaAs STEPHAN SCHILLER, MICHAEL HANSEN, INGO ERNSTING, SERGEY VASILYEV, Heinrich-Heine-Universitaet Duesseldorf, ARNAUD GRISARD, ERCI LALLIER, Thales Research and Technology, BRUNO GERARD, III-V Lab, Palaiseau, France — We demonstrate a robust and simple method for measurement, stabilization and tuning of the frequency of cw mid-infrared (MIR, 5 - 12 μm) lasers, in particular of quantum cascade lasers, allowing implementation of flexible and "turn-key" spectrometers for a range of high-resolution spectroscopic tasks. The MIR laser wave is upconverted by sum-frequency generation in an orientation-patterned GaAs crystal with the output of a standard high-power cw 1.5 μm fiber laser, subsequent amplification of the sum-frequency wave, Continuous measurements of this wave's and the fiber laser's frequency by a standard Er:fiber frequency comb provide signals allowing frequency control of the MIR laser. The proof of principle is performed with a quantum cascade laser at 5.4 μm, which is upconverted to 1.2 μm. The absolute QCL frequency is determined with 100 kHz-level inaccuracy relative to an atomic frequency reference. Frequency stabilization to sub-10 kHz level, controlled frequency tuning and long-term stability are demonstrated. The whole system is nearly turn-key, requiring only short warm-up time. This is an important advantage for use of the apparatus as part of more complex experimental set-ups. Further extensions of the system are possible and will be discussed.

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Date submitted: 16 Jan 2013 Electronic form version 1.4