Ultrashort pulse generation in quantum cascade lasers

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In recent years, quantum cascade lasers [1] (QCLs) have matured to become compact, powerful sources of coherent mid-infrared light. While frequency comb operation was demonstrated almost a decade ago [2], the formation of ultrashort high intensity QCL pulses remained illusive. This talk will give an overview on modelocking mechanisms in semiconductor lasers, with an emphasis on self-modelocking observed in QCLs. Contrary to conventional modelocked sources, QCL combs are associated with a strongly frequency modulated intracavity field [3,4], as shown in Figure 1a. The in-depth understanding of the emitted field enabled us for the first time to generate femtosecond pulses from a QCL source using external phase compensation (Figure 1b) [5]. Our configuration is strikingly similar to chirped pulse amplification schemes and may lead to unprecedented levels of output peak power from semiconductor lasers in the future. We will present first results on fully integrating such a configuration on a chip (Figure 1c) [6].
These results will be put into context with further QCL short pulse generation techniques including recent results on gain-switching, active mode-locking [7,8] and soliton formation [9].

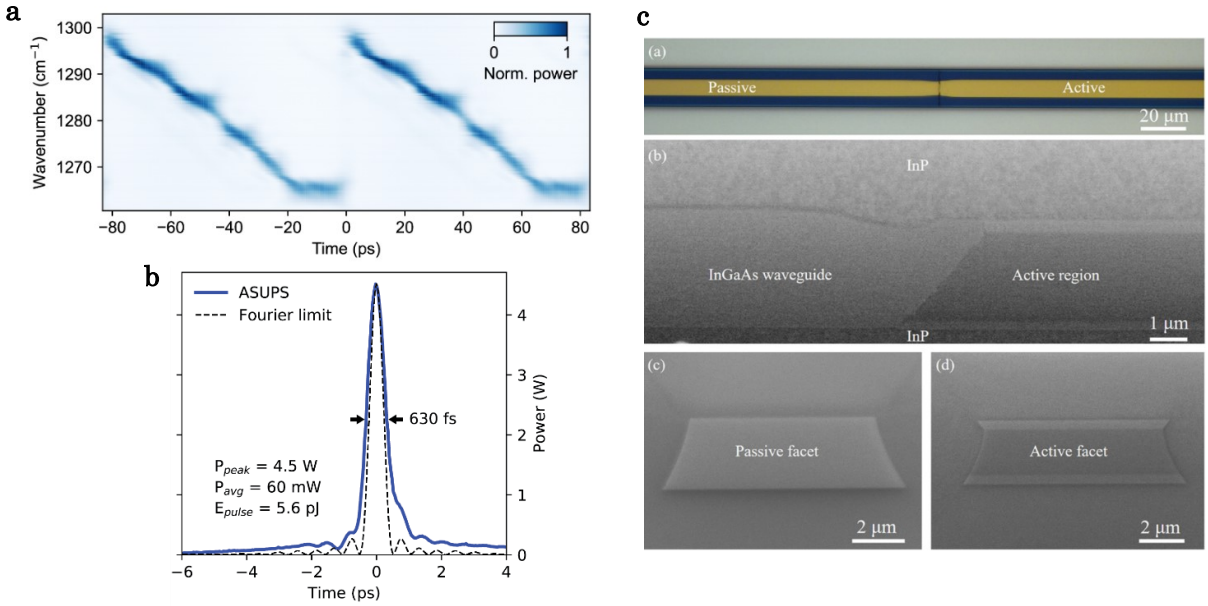

Figure 1: a Instantaneous frequency of a QCL comb. **b** Ultrashort QCL pulse after external phase compensation as measured by optical sampling. **c** Integration of QCL combs with passive waveguides.

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