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Terahertz (THz) short pulse generation in quantum cascade lasers

In the terahertz (THz) range, a semiconductor based technology for intense and ultrashort pulse generation has yet to be realized. Although THz quantum cascade lasers (QCLs) are a foundational semiconductor laser in the THz range, to date, the generation of stable and ultrashort pulses from QCLs has proven to be difficult. These devices, first realized in 2002, permit the frequency, and bandwidth to be entirely engineered. Active mode locking, where the device is electrically modulated at its' roundtrip, has been extensively applied but the pulses generated so far have been limited to the range of 10ps to 20ps, despite several years of research effort. Although THz QCLs with extremely large gain bandwidths have been realized leading to impressive developments in frequency comb generation, this has not translated directly into the formation of stable ultra-short pulses in the THz range. Here, we resolve the THz QCL short pulse bottleneck through an on-chip geometry that permits the GDD of the QCL to be compensated, leading to considerably shorter pulses when the QCL is active mode locked. This is realized through the monolithic integration of a small resonator at one end of a 2.5 THz QCL cavity, based on a Gires-Tournois Interferometer (GTI) approach that adds an opposite dispersion to that of the material. This directly results in pulse durations as shorts as 4 ps, from 16 ps with a standard QCL geometry.

Biography

Jerome Tignon has completed his PhD at École Normale Supérieure (ENS/SU) in Paris in 1996 and his Postdoctoral studies at Lawrence Berkeley National Lab (LBNL Berkeley, CA) in the Chemla group (1996-98). He is currently the Director of the Laboratoire Pierre Aigrain in the Physics Department of Ecole Normale Superieure in Paris. He has published more than 150 papers, given over 50 invited talks and will be the chairman of IRMMW-THz in Paris (2019).

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