

CNET-ICT-296500

Information Society Technologies

FET Open Project

TERACOMB

**Quantum cascade lasers based
terahertz frequency combs**

DELIVERABLE D 1.2 **Project website**

Due date of Deliverable: 30.09.2012

Actual Submission Date: 13.02.2013

Start date of project: 1st June 2012

Duration: 36 months

Organisation name of lead contractor for this deliverable:

**Technische Universität Wien,
Vienna, Austria
Author: J. Darmo, M. Pexa, D. Dietze**

Revision: First

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

Objective

To create a platform for propagation of the Project and dissemination of the latest achievement of the project.

Introduction

The project website serves as main platform to communicate the project essentials to wide audience – either experts or general public. The website has standard structure with several sub-panels focused on individual features of the project. The main page provides basic information about the project that is subsequently detailed on other pages connected via common menu. The main page also carries information about highlights, recent achievements and upcoming events of the project (see Fig.1).

TERACOMB
an FP7 project

quantum cascade lasers based terahertz frequency combs

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What is the TERACOMB project?

TERACOMB is an ambitious project focused on pursuing the technology of quantum cascade lasers (QCL) to generate a frequency comb (FC) in the terahertz frequency region.

To achieve the project goals, the main players in the QCL and FC technology have been brought on board. They are represented by senior scientists in their mid-career stage guaranteeing a long lasting dissemination/exploitation of the project achievements.

The expertise of the TERACOMB project partners covers the physics and technology of quantum cascade lasers, the growth of advanced semiconductor heterostructures, terahertz time-domain and time-resolved spectroscopy, microwave techniques, fibre laser technology, precise time and frequency measurement techniques, and the frequency comb technology. All that knowledge is exploited towards success of the TERACOMB project – the demonstration of a reliable terahertz frequency comb.

Last, but not least, the TERACOMB project could be brought to life thanks to the financial support of the European taxpayers via the European Commission.

First Teracomb- Paper!
04.03.13 13:35
Congratulations to Daniel Dietze, Karl Unterrainer and Juraj Darmo, who published the first...

Project Meeting
11.01.13 12:02
A technical meeting has been held at ETH Zurich on 11th, January 2013 where the project partners...

Invited talk
20.12.12 11:01
Juraj Darmo of Vienna University of Technology has been invited to give a talk at the CLEO 2013...

 This project is funded by the European Union

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Fig 1: Main page of the homepage of TERACOMB project.

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Introduction

Despite significant research efforts during the past 10 years, the terahertz (THz) spectral range remains vastly underexplored, owing essentially to the insufficient signal-to-noise ratio (SNR) achievable with present technology.

The project's aim is to address this problem by building a new technological platform enabling the generation of high power and broad bandwidth THz frequency combs (FCs) with a high frequency stability. The demonstration of FCs in the visible and near-IR spectral ranges has been among the main breakthroughs in the field of optics in the past decade. FCs are commonly generated by mode-locked lasers. In the frequency domain they consist of a broad spectrum of narrow lines, separated by a constant frequency interval, corresponding in the time domain to the repetition rate of the emitted pulse train. The time duration of the emitted pulses is roughly given by the inverse of the spectral bandwidth. Due to the lack of mode-locked lasers, FCs in the THz range are nowadays generated by inherently inefficient non-linear conversion techniques. This is the main cause for the low SNR of present THz systems.

The THz FCs envisioned in this project will be based on THz quantum cascade lasers (QCLs), a novel, compact and powerful THz semiconductor laser source. THz FCs will be generated by mode-locked THz QCLs, and/or by using THz QCLs as semiconductor amplifiers. This will allow the production of FCs with average powers in excess of 10mW, with a spectral bandwidth > 1 THz, and a corresponding pulse duration < 1 ps. Such high power THz FCs will be combined with highly sensitive coherent detection techniques based on compact fiber lasers that will be developed ad hoc in this project. The ultimate goal is the realization of an enabling THz technology, which may be adapted for a wide variety of applications in fields such as physics, chemistry, biology and medicine.

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Science

Description of the main techniques used in this project.

- Terahertz radiation
- Quantum cascade lasers
- Frequency combs

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Objectives

1. Demonstration of a broadband (bandwidth of 1 THz) cw THz QCL with regular comb teeth
2. Demonstration of a 1-THz broad, QCL-based amplifier for a THz frequency comb
3. Demonstration of a 1-THz broad frequency comb based on a mode-locked QCL generating sub-ps pulses
4. Development of a technique to increase the time resolution of the coherent sampling (< 500 fs time resolution) and increase the sensitivity of the electro-optic (EO) detection

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M. Rösch, G. Scalari, M. Beck, and J. Faist, "Broadband homogeneous quantum cascade laser emitting at 2.3 THz", Talk at CLEO Europe 2013, CB/CC-1.2 (1323) Mon 14.45

D. Dietze, K. Unterrainer, and J. Darmo, "Role of geometry for strong coupling in active terahertz metamaterials", Phys. Rev. B 87, 075324 (2013), DOI: 10.1103/PhysRevB.87.075324

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Fig 2: Sub-pages PROJECT of TERACOMB project homepage.

The screen shots of the subpage PROJECT of the Project website are shown in the Fig.2. These webpage summarize the project focus. The project abstract is in the Introduction, while the other panels contain objectives of the project and explain basic science facts of the project. Last panel of this section presents current publication output of the project.