

# **ORAL SESSION n°6**

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**Thursday 11 May 16:30-18:00**

**Chaired by :**

**Dr. Thomas Crowe & Dr. Didier Lippens**



## Terahertz quantum-cascade lasers as local oscillators

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The main challenge for the space THz program is solid-state local oscillators that can meet space qualifications in terms of output power levels and power efficiencies. Semiconductor electronic devices (such as frequency multipliers) are limited by the conversion efficiency and RC roll-off to below 2 THz. Conventional semiconductor photonic devices (such as bipolar laser diodes) are limited to above 10 THz even using small-gap lead-salt materials. Transitions between subbands in semiconductor quantum wells were suggested as a method to generate long wavelength radiation at customizable frequencies. The recently developed quantum-cascade lasers (QCL) at THz hold great promise to bridge the so-called "THz gap" between conventional electronic and photonic devices, especially for local-oscillator applications. Based on two novel features, namely resonant-phonon-assisted depopulation (Fig. 1(a)) and metal-metal waveguides for mode confinement, we have developed many THz QCLs with record performance. They include by not limited to: a maximum pulsed operating temperature of 164 K (Fig. 1(b)), a maximum cw operating temperature of 117 K (Fig. 1(c)), and the longest wavelength ( $\sim 160 \mu\text{m}$ , 1.9 THz) QCL to date without the assistance of magnetic fields (Fig. 1(d)), and more than 100 mW of cw power. Our collaborators have demonstrated the use of QCL as a local oscillator at 2.8 THz, and have achieved frequency/phase locking at  $\sim 3$  THz. We will present more details and perspective at the symposium.

