Continuous-Wave Coherent and Tunable THz emission by photomixing driven by a dual-frequency external-cavity laser emitting at 1.064 µm: State-of-the art to potential applications

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The development of THz applications is presently mainly limited by the lack of flexible sources. Photo-mixing techniques are attractive for THz emission, since they rely on mature photonic components and offer straightforward broadband tunability. However, the scale factor between the laser frequencies (100's of THz) and the beat frequency (THz) have a deleterious and significant impact on the THz signal in terms of output power and frequency noise that could be limiting for real applications. We recently proposed a robust dual-frequency vertical-external-cavity surface-emitting laser [1] based on the simultaneous operation of two transverse modes within a single-cavity. More recently, we demonstrated coherent and tunable THz emission from this dual-frequency laser by excitation of a commercial uni-travelling-carrier photodiode [2]. As shown in the figure, the THz frequency noise is lower than the laser one for each transverse mode, thus validating the concept of this *free-running* dual-frequency laser.

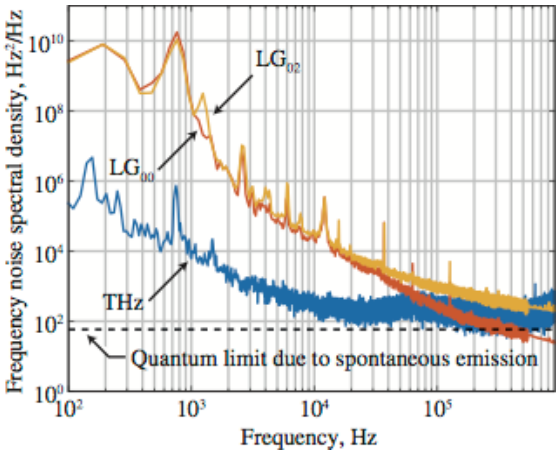

Fig.1. Frequency noise of the THz source versus dual-frequency source

We will review the principle of operation of the dual-frequency laser and expose the state-of-the-art of the performances of the THz source, focusing on experimental techniques that offer a full characterization of the THz signal, such as output power, power spectral density and frequency noise. From these performances, we will discuss on two specific applications of this THz source, namely spectroscopy and imaging. We will propose possible schemes for spectroscopy applications based on the demonstrated 50–700-GHz 15-GHz-steps tunability and spectral coherence of the THz signal, along with perspectives on continuous tunability. We will also discuss on possible imaging applications by reporting preliminary imaging experiments and by investigating possible solutions to improve the output power.

References

[1] R. Paquet et al., *Optics Letters*, vol. 41(16), pp. 3751–3754 (2016)
[2] S. Blin et al., *Journal of Selected Topics in Quantum Electronics*, to be published (2017)