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100 GHz-Carrier OFDM Radio Transmission enabled by Silicon Photonics and Graphene

The talk presents the latest results of a W-band (75-110 GHz) point-to-point radio transmission experiment where a silicon photonic integrated circuit is employed to generate a ~100 GHz-frequency spaced optical local oscillator (OLO), and a graphene-integrated optoelectronic mixer is used for data signal up-conversion.

With reference to Fig. 1, the photonic integrated circuit (PIC) employed for ~100 GHz-carrier synthesis includes an optical frequency comb (OFC) generation stage driven by a ~19-GHz electrical local oscillator (LO), followed by a novel multi-resonant optical filter (MROF) for selecting the two desired OFC harmonics. The beating of such two-tone OLO in an off-chip photodiode (PD) or photo-mixer generates the target ~100 GHz-carrier wave. PIC characterization includes phase noise performance analysis of the generated frequency carrier after photo-detection, resulting to be in line with ideal frequency multiplication of the employed LO. OLO output frequency tunability in the range 96 — 100 GHz is also verified. The PIC generating a 96-GHz OLO has been eventually used to up-convert a ~GHz-wide quadrature phase shift keying (QPSK) orthogonal frequency division multiplexed (OFDM) signal through both an optoelectronic modulation and photodetection chain and a novel silicon nitride (SiN) optoelectronic mixer based on graphene (G-OEM) [1]. After radio transmission through W-band antennas and final down-conversion through a commercial device, the signal has been acquired and bit error rate (BER) performance has been evaluated, demonstrating BER values lower than typical FEC thresholds for net information rate up to 2.5 Gb/s when using the G-OEM and 3.5Gb/s in case of modulation and photodetection.

References

[1] Montanaro, A., Piccinini, G., Mišeikis, V. *et al.* Sub-THz wireless transmission based on graphene-integrated optoelectronic mixer. *Nat Commun* **14**, 6471 (2023). https://doi.org/10.1038/s41467-023-42194-6

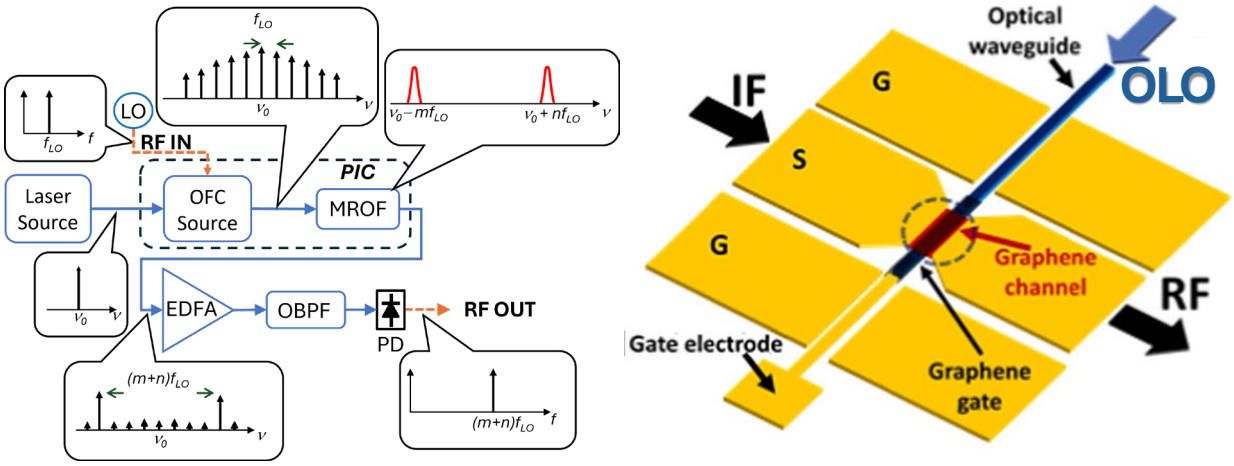

Figure 1: Schematic operation of the proposed photonic integrated millimeter-wave band frequency synthesizer for the case of m+n frequency multiplication factor of the LO frequency, being m and n the order of selected comb harmonics (left); schematic representation of the graphene-integrated optoelectronic upconverter (right).

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