Photonic synthesis of low noise W-band signals

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Photonic synthesis of microwave frequencies via optical frequency division of ultra-stable cavity-stabilized lasers (OFD) has yielded 10 GHz signals with exceptional performance at room temperature. Recent measurements have demonstrated a close to carrier phase noise less than -100 dBc/Hz at 1 Hz offset and a high frequency noise floor less than -177 dBc/Hz [1,2]. The extension of this technology to generation of low noise W-band (75 GHz – 110 GHz) signals has applications to radio astronomy, communications and W-band radar.

Technological challenges exist in direct photodetection in the W-band making it uncertain as to whether a purely photonic approach or a hybrid photonic/electronic approach will result in the best spectral purity. In Figure 1 we present the results of the absolute phase noise of two 90 GHz signals generated in a hybrid approach via 9 times electronic multiplication of the low noise 10 GHz signal generated from an OFD. Also shown is a measurement of the absolute phase noise via 9 times electronic multiplication of a room temperature sapphire loaded cavity oscillator. To show the potential of direct optical synthesis we include the phase noise of an optical frequency divider (OFD) scaled to 90 GHz.

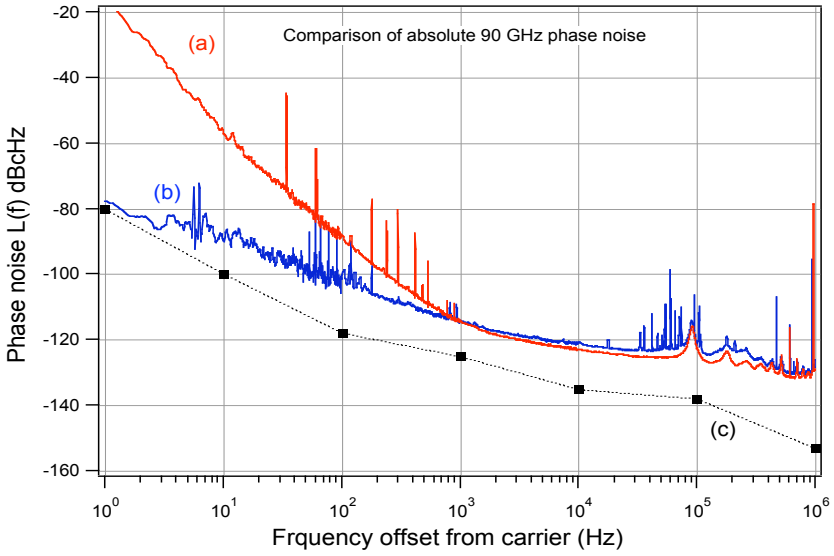

Fig. 1: Absolute phase noise comparison of 90 GHz signals obtained via a) 9 times electronic multiplication of an 10 GHz SLCO, b) 9 times electronic multiplication of 10 GHz from an OFD and c) the calculated noise obtained via perfect 9 times multiplication of the 10 GHz absolute phase noise of an OFD to 90 GHz.

References:

[1] Fortier T.M et al., Nature Photonics **5**, 425–429 (2011)

[2] Quinlan F.Q et al, Optics Letters in press (2014)