Dual-polarization fiber lasers for radio-over-fibre?

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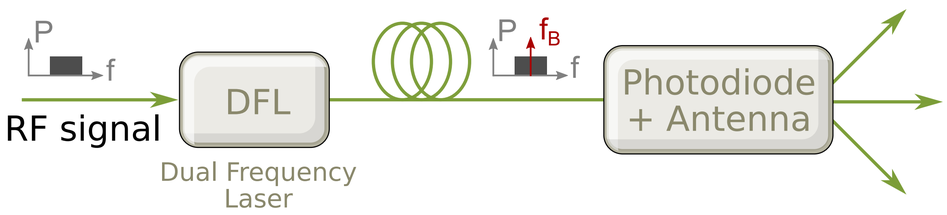
Context

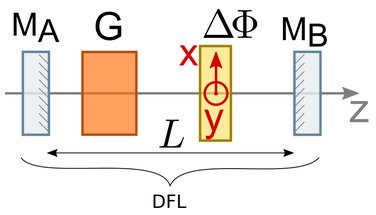
Wireless technologies are developed to replace wires in the personal network. But with the increasing demand, the current Wi-Fi bands (2.4 or 5 GHz) tends to become **saturated**. The millimetre-wave band (from 57 to 66 GHz) could be an attractive alternative to exploit. It could provide:

- Higher flow rate
- High propagation attenuation and non-propagation across the walls

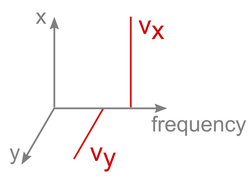
⇒ Solution: optical transmission of analog signals as **radio-over-fibre** (RoF)

Optical Transmission of Microwave Analog Signals





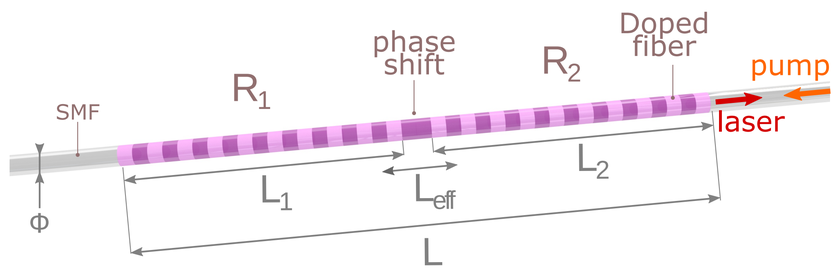
$$\Delta\nu = \frac{c}{2L}\frac{\Delta\Phi}{\pi}$$



Stabilization of the beat frequency against a reference (local oscillator)

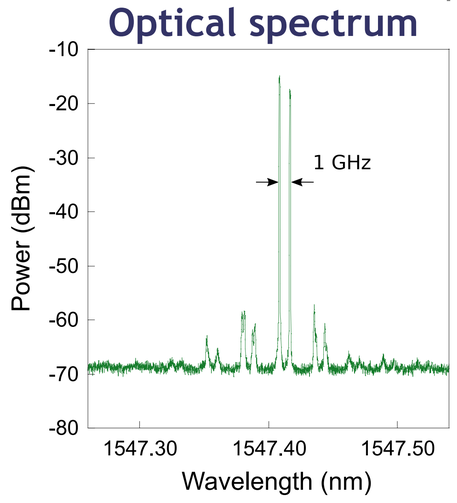
Dual Frequency Fiber Lasers

Distributed feedback (DFB) fiber with oscillation of two orthogonal polarizations at different frequencies



λ=1547 nm (C band)
P=100 µW

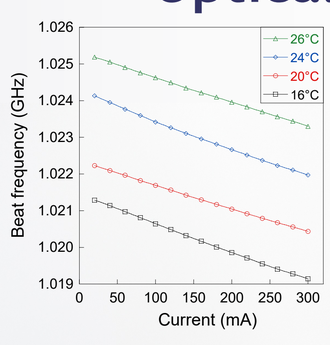
Optical spectrum



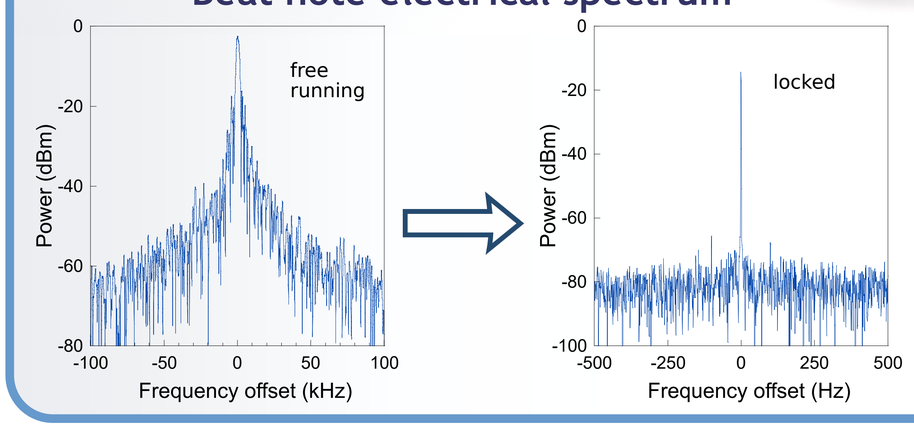
Preliminary: beat frequency at **1 GHz**

Two stabilization methods

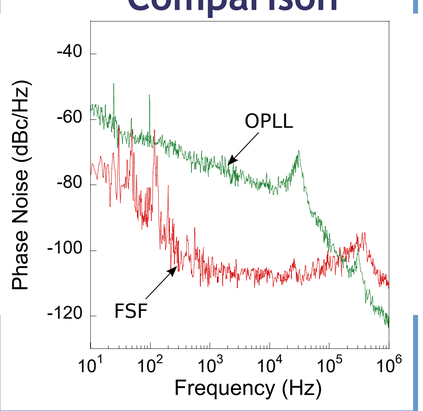
Optical Phase-Locked Loop (OPLL)



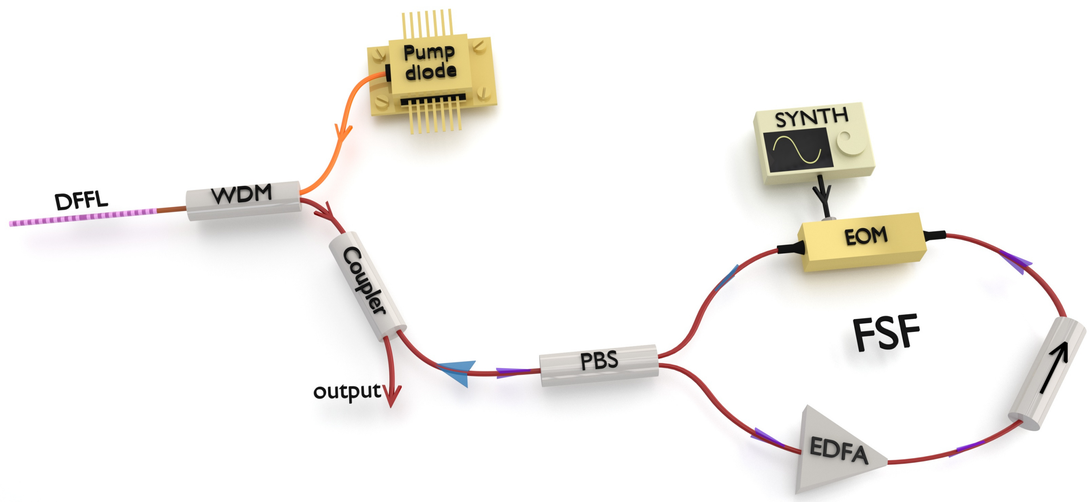
Beat note electrical spectrum



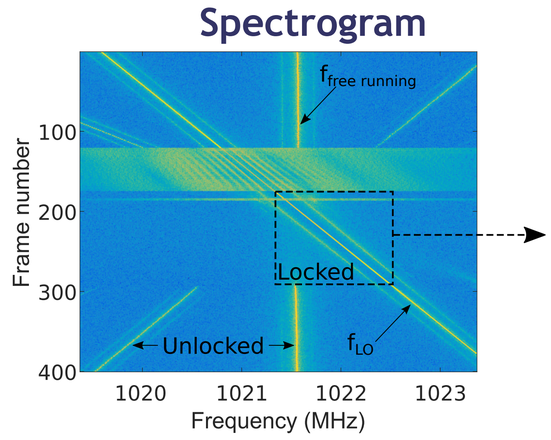
Comparison



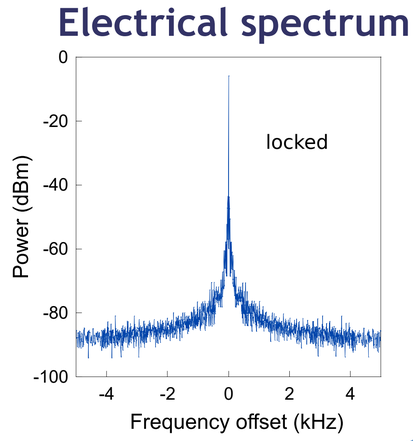
Frequency-Shifted Feedback (FSF)



Spectrogram



Electrical spectrum



Conclusions

- OPLL and FSF methods validated
- Stabilization works at 1 GHz
- High spectral purity in agreement with LO (1 Hz)
- 1 MHz lock-in-range
- Also demonstrated with a beat frequency at 300 MHz and 10 GHz

Perspective

- Study different fiber laser architectures (DBR, PM fiber)
- Extend to higher frequencies of the beat note (use elasto-optic effect)
- Other control method : Kerr effect?
- Communication experiment with IETR antenna

References

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