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# Phase locking of dual-polarization DFB fiber lasers through pump-power modulation

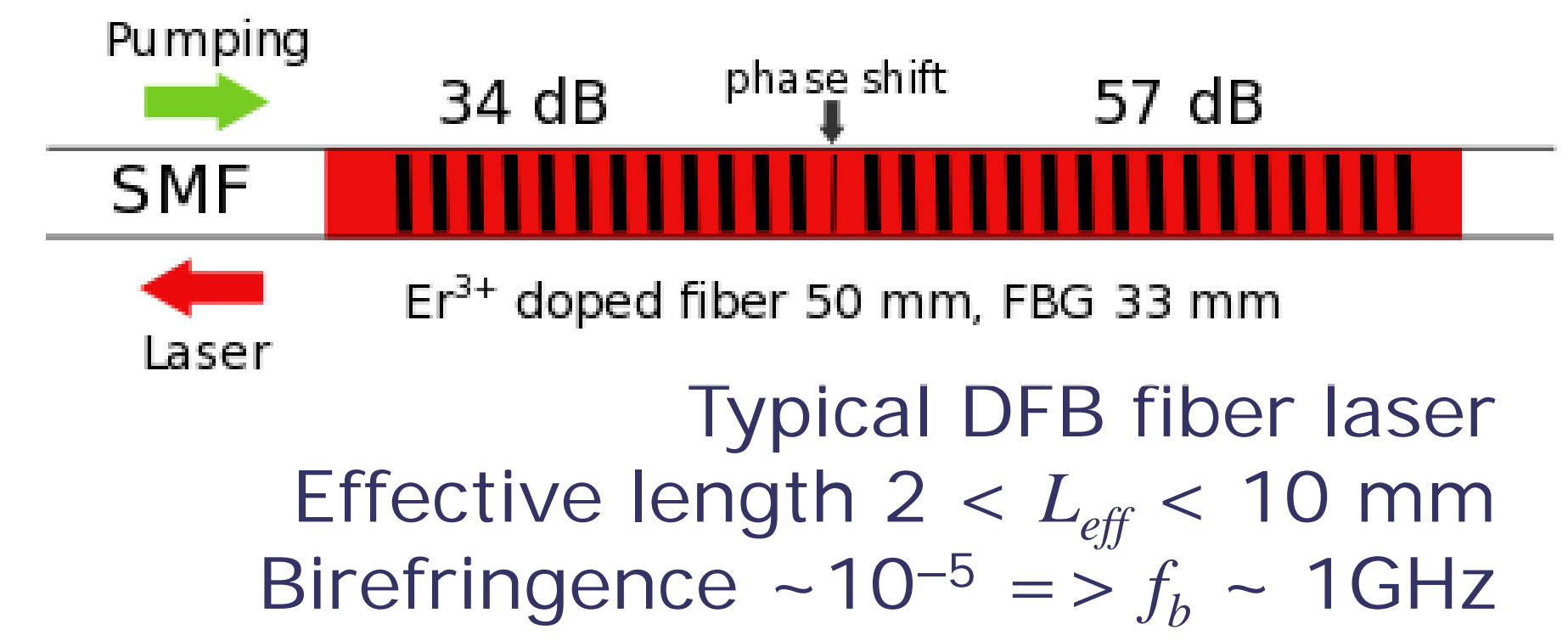
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## Motivation: DFB fiber laser as a microwave-optical source?

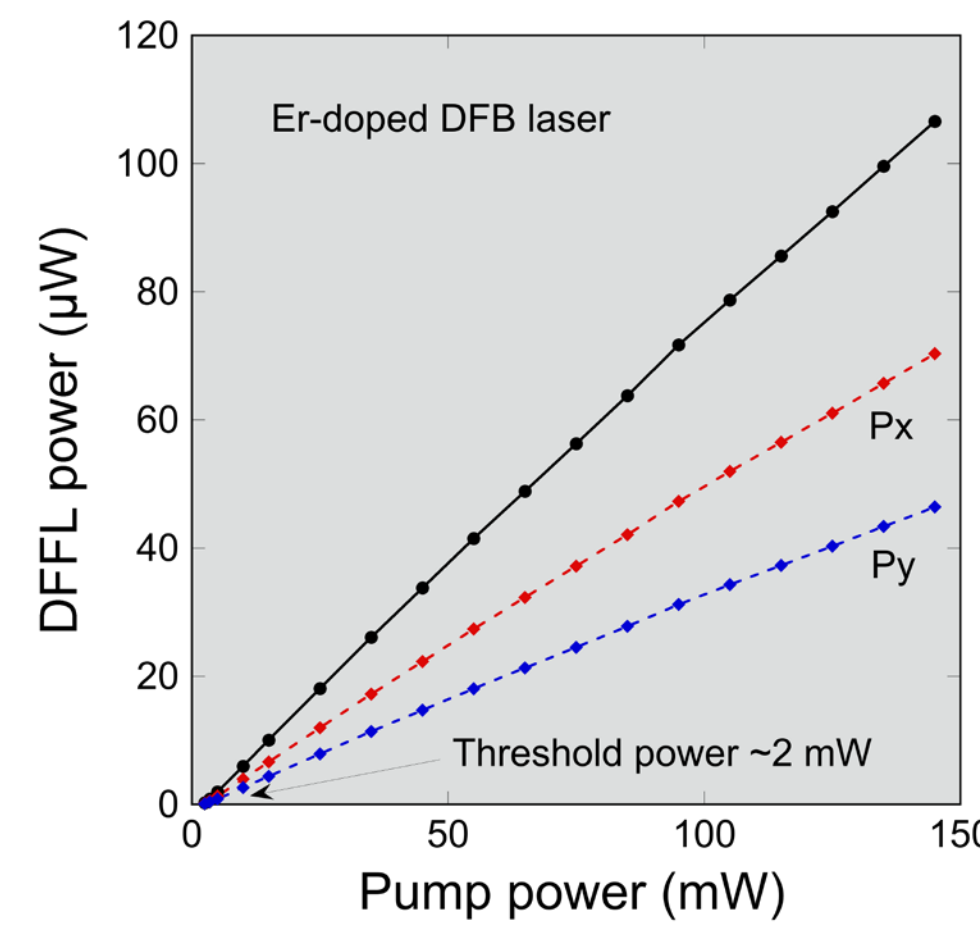
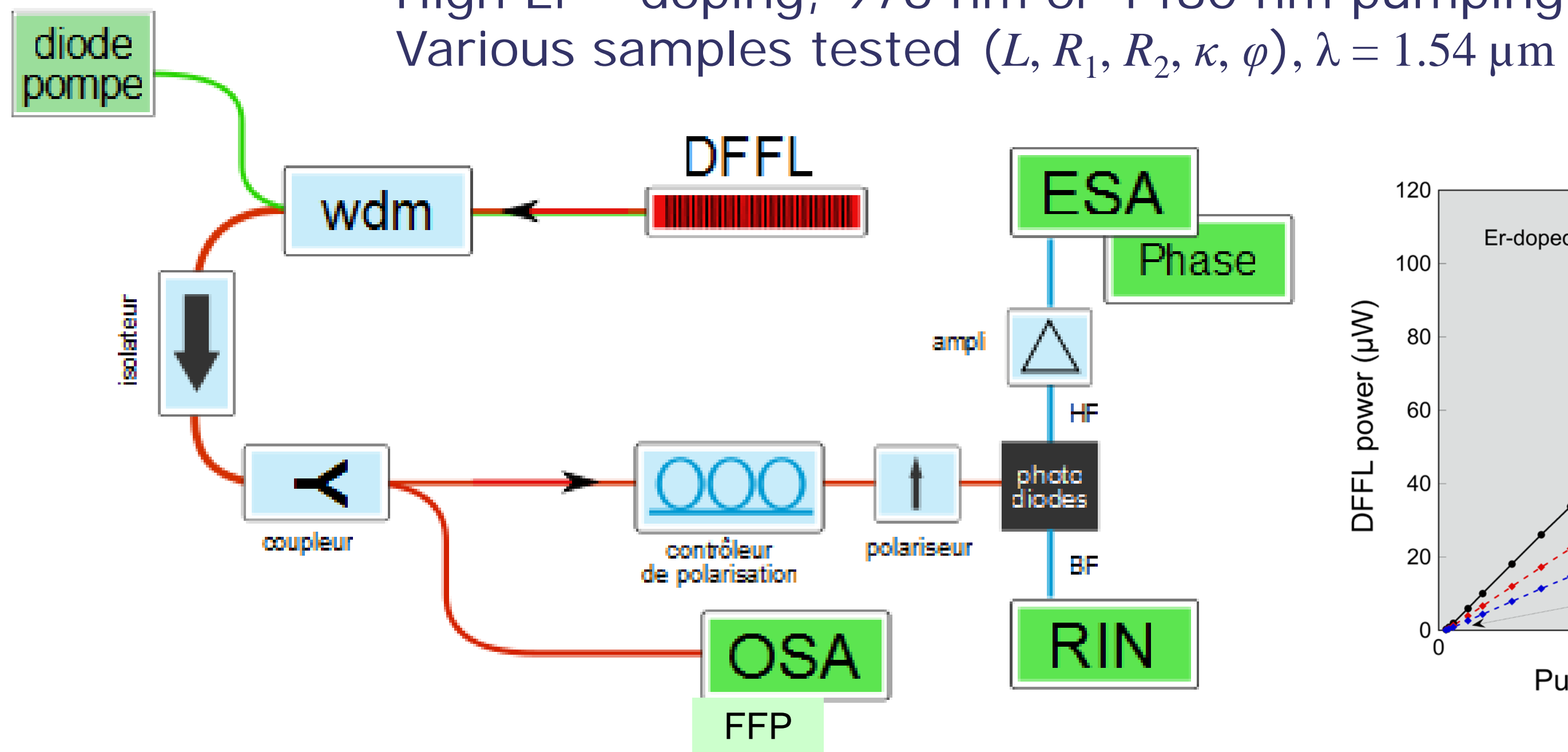
DFB fiber lasers => usually single-frequency, but dual-polarization oscillation possible – Birefringence due to photo-inscription of the FBG  
*Question:* use the beat note for microwave photonics?

**Aim:** characterization and stabilization of a DFFL, here preliminary work on pump-power beat frequency tuning and locking

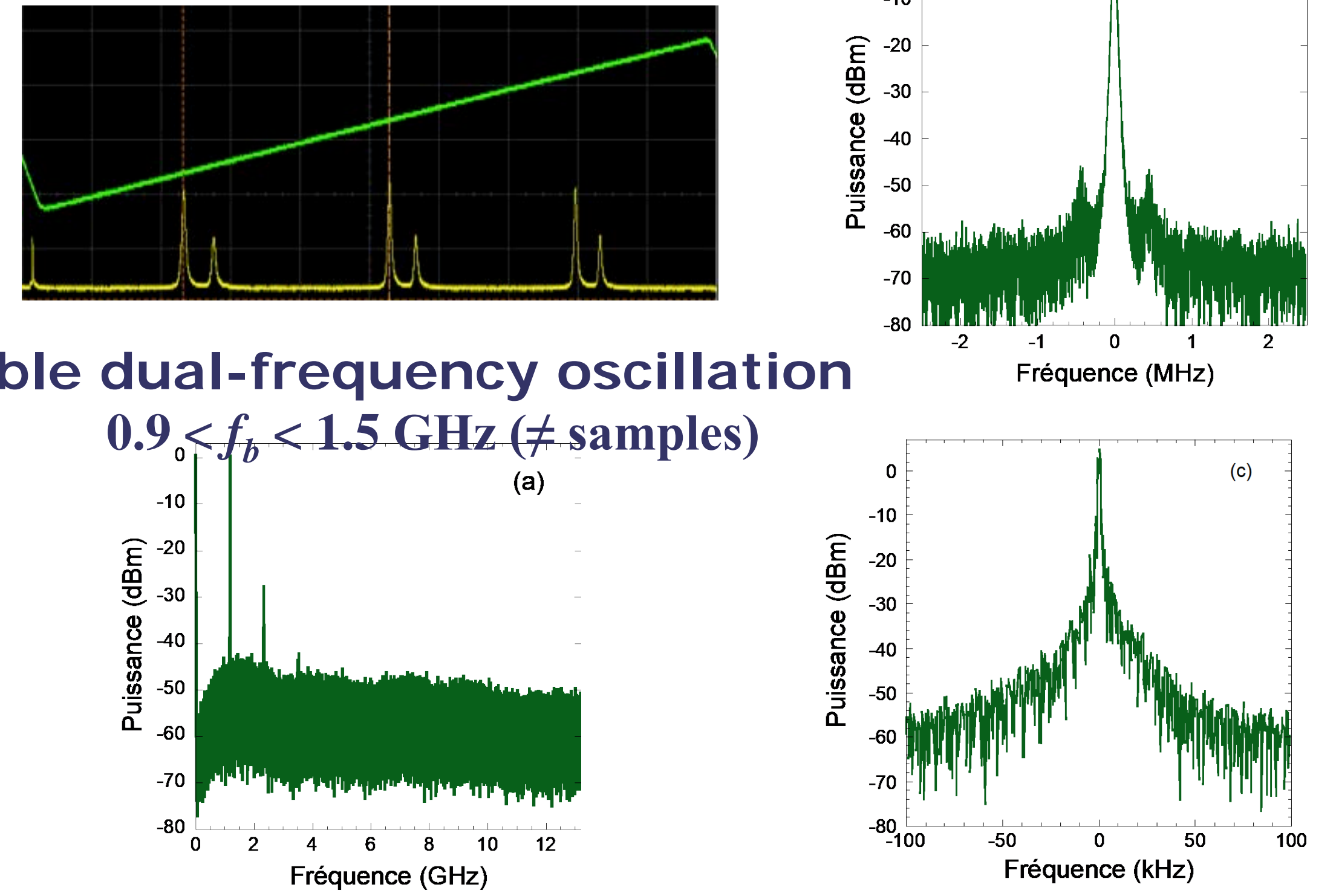


## Dual-frequency fiber laser (DFFL) characterization

High Er<sup>3+</sup> doping, 976 nm or 1480 nm pumping  
Various samples tested ( $L, R_1, R_2, \kappa, \varphi$ ),  $\lambda = 1.54 \mu\text{m}$

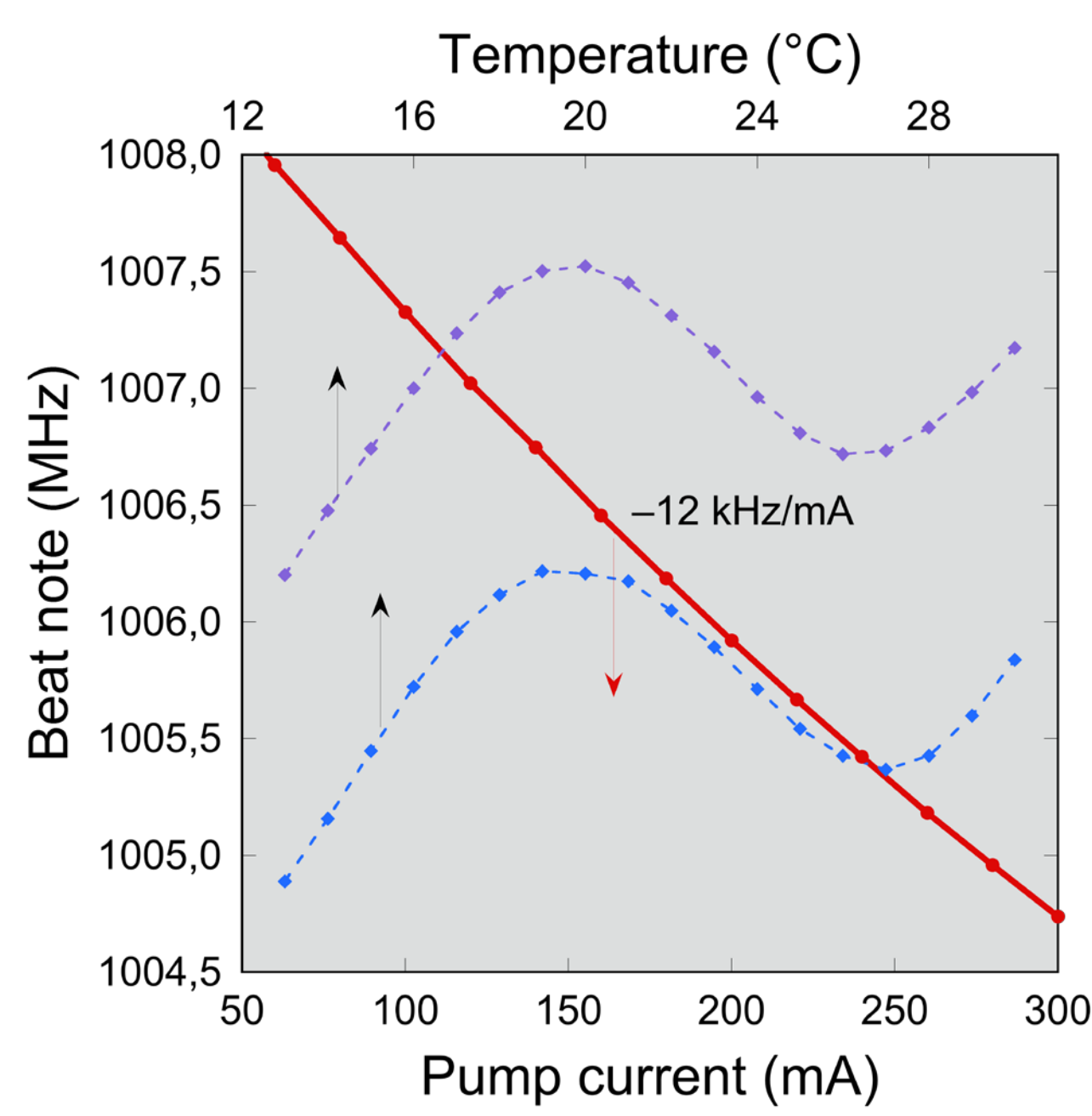


**Stable dual-frequency oscillation**  
 $0.9 < f_b < 1.5 \text{ GHz}$  ( $\neq$  samples)



## Beat frequency tuning and locking

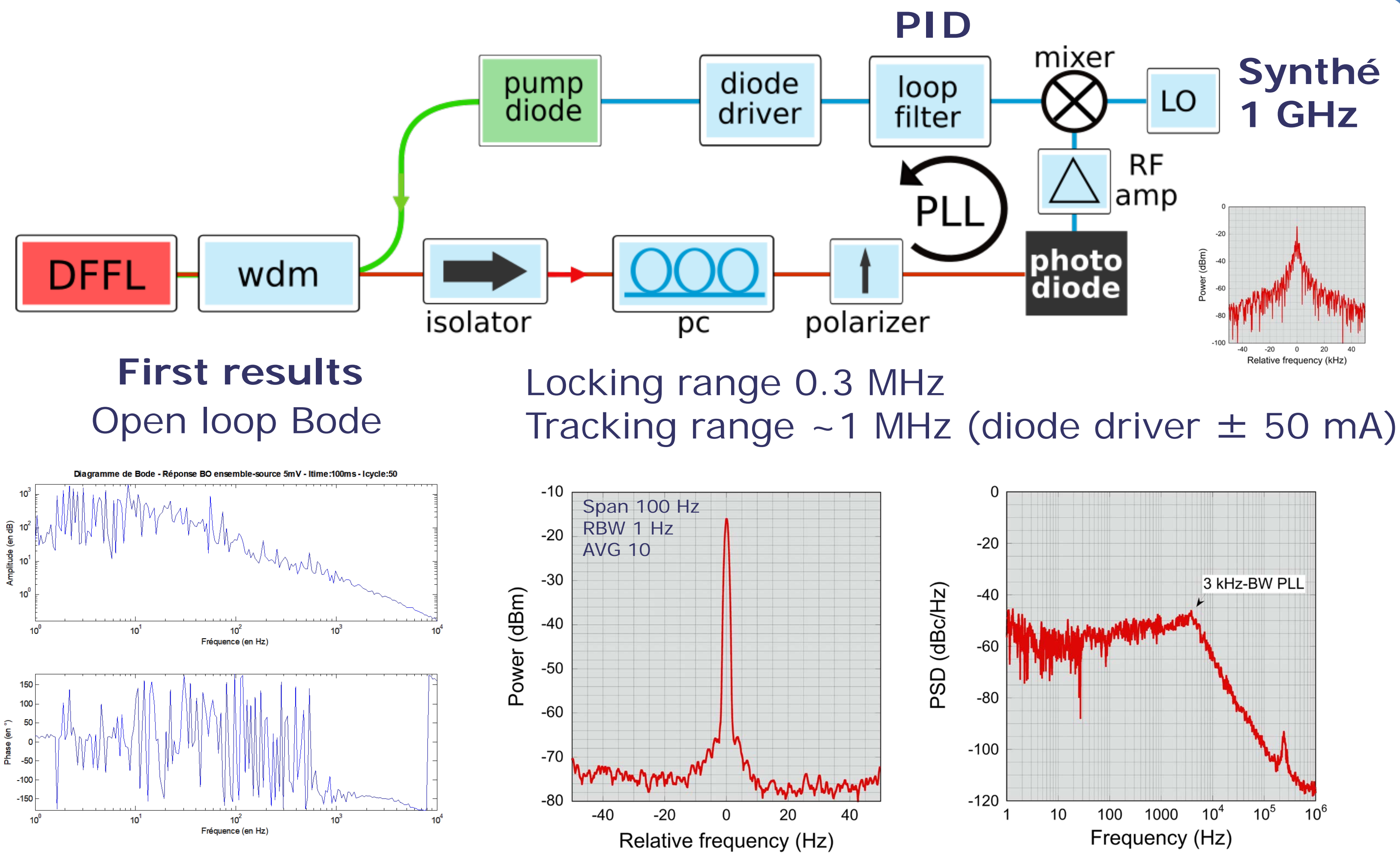
Temperature tuning  $\frac{\partial n}{\partial T}$  + Pump power tuning



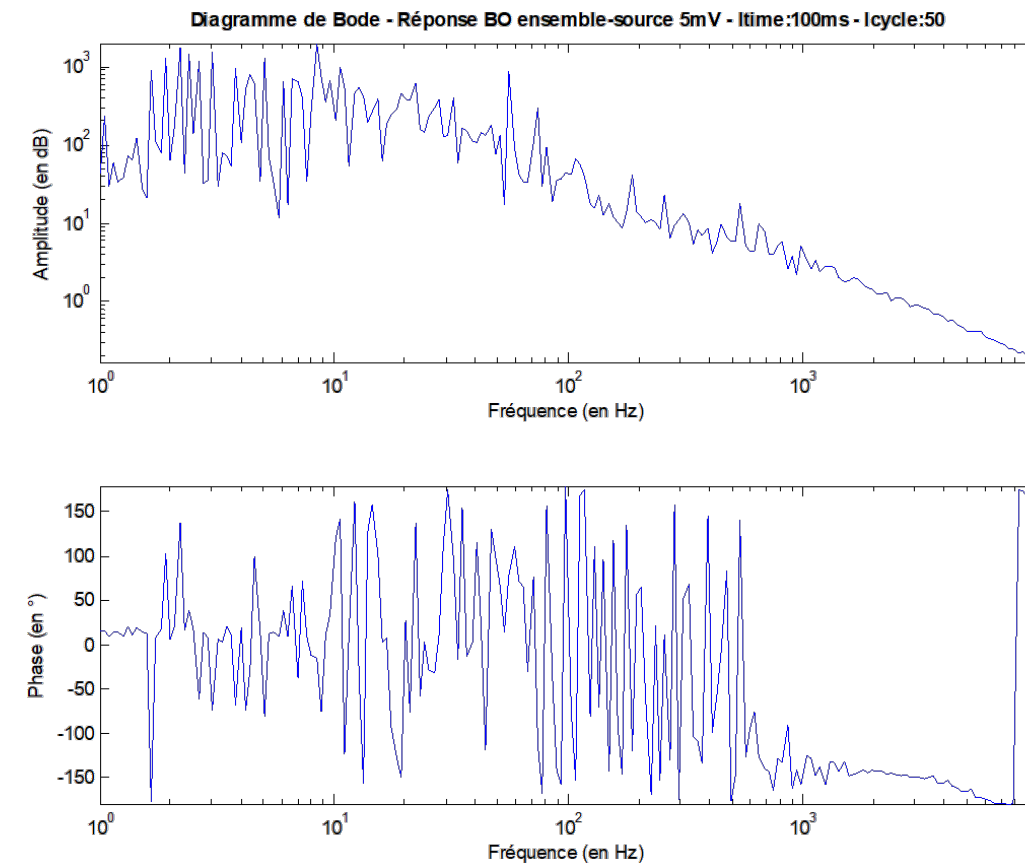
Independent of outside temp.

VCO actuator (low BW)

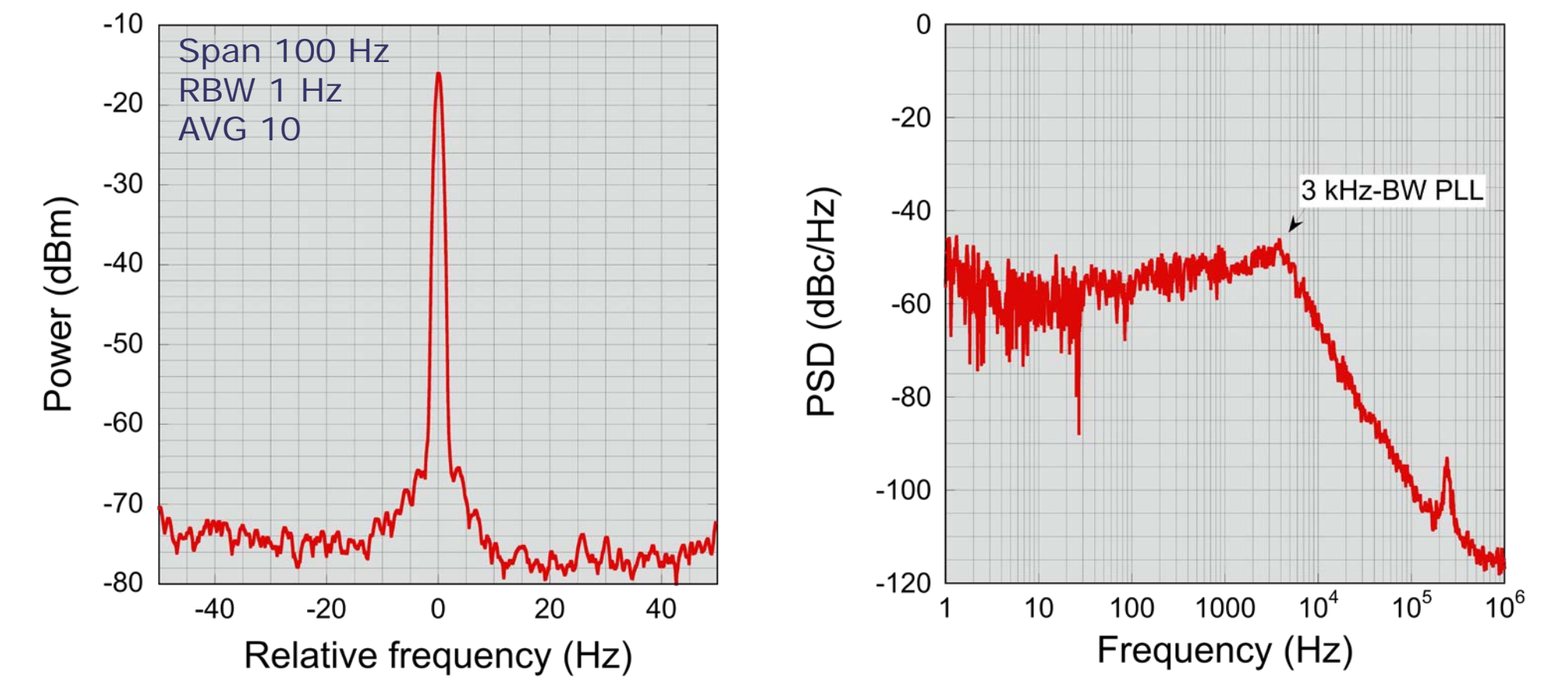
=> Needs dual-polarization modelling



**First results**  
Open loop Bode



Locking range 0.3 MHz  
Tracking range ~1 MHz (diode driver  $\pm 50 \text{ mA}$ )



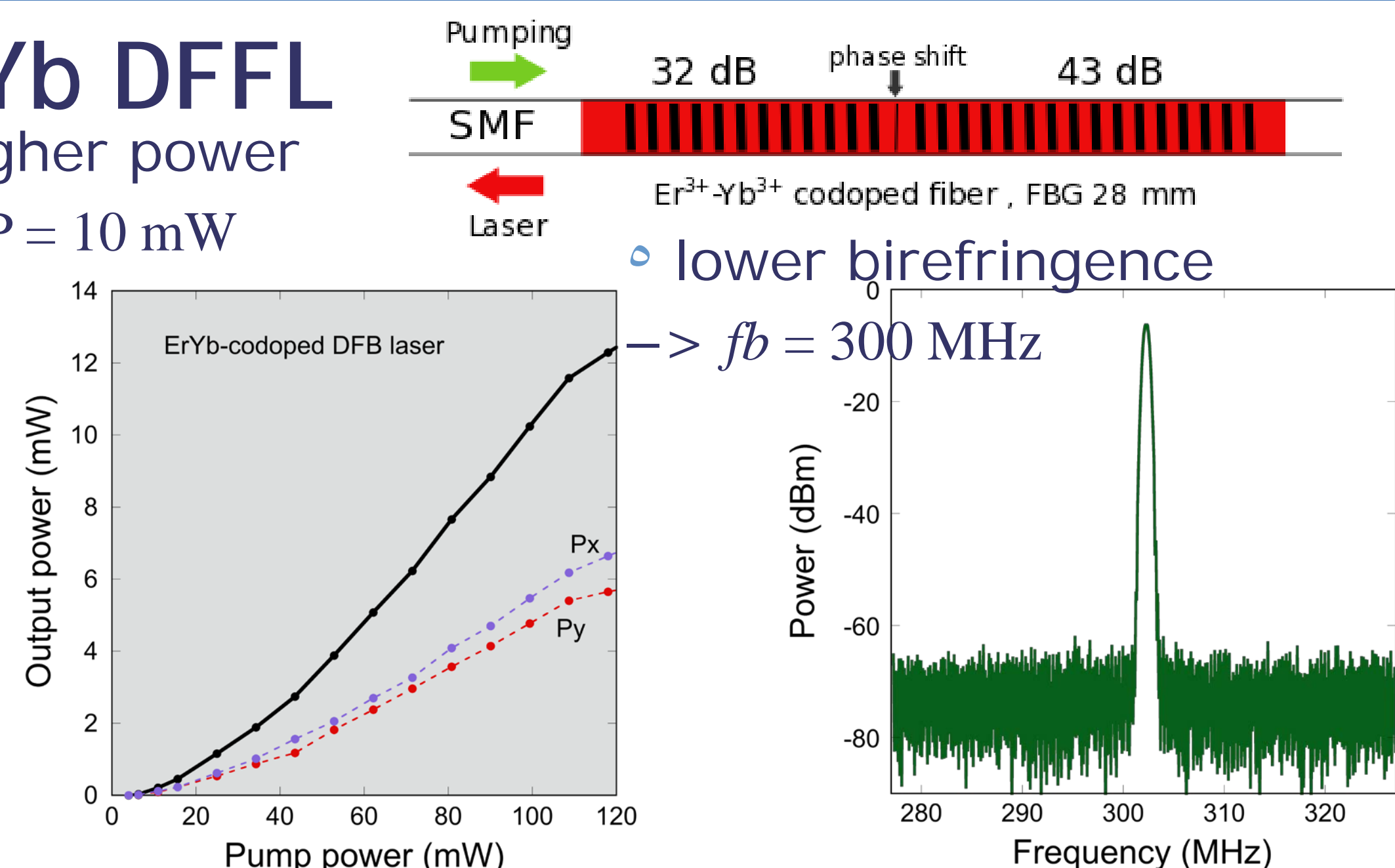
## Er-Yb DFFL

• higher power

-> P = 10 mW

• lower birefringence

->  $f_b = 300 \text{ MHz}$



## Conclusions

- DFFLs characterized experimentally
- simple phase-locked loop demonstrated for DFFL
- compensates for slow drifts ( $< 3 \text{ kHz}$ )

**Next...**

- Further loop optimization for phase noise reduction
- Dual-polarization laser simulation
- Study DBR architecture
- PZT actuator for higher beat notes (10 GHz range)

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