Heterodyne detection in ALPS II

15th PATRAS Workshop on Axions, WIMPs and WISPs

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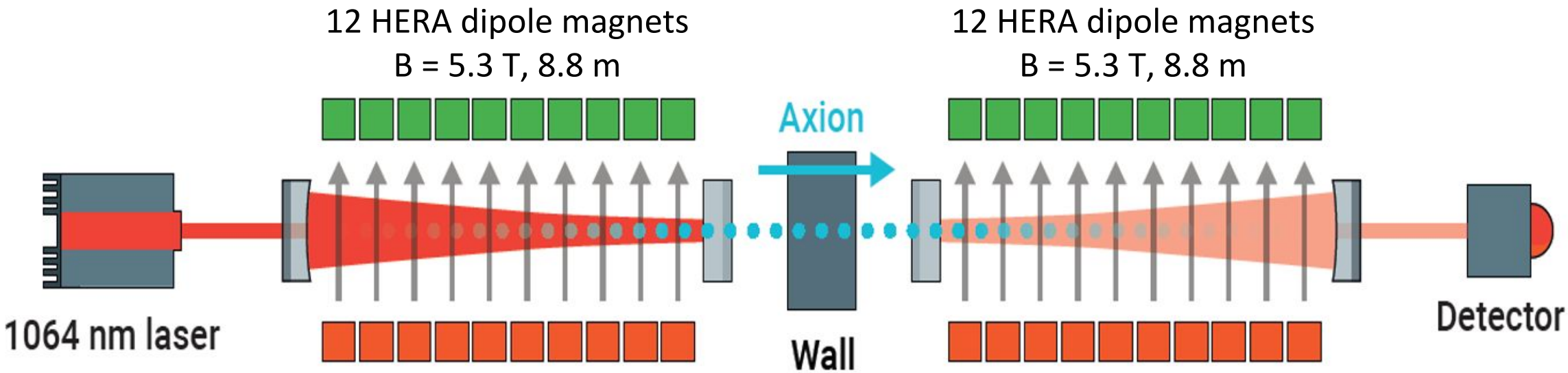
ALPS II - LSW with Optical Cavities



P= 30 W

Production cavity (PC)

Power build-up: 5,000

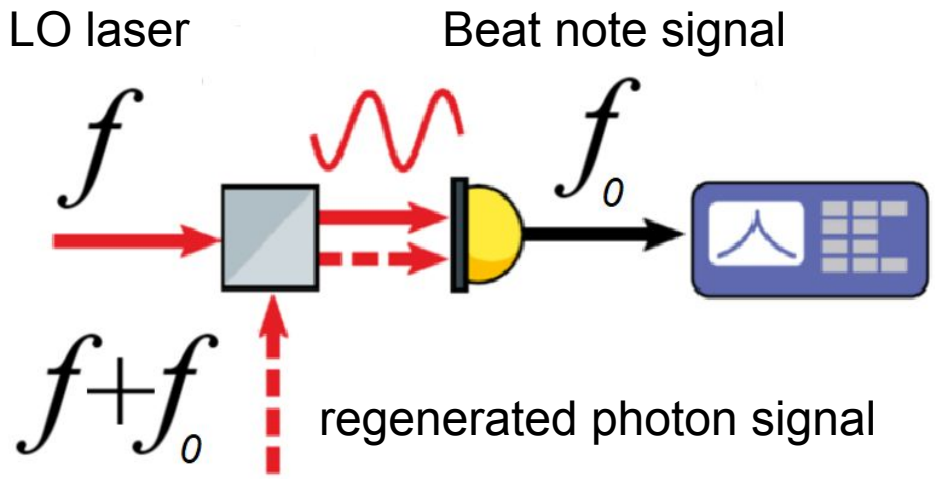
(150 kW circulating power)

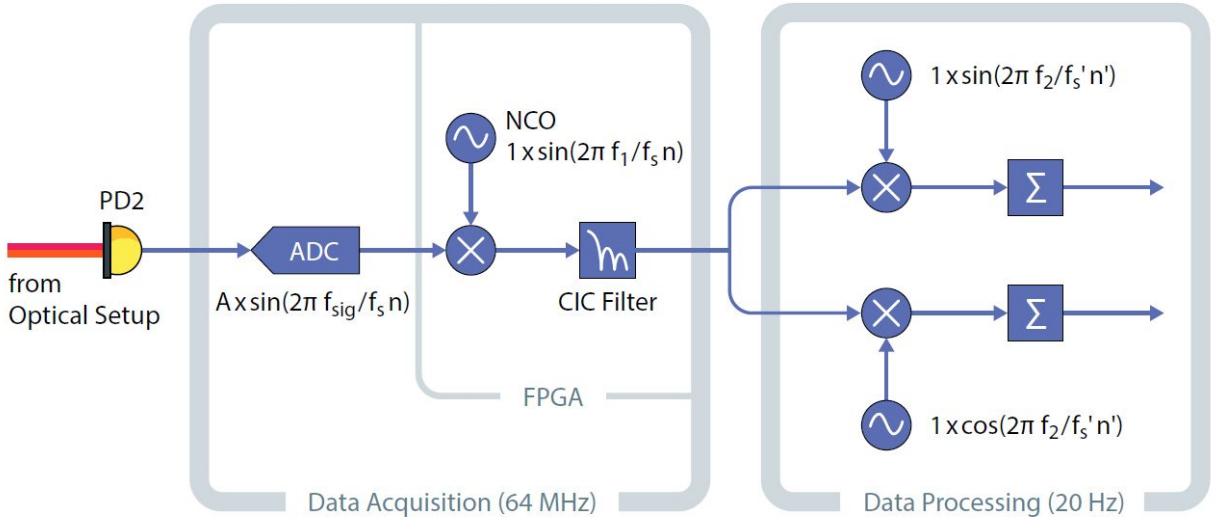
Regeneration cavity (RC)

Finesse: 120,000

expected signal ~few photons / week!

Heterodyne detection



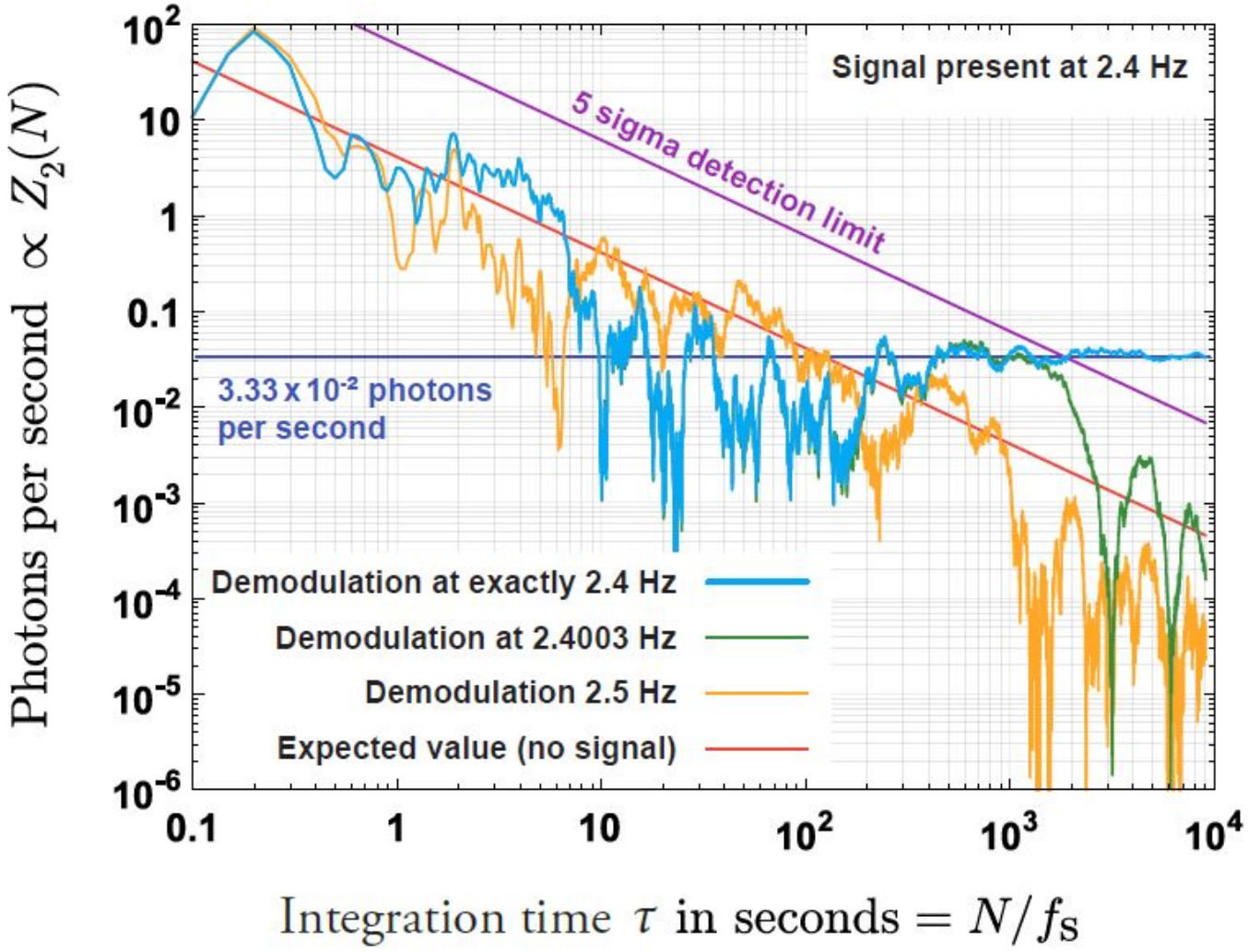


- interference between strong local oscillator and regenerated photon signal creates beat note
- coherent signals sum while noise averages out
- excellent energy resolution

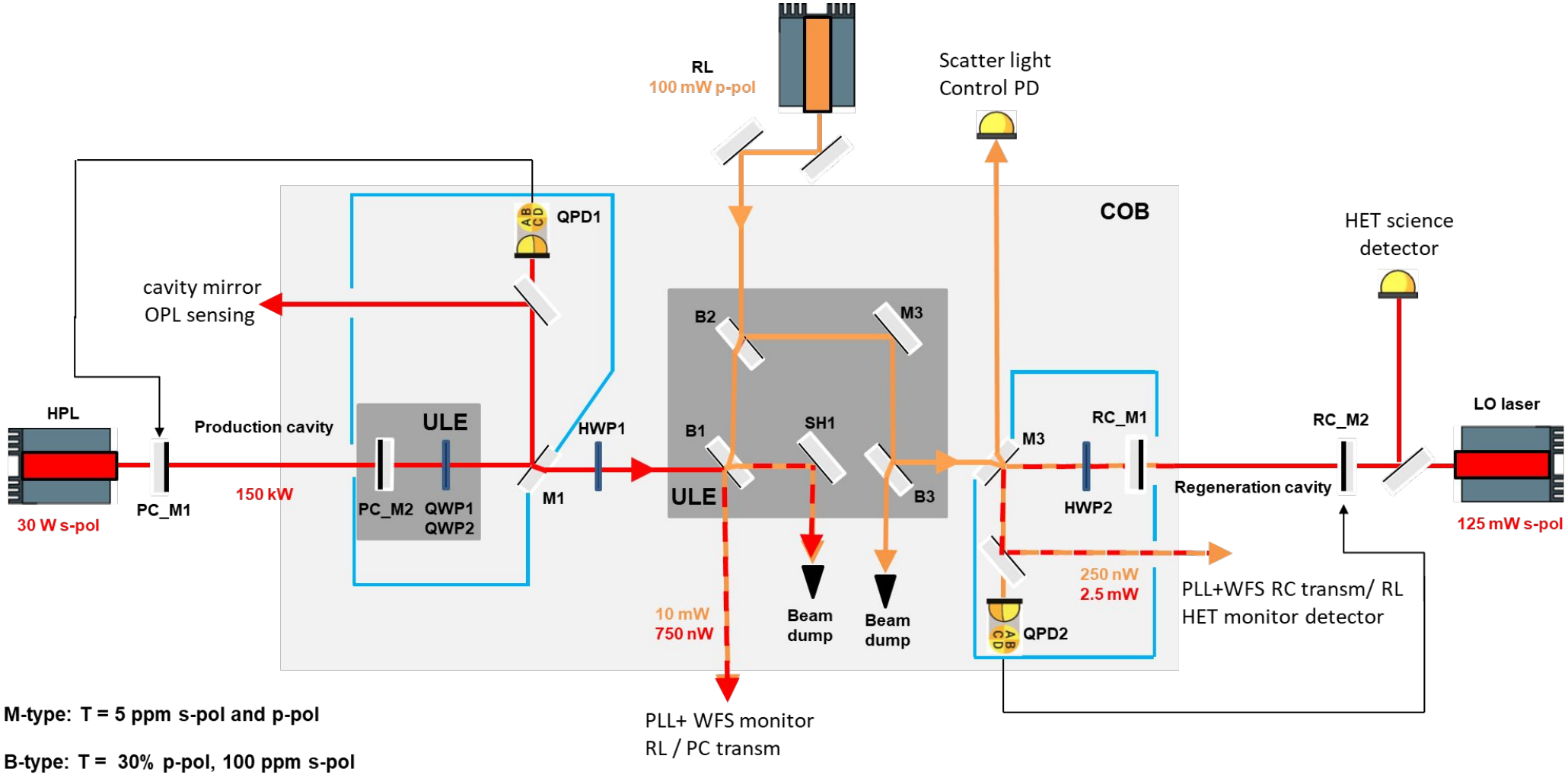
- digital double demodulation of the interference signal
- first demodulation stage occurs in the FPGA
- second I/Q demodulation at 20Hz

Experimental results

- low power signal (6.33e-21 W) generated from 2nd order modulation sideband and passive filters
- measurement at expected frequency yields detection at this power to 5σ after 3 days integration time
- no signal present when demodulating at nearby frequencies



Implementation in ALPS II



M-type: T = 5 ppm s-pol and p-pol

B-type: T = 30% p-pol, 100 ppm s-pol