STABILIZING AN OPTICAL COMB WITH A DIGITAL PHASE LOCK LOOP

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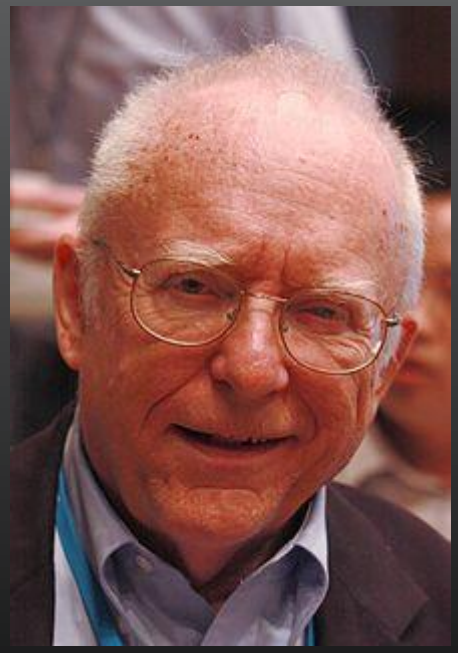
NOBEL PRIZE AWARDED FOR DEVELOPMENT OF OPTICAL COMBS

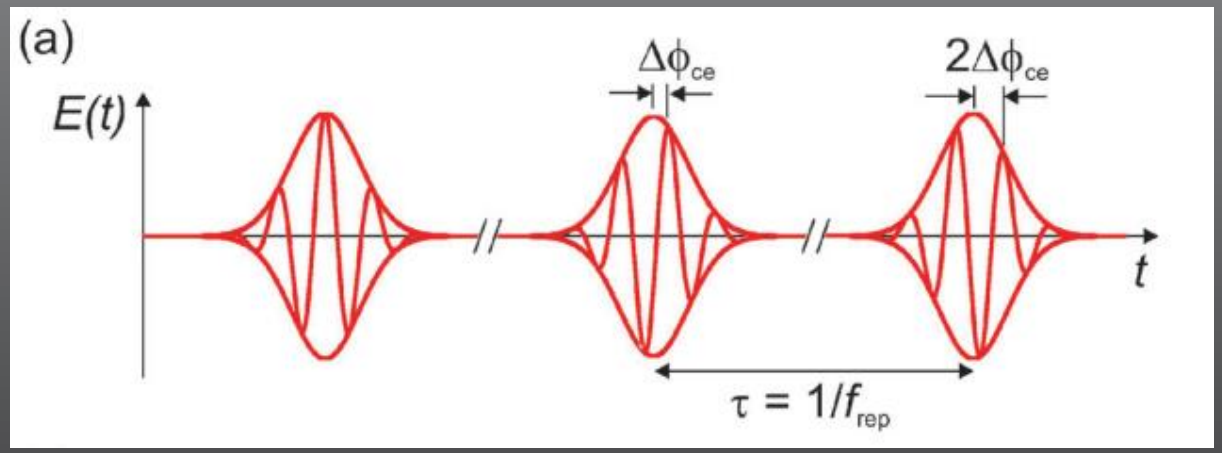
- DEVELOPED BY JOHN HALL AND THEODORE HANSCH (AWARDED NOBEL PRIZE IN 2005)
- OPTICAL COMBS ALLOW FOR A DIRECT LINK BETWEEN RADIO FREQUENCIES AND OPTICAL FREQUENCIES
- CAN BE USED IN PRECSION OPTICAL METROLOGY AND DUAL COMB SPECTROSCOPY
- MORE PRECSICE GPS AND OPTICAL CLOCK TECHNOLOGY



JOHN HALL

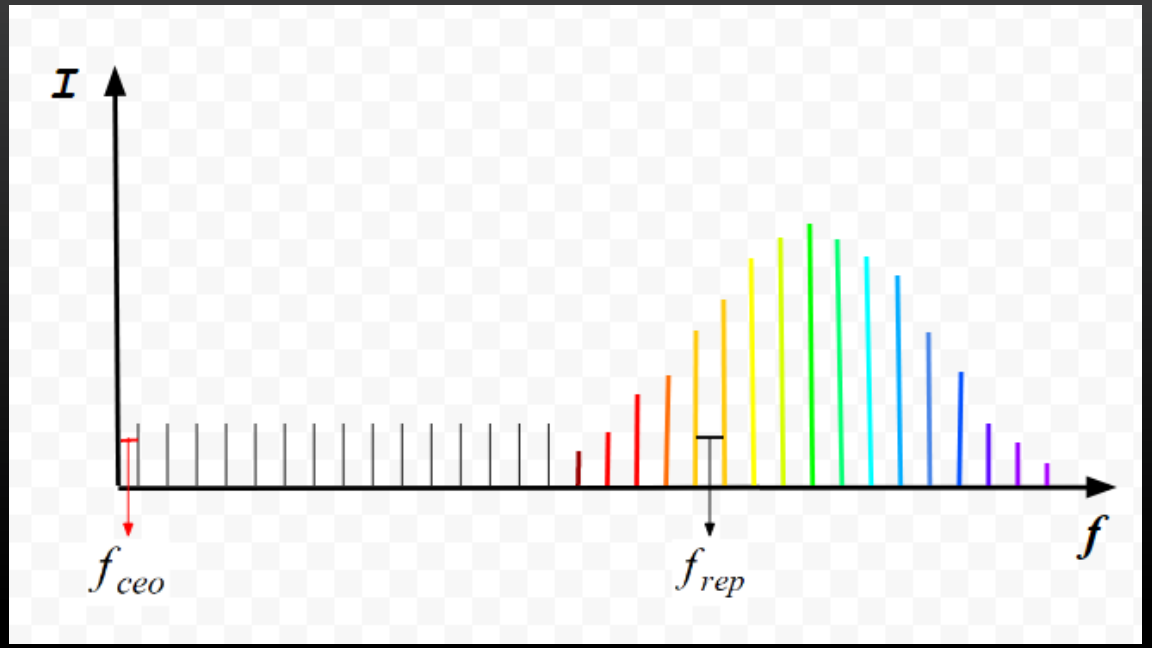
THEODORE HANSCH

[1]

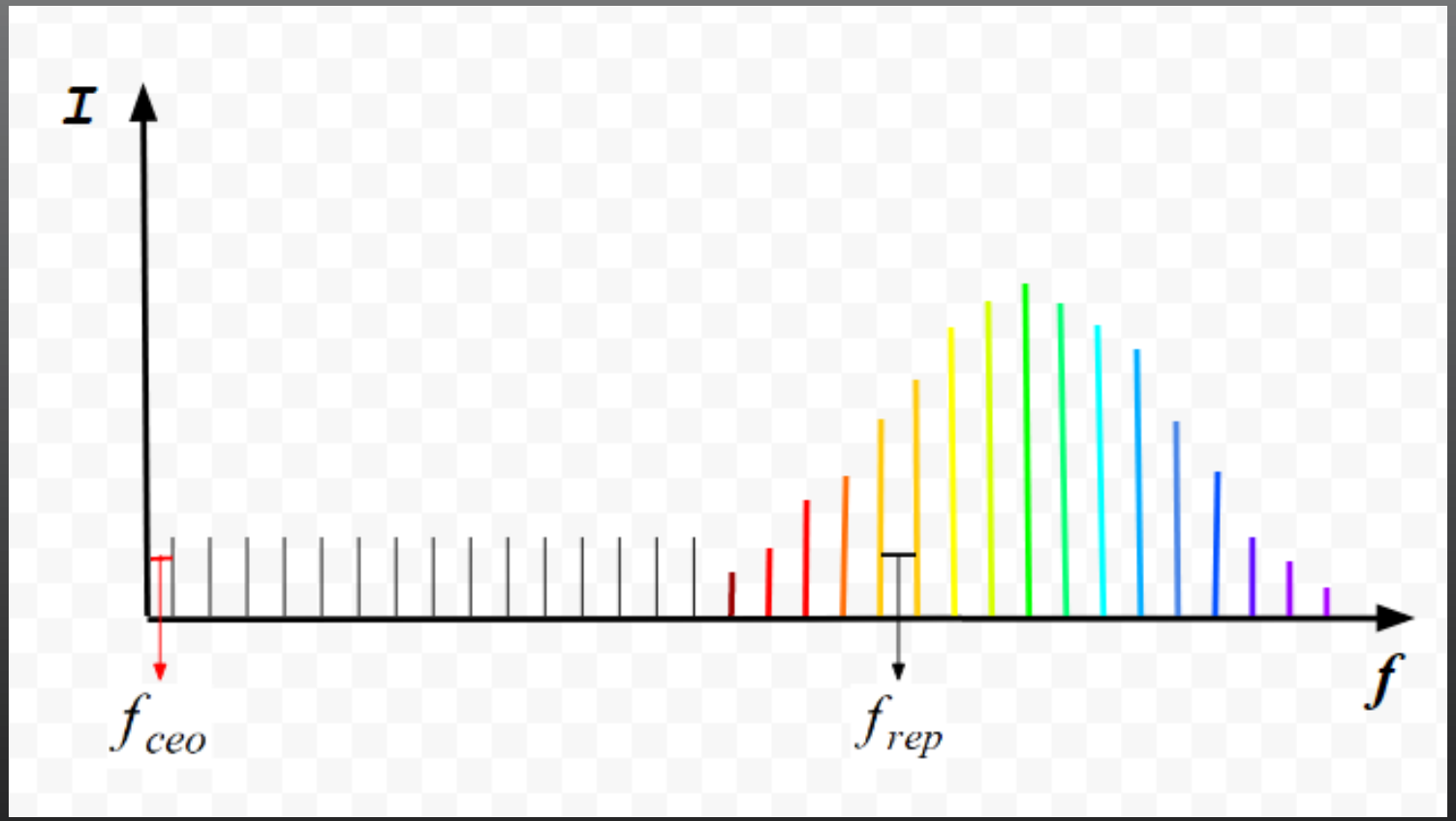


FOURIER TRANSFORM

OPTICAL COMB



AN OPTICAL COMB IS THE SPECTRAL CONTENT OF A PULSE WAVE TRAIN

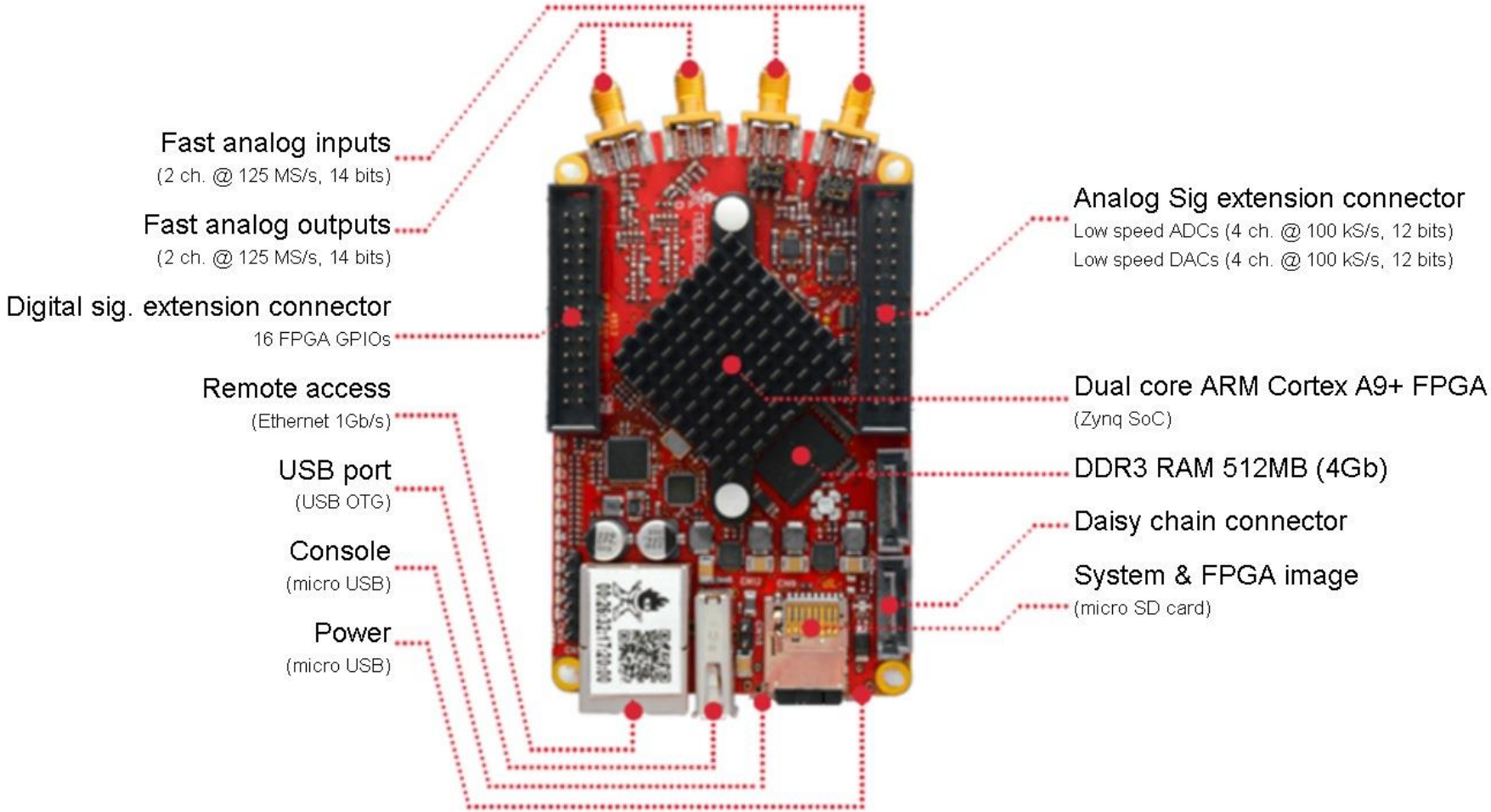


$$f_n = n \cdot f_{rep} + f_{ceo}$$

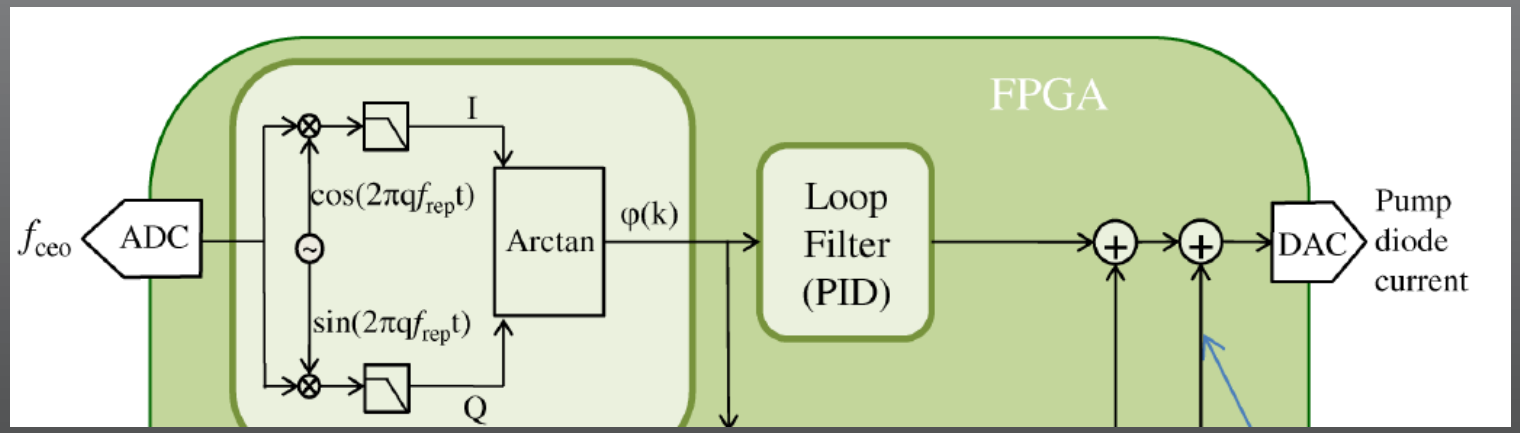
OPTICAL COMB EQUATION

redpitaya

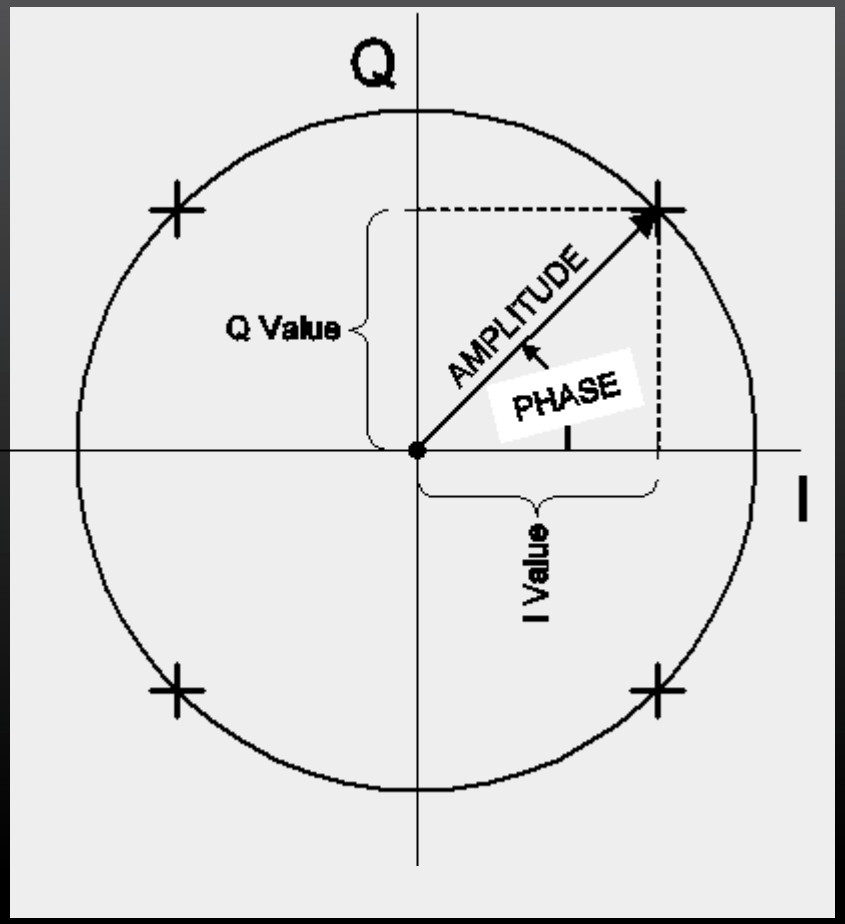
Hardware Overview

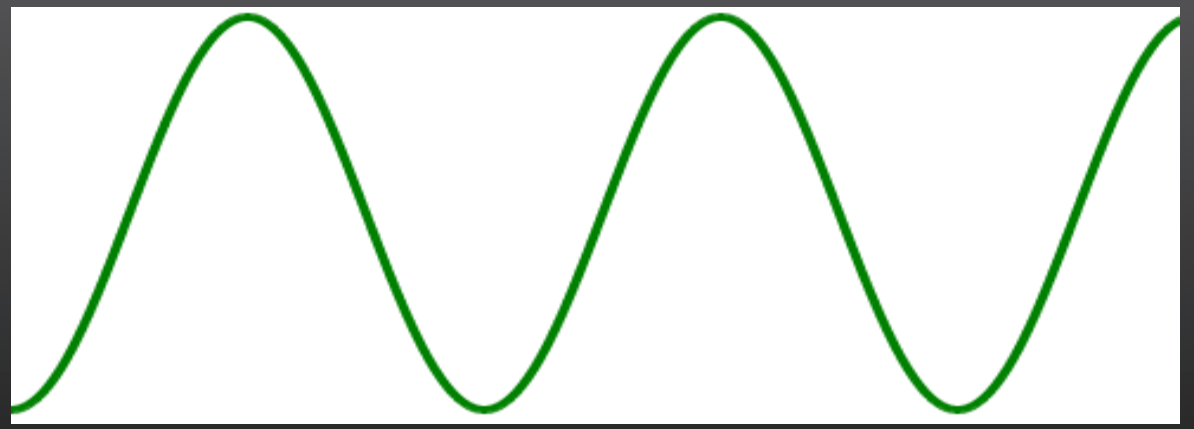


[2]

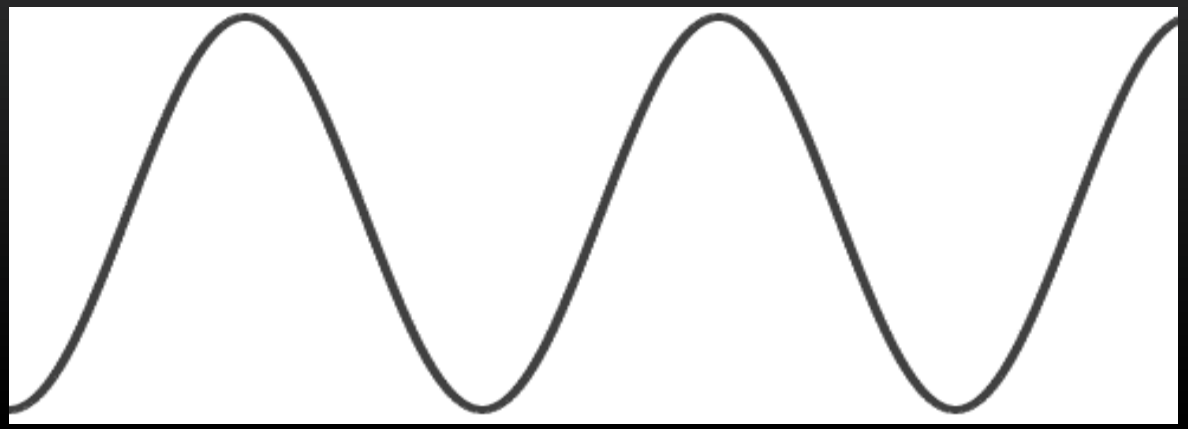


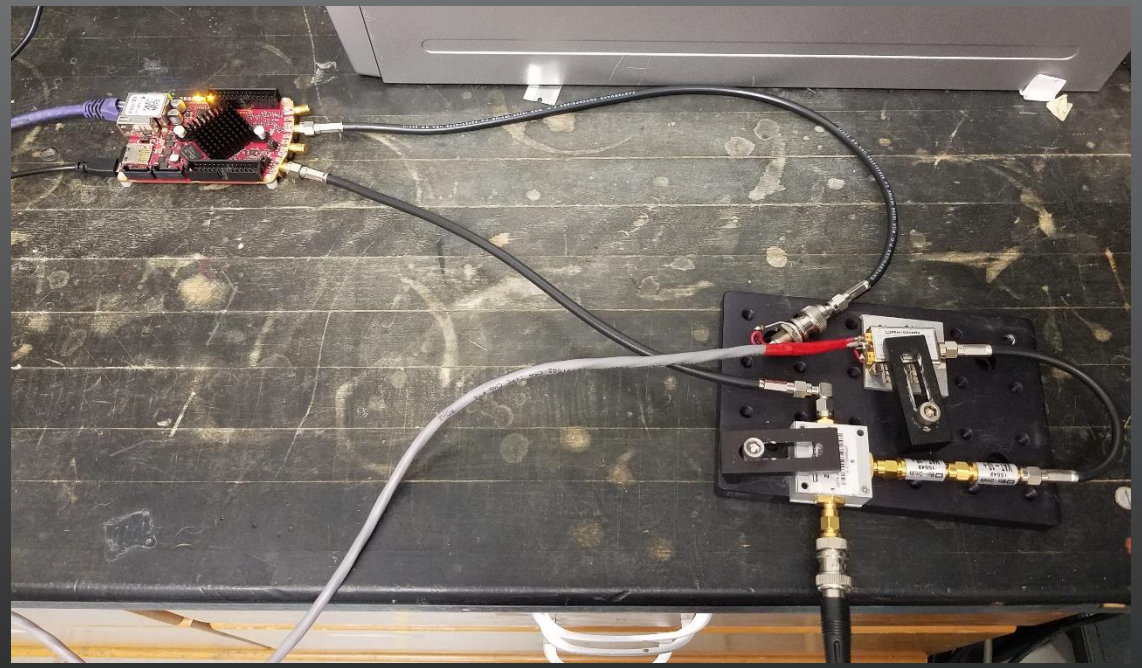
redpitaya



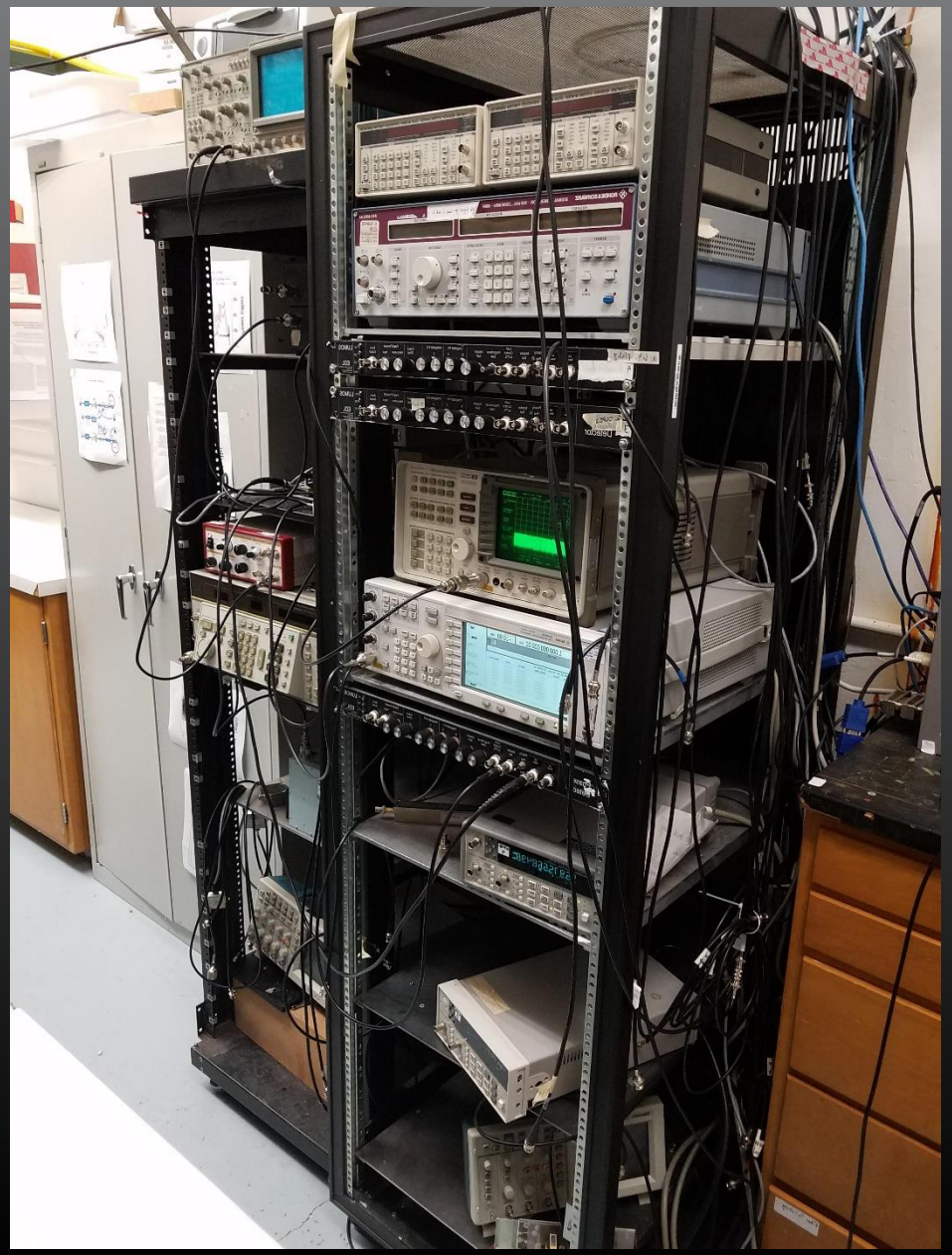


IN PHASE



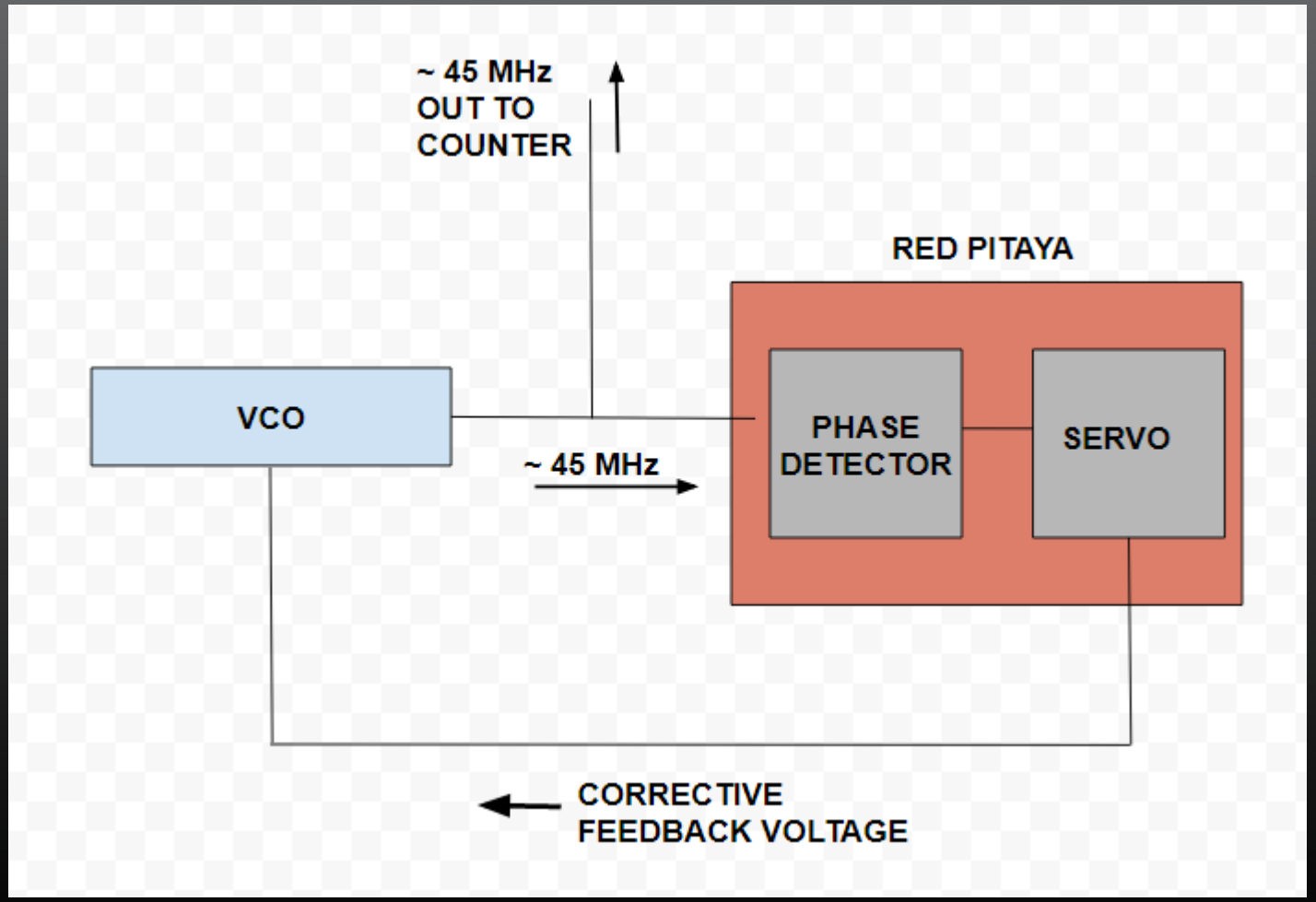


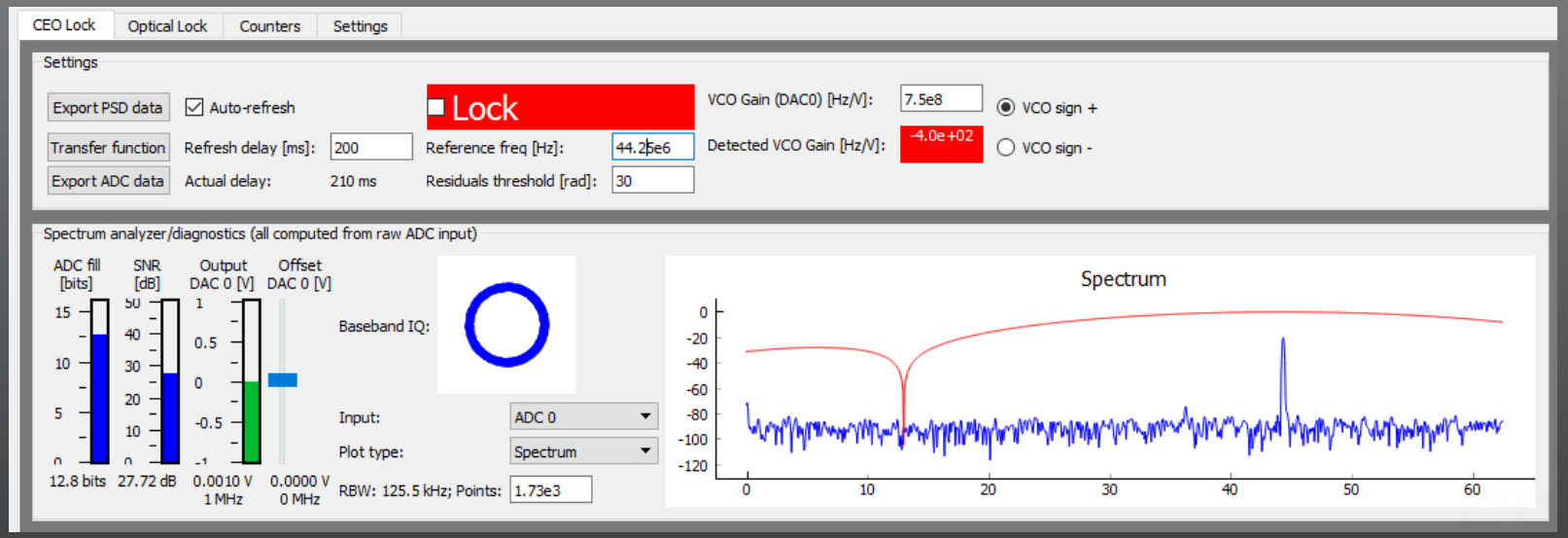
VS.

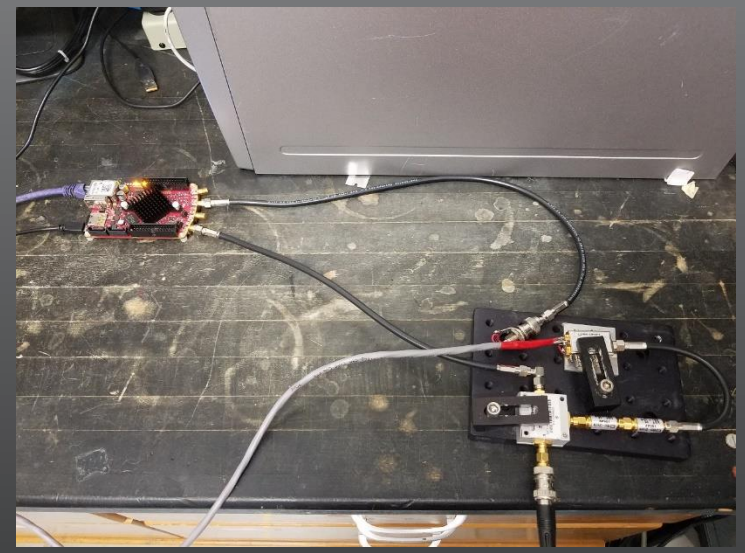


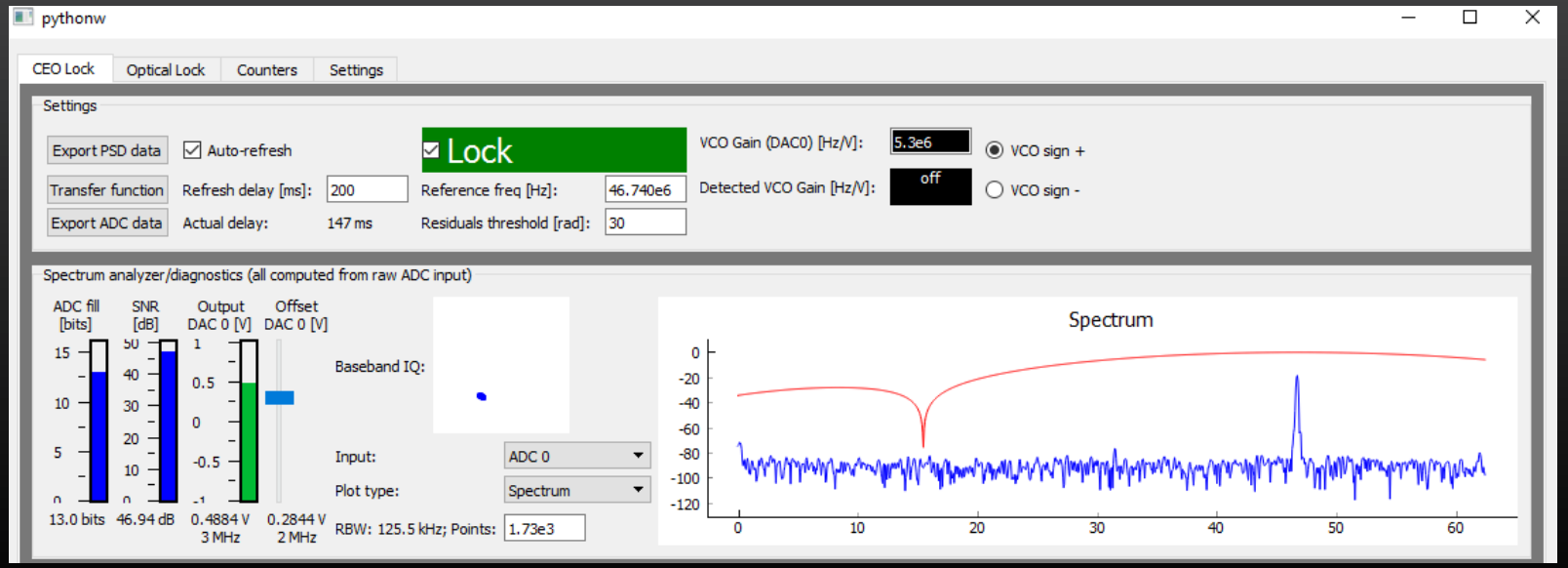
- COMPACT
- TENS OF THOUSANDS OF DOLLARS CHEAPER
- MUCH LESS POWER COMPSUMPTION
- MOBILE AND EASILY DEPLOYABLE
- CAN BE CONTROLLED REMOTELY

LOCKING A VOLTAGE CONTROLLED OSCILLATOR WITH RED PITAYA







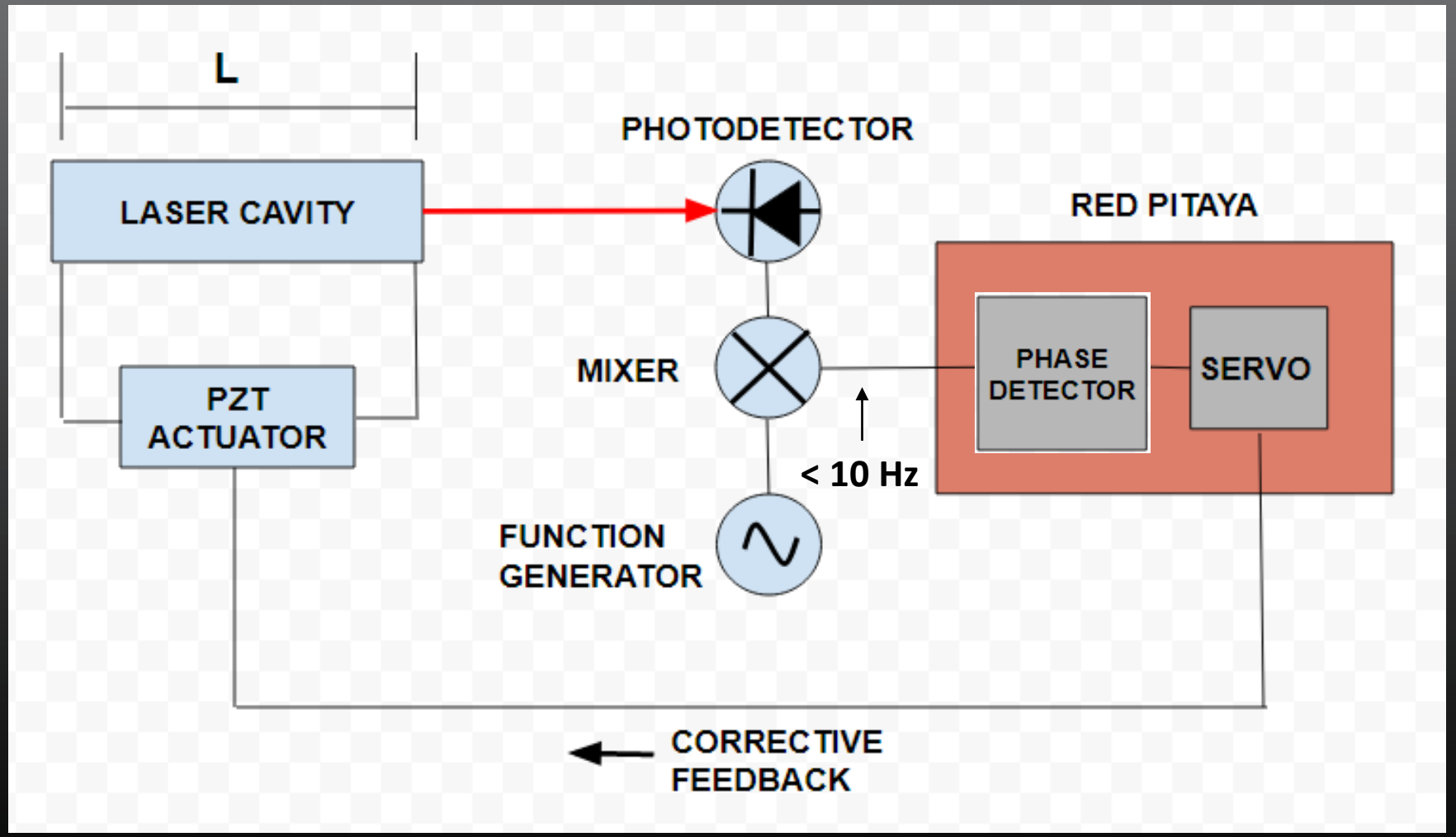


PRE-LOCK ERROR:
± 100 Hz

POST-LOCK ERROR:
± .01 Hz

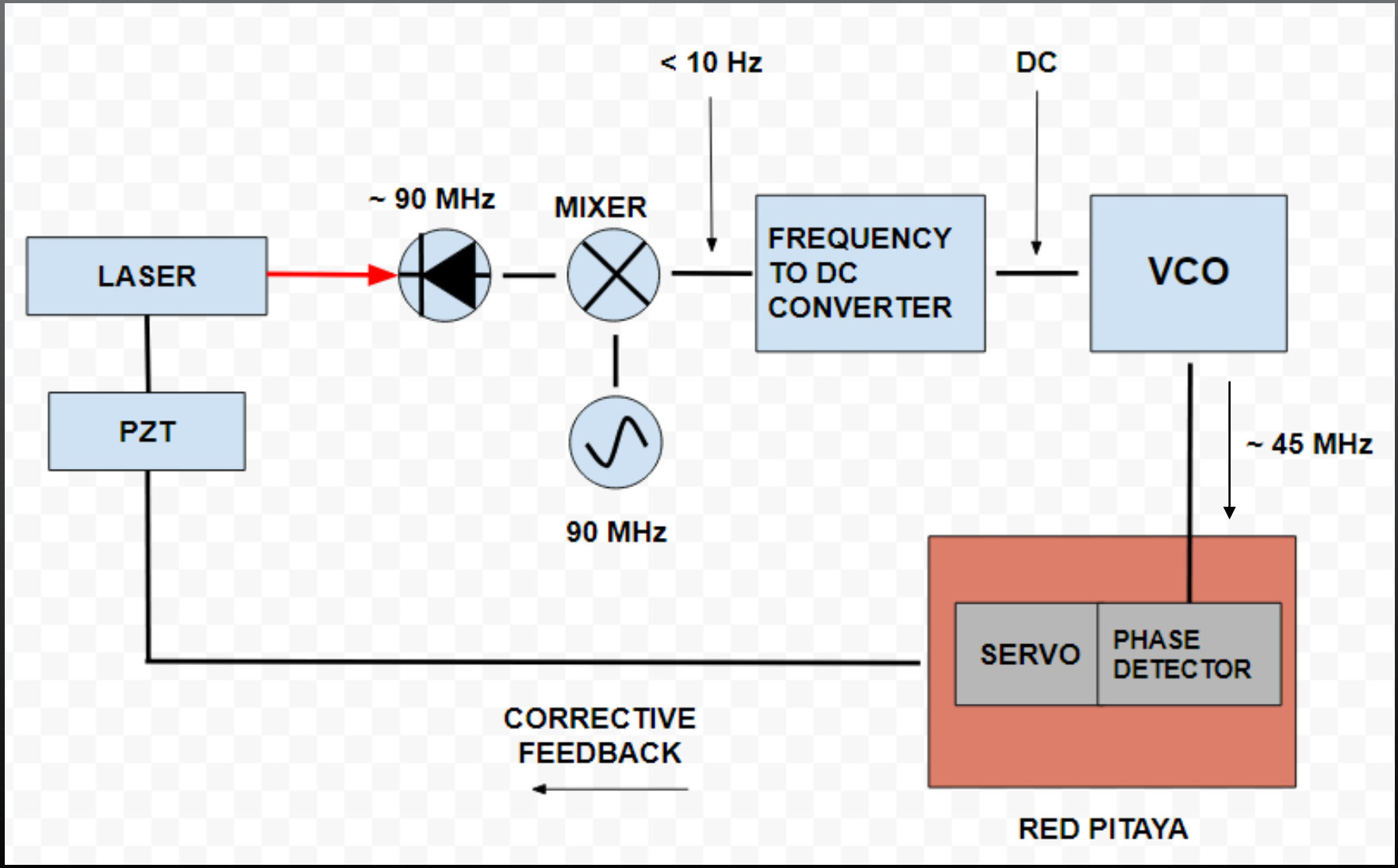
SCHEMATIC FOR REPETITION FREQUENCY LOCK THEOREICAL TECHNIQUE

f_{rep}



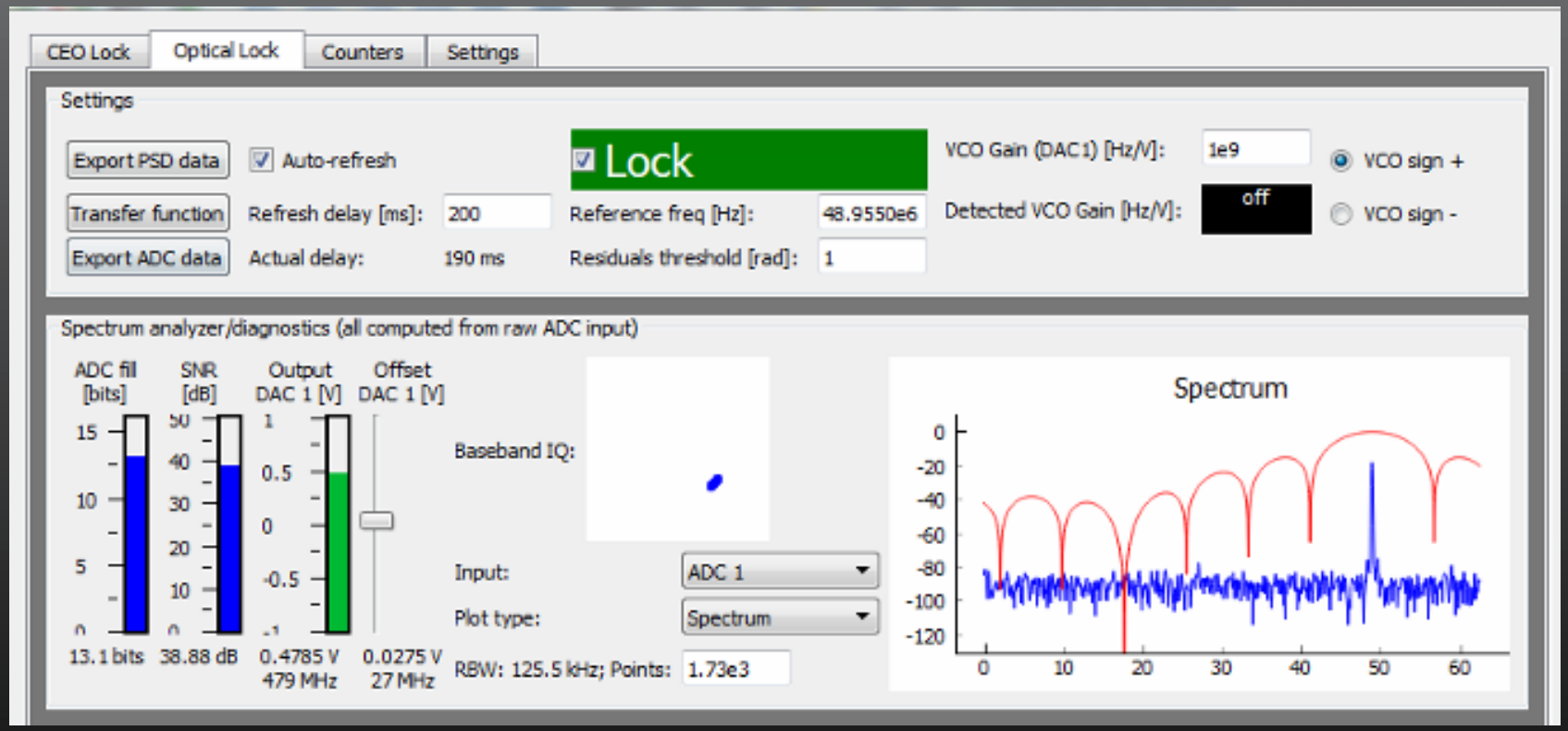
$$f_n = n \cdot f_{rep} + f_{ceo}$$

SCHEMATIC FOR REPETITION FREQUENCY LOCK f_{rep}



$$f_n = n \cdot f_{rep} + f_{ceo}$$

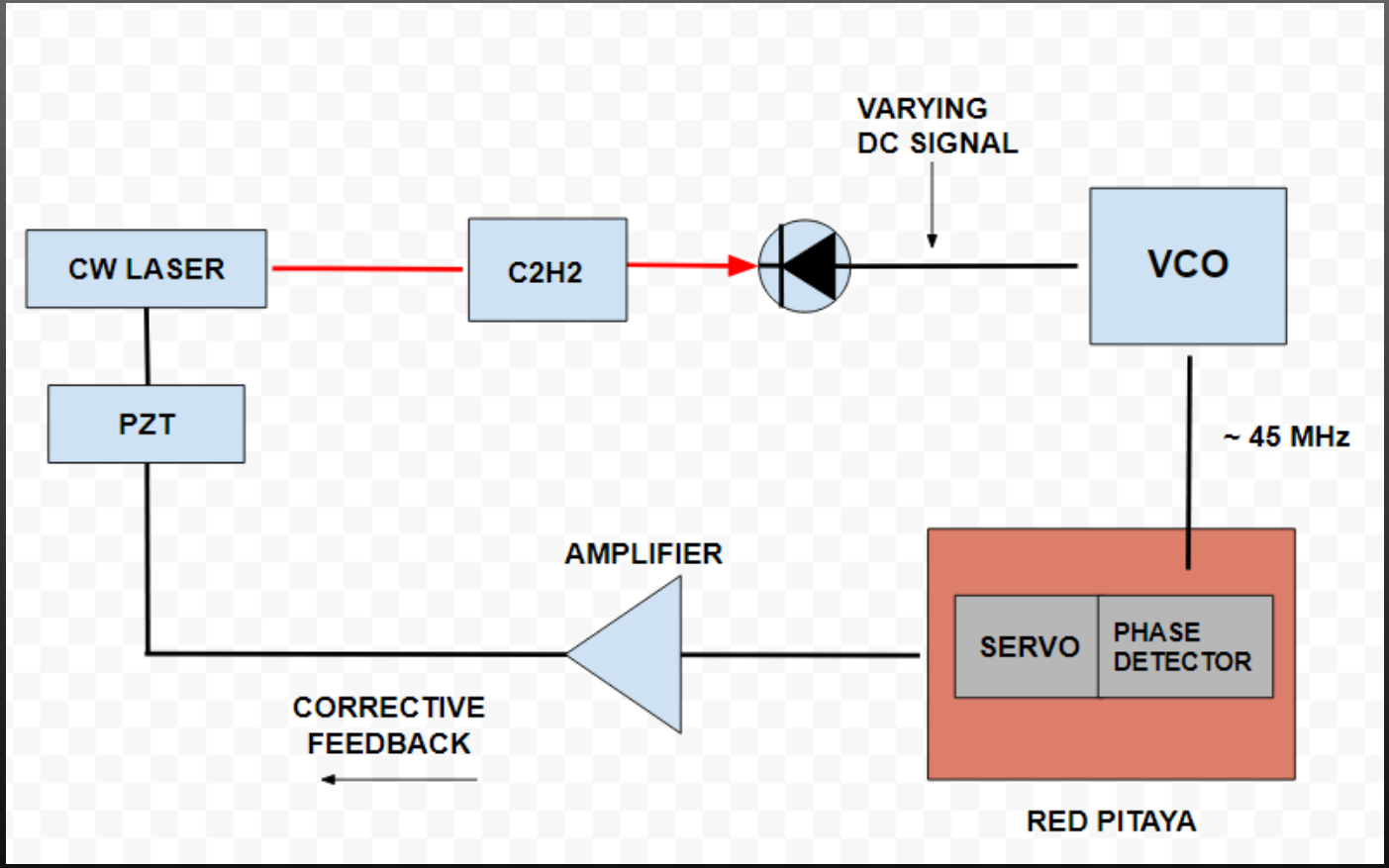
RESULTS OF PULSE REPETITION LOCK

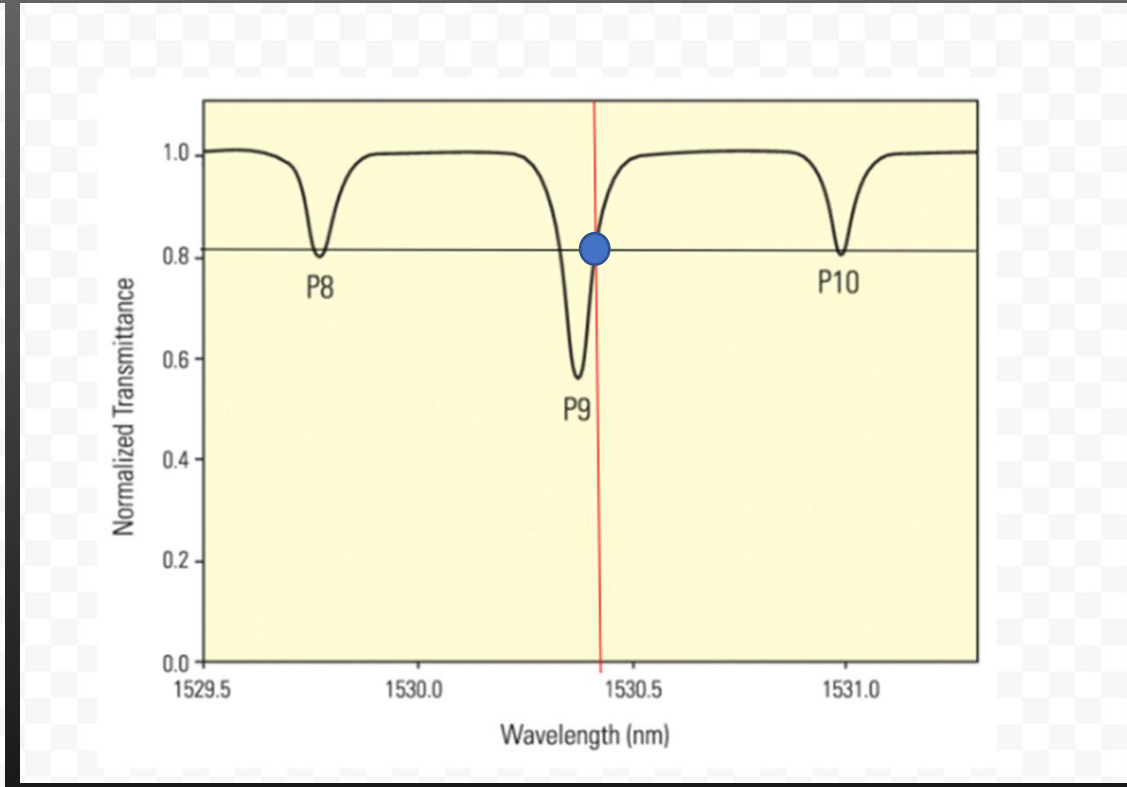


PRE-LOCK ERROR: ± 1 Hz

POST-LOCK ERROR: ± 0.1 Hz

SCHEMATIC FOR OPTICAL LOCK





SOURCES:

[1] Chem. Soc. Rev., 2012, 41, 5174–5184

[2] Brian Washburn. *Agro-combs: A mid-infrared dual-comb spectrometer for the detection of agriculturally significant gases*. (2017) Kansas State University

[3] National Physical Laboratory. *Self-Referencing of an Optical Frequency Comb*. (2007) Retrieved from http://www.npl.co.uk/science-technology/time-frequency/optical-frequency-standards-and-metrology/research/self-referencing-of-an-optical-frequency-comb

[4] Coddington. Newbury. Swann. *Dual Comb Spectroscopy* (April 14th, 2016) Optica. Vol 3. No 4.

[5] Coddington. Newbury. Swann. *Coherent Multiheterodyne Spectroscopy Using Stabilized Optical Frequency Combs* (January 2nd, 2008)

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