Building A Two-mode Squeezed Vacuum Source for Quantum Communications

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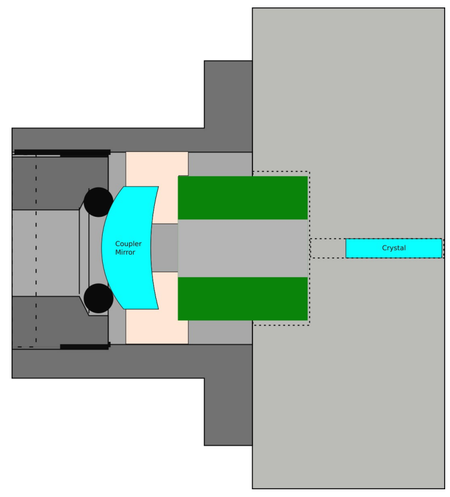
Introduction

A Two-Mode Squeezed Vacuum (TMSV) is a quantum resource proven useful in several aplications in Quantum Technology, one of them being Quantum Key Distribution (QKD). Here we report the building of a TMSV source for use in QKD. Our system will comprise of two OPO, ith its squeezed vacuum outputs combined in a balanced beam splitters. Active controls are employed for cavities stabilization, squeezing phase lock and relative phase lock between squeezed fields. The new cavity for the first OPO was designed and is in operation. Our target is to obtain 13 dB of corrected squeezing for the amplitude quadrature and a combined Duan inequality violation of up to 10 dB. We will show the status and our more recent results towards those goals.

Optical Parametric Oscillator (OPO)

- Type 0 PPKTP crystal
- Outside Face
  - ROC=-10mm
  - HR@775/1550nm
- Coupling mirror
  - ROC=25mm
  - R@775nm=97.5%
  - R@1550nm=90%

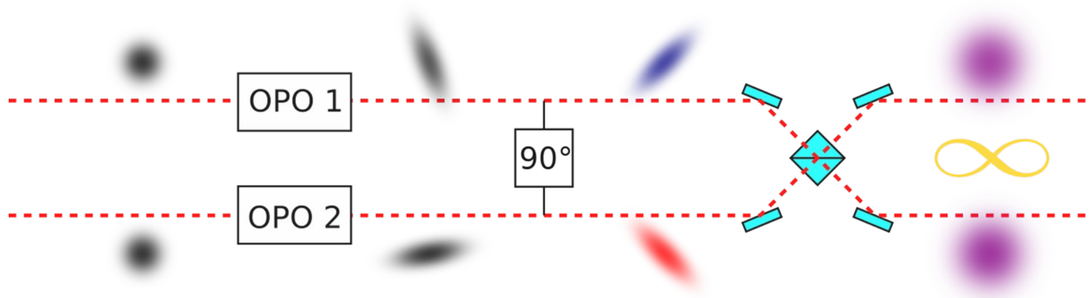


Two Mode Squeezed Vaccum

- Optical Parametric Oscillators (OPOs) Squeeze Incoming Vaccum Fields

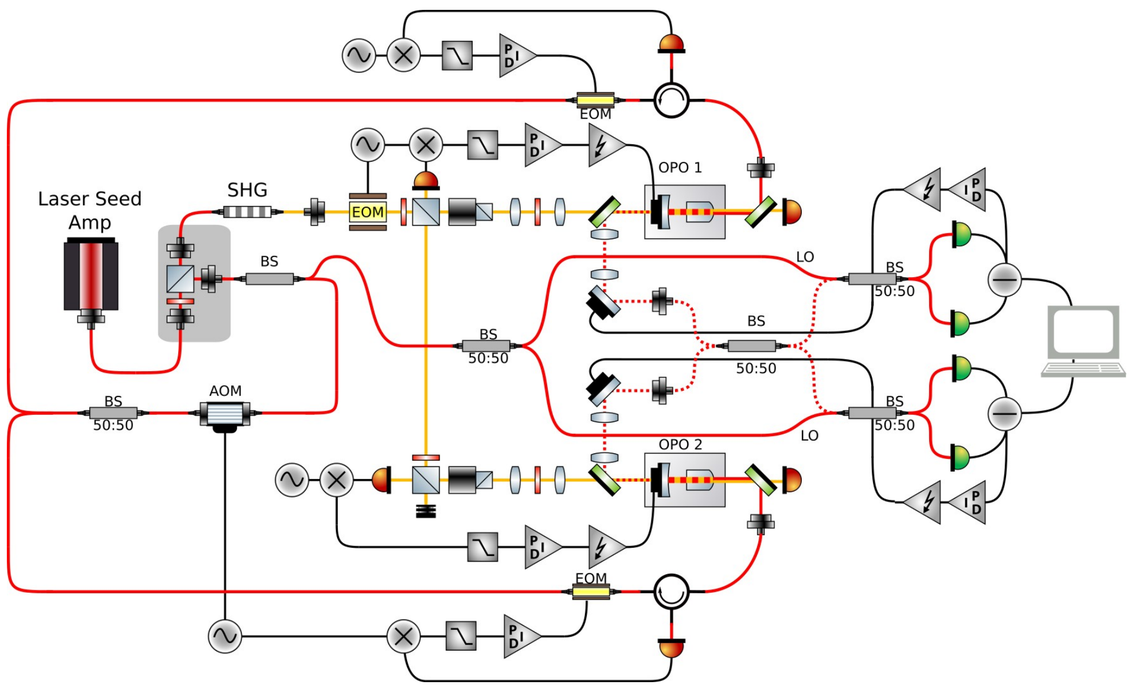
$$\hat{H}'_I = i\hbar \frac{\chi}{\tau} (\hat{a}_0^\dagger \hat{a}^2 - \hat{a}_0 \hat{a}^{\dagger 2})$$

- Squeezing Fields are locked in quadrature
- Beam splitter transformation produces two entangled fields ready to be used.



Experimental Setup

- Two OPOs producing squeezed vaccum
- Phase locking between Pump and Squeezed Outputs
- Locking Between the two OPOs
- Homodyne detection to measure entanglement

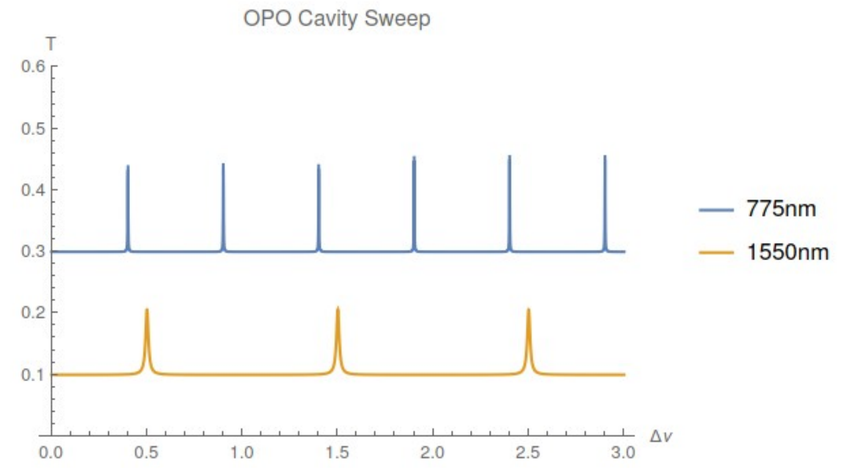


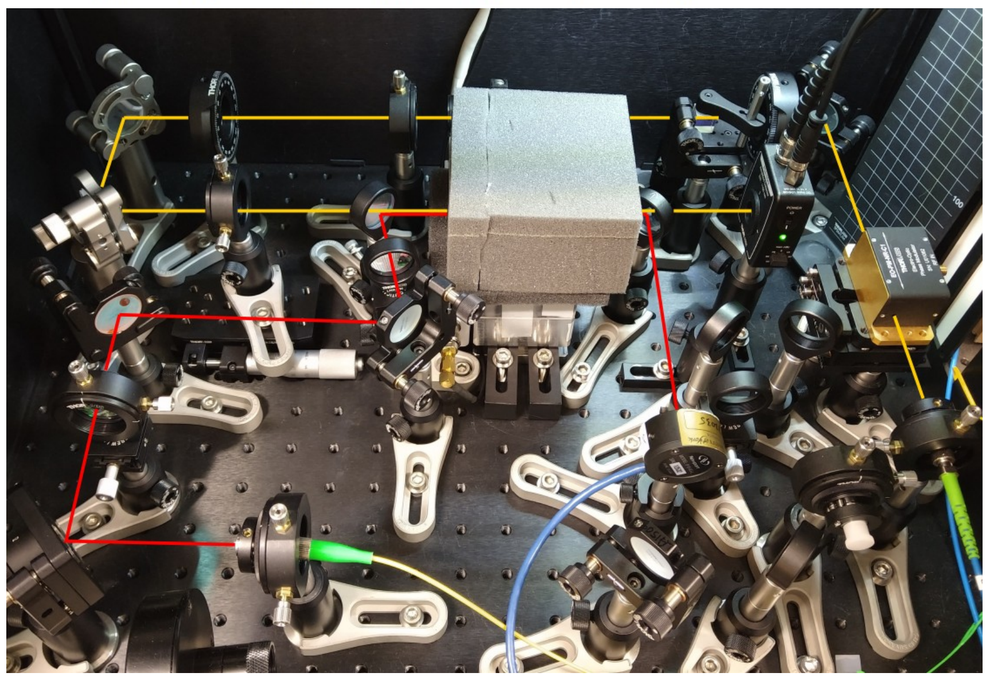
Projected Results

- Low Threshold: >5mW
- Squeezing: <13dB
- Duan Entanglement: <10dB

Current Status

- Pump and SQZ Vaccum aligned and Mode Matched
- Finesse@775nm=182 (designed=188)
- Finesse@1550nm=47 (designed=59)





Next Steps

- Find Phase Matching Temperature
- Lock Cavity on Resonance with PDH
- Install Homodyne Detection
- Detect and Optimize Squeezing
- Lock Squeezing Phase
- Build Second OPO
- Lock OPOs Together
- Measure Entanglement

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