Investigation of Squeezed Light with an Injection-Locked Laser System

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Implication of Uncertainty Principle for Light

$$(\Delta x)(\Delta p) \geq \hbar/2$$

Everyone's favorite uncertainty relation.

Implication of Uncertainty Principle for Light

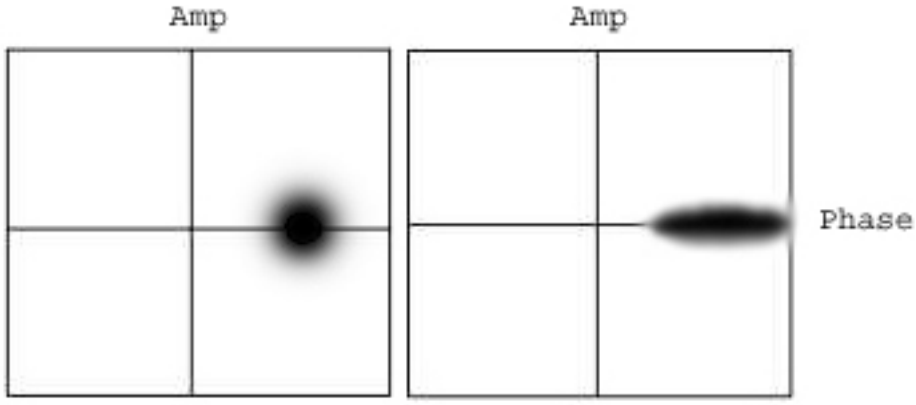
$$(\Delta A)\,(\Delta \phi) \geq 1$$

Another uncertainty relation, this time between the amplitude (A) and the phase (Phi) of the EM field.

➔ Fundamental Quantum Noise Limit

Squeezed light has suppressed noise

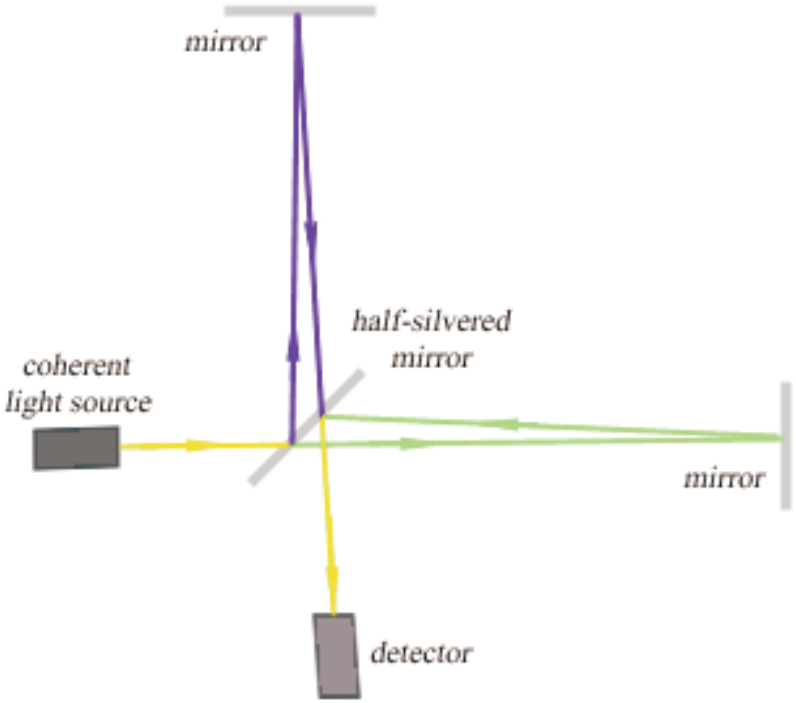
- Coherent states have equal uncertainty in amplitude and phase
- Squeezed states have less uncertainty in either amplitude or phase (and more in the other)



Allows noise to be suppressed below the quantum limit!

Suppressed noise has useful applications

- Interferometry
  - LIGO
- Communications
  - Increase signal to noise ratio



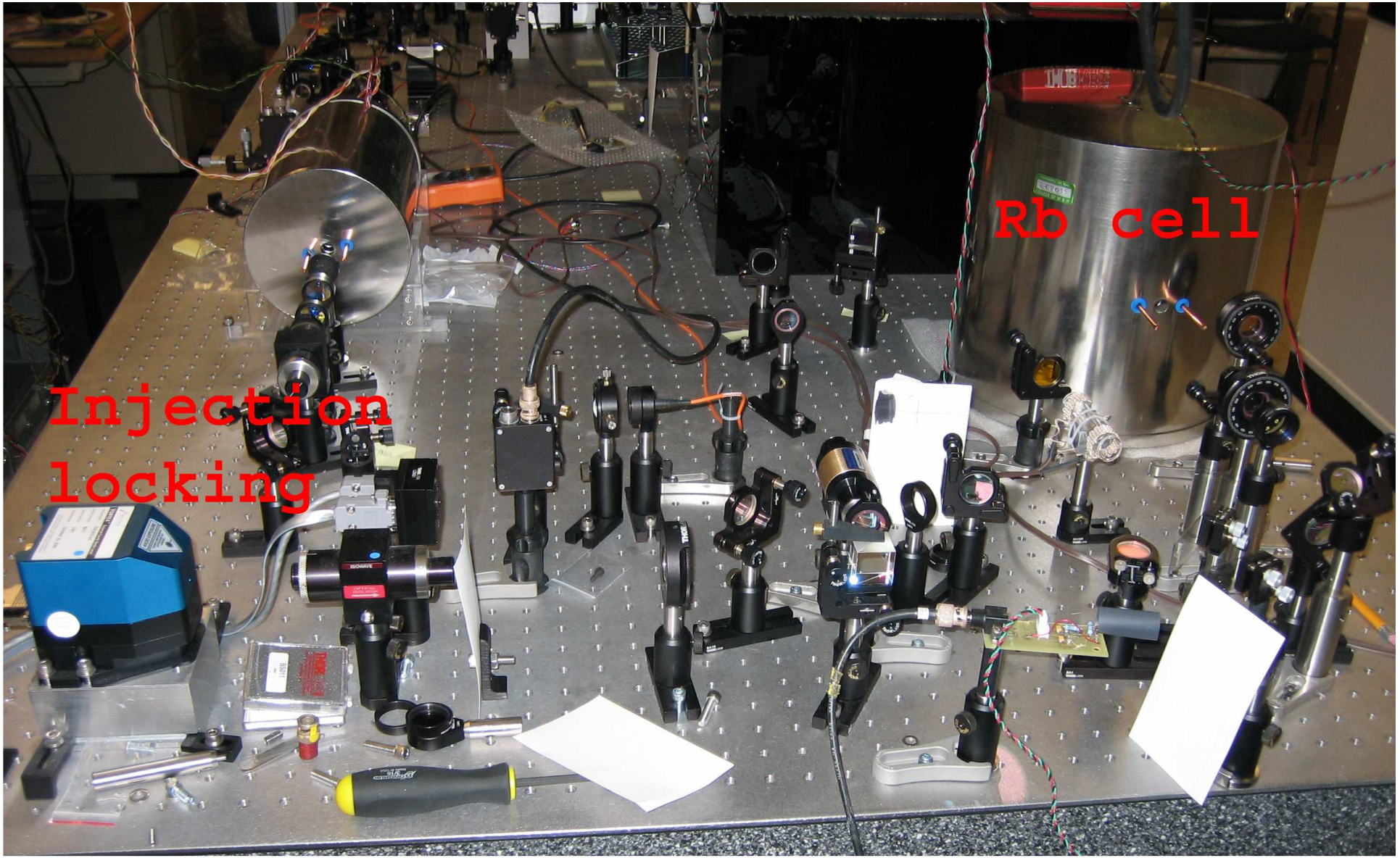
A Michelson interferometer

A Squeezing Method

- Nonlinear interaction with Rb atoms creates squeezed state

It is (nearly) that simple.

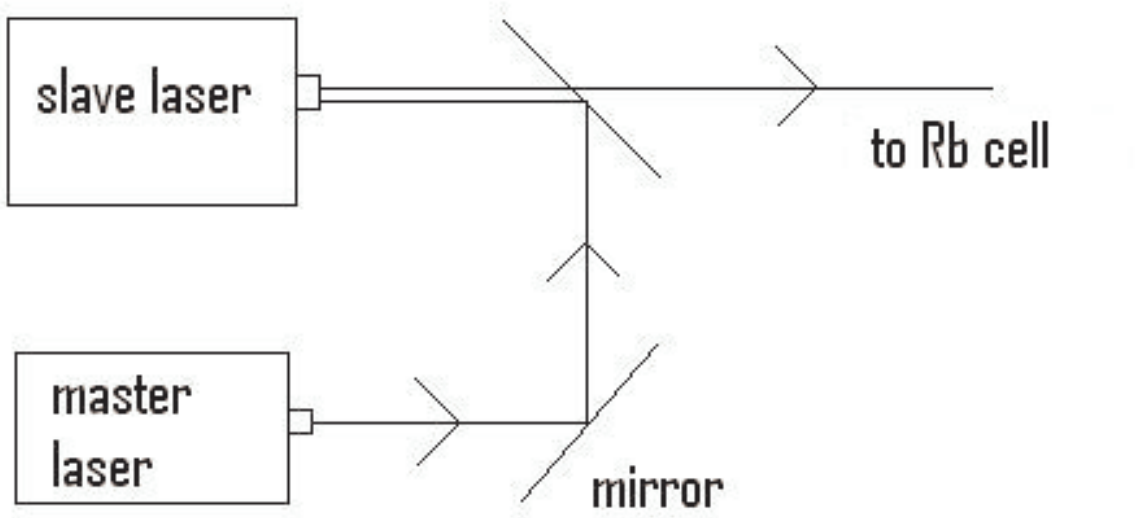
How it really looks



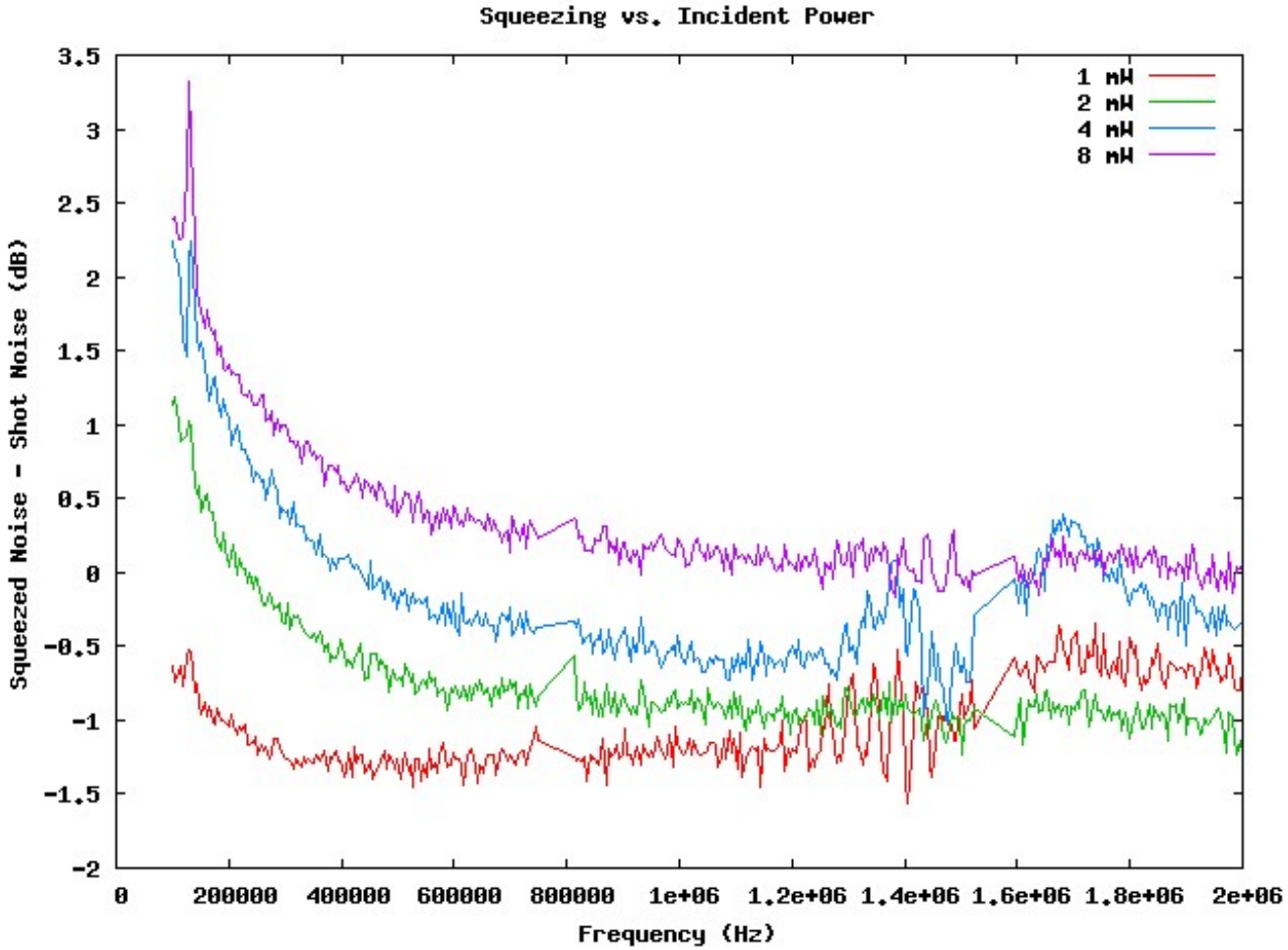
Injection Locking

- Previous experiment
  - More power = larger squeezing

- Injection locking gives more power



Squeezing Results



Contrary to expectations, squeezing does not increase with incident laser power