Quantum enhanced measurements group

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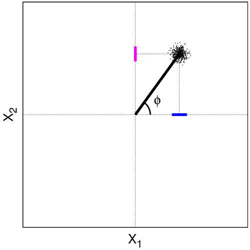
Squeezed states of light, go beyond shot noise

$$E(\phi) = |a|e^{-i\phi} = |a|\cos(\phi) + i|a|\sin(\phi) = X_1 + iX_2, \quad \phi = \omega t - kz$$

- $[a, a^\dagger] = 1$
- $[X_1, X_2] = i/2$
- $\Delta X_1 \Delta X_2 \geq 1/4$



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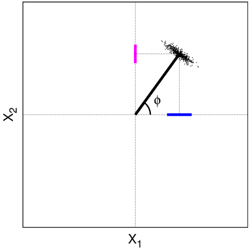
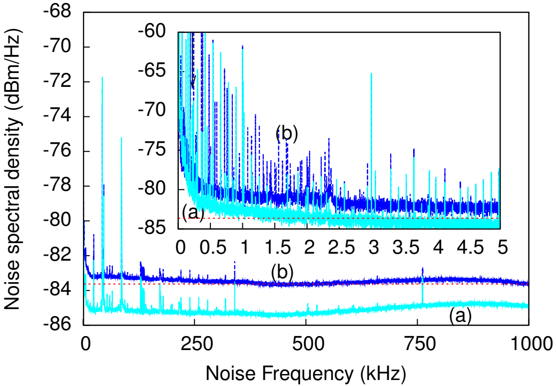
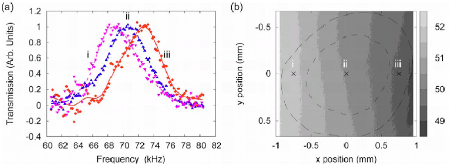


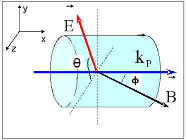


Magnetometry

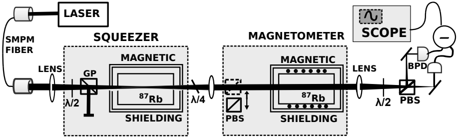
Magnetic field map

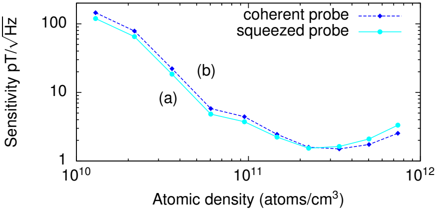


Magnetic field compass



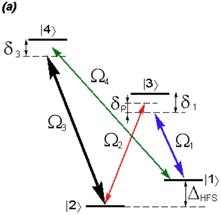
Magnetometer with squeezing enhancement

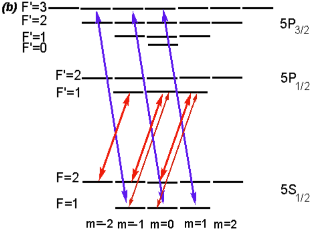




Fast optical gyroscope

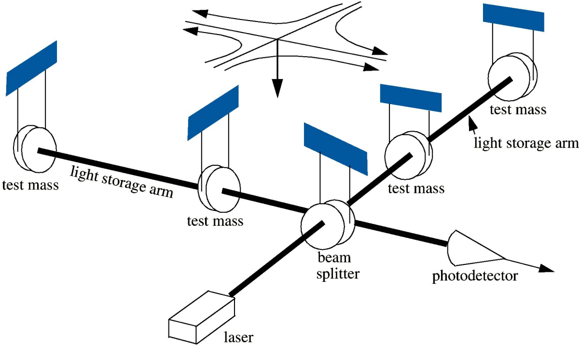
$$\Delta f = \frac{4A\Omega}{\lambda P c} \frac{c}{n + f\partial n/\partial f} = \frac{4A\Omega}{\lambda P c} v_g$$





Gravitational wave detectors

- $L = 4$ km
- $h \sim 2 \times 10^{-23}$
- $\Delta L \sim 10^{-20}$ m



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