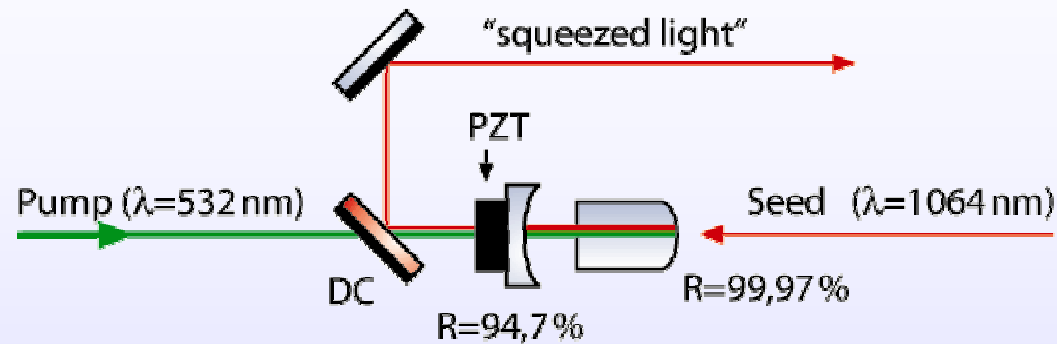


Experimental characterization of frequency-dependent squeezed light

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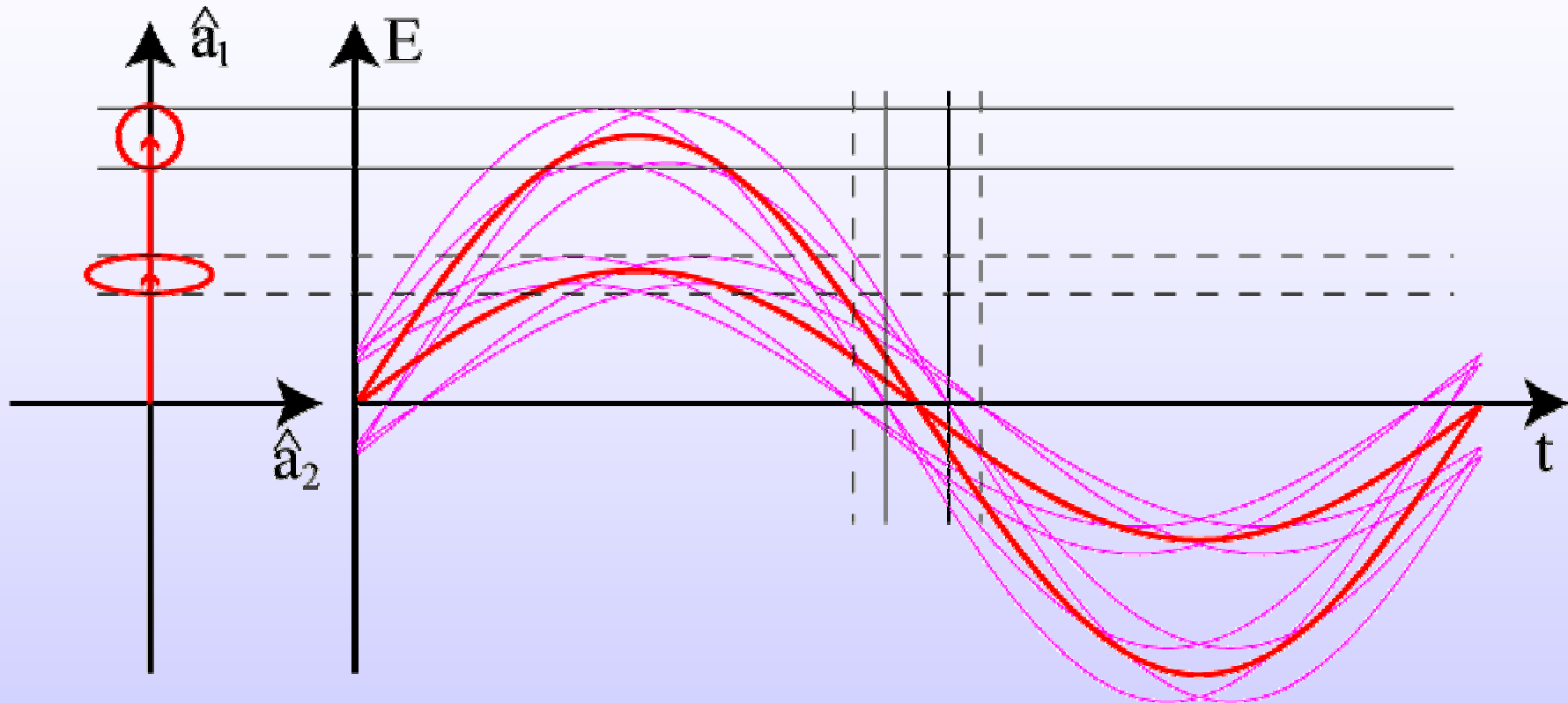
OPA squeezing



Parametric amplification

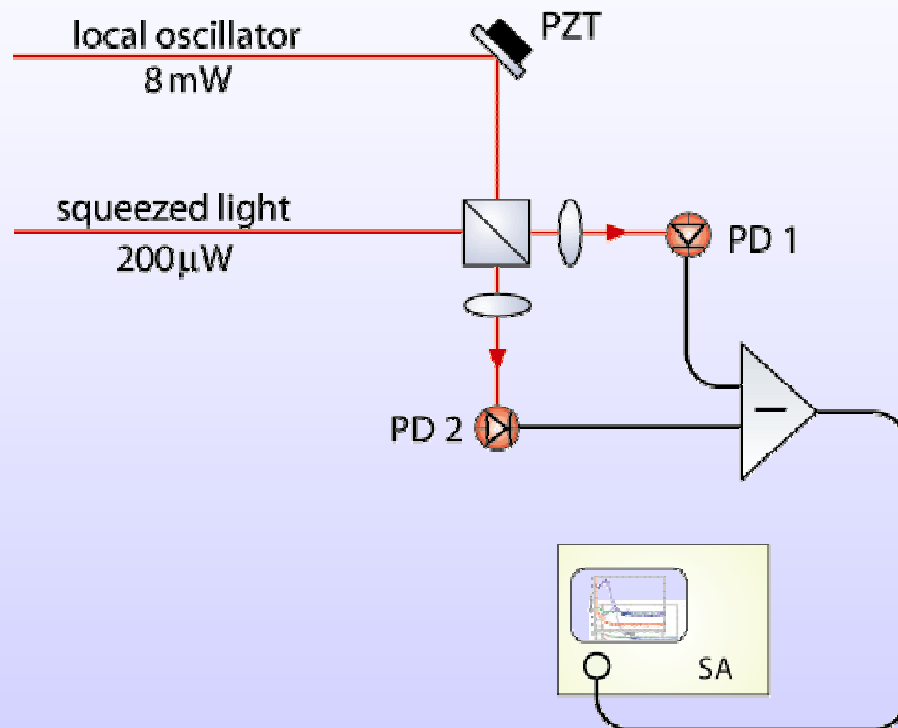
- $\text{MgO}:\text{LiNbO}_3$ – crystal as nonlinear material
- strong interaction between seed- and pumpfield
- fractions in phase are amplified

simple explanation of how to generate squeezing



$$\Delta^2 \hat{a}_1 \Delta^2 \hat{a}_2 \geq \frac{1}{4}$$

detection of squeezing

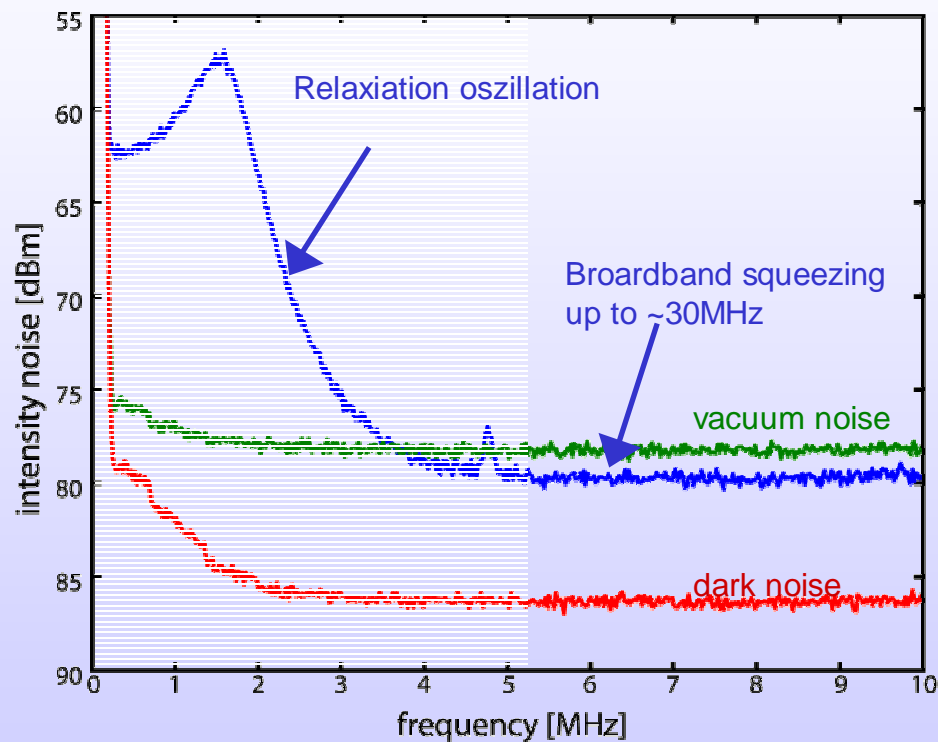


homodyne detection

- 50/50 beamsplitter
- signal amplification due to overlapping of a strong local oscillator
- phasesensitive measurement

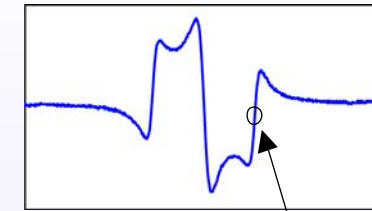
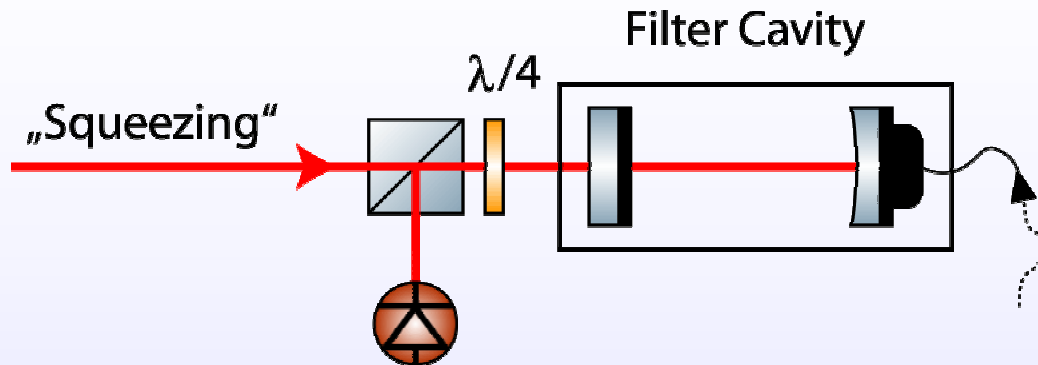


squeezing spectrum



- amplitude squeezing at $f > 3,5\text{MHz}$
- squeezed noise $2 \pm 0,3\text{dB}$ below vacuum noise

reflection at a cavity & quadrature picture



locked at
 $\omega + \Omega = \omega + 15\text{MHz}$

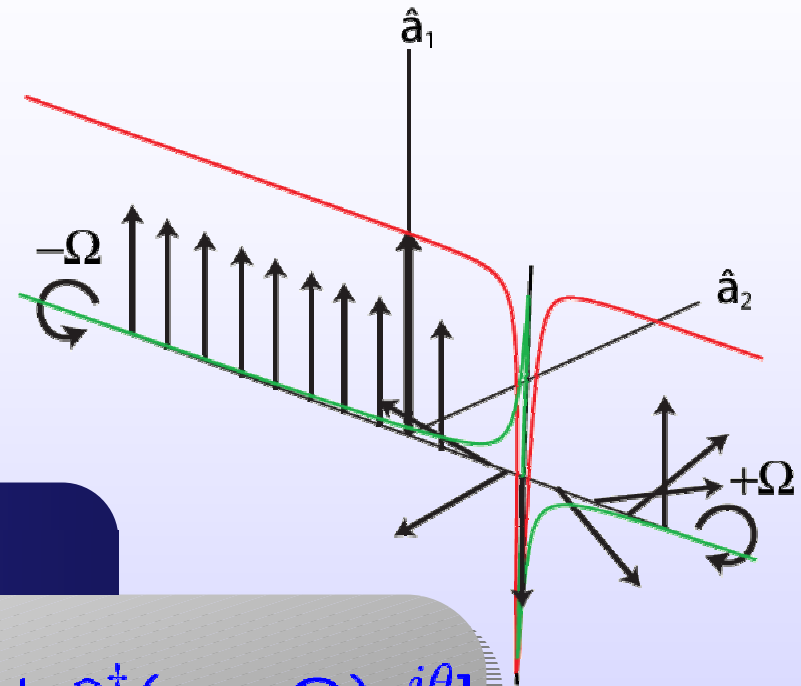
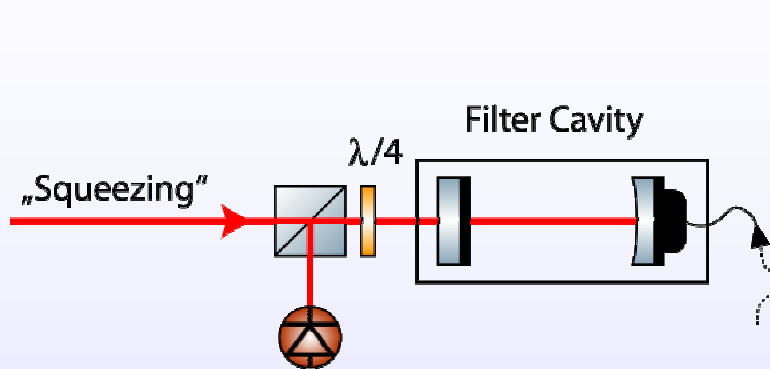
$$\hat{E} = \hat{a}_1 \cos(\omega t) + \hat{a}_2 \sin(\omega t)$$

$$\hat{a}_1(\Omega) = \frac{\hat{a}(\omega + \Omega) + \hat{a}^\dagger(\omega - \Omega)}{\sqrt{2}} \quad \text{amplitude quadrature}$$

$$\hat{a}_2(\Omega) = \frac{\hat{a}(\omega + \Omega) - \hat{a}^\dagger(\omega - \Omega)}{\sqrt{2}i} \quad \text{phasen quadrature}$$

$$\hat{a}_\theta(\Omega) = \frac{1}{\sqrt{2}} [\hat{a}(\omega + \Omega)e^{-i\theta} + \hat{a}^\dagger(\omega - \Omega)e^{i\theta}] \quad \text{arbitrary Quadratur}$$

reflection at a cavity & quadrature picture

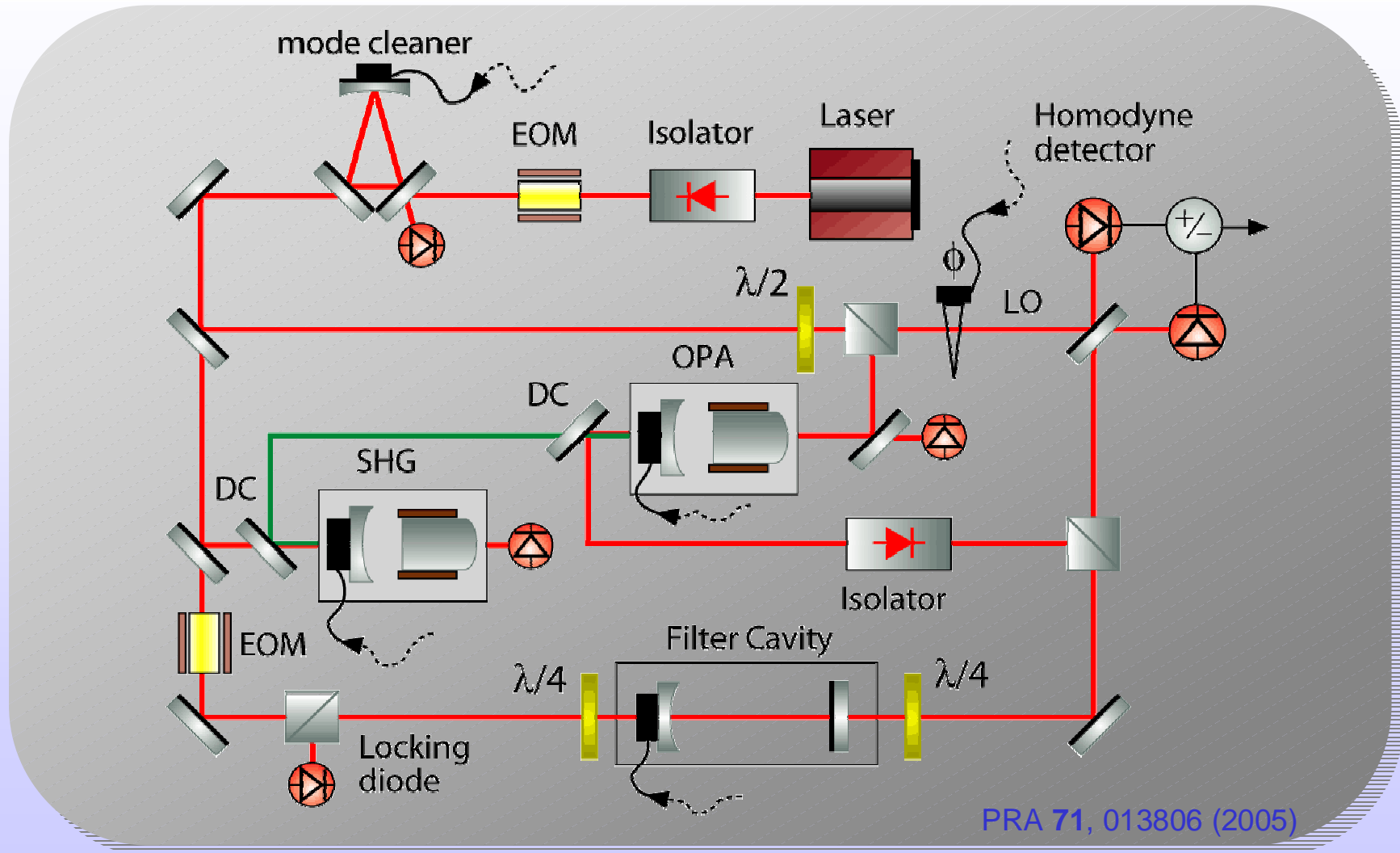


Influence of a detuned Cavity

$$\begin{aligned}\tilde{a}_{\theta'}(\Omega) &= \frac{1}{\sqrt{2}}[\tilde{a}(\omega + \Omega)e^{-i(\theta + \phi)} + \tilde{a}^\dagger(\omega - \Omega)e^{i\theta}] \\ &= \frac{e^{-i\phi/2}}{\sqrt{2}}[\tilde{a}(\omega + \Omega)e^{-i\theta'} + \tilde{a}^\dagger(\omega - \Omega)e^{i(\theta')}] \\ &\text{mit } \theta' = \theta + \phi/2\end{aligned}$$

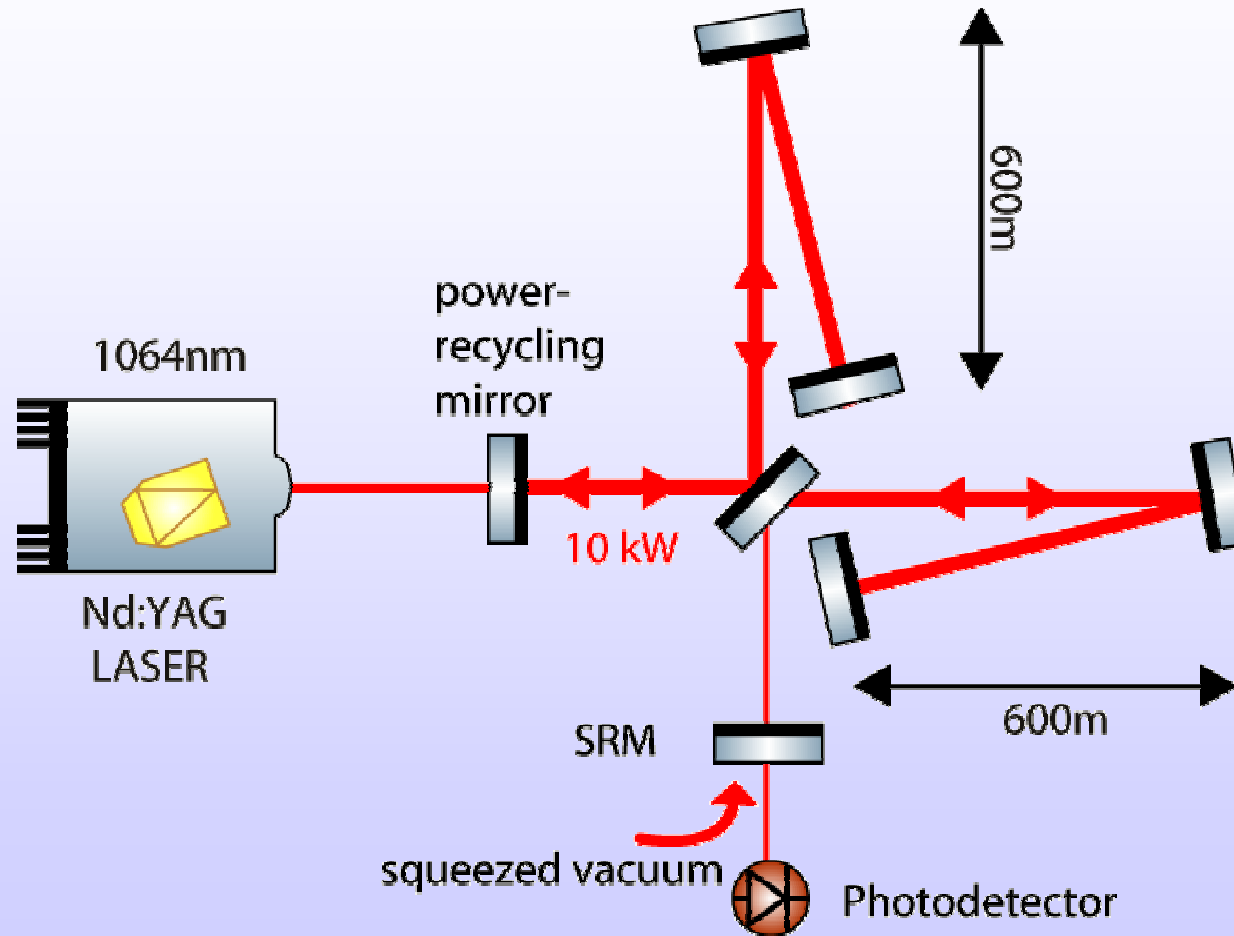


creation of frequency-dependent squeezing



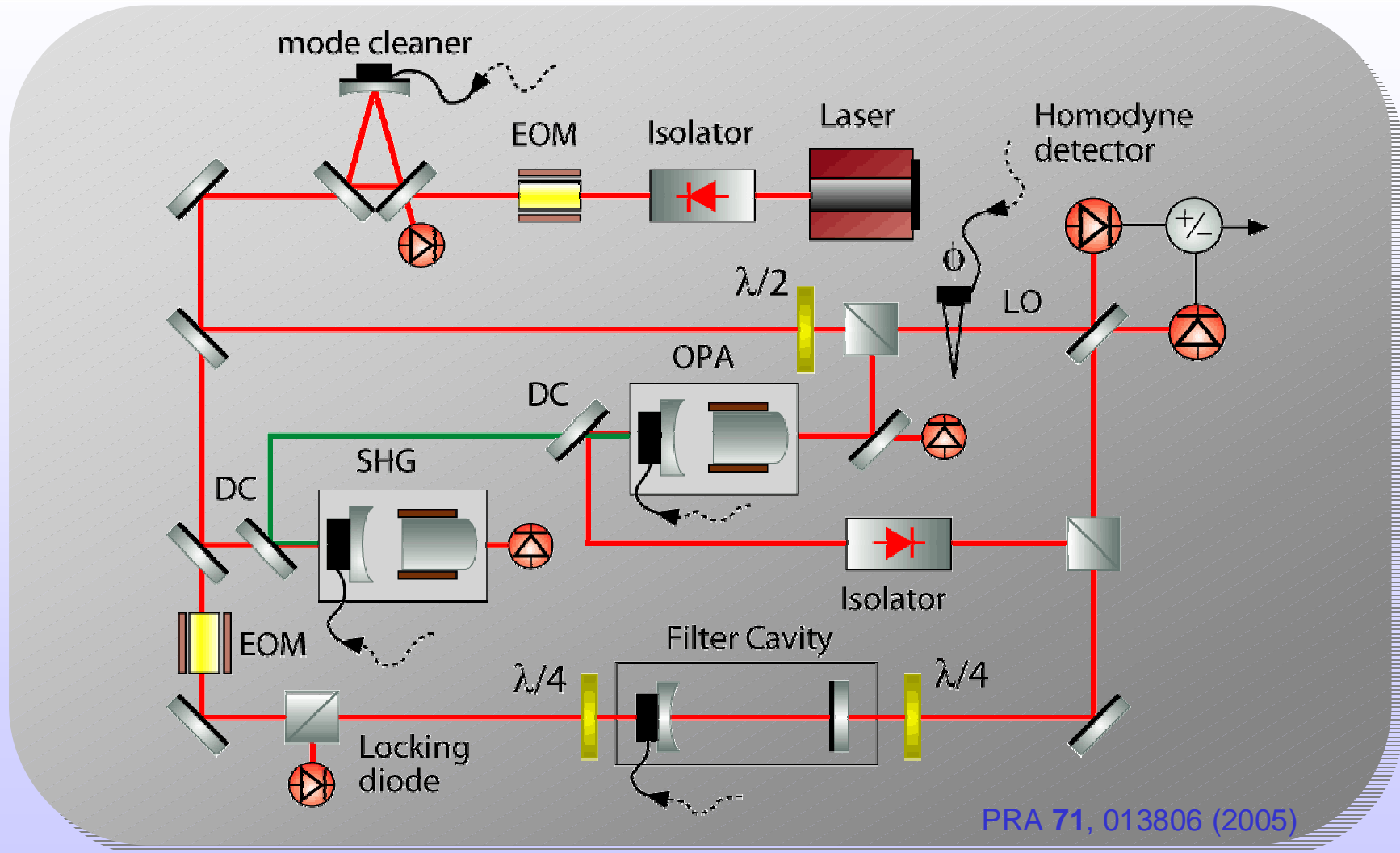


motivation of the experiment





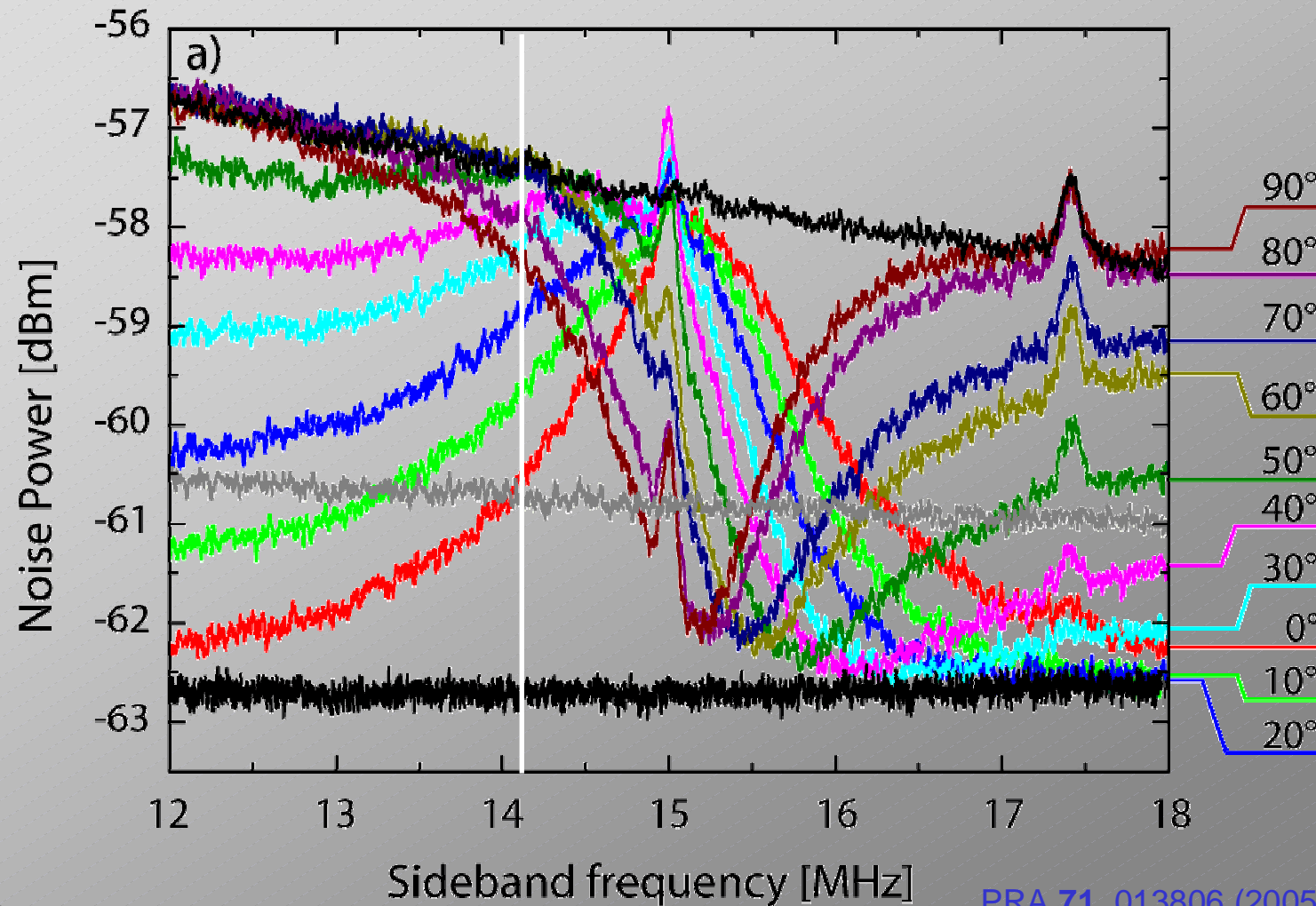
creation of frequency-dependent squeezing



PRA 71, 013806 (2005)



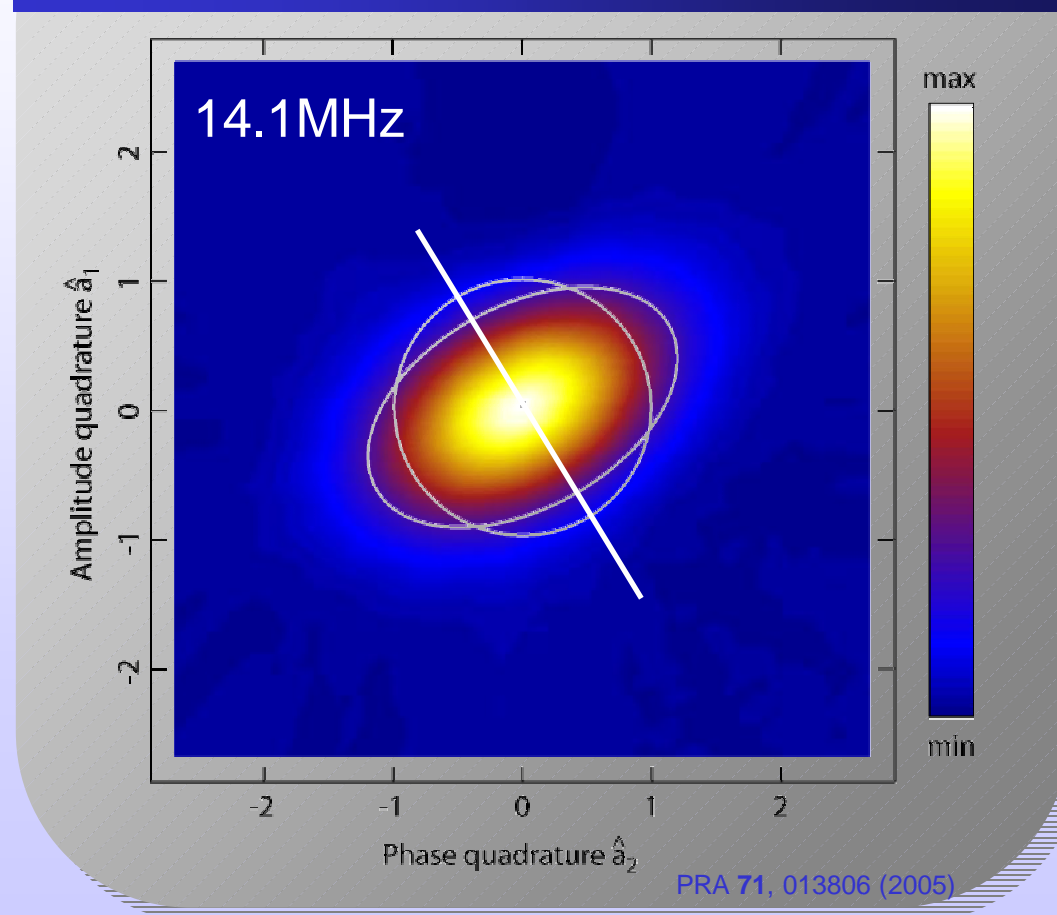
frequency-dependent squeezing





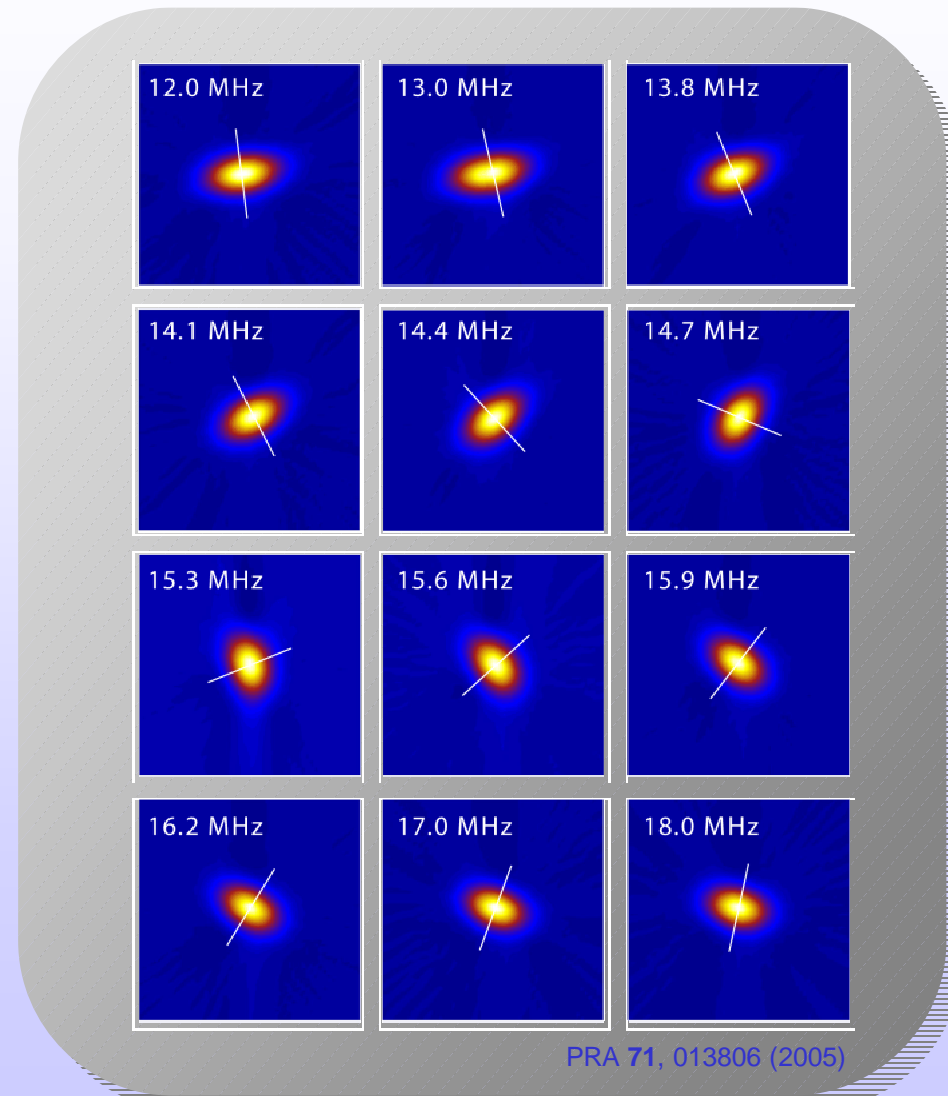
tomography of a squeezed state

Contour Plot of a Wigner Function





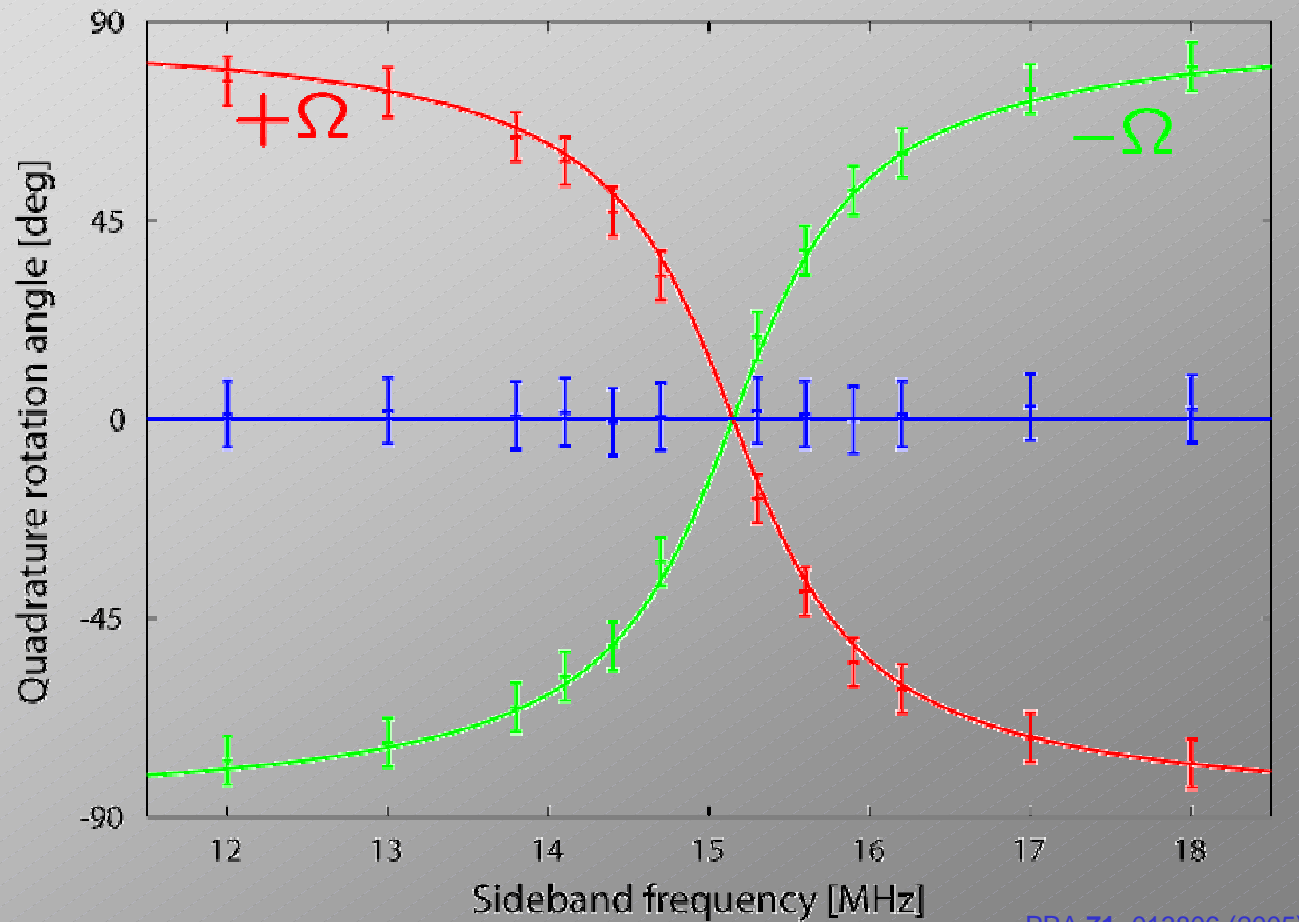
tomography of frequency-dependent squeezed light



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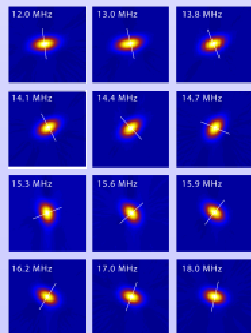
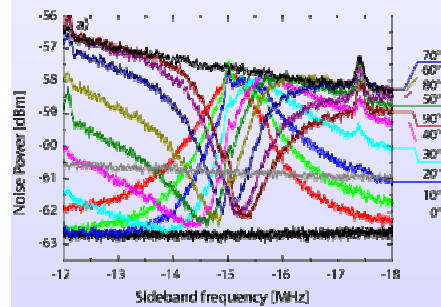
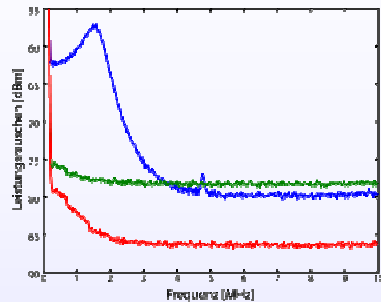


evolution of the squeezing angle



PRA 71, 013806 (2005)

conclusion



OPA Squeezing
(non-linear process, MgO:LiNbO₃-crystal)

creation of frequency-dependent squeezing
(reflection at a cavity)

results
(freq.dep. light, tomography of squeezed states)