



# **Interferometer Topologies and Prepared States of Light – Quantum Noise and Squeezing**

**Convenor: Roman Schnabel**

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- 8:30 R. Schnabel (AEI) Introduction: Why Squeezing is Remarkable
- 8:45 S. Dwyer (MIT) The Squeezed H1 Detector
- 9:08 H. Grote (AEI) The Squeezed GEO Detector
- 9:30 Break
- 10:00 H. Miao (UWA) Introduction to Radiation Pressure Noise  
Squeezing and Opto-mechanical Coupling
- 10:20 P. Kwee (MIT) Filter Cavity Concepts
- 10:35 R. Ward (ANU) Ponderomotive Squeezing Rotator
- 10:50 Z. Korth (Caltech) Optomechanically Induced Transparency
- 11:05 B. Barr (Glasgow) Observing Optical Springs with 100g Mirrors
- 11:25 G. Cole (Vienna) Quantum Optomechanics
- 11:45 H. Kaufer (AEI) Optomechanics with a 50ng Membrane
- 12:00 K. Agatsuma (NAOJ) Accurate Quantum Efficiency Measurement
- 12:15 D. Friedrich (ICRR) Quantum Radiation Pressure Experiment with  
a suspended 20mg Mirror
- 12:30 Adjourn

# Why Squeezing is Remarkable

Roman Schnabel

Albert-Einstein-Institut (AEI)

Institut für Gravitationsphysik

Leibniz Universität Hannover



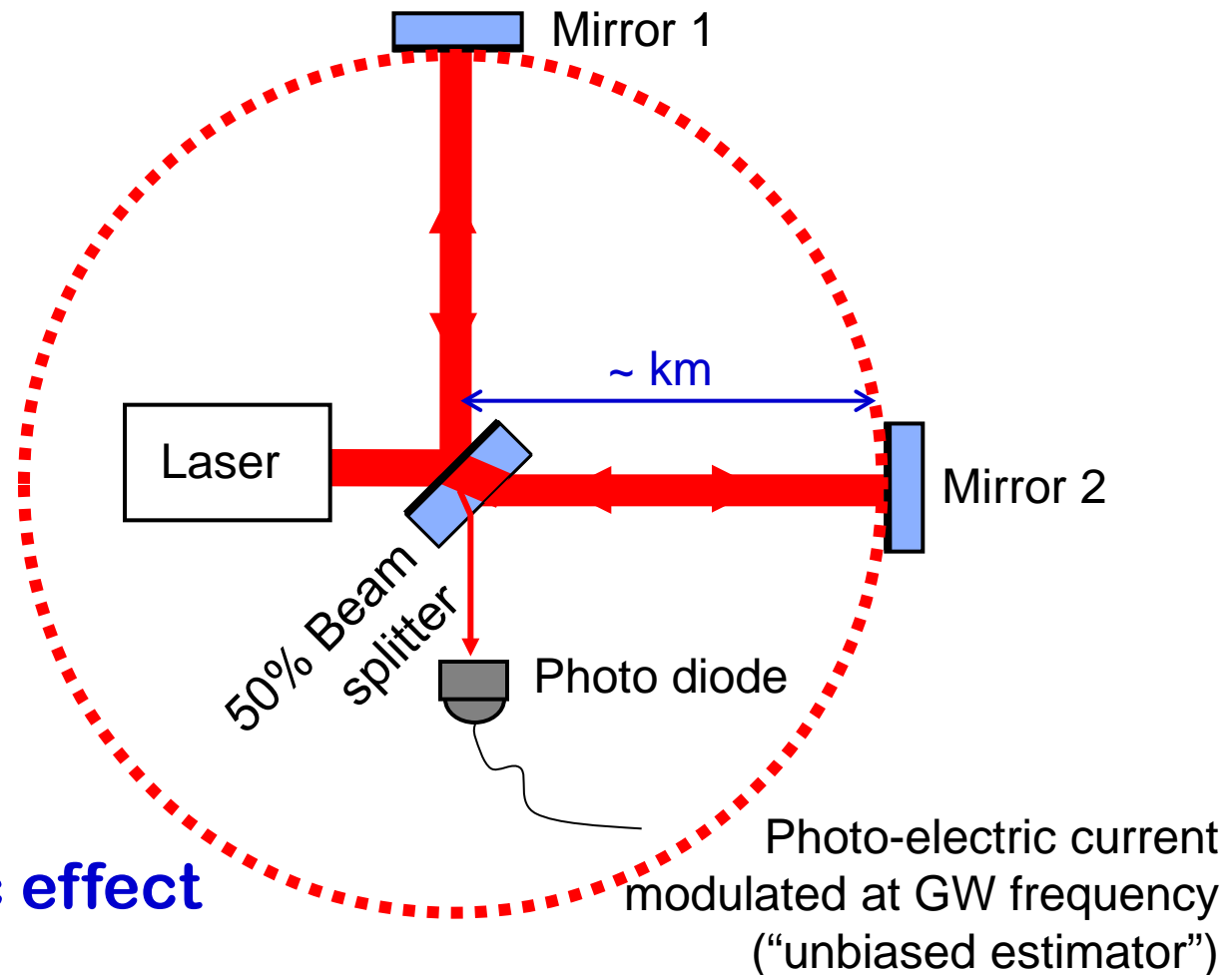
# Gravitational Wave Detection

1) Test masses

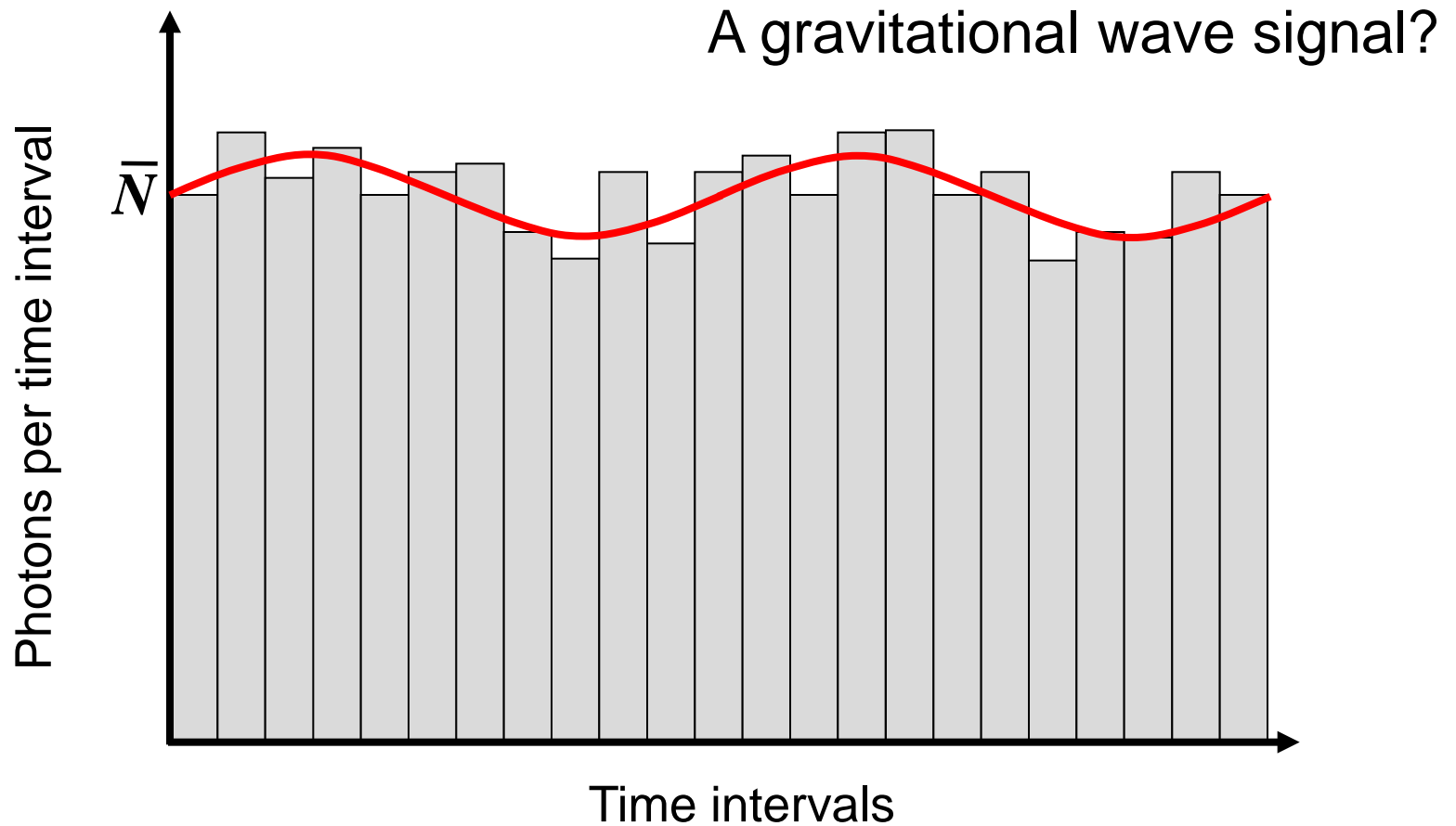
2) Laser light

3) Interference

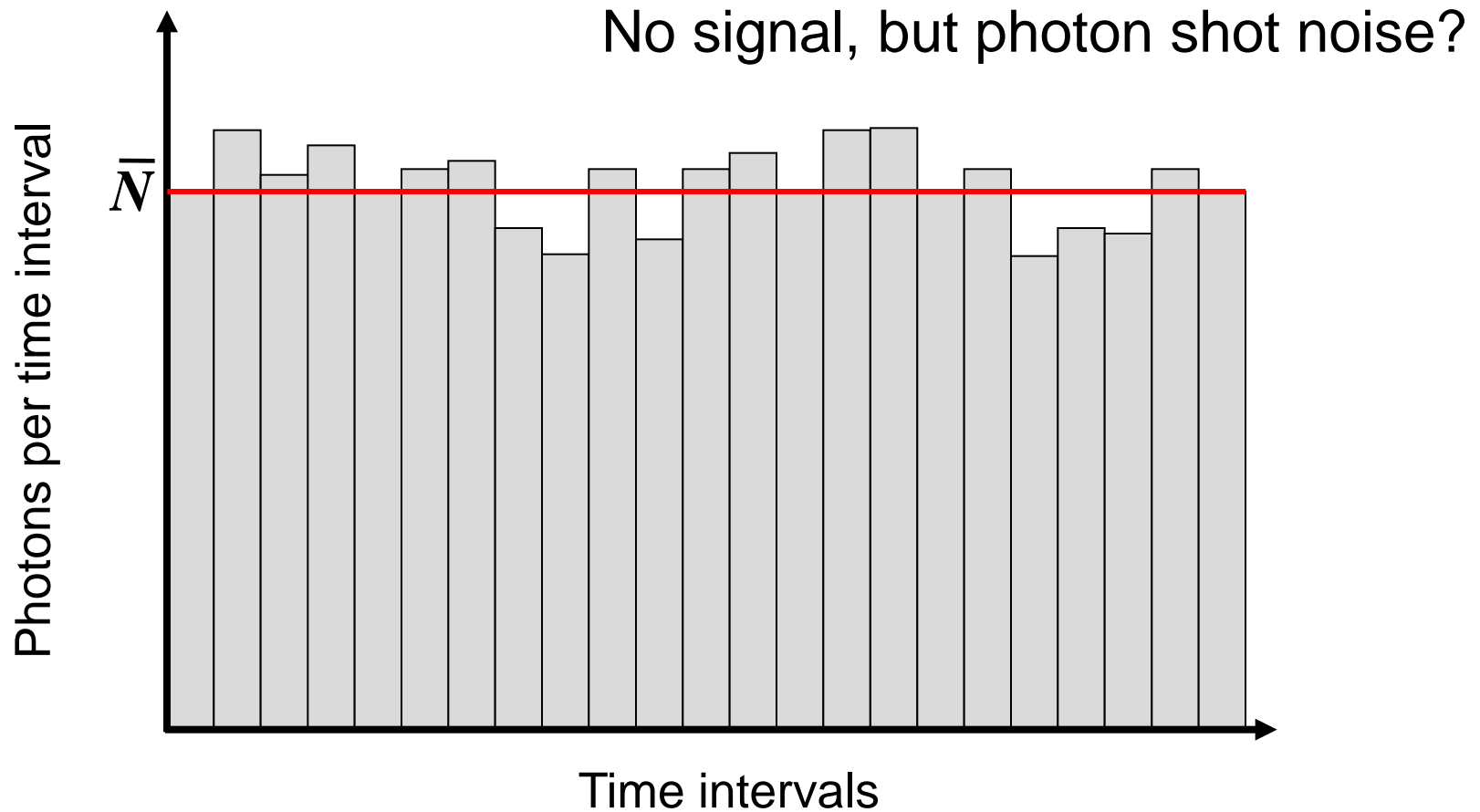
4) Photo-electric effect



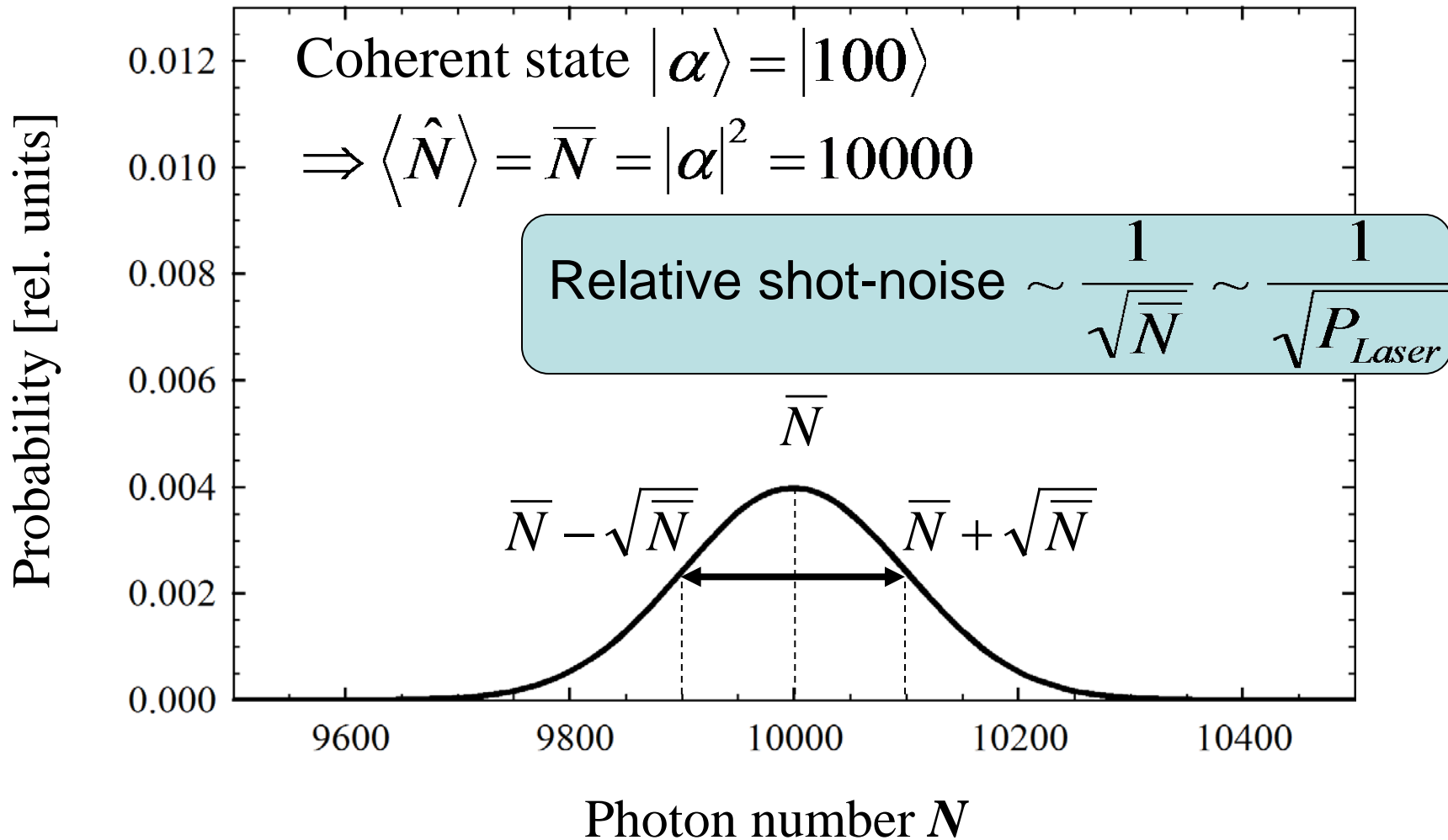
# Photo-Electric Current



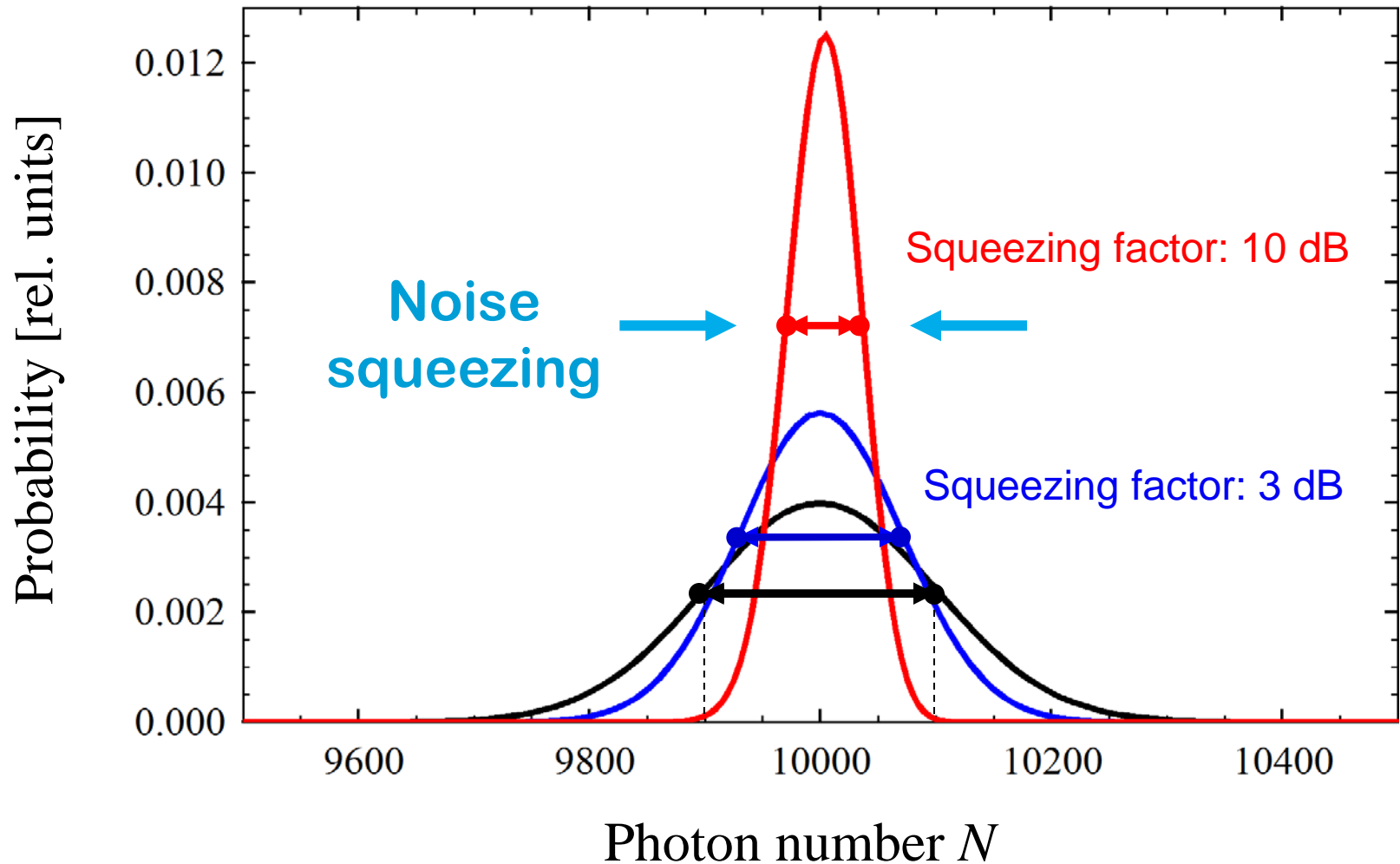
# Photo-Electric Current



# Photon Counting Statistics

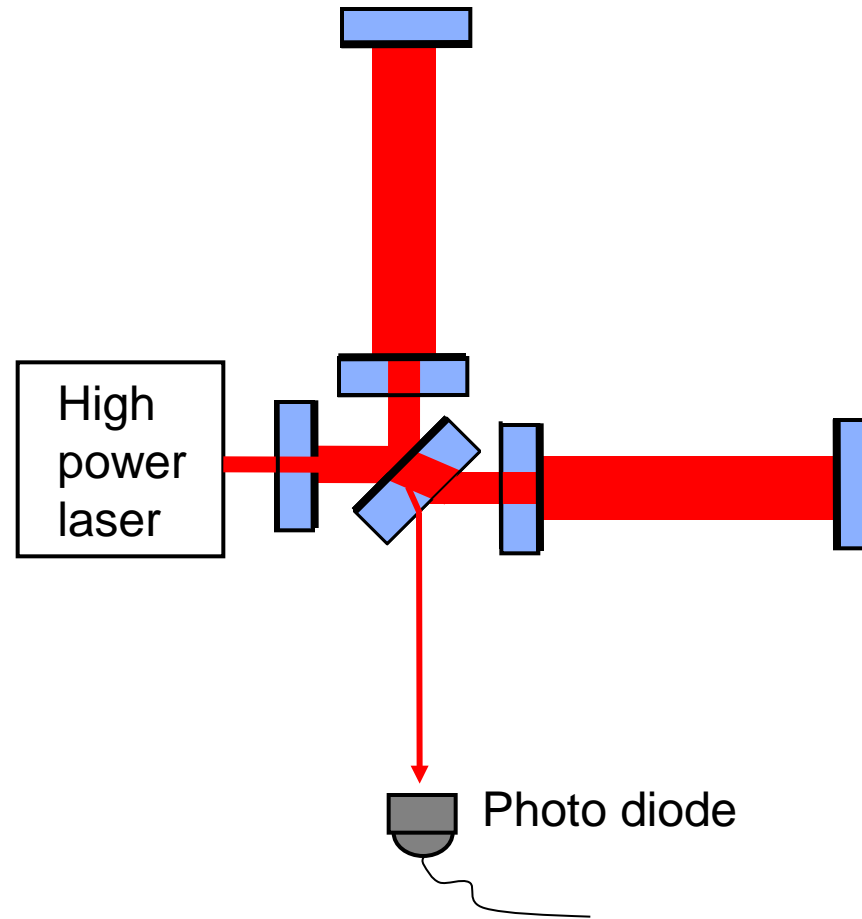


# “Squeezed” Counting Statistics

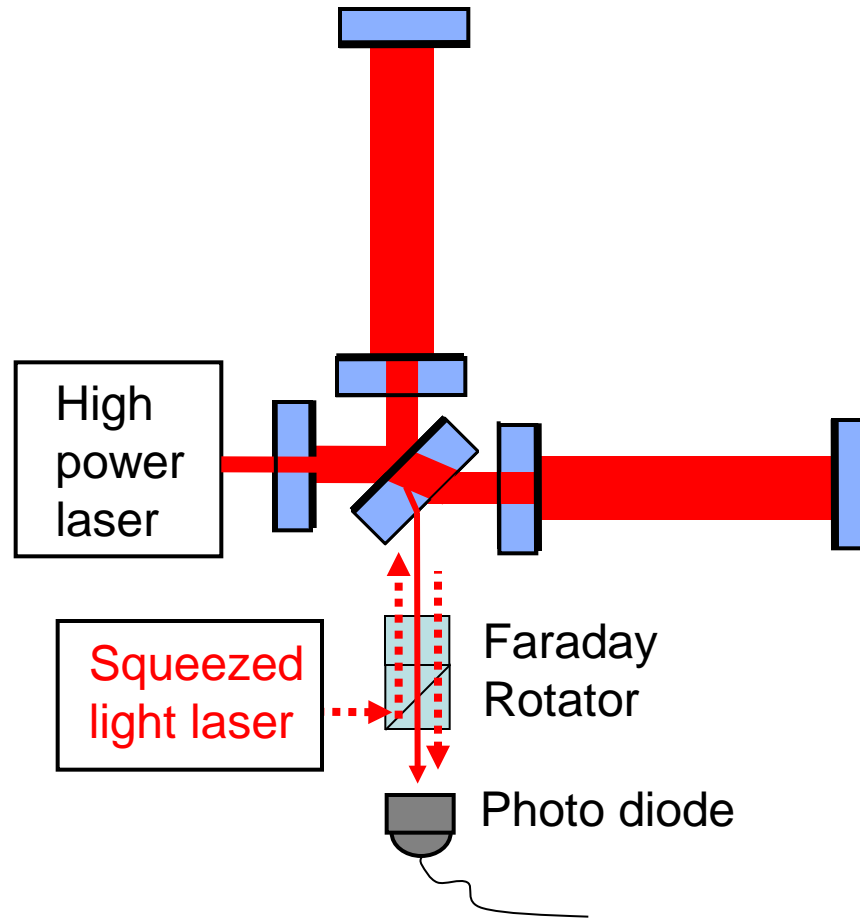




# Shot-Noise

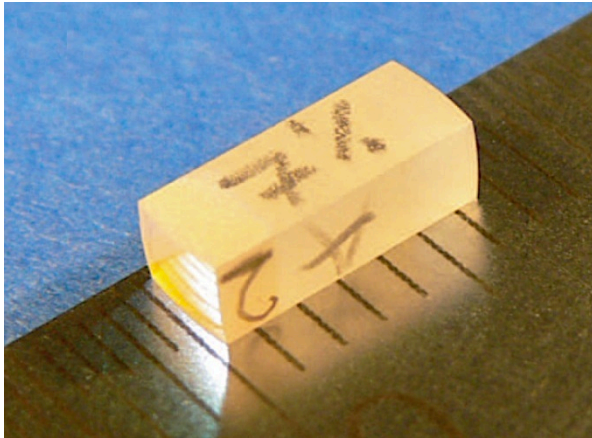


# Shot-Noise Squeezing

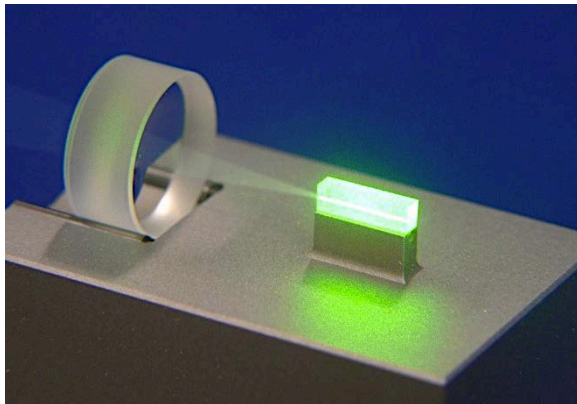


[Caves, Phys. Rev. D 23, 1693 (1981)]

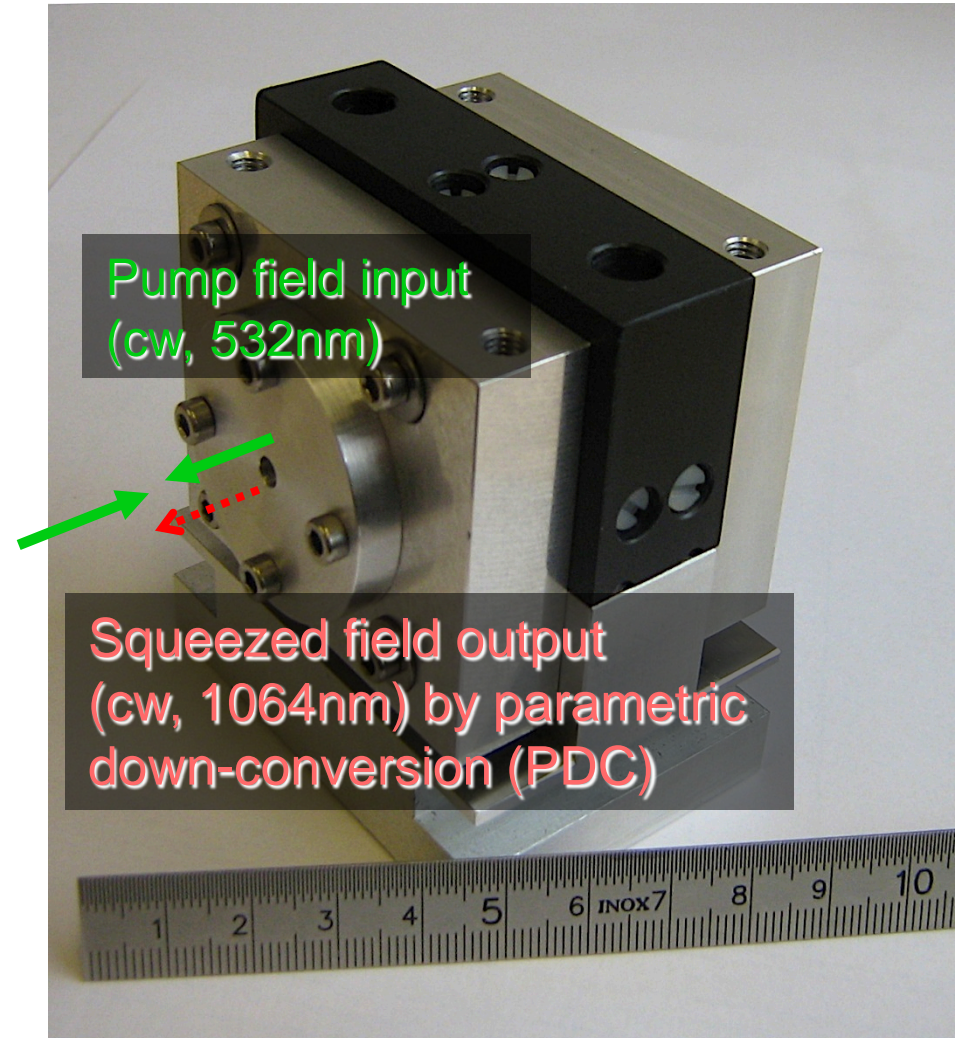
# Generation of Squeezed Light (PDC)



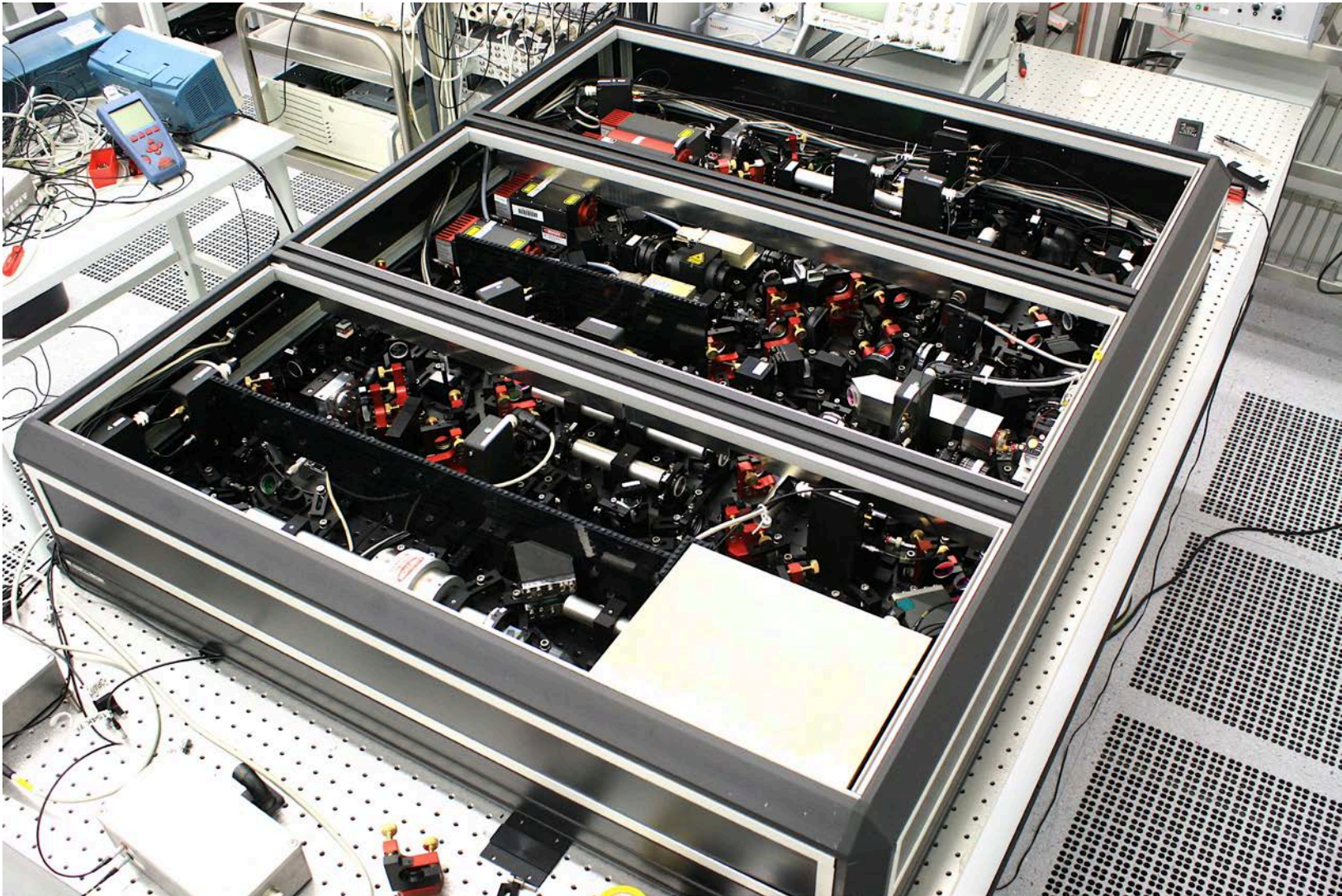
$\chi_2$ -nonlinear crystal:  
MgO:LiNbO<sub>3</sub> or PPKTP



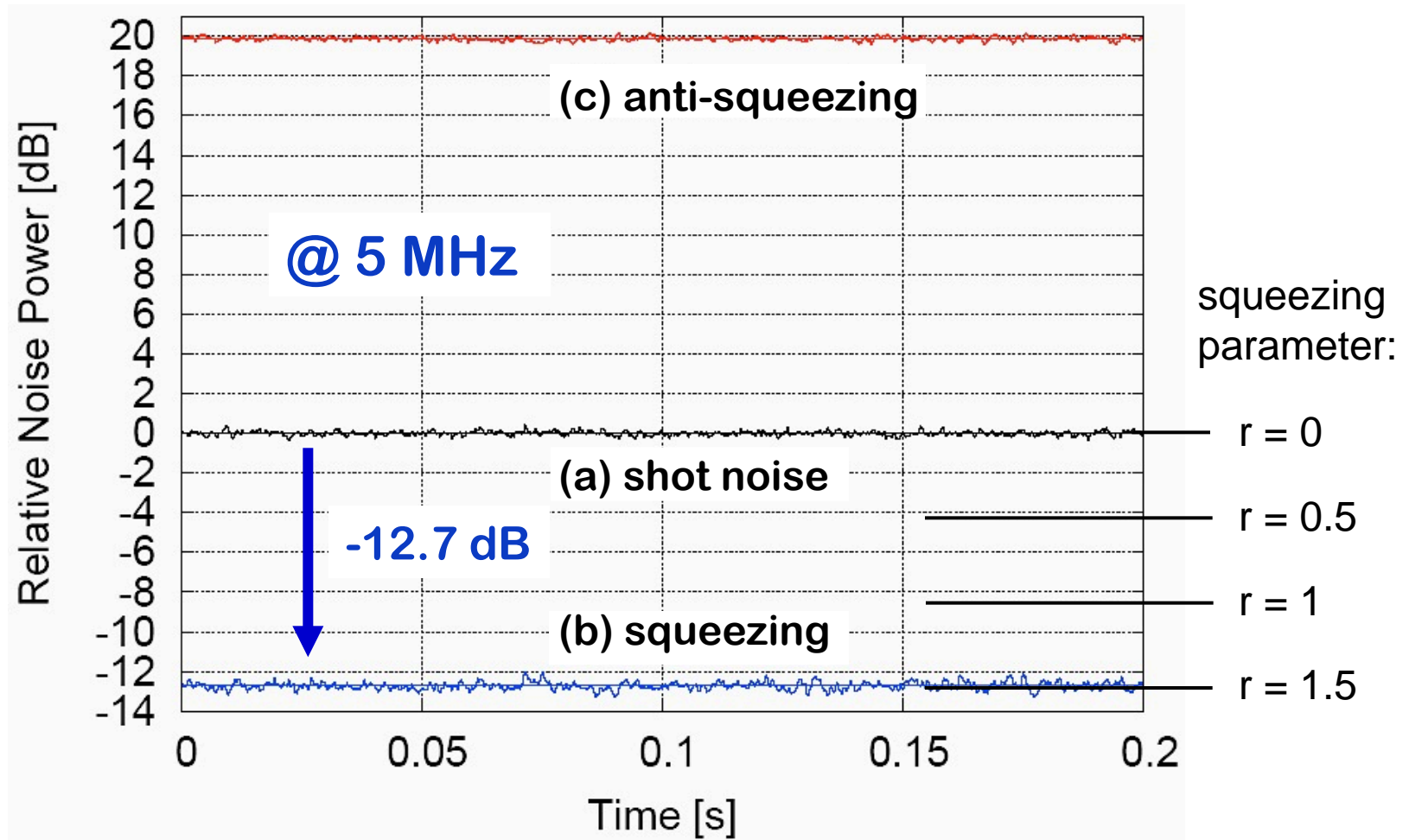
Standing wave cavity



# The GEO600 Squeezed Light Laser

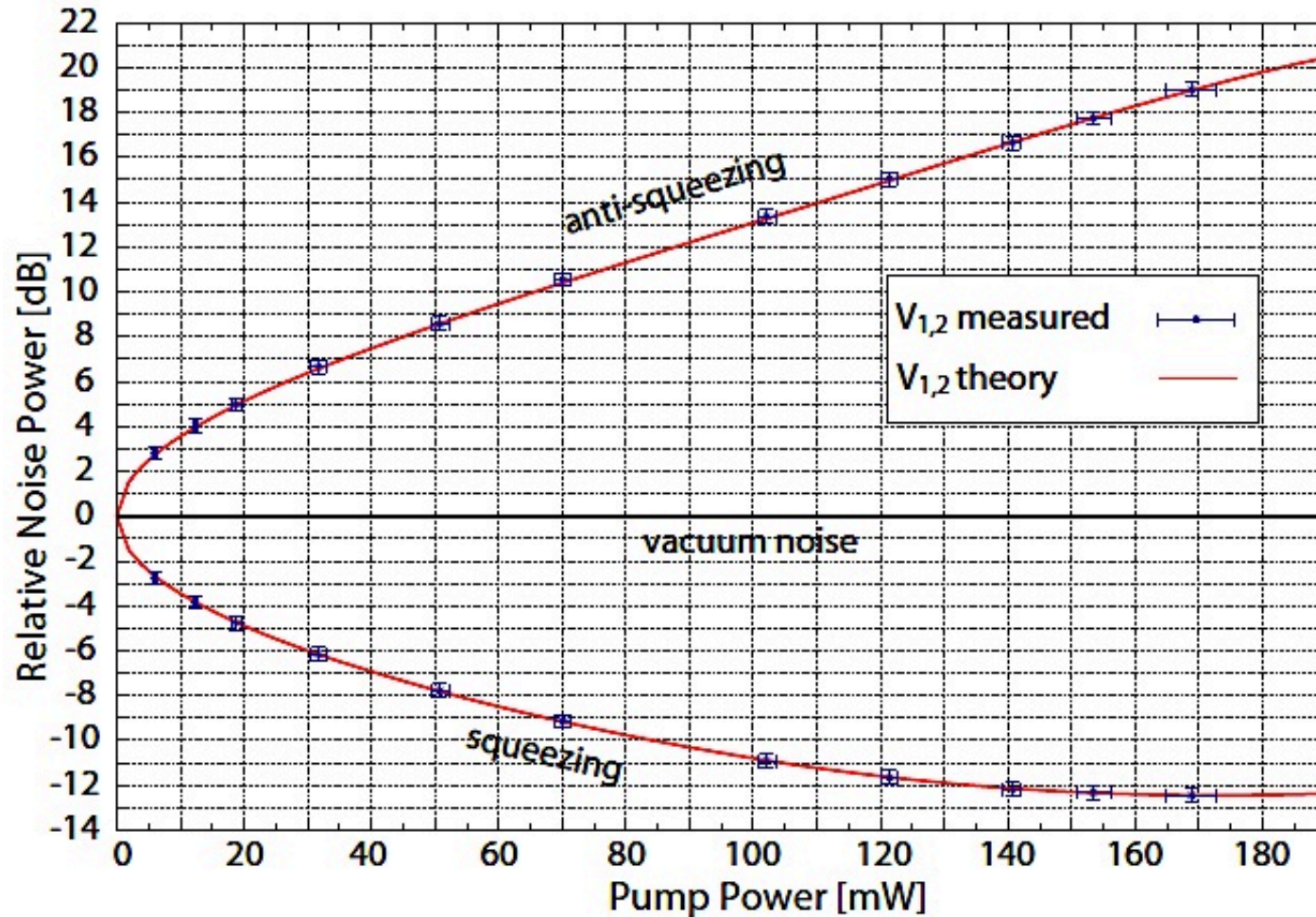


# 12.7 dB @1064 nm / Time Series



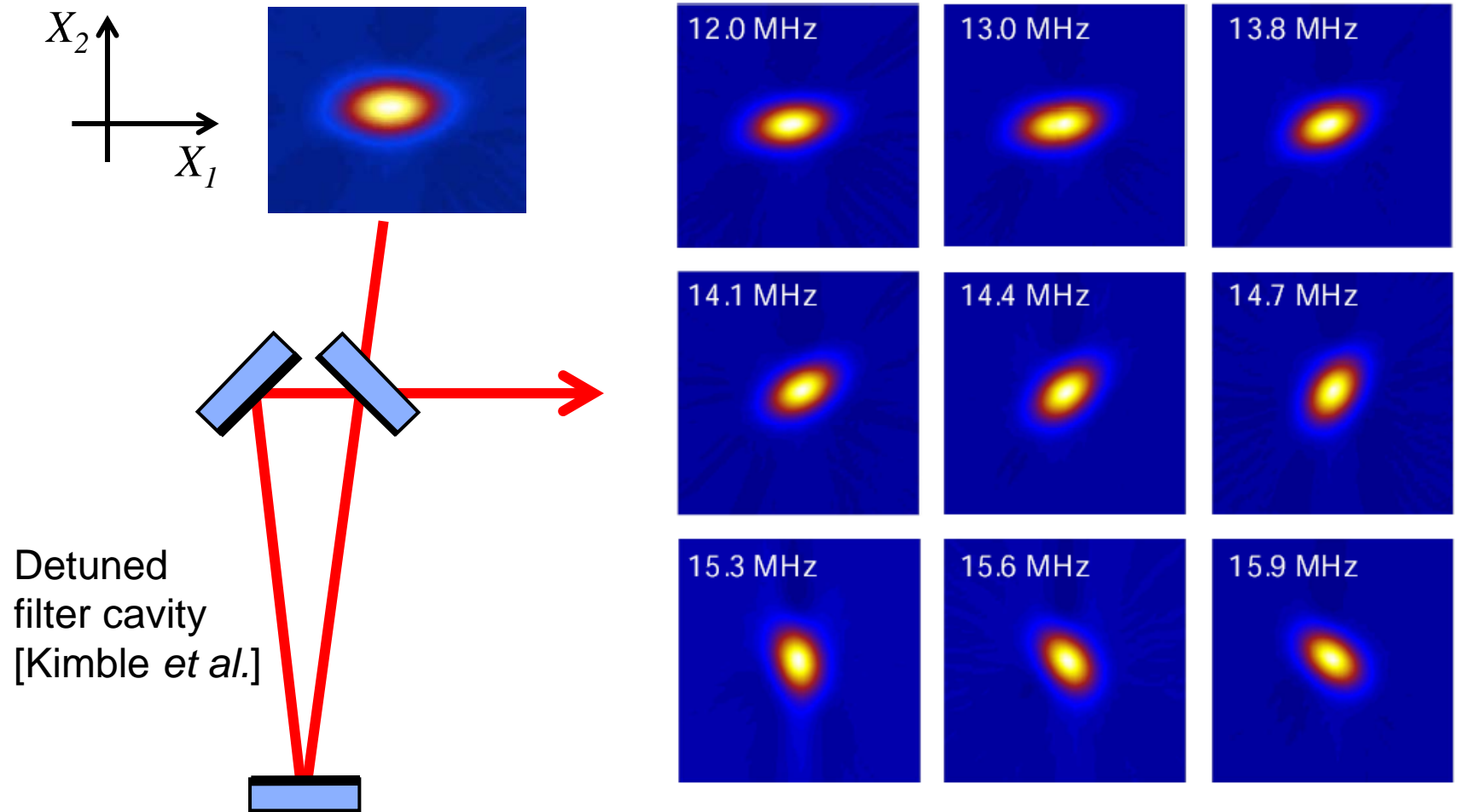
[T. Eberle *et al.*, PRL **104**, 251102 (2010)]

# 12.3 dB @ 1550nm / Scaling with Pump



[M. Mehmet *et al.*, Opt. Exp. **19**, 25763 (2011)]

# Frequency Dependent Squeezing



[Chelkowski *et al.*, Phys. Rev. A **71**, 013806 (2005)].

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