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Sub-Shot-Noise Stimulated Raman Scattering Using a Fiber Squeezing Source

In state-of-the-art stimulated Raman scattering (SRS) measurements, quantum uncertainty of light states becomes a significant source of noise. When measured, this uncertainty manifests itself as the shot noise. A laser free of technical noise produces a coherent state, for which the shot noise scales as $P^{1/2}$ with the light power. For samples where photodamage is a concern, this noise cannot be mitigated by increasing the laser power. Recently, several groups demonstrated that usage of certain quantum light states can improve the signal-to-noise ratio (SNR) as compared to measurements using coherent light. In particular, squeezed states produced using a second-order nonlinear crystal were previously employed to lower the noise floor, for a review see [1]. In this work, we use our robust squeezing source based on the Kerr effect in fibers [2] to achieve a 3.0 dB advantage in SNR over measurements with coherent states. Our setup provides a spatially perfect single-mode beam of squeezed light which requires no active stabilization, making it ideally suited for imaging applications.

References

- [1] Z. Xu et al., Appl. Phys. Lett. 127 (2025) 040501.
- [2] N. Kalinin et al., Adv. Quantum Technol. 6 (2023) 2200143.

Figures

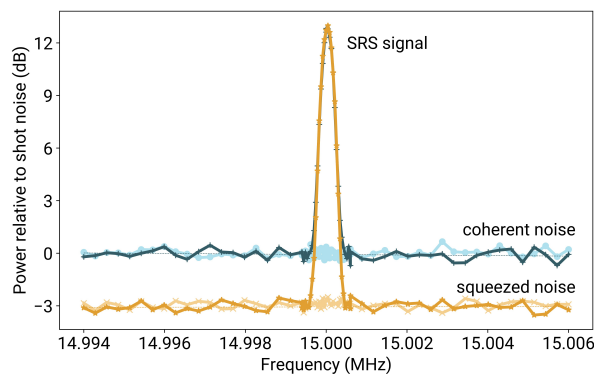


Figure 1: SRS signal for the 464 cm^{-1} line in quartz (bright lines) and the quantum noise floor (faded lines) for a coherent and squeezed states.