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Quantum Sensing with Truncated Nonlinear Interferometry

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Quantum sensors that leverage quantum noise reduction in squeezed light sources are increasingly capable of exceeding the sensitivity of state-of-the-art classical sensors. Many recent demonstrations of this class of quantum sensor have relied on intensity difference squeezing. Here, we show that phase squeezing in a truncated nonlinear interferometer enables classically inaccessible beam displacement measurements for atomic force microscopy. This approach allows us to minimize backaction noise while also operating below the photon shot noise level with reduced experimental complexity compared with intensity difference measurements. With sufficient quantum noise reduction, this approach will enable broadband atomic force microscopies that no longer require resonant operation.