Quantum enhanced optomechanical magnetometry

The resonant enhancement of both mechanical and optical response in microcavity optomechanical devices allows exquisitely sensitive measurements of stimuli, such as acceleration, mass, and magnetic fields. In this work, we show that quantum correlated light can improve the performance of such sensors, increasing both their sensitivity and their bandwidth. Specifically, we develop a silicon-chip-based cavity optomechanical magnetometer that incorporates phase squeezed light to suppress optical shot noise. At frequencies where shot noise is the dominant noise source, this allows a 20% improvement in magnetic field sensitivity. Furthermore, squeezed light broadens the range of frequencies at which thermal noise dominates, which has the effect of increasing the overall sensor bandwidth by 50%. These proof-of-principle results open the door to apply quantum correlated light more broadly in chip-scale sensors and devices.

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