Docket #: S24-090

Achieving Quantum Advantage in Power-Constrained Photonic Sensors

Stanford researchers have improved sensing capabilities by inventing a novel set of quantum-enhanced optical sensors at chip scale. This invention enables high-precision, low-power optical sensing, making quantum advantages accessible in portable technologies for the first time.

The invention addresses key challenges in reducing noise in miniaturized sensors with limited total power. Previously, ultra-sensitive measurements were restricted to large, high-power systems like LIGO. To overcome these challenges, the researchers propose efficient implementations of interferometers which use squeezed light to redistribute quantum noise and boost signal-to-noise ratio (SNR). These approaches can surpass the traditional precision limits set by shot noise, a quantum fluctuation that typically constrains sensor performance in power-limited environments.

As integrated sensors are now common in smartphones and Internet of Things (IoT) devices, this technology has huge potential to bridge the gap between quantum physics and everyday sensing applications.

Stage of Development: Proof of Concept

Applications

- **Optical sensors**

Advantages

- **Low power requirement**
- **Ultra-high sensitivity with quantum advantage**
- **Small in size at chip scale**

Publications

- Dean, Devin J., Taewon Park, Hubert S. Stokowski, Luke Qi, Sam Robison, Alexander Y. Hwang, Jason F. Herrmann, Martin M. Fejer & Amir H. Safavi-Naeini, et al. Low-power integrated optical amplification through second-harmonic resonance. Nature (2026).
- Zaske, Sara. New chip-sized optical amplifier can intensify light 100 times. Stanford Report (2026).

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