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Quantum enhancement in a multi-parameter quantum sensor.

Friday 8 August 2025 09:00 (20 minutes)

We study quantum enhancement of sensitivity and bandwidth using squeezed light in a multi-parameter quantum sensor, the hybrid rf-dc optically pumped magnetometer (hOPM) [1]. Using a single-spin ensemble, the hOPM acquires both the dc field strength (scalar magnetometry) and resonantly detects one quadrature of the magnetic field at a programmed frequency (rf magnetometry). In contrast to scalar OPMs [2], the back-action evasion in the hOPM is incomplete, leading to a complex interplay between the three quantum noise sources in this system: photon shot noise, spin projection noise, and measurement back-action noise. We observe these interactions using squeezed light as a tool to control the distribution of optical quantum noise between polarization Stokes components, and the resulting effect on readout quantum noise and measurement back-action [3].

[1] M. Lipka et al, Phys. Rev. Applied 21, 034054, (2024)
[2] Ch. Troullinou et al, Phys. Rev. Lett. 127, 193601 (2021).
[3] A. Sierant, in preparation.

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