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Quantum Chaotic Sensors

Quantum metrology has concentrated almost exclusively on using integrable systems as sensors, such as precessing spins or harmonic oscillators prepared in non-classical states. Here we show that large benefits can be drawn from rendering integrable quantum sensors chaotic, both in terms of achievable sensitivity as well as robustness to noise, while avoiding the challenge of preparing and protecting large-scale entanglement. We apply the method to spin-precession magnetometry and show in particular that the sensitivity of state-of-the-art magnetometers can be further enhanced by subjecting the spin-precession to non-linear kicks that render the dynamics chaotic. [Lukas J. Fiderer and Daniel Braun, Nature Communications 9, 1351 (2018)].