Contribution ID: **64**   Type: **Poster**

Recent developments in quantum metrology

We summarize our recent work on quantum chaotic sensors, machine learning in quantum metrology, and Bayesian experimental design and data analysis.

Measurement devices have traditionally always used integrable systems as sensors, such as precessing spins or harmonic oscillators prepared in non-classical states. But large benefits can be drawn from rendering integrable quantum sensors chaotic, both in terms of achievable sensitivity as well as robustness to noise [1].

After demonstrating the principles at the hand of the "kicked top", we apply the method to spin-precession magnetometry and show that the sensitivity of state-of-the-art magnetometers can be further enhanced by subjecting the spin-precession to non-linear kicks realized with off-resonant laser pulses that render the dynamics chaotic [2]. Further drastic improvements can be achieved by optimizing the individual kicking strengths with reinforcement learning [3]. More generally, we discuss the benefits of Bayesian experimental design and data analysis in the context of quantum metrology [4,5].

[1] Quantum metrology with quantum-chaotic sensors, Lukas J. Fiderer and Daniel Braun, Nature Communications 9, 1351 (2018).

[2] A quantum-chaotic cesium-vapor magnetometer, Lukas J. Fiderer and Daniel Braun, Conf. Proceedings "Optical, Opto-Atomic, and Entanglement-Enhanced Precision Metrology", 10934, 10934S (2019); arXiv:1903.02393 [quant-ph]

[3] Improving the dynamics of quantum sensors with reinforcement learning, Jonas Schuff, Lukas J. Fiderer, and Daniel Braun, NJP 22, 035001 (2020).

[4] Neural-Network Heuristics for Adaptive Bayesian Quantum Estimation, Lukas J. Fiderer, Jonas Schuff, and Daniel Braun, PRX Quantum 2, 020303 (2021)

[5] Principles of quantum functional testing, Nadia Milazzo, Olivier Giraud, Giovanni Gramegna, and Daniel Braun, arXiv:2209.11712

Email Address of submitter

daniel.braun@uni-tuebingen.de

Short summary of your poster content

Poster printing

Yes

Primary authors: Mr SCHUFF, Jonas (University Oxford); Dr FIDERER, Lukas J. (University Innsbruck); Dr MILAZZO, Nadia (ColibrITD); Dr GIRAUD, Olivier (University Paris-Saclay); Dr GRAMEGNA, Giovanni (Eberhard Karls University Tübingen); Prof. BRAUN, Daniel (Eberhard Karls University Tübingen)

Presenter: Prof. BRAUN, Daniel (Eberhard Karls University Tübingen)

Session Classification: Networking cocktail and Poster Session