FM 71: Focus Talk: Quantum Control

Time: Thursday 11:00–12:00 Location: 2004

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Optimal control of quantum systems — •Steffen J. Glaser — Technische Universität München

Quantum systems can be manipulated by external controls, such as sequences of electromagnetic pulses. Optimal Control Theory offers powerful analytical and numerical tools to explore the physical limits of pulse sequences, providing not only pulse sequences of unprecedented performance but also a deeper understanding of the principles on which the optimal pulse sequences are based (1).

In this focus talk, important concepts of Optimal Control Theory will be reviewed and illustrated with examples of uncoupled and coupled spins/qubits. Furthermore, the concept of concurrently optimized cooperative (COOP) pulses will be discussed. In contrast to individually optimized pulses for a given sub task, COOP pulses provide significant performance gains with respect to the overall task. Examples include ultra-broadband Ramsey and Hahn echo sequences (2,3) for quantum sensing and spectroscopy.

The analysis and the design of quantum control experiments is further enhanced by novel interactive visualization tools based on a generalized Wigner representation. The DROPS representation (4) of spin operators and its implementation in the SpinDrops app (5) make it possible to design and analyze pulse sequences interactively.

References: (1) Glaser et al, Eur Phys J D 69, 279 (2015); (2) Braun et al, New J Phys 16, 115002 (2014); (3) Kallies et al, J Magn Reson 286, 115 (2018); (4) Garon et al, Phys Rev A 91, 042122 (2015); (5) Glaser et al, www.spindrops.org.