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Institut für Experimentalphysik

HEARINGS
im Rahmen des Besetzungsverfahrens
für die Laufbahnstelle
QUANTUM ENGINEERING

Mittwoch, 4.3.2020 ICT, Technikerstraße 21a – Seminarraum 1	
Guillaume SALOMON	
13:00 – 13:45	Öffentlicher Vortrag und anschließende Diskussion: **“Exploring strongly correlated quantum systems at the single particle level”** *Developing new approaches to study quantum many-body systems is of fundamental importance in various fields of physics ranging from high energy and condensed matter physics to quantum information and quantum computation. It also holds promise for a better understanding of materials, such as high-Tc superconductors, and fault-tolerant quantum computing. Ultracold atoms have emerged as versatile and well controlled platforms to study fundamental problems in quantum many-body physics. In particular, spin-resolved quantum gas microscopy enables to probe strongly correlated fermions with a resolution down to the single particle and offers fascinating opportunities for experiments. I will report first on our experimental studies of the interplay between doping and magnetism in the Fermi-Hubbard model revealing fundamental differences between one and two dimensions. I will then discuss the perspectives offered by single particle detection and control, in particular to study topological order predicted in mesoscopic rotating gases and synthetic frustrated spin systems.*
Christian SANNER	
13:45 – 14:30	Öffentlicher Vortrag und anschließende Diskussion: **“Testing fundamental physics with atomic clocks: Why it's worth to measure time with 19 digits”** *State-of-the-art atomic clocks reach fractional frequency uncertainties at the 9e-19 level. These accurate quantum sensors make it possible to test fundamental physics with unprecedented precision. After an introduction to optical clocks I will report on a recent test of relativity with ytterbium ion clocks that led to hundredfold improved spacetime anisotropy limits [1]. I will then discuss how quantum-engineered clock systems can further improve such searches for new physics beyond the standard model.* *[1] C. Sanner et al., Nature 567, 204 (2019).*

*) Die Veröffentlichung von Namen und Titel erfolgt nur auf Zustimmung der Vortragenden.

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<table>
<tr><th colspan="2">Donnerstag, 5.3.2020
ICT, Technikerstraße 21a – Seminarraum 1</th></tr>
<tr><th colspan="2">Thomas MONZ</th></tr>
<tr><td>9:00 – 9:45</td><td>Öffentlicher Vortrag und anschließende Diskussion:
“Quantum engineering with trapped ions”
Over the last decades, quantum technology has made impressive contributions towards understanding the foundations of quantum physics. In particular, trapped ion experiments have pioneered many ground-breaking experiments. Current research efforts aim at storing and controlling ever more ions with one of the goals being a large-scale quantum information processor. Such a device requires high-fidelity control in combination with error correction techniques. I will present the path and status towards the realization of a fault-tolerant ion-trap quantum computer within one of my international collaborations. The presentation will conclude with an outlook towards upcoming research applications of this device, and how these efforts are enabled and facilitated by the integration of engineering.</td></tr>
<tr><th colspan="2">Andrea ALBERTI</th></tr>
<tr><td>9:45 – 10:30</td><td>Öffentlicher Forschungsvortrag und anschließende Diskussion:
“Neutral atoms in optical lattices: a scalable platform for quantum information science”
Neutral atoms trapped in optical lattices enable quantum information to be stored and processed in large ensembles of identically prepared quantum particles, where each atom carries a single qubit of information in its internal states. In this seminar, I will show how large ensemble of atoms can be prepared into a virtually zero entropy state using a combination of algorithmic cooling and sideband cooling techniques; we are working to scale their number up to a thousand. This favourable scalability relies on our capability of shifting atoms in space by large distances in a direction dependent on their internal state. Once loaded into the optical lattice, individual atoms are detected and manipulated with single lattice-site precision using a high-resolution objective lens. Ultracold collisions between atoms enable entangling gates. I will present plans how to use group III atoms to realize quantum gates on the microsecond time scale by operating in deep lattice potentials, while avoiding decoherence by off-resonant photon scattering for several seconds. This new platform holds the promise to combine the strengths of trapped ion systems, enabling fast gates with high control, with the advantage of an inherently scalable platform. My vision is to use this platform to carry out deep quantum circuits and possibly realize the dream of an ever-living quantum memory using concatenated error correction code.</td></tr>
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