

# Physikalisches Kolloquium

**Philip Willke, Physikalisches Institut, KIT**  
**»Quantum Coherent Control of Atomic and Molecular Spins on Surfaces«**

*Einführung: W. Wernsdorfer*

---

**Abstract:** The quantum nature of a physical system often emerges from its fundamental building blocks and demands a profound understanding to harvest its advantages for quantum devices. An important advantage can arise here from knowledge of the atomic-scale environment of a quantum object to design its properties. Scanning probe methods are able to resolve quantum systems such as single atoms and molecules on a microscopic scale, but often cannot simultaneously perform coherent manipulation of their quantum properties as common in other architectures, such as superconducting qubits, NV centers or ion traps.

In this talk, I will present a path for a coherent control of single atoms and molecules on surfaces by advancing the recently realized combination of electron spin resonance (ESR) and scanning tunneling microscopy (STM) [1,2]. The main goal is to create a new solid-state architecture for magnetic sensing and quantum information processing operating on the atomic scale.

For instance, ESR-STM can be used to sense the magnetic coupling between atomic spin centers on the surface [3] and on the STM tip [4]. It also allows us to detect the hyperfine interaction between the electron and nuclear spin of different atomic species [5,6] (Fig. 1). Finally, we show first coherent manipulation of the single atom electron spin using pulsed spin resonance [7] opening up the path towards quantum information processing using atomic building blocks. In addition, I will show an outlook on the planned experiments at KIT.

---

**Freitag, 22.01.2021, 16:00 Uhr,  
live über Zoom.**