

## IQST Seminar by Dr. Soo-hyon Phark

Center for Quantum Nanoscience, Institute for Basic Science, Korea

### Single- and Two-Qubit Quantum Gates to Bottom-up Crafted Spin Qubits

**Time:** Monday, 02 March 2026, 14:00 – 15:00

**Location:** Pfaffenwaldring 57, Room 6.141

#### Abstract:

Scanning tunneling microscopy (STM) combined with electron spin resonance (ESR) [1] enables bottom-up designed electron spin qubit platforms on solid surface, driven and read out in an all-electrical fashion [2,3]. However, demonstration of universal quantum gates using the first physical setup, Ti atoms on a two-monolayer MgO/Ag, has been remained as a challenging task due to the poor lifetime and quantum coherence in the order of  $\sim 100$  ns [3]. In this talk, I first share a dramatic increase in lifetime and coherence time of bottom-up crafted multiple spin nanostructures using Ti atoms on three-monolayer MgO/Ag [4]. Second, I show a demonstration of universal quantum gates and implementation of quantum state tomography to the tailored single-, two-qubit systems. A survey on inherent challenges in hand and outlook of this noble qubit platform will be followed [5,6].

[1] S. Baumann et al. *Science* 350, 417-420 (2015)

[2] K. Yang et al. *Science* 366, 509-512 (2019)

[3] Y. Wang et al. *Science* 382, 87-92 (2023)

[4] S. Phark et al. *Nat. Commun.* (2026), <https://doi.org/10.1038/s41467-026-68314-6>

[5] C. Wolf, A. J. Heinrich, S. Phark, *ACS Nano* 18, 28469-28479 (2024)

[6] S. Phark et al. "Roadmap on atomically-engineered quantum platforms" *Nano Futures* 9, 032001 (2025)

For more information, please contact Prof. Dr. Sebastian Loth at [office@fmq.uni-stuttgart.de](mailto:office@fmq.uni-stuttgart.de)