TECHNISCHE UNIVERSITÄT DRESDEN

Institut für Festkörper- und Materialphysik

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IFMP Seminar

Date Monday, July 06, 2026, at 14:50

REC/C213

Zoom: 633 2801 2201, Passcode: IFMP2025-6
(*availability not guaranteed!*)

Speaker **Ricardo Javier Peña Román**
IFMP, TU Dresden

Title **Development of a UHV-LT Scanning NV Microscope: From Instrumentation Challenges to Quantum Magnetic Imaging**

Abstract Nitrogen-Vacancy Scanning Probe Microscopy (NV-SPM) has recently gained significant interest as a robust quantum sensing tool for quantitative magnetic imaging with high magnetic sensitivity and nanoscale spatial resolution. However, extending the operation of NV-SPM to ultra-high vacuum (UHV) and low-temperature (LT) conditions remains challenging, requiring the integration of stable scanning-probe architectures, optimized NV probes, and reliable control of the NV charge state in such environments to investigate the magnetic properties of a broad range of quantum materials that are accessible only under well-controlled conditions.

I will present the development of a home-built scanning NV microscope designed for magnetic imaging under UHV and cryogenic conditions [1]. I will first discuss the design, implementation, and benchmarking of the NV microscope, focusing on the key challenges associated with operating NV centers in vacuum, including charge-state stability, probe characterization, and the optimization of experimental parameters for reliable quantum sensing. Additionally, I will show a compact and modular tip-holder design developed to improve the robustness, reproducibility, and flexibility of NV-SPM experiments while maintaining compatibility with other scanning probe techniques [2]. Finally, I will demonstrate how these instrumental developments enable nanoscale magnetic imaging by presenting NV magnetometry measurements of synthetic three-dimensional spin textures [3]. I will conclude by discussing future perspectives for UHV-LT scanning NV microscopy.

[1] Pinto, PhD thesis, EPFL (2023)
[2] Maity et al., Discov. Quantum Sci. **2**, 17 (2026)
[3] Peña Román et al. J. Phys. Chem. C, **130**, 4323 (2026)

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