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Physikalisches Kolloquium
Einladung

Physics Colloquium
Invitation

Monday, 11 May 2026

Lecture Hall **O25/H2**, at 16:15
Coffee and cookies will be served in front of the lecture hall from 16:00

Certifying Quantum Devices: From Bell Nonlocality to Device Verification

Dr. Patrick Emonts

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<https://www.uni-ulm.de/nawi/institute-for-complex-quantum-systems/ag-emonts/research/>



As quantum technologies continue to mature, the ability to reliably certify the behavior of quantum devices has become a central challenge. Now can we trust the functioning of a quantum processor when its internal workings may be complex, imperfect, or even partially unknown? In this colloquium, I will present recent techniques to certify quantum devices that are rooted in the device-independent paradigm.

At the heart of device-independent certification is Bell nonlocality, where certification relies solely on observed measurement statistics. In this framework, the validity of quantum behavior can be established without making assumptions about the internal structure of the device, enabling strong and conceptually striking forms of verification based only on input–output correlations. However, this scenario is hard to achieve on actual hardware: we can hardly achieve space-like separation on a quantum chip.

Our new questions thus becomes: what can we achieve if we start to relax some of the assumptions? While it brings us closer to a device-dependent paradigm, which certification assumes the validity of quantum mechanics, it can give us something more. I will show how this approach enables powerful diagnostic tools and scalable verification strategies that are essential for characterizing near-term quantum hardware. As an illustration, I will present recent results from an experiment carried out in collaboration with an experimental group using superconducting quantum hardware. This experiment demonstrates how ideas from nonlocality-based certification can be implemented on state-of-the-art platforms.

Host: Prof. Dr. Joachim Ankerhold, Institute of Complex Quantum Systems

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