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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Seminar über Quanten-, Atom- und Neutronenphysik (QUANTUM)

Nov. 14, 2024 at 2:15 p.m.
IPH Lorentzraum 05-127

Dr. Lykourgos Bougas
HIM (Mainz)

Revolutionizing Quantum Computing: Scalable Room-Temperature Quantum Accelerators using NV Centers in Diamond

Quantum computing is moving beyond its traditional mainframe infrastructure with the realization of room-temperature technologies powered by the nitrogen-vacancy (NV) centers in diamond. At Quantum Brilliance, we are at the forefront of this innovation, developing compact quantum accelerators based on NV centers—artificial atoms that enable fully functional qubits in a solid-state environment. This innovation holds the potential to make quantum computing not only more accessible but also more practical. Our mission is to deliver room-temperature quantum processors that can be deployed across a variety of environments, from centralized data centers to the network edge.

To achieve this, we are overcoming key technological challenges, such as the precise arrangement of NV centers at nanometer scales to enable magnetic coupling for multi-qubit operations across nodes. Quantum Brilliance addresses this using a breakthrough 'bottom-up' fabrication technique, leveraging atomically precise surface chemistry and lithography to build scalable diamond devices. Beyond scalability, we are also focused on advancing the performance, miniaturization, and manufacturability of these devices—crucial for achieving high-speed, high-fidelity spin control and efficient qubit readout in low-power, compact systems.

These technological advancements are positioning diamond quantum technologies as a leading force in the transition to compact, high-

performance quantum computing and quantum information processing. With pre-production prototypes underway, Quantum Brilliance is on track to develop quantum accelerators with over 50 qubits, poised to outperform classical CPUs and GPUs in critical applications within the next five years.

In this presentation, I will explore the key innovations driving the performance, miniaturization, and scalability of diamond-based quantum technologies, and how these breakthroughs are set to transform the quantum computing landscape, enabling scalable, mass deployable quantum compute systems.

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