Contribution ID: **57** Type: **Oral**

# A Powerfull Cryogenic Plateform at 0.5-1.0 K for Spin-Qubits Quantum Processor Applications

*Wednesday 29 October 2025 09:10 (15 minutes)*

The development of Quantum Processing Units (QPUs) based on spin-qubit technology requires significant cooling power in the 0.5–1.0 K temperature range. We present the design and performance of QuCUBE, a cryogenic platform delivering 100 mW of cooling power at 500 mK through a high-flow helium-3 Joule–Thomson refrigerator pre-cooled by a 4 K pulse-tube cryocooler. QuCUBE can also operate at 1.0 K with enhanced cooling capacity (˜250 mW) using helium-4.

The platform is currently employed for the development of a 100-qubit spin-based QPU by the start-up Quobly in Grenoble. We report on the achieved performance and operational insights gained from intensive system use. Owing to the high level of integration enabled by CMOS silicon technology, spin qubits promise compact device volumes even at larger scales. According to the current roadmap, a demonstration of more than 1,000 qubits is anticipated by 2030, requiring a proportional scaling of the cryogenic infrastructure.

We conclude by outlining ongoing developments at the Néel Institute and Absolut System aimed at maintaining a compact cryogenic architecture while ensuring compatibility with next-generation quantum components.

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**Track Classification:** Cryogenics for Quantum Technologies