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C1Or2C-03: Ultra Compact Rack Cryostat System for Quantum applications

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In this talk, we present the development and implementation of the world's smallest fully automated cryostat system designed to operate below 3K, achieving a base temperature of 2.3K. This ultra-compact system is specifically engineered for seamless integration with Superconducting Nanowire Single-Photon Detectors (SNSPDs) and deterministic single-photon sources (SPS), making it an ideal solution for quantum computing and quantum communication applications in data centers.

The cryostat system is using a bellows driven Helium compressor combined with a commercial GM coldhead. An integrated control and pumping system is ensuring ease of use and reliability. It is designed with a strong focus on high efficiency in both energy consumption and space utilization, making it a highly practical solution for modern applications with a space requirement of only 10U in a server rack. Additionally, the system is mobile and prepared for deployment in research facilities, offering flexibility for various applications. We will discuss the technical challenges overcome in the design and the innovative solutions implemented to achieve such low temperatures in a compact form factor. Furthermore, we will provide examples of practical applications and recent deployments of this system in data centers, highlighting its impact on enhancing quantum computing and communication capabilities.

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