

## Application showcase

# L-Type Rapid for long-term $T_1$ benchmarking of superconducting qubits

Understanding the relaxation time  $T_1$  of a qubit is a key indicator for its overall performance in quantum computing applications. The ability to capture  $T_1$  statistics over extended periods of time allows researchers to assess the impact of two-level system (TLS) fluctuations and other environmental factors on qubit stability.

In this showcase, we demonstrate how extended  $T_1$  measurements can be conducted using the newest configuration of our **L-Type Rapid** fast characterization cryostat offering **50 mK** base temperature and **100 mK continuous operation**. Using a **Zurich Instruments SHFQC+**, we characterized the  $T_1$  of a superconducting transmon qubit supplied by **Peak Quantum** over a 24-hour period at 100 mK. Our results, shown in Fig.1, demonstrate an average  $T_1$  of 97  $\mu\text{s}$ .

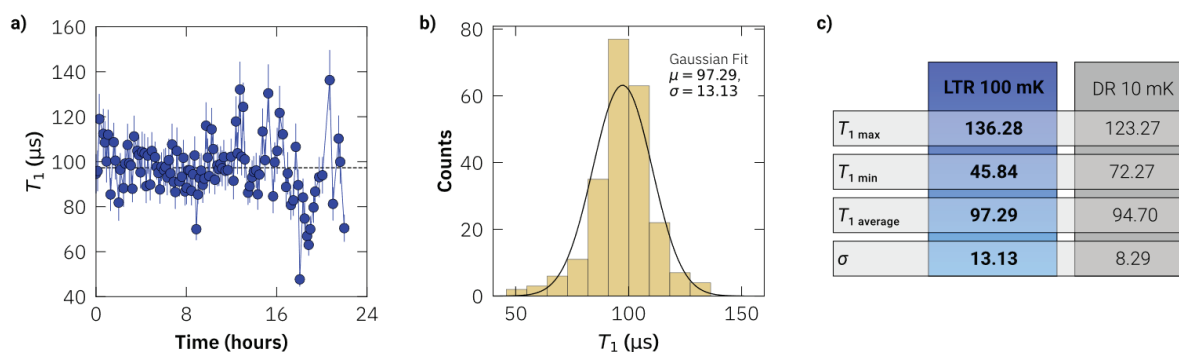


Figure 1: Long-term study of  $T_1$  for a transmon qubit in a kiutra L-Type Rapid (LTR). a)  $T_1$  measurements as a function of time. b) Histogram of the  $T_1$  measurements. The data shows a gaussian distribution around an average  $T_1$  of 94  $\mu\text{s}$ . c) Comparison of  $T_1$  statistics for data collected in the LTR at 100 mK and in a dilution refrigerator at 10 mK.

To benchmark the performance of the L-Type Rapid, we compared our results with the pre-characterization data provided by Peak Quantum, acquired for the same qubit in a dilution refrigerator at 10 mK. Our analysis shows that  $T_1$  measurements at 100 mK in the L-Type Rapid are matching the results obtained at 10 mK in a dilution refrigerator both in quality and consistency. This demonstrates how the L-Type Rapid enables high-fidelity qubit characterization even at 100 mK, significantly enhancing experimental efficiency and throughput.

## Acknowledgements

We want to thank **Peak Quantum** for providing us with the qubit chip and for performing the reference measurement in a dilution refrigerator and **Zurich Instruments**, for providing us with the SHFQC+, used for this application showcase.

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