Fast and Error-Correctable Quantum RAM

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Quantum devices can process data in a fundamentally different way than classical computers. To leverage this potential, many algorithms require the aid of a quantum Random Access Memory (QRAM), i.e. a module capable of efficiently loading large datasets onto the quantum processor [1]. However, a realization of this fundamental building block is still outstanding due to many crucial challenges, including incompatibility with current quantum hardware and quantum error-correction. In our work [2], we develop a QRAM design, that enables fast and robust QRAM calls, naturally allows for fault-tolerant and error-corrected operation, and can be integrated on present hardware. Our proposal employs a special quantum resource state that is consumed during the QRAM call, after being assembled efficiently in a dedicated module. This places a long missing, fundamental component of quantum computers within reach of currently available technology.
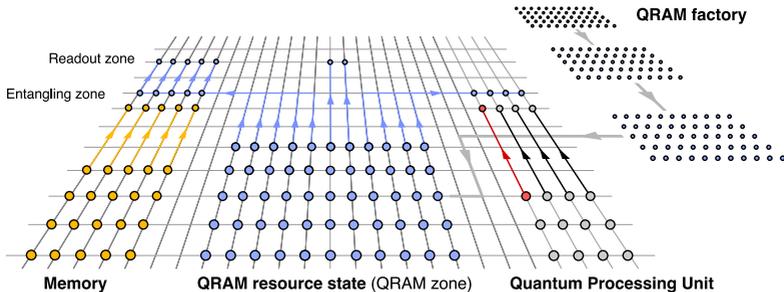
Fig. 1: Proposed Quantum RAM: The quantum query is realized via a fast Clifford interface between the QPU quantum register and a resource-state, which is assembled independently in the QRAM factory.

References

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