Error correction in superconducting quantum circuits

We look at the quantum repetition code and explain how it can be used to increase the fault tolerance of qubits to environmental influences. The quantum repetition code allows us to correct a certain kind of qubit errors, namely bit-flip errors, and is a part of the more complex surface code which can correct both bit-flip and phase-flip errors. We will also show how parts of the classical repetition code, such as the error correction algorithm, carries over to the quantum version. We subsequently focus on an experimental realization published in Nature[1] where on an aluminium based chip an alternating pattern of 4 measurement and 5 data qubits was arranged to perform the data repetition code. The entanglement of the ancillary qubits with the data qubits was performed with two pi pulses and a controlled phase gate. Finally the authors of the paper claim having increased the fidelity by a factor of 8.5 of their qubit system. Aditionally a Lambda of 3.2 has been found.

Reference:

[1] J. Kelly et al.,State preservation by repetitive error detection in a superconducting quantum circuit, Nature **519**, 66-69 (2015)