

Sources of magnetic fluctuation on surface of qubits

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In quantum computing, quantum information is lost due to a loss of synchronization (dephasing) in the electronic flow and energy relaxation. Magnetic flux noise is a dominant source of dephasing and energy relaxation in superconducting qubits. Our theoretical predictions pointed out oxygen and hydrogen as the causes of noise in these systems. These predictions were examined and confirmed by experiments that saw the reduction of magnetic noise for superconducting niobium and aluminum thin films after the surface treatment with ammonia. The identification of these adsorbates as sources explains the weak dependence of this type of noise on device materials. This new understanding of the origin of magnetic flux noise could lead to frequency-tunable superconducting qubits with improved dephasing times for practical quantum computers.