Protection of quantum information in a chain of Josephson junctions: the Magenium qubit

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Symmetry considerations are key towards our understanding of the fundamental laws of Nature. The presence of a symmetry implies that a physical system is invariant under specific transformations and this invariance may have deep consequences. For instance, symmetry arguments state that a system will remain in its initial state if incentives to actions are equally balanced. Here, we apply this principle to a chain of qubits and show that it is possible to engineer the symmetries of its Hamiltonian in order to keep quantum information intrinsically protected from both relaxation and decoherence. We show that the coherence properties of this system are strongly enhanced relative to those of its individual components. Such a qubit chain can be realized using a simple architecture consisting of a relatively small number of superconducting Josephson junctions.