Atomic-scale assembly and control of spins via Scanning Tunneling Microscopy (STM)

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Advancements in quantum science are paving the way for technologies that operate at the level of individual particles. In this study, we report a breakthrough in solid-state quantum engineering: the atomically precise assembly and control of electron-spin qubits. Leveraging the dual capabilities of a scanning tunneling microscope (STM) for both fabrication and measurement, we construct and manipulate coupled spin systems with single-atom resolution [1,2]. When positioned on superconducting surfaces, these engineered structures reveal rich quantum behavior, including the formation of Majorana bound states [3,4,5]. Our exploration of these exotic states provides valuable insight into non-Abelian exchange statistics—a cornerstone for realizing topological quantum computing. These results establish a versatile and highly tunable platform for quantum information processing based on spin arrays built atom by atom.

References

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