Probing spin fractionalization with absolute magnetometry ESR-STM

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One dimensional chains of antiferromagnetically coupled spins have gathered significant attention due to their distinct properties, particularly the realization of symmetry protected topological phases. These phases manifest as a gap in the bulk excitation spectrum and the emergence of effective degrees of freedom with fractional spin values at the edges of the chain [1,2]. Recent progress in on surface nanographene Haldane spin chains, studied by means of scanning tunneling inelastic spectroscopy, has provided indirect evidence of fractionalization via the observation of Kondo peaks at the chain edges [3].

In this work, we propose a new approach to study these fractional degrees of freedom using scanning tunneling microscopy electron-spin resonance (STM-ESR)[4] by mapping the stray field generated by the $S_z= \pm1$ states of the low energy manifold in the Haldane spin chain [5]. We use machine learning techniques to invert the Biot-Savart equation and obtain the expectation value of the local spin operators. This provides a direct measurement of two emergent properties: the fractional magnetic moment and the localization length ξ.

References

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Figures

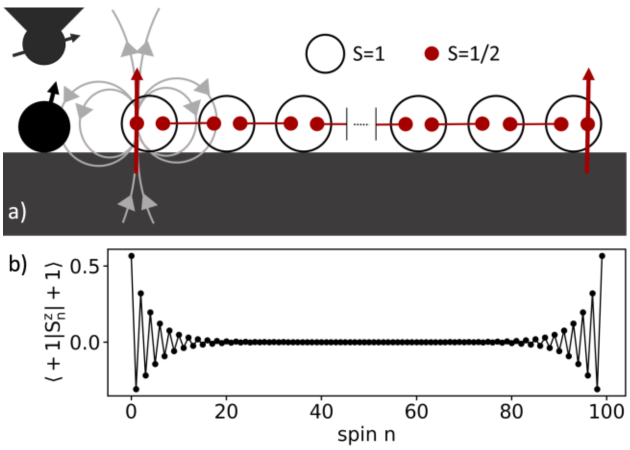

Figure 1: a) Scheme of the proposed experiment to measure fractionalization by means of ESR-STM. A Haldane chain is built on a kondo-free surface. The system is described as if there were two S = 1/2 objects at the edge. An ESR active atom (sensor atom) is placed near the chain to infer the magnetic moments of such chain from its stray field. b) Spin density of the $S_z = +1$ triplet state for $\beta = 0.09$.