Strongly-interacting, two-dimensional ensembles of spin defects in hexagonal boron nitride

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Abstract:
Conventionally, strongly interacting color center ensembles are three-dimensional in nature. While such systems have been used extensively as both quantum sensors and simulators of many-body dynamics, the ability to access lower dimensional physics using such solid-state color centers remains an exciting prospect [1]. Here, we investigate the many-body dynamics of ensembles of negatively-charged boron vacancy (V_B^-) defects in few-layer hBN flakes [2], where the flake thickness is smaller than the average inter-defect spacing. In this regime, we demonstrate that the emergent spin dynamics are governed by the native dipolar interactions between the V_B^- defects. In particular, we utilize a form of many-body noise spectroscopy where the dimensionality directly enters the temporal profile of the V_B^- decoherence dynamics [3]. Building on this, we perform measurements of local spin auto-correlation functions in order to explore and contrast spin transport in two-dimensional thin flakes and three-dimensional bulk ensembles [4].

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