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Cooperative spin decoherence in finite spin chains FERNANDO DELGADO, JOAQUIN FERNANDEZ-ROSSIER, INL-International Iberian Nanotechnology Laboratory — Overcoming the problem of relaxation and decoherence of magnetic nanostructures is one of the mayor goals in magnetic data storage. Although spin chains with as few as 12 magnetic atoms have revealed stability in cryogenic conditions [1], understanding the mechanism leading to these effects is essential for the engineered of stable structures. Here we consider the problem of spin decoherence and relaxation of finite size quantum spin chains due to elastic and spin conserving interactions with an electron gas. Specifically, we consider how the decoherence (T_2) and relaxation (T_1) times between the two degenerate ground states of a chain of N coupled spins compares with the one of an isolated spin in the same environment. We find that the spin decoherence time of Ising chains can be either enhanced or suppressed depending on the matching between the Fermi wavelength $2\pi/k_F$ and the inter-spin distance a. In particular, we find that depending on the values of $k_F a$, it can show, for certain values that depends on the dimensionality of the electron gas, a cooperative enhancement proportional to N^2 of the decoherence, analogous to super radiance decay of atom ensembles, or a suppression. [1] S. Loth et al., Science 335, 196 (2012).

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