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Chern Number effective Hamiltonian for Mn clusters in GaAs. TOR OLOF STRANDBERG, Lund/Kalmar University, Sweden, CARLO M. CANALI, Kalmar University, Sweden, ALLAN H. MACDONALD, University of Texas at Austin, USA — Small numbers of Mn atoms can be manipulated into arbitrary spatial arrangements on the $< 110 >$ surface of GaAs by means of a novel STM atom-by-atom substitution technique, which enables the replacement of individual Ga atoms by Mn[1]. The tunnelling differential conductance over an isolated Mn atom reveals a large and broad resonance in the GaAs energy gap. For a Mn pair placed less than 1nm apart, the resonance splits into two peaks, whose spacing is thought to be related to the exchange-energy interaction between Mn ions. We report on theoretical results for the local density of states and the Mn acceptor-level splittings for a Mn dimer, based on a tight-binding model of Mn substitutions on the $< 110 >$ GaAs surface. We compare our model with previous work which does not account for the surface. We then derive an effective quantum spin Hamiltonian for the Mn cluster, based on a Chern number theory developed recently, which includes Berry phase effects[2]. The influence of quantum fluctuations of the Mn spin orientations on the tunnelling differential conductance will be discussed. [1] D. Kitchen et al., Nature **442**, 436 (2006). [2] C.M. Canali, A. Cehovin and A.H. MacDonald, Phys. Rev. Lett. **91**, 046805 (2003)

Tor Olof Strandberg
Lund/Kalmar University

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