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First-principles study of magnetic exchange interactions in scanning probe microscopy STEFAN HEINZE, CESAR LAZO, PAOLO FERRIANI, Institute of Theoretical Physics and Astrophysics, University of Kiel, Germany — In the last years, spin-polarized scanning tunneling microscopy (SP-STM) has been established as a technique to resolve complex magnetic structures down to the atomic scale. More recently, it has even become possible to detect the exchange interactions between tip and sample by magnetic exchange force microscopy (MExFM). However, the interpretation of such measurements is non-trivial, especially on the atomic scale. Here, we use density functional theory in order to study the effect of exchange interactions in SP-STM and MExFM measurements. First, we demonstrate the occurrence of a spin-valve effect for single Co and Cr atoms on Fe islands on W(110) contacted by an SP-STM tip as a result of the spin-dependent orbital symmetry of the states in the vicinity of the Fermi energy [1]. We find that the exchange interaction between tip and adsorbed atoms affects the magnetoresistance in the tunneling regime. Second, we explain the quantitative measurement of the exchange interaction across a vacuum gap using MExFM applied to an Fe monolayer on W(001) [2]. We show how the chemical tip composition influences the magnitude and distance dependence of the exchange forces.

[1] M. Ziegler et al., New J. Phys. 13, 085011 (2011).
[2] R. Schmidt et al., Phys. Rev. Lett. 106, 257202 (2011).

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