# Quantum Fluctuations and Exchange Bias

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The theory of exchange bias is reviewed in order to analyze the mechanisms that have been put forward to explain the phenomenon. Particular emphasis is given to quantum fluctuations. In fact, ground-state fluctuations reduce the zero-temperature magnetic moments of the spins in a quantum antiferromagnet. In the neighborhood of surfaces, interfaces, and other defects which break translational symmetry, these fluctuations are not uniform. Consequently, the magnetic moments of up and down spins do not compensate each other exactly–as they do in a bulk antiferromagnet. At a surface or interface this leads to a small magnetic dipole density. The corresponding dipole field can account for the magnitude of observed exchange anisotropies. At finite temperatures localized surface (interface) excitations are populated and change the dipole density, making the exchange field temperature-dependent. In a pure antiferromagnet fluctuations may induce a net surface magnetization, that should be observable in nano-particle magnetization measurements for which the surface to volume ratio is not negligible.