6.7 Reflection Spectroscopy of Spin Polarized Atoms Near a Dielectric Surface

(St. Grafström and D. Suter)

We used laser-assisted magnetic resonance to study surface-induced spin relaxation of atomic spins interacting with a glass surface. Optical pumping with polarization-modulated light in a transverse magnetic field creates the spin-polarization. For detection a probe laser beam is reflected at the surface and the change of its polarization is monitored. We present a comprehensive theoretical description, taking into account the spin relaxation at the surface, which leads to a spatially inhomogeneous magnetization near the surface as a result of the transient behavior of the atoms in this region. Analytical expressions were derived for the magnetic resonance signal, which show that the wall relaxation causes a clear modification of the line shape, characterized by pronounced wings. The experimental results obtained with bare and silicone-coated Pyrex-glass surfaces can be very well described by the theory. The bare glass surface causes strong relaxation, whereas the silicone-coated surface is only weakly depolarizing. The analysis of the magnetic resonance line shape indicates that the depolarization probability per wall collision is ~0.01 in the latter case. The results were compared with corresponding results from the analysis of the optical line shape as measured in the same experiment. Both types of measurements can be interpreted within the same theoretical framework and are fully consistent with one another.