

## Spin Dynamics and Relaxation in Electron Transport Through Regular and Chaotic Cavities

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We present a semiclassical theory for spin-dependent quantum transport through ballistic cavities with complex scattering properties [1]. This approach allows us to distinguish different types of spin relaxation in systems with chaotic, regular, and diffusive orbital classical dynamics. For systems with spin-orbit interaction we demonstrate that the character of the orbital classical dynamics affects the spin evolution and relaxation. We consider in particular weak localization phenomena and find that for experimentally relevant spin-orbit coupling strengths, integrable ballistic systems can exhibit weak localization, while corresponding chaotic systems show so-called weak antilocalization. We further calculate the magneto-conductance and analyze how the weak antilocalization is suppressed with decreasing quantum dot size, as observed in related experiments in ballistic quantum dots [2].

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- [1] O. Zaitsev, D. Frustaglia, and K. Richter, *Phys. Rev. Lett.* **94**, 026809 (2005).  
[2] D. M. Zumbühl, J. B. Miller, C. M. Marcus, K. Campman, and A. C. Gossard, *Phys. Rev. Lett.* **89**, 276803 (2002).