Ballistic spin dynamics in Rashba spin-orbit coupled systems

RYO MATSUMOTO, Department of Physics, Tokyo Institute of Technology, SHUICHI MURAKAMI, Department of Physics, Tokyo Institute of Technology, PRESTO, Japan Science and Technology Agency — We theoretically study a time evolution of a transient spin grating in a two-dimensional electron gas with a Rashba spin-orbit coupling in a ballistic regime. We calculate the out-of-plane spin Fourier components, which decays with a rapid oscillation. We investigate their lifetime and frequency and analyze their dependence on the grating vector \( q \) and the spin-orbit coupling constant \( \alpha \). The frequency is proportional to \( q \) and \( \alpha \), and we find that the lifetime of the spin polarization is proportional to the inverse square of \( \alpha \) for the small \( q \) limit. Finally we compare our calculation with the case for a diffusive regime. We show that the lifetime of the spin polarization is longer when the grating vector becomes smaller, which is in contrast with the diffusive case.