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Title : Gate-Controlled Spin Precession in Quantum Hall Edge Channels

Abstract :
The spin degree of freedom of mobile electrons can be a fundamental resource of quantum information processing. Injection, coherent manipulation and readout of spin by all-electrical means pave the way for a solid-state analogue of photonic qu antum circuits: Quantum logic gates may be implemented in a coherent circuit by encoding flying qubits in the spin degree of freedom of ballistic electrons.
Here we present the first experimental demonstration of gate-controlled spin precession in quantum Hall edge channels, by exploiting effective magnetic fields induced via spin-orbit interaction (SOI). The trajectory of edge channels is abruptly bent at a corner of a biased metal gate, where SOI-induced magnetic field changes its direction nonadiabatically. This triggers spin precession of edge-channel electrons by making a superposed state of up- and down-spin edge states. The electrons travel along the potential boundary of the gate acquiring the phase of precession, and the final spin state at the end of the gate structure is readout as a population of the up-spin edge channel.
The population exhibits distinct oscillation corresponding to the phase of precession, which is contr olled either by (i) changing the Larmor precession frequency proportional to the externally applied magnetic field or by (ii) tuning the drift velocity of electrons influenced by gate-bias voltage. We argue that this effect can also be described as a spin version of the Mach-Zehnder interferometer, which was experimentally demonstrated for the first time.