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Stern-Gerlach effect and spin separation in InGaAs nanstructures[1]

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The demonstration of quantized spin splitting by Stern and Gerlach in 1922 is one of the most important experiments in modern physics. We utilized an effective non-uniform magnetic field which originates from Rashba spin orbit interaction (SOI) and demonstrated an experimental manifestation of electronic Stern-Gerlach spin separation in InGaAs based quantum point contacts (QPCs) [1]. Lateral potential confinement in a trench-type QPC creates a spatial modulation of Rashba SOI inducing a spin dependent force Clear conductance plateaus are observed in steps of $2e^2/h$when the strength of Rashba SOI becomes small. However, when the Rashba SOI is enhanced by applying the top gate, a half-integer plateau additionally appears at $0.5(2e^2/h)$, indicating the spin polarized current. We found that the spin polarization of the conduction electrons in this plateau is as high as 70%. Our new approach for generating spin polarization in semiconductor nanostructures provides a way to seamlessly integrate electrical spin generation, manipulation, and detection in a single semiconductor device without the need for either external magnetic fields or magnetic materials.

[1] M. Kohda *et al.* Nature Communications 3, 1082 (2012).

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