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Realization of an all-electric spin transistor using quantum point contacts TSE-MING CHEN, POJEN CHUANG, SHENG-CHIN HO, National Cheng Kung University, LUKE SMITH, FRANCOIS SFIGAKIS, University of Cambridge, MICHAEL PEPPER, University College London, CHIN-HUNG CHEN, JU-CHUN FAN, National Cheng Kung University, JONATHAN GRIFFITHS, IAN FARRER, HARVEY BEERE, GEB JONES, DAVE RITCHIE, University of Cambridge — The spin field effect transistor envisioned by Datta and Das opens a gateway to spin information processing. Although the coherent manipulation of electron spins in semiconductors is now possible, the realization of a functional spin field effect transistor for information processing has yet to be achieved, owing to several fundamental challenges such as the low spin-injection efficiency due to resistance mismatch, spin relaxation, and the spread of spin precession angles. Alternative spin transistor designs have therefore been proposed, but these differ from the field effect transistor concept and require the use of optical or magnetic elements, which pose difficulties for the incorporation into integrated circuits. Here, we present an all-electric all-semiconductor spin field effect transistor, in which these obstacles are overcome by employing two quantum point contacts as spin injectors and detectors. Distinct engineering architectures of spin-orbit coupling are exploited for the quantum point contacts and the central semiconductor channel to achieve complete control of the electron spins—spin injection, manipulation, and detection—in a purely electrical manner. Such a device is compatible with large-scale integration and hold promise for future spintronic devices for information processing. Ref: P. Chuang et al., Nat. Nanotechnol. 10, 35 (2015).

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