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Single-shot read-out of an individual electron spin in a quantum dot

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We demonstrate a fully electrical technique to read out the spin state of a single electron confined in a semiconductor quantum dot [1]. The quantum dot is formed by metal surface gates on top of a GaAs/AlGaAs heterostructure that contains a two-dimensional electron gas. The spin measurement relies on the Zeeman splitting of the orbital states, induced by a large in-plane magnetic field. We tune the dot potential such that a spin-up electron is trapped on the dot, whereas a spin-down electron has enough energy to tunnel to the reservoir. By detecting whether or not a single-electron tunneling event occurs, using a nearby quantum point contact, the original spin state is revealed. Using this single-shot spin measurement technique (with a visibility of $\sim 65\%$), we observe very long single-spin energy relaxation times (up to ~ 0.85 ms at a magnetic field of 8 T). Finally, we discuss improvements to the spin read-out technique, which could allow it to work for smaller Zeeman energy, and to be less sensitive to charge noise. [1] J.M. Elzerman, R. Hanson, L.H. Willems van Beveren, B. Witkamp, L.M.K. Vandersypen and L.P. Kouwenhoven, *Nature* 430, 431 (2004)